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Technology and Assessment Division

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WORK PLAN - VOLUME 1
SECOND SUBMITTAL
MISSOURI ELECTRIC WORKS
CAPE GIRARDEAU, MISSOURI

MEW PRP COMMITTEE

July, 1989

203896

WORK PLAN
FOR THE
MISSOURI ELECTRIC WORKS
REMEDIAL INVESTIGATION/FEASIBILITY STUDY

PREPARED FOR

MISSOURI ELECTRIC WORKS PRP COMMITTEE

BY

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0 0 EXECUTIVE SUMMARY

The Missouri Electric Works (MEW) site is a 6 4 acre parcel located adjacent to Missouri Highway 61, southwest of the City of Cape Girardeau This site has been used for the repair, rebuilding and/or sale of electrical equipment since 1953 Previous studies by Region VII EPA and its representatives have identified the polychlorinated biphenyl (PCB), arochlor 1260, as the chemical species of concern A summary of the site investigations conducted at the MEW location is presented in the final report, Expanded Site Investigation, Missouri Electric Works, December 16, 1987

This document consists of the scope-of-work for the Remedial Investigation (RI) and Feasibility Study (FS) at the MEW site The Quality Assurance Project Plan and Health and Safety Plan, which support the Work Plan, are included as Appendices Also included as Appendices are the Endangerment Assessment Planning Document and Feasibility Study Planning Document, which are required by the Consent Order

The RI activities are designed 1) to define the areal extent of contamination, 2) to assess the impact the contaminants have on public health, welfare and the environment, and 3) to provide data for determining a cost-effective remedial alternative for mitigating adverse human and environmental impact

The scope-of-work for the RI is divided into two phases to allow for data evaluation This phased approach will ensure that RES-FS establishes the 10 and 25 ppm concentration lines Additionally, the results of phase I tasks, such as the geophysical survey, will determine the level of effort required for phase II

During the site investigation, both on and off-site sediment and soil samples and on-site groundwater samples will be collected and analyzed to assist in characterizing the degree and extent of contamination associated with the site Laboratory testing will primarily include analyses for PCBs (Arochlor 1260) and volatile organic compounds Additional analyses will be performed on selected samples to determine soil properties and inorganic concentrations

A Risk Assessment will be completed to assess the human health and environmental impact(s) of the site contamination This document will be based upon a scenario in which no remedial actions are implemented at the MEW site

A Remedial Investigation Report will be prepared describing field activities, laboratory analyses, results, evaluations and the exposure assessment This report will also reference previous site studies so that all of the data collected can be summarized

1 0 INTRODUCTION

In late June, 1987, U S EPA notified 40 parties of the existence of PCB contamination at the Missouri Electric Works (MEW) site in Cape Girardeau, Missouri, and their potential responsibility for the cost of appropriate removal or remedial action Subsequently, EPA made five additional notifications, the most recent in April, 1988 Thus far, approximately 450 PRPs have been identified

After the initial notification, the 40 originally named PRPs met to consider a joint response to common issues at the Site Numerous meetings have been held since September, 1987, to obtain additional information and to inform EPA that

1 The group of participating PRPs was interested in working with EPA to resolve problems at the site, and

2 they were willing to undertake a more extensive site characterization to better delineate the extent of contamination and confirm that groundwater at the site was not, in fact, contaminated, and

3 they were willing to undertake a Remedial Investigation and Feasibility Study (RI/FS) consistent with U S EPA Region VII guidance and National Contingency Plan (NCP) requirements

This Work Plan addresses the procedures to be followed in accomplishing Item 2 above It includes sample collection procedures, a Quality Assurance Project Plan, a Site Health and Safety Plan and analytical procedures The principal goals of the project are to supplement existing site investigative data, refine current estimates of PCB contamination, resolve any outstanding concerns regarding groundwater contamination, and propose and evaluate remedial alternatives

2 0 BACKGROUND

The Missouri Electric Works Inc facility is a 6 4 acre site located in an industrial area of the southern portion of Cape Girardeau, Missouri, on Missouri Highway 61 (Figure 1) The approximate legal description of the site is the SW 1/4 of the NW 1/4 of Section 12, Township 30 North, Range 13 West, in Cape Girardeau County, Missouri The approximate site dimensions are 349 feet (north-south) by 798 feet (east-west) (See Figures 2-1 and 2-2)

The MEW site is situated in the hills along the valley wall just west of the Mississippi River flood plain, approximately 1 5 miles west of the Mississippi River Intermittent run-off channels emanate from the south and east boundaries of the site, which may eventually drain into the Cape LaCroix River, located 0 7 miles from the site The Cape LaCroix River flows 1 1 miles and enters the Mississippi River

MEW sells, services, and remanufactures electric motors, transformers, and electrical equipment controls During past operational practices, MEW reportedly recycled materials from old units, selling copper wire and reusing the dielectric fluids from the transformers The salvaged transformer oil was filtered through Fuller's earth for reuse An estimated 90 percent of the oil was recycled with the remaining 10 percent being disposed

MEW has been at its present location since 1953 According to EPA documents, more than 16,000 transformers have been repaired or scrapped on-site The total amount of transformer oil that has been discarded in this period was estimated to be 28,000 gallons In 1984, approximately 5,000 gallons of waste oil was removed by a contractor

The MEW plant and general office occupy a building at the northwest end of a lot that overlooks Highway 61 The remainder of the lot is an open field, portions of which are littered with various objects including old transformers, empty drums, old pallets, and trash The MEW property has been found to be contaminated with polychlorinated biphenyls (PCBs) The PCB contamination apparently is a result of past handling and storage procedures of the transformer fluids on site

Two major sampling efforts were conducted by Ecology and Environment (E & E) through EPA's FIT program The first investigation, performed in October 1985 under Technical Directive Document (TDD) # R-07-8509-04, principally involved on-site surface soil sampling The purpose of the first investigation was to define the areal extent of surface PCB contamination The results of this sampling effort detected significant surface contamination within the site boundary Contamination was found in 96 of 104 on-site samples analyzed

The second investigation, performed in July 1986 under TDD # R-07-8509-04B, involved subsurface sampling (0 to 4 feet deep) at various intervals, off-site surface soil sampling, and off-site drainage channel sediment sampling This investigation extended the areal extent of the surface samples collected in the initial investigation beyond the perimeter of the MEW property The surface water and sediment associated with the drainageways downgradient from the site were also sampled This sampling indicated that there were areas where PCBs had migrated off site based upon the analysis at the sediments However, no PCBs were detected in the

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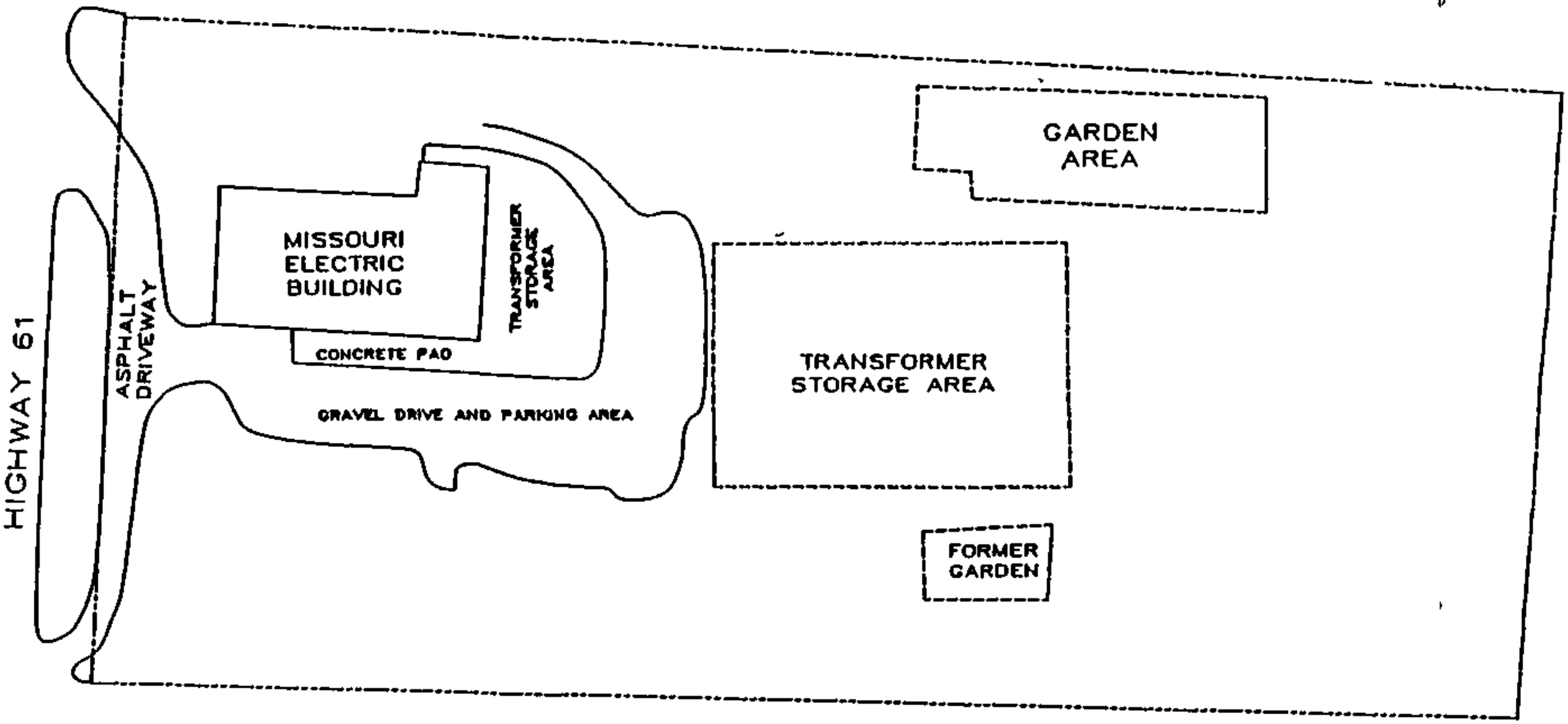
FIGURE 2–1
AREA MAP



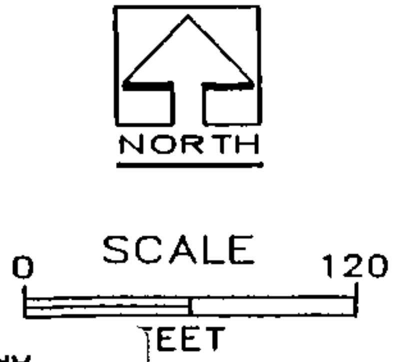


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FIGURE 2–2
SITE MAP

surface water samples A sample of the on-site drinking water well was also obtained during this investigation, PCBs were not detected in the water

An Expanded Site Investigation (ESI) was performed by E & E during May and June 1987 During the ESI, six (6) wells were installed and sampled Well nos 3 and 5, located in the southeast corner of the site, contained 3 9 and 3 5 ug/l (ppb) PCBs, respectively The wells were resampled during October 1987 The purpose of this sampling event was to obtain filtered and unfiltered samples to determine if the previously reported PCB concentrations were attributable to soil particles or solubilized PCBs No PCBs were detected from any of the groundwater samples collected, indicating that the previously reported PCB groundwater levels could have been due to particle contamination during well installation/development or cross contamination during sampling

The on-site drinking water well has been sampled by the site owner and no PCBs were detected

John Mathis and Associates, Inc sampled well nos 3 and 5 on August 3, 1988, on behalf of the MEW PRP Committee The analytical results of the unfiltered samples indicated Aroclor 1260 at concentrations of 2 0 ug/l and 3 2 ug/l for well nos 3 and 5, respectively A sample aliquot from well no 5 was filtered through a 0 45 micron filter prior to analysis PCBs were not detected in this sample at the 0 5 ug/l detection limit

3 0 REMEDIAL INVESTIGATION SCOPE-OF-WORK

The scope-of-work for the Remedial Investigation will include the following tasks

1 Project Operation Plans
2 Study Area Surveys
3 Site Characterization
4 Data Management and Validation
5 Remedial Investigation Report
6 Quality Assurance
7 Technical Management

3 1 PROJECT OPERATIONS PLANS (TASK 100)

The Project Operations Plans (POP) or comparable document(s) are the instruments for execution of the RI The POPs identify the individuals responsible and include all information necessary to perform field activities during the Remedial Investigation The POPs include sampling and analysis procedures, a Health and Safety Plan, and a Quality Assurance Project Plan (QAPP)

Each of the project operations plans are discussed and referenced below

3 1 1 Site Investigation Procedures

Standard Operating Procedures (S O P s) referenced in sections 3 3 and 3 4, are included as Appendix A The S O P s address specific project tasks (i e decontamination, monitoring well sampling, etc) for use by field personnel These S O P s are guidelines only and will not preclude or take precedence over the HSP or QAPP Proposed or planned field procedures and activities which are not addressed by the S O P protocol have been developed and incorporated into the context of the other project documents (i e QAPP, HSP, etc)

3 1 2 Quality Assurance Project Plan

A Quality Assurance Project Plan (QAPP) has been developed for the activities associated with the Remedial Investigation The QAPP is included as Appendix B

3 1 3 Health & Safety Plan

A Health and Safety Plan (HSP) has been prepared which establishes guidelines and requirements for the safety of field and laboratory personnel during the conduct of the field activities The HSP is included as Appendix C

3 2 HISTORICAL STUDY SURVEY (TASK 200)

A historical study survey is being performed to identify possible additional areas of concern, i e burn areas, waste deposition areas, spill areas, areas of site improvements, etc Sources of information include the following

1 A preliminary site inspection by RES-FS

2 Recent EPA investigative results

3 Interviews with the site owner

4 Aerial photographs from commercial or government sources

Based upon RES-FS' 12/8/88 site inspection, there are indications that the east end of the site may be the location of trash dumping operations Consequently, additional investigative activities (geophysical survey and trenching) have been included in the scope-of-work (refer to Tasks 500 and 600)

According to former employees of MEW, as documented by interviews given to EPA and provided to RES-FS in correspondence dated 12/30/88, limited quantities of solvents were utilized to clean transformers and were either washed from the processing area onto the ground or dumped southeast of the MEW building According to one of the interviewees, a solvent which was utilized was Navy Brand Solvent Based on these observations, additional investigative activities have been included in the Work Plan (refer to Task 700 and 800) and several of the activities have been amended to include the sample analysis for volatile organics

Based upon discussions with the site owner during RES-FS' 12/8/88 site visit, the facility sanitary sewer is discharged to a septic tank system immediately north of the MEW process building No information was given as to process sinks, sumps, floor drains, etc Consequently, RES-FS will inspect the building to determine the disposition of spilled solvents/oils and the subsequent washdown of those materials, i e floor drains/sumps to septic system, floor drains/sumps to separate drainage system, washout sinks, etc (Refer to Task 700)

Additionally shallow soil borings will be obtained from the septic tank drain field and any other discharge areas as specified in Task 800

The results of RES-FS' historical study survey will be submitted to U S EPA as a separate document by April 23, 1989 (90 days after the signing of the Consent Order) The data obtained from the survey will be utilized to determine the placement of the on-site soil sampling locations for the detection of volatile organics

3 3 PHASE I SITE INVESTIGATION

Activities which will be performed during phase I of the site investigation include the following

1 Task 300 - Mobilization

2 Task 400 - Topographic Survey

3 Task 500 - Geophysical Survey

4 Task 700 - Process Building Investigation

5 Task 800 - Shallow Subsurface Investigation

6 Task 900 - Surface Soil Sampling

7 Task 1000 - Sediment Sampling

8 Task 1100 - Groundwater Sampling

9 Task 1400 - Sample Analysis

Each of these activities is discussed below

3 3 1 Mobilization (Task 300)

Several work tasks will need to be performed during the actual site mobilization These tasks, in the anticipated chronological order in which they will occur, include

1 The locations of the van, office trailer (if needed), parking areas, drum storage and decontamination areas will be determined

2 The van and possible office trailer will be leveled and secured

3 The van will be arranged for work start-up The van will contain the following

- Safety and first aid supplies
- Hardware and spare parts
- Samplers, shovels, and hoses
- Small office space
- Drinking water
- Sample jars and storage
- A portable toilet will be installed in the Contamination Reduction Zone

4 A decontamination area will be established The personnel decontamination tubs and equipment will be set up Open head, 55-gallon drums will be set up for contaminated items

During mobilization, Level D personal protection will be required Particular attention will be given to cleaning boots and hands

Total mobilization will require 1-2 working days

3 3 2 Topographic Survey (Task 400)

A topographic map of the site will be prepared at a 1" = 50' scale with 1 to 2 foot contour intervals by a registered surveyor This map will serve as a site plan showing all pertinent planimetric and topographic features upon which additional information can be plotted Surface contours and spot elevations obtained from the topographic map will be used to determine surface water run-off pattern

The surveyor will also establish a permanent grid system over the site Temporary wooden stakes, 3 feet high with flags and marked for reference purposes, will be placed at 50-100' intervals Permanent stakes or benchmarks will also be installed so that the grid can be regenerated at a later date The grid will be used to accurately document the locations of all on-site sampling and monitoring activities (See Figure 3-1)

The survey and grid system generation will require 4 to 5 days Level D personal protective equipment will be worn during this activity, as specified in section 7 0 of the HSP

3 3 3 Geophysical Survey (Task 500)

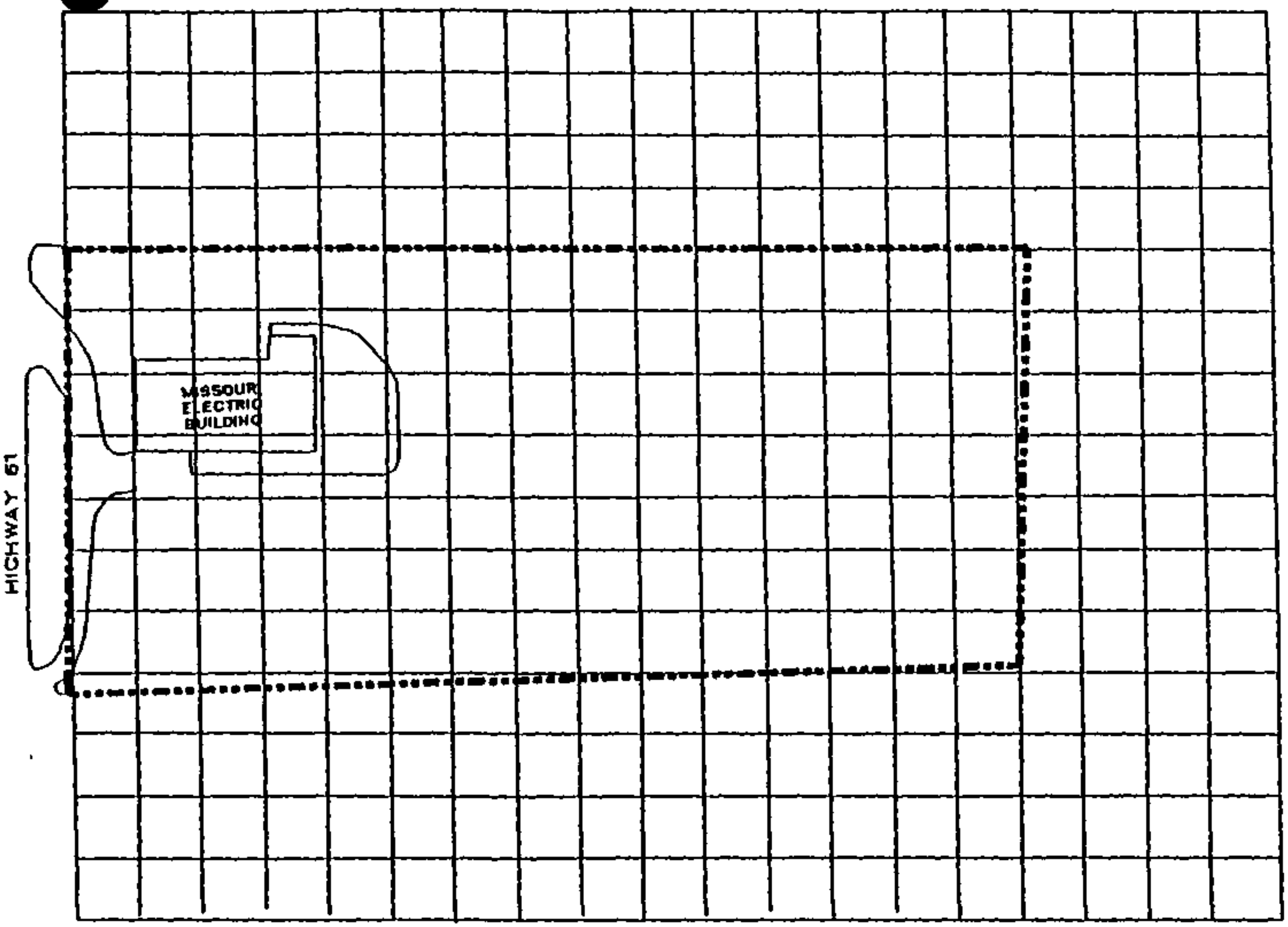
A field geophysical survey will be performed over the east portion of the site to determine the location of buried metal deposits and contaminants with high conductivity The maximum survey area will be 300 feet (north to south) x 200 feet (east to west) of the portion of the site east of MW-2 and MW-3 The survey will be based on 20 foot station intervals Anomalous data between grid points will require investigation at closer spacing Additionally, the south-central drainage ditch will be inspected/evaluated, along with the U S EPA site representative, to determine the usefulness of extending the survey to this area

Both electromagnetic and magnetic measurements will be obtained and plotted to form a contour map showing locations of high conductive and magnetic flux Instruments which will be utilized are a Geonics EM31 Terrain Conductivity Meter and an EDA OMNI IV Magnetometer/Gradiometer Both of these instruments will down load digital data to a field computer The data will be plotted in the field to verify the adequacy of the survey prior to demobilization S O P #2 details the procedure which will be followed for the geophysical survey

The geophysical survey will require 1 to 2 days Level D personal protective equipment will be worn during this activity, as specified in section 7 0 of the HSP

3 3 4 Process Building Investigation (Task 700)

The MEW process building will be inspected to determine the potential disposition of spilled materials and the subsequent washdown of the those materials, i e floor drains, washout sinks, sumps, etc The results of this investigation will determine the locations of the borings proposed for Task 800



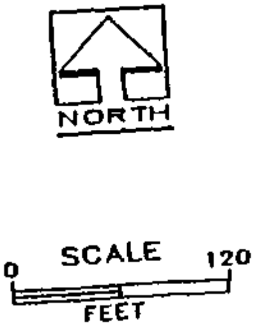


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FIGURE 3–1
SAMPLING GRID REFERENCE

3 3 5 Shallow Subsurface Exploration (Task 800)

Shallow soil samples will be obtained to determine the areas in which solvent/waste discharge has occurred The sample locations will be based upon the interviews of former employees, the results of the process building investigation (Task 700) and visual observations of the soil surface

At this time, RES-FS anticipates that approximately six (6) shallow soil borings will be augered in those areas that solvents were reportedly discharged The borings will be located around the north and east sides of the MEW building and in several locations southeast of the processing building The locations will be chosen so as not to duplicate the efforts of the planned subsurface sampling to be performed during phase II (Task 1200) Soil samples will be obtained from each boring at depth intervals of 0' to 0 5' and 0 5' to 1' The samples will be analyzed for PCBs and volatile organics (see Table 3-1) Additionally, up to 15 of the 144 subsurface soil samples, which will be obtained during phase II soil boring investigation (Task 1200), may also be analyzed for the volatile organics

Based upon discussions with Mr Giles during RES-FS' 12/8/88 site visit, the sanitary sewer is discharged to a septic tank system immediately north of the MEW process building (No information was given as to process sinks, sumps, floor drains, etc) Assuming that there are no additional discharge lines from the building, two borings will be drilled, utilizing hand augers or powered augers, to a depth of approximately 5 feet in the immediate vicinity of the septic tank drain field Three samples per boring will be obtained ahead of the augers with Shelby tubes Additional borings may be warranted if the investigation of the building (Task 700) indicates that there is a separate discharge line(s) for the washdown waters S O P #5 details the procedures for obtaining the shallow subsurface samples The samples will be analyzed for PCBs and the volatile organics

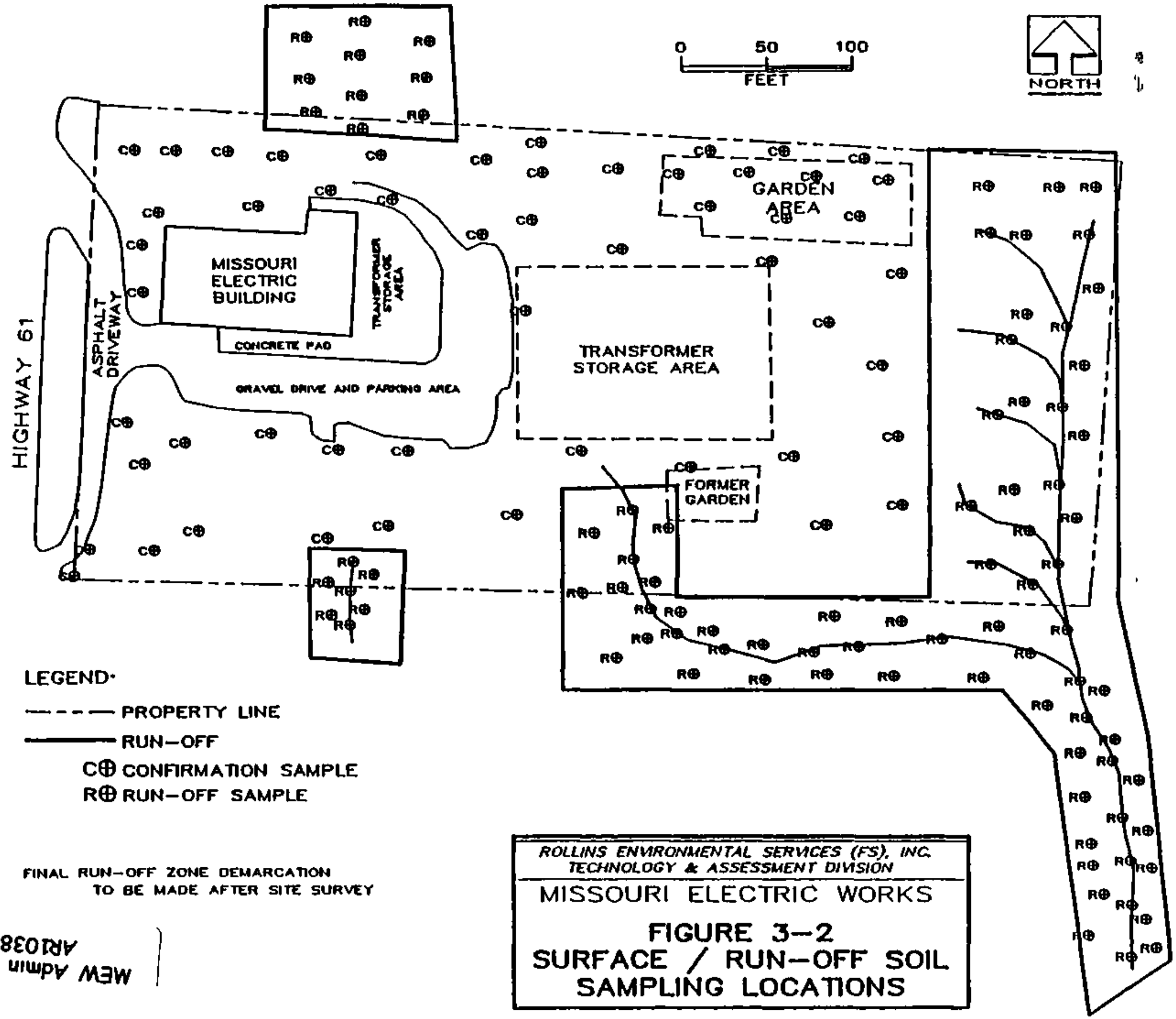
The shallow subsurface investigation will require 1 to 2 days Modified level D personnel protective equipment will be worn during this activity However, respiratory protection will be worn if organic vapor concentrations in the breathing zone exceed criteria included in section 7 0 of the HSP or if there is a potential for dust/particulate generation

3 3 6 Surface Soil Sampling (Task 900)

Based on the kriged concentration estimate and kriged error of estimation maps (constructed with the E&E data collected 10/86 and 7/87) (see Attachment 3-1) of the MEW site, the sampling locations shown in Figure 3-2 were selected at the property limits and in off-site suspect areas Analytical data from these sampling locations will define the 10 and 25 ppm PCB concentration line

TABLE 3-1
VOLATILE ORGANIC LIST

VOLATILES		CAS NUMBER
1	Chloromethane	74-87-3
2	Bromomethane	74-83-9
3	Vinyl Chloride	75-01-4
4	Chlorethane	75-00-3
5	Methylene Chloride	75-09-2
6	Acetone	67-64-1
7	Carbon Disulfide	75-15-0
8	1,1-Dichloroethene	75-35-4
9	1,1-Dichloroethane	75-35-3
10	trans-1,2-Dichlorethene	156-60-5
11	Chloroform	67-66-3
12	1,2-Dichloroethane	107-06-2
13	2-Butanone	78-93-3
14	1,1,1-Trichloroethane	71-55-6
15	Carbon Tetrachloride	56-23-5
16	Vinyl Acetate	108-05-4
17	Bromodichloromethane	75-27-4
18	1,1,2,2-Tetrachlorethane	79-34-5
19	1,2-Dichloropropane	78-87-5
20	trans-1,3-Dichloropropene	10061-02-6
21	Trichloroethene	79-01-6
22	Dibromochloromethane	124-48-1
23	1,1,2-Trichloroethane	79-00-5
24	Benzene	71-43-2
25	cis-1,3-Dichloropropene	10061-01-5
26	2-Chloroethyl Vinyl Ether	110-75-8
27	Bromoform	75-25-2
28	2-Hexanone	591-78-6
29	4-Methyl-2-pentanone	108-10-1
30	Tetrachlorethene	127-18-4
31	Toluene	108-88-3
32	Chlorobenzene	108-90-7
33	Ethyl Benzene	100-41-4
34	Styrene	100-42-5
35	Total Xylenes	



FINAL RUN-OFF ZONE DEMARCATION
TO BE MADE AFTER SITE SURVEY

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FIGURE 3-2
SURFACE / RUN-OFF SOIL
SAMPLING LOCATIONS

Figure 3-3 shows the additional sampling points outside of the site boundaries Samples are designated (grouped) as either C (confirmational sample), R (run-off area sample), or F (off-site sample) The placement of these samples is based on the spatial variation analysis generated from the E&E data and the RES-FS site visit in which the need for separate sampling environments (the "flat" site areas versus the run-off areas) was recognized

The data from the analysis of these samples will be evaluated with respect to spatial variation as separate regions Then a kriged analysis will be made on each region and recommendations made for further sampling during phase II, if required

Two to three man sampling crews will obtain the samples at the approximate locations designated on Figures 3-2 and 3-3 However, recent earth moving activities have occurred behind the Cape Carpet property, as reported in RES-FS' Historical Study Survey Consequently, surface samples will not be collected in areas where soil was removed Following procedures outlined in S O P #5, a hand auger will be used to obtain samples at one foot intervals from the stockpiled soil (if present) south of the Cape Carpet building

The samples will be obtained with disposable stainless steel spoons from a depth of 0 to 6 inches The soil will be placed into pre-labeled, laboratory-cleaned, 6-8 ounce glass containers with teflon or foil lined lids The samples will be marked with a unique sample number, as specified in section 6 0 of the QAPP, and placed into ice chests Sampling data will be recorded in a bound field log immediately after sampling Data which will be recorded includes

1 Sample number

2 Time

3 Sample team members

4 Visual observations

5 Location relative to the grid

6 PID readings at selected excavations and at the breathing zone (on-site only)

Nondisposable sampling equipment will be decontaminated between each sample location to prevent cross-contamination between samples Decontamination procedures will include two rinses with an industrial detergent (Alconox or equivalent), followed by a distilled water rinse

Procedures for surface soil sampling and decontamination are included as S O P s 4 and 9, respectively Sample custody procedures are included in section 7 0 of the QAPP

The surface soil sampling will require 5 to 6 days Level D or modified level D personal protective equipment will be worn during this activity, as specified in section 7 0 of the HSP

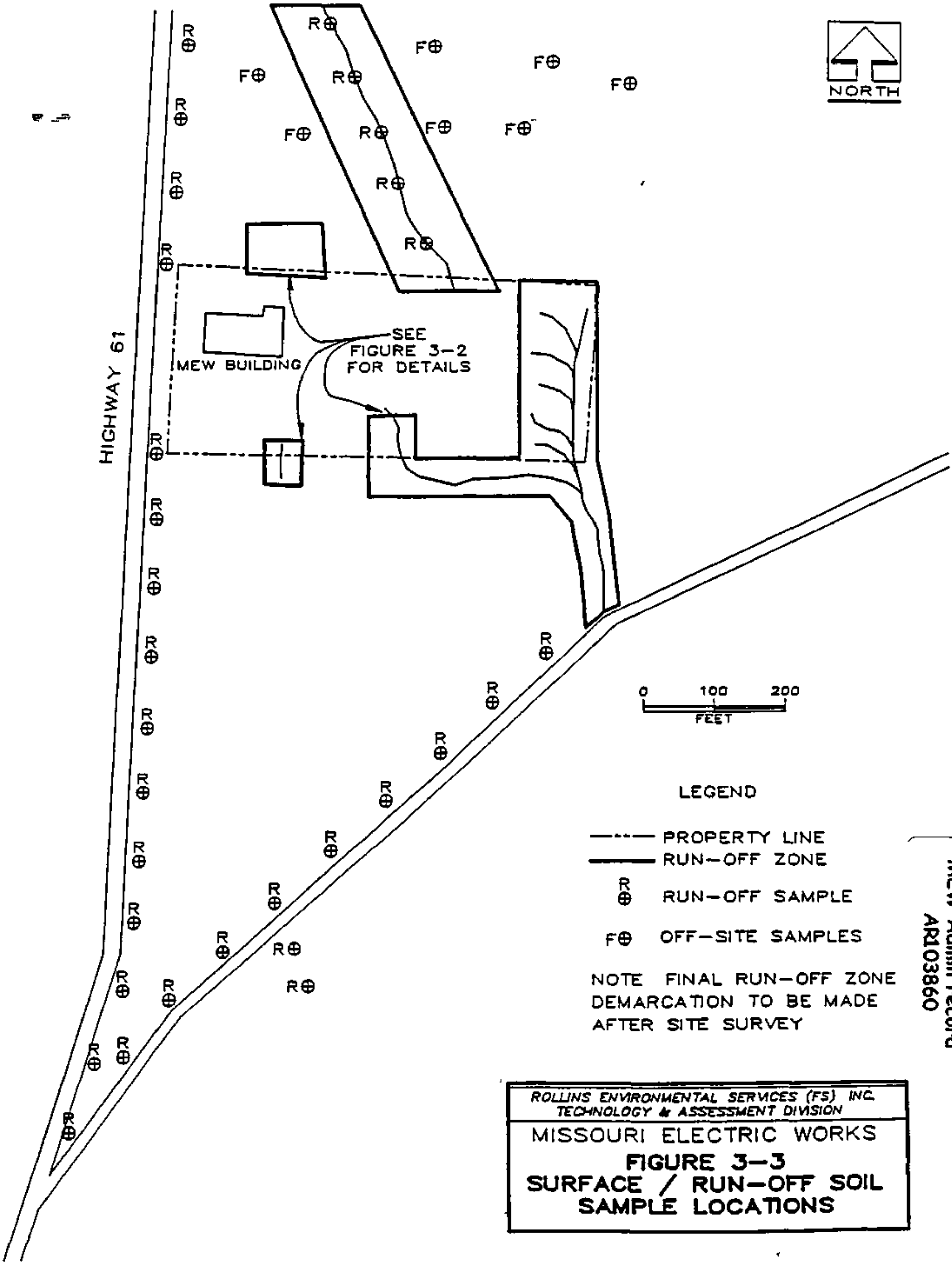

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FIGURE 3–3
SURFACE / RUN–OFF SOIL SAMPLE LOCATIONS

3 3 7 Sediment Sampling (Task 1000)

Sediment samples will be obtained from the ditches and swales potentially impacted from site run-off Due to the effects the topography will have on contaminant transport, these samples have been statistically evaluated separately from the surface samples associated with Task 900 The initial sample locations will be located inside contaminated areas shown by the EPA data and proceed downstream at 25 to 100 foot intervals depending on the proximity to the site The anticipated sampling locations are indicated on Figures 3-2 and 3-3 as "R" (run-off area sample) Selected run-off area samples which are located on the eastern slope of the property may not be collected until phase II (Task 1100), depending on the results of the geophysical survey (Task 500)

Two to three man sampling crews will obtain grab samples of the sediment from the bottom of the ditch or swale (representative of the maximum contamination levels based on erosional deposition of PCBs associated with sediment) The soil will be placed into pre-labeled, laboratory cleaned, 6-8 ounce glass containers with teflon or foil lined lids Sampling data will be recorded in a bound field log immediately after sampling

To augment the sediment sampling data, a surface water sample will be obtained from the marshy area between Wilson Road and Cape LaCroix Creek The sample will be obtained by immersing a 1/2 liter amber glass container beneath the water surface at a depth half-way between the surface and the bottom so that the bottom sediment is not disturbed

The samples will be marked with a unique sample number, as specified in section 7 0 of the QAPP, and placed into ice chests The sediment samples will be analyzed for PCBs only

Procedures for sediment sampling and decontamination are included as S O P s 6 and 9, respectively Sample custody procedures are included in section 7 0 of the QAPP

The sediment sampling activity is expected to last 1 to 2 days Level D personal protective equipment will be worn during this activity, as specified in section 7 0 of the HSP

3 3 8 Monitoring Well Sampling (Task 1100)

Existing on-site monitoring wells Nos 3 (deep/bedrock) and 5 (shallow) have previously been sampled by both the EPA and PRPs (See Figure 3-4) Results have indicated on one occasion the presence of PCBs in the samples, however, it is believed that PCB contaminated surface sediment may be contributing to the analytical results as opposed to contamination representative of the aquifer RES-FS will attempt to redevelop and purge the wells in order to remove the sediment so that a representative sample of the formation water can be obtained The water within the well will be agitated to suspend the sediment by raising and lowering a stainless steel bailer through the full length of the water column A bladder pump will be utilized to remove the water The length of time pumping will be dependent upon the yield of the individual wells and the amount of sediment present in the water The redevelopment process will be ceased when water is visibly free of suspended sediments or when the overpumping efforts are no longer producing a visible reduction in the sediment levels

After redevelopment, the wells will be allowed to recover for 12 to 24 hours The wells will be sampled after the recovery period The sampling period may be extended over several hours to allow the wells to recharge (especially MW-5) All sample containers, except those for volatile organics, will receive a portion of the water from each bailer so as to make sure all containers contain a portion of water removed from each of the periods when there is water present in the well Two one-liter sample aliquots will be obtained from each well, utilizing a teflon bailer One of the aliquots will be filtered in the field utilizing a 0 45 micron filter (Although the filtering of water samples for PCB analysis is not per CLP protocol, the data generated will be used during the evaluation of potential groundwater problems) The remaining aliquot will not be filtered A separate sample will also be obtained for volatile organic analysis This sample will not be filtered Field measurements of pH, specific conductance and temperature measurements will be obtained

The samples will be placed into prelabeled, laboratory cleaned glass containers with teflon lined lids As specified in section 6 0 of the QAPP, the samples will be marked with a unique sample number and placed into ice chests Sampling data will be recorded in a bound field log immediately after sampling Data which will be recorded includes

1. Sample number
2. Time
3. Sample team members
4. Visual observations
5. Depth to water prior to development
6. Depth to water after development
7. pH, temperature, specific conductance

Procedures for monitoring well sampling are included as S O P #8

The monitoring well redevelopment and subsequent sampling will occur over a two to three day period Level D personnel protective equipment will be worn during this activity, as specified in section 7 0 of the HSP

3 3 9 Sample Analysis (Task 1400)

All soil matrix samples obtained from the surface, sediment and shallow subsurface exploration sampling activities will be analyzed for PCBs utilizing ASTM method 3304-77 The groundwater samples will be analyzed for PCBs per ASTM method 3534-85 The soil matrix samples from the shallow subsurface exploration and groundwater samples will also be analyzed for the volatile organics included in Table 3-1 per EPA method 8240

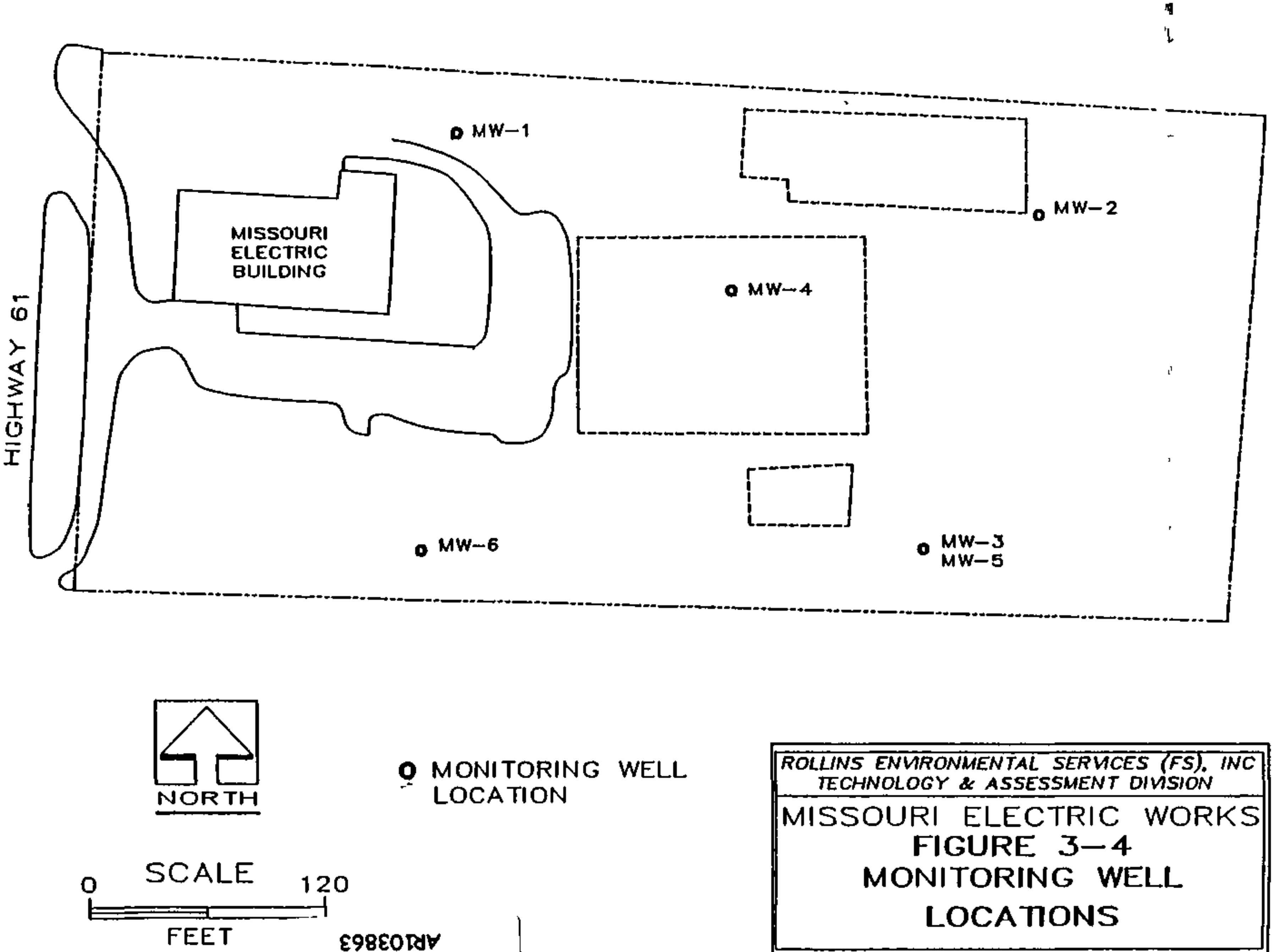

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FIGURE 3–4
MONITORING WELL
LOCATIONS

Duplicate samples will be obtained in the field at the rate of one per 20 samples per matrix Field equipment blanks will obtained from each sampling team at the end of each day of sampling Furthermore, split sampling with the U S EPA site representative will be conducted at a frequency of 10% (maximum)

The analytical parameters for each task are included in Table 3-2 Analytical procedures are included in section 9 0 of the QAPP Section 3 0 of the QAPP details the type and rate of quality control samples which will be obtained

APR Laboratories will perform all of the chemical analyses for the phase I activities

3 4 PHASE II SITE INVESTIGATION

Activities which will be performed during phase II of the site investigation include

1 Task 310 - Mobilization
2 Task 600 - Trenching
3 Task 910 - Supplemental Surface Soil Sampling
4 Task 1010 - Supplemental Sediment Sampling
5 Task 1200 - Soil Boring for Depth Profiles
6 Task 1300 - Soil Properties Sampling
7 Task 1410 - Sample Analysis

Each of these activities is discussed below

3 4 1 Mobilization (Task 310)

Mobilization activities for phase II will be similar to the phase I mobilization activities, with the exception that the grid will not be reestablished Additionally, several of the support facilities may remain from phase I

Mobilization for phase II is expected to take 1 day Level D personnel protective equipment will be worn as detailed in section 7 0 of the HSP

3 4 2 Trenching (Task 600)

As previously discussed in section 3 3 3 (Task 500), a geophysical survey will be performed over the east end of the site to determine the absence or presence of buried wastes The data will be plotted to determine areas of high conductance and/or areas of high magnetic variability Based upon the contour plots, areas will be selected for exploration The locations and numbers of trenches will be presented to EPA for approval prior to phase II mobilization

TABLE 3 2
ANALYTICAL SUMMARY
MISSOURI ELECTRIC WORKS RI/FS

TASK	TYPE OF SERVICE	EST QUANTITY (a)	PARAMETERS
600	SUBSURFACE SOIL/WASTE	9	PCBs (AROCHLOR 1260) (ASTM 3304 77) VOLATILE ORGANICS (EPA 8240) VISUAL CLASSIFICATION
800	SUBSURFACE SOIL	18	PCBs (AROCHLOR 1260) (ASTM 3304 77) VOLATILE ORGANICS (EPA 8240) VISUAL CLASSIFICATION
900/910	SURFACE SOIL (b)	68	PCBs (AROCHLOR 1260) (ASTM 3304 77) VISUAL CLASSIFICATION
1000/1010	SEDIMENT SOIL (b)	113	PCBs (AROCHLOR 1260) (ASTM 3304 77) VISUAL CLASSIFICATION
1100	GROUNDWATER	6	PCBs (ASTM 3534 85) VOLATILE ORGANICS (EPA 8240) FIELD DETERMINATIONS pH, TEMPERATURE, SPECIFIC CONDUCTANCE
1200	SOIL BORINGS	128	PCBs (AROCHLOR 1260) (ASTM 3304 77) TRICHLOROETHANE, TRICHLOROETHYLENE, METHYLENE CHLORIDE (EPA 5030 + 8010) VISUAL CLASSIFICATION
1300	SOIL	12	BTU (ASTM D240 64), DENSITY (COE EM1110 2 1906), CEC (EPA 9080), PARTICLE SIZE DETERMINATION (D422 63), THERMAL CONDUCTIVITY (C), % MOISTURE (ASTM 2216 80), pH (EPA 9045), TOTAL CHLORIDES (EPA 9251), ATTERBERG LIMITS (ASTM D4318 84), TOTAL METALS (Al, As, Ba, Cd, Ca, Cr, Cu, Fe, Pb, Mg, Mn, Hg, Ni, K, Se, Ag, Na, Zn) VISUAL CLASSIFICATION

A PROJECTED QUANTITIES, ACTUAL NUMBER OF SAMPLES MAY CHANGE BASED UPON FIELD CONDITIONS AND PHASE I ANALYTICAL RESULTS

B ESTIMATED QUANTITIES BASED ON PHASE I PROJECTIONS ONLY THE QUANTITY OF SAMPLES WHICH WILL BE OBTAINED DURING PHASE II IS DEPENDENT UPON THE PHASE I ANALYTICAL RESULTS

C AS REFERENCED IN GEOTECHNICAL TESTING JOURNAL, VOL 6, MARCH DECEMBER 1983

The excavation, sampling and analysis plan is designed to provide data on

1 Location of waste dump area samples

2 Physical states and types of waste

3 Chemical constituents of waste

4 Dimensions of waste deposits

5 Degree of soil contamination

Excavation will be done by backhoe under the guidelines of S O P #3 Backhoe Trench Excavation, S O P #1-Vapor Sampling Procedures, and Section 6 0 of the QAPP

As the excavation progresses, a separate log sheet of each excavation will be kept and the following recorded

1 Location relative to the 50-100 foot grid system

2 Soil cover depth and strata

3 Vapor concentrations

4 Depths of all strata

5 Strata appearance

6 Drum/transformer markings, condition and markings

7 Waste appearance and descriptions

8 Sample numbers, depths, and descriptions

9 Lateral boundaries of waste deposits

10 Reference to photographs taken

Excavation will proceed until wastes are encountered Samples may be taken at this stage Excavation will further proceed until undisturbed soil beneath the waste is encountered Contamination will be judged by disturbed strata, color, texture, and/or vapor requirements An area of at least 10 sq ft of this undisturbed soil will be exposed for characterization and possible sampling After sampling and characterization are completed each excavation will be backfilled, utilizing the backhoe The excavated materials will be placed back into the trench in the reverse order of removal, i e , last material excavated - first material backfilled

Personnel observing the trench excavations will stand upwind and at the end of the trench, in case of sidewall collapse Additionally, lighting will be provided, as necessary, in order to adequately observe and monitor the excavation

Initially, Level C personal protection will be worn during the trenching activity (See Section 7 0 of the HSP) Level B protection may be required if vapor concentrations are too high or if special tasks warrant higher protection

The trenching activity will require 1 to 5 days, depending on the number of areas excavated and the types of wastes encountered

3 4 3 Supplemental Surface Soil Sampling (Task 910)

Additional surface soil samples may be required if the first phase sampling and analysis does not completely define the areal extent of the PCB contamination Additional samples may also be required due to information gained during the historical site survey

The surface soil sampling procedures will be identical to those listed in section 3 3 2

3 4 4 Supplemental Sediment Sampling (Task 1010)

Additional sediment samples may be obtained from run-off areas if the first phase sampling and analysis did not completely define the areal extent of the PCB contamination

The sediment sampling procedures will be identical to those listed in section 3 3 3

3 4 5 Soil Borings for Depth Profiles (Task 1200)

Soil borings will be performed to determine depth profiles of the PCB contamination as well as organic solvents historically associated with the cleaning of equipment, i e , trichloroethylene (TCE), trichloroethane (TCA) and methylene chloride Eight soil borings will be placed around EPA borings 1, 3, 4, 5, and 9 The borings will be placed at 12 5 and 25 feet from the EPA borings in the north, south, east and west directions, as indicated on Figure 3-5

The borings will be installed utilizing hand augers A decontaminated split spoon sampler will be driven ahead of the auger bit to collect decontaminated samples at one foot depth intervals for the upper two feet and at 0 5 foot intervals to the maximum depth of the boring The depth and locations of the borings are indicated on Figure 3-5

The samples will be placed into prelabeled, laboratory cleaned glass containers with teflon or foil lined lids As specified in section 7 0 of the QAPP, the samples will be marked with a unique sample number and placed into ice chests Sampling data will be recorded in a bound field log immediately after sampling Data which will be recorded includes

1 Sample number, location and depth

2 Time

3 Sample team members

4 Visual observations per USCS nomenclature

5 PID readings in the borehole and at the breathing zone

Procedures for the soil boring activity is included as S O P #5 Decontamination procedures are included as S O P #9

The soil boring is expected to require 2 to 3 days for completion Modified level D personal protective equipment will be worn during this activity However, respiratory protection will be worn if organic vapor concentrations in the breathing zone exceed the limits included in section 7 0 of the HSP or if there is a potential for dust/particulate generation RES-FS will continually monitor the organic vapors during the soil boring activity with either a PID and/or FID

3 4 6 Soil Properties Sampling (Task 1300)

Samples will be collected from six locations, at a depth of 0 5 and 1 foot, to characterize three general surface soil conditions that could impact remedial alternatives The locations will be of the following surface soil conditions

1 Oil saturated areas

2 Deep gully areas located on the south side of the property and the north side of the property behind the MEW building

3 Clay soil areas covered with grass (typical of the MEW yard)

For three sampling locations, one in each of the material types and at both the six inch and one foot depth (i e six samples) the following tests will be performed

1 BTU testing

2 Soil density testing (wet and dry)

3 Cation exchange capacity (CEC)

4 Particle size determination (sieve analysis and hydrometer analysis)

5 Thermal conductivity measurements

For all 12 samples the following tests will be performed

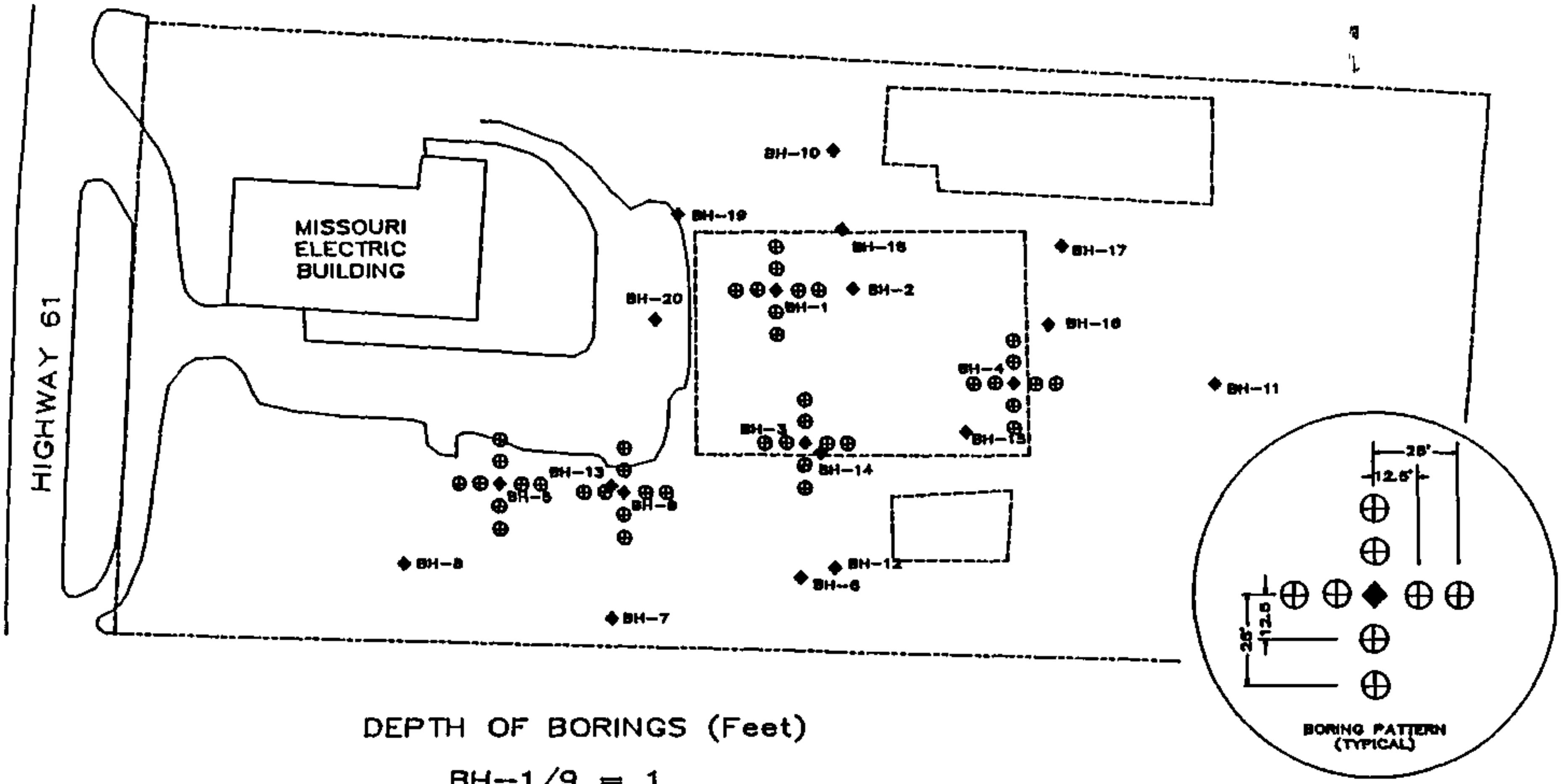
1 Natural moisture content

2 Soil pH

3 Chloride concentration

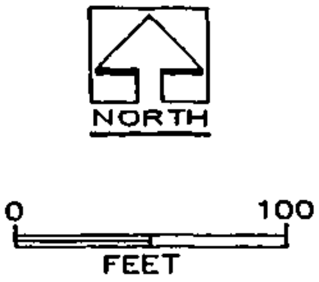
4 Total metals concentration (see Table 3-3)

5 Atterberg limits (liquid and plastic limits)



DEPTH OF BORINGS (Feet)

BH-1/9 = 1
BH-5 = 3
BH-3/4 = 4



◆ SOIL BORING LOCATION

⊕ PROPOSED SOIL BORING LOCATION

ROLLINS ENVIRONMENTAL SERVICES (FS), INC
TECHNOLOGY & ASSESSMENT DIVISION

MISSOURI ELECTRIC WORKS

FIGURE 3-5

SOIL BORING LOCATIONS

TABLE 3-3
INORGANIC ANALYTICAL PARAMETERS

PARAMETER
Aluminum
Arsenic
Barium
Cadmium
Calcium
Chromium
Copper
Iron
Lead
Magnesium
Manganese
Mercury
Nickel
Potassium
Selenium
Silver
Sodium
Zinc

The samples will be obtained with either shovels, trowels or hand augers and shelby tubes per S O P #5 Non-disposable sampling equipment will be decontaminated between samples as per S O P #9

The samples will be placed into prelabeled, laboratory cleaned glass containers with teflon or foil lined lids As specified in section 7 0 of the QAPP, the samples will be marked with a unique sample number and placed into ice chests Sampling data will be recorded in a bound field log immediately after sampling Data which will be recorded includes

1 Sample number, grid location and depth

2 Time

3 Sample team members

4 Visual observations per USCS nomenclature

5 PID readings in the excavation and in the breathing zone

The soil properties sampling will require one day for completion Modified level D personal protective equipment will be worn as detailed in section 7 0 of the HSP

3 4 7 Sample Analysis (Task 1410)

All soil samples obtained from the trenches, borings and the supplemental soil and sediment samples will be analyzed for PCBs utilizing ASTM method 3304-77 Selected samples from around each U S EPA bore hole will be analyzed for trichloroethane (TCA), trichloroethylene (TCE) and methylene chloride utilizing EPA methods 5030 and 8010 The trench samples will be analyzed for the volatile organic compounds in addition to PCBs

Duplicate samples will be obtained in the field at the rate of one per 20 samples per sample matrix Field equipment blanks will be obtained from each sampling team at the end of each day of sampling Furthermore, split sampling with the U S EPA site representative will be conducted at a frequency of 10% (maximum)

The samples obtained in the soil properties sampling activity will be analyzed for the following parameters

Parameter	Method
BTU	ASTM D42-80
Soil density testing (wet and dry)	ASTM 2850-87
Cation exchange capacity (CEC)	EPA 9080
Particle size determination (sieve analysis and hydrometer analysis)	ASTM D422-63
Thermal conductivity measurements	Journal Geotechnical Engineers Division, Vol 104-GT-10, October '78
Natural moisture content	ASTM D2216-80
Soil pH	EPA 9045

Chloride concentration	EPA 9250/51/52
Total metals concentration	EPA 3050 + AA
Atterberg limits (liquid and plastic limits)	ASTM D4318-84

The analytical parameters for each task are included in Table 3-2 Analytical procedures are included in section 9 0 of the QAPP Section 3 0 of the QAPP details the type and rate of quality control samples which will be obtained

APR Laboratories will perform all of the sample analyses except the geotechnical parameters, i e, soil density, particle size determination, thermal conductivity moisture content, and Atterberg limit McClelland Engineers will perform the geotechnical analyses (Note the raw data generated from the physical properties testing of soils will be submitted to Ms Pauletta France-Isetts, RPM for the MEW site, prior to issuing the data as final)

3 5 DATA MANAGEMENT AND VALIDATION

3 5 1 Sample Locations and Numbering

As previously discussed, preliminary sample locations have been determined for the phase I soil sampling and phase II soil boring activities The remaining sample locations are dependent upon the results of the site observations or phase I analytical data For instance, the location of the sediment sampling and soil properties sampling will be determined in the field, based upon the judgement of the Program Manager or On-site Coordinator

The exact locations of each sampling point will be described in a bound log book along with a sketch, if necessary, that includes a minimum of two, and if possible three, distance measurements The measurements will be referenced to the grid stakes and/or from permanent ground features and landmarks The field documentation procedures are discussed in section 7 1 of the QAPP

All pertinent sample collection data will also be recorded in the log The log books will become part of the permanent project records

RES-FS will assign each sample a unique alphanumeric code, which will be referenced on all subsequent correspondence and data The numbering system is discussed in section 6 1 of the QAPP

3 5 2 Chain-of-Custody

Chain of custody record will be maintained at the job site, during sample transport and at the laboratory Chain-of-custody procedures are detailed in section 7 1 3 of the QAPP

3 5 3 Analytical Data Management

The Program Manager will coordinate the analysis of the surface soil and sediment samples with the Laboratory Director in order to prioritize the critical samples which initially need to be analyzed to ensure that the cut-off level is reached during phase I Once the limits have been established, the analysis can be performed sequentially, starting at the expected highest concentration until the analytical results indicate less than 10 ppm PCBs for the surface samples and less than 25 ppm PCBs for the borehole samples All of the samples from the boring closest to and downgradient of each EPA borehole will be analyzed If the analytical results indicate greater concentrations at depth, then all of the samples from the remaining seven borings will be analyzed Surplus samples which do not have to be analyzed in order to define the spatial extent of the contamination will be retained by the laboratory for a period of one-year It should be noted that if sufficient surface soil samples are not obtained and analyzed during phase I to define the cut-off level of 10 ppm, additional surface soil samples will be obtained during phase II

The Program Manager will also communicate with the Laboratory Director to ensure that samples which are shipped are received in good condition and that the appropriate holding times for the samples are not exceeded (Note The holding times are applicable to the water matrix samples and the soil matrix samples designated for volatile organic analysis)

3 6 REMEDIAL INVESTIGATION REPORT

A RI Report will be generated which characterizes the site and summarizes the data collected and conclusions drawn from all investigative areas Analytical data will be reported tabularly referenced to figures and drawings All supporting data, i e historical investigations, data packages, etc , will be included as Appendices

3 7 QUALITY ASSURANCE

All site activities and data will be managed in accordance with the Quality Assurance Project Plan, which is included as Appendix B

3 8 TECHNICAL MANAGEMENT

Technical activities occur throughout the RI activities General management responsibilities include

1 Establishment of project plans, approach and records, as required by the Consent Order
2 Participation at review meetings with EPA
3 Preparation of weekly progress reports during the field activities and monthly progress reports during non-field activities
4 Maintenance of the quality assurance programs
5 Coordination of subcontractors

4 0 RISK ASSESSMENT

A Risk Assessment will be performed to quantify the risk to human health and the environment posed by the site in the no-action scenario At this time the primary indicator compound is PCB (Arochlor 1260) and the primary contaminant pathway is migration of PCB contaminated sediment off-site due to run-off and/or tracking or contaminants by humans or equipment Exposure points are the site itself and adjacent soil surfaces through which the exposure scenarios of inhalation, dermal exposure and incidental ingestion of contaminants could occur Populations at risk include the work force at the MEW facility, the workers at the adjacent commercial facilities, and the residence near the facility, and recreational users of the downstream surface water bodies

These assumptions will be evaluated and developed in detail based upon the information gained during the site investigation A Risk Assessment Planning Document is included as Appendix D

5 0 FEASIBILITY STUDY

RES-FS will perform a Feasibility Study of the MEW site The study will develop specific remedial alternatives based on the data obtained during the site investigation Initially 4 to 6 remedial technologies will be evaluated

A Feasibility Study Planning Document is included as Appendix E

ATTACHMENT 3-1

GEOSTATISTICAL ANALYSIS OF THE MEW PCB ANALYTICAL DATA

ATTACHMENT 3-1
GEOSTATISTICAL ANALYSIS OF THE MEW PCB ANALYTICAL DATA

RES-FS has input the EPA generated surface soil data into a geostatistical modeling program in order to optimize the surface sampling program. The first step in the modeling program required digitizing all of the existing data points into a format (northing and easting) which were then read into the model. In order to do this, the existing E & E data (collected 10/86) had to be redefined from its "5 samples per 50 foot square" composited number to a single data point (defined as the center of the composited block). In addition to this data, the soil boring data collected on 7/87, was added to the data base. Only the boring samples collected from 0-6" were included in this analysis, but since these samples are true single point values as opposed to the composite samples they increased the predictive capability of the model. This data is presented in Figure 1, which shows the posted data points.

The next step in the modeling process was to generate a variogram of the data, which expresses the degree of spatial variation as a function of distance. This is an important step in the modeling process, because it establishes the degree of spatial relationship between adjacent samples so that optimum interpolation and prediction can be achieved (kriging elipse). The variograms used to create the kriging elipse are shown in Figures 2, 3, and 4. The general trend in the data shows a longer range (approximately 230 feet) of spatial relationship in the east-west direction and a very short range (approximately 98 feet) of spatial relationship in the north-south direction. The elipse generated by the anisotrophic rose (Figure 5) will be used to make kriged estimates of the unknown areas between known data points.

The kriging elipse, generated through the variogram analysis, is then applied to individual blocks (at this site designated as 50' squares) in order to predict the concentration of that block. Using this anisotropy effect the concentration of the block is estimated by "weighting" the field data based on its distance to the center of the block and its relationship to the elipse.

The results of this modeling are presented as both a kriged block map and a concentration contours map (Figures 6 and 7). The block map shows the actual predicted value (in ppm PCB) of each kriged block (all blocks with a value greater than 10 ppm PCB). The contour map shows concentrations contours at two intervals, 10-50 ppm (each line representing 10 ppm) and 100-500 ppm (each line representing 100 ppm).

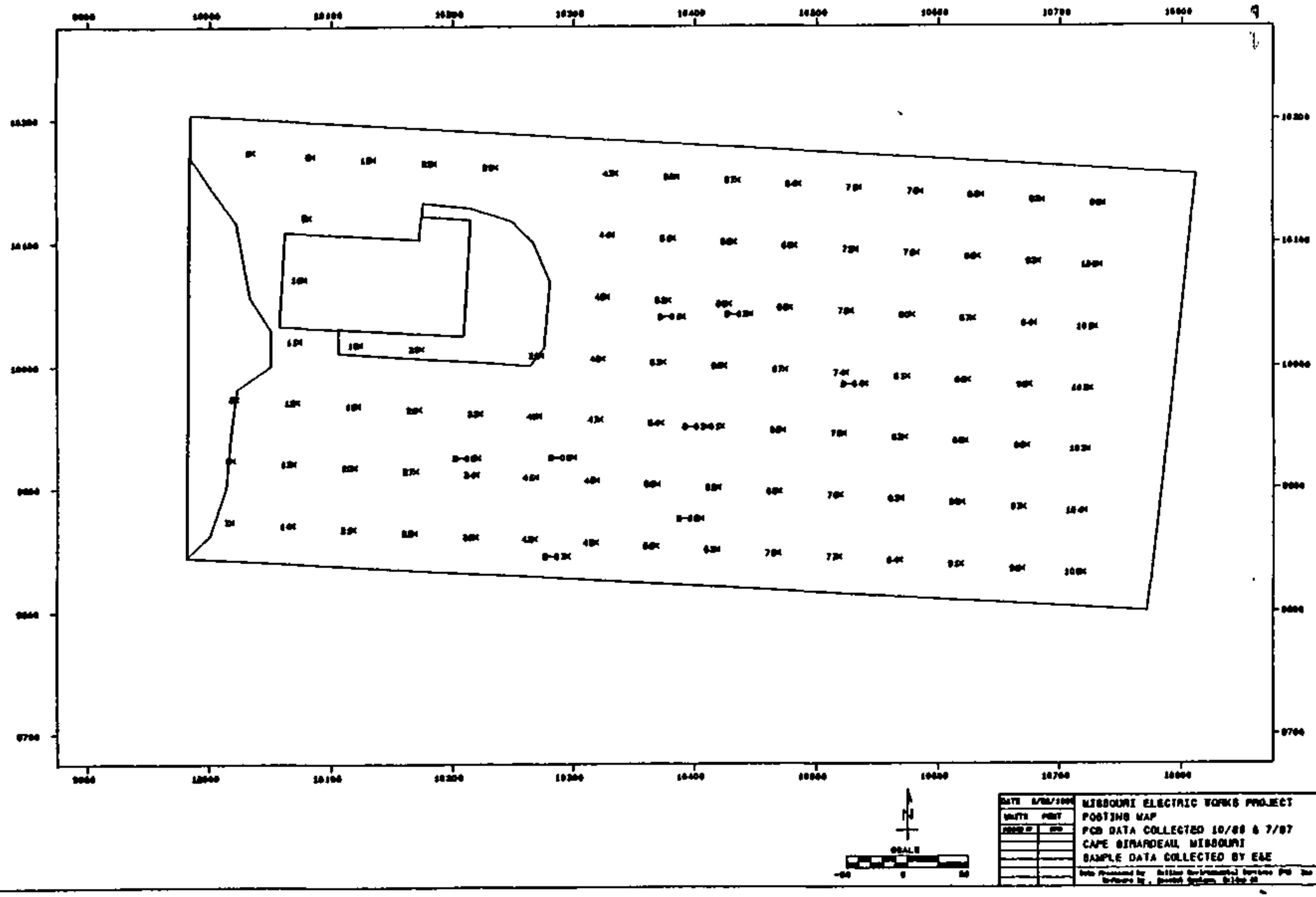
In addition to the concentration maps are the kriged error of estimation (EOE) maps, both block and contour (Figures 8 and 9). The utility of EOE maps is to point out the high predictive probability of the area within the known points (interpolated concentration) and the low predictive probability outside of the known points (extrapolated concentration). Based on the model, the sampling program for this phase of work can be concentrated in areas where, on the EOE contour map, the error of estimation increases rapidly (see Figure 9).

There are some conclusions drawn from the modeling of the E&E data which provide a basis for the sampling program described in this work plan.

- Within the boundaries of the existing data the minimal spatial variation is 98 feet. This number is an indication of the distance between sampling points at which the predictive probabilities are still precise. This number is used in this work plan to calculate sample locations and numbers of samples.

- Grab samples as opposed to composite samples will be collected The composite samples over a distance or area tends to smooth out trends in the model and will therefore be detrimental in determining "action" boundaries for remediation

- Using Figure 9 as a guideline, the kriging EOE of 1 3 will be arbitrarily chosen as the upper limit of sampling confidence Therefore, the area within the kriged EOE of 1 3 will be "grab" sampled for confirmation of composite data and the area outside the kriged EOE of 1 3 and the areas of visual runoff (based on site visit and topography maps) will be sampled separately as different environments Figure 10 indicates the kriged error of estimation threshold line of 1 3



DATE	5/88/1988
UNITS	FEET

MISSOURI ELECTRIC WORKS PROJECT
POSTING MAP
PCB DATA COLLECTED 10/88 & 7/87
CAPE GIRARDEAU, MISSOURI
SAMPLE DATA COLLECTED BY E&E

Figure 1
Posting Map

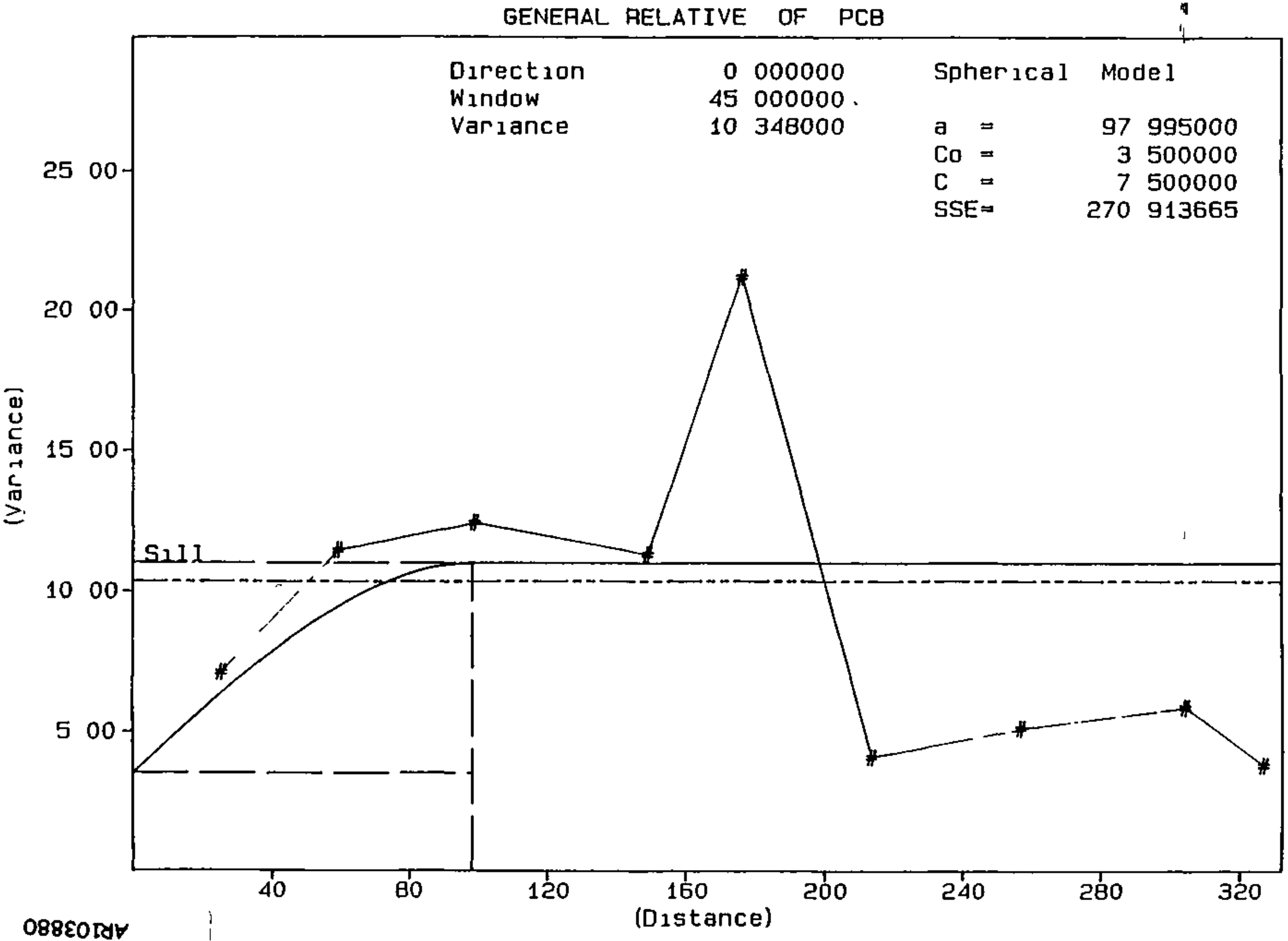


FIGURE 2

VARIOGRAM - NORTH (0 DEGREES)

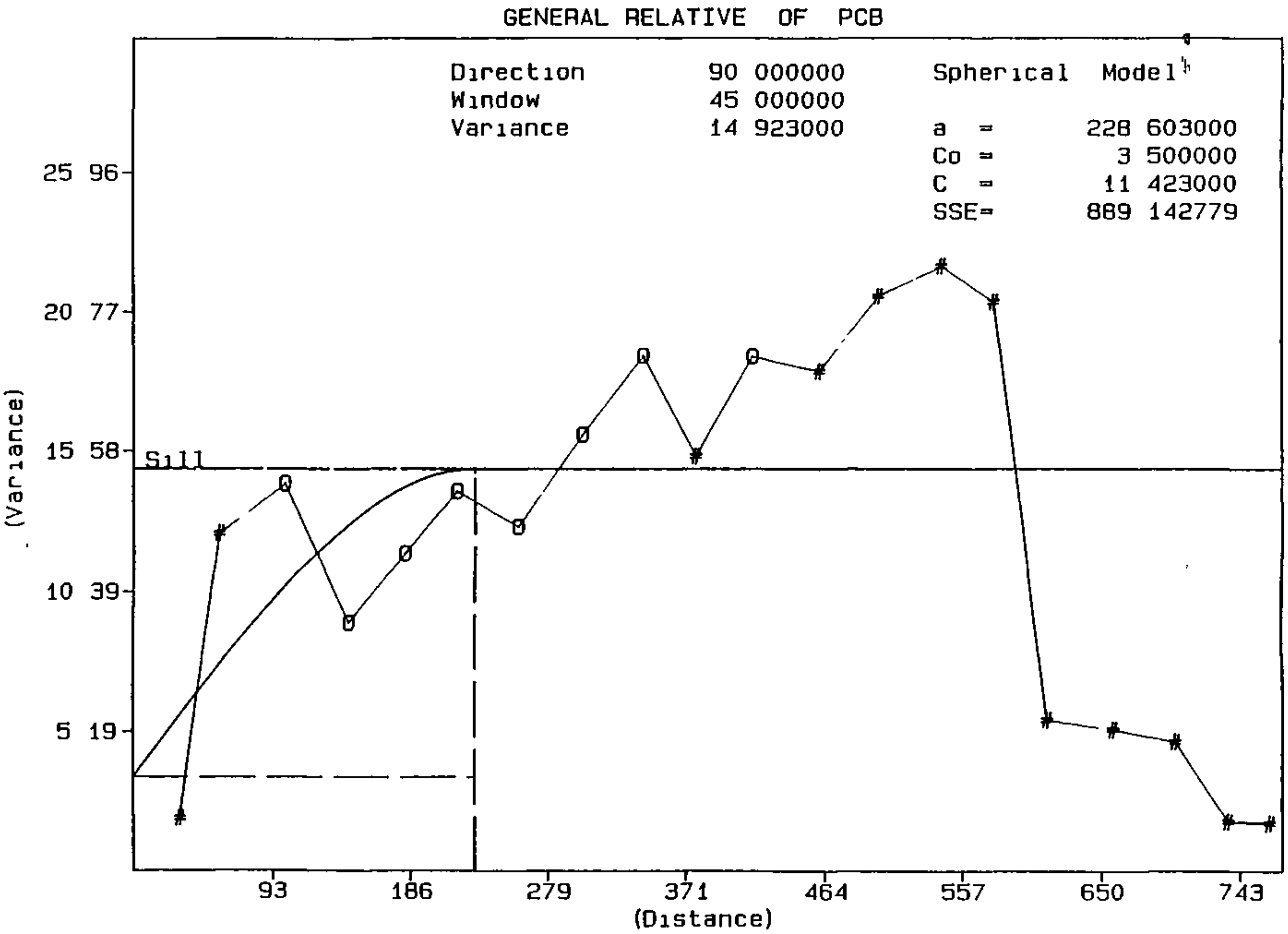


FIGURE 3

VARIOGRAM - EAST (90 DEGREES)

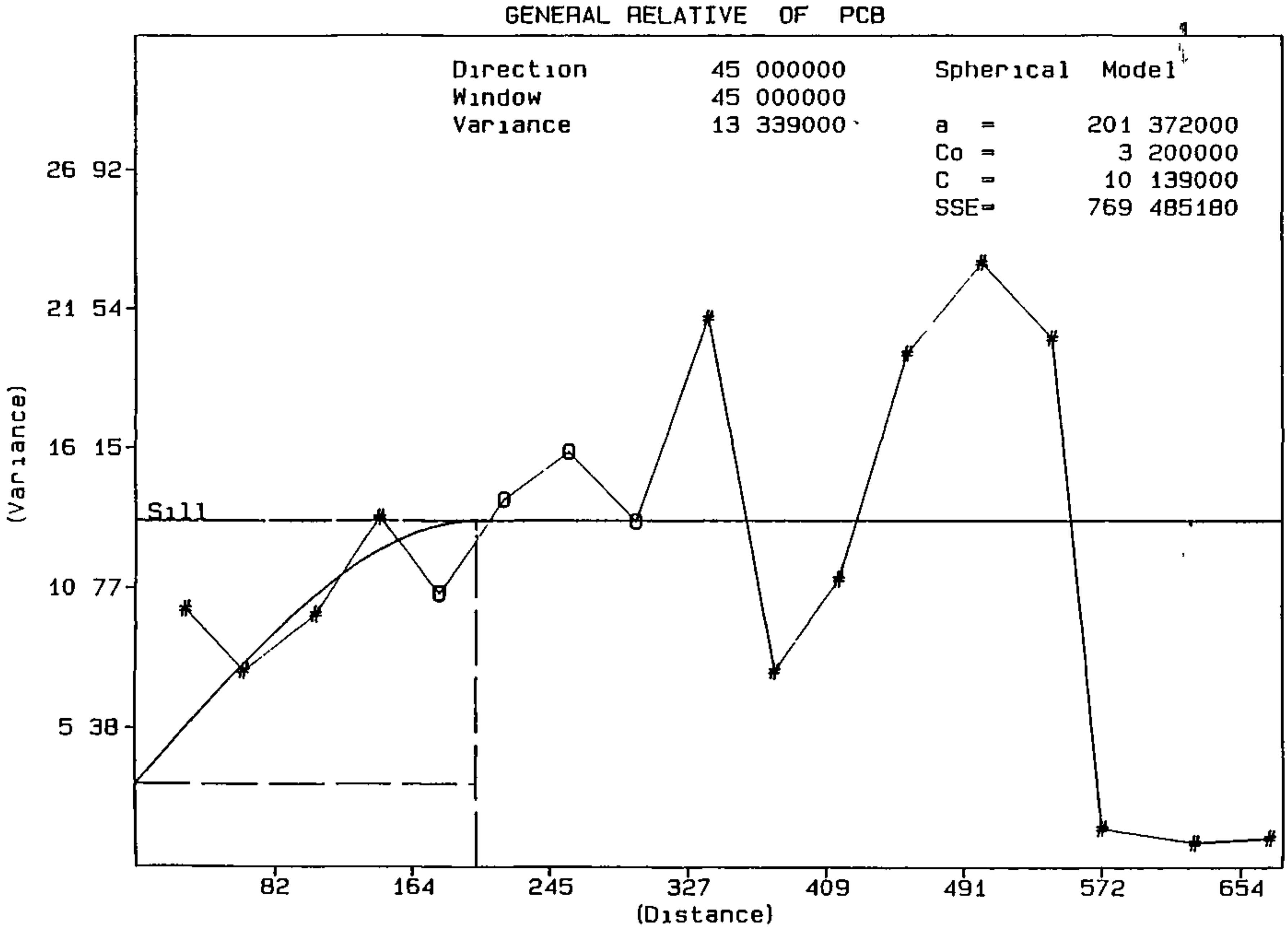
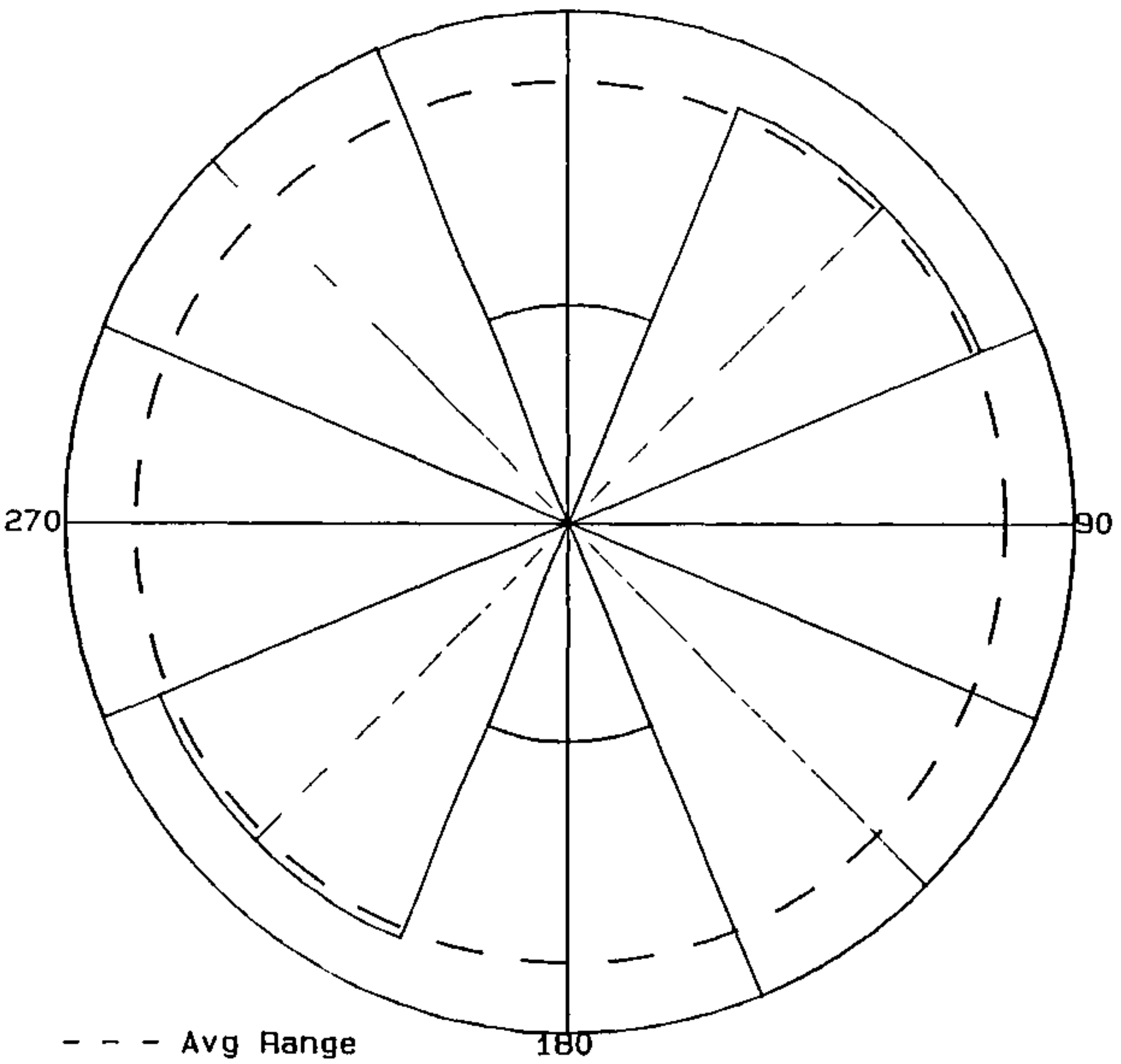


FIGURE 4

VARIOGRAM - NORTHEAST (45 DEGREES)

ANISOTROPHIC ROSE
PCB CONC -MEW SITE



	Range,	Angle,	Window
2	229	0	180
4	98	0	45
6	201	45	45
8	229	90	45
10	229	135	45

FIGURE 5
ANISOTROPHIC ROSE

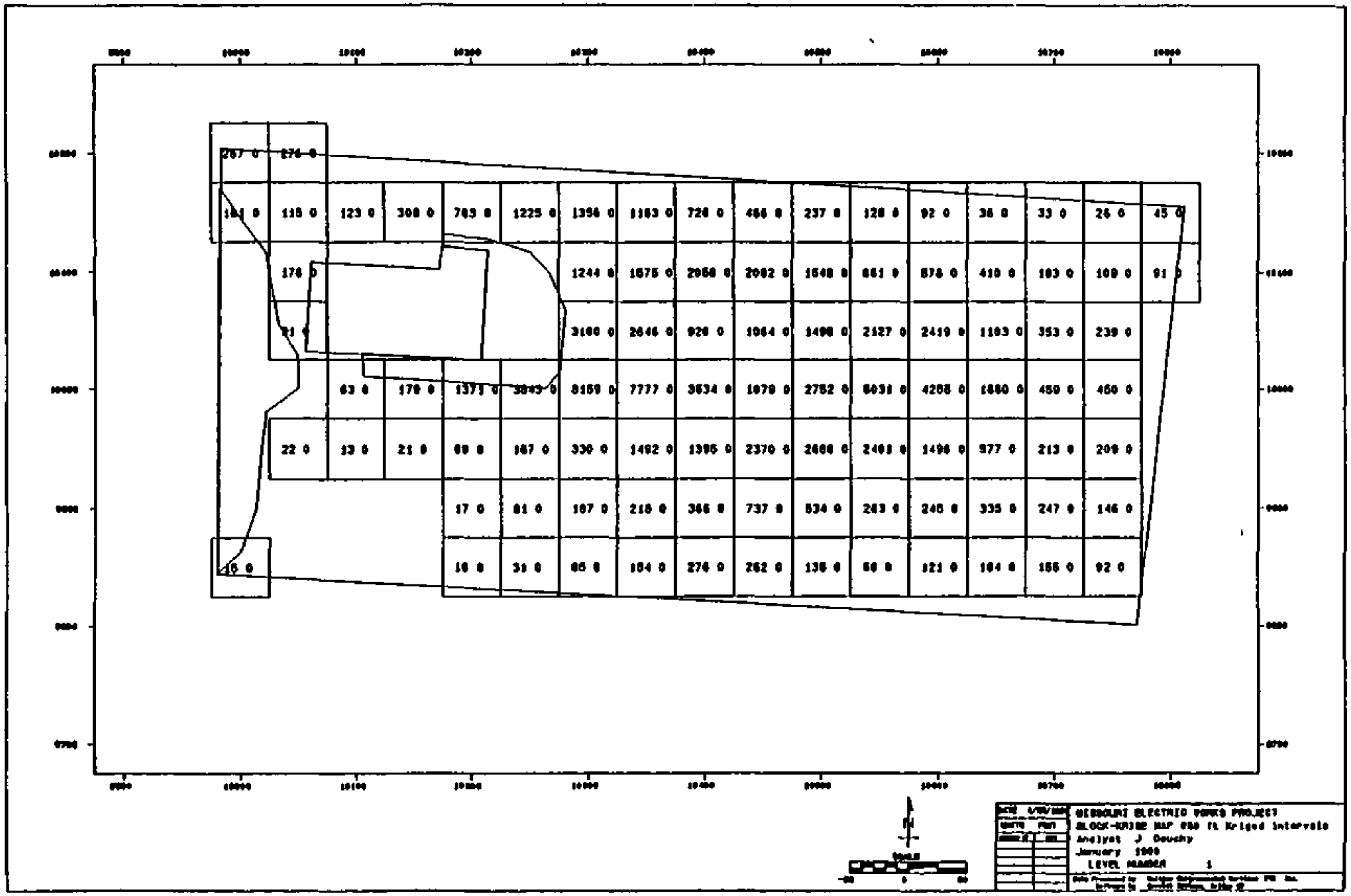


FIGURE 6

KRIGED CONCENTRATION BLOCK MAP

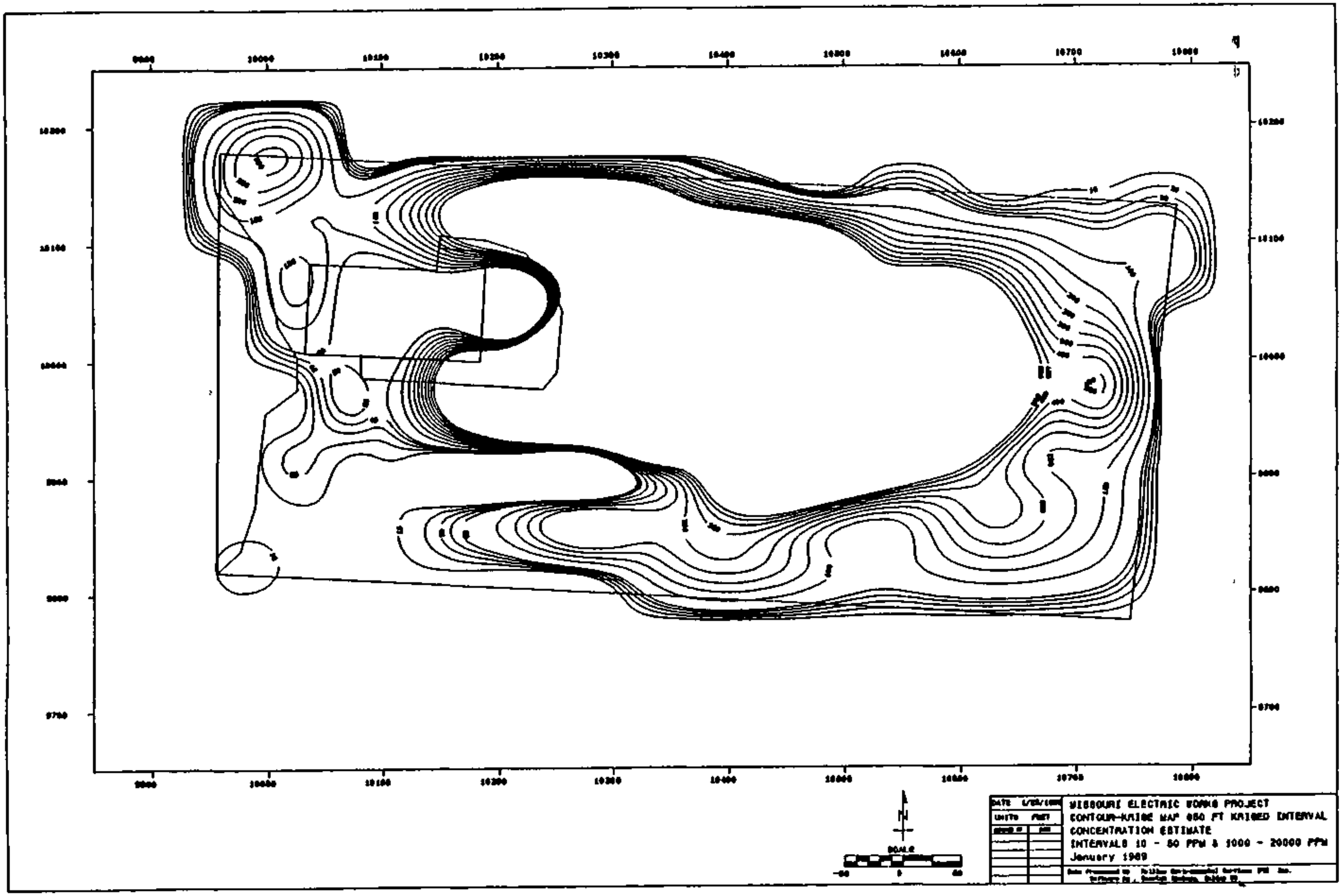


Figure 7
Kriged Concentration Contour Map

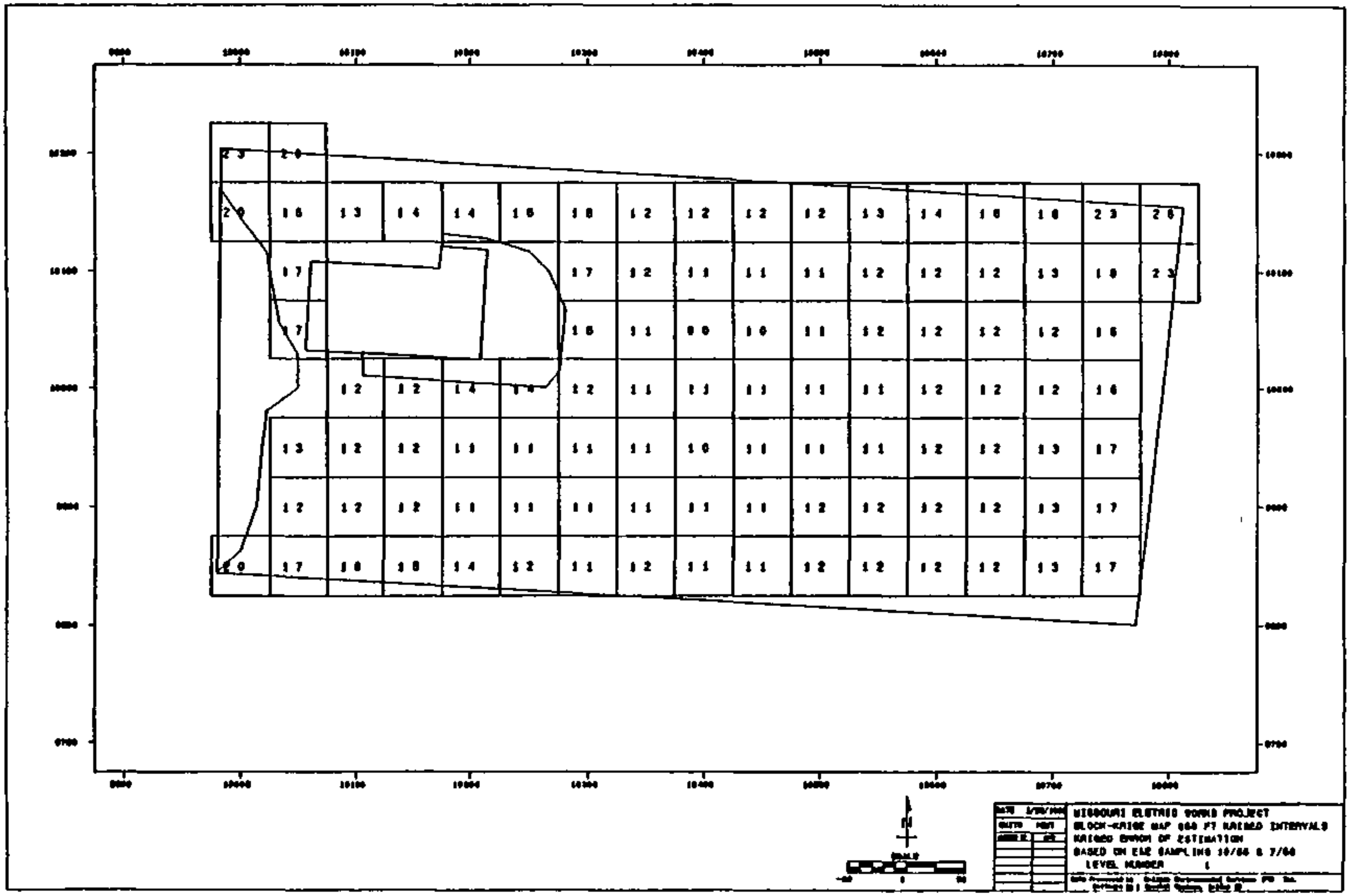


FIGURE 8

KRIGED ERROR OF ESTIMATION BLOCK MAP

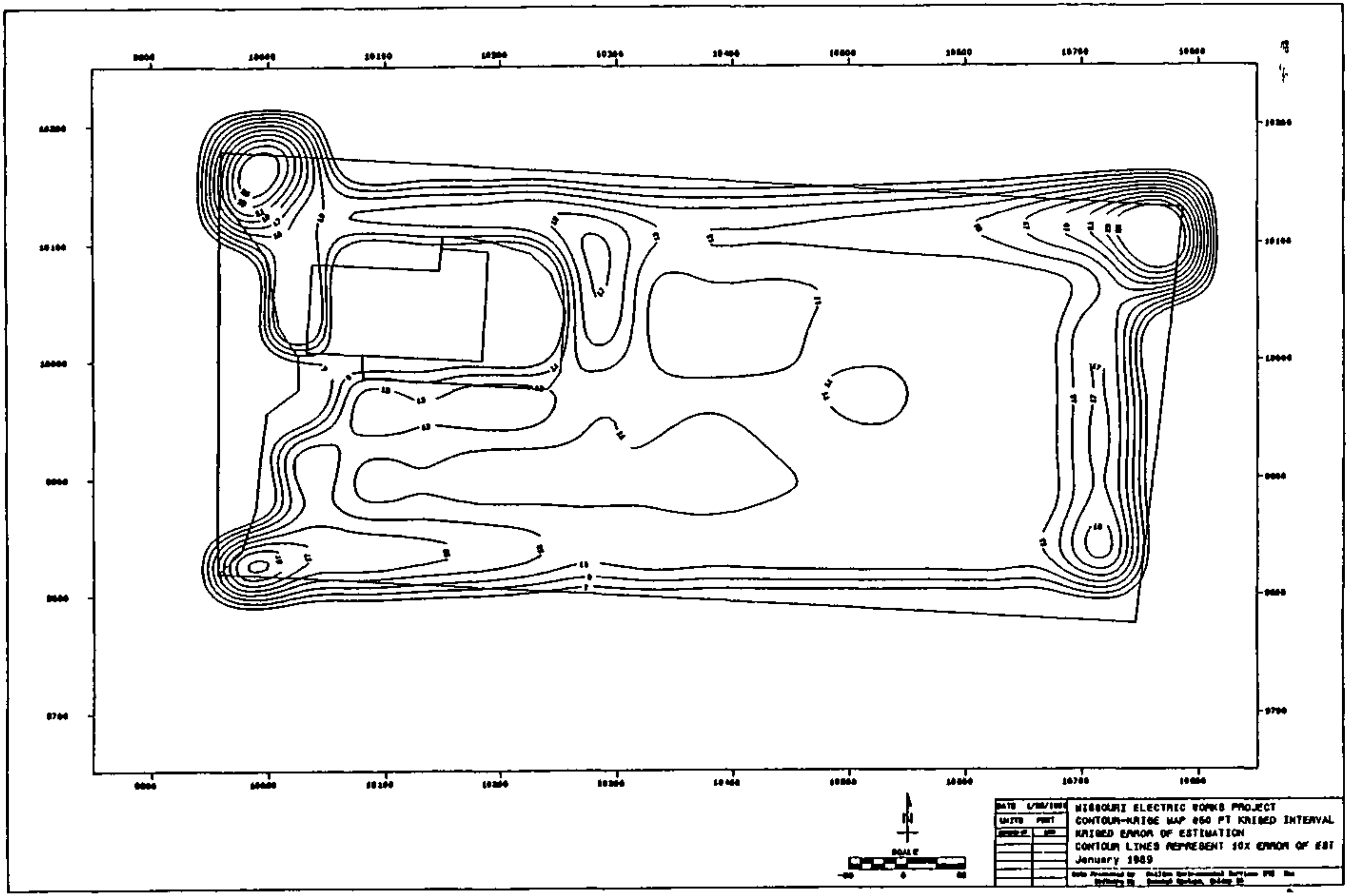


Figure 9
Kriged Error of Estimation Contour Map

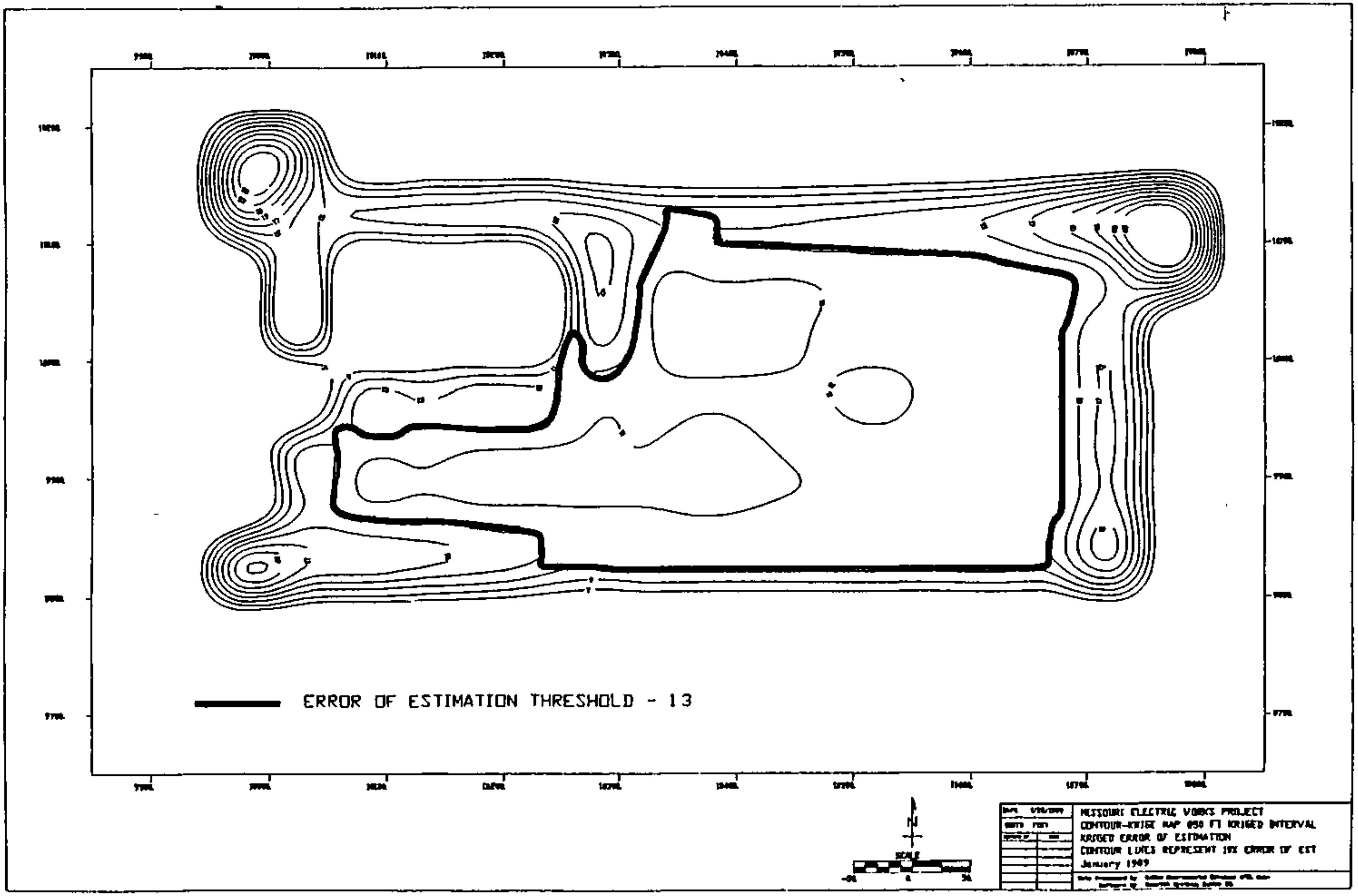


Figure 10
Kriged Error of Estimation Threshold Line

APPENDIX A

STANDARD OPERATING PROCEDURES
FOR THE
MISSOURI ELECTRIC WORKS
REMEDIAL INVESTIGATION/FEASIBILITY STUDY

PREPARED FOR

MISSOURI ELECTRIC WORKS PRP COMMITTEE

BY

ROLLINS ENVIRONMENTAL SERVICES (FS), INC
TECHNICAL AND ASSESSMENT DIVISION
9000 GULF FREEWAY, SUITE 245
HOUSTON, TEXAS 77017

JUNE 22, 1989

TABLE OF CONTENTS

S O P #1
SEMI-QUALITATIVE/QUANTITATIVE VAPOR SAMPLING PROCEDURES

GENERAL

During field activities at the site, on-site air quality monitoring will be performed using the equipment described below Based upon an evaluation of the air monitoring data, the type of work in progress and assessment of exposure etc , the Health and Safety Officer may modify the levels of personnel, protection and frequency of sampling and may modify or stop work as required to ensure safety

JOB SPECIFIC INSTRUMENTATION

Flame Ionization Detector (FID) Instrument

Foxboro Century Organic Vapor Analyzer - Model OVA 128 with Factory Mutual Research Corp strip chart recorder Used to measure trace amounts of organic compounds in the air The FID is most sensitive to hydrocarbons (including methane), somewhat less sensitive so compounds containing oxygen and nitrogen Halogenated compounds also show a lower relative response than nonhalogenated hydrocarbons PCBs will not be detected by this instrument

Specifications listed in attached S O P #1 A

Calibration This instrument will be recalibrated prior to each sampling event or field usage (if the instrument is inactive for greater than 48 hours during any sampling event it will be recalibrated)

Calibration will be done using a benzene standard span gas following the calibration procedures attached in S O P #1 B

Photoionization Detector (PID) Instrument

Photovac Incorporated - Model TIP Used to detect trace concentrations of certain organic gases and a few inorganic gases in the air The PID is most sensitive to aromatic hydrocarbons, aliphatic amines, and unsaturated chlorinated hydrocarbons

Carbonyl and unsaturated hydrocarbons, sulfides, ammonia, and the heavier paraffins C_5 - C_7 can also be detected but with a lesser degree of sensitivity Methane, ethane and other light paraffins are not detected by the PID PCBs will not be detected with this instrument

Specifications listed in attached S O P #1 C

Calibration This instrument will be recalibrated prior to each sampling event or field usage (if the instrument is inactive for greater than 48 hours during any sampling event it will be recalibrated) Calibration will be done using a standard span gas

Explosimeter Instrument

MSA Combustion Gas and Oxygen Alarm - Model 260 Used to measure the concentrations of flammable vapors and gases in the air Flammable gas concentrations are measured as percentages of the Lower Explosive Limit (LEL)

Specifications listed in attached S O P #1 D

Calibration This instrument will be recalibrated prior to each sampling event or field usage (if the instrument is inactive for greater than 48 hours during any sampling event it will be recalibrated) Calibration will be done using MSA Calibration Check Gas, following the calibration procedures attached in S O P #1 E

INITIAL AIR QUALITY SURVEY

The semi-qualitative/quantitative monitoring procedures will include an initial traverse of the site perimeter followed by a survey along two (2) perpendicular traverses through the site interior Both PID and FID instrument readings will be obtained at 25 foot intervals along the survey traverses The results of the survey will be used to determine the appropriate levels of respiratory protection

TRENCHING

Subsurface sampling at hazardous waste sites can create hazards to both workers and the public (for example, biodegradation of buried organic material may produce flammable methane and buried drums or containers may contain flammable or toxic liquids), consequently, adequate safety precautions must be followed

Minimum protection levels for initial trenching operations will be level C protection This level may be modified depending on monitoring results or on information gained during the geophysical investigation

When the waste is penetrated, the FID, PID and LEL instrument will be placed immediately above or into the opening If the FID or PID reading is above 500 ppm or if the LEL instrument reading is above 10% of the LEL, the excavation will be immediately backfilled

If readings at the opening are below 500 ppm with both the FID and PID instruments, the probes of both instruments will be moved to the level of the personal breathing zone, three feet upwind of the opening If PID levels are above background, level C respiratory protection will be required If readings exceed 5 ppm level B will be required

Subsequently, FID and PID readings will be taken at the breathing zone fifty feet downwind of the opening to determine the possibility of off-site contamination Additional readings at varied distances from the opening may be required If downwind vapor concentrations are determined to be leaving the site at levels greater than background, the excavation will be closed

Instruction

MI
611-132
December 1985

Model OVA 128
CENTURY Organic Vapor Analyzer

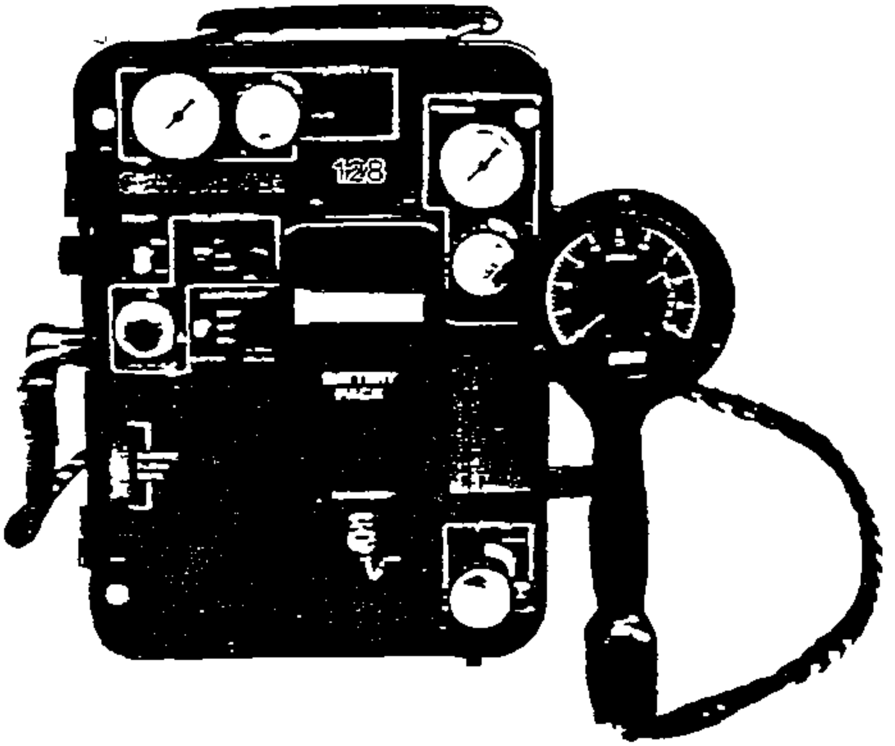


FIGURE 1
PORTABLE ORGANIC VAPOR ANALYZER

MEW Admin record
AR103893

FOXBORO®

® Registered Trademark

GENERAL DESCRIPTION

The OVA 128 Analyzer is designed to detect and measure hazardous organic vapors and gases found in most industries It has broad application since it has a chemically resistant sampling system and can be calibrated to almost all organic vapors It can provide accurate indication of gas concentration in one of three ranges 0 to 10 ppm, 0 to 100 ppm, or 0 to 1000 ppm While designed as a lightweight portable instrument, it can be permanently installed to monitor a fixed point

The instrument utilizes the principle of hydrogen flame ionization for detection and measurement of organic vapors. The instrument measures organic vapor concentration by producing a response to an unknown sample, which can be related to a gas of known composition to which the instrument has previously been calibrated. During normal survey mode operation, a continuous sample is drawn into the probe and transmitted to the detector chamber by an internal pumping system.

The sample stream is metered and passed through particle filters before reaching the detector chamber Inside the detector chamber, the sample is exposed to a hydrogen flame which ionizes the organic vapors When most organic vapors burn, they leave positively charged carbon-containing ions An electric field drives the ions to a collecting electrode As the positive ions are collected, a current corresponding to the collection rate is generated. This current is measured with a linear electrometer preamplifier which has an output signal proportional to the ionization current A signal conditioning amplifier is used to amplify the signal from the preamp and to condition it for subsequent meter or external recorder display The display is an integral part of the Probe/Readout Assembly and has 270° scale deflection.

In general, the hydrogen flame ionization detector is more sensitive for hydrocarbons than any other class of organic compounds The response of the OVA varies from compound to compound, but gives repeatable results with all types of hydrocarbons, i e , saturated hydrocarbons (alkanes), unsaturated hydrocarbons (alkenes and alkynes) and aromatic hydrocarbons

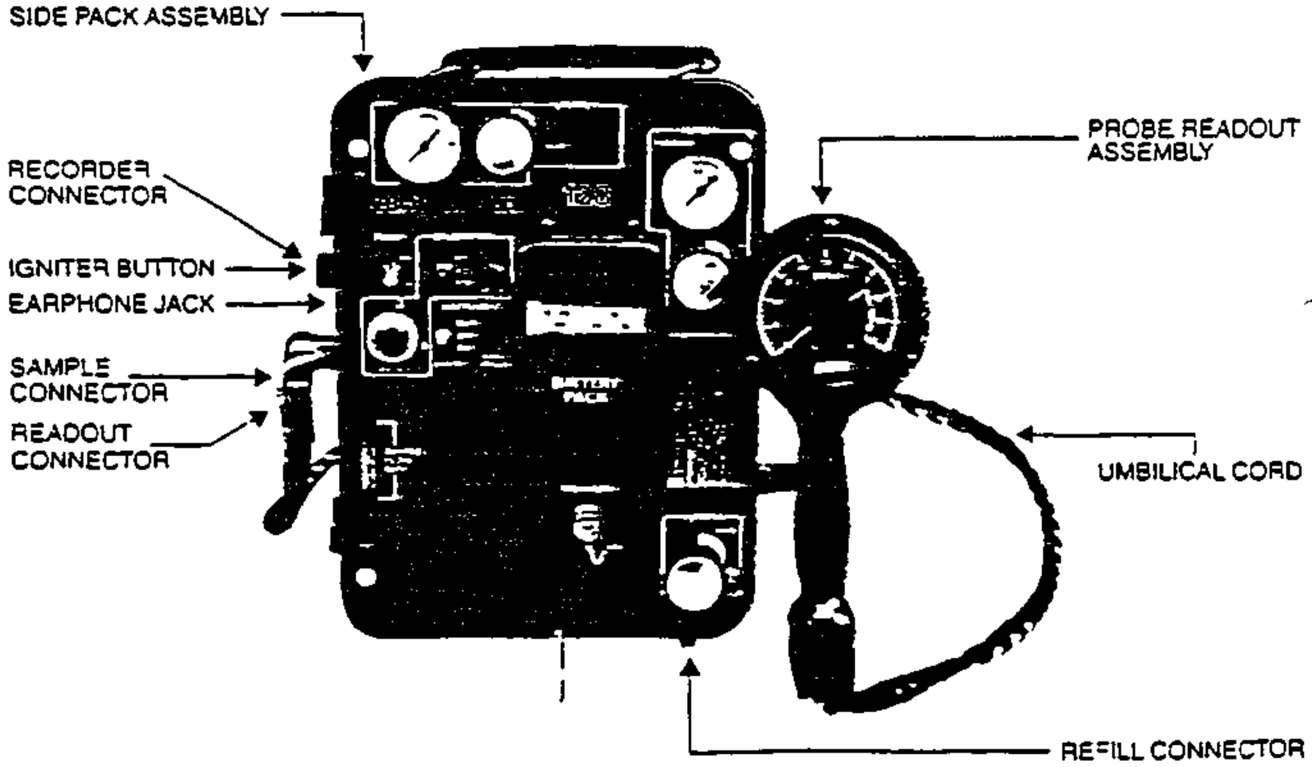


FIGURE 2
PORTABLE ORGANIC VAPOR ANALYZER

Typical response of various hydrocarbons, relative to methane is as follows *

Compound	Relative Response (percent)
Methane	100 (reference)
Hexane	70
Propane	64
N-butane	61
N-pentane	100
Ethylene	85
Acetylene	200
Benzene	150
Toluene	120
Ethane	90

Compounds containing oxygen, such as alcohols, ethers, aldehydes, carbolic acid and esters give a lower response than that observed for hydrocarbons This is particularly noticeable with compounds having a high ratio of oxygen to carbon such as the lower members of each series which have one, two or three carbons With compounds containing higher numbers of carbons, the effect is diminished to such an extent that the response is similar to that of the corresponding hydrocarbons

Nitrogen-containing compounds (i e , amines, amides, and nitriles) respond in a manner similar to that observed for oxygenated materials Halogenated compounds also show a lower relative response as compared with hydrocarbons Materials containing no hydrogen, such as carbon tetrachloride, give the lowest response, the presence of hydrogen in the compounds results in higher relative responses Thus, $CHCl_3$ gives a much higher response than does CCl_4 As in the other cases, when the carbon to halogen ratio is 5 1 or greater, the response will be similar to that observed for simple hydrocarbons

*NOTE Each OVA detector will have slightly different responses for organic vapors relative to methane The user should determine responses for his individual instrument The typical response of various compounds relative to methane is as follows

KETONES	
Acetone	60
Methyl ethyl ketone	80
Methyl isobutyl ketone	100
ALCOHOLS	
Methyl alcohol	15
Ethyl	25
Isopropyl	65
HALOGEN COMPOUNDS	
Carbon tetrachloride	10
Chloroform	65
Trichloroethylene	70
Vinyl chloride	35

The OVA has negligible response to carbon monoxide and carbon dioxide which, due to their structure, do not produce appreciable ions in the detector flame Thus, other organic materials may be analyzed in the presence of CO and CO_2

Applications

(1) Measurement of most toxic organic vapors present in industry for compliance with Occupational Safety and Health Administration (OSHA) requirements

(2) Evaluation and monitoring applications in the air pollution field

(3) Source identification and measurement for fugitive emissions (leaks) as defined by EPA

(4) Forensic science applications

(5) Controlling and monitoring atmospheres in manufacturing and packaging operations

(6) Leak detection related to volatile fuel handling equipment

(7) Monitoring the background level of organic vapors at hazardous waste sites

(8) Quality control procedures geared to leak checking, pressurized system checks, combustion efficiency checks, etc

Major Features

The basic instrument consists of two major assemblies, the Probe/Readout Assembly and the Side Pack Assembly (See Figure 2). The recorder is optional on all models, but is normally used with all instruments which incorporate the GC Option The output meter and alarm level adjustments are incorporated in the Probe/Readout Assembly

The Side Pack Assembly contains the remaining operating controls and indicators, electronic circuitry, detector chamber, hydrogen fuel supply, and electrical power supply

Other major features are linear scale readout, approximately two second response time and portable operating time of 8 hours for fuel supply and battery pack A battery test feature allows charge condition to be read on the meter Hydrogen flame-out is signified by an audible alarm plus a visual indication on the meter The instrument contains a frequency modulated detection alarm which can be preset to sound at a desired concentration level The frequency of the detection alarm varies as a function of detected level giving an audible indication of organic vapor concentration. An earphone is provided to allow the operator to hear the alarm in noisy areas or to avoid disturbing workers

During use, the Side Pack Assembly can be carried by the operator on either his left or right side or as a back pack. The Probe/Readout Assembly can be detached from the Side Pack Assembly and disassembled for transport and storage.

Standard Accessories

A variety of sampling fixtures can be used In addition, small diameter tubing can be used for remote sampling or electrically insulated flexible extensions can be used for places that are difficult to reach.

Telescoping Probe

Probe length can be increased or decreased over a 22 to 30 inch range to suit the individual user. A knurled locking nut is used to lock the probe at the desired length. The probe is attached to the Readout Assembly When appropriate, the probe is replaced with a Close Area Sampler, which is supplied as a standard accessory

Sampling Accessories

Part Number	Description
510125-1	Close area sampler - Connects directly to the readout assembly
510035-1	Telescoping wand - Adjustable length -accommodates the probe listed below
510126-1	Tubular area sampler - Used with the telescoping wand

Particulate Filters

The primary filter of porous stainless steel is located behind the sample inlet connector (see Side Pack Assembly drawing) In addition, a replaceable porous metal filter is installed in the "close area" sampler

Carrying Case

An instrument carrying case is provided to transport, ship and store the disassembled Probe/Readout Assembly, the Side Pack Assembly and other equipment

Specifications

READOUT 0 to 10, 0 to 100, 0 to 1000 ppm (linear)
SAMPLE FLOW RATE 1 1/2 to 2 1/2 litre per minute at 22°C, 760 mm, using close area sampler
RESPONSE TIME Approximately 2 seconds for 90% of final reading
PRIMARY ELECTRICAL POWER. 12 volt (nominal) battery pack.
FUEL SUPPLY Approximately 75 mL volume tank of pure hydrogen, maximum pressure 2400 psig, fillable in case
HYDROGEN FLOW RATE Factory set 12.5 ±0.5 mL/min (minus GC option) 11.0 ±0.5 mL/min (GC models)
PORTABLE OPERATING TIME Minimum 8 hours with battery fully charged, hydrogen pressure at 1800 psig
PHYSICAL DIMENSIONS 9" x 12" x 5" (229 mm x 305 mm x 127 mm) Sidepack only
WEIGHT 12 pounds (5.5 kg) (sidepack and hand-held probe assembly)
DETECTION ALARM Audible alarm plus meter indication User preset to desired level
FLAME-OUT ALARM Audible alarm plus meter indication (needle drops off scale in negative direction)
BATTERY TEST Battery charge condition indicated on readout meter Upon activation of momentary contact switch, a meter reading above the indicator line means that there is 4 hours minimum service life remaining (at 22°C)
FILTERS In-line sintered metal filters will remove particles larger than 10 microns.
OPERATING TEMPERATURE RANGE 10°C to 40°C
MINIMUM AMBIENT TEMPERATURE 15°C for Flame Ignition (coldstart)
ACCURACY Based on the use of a calibration gas for each range

Calibration Temp °C	Operating Temp °C	Accuracy in % of Individual Full Scale X1	X10	X100
20 to 25	10 to 35	±20	±10	±10
20 to 25	10 to 40	±20	±20	±20

RELATIVE HUMIDITY 5% to 95% Effect
on accuracy ±20% of individual
full scale
RECORDER OUTPUT 0 to 5 volts
MINIMUM DETECTABLE LIMIT (METHANE)
0 2 ppm
STANDARD ACCESSORIES

1 Instrument carrying and storage case
2 Hydrogen fuel filling hose assembly
3. Battery charger
4 Earphone
5 Various sampling fixtures
6 Maintenance tool kit
7 Operators manual (2 each)
8 Padded leather carrying straps

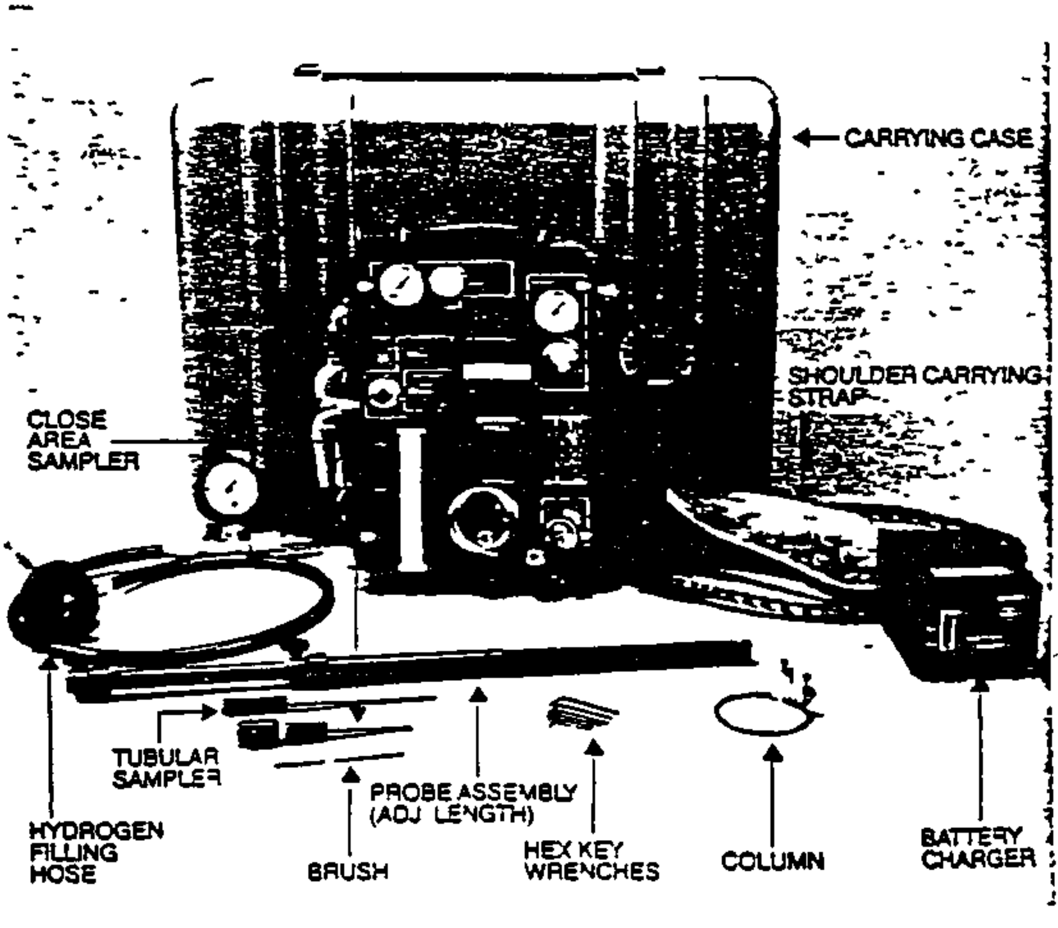


FIGURE 3
OVA-128 ANALYZER COMPONENTS
(Gas Chromatograph Model Shown)

OPERATING PROCEDURES

Controls and Indicators

Sidepack Assembly

1) INSTR/BATT Test Switch* - Three position toggle switch controls all instrument electrical power except the pump and alarm power It also permits display of the battery charge condition on the readout meter

2) PUMP (ON/OFF) Switch* - Toggle switch controls power to the internal pump and audio alarms.

3) Igniter Switch - Momentary push button switch connects power to the igniter coil in the detector chamber and simultaneously disconnects power to pump.

4) CALIBRATE Switch (range selector) -Selects the desired range X1 (0 to 10 ppm), X10 (0 to 100 ppm); X100 (0 to 1000 ppm).

5) CALIBRATE ADJUST (zero) Knob -Potentiometer used to "zero" the instrument.

6) GAS SELECT KNOB (span control) - Ten-turn dial readout potentiometer sets the gain of the instrument (commonly referred to as span control).

7) Recorder Connector - Five-pin connector used to connect the instrument to an external recorder with the following pin connections.

   Pin E - + 12 V dc
   Pin H - Ground
   Pin B - Signal 0 to 5 V dc

8) Charger Connector - BNC connector used to connect the battery pack to the battery charger

9) HYDROGEN TANK VALVE - Valve used to supply or close off the fuel supply from the hydrogen tank.

10) HYDROGEN TANK PRESSURE Indicator - High pressure gauge measures pressure in the hydrogen fuel tank which is an indication of fuel supply

11) HYDROGEN SUPPLY VALVE - Valve used to supply or close off hydrogen fuel to the detector chamber.

12) HYDROGEN SUPPLY PRESSURE Indicator - Low pressure gauge used to monitor hydrogen pressure at the capillary restrictor

13) SAMPLE FLOW RATE Indicator - Indicator to monitor the sample flow rate

14) REFILL CONNECTION - ¼ in AN fitting to connect the hydrogen refill hose to the instrument

15) REFILL VALVE - Valve to open one end of the instrument fuel tank for refilling with hydrogen.

16) EARPHONE JACK - Used to connect the earphone, speaker is disabled when earphone is used.

17) VOLUME Knob - Potentiometer adjusts the volume of the internal speaker and earphone

18) Readout and Sample Connectors - Used to connect the sample hose and umbilical cord from the Probe/Readout to the Side Pack.

Controls and Indicators

Probe/Readout Assembly

1) Meter - Linear scaled 270° meter displays the output signal level in ppm

2) Alarm Level Adjust Knob - Potentiometer (located on the back of the Readout Assembly) is used to set the concentration level at which the audible alarm is actuated.

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*Special Switch - switch handle must be pulled to change position This prevents accidental movement

Startup Procedure

a) Connect the Probe/Readout Assembly to the Sidepack Assembly by attaching the sample line and electronic jack to the Sidepack

b) Select the desired sample probe (close area sampler or telescoping probe) and connect the probe handle Before tightening the knurled nut, check that the probe accessory is firmly seated against the flat seals in the probe handle and in the tip of the telescoping probe

c) Move the Instr/Batt Switch to the test position The meter needle should move to a point beyond the white line, indicating that the integral battery has more than 4 hours of operating life before recharging is necessary

d) Move the Instr/Batt Switch to the "ON" position and allow a 5 minute warm-up

e) Turn the Pump Switch on

f) Use the Calibrate Adjust knob to set the meter needle to the level desired for activating the audible alarm If this alarm level is other than zero, the Calibrate Switch must be set to the appropriate range

g) Turn the Volume Knob fully clockwise.

h) Using the Alarm Level Adjust knob, turn the knob until the audible alarm is activated.

i) Move the Calibrate Switch to X1 and adjust the meter reading to zero using the Calibrate Adjust (zero knob)

j) Open the hydrogen Tank Valve 1 or 2 turns and observe the reading on the Hydrogen Tank Pressure Indicator (Approximately 150 psi of pressure is required for each hour of operation)

k) Open the Hydrogen Supply Valve 1 or 2 turns and observe the reading on the Hydrogen Supply Pressure Indicator The reading should be between 8 and 12 psi.

Note. With GC instrument, a column or jumper must be installed

l) After approximately one minute, depress the Igniter Button until the hydrogen flame lights The meter needle will travel upscale and begin to read "Total Organic Vapors" Caution Do not depress igniter for more than 6 seconds If flame does not ignite, wait one minute and try again

m) The instrument is ready for use NOTE If the ambient background organic vapors are "zeroed out" using the Calibrate Adjust knob, the meter needle may move off-scale in the negative direction when the OVA is moved to a location with lower background If the OVA is to be used in the 0 to 10 ppm range, it should be "zeroed" in an area with very low background A charcoal filter (Part No. 510095-1) can be used to generate the clean background sample

Operating Procedures

The following procedure describes operation of the OVA in the "Survey Mode" to detect total organic vapors

a) Set the CALIBRATE Switch to the desired range Survey the areas of interest while observing the meter and/or listening for the audible alarm indication For ease of operation, carry the Side Pack Assembly positioned on the side opposite the hand which holds the Probe/Readout Assembly For broad surveys outdoors, the pick-up fixture should be positioned several feet above ground level When making quantitative readings or pinpointing, the pickup fixture should be positioned at the point of interest

b) When organic vapors are detected, the meter pointer will move upscale and the audible alarm will sound when the setpoint is exceeded. The frequency of the alarm will increase as the detection level increases

If the flame-out alarm is actuated, check that the pump is running, then press the igniter button. Under normal conditions, flame-out results from sampling a gas mixture that is above the lower explosve level which causes the hydrogen flame to extinguish. If this is the case, reignition is all that is required to resume monitoring. Another possible cause for flame-out is restriction of the sample flow line which would not allow sufficient air into the chamber to support combustion. The normal cause for such restriction is a clogged particle filter.

It should be noted that the chamber exhaust port is on the bottom of the case and blocking this port with the hand will cause fluctuations and/or flame-out.

Shut Down Procedure

The following procedure should be followed for shut down of the equipment.

A. Close HYDROGEN TANK VALVE
B. Close HYDROGEN SUPPLY VALVE
C. Move INSTR Switch to OFF
D. Wait 5 seconds and move PUMP Switch to OFF. INSTRUMENT IS NOW IN A SHUT DOWN CONFIGURATION

Fuel Refilling

NOTE Use PREPURIFIED or ZERO grade hydrogen (certified total hydrocarbons as methane <0.5 ppm recommended).

a) The instrument and the charger should be completely shut down during hydrogen tank refilling operations. Refilling should be done in a ventilated area. THERE SHOULD BE NO POTENTIAL IGNITERS OR FLAME IN THE AREA.

b) If you are making the first filling on the instrument or if the filling hose has been allowed to fill with air, the filling hose should be purged with hydrogen prior to filling the instrument tank. This purging is not required for subsequent fillings.

c) The filling hose assembly should be left attached to the hydrogen supply tank when possible. Ensure that the FILL/BLEED Valve on the instrument end of the hose is in the OFF position. Connect the hose to the refill connection on the Side Pack assembly.

d) Open the hydrogen supply bottle valve slightly. Open the REFILL VALVE and the HYDROGEN TANK VALVE on the instrument panel and place the FILL/BLEED Valve on the filling hose assembly in the FILL position. The pressure in the instrument tank will be indicated on the HYDROGEN TANK PRESSURE Indicator.

e) After the instrument fuel tank is filled, close the REFILL VALVE on the panel, the FILL/BLEED Valve on the filling hose assembly and the hydrogen supply bottle valve.

f) The hydrogen trapped in the hose should now be bled off to atmospheric pressure. CAUTION should be used in this operation as described in Step (g) below, since the hose will contain a significant amount of hydrogen at high pressure.

g) The hose is bled by turning the FILL/BLEED Valve on the filling hose assembly to the BLEED position. After the hose is bled down to atmospheric pressure, the FILL/BLEED Valve should be turned to the FILL position to allow the hydrogen trapped in the connection fittings to go into the hose assembly. Then, again, turn the FILL/BLEED Valve to the BLEED position and exhaust the trapped hydrogen. Then turn the FILL/BLEED Valve to OFF to keep the hydrogen at one atmosphere in the hose so that at the time of the next filling there will be no air trapped in the filling line.

h) Close the HYDROGEN TANK VALVE.

i) With the HYDROGEN TANK VALVE and the HYDROGEN SUPPLY VALVE closed, a small amount of HYDROGEN at high pressure will be present in the regulators and plumbing. As a leak check, observe the HYDROGEN TANK PRESSURE Indicator while the remainder of the system is shut down and ensure that the pressure reading does not decrease rapidly (more than 350 psi/h) which would indicate a significant leak in the supply system.

Battery Charging

WARNING Never charge in a hazardous environment.

a) Plug charger connector into mating connector on battery cover and insert ac plug into 115 V ac wall outlet

b) Move the battery charger switch to the ON position The lamp above the switch button should illuminate

c) Battery charge condition is indicated by the meter on the front panel of the charger, meter will deflect to the left when charging When fully charged, the pointer will be in line with "charged" marker above the scale

d) Approximately one hour of charging time is required for each hour of operation However, an overnight charge is recommended The charger can be left on indefinitely without damaging the batteries When finished, move the battery charger switch to OFF and disconnect from the Side Pack Assembly.

THE FOLLOWING ARE SPECIAL INSTRUCTIONS FOR RECHARGING BATTERIES WHICH HAVE BEEN COMPLETELY DISCHARGED

It has been established that the above battery charging procedures may not be effective when the operator has allowed the battery to COMPLETELY discharge

When this happens and the above procedures fail to charge the battery, perform the following additional steps

e) Remove the battery from the instrument case

f) Connect to any variable dc power supply

g) Apply 40 volts at ½ ampere maximum.

h) Observe the power supply meter As soon as the battery begins to draw current, gradually reduce the power maintaining ½ A maximum until the meter reads approximately 15 volts

NOTE. The time required to reach the 15 volt reading will depend on degree of discharge

i) Repeat steps (a), (b), (c), and (d) above to complete the charging cycle

SUMMARY OF OPERATING PROCEDURES

Start Up

a) Check battery condition by moving the INSTR Switch to the BATT position

b) Move INSTR Switch to ON and allow five (5) minutes to warm-up

c) Use the Calibrate Adjust knob to set the meter needle to the level desired for activating the audible alarm If this alarm level is other than zero, the Calibrate Switch must be set to the appropriate range

d) Turn the Volume Knob fully clockwise

e) Using the Alarm Level Adjust knob, turn the knob until the audible alarm is activated

f) Set CALIBRATE Switch to X1 position, use CALIBRATE Knob and set meter to read 0.

g) Move PUMP Switch to ON position, then place instrument panel in vertical position and check SAMPLE FLOW RATE indication The normal range is 1 5 to 2 5 units If less, check filters

h) Open the HYDROGEN TANK VALVE and the HYDROGEN SUPPLY VALVE Wait one minute for hydrogen to purge the system

i) Depress Igniter Button until burner lights Do not depress Igniter Button for more than six seconds (If burner does not ignite, let hydgrogen flow for one minute and again attempt ignition)

j) Use CALIBRATE Knob to "zero" out ambient background For maximum sensitivity below 10 ppm, set CALIBRATE Switch to X1 and readjust zero on meter To avoid false flame-out alarm indication, set meter to 1 ppm with CALIBRATE Knob and make differential readings from there.

Shut Down

a) Close the HYDROGEN SUPPLY VALVE

b) Close the HYDROGEN TANK VALVE

c) Move the INSTR Switch and PUMP Switch to OFF

d) Instrument is now in shut down configuration

CALIBRATION

Recalibration to Various Organic Vapors

The OVA 128 is capable of responding to nearly all organic compounds. At the time of manufacture, the analyzer is calibrated to mixtures of methane in air. For precise analysis it is necessary to recalibrate with the specific compound of interest. The GAS SELECT control is used to set the electronic gain for a particular compound.

The instrument is recalibrated using a mixture of a specific vapor in air, with known concentration. After the instrument is in operation and the normal background is zeroed, draw a sample of the calibration gas into the instrument. The GAS SELECT Knob on the panel is then used to set the readout meter indication to correspond to the concentration of the calibation gas mixture.

The instrument has now been calibrated to the vapor mixture being used. After this adjustment, the setting on the "digidial" should be recorded for that particular organic vapor compound. This exercise can be performed for a large variety of compounds, thereby generating a "library" which can be used for future reference without need for additional calibration standards.

To read a particular compound, the GAS SELECT control is turned to the predetermined setting for the compound. Calibration on any one range automatically calibrates the other two ranges.

Using Empirical Data

Relative response data can be used to estimate the concentration of a vapor without need to recalibrate the analyzer. With the instrument calibrated to methane, obtain the concentration reading for a calibration sample of the test vapor. The response factor (R) in percent, for that vapor is

$$R = \frac{\text{Actual Concentration}}{\text{Measured Concentration}}$$

To determine the concentration of an unknown sample of that vapor, multiply the measured concentration by R.

Calibration Standards

Commercial Standards

Commercially available standard samples offer the most convenience and are recommended for the most precise analyses. Always remember to obtain the desired vapor in an air background. Samples should be drawn from the cylinder into a collapsed sample bag, then drawn from the bag by the instrument to prevent a pressure or vacuum at the sample inlet.

Preparation of Standards

The following procedure is for generating calibration standards as an alternative to using commercial mixtures.

Obtain a five (5) gallon glass bottle and determine its volume by measuring the volume of water needed to fill it (use of a 1000 mL graduated cylinder is convenient). Another approach is to weigh the empty bottle, fill it with water and weigh again. The difference between the two values is the weight of water. By multiplying the weight of water in pounds by 0.455, obtain the volume of the bottle in liters. Empty the water and allow the bottle to dry. Place a one-foot piece of Teflon tubing in the flask to aid in mixing the vapors uniformly with the air. The volume of such a bottle should be about 20 liters, which is 20,000 mL. If the volume were 20,000 mL, then a 2 mL sample of a gas would be equivalent to 200 mL per 2 million mL or 100 ppm (V/V). Use of a gas tight Syringe, readable in 0.01 mL, allows the preparation of mixtures in the 1-2 ppm range, which are sufficient for the quantitative estimation of concentrations. A plastic stopper is loosely fitted to the tip of the bottle. The needle of the syringe is placed inside the jug neck and the stopper squeezed against the needle to decrease leakage during sample introduction. Inject the sample into the bottle and withdraw the needle without removing the stopper. Tighten the stopper and shake the bottle for a few minutes with sufficient vigor that the plastic tubing in the bottle moves around to ensure good mixture of the vapors with the air.

Calculations

$$\text{Injection} = \frac{\text{Volume Concentration X Molecular Weight X System Volume}}{\text{Density X Molar Volume at STP*}}$$

$$= \frac{(C)\ (MW)\ (V)}{(D)\ (V)}$$

Using the Ideal Gas Law, PV=RT, the molar volume of any gas at STP (25°C and 1 atm) is

$$V = \frac{RT}{P} = \frac{\text{Universal Gas Constant x Temperature}}{\text{Pressure}}$$

$$= \frac{\left[\left(0.08206\ \frac{\text{litre atm}}{\text{mol K}}\right)\right](298.15\ \text{K})}{1\ \text{atm}}$$

$$= (24.47\ \text{L})\ (\text{mol}^{-1})$$

Therefore, the injection volume necessary to prepare 1 liter of a 100 ppm sample of hexane would be

$$\text{Injection Volume} = \frac{(100\ \text{ppm})\ [(86.18\ \text{g})\ (\text{mol}^{-1})]\ (1\ \text{liter})}{[(0.659\ \text{g})\ (\text{mL}^{-1})]\ [(24.47\ \text{L})\ (\text{mol}^{-1})]\ [(1000\ \text{mL})\ (1^{-1})]}$$

$$= 0.534\ \mu L$$

* STP - Standard Temperature and Pressure

Primary Calibration for Methane

Internal electronic adjustments are provided to calibrate and align the circuits After initial factory calibration, it should not be necessary to repeat the calibration unless the analyzer undergoes repairs which affect calibration If the OVA 128 will be extensively used for analysis of a sample other than methane, recalibration of the electronics (after resetting the GAS SELECT CONTROL) may result in better accuracy See Recalibration to Various Organic Vapors above

Primary calibration of this instrument is accomplished at the factory using methane-in-air, sample gases

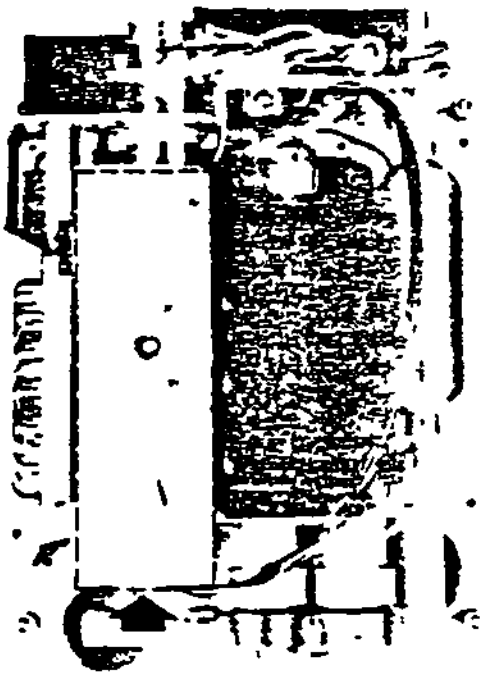


FIGURE 4
LOCATION OF ELECTRONIC ADJUSTMENTS

Calibration Using Known Samples for Each Range *(Refer to Figure 4)*

The accuracy stated under Specifications is obtained when the instrument is calibrated with known concentrations for each range Prepare separate samples of methane-in-air in these concentration ranges 7 to 10 ppm, 90 to 100 ppm, and 900 to 1000 ppm Calibrate the instrument as follows

a) Place the instrument in normal operation and allow a minimum of 15 minutes for warm-up and stabilization

b) Set the GAS SELECT control to 300.

c) Set the CALIBRATE Switch to X1

d) Set the CALIBRATE ADJUST (Zero) Knob so that the meter reads zero.

e) Check that the meter reads zero on the X10 and X100 ranges.

f) Set the CALIBRATE Switch to X1 and introduce the sample with known concentration in the 7 to 10 ppm range

g) Adjust R31 so that the meter reading corresponds to the sample concentration

h) Set the CALIBRATE Switch to X10 and introduce the sample with known concentration in the 90 to 100 ppm range

i) Adjust R32 so that the meter reading corresponds to the sample concentration.

j) Set the CALIBRATE Switch to X100 and introduce the sample with known concentration in the 900 to 1000 ppm range

k) Adjust R33 so that the meter reading corresponds to the sample concentration.

l) The instrument is now calibrated for methane and ready for service

Calibration Using a Single Sample Calibration *(Refer to Figure 4)*

Calibration may be accomplished using a single known sample of methane in air in the range of 90 to 100 ppm This may not provide the accuracy stated under specifications but is adequate for field survey work

a) Place instrument in normal operation with CALIBRATE Switch set to X10 and GAS SELECT control set to 300

b) Use the CALIBRATE ADJUST (zero Knob to adjust the meter reading to zero.

c) Introduce a methane sample of a known concentration (between 90 and 100 ppm not to exceed 100 ppm) and adjust trimpot R-32 so the meter reading corresponds to the known sample.

d) This sets the instrument gain for methane with the panel mounted gain adjustment (GAS SELECT) set at a reference number of 300

e) Turn off HYDROGEN SUPPLY VALVE to put out flame.

f) Leave CALIBRATE Switch on X10 position and use CALIBRATE ADJUST (zero) Knob to adjust meter reading to 4 ppm

g) Place CALIBRATE Switch in X1 position and using trimpot R-31 adjust meter reading to 4 ppm

h) Move CALIBRATE Switch to X10 position again Use CALIBRATE ADJUST (zero) Knob to adjust meter to a reading of 40 ppm.

i) Move CALIBRATE Switch to X100 position and use trimpot R-33 to adjust meter reading to 40 ppm

j) Move CALIBRATE ADJUST (zero) Knob to adjust meter reading to zero

k) Unit is now balanced from range to range, calibrated to methane, and ready to be placed in normal service

*TIP** SPECIFICATIONS

GENERAL

Size	45 cm (18") long 6 3 cm (2 5") diameter (maximum)
Weight	1 5 Kg (3 lbs) approximately
Detector type	Photoionization 10 6 eV UHF excited electrodeless discharge tube
Safety approvals	Applications pending

PNEUMATIC

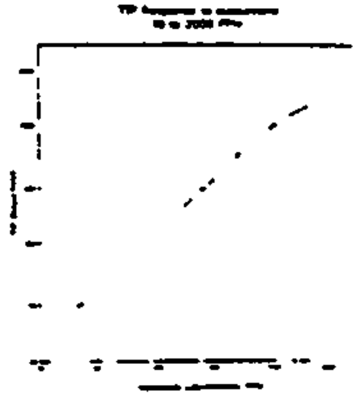
Inlet flowrate	275 mL/min approximately
Inlet fitting	1/8" stainless steel Swagelok™
Inlet filter	15 µm replaceable-stainless steel cartridge

ELECTRICAL

Display	3 1/2-digit liquid crystal (0 0 to 1999 counts), illuminated
Battery type	NiCd
Charge/discharge time	16 hr/4 hr approximately charger provided
Low battery indication	at 95% discharge
Signal outputs	1 Volt FS, analog concentration, and modulated pulse for external (optional) earphone
External power	12 Volt DC 0 4 A. (*TIP** has internal regulation)

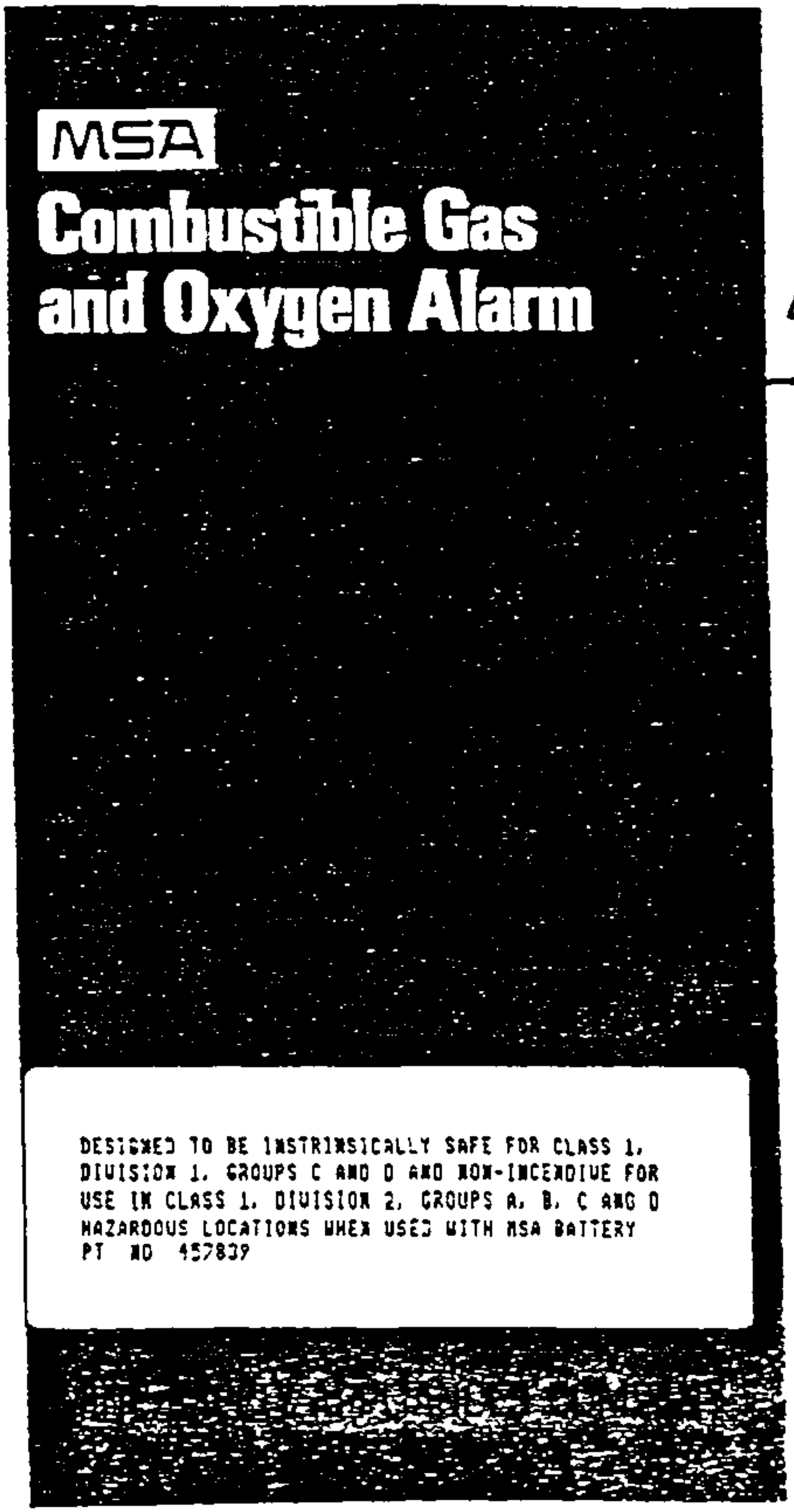
PERFORMANCE

Range	0 — 2000 ppm
Detection limit	0 05 ppm (benzene)
Linearity	0 — 100 ppm, ±10% 100 — 1000 ppm, ±15% (see chart)
Response time	3 sec (10% to 90% FS 10 ppm benzene)
Precision	1% (10 ppm benzene)



DETECTABLE COMPOUNDS

These include virtually all gases and vapors whose ionization potential is below 10 6 eV Such a range encompasses a very large number of solvent materials and some important pollutant species including benzene vinyl chloride hydrogen sulfide ethylene oxide arsine and phosphine



MSA

Combustible Gas and Oxygen Alarm

part no.
449900

DESIGNED TO BE INSTRINSICALLY SAFE FOR CLASS 1, DIVISION 1, GROUPS C AND D AND NON-INCENDIVE FOR USE IN CLASS 1, DIVISION 2, GROUPS A, B, C AND D HAZARDOUS LOCATIONS WHEN USED WITH MSA BATTERY PT NO 457839

CONTENTS

FIGURES

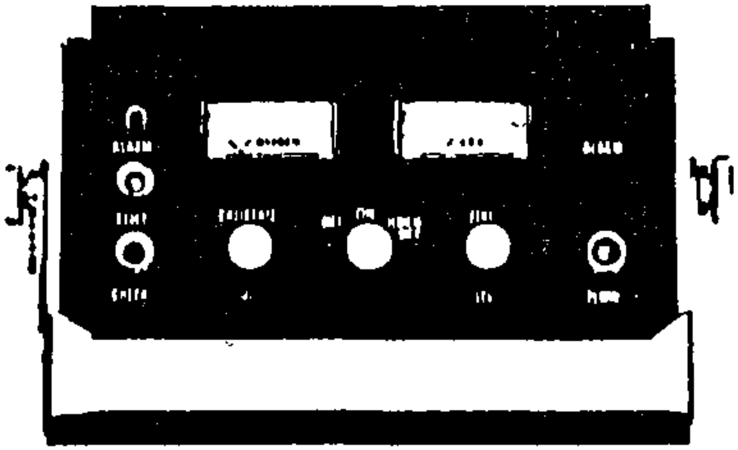


FIGURE 1 — MSA MODEL 260 CONTROL PANEL

I. CAUTIONS AND LIMITATIONS

Prior to testing potentially dangerous atmospheres with the MSA* Model 260 Combustible Gas and Oxygen Alarm the user should be familiar with the first five sections of this instruction manual

Cautions and limitations associated with the use of the Model 260 are as follows

1 The Model 260 is designed to measure combustible gas or vapor content in air It will not indicate the combustible gas content in an inert gas background, furnace stack or in a reducing atmosphere Further, this instrument should not be used where the oxygen concentration exceeds that of fresh air (oxygen enriched atmospheres)

2 Proper readings are obtained only when the battery has a sufficient level of charge
   a The battery charge level should be checked occasionally throughout a testing period
   b Upon receiving a new Model 260, it is recommended that the battery be charged for at least 16 hours
   c As a regular monthly maintenance item for optimum battery service, the Model 260 should be run for 8 to 10 hours and then fully charged for 24 to 36 hours
   d After each day of use or if the indicator has not been used for more than 7 days the battery should be charged for a minimum of 16 hours
   e Do not operate Model 260 while it is charging
   f Recharging must be done in a non hazardous location known to be free of combustible gases or vapors

3 Certain materials such as silicone, silicates and organic lead compounds tend to poison the pelement catalyst thereby giving erroneously low readings Calibration checks should be made frequently if such materials are suspected to be present in the tested *atmosphere (See Section III for more detail)*

4 The combustible gas indicator detects only combustible gases and vapors in air It will not indicate the presence of combustible airborne mists or dusts such as lubricating oils, coal dust, or grain dust

5 Pressurized or low pressure samples will give erroneous oxygen percent readings For atmospheric sampling at higher or lower altitudes the instrument oxygen meter *should be calibrated* at the elevation where sampling is to take place

6 Acid gases such as carbon dioxide will shorten the service life of the oxygen sensor

7 The oxygen sensor is packaged separately in an inert atmosphere It must be installed before the Model 260 can be used

8 When sampling with accessory sampling lines, a 50 foot sample line will increase the initial response time of the Model 260 to approximately 30 seconds and the final response to approximately 3 minutes Two 50 foot lines connected in series will increase the response times to 60 seconds and 6 minutes respectively Lines over 100 feet in length are not recommended

INITIAL INSTALLATION INSTRUCTIONS FOR OXYGEN SENSOR

The oxygen sensor used in the Model 260 to measure the oxygen concentration is now packaged separately The oxygen sensor must be installed in the Model 260 prior to placing the instrument into service Once installed it should be left in place until end of its useful life *normally one year*

To install the sensor

1 Remove the carrying handle by loosening both knurled screws and spreading the handle beyond the collars Lift it from the shafts of the screws

2 Remove the left side of the case by removing the four mounting screws Slowly draw the side away from the case as far as the connecting wires will permit (Hold the case lid to prevent its falling from the case)

3 Slide the top panel approximately three inches from the remainder of the case

4 Open the protective bag containing the oxygen sensor and install the O ring provided onto the threaded end of the sensor

5 Screw the sensor into the manifold by hand firmly so as to compress the O ring and prevent sample flow leakage

6 Push the connectors onto the two terminals at the top of the sensor — the gray wire to the positive terminal and the yellow *wire to the negative*

7 Reassemble the case by sliding the top panel back into position

8 Place the case side in position and install the lid hinge pins into each side

9 Install the mounting screws Note Insert all four screws loosely before tightening any one of them

10 Reattach the handle

11 See the instruction manual pages for leak testing the sample flow system and adjusting the oxygen calibration

II. INSTRUMENT DESCRIPTION

The MSA Model 260 Combustible Gas and Oxygen Alarm is a hand carried battery operated instrument (See Figures 1 and 2) It has been designed to sample atmospheres for combustible gases or vapors and oxygen content and warn the user when pre determined concentrations of either are reached

Major features of the Model 260 are ease of operation and reliability Integrated circuit electronics and rugged components have been used to provide a tough compact instrument

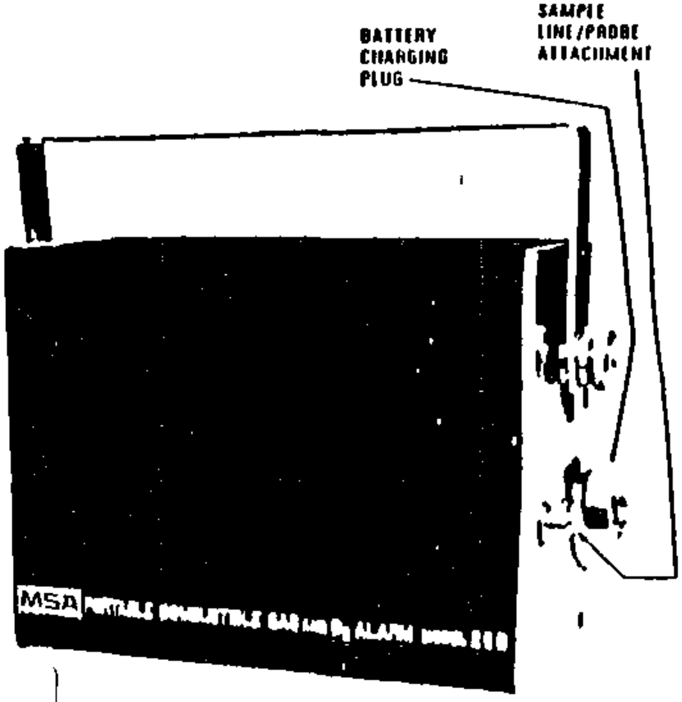


FIGURE 2 —
SAMPLE LINE/PROBE AND BATTERY CHARGING CABLE ATTACHMENTS

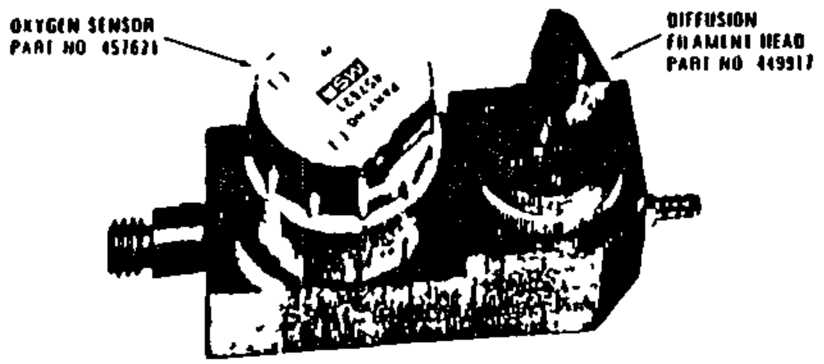


FIGURE 3 — MANIFOLD BLOCK

The Model 260 is two completely separate indicators in a single housing and uses a common flow system Oxygen and combustible gas concentrations shown on separate meters are automatically indicated by red alarm lights and an audible alarm Other controls provide quick on site operational checks The zero and calibrate controls may have lift to adjust ' knobs to prevent accidental changing of adjustments

A small pump pulls the atmospheric sample through a manifold block in which the oxygen sensor and combustible gas diffusion head are mounted (Figure 3) The flow then passes through the pump and to a flow indicator on the control panel prior to being exhausted (Figure 4) The approximate flow rate is 1 liter per minute

The Model 260 is powered by a rechargeable 2 4 volt Ni Cd battery pack (Figure 5) sealed in a plastic case Recharging circuitry is contained within the instrument Recharging requires only connecting the instrument into a 115V ac outlet using the cord supplied with the instrument

The battery also can be recharged from a 12V dc source (such as an automobile battery) by the use of an accessory charge cord The connectors of the charging cords are keyed to the receptacle on the instrument to prevent accidental use of an incorrect power supply A fully charged battery provides over 8 hours of continuous non alarm operation

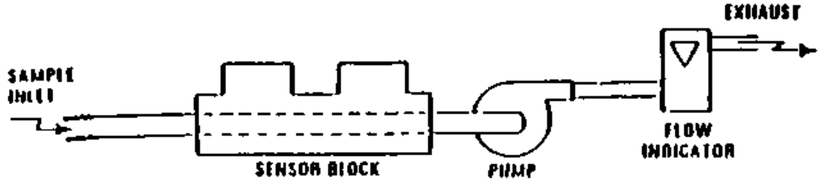


FIGURE 4 — FLOW DIAGRAM

III USE AND LIMITATIONS

The MSA Model 260 Oxygen and Combustible Gas Alarm provides an efficient and reliable method of testing atmospheres for sufficient oxygen content for life support and/or the presence of combustible gases or vapors which may pose a potential flammability hazard Common examples of such locations are man holes storage tanks tank cars confined spaces pumping stations etc

It is important that the instrument response be appraised by someone skilled or experienced in properly interpreting the instrument readings with respect to particular conditions on going operations and safe practices For example an atmosphere that shows no flammability hazard can still be toxic to workmen Also a tank or vessel which is safe before work is initiated may be rendered unsafe by work activities which cause a temperature increase or by stirring or handling bottom sludge in petroleum tanks

Combustible gases will burn or explode only when the fuel/air mixtures are within certain proportions For most common hydrocarbon gases this range of proportions runs from approximately 1% to as high as 15% by volume in air The minimum concentration of a particular combustible gas in air which can be ignited is defined as the LOWER EXPLOSIVE LIMIT, abbreviated L E L The maximum concentration that can be ignited is defined as the UPPER EXPLOSIVE LIMIT, abbreviated U E L In some references the terms are called LOWER and UPPER LIMITS of FLAMMABILITY (LFL or UFL)

The combustible measurement is dependent upon catalytic combustion of the flammable gas in combination with the oxygen in the air Conditions can exist in a closed space where not enough oxygen remains to provide a correct combustible gas reading (NOTE This low oxygen level is far below what is required for human life) In these instances the % oxygen reading is most important A low oxygen concentration in an enclosed atmosphere indicates that (1) some other gas has displaced much of the air or (2) some process has consumed much of the available oxygen

Upon initially opening and probing an enclosed area move the probe into the area slowly while watching the meters to provide the earliest possible indication of a potentially dangerous condition

Be prepared to vacate the area if the Model 260 combustible or oxygen meter indicates the possibility of a hazardous condition

The oxygen sensor responds to the partial pressures of oxygen in the atmosphere being tested For this reason changes in atmospheric or sample pressure will change the oxygen reading Calibration should be checked and adjusted at the elevation where the instrument is to be used

The oxygen sensor is temperature compensated in the range of 32 to 104°F (0 to 40°C) use down to 0°F is possible when calibrated at the temperature and if more sampling time is allowed for slow sensor response — approximately 3 minutes without sample line

The life of the oxygen sensor is reduced by exposure to carbon dioxide The sensor life will be reduced to 2 days in 100% carbon dioxide 50 days in 5% and 100 days in 1% The effect is cumulative therefore all tests of atmospheres containing excess concentrations of carbon dioxide should be stopped as soon as a constant reading is obtained Abnormally slow recoveries to the air calibration point after exposure to high carbon dioxide is to be expected

Certain materials in the sampled atmosphere affect the catalytic material on the pelement and may cause the indicator to respond incorrectly Included are organic lead compounds such as are used in leaded gasoline and silicon compounds in the form of silanes, silicones and silicates (often found in hydraulic fluids)

When an atmosphere contaminated with leaded gasoline is tested the lead produces a solid product of combustion which, upon repeated exposure may develop a coating upon the detector pelement resulting in a loss of sensitivity To reduce this possibility, an inhibitor filter is available for insertion in an external cartridge holder This device chemically reacts with the tetra ethyl lead vapors to produce a more volatile lead compound

The inhibitor filters are available in packages of six each and identified by part number 47740 Each consists of a glass ampoule wrapped with cotton and filled with chemical. To prepare the item for use the ampoule should be crushed between the fingers then inserted in the external cartridge holder One inhibitor filter will provide instrument protection for eight hours of continuous testing

Silanes silicones, silicates and other volatile compounds containing silicon in the tested atmosphere may seriously impair the response of the instrument Some of these materials rapidly poison the detector filament so that it will not function properly When such materials are even suspected to be in the atmosphere being tested the instrument calibration must be checked after each series of tests

As mentioned previously the battery must have a sufficient charge level for the Alarm to function properly For this reason, a convenient battery check push button has been included on the Alarm control panel The battery should also be performance-checked monthly See Section VI MAINTENANCE AND CALIBRATION

The Model 260 Combustible Gas Indicator is normally calibrated on pentane as being representative of the flammability characteristics of most commonly encountered combustible gases The meter scale is calibrated from zero to 100% L E L which corresponds to actual volume concentrations of 0 to approximately 1 4% pentane in air A booklet of response curves is supplied with the Model 260 Those curves may be used to interpret meter readings when sampling combustible gases other than pentane Calibration for combustibles other than pentane may be made on special order

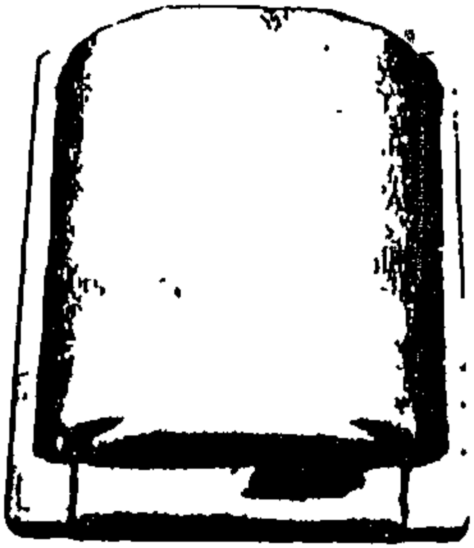


FIGURE 5 — BATTERY PACK

Accessory Items

A number of accessories are available for use with the Model 260 Combustible Gas and Oxygen Alarm Part numbers are listed in the last section

Sample lines	special synthetic rubber lines which have minimal gas adsorption characteristics are available in 5 10 25 and 50 foot lengths
Sample probes	3 foot hollow brass probe a 3 foot plastic probe for possible electrical hazards and a 4 foot solid end probe to prevent liquid pickup from wet tank bottoms, etc
Dust filter	a cotton filter fitting an external holder provides sensor protection from dirt accumulation in dusty or dirty atmospheres
Inhibitor filter	protects catalytic filaments from being poisoned by leaded fuels Fits external filter holder
External filter holder	accommodates either a dust filter or an inhibitor filter
Line trap assembly	prevents liquids from being drawn into the instrument

Calibration check equipment	consists of a supply of calibration gas a flow regulator and an adapter hose
Harness carrying	neck and waist straps to hold the Model 260 while climbing etc

IV PRINCIPLES OF OPERATION

A block diagram of the MSA Model 260 is shown in Figure 6 The oxygen and combustible gas indicators are operated simultaneously Each indicator has an alarm warning light which provides a visual alarm signal An alarm signal on either unit will energize an audible alarm as well A switch allows the audible alarm to be turned off if so desired The alarm lights will stay on until the reset button is pushed after the concentration returns to the predetermined level

Oxygen Analyzer

The oxygen analyzer is a galvanic type cell containing dissimilar metal electrodes in a special electrolyte The cell is sealed with a membrane which allows oxygen to diffuse into the active area The current generated by the cell is proportional to the oxygen partial pressure in the atmospheric sample passing over the face of the membrane The generated current passes through a resistance to provide a voltage input signal for an amplifier The output of the amplifier drives the oxygen indicating meter and also serves as an input to the alarm comparator circuitry

Combustible Gas Indicator

The flammable properties of combustible gases are used as a basis of detection for the combustible gas indicator The sensor consists of a pair of pelletized filaments called 'pelements' arranged in an electrically balanced bridge circuit The detector pelement is treated with a special catalyst The catalyst causes the combustible gases to combine with oxygen at much lower temperatures than would be required for normal burning The inactive compensator pelement is also exposed to the sample flow and acts to offset any electrical changes caused by flow conditions sample temperature pressure and/or humidity

Combustible gases in the sample combine with oxygen at the surface of the catalyzed detector pelement Heat is liberated by this chemical reaction increasing the temperature of this pelement causing an associated increase in the pelement electrical resistance

Increased resistance of the detector pelement unbalances the bridge causing a voltage change in the mid point connection between the detector pelement and compensating pelement This voltage signal is applied to an amplifier which drives the combustible gas indicating meter and provides an input for an alarm comparator circuit

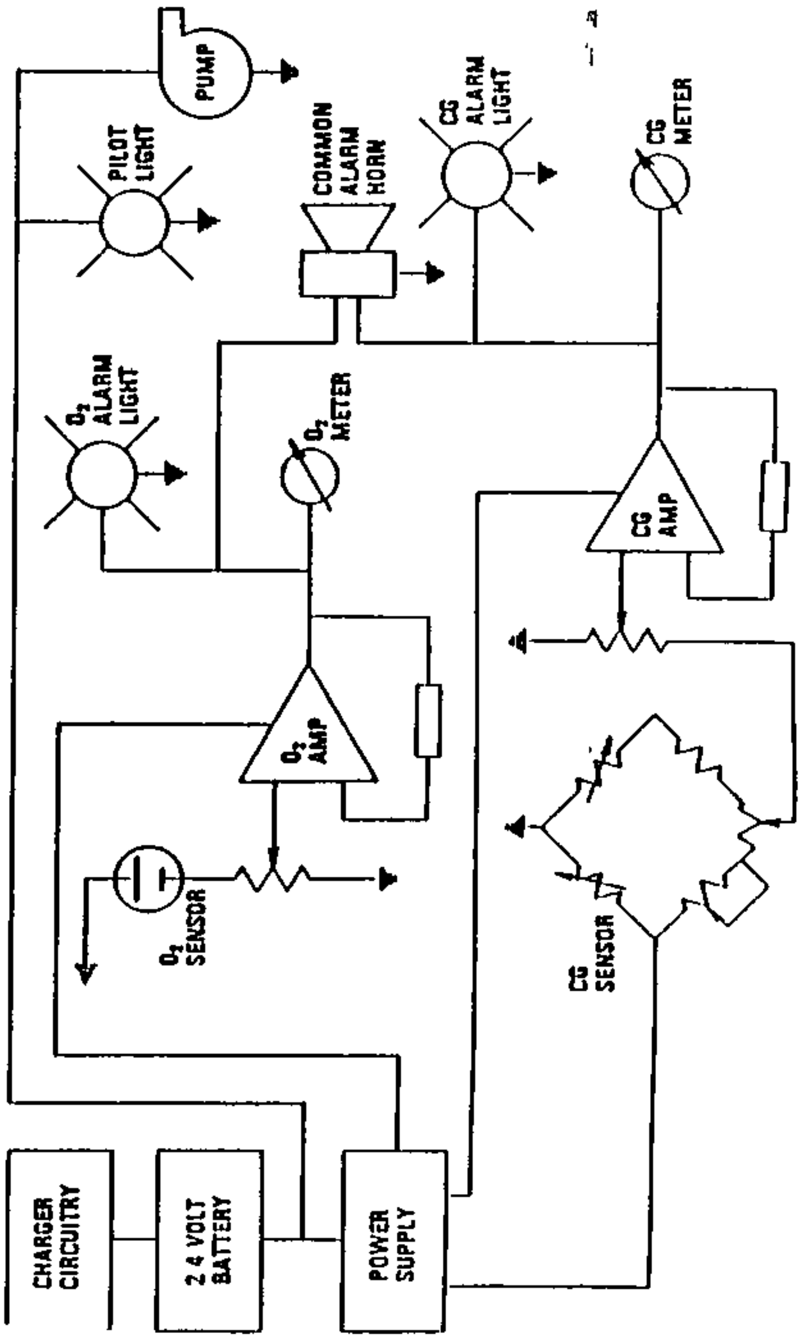


FIGURE 6 — BLOCK DIAGRAM

V OPERATING PROCEDURE

The Model 260 should be checked and zeroed in an uncontaminated atmosphere Refer to Figure 1 and use the following procedure

1 Open the instrument lid Turn the center ON OFF control to the far right HORN-OFF position Both meter pointers will move and one or both alarm lights may light
2 If the % oxygen meter pointer stabilizes at a value other than 20 8% the pointer should be set to 20 8% by using the CALIBRATE O_2 control
3 The % LEL meter pointer should be set to zero by adjusting the ZERO LEL control
4 If either the alarm lights are lighted press the Alarm Reset button
5 Momentarily place a finger over the sample inlet fitting or the end of the sample line probe Observe that the flow indicator float drops out of sight indicating no flow If the float does not drop check out the flow system for leaks as described under Section VII
6 Press the CHECK button and observe the % LEL meter The pointer must read at 80% LEL or higher as marked by the BATTERY zone on the meter If the pointer reading is less the batteries must be recharged No tests should be attempted as the instrument will not perform properly See Section VI for battery charging instructions
7 If it is desired that the audible alarm sound for combustible gas or low oxygen concentrations turn the center ON-OFF control back one position to the ON setting
8 Accessory equipment such as sampling lines probes carrying harness filters or line traps should be attached as required See Figure 2
9 The instrument is ready for atmospheric sampling

VI MAINTENANCE AND CALIBRATION

Battery Service

The primary maintenance item of the Model 260 is the rechargeable 2 4 volt nickel cadmium (Ni-Cd) battery (Figure 7) The battery is recharged by simply removing the screw cap covering receptacle and connecting one end of the charging cable to the instrument and the other end to a 115V ac outlet

If desired the battery can be recharged from a 12V dc source An accessory battery charging cable is available one end of which plugs into the Model 260 while the other end is fitted with an automobile cigarette lighter plug

Recommended charging time is 16 hours It may be left on charge for longer periods without damaging the battery
CAUTION RECHARGING MUST BE DONE IN A NON-HAZARDOUS LOCATION

The batteries sometimes will not supply full power capacity after repeated partial use between chargings For this reason it is recommended that the batteries be exercised at least once monthly Run the Model 260 for 8 to 10 hours and then recharge

If the instrument has not been used for 30 days the batteries should be charged prior to use

Should the battery not respond to recharging or not hold a charge the battery should be replaced Replacement procedure is as follows

1 Loosen the knurled screws holding the handle and remove the handle
2 Looking at the front panel of the instrument remove the right side (audible alarm side panel) by unscrewing the four side panel screws
3 Gently pull the side panel loose and tilt the instrument to help the battery case slide out Disconnect the molded nylon plug
4 Install new battery in the reverse procedure outlined above

Calibration

Before the calibration of the combustible gas indicator can be checked the Model 260 must be in operating condition as described in the OPERATING PROCEDURE Section V Optional calibration equipment is shown in Figure 8 Calibration check adjustment is made as follows

1 Attach the flow control to the recommended calibration gas tank
2 Connect the adapter hose to the flow control
3 Open flow control valve
4 Connect the adapter-hose fitting to the inlet of the instrument after about 15 seconds the L E L meter pointer should be stable and within the range specified on the calibration sheet accompanying the calibration equipment If the meter pointer is not in the correct range stop the flow remove the right hand side cover Turn on the flow and adjust the S control with a small screwdriver to obtain a reading as specified on the calibration sheet
5 Disconnect the adapter hose fitting from the instrument
6 Close the flow control valve
7 Remove the adapter hose from the flow control
8 Remove the flow control from the calibration gas tank
9 Replace the side cover on the Model 260

CAUTION Calibration gas tank contents are under pressure Use no oil grease or flammable solvents on the flow control or the calibration gas tank Do not store calibration gas tank near heat or fire or in rooms used for habitation Do not throw in fire incinerate or puncture Keep out of reach of children It is illegal and hazardous to refill this tank Do not attach the calibration gas tank to any other apparatus than described above Do not attach any gas tank other than MSA calibration tanks to the regulator

Printed Circuit Board Adjustments

The printed circuit board contains six adjustment pots as shown in Figure 9 These are dentified as

Oxygen Indicator Adjustment

O_2H — The oxygen high alarm point adjustment (factory set at 25%)
O_2L — The oxygen low alarm point adjustment (factory set at 19 5% oxygen)

Combustible Gas Indicator Adjustments

CGA — The combustible gas alarm point adjustment (factory set at 50% L E L)
S — After zeroing span is adjusted by sampling calibration gas and adjusting the read out accordingly
CZ — *Coarse zero is adjusted by setting the ZERO L E L control* at mid range sampling fresh air and adjusting the % L E L meter to read zero
B-CHK This controls the battery charge indication and is factory set to read at B in the word BATTERY on the meter face when the battery voltage measured with a voltmeter is 2 25V

S.O.P. #2
GEOPHYSICAL SURVEY

INTRODUCTION

A field geophysical survey will be performed over the east portion of the site (approximate survey area = 300 feet (north to south) x 200 feet (east to west)) of the area east of MW-2 and MW-3) to determine the location of buried metal deposits and contaminants with high conductivity. The survey will be based on 20 foot station intervals. If high readings (i.e., anomalies) are detected at adjacent stations, then additional measurements will be obtained at closer intervals (i.e., less than 20 feet).

Both electromagnetic and magnetic measurements will be obtained and plotted to form a contour map showing locations of high readings (i.e., due to high conductive and magnetic flux). Instruments which will be utilized are a Geonics EM31 Terrain Conductivity Meter and an EDA OMNI IV Magnetometer/Gradiometer. Both of these instruments will down-load digital data to a field computer. The data will be plotted in the field to verify the adequacy of the survey prior to demobilization by the survey crew.

MAGNETOMETER SURVEY

A magnetometer responds to the presence of buried ferrous metals. At hazardous waste sites, magnetometers are used to:

- Locate buried drums,
- Define boundaries of trenches filled with ferrous containers,
- Locate ferrous underground utilities, such as iron pipes or tanks, and the permeable pathways often associated with them, and
- Aid in selecting drilling locations that are clean of buried drums, underground utilities, and other obstruction.

Several factors will influence the effectiveness or response of a magnetometer, however, the mass of a buried target and its depth are the most important. The magnetometer's response will be directly proportional to the mass of ferrous metal present (i.e., high readings will be associated with large amounts of buried metal) and will vary by one over the distance cubed (1/d3) for total field measurements (i.e., the greater the depth, the lower the reading). Typically, a single drum can be detected at distances up to 6 meters, while massive piles of drums can be detected at distances up to 20 meters or more.

An EDA OMNI IV Magnetometer will be utilized. Operating procedures and equipment specifications are included as S.O.P. #2A.

TERRAIN CONDUCTIVITY SURVEY

Terrain conductivity is an effective, means of shallow subsurface investigation at hazardous waste sites. The method can be used to assess lateral and vertical changes in the subsurface to locate buried wastes and to evaluate contaminant plumes.

The method is based on the variable electrolytic conduction of different subsurface materials. The variation in conduction arises from differences in moisture content, density and chemical composition within subsurface materials.

At hazardous waste sites, the leaching and migration of underground contaminants can cause changes in the chemical composition of soils and groundwater and, as a consequence, changes in the conductance of those materials In the case of buried objects such as steel drums, these metallic objects should be far less resistive than the soils in which they were buried Delineation of these changes can be of great value in evaluating contaminant plumes and locating buried wastes at hazardous waste sites

A Geonics EM31 Terrain Conductivity Meter will be utilized for the survey Operating procedures and equipment specifications are included as S O P #2B

S O P #2A
EDA OMNI IV OPERATING PROCEDURES/SPECIFICATIONS
SUMMARY OF OPERATING PROCEDURES

1 Check battery for full charge

2 Turn on "on" switch

3 Standardize gamma readings at 0 with "standardization" potentiometer in non-contaminated area "Sensitivity at 100"

4 Move to apparent contaminated area to detect response If no response, set sensitivity to 10 and zero again

5 When zeroed and detection is within the scale range, start at grid line +0 00 and proceed to stake +20' noting gamma reading Continue along grid lines at 20' intervals

6 During a grid line measurement, rechecks should be made on the previous grid line readings This recheck procedure should be followed throughout the program on the previous grid line

7 After the measurement program is completed for the area, the points of highest magnetic field perturbation should be further examined at closer intervals to define the location of ferrous metal burial

8 The magnetometer should be zeroed in the same area and replications of prior anomalous readings should be a part of the calibration procedure

SECTION 1

GENERAL INFORMATION

1.1 SCOPE OF MANUAL

This manual describes the OMNI-IV Tie-Line magnetometer system designed and manufactured by EDA Instruments Inc. EDA Instruments Inc.'s head office is located in Toronto, Ontario, Canada with offices located in Denver, Colorado, U.S.A. and distributor's worldwide. This manual was written to assist the user in the proper operation of the system and therefore, should be read prior to the testing and operation the unit. Also, the manual will provide references to the proper maintenance and understanding of all the features incorporated. The technical specifications are given in Table 1.1.

1.2 PURPOSE OF THE INSTRUMENT

The OMNI-IV is a portable, microprocessor-based magnetometer system which is capable of measuring changes or contrasts in the earth's magnetic field. The data is both sensitive and highly repeatable.

The OMNI-IV is a multi-purpose instrument designed to operate as:

a. Tie-line magnetometer

b. Total field magnetometer

c. Recording base station magnetometer

d. Gradiometer

The primary purpose of the system is to:

- measure and store the magnitude of the earth's magnetic field independent of it's direction.

Further details are given in Section 3 of this manual.

Measurements are obtained by the use of a proton precession sensor carried on a pole to measure the magnetometer total field magnitude. An electronics console is worn on the front of the operator that allows the operator to view and store the collected data in internally protected memory. The data stored is protected by a lithium battery which also powers a real-time clock.

Along with the magnetometer data, the OMNI-IV stores the following information:

- -line number
- -position number
- -date and time
- -direction of travel
- -statistical error of the magnetometer readings
- -signal strength and rate of decay of the magnetometer sensor
- -natural and cultural features

The data can be stored using three different types of storage modes:

Spot Record	-which assigns a record number to the readings.
Multi Record	-which assigns a line and position value to the reading using the value last stored in memory. This feature allows for multiple readings at one station.
Auto Record	-which assigns a line and position value automatically incremented from the last station using the station(position) spacing entered by the operator. This allows the operator to increment or decrement the position without pressing any of the line or position keys.

The standard OMNI-IV has the capability of storing up to approximately 1300 readings consisting of a total field and vertical gradient reading, and the associated information mentioned previously.

The extended memory version has the capability of storing up to approximately 7400 readings consisting of a total field and vertical gradient reading and the associated information mentioned previously. In base station mode, the system can store up to 18,000 base station readings.

Also, for simplicity of operation, the record keys are used to initialize the system and to retrieve the data stored in memory. Any of the three memory keys may be used for these functions.

The OMNI-IV stores only the raw data for magnetometer measurements. Corrections for magnetometer diurnal variations of the total field measurements is performed internally using either the tie-line (looping) method or a compatible base station unit. For correcting the magnetometer total field values, a PPM-375, PPM-400, OMNI IV (old or new) or OMNI-PLUS system may be used.

Further, the raw data is retained until the instrument is re-initialized even after corrected data has been computed.

Data stored in memory is completely protected by a lithium battery. This battery also powers the real time clock.

Field Measurement Features

The OMNI-IV has been designed to provide the user with features that will enhance both the ease of use and data quality. These features are noted below

The OMNI-IV has been designed to accurately measure the magnitude of the earth's magnetic field at the location of where the measurement is taken. When the READ key is pressed the previous magnetometer total field reading is displayed followed by the new magnetometer total field reading for your particular station. At this point, all measurements have been completed and the data may be stored using one of the RECORD keys.

The instrument outputs the data as it is recorded (ie. The direction the operator is walking). The station and line values are stored using +/- designations. However, the data may be later outputted using N,S,E or W signs (see Section 3 and 6).

Natural/Cultural Features. The OMNI-IV is equipped with a "built-in notebook" with actual words of features that the operator may wish to record along with the data. The features are accessed using the SPECIAL key and is described on page 4-22 of this manual.

Magnetometer Features

Polarizing Cycle. During this period the sensor or sensors are energized. The OMNI-IV magnetometer utilizes the principle of constant energy polarization. Most instruments utilize a fixed polarization time regardless of the battery voltage. It can be demonstrated that with such a method, a 40% deterioration occurs in sensor signal strength rendering the instrument to be more and more inaccurate (scatter phenomena).

The microprocessor within the instrument computes the battery voltage during polarization and at a specific point determines whether or not the polarization time should be increased. This method ensures that the sensor always receives the same amount of energy per unit of time. Although the performance is not linear, a significant improvement results even when the battery is approaching the depletion state.

Signal Analysis Cycle. At the end of the sensor energizing period, the signal decay cycle occurs. The precession signal is monitored and the decay rate analyzed. This precession signal is compared statistically to an optimized decay curve at 400 points along the curve. Computations are made and result of the computations displayed as error.

Tuning Sequency. After the signal analysis period, this new value becomes the basis for the next reading. The measurement portion of the reading sequence occupies typically 2 seconds.

Display Cycle. The selected parameter is displayed on the liquid crystal display (LCD) for approximately 8.5 seconds. At this time, the audio circuits provide a sequence of beeps which indicate that the instrument will be shut down after another 8.5 seconds unless the same command or another command is keyed.

Note

During this cycle, valid readings, location and time values are entered into scratch-pad memory as a data block.

To summarize, a typical reading sequence terminates after about 20 seconds. Then the computer turns off the power.

Audio Circuits. The instrument provides both visual and audio feedback. Every time that a key is pressed, an audio beep will be heard. Parameters are displayed for 8.5 seconds only. The moment that this visual period has elapsed, the audio is activated to give repeated beeps for another 8.5 seconds period to indicate the end of the data block display period. If the operator fails to press any key during this warning period, the instrument turns off automatically. Every time that a key is pressed, a new 8.5 second period is initiated. This allows the operator to have time to evaluate the program data. This display period may be extended by pressing the same key or another key. However, selection of a different key initiates a different display response.

Statistical Error Alarm. Following each reading, the instrument computes the true statistical error of total field reading. This value represents the confidence level of data. A visual alarm may be triggered based on the following criteria:

a. When a statistical error of a particular reading is equal to or larger than 0.2 gamma, the least significant digit of the displayed total field flashes on and off. For example, assume that this statistical error is 0.23 gamma and the displayed total field is: 57936.4. In this case, the 4 flashes on and off. Flashing the least significant digit on and off indicates that the accuracy is impaired and the operator should be warned.

b. When the statistical error of a particular reading is equal to or larger than 2.0 gammas, the last two least significant digits of the displayed total field flash on and off. For example, assume that the statistical error is 2.3 gamma and the displayed total field is: 57936.4. In this case, the 6 and 4 flash on and off. Flashing the two least significant digits on and off indicates that the accuracy is badly impaired and an audio warning sounds to alert the operator.

Note

If the error is larger than 2.0 gammas, take another reading.

Automatic Fine Tracking (Tuning) of Magnetometer Total Field

The OMNI-IV contains high technology circuits which allow for automatic fine tracking (tuning) over the entire field strength from 18,000 to 110,000 gammas, under computer control. An optimized tuning algorithm ensures that the system is tuned for optimum performance.

Under normal operating conditions a ±15% capture tuning range from reading to reading is achieved. The capture tuning range is defined as the difference between the previous and current readings relative to the previous reading. However, if a larger difference is computed, the instrument will warn the operator of this and further measurements are inhibited automatically. The warning is both visual and audible. The displayed total field reading is flashed on and off with an audio alarm to inform the operator that the displayed value is invalid. The value displayed, however, is the previous total field value, and should be changed manually to reflect the new tuning field.

APPENDIX A-1

FIELD MAINTENANCE

SENSORS

To refuel a sensor, remove the rubber cap on the top to expose the brass screws inside. Next, remove the brass screws and insert a small funnel into one of the holes. Use good quality white gasoline for the fuel (EDA uses Coleman camping fuel). The fuel should be filtered through a "drip coffee filter" in order to remove any metallic impurities. Metallic particles will poison a sensor and can render it useless. Refueling can be dangerous so do it in a well ventilated area and well away from any open flame. A small dab of liquid gasket (EDA uses Loctite 515 sealant "gasket eliminator") under the screws before tightening down is recommended. Replace the rubber cap and test out the sensor.

REMOTE SENSOR

The coils and cable of the sensor can be checked for shorts and open Cots with a standard multimeter. On a remote sensor connector, Pins A,B,C are not used, Pins D and F are the sensor coils (there should be 13 to 14 ohms between them). Pin E is the shield ground, there should be no connection between this and any other pin on the remote sensor.

GRAD SENSOR

Grad sensors have two sets of coils in them. Pins A and C are one coil and D and F are the other. Both the coils should have 13 to 14 ohms between each pair. Pins B and E are connected together (shield grounds) and there should be no connection between this pair and any other pins.

MAG POLARIZATION TEST

With a total field console, connect a multimeter across Pins D and F (no sensor connected). Put the mode switch to TFM and try and take a reading. You should see 16 to 18 VOLTS on the meter for a couple of seconds. The actual voltage and duration will vary slightly depending on the state of the console's batteries.

With a grad console, use the GRAD position on the mode switch and test across Pins A and C as well as D and F. Results should be similar as stated above.

If the console tests out OK its fine and if not, the problem is probably on the Precession board. Send it back to EDA for repair along with the sensor you were using with it.

Shorted sensor connectors are the major cause of this sort of problem. Visually inspect the connector before each day of use to make sure that the connector shell (the bit that clamps onto the cable) has not come loose from the connector body (the bit with the pins in it). If you find that is loose or twisted, carefully take it apart and check to make sure the wiring is not damaged. If the wiring is OK, put it back together and tighten it up. You can use a little "removal LOCTITE" or similar product to help secure the threads but DO NOT USE any epoxy glue or non removeable LOCTITE. If in doubt, do not use anything at all.

EM31

2. OPERATING INSTRUCTIONS

The EM31 can be used both to measure the electrical conductivity of the ground and to detect buried metal objects Section 2 1 describes the procedure for measuring ground conductivity and section 2 2 for buried metal detection

2 1 Ground Conductivity Measurements

2 1 1 Initial Set-up Procedure

a) Using the identifying labels on the tubes select the transmitter coil tube, align it with respect to the main tube, insert it and fix it with the clamp

b) Check the battery condition, plus and minus, by setting the Mode switch (MODE SELECTOR SWITCH) to the OPER position and the Range switch to the +B and -B positions respectively. If the needle reads inside the BATT mark on the meter, batteries are in good condition, otherwise replace the batteries with a fresh set of C size alkaline batteries.

c) Check the zero reading by setting the Mode switch to the OPER position and the Range switch to the least sensitive position 1,000 mmhos/meter (this minimizes any external noise interference while checking the zero position). If a zero adjustment is required adjust the DC ZERO CONTROL located under the front panel to obtain a zero reading To do this the battery pack must be removed to gain access to the controls.

d) Align and connect the receiver coil tube to the main frame tube The instrument is now ready to proceed with the functional checks.

2.1.2 Equipment Functional Checks

The Range switch should be set at 30 millimhos/meter position for all the following tests. (If the reading is off scale, i.e., greater than 30 millimhos/meter, see note.)

a) Set the Mode switch to the COMP position and adjust the meter reading to zero using the COARSE and FINE COMPENSATION controls.

b) To check the phasing of the instrument set the Mode switch to the PHASE position. Note the meter reading and rotate the COARSE control one step clockwise If the meter reading remained the same, the phasing is already correct, return the COARSE control to its original position (one step counter clockwise) and no further adjustment is necessary.

If there was a difference in the meter readings taken before and after the COARSE control was rotated one step clockwise then a phase adjustment is required With the COARSE control in its original position adjust the PHASE potentiometer about 1/4 turn clockwise and note the new meter reading. Rotate the COARSE control one step clockwise, take a reading, and return the COARSE control to its original position If the <u>difference</u> in meter readings has decreased, repeat the procedure using a further clockwise adjustment, until rotating the COARSE control the one step clockwise produces no change in the meter reading.

If, on the other hand, the difference in meter readings was increased, the PHASE potentiometer should be rotated in a counter clockwise direction instead and the procedure described above repeated until there is no change in the meter readings Always remember to set the COARSE control back to its original position This can be confirmed by setting the Mode switch in the COMP position and checking that the meter reads zero If it does not read zero, repeat steps (a) and (b)

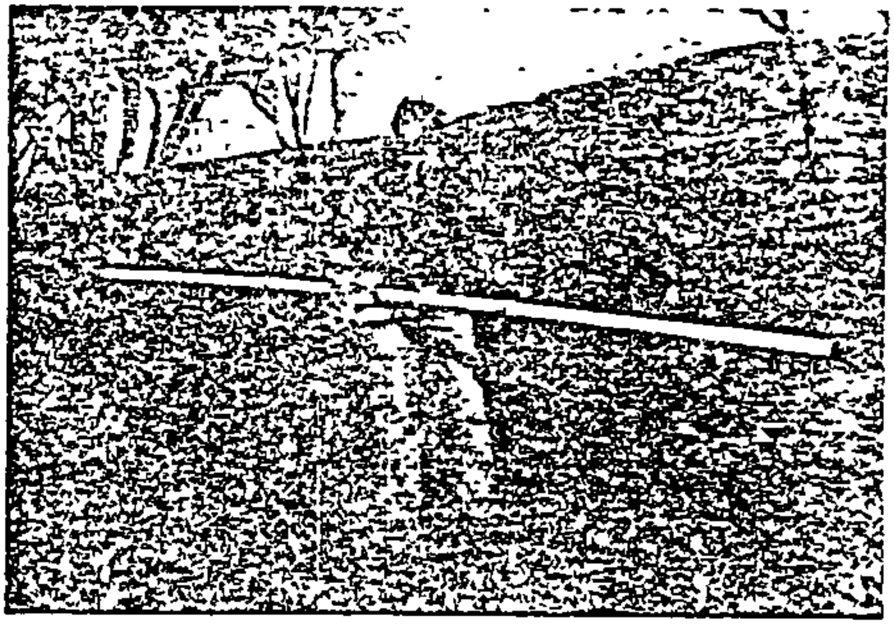
c) To check the sensitivity of the instrument, set the Mode switch to the COMP position and rotate the COARSE contro clockwise one step The meter should read between 75% and 85% (22 to 26 millimhos/meter) of full scale deflection (inside black mark) It is unlikely that the sensitivity of the instrument will vary, however it may be useful to record the actual meter reading for comparison at a later date

Return the COARSE switch to its original position and the EM31 is now ready to make ground conductivity measurements

NOTE When conducting the functional tests over ground of higher conductivity than 30 millimhos/meter, the Range switch should be set at the appropriate level At whatever level the Range switch is in, the reading taken in (c) should still be between 22 and 26 millimhos/meter

2.1.3 Operating Procedure

a) Wearing the instrument with the shoulder strap adjusted so that the instrument rests comfortably on the hip as shown, switch the Mode switch to the OPER position and rotate the Range switch so that the meter reads in the upper two thirds of the scale The full scale deflection is now indicated by the Range switch and the instrument is reading the terrain conductivity directly in millimhos per meter



b) The EM31 can be operated continuously while moving from one measurement station to the next however, the instrument has a time constant of about one second for which the operator should adjust his walking speed to obtain greatest accuracy

Alternatively, to extend battery life the instrument can be switched on at each measurement station when not using a recorder The operator will notice that the type of integrator used results in a slight initial overshoot of the needle at turn on This is normal, and that at least two seconds should be allowed after turn on before the measurement is taken

2 2 Buried Metal Detection

2 2 1 Set-up and Operating Procedure

The inphase component of the magnetic field is significantly more sensitive to large metallic objects than the quadrature-phase component used for ground conductivity measurements

a) The inphase component is readily measured with the EM31 by simply taking the reading with the Mode switch in the COMP position rather than in the OPER position.

It is recommended that the 30 mmho/m range be used since it usually gives adequate sensitivity, however more or less sensitive positions of the Range switch may also be used

b) To carry out a survey measuring the inphase component set the Mode switch to the COMP position and adjust the COARSE and FINE compensation controls so that a meter deflection of about 20% of full scale deflection is obtained. (The procedure of adjusting to 20% of the full scale deflection rather than to zero is only a convenience to allow for negative readings on the meter and under certain conditions a possible change in the reference level. For example, a sudden jar to the instrument can result in a small positive or negative change in the inphase reference level)

The survey is then carried out exactly as if the conductivity were being measured.

c) This lack of a true zero reference should not cause any serious problems since when using the inphase component one is usually only looking for buried metallic objects

These will be easily recognizable by relatively localized meter deflections occuring either singly or in a series of responses depending on the number of buried objects, their spacing and depth of burial

Notes (1) The 20% offset should only be used when the inphase component only is being measured continuously If both conductivity (quadrature phase) and inphase measurements are being made at each station the procedure described in 2 1 2 (a) should be used so that accurate ground conductivity measurements are obtained If negative inphase measurements are obtained one should check the inphase reference level and/or the area for buried metallic objects or utilities

(2) Similarly when the dual channel recorder is being used there should be no zero offset as described in 2 2 1 (b) and the meter reading set to zero using the COARSE and FINE controls as described in 2 1 2 (a)

A zero offset for negative inphase readings can however be allowed for on the recorder by setting the zero position of the pen at some arbitrary positive value when calibrating the recorder

3 INSTRUMENT CALIBRATION

Prior to shipping, the instrument is calibrated in the factory to read properly If necessary, calibration procedures are easily carried out as described below

IMPORTANT The most critical adjustment is the QF (quadrature fine) potentiometer which has been precisely adjusted at the factory

Before any adjustments are made it is strongly recommended that the instrument first be set up at a fixed height over a known location and the ground conductivity carefully noted If this adjustment is misaligned the instrument will have to be recalibrated over ground of known conductivity

3 1 Null Calibration

The zero setting of the EM31 can be readily set by following the procedure described in section 2.1 1 (c).

3 2 Absolute Calibration

Absolute instrument calibration is easily achieved if an area of ground is available of known and constant conductivity down to the depth of penetration of the instrument. The procedure is simple, the instrument is located over the known area at the usual operating height (approximately 1m) and the QF compensation control is adjusted until the meter reads the correct terrain conductivity If the ground conductivity is high the graph of Fig 3 must be used to correctly set the instrument reading

It is wise to maintain such an area as a calibration check area even if the variation of the conductivity with depth at that area is not accurately known This is useful for cross checking with future measurements

Note

The QF and NULL controls are located under the front panel Battery pack should be removed to have access.

S O P #3
BACKHOE TRENCH EXCAVATION AND SAMPLING

Backhoe sampling in waste areas is preferentially used where drilling rig access may be difficult or where high hazard sampling such as buried drums may be expected Backhoe sampling is rapid, allows wide sample selection, reveals waste and soil layering and can, through trenching, define the boundaries of waste pits

When the sampling site is selected, the brush is removed A Catapiller 235 tracked crawler backhoe or equivalent with enclosed cab is preferred equipment for this operations This backhoe is diesel powered and has a maximum of 23' vertical reach The bucket will be of a cleanout type (non-toothed) so as not to puncture buried drums

The backhoe operator will follow the same safety precautions required for waste contact activities as specified in the Health and Safety Plan During all of the trenching operations the site Health and Safety Officer will conduct air monitoring with the FID and PID detector instruments and the explosimeter to insure the safety of the operator and any support personnel in the excavation area (refer to S O P #1) If it is determined by the H & S Officer that conditions in the area warrant additional protection, the next level of safety protection will be used (i e , Level C or Level B) The backhoe operator will be in voice or radio contract with ground personnel Hand signals will also be used

Excavation will proceed by removing the topsoil or cover and proceeding to dig in approximately 0 5 to 1 0 foot deep cuts using a scooping motion The initial excavation will be about 8 feet long and 3-4 feet wide As the excavation proceeds, the topsoil or cover is placed in one pile and the waste, when uncovered, is placed in a separate pile All excavated materials will be placed on 4 ml plastic sheeting to prevent the spread of contamination Efforts will be made to deposit materials in order of excavation

During excavation, visual observation of the pit will be made for soil color changes, layering, former bottom layers containing brush, grass and trash, and depth at which water enters the trench Observations as to strata, soil compaction and similarity to other excavations can be used to determine whether or not the area has been disturbed The excavation will also be observed for signs of sidewall collapse All observations and sampling at the excavation will be done from an upwind direction To prevent possible hazards from sidewall collapse, trench logging will be conducted from an observation position at the end of the trench

If and when waste is uncovered it will be deposited on the ground (plastic sheeting) so that any water present will flow back into the excavation The waste will be tested for organic vapor hazards with both FID (methane) and PID instruments Vapor tests will be done at the waste surface, at the ground personnel breathing zone and 50 feet downwind of the waste See S O P #1 Vapor Sampling Procedures

Waste will be sampled from the backhoe bucket or from the waste pile immediately after deposit on the plastic sheeting and will be taken from the interior of the waste mass so as not to include possible sidewall contamination The decision for taking grab or composite samples will be determined in the field, depending on the waste characteristics For instance, a composite sample would be obtained from a visually homogenous layer of sand, whereas, a grab sample would be obtained of the most visibly contaminated soil around a leaking transformer

A detailed description of these samples will be recorded Sample data will include the following information, as a minimum, soil consistency, color and general appearance, free liquid accumulation, organic films or sheens, and vapor analysis (using a FID of PID instrument)

The depth of the trench will be measured using a drop tape or similar method

When the bottom of the trench is reached based on a change in resistance of the strata or apparently undisturbed material, a sample of this strata will be obtained A sample of the bottom strata will also be checked for volatile organics with the PID and/or FID

The excavation will be refilled in reverse order of removal That is, the last materials excavated shall be placed first into the trench so that the original topsoil layer covers the finished trench excavation All loose soil around the excavation will be placed in the trench The excavation shall be refilled and compacted with a backhoe or front end loader

The backhoe bucket will be decontaminated before trenching is continued at a new sampling location Decontamination will consist of a steam or high-pressure water wash The decontamination process will occur in a previously identified contaminated zone The resultant rinsate will be discharged to the surface A rinsate sample will be obtained at the end of the trenching activities and analyzed for PCBs to document backhoe decontamination

S O P #4
SURFACE SOIL SAMPLING

Surface soil sampling will be performed at predetermined grid locations on and off the MEW site The samples will be obtained from a depth of 0 to 0 5 feet

To obtain shallow samples, the following procedure will be used

1 Utilizing a clean shovel, pick or trowel, dig a furrow or hole to a depth of 0 5 feet (Note the width and length will vary between 0 5 x 0 5 feet and 1 0 x 1 0 feet, depending on the size of the shovel/pick/trowel and the soil consistency)

2 Widen the sides of the hole, as necessary, and clean out the hole

3 Carefully insert a new stainless steel spoon in the hole

4 Obtain a composite sample, representative of the 0 to 0 5 foot depth by scraping the sidewall of the hole

5 Carefully withdraw the sampling tool with the soil aliquot

6 Remove any rocks, debris, metal, etc larger than 1" in diameter

7 Containerize sufficient sample to fill the sample jar

8 Refill the excavation

In the event that more than one sample container is required for different analytical procedures, the volatile fraction will be obtained first, followed by the semi-volatile, pesticide/PCB, and metal fraction

Since shallow samplings are often performed a great distance from the decontamination area it is more efficient and equally effective to bring decontamination to the sampling point

A large wheeled garden cart lined with plastic sheeting, will carry the following equipment to the sampling site

1 Sampling tools

2 2 gallons of Alconox or TSP detergent wash water

3 Squeeze bottles with rinse water

4 Stainless steel spoons, spatulas and scrapers (enclosed in gallon-size plastic bags)

5 Solvents

6 Brushes, disposable wipes and gloves

7 Sample containers

8 5 gallon open head bucket for dry wastes

After each sample is taken, the nondisposable sampling tools will be decontaminated Each tool will be first scraped clean of soil and waste Then the tool will be washed in detergent water with brushes and wipes If the tool is contaminated with non-water dispersable materials it will be cleaned with methanol Finally the sampling tool will be thoroughly rinsed with distilled water The disposable sampling tools, i e , stainless steel spoons, will be temporarily containerized in plastic bags

When the wash water becomes visibly contaminated, the water will be discharged and the wash pail cleaned and refilled

The grid location, measurement of hole, soil strata and waste description will be recorded on a sample data sheet

Level D personal protection will be utilized with PID readings being made in accordance with S O P #1 when sampling on-site

SOP #5
SOIL BORING AND SOIL SAMPLING

Soil borings will be performed to determine depth profiles of the contaminants A total of 32 borings will be placed around 5 of the EPA borings as indicated in section 3 4 5 of the Work Plan

The borings will be installed utilizing either hand augers or a drill rig If hand augers are utilized the following procedures will be followed

1 3 to 4 inch diameter hand augers will be utilized to drill down to the desired sample depth

2 The auger will carefully be removed and the borehole cleaned out as necessary

3 Decontaminated Shelby tubes or split spoons (6 to 8" length) will be pushed/driven into the depth interval to be sampled, utilizing a slide hammer

4 The sampler will be carefully removed to prevent cave-in of the borehole

5 The sample will manually be extruded from the tube/spoon sleeves and the material identified as "slough" removed from the upper portion of the core utilizing a stainless steel spoon or spatula

*6 The cores will be split lengthwise down the middle utilizing a stainless steel spatula or spoon

**7 Soil types, visual observations, discolorations, strong odors, and PID or FID measurements will be recorded per the USCS

8 A precleaned and labeled container will be filled to capacity with a cross-section or representative composite of the core

9 The Shelby tube or split spoon will be decontaminated between each sample as per SOP #9

Borings requiring the use of a drill rig will be performed with a CME 55 truck mounted rig (or equivalent) with 4-6 inch hollow stemmed augers The following procedures will be followed

1 The boring will be augered down to the desired sample depth

2 Samples will be obtained out front of the auger flight or rotary bit with a decontaminated Shelby tube or split spoon at the desired depth interval

3 The sample will be extruded and the "slough" removed from the upper portion of the core, utilizing a stainless steel spoon or spatula

*4 The cores will be split lengthwise down the middle utilizing a stainless steel spatula or spoon

S O P #5 (CONT)

**5 Soil types, visual observations, discolorations, strong odors, and PID or FID measurements will be recorded per the USCS

6 Precleaned and labeled containers will be filled to capacity with a cross section or representative composite of the core

7 The Shelby tube or split spoon will be decontaminated between each sample as per SOP #9 The auger flights will be decontaminated between boreholes per SOP #9

* If samples for volatile organic analysis are required, a soil aliquot will be immediately placed in a 40 ml vial and sealed to decrease the chances for volatilization

** Continuous monitoring will be performed during the soil boring activities utilizing FID and/or PID instruments Measurements will be recorded at the beginning and end of each soil boring and whenever a sample is obtained

The boreholes will be filled with noncontaminated fill material, i e , clay-rich soil, cement, bentonite, etc The cuttings resulting from the boring operation will be left on-site To ensure no contamination or run-off , the cuttings will be placed in natural depressions in the contaminated areas away from site boundaries and existing drainage channels and swales

As stated in S O P #9, samples will be collected of the rinsate resulting from the decontamination of the equipment One sample will be obtained from both the backhoe and auger flight at the end of the field activities to confirm decontamination Rinsate samples from the hand tools, i e bailer, stainless steel spatula, split spoon, etc will be obtained as field blanks per routine QA/QC procedures

S O P #6
SEDIMENT SAMPLING

The location of the sediment samples will be determined in the field Sediment samples from dry or shallow stream beds (water less than 3 feet) will be obtained from the middle of a streambed with a stainless steel spoon or spatula The sample will be obtained from the surface to a depth of 1 inch The sample containers will be filled to capacity

Sediment samples from stream beds with a water depth greater than 3 feet will be obtained by a bucket sampler or an Eckman dredge A bucket sampler is a cylindrical device of either 4 inch or 8 inch diameter size with hinged bottom lids operated by a push rod The sampler is pushed into the sediment with bottom lids open When a 2 inch or 4 inch penetration (depending on bucket size used) is reached, the lids are pulled shut, trapping the top 2 inches or 4 inches of sediment

A surface water sample will be obtained from the marshy area between Wilson Road and Cape LaCroix Creek to augment the sediment sampling data The sample will be obtained by immersing a 1/2 liter amber glass container beneath the water surface at a depth half-way between the surface and the bottom so that the bottom sediment is not disturbed

After each sample is obtained, all equipment used will be washed with water containing an inorganic detergent such as Alconox or TSP The sample will then be thoroughly rinsed with distilled water

The decontamination will be done at the sampling site using the decontamination method as outlined in S O P #9

Level D personal protection will be worn Respirators will not be worn unless PID instrument readings are above 5 ppm in the breathing zone

S O P #7

MONITORING WELL SAMPLING EQUIPMENT

In conjunction with S O P #8, water level, pH, temperature, and specific conductivity data will be collected at each well Water level measurements will be collected prior to flushing and sampling Specific conductivity, pH, and temperature measurements will be taken after flushing and sampling

Water level measurements are determined to establish the direction of groundwater flow and to determine the gradient of the potentiometric surface Water levels will be measured from the top of the standpipe using an electric water level indicator Measurements will be taken and recorded in triplicate and averaged for use in determining piezometric surface

Specific conductance measurements allow approximation of groundwater ionic strength, an indicator of total dissolved solids within the groundwater Specific conductivity and temperature measurements will be taken with a S-C-T meter equipped with a 100 foot probe The probe will be lowered into the well for an in-situ measurement of conductivity and temperature

Measurement of pH will be taken with Cole-Parmer pH pen properly field calibrated with standards and adjusted to temperature The measurement will be taken in a collection beaker after pumping

Measuring devices will be decontaminated after each use by rinsing the instrument/probe with distilled water three separate times

JOB SPECIFIC INSTRUMENTATION

S-C-T Meter

Yellow Springs Instrument Co , Inc -
Model 33 S-C-T meter with YSI 3300 Series Conductivity/Temperature Probe
Specifications listed in attached S O P #7-A
Calibration This instrument will be recalibrated prior to each well sampling event, following the calibration procedures in S O P #7-A

Electronic Water Level Meter

QED Environmental Systems, Inc - Model 6000 with 150 foot flat tape
Specifications listed in attached S O P #7-B
Calibration This instrument is calibrated at the factory Field calibration is not required

Cole - Parmer pH Pen

Model 5941-00
Specifications listed in attached S O P #7-C
Calibration This instrument will be recalibrated prior to each well sampling event, following the calibration procedures in S O P #7-C

S O P #7-A
YSI S-C-T-METERS

SPECIAL INSTRUCTIONS FOR USING YSI 3311X SCT PROBES

When using YSI 3311X SCT Probes with cable lengths greater than 50' a very small but constant error in all conductivity readings will be introduced by the extra cable length This error may be determined as follows by slightly altering the standard operating procedure when setting up the YSI Model 33 SCT Meter to make conductivity measurements

SETUP

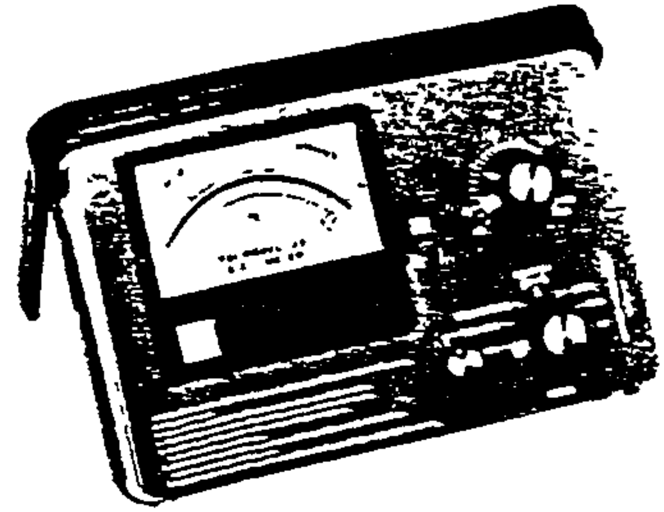
(a) Adjust meter zero (if necessary) by turning the bakelite screw on the meter face so that the meter needle coincides with the zero on the conductivity (umhos/cm) scale

(b) Calibrate the meter by turning the switch to red line and adjusting the meter needle with the red line control to the red line on the scale If this cannot be accomplished, replace the batteries

(c) Plug the dry probe into the probe jack on the side of the instrument Any difference between the reading <u>with</u> and <u>without</u> the dry probe plugged into the instrument represents the error introduced by the extra cable length Subtract this value from all conductivity readings This error will generally be insignificant on the X10 and X100 conductivity scales The error has no effect on temperature and salinity readings

(d) Put the probe in the solution to be measured and follow the standard procedures shown in the YSI Model 33 instruction manual

INSTRUCTIONS FOR YSI MODEL 33 AND 33M S-C-T METERS



Scientific Division
Yellow Springs Instrument Co., Inc
Yellow Springs Ohio 45387 • Phone 513-767-7241

MEW Admin record
AR103943

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GENERAL DESCRIPTION

The YSI Model 33 and 33M S C T Meters are portable battery powered transistorized instruments designed to accurately measure salinity conductivity and temperature They use a probe consisting of a rugged plastic conductivity cell and a precision YSI thermistor temperature sensor combined in a single unit

Conductivity with the Model 33 is expressed as *micromhos/centimeter* (μmhos/cm) with the 33M it s millisiemens/meter (mS/m) These are measurements of the electrical conductance the sample would show if measured between opposite faces of a 1cm cube (*Conversion information 1 μmho/cm = 0 1 mS/m*) Salinity is the number of grams of salt/kilogram of sample (‰ = parts per thousand) This measurement assumes the sample contains a standard sea water salt mixture The sample temperature is measured in degrees Celsius

Salinity measurements are manually temperature compensated by direct dial Conductivity measurements are not temperature compensated however a temperature function is provided on the instrument to aid with calculation of corrections Also when just temperature and conductivity are known it is possible to calculate salinity and when only temperature and salinity are known it is possible to calculate conductivity

SPECIFICATIONS

Model 33 Conductivity

Ranges	0 500, 0 5 000 0 50 000 μmhos/cm with YSI 3300 Series Probes (Note The μmho designations on the meter are a shorthand form for μmho/cm)
Accuracy	±2 5% max error at 500 5 000 and 50 000 plus probe ±3 0% max error at 250 2 500 and 25 000 plus probe See Error Section
Readability	2 5 μmhos/cm on 500 μmho/cm range 25 μmhos/cm on 5 000 μmho/cm range 250 μmhos/cm on 50 000 μmho/cm range
Temperature Compensation	None

Model 33M Conductivity

Ranges	0 50 0 500 0 5 000 mS/m with YSI 3300 Series Probes
Accuracy	±2 5% max error at 50 500 and 5 000 plus probe ±3 0% max error at 25 250 and 2 500 plus probe See Error Section
Readability	0 25 mS/m on 50 mS/m range 2 5 mS/m on 500 mS/m range 25 0 mS/m on 5 000 mS/m range
Temperature Compensation	None

Salinity

Range	0 40 ‰ in temperature range of 2 to +45°C
Accuracy	Above 4°C ±0 9 ‰ at 40 ‰ and ±0 7 ‰ at 20 ‰ plus conductivity probe Below 4°C ±1 1 ‰ at 40 ‰ and ±0 9 ‰ at 20 ‰ plus conductivity probe See Error Section
Readability	0 2 ‰ on 0 40 ‰ range
Temperature Compensation	Manual by direct dial from 2 to +45°C

Temperature	
Range	2 to +50°C
Accuracy	±0 1°C at 2°C ±0 6°C at 45°C plus probe See Error Section
Readability	±0 15°C at 2°C to ±0 37°C at 45°C
Power Supply	Two D size alkaline batteries Eveready E95 or equivalent provide approximately 200 hrs of operation
Probe	YSI 3300 Series Conductivity/Temperature Probe Nominal Probe Constant K = 5/cm
Accuracy	± 2% of reading for conductivity and salinity Error of ±0 1°C at 0°C and ±0 3°C at 40°C
Instrument	
Ambient Range	Satisfactory operation 5 to +45°C A maximum error of ±0 1% of the reading per °C change in instrument temperature can occur This error is negligible if the instrument is readjusted to redline for each reading

OPERATION PROCEDURE

1 **Setup**

(a) Adjust meter zero (if necessary) by turning the bakelite screw on the meter face so that the meter needle coincides with the zero on the conductivity scale

(b) Calibrate the meter by turning the MODE control to REDLINE and adjusting the REDLINE control so the meter needle lines up with the redline on the meter face If this cannot be accomplished replace the batteries

(c) Plug the probe into the probe jack on the side of the instrument

(d) Put the probe in the solution to be measured (See Probe Use)

2 **Temperature**

Set the MODE control to TEMPERATURE Read the temperature on the bottom scale of the meter in degrees Celsius Allow time for the probe temperature to come to equilibrium with that of the water before reading

3 **Salinity**

(a) Transfer the temperature reading from Step 2 to the °C scale on the instrument

(b) Switch the MODE control to the SALINITY position and read salinity on the red 0 40 ‰ meter range

(c) Depress the CELL TEST button The meter reading should fall less than 2% if greater the probe is fouled and the measurement is in error Clean the probe and re measure

4 **Conductivity on Model 33 (Model 33M data are in parentheses)**

(a) Switch the MODE control to the X100 scale If the reading is below 50 on the 0 500 range (5 0 on the 0 50 range) switch to the X10 scale If the reading is still below 50 (5 0) switch to the X1 scale Read the meter scale and multiply the reading appropriately The answer is expressed in μmhos/cm (mS/m) Measurements are not temperature compensated

Example	Meter Reading	247 (24 7)
	Scale	X10
	Answer	2470 μmhos/cm (247 0 mS/m)

(b) When measuring on the X100 and X10 scales depress the CELL TEST button. The meter reading should fall less than 2%; if greater, the probe is fouled and the measurement is in error. Clean the probe and re-measure.

NOTE The CELL TEST does not function on the X1 scale.

5 Error

The maximum error in a reading can be calculated by using the graphs in the following sections.

(1) Temperature

The temperature scale is designed to give the minimum salinity error when the temperature readings are used to compensate salinity measurements.

Figure 1 shows total error for probe and instrument versus °C meter reading.

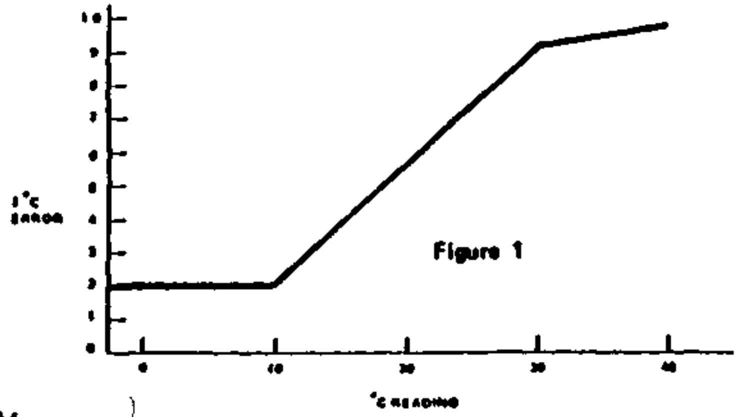


Figure 1

Example	**Meter Reading**	15°C
	Total Error	0.4°C
	Accuracy	15°C ± 0.4°C for probe and instrument combined

(2) Conductivity on Model 33 (Model 33M data are in parentheses.)

Figure 2 shows the worst case conductivity error as a function of the conductivity reading for the probe and instrument combined.

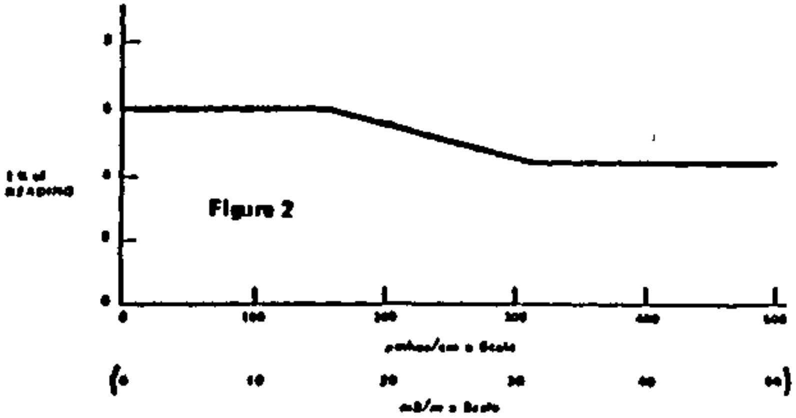


Figure 2

Example	**Meter Reading**	360 µmhos/cm (36 mS/m)
	Scale	X10
	% Reading Error	± 4.5%
	Accuracy	3600 ± 162 µmhos/cm (360 ± 16.2 mS/m) for probe and instrument

(3) Salinity

The salinity readings are a function of temperature and conductivity therefore the accuracy is a function of both The temperature scale and temperature control have been designed to minimize the temperature error contribution to the salinity error The error shown in Figure 3 is the total of the temperature and conductivity probe the temperature scale and the salinity scale error

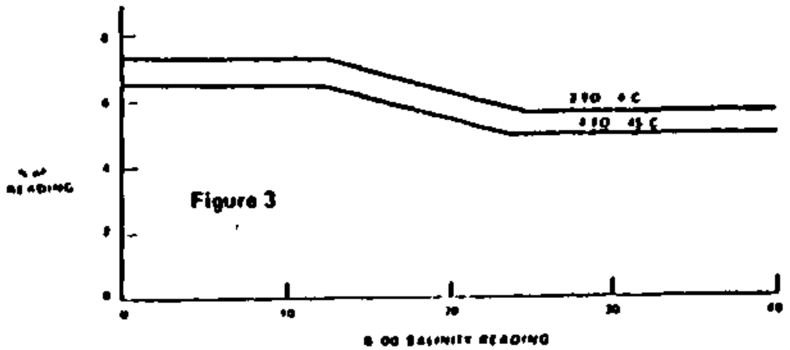


Figure 3

Example	Meter Reading	10 0/00 @ 10°C
	% of Reading Error	6 5%
	Accuracy	10 0/00 ± 0 65 0/00 for all errors combined worst case

CIRCUIT DESCRIPTION MAINTENANCE AND CALIBRATION

1 Description

The circuit is composed of two parts a multivibrator and switching transistors The multivibrator produces a square waveform voltage The square wave is applied to two switching transistors They alternately apply two batteries of opposite polarity to the probe thus providing AC power which minimizes polarization effects The meter is in series with one battery and measures the current from it The current from the battery is proportional to the conductance of the cell Salinity is measured in a special range conductivity circuit which includes a user adjusted temperature compensator In the temperature redline and X1 positions the multivibrator operates at 100 Hz In the salinity X100 and X10 positions the multivibrator operates at 600 Hz and in these ranges pushing the CELL TEST button drops the frequency to 100 Hz allowing the operator to judge the degree of probe polarization

2 Maintenance

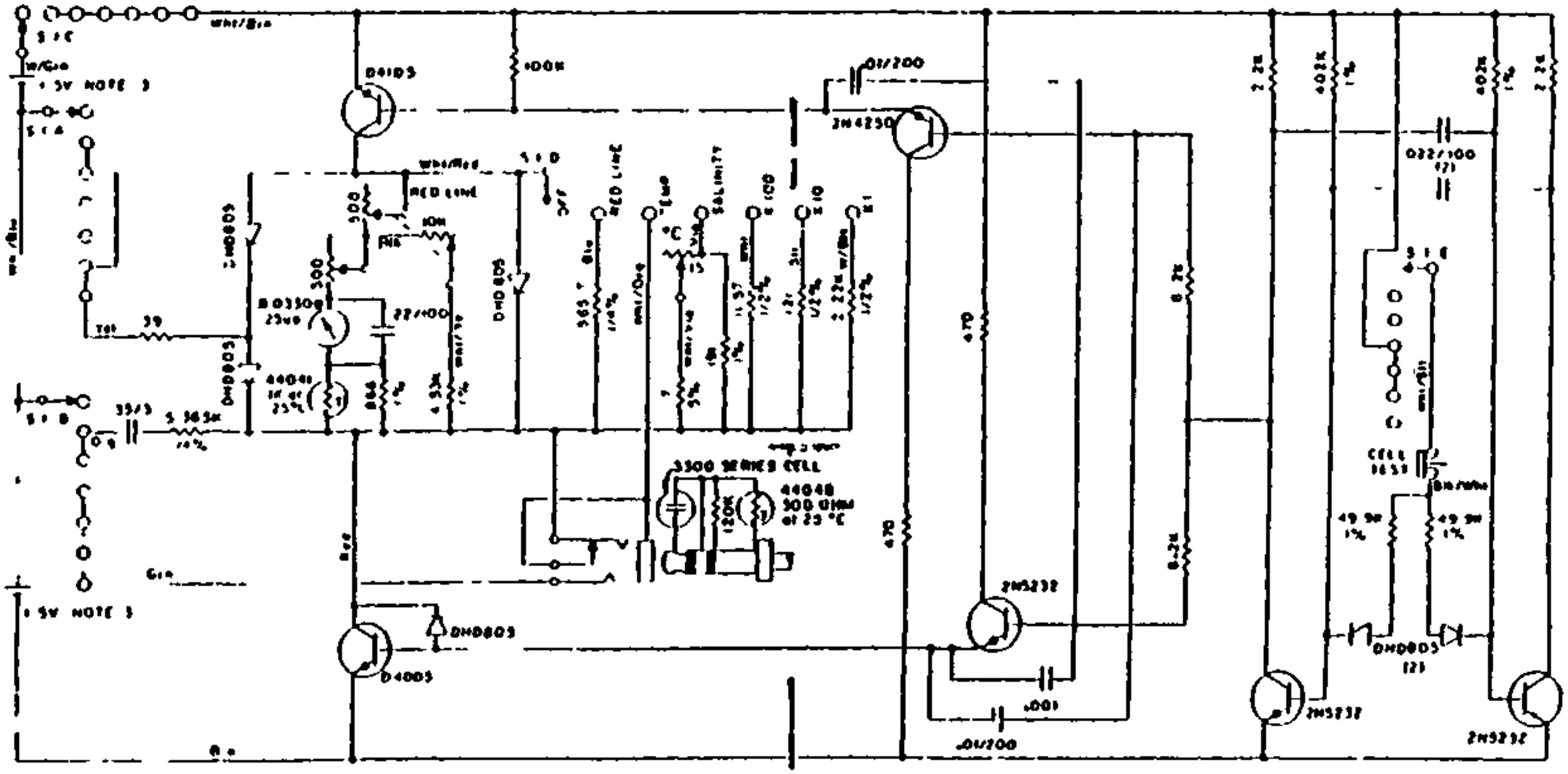
The only maintenance required is battery replacement Two D size alkaline flashlight cells such as Eveready E95 or equivalent will provide 200 hrs of operation Accuracy will not be maintained if zinc carbon D cells are used Battery replacement is indicated when the redline adjustment cannot be accomplished

Replace batteries every six months to reduce the danger of corrosion due to leaky batteries To replace batteries remove the six screws from the rear plate The battery holders are color coded The Positive (+ button) end must go on red

3 Calibration of Model 33 (Model 33M data are in parentheses)

It is possible for the temperature knob to become loose or slip from its normal position In an emergency the dial can be re positioned It must be emphasized that this is an emergency procedure only and that the instrument should be returned to the factory for proper recalibration at the earliest opportunity

S O P #7A (Cont'd)

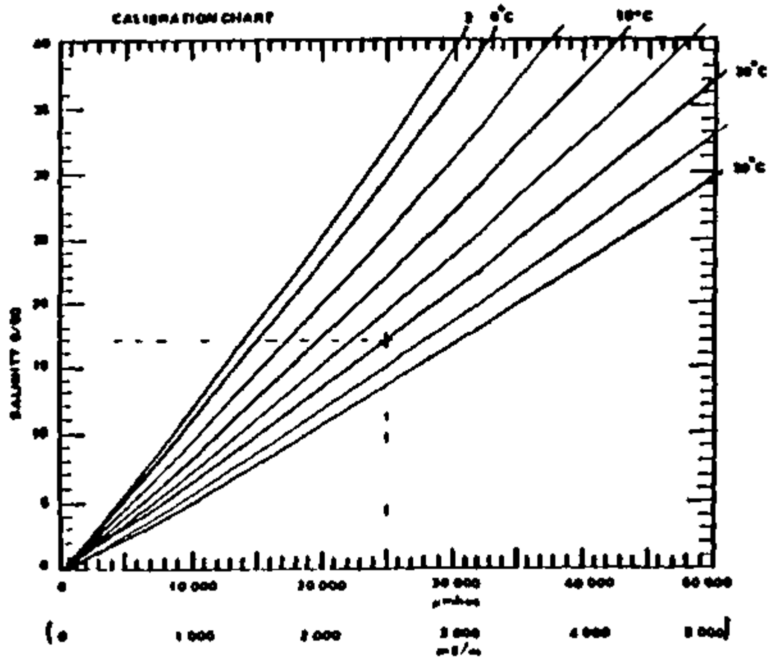


YSI MODEL 33 AND 33M B 03321 E

NOTE
1 [illegible]
2 [illegible]
3 [illegible]

This schematic is representative only, and may be slightly different from the circuit in your instrument

(a) Read the temperature and conductivity of the solution Determine the salinity of the solution by running a line vertically on the graph from this conductance value until it intersects the appropriate °C line (interpolate as required for temperature between the given °C lines) From this intersection extend a line horizontally to the edge of the graph This determines the salinity for this sample
Example 25 000 µmhos/cm and 20°C gives a salinity of 17
(Example 2 500 mS/m and 20°C gives a salinity of 17)



(b) Remove the °C knob switch to SALINITY and turn the control shaft until the meter needle indicates the salinity value determined in Step (a) In the example given the value is 17

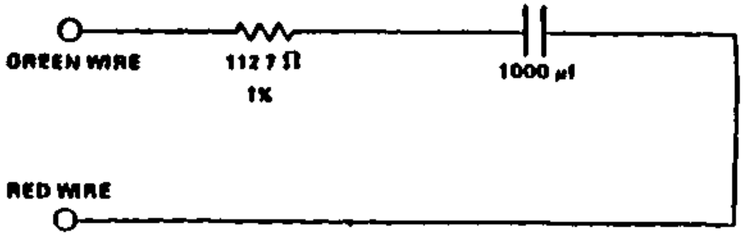
(c) Switch to TEMPERATURE (Note This temperature reading must be the same as Step (a) if not begin again at Step (a)) Place the knob on the control shaft (without turning the control shaft) with the knob pointer at the same temperature as the meter reading and tighten both set screws securely

At earliest opportunity recalibrate using the following procedure or return the instrument to factory for service

(a) Set the instrument for a salinity measurement as normal

(b) Substitute a 1000 µf capacitor and 112 7 ohm 0 1% tolerance resistor for the probe

Connect the resistor and capacitor between the green wire and red wire on the jack connections inside the instrument



(c) Turn the temperature dial until the meter reads redline

Now install the temperature knob with the arrow at 25°C This is a temporary calibration only Return the instrument to the factory for proper recalibration

PROBE

1 Description of YSI 3300 Series Conductivity/Temperature Probe

The YSI 3300 Series Conductivity Probes are designed for field use utilizing construction and design for rugged accurate service

Each probe features a built in cell constant of 5 0 (500 0/M) ± 2% a precision YSI thermistor temperature sensor of ± 0 1°C accuracy at 0 C and ± 0 3°C at 40°C and a low capacitance cable assembly terminating in a three therminal 0 25 dia phone type connector

The 3310 has a 10 ft cable and the 3311 is a 50 ft version Other lengths are available on special order

The probe has a rigid P V C body platinized pure nickel electrodes and a durable cable providing resistance to a wide range of water borne substances

2 Maintenance

(a) Cleaning

When the cell test indicates low readings the probable cause is dirty electrodes Hard water deposits oils and organic matter are the most likely contaminants

For convenient normal cleaning soak the electrodes for 5 *minutes* with a locally available bathroom tile cleaning preparation such as *Dow Chemical* Bathroom Cleaner Horizon Industries Rally Tile Porcelain and Chrome Cleaner Johnson Wax Envy Instant Cleaner or Lysol Brand Basin Tub Tile Cleaner

For stronger cleaning a 5 minute soak in a solution made of 10 parts distilled water 10 parts isopropyl alcohol and 1 part HCl can be used

Always rinse the probe after cleaning and before storage

CAUTION Do not touch the electrodes inside the probe
Platinum black is soft and can be scraped off

If cleaning does not restore the probe performance re platinizing is required

(b) Re Platinizing

Equipment Required —

(1) YSI #3140 Platinizing Solution 2 fl oz (3% platinum chloride dissolved in 0 025% lead acetate solution)
(2) YSI Model 33 or 33M S C T Meter
(3) 50 ml glass breaker or equivalent bottle
(4) Distilled water

Procedure —

(1) Clean the probe as in Section (a) — either method
(2) Place the cell in the beaker and add sufficient YSI #3140 solution to cover the electrodes Do not cover the top of the probe
(3) Plug the probe into the Model 33 or 33M switch to the X100 scale to platinize the electrode Move the probe slightly to obtain the highest meter reading and continue platinizing for the approximate time shown below

Meter Reading		Time
µmhos/cm	mS/m	(minutes)
30 000	3 000	5
25 000	2 500	6
20 000	2 000	8
15 000	1 500	11
10 000	1 000	16

(4) After the elapsed time remove the probe and rinse in fresh water

(5) Return the solution to its container 2 oz of solution *should be sufficient for 50 treatments*

(c) *Storage*

It is best to store conductivity cells in deionized water Cells stored in water require less frequent platinization Any cell that has been stored dry should be soaked in deionized water for 24 hours before use

3 Probe Use

(a) *Obstructions near the probe can disturb readings* At least two inches of clearance must be allowed from *non metallic* underwater objects Metallic objects *such as piers* or weights should be kept at least 6 *inches from* the probe

(b) Weights are attached to the cable of the YSI 3310 and 3311 *Probes The YSI 3327* Weights are supplied in pairs with a *total weight* of 4 ounces per pair Should it become necessary to add more weight to overcome water currents we suggest limiting the total weight to two pounds *(8 pairs) For weights* in excess of two pounds use an *independent* suspension cable In either case weights *must* be kept at least 6 inches away from the probe

(c) Gentle agitation by *raising* and lowering the probe several times *during a measurement* insures flow of specimen solution through the probe and improves the time response of the *temperature sensor*

4 Cell Calibration & Standard Solutions

The YSI #3300 *Series* Cells are calibrated to absolute accuracy of ± 1 5% based on a standard solution Since the literature on conductivity *does* not indicate a consistently accepted standardization method we have chosen the 0 01 demal KCl solution *method as* determined by Jones and Bradshaw in 1937 as our *standard* Recent textbooks as well as the ASTM standards *concur* with this choice

The solution is prepared by diluting 0 745 grams of pure dry KCl with distilled water until the solution is 1 kilogram The table below shows the values of conductivity this solution would have if the *distilled* water were non conductive However since even *high purity* distilled water is slightly conductive the *measured conductivity* will be higher by an amount *equal* to the water s conductivity

Temperature °C	*Conductivity* µmhos/cm	mS/m
15	1141 5	114 2
16	1167 5	116 8
17	1193 6	119 4
18	1219 9	122 0
19	1248 4	124 6
20	1273 0	127 3
21	1299 7	130 0
22	1326 6	132 7
23	1353 6	135 4
24	1380 8	138 1
25	1408 1	140 8
26	1436 5	143 7
27	1463 2	146 3
28	1490 9	149 1
29	1518 7	151 9
30	1546 7	154 7

The operator *may* use the standard solution and the table to check accuracy of a cell s constant or to determine an unknown constant The formula is shown below

$$K = \frac{R(C_1 + C_2)}{10^6} \quad \text{or} \quad \frac{R(S_1 + S_2)}{10^5}$$

where K = Cell constant

R = Measured resistance in Ω

C_1 = Conductivity in µmhos/cm
C_2 = Conductivity in µmhos/cm of the distilled water used to make solution
S = Conductivity in mS/m
S = Conductivity in mS/m of the distilled water used to make the solution

R C and C or S and S_2 must either be determined at the same temperature or corrected to the same temperature to make the equation valid

Note For further information on conductivity and the above standard information refer to ASTM Standards Part 23 — Standard Methods of Test for Electrical Conductivity or Water and Industrial Waste Water – ASTM Designation D1125 64

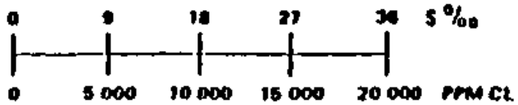
YSI MODEL 33 AND 33M USED WITH YSI 51A 54 and 57 OXYGEN METERS

If the salinity measurement is to be used for salinity correction on the 51A the reading should be converted to Chlorosity The formula is

$$\text{PPM Chlorosity} = \frac{\text{Salinity ‰} \quad 0.03}{1.8} \times 10^3$$

For these instruments the 0.03 can be neglected so the equation simplifies to

$$\text{PPM Cl} = \frac{\text{S ‰} \times 10^3}{1.8}$$



For salinity correction when using the Model 57 use the salinity reading direct from the Model 33 or 33M No conversion is necessary

Model 33 and 33M salinity readings taken in conjunction with Model 54 *dissolved oxygen readings can be used to correct the Model* 54 for salinity and to make post measurement salinity corrections to dissolved oxygen data Correction tables are available from the factory

WARRANTY

All YSI products carry a one year warranty on workmanship and parts exclusive of batteries Damage through accident misuse or *tampering will be repaired at a nominal charge*

If you are experiencing difficulty with any YSI product it may be returned to an authorized YSI dealer for repair even if the warranty has expired If you need factory assistance for any reason contact

Service Department
Yellow Springs Instrument Co Inc
P O Box 279
Yellow Springs Ohio U S A
Phone (513) 767 7241

ELECTRONIC WATER LEVEL METER

Now measuring static water levels can be quick and easy with the SAMPLE PRO Electronic Water Level Meter

The smooth profile, weighted probe is attached to an easy-to-read flat tape and triggers both audio and visual alarms on water contact The comfortable balance and smooth operation of the reel and stand-up frame are ideal for convenient, accurate field use.

When you have to monitor groundwater, go with the Pros—SAMPLE PRO Electronic Water Level Meter

For further information contact

QED Environmental Systems Inc

PO Box 3726

Ann Arbor Michigan 48106

In Michigan (313) 995-2547

SAMPLE PRO®

Groundwater Sampling Supplies

QED Environmental Systems Inc

S O P #7C
pH PEN

SPECIFICATIONS

- Range	0 0 to 14 0 pH
- Resolution	0 1 pH
- Accuracy	+/- 0 2 pH
- Battery	4 x 1 4 V (DURACELL MP 675H or equivalent)
- Battery life	1,000 hours
- Operating temperature	0 to 50° C (32° F to 122° F)
- Size (L x W x H)	6" x 1-1/4" x 3/4"
- Calibration	By offset trimmer
- Weight	2 3 oz

OPERATING INFORMATION

- Remove protective cap
- Turn on pHep by On-Off switch located on top
- Dip pHep in solution up to immersion level Under no circumstances immerse above display level
- Stir gently and wait a few seconds If electrode is dry wait a bit longer
- When not in use, switch off pHep and replace protective cap
- Large differences in readings of pH (+/- 0 5 pH) could be due to dry electrode or run-down batteries To improve performance leave pHep up to immersion level in tap water for a few minutes at least once a week
- To change batteries, pull out the battery case and replace batteries
- To recalibrate the instrument, dip in pH 7 solution and adjust the reading if necessary by offset trimmer using a small screwdriver

S O P #8
MONITORING WELL SAMPLING PROTOCOL

After monitoring wells have been developed to provide proper hydraulic connection between the well and the aquifer, groundwater samples will be collected At subsequent sampling events, an adequate volume of water must be purged from the well casing to ensure that samples collected are representative of the groundwater

Groundwater sampling procedures involve the following protocol

1 A plastic liner will be placed on the ground around the well to provide a clean dry surface

2 The well cap will be removed and placed in a clean area

3 The static water level will be measured, with a calibrated electric water level instrument, as follows

- The probe will be lowered down the well until the meter dial deflects, indicating contact of the probe with the water surface
- Three replicate measurements will be made to ensure reproductibility
- The depth to water will be referenced to the top of the casing This will be converted to water level elevation (MSL) from the surveyed top of the casing
- The data will be recorded according to the procedures included in the QAPP
- The probe will be rinsed with distilled water after each use

4 The volume of water initially contained in the well will be recalculated from the formula $V_w = (L-H) 3 14 r^2$, where V_w is the volume of water contained in the well in 1 ft^3, L is the length of the well pipe in ft , H is the depth in ft from the top of the casing to the water level, and r is radius of the well casing in ft

5 Each well will be purged to the equivalent of 3 well volumes using a Johnson-Kleck 2 in submersible pump or a teflon bailer Specific conductance readings will start after 2 casing volumes have been purged and will continue until readings stabilize (with a minimum of 3 casing volumes to be purged) Each well will have a section of tubing or rope dedicated for sampling The pump and/or bailer will be rinsed with distilled water between wells Note Representative samples of the rinsate from the decontamination procedures will be obtained for field blanks

6 Samples will be collected in glass bottles The volatile organic bottles will be collected immediately after purging There will be no air space in volatile organics bottles (In the event that the well recharges slowly, i e , monitoring well No 5, the VOA vials will be initially filled The other containers will be filled with a portion from each bailer) The samples will be iced for transport

7 Field analyses for temperature, pH, and specific conductance will be performed at the point of sampling with calibrated equipment (see S O P #7)

8 The well cap will be placed on the well

9 All sample bottles will have been laboratory washed

10 Samples will be identified, handled, preserved and analyzed according to Section 6 of the QAPP

11 Recordkeeping procedures will be in accordance with Section 7 of the QAPP

The rinsate from any purging or redevelopment operation will be discharged to the ground surface The discharge will be controlled so that there is no run-off from the site

S O P #9
PERSONNEL AND EQUIPMENT DECONTAMINATION

Three contamination levels will be delineated and marked out with stakes and traffic tape These will be

- The Exclusion Zone which will be the actual waste area or where contamination could occur

- The Contamination Reduction Zone where personnel decontamination will be done and will include the back portion of the trailer

- The Clean Zone where office activities and non-waste contact tasks will be performed

All persons entering the Exclusion Zone must be attired in designated protective gear Upon leaving the Exclusion Zone, personnel will enter the Contamination Reduction Zone and must remove all contaminated gear and thoroughly wash boots in the provided boot wash tubs After washing and rinsing boots, contaminated protective suits and gloves must be deposited in the open head waste drums Hands and face will be washed in the basins provided Personal equipment such as respirators, hard hats and test equipment should be checked for contamination before proceeding from the Contamination Reduction Zone to the Clean Zone Details of Personal Decontamination are found in the Health and Safety Plan, Section 14

Hand sampling equipment, i e , trowels, scoops, hand augers, etc may be cleaned at the sampling site This equipment will be cleaned by a triple rinse consisting of an Alconox or TSP rinse/scrub, distilled water rinse and methanol rinse The detergent rinsates will be discharged onto the site surface Spent methanol, which does not evaporate, will be drummed for disposal

Equipment, such as auger flights, will be decontaminated prior to beginning any field activities, between sampling locations (i e , boreholes, trenches, etc) and after completion of field activities with a steam cleaner or high pressure wash The rinsate will be discharged onto the site surface within a known contaminated area Samples of rinsate from the backhoe and auger flights will be collected for chemical analysis to document decontamination Rinsate samples from the hand tools, i e , bailer, stainless steel spatula, split spoon, etc will be obtained as field blanks per routine QA/QC field procedures

All contaminated personal protective clothing and debris will be collected and containerized for proper disposal

APPENDIX B

QUALITY ASSURANCE PROJECT PLAN FOR THE MISSOURI ELECTRIC WORKS REMEDIAL INVESTIGATION/FEASIBILITY STUDY

PREPARED FOR

MISSOURI ELECTRIC WORKS PRP COMMITTEE

BY

ROLLINS ENVIRONMENTAL SERVICES (FS), INC
TECHNICAL AND ASSESSMENT DIVISION
9000 GULF FREEWAY, SUITE 245
HOUSTON, TEXAS 77017

JUNE 22, 1989

APPENDIX B
QUALITY ASSURANCE PROJECT PLAN
REMEDIAL INVESTIGATION/FEASIBILITY STUDY
MISSOURI ELECTRIC WORKS
JUNE 22, 1989

Concurrences

Approval for Rollins Environmental Services (FS), Inc
Name Dr Joe Dauchy
Title RES-FS National Technical Director/MEW Quality Assurance Officer
Signature Date

Approval for Rollins Environmental Services (FS), Inc
Name Rick Smith
Title MEW Program Manager
Signature Date

Approval for Rollins Environmental Services (FS), Inc
Name William C Looney
Title MEW On-Site Coordinator/Health and Safety Officer
Signature Date

Approval for APR Laboratories, Inc
Name Sammy Russo
Title Laboratory Director
Signature Date

Approval for Implementation
Title
Signature Date

Title
Signature Date

Title
Signature Date

Title
Signature Date

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1 RES-FS On-Site Coordinator Bill Looney (1)
2 RES-FS Program Manager Rick Smith (1)
3 RES-FS Quality Assurance Officer Joe Dauchy (1)
4 APR Laboratories Sammy Russo (1)
5 Union Electric Company Warren Mueller (1)
6 MEW PRP Technical Consultant. Dr Terry West (1)
7 U S EPA Project Coordinator Pauletta France-Isetts (1)
8 U S EPA Assistant Regional Council Anne W Rowland (1)

LIST OF TABLES

LIST OF ATTACHMENTS

Attachment

4-1 RESUMES OF KEY RES-FS PERSONNEL
4-2 SUBCONTRACTOR CAPABILITY STATEMENTS

7-1 LABORATORY QA/QC PROCEDURES

9-2 ANALYTICAL PROCEDURES

LIST OF FIGURES

2 0 INTRODUCTION

2 1 PURPOSE AND SCOPE

The purpose of this Quality Assurance Project Plan (QAPP) is to document the quality assurance requirements applicable to the consulting services provided by Rollins Environmental Services (FS), Inc (RES-FS) and its subcontractors to the MEW PRP Committee for the Missouri Electric Works Remedial Investigation and Feasibility Study (RI/FS) This plan describes the requirements for organizing, planning, performing, reviewing and documenting activities which affect the quality of work conducted on the MEW site by personnel, consultants and subcontractors of RES-FS This plan is intended to incorporate the requirements of EPA The scope of this plan includes field sampling, analytical testing, equipment maintenance, data reduction and reporting

The MEW project QAPP as presented herein applies to all work performed by RES-FS and subcontractors as authorized by the MEW PRP Committee, whether performed at the site or in any office or laboratory, as well as the services and/or items provided by RES-FS personnel which affect the quality of elements in the authorized work

2 2 DISTRIBUTION CONTROL

This QAPP and all documents that affect the referenced quality assurance requirements are controlled documents The Program Manager is responsible for control of the distribution and accountability of all documents relating to the project He issues all copies of documents relating to the site QAPP, and revisions thereto, and maintains a record of distribution

The QAPP and other documents are issued to various persons for their use Many plans and documents are issued to a specific person because of the title or function the person holds It is the responsibility of the Program Manager and the Quality Assurance/Quality Control Officer to continually monitor title and function changes and issue or cancel the QAPP and documents as personnel change

Acknowledgement of receipt of the documents, and of receipt of revisions of the documents are recorded by the document holder signing an appropriate Receipt Acknowledgement form and returning it to the Program Manager for inclusion in the project files Examples of the Receipt Acknowledgement forms used for this project are presented in Figures 2-1 and 2-2 The Receipt Acknowledgement form for the document or document revisions must be signed by the person to whom the document or revision is assigned

The holder of each controlled document is responsible (1) to keep the latest revised copy, (2) to destroy or appropriately mark as "SUPERSEDED" or "VOID" all old copies and/or revisions replaced, (3) to return the Receipt Acknowledgement form to the Program Manager, and (4) to return his copy when his need for the document no longer exists because of reassignment from the project, retirement, termination of employment, or cancellation by the Program Manager A "master" project document will be retained at Union Electric facilities, as described in Section 7 3

FIGURE 2-1
ACKNOWLEDGEMENT OF RECEIPT OF QA/QC PLAN
ROLLINS ENVIRONMENTAL SERVICES (FS), INC
MISSOURI ELECTRIC WORKS RI/FS PROJECT
QA/QC PLAN

TO	Rick Smith, RES-FS Program Manager, Missouri Electric Works Project
FROM	______________________
SUBJECT	Acknowledgement of Receipt of "QA/QC Plan Missouri Electric Works Site Project, Rollins Environmental Services (FS), Inc "

I hereby acknowledge receipt of QA/QC Plan No ____________
I understand that this Plan is the property of RES-FS and is assigned on a loan basis It is my responsibility to maintain this Plan current by replacement with revised copies as they are issued

I will promptly surrender this Plan upon request of the RES-FS Program Manager or whenever I no longer have need of the Plan because of reassignment from the Project, retirement, termination of employment, or cancellation

ACKNOWLEDGED BY

____
(Signature)

____
(Date)

PLEASE RETURN THIS COMPLETED ACKNOWLEDGEMENT TO
Rollins Environmental Services (FS), Inc
9000 Gulf Freeway, Suite 245
Houston, Texas 77017
Attn Rick Smith, MEW Program Manager

FIGURE 2-2
ACKNOWLEDGEMENT OF RECEIPT OF REVISED QA/QC PLAN

ROLLINS ENVIRONMENTAL SERVICES (FS), INC
Missouri Electric Works RI/FS PROJECT
QA/QC PLAN

TO	Rick Smith, RES-FS Program Manager, Missouri Electric Works Project
FROM	____________________
SUBJECT	Acknowledgement of Receipt of "QA/QC Plan, Revision ________ Missouri Electric Works Site Project, Rollins Environmental Services (FS), Inc "

I hereby acknowledge receipt of Revision No __________, dated ____________________, for QA/QC Plan No ____________________

I further acknowledge that superseded Plans have been marked "SUPERSEDED" or have been destroyed

ACKNOWLEDGE BY

____
(Signature)

____
(Date)

PLEASE RETURN THIS COMPLETED ACKNOWLEDGEMENT TO
Rollins Environmental Services (FS), Inc
9000 Gulf Freeway, Suite 245
Houston, Texas 77017
Attn Rick Smith, MEW Program Manager

3 0 PROJECT DESCRIPTION

3 1 SCOPE

The scope of services for the MEW RI/FS to be performed by RES-FS is divided into three conceptual phases as follows

Activities	Anticipated Dates
Initial Activities	November '88 - February '89
Site Investigations	March '89 - May '89
Feasibility Studies	May '89 - October '89

These activities and the rationale for these activities are described in the Work Plan The tasks associated with the RI/FS, and their anticipated start/finish date, are listed in Table 3-1 It should be noted that the start/finish dates are dependent, in part, upon the state/federal agency review process

The overall objective of this project is to perform a RI/FS to determine the spatial extent of contamination at the MEW site, and to develop and evaluate remedial action alternatives appropriate for site remediation All tasks and subtasks are directed toward accomplishment of this objective

The site investigation for the MEW site will be performed in two phases in order to characterize the degree and extent of contamination at the site APR Laboratories will conduct the required chemical analyses at their facility in Dickinson, Texas McClelland Engineers, located in Houston, Texas, will conduct the required geotechnical analyses All sampling and laboratory analyses will be conducted in accordance with protocols and guidelines set forth in this document Specifically, this includes the following areas

- Preparation of sample containers
- Sampling procedures
- Sample preservation
- Sample custody
- Sample holding time
- Analytical procedures
- Calibration procedures and frequency
- Data reduction validation
- Internal QC checks

3 2 INTRODUCTION/BACKGROUND

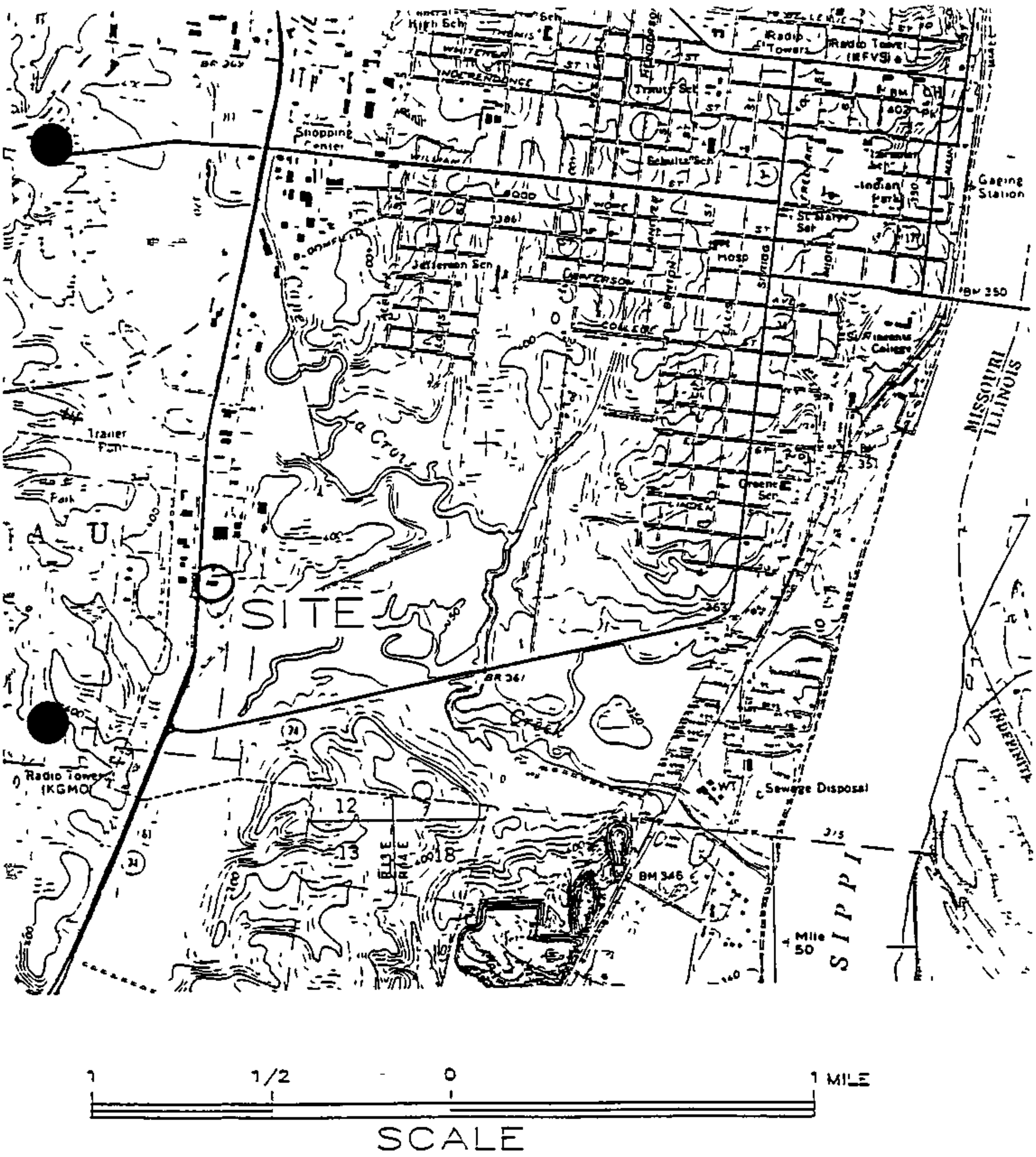
The Missouri Electric Works Inc facility is a 6 4 acre site located in an industrial area of the southern portion of Cape Girardeau, Missouri, on Missouri Highway 61 (Figure 3 -1) The approximate legal description of the site is the SW 1/4 of the NW 1/4 of Section 12, Township 30 North, Range 13 West, in Cape Girardeau County, Missouri The approximate site dimensions are 349 feet north-south by 798 feet east-west

TABLE 3-1

PROJECT ACTIVITY LIST

MEW RI/FS

ACTIVITY	DESCRIPTION	EARL START	EARL FINISH
000100	PROJECT APPROVALS	21JAN89	21MAR89
000200	HISTORICAL STUDY DOCUMENT	21JAN89	20APR89
000300	SITE MOBILIZATION-PHASE I	22MAR89	24MAR89
000400	TOPOGRAPHIC SURVEY	25MAR89	27MAR89
000700	PROCESS BUILDING EVALUATION	25MAR89	25MAR89
000800	SHALLOW SUBSURFACE EXPLORATIO	26MAR89	26MAR89
000500	GEOPHYSICAL SURVEY	28MAR89	29MAR89
000900	SURFACE SAMPLING - PHASE I	28MAR89	01APR89
001400	SAMPLE ANALYSIS - PHASE I	30MAR89	28APR89
001000	SEDIMENT SAMPLING - PHASE I	02APR89	03APR89
001100	GROUNDWATER SAMPLING	04APR89	05APR89
000021	DEMOBILIZATION - PHASE I	06APR89	06APR89
000310	SITE MOBILIZATION - PHASE II	29MAY89	29MAY89
000600	TRENCHING	30MAY89	31MAY89
000910	SURFACE SAMPLING - PHASE II	30MAY89	31MAY89
001010	SEDIMENT SAMPLING - PHASE II	30MAY89	01JUN89
001200	SOIL BORINGS FOR DEPTH	01JUN89	05JUN89
001410	SAMPLE ANALYSIS - PHASE II	01JUN89	30JUN89
001300	SOIL PROPERTIES SAMPLING	06JUN89	10JUN89
0000D2	DEMOBILIZATION - PHASE II	11JUN89	11JUN89
001500	RISK ASSESSMENT DOCUMENT	30AUG89	10SEP89
001600	DATA EVAL & CHAR. REPORT	11SEP89	30SEP89
001700	FEASIBILITY STUDY REPORT	01OCT89	30OCT89



ROLLINS ENVIRONMENTAL SERVICES (FS), INC
TECHNOLOGY & ASSESSMENT DIVISION

MISSOURI ELECTRIC WORKS

FIGURE 3–1
AREA MAP

The MEW site is situated in the hills along the valley wall just west of the Mississippi River flood plain, approximately 1.5 miles west of the Mississippi River. Intermittent run-off channels emanate from the south and east boundaries of the site, which eventually drain to the Cape LaCroix River, located 0.7 miles from the site. The Cape LaCroix River flows 1.1 miles and enters the Mississippi River.

Missouri Electric Works sells, services, and remanufacturers electric motors, transformers, and electrical equipment controls. During the past operational practices, MEW reportedly recycled materials from the old equipment, selling copper wire and reusing the dielectric fluids from the transformers. The salvaged transformer oil was filtered through Fuller's earth and an estimated 90 percent was reused. The remaining 10 percent reportedly was disposed.

MEW has been at its present location since 1953. According to EPA documents, more than 16,000 transformers have been repaired or scrapped on-site. The total amount of transformer oil that has been discarded in this period was estimated to be 28,000 gallons. In 1984, approximately 5,000 gallons of waste oil was removed by a removal contractor.

The MEW plant and general office occupy a building at the west end of a lot that overlooks Highway 61. The remainder of the lot is an open field, portions of which are littered with various objects including old transformers, empty drums, old pallets, and trash (Figure 3-2). The MEW property has been found to be contaminated with Arochlor 1260 polychlorinated biphenyls (PCBs). The PCB contamination is a result of past handling and storage procedures of the transformer fluids on site.

Two major sampling efforts were conducted by the E & E/FIT at the Missouri Electric Works site. The first investigation, performed in October 1985 under Technical Directive Document (TDD) # R-07-8509-04, principally involved on-site surface soil sampling intended to define the areal extent of surface PCB contamination.

Two off-site background samples were obtained in the same manner as the on-site soil samples. The results of this sampling effort detected significant surface contamination within the site boundary. Contamination was found in 96 of 104 on-site samples analyzed.

The second investigation, performed in July 1986 under TDD # R-07-8509-04B, involved subsurface sampling (0 to 4 feet deep) at various intervals, off-site surface soil sampling, and off-site drainage channel sediment sampling. This investigation extended the areal extent of the surface samples collected in the initial investigation beyond the perimeter of the MEW property. The surface water and sediment associated with the drainageways downgradient from the site also were sampled. This sampling indicated that there were areas where PCBs had migrated off site, based upon the analysis of the sediments. However, no PCBs were detected in the surface water samples. A sample of the on-site drinking water well was also obtained during this investigation, PCBs were not detected.

An Expanded Site Investigation (ESI) was performed by E & E during May and June 1987. During the ESI six (6) wells were installed and sampled. Well nos. 3 and 5, located in the southeast corner of the site, contained 3.9 and 3.5 ug/l (ppb) PCBs, respectively. The wells were resampled during October 1987. The purpose of this sampling event was to obtain filtered and unfiltered samples to determine if their previously reported PCB concentrations were attributable to soil particles or solubilized PCBs No PCBs were detected from any of the groundwater samples collected, indicating that the previously reported PCB groundwater levels could have been due to particle contamination during well installation/development or cross contamination during sampling

The on-site drinking water well has been sampled by the site owner and no PCBs were detected

John Mathis and Associates, Inc sampled well nos 3 and 5 on August 3, 1988, on behalf of the MEW PRP Committee The analytical results of the unfiltered samples indicated Aroclor 1260 at concentrations of 2 0 ug/l and 3 2 ug/l for well nos 3 and 5, respectively A sample aliquot from well no 5 was filtered through a 0 45-micron filter prior to analysis PCBs were not detected in this sample at the 0 5 ug/l detection limit

3 3 PROJECT MILESTONES

Table 3-1 lists the tasks which will be performed to complete the RI/FS A start and finish date is included with each task

Figure 3-3 includes a bar chart for the expected project schedule

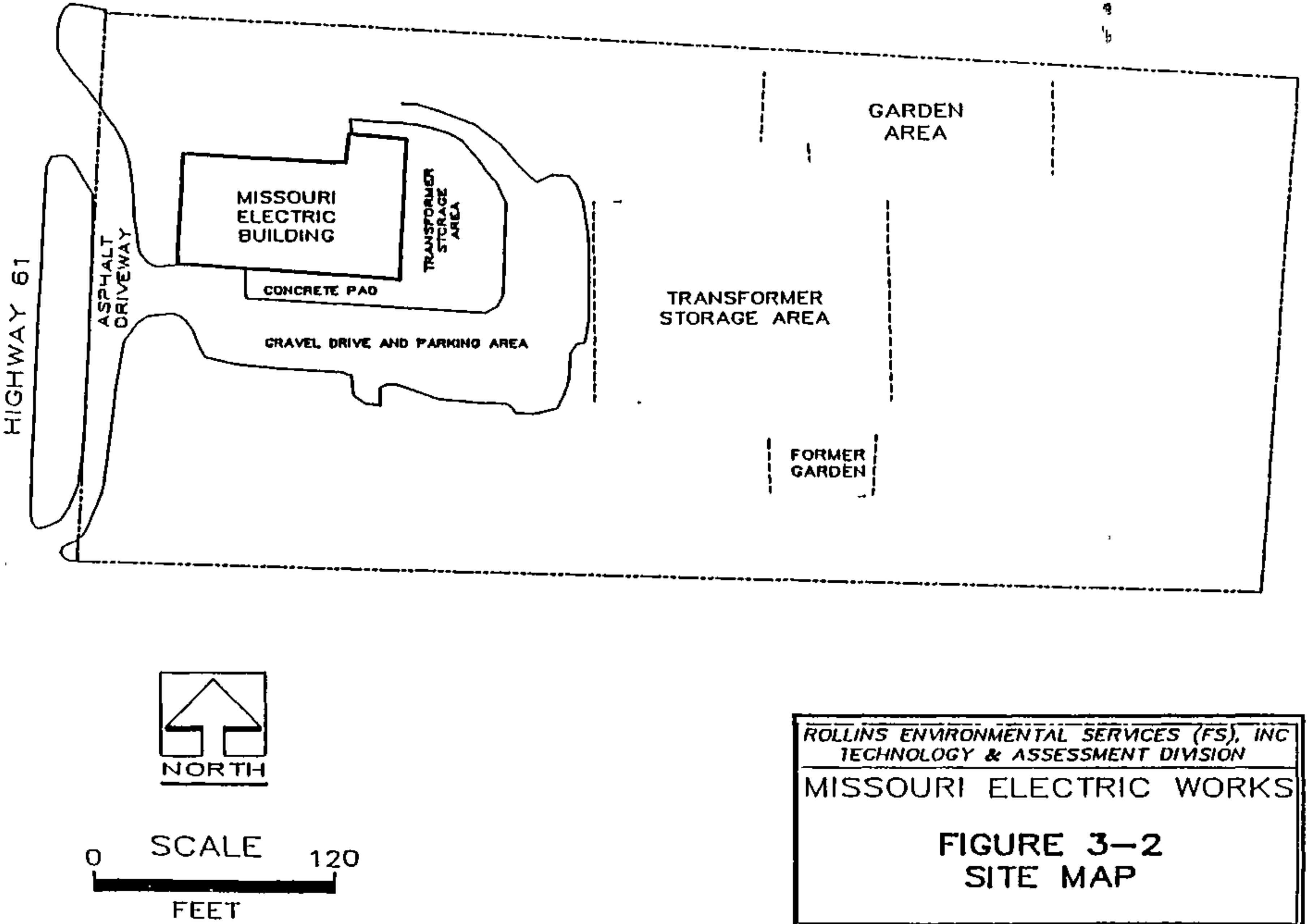
3 4 DATA USAGE

Before alternatives for remedial actions can be considered in the FS, there must be sufficient information available to develop, screen, and evaluate potential alternatives The remedial investigation will be performed to gather and assess information needed to accomplish the following

- Determine if pollution or physical conditions at the site pose a threat to human health or the environment
- Determine the location and type of contamination in the ground water, sediments and surface and subsurface soils surrounding the site in sufficient detail to develop and evaluate remedial action alternatives
- Define the pathways of migration from the site
- Define onsite and offsite physical features and facilities that could affect contaminant migration and contaminant cleanup
- Develop, screen and evaluate the cost-effective remedial action(s)

Once the data has been obtained and evaluated in the RI report, the following tasks will be performed as part of the feasibility study

- Develop and evaluate remedial action alternatives
- Rank the acceptable remedial action alternatives



ROLLINS ENVIRONMENTAL SERVICES (FS), INC
TECHNOLOGY & ASSESSMENT DIVISION

MISSOURI ELECTRIC WORKS

FIGURE 3–2
SITE MAP

- Recommend a cost-effective remedial action(s) for the site

The RI includes several tasks (See Table 3-1) designed for gathering data in order to evaluate the feasible remedial alternatives Each task is detailed in Section 3 of the Work Plan and Section 6 of the QAPP Specific RI task objectives are listed below

1 Project Approvals (Task 100) A number of activities will be performed prior to the start of on-site work Specific activity elements to be developed include

- Project schedule with milestones and deliverables
- Staffing plan, identifying key personnel and project responsibilities
- Health and Safety Plan (HSP)
- Detailed plans for field work, including
- Provisions for field support facilities,
- Description of field techniques, and
- Identification of subcontractors, as required
- Quality Assurance Project Plan (QAPP), including Standard Operating Procedures

Additionally, the project Safety Officer will contact representatives of the Police and Fire Departments to apprise them of project activities and establish a system for emergency response He will also identify local hospitals and/or emergency centers and acquaint their personnel with potential hazards that might be encountered The completion and approval of these activities will help ensure the cost effective, technically sound and safe conduct of all phases of the remedial investigation

2 Historical Study Survey (Task 200) A historical study survey will be performed to identify additional areas of concern The data obtained from the survey will be utilized in the selection of additional site investigative activities and/or the selection of sampling locations

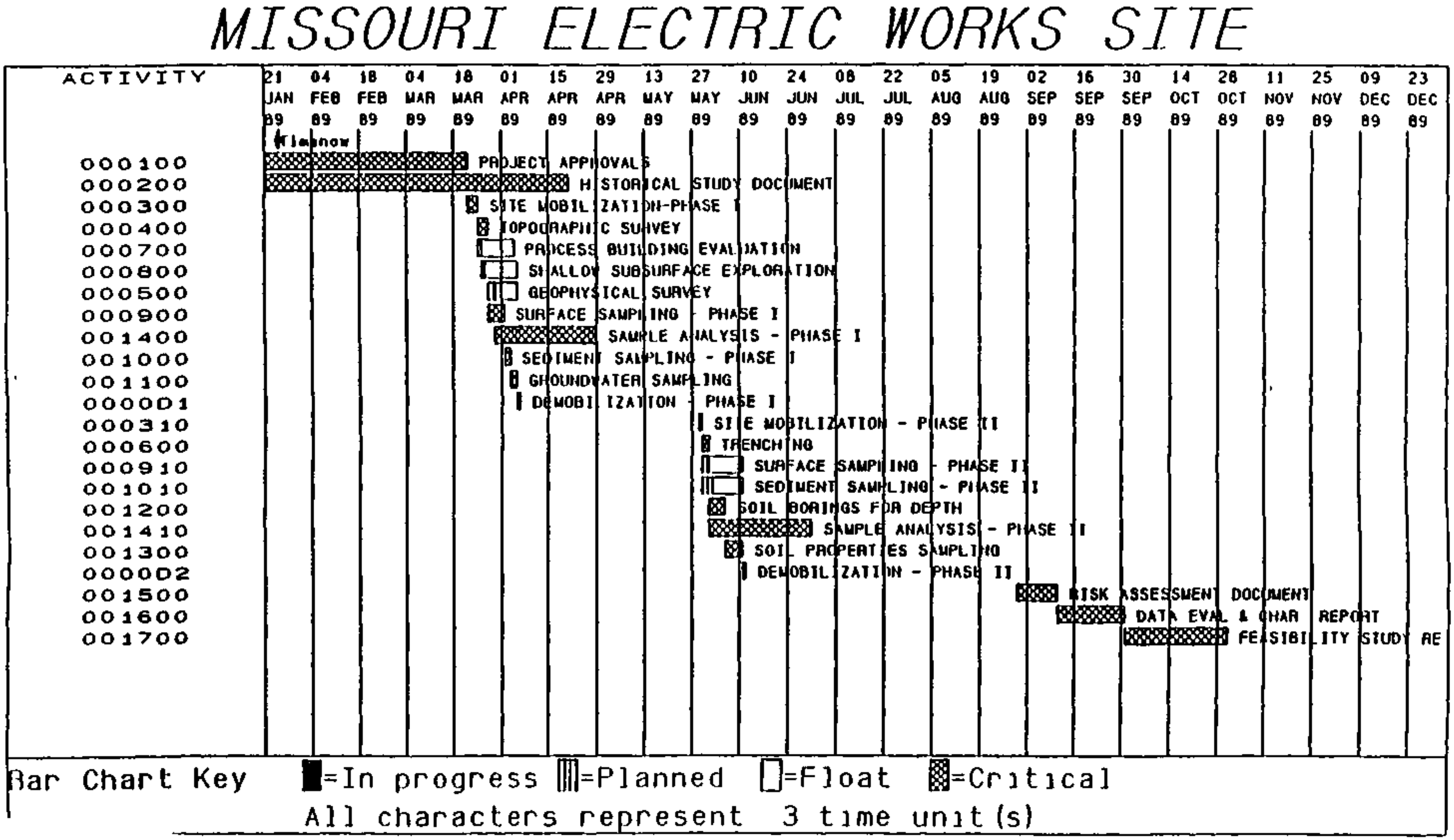
3 Site Mobilization (Task 300/310) Several work tasks will need to be performed during the phase I and II site mobilizations These tasks include

- The locations of the van, office trailer (if needed), parking areas, drum storage and decontamination areas will be determined
- The van and possible office trailer will be leveled and secured

FIGURE 3-3

PROJECT SCHEDULE - BAR CHART

MEW RI/FS



- The van will be arranged for work start-up

- A decontamination area will be established

- The contamination reduction and clean zone areas will be taped off with stakes and traffic tape The personnel decontamination tubs and equipment will be set up Open head waste drums will be set up in the contamination reduction zone

4 Topographic Survey (Task 400) During phase I a site map with contour elevations will be prepared The map will show all site and topographic features The surface contours will be used to determine surface water runoff patterns

The surveyors will establish a grid system over the site during the phase I mobilization Temporary wooden stakes, 3 feet high with flags and marked for reference purposes, will be placed at 50-100' intervals Permanent stakes or benchmarks will also be established so that the grid can be regenerated for future sampling events The grid will be used to accurately document the locations of all on-site sampling and monitoring activities

5 Geophysical Survey (Task 500) A geophysical survey will be performed during phase I to determine the locations of buried metal deposits and contaminants with high conductivity The survey will investigate the east end of the site

6 Trenching (Task 600) Based upon visual observiations and/or the geophysical survey, suspected waste burial areas will be excavated with a backhoe during phase II This activity will be conducted to determine the dimensions of the waste deposits, as well as the chemical and physical characteristics of any buried wastes Selected samples will be analyzed for PCBs and the volatile organics

7 Process Building Investigation (Task 700) The MEW process building will be inspected to determine the presence or absence of floor drains and sumps and the associated discharge points The results of the investigation will be utilized to determine areas which need further investigation for potential PCB and volatile organic contamination

8 Shallow Subsurface Investigation (Task 800) Shallow soil samples will be obtained from the septic tank drain field located north of the MEW process building, the areas north, east, and southeast of the process building and additional areas potentially impacted by discharge from the MEW process building The samples will be analyzed for PCBs and the volatile organics

9 Surface Soil Sampling (Task 900/910) Utilizing the existing analytical data, in combination with a geostatistical model, surface soil sample locations have been designated in order to define the 10 ppm action line for PCB contamination The data from the analysis of the samples will be input into the model and evaluated to determine the adequacy of the data and recommendation for additional sample locations

10 Sediment Sampling (Task 1000/1010) Sediment samples will be obtained to determine the extent and potential for further contamination to off-site areas resulting from several migration pathways, such as, surface water run-off, air transport and shallow subsurface migration This information will also be utilized to determine the potential for direct contaminant contact to either fauna, flora or humans The results from this task will determine the need for addressing remedial actions to control surface water run-off and leachate and/or to remediate surrounding surface water bodies The samples will be analyzed for PCBs

11 Groundwater Sampling (Task 1100) Groundwater samples will be collected from existing wells at the MEW site All samples will be analyzed for PCBs and the volatile organics The data will be utilized to define the vertical and lateral limit of groundwater contamination, if it exists, and to determine the need for addressing remedial alternatives for the control/removal of groundwater contaminants

12 Soil Boring for Depth Profiles (Task 1200) The soil boring activity program includes drilling thirty two (32) soil borings around the site This program is designed to meet the following objectives

- Estimate the current lateral and vertical extent of contamination and the associated volume of contaminated soil
- Evaluate the potential for future soil and groundwater contamination

Representative soil samples will be obtained for chemical analysis The results will be utilized to determine the extent of subsurface contamination and the potential for the movement of contaminants in the subsurface The samples will be chemically analyzed for PCBs, TCA, TCE and methylene chloride

13 Soil Properties Evaluation (Task 1300) Soil samples will be obtained to depths of one foot to characterize the three expected soil types or properties that could impact remedial alternatives The samples will be analyzed for BTU, soil density, moisture content, pH, cation exchange capacity, particle size, thermal conductivity, total chloride, total metals and Atterberg limits The results will affect the operational and economic feasibility of the remedial alternatives

14 Sample Analysis (Task 1400/1410) Testing which will be conducted during the RI will include field, chemical laboratory, and geotechnical laboratory determinations The results of the testing will be the basis for which all feasible remedial alternatives are evaluated

3 5 MONITORING NETWORK DESIGN AND RATIONALE

The remedial investigation includes several tasks and subtasks which specify the monitoring or sampling of the site The investigation is designed to identify the nature of the wastes, the volume and distribution of wastes, target receptors, contaminant pathways and extent of off-site contamination in order to determine and assess feasible remedial alternatives Details of the monitoring network are included in the Work Plan

3 6 SAMPLE MATRICES AND ANALYTICAL PARAMETERS

Table 3-2 is a summary of all anticipated sampling and analyses for the anticipated RI activities at the MEW site The blanks, duplicates and spike samples required are summarized in Table 3-3 Table 3-4 is a listing of the volatile organic compounds Table 3-5 is a listing of chemical and physical parameters which will be performed for Task 1300 (Soil Properties Evaluation)

TABLE 3 2
ANALYTICAL SUMMARY
MISSOURI ELECTRIC WORKS RI/FS

TASK	TYPE OF SERVICE	EST QUANTITY (a)	PARAMETERS
600	SUBSURFACE SOIL/WASTE	9	PCBs (AROCHLOR 1260) (ASTM 3304 77) VOLATILE ORGANICS (EPA 8240) VISUAL CLASSIFICATION
800	SUBSURFACE SOIL	18	PCBs (AROCHLOR 1260) (ASTM 3304 77) VOLATILE ORGANICS (EPA 8240) VISUAL CLASSIFICATION
900/910	SURFACE SOIL (b)	68	PCBs (AROCHLOR 1260) (ASTM 3304 77) VISUAL CLASSIFICATION
1000/1010	SEDIMENT SOIL (b)	113	PCBs (AROCHLOR 1260) (ASTM 3304 77) VISUAL CLASSIFICATION
1100	GROUNDWATER	6	PCBs (ASTM 3534 85) VOLATILE ORGANICS (EPA 8240) FIELD DETERMINATIONS pH, TEMPERATURE, SPECIFIC CONDUCTANCE
1200	SOIL BORINGS	128	PCBs (AROCHLOR 1260) (ASTM 3304 77) TRICHLOROETHANE, TRICHLOROETHYLENE, METHYLENE CHLORIDE (EPA 5030 + 8010) VISUAL CLASSIFICATION
1300	SOIL	12	BTU (ASTM D240 64), DENSITY (COE EM1110 2 1906), CEC (EPA 9080), PARTICLE SIZE DETERMINATION (D422 63), THERMAL CONDUCTIVITY (C), % MOISTURE (ASTM 2216 80), pH (EPA 9045), TOTAL CHLORIDES (EPA 9251), ATTERBERG LIMITS (ASTM D4318 84), TOTAL METALS (Al, As, Ba, Cd, Ca, Cr, Cu, Fe, Pb, Mg, Mn, Hg, Ni, K, Se, Ag, Na, Zn) VISUAL CLASSIFICATION

A PROJECTED QUANTITIES, ACTUAL NUMBER OF SAMPLES MAY CHANGE BASED UPON FIELD CONDITIONS AND PHASE I ANALYTICAL RESULTS

B ESTIMATED QUANTITIES BASED ON PHASE I PROJECTIONS ONLY THE QUANTITY OF SAMPLES WHICH WILL BE OBTAINED DURING PHASE II IS DEPENDENT UPON THE PHASE I ANALYTICAL RESULTS

C AS REFERENCED IN GEOTECHNICAL TESTING JOURNAL, VOL 6, MARCH DECEMBER 1983

TABLE 3 3
SUMMARY OF BLANKS AND DUPLICATES
MISSOURI ELECTRIC WORKS RI/FS

TASK	TYPE OF SAMPLE	DUPLICATES	BLANKS (c)	SPIKES
600	SUBSURFACE SOIL/WASTE (9)	1	1	1
800	SUBSURFACE SOIL (18)	1	1	1
900/910	SURFACE SOIL (68)	4	4	4
1000/1010	SEDIMENT (113)	6	6	6
1100	GROUNDWATER (6)	1	1	1
1200	SOIL BORINGS (128)	7	7	7
1300	SOIL (12) (d)	1	1	1

(a) ESTIMATED TOTAL NUMBER OF SAMPLES, EXCLUDING BLANKS DUPLICATES AND SPIKES, SHOWN IN PARENTHESIS, ESTIMATED QUANTITIES BASED ON PHASE I PROJECTIONS ONLY

(b) ADDITIONAL SAMPLE VOLUMES WILL BE OBTAINED FOR THE REQUIRED QC ANALYSES

(c) FIELD EQUIPMENT BLANKS AND TRIP BLANKS

(d) SPIKES AND/OR BLANKS ARE NOT APPLICABLE TO PHYSICAL PARAMETERS, SUCH AS, BTU, DENSITY, CEC, PARTICLE SIZE DETERMINATION, THERMAL CONDUCTIVITY, X MOISTURE AND ATTERBERG LIMITS

TABLE 3-4
VOLATILE ORGANIC LIST

VOLATILES		CAS NUMBER
1	Chloromethane	74-87-3
2	Bromomethane	74-83-9
3	Vinyl Chloride	75-01-4
4	Chlorethane	75-00-3
5	Methylene Chloride	75-09-2
6	Acetone	67-64-1
7	Carbon Disulfide	75-15-0
8	1,1-Dichloroethene	75-35-4
9	1,1-Dichloroethane	75-35-3
10	trans-1,2-Dichlorethene	156-60-5
11	Chloroform	67-66-3
12	1,2-Dichloroethane	107-06-2
13	2-Butanone	78-93-3
14	1,1,1-Trichloroethane	71-55-6
15	Carbon Tetrachloride	56-23-5
16	Vinyl Acetate	108-05-4
17	Bromodichloromethane	75-27-4
18	1,1,2,2-Tetrachlorethane	79-34-5
19	1,2-Dichloropropane	78-87-5
20	trans-1,3-Dichloropropene	10061-02-6
21	Trichloroethene	79-01-6
22	Dibromochloromethane	124-48-1
23	1,1,2-Trichloroethane	79-00-5
24	Benzene	71-43-2
25	cis-1,3-Dichloropropene	10061-01-5
26	2-Chloroethyl Vinyl Ether	110-75-8
27	Bromoform	75-25-2
28	2-Hexanone	591-78-6
29	4-Methyl-2-pentanone	108-10-1
30	Tetrachlorethene	127-18-4
31	Toluene	108-88-3
32	Chlorobenzene	108-90-7
33	Ethyl Benzene	100-41-4
34	Styrene	100-42-5
35	Total Xylenes	

TABLE 3-5 -
PARAMETERS FOR SOILS PROPERTIES EVALUATION

PARAMETER	METHOD
BTU	ASTM D240-64
Soil density testing (wet or dry)	COE EM 1110-2-1906
Cation exchange capacity (CEC)	EPA 9080
Particle size determination (sieve analysis and hydrometer analysis)	ASTM D422-63
Thermal conductivity measurements	*
Natural moisture content	ASTM 2216-80
Soil pH	EPA 9045
Chloride concentration	EPA 9251
Atterberg limits (liquid and plastic limits)	ASTM D4318-84
Metals concentration	**
- Aluminum	EPA 7020
- Arsenic	EPA 7061
- Barium	EPA 7080
- Cadmium	EPA 7130
- Calcium	EPA 7140
- Chromium	EPA 7190
- Copper	EPA 7210
- Iron	EPA 7380
- Lead	EPA 7420
- Magnesium	EPA 7450
- Manganese	EPA 7460
- Mercury	EPA 7471
- Nickel	EPA 7520
- Potassium	EPA 7610
- Selenium	EPA 7741
- Silver	EPA 7760
- Sodium	EPA 7770
- Zinc	EPA 7950

* As referenced in Geotechnical Testing Journal, Vol 6, March - December 1983

** Acid extration per EPA Method 3050

4 0 PROJECT ORGANIZATION AND RESPONSIBILITY

4 1 OVERALL RESPONSIBILITY

The Program Manager is responsible for the overall management of the RI/FS of the MEW site Although subcontractors may be used for some projects tasks, RES-FS assumes full responsibility for ensuring that their actions comply with all aspects of the approved Work Plan (e g , S O Ps, Health and Safety Plan and Quality Assurance Project Plan)

The Program Manager will be RES/FS' prime point of contact with the MEW PRP Committee, EPA and MDNR and will have responsibility for technical, financial and scheduling matters Furthermore, the Program Manager will coordinate the deployment of corporate resources required to successfully complete the project In the Program Manager's absence, the On-Site Coordinator, or a designated representative, will act as the point of contact

The organization of key personnel assigned to the project is presented in Figure 4-1 Resumes of key project individuals are included in Attachment 4-1

4 2 MONITORING AND SAMPLING OPERATIONS AND QC

The subcontractors, and their specific project task(s), which will be utilized in the monitoring and sampling field activities are listed below

SUBCONTRACTOR	FIELD TASK
McClelland Engineers	Geotechnical Laboratory Analysis
APR Laboratories	Chemical Analysis
Neponset Geophysical Corp	Geophysical Survey

Capability Statements for each contractor are included as Attachment 4-2

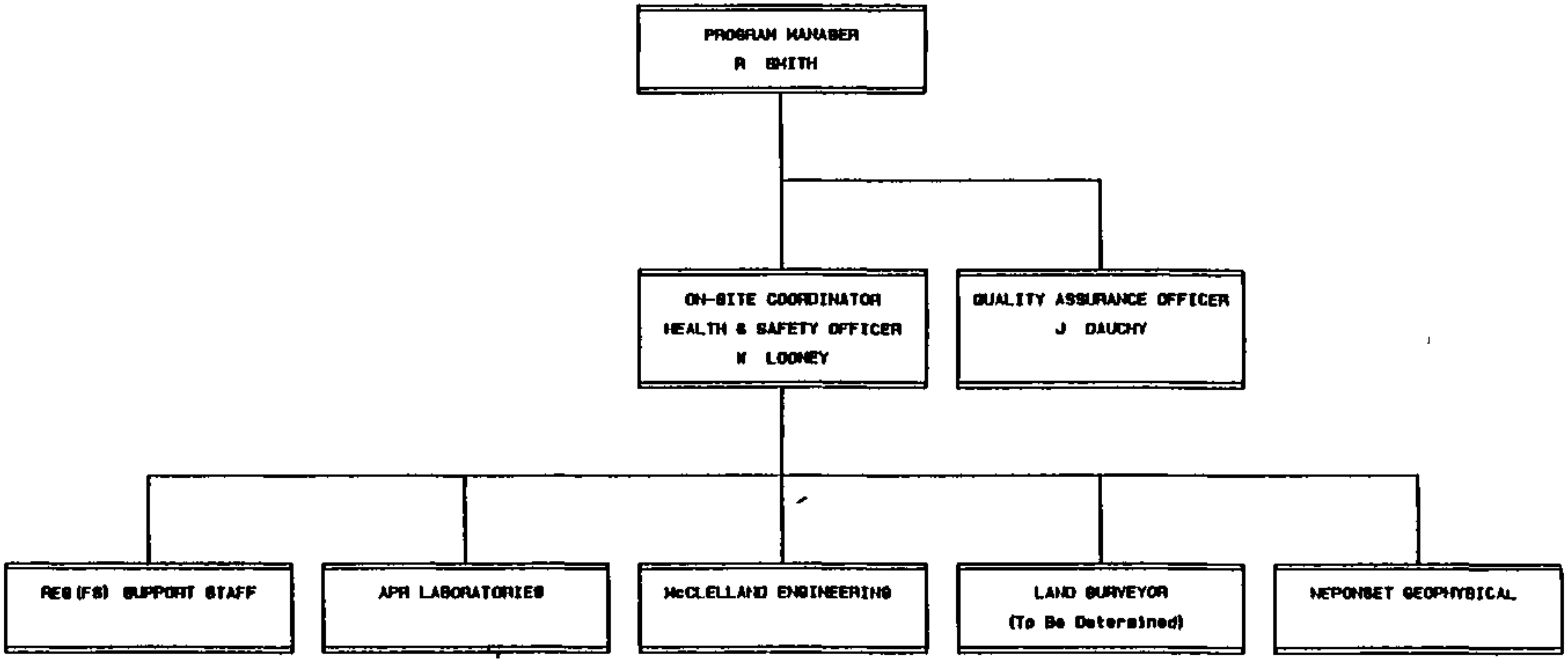
Each subcontractor will be responsible for following the approved guidelines included in the Work Plan, Health and Safety Plan and Quality Assurance Project Plan The RES-FS On-Site Coordinator will supervise all field activities to ensure the safe and proper performance of all activities

4 3 LABORATORY ANALYSES AND QC

RES-FS has retained APR Laboratories of Dickinson, Texas to perform the analyses of chemical parameters identified in Table 3-2

The soil testing laboratory of McClelland Engineers, located in Houston, Texas will perform the testing of soil parameters identified in Table 3-2

FIGURE 4-1
ORGANIZATION CHART
MEW RI/FS PROJECT



4 4 SPECIALIZED RESPONSIBILITIES FOR LABORATORY SERVICES

APR's Laboratory Director and McClelland's Chief Quality Control Officer will perform a data review/assessment of the analytical data prior to submittal to RES-FS The RES-FS QA/QC Officer, Joe Dauchy, will perform the final data review

The analytical program for the Missouri Electric Works project has been prepared by RES-FS in consultations with APR Laboratories and McClelland Engineers This program (analytical, methodology and QC) is presented for review and approval by the EPA Region VII QA Officer

4 5 QUALITY ASSURANCE

4 5 1 Overall QA Responsibility

The Program Manager has overall responsibility for establishing the QAPP and for its implementation in all project activities

The RES-FS Quality Assurance/Quality Control (QA/QC) Officer reports to the Program Manager, and coordinates with the Program Manager in the implementation of the QAPP The project QA Officer has access to the On-Site Coordinator and other project personnel He has the responsibilities to monitor and verify that the project work is performed in accordance with the QAPP, the various procedures and to assess overall QA effectiveness

4 5 2 Field QA Responsibility

The RES-FS QA Officer has responsibility for the on-site field QA The QA/QC Officer and/or an assigned representative will work closely with the On-Site Coordinator to insure that all RES-FS field staff and subcontractors are in compliance with all field requirements of the QAPP

4 5 3 Laboratory QA Responsibility

APR is responsible to the Program Manager for completion of the analytical tasks and QAPP activities McClelland is also responsible to the Program Manager for completion of the soil testing activities and any required QAPP activities

Quality Coordinators will be assigned by both APR and McClelland management to implement the project QAPP and to monitor project activities on a daily basis for conformance They will report to the Project QA/QC officer on QAPP activities

4 5 4 QA Reports to Management

Section 16 0 of this QAPP describes the periodic QA reporting requirements for the Missouri Electric Works project

After the field work has been completed and the chemical analyses and soil testing are completed and assessed, a final quality assurance report will be prepared to be included in the final RI report The report will summarize the QA and audit information, indicating any corrective actions taken and the overall results of the

QAPP The Project QA/QC Officer, in coordination with the APR and McClelland Quality Coordinators, will prepare the summary

4 6 PERFORMANCE AND SYSTEMS AUDITS

Internal audits are performed to review and evaluate the adequacy of the QAPP, and to ascertain whether it is being completely and uniformly implemented The project QA Officer is responsible for such audits and will cause them to be performed according to a schedule planned to coincide with appropriate activities on the project schedule

Section 12 0 of this QAPP describes the periodic field and laboratory assessments and performance and systems audits to be completed during the Missouri Electric Works project

5 0 QUALITY ASSURANCE OBJECTIVES

The overall objective of the Missouri Electric Works Remedial Investigation is to provide a complete, accurate, precise and representative summary of the current state of the site The samples and the data generated from these samples and the site generated data must provide the information necessary to complete the site summary However, all data is subject to some error such as inability to collect samples, sampling analysis errors, faulty selection of sampling sites or inappropriate data reduction Control or recognition of these errors is important in analyzing the data and in preparing the final summary Establishing appropriate levels of control over sources of error and quantifying these errors when possible will assist in assessing the impact of errors on the project

5 1 QUALITY ASSURANCE OBJECTIVES

Quality assurance objectives for measurement data are usually expressed in terms of accuracy, precision, completeness, representativeness and comparability Definitions and descriptions of how these characteristics will be obtained are as follows

Accuracy

Accuracy is a measure of the system bias Bias is defined as the difference between the mean (average) of the true sample values and mean (average) of the laboratory analyses The exact system bias will never be known since the true sample values are not accessible, however, inferences can be drawn from an examination of field and trip blank analyses and laboratory matrix spiked sample analyses Field blanks measure the bias introduced by contaminated equipment, sample handling and shipping and laboratory procedures Trip blanks measure the bias introduced by field, shipping and laboratory procedures Spiked samples measure biases in laboratory analyses

Acceptable accuracy measures are dependent on the sample matrix and are discussed in Section 5 3 Accuracy measures are not meaningful for the screening tests conducted in the field based on the semi-qualitative/quantitative data acquired from the PID and FID and the nature of the pH and temperature conductivity meters Accuracy of the pH and temperature/conductivity meters will be checked by calibrating prior to daily use and a calibration check at the end of the day's use

ASTM procedures for geotechnical testing do not discuss accuracy in the proposed methods Such measures are not applicable based on the heterogeneity of the samples collected, i e , a matrix mean (X) may vary significantly due to the inherent nature of the samples Statements of expected accuracy can not be made due to this large variance in samples

Precision

Precision is the measure of the variability of individual sample measurements Precision will be inferred through the use of duplicate samples If duplicate samples contain identical contaminant concentrations, any variability in the laboratory analyses must be due to variability induced by sampling, handling, or laboratory procedures Acceptable precision values are dependent on the sample matrix and are discussed in Section 5 3 Precision values for field screening are not meaningful based on the lack of reproducibility of the samples Field screening will be in a real time mode making duplication very difficult for the PID and FID The pH and temperature/conductivity meters are continuous readout instruments and duplicate readings of the same sample will not yield precision values Duplicate geotechnical tests will not be run based on the heterogeneity and expected variations of the materials

Completeness

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 Completeness is usually expressed as a percentage

RES-FS' goal for this project is 100% completeness However, site access, sampling protocol problems, analytical problems, and the data validation process can all contribute to missing or suspect data

Comparability

Comparability expresses the confidence with which one set of data can be compared with another Comparability can be related to precision and accuracy as these quantities are measures of data reliability At this site, no attempt will be made to quantify the relative reliability of data obtained during different studies

Qualitatively, data subjected to strict QA/QC procedures will be deemed more reliable than other data, will be obtained from a given procedure and will be reported in consistent units to allow for easy comparisons

Representativeness

Representativeness is the degree to which a set of data accurately reproduce the characteristics of the population Data is usually considered representative if the sample distribution is within statistically defined bounds of the population mean and variance

Representativeness will be controlled by the preliminary data assessment and by performing all sampling in a meticulous manner in strict compliance with the procedures described in this document and in the Standard Operating Procedures (SOP's) found in Appendix A

5 2 FIELD DATA QUALITY OBJECTIVES

The field data quality objectives can be broken into two major segments, those pertaining to field observations and field instruments and those related to sample selection, collection and shipping

The following field activities and observations will be coordinated with the appropriate field instruments

1 Monitoring well sampling
2 Air Monitoring

These activities will provide general and detailed information regarding the site condition that will be used in the final site evaluation

All activities will be executed per the Standard Operating Procedures (SOP's) found in Appendix A Calibration of the field equipment, as noted in the respective SOP's, adherence to operational procedures and documentation of all observations and readings will assure the accuracy, completeness and representativeness of the data Because of the general and qualitative measurements from most of these procedures, accuracy and precision values are not applicable

The following media will be sampled during the Missouri Electric Works site RI

1 Soil
2 Sediment
3 Groundwater
4 Air

The results from sampling these media will be used to develop the analytical data base to provide answers to questions regarding the site and, ultimately, to generate the overall summary of the current state of this site The analytical data must be sufficiently accurate and precise to identify the compounds present and the respective concentrations

Field duplicates, field blanks, and trip blanks will be collected and submitted to the analytical subcontractor laboratory to provide data for assessing the quality of these data Duplicate samples will be collected and analyzed to check for sampling and analytical reproducibility Blank samples will be collected and analyzed to check for systematic errors in the sampling and analytical procedures and ambient site conditions

The following paragraphs discuss the DQO's for each sample media

Soil Samples

Soil samples will be collected from the surface and soil borings Analysis of these samples will provide qualitative and quantitative data on the presence of the target compounds Qualitative soil classification data will also be generated These data will be used to assess the spread of contamination through the soils and to evaluate potential remedial activities for the site

Soil samples will be collected according to section 6 and to the S O P 's described in Appendix A Laboratory analysis will follow the procedures discussed in this document DQO's for the laboratory will be discussed in Section 5 3

Accuracy and precision of measurements obtained during field observations are not applicable due to the semi-qualitative/quantitative use of the data Representativeness will be controlled by careful documentation of the sampling location and by following the S O P as described Deviations from the sampling procedures will be described in the field log book

Sediment Samples

Sediment samples will be collected from the drainage areas in the proximity of the site Analysis of these samples will provide qualitative and quantitative data on the migration and extent of contamination The data will be used to assess if remedial alternatives should include all or some of the above areas and what types of remediation will be necessary

Sediment samples will be collected per section 6 0 and S O P #6 Representativeness will be controlled by proper documentation of the sampling locations and careful attention to the appropriate SOP Sampling deviation will be noted in the field log book

Groundwater Samples

Groundwater samples will be collected from the existing monitoring wells Analysis of the groundwater samples will provide qualitative and quantitative data to assess the extent of groundwater contamination The data will be used to evaluate needed remedial activities in the feasibility study

Groundwater samples will be collected as described in Section 6 0 of this document and S O P #7 Samples will be field screened for pH, temperature and conductivity Laboratory DQO's are discussed in Section 5 3 Accuracy of the field screening will be confirmed with pre-activity and post-activity calibration of the instrument Representativeness will be controlled by the preliminary existing well assessment and attention to appropriate sampling procedures Sampling deviation will be noted in the field log book

Air Sampling

Semi-qualitative/quantitative air sampling will be initially conducted utilizing a PID and/or FID to determine the areas of concern The results from the air quality survey will be used to determine the general air quality and personal respiratory protection requirements Additionally, air sampling will be conducted during field acitivities which disturb the on-site soils The resultant data will be utilized to determine abatement requirements during potential remedial activities which disturb the soil/waste

5 3 ANALYTICAL LABORATORY DATA QUALITY OBJECTIVES

All groundwater, surface water, soil, and sediment samples will be analyzed by APR Laboratories using ASTM and U S EPA procedures The quality assurance goals for these analyses are established in the procedures included as Attachment 9-1 and 7-1

5 4 LEVEL OF QUALITY ASSURANCE

The quality control procedures used for this project and their frequency for the target compounds are described in Table 5-1 APR Laboratories will report and submit QA/QC data identifying the samples used for matrix spikes and matrix spike duplicates, the surrogate spikes and the percent recoveries and laboratory duplicates

5 5 ACCURACY AND PRECISION

The quality control limits of accuracy and precision for organic analyses are shown in Tables 5-2 and 5-3 Table 5-2 lists the organic surrogate spike recovery limits for volatiles for water and soil/sediment matrices Table 5-3 lists the matrix spike recovery limits for water and soil/sediment for volatiles These control limits will be completely without any outliers unless the results are deemed to be altered due to matrix effects Any outliers will be evaluated so that matrix interferences effects may be determined All such evaluations will be noted in the narrative for the respective set of samples Table 5-4 lists the precision, accuracy and completion objectives for the inorganics

5 6 METHOD DETECTION LIMITS

The method detection limits for the organic parameters monitored are listed in Tables 5-5 and 5-6 for the volatile organics and PCBs, respectively Table 5-7 lists the detection limits for the inorganics

TABLE 5-1
QUALITY CONTROL PROCEDURES
APR LABORATORIES

PARAMETER	LAB BLANKS	SPIKES OR SURROGATES	LAB DUPLICATES	REFERENCE SAMPLES
Volatiles	One per set of samples, every 12 hours or with every 20 samples whichever is more	Surrogate added to each sample and blank, ms* for each set or every 20 samples, whichever is more msd** for each set of every 20 samples, whichever is more	---	Quarterly
PCBs	One per set or every 20 samples	Surrogate added to each sample and blank, ms* for each set or every 20 samples, whichever is more msd** for each set of every 20 samples, whichever is more	---	Quarterly
Metals	One per set or every 20 samples	One spike per set of samples or for every 20 samples, whichever is more	Duplicate for each set or every 20 samples, whichever is more	Quarterly

---

*ms stands for matrix spike
**msd stands for matrix spike duplicate

TABLE 5-2
ORGANIC SURROGATE SPIKE RECOVERY LIMITS
APR LABORATORIES

FRACTION	SURROGATE COMPOUND	LOW/MEDIUM WATER	LOW/MEDIUM SOIL/SEDIMENT
VOA	Toluene-d_8	88-110	81-117
VOA	4-Bromofluorobenzene	86-115	74-121
VOA	1,2-Dichloroethane-d_4	76-114	70-121

*These limits are for advisory purposes only They are not used to determine if a sample should be re-analyzed

TABLE 5-3
MATRIX SPIKE RECOVERY LIMITS*
APR LABORATORIES

FRACTION	MATRIX SPIKE COMPOUND	WATER*	SOIL/ SEDIMENT*
VOA	1,1-Dichloroethene	61-145	59-172
VOA	Trichlorethene	71-120	62-137
VOA	Chlorobenzene	75-130	60-133
VOA	Toluene	76-125	59-139
VOA	Benzene	76-127	66-142

*These limits are for advisory purposes only They are not to be used to determine if a sample should be re-analyzed

TABLE 5-4
PRECISION, ACCURACY AND COMPLETENESS OBJECTIVES
APR LABORATORIES

Measurement Parameters	Aluminum Arsenic Barium Cadmium Calcium Chromium Copper Iron Lead Magnesium Manganese Mercury Nickel Potassium Selenium Silver Sodium Zinc
Methods	Atomic Absorption (AA) Spectroscopy Gravimetric Determination Colormetric Determination
Reference	"Test Methods for Evaluating Solid Waste", SW 846, U S EPA
Experimental Conditions	Spiked and unspiked field samples
Precision	
Relative Percent Difference	± 20%
Accuracy	
Percent Recovery	75%
Completeness	90%

TABLE 5-5

VOLATILE ORGANIC LIST

DETECTION LIMITS**

			DETECTION LIMITS*	
VOLATILES		CAS NUMBER	LOW WATER[a] ug/L	LOW SOIL/ SEDIMENT[b] ug/Kg
1	Chloromethane	74-87-3	10	10
2	Bromomethane	74-83-9	10	10
3	Vinyl Chloride	75-01-4	10	10
4	Chlorethane	75-00-3	10	10
5	Methylene Chloride	75-09-2	5	5
6	Acetone	67-64-1	10	10
7	Carbon Disulfide	75-15-0	5	5
8	1,1-Dichloroethene	75-35-4	5	5
9	1,1-Dichloroethane	75-35-3	5	5
10	trans-1,2-Dichlorethene	156-60-5	5	5
11	Chloroform	67-66-3	5	5
12	1,2-Dichloroethane	107-06-2	5	5
13	2-Butanone	78-93-3	10	10
14	1,1,1-Trichloroethane	71-55-6	5	5
15	Carbon Tetrachloride	56-23-5	5	5
16	Vinyl Acetate	108-05-4	10	10
17	Bromodichloromethane	75-27-4	5	5
18	1,1,2,2-Tetrachlorethane	79-34-5	5	5
19	1,2-Dichloropropane	78-87-5	5	5
20	trans-1,3-Dichloropropene	10061-02-6	5	5
21	Trichloroethene	79-01-6	5	5
22	Dibromochloromethane	124-48-1	5	5
23	1,1,2-Trichloroethane	79-00-5	5	5
24	Benzene	71-43-2	5	5
25	cis-1,3-Dichloropropene	10061-01-5	5	5
26	2-Chloroethyl Vinyl Ether	110-75-8	10	10
27	Bromoform	75-25-2	5	5
28	2-Hexanone	591-78-6	10	10
29	4-Methyl-2-pentanone	108-10-1	10	10
30	Tetrachlorethene	127-18-4	5	5

TABLE 5-5 (CONT)

VOLATILE ORGANIC LIST

DETECTION LIMITS**

			DETECTION LIMITS*	
VOLATILES		CAS NUMBER	LOW WATER[a] ug/L	LOW SOIL/ SEDIMENT[b] ug/Kg
31	Toluene	108-88-3	5	5
32	Chlorobenzene	108-90-7	5	5
33	Ethyl Benzene	100-41-4	5	5
34	Styrene	100-42-5	5	5
35	Total Xylenes		5	5

---

[a] Medium Water Detection Limits for Volatile Compounds are 100 times the individual Low Water Detection Limits

[b] Medium Soil/Sediment Detection Limits for Volatile Compounds are 100 times the individual Low Soil/Sediment Detection Limits

*Detection limits listed for soil/sediment are based on wet weight The detection limits calculated by the laboratory for soil/sediment, calculated on dry weight basis, as required by the contract, will be higher

**Specific detection limits are highly matrix dependent The detection limits listed herein are provided for guidance and may not always be achievable

TABLE 5-6

DETECTION LIMITS** FOR PCBs

PESTICIDES		CAS NUMBER	DETECTION LIMITS* LOW WATER[a] ug/L	 LOW SOIL/ SEDIMENT[b] mg/Kg
1	AROCLOR-1016	12674-11-2	1 0	1 0
2	AROCLOR-1221	11104-28-2	1 0	1 0
3	AROCLOR-1232	11141-16-5	1 0	1 0
4	AROCLOR-1242	53469-21-9	1 0	1 0
5	AROCLOR-1248	12672-29-6	1 0	1 0
6	AROCLOR-1254	11097-69-1	1 0	1 0
7	AROCLOR-1260	11096-82-5	1 0	1 0

---

[a] Medium Water Detection Limits for are 100 times the individual Low Water CRDL

[b] Medium Soil/Sediment Detection Limits are 15 times the individual Low Soil/Sediment CRDL

*Detection limits listed for soil/sediment are based on wet weight The detection limits calculated by the laboratory for soil/sediment, calculated on dry weight basis, will be higher

**Specific detection limits are highly matrix dependent The detection limits listed herein are provided for guidance and may not always be achievable

TABLE 5-7

DETECTION LIMITS FOR ELEMENTS DETERMINED BY ATOMIC ABSORPTION SPECTROSCOPY

PARAMETER	DETECTION LEVEL	
	Soil (mg/kg)	Water (mg/l)
Aluminum	10 0	0 1
Arsenic	0 2	0 002
Barium	10 0	0 1
Cadmium	0 5	0 005
Calcium	1 0	0 01
Chromium	5 0	0 05
Copper	2 0	0 02
Iron	3 0	0 03
Lead	10 0	0 1
Magnesium	0 1	0 001
Manganese	1 0	0 01
Mercury	0 02	0 0002
Nickel	4 0	0 04
Potassium	1 0	0 01
Selenium	0 02	0 002
Silver	1 0	0 01
Sodium	0 2	0 002
Zinc	0 5	0 005

6 0 SAMPLING PROCEDURES

The sample point selection process and sample collection procedures for each media to be sampled are covered by this section The sampling media to be sampled are

- Surface Soil and Sediment Sampling
- Groundwater
- Subsurface Soils

Sampling procedures for each task will be defined below Additionally, sections are included regarding the methodology for documenting sample locations, sample numbers, sample containers and sample preservation and decontamination

6 1 SAMPLING LOCATIONS AND NUMBERS

Preliminary sample locations have been predetermined for some tasks based on available data and/or the project data objectives The sampling locations and the corresponding figure number, as appropriate, are

- Sampling Grid Reference Survey, Figure 6-1
- Surface Soil and Sediment Samples (on-site), Figure 6-2
- Surface Soil and Sediment Samples (off-site), Figure 6-3
- Monitoring Well Locations, Figure 6-4

However, the exact location of all samples will be determined in the field based upon field conditions The locations will be determined by either the RES-FS Program Manager or On-Site Coordinator The EPA and MDNR On-Site Coordinator(s) will be consulted, if present

The exact locations of each sampling point will be described in the project log book along with a sketch that includes a minimum of two (2), if possible three (3), distance measurements

The measurements will be referenced to marked grid stakes and/or from permanent ground features and landmarks which are included on the site topographic map

There will be two (2) identification numbers used for each sample One will be the serial identification number assigned by the laboratory The other identification will be an in-house number designed to incorporate site specific field data into an alphanumeric code The in-house numbering will consist of the following four (4) components

- Project Identification
- Sample Type
- Sample Location
- Sample Number

The project identification is a three (3) letter designation unique to the site For this project, the identification will be MEW, which stands for the Missouri Electric Works site

Each sample type collected during the sampling program will be identified by one of the following 2-3 digit alpha codes

- GW - Monitoring Well Groundwater Sample
- SS - Surface Soil Sample
- SB - Soil Boring Sample
- SD - Sediment Sample
- XXB - XX(Matrix Type) Blank

A three (3) digit number will be used to indicate the sampling location Thus, the identification system will require that all sampling locations be given a separate number The field ties to these sampling locations as well as other pertinent data will be kept in the field sampling notebook

A two (2) digit number will be used to consecutively number replicate samples taken at a sampling site Examples of a sample number are

MEW-SS-001-01 = MEW, surface soil sample, location 001, first sample
MEW-SSB-001-01 = MEW, surface soil sample blank, location 001, first sample

6 2 SAMPLE CONTAINERS AND SAMPLE PRESERVATION

The required sample containers, filling instructions, sample preservation methods, and shipping instructions are summarized in Table 6-1 for each of the sample types

The collected sample containers will be kept out of direct sunlight and, after decontamination and labeling, will be placed in coolers and stored at approximately 4°C (except geophysical and high hazard samples) until they are packaged for shipping to the proper laboratory Samples designated for APR will be packaged and shipped within two days of collection

6 3 DECONTAMINATION OF SAMPLING EQUIPMENT

There are several categories of equipment which will require cleaning prior to use, and between sample events These include

- Hand Sampling Equipment
- Field Monitoring Equipment
- Drilling Equipment

The procedures which will be utilized for each is included in S O P #9

6 4 SITE SAMPLING ACTIVITIES

Several sampling activities are anticipated for the site investigation of the MEW facility Each activity is discussed below

TABLE 6-1
SAMPLE CONTAINERS, PRESERVATIVES, AND HOLDING TIMES

Parameter	Container	Preservation	Holding Time	Procedure
WATER and LIQUIDS				
Purgeable Organic Compounds (Volatiles)	2-40 ml glass vials with Teflon lined caps	iced to 4°C	7 days for analysis	fill completely to exclude air bubbles
PCBs	2-one liter glass bottles (amber) with Teflon lined caps	iced to 4°C	5 days for extraction analysis within 40 days of extraction	fill bottle to neck
SOILS AND SOLIDS				
Purgeable Organic Compounds (Volatiles)	6-8 ounce wide-mouth glass jar with teflon lined caps	iced to 4°C	7 days for analysis	fill completely
PCBs	6-8 ounce wide-mouth glass jar with teflon lined caps	iced to 4°C	not established	fill completely
Metals	6-8 ounce wide-mouth glass jar with teflon lined caps	iced to 4°C	analysis within 6 months	fill completely

6 4 1 Topographic Survey (Task 400)

During the phase I activities, a topographic map of the site will be prepared, at a 1" = 50' scale with 1 to 2 foot contour intervals, by a registered surveyor This map will serve as a site plan showing all pertinent planimetric and topographic features upon which additional information can be plotted Surface contours and spot elevations obtained from the topographic map will be used to determine surface water run-off pattern

The surveyor will also establish a permanent grid system over the site Temporary wooden stakes, 3 feet high with flags and marked for reference purposes, will be placed at 50-100 foot intervals Permanent stakes or benchmarks will be established so that the grid can be regenerated for future sampling activities The grid will be used to accurately document the locations of all on-site sampling and monitoring activities (See Figure 6-1)

6 4 2 Geophysical Survey (Task 500)

A field geophysical survey will be performed over the east portion of the site to determine the location of buried metal deposits and contaminants with high conductivity The maximum survey area will be 300 feet (north to south) x 200 feet (east to west) of the portion of the site east of MW-2 and MW-3 The survey will be based on 20 foot station intervals Anomalous data between grid points will require investigation at closer spacing Additionally, the south-central drainage ditch will be inspected/evaluated, along with the U S EPA site representative, to determine the usefulness of extending the survey area to this area

Both electromagnetic and magnetic measurements will be obtained and plotted to form a contour map showing locations of high conductive and magnetic flux Instruments which will be utilized are a Geonics EM31 Terrain Conductivity Meter and an EDA OMNI IV Magnetometer/Gradiometer Both of these instruments will download digital data to a field computer The data will be plotted in the field to verify adequacy prior to demobilization S O P #2 details the procedure which will be followed for the geophysical survey

6 4 3 Trenching (Task 600)

Trenching will be conducted during the phase II site activities The number and locations of the trenches will be dependent upon the results of the phase I geophysical survey (Task 500)

The trenching activities will be designed to provide data on

1 Location of waste samples
2 Physical states and types of waste
3 Chemical constituent of waste
4 Dimensions of waste deposits

The trenching will be done by backhoe per S O P #3 Excavation will proceed until wastes are encountered Samples may be taken at this stage Excavation will further proceed until undisturbed soil beneath the waste is encountered Contamination will be judged by disturbed strata, color, texture, and/or vapor requirements An area of at least 10 sq ft of this undisturbed soil will be exposed for characterization and possible sampling

6 4 4 Process Building Investigation (Task 700)

The MEW process building will be inspected to determine the potential disposition of spilled materials and the subsequent washdown of the those materials, i e floor drains, washout sinks, sumps, etc The results of this investigation will determine the locations of the borings proposed for Task 800

6 4 5 Shallow Subsurface Exploration (Task 800)

Shallow soil samples will be obtained during the phase I site activities to determine the areas in which solvent/waste discharge has occurred The sample locations will be based upon the depositions of former employees, the results of the process building investigation (Task 700) and visual observations of the soil surface

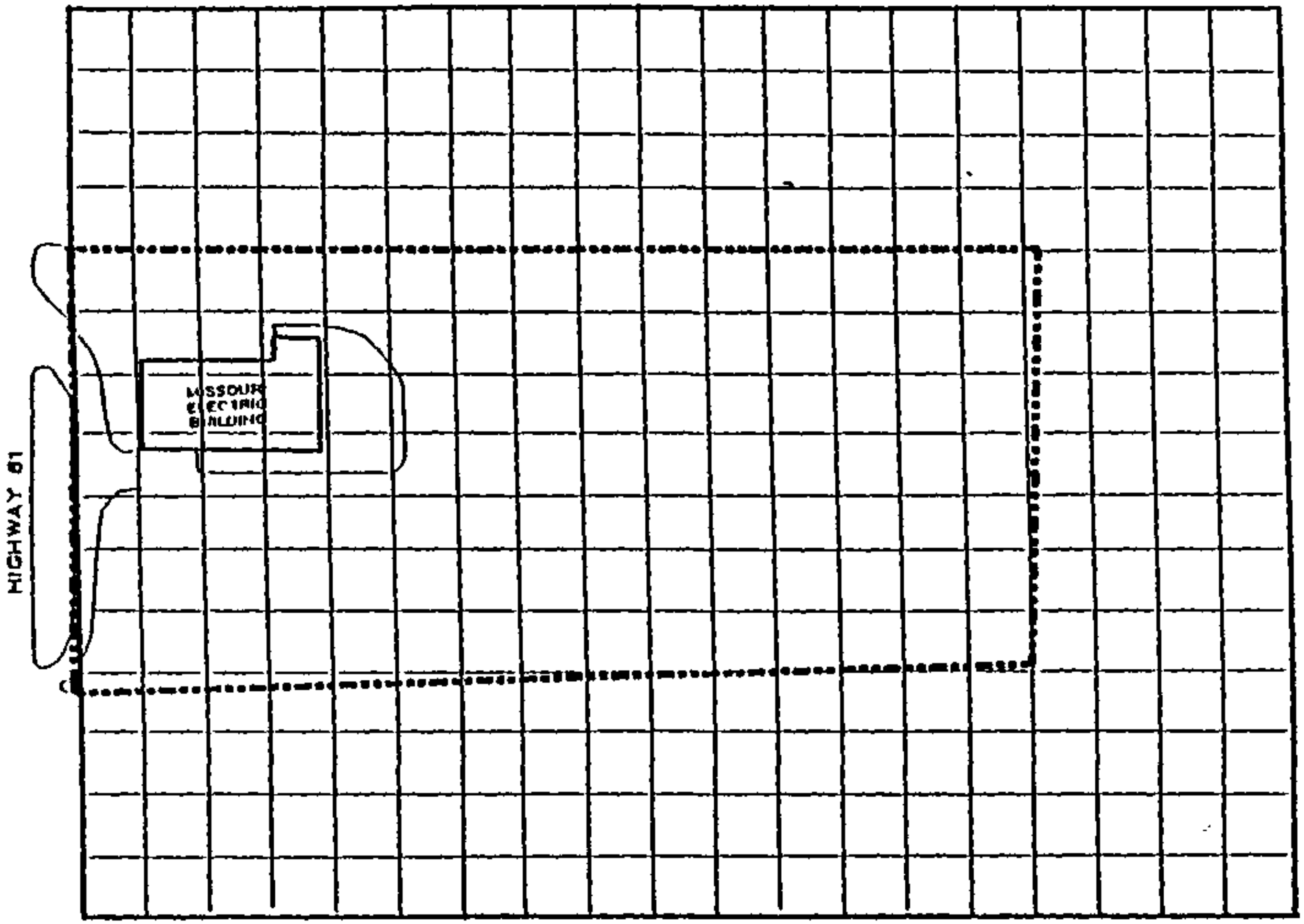
At this time, RES-FS anticipates that approximately six (6) shallow soil borings will be drilled in those areas where solvents were reportedly discharged, based upon statements by former MEW employees The borings will be installed around the north and east sides of the MEW building and from several locations southeast of the processing building The locations will be chosen so as not to duplicate the efforts of the planned subsurface sampling to be performed during phase II (Task 1200) Soil samples will be obtained from each boring at depth intervals of 0' to 0 5' and 0 5' to 1' The samples will be analyzed for PCBs and volatile organics Additionally, up to 15 of the 144 subsurface soil samples, which will be obtained during the phase II subsurface investigation (Task 1200), may also be analyzed for the volatile organics

Two additional borings will be drilled, utilizing hand augers or powered augers, to a depth of approximately 5 feet in the immediate vicinity of the septic tank drain field which is located immediately north of the MEW process building Three samples per boring will be obtained ahead of the augers with Shelby tubes Additional borings may be warranted if the investigation of the building (Task 700) indicates that there is a separate discharge line(s) for the washdown waters S O P #5 details the procedures for obtaining the shallow subsurface samples The samples will be analyzed for PCBs and the volatile organics

6 4 6 Surface Soil Sampling (Task 900/910)

Based on the kriged concentration estimate and kriged error of estimation maps (constructed with the E&E data collected 10/86 and 7/87) (see Attachment 3-1 of the Work Plan) of the MEW site, the sampling locations shown in Figure 6-2 were selected These sampling locations will provide for

- Additional sample points at the property limits to define the concentration at the property boundary and define the 10 ppm action line, and
- Additional data, off-site in suspect areas



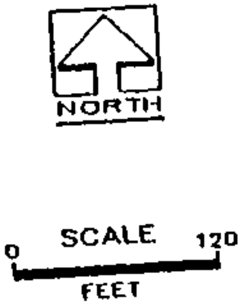


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FIGURE 6-1
SAMPLING GRID REFERENCE

Figure 6-3 shows the additional sampling points outside of the site boundaries Samples are designated (grouped) as either C (confirmational sample), R (run-off area sample), or F (off-site sample) The placement of these samples is based on the spatial variation analysis numbers generated from the E&E data (min 97-max 223) and the RES-FS site visit which pointed out the need for separate sampling environments (the "flat" site areas versus the run-off areas)

The analytical data from these samples will be re-evaluated with respect to spatial variation as separate regions A kriged analysis will then be made on each region and recommendations made at that point for further sampling during phase II, if required

Two to three man sampling crews will obtain the samples at the locations designated on Figures 3-2 and 3-3 However, recent earth moving activities have occurred behind the Cape Carpet property, as reported in RES-FS' Historical Study Survey Consequently, surface samples will not be collected in areas where soil was removed Following procedures outlined in S O P #5, a hand auger will be used to obtain samples at one foot intervals from the stockpiled soil (if present) south of the Cape Carpet building The surface soil samples will be obtained with disposable stainless steel spoons from a depth of 0 to 6 inches per S O P #4

6 4 7 Sediment Sampling (Task 1000/1010)

Sediment samples will be obtained from the ditches and swales potentially impacted by site run-off The initial sample locations will be located inside contaminated areas shown by the EPA data and proceed downstream at 25 to 100 foot intervals, depending on the proximity to the site The anticipated sampling locations are indicated on Figures 6-2 and 6-3 as "R" (run-off area sample)

Two to three man sampling crews will obtain grab samples of the sediment from the bottom of the ditch or swale to be representative of the maximum contamination levels based on erosional deposition of PCBs associated with sediment Sampling procedures for the sediment sampling are included as S O P #6

To augment the sediment sampling data, a surface water sample will be obtained from the marshy area between Wilson Road and Cape LaCroix Creek The sample will be obtained by immersing a 1/2 liter amber glass container beneath the water surface at a depth half-way between the surface and the bottom so that the bottom sediment is not disturbed

Additional sediment sampling of run-off areas will be performed during phase II, if necessary, in order to define the extent of downstream PCB migration

6 4 8 Monitoring Well Sampling (Task 1100)

RES-FS will attempt to redevelop and purge monitoring wells 3 and 5 in order to remove the sediment so that a representative sample of the formation water can be obtained (see Figure 6-4) The water within the well will be agitated to suspend the sediment by raising and lowering a stainless steel bailer through the full length of the water column A bladder pump will be utilized to remove the water The length of time pumping will be dependent upon the yield at the individual wells and the amount of sediment present in the water The redevelopment process will be ceased

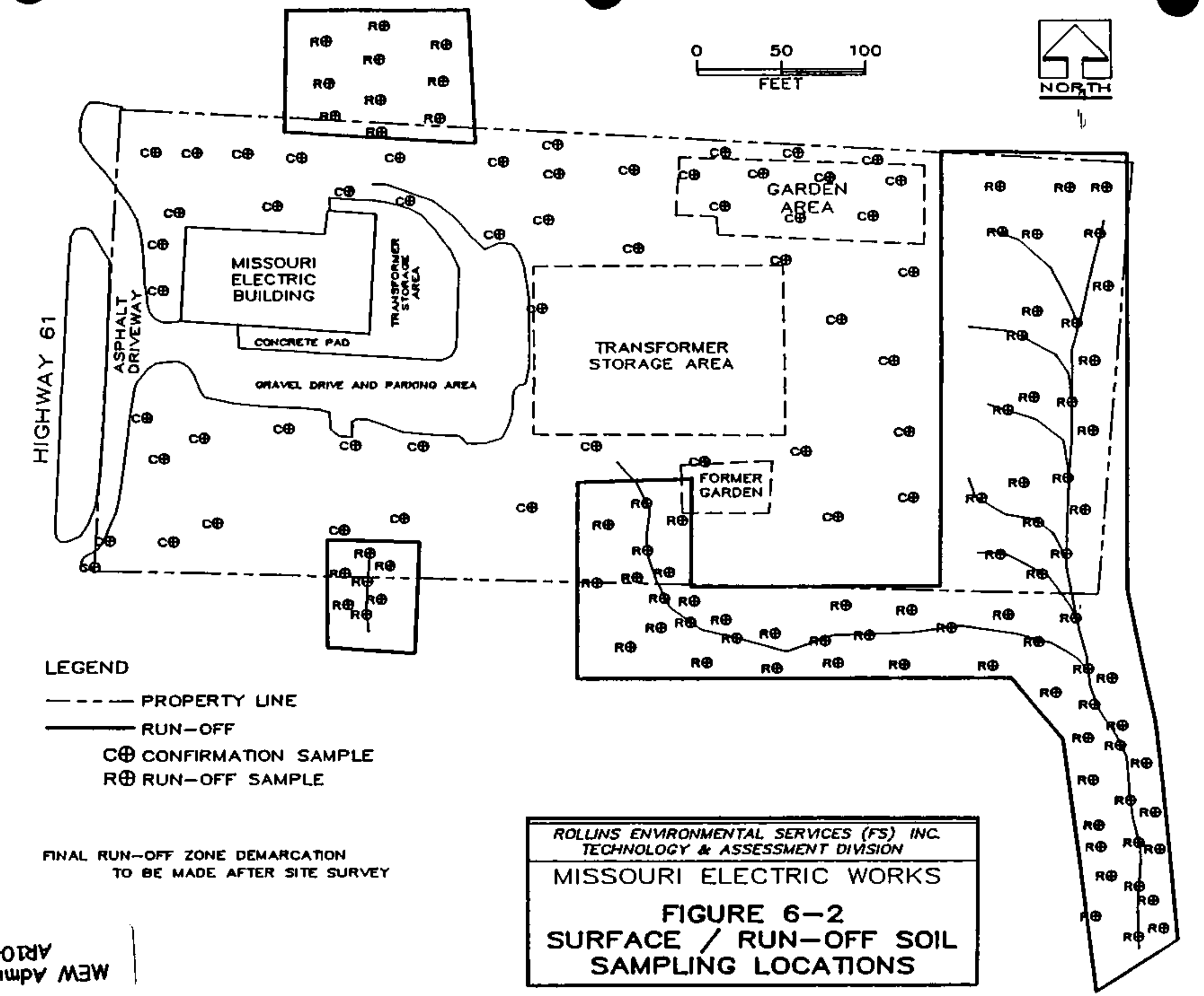

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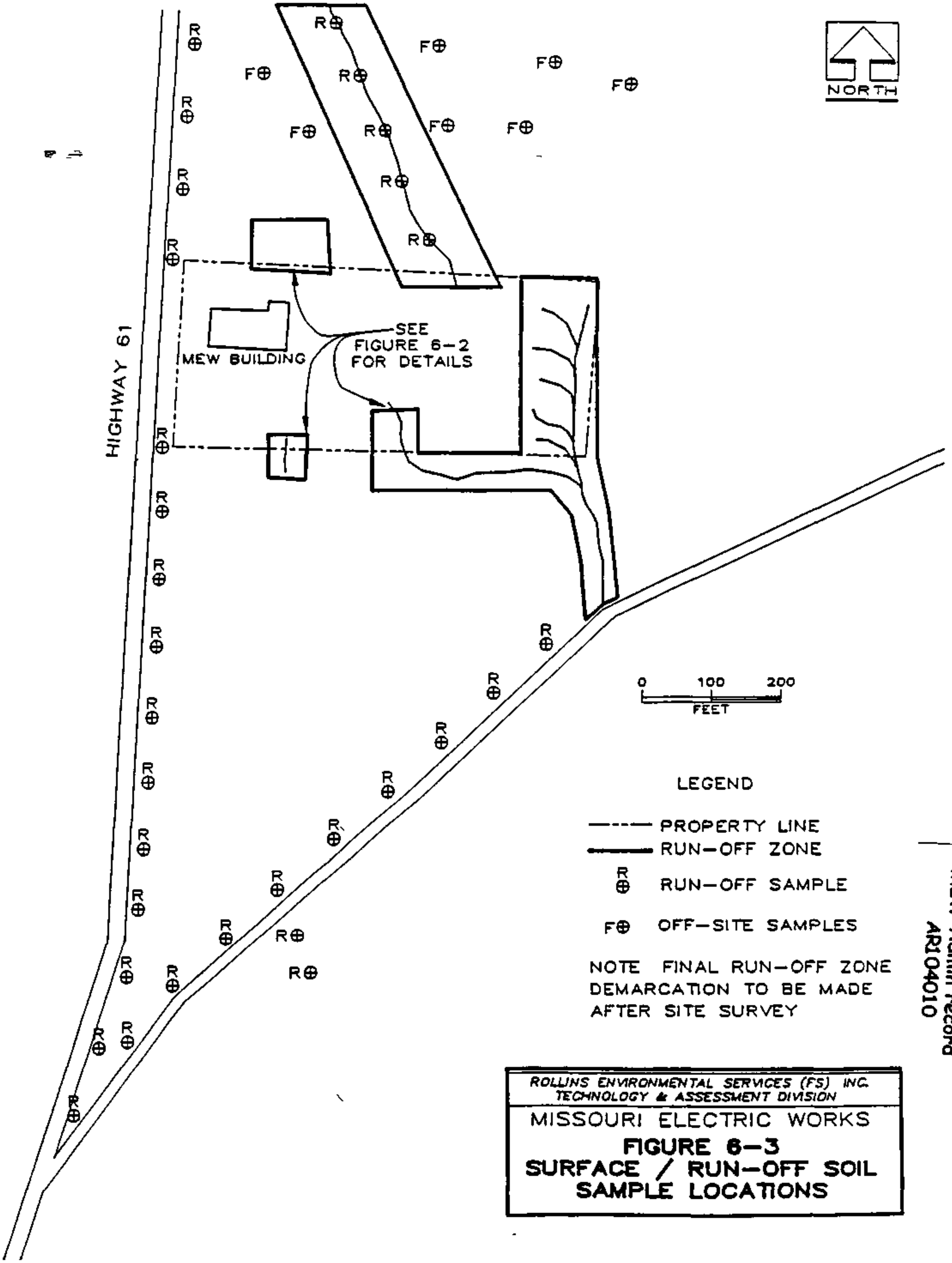
FIGURE 6-2
SURFACE / RUN-OFF SOIL SAMPLING LOCATIONS



NOTE FINAL RUN-OFF ZONE
DEMARCATION TO BE MADE
AFTER SITE SURVEY

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FIGURE 6-3
SURFACE / RUN-OFF SOIL SAMPLE LOCATIONS

when water is visibly free of suspended sediments or when the overpumping efforts are no longer producing a visible reduction in the sediment levels

After redevelopment, the wells will be allowed to recover for 12 to 24 hours prior to sampling The wells will be sampled after the recovery period The sampling period may be extended over several hours to allow the wells to recharge (especially MW-5) All sample containers, except those for volatile organics, will receive a portion of the water from each bailer so as to make sure all containers contain a portion of water removed from each of the periods when there is water present in the well Two one-liter sample aliquots will be obtained from each well, utilizing a teflon bailer One of the aliquots will be filtered in the field utilizing a 0 45 micron filter (Although the filtering of samples is not per CLP protocol, the data generated will be used during the evaluation of potential groundwater problems) The remaining aliquot will not be filtered A separate sample will also be obtained for volatile organic analysis This sample will not be filtered Field measurements of pH, specific conductance and temperature measurements will be obtained

Monitoring well sampling procedures are included as S O P #8

6 4 9 Soil Borings for Depth Profiles (Task 1200)

Soil borings will be performed during phase II to determine depth profiles of the PCB contamination, as well as, TCE, TCA and methylene chloride Eight soil borings will be placed around EPA borings 1, 3, 4, 5, and 9 The borings will be placed at 12 5 and 25 feet from the EPA borings in the north, south, east and west directions, as indicated on Figure 6-5

The borings will be installed utilizing hand augers A decontaminated split spoon sampler will be driven ahead of the auger bit to collect undisturbed samples at one foot depth intervals for the upper two feet and at 0 5 foot intervals to the maximum depth of the boring The depth and locations of the borings are indicated on Figure 3-5

Procedures for conducting the soil boring activity are included as S O P #5

6 4 10 Soil Properties Sampling (Task 1300)

During the phase II site activities, samples will be collected from six locations, at a depth of 0 5 and 1 foot, to characterize three general surface soil conditions that could impact remedial alternatives The locations will be of the following surface soil conditions

1 Oil saturated areas

2 Deep gully areas located on the south side of the property and the north side of the property behind the MEW building

3 Clay soil areas covered with grass (typical of the MEW yard)

For three sampling locations, one in each of the material types and at both the six inch and one foot depth (i e six samples) the following tests will be performed

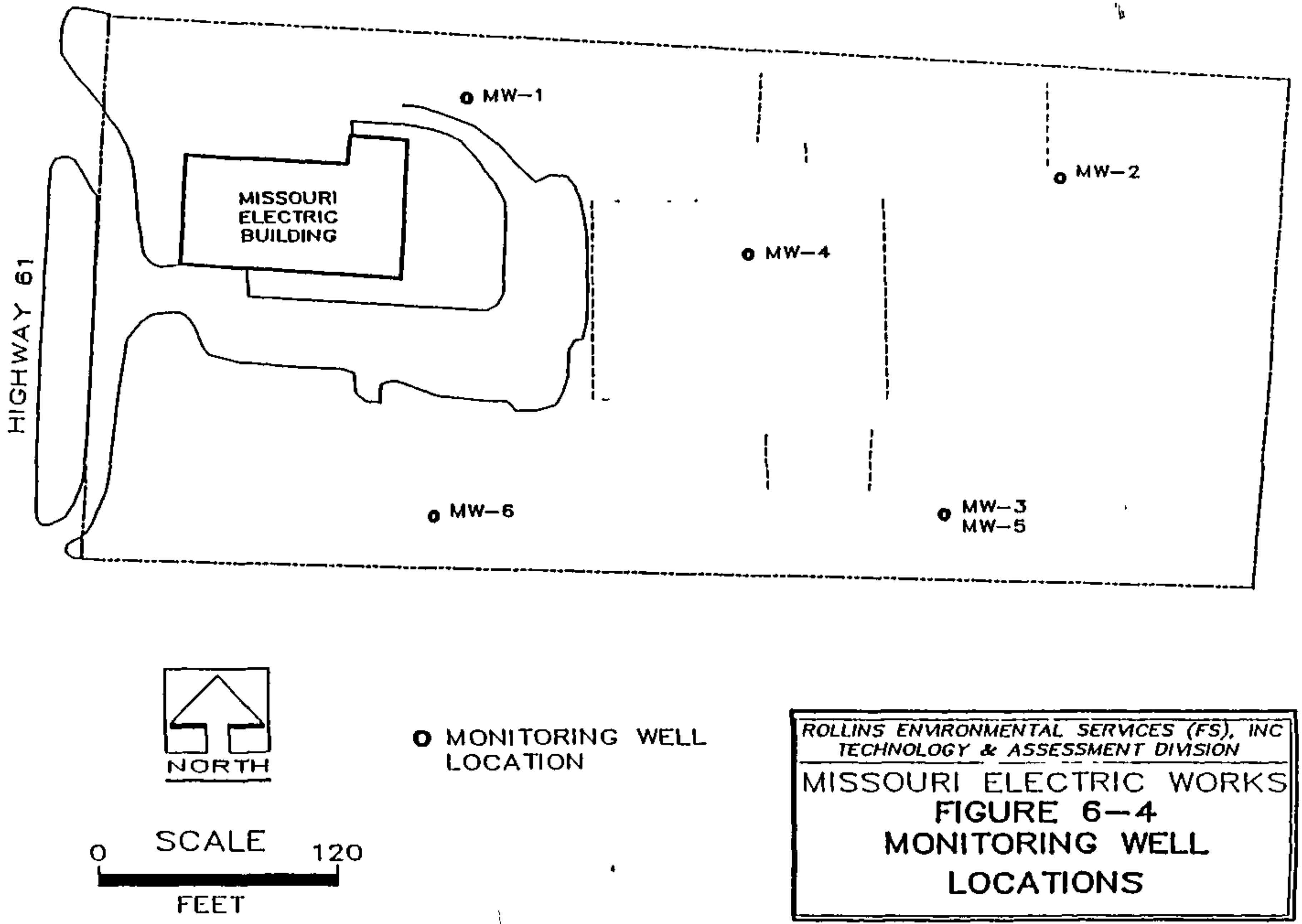

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FIGURE 6-4
MONITORING WELL LOCATIONS

1 BTU testing

2 Soil density testing (wet and dry)

3 Cation exchange capacity (CEC)

4 Particle size determination (sieve analysis and hydrometer analysis)

5 Thermal conductivity measurements

For all 12 samples the following tests will be performed

1 Natural moisture content

2 Soil pH

3 Chloride concentration

4 Total metals concentration

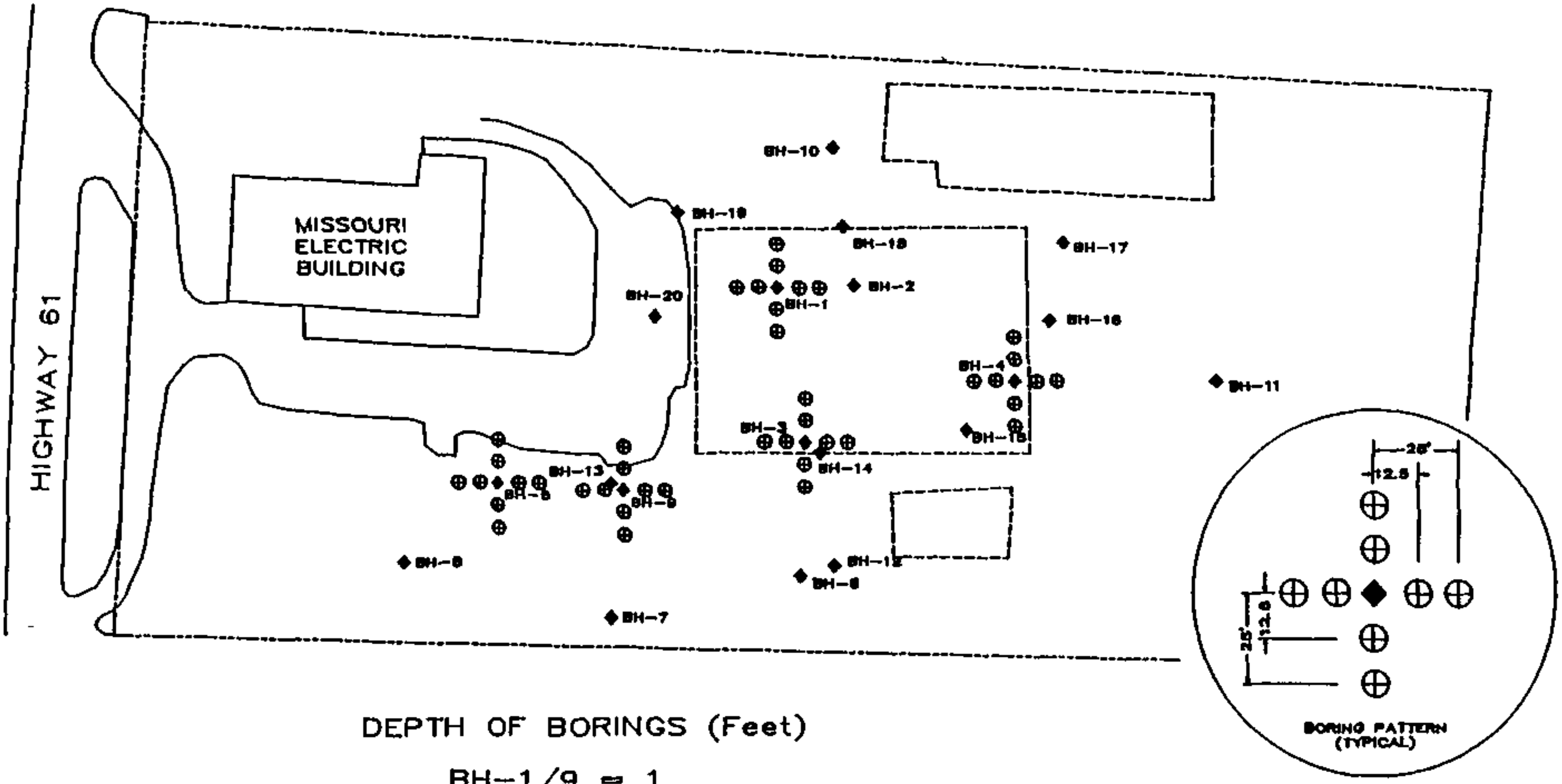
5 Atterberg limits (liquid and plastic limits)

The samples will be obtained with either shovels, trowels or hand augers and shelby tubes per S O P #5

6 4 11 Sample Analysis (1400/1410)

All soil and water matrix samples will be analyzed for PCBs utilizing ASTM methods 3304-77 and 3534-85 Selected samples will be analyzed for the list of volatile organics per EPA method 8240 The soil boring samples obtained during Task 1200 will be analyzed for TCA, TCE and methylene chloride utilizing EPA methods 5030 and 8010

The soil samples obtained during Task 1300 will be analyzed for geophysical parameters which could affect the operational or cost feasibility of remedial alternatives The raw data generated from the physical property testing of soils will be submitted to Ms Pauletta France-Isetts, RPM for the MEW site, prior to issuing the data as final The list of parameters for Task 1300 is included as Table 3-5



DEPTH OF BORINGS (Feet)

BH-1/9 = 1
BH-5 = 3
BH-3/4 = 4

NORTH

0 100
FEET

◆ SOIL BORING LOCATION

⊕ PROPOSED SOIL BORING LOCATION

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FIGURE 6-5
SOIL BORING LOCATIONS

7 0 SAMPLE CUSTODY

Verifiable sample custody is an integral part of RES-FS' field and laboratory operations Several steps will be taken in the field and laboratory to document and ensure that samples collected in the field have been properly acquired, preserved, and identified The following sections describe these steps in detail

7 1 FIELD SAMPLING DOCUMENTATION

7 1 1 Documentation of Sample Acquisition

A key piece of information that will be documented is the sample acquisition data All information pertinent to field observations, surveys, and sampling will be recorded in a bound logbook with consecutively numbered pages Entries in the logbook will include at least the following

- location of sampling activity and addresses,
- purpose of sampling (e g , definition of contamination, waste analysis, etc)
- type of process (if known) producing wastes,
- type of waste (e g , sludge, liquid, etc),
- number and approximate volume of samples taken,
- location of sampling point,
- description of sampling point,
- date and time of collection,
- collector's sample identification number(s),
- sample distribution (e g , chemical laboratory, geotechnical laboratory etc),
- sample preservation,
- filtering methodology,
- references such as maps or photographs of the sampling site,
- field observations,
- any field measurements made such as pH, specific conductivity or other field parameters, and
- weather conditions

Since sampling situations can be quite diverse, the documentation in the logbook will be sufficient to reconstruct the sampling situation without relying on the collector's memory

7 1 2 Documentation of Sample Preservation

Proper sample preservation is important in retaining the sample characteristics prior to analysis Sample preservation will be performed by the sampling personnel as described in Section 6 0 Sampling preservation will be documented by the sampling personnel on the chain of custody form and also in the field logbook

7 1 3 Chain of Custody

In addition to the field logbook, each sample sent off-site will be recorded on a chain of custody record An identifying code will be assigned to each sample and this code will be used on the chain of custody and in the logbook to ensure that the sample description is identifiable A brief description of the sampling point will also be placed on the chain of custody form

Chain of custody forms will become permanent records of all sample handling and shipment Samples will be collected in accordance with the sampling procedures designated in Section 6 0 If standard sampling procedures are not used, a written justification for each deviation will be placed in the project file Upon completion of sampling, the sample will be prepared for shipment in accordance with the applicable sample instructions including preservation, labeling and logging

The person collecting a sample will initiate document(s) at the source of the sample and start the chain of custody procedure Chain of custody documentation will include the following applicable data

- field sample number and site name and project,
- date sample taken,
- date sample submitted to the laboratory,
- sample taken by (signature),
- information describing source of sample and sample itself,
- sampling method used,
- expected interferences, if any,
- remarks,
- preservation technique,
- number and type of shipping containers,
- signature of persons relinquishing and obtaining custody of samples,
- indication of sample disposition

An example of the chain of custody that will be used is shown in Figure 7-1

The sample will be kept in limited access or locked storage at the proper temperature until custody is relinquished from the site and formal documentation of the transfer is completed

The Program Manager or On-site Coordinator will be responsible for sample storage and shipment and for completing the sample accountability records Upon each transfer of custody, the person involved will verify sample numbers and condition

CHAIN OF CUSTODY RECORD

PROJECT NO

PROJECT NAME

SAMPLERS: (Signature)

LABORATORY

FIELD SAMPLE NUMBER	DATE	TIME	COMP	GRAB	STATION LOCATION	NO. OF CONTAINERS	PARAMETERS														

Relinquished by (Signature) (Printed)	Date/Time	Received by: (Signature) (Printed)	Relinquished by (Signature) (Printed)	Date/Time	Received by: (Signature) (Printed)
Relinquished by (Signature) (Printed)	Date/Time	Received for Laboratory by: (Signature) (Printed)	Date/Time	Remarks	

FIGURE 7-1

CHAIN-OF-CUSTODY FORM

and will document the sample acquisition and transfer The field sample custodian will properly package the samples, indicate the shipping method and describe the sample accountability record, and obtain shipment documentation such as certified mail receipt or bill of lading number

On transfer of custody of the samples to the transport agency, the field sample custodian will sign and retain a copy of the shipment documentation, witness the transport company custody signature, and send a copy of the chain of custody with the samples On arrival at the laboratory, the sample custodian will sign for custody and return a copy of the completed chain of custody to RES-FS Laboratory custody procedures will then be conducted per Section 7 2

Groundwater and soil samples will be shipped as environmental samples by commercial carrier following DOT regulations Samples classified as hazardous materials will be shipped according to DOT regulations for hazardous materials

7 1 4 Tags

Each sample will be tagged and sealed

Sample tags are necessary to prevent misidentification of samples Gummed paper tags will be used The tag will include at least the following information

- name of collector
- date and time of collection
- place of collection
- collector's sample number, which uniquely identifies the sample

An example of a sample tag that will be used is shown in Figure 7-2

Sample seals are used to preserve the integrity of the sample from the time it is collected until it is opened in the laboratory Gummed paper seals will be used as official samples seals

The seal will be attached in such a way that it is necessary to break it in order to open the sample container ensuring the sample has not been tampered with

7 1 5 Field Tracking Forms

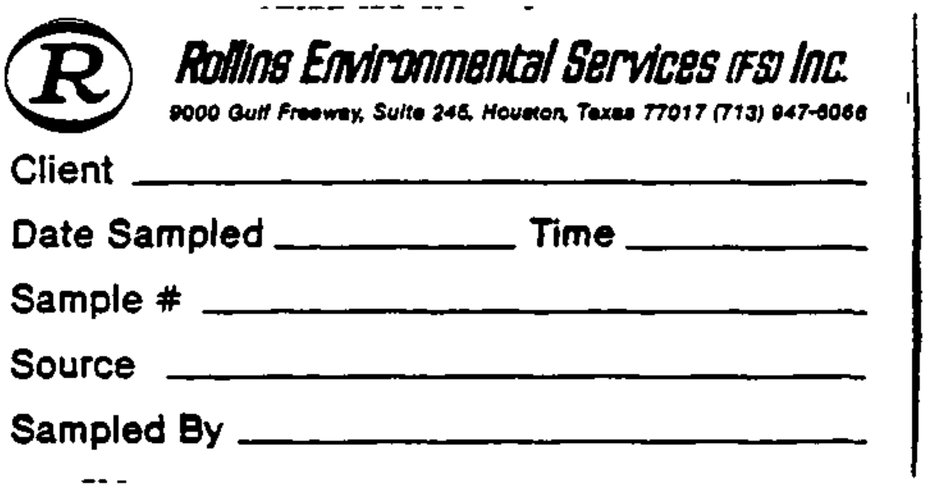
The chain of custody form will be supplemented in the field by a field tracking form This form, shown in Figure 7-3, is a complete listing of samples taken, the sample collector and the date and time of collection Field tracking establishes sample custody prior to shipment and, as such, provides additional sample control

7 2 LABORATORY OPERATIONS

The procedures which will be used by APR Laboratories and McClellend Engineers for sample receipt, chain of custody, sample identification, sample extract identification, tracking of sample analyses, laboratory data assembly and documentation control are described below

FIGURE 7-2

SAMPLE TAG



Rollins Environmental Services (FS) Inc.

9000 Gulf Freeway, Suite 246, Houston, Texas 77017 (713) 947-6066

Client ______________________________

Date Sampled ____________ Time ____________

Sample # ____________________________

Source ______________________________

Sampled By __________________________

FIGURE 7-3

FIELD TRACKING FORM

W/O NO. ____________

PAGE ____

FIELD SAMPLE CODE	BRIEF DESCRIPTION	DATE	TIME(S)	SAMPLER

Laboratory Sample Receipt Procedures The following laboratory receipt procedures will be used

- The samples will be delivered directly to the laboratory receptionist on weekdays Shortly after arrival, the samples will be transferred to the geotechnical laboratory On weekends, holidays or outside of regular working hours, the sample custodian or his authorized personnel (only sample custodian is mentioned hereafter) will receive the samples shipped directly to the lab

- The sample custodian will examine the shipping container and record the following information on a Log-in Sheet (called the Sheet herein), one case per form(s)

  - presence/absence of custody seal(s) on the shipping container(s)
  - condition of custody seal (i e , intact, broken)
  - The sample custodian will open the shipping container, remove the enclosed sample documents and record on the sheet.

    - presence/absence of the chain-of-custody record(s)
    - presence/absence of airbills and/or bills of lading documenting shipment of samples
    - case and airbill numbers

  - Remove sample containers and record on the sheet

    - condition of samples (intact, broken, leaking, etc)
    - presence/absence of sample tags

- If sample tags are present

    - record sample tag numbers
    - compare with chain of custody record(s)

- Compare the following documents to verify agreement among the information contained on them

    - chain of custody records
    - sample tags
    - airbills or bills of lading

Document both agreement among the forms and any discrepancies found If discrepancies are found, contact the RES-FS QA/QC Officer or Program Manager for clarification and notify appropriate laboratory personnel

- If all samples recorded on the chain of custody record were received by the lab and there are no problems observed with the sample shipment, the custodian will sign the chain of custody record in the "received for laboratory by" box on the document If problems are noted, sign for shipment and note problems in remarks box of the sheet detailing the problems The RES-FS QA/QC Officer or Program Manager will be contacted for direction The appropriate lab personnel will be notified The problems and RES-FS directions will be detailed in the case narrative

- Log-in Samples The procedure for sample identification will be performed at this time The information on the date and time of sample receipt, chain of custody record number, RES-FS sample numbers, APR/McClellend lab numbers and sample tag numbers will be recorded on the table of sheet

Laboratory Chain of Custody Procedures The National Enforcement Investigations Center (NEIC) of EPA defines custody of evidence in the following ways

- It is in your actual possession, or
- It is in your view, after being in your physical possession, or
- It was in your possession and then you locked or sealed it up to prevent tampering, or
- It is in a secure area

In order to satisfy these custody provisions, the following standard operating procedures will be implemented

- Samples will be stored in a secure area
- Access to the laboratory will be through a monitored reception area
- Visitors will sign-in the reception area and be escorted while in the laboratory
- All transfers of samples into and out of storage will be documented on an internal chain of custody record
- After a sample has been removed from storage by the analyst, the analyst is responsible for the custody of the sample Each analyst must return the samples to the storage area before the end of the working day

Laboratory Sample Identification The following procedures will be used to determine laboratory sample identification

- During the sample receiving process, the laboratory sample custodian or other designated personnel will assure that each sample container is identified with a unique RES-FS sample ID number and that this number is recorded in the Sample Log-in Sheet

- The sample custodian will remove the sample tag and place it in the appropriate case file If stick-on labels are used instead of tie-on sample tags, this fact will be noted in the comment section of the log-in sheet

Laboratory Tracking of Sampling Analysis A system for tracking the sample through preparation and analysis is needed because of the evidentiary nature of the sample analysis results The laboratory records may be used in court as evidence in enforcement proceedings Consequently, the following procedure will be used to track sample analyses

- Both the preparation and the analysis of samples will be documented
- All notebook pages, computer printouts, and other laboratory documents will show the case/sample number, date, signature (initials) of the analyst and other pertinent information
- Upon completion of analysis, data will be filed in the appropriate case or sample files
- All sample preparation information will be documented in laboratory notebook All sample analysis data will be documented using log-books When sample preparation or analysis is finished by an individual, the completed documents will be placed in the appropriate sample and/or case files

Laboratory Data Assembly The following procedures will be adhered to for assembly of the project data.

- A procedure for organization and assembly of all documents relating to each case will be implemented by the sample custodian or designated person
- This procedure will ensure that all documents are compiled in one location for submission to RES-FS in single case files, arranged by RES-FS sample number Case file folders will be prepared as follows
    - Using appropriate file folders, preferably assign one folder to each case according to RES-FS case number
    - Place all documents, sample tags, RES-FS forms, and laboratory generated data, pertaining to one case in the folder
    - Documents should be arranged by document type within the case folders, i e , all sample tags together, all traffic reports together, all deliverables, etc
    - These document case files will be filed in one location and stored in a secure area

The QA/QC Plans for both APR Laboratories and McClelland Engineers are included as Attachment 7-1

7 3 EVIDENCE FILES

All controlled documents, log books, reports and data packages will be submitted to Union Electric Company, located in St Louis, Missouri after the RI/FS completion At this location the files will be stored in a secure area All transfers of data into and out of the storage area will be documented on an internal chain of custody record

The files will be kept for a minimum of six (6) years after the termination of the RI/FS After the 6 year period, the EPA will be notified within thirty (30) days prior to the destruction of any documents

TABLE 7-1
CASE AND SAMPLE FILE DOCUMENTS

File inventory
* Chain of custody form
* Sample tag(s)
* Airbill(s)
* Copies of analysts' notebook pages
* Copies of instrument logbook pages
Sample tracing documents
    Sample log-in sheet
    Sample transfer sheet
Deliverables

* If received with sample shipment

Each file must contain the above documents in the sequence as listed or a memo explaining their absence (one memo may cover several documents)

8 0 CALIBRATION PROCEDURES AND FREQUENCY

8 1 FIELD CALIBRATION PROCEDURES

The field environmental monitoring equipment which will be utilized include

- Combustion gas indicator (see S O P #1)
- FID (see S O P #1)
- PID (see S O P #1)
- Temperature/Conductivity Meter (see S O P #7)
- Water Level Indicator (see S O P #7)
- pH Meter (see S O P #7)

Each instrument will be calibrated and maintained in accordance with the manufacturer's procedures (Refer to the appropriate S O P listed above for manufacturer's specifications)

8 2 CHEMISTRY LABORATORY CALIBRATION PROCEDURES

The calibration procedures and frequency of calibration will follow the specifications of the appropriate U S EPA and ASTM as presented in Attachment 9-1 and Section 11 of this document The use and frequency of these procedures will be verified by internal audit Additionally, a project specific quality assurance audit will be conducted by the Quality Assurance Officer

8 3 GEOTECHNICAL LABORATORY CALIBRATION PROCEDURES

The calibration procedures and frequency of calibration for geotechnical procedures will follow the requirements in the ASTM methods (see Attachment 9-1)

9 0 ANALYTICAL PROCEDURES

All soil, sediment and groundwater samples collected during this project will be analyzed for PCBs per ASTM guidelines Specifically, all testing of soil matrix samples for PCBs will conform to the guidelines specified in ASTM D3304-77 Water samples wil be analyzed per ASTM D3534-35

The groundwater samples and selected soil samples will be analyzed for the volatile organics per U S EPA method 8240

Selected soil samples will be analyzed for TCA, TCE and methylene chloride The samples will be analyzed per U S EPA method 8010

Samples obtained for purposes of establishing soil properties will be analyzed for BTU (ASTM D240-64), soil density (COE EM 1110-2-1906), cation exchange capacity (EPA 9080), particle size determination (ASTM D422-63), thermal conductivity (as referenced in Geotechnical Testing Journal, Vol 6, March - December 1983), moisture content (ASTM 2216-80), soil pH (EPA 9045), total chloride (EPA 9251), Atterberg limits (ASTM D4318-84) and total metals (extraction only EPA 3050, followed by the following atomic absorption techniques A1-7020, As-7061, Ba-7080, Cd-7130, Ca-7140, Cr-7190, Cu-7210, Fe-7380, Pb-7420, Mg-7450, Mn-7460, Hg-7471, Ni-7520, K-7610, Se-7741, Ag-7760, Na-7770, Zn-7950)

The analytical procedures for each parameter are included as Attachment 9-1

10 0 DATA REDUCTION, VALIDATION AND REPORTING

The three types of data that will be generated by this project include chemical data, geotechnical data, and geophysical data The chemical data will be handled by APR Laboratories The geotechnical and geophysical data will be handled by RES-FS and McClellend Engineers The following guidelines will apply to each type of data

10 1 DATA REDUCTION

Data reduction will be carried out using prescribed documented techniques Any statistical summaries of the data will be presented in such a manner that the reviewer can easily judge the validity of the procedure and of any conclusions drawn Assumptions made in performing any statistical analyses will be clearly stated, as will confidence/significance levels used for any test hypotheses Data summaries will be checked against the raw data for consistency and summary statistics recalculated in the event of doubt

Chemical data reduction will be done in conformance with the prescribed methods referenced in Section 9 0 of this plan

10 2 DATA VALIDATION

Chemical, geotechnical, and geophysical data will be validated by the designated Quality Assurance Coordinator The criteria for acceptance/rejection of analytical data will focus on data usability The usability of the data will be determined by several factors such as the quality control limits in Table 5-1, location of sample, data from the sample area for the same parameter derived from previous or subsequent episodes, etc

The Analysis Coordinator for each analytical task will perform a review of all data This review will consist of the following elements, review of analytical program, examination of results, verification of results

10 2 1 Review of Analytical Program

The responsible individual will review each set of results to ensure that the required program elements, such as method blanks, surrogate spikes, and QC samples, have been accomplished according to the program design The supporting data will be reviewed to ensure that analyses were performed under the correct conditions and that all required procedural steps were performed

10 2 2 Examination of Results

The Analytical Coordinator will examine the results obtained along with the pertinent chromatogram, spectra, absorption traces, and geophysical logs to ensure that the results are reasonable and that the analyst has interpreted the results correctly Any unusual or unexpected results will be reviewed and a resolution will be made as to whether the analysis should be repeated or the results recalculated

10 2 3 Recalculation of Results

The Analytical Coordinator will selectively recalculate results to ensure that the calculation was performed properly Emphasis will be placed on the those results showing a significant concentration of one or more of the analytes of interest At a minimum, one set of calculations will be checked for each batch of samples analyzed

10 3 DATA REPORTING

Following data validation, the verified data will be transferred from the analytical data sheets to reporting forms The Analytical Coordinator will be responsible for ensuring that all required information is recorded for reviewing the completed form for the accuracy of the transferred information All data will be verified against the analytical data sheets, and the completed forms will be reviewed by the individual responsible for the analysis prior to submission of the results to the sponsor

11 0 INTERNAL QC CHECKS AND FREQUENCY

Internal quality control checks will be made in the laboratory and the field These checks are discussed in this section

11 1 INTERNAL QC CHECKS AND FREQUENCY - LABORATORY

Quality Control (QC) sample frequency will follow the standard requirements cited earlier in this document Internal quality control procedures for groundwater, surface water, soil and sediment samples will follow the appropriate U S EPA and ASTM guidelines These procedures specify the number of laboratory blanks to be used, the number of calibration standards, the frequency that the calibration standards must be run, the frequency at which laboratory duplicate samples must be run, and the frequency at which spiked and referenced samples must be run Field blanks (where applicable) will be collected to check for sample contamination due to field sampling equipment

11 2 INTERNAL QC CHECKS AND FREQUENCY - FIELD

The combustible gas analyzer PID and FID are analytical instruments, that will be used in the field, which are scanning type instruments to approximate real time concentrations Calibration and standardization are done by span gases Electronic field instruments are zeroed electronically as an internal electronic adjustment, which compensates for the aging of batteries and changes in instrumentation characteristics Duplicates, spikes and splits are not feasible due to the nature of the instruments

The pH and temperature/conductivity meters will also be used on-site Calibration and checks of the pH meter are done by standard solutions Several duplicate readings are generally used to improve data quality when using this instrument The temperature/conductivity meter is factory calibrated for conductivity, while the thermometer is "air" calibrated prior to each use

12.0 PERFORMANCE AND SYSTEMS AUDITS

Internal audits are performed to review and evaluate the adequacy of the QAPP, and to ascertain whether it is being completely and uniformly implemented. The Quality Assurance Officer is responsible for such audits will ensure that they are performed according to a schedule planned to coincide with appropriate activities on the project schedule. Such audits may be supplemented by additional audits for one or more of the following reasons:

a. When significant changes are made in the RES-FS QAPP.
b. When it is necessary to verify that corrective action has been taken on a nonconformance reported in a previous audit.
c. When requested by the Program Manager.

The objectives of performance and systems audits are to ensure that the quality assurance program developed for this project is being implemented according to the specified requirements, to assess the effectiveness of the quality assurance program, to identify nonconformances and to verify that identified deficiencies are corrected. Upon discovery of any significant deviation from the quality assurance program, the RES-FS Program Manager shall be informed of the nature, extent, and corrective action taken to remedy the deviation.

12.1 PERFORMANCE AUDITS

A performance audit can be defined as a review of the existing sample and quality assurance data to determine the accuracy of the total measurement system(s) or a component part of the system. The analysis of project specific performance evaluation samples and the participation in scheduled inter-laboratory studies may be included as part of the performance audit.

12.1.1 Laboratory Performance Audit

The APR laboratory director will monitor and audit the performance of the QA procedures to ensure that the project is performed in accordance with the data quality objectives. The results of any U.S. EPA or State audits will be made available upon request to RES-FS for subsequent review. Additional audits may be scheduled by RES at various times to evaluate the execution of sample identification, sample control and chain of custody procedures. Results from the analysis of any performance evaluation samples will be made available to RES-FS for review. Any problems will be identified and corrective actions will be taken if necessary.

12.1.2 Field Performance Audit

At least one field performance audit will be conducted by RES-FS QA Officer or his designee. The field auditor will observe and review the procedures being used to ensure that they conform with the operating procedures described in the Work Plan. Specific attention will be given to sampling procedures and preservation to demonstrate that required methods are being used. Field instrumentation quality assurance procedures will also be verified to ensure that all proper procedures are being followed. Analytical results and quality assurance samples and analyses will be reviewed and recommendations on the adequacy and necessity for repetition of analysis will be made The RES-FS QA Officer will review the data for questionable results and will determine if repeat analyses are required Significant analytical problems will be discussed with the RES-FS QA Officer and APR Manager

The field auditor will report to the RES-FS QA Officer orally within 5 days on the results of each audit to transmit any significant problems with the field quality assurance program A written report will be made by the field auditor of each field audit within 10 days after each audit

12 2 SYSTEMS AUDIT

A systems audit consists of an evaluation to determine if the components of the measurement system(s) were properly selected and are being used correctly A systems audit includes a careful evaluation of field and laboratory quality control procedures

12 2 1 Laboratory Systems Audit

A laboratory systems audit will be conducted on a regular basis by the APR Manager The APR Manager will conduct an initial systems audit to ensure that all instruments proposed for use were properly selected for the given methods and are performing properly This will include a review of the analytical methods proposed for use and the laboratory procedures prepared from these methods Necessary changes will be confirmed in writing to the RES-FS QA Officer, to ensure that the laboratory meets all of the measurement systems requirements of the quality assurance plan After this initial systems audit is complete, the APR Laboratory Manager will

- implement the analytical plan and ensure that all quality control measures are executed as written,
- ensure that all analysts and technicians are properly trained,
- verify on a routine basis that all instruments are performing properly and that conditions, etc , are as specified in the Work Plan, and
- conduct periodic evaluations of personnel and instruments during the course of the analyses to ensure that initial conditions persist

The APR Manager will report orally to the RES-FS QA Officer if the systems audit shows a significant discrepancy from the Work Plan or Quality Assurance Plan Each major systems change will require a written summary to RES-FS QA Officer to document the change made All system changes will be documented in the project Quality Assurance notebook

The APR Manager, or his designee, will conduct the following as part of the routine analytical system to ensure compliance with the work plan and quality assurance requirements

- verify that incoming samples correspond to the chain of custody form or packing list that accompanies them,

- inspect the samples and document the condition of each sample, especially any circumstances which might have adverse effect on the analytical results,
- note the analyses required on each sample and transmit this information to the Analysis Coordinators,
- review all data generated to ensure that all analyses were run as specified, including quality controls, and
- prepare the data for submission to the sponsor or for entry into a computerized data bank, as appropriate

The APR Manager will periodically review the data records to ensure that the requirements are being met

The APR Manager, or his designee, will perform the following functions to ensure the sample collection systems meet the requirements He will

- ensure that proper container cleanup procedures are followed prior to use and that containers are protected from contamination once prepared for use,
- provide a sample of containers to the analytical coordinator, who will determine if the containers are free of contamination,
- prepare field spikes, duplicates, and blanks, as called for in the work plan, and provide these for analysis along with field samples, ensuring that the analyst is unable to distinguish between actual and quality control samples, and
- maintain all records necessary including chain of custody information on the samples

The RES-FS QA Officer will conduct at least one detailed laboratory systems audit during the project This audit will be described in Section 12 3

12 2 2 Field Systems Audit

At least one field system audit will be conducted by the RES-FS QA Officer, or his designee The field auditor will review the field equipment selection and use to ensure that the equipment is capable of safely and accurately performing the desired functions Equipment selection review will be based on the capabilities and limitations of the instrument/sampling device Use will be reviewed based on observations and comparison of actual versus expected results The first field systems audit is expected to be conducted soon after field start up

The field auditor will meet with key field staff members to evaluate the field program and determine if changes are necessary to improve the results A written record of these meetings will be placed into the project file within 10 days after the meeting and program revisions will be incorporated as necessary

The field auditor will submit a written report within 10 days after each audit and will discuss significant changes with the project management prior to any major changes

12 3 DETAILED LABORATORY PERFORMANCE AND SYSTEMS AUDIT

As part of the quality assurance program, the RES-FS QA Officer will conduct a detailed laboratory performance and system audit during the project

The objectives of the detailed audit are

- To determine that a quality assurance program has been put into use and documented in accordance with specified requirements,
- To verify by examination and evaluation of objective evidence that the documented program has been implemented,
- To assess the effectiveness of the quality assurance program,
- To identify nonconformances, and
- To verify correction of identified deficiencies

The APR Laboratory Manager will be notified of the audit at a reasonable time before the audit is performed This notification may be in writing and include such information as the general scope and schedule of the audit and the name of the audit team leader

A brief pre-audit conference will be conducted at the audit site with APR management The purpose of the conference will be to confirm the audit scope, present the audit plan, discuss audit sequence and plan for the post-audit conference

Audits are performed on the basis of written checklists or list of questions prepared prior to the audit to ensure the depth and continuity of the audits During the conduct of the audit, each item on the list is marked with one of the following entries,

S	Item is satisfactory
U	Item is unsatisfactory
X	Item is not applicable
N	Item was not audited

The audit checklist is intended for use as a guide and will not restrict the audit investigation when findings raise further questions that are not specifically included in the checklist The checklist will include, as a minimum, review of QA data, laboratory procedures, chain of custody records, calibration records, and problem resolutions

Selected elements of the quality assurance program shall be audited to determine whether they are being implemented effectively

Conditions requiring immediate corrective action shall be reported immediately to the Program Manager and resolutions will be recommended to replace the faulty procedures

At the conclusion of the audit, a post-audit conference will be held with APR Management to present audit findings and clarify misunderstandings Audit findings shall be concisely stated by the RES-FS QA Officer on the List of Findings for Post-Audit Conference (Figure 12-1) The findings of the audit will be acknowledged by the Laboratory Manager signing the post-audit conference record

An audit report will be prepared within 15 working days by the RES-FS QA Officer and signed by the applicable APR QA Officer The report will include the following

- Description of audit scope
- Identification of the auditors
- Persons contacted during pre-audit, audit and post-audit activities
- A summary of audit results, including an evaluation statement regarding the effectiveness of the QA Program elements which were audited
- Details of findings and program deficiencies will be reported on a Standard Audit Report Format similar to Figure 12-2 Each finding and program deficiency shall be identified and described in sufficient detail to assure that corrective action can be effectively carried out by the project organization
- Recommendations for correcting the findings or improving the QA Program
- The audit report will be addressed to the Program Manager

The APR Laboratory Manager or his designated representative will respond to the audit deficiencies by completing a Corrective Action plan in written form within 20 working days The response will clearly state the corrective action for each finding, including action to prevent recurrence and the date the corrective action will be completed If corrective action has been completed, supporting documentation will be attached to the reply

Follow-up action will be performed by the APR Laboratory Manager or his designated representatives to

- Evaluate the adequacy of the response
- Assure the corrective action is identified and scheduled for each nonconformance
- Confirm that corrective action is accomplished as scheduled Re- audits will be conducted and reported in the same manner as the original audit

FIGURE 12-1

QUALITY ASSURANCE AUDIT FINDING REPORT

Project ____________________

Audit No __________ Audit Date ____________

Audit Finding No ____________________

QUALITY ASSURANCE AUDIT
FINDING REPORT

Audited
Organization ____________________

Audited
Area ____________________

10 CFR 50 Appendix B Requirement ____________________

NQA-A ____________________

QAM ____________________

OBSERVATION/FINDING

RECOMMENDATION

Corrective Action Required Yes Prepared By ____________________

No ____________________

CORRECTIVE ACTION REPLY Response Date Due ____________________

Prepared By ______________ Title ______________ Date __________

CORRECTIVE ACTION VERIFIED

By ____________________

Title ______________ Date __________

FIGURE 12-2
STANDARD AUDIT REPORT FORMAT

Project No ______________________________

To ____, Project Director

Subject Report of Audit of (project unit), on (date)

PURPOSE

Give the name and title of the person conducting the audit, and list any individuals who may have assisted in conducting the audit

PERSONNEL CONTACTED

Present the checklist from which the audit was conducted, with the appropriate S, U, X or N marking for each item op the list

DISCUSSION

Indicate nonconformance noted A nonconformance is defined as a deficiency in characteristic, procedure or documentation which renders the quality of an item unacceptable or indeterminate Examples of nonconformance include incorrect or inadequate documentation or deviations from prescribed office, field, or laboratory procedures

CORRECTIVE ACTION

Indicate action to correct and to prevent recurrence of nonconformances, and dates by which reply to audit must be received and corrective action completed

RECOMMENDATIONS

Present suggestions regarding items or procedures which are not considered nonconformances, but which may result in nonconformances if allowed to continue, or for which relatively minor changes may result in improved quality

- Follow-up action may be accomplished through written communication, re-audit, or other appropriate means

Records will be generated and retained for all audits Records will include audit reports, written replies, the record of completion of corrective actions, and documents associated with the conduct of audits which support audit findings and corrective actions as appropriate

12.4 NONCONFORMING ITEMS AND DISPOSITION

12.4 1 Nonconforming Items

The supervisory and staff personnel will, during the execution of their normal activities, make certain that the work is performed in accordance with the requirements of the QAPP, establish procedures or accepted professional practices Rework or revision of work due to nonconformance is described in the applicable work procedure Any irregularities and/or deviations will be reported in writing to the QA Officer and the Program Manager Any person may originate a report on irregularities and/or deviations

The originator of a Nonconformance and Disposition Action Report (NCR) will describe his findings on the form provided for this purpose (Figure 12-3) A nonconformance is defined as a deficiency which renders the quality of an item unacceptable or indeterminate Depending on the nature of the nonconformance, the quality of the item in question may be accepted following an investigation of the nonconformance

The work which has the irregularities and/or deviations may be temporarily stopped while the nonconformance is being investigated Table 16-1 is a summary of the written quality assurance reports that will be submitted to management

<u>Disposition</u>

The Program Manager will be responsible for initiating disposition action on all nonconforming items The procedure will be as follows

- The RES-FS Program Manager will review the nonconformance and disposition action reports and take the necessary action, he will complete the disposition section of the report
- The RES-FS Quality Assurance Officer or his designee will review, verify and countersign the Program Manger's disposition
- The completed report will be filed in the appropriate file

12 5 SCHEDULE OF AUDITS

A summary of the performance and systems audits to be performed is shown in Table 12-1

FIGURE 12-3

NONCONFORMANCE AND DISPOSITION ACTION REPORT (NCR)

Date ____________________

<u>SUBMITTAL</u> NCR NO ____________________

TO ____________________

Description of Nonconformance and Cause ____________________

____

____

Proposed Disposition ____________________

____

____

Submitted
by ____________________ Location ____________________
Approved by ____________________ Date ____________________

<u>DISPOSITION</u> (by Project Manager or designee)

Implementation of Disposition Assigned to ____________________

Actual Disposition ____________________

____

____

____

____________ Disposition completed on ____________________
(Date)

____
(Signature)

<u>VERIFICATION</u>

Disposition reviewed and work inspected by ____________________ on ____________
Disposition verified by
____________________ on ____________________
(Use additional sheet or memo if needed)

TABLE 12 1
SCHEDULE OF AUDITS TO BE PERFORMED
MISSOURI ELECTRIC WORKS RI/FS

AUDIT TYPE	CONDUCTED BY	AREA	SCHEDULE	(WORKING DAYS AFTER AUDIT) REPORT SCHEDULE	REPORT TYPE
SYSTEM STARTUP	APR LABORATORY MANAGER	LABORATORY	PRIOR TO PROJECT START OR IMMEDIATELY FOLLOWING	5 10	ORAL WRITTEN
SYSTEM STARTUP	RES FS FIELD COORDINATOR	FIELD	FOLLOWING STARTUP	5 10	ORAL WRITTEN
PERFORMANCE	APR LABORATORY MANAGER	LABORATORY	WEEKLY	5 MONTHLY	ORAL WRITTEN
PERFORMANCE	RES FS QA OFFICER OR DESIGNEE	FIELD	SEMIMONTHLY	5 MONTHLY	ORAL WRITTEN
IN DEPTH SYSTEMS AND PERFORMANCE	RES FS OFFICER	FIELD AND LABORATORY	MID PROJECT	15	WRITTEN
AUDIT FOLLOWUP	RES FS QA OFFICER OR DESIGNEE	FIELD AND LABORATORY	AS NEEDED	20	WRITTEN
SYSTEMS	APR LABORATORY MANAGER	LABORATORY	SEMIMONTHLY	MONTHLY	WRITTEN
SYSTEMS	RES FS FIELD COORDINATOR	FIELD	SEMIMONTHLY	MONTHLY	WRITTEN

13 0 PREVENTATIVE MAINTENANCE

13 1 LABORATORY MAINTENANCE

All instruments will be maintained in accordance with manufacturer's recommendations and/or normal laboratory practice All maintenance will be documented and maintained in permanent records by the individual responsible for each instrument This will include both routine, scheduled maintenance and unscheduled maintenance required by operational failures

All nonroutine or scheduled maintenance will be reported to the Analysis Coordinator responsible for that instrument and will enter the communication scheme reported in Section 12 0 The Analysis Coordinators will review the maintenance records on a regular basis to ensure required maintenance is occurring

13 2 FIELD MAINTENANCE

All field instruments, sampling equipment and machinery will be maintained in accordance with manufacturers recommendations and normal field practice All maintenance will be documented in permanent records by the individual responsible for each item This will include routine scheduled maintenance and unscheduled maintenance Unscheduled maintenance will be reported to the Site Coordinator/Manager who will report the activity to the Project QA/QC Officer and the Program Manager The Site Coordinator/Manager will review the maintenance records on a regular basis to ensure required maintenance is occurring

14 0 DATA ASSESSMENT

All data generated will contain a statement on the accuracy and precision of the methodology used to obtain them The procedures and equations for determining the accuracy and precision are discussed in Section 9, Analytical Procedures, and Section 11, Internal QC Checks and Frequency These procedures will be reviewed during the performance audits described in Section 12, Performance and Systems Audits, to ensure that the procedures are being implemented and accurately followed Field data will be assessed by the procedures referenced in this document and those respective operating procedures referenced in the Standard Operating Procedures found in Appendix A to the Work Plan These procedures will also be reviewed during the performance audits

15 0 CORRECTIVE ACTION

The ultimate responsibility for maintaining quality in the analyses lies with the RES-FS Program Manager The routine operation of the quality assurance program, however, falls upon the RES-FS QA/QC Officer, and the APR Laboratory Manager

The APR Laboratory Manager will have the responsibility for ensuring that his personnel are adequately trained to perform analyses, that equipment and instrumentation under his control are calibrated and functioning properly, and that systems audits are performed on a regular basis

The APR Manager will have the responsibility for preparation and implementation of quality assurance plans The APR Manager or his designee will review the data generated to ensure that quality control samples are run as specified in the protocol

The RES-FS Quality Assurance Officer will have the responsibility for the preparation of S O Ps and quality assurance guidelines for the project, and for conducting/evaluating the results from systems audits The RES-FS Quality Assurance Officer will review program plans for consistency with organizational and contractual requirements and advise the APR Laboratory Manager

The RES-FS QA Officer or his designee also have responsibility for conducting and evaluating the QA procedures for the field testing and the geochemical and geophysical/geochemical testing laboratory manager will assist the RES-FS QA Officer in this task and ensure that all necessary corrective action items will be completed

16 0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

Section 12 describes the periodic assessments and performance and systems audits to be completed during the MEW Site Project Table 16-1 is a summary of the written quality assurance reports that will be submitted to management

As reported in Section 12, weekly assessment of the sample and quality assurance for accuracy, precision and completeness will be conducted and reported orally to the RES-FS QA Officer All audits and quality assessments will be reported in oral and written form to the QA Officer to provide rapid response to quality assurance problems and documentation of the audit and response in the project files

After the field work has been completed and the final analyses are completed and checked, a final quality assurance report will be prepared to be included in the final RI report The report will summarize the quality assurance and audit information, indicating any corrective actions taken and the overall results of the QAPP

TABLE 16-1
QA REPORTS TO MANAGEMENT

Report	Responsibility	Schedule
Laboratory Start Up Systems Audit Results	Laboratory Manager	10 days after audit
Field Start Up Systems Audit Results	RES-FS Officer	10 days after audit
Laboratory Performance Audit Results	Laboratory Manager	Monthly
Field Performance Audit Results	RES-FS Officer	10 days after audit
Laboratory Systems Audit Results	Laboratory Manager	Monthly
Field Systems Audit Results	RES-FS Officer	10 days after audit
In-depth Performance and Systems Audit Results	RES-FS Officer	Mid Project
Audit Deficiency Resolution	Field or Laboratory Personnel	As needed, 20 days after notice
Laboratory Quality Assurance Summary	Laboratory Manager	30 days after submittal of final data package
Summary Data Within Project Files	Laboratory Manager	30 days after submittal of final data package
Inventory of Samples in Storage	Laboratory Manager	30 days after submittal of final data package
Quality Assurance Summary	RES-FS Officer	At Project Conclusion

ATTACHMENT 4-1

RESUMES OF KEY RI-FS PERSONNEL
MEW RI/FS

JOSEPH W DAUCHY, Ph D

National Technical Director
<u>Rollins Environmental Services (FS), Inc</u>

Responsible for Technical support to all Rollins Environmental Services (FS), Inc offices, including the assessment of technologies and techniques to determine feasible remedial alternatives

Director of Assessment/Remedial Investigation Program for RES(FS) P&L Responsibility for RES(FS) Commercial Assessment Business

Regional Field Service Manager (Texas)
<u>Rollins Environmental Services (FS), Inc</u>

P&L responsible for Texas field services operations Managed or supervised over 48 hazardous waste cleanup/handling projects

Project Manager
<u>Rollins Environmental Services (TX), Inc</u>

Supervised remediation of abandoned and uncontrolled hazardous waste sites involving the cleanup of drums, tanks, contaminated soil and debris, and PCB electric equipment Specified safety procedures and equipment for personnel and environment protection

Senior Scientist
<u>Geraghty & Miller, Inc , Houston, Texas</u>

Managed and supervised major client projects including well installation, sampling, and regulatory agency interaction Programs included groundwater monitoring, RCRA monitoring, and injection well feasibility

<u>Education</u>

Ph D - Environmental Science, Emphasis in Aquatic Chemistry, University of Texas at Dallas, 1980

M S , Environmental Science, emphasis in Aquatic Chemistry, University of Texas at Dallas, 1977

M S , Chemistry, emphasis in biochemistry and analytical chemistry, New Mexico Institute of Mining and Technology, 1976

B S , Science/Chemistry, New Mexico Institute of Mining and Technology, 1974

<u>Other</u>

Co-holder of Rollins Environmental Vault patent

JAMES R SMITH

Assistant National Technical Director
Rollins Environmental Services (FS),Inc

Responsible for the design and management of remedial investigations Assess technologies and techniques to determine remedial alternatives Provide technical support to five (5) Regional Field Service Offices

Assistant Regional Office Manager (Texas)
Rollins Environmental Services (FS), Inc

Responsible for the operational coordination and quality control of remedial proposals and projects out of the Texas Regional Office Directly managed over 30 hazardous waste site remediation projects Design solutions, determine analytical procedures, estimate costs and present proposals to clients

Environmental Consultant
Toxcon Engineering Company, Houston, Texas

Defined federal and state solid waste requirements for industrial facilities Developed site specific hazardous waste management plans Contingency, SPCC, training, waste analysis, inspection and safety plans were formulated Designed and executed sampling programs at uncontrolled hazardous waste sites Determined appropriate remedial techniques considering economics and available technology Supervised site cleanups Other responsibilities included preparation of RCRA permits, environmental audits and ambient air monitoring to determine OSHA compliance

Laboratory Technician
Lubrizol Corporation, Deer Park, Texas

Responsible for analysis of process samples Utilized techniques involving wet analysis, gas chromatography and atomic absorption

Nuclear Civil Quality Control Inspector
Brown & Root, Inc, Bay City, Texas

Responsibilities included surveillance of construction activities and preparation of inspection and nonconformance reports

Education

B S ,Microbiology, Texas A&M University, College Station, Texas, 1978

Graduate studies, Environmental Management, University of Houston, Houston, Texas, 1980-1983

WILLIAM C LOONEY, JR

Program Manager
Rollins Environmental Services (FS), Inc

Responsible for technical support to all Rollins Environmental Services (FS), Inc offices, including assessment of site characteristics, remedial alternatives, health and safety requirements and preparation of plans

Project Manager
Rollins Environmental Services (FS), Inc

Responsible for management of over 40 hazardous waste remediation projects Developed mitigation procedures, evaluated site characteristics, estimated costs, and presented proposals Responsible for performance of work Southwest Region Health and Safety Officer Site Safety Officer for initial work at a major superfund site

Company Commander
United States Army

Commanded advanced individual training company of over 400 personnel Directed all command, control, administrative, logistics, training and human resources management

Instructor
United States Army

Chief instructor and subject matter expert for all aspects of chemical, biological, and radiological (CBR) operational doctrine and training Developed course contents, training programs, outlines and curricula Developed expedient equipment decontamination methods

Assistant Division Chemical Officer
United States Army

Served on general staff as chemical officer and manager of CBR funds, equipment and training Responsible for nuclear and chemical target analysis, fallout and chemical hazard predictions Division nuclear/chemical accident/incident control officer

Chief - Operations Division
United States Army

Supervised operational performance of escort and disposal teams Responsible for politically sensitive missions involving recovery, escort, and disposal of chemical agents, munitions, and other hazardous material Directed performance of a worldwide chemical accident response team

Education

B S Chemistry, Wofford College, 1971

EDWARD A COUNCIL, III

Project Manager/Hydrogeologist
<u>Rollins Environmental Services (FS), Inc</u>

Responsible for the management and implementation of hydrogeologic assessments for hazardous waste disposal sites Evaluate multiple technologies to determine and design feasible remedial options for soil and groundwater contamination projects Provide technical assistance for all Field Services offices and company waste disposal facilities Support sales efforts and represent clients during regulatory technical meetings

Hydrogeologist
<u>Dynamac Corporation, Rockville, MD</u>

Contracted as scientific staff to the Environmental Planning Branch of the U S Air Force Regional Civil Engineer, Central Region Designed and implemented groundwater and other environmental management programs in compliance with State and Federal regulations Duties included coordinating interagency efforts between federal installations, EPA, and state regulatory agencies regarding past hazardous waste disposal sites and practices of the U S Air Force

Research Assistant
<u>Applied Marine Research Laboratory, Norfolk, VA</u>

Conducted geotechnical, chemical, statistical, and computer analyses on sediments from fluvial, estuarine, and oceanic depositional environments Duties included developing and streamlining all chemical and statistical methodologies Other duties included sediment sampling, petrography, data review and interpretation, and preparation of reports

<u>Education</u>

M S , Geology, Old Dominican University, Norfolk, VA, 1987
B A , Environmental Sciences, University of Virginia, Charlottesville, VA, 1981

<u>Other</u>

Member	National Water Well Association
Member	Geological Society of America
Member	Society of Economic Paleontologist and Mineralogists
Member	American Association of Petroleum Geologists

ALICIA M PASTERNAK

Site Engineer/Project Manager
Rollins Environmental Services (FS), Inc

Provides engineering for the assessment/remedial design of hazardous waste sites Provides technical assistance for all Field Services offices with regard to site engineering and planning Responsible for health and safety programs, OSHA compliance and regulatory liaison

Project Engineer
Envirosystems Corporation

Responsible for the hazardous waste operations at several Department of Defense installations located throughout the Southeast United States Duties included hazardous waste site investigation, sampling, identification, categorization, packaging, manifesting, transportation and disposal of various waste streams

Planning Engineer
Texas State Department of Highways and Public Transportation

Duties included reviewing schematics, working with the design, planning and engineering of the highways Active in public relations and various governmental agencies

Education

B S , Chemical Engineering, Texas A&M University, College Station, Texas, 1985

Other

Member, AIChE

Engineer in Training (E I T)

ATTACHMENT 4-2

SUBCONTRACTOR CAPABILITY STATEMENTS (APR LABORATORIES, McCLELLAND ENGINEERS, NEPONSET GEOPHYSICAL) MEW RI/FS

ASBESTOS ABATEMENT
DRUG SCREENING
ENGINEERING
ENVIRONMENTAL
FIRE INVESTIGATION
INDUSTRIAL HYGIENE
MOBILE LAB
PETROLEUM

CAPABILITIES
and
SCHEDULE OF CHARGES

MEW Admin record
AR104052

APR
Laboratories, Inc

3323 Gulf Freeway • P O Box 1188 • Dickinson Texas 77539

vironmental • Petroleum • Drug Screening • Industrial Hygiene • Engineering • Asbestos Abatement • Mobil Lab • Fire Investigation

APR
Laboratories Inc

Phone 713-337 67
Fax # 713-337 35

Today's environmental standards demand that laboratory analysis must be more accurate and more precise than ever before. APR LABORATORIES, INC. operates a complete analytical laboratory for wet chemical and instrumental analysis, including priority pollutants, herbicides, pesticides, metals, and all RCRA hazard evaluation tests. We also have the capability of characterizing waste and wastewater samples for treatment or discharge. APR has a staff of qualified chemists versed in a broad spectrum of technology and analytical processes. Methods employed in laboratory analysis range from "Standard Methods" to the newest and most sophisticated Gas Chromatography/Mass Spectrometry (GC/MS) instrumental techniques, this, of course, enables us to also provide our clients with the capabilities of identifying unknown complex compounds.

APR LABORATORIES, INC. also maintains an extensive network of staff consultants who range from scientists and engineers to industrial hygienists and construction specialists. APR is experienced in environmental services engineering and has performed a wide range of projects from basic engineering studies to complete turnkey management operations. We can provide all levels of permitting at both state and federal levels.

Premium quality service and timely turnaround of samples has awarded APR LABORATORIES, INC. a well recognized and respected reputation. To minimize reporting time, results can be transmitted by facsimile, with written confirmation mailed the same day. We feel that our fee schedule is highly competitive. There is a schedule of charges together with a list of laboratory and consulting services on the following pages.

We welcome your inquiries, and would be privileged to add you to our list of satisfied clients.

LABORATORY SERVICES

LABORATORY SERVICES

ASBESTOS ABATEMENT

DRUG TESTING

ENVIRONMENTAL

* DRINKING WATER
* WASTE WATER
* WASTE WATER SLUDGE
* GROUNDWATER MONITORING
* HAZARDOUS WASTE CHARACTERIZATION
* PESTICIDES
* PCB'S
* BIOASSAYS
* INDUSTRIAL HYGIENE ANALYSIS

ENVIRONMENTAL SITE ASSESSMENT

FORENSIC CHEMISTRY

* ARSON INVESTIGATION
* CARGO LOSS
* PRODUCT CONTAMINATION
* FAILURE ANALYSIS
* HAZARDOUS WASTE FINGERPRINTING
* TRACE EVIDENCES

GENERAL

* PRODUCT PURITY
* FORMULATIONS
* COOLANTS
* ANTIFREEZE
* CORROSION INHIBITORS
* MICROBIOLOGICAL STUDIES
* METALS
* INORGANICS
* ORGANICS
* TRACE ANALYSIS

PETROLEUM PETROCHEMICAL

* GAS AND LIQUID HYDROCARBONS
* GLYCOLS
* AMINES
* GASEOUS SULFUR COMPOUNDS
* LUBRICANTS
* SPECIALTY GAS ANALYSIS
* MINERAL PATTERNS
* OVERBOARD DISCHARGES
* FUELS

CONSULTING SERVICES

CONSULTING SERVICES

- LEGAL EXPERT TESTIMONY
- ARSON INVESTIGATIONS
- HAZARDOUS WASTE:
    - Field sampling Surveys
    - Remedial Action Analytical Support
    - Pollutant Chemodynamics
    - Groundwater Hydrology Evaluation
    - Remedial Action Specification
- ENVIRONMENTAL PERMITTING: NPDES, RCRA PART B, PSD, TDWR, TACB, TDH, TRC
- NATURAL GAS PROCESSING PLANTS:
    - STARTUP
    - PROCESS UPSET
    - POLLUTION CONTROL EQUIPMENT EFFICIENCY DEMONSTRATION
- ENGINEERING SERVICES
    - Economic Studies
    - Process Design
    - Glycol and Amine Unit Evaluaion
    - Corrosion Surveys
- PROCESS INSTRUMENTATION CERTIFICATION AND CALIBRATION
- WASTEWATER TREATABILITY STUDIES
- MUNICIPAL WASTEWATER AND DRINKING WATER PLANT OPERATIONS
- PROCESS QUALITY CONTROL:
    - Operation Manual and Procedures Preparation
    - Laboratory Setup
- PETROCHEMICAL CARGO LOSS EVALUATION
- INDUSTRIAL HYGIENE SITE SURVEYS
- SPECIALIZED MICROBIAL CULTURE RESEARCH AND DEVELOPMENT
- ANALYTICAL METHODOLOGY DEVELOPMENT

3323 Gulf Freeway • P O Box 1188 • Dickinson Texas 77539

Environmental • Petroleum • Drug Screening • Industrial Hygiene • Engineering • Asbestos Abatement • Mobil Lab • Fire Investigation

A P R Laboratories Inc

Phone 713 337-670
Fax # 713-337 35

SAMMY RUSSO	**PRESIDENT**
Education	A.A. Chemistry, 1963 Alvin Junior College B.S. Biology, 1965 Lamar University M.S. Biochemistry, 1973 Texas A&M University Ph.D. Course work completed-Microbiology Texas A&M University 1973
Professional & Honorary Affiliations	Beta Beta Beta Honor Society Air Pollution Control Association Waste Water Analysts Association Gas Processors Association Society of Petroleum Engineers American Chemical Society
Presentations	"Semiautomation of the A.O.A.C Carr-Price Extraction Method for Vitamin A" Presented before the Association of Official Feed Control Chemists, March 1973. Benzene Monitoring in Gas Processing Plants" Presented before the Gas Processors Association, October 1977. "Classical & Conventional Methods of LPG Sulfur Analysis" Presented at the National GPA Convention, March, 1979.
Experience	Mr. Russo joined the staff of A P R Laboratories in June 1983. As president, he is responsible for all administrative, scientific and financial aspects of A P R Laboratories. Mr. Russo is a trained

scientist with experience both in area industry and state governmental control agencies His training includes not only water and air pollution monitoring techniques, but also the techniques for testing industrial health and safety. Mr. Russo is an experienced laboratory manager and chemist with twenty years of educational and industrial experience

Prior to joining A P R Laboratories, Mr. Russo was Director of Environmental Services and Manager of Projects for Southern Petroleum Laboratories. He joined the staff of Southern Petroleum Laboratories in August 1974 and started the Environmental Services Department and established SPL's international services. He was responsible for all methods review and development and extablished new techniques and methods for the analysis of trace sulfur compounds, geothermal brine waters, trace organics in sea waters, drilling fluids and petroleum products and by-products.

As manager of special projects Mr. Russo specializes in state of the art techniques for the analysis of hydrocarbon, sulfur and brine samples on site. Mr. Russo has performed analytical surveys in Saudi Arabia, Syria, Dubai, Europe and throughout the United States. He is a recognized authority for the analysis of sulfur compounds in gas and gas processing streams. While at SPL Mr. Russo managed numerous treatability studies on industrial waste and developed methods for the analysis of geothermal brine waters.

Prior to joining Southern Petroleum Laboratories, Inc., Mr. Russo was Assistant Laboratory Director at Technology Incorporated and provided analytical support for NASA's Apollo and Sky Lab Space Programs. He was responsible for the day to day operation of the laboratory, research and development of new methods, and procedural quality control.

Prior to employment with Technology Incorporated, Mr. Russo was an Assistant Research Chemist at the State of Texas Agricultural Analytical Services Laboratory. He supervised the Vitamin, Antibiotics and Microbiological Laboratories for the State's Feed, Fertilizer and Pesticide Control Agency. Mr. Russo developed a tube diffusion technique for the assay of antibiotics, semi-automated the A.O.A.C. Carr-Price Vitamin A Assay, initiated atomic absorption studies for the analysis of high-level cyanocobalmins using cobalt as an analytical parameter, and assisted in the developmental application of ion-specific electrodes for feed analysis and the application of high pressure liquid chromatography for Vitamin analysis.

As a graduate assistant, he taught for four years at Texas A & M University. In 1966 he worked for Comtronix Service where he serviced communication equipment, radar and scientific instruments. In 1964 Mr. Russo was employed as a research technician for Monsanto. His duties included the analysis of organic compounds using gas chromatography, Mass Spectrometry, Infrared, UV and Visible Spectrometry.

Special Capabilities

Specialist in on site sulfur and hydrocarbon analysis, new methods development, and quality control, with 20 years of analytical experience in inorganic, organic and instrumental analysis.

Mr. Russo is a trained fire investigator with more than twelve years of experience in fire investigation. He has been qualified in State and Federal Courts, both criminal and civil, as an expert in the chemistry of fires and explosions. He has completed the 80 hour training course required for certification of State Fire Marshals and Law Enforcement/Arson Investigators. He has also been a guest lecturer to teach the "Chemistry of fires" as part of this program.

Solving Waste Management Problems

McClelland

MEW Admin record
AR104061

[redacted]

McCLELLAND ENGINEERS - AN OVERVIEW

McClelland Engineers is among the leading domestic and international consulting engineering firms, and is currently 76th on the Engineering News Record listing of the Top 500 U S Design Firms We provide engineering services in the following fields of specialization

Waste Management

Geosciences (both land and marine)
- geotechnical
- geophysical
- geological
- geochemical

Environmental Sciences

Construction Materials Engineering and Testing

McClelland has applied its expertise on projects throughout the world with particular emphasis in those geographic regions of petroleum production Early association with the petroleum industries has oriented McClelland towards projects vast in extent or complexity, those requiring innovative techniques, and projects in remote geographic regions

McCLELLAND'S RESOURCES

The facilities and equipment available to support McClelland's waste management professionals are extensive and include the most versatile fleet of exploration equipment in the Southwest Equipment resources include

- o Drilling rigs
- o Cone penetrometer systems
- o VZV Probe®
- o Field analytical equipment
- o Geophysics
- o Sampling equipment
- o Laboratories (geotechnical and materials)

Drill Rigs

McClelland's drilling capability is very versatile We own and operate skid- and truck-mounted rigs that can gain access to any location Skid rigs can be mounted on pontoons or barges for accessing ponds and bayous Truck and marsh buggy-mounted equipment is suited to hard ground or very soft ground conditions

The following drill rigs are available

Rig	Mounting	Units	Depth Capability, ft
Failing 3000	Trailer	1	3,000
Failing 2000	Skid	1	2,000
Failing 1500	Skid	2	1,000
Failing 1500	Truck	1	1,000
CME 75	Truck	2	1,000
CME 55	Truck	2	400
Failing 250	Truck	1	300
Failing 250	All-terrain vehicle	1	300
Failing 36	Truck	2	150
Mobile B-53	All-terrain vehicle	1	300
Mobile B-53	Truck	1	300
Specialty 50	Hand portable	1	70
Hand Auger	Hand portable	2	20

Cone Penetrometer Systems

Electric cone penetrometer soundings are a particularly cost effective way to define subsurface stratigraphy when used to complement standard geotechnical borings McClelland operates the following systems

Rig	Mounting	Units	Depth Capability ft
Mobile B-53	Truck	1*	100
Mobile B-53	All-terrain vehicle	1*	100
Mini-cone	Pickup	3*	40
Gravity cone	Truck	1**	150
Gravity cone	All-terrain vehicle	1**	150

* VZV Probe® systems available for soil gas sampling and testing <u>above</u> groundwater level

** Conductivity cone systems available for contamination assessments <u>below</u> groundwater level

VZV Probe®

McClelland has developed a cone system which enables us to investigate contaminants in the soil gas above groundwater level The system extracts a sample of soil gas at selected depths (up to 35 ft or more if needed) The samples are tested by an OVA/GC on location to allow an almost immediate assessment of whether contaminants are present Numerous locations can be tested in a day New locations can be selected based on that day's test results And the systems are inexpensive relative to monitor wells and laboratory analytical tests

Field Analytical Equipment

A variety of meters and analytical devices are used by our field investigation teams and include

- o Photovac-10s50 OVA/Gas Chromatograph
- o Foxboro-128 OVA/Gas Chromatographs (2)
- o United Technologies TLV Sniffer (1)
- o Analytical Instrument Development Model 580 OVM (1)
- o pH Meters (2)
- o Conductivity Meters (2)
- o Dissolved Oxygen Meter (1)
- o Drager Multi Gas Detector (1)

High volume air sampling equipment is also available for air quality monitoring work

Geophysics

Equipment owned by McClelland Engineers and operated by our technicians or projects professionals includes

- One Neltronic geophysical logging system mounted in a 4-wheel-drive van capable of running gamma, resistivity, and self-potential logs to a depth of 2,500 ft
- Four portable logging units capable of running gamma, resistivity, and self-potential logs to a depth of 1,000 ft
- Surface electrical resistivity sounding and profiling equipment
- Seismic reflection and refraction equipment
- Cross-hole seismic equipment
- In situ vane shear equipment

Other equipment which we have used extensively on a rental basis are ground-penetrating radar and noncontacting conductivity meters

Sampling Tools

In addition to standard geotechnical sampling tools, our waste management professionals have a variety of tools to sample sludges, water columns, and sediments

- Eckmun Dredge
- Kemmerer (thief) sampler
- Bailers (stainless, teflon, and PVC)
- Submersible pumps (250-ft capability)
- Simme utility pump (20-ft capability)
- Suspended sediment sampler
- M-scope water level meter

Specialized sampling tools can be readily fabricated by our machine shop, when required, to meet project requirements which are extraordinary

Laboratories

Analytical chemical testing is performed by selected laboratories under subcontract to McClelland Engineers Strict chain-of-custody procedures are followed for hazardous waste samples, and QA checks on laboratory results are accomplished by trip blanks, field blanks, and duplicate samples

Geotechnical and construction materials testing is performed in McClelland's laboratories McClelland's Houston laboratory was reviewed by the American Association for Laboratory Accreditation in 1986 They concluded their report with the statement "This laboratory would easily be considered one of the best geotechnical laboratories in the country "

A2LA American Association For Laboratory Accreditation

September 30, 1988

Jeffrey J Danielski, P E
McClelland Engineers, Inc
6100 Hillcroft
P O Box 740010
Houston, TX 77274

Dear Mr Danielski

Your laboratory has been approved for continued accreditation by the American Association for Laboratory Accreditation (A2LA) in the Geotechnical and Construction Materials fields of testing for the test standards listed on the enclosed Scopes of Accreditation A2LA Certificates numbered 0023-01 and 0023-02 are enclosed and may be displayed in a prominent place in your facility

Your laboratory is now accredited for a two-year time span through September 30, 1990, by virtue of the reassessment of your laboratory and an evaluation by the A2LA Accreditation Council of all activity related to this assessment and any recent proficiency testing results Next year, you must pay an annual review fee and submit updated information on your facilities, key personnel and applicable proficiency testing results In addition, A2LA must be notified in writing at any time that significant changes occur in location, ownership, management, authorized representative or major facilities of your laboratory

We urge you to promote and advertise your accreditation in accordance with the enclosed advertising policy as approved by the A2LA Board of Directors Such publicity strengthens our own public information program and leads to broader recognition and acceptance of A2LA accredited laboratories Copies of the A2LA logo are also enclosed

We are pleased that you have chosen to continue as an A2LA accredited laboratory

Very truly yours,

John W Locke

John W Locke
President

Enclosures

656 Quince Orchard Road • #704 • Gaithersburg MD 20878-1409 • 301-670-1377

A2LA American Association For Laboratory Accreditation

SCOPE OF ACCREDITATION

MCCLELLAND ENGINEERS, INC
6100 Hillcroft, P O Box 740010
Houston, TX 77274
Jeffrey J Danielski, P E Phone 713 772 3700

GEOTECHNICAL

Valid To September 30, 1990 Certificate Number 0023-01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following tests

Soils

ASTM D421 D422 D427 D698 D854 D1140 D1556
D1557 D1883 D2166 D2167 D2216 D2434 D2435
D2487 D2850 D2922 D2937 D3017 D3080 D4015
D4186 D4221 D4253 D4254 D4318 D4373 D4546
Triaxial Compression (CU and CD)

Permeability in Flexible Wall Membrane with Back Pressure
Thermal Conductivity of Soil by Thermal Needle Procedure

Soil-Cement

ASTM D558 D559 D560 D1632 D1633 D1635

John W Locke

A2LA American Association For Laboratory Accreditation

SCOPE OF ACCREDITATION

MCCLELLAND ENGINEERS, INC
6100 Hillcroft, P O Box 740010
Houston, TX 77274
Jeffrey J Danielski, P E Phone 713 772 3700

CONSTRUCTION MATERIALS

Valid To September 30, 1990 Certificate Number 0023-02

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following tests under the ASTM recommended practice E329

Concrete

ASTM	C31	C39	C42	C78	C138	C143	C172
	C173	C174	C192	C231	C293	C495	C496
	C567	C597	C617	C803	C805		

Aggregates

ASTM	C29	C33	C40	C70	C88	C117	C123
	C127	C128	C131	C136	C142	C535	C566
	C702	D75					

Soils

ASTM	D421	D422	D558	D559	D560	D698	D854
	D915	D1140	D1556	D1557	D1633	D2167	D2216
	D2217	D2487	D2488	D2922	D2937	D3017	D4318

Bituminous

ASTM	D75	D140	D290	D979	D1188	D1559	D1560
	D2041	D2172	D2726	D2950	D3203	D3549	
AASHTO	T30						

Steel

ASTM A370 A615
AISC Bolt-torque
AISC, ASME, AWS Erection (visual), Welding (visual), Welding Qualification, Fabrication (both field and shop inspection)

Nondestructive

ASTM	E94	E114	E164	E165	E213	E273	E543
	E709						

John W Locke

656 Quince Orchard Road • #704 • Gaithersburg, MD 20878-1409 • 301-670-1377

THE AMERICAN ASSOCIATION FOR LABORATORY ACCREDITATION

THROUGH ITS ACCREDITATION COUNCIL
HAS CONFERRED UPON

MCCLELLAND ENGINEERS, INC.

ACCREDITATION FOR TECHNICAL COMPETENCE IN

GEOTECHNICAL TESTING

THIS LABORATORY IS ACCREDITED FOR ONLY THOSE TESTS OR SPECIFIC TYPES OF TESTS IDENTIFIED IN THE SCOPE OF ACCREDITATION FILED IN THE OFFICE OF THIS LABORATORY AND IN THE OFFICE OF THE AMERICAN ASSOCIATION FOR LABORATORY ACCREDITATION

PRESENTED THIS 30TH DAY OF SEPTEMBER 1988

John W Locke
PRESIDENT
FOR THE ACCREDITATION COUNCIL

CERTIFICATE NUMBER 0023-01

VALID TO SEPTEMBER 30, 1990

MEW Admin record
AR104070

THE AMERICAN ASSOCIATION FOR LABORATORY ACCREDITATION

THROUGH ITS ACCREDITATION COUNCIL
HAS CONFERRED UPON

MCCLELLAND ENGINEERS, INC.

ACCREDITATION FOR TECHNICAL COMPETENCE IN

CONSTRUCTION MATERIALS TESTING

THIS LABORATORY IS ACCREDITED FOR ONLY THOSE TESTS OR SPECIFIC TYPES OF TESTS IDENTIFIED IN THE SCOPE OF ACCREDITATION FILED IN THE OFFICE OF THIS LABORATORY AND IN THE OFFICE OF THE AMERICAN ASSOCIATION FOR LABORATORY ACCREDITATION

PRESENTED THIS 30TH DAY OF SEPTEMBER 1988

John W Locke
PRESIDENT
FOR THE ACCREDITATION COUNCIL

CERTIFICATE NUMBER 0023-02

VALID TO SEPTEMBER 30, 1990

American Association For Laboratory Accreditation

CONSTRUCTION MATERIALS FIELD OF TESTING

SELECTION LIST

To apply for A2LA accreditation under this field of testing, each applicant must identify every applicable standard or reference document for which accreditation is sought If a standard is not listed, but you would like to be accredited for it, identify it by short title and designation on a separate attachment To be considered for accreditation, a copy of each selected standard and the requisite equipment must be accessible to the laboratory Enrollment in at least one applicable reference sample program of the Construction Materials Reference Laboratories (CMRL) (NBS, Bldg 226, Room A365, Gaithersburg, MD 20899, 301-975-6704) is required The standards with an asterisk (*) are part of the CMRL reference sample program Check all of those standards for which accreditation is sought

Concrete

	DESIGNATION	SHORT TITLE
X	ASTM E 329	Practice for Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction
	C1077	Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
X	C 31	Making & Curing Concrete Test Specimens in the Field
X	C 39*	Compressive Strength of Cylindrical Concrete Specimens
X	C 42	Obtaining & Testing Drilled Cores/Sawed Beams of Concrete
X	C 78	Flexural Strength (Simple Beam with Third-Point Loading)
	C 85	Cement Content in Hardened Portland Cement Concrete
	C 94	Spec for Ready Mixed Concrete
	C 116	Comp Strength Using Portions of Beams Broken in Flexure
X	C 138*	Unit Weight, Yield
X	C 138	Air Content, Gravimetric
	C 140	Sampling & Testing Concrete Masonry Units
X	C 143*	Slump of Portland Cement Concrete
	C 157	Length Change of Hardened Cement Mortar and Concrete
X	C 172	Sampling Freshly Mixed Concrete
X	C 173*	Air Content, Volumetric
X	C 174	Measuring Length of Drilled Concrete Cores
X	C 192*	Making & Curing Concrete Test Specimens in the Laboratory
	C 215	Trans , Long & Tors. Frequencies of Concrete Specimens
X	C 231	Air Content, Pressure
	C 232	Bleeding of Concrete
	C 234	Comparing Concrete on the Basis of the Bond Developed with Reinforcing Steel
X	C 293	Flexural Strength (Simple Beam using Center-Point Loading)
	C 311	Sampling & Testing Fly Ash or Natural Pozzolans

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	DESIGNATION	SHORT TITLE
Concrete (continued)		
	ASTM C 341	Length Change of Drilled or Sawed Specimens
	C 360	Ball Penetration
	C 403	Time of Setting by Penetration Resistance
	C 418	Abrasion Resistance of Concrete by Sandblasting
	C 426	Drying Shrinkage of Concrete Block
	C 457	Air-Void Content & Parameters of the Air-Void System
	C 469	Static Modulus of Elasticity & Poisson's Ratio
X	C 495	Compressive Strength of Lightweight Insulating Concrete
X	C 496	Splitting Tensile Strength
	C 512	Creep of Concrete in Compression
X	C 567	Unit Weight of Structural Lightweight Concrete
	C 597	Pulse Velocity through Concrete
X	C 617	Capping Cylindrical Concrete Specimens
	C 642	Specific Gravity, Absorption, & Voids in Hardened Concrete
	C 666	Resistance of Concrete to Rapid Freezing & Thawing
	C 671	Critical Dilation of Conc Specimens Subject to Freezing
	C 672	Scaling Resistance of Surfaces Exposed to Deicing Chems
	C 684	Making, Accelerated Curing & Testing
	C 779	Abrasion Resistance of Horizontal Concrete Surfaces
	C 801	Mechanical Properties of Concrete under Triaxial Loads
	C 803	Penetration Resistance of Hardened Concrete
X	C 805	Rebound Number of Hardened Concrete
	C 823	Exam & Sampling of Hardened Concrete in Construction
	C 856	Petrographic Examination of Hardened Concrete
	C 873	Comp Strength of Concrete Cylinders Cast in Place
	C 900	Pullout Strength of Hardened Concrete
	C 918	Developing Early Age Compression Test Values & Projections
	C 944	Abrasion Resistance by Rotating Cutter Method
Aggregates		
X	C 29	Unit Weight & Voids
X	C 33	Spec for Concrete Aggregates
X	C 40	Organic Impurities in Fine Aggregates for Concrete
X	C 70	Surface Moisture in Fine Aggregates
	C 87	Effect of Organic Impurities on Strength of Mortar
X	C 88*	Soundness of Aggregates by Use of NaSO4 & MgSO4
X	C 117*	Matl Finer than 0 075 mm Sieve in Min Aggs by Washing
X	C 123	Lightweight Pieces in Aggregate
X	C 127*	Specific Gravity & Absorption of Coarse Aggregate
X	C 128*	Specific Gravity & Absorption of Fine Aggregate
X	C 131*	Resistance to Degradation of Small Size Coarse Aggregate by Abrasion & Impact in the Los Angeles Machine
X	C 136*	Sieve Analysis of Fine and Coarse Aggregate
X	C 142	Clay Lumps & Friable Particles in Aggregates
	C 227	Potential Alkali Reactivity of Cement-Aggr Combinations
	C 289	Potential Reactivity of Aggregates (Chemical Method)
	C 295	Petrographic Examination of Aggregates for Concrete
	C 330	Spec for Lightweight Aggregates for Concrete
	C 331	Spec for Lightweight Aggregates for Conc Masonry Units

	DESIGNATION	SHORT TITLE
Aggregates (continued)		
	ASTM C 332	Spec for Lightweight Aggregates for Insulating Concrete
	C 441	Effectiveness of Mineral Admixtures in Preventing Excessive Expansion Due to the Alkali-Aggregate Reaction
X	C 535	Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion & Impact in the Los Angeles Machine
X	C 566	Total Moisture Content of Aggregate by Drying
	C 586	Alkali Reactivity of Carbonate Rocks for Aggregate
	C 641	Staining Materials in Lightweight Concrete Aggregates
X	C 702	Reducing Field Samples of Aggregate to Testing Size
X	D 75	Sampling Aggregates
Cement		
	C 91*	Spec for Masonry Cement
	C 109*	Compressive Strength of Hydraulic Cement Mortars
	C 114*	Chemical Analysis for Hydraulic Cement
	C 115*	Fineness of Portland Cement by the Turbidimeter
	C 150*	Spec for Portland Cement
	C 151*	Autoclave Expansion of Portland Cement
	C 183	Sampling & Acceptance of Hydraulic Cement Mortar
	C 184	Fineness of Portland Cement by 0 15 mm & 0.075 mm Sieves
	C 185*	Air Content of Hydraulic Cement Mortar
	C 186*	Heat of Hydration of Hydraulic Cement
	C 187*	Normal Consistency of Hydraulic Cement
	C 188*	Density of Hydraulic Cement
	C 191*	Time of Setting of Hydraulic Cement by Vicat Needle
	C 204*	Fineness of Portland Cement by Air Permeability Apparatus
	C 266*	Time of Setting of Hydraulic Cement by Gillmore Needles
	C 430*	Fineness of Hydraulic Cement by 0 045 mm Sieve
	C 451*	Early Stiffening of Portland Cement (Paste Method)
	C 452	Pot Expansion of Port Cem Mortars Exposed to Sulfate
	C 595*	Spec for Blended Hydraulic Cements
	C 917	Evaluation of Cement Strength Uniformity from a Single Source
Soils		
	D3740	Practice for Evaluation of Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
X	D 421	Dry Preparation of Soil Samples
X	D 422*	Particle-Size Analysis of Soils
	D 425	Centrifuge Moisture Equivalent of Soils
	D 427	Shrinkage Factors of Soils
X	D 558	Moisture-Density Relations of Soil-Cement Mixtures
X	D 559	Wetting-Drying Tests of Compacted Soil-Cement Mixtures
X	D 560	Freezing-&-Thawing Tests of Compacted Soil-Cement Mixtures
X	D 698*	Moisture-Density Relations of Soils & Soil-Aggregate Mixtures Using 5 5-lb Rammer & 12-in Drop
	D 806	Cement Content of Soil-Cement Mixtures

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	DESIGNATION	SHORT TITLE
Soils (continued)		
X	ASTM D 854*	Specific Gravity of Soils
X	D 915	Testing Soil-Bituminous Mixtures
X	D1140	Amount of Material in Soils Finer than 0 075 mm Sieve
X	D1556	Density of Soil in Place by the Sand Cone Method
X	D1557	Moisture-Density Relations of Soils & Soil-Aggregate Mixtures Using 10-lb Rammer & 18-in Drop
	D1558	Moisture Content Peretration Resistance Relationships of Fine Grained Soils
X	D1633	Compressive Strength of Molded Soil-Cement Cylinders
	D1634	Compressive Strength of Soil-Cement Using Portions of Beams Broken in Flexure (Modified Cube Method)
	D1635	Flexural Strength of Soil-Cement using Simple Beam with Third-Point Loading
X	D2167	Density & Unit Wt of Soil in Place by Rubber-Balloon
X	D2216	Water Content of Soil, Rock & Soil-Aggregate Mixtures
X	D2217	Wet Preparation of Soil Samples
X	D2487	Classification of Soils for Engineering Purposes
X	D2488	Description & Identification of Soils (Visual-Manual)
	D2844*	Resistance R-Value & Expan. Press of Compacted Soils
X	D2922	Density of Soil & Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
X	D2937	Density of Soil in Place by Drive Cylinder Method
X	D3017	Moisture Content of Soil & Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
	D3282	Classification of Soils & Soil-Aggregate Mixtures for Highway Construction Purposes
	D4253	Max Index Density of Soils Using a Vibratory Table
	D4254	Min Index Density of Soils & Calc of Relative Density
X	D4318*	Liquid Limit, Plastic Limit & Plasticity Index of Soils
Bituminous		
X	E 329	Practice for Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction
	D3666	Practice for Evaluation of Inspection & Testirg Agencies for Bituminous Paving Materials
	D 5*	Penetration of Bituminous Materials
	D 6	Loss on Heating of Oil & Asphaltic Compounds
	D 20	Distillation of Road Tars
	D 36	Softening Point of Bitumen (Ring-and-Ball Apparatus)
	D 70*	Specific Gravity of Semi-Solid Bituminous Materials
X	D 75	Sampling Aggregates
	D 88	Saybolt Viscosity
	D 92*	Flash & Fire Points by Cleveland Open Cup
	D 95	Water in Petroleum Prods & Bitum Matls by Distillation
	D 113	Ductility of Bituminous Materials
	D 139	Float Test for Bituminous Materials
X	D 140	Sampling Bituminous Materials
	D 243	Residue of Specified Penetration
	D 244	Testing Emulsified Asphalts

	DESIGNATION	SHORT TITLE
Bituminous (continued)		
X	ASTM D 290	Practice for Bituminous Mixing Plant Inspection
	D 402*	Distillation of Cut-Back-Asphaltic (Bituminous) Products
	D 872	Sulfonation Index of Road Tars
X	D 979	Sampling Bituminous Paving Mixtures
	D1074	Compressive Strength of Bituminous Mixtures
	D1075	Effect of Water & Cohesion of Compacted Bitum Mixtures
X	D1188	Bulk Spec Gravity & Density of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens
	D1461	Moisture of Vol Distillates in Bitum Paving Mixtures
X	D1559*	Resistance to Plastic Flow of Bitum Mixtures Using Marshall Apparatus
X	D1560*	Resistance to Deformation & Cohesion of Bitum. Mixtures by Means of Hveem Apparatus
	D1561	Preparation of Bituminous Mixture Test Specimens by Means of California Kneading Compactor
	D1665	Engler Specific Viscosity of Tar Products
	D1754*	Effect of Heat & Air on Asphaltic Materials (Thin-Film Oven Test)
	D1856*	Recovery of Asphalt from Solution by Abson Method
X	D2041*	Theoretical Max Spec Gravity of Bitum Paving Mixtures
	D2042*	Solubility of Asphaltic Materials in Trichloroethylene
	D2170*	Kinematic Viscosity of Asphalts (Bitumens)
	D2171*	Viscosity of Asphalts by Vacuum Capillary Viscometer
X	D2172*	Quant Extraction of Bitumen from Bitum. Paving Mixtures
X	D2726	Bulk Specific Gravity of Compacted Btuminous Mixtures Using Saturated Surface-Dry Specimens
	D2872*	Effect of Heat & Air on a Moving Film of Asphalt (Rolling Thin-Film Oven Test)
X	D2950	Density of Bituminous Concrete in Place by Nuclear Method
	D3142	Specific Gravity or API Gravity of Liquid Asphalts by Hydrometer Method
	D3143*	Flash Point of Cutback Asphalt with Tag Open Cup Apparatus
X	D3203*	Percent Air Voids in Compacted Dense & Open Bituminous Paving Materials
X	D3549	Thick or Ht. of Compacted Bitum Paving Mixture Specimens
	D4123	Resilient Modulus of Bituminous Mixtures by Repeated-Load Indirect Tensile Test
	D4296	Sampling Pitch
X	AASHTO T30*	Mechanical Analysis of Extracted Aggregates
Roofing		
	ASTM D1863	Spec for Mineral Aggregate Used on Built-Up Roofs
	D1864	Moisture in Mineral Aggregate Used on Built-Up Roofs
	D1865	Hardness of Mineral Aggregate Used on Built-Up Roofs
	D1866	Translucency of Mineral Aggregate Used on Built-Up Roofs
	D2829	Sampling & Analysis of Built-Up Roofs
	D3617	Sampling & Analysis of New Built-Up Roof Membranes

	DESIGNATION	SHORT TITLE
	Steel	
X	ASTM E 329	Practice for Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction

References AISC Manual of Steel Construction; ASME Welding Code, AWS Code for Welding in Building Construction, AWS Specs for Welded Highway & Railroad Bridges

	Field Inspection	
X	AWS, ASME, AISC	Erection, Visual
X	AISC	Bolt-torque
	AISC	Rivet
X	AWS, ASME	Welding, Visual
X	AWS, ASME, AISC	Welding Qualifications
	Shop Inspection	
X	AWS, ASME, AISC	Fabrication
X	AWS, ASME	Welding
X	AWS, ASME	Welder Qualification
	Laboratory Testing	
X	ASTM A 370	Mechanical Tests for Steel Products
X	A 615	Spec. for Deformed & Plain Billet-Steel Bar for Concrete Reinforcement (Tests)
		Metallurgical Analysis

Nondestructive (Laboratory X and/or Field X):

X	ASTM E 543	Practice for Determining the Qualifications of Nondestructive Testing Agencies
X	E 94	Guides for Radiographic Testing [E142 & E431]
X	E 114	Ultrasonic Pulse-Echo Straight Beam Testing by the Contact Method
	E 127	Fabricating & Checking Aluminum Alloy Ultrasonic Standard Reference Blocks
X	E 164	Ultrasonic Contact Examination of Weldments
X	E 165	Liquid Penetrant Inspection [E433]
X	E 213	Ultrasonic Inspection of Metal Pipe & Tubing
	E 214	Immersed Ultrasonic Testing by the Reflection Method Using Pulsed Longitudinal Waves
X	E 273	Ultrasonic Examination of Longitudinal Welded Pipe & Tubing
	E 317	Evaluating Perf Character of Ultrasonic Pulse-Echo Test Systems without Use of Electronic Meas. Instruments
	E 428	Fabrication & Control of Steel Reference Blocks Used in Ultrasonic Inspection
	E 494	Measuring Ultrasonic Velocity in Materials
X	E 709	Magnetic Particle Examination

MEW Admin record
AR104077

WASTE MANAGEMENT PROFESSIONALS

McClelland Engineers has assembled a staff of waste management professionals that have the qualifications and experience to address all aspects of waste management projects Our staff includes the following technical disciplines

Civil Engineering
- Environmental
- Geotechnical
- Construction

Chemistry
Chemical Engineering
Geology
- Hydrogeology
- Geophysics
- Geochemistry

Geochemistry
Industrial Hygiene and Safety

The experience and general technical background of key technical and management staff follow

Name	Education	Experience (years)	Project Assignment
R.B Beck	B S Chem. Eng	4	Chemical Engineer
S.J Bialobok	B.A.Chem M S Geology	12	Geochemistry Regulatory Compliance
G R. Bird	B S Civil Eng M S Civil Eng	23	Remedial Design Construction Management
J M Cibor	B S Civil Eng M S Civil Eng	10	Geotechnical Engineer
J.J Criner	B S Environmental Science	1	Field Investigation Chemistry
J L. Cuddihee	B.A. Geology M.A. Geology	7	Hydrogeology
H.C Day	B.A. Chemistry B.A. Geology M S Geology	8	Hydrogeology Geochemistry Regulatory Compliance
B R Elsbury	B S Mech Eng M S Civil Eng	16	Geotechnical Engineer Remedial Design
J R Hooper	B S Civil Eng M S Civil Eng	25	Geohydrology
G W Keaveny	B S Geological Eng	4	Geotechnical Engineer
L.A. Klostermann	B S Civil Eng M S Civil Eng	4	Geotechnical Engineer

Name	Education	Experience (years)	Project Assignment
A.K. Leong	B S Civil Eng M S Civil Eng	1	Hydrogeology/Environmental Computer Applications
B E McCullough	B S Microbiology	9	Project Manager Environmental Scientist
D G McQuillen	B S Geology M S Geology	5	Geohydrology UST Compliance
G R. Mehdiratta	B S Civil Eng M.S Civil Eng Ph D Civil Eng	16	Project Manager Remedial Design Geotechnical Engineer
H.F Millard	B S Geology	2	Hydrogeology
P C Moore	B S Geology	6	Hydrogeology
W W Parker	B S Civil Eng M S Civil Eng Ph.D Civil Eng	16	Remedial Design Construction Mmgt
S.L. Schwartz	B S Geology/ Hydrogeology	10	Project Manager Hydrogeology Regulatory Compliance
A.M Seifer	B S Geology	2	Hydrogeology
H.J Smahlik	B S Ind Tech M S Ind Hygiene	14	Safety and Industrial Hygiene
A.D Taer	B S Geology M S Geology	3	Hydrogeology
T.H Turton	B S Civil Eng M S Civil Eng	21	Project Manager Geotechnical Engineer

All of McClelland's waste management professionals are trained and experienced in the health and safety aspects of working on hazardous waste sites in compliance with OSHA's rules promulgated in 29 CRF 1910.120. They participate in McClelland's Medical Monitoring Program - a program that documents each professional's initial and continuing health

STANDARD FORM (SF)

254

Architect Engineer and Related Services Questionnaire

1 Firm Name / Business Address

McClelland Engineers, Inc
6100 Hillcroft
P O Box 740010
Houston, Texas 77274

1a Submittal is for ☐ Parent Company ☒ Branch or Subsidiary Office

2 Year Present Firm Established 1955

3 Date Prepared February 24, 1988

4 Specify type of ownership and check below if applicable

Corporation

- ☐ A Small Business
- ☐ B Small Disadvantaged Business
- ☐ C Woman owned Business

5 Name of Parent Company, if any

Fugro-McClelland B V

5a Former Parent Company Name(s), if any, and Year(s) Established

Greer & McClelland - 1946

6 Names of not more than Two Principals to Contact Title / Telephone

1) William J Emrich, P E , President (713) 772-3700
2) Kenneth J Koch, P E , Executive Vice President (713) 772-3700

7 Present Offices City / State / Telephone / No Personnel Each Office

7a Total Personnel 325

Houston, Texas	713-772-3700	177
Dallas, Texas	214-357-3801	16
Austin, Texas	512-444-3233	42
New Orleans, Louisiana	504-733-1754	6
Lake Charles, Louisiana	318-439-1731	10
St Louis, Missouri	314-428-8880	27
Ventura, California	805-644-5535	46
San Antonio, Texas	512-655-9516	1

8 Personnel by Discipline *(List each person only once by primary function)*

40	Administrative
	Architects
2	Chemical Engineers
	Civil Engineers
2	Construction Inspectors
13	Draftsmen
	Ecologists
	Economists
	Electrical Engineers
4	Estimators
16	Geologists
1	Hydrologists
	Interior Designers
	Landscape Architects
4	Mechanical Engineers
	Mining Engineers
	Oceanographers
5	Planners Urban/Regional
	Sanitary Engineers
48	Soils Engineers
	Specification Writers
	Structural Engineers
	Surveyors
	Transportation Engineers
3	Data Processing Experts
32	Drillers, helpers
63	Engineering Technicians
9	Environmental Scientists
1	Hazardous Waste Specialists
4	Laboratory Experts
12	Operation & Maintenance
1	Safety Engineer
11	Testing Experts
8	Materials Engineers

9 Summary of Professional Services Fees Received (Insert index number)

Last 5 Years (most recent year first)

	1987	1986	1985	1984	1983
Direct Federal contract work, including overseas	5	3	3	2	2
All other domestic work	8	8	8	8	8
All other foreign work*	4	8	8	8	8

*Firms interested in foreign work, but without such experience, check here ☐

Ranges of Professional Services Fees

INDEX	
1	Less than $100 000
2	$100 000 to $250 000
3	$250 000 to $500 000
4	$500 000 to $1 million
5	$1 million to $2 million
6	$2 million to $5 million
7	$5 million to $10 million
8	$10 million or greater

MEW Admin record
AR104080

10 Profile of Firm's Project Experience, Last 5 Years

Profile Code	Number of Projects	Total Gross Fees (in thousands)	Profile Code	Number of Projects	Total Gross Fees (in thousands)	Profile Code	Number of Projects	Total Gross Fees (in thousands)
1) 028	42	3,615	11)			21)		
2) 033	153	4,679	12)			22)		
3) 097	4,607	182,098	13)			23)		
4) 106	1,045	9,143	14)			24)		
5) 217	84	8,489	15)			25)		
6) 225	137	2,430	16)			26)		
7) 266	262	6,594	17)			27)		
8)			18)			28)		
9)			19)			29)		
10)			20)			30)		

11 Project Examples, Last 5 Years

Profile Code	"P", "C", "JV", or "IE"	Project Name and Location	Owner Name and Address	Cost of Work (in thousands)	Completion Date (Actual or Estimated)
099 266	P	1 Clay Liner Evaluation Research Houston, Texas	Environmental Protection Agency Contracts Management, S W Cincinnati, Ohio 45268	400 (Fee)	Ongoing
028 033 097 117 266	P	2 Landfill Modernization Plan Casmalia Class 1 Landfill California	Casmalia Resources 559 San Ysidro Road Santa Barbara, California 93150	600 (Fee)	Ongoing
073 077	C	3 Deepwater Pipeline Route Gulf of Mexico	Conoco Inc P O Box 2197 Houston, Texas 77252	600	Ongoing
217 266	P	4 Hazardous Waste Confirmation Studies Point Mugu, California	Department of the Navy Naval Energy and Environmental Support Activity Port Hueneme, California 93043-5014	29 (Fee)	Ongoing
028 033 095 097 114	P	5 Southern California Pipeline System Santa Barbara, San Luis Obispo, Ventura and Los Angeles Counties, California	Four Corners Pipeline Company 5900 Cherry Avenue Long Beach, California 90805	400 (Fee)	Ongoing
042 097 106	P	6 Hydraulic Landfill Construction Port of Los Angeles Los Angeles, California	Port of Los Angeles 425 S Palos Verdes Street San Pedro, California 90733-0151	500 (Fee)	1991
097 109	C	7 Brushy Creek Regional Wastewater System Tunnel Williamson and Milam Counties, Texas	Brushy Creek Water Control and Improvement District No 1 P O Box 882 Taylor, Texas 76574	650 (Fee)	1989

097	C	8 Neutral Buoyancy Laboratory Johnson Space Center Houston, Texas	National Aeronautics & Space Administration Johnson Space Center, Bldg 9 Houston, Texas 77058	21	1988
097	C	9 Drilling and Laboratory Testing Programs Texas and Louisiana Gulf Coasts	U S Army Corps of Engineers Galveston District 400 Barracuda Street Galveston, Texas 77553	250	1988
024 097	C	10 Morris Sheppard Dam Lake Possum Kingdom Mineral Wells, Texas	Brazos River Authority 4400 Cobbs Waco, Texas 76714	950	1988
054 266	P	11 Groundwater Contamination Investigations Various locations	Naval Facilities Engineering Command Southern Division 2144 Melbourne Street Charleston, South Carolina 29411	400 (Fee)	1987
073 097	C	12 Barrier Island Beach Restoration Isle Dernieres, Louisiana	Louisiana Department of Transportation and Development 1201 Capitol Access Road Baton Rouge, Louisiana 70802	105	1987
097 225	C	13 Geologic Hazards Survey Deepwater Lease Clearances Gulf of Mexico	Shell Offshore Inc P O Box 60149 New Orleans, Louisiana 70160	500	1987
046 106	C	14 Runway 8-26 Asphalt Overlay Houston Intercontinental Airport Houston, Texas	City of Houston Public Works Department Airport Engineers Office 16390 Kennedy Blvd Houston, Texas 77032	170	1987
106 265	C	15 South Houston Service Center Houston Lighting & Power Company Houston, Texas	Houston Lighting & Power Company P O Box 1700 Houston, Texas 77001	10 (Fee)	1987
097 106	C	16 George R Brown Convention Center Houston, Texas	City of Houston Public Works Department Engineering Division 900 Bagby Houston, Texas 77002	300 (Fee)	1987
087 097 109	JV C	17 Dallas Area Rapid Transit Subways Dallas, Texas	Dallas Area Rapid Transit 601 Pacific Avenue Dallas, Texas 75202	140 (Fee)	1987
054 266	P	18 Hazardous Waste Site Surveys Task Order Contract	U S Army Engineering Division 106 Wynn Drive Huntsville, Alabama 35807	63 (Fee)	1986
217	C	19 Relief Wells South Texas Nuclear Project Bay City, Texas	Houston Lighting & Power Company P O Box 1700 Houston, Texas 77001	2 000 (Fee)	1986

006 046 097 106	C	20 Runway 9-27 Houston Intercontinental Airport Houston, Texas	City of Houston Public Works Department Airport Engineers Office 16390 Kennedy Blvd Houston, Texas 77032	1 200	1986
042 097	C	21 Waterfront Facilities Lake Charles Navy Homeport Lake Charles, Louisiana	Naval Facilities Engineering Command Southern Division, 2144 Melbourne Street Charleston, South Carolina 29411	20 (Fee)	1986
025 097	C	22 Stacy Dam Coleman and Concho Counties, Texas	Colorado River Municipal Water District P O Box 869 Big Spring, Texas 79720	455 (Fee)	1986
007 097	P	23 Northstar Gravel Island Beaufort Sea, Alaska	Amerada Hess Corporation 550 W 7th Street, Suite 1400 Anchorage, Alaska 99501	350 (Fee)	1986
011 097	C	24 Cable-stayed Suspension Bridge Houston Ship Channel Harris County, Texas	Texas State Department of Highways and Public Transportation, District 12 P O Box 1386 Houston, Texas 77251	1,071 (Fee)	1986
028 033 117	P	25 Community Development Block Grant Program FY 1984-1986 Los Angeles, California	County of Los Angeles Community Development Commission 1436 Goodrich Blvd Los Angeles, California 90022	150 (Fee)	1986
070 097	C	26 Air Combat Training Range Charleston TACTS Offshore Georgia	Naval Facilities Engineering Command Chesapeake Division Navy Yard Washington, D C 20374	1,500 (Fee)	1985
046 097	C	27 Sam Houston Tollway Houston, Texas	Harris County Toll Road Authority 233 Benmar, Suite 620 Houston, Texas 77060	646 (Fee)	1985
054 217 266	C	28 Hydrocarbon Recovery Well Program Miami International Airport Miami, Florida	Miami International Airport P O Box 592098 Miami, Florida 33159	200 (Fee)	1985
070 097	P	29 Pacific Enewetak Atoll Coring Expedition Enewetak Atoll Marshall Islands	Defense Nuclear Agency/SPSS Washington, D C 20305-1000	4,500	1985
048 097	C	30 Veterans Administration Medical Facility 2002 Holcombe Houston, Texas	Veterans Administration 810 Vermont Ave NW Washington, D C 20420	70 (Fee)	1985

12 The foregoing is a statement of facts

Signature William J Emrich Typed Name and Title William J. Emrich, President

Date March 8, 1988

Standard Form 254 July 1975

ATTACHMENT

McCLELLAND ENGINEERS LABORATORY
HEALTH AND SAFETY PROCEDURES
MISSOURI ELECTRIC WORKS RI/FS

1. LABORATORY SAFETY

1 1 Safe Use, Handling and Storage of Chemicals

Chemicals in any form and soil samples containing unknown hazards shall be safety stored, handled and used Attention shall be paid to the labels on the containers concerning the hazardous nature of the chemicals or contaminated sample and precautions that shall be taken while using them. All contaminated soil samples shall be opened and handled under a properly designed ventilated hood with a minimum face velocity of 100 ft per minute

1.2 Gases and Flammable Solvents

Gas cylinders must be securely fastened so that they cannot be dislodged or tipped in any direction. Connections, gages, regulators, or fittings must not be interchanged among cylinders

Flammable solvents must be stored in well-ventilated designated areas Flammable solvents in glass containers shall be stored in fire-proof cabinets

1.3 Protective Clothing

At a minimum, protective goggles or glasses with side shields and a lab apron shall be worn by personnel working with chemicals or contaminated soil samples Dependent on the chemical or suspected contaminant(s) in the soil sample, rubber gloves shall also be worn. Generally, nitrile gloves shall be worn if the contaminant is unknown unless otherwise indicated Other protective clothing such as safety shoes, disposable chemical resistant clothing etc , may be indicated.

1 4 Chemical Hazards

Acids shall be stored together, except for perchloric acid which shall not be placed next to glacial acetic acid Strong mineral acids such as hydrochloric, hydrofluoric, sulfuric and nitric are some of the most hazardous chemicals Organic acids are less hazardous because of their comparatively low ionization potentials, but such acids as phenol (carbolic acid), hydrocyanic, and oxalic are extremely hazardous because of their toxic properties

Oxidizing agents, in contact with organic matter, can cause explosions and fire They are oxothermic and decompose rapidly, liberating oxygen, which reacts with organic compounds

Volatile and corrosive chemicals shall be handled carefully under a fume hood

In the event that chemicals come in contact with skin, immediate washing shall be undertaken A wash basin is provided in the laboratory for eye washing should chemicals come in contact with the eyes Should chemicals be swallowed, immediately contact EMS and the local Poison Control Center Care for shock and check breathing frequently Do not give anything by mouth until advised by medical professionals

1 5 Fire Hazards

There are fire extinguishers strategically located throughout the laboratory Laboratory personnel shall be familiar with the locations and use of these fire extinguishers The laboratory is also equipped with a safety shower, in the event that clothes are on fire

1 6 Training

All laboratory personnel who work with chemicals or contaminated soil samples shall be trained and medically monitored in accordance with OSHA regulation 29CFR1910 120 For specific details see Chap 15, Sec 3, Subsec 2 Health & Safety Training and Chap 15, Sec 3, Subsec 3 Medical Monitoring for Hazardous Materials Personnel

1 7 Other Safety Guidelines

Smoking, drinking and eating in the laboratory are not allowed Only authorized personnel can enter the laboratory Other people entering the laboratory shall get permission from the laboratory manager, and shall be accompanied by an authorized personnel at all time while inside the laboratory When the last authorized person leaves the laboratory at any time, the laboratory door shall be locked to prevent other people from wandering in.

Used chemicals and/or chemical solutions shall not be poured down the drain but shall be retained in waste containers and stored on site for proper disposal at a later date

The quantity of water generated in the laboratory is less than 100 kg (200 lb) per month and a generator or storage permit is not required (40 CFR 261.5)

NEPONSET GEOPHYSICAL CORPORATION

Experience

The NGC staff has extensive experience in conducting geophysical surveys, and resumes of the geophysical staff are enclosed under same cover. Note that all NGC field personnel have received 40-hour health and safety training and are included in the corporate medical monitoring program.

The following case histories are representative of geophysical applications using electromagnetics and magnetics for RI/FS investigations and property transfers. The names of the clients and sites have been omitted to maintain confidentiality.

- A magnetometry/gradiometry survey was conducted at an 8-acre site that was being offered for purchase, and the seller was required to verify the absence of buried hazardous waste on the parcel prior to the property transfer. The survey was conducted using a 12.5-foot grid, and several anomalies were identified. Subsequent exploratory trenching showed that debris existed at all anomalous locations, including a 5-drum cluster containing chemical wastes.

- A magnetometer/gradiometer and an EM31 terrain conductivity meter were used to conduct a survey at a small municipal landfill. The landfill operation consisted of using trenches in somewhat random orientations. The survey was used to better map the boundaries of the known cluster of trenches, verify that additional trenches did not exist, and show that conductive contaminate had migrated off-site.

- An abandoned sand and gravel quarry was used for disposal of municipal and industrial wastes in the 1960's. The landfill boundaries were never accurately determined, and the purpose of the survey was to utilize GPR and EM to define the boundaries of the disposal pit(s). The data from the two methods correlated closely, and based on subsequent excavations, the accuracy of the geophysically defined border was within 2 to 3 feet.

Table 1
Neponset Geophysical Corporation
Staff Experience - Environmental Application

Project	Client/ Owner	Location	Description	Year	Geophysical Project Cost
Sharon Facility	Westinghouse Electric Co	Sharon Pennsylvania	Processing of seismic refraction data for a hydrogeologic assessment	1986	$ 15,000
Conservation Chemical Corp. Site	Front Street Trust	Kansas City Missouri	Seismic refraction to determine feasibility and design parameters for slurry wall construction	1986	35,000
Regional Coal Gasification Assessment	Illinois Power Co	State of Illinois	Industrial archaeology to verify facility plans and waste disposal of abandoned Coal Gasification plants	1986	25,000
Duell & Gardner Site	Michigan DNR	Muskegon Michigan	Definition of buried waste and ground-water contaminate patterns for RI/FS	1986	12,000
Scranton Disposal Site	Paul C Rizzo and Assoc	Scranton Pennsylvania	Located 10 borings on landfill to avoid drilling into potential hazards	1986	5,000
Northrop Envinronmental Audit	Northrop Corporation	Chicago Illinois	Evaluate environmental liability of an industrial property under consideration for purchase	1986	5,000

Table 1
Neponset Geophysical Corporation
Staff Experience - Environmental Application

Project	Client/ Owner	Location	Description	Year	Geophysical Project Cost
Northrop Facility	Northrop Corporation	Chicago Illinois	Confidential - Environmental evaluation	1987	$ 5,000
Aber Road Facility	CECOS International	Williamsburg Ohio	Define bedrock topography and overburden stratigraphy	1987	50,000
Rose Chemical Site	Rose Chemical	Holden Missouri	Locate and define small, scattered drum burials	1987	5,000
Sartomer Chem Site	ARCO Chemical Company	West Chester Pennsylvania	Identify buried utilities that may be conduits for contaminate migration	1987	12,000
Mobil Mining & Minerals Site	Mobil Mining & Minerals Co	Carteret New Jersey	Locate buried objects for subsequent excavation	1987	5,000
Harris Broadcast Quincy Site	Harris Broadcast, Inc	Quincy Illinois	Refraction survey to define bedrock topography & overburden stratigraphy	1987	30,000
Regional Coal Gasification Assessment	Illinois Power Co	State of Illinois	Industrial archaeology to verify facility plans and waste disposal of abandoned Coal Gasification plants	1987	$ 4,000

Table 1
Neponset Geophysical Corporation
Staff Experience - Environmental Application

Project	Client/ Owner	Location	Description	Year	Geophysical Project Cost
Bloomington Service Area Assessment	Illinois Power Co	Bloomington Illinois	Characterization and location of buried materials	1987	5,000
Property Evaluation	Burlington Northern	Brainard Minnesota	Characterization of property to evaluate environmental liability	1988	10,000
Property Evaluation	Illinois Power Co	Champaign Illinois	Survey to evaluate environmental liability prior to sale of parcel	1988	5,000
Industrial Landfill Characterization	Grace	Henry Illinois	Definition of landfill size and character	1988	4,000
Waste Location Property Transfer	US Corps of Engineers	Millington Tennessee	Characterization and location of buried materials	1988	1,500
Trench Identification	IT Corporation	Louisiana	Definition of landfill size and location of buried materials	1988	4,500
Identify Sand Channels	BFI	Ohio	Definition of stratigraphic changes at a sanitary landfill	1988	8,000

Table 2
Neponset Geophyscial Corporation
Summary of Geophysical Survey Capability

- Seismic Reflection
- Seismic Refraction
- Electrical Resistivity
- Electrical Resistivity VES Profiling
- Induced Polarization
- Electromagnetics
- Magnetics
- Micro-Gravity
- Ground Penetrating Radar
- Borehole Logging
- Geotomagraphy
- Acoustic (Sub-Bottom) Profiling
- Gravity/Magnetics Modeling

Note 1   Includes methods under development for use in 1989

Thomas A. Brooks

Project Manager
President, Neponset Geophysical Corporation

Education

B.S. Geophysical Engineering, Colorado School of Mines

Affiliations

Society of Exploration Geophysicists
European Association of Exploration Geophysicists
National Water Well Association
Association of Ground Water Scientists and Engineers

Experience and Background

Mr. Brooks received his B.S. Degree in Geophysical Engineering from the Colorado School of Mines (CSM), and during that time he was employed by the CSM Exploration Research Laboratory where Mr Brooks became experienced in numerous geophysical methods in a research and development environment. Mr. Brooks has over 8 years of practical experience in applied geophysics, and has worked exclusively with engineering applications since 1982. He has been involved in all aspects of project management, and has managed projects that have required 2 to over 90 personnel

In addition to project management, Mr. Brooks is responsible for technical and software developments. He is an experienced geophysical programmer, and has been involved with software implementations for numerous applications In particular, he is adept at implementing technical software on micro- and minicomputer environments.

Mr. Brooks is President and Founder of Neponset Geophysical Corporation (NGC), a firm dedicated to providing quality geophysical services to the engineering and waste management industries since 1985. Mr. Brooks has been involved in adapting geophysical techniques to the engineering and waste management industry, and he has been directly involved in the geophysical investigation of over 100 sites. Mr. Brooks has also been employed as an instructor of geophysical field methods as well as a review editor to technical trade journals.

David W. Marcum

Project Geophysicist
Neponset Geophysical Corporation

Education

B S Geophysical Engineering, Colorado School of Mines

Affiliations

Society of Exploration Geophysicist
Denver Geophysical Society

Experience and Background

Mr. Marcum obtained his B S. Degree in Geophysical Engineering from the Colorado School of Mines (CSM). He currently works at Neponset Geophysical Corporation as a Project Geophysicist, and his current duties include survey design, data acquisition, field management, data analysis/interpretation, and report preparation. He is also responsible for programming geophysical analysis software and other technical developments at NGC. Prior to joining NGC, Mr. Marcum was a geophysical consultant specializing in data acquisition techniques as well as providing data analysis and interpretation.

Mr Marcum was employed at Neotech, Inc. from 1981 through 1986 as an exploration geophysicist where his duties included survey design, data quality testing, data interpretation and computer modeling He has been involved in management of geophysical field crews Prior to obtaining his B S degree, Mr. Marcum was a computer operator for Neotech and a geophysical field technician for the Colorado School of Mines research projects.

Mr. Marcum brings a broad range of personal and practical experience to NGC, and he has been employed as an instructor of geophysical field methods

ATTACHMENT 7-1

QA/QC PLAN/PROCEDURES
(APR LABORATORIES AND McCLELLAND ENGINEERS)
MEW RI/FS

QUALITY CONTROL STATEMENT

I. INTRODUCTION

A. Importance of Quality Control

The role of the analytical laboratory is to provide qualitative and quantitative data to be used in decision making. To be valuable, the data must accurately describe the characteristics or the concentration of constituents in the sample submitted to the laboratory. In many cases, an approximate or incorrect result is worse than no answer at all, because it will lead to faulty interpretations.

Analyses serve many functions, such as the evaluation of raw material or product quality, process monitoring through reaction intermediates, or determination of environmental quality. Decisions made using analytical data are far reaching. For example, standards are set to establish satisfactory conditions for a given product's use, or guidelines are set for effluent quality. The laboratory data defines whether these standards are being met. If the laboratory data indicate a violation of the standard, action is required on the part of operations personnel.

The consequences of faulty analyses can be severe. Decisions on process changes , plant modification, or even the construction of a new facility may be based on the results of laboratory analysis. In environmental analysis, a false high figure can result in unnecessary expense as a manufacturer attempts to correct a non-existent control problem. Conversely, a false low figure can result in inadvertent contamination of the environment. The financial implications alone provide significant reason for extreme care in analysis.

The analyst must always be aware of his responsibility to provide laboratory results that are an adequate representation of the sample. Furthermore, the analyst must be aware that his professional competence, the procedures he has used, and the reported values may be used and challenged in court. To satisfactorily meet this challenge, the analytical data must be backed up by an adequate program to document the proper control and application of all the factors which affect the final result.

Because of the importance of laboratory analysis and the actions taken as a result, a program to ensure the reliability of the data is essential. All analysts practice quality control to varying degrees, depending somewhat upon their training, professional pride, and awareness of the importance of the work they are doing. Under the pressure of the daily workload, however, analytical quality control may be easily neglected. ' An established control program, applied routinely to every analytical test, is vital to assuring the reliability of the final results.

B. Functions of Quality Control

The quality control program has two primary functions:

1. Control of the quality of analyses, in order to meet the program requirements for reliability

2. Measurement of quality (monitoring the reliability of the results reported)

For example, the processing of spiked or duplicate samples is a measurement of quality, while the use of analytical grade reagents is a control measure.

Just as each analytical method has a rigid protocol, so the quality control associated with that test must also involve definite required steps to monitor and assure that the result is correct. The steps in quality control will vary with the type of analysis. For example, in an instrumental method, the check-out of the instrument response and the calibration of the instrument in concentration units is also a quality control function. Ideally, all variables which can affect the final answer should be considered, evaluated, and controlled.

This handbook considers the factors which go into creating an analytical result, and provides recommendations for the control of these factors in order to insure that the best possible answer is obtained. In addition, protocols are established for routine monitoring of the quality of results, using spikes, duplicates, and samples of known concentrations. A program based on these recommendations will give the analyst and his supervisor confidence in the reliability and representative nature of the sample characteristics being reported.

C. Responsibility

Without exception, the final responsibility for the reliability of the analytical results submitted rests with the laboratory manager.

The laboratory manager retains ultimate responsibility for all of the following:

1. Training personnel
2. Insuring reliability of test results
3. Maintaining appropriate records
4. Monitoring the quality control program
5. Making sure that the instruments are accurate and properly calibrated

D. Analytical Methods

In general, the widespread use of an analytical method indicates that it is a reliable method of analysis (or the most reliable method available), and this fact tends to support the validity of the test result reported. Conversely the use of a little-known technique forces the data user to place faith in the judgement of the analyst. When the analyst uses a "private" method, or one not commonly accepted in the field, he must stand alone in defending both his choice of the method and the results obtained.

The need for standardization of methods is readily apparent. Uniform methods between laboratories are also important in order to remove the methodology as a variable in comparison or joint use of data between locations. Uniformity of methods is particularly important when laboratories are providing data to a common data bank. A lack of standardization of methods raises doubts of the validity of the results reported. The use of different analytical procedures to measure the same constituent, whether within one laboratory, or in several laboratories, raises the question of which procedure is superior, and why the superior method is not used throughout.

The physical and chemical methods used should be selected by the following criteria:

1. The method should measure the desired constituent with sufficient precision and accuracy to meet the data needs, in the presence of the interferences normally encountered in the sample stream.
2. The selected method should have been sufficiently tested to establish its validity.
3. Where available, methods specified by federal, state, or local statute, or those approved by a regulatory agency or other appropriate organization should be selected in preference to methods not so approved.
4. The procedure should utilize equipment and skills normally available in the analytical laboratory, and be economically feasible.
5. The method should be sufficiently rapid to permit routine use for the examination of large numbers of samples, and to provide data within the time frame required.

Regardless of the analytical method used, the specific methodology should be carefully documented. Statements regarding the methods used in arriving at laboratory data must be clearly and honestly stated. The methods used must be adequately referenced and the procedures applied exactly as described.

Knowing the specific method which has been used, the reviewer can apply the associated precision and accuracy of the data when interpreting the laboratory results. If the analytical methodology is in doubt, the data user may honestly question the reliability of the result he is to interpret.

The advantages of strict adherence to accepted methods should not stifle investigations leading to improvements in analytical procedures. In spite of the value of well-documented, accepted methods, occasions do arise when a procedure must be modified to eliminate unusual interference, yield increased sensitivity, or minimize unacceptable delays. When modification is necessary, the revision should be carefully worked out to accomplish the desired result. It is advisable to assemble data using both the regular and the modified procedures to show the superiority of the latter. This useful information can be brought to the attention of the individuals and groups responsible for methods standardization. For maximum benefit, the modified procedure should be rewritten in the standard format so the the substituted procedure can be used throughout the laboratory for routine examination of samples. Responsibility for the use of a non-standard procedure rests with the analyst and his supervisor, since such use represents a departure from accepted practice.

In field operations, the problem of transport of samples to the laboratory, the need for an immediate response to changing conditions, or the need to examine a large number of gross values will sometimes require the use of rapid field methods yielding approximate answers. Such methods should be used with caution, and with a clear understanding that the results obtained do not compare in reliability with those obtained using standard laboratory methods. the fact that "quick and dirty" methods have been used should be noted, and the results should not be reported along with more reliable laboratory derived analytical information. The data user is entitled to know that approximate values have been obtained for screening purposes only, and that the results do not represent the customary precision and accuracy obtained in the laboratory.

E. Scope

This manual is the basic policy manual for all analytical procedures used at APR Laboratories. All emnployees will be familiar with this manual. Any exceptions to the policies and procedures stated in this manual must be be approved by the laboratory manager, and will be noted in the appropriate records.

TABLE 1

PARAMETER	DAILY QUALITY CONTROL REQUIREMENTS
pH	Calibration with 2 standards
Conductivity	Calibration with 1 standard
TSS	Analysis of one blank and duplicates on a 10% basis (at least one duplicate)
BOD	Analysis of a blank, a standard and duplicates on a 10% basis (at least one duplicate)
TDS	Analysis of a blank and duplicates on a 10% basis (at least one duplicate)
Oil and Grease	Analysis of a blank and a standard or a duplicate
Alkalinity	Analysis of a standard and duplicates on a 10% basis (at least one duplicate)
All other titrimetric analyses	Analysis of 2 standards, duplicates and spikes on a 10% basis (at least one duplicate and spike)
All colorimetric analyses and specific ion probe analyses (spike not required for phenol or sulfide analysis)	Analysis of a standard, duplicates and spikes on a 10% basis (at least one duplicate and spike
TOC analyses	Analysis of 2 standards, duplicates and spikes on a 10% basis (at least one duplicate and spike)
Atomic absorption analyses	Analysis of 2 standards, duplicates and spikes on a 10% basis (at least one duplicate and spike)
Gas chromatography analyses	Analysis of blank and 1 standard, duplicates and spikes on 10% basis (at least one duplicate and spike per month)

IV. LABORATORY PROTOCOL: ORGANIC CONSTITUENTS

TABLE OF CONTENTS

A. SAMPLE COLLECTION

Sample collection is monitored for contamination by the use of a field blank. The field blank also verifies that the sample was not contaminated during shipment. A field blank results from contacting all sampling equipment with reagent water. This blank is then analyzed in the same manner as the sample. Field blanks for purgeables are sent from the laboratory to the sampling site and returned as a check on possible contamination of the sample by permeation of volatiles through the septum seal. Field blanks for non-aqueous media are determined by the methods used.

B. SAMPLE PREPARATION

Three major areas must be monitored in sample preparation: preservation, extraction/concentration, and clean-up. All three steps are not necessarily a part of all analytical methods. For example, the use of clean-up techniques is not always required for gas chromatograph/mass spectrometry analyses, but is often needed for chlorinated pesticides analysis. In order to evaluate each of these aspects of sample preparation, the following QC mechanisms are presented.

1. Holding Time Evaluation

The preservation techniques employed may be affected by the sample matrix. Often it is impossible to monitor these effects. By preparing a synthetic sample of the same media as the real samples and analyzing it after a period of time, the preservation technique can be monitored and its performace evaluated.

Prepare an aliquot of clean water, soil, or whatever media is being tested by placing an amount similar to the nominal sample size into a sample container. Add a known amount of chemicals being measured by the method to the aliquot. Thoroughly mix the aliquot and preserve identically to real samples. Hold the aliquot for a time corresponding to the longest time a real sample will be held. Analyze the aliquot and determine the recovery of the chemicals. Compare these results to results of identical aliquots spiked and analyzed immediately.

2. Matrix Spiked Sample

During routine use of a validated method, a representative number of real samples are spiked (fortified) with the componenets of interest. If the analysis is for a small number of particular chemicals, the samples are spiked with all of the components of interest. If the analysis is a scan for a large group of chemicals, then a smaller representative group of chemicals is selected. The specific chemical chosen are listed as parts of the individual methodologies.

Spiking concentrations are dependent upon the backgound levels in the original sample. When spiking for a scan analysis, nominal spiking levels are used as described by the methods. If a small number of specific chemicals are being measured, the original sample is analyzed first. If the background concentration is greater than the midpoint of the calibration curve, the concentration of the spike should be equal to the original sample concentration.

Calculate the recovery of individual spiking components as follows:

$$\text{\% Recovery (accuracy)} = \frac{(SSR-SR)}{SA} \times 100$$

Where: SSR = spiked sample result
SR = sample result
SA = spike added

The recovery data are summarized in the ORGANICS QUALITY CONTROL RECORD by analyte or on the ORGANICS QC WORKSHEET for multi-analyte results. The sample data are compared to the mean ± 3 standard deviations of the method validation or other previous results. If the result is within this range, the data are acceptable. If the results are outside this range for more than 2 components in the spike mix, the analysis should be repeated. The mean and standard deviation of the recoveries for each component are updated periodically as additional data become available.

3. Surrogate Spiked Sample

Specific compound analysis of samples by gas chromatography/mass spectrometry allow the spiking of real samples with isotope labeled or nonprobable organics to determine recoveries in every sample. Each method using this technique lists the compounds and concentrations of surrogate spiking compounds to be used.

Every sample, matrix spiked sample, and duplicate sample and reagent blank is spiked with the surrogate components before preparation. The percent recovery is calculated and recorded as in

Section2.2.3. If the recovery falls outside the mean ±3 standard deviation range, the sample is prepared again to verify the matrix effect.

4. Duplicate Sample

A duplicate extraction results from splitting a sample and extracting equal amounts of it using the same procedure. Ideally, the results will be identical. However, variations in the procedure will cause differences. These differences are a measure of the precision of the method in real operating circumstances.

During routine use of a method, a representative number of samples must be split and analyzed in duplicate. NOTE: Provisions should be made before sampling to collect additional sample for this purpose. The duplicates should be analyzed as routine samples and the final results compared. Calculate the mean, difference, and standard deviation of the duplicate values and record on side of ORGANICS QUALITY CONTROL RECORD. For any group of duplicate analyses that are considered similar to each other, their differences and means can be used to estimate the critical differance (R_c) between similar future duplicate analyses. Calculate R_c as follows:

$$R_c = \frac{3.27(c)}{n} \mathop{}_{i=1}^{n} \begin{matrix} R_i \\ x_i \end{matrix}$$

c = concentration level
n = number of duplicate analyses
R_i = difference of duplicate pairs
X_i = mean of duplicate pairs

From these data, develop a table of R_c values for various concentration values. Use these initial critical difference values to judge the acceptability of succeeding duplicate results generated under the same conditions. Revise and update as additional duplicate data becomes available. When more than 15 pairs of duplicates are available within any specific concentration level, c, R_c should be calculated directly from the average range of these duplicates alone. Thus, R_c is calculated as follows:

$$R_c = \frac{3.27(c)}{n} \mathop{}_{i=1}^{n} R_i$$

5. Method Blank

A method blank is the resultant extract from the analysis of pure, organic free reagent water. More generally, a reagent blank is generated by passing clean matrix through the entire analytical scheme.

Method blanks are used in all analyses to verify, qualitatively, that no false positives will occur and quantitatively, that concentrations are accurate and do not reflect contamination.

6. Clean-up

Extracts which contain many interferences may require clean-up before analysis. Clean-up is generally, though not always, accomplished with a solid adsorbent such as alumina or Florisil. The adsorbent must be calibrated before being used routinely to insure that fractionation patterns are correct and recovery from the adsorbent is complete. This is done by subjecting a standard to the clean-up procedure. Each method which includes a clean-up procedure specifies a calibration standard. In addition, the recovery of each compound through the system shoule be verified by subjecting a standard solution of the compound to the clean-up. The results are recorded in the SAMPLE CLEAN-UP PERFORMANCE RECORD.

C. DEFINITION OF AUDIT LEVELS FOR SAMPLE PREPARATION

1. Sample preparation audits are performed a representative number of times. For the purpose of this document,"a representative number" means: One audit of that type performed for every 20 samples analyzed. If fewer than 20 samples are received, they are batched into groups of 20 for QC purposes.

D. SAMPLE ANALYSIS

1. All analyses are recorded in logbooks assigned to each type of instrument. All runs performed on an instrument are recorded in the logbooks. Each run, is numbered sequentially and recorded in the logbook.

The same basic technique are used for quality control audit in all chromatographic techniques except GC/MS, including gas chromatography with flame ionization, electron capture, nitrogen phosphorous detection, etc. and high pressure liquid chromatography. The steps involve calibrating the

GC with a standard mix, preparing a calibration curve, and analyzing standards to confirm the continued validity of the calibration curve.

2. Standard Mix

A standard mix is a solution of two or more compounds of known concentration in an organic solvent. A standard mix is used to audit the performance of the chromatographic system. Both qualitative (retention times) and quantitative (response) performances are monitored by the routine analysis of this solution. Each type of chromatograph/detector system is monitored by a different standard mix. These mixes and the concentrations used are given in the particular methods. The appropriate standard mix is analyzed daily, before routine analytical work begins. The results of the analysis are entered in the INSTRUMENT CALIBRATION RECORD. An instrument is considered functional and ready for routine analyses when the following criteria are met:

a. The retention time of two specified compounds deviates less than 3 standard deviation units from the average value. The average and standard deviation values are determined by analyzing a standard a minimum of ten times and calculating the average retention time and standard deviation.

b. The area counts of the same two compounds are above a certain minimum area count The minimum area count is established by analyzing a standard a minimum of ten times, calculating the average area count and dividing by 2.

c. The resolution between two critical peaks must be greater than given value. The peaks chosen and the resolution value needed are given in each method for each chromatographic system. Resolution is defined as follows:

$$R = \frac{2(RT_2-RT_1)}{W_2+W_1}$$

where R = Resolution
RT_2 = the retention time of peak 2
RT_1 = the retention time of peak 1
W_2 = the width of peak 2 at half-height
W_1 = the width of peak 1 at half-height

If these criteria are not met, the standard mix should be reanalyzed. If the results do not change, the chromatographic system must be trouble-shooted. Problems may arise from a leaking septum, a dirty detector, or a deteriorating column, to name a few possibilities.

The INSTRUMENT CALIBRATION RECORD is kept in a binder with information concerning maintenance required on the system. Thus, a complete record on the performance of the instrument is available.

3. Calibration curves and Standards

Definition—Calibration curves are prepared from the results of the analysis of at least three standards and a blank. Calibration curves are plots of the instrument response versus concentration. Typically, the plot will be linear. A plot is defined as linear if the correlation coefficient (R) calculated from linear regression analysis is 0.996 or greater.

Application—Each component being analyzed is standardized by analysis of at least three standards and a blank. The standards concentrations should be evenly distributed throughout the range of the method. The calibration data are plotted and applied to a least squares regression analysis.

$$m = \frac{n(\ xy) - (\ x)(\ y)}{n(\ x^2) - (\ x)^2}$$

$$b = \frac{y - b(\ x)}{n}$$

$$R = \frac{n(\ xy) - (\ x)\ (\ y)}{(n(\ x^2) - (\ x)^2)\ (n(\ y^2) - (\ y)^2)}$$

where: m = slope of line
n = number of x,y pairs
x = insturment response
y = concentration of standards
b = intercept of line
R = correlation coefficient

The slope of the line is the response factor and the correlation coefficient is a measure of the fit of the line to the data (linearity). If the response is not linear, additional data points are required to define the response curve. The calibration curve is checked by analyzing standards. The response of the standards should be such that the response factor (slope) of the calibration curve calculated with the new data is within ±20% of the original response factor.

E. DATA REDUCTION

1. GC Retention Times

The GC retention time for each suspect peak is compared with the retention time of a pure chemical.

Each peak identification is checked. If the retention time is not correct, the identification is void. If the retention time is correct, the sample is analyzed under a different set of chromatographic conditions to verify ne identification. Acceptable retention time windows are defined by the method being used.

2. Peak Measurement and Calcuations

The computer or manual area, peak height or other measurement is audited.

The measurement process is audited when possible. GC peaks determined by computer cannot be directly checked. Relative instrument responses from peaks of the same size, however, can be compared to catch gross errors.

The concentration of a given component is calculated in the following manner:

$$C = A \times RF$$

where C = concentration
A = area or peak measurement
RF = response factor

It is also acceptable to calcualte concentration based on direct comparison with a standard, providing this standard is within ±10% of the concentration of the unknown.

F. OTHER AUDIT PROCEDURES

1. Completeness and Accuracy of Data

Completeness is having all the support and audit data to document the reported results. Accuracy is the verification of reported data tables.

Each projects' data must be checked to assure adequate support and audit data are available. If additional information is needed, it should be collected as soon as possible before finished data are approved. In addition, all data charts and tables reported must be checked over to verify their accuracy.

2. External Audit Samples

External audit samples are standard solutions prepared by an outside source which are analyzed as unknowns. The purpose of analyzing audit samples is to monitor the accuracy of analytical methods. Audit samples should be analyzed semi-annually or whenever available.

G. QUALITY CONTROL CHARTS

1. Many quality control checks are used in the course of routine analysis. The results of these checks may often be quickly assessed by using quality control charts.
2. Record the results from a number of tests. After about 10 values, calculate the mean and standard deviation of the results. Record them on the control chart. Set up the scale of the graph and plot the values.

3. If the subsequent results show bias or values ±2 standard deviations, the method must be evaluated to determine and remedy the problem.

OVERVIEW

OPERATION	PROCEDURE	AUDIT	FREQUENCY
SAMPLE PREPARATION	Extraction/Concentration	Method Blank	2
		Field Blank	2
		Spike	2
		Duplicate	3
	Clean-up	Standard	6
SAMPLE ANALYSIS	GC, HPLC	Standard Mix	4
		Standards	3
DATA REDUCTION	Qualitative	GC Retention Times	5
		Verification by Second Analysis	5
	Quantitative	Peak Measurement	5
		Calculations	5
DATA REPORTING		Completeness	1
		Accuracy	1

FREQUENCY CODES:
1 once per project
2 once per 20 samples
3 once per 10 samples or at least daily
4 daily
5 in every case
6 as new reagents are received

SAMPLE CLEAN-UP PERFORMACE RECORD

For recording performance data for sample
clean-up columns such as Florisil

SAMPLE CLEAN-UP PERFORMANCE RECORD

parameter ______ method ______ analyte ______________ adsorb ______

run number												
date												
concentration												
FR 1												
FR 2												
FR 3												
FR 4												
FR 5												
FR 6												
FR 7												
FR 8												
FR 9												
FR 10												
FR 11												
FR 12												
total recovery												
average												
no runs in average												
std dev												
% RSD												
analyst												

MEW Admin record
AR104114

ORGANICS QUALTIY CONTROL RECORD - 1

ORGANICS QUALITY CONTROL RECORD - 2

ORGANICES QUALITY CONROL WORKSHEET

ORGANICS QUALITY CONTROL RECORD

parameter ______ method ______ analyte ______ matrix ______

no	date	analyst	amnt of spike	spiked into			percent recovery	avg	std dev	%RSD
				blank	samp. no	description				

MEW Admin record
AR104116

parameter______ method______ analyte______ matrix______

o.	date	analyst	sample		value 1	value 2	diff	avg	std dev	%RSD
			no	description						

ORGANICS QC WORKSHEET

SAMPLE NO	parameter	method		analyst	date

COMPONENT	DUPLICATE			SPIKE			
	VALUE	VALUE	DIFF	ADDED	ORIG	TOTAL	% RECOVERY

ORGANIC INSTRUMENT LOGBOOK

GC INSTRUMENT CODE LOG

Used for establishing alphabetic code
for reference to particular instruments.

CHROMATOGRAPHIC COLUMN LOG

Used for storage of information about
preparation and conditioning of GC columns.

GC INSTRUMENT CODE LOG

code	description	s/n	detector(s)

CHROMATOGRAPHIC COLUMN LOG

column no	description	for inst. code(s)	prepared		conditioned			repacked or broken
			date	anal	temp &	date	anal.	

CHROMATOGRAPH CALIBRATION RECORD

inst. code
inst. type
detector
column no.
phase & type
conditions
param(s)
method(s)

	run no.	date	anal.	compound		compound		resolution		
				rt	area	rt	area	rt	rt	R
acceptable ranges										

GC CONDITIONS										DETECTOR CONDITIONS							
COL. NO	PHASE	INJ °C	INIT °C	INIT. min	PROG °C/min	FINAL °C	FINAL min	FLOW cc/min	CAP PRESS psig	TYPE	ATTEN	SENS RANGE	TEMP °C	MASS RANGE	SCAN TIME (sec)	SETUP FILENAME	ANALYST

COMMENTS

• autosampler position	sample description	sample no.	date	%sol/vol	inj vol	std amnt	int std added	run no.	disk / tape file	comments	analyst

QUALITY CONTROL CHART

parameter	method	value

comments

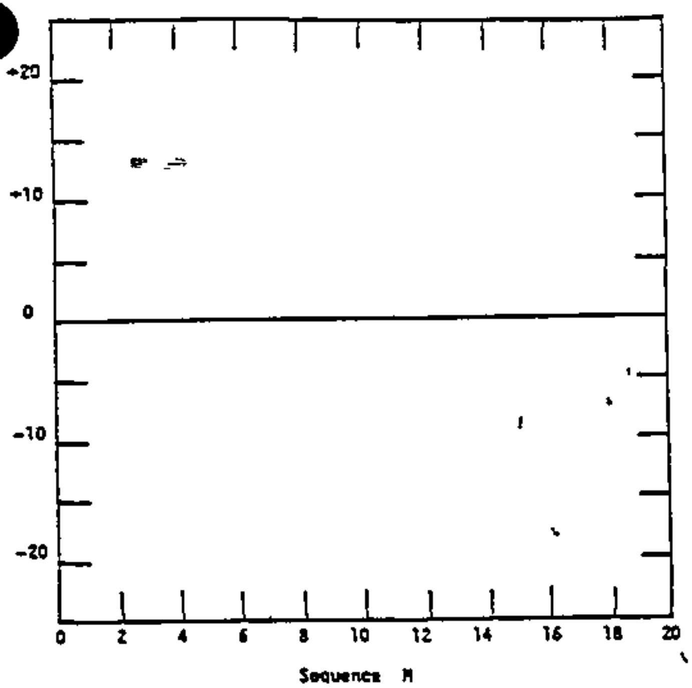
LIMITS	-2 std dev	-1 std dev	mean	+1 stddev	+2 std dev

date	anal	value	scale

Target Y = 0%

Acceptance Y = ± ________%

$Y = \pm \left| \frac{A - B}{A + B} \right| 100$



Parameter ____________________ Conc Range ____________

Method ____

Analyst ____

Sequence M	Sample Number	Duplicate Set A	Duplicate Set B	% Deviation ± Y
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

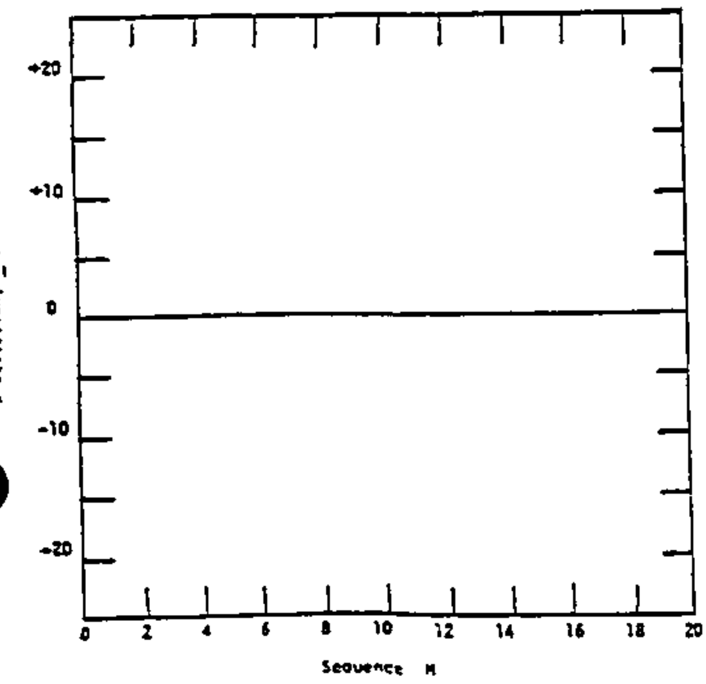
Reviewed By ____________________ Date ____________

ANALYTICAL PRECISION CONTROL CHART

Target Y = 0%

Acceptance Y = ± ________%

$Y = \pm \left| \frac{A - B}{A + B} \right| 100$



Parameter ____________________ Conc Range ____________

Method ____

Analyst ____

Sequence M	Sample Number	Duplicate Set A	Duplicate Set B	% Deviation ± Y
1				
2				
3				
4				
5				
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20				

Reviewed By ____________________ Date ____________

TEST METHOD

CERT NO.	STD	COUNTS	DIL.	RESULTS MG/L	DATE	TIME	ANALYST	DETECTION LIMIT	Remarks - QA Other Calculations

Date__________Time__________Analyst __________

Duplicate 1__________Duplicate 2 __________

Spike__________% Recovery__________

Total # Samples__________Total # Dup. & Spikes __________

Date O.K.'D__________Signed __________

Remarks __________

____

Initial Calibration Data
Volatile HSL Compounds

Case No ______________ Instrument I D ______________

Laboratory Name ______________ Calibration Date ______________

Minimum $\overline{RF}$ for SPCC is 0 300 (0 25 for Bromoform) Maximum % RSD for CCC is 30%

Laboratory ID								
Compound	RF_{20}	RF_{50}	RF_{100}	RF_{150}	RF_{200}	$\overline{RF}$	% RSD	CCC SPCC*
Chloromethane								• •
Bromomethane								
Vinyl Chloride								•
Chloroethane								
Methylene Chloride								
Acetone								
Carbon Disulfide								
1 1 Dichloroethene								•
1 1 Dichloroethane								• •
Trans 1 2 Dichloroethene								
Chloroform								•
1 2 Dichloroethane								
2 Butanone								
1 1 1 Trichloroethane								
Carbon Tetrachloride								
Vinyl Acetate								
Bromodichloromethane								
1 2 Dichloropropane								•
Trans 1 3-Dichloropropene								
Trichloroethene								
Dibromochloromethane								
1 1 2 Trichloroethane								
Benzene								
cis 1 3 Dichloropropene								
2 Chloroethylvinylether								
Bromoform								• •
4-Methyl 2 Pentanone								
2 Hexanone								
Tetrachloroethene								
1 1 2 2-Tetrachloroethane								• •
Toluene								•
Chlorobenzene								• •
Ethylbenzene								•
Styrene								
Total Xylenes								

RF Response Factor (subscript is the amount of ug/L)
$\overline{RF}$ Average Response Factor
%RSD Percent Relative Standard Deviation

CCC Calibration Check Compounds (•)
SPCC System Performance Check Compounds (••)

Form VI

GC/MS TUNING AND MASS CALIBRATION

Bromofluorobenzene (BFB)

Case No ____________ Laboratory Name ______________________________

Instrument ID ____________ Date ____________________ Time ____________

Data Release Authorized By ______________________________

m/e	ION ABUNDANCE CRITERIA	%RELATIVE ABUNDANCE
50	15.0 40.0% of the base peak	
75	30.0 60.0% of the base peak	
95	Base peak 100% relative abundance	
96	5.0 9.0% of the base peak	
173	Less than 1.0% of the base peak	
174	Greater than 50.0% of the base peak	
175	5.0 9.0% of mass 174	( )[1]
176	Greater than 95.0% but less than 101.0% of mass 174	( )[1]
177	5.0 9.0% of mass 176	( )[2]

[1] Value in parenthesis is % mass 174

[2] Value in parenthesis is % mass 176

THIS PERFORMANCE TUNE APPLIES TO THE FOLLOWING SAMPLES BLANKS AND STANDARDS

SAMPLE ID	LAB ID	DATE OF ANALYSIS	TIME OF ANALYSIS

FORM V

MEW Admin record
AR104128

GC/MS TUNING AND MASS CALIBRATION
Decafluorotriphenylphosphine (DFTPP)

Case No ______ Laboratory Name ______

Instrument ID ______ Date ______ Time ______

Data Release Authorized By ______

m/e	ION ABUNDANCE CRITERIA	%RELATIVE ABUNDANCE
51	30.0 - 60.0% of mass 198	
68	less than 2.0% of mass 69	( )[1]
69	mass 69 relative abundance	
70	less than 2.0% of mass 69	( )[1]
127	40.0 - 60.0% of mass 198	
197	less than 1.0% of mass 198	
198	base peak, 100% relative abundance	
199	5.0 - 9.0% of mass 198	
275	10.0 - 30.0% of mass 198	
365	greater than 1.00% of mass 198	
441	present, but less than mass 443	
442	greater than 40.0% of mass 198	
443	17.0 - 23.0% of mass 442	( )[2]

[1] Value in parenthesis is % mass 69

[2] Value in parenthesis is % mass 442

THIS PERFORMANCE TUNE APPLIES TO THE FOLLOWING SAMPLES, BLANKS AND STANDARDS

SAMPLE ID	LAB ID	DATE OF ANALYSIS	TIME OF ANALYSIS

FORM V

Initial Calibration Data
Semivolatile HSL Compounds
(Page 2)

Case No ____________ Instrument ID ____________________

Laboratory Name ____________________ Calibration Date ____________________

Minimum $\overline{RF}$ for SPCC is 0 050 Maximum % RSD for CCC is 30%

Laboratory ID								
Compound	RF_{20}	RF_{50}	RF_{80}	RF_{120}	RF_{160}	$\overline{RF}$	% RSD	CCC SPCC**
2 4 Dinitrotoluene								
2 6 Dinitrotoluene								
Diethylphthalate								
4 Chlorophenyl phenylether								
Fluorene								
4 Nitroaniline	†							
4 6 Dinitro 2 Methylphenol	†							
N Nitrosodiphenylamine (1)								•
4 Bromophenyl phenylether								
Hexachlorobenzene								
Pentachlorophenol	†							•
Phenanthrene								
Anthracene								
Di N Butylphthalate								
Fluoranthene								•
Pyrene								
Butylbenzylphthalate								
3 3 Dichlorobenzidine								
Benzo(a)Anthracene								
bis(2 Ethylhexyl)Phthalate								
Chrysene								
Di n Octyl Phthalate								•
Benzo(b)Fluoranthene								
Benzo(k)Fluoranthene								
Benzo(a)Pyrene								•
Indeno(1 2 3 cd)Pyrene								
Dibenz(a h)Anthracene								
Benzo(g h i)Perylene								

Response Factor (subscript is the amount of nanograms)
$\overline{RF}$ -Average Response Factor
%RSD Percent Relative Standard Deviation
CCC -Calibration Check Compounds ( )

SPCC System Performance Check Compounds (**)
† Not detectable at 20 ng
(1) Cannot be separated from diphenylamine

Form VI

MEW Admin record
AR104130

Initial Calibration Data
Semivolatile HSL Compounds
(Page 2)

Case No ____________ Instrument ID ____________

Laboratory Name ____________ Calibration Date ____________

Minimum $\overline{RF}$ for SPCC is 0 050 Maximum % RSD for CCC is 30%

Laboratory ID								
Compound	RF_{20}	RF_{50}	RF_{80}	RF_{120}	RF_{160}	$\overline{RF}$	% RSD	CCC SPCC *
2 4 Dinitrotoluene								
2 6 Dinitrotoluene								
Diethylphthalate								
4 Chlorophenyl phenylether								
Fluorene								
4 Nitroaniline	↑							
4 6 Dinitro 2 Methylpheno	↑							
N Nitrosodiphenylamine (1)								•
4 Bromophenyl phenylether								
Hexachlorobenzene								
Pentachlorophenol	↑							•
Phenanthrene								
Anthracene								
Di N Butylphthalate								
Fluoranthene								•
Pyrene								
Butylbenzylphthalate								
3 3 Dichlorobenzidine								
Benzo(a)Anthracene								
bis(2 Ethylhexyl)Phthalate								
Chrysene								
Di n Octyl Phthalate								•
Benzo(b)Fluoranthene								
Benzo(k)Fluoranthene								
Benzo(a)Pyrene								•
Indeno(1 2 3 cd)Pyrene								
Dibenz(a h)Anthracene								
Benzo(g h i)Perylene								

Response Factor (subscript is the amount of nanograms)

$\overline{RF}$ -Average Response Factor

%RSD Percent Relative Standard Deviation

CCC -Calibration Check Compounds (*)

SPCC System Performance Check Compounds (**)

↑ Not detectable at 20 ng

(1) Cannot be separated from diphenylamine

Form VI

MEW Admin record
AR104131

ATTACHMENT

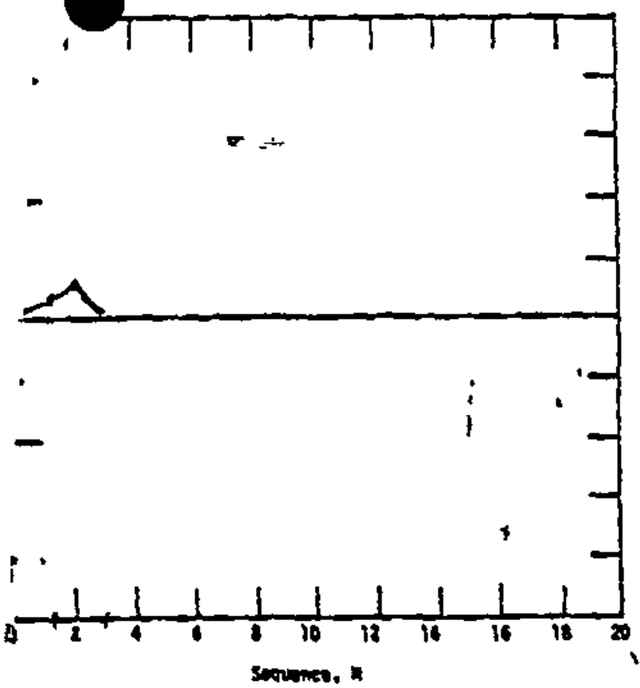
APR LABORATORIES EXAMPLE WORK SHEETS
MISSOURI ELECTRIC WORKS RI/FS

ANALYTICAL PRECISION CONTROL CHART

Target Y = 0%

Acceptance Y = ± ________ %

$Y = \pm \left| \frac{A - B}{A + B} \right| 100$



Parameter *Aluminum* Conc Range ________

Method *202.1*

Analyst *MJ*

Sequence N	Sample Number	Duplicate Set A	Duplicate Set B	% Deviation ± Y
1	42761	128	125	1.18
2	42279	125	132	2.04
3	43740	272	270	0.36
4				
5				
6				
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8				
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19				
20				

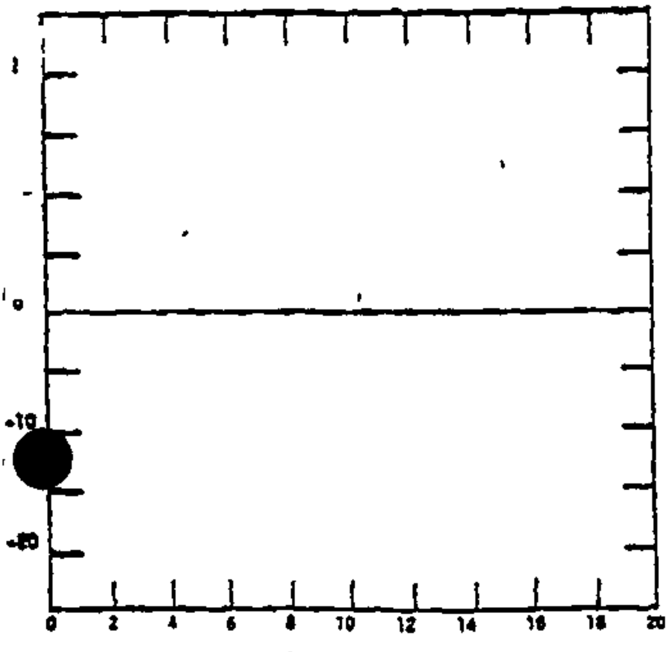
Reviewed By ________ Date ________

ANALYTICAL PRECISION CONTROL CHART

Target Y = 0%

Acceptance Y = ± ________ %

$Y = \pm \left| \frac{A - B}{A + B} \right| 100$



Parameter ________ Conc Range ________

Method ________

Analyst ________

Sequence N	Sample Number	Duplicate Set A	Duplicate Set B	% Deviation ± Y
1				
2				
3				
4				
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19				
20				

Reviewed By ________ Date ________

TEST: ALUMINUM METHOD· 202.1

CERT. NO.	STD	COUNTS	DIL.	RESULTS MG/L	DATE	TIME	ANALYST	DETECTION LIMIT	Remarks - QA Other Calculations
		0		0	2/1	1530	mz	0.1	
	5ppm	210							
	2.5ppm	100							
	0.5ppm	22							$\bar{x}$ = 126.5
42761		128	1:10	32.0					%D = 1.18
Dup		125	1:10	31.2					%Rec = 146 − 126(10)
Spike		146	1:10	36.5					22
									%Rec = 90.9

Date 2/1 Time 1530 Analyst mz

Duplicate 1 128 Duplicate 2 125

Spike 146 % Recovery 90.9

Total # Samples 1 Total # Dup. & Spikes 2

Date O.K.'D ______ Signed ______

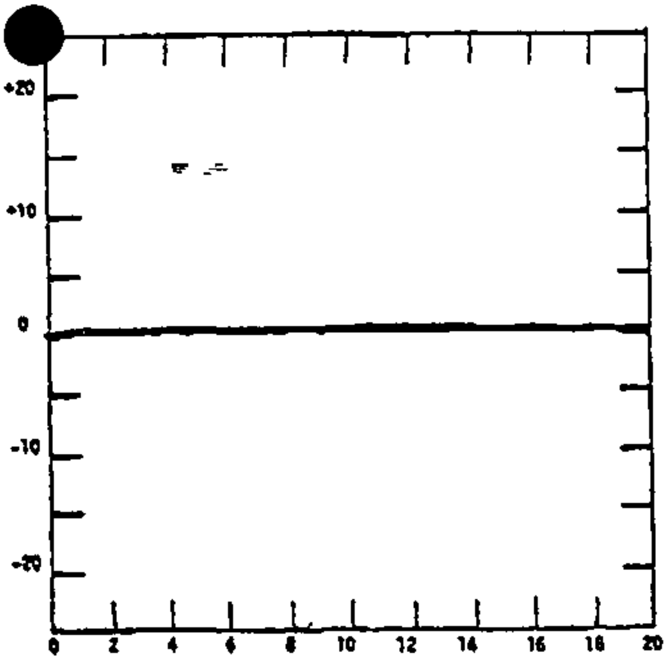
Remarks ______

[illegible]

Target T = 0%

Acceptance T = ± 0 %

$T = \pm \left|\frac{A - B}{A + B}\right| 100$



Sequence, N

Parameter ARSENIC Conc Range

Method 206.3

Analyst MJ

Sequence N	Sample Number	Duplicate Set A	Duplicate Set B	% Deviation ± T
1	#42510	ND	ND	0
2	#42602	ND	ND	0
3	#42628	ND	ND	0
4	#42648	ND	ND	0
5	#42700	ND	ND	0
6	#42764	ND	ND	0
7	#42761	ND	ND	0
8	#43091	ND	ND	0
9	#43141	ND	ND	0
10	#43156	ND	ND	0
11	#43191	ND	ND	0
12	#43192	ND	ND	0
13	#43009	ND	ND	0
14	#43004	ND	ND	0
15	#43222	ND	ND	0
16	#43272	ND	ND	0
17	#43279	ND	ND	0
18	#43352	ND	ND	0
19	#43418	ND	ND	0
20	#43427	ND	ND	0

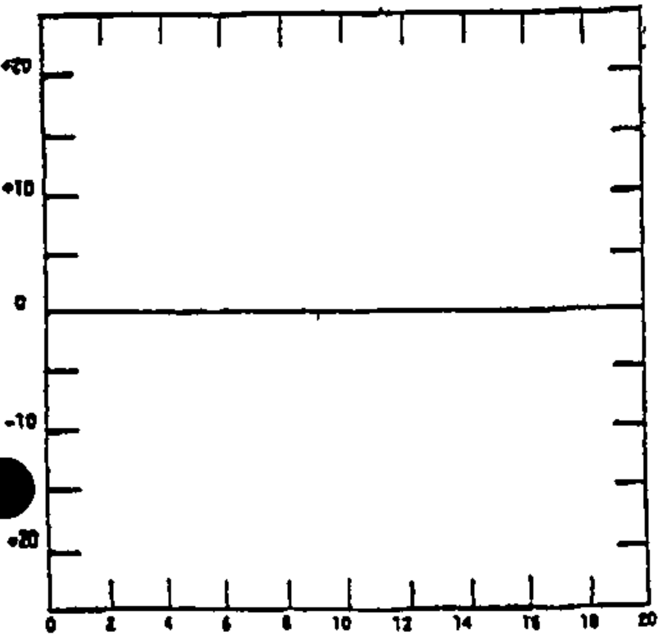
Reviewed By Date

ANALYTICAL PRECISION CONTROL CHART

Target T = 0%

Acceptance T = ± %

$T = \pm \left|\frac{A - B}{A + B}\right| 100$



Sequence N

Parameter Conc Range

Method

Analyst

Sequence N	Sample Number	Duplicate Set A	Duplicate Set B	% Deviation ± T
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

Reviewed By Date

TEST: ARSENIC (EPTOX) METHOD: 206.3

CERT NO.	STD	COUNTS	DIL.	RESULTS MG/L	DATE	TIME	ANALYST	DETECTION LIMIT	Remarks - QA Other Calculations
Blk		0		0	2/24	1300	MZ	0.002	
	10.0ppm	350							
	5.0ppm	160							
	1.0ppm	28							
43368		ND		<0.002					$\bar{x}$ = 0
43369		ND		<0.002					%D = 0
43370		ND		<0.002					%Rec = 25-0 (100)
43371		ND		<0.002					28
43372		ND		<0.002					%Rec = 89%
43373		ND		<0.002					
43399		ND		<0.002					
43352		ND		<0.002					
Dup		ND		<0.002					
Spike	(1ppm)	25		0.892					

Date 2/24 Time 1300 Analyst MZ

Duplicate 1 ND Duplicate 2 ND

Spike 43352 (25 counts) % Recovery 89%

Total # Samples 8 Total # Dup & Spikes 2

Date O.K.'D ________ Signed ________

Remarks ________

'EST: BARIUM (EP TOX) METHOD: 208.1

ERT NO.	STD	COUNTS	DIL.	RESULTS MG/L	DATE	TIME	ANALYST	DETECTION LIMIT	Remarks - QA Other Calculations
Blk		0		0	1/20	1300	MZ	0.1mg/L	
	10.0PPM	98							
	5.0PPM	90							
	1.0PPM	10							$\bar{X}$=0
27		ND		<0.1					%D=0
12718		ND		<0.1					%Rec = 9-0 (10)
1731		ND		<0.1					10
12732		ND		<0.1					%Rec = 90%
2726		ND		<0.1					
12727		ND		<0.1					
2765		ND		<0.1					
2762		ND		<0.1					
2766		ND		<0.1					
2764		ND		<0.1					
Dup		ND		<0.1					
Spk		9		0.90					

Date 1/20 Time 1300 Analyst MZ

Duplicate 1 ND Duplicate 2 ND

Spike 9 % Recovery 91%

Total # Samples 10 Total # Dup & Spikes 2

Date O.K.'D ________ Signed ________

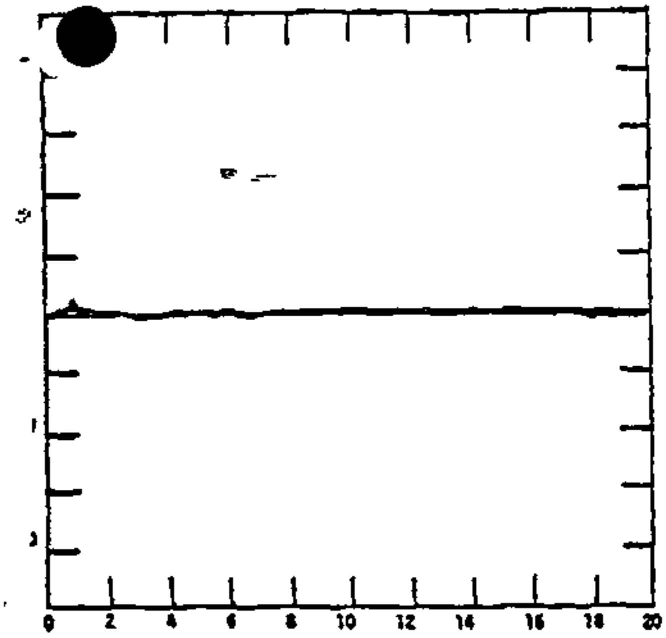
Remarks ________

MEW Admin record
AR104137

Target: Y = 0% CADMIUM

Acceptance Y = ± 0 %

$Y = \pm \left| \frac{A - B}{A + B} \right| 100$



Method 213.1

Analyst [illegible]

Sequence N	Sample Number	Duplicate Set A	Duplicate Set B	% Deviation ± Y
1	93013	155	154	0.323
2	93030	ND	ND	0
3	93022	ND	ND	0
4	93094	ND	ND	0
5	93028	ND	ND	0
6	93154	ND	ND	0
7	93309	ND	ND	0
8	93307	ND	ND	0
9	93353	ND	ND	0
10	93369	ND	ND	0
11	93386	ND	ND	0
12	93998	ND	ND	0
13	93452	ND	ND	0
14	93493	ND	ND	0
15	93599	ND	ND	0
16	93625	ND	ND	0
17	93638	ND	ND	0
18	93631	ND	ND	0
19	93692	ND	ND	0
20	93700	ND	ND	

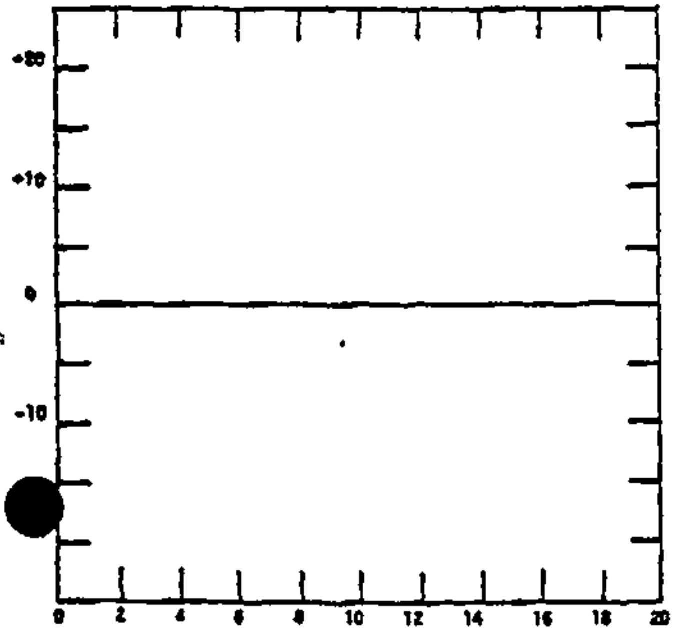
Reviewed By ______ Date ______

ANALYTICAL PRECISION CONTROL CHART

Target: Y = 0%

Acceptance Y = ± ______ %

$Y = \pm \left| \frac{A - B}{A + B} \right| 100$



Parameter ______ Conc Range ______

Method ______

Analyst ______

Sequence N	Sample Number	Duplicate Set A	Duplicate Set B	% Deviation ± Y
1				
2				
3				
4				
5				
6				
7				
8				
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17				
18				
19				
20				

Reviewed By ______ Date ______

TEST: CADMIUM TOTAL & EP TOX METHOD: 213.1

CERT NO.	STD	COUNTS	DIL.	RESULTS MG/L	DATE	TIME	ANALYST	DETECTION LIMIT	Remarks - QA Other Calculations
Blk		0		0	11/10	1100	MZ	0.005 mg/L	
	1.0	500							
	0.5	245							
	0.1	49							
42013	T	374	1:100	763.2					
42013	E	155	1:100	31.6					
Dup	(42013)	154	1:100	31.4					x̄ = 154.5
Spike	42013	202	1:100	41.2					%D = 0.323
4190		ND		<0.005					%Rec = 202 - 159
									49
									%Rec = 97.9

Date ~~11/10~~ 11/10 Time 1100 Analyst MZ

Duplicate 1 165 Duplicate 2 154

Spike 202 % Recovery 97.9

Total # Samples 2 Total # Dup & Spikes 2

Date O K.'D ____ Signed ____

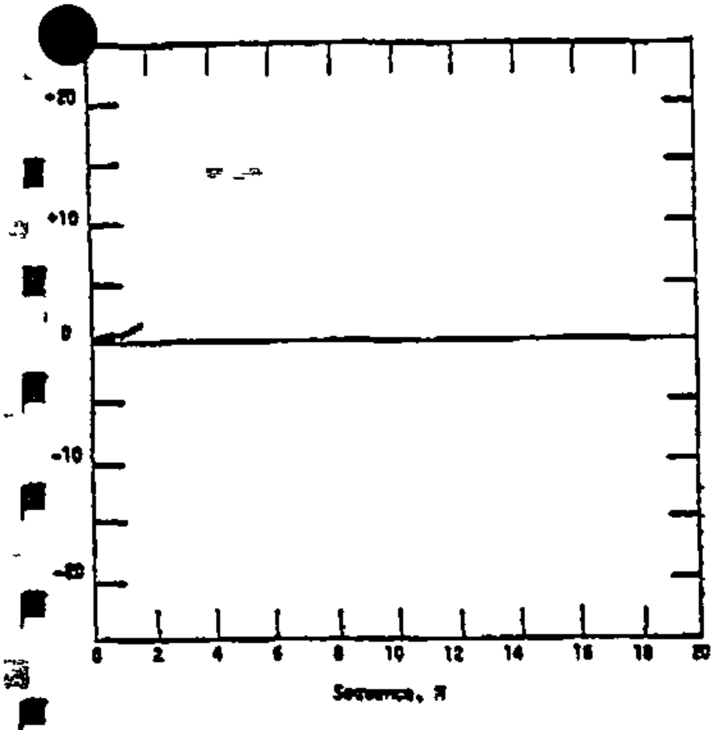
Remarks ____

ANALYTICAL PRECISION CONTROL CHART

Target. Y = 0%

Acceptance Y = ± ________ %

$Y = \pm \left| \frac{A - B}{A + B} \right| 100$



Parameter CALCIUM Conc. Range ________

Method 215.1

Analyst MZ

Sequence N	Sample Number	Duplicate Set A	Duplicate Set B	% Deviation ± Y
1	93810	141	140	0.356
2	93279	276	274	0.363
3				
4				
5				
6				
7				
8				
9				
10				
11				
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13				
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16				
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20				

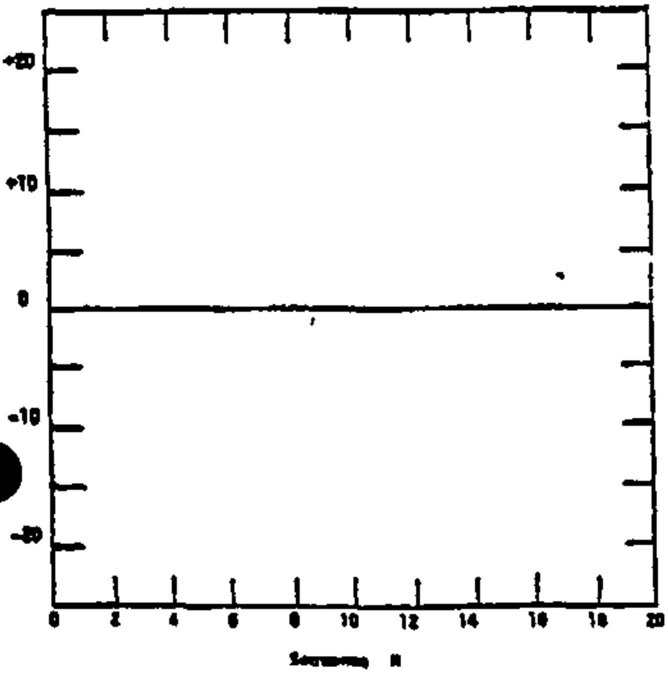
Reviewed By ________ Date ________

ANALYTICAL PRECISION CONTROL CHART

Target. Y = 0%

Acceptance Y = ± ________ %

$Y = \pm \left| \frac{A - B}{A + B} \right| 100$



Parameter ________ Conc. Range ________

Method ________

Analyst ________

Sequence N	Sample Number	Duplicate Set A	Duplicate Set B	% Deviation ± Y
1				
2				
3				
4				
5				
6				
7				
8				
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10				
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16				
17				
18				
19				
20				

Reviewed By ________ Date ________

Calcium

CERT. NO.	STD	COUNTS	DIL.	RESULTS MG/L	DATE	TIME	ANALYST	DETECTION LIMIT	Remarks - QA Other Calculations
Blk		0		0	2/15	1030		0.01	
	10.0ppm	472							
	5.0ppm	235							
	1.0ppm	50							$\bar{X}$ = 140.5
42809		161	1:1000	3925					%D = 0.355
42810		141	1:1000	3000					%Rec = $\frac{188-140}{50}$
Dup		140	1:1000	2978					
Spike		188	1:1000	4000					%Rec = 96 %

Date 2/15 Time 1030 Analyst

Duplicate 1 14 Duplicate 2 140

Spike 188 % Recovery 96 %

Total # Samples 2 Total # Dup. & Spikes 2

Date O.K.'D ____ Signed ____

Remarks ____

ANALYTICAL PRECISION CONTROL CHART

Target Y = 0%

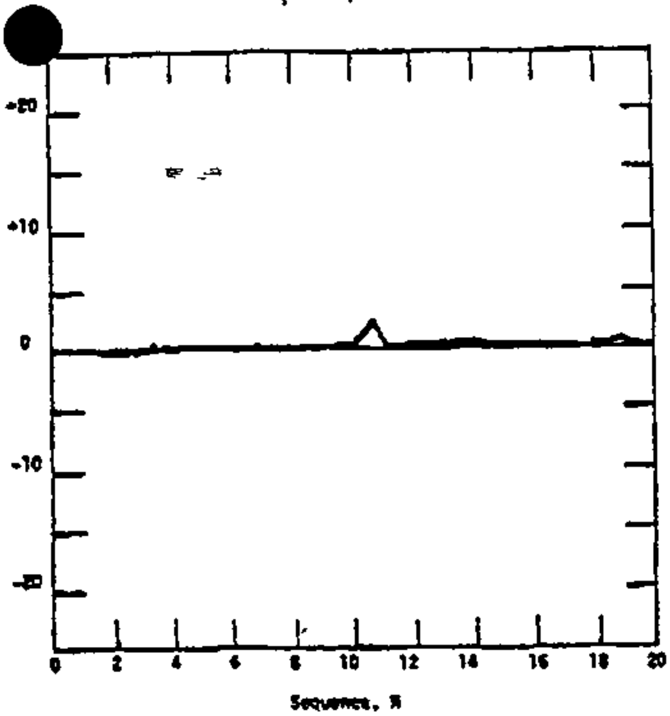
Acceptance Y = ± ________ %

$Y = \pm \left|\frac{A - B}{A + B}\right| 100$

Parameter CHROMIUM Conc Range ________

Method 218.1

Analyst MZ



Sequence N	Sample Number	Duplicate Set A	Duplicate Set B	% Deviation ± Y
1	42072	ND	ND	0
2	43095	ND	ND	0
3	43078	655	659	0.42
4	42279	ND	ND	0
5	42259	ND	ND	0
6	42302	ND	ND	0
7	42354	ND	ND	0
8	42369	ND	ND	0
9	42396	ND	ND	0
10	42389	ND	ND	0
11	42452	42	40	2.43
12	42497	ND	ND	0
13	42579	ND	ND	0
14	42358	ND	ND	0
15	42625	ND	ND	0
16	42629	ND	ND	0
17	42631	ND	ND	0
18	42686	246	244	0.408
19	42691	472	469	0.319
20	42700	ND	ND	0

Reviewed By ________ Date ________

ANALYTICAL PRECISION CONTROL CHART

Target Y = 0%

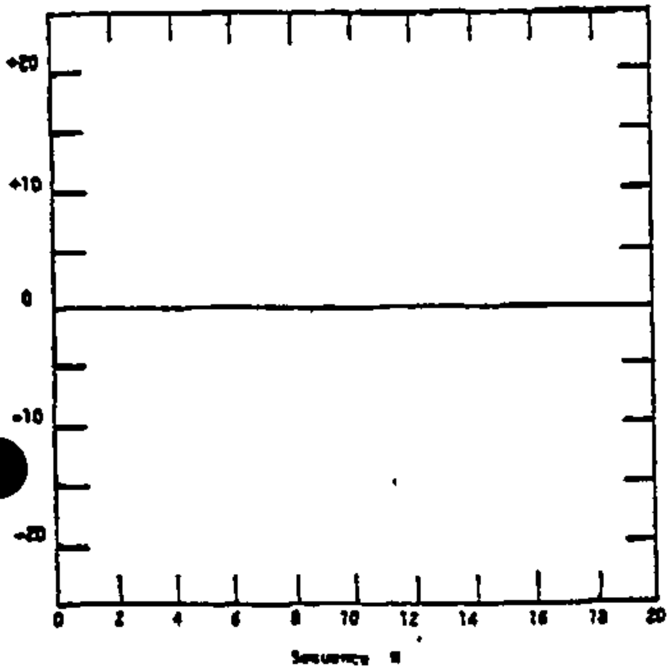
Acceptance Y = ± ________ %

$Y = \pm \left|\frac{A - B}{A + B}\right| 100$

Parameter ________ Conc Range ________

Method ________

Analyst ________



Sequence N	Sample Number	Duplicate Set A	Duplicate Set B	% Deviation ± Y
1				
2				
3				
4				
5				
6				
7				
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9				
10				
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15				
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17				
18				
19				
20				

Reviewed By ________ Date ________

TEST: CHROMIUM (EP TOX [illegible])

NO.	STD	COUNTS	DIL.	RESULTS MG/L	DATE	TIME	ANALYST	DETECTION LIMIT	Remarks - QA Other Calculations
1		0		0	4/17	1000	MZ	0.05	
	10.0 ppm	630							
	5.0 ppm	298							
	1.0 ppm	108							
3958E		ND		<0.05					$\bar{X}$ = 0
3957E		ND		<0.05					%D = 0
3960E		ND		<0.05					%Rec = 104 - 0 ([illegible])
3961E		ND		<0.05					108
43965E		ND		<0.05					%Rec = 96.2%
44009E		ND		<0.05					
44011E		ND		<0.05					
43960(D)		21		1.9					
43959(D)		30		2.7					
43958(D)		ND		<0.05					
Dup		ND		<0.05					
Spk		104		0.962					

Date 4/17 Time 1000 Analyst MZ

Duplicate 1 ND Duplicate 2 ND

Spike 104 % Recovery 96.2

Total # Samples 10 Total # Dup. & Spikes 2

Date O.K.'D ____________ Signed ____________

Remarks ____________

MEW Admin record
AR104143

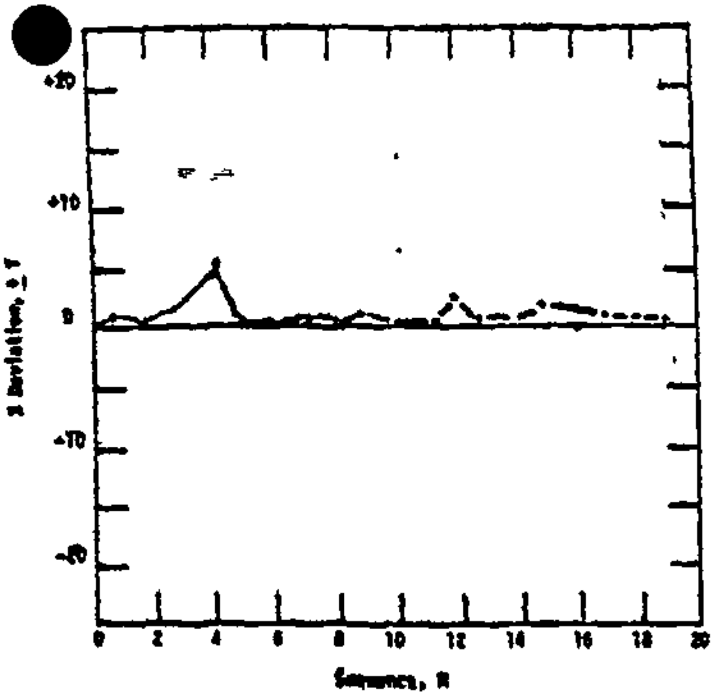
Target Y = 0% Copper

Acceptance Y = ± _______ %

$Y = \pm \left|\frac{A-B}{A+B}\right| 100$

Method 220.1

Analyst MZ



Sequence N	Sample Number	Duplicate Set A	Duplicate Set B	% Deviation ± Y
1	41626	95	96	0.523
2	41702	174	173	0.29
3	41844	59	56	2.60
4	41738	20	18	[illegible]
5	41780	77	76	0.65
6	42302	455	452	0.31
7	42443	297	296	0.33
8	42621	430	431	0.28
9	60	345	340	103
10	42553	193	190	0.783
11	43227	629	630	0.230
12	43098	34	32	3.2
13	43233	434	432	0.33
14	43425	246	244	0.408
15	43515	112	115	1.31
16	43273	110	110	0
17	43292	43	42	1.2
18	43920	93	91	1.2
19	44009	160	156	1.2
20				

Reviewed By _______________ Date _______________

ANALYTICAL PRECISION CONTROL CHART

Target: Y = 0%

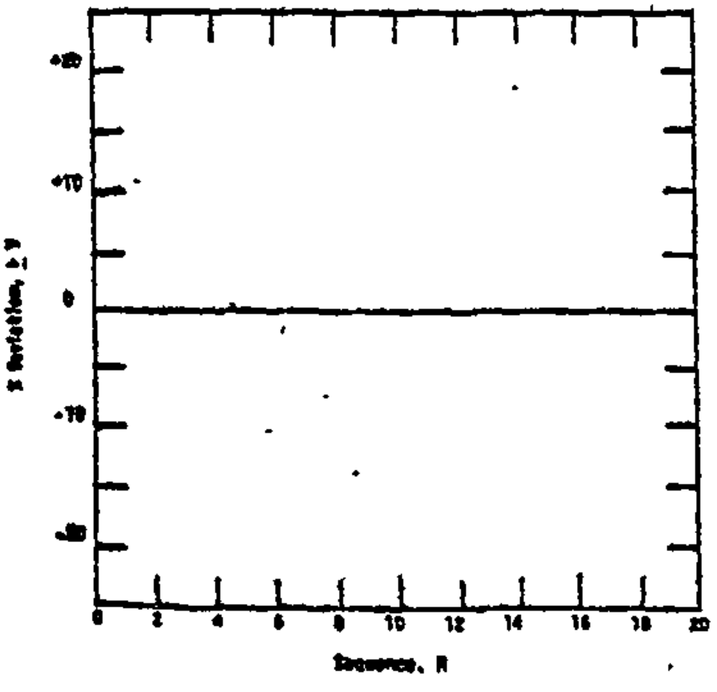
Acceptance Y = ± _______ %

$Y = \pm \left|\frac{A-B}{A+B}\right| 100$

Parameter _______________ Conc. Range _______________

Method _______________

Analyst _______________



Sequence N	Sample Number	Duplicate Set A	Duplicate Set B	% Deviation ± Y
1				
2				
3				
4				
5				
6				
7				
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Reviewed By _______________ Date _______________

TEST· COPPER (TOTAL) METHOD 220.1

CERT. NO.	STD	COUNTS	DIL.	RESULTS MG/L	DATE	TIME	ANALYST	DETECTION LIMIT	Remarks - QA Other Calculations
Blk		0		0	2/1	1000	mz	0.02 mg/l	
	1.0ppm	567							
	0.5ppm	279							
	0.1ppm	57							
42763		47		0.082					$\bar{X}$ = 191
42823		193		0.345					%D = 0.783
Dup		190		0.340					%Rec = 247-191 [100
Spike	(0.1)	247		0.442					57
									%Rec = 98.2

Date 2/1 Time 1000 Analyst mz

Duplicate 1 193 Duplicate 2 190

Spike 247 % Recovery 98.2

Total # Samples 2 Total # Dup & Spikes 2

Date O K 'D ______ Signed ______

Remarks ______

Target T = 0%

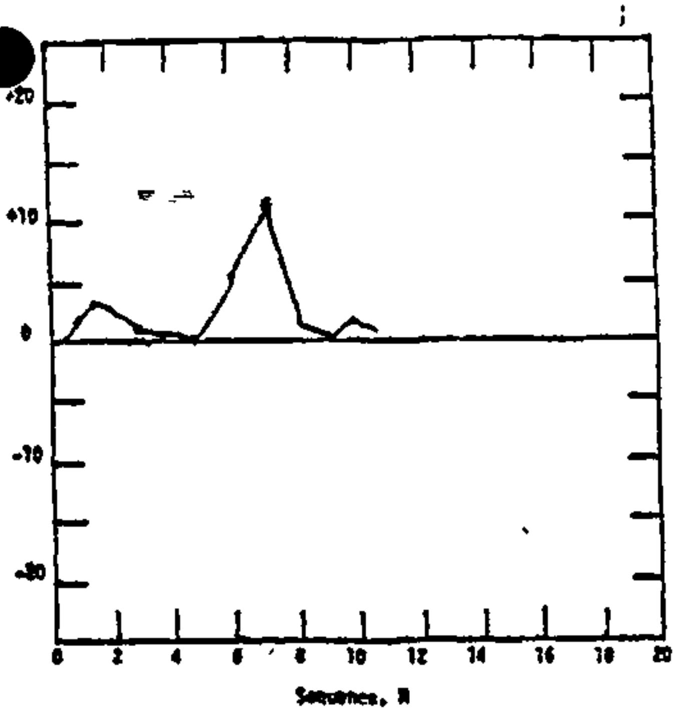
Acceptance T = ± ______ %

$T = \pm \left|\frac{A - B}{A + B}\right| 100$

Iron

Method 236.1

Analyst AC



Sequence N	Sample Number	Duplicate Set A	Duplicate Set B	% Deviation ± T
1	41197	29	30	1.69
2	41130	60	64	3.22
3	41920	38	39	1.3
4	BB	625	620	0.403
5	42695	23	23	0
6	43063	10	9	5.3
7	43161	5	4	11.1
8	43779	104	108	1.9
9	43784	ND	ND	0
10	43798	20	21	2.4
11	44131	210	205	1.2
12				
13				
14				
15				
16				
17				
18				
19				
20				

Reviewed By ______________ Date ______________

ANALYTICAL PRECISION CONTROL CHART

Target: T = 0%

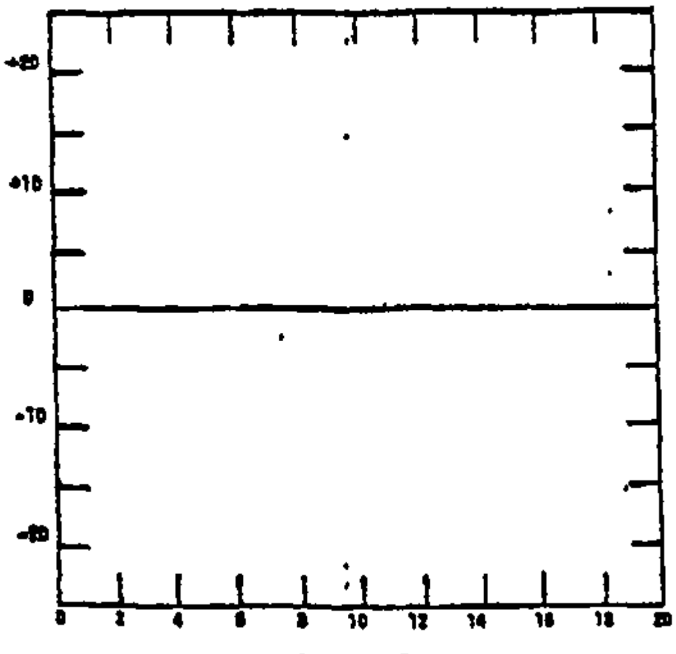
Acceptance: T = ± ______ %

$T = \pm \left|\frac{A - B}{A + B}\right| 100$

Parameter ______________ Conc. Range ______________

Method ______________

Analyst ______________



Sequence N	Sample Number	Duplicate Set A	Duplicate Set B	% Deviation ± T
1				
2				
3				
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Reviewed By ______________ Date ______________

MEW Admin record
AR104146

'EST: IRON (TOTAL) METHOD: 236.1

ART. NO.	STD	COUNTS	DIL.	RESULTS MG/L	DATE	TIME	ANALYST	DETECTION LIMIT	Remarks - QA Other Calculations
		0		0	2/21	1400	MZ	0.03	
	10.0ppm	404							
	5.0ppm	200							
	1.0ppm	42							$\bar{x}$ = 103
12778	(x10)	93	1:1000	23250.0					%D = 1.88
2779	(x10)	104	1:1000	26000.0					%Rec = 143 - 103 (100)
Dup	(x10)	102	1:1000	25500.0					42
Spike	(x10)	143	1:1000	35750					%Rec = 95.2

Date 2/21 Time 1400 Analyst MZ

Duplicate 1 104 Duplicate 2 102

Spike 143 % Recovery 95.2

Total # Samples 2 Total # Dup & Spikes 2

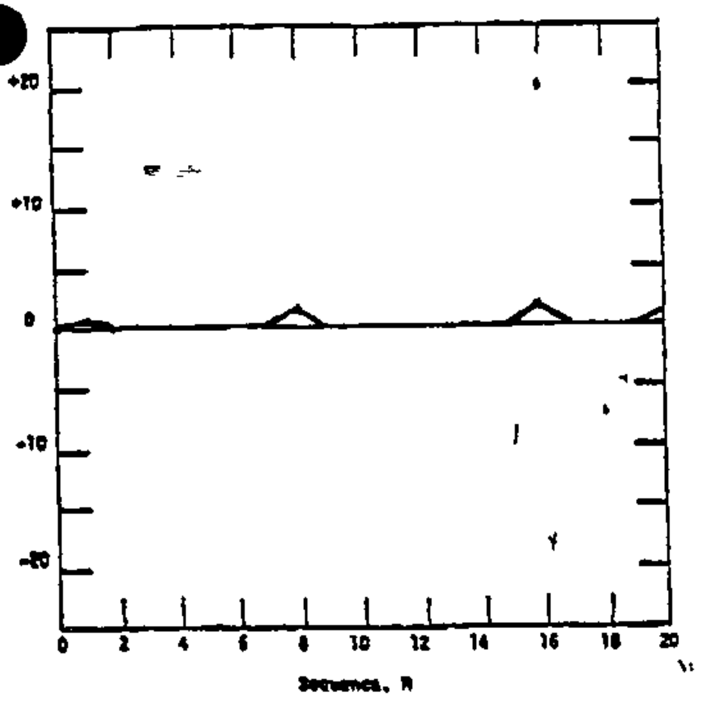
Date O K.'D. ____ Signed ____

Remarks ____

Target Y = 0%

Acceptance: Y = ± ________%

$Y = \pm \left|\frac{A - B}{A + B}\right| 100$



Parameter LEAD Conc Range ________

Method 239.1

Analyst RE

Sequence N	Sample Number	Duplicate Set A	Duplicate Set B	% Deviation ± Y
1	42079	200	198	0.50
2	42160	ND	ND	0
3	42166	ND	ND	0
4	42135	ND	ND	0
5	42136	ND	ND	0
6	42187	ND	ND	0
7	42328	ND	ND	0
8	42329	67	65	1.5
9	42332	ND	ND	0
10	42364	ND	ND	0
11	42368	ND	ND	0
12	42369	ND	ND	0
13	42429	ND	ND	0
14	42496	ND	ND	0
15	42493	52	50	1.96
16	42497	ND	ND	0
17	42579	ND	ND	0
18	42602	ND	ND	0
19	42619	ND	ND	0
20	42421	55	54	0.917

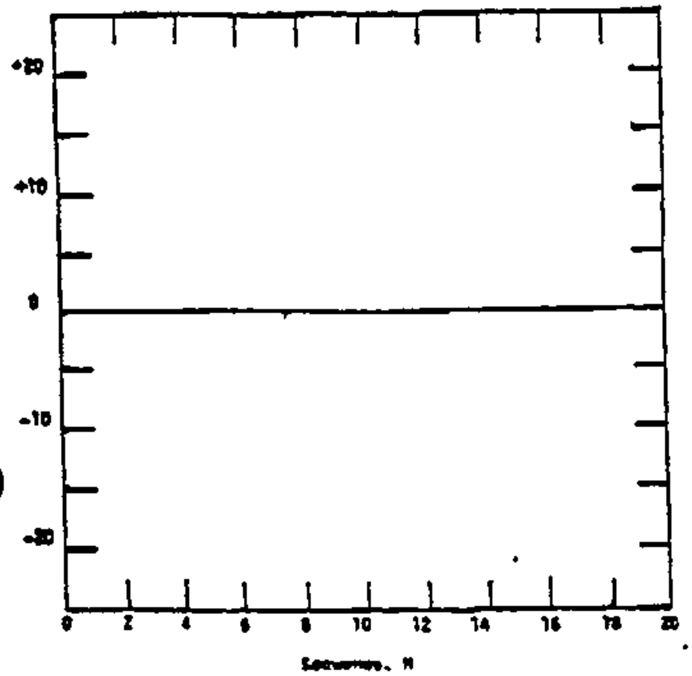
Reviewed By ________ Date ________

ANALYTICAL PRECISION CONTROL CHART

Target Y = 0%

Acceptance Y = ± ________%

$Y = \pm \left|\frac{A - B}{A + B}\right| 100$



Parameter ________ Conc Range ________

Method ________

Analyst ________

Sequence N	Sample Number	Duplicate Set A	Duplicate Set B	% Deviation ± Y
1				
2				
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Reviewed By ________ Date ________

TEST. *LEAD EPTOX & TOTALS* METHOD: *239.1*

CERT NO.	STD	COUNTS	DIL.	RESULTS MG/L	DATE	TIME	ANALYST	DETECTION LIMIT	Remarks - QA Other Calculations
Blk		0		0	11/30	1100	ME	0.1mg/L	
	10 ppm	690							
	5 ppm	344							
	1 ppm	69							
41997		690	1:10	100mg/L					
[illegible]27	(1:10)	121	1:100	1753mg/L					
42/28	(1:10)	70	1:100	1014mg/L					
42/29	(1:10)	129	1:100	1875mg/L					$\bar{X}$ = 0
42/30	(1:10)	630		91.3					%RD = 0
42/31	(1:10)	97		14.05					%Rec = 67-0(100,
42/32	(1:10)	629		91.1					69
42/33	(1:10)	125		18.1					%Rec = 97.1
42/34	(1:10)	104		15.1					
42/35		ND		<0.1					
Dup		ND		<0.1					
Spk		67		0.971					

Date *11/30* Time *1100* Analyst *ME*

Duplicate 1 *ND* Duplicate 2 *ND*

Spike *67* % Recovery *97.1*

Total # Samples *10* Total # Dup & Spikes *2*

Date O K.'D ______ Signed ______

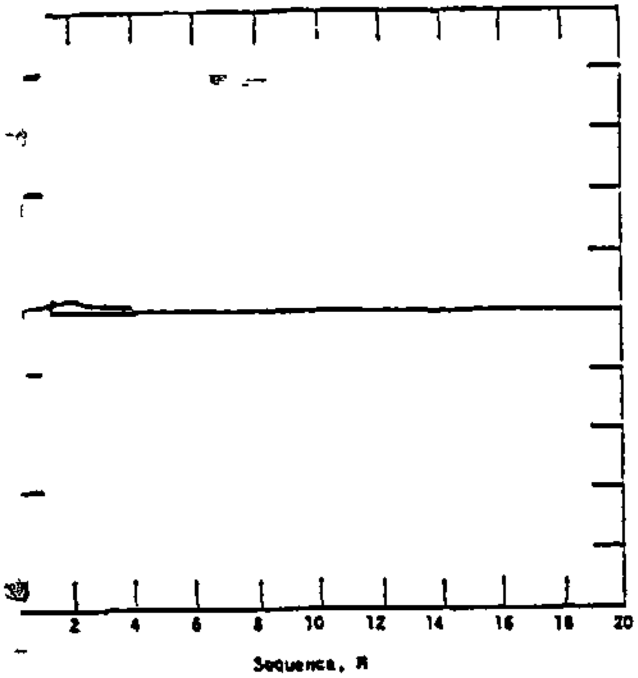
Remarks ______

ANALYTICAL PRECISION CONTROL CHART

Target Y = 0%

Acceptance Y = ± ________ %

$$Y = \pm \left| \frac{A - B}{A + B} \right| 100$$



Parameter *MAGNESIUM* Conc Range ________

Method *242.1*

Analyst ________

Sequence N	Sample Number	Duplicate Set A	Duplicate Set B	% Deviation ± Y
1	42810	463	460	0.255
2	43779	120	118	0.840
3	43740	638	635	0.235
4	43789	221	220	0.32
5				
6				
7				
8				
9				
10				
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12				
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14				
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17				
18				
19				
20				

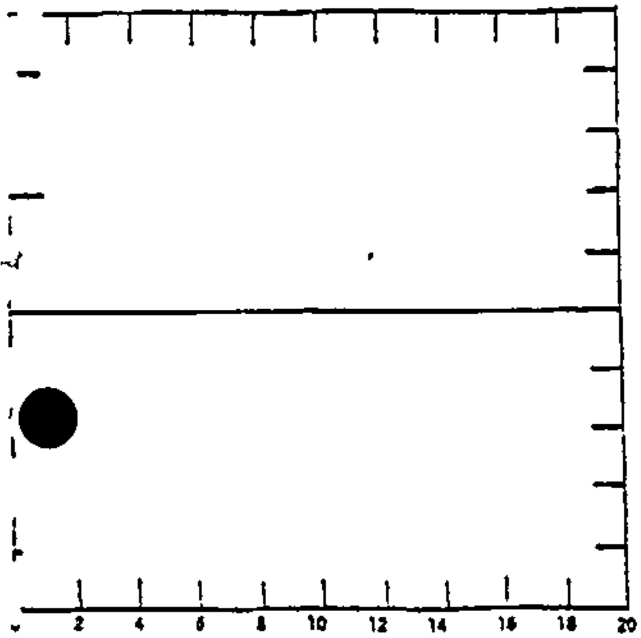
Reviewed By ________ Date ________

ANALYTICAL PRECISION CONTROL CHART

Target Y = 0%

Acceptance Y = ± ________ %

$$Y = \pm \left| \frac{A - B}{A + B} \right| 100$$



Parameter ________ Conc Range ________

Method ________

Analyst ________

Sequence N	Sample Number	Duplicate Set A	Duplicate Set B	% Deviation ± Y
1				
2				
3				
4				
5				
6				
7				
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15				
16				
17				
18				
19				
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MEW Admin record
AR104150

TEST· *MAGNESIUM (TOTAL)* METHOD *242.1*

	STD	COUNTS	DIL.	RESULTS MG/L	DATE	TIME	ANALYST	DETECTION LIMIT	Remarks - QA Other Calculations
BLK		0		0	3/28	0900	MZ	0.001	
	0.50ppm	368							
	0.25ppm	180							
	0.05ppm	38							
-740	(Na)	638	1/1000	8668					$\bar{x}$ = 636
dup	(Na)	635	1/1000	8627					%D = 0.235
Spike	(Na)	671	1/1000	9116					%Rec = 671 − 636 (100)
									38
									%Rec = 92.1

Date *3/28* Time *0900* Analyst *MZ*

Duplicate 1 *638* Duplicate 2 *635*

Spike *671* % Recovery *92.1*

Total # Samples *1* Total # Dup & Spikes *2*

Date O.K.'D ______ Signed ______

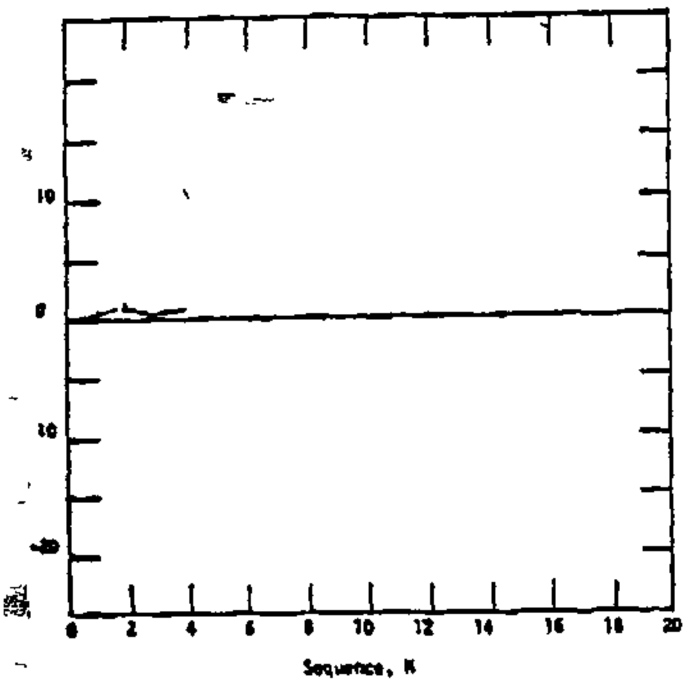
Remarks ______

ANALYTICAL PRECISION CONTROL CHART

Target Y = 0% Manganese

Acceptance Y = ± ________ %

$Y = \pm \left|\frac{A - B}{A + B}\right| 100$



Parameter MANGANESE Conc Range ________

Method 243.1

Analyst MZ

Sequence N	Sample Number	Duplicate Set A	Duplicate Set B	% Deviation ± Y
1	#2015	196	195	0.255
2	#3161	117	115	0.862
3	#3233	372	375	0.265
4	#3756	110	109	0.452
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

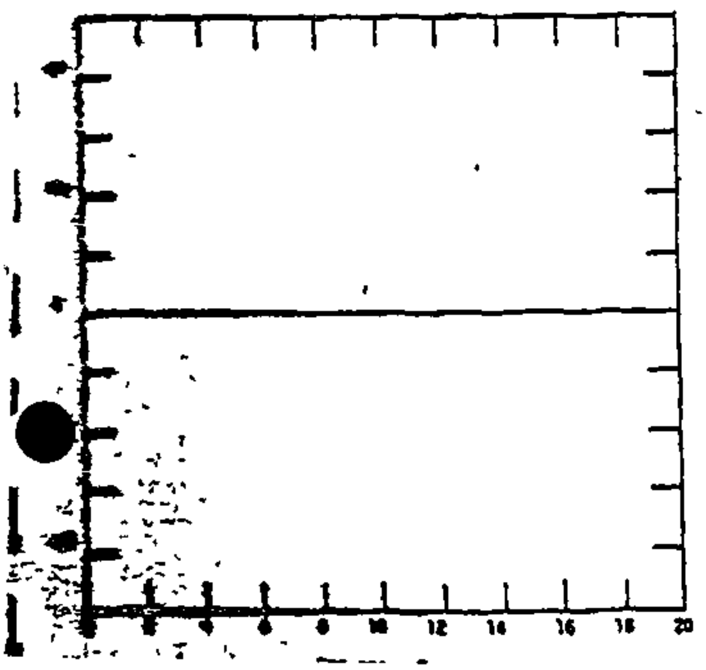
Reviewed By ________ Date ________

ANALYTICAL PRECISION CONTROL CHART

Target Y = 0%

Acceptance Y = ± ________ %

$Y = \pm \left|\frac{A - B}{A + B}\right| 100$



Parameter ________ Conc Range ________

Method ________

Analyst ________

Sequence N	Sample Number	Duplicate Set A	Duplicate Set B	% Deviation ± Y
1				
2				
3				
4				
5				
6				
7				
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10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

Reviewed By ________ Date ________

EST: MANGANESE (TOTAL) METHOD· 243.1

RT O.	STD	COUNTS	DIL.	RESULTS MG/L	DATE	TIME	ANALYST	DETECTION LIMIT	Remarks - QA Other Calculations
		0		0	11/9	1530	MZ	0.01mg/L	
	1ppm	404							
	0.5ppm	200							
	0.1ppm	42							
013		196	0.490						
Dup		195	0.487						$\bar{x}$=195.5
ike		235	0.587						%D=0.255
									%Rec = 235-195
									42
									%Rec = 95.2

Date 11/9 Time 1530 Analyst MZ

Duplicate 1 196 Duplicate 2 195

Spike ~~0.58~~ 235 % Recovery 95.2

Total # Samples 1 Total # Dup. & Spikes 2

Date O.K.'D ______ Signed ______

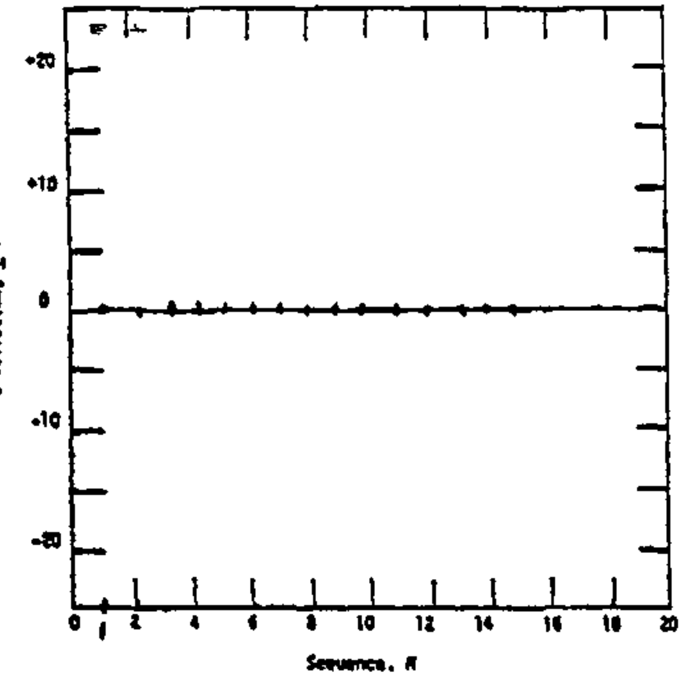
Remarks ______

ANALYTICAL PRECISION CONTROL CHART

Target Y = 0%

Acceptance Y = ± ______ %

$Y = \pm \left|\frac{A - B}{A + B}\right| 100$



Parameter MERCURY Conc Range ______

Method 245.1

Analyst [illegible]

Sequence N	Sample Number	Duplicate Set A	Duplicate Set B	% Deviation ± Y
1	41671	~~[illegible]~~50	0	0
2	41641	ND<.4	0	0
3	41673	ND<.2	0	0
4	41772	0	0	0
5	41717A	0	0	0
6	41825	0	0	0
7	41846	0	0	0
8	41892	0	0	0
9	41906	0	0	0
10	42013	0	0	0
11	42050	0	0	0
12	42072	0	0	0
13	42095	0	0	0
14	[illegible]	0	0	0
15	[illegible]	0	0	0
16				
17				
18				
19				
20				

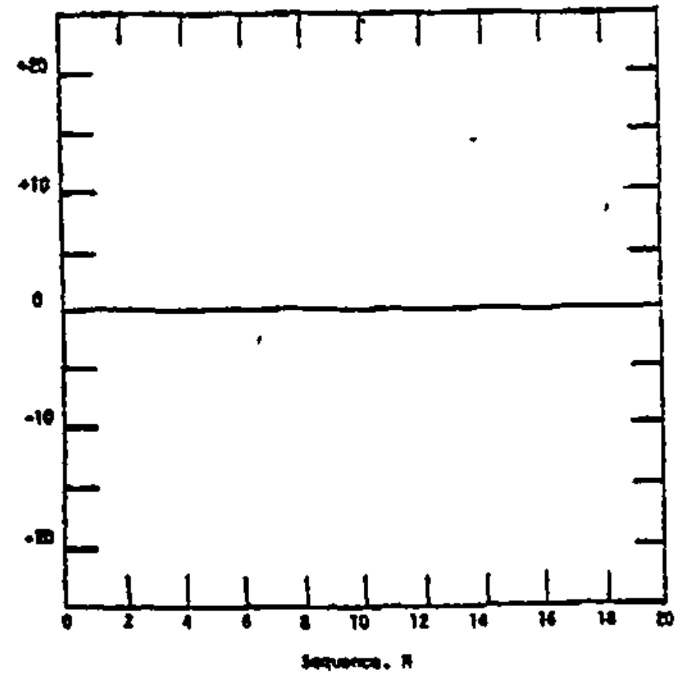
Reviewed By ______ Date ______

ANALYTICAL PRECISION CONTROL CHART

Target Y = 0%

Acceptance Y = ± ______ %

$Y = \pm \left|\frac{A - B}{A + B}\right| 100$



Parameter ______ Conc Range ______

Method ______

Analyst ______

Sequence N	Sample Number	Duplicate Set A	Duplicate Set B	% Deviation ± Y
1				
2				
3				
4				
5				
6				
7				
8				
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10				
11				
12				
13				
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17				
18				
19				
20				

Reviewed By ______ Date ______

CERT. NO.	STD	COUNTS	DIL.	RESULTS MG/L	DATE	TIME	ANALYST	DETECTION LIMIT	Remarks - QA Other Calculations
BlK		0		0	10/3	1300	MZ	0.0002	
	0.05	500							
	0.025	240							
	0.005	99							
41610		ND		<0.0002					S = 0
41611		ND		<0.0002					%D = 0
4164		ND		<0.0002					%Rec = 498 - 0
4165		ND		<0.0002					501
41668		ND		<0.0002					%Rec = 99.6
41669		ND		<0.0002					
41670		ND		<0.0002					
41671		ND		<0.0002					
Dup		ND		<0.0002					
Spike	(0.05)	498		0.0499					

Date 10/3 Time 1300 Analyst MZ

Duplicate 1 ND Duplicate 2 ND

Spike 498 % Recovery 99.6

Total # Samples 8 Total # Dup. & Spikes 2

Date O.K.'D ______ Signed ______

Remarks ______

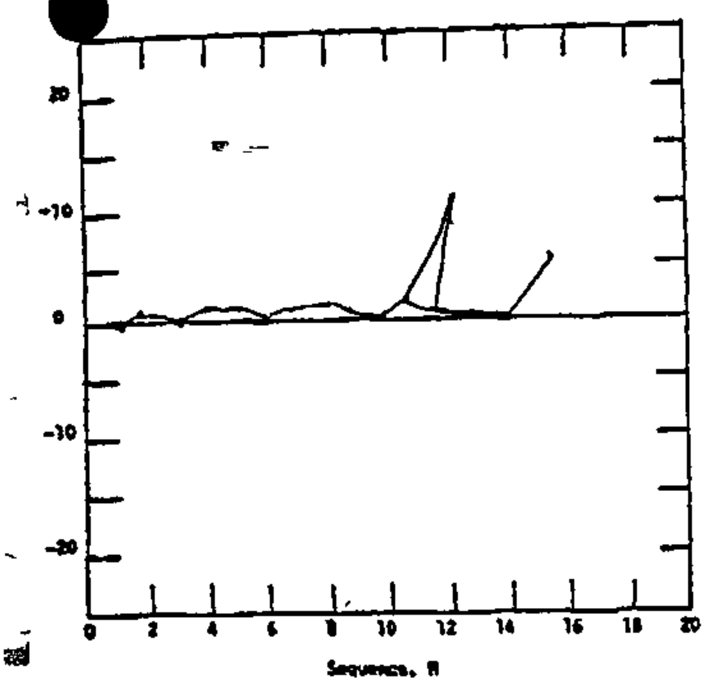
MEW Admin record
AR104155

ANALYTICAL PRECISION CONTROL CHART

Target Y = 0%

Acceptance: Y = ± ______%

$Y = \pm \left| \frac{A - B}{A + B} \right| 100$



Parameter NICKEL Conc Range ______

Method 249.1

Analyst BC

Sequence N	Sample Number	Duplicate Set A	Duplicate Set B	% Deviation ± Y
1	41678	ND	0	0
2	41702	156	154	0.64
3	[illegible]	0	0	0
4	41738	21	20	2.4
5	42013	20	21	2.4
6	42037	309	311	0.32
7	42346	46	44	2.2
8	42443	20	19	2.5
9	AA	50	48	2.04
10	42761	97	95	1.04
11	43233	83	80	3.6
12	43426	154	150	1.3
13	43713	15	18	9.1
14	43797	ND	ND	0
15	43920	20	18	5.2
16				
17				
18				
19				
20				

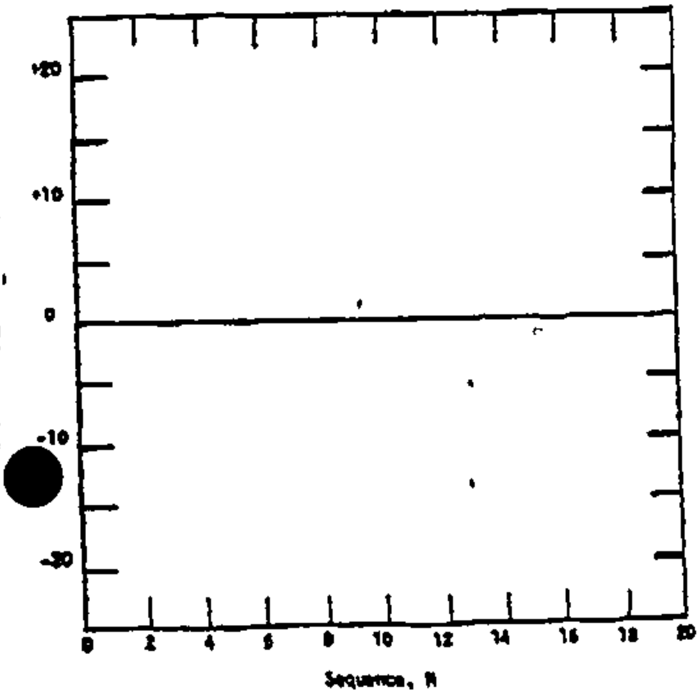
Reviewed By ______ Date ______

ANALYTICAL PRECISION CONTROL CHART

Target: Y = 0%

Acceptance Y = ± ______%

$Y = \pm \left| \frac{A - B}{A + B} \right| 100$



Parameter ______ Conc Range ______

Method ______

Analyst ______

Sequence N	Sample Number	Duplicate Set A	Duplicate Set B	% Deviation ± Y
1				
2				
3				
4				
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7				
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Reviewed By ______ Date ______

TEST: NICKEL (TOTAL) METHOD: 249.1

	STD	COUNTS	DIL.	RESULTS MG/L	DATE	TIME	ANALYST	DETECTION LIMIT	Remarks - QA Other Calculations
lk		0		0	12/16	1000	MJ	0.04 mg/L	
	10.0 ppm	360							
	5.0 ppm	180							
	1.0 ppm	34							$\bar{X}$ = 19.5
42493		20		0.58					%D = 2.56
Dup		19		0.55					%Rec = $\frac{50-19}{34}$
Spike		50		1.47					
									%Rec = 91.1

Date 12/16 Time 1000 Analyst MJ

Duplicate 1 20 Duplicate 2 19

Spike 50 % Recovery 941

Total # Samples 1 Total # Dup. & Spikes 2

Date O.K.'D ______ Signed ______

Remarks ______

ANALYTICAL PRECISION CONTROL CHART

Target: Y = 0% Potassium

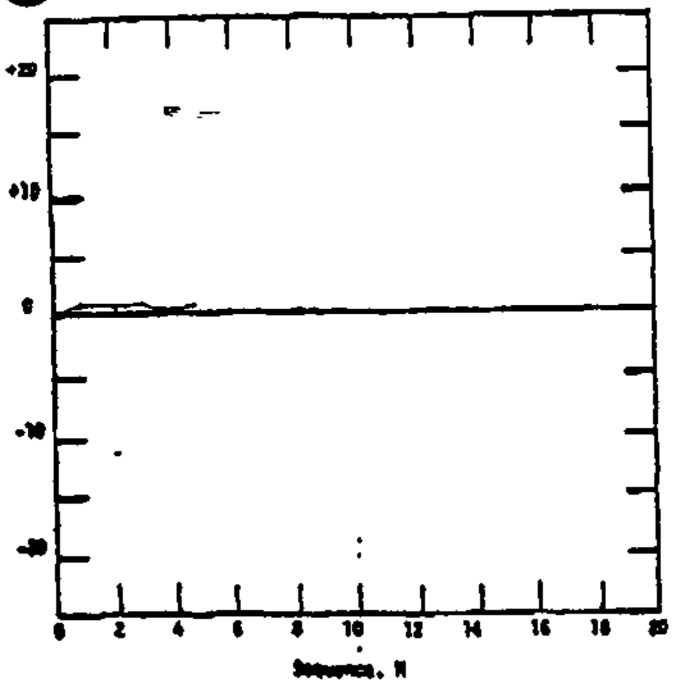
Acceptance Y = ± ______ %

$Y = \pm \left| \frac{A - B}{A + B} \right| 100$

Parameter POTASSIUM Conc. Range ______

Method 258.1

Analyst



Sequence N	Sample Number	Duplicate Set A	Duplicate Set B	% Deviation ± Y
1	41678	228	225	0.44
2	41565	382	384	0.38
3	42724	4231	239	0.416
4	43225	472	470	0.21
5	43709	404	400	0.49
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

Reviewed By ______ Date ______

ANALYTICAL PRECISION CONTROL CHART

Target. Y = 0%

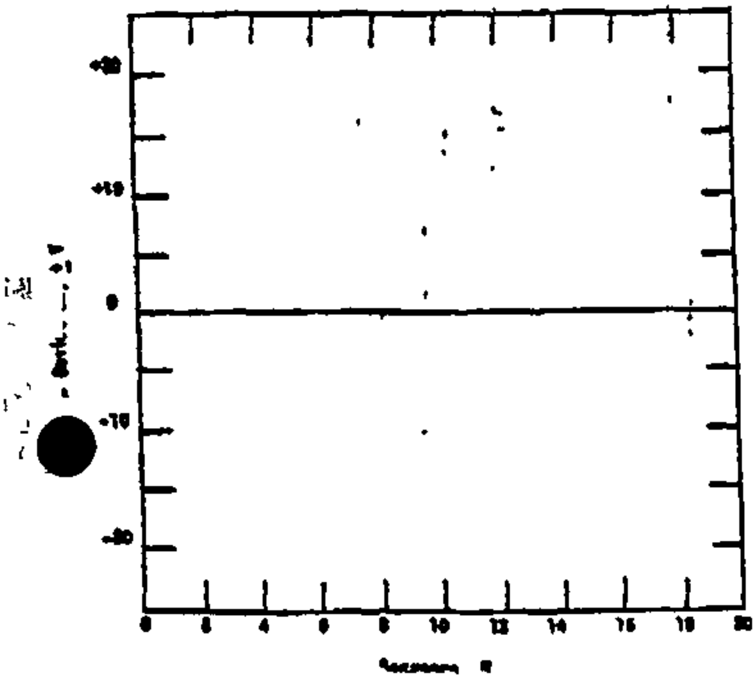
Acceptance Y = ± ______ %

$Y = \pm \left| \frac{A - B}{A + B} \right| 100$

Parameter ______ Conc. Range ______

Method ______

Analyst ______



Sequence N	Sample Number	Duplicate Set A	Duplicate Set B	% Deviation ± Y
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

Reviewed By ______ Date ______

TEST: Potassium (Total) 258.1

CERT NO.	STD	COUNTS	DIL.	RESULTS MG/L	DATE	TIME	ANALYST	DETECTION LIMIT	Remarks - QA Other Considerations
BlK		0		0	2/23	1630	MZ	0.01	
	10ppm	898							
	5ppm	440							
	1.0ppm	86							x̄=471
83283	(10X)	472	1:100	5363.6					%D=0.21
Dup	(10X)	470	1:100	5340					%Rec=556−471/86
Spk	(10X)	556	1:100	6318					86
									%Rec=98.8

Date 2/23 Time 1630 Analyst MZ

Duplicate 1 420 Duplicate 2 422

Spike 556 % Recovery 98.8

Total # Samples 1 Total # Dup. & Spikes 2

Date O.K.'D______ Signed ______

Remarks ______

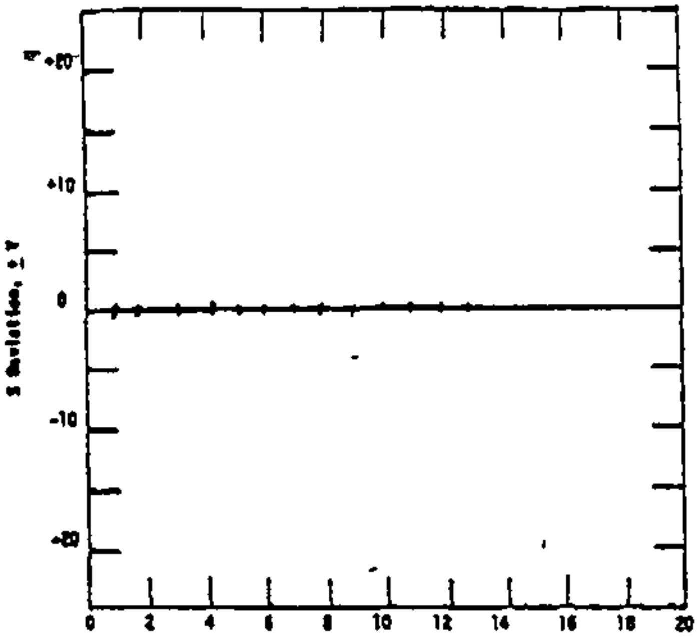
ANALYTICAL PRECISION CONTROL CHART

Target Y = 0%

Acceptance Y = ± ________ %

Selenium

$Y = \pm \left| \frac{A - B}{A + B} \right| 100$



Parameter SELENIUM Conc Range ________

Method 270.3

Analyst AZ

Sequence N	Sample Number	Duplicate Set A	Duplicate Set B	% Deviation ± Y
1	41687	0	0	0
2	41693	0	0	0
3	41776	0	0	0
4	41825	0	0	0
5	41717A	0	0	0
6	41892	0	0	0
7	41906	0	0	0
8	42013	0	0	0
9	42030	0	0	0
10	42077	0	0	0
11	42095	0	0	0
12	42252	0	0	0
13	42299	0	0	0
14				
15				
16				
17				
18				
19				
20				

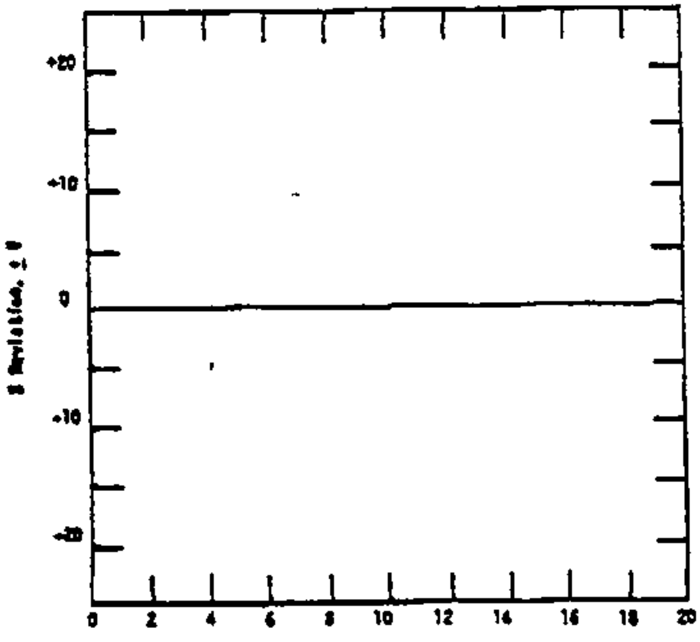
Reviewed By ________________ Date ________

ANALYTICAL PRECISION CONTROL CHART

Target Y = 0%

Acceptance Y = ± ________ %

$Y = \pm \left| \frac{A - B}{A + B} \right| 100$



Parameter ________________ Conc Range ________

Method ________________

Analyst ________________

Sequence N	Sample Number	Duplicate Set A	Duplicate Set B	% Deviation ± Y
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

Reviewed By ________________ Date ________

TEST: SELENIUM EPTOX METHOD: 270.3

CERT NO.	STD	COUNTS	DIL.	RESULTS MG/L	DATE	TIME	ANALYST	DETECTION LIMIT	Remarks - QA Other Calculations
BlK		0		0	11/15	1400	MZ	0.002mg/L	
	1.0ppm	500							
	0.5ppm	230							
	0.1ppm	48							
42026		ND		<0.002					
42027		ND		<0.002					
43030		ND		<0.002					$\bar{x}$=0
Dup		ND		<0.002					%D=0
Spike		46		0.0958					%Rec = 46-0
									48
									%=95.8

Date 11/15 Time 1400 Analyst MZ

Duplicate 1 ND Duplicate 2 ND

Spike 46 % Recovery 95.8

Total # Samples 3 Total # Dup. & Spikes 2

Date O K.'D________ Signed ________

Remarks ________

ANALYTICAL PRECISION CONTROL CHART

Target Y = 0%

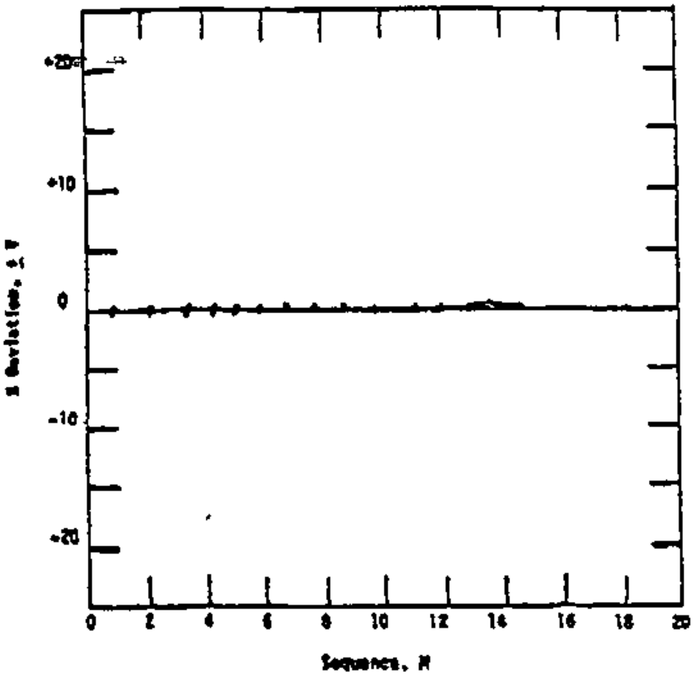
Acceptance Y = ± ______ %

$$Y = \pm \left| \frac{A - B}{A + B} \right| 100$$

Parameter SILVER Conc Range ______

Method 272.1

Analyst MZ



Sequence N	Sample Number	Duplicate Set A	Duplicate Set B	% Deviation ± Y
1	41641	ND=0	0	0
2	41693	ND=0	0	0
3	41720	ND=0	0	0
4	41272	ND=0	0	0
5	41776	ND=0	0	0
6	41825	0	0	0
7	41846	0	0	0
8	41728	0	0	0
9	41859	0	0	0
10	41284	0	0	0
11	41938	0	0	0
12	41906	0	0	0
13	41999	0	0	0
14	42013	0.210	0.209	0.238
15	42030	0	0	0
16				
17				
18				
19				
20				

Reviewed By ______ Date ______

ANALYTICAL PRECISION CONTROL CHART

Target Y = 0%

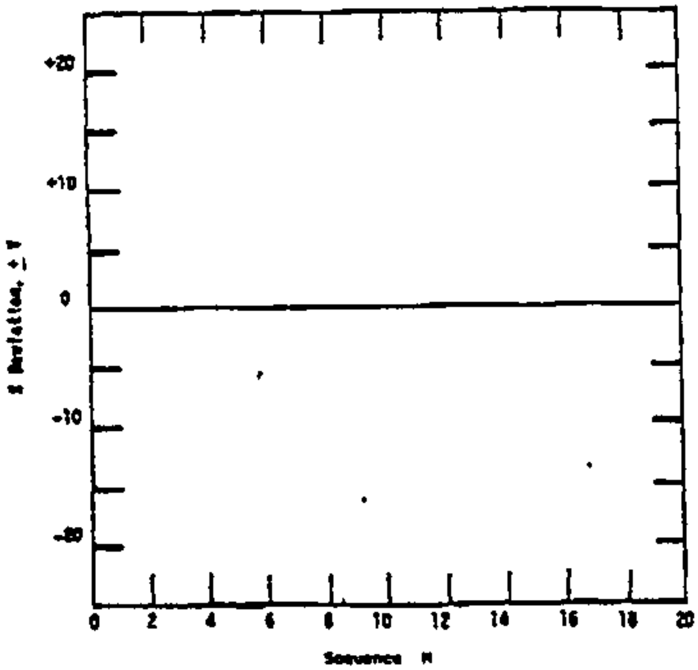
Acceptance Y = ± ______ %

$$Y = \pm \left| \frac{A - B}{A + B} \right| 100$$

Parameter ______ Conc Range ______

Method ______

Analyst ______



Sequence N	Sample Number	Duplicate Set A	Duplicate Set B	% Deviation ± Y
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

Reviewed By ______ Date ______

TEST: SILVER Total & EP Tox METHOD: 272.1

CERT NO.	STD	COUNTS	DIL.	RESULTS MG/L	DATE	TIME	ANALYST	DETECTION LIMIT	Remarks - QA Other Calculations
Blk		0		0	11/10	1030	MZ	0.01mg/l	
	1.0ppm	569							
	0.5ppm	300							
	0.1ppm	57							
T 4203		212	1:10	3.53					
E 4203		210	1:10	3.50					
Dup		209	1:10	3.48					$\bar{x}$=209.5
Spike		265	1:10	4.41					%D=0.238
									%Rec= $\frac{265-209}{57}$
									% = 98.2

Date 11/10 Time 1030 Analyst MZ

Duplicate 1 210 Duplicate 2 209

Spike 265 % Recovery 98.2

Total # Samples 2 Total # Dup. & Spikes 2

Date O K.'D __________ Signed __________

Remarks __________

MEW Admin record
AR104163

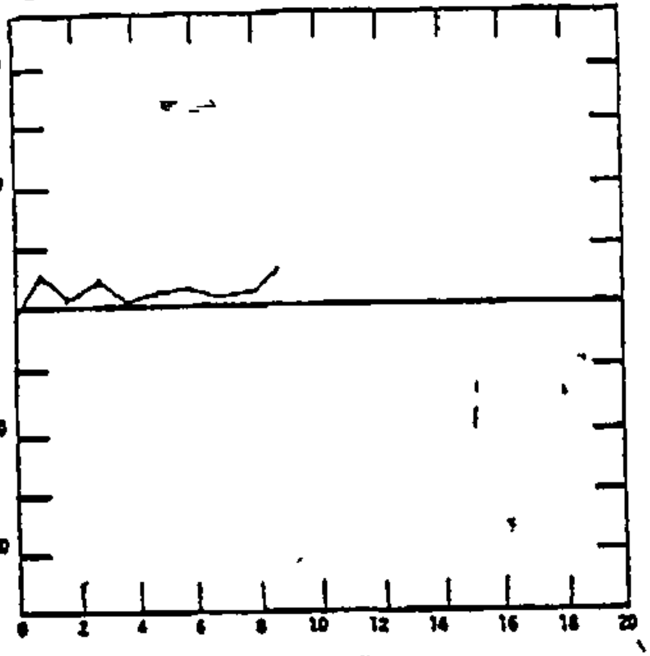
ANALYTICAL PRECISION CONTROL CHART

Target Y = 0%

Sodium

Acceptance: Y = ± ________%

$$Y = \pm \left| \frac{A - B}{A + B} \right| 100$$



Parameter Sodium Conc. Range ________

Method 273.1

Analyst ________

Sequence N	Sample Number	Duplicate Set A	Duplicate Set B	% Deviation ± Y
1	[illegible]	160	169	2.73
2	4461	112	110	0.90
3	42552	44	42	2.4
4	42594	283	281	0.34
5	42654	270	268	0.37
6	42761	300	295	0.84
7	42810	695	690	0.361
8	43233	314	310	0.641
9	43708	85	80	3.0
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

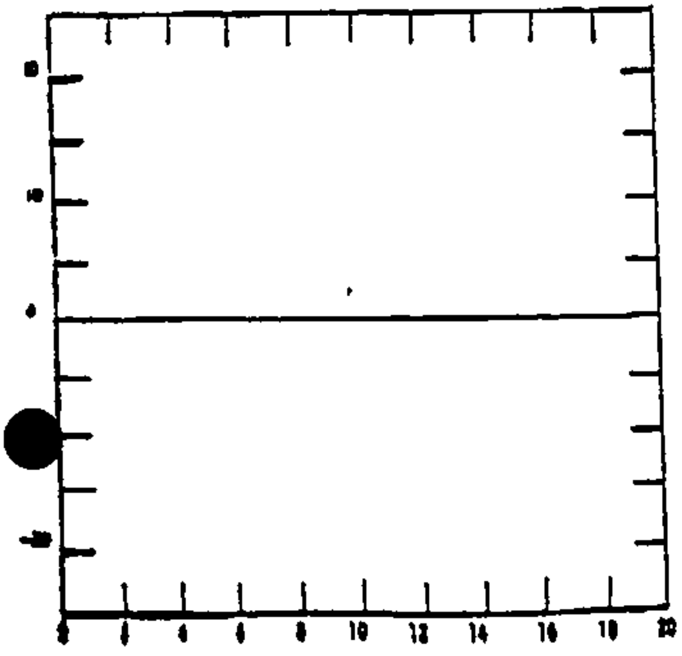
Reviewed by ________ Date ________

ANALYTICAL PRECISION CONTROL CHART

Target. Y = 0%

Acceptance. Y = ± ________%

$$Y = \pm \left| \frac{A - B}{A + B} \right| 100$$



Parameter ________ Conc. Range ________

Method ________

Analyst ________

Sequence N	Sample Number	Duplicate Set A	Duplicate Set B	% Deviation ± Y
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

MEW Admin record
AR104164

TEST: Sodium (Total) METHOD: 273.1

CERT NO.	STD	COUNTS	DIL.	RESULTS MG/L	DATE	TIME	ANALYST	DETECTION LIMIT	Remarks - QA Other Calculations
Blk		0		0	2/23	1645	MZ	0.002	
	1.0ppm	312							
	0.5ppm	150							
	0.1ppm	45							
43293 (10x)		314	1/1000	10,064 1					$\bar{x}$ = 312
Dup (10x)		310	1:1000	9 935 0					%D = 0.641
Spike (10x)		354	1:1000	1134-1					%Rec = 354-312(×[illegible]
									45
									%Rec = 93.3

Date 2/23 Time 1645 Analyst MZ

Duplicate 1 314 Duplicate 2 310

Spike 354 % Recovery 93.3

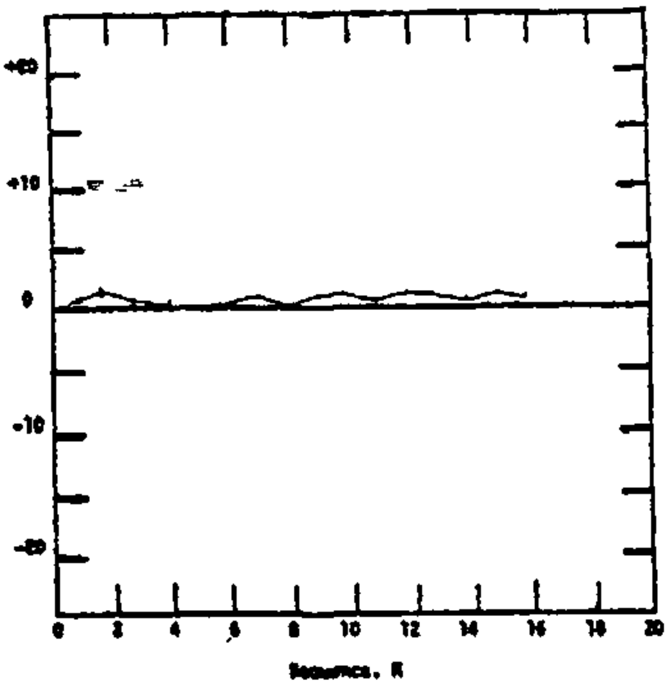
Total # Samples 1 Total # Dup. & Spikes 2

Date O.K.'D ____________ Signed ____________

Remarks ____________

Acceptance: T = ± ______ % Zinc

$T = \pm \left| \frac{A - B}{A + B} \right| 100$



Method 207.1

Analyst MG

Sequence N	Sample Number	Duplicate Set A	Duplicate Set B	% Deviation ± T
1	41678	230	228	0.436
2	41702	82	80	1.2
3	41814	240	238	0.418
4	41938	591	587	0.469
5	42019	62	62	0
6	42307	405	403	0.247
7	42455	739	735	0.271
8	42501	946	945	0.05
9	42638	328	325	0.4
10	42873	600	590	0.8
11	43277	412	410	0.24
12	43321	225	223	0.44
13	43333	420	418	0.24
14	43425	425	423	0.24
15	43635	393	390	0.38
16	43692	539	536	0.27
17				
18				
19				
20				

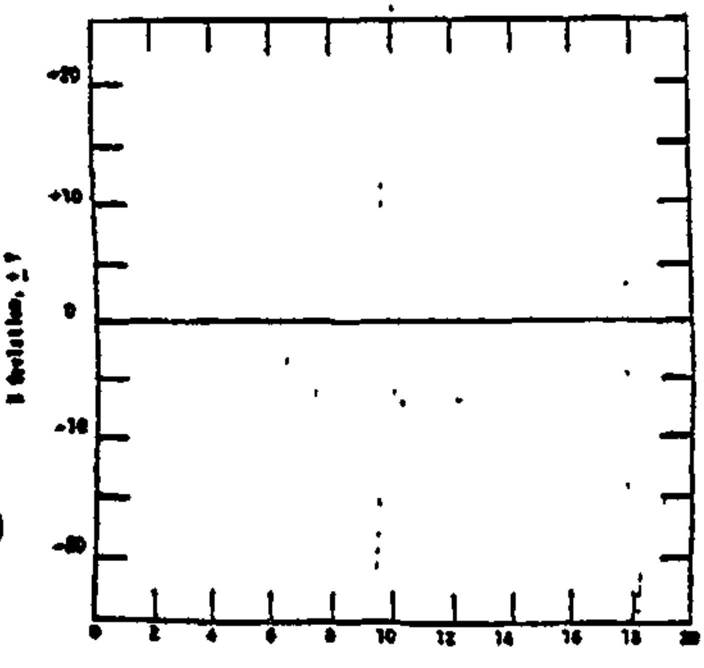
Reviewed By ______________ Date ______________

ANALYTICAL PRECISION CONTROL CHART

Target: T = 0%

Acceptance: T ≤ ± ______ %

$T = \pm \left| \frac{A - B}{A + B} \right| 100$



Parameter ______________ Conc. Range ______________

Method ______________

Analyst ______________

Sequence N	Sample Number	Duplicate Set A	Duplicate Set B	% Deviation ± T
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

Reviewed By ______________ Date ______________

MEW Admin record
AR104166

CERT. NO.	STD	COUNTS	DIL.	RESULTS MG/L	DATE	TIME	ANALYST	DETECTION LIMIT	Remarks - QA Other Calculations
Blk		0		0	11/9	1645	MZ	0.005mg/l	
	1.0ppm	500							
	0.5ppm	290							
	0.1ppm	49							
41980		85		0.173					
41985		52	1:10	1.06					
42013		62	1:100	12.6					
Dup		62	1:100	12.6					$\bar{x}=62$ %D=0
Spike		109	1:100	18.7					%Rec = $\frac{109-62}{49}$
									%Rec = 95.9

Zinc

Date 11/9 Time 1645 Analyst MZ

Duplicate 1 62 Duplicate 2 62

Spike 109 % Recovery 95.9

Total # Samples 3 Total # Dup. & Spikes 2

Date O.K.'D ______ Signed ______

Remarks ______

Organics Analysis Data Sheet
(Page 1)

Sample Number

Laboratory Name APR
Lab Sample ID No
Sample Matrix waste water
Data Release Authorized By

Case No
QC Report No 4/14/89
Date Sample Received 4/11/89

Volatile Compounds

Date Extracted/Prepared 4/12/89
Date Analyzed 4/14/89
Conc/Dil Factor none pH 6.4
Percent Moisture (Not Decanted) 100%

CAS Number		[✓ ug/l] or ug/Kg (Circle One)
74 87 3	Chloromethane	10 U
74 83 9	Bromomethane	10 U
75 01-4	Vinyl Chloride	10 U
75 00 3	Chloroethane	10 U
75 09 2	Methylene Chloride	5 U
67 64 1	Acetone	100 U
75 15 0	Carbon Disulfide	5 U
75 35-4	1 1 Dichloroethene	5 U
75 34 3	1 1 Dichloroethane	5 U
156 60 5	Trans 1 2 Dichloroethene	5 U
67 66 3	Chloroform	5 U
107-06 2	1 2-Dichloroethane	5 U
78 93 3	2-Butanone	100 U
71 55 6	1 1 1 Trichloroethane	5 U
56 23 5	Carbon Tetrachloride	5 U
108 05 4	Vinyl Acetate	50 U
75 27-4	Bromodichloromethane	5 U

CAS Number		[✓ ug/l] or ug/Kg (Circle One)
78 87 5	1 2 Dichloropropane	5 U
10061-02-6	Trans 1 3 Dichloropropene	5 U
79 01 6	Trichloroethene	5 U
124-48 1	Dibromochloromethane	5 U
79 00 5	1 1 2 Trichloroethane	5 U
71-43 2	Benzene	5 U
10061 01 5	cis 1 3 Dichloropropene	5 U
110 75 8	2 Chloroethylvinylether	10 U
75 25 2	Bromoform	5 U
108 10 1	4 Methyl 2 Pentanone	50 U
591 78 6	2 Hexanone	50 U
127 18 4	Tetrachloroethene	5 U
79 34 5	1 1 2 2-Tetrachloroethane	5 U
108 88 3	Toluene	5 U
108 90 7	Chlorobenzene	5 U
100-41 4	Ethylbenzene	5 U
100 42 5	Styrene	5 U
	Total Xylenes	5 U

Data Reporting Qualifiers

For reporting results to EPA, the following results qualifiers are used. Additional flags or footnotes explaining results are encouraged. However, the definition of each flag must be explicit.

Value	If the result is a value greater than or equal to the detection limit report the value
U	Indicates compound was analyzed for but not detected. Report the minimum detection limit for the sample with the U (e g 10U) based on necessary concentration dilution action. (This is not necessarily the instrument detection limit.) The footnote should read U Compound was analyzed for but not detected. The number is the minimum attainable detection limit for the sample
J	Indicates an estimated value. This flag is used either when estimating a concentration for tentatively identified compounds where a 1 response is assumed or when the mass spectral data indicated the presence of a compound that meets the identification criteria but the result is less than the specified detection limit but greater than zero (e g 10J). If limit of detection is 10 µg/l and a concentration of 3 µg/l is calculated report as 3J
C	This flag applies to pesticide parameters where the identification has been confirmed by GC/MS. Single component pesticides ≥ 10 ng/ul in the final extract should be confirmed by GC/MS
B	This flag is used when the analyte is found in the blank as well as a sample. It indicates possible/probable blank contamination and warns the data user to take appropriate action
Other	Other specific flags and footnotes may be required to properly define the results. If used, they must be fully described and such description attached to the data summary report

Form I

Laboratory Name APR

Case No

Sample Number

Organics Analysis Data Sheet
(Page 3)

Pesticide/PCBs

Date Extracted/Prepared 4/19/89

Date Analyzed 4/19/89

[✓ Conc]/Dil Factor 3/1

Percent Moisture (decanted) 75%

GPC Cleanup ☐Yes ☒No

Separatory Funnel Extraction ☐Yes

Continuous Liquid - Liquid Extraction ☐Yes

CAS Number		ug/l or [✓ ug/Kg] (Circle One)
319 84 6	Alpha BHC	n/a
319 85 7	Beta BHC	
319 86 8	Delta BHC	
58-89 9	Gamma BHC (Lindane)	
76 44 8	Heptachlor	
309 00 2	Aldrin	
1024 57 3	Heptachlor Epoxide	
959 98 8	Endosulfan I	
60 57 1	Dieldrin	
72 55 9	4 4 DDE	
72 20 8	Endrin	
33213 65 9	Endosulfan II	
72 54 8	4 4 DDD	
1031-07 8	Endosulfan Sulfate	
50 29 3	4 4 DDT	
72-43 5	Methoxychlor	
53494 70 5	Endrin Ketone	
57 74 9	Chlordane	
8001 35 2	Toxaphene	
12674 11 2	Aroclor 1016	40 U
11104 28 2	Aroclor 1221	40 U
11141 16 5	Aroclor 1232	40 U
53469 21 9	Aroclor 1242	40 U
12672 29 6	Aroclor 1248	40 U
11097 69 1	Aroclor 1254	40 U
11096 82 5	Aroclor 1260	40 U

V_i = Volume of extract injected (ul)

V_s = Volume of water extracted (ml)

W_s = Weight of sample extracted (g)

V_t = Volume of total extract (ul)

V_s n/a or W_s 30 V_t 10,000 V_i 1

MEW Admin Record
AR104169

Form 1

McCLELLAND CONSULTANTS

Houston Geotechnical Laboratory

Quality Assurance Manual

McClelland Consultants' laboratory's primary objective is to provide high quality, state-of-the-practice material testing service that is responsive to both internal and client needs.

With the constant refinement of testing procedures and data acquisition equipment, along with the extreme specialization of testing categories, it is essential that a comprehensive Quality Assurance Program be implemented and enforced in the Houston Laboratory.

Contained in this manual are the policies and procedures which comprise our Quality Assurance Program. These policies and procedures are enforced directly by the Laboratory Manager through his supervisory staff. Any modifications to this manual shall be reviewed and approved by the Laboratory Manager.

McCLELLAND CONSULTANTS

INTRODUCTION

1.1 The purpose of this Manual is to establish and define the policies and procedures of the McClelland Consultants Houston Laboratory's Quality Assurance Program.

1.2 The function of the Quality Assurance Program is to present a standard which enables the Laboratory Manager to evaluate the laboratory's procedures in determining the engineering properties of construction materials.

1.3 This Manual defines the methods and procedures for maintaining the highest possible level of accuracy in testing.

It is necessary that the program defined in this manual is not only implemented, but carried on continually by evaluation of procedures, equipment calibration, computer software refinement, and participation in standardization and inspection programs.

1.4 The Laboratory Manager will establish and enforce the Quality Assurance Program and all laboratory procedures.

1.5 The Quality Control Manual will be reviewed and updated when necessary

1.6 All sections of the Quality Control Manual shall be contained in this document.

QUALITY POLICIES

SCOPE

2.1 The Houston Laboratory Department Quality Assurance Program is intended to establish basic guidelines for all laboratory activities with specific emphasis on those functions that directly affect the quality of tests performed and the reduction of data

CHIEF QUALITY CONTROL OFFICER

2.2 The position of Chief Quality control Officer shall be established.

REQUIREMENTS

2.3 The requirements of the Quality Assurance Program and the Qualtiy Assurance Manual shall be secondary only to requirements or the client. In the event that client requirements differ from established and documented procedures, the clients requests will be honored and our reports will indicate procedures followed.

The requirements of the Qualtiy Assurance Program shall conform to requirements established by approved agencies (A2LA, ASTM, AASHTO) and/or McClelland Consultants.

PLANNING REQUIREMENTS

2.4 The Quality Assurance Program shall be established and enforced by the Chief Quality Control Officer and the management of McClelland Consultants.

The Chief Quality Control Officer will monitor the enforcement of the program.

CONTROL AND REVISIONS

2.5 The Chief Quality Control Officer shall distribute copies of the Quality Assurance Manual and maintain a current record of all copy holders. It shall be available to all of the technical staff engaged in the performance of materials tests.

The Quality Assurance Manual may be revised in its entirety, by section, or by topic. Revisions will be made only with the approval of the Chief Quality Control Officer. In the event of revision, the date shall be noted on the page of the revision.

NON-CONFORMANCE

2.6 Non-conformances shall be reported in writing to the Chief Quality Control Officer. A time shall be established in which corrective action must be taken.

LABORATORY ORGANIZATION FOR QUALITY ASSURANCE

SCOPE

3.1 This section will define the routing of work through the quality control check points. Figure 3-1 illustrates the flow of work through the laboratory. This section will define the positions and responsibilities as they are incorporated in the Quality Assurance Program. Section 6 describes the qualifications necessary to staff these positions.

LABORATORY MANAGER

3.2 The function of the Laboratory Manager is to direct the overall operation of the department.

The Laboratory Manager reviews all procedures, equipment and facilities pertaining to the enforcement of the Quality Control Program, and evaluates the possible application of state-of-the-art equipment and computer software for production purposes.

The Laboratory Manager oversees the entire staff of engineers and technicians conducting materials testing.

He is directly responsible to insure that the application of the Quality Assurance Program is paramount in testing and equipment calibration procedures.

The Laboratory Manager will direct his staff to insure that samples are inspected for proper identification and have not been disturbed in transit so as to cause significant variations in tested properties.

He will assume the responsibility of having documented testing and calibration procedures. In addition he will make periodic checks during testing to insure that the tests are being performed according to documented procedures, and that the equipment being used is in proper calibration.

The Laboratory Manager will direct the supervisory personnel in the enforcement of the policies of the Quality Assurance Program. The Laboratory Manager will use supervisory personnel to monitor the application of the Quality Assurnce program. These supervisory personnel will oversee the following tasks or testing areas:

1) Material Properties
2) Material Strengths
3) Material Dynamic Characteritics

His policies are carried out by the following supervisory personnel, who will delegate the inspection duties to their subordinates

1) Project Engineer
2) Field Coordinator
3) Lead Technicians

DATA PROCESSING

3.3 The Laboratory Manager oversees the computation and processing of laboratory data

He enforces the Quality Assurance Policy by ensuring that tests are computed in accordance with documented procedures. He is directly responsible for reviewing all computer software and insuring that they also are in accordance with documented procedures. He maintains an updated documentation record of computer programs and has the ultimate responsibility for the application of software modifications.

The Laboratory Manager and/or Project Engineer serves as a quality control inspector by reviewing all data in its final form before being reported. Any discrepancies between any of the tested or visual properties of a material dictate an evaluation by an engineer. If there is no apparent explanation for the discrepancies, the test will be returned to the laboratory and, if necessary, run again.

Quality Assurance procedures are also enforced by the Laboratory Manager through his subordinates. These include the following:

1) Senior Laboratory Testing clerk
2) Data Processing Computer Operator
3) Laboratory Aid (Data Processing)
4) Laboratory Technicians

PROJECT ENGINEER

3.4 The Project Engineer's contribution to the Quality Assurance Program is to review Testing data. He will determine whether the tests have been satisfactorily completed. In the event that they are not, he may recommend re-running of the tests. The Project Engineer's decision to accept or re-run a test is final and needs no further approval.

FIELD COORDINATOR

3.5 The Field Coordinator's quality assurance function is to maintain files of written instructions for field services. The coordinator schedules the technician for the project, transfers instructions, and verifies receipt of field reports from the technician. The reports are then sent to the project engineer for technical review and distribution to the client.

LEAD TECHNICIANS

3.6 The Lead Technicians will all assume the same Quality Assurance enforcement responsibilities. They will be the actual Quality Control Inspectors, as they will monitor all testing as it is being done by the technicians.

The prime responsibility of the Lead Technicians pertaining to the enforcement of the Quality Assurance Program is to insure that testing and calibration conducted by technicians are performed in adherence to the established and documented procedures provided by the Laboratory Manager.

In addition to their monitoring responsibilities, the Lead Technicians will review all tests completed on a daily basis. Review of these forms will consist of making certain that all tests forms are complete, and that raw data initially appears to be within established standards. Upon completion of this initial review the tests will then be routed to the Senior Laboratory Testing Clerk.

SENIOR LABORATORY TESTING CLERK

3.7 The Senior Laboratory Clerk plays a key part in the Quality Assurance policy of the laboratory. This position is a focal point for work assignments coming in and leaving the laboratory. The clerk's responsibility is to compute, check, plot and summarize all test data completed by the laboratory. This is accomplished by either doing the data reduction or overseeing the work of the Data Processing Computer Operator and the Laboratory Aid.

Any test discrepancies found in the computed data will be checked for computation errors, and if none are found, the test will be returned to the Lead Technician for verification.

DATA PROCESSING COMPUTER OPERATOR

3.9 The responsibility of computing and reducing laboratory data lies with the Data Processing Computer Operator. As an integral part of the Quality Assurance Program the computer operator reviews, prior to computer input, and checks for data which grossly deviates from the norm. These deviations consist primarily of weights or dimensions that are apparently in error.

In the event that a discrepancy is found, the test will be given to the Senior Laboratory Clerk who will route it to the appropriate Lead Technician in the laboratory.

LABORATORY AIDE (DATA PROCESSING)

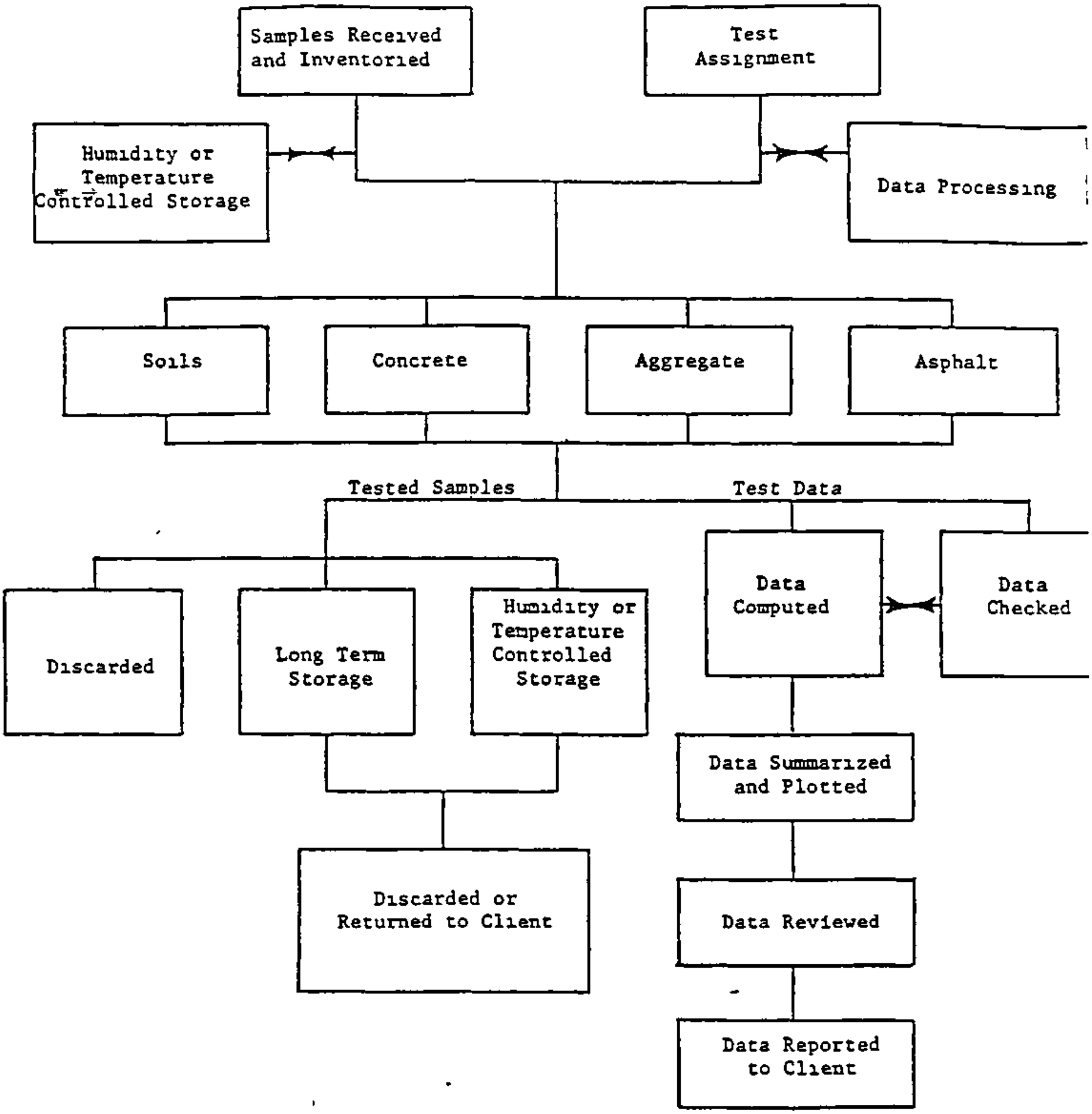
3.10 The function of the Laboratory Aide, in Data Processing, is to check the accuracy of the data input and to summarize and plot the computed data.

If an error is detected, the test will be given back to the Senior Laboratory Testing Clerk and will be re-computed

Summarization and plotting of test data by one Laboratory Aide will be checked by either the Laboratory Manager, Lab Clerk, or another Aide. In any case, the final reports will be reviewed by the Laboratory Manager or Project Engineer.

LABORATORY TECHNICIAN

3.11 The Laboratory Technicians will conduct tests. Tests are to be run in accordance with established and documented procedures, unless otherwise directed by the Laboratory Manager. It is the Laboratory Technicians responsibility, on a daily basis, to check test equipment to insure proper calibration. If required, equipment shall be calibrated before each test is performed.



TESTING FLOW CHART
Fig. 3-1

OPERATIONAL PROCEDURES

SCOPE

4.1 This section will define the procedures established for the operation of the laboratory. The procedures defined are a general overview of operation.

Detailed testing and computational procedures are defined in separate laboratory and data processing manuals.

SAMPLE RECEIVING

4.2 Samples arriving in the laboratory will be logged in by a lab warehouseman. The warehouseman will then compare his record with the field inventory. In the event of a discrepancy, the field technician, field coordinator, or engineer shall be notified.

PRE-TESTING-STORAGE

4.3 Samples will be stored in a temperature-controlled environment prior to testing. They will be stored in a place that is easily accessible for preliminary review.

TESTS ASSIGNMENTS

4.4 Laboratory testing assignments will be made by the project engineer on the standard McClelland Form LAB 1.08 (1/83) or LAB 1.08A (6/88). The form will then be routed to the Senior Laboratory Testing Clerk.

FORMATION OF TESTING STATUS RECORD

4.5 The Laboratory Testing Clerk will receive the test assignment form and establish a computer file of the number of, and type of test assigned. Also recorded, will be information pertaining to the client and engineers assigned to the job.

PREPARATION OF LABORATORY TESTING DATA FORMS

4.6 Testing data forms for each test to be performed in the laboratory will be filled out by the Senior Laboratory Testing Clerk. The forms will be prepared for each sample to be tested and will include a combination of either the job number, lab number, sample number, sample location, and sample depth. Any special comments or instructions recorded on the assignment sheet for a particular test will be noted on the test data sheet.

Upon completion of test data forms by the Senior Laboratory Testing Clerk, the forms will be routed to the Laboratory Manager or Lead Technician for review and scheduling into testing.

LABORATORY TESTING

4.7 The Lead Technician will assign tests to be completed by technicians within his group. The tests will be conducted in accordance with the Laboratory Procedures Manual.

DATA COMPUTATION (DATA PROCESSING)

4.8a The majority of tests conducted in the laboratory will be computed by the Senior Laboratory Testing Clerk.

The Senior Laboratory Testing Clerk will record each test as being completed and ensure that the test performed was actually the test assigned. Notation will be made here as to any deviations from the original assignment and the client will be notified.

The Senior Laboratory Testing Clerk will distribute test data that require plotting to the computer operator. The computer operator will compute and plot the tests. The programs used for computing shall be individually documented in the Laboratory Computer Documentation Manual

The Computer Operator will bring to the attention of the Laboratory Manager any test results which generate a computer system error. System errors in this case may be caused by data that yields unreasonable results. These results are items such as division by zero, imaginary roots, etc.

In the event of ambiguous data, the Laboratory Manager will route the test to the lead technician.

The Laboratory Manager will determine if the data has been recorded improperly and correct it, or instruct a technician to re-run the test. Tests requiring no correction will have hard copy computer outputs of the input data and output results. The Laboratory Aide will check the data versus the hard copy to ensure that the data has been entered correctly into the computer. In the event that an input error is detected, the test will be re-computed.

DATA COMPUTATION (LABORATORY)

4.8b The Laboratory Manager will determine which types of tests will be computed in laboratory testing.

The purpose of laboratory computation is to allow the Technician or Lead Technician to see the results before proceeding with other tests assigned to the same sample.

TABULATION AND PLOTTING OF DATA

4.9 Upon completion of computing and checking, data will be summarized and plotted in accordance with the procedures defined in The Laboratory Data Processing Procedure Manual.

All boring logs and test reports will be reviewed by the Laboratory Manager or the Project Engineer. This review will include spot-checks for accuracy in addition to overall neatness.

Any discrepancies in classification and actual test results or any data that appears unusual on the report will be noted at this point. Plotted or tabulated data that does not appear to conform to the properties classified may warrant re-running of the tests.

After the final review, the Senior Laboratory Testing Clerk will count the total number of tests run for invoicing and record the job as being completed. The Project Engineer will be notified that the job has been completed.

CALIBRATION OF EQUIPMENT

SCOPE

5.1 This section establishes the essential elements of equipment calibration procedures and equipment inventory documentation.

RECORDS

5.2 Records shall be maintained for equipment which requires calibration. These records shall include, but not be limited to the following:

A. Manufacturer

B. Model and Serial Number

C. Properties to be Calibrated

D. Range of Operation for Valid Calibration

E. Reference to Documented Calibration Procedures

F. Dates of Calibration

G. Allowable Tolerance

H. History of Equipment Repairs

I. Traceability to National Burearu of Standards

CROSS-REFERENCING

5.3 It shall be necessary to cross-reference test equipment and calibration standards with the necessary sources to establish verification.

The Laboratory Manager will determine when calibration and cross-referencing of calibration data shall be done with in-house or external equipment.

INTERVALS

5.4 The Laboratory Manager or the Chief Quality Control Officer may establish the calibration intervals of each type of testing apparatus based upon known standards when applicable. He shall have the option to allow the Lead Technician to schedule the calibration so as not to interfere with work schedule.

After determining what the proper interval is for each piece of equipment, the interval may not be increased without revision of the manual. Intervals may be shortened as required to assure accuracy in the event of damage or extension of the range of the equipment.

CALIBRATION PROCEDURE

5 5 Procedures used for equipment calibration are defined in the Laboratory Calibration Procedure Manual. The Calibration Manual will not only describe procedures, but other information such as calibration points, accuracy required and governing specifications.

LABELING

5 6 Calibration stickers shall be used on most equipment showing the calibration date.

ATTACHMENT

DOCUMENTATION OF CALIBRATION FOR McCLELLAND ENGINEERS MISSOURI ELECTRIC WORKS RI/FS

McClelland engineers, inc.

P O Box 740010 Houston Texas 77274

Date 10-11-88
Requisitioner KH
Purchase Order No LAB 421

Vendor ABS

Ship to

Attn

Attn

INVOICE IN TRIPLICATE

Date Wanted	Shipping Date	FREIGHT PAID BY MEI ☐ Vendor ☐	FOB ☐ Origin ☐ Destination

Item	Quantity	Job No	A/C No	Work Code	Description	Unit Price	Total
	1	126410.21			Calibrate Balances		380^{00}
							380.43

Received by

Date

APPROVALS			
G	KH	C	
F		B	
E		A	
D			

Requisition No 55656

VENDOR COPY

FORM 115 12 (77)

MEW Admin record
AR104184

[illegible]METRICS, INC.
specialty laboratory supplies

◀ SERVING YOU FROM

P O BOX
15825
BATON ROUGE LA
70895

CUSTOMER NO	INVOICE DATE	INVOICE NO	SALESMAN	TERMS	SHIPPED VIA	SALES ORD NO	CUSTOMER ORDER NO
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

PART NO	DESCRIPTION	ORD	SHIP	B O	UNIT PRICE	AMOUNT
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		1		[illegible]	[illegible]

SOLD TO [illegible]

SHIPPED TO [illegible]

SUB-TOTAL ▶	[illegible].43
TAX ▶	[illegible].00
TRANSPORTATION ▶	[illegible].00
INVOICE TOTAL ▶	[illegible].43

DUPLICATE INVOICE

NO OTHER STATEMENTS WILL BE RENDERED!

PLEASE RETURN THIS STUB WITH YOUR PAYMENT

Thank You!

DELINQUENT ACCOUNTS SUBJECT TO A LATE CHARGE OF 1½% PER MONTH NOT TO EXCEED 18% PER YEAR

ATTORNEY FEES IF ANY ARE ADDITIONAL AND WILL BE ADDED. WE REPRESENT COMPLIANCE WITH THE FAIR LABOR STANDARDS ACT OF 1938 AS AMENDED

OFFICE USE ONLY
[illegible]

McClelland engineers, inc /geotechnical consultants

INSTRUMENT CALIBRATION

Date 9 / 8 / 88 Initials WFJ Station/Channel V / L

INSTRUMENT

Type OHAUS CENT-O-GRAM 2610 EAL

Mfgr ______

S/N ——

Excitation ——

Attenuator: ——

STANDARD

Type CLASS S WEIGHTS

Mfgr Christian Becker

S/N J-9112

LINEAR REGRESSION SUMMARY

Corr. Coeff ______

Intercept ______

Slope: ______

Calibration: ______

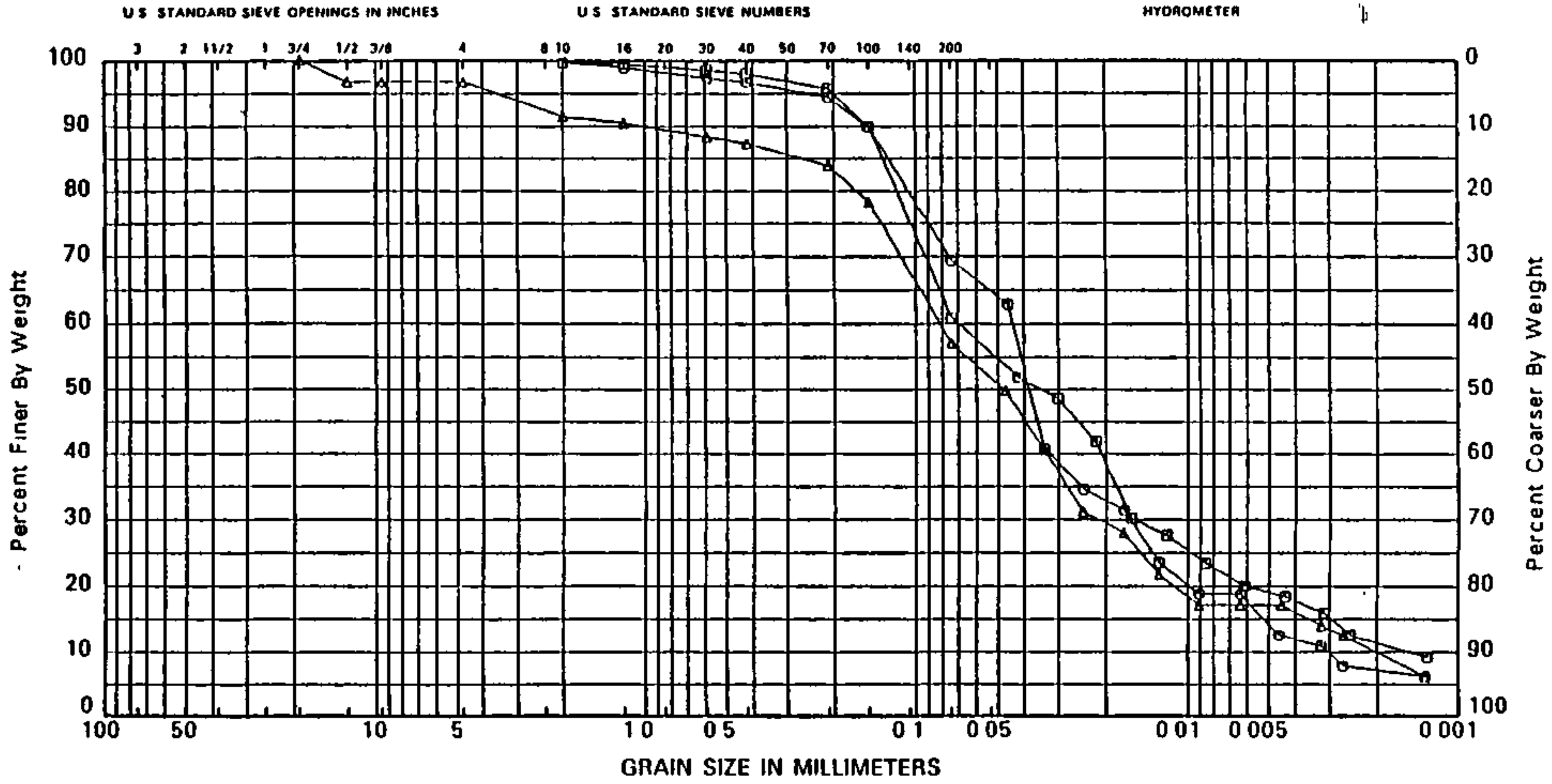
NOTES

* This column provided for load cell calibrations. Do not use these values in linear regression calculation.

Standard ( )	Instrument ( ) gms	* (Kg)
1	1.05	
3	3.00	
10	10,0	
20	19,9	
30	30,0	
50	50	
100	100	
150	149,9	
180	182.0	
200	200,0	

McCLELLAND ENGINEERS

GRAIN SIZE CURVES



GRAVEL		SAND			SILT or CLAY
Coarse	Fine	Coarse	Medium	Fine	

CURVE	BORING NO	PENETRATION Ft	MATERIAL
-○-○-○-	1	0 0	
-△-△-△-	2	0 0	
-□-□-□-	3	0 0	

PLATE

PERSONNEL

SCOPE

6.1 This section will establish the qualifications needed to occupy the positions described in Section 3. Meeting these qualifications is essential to maintaining a Quality Assurance Program, since each of these positions associates itself with a key area of responsibility in insuring quality testing and data reduction.

LABORATORY MANAGER

6.2 The Laboratory Manager position is shared by two persons. These two persons share the prescribed functions of the Laboratory Manager with one person designated primarily toward office testing and the other primarily toward field testing services. However, both have the flexibility to serve in an interim capacity for each other.

The position of Laboratory Manager usually requires five or more years of experience. During this period, he must have demonstrated not only strong technical abilities, but also the following managerial and personal qualities: Leadership, fiscal responsibility, skill in interpersonal relationships, project organizational ability and high professional standards.

The Laboratory Manager shall be a graduate of an accredited university, or shall have had reasonable experience and knowledge of laboratory operations and procedures in lieu of university accreditation.

FIELD COORDINATOR

6.3 The Field Coordinator must have the ability to interact with people effectively. He must show a strong sense of responsibility toward supporting company policies and should inspire peers and subordinates with a spirit of loyalty, cooperation and teamwork. The Coordinator must have previously demonstrated the ability to organize personnel and facilities, and accept responsibility for completeness of assignments that are technically correct and on time

The Field Coordinator must have a well-rounded knowledge of field and laboratory testing procedures, in addition to being flexible in the application of this knowledge to changing testing requirements

The Field Coordinator should have spent two or three years as a team leader directing the work of four to six field technicians and engineers. He should be a certified engineering technician or equivalent. The certification may be waived and the experience required reduced to two years if the individual does possess a Civil Engineering Bachelor of Science Degree.

PROJECT ENGINEER

6.4 The Project Engineer assigned to a lab project must have previously demonstrated the ability to organize, coordinate, and execute a project assignment, including final report preparation and review.

The Project Engineer must have a well-rounded knowledge of data reduction procedures. He must exhibit mature skill in applying this knowledge to specific situations.

He must have acquired knowledge of the company's legal responsibilities to both the clients' and the public. His project supervision in the laboratory should ensure a high level of quality and technology.

His qualifications in addition to the previously mentioned experience should include a Bachelor of Science Degree in Engineering and also advanced graduate work.

LABORATORY LEAD TECHNICIAN

6.5 The Laboratory Lead Technician must have the ability to organize and interact with people effectively. He must show a strong sense of responsibility toward supporting company policies and should inspire peers and subordinates with a spirit of loyalty, cooperation and teamwork.

The Laboratory Lead Technician must have a thorough knowledge of ASTM and MEI testing procedures and their application to testing. He must be familiar with laboratory testing equipment and be able to instruct others in its proper use.

The Laboratory Lead Technician must be a certified engineering technician with at least three years experience in general testing, plus two years experience as a Senior Technician. The previous may be waived with a Bachelor of Science Degree and one year experience in our realm of testing.

SENIOR LABORATORY TESTING CLERK

6.6 The Senior Laboratory Testing Clerk must be able to organize data and communicate effectively with both laboratory and engineering staff.

As the focal point for communications and transmittal of data, it is essential that the clerk maintains an accurate record of job status and ensures completeness of the jobs prior to reporting.

The Senior Laboratory Testing Clerk must be a graduate of an accredited high school.

DATA PROCESSING COMPUTER OPERATOR

6.7 The Computer Operator must be able to accurately and efficiently compute laboratory tests. A knowledge of MEI's computation procedures is essential.

The Computer Operator must be a graduate of an accredited high school and show proficiency in computer operations.

LABORATORY TECHNICIAN

6.8 The Laboratory Technician must be able to perform tests accurately and efficiently, in accordance with established and documented procedures. This position requirements include completion of an accredited high school curriculum and a fundamental knowledge of the ASTM test procedures, or other appropriate procedures that may apply.

QUALITY CONTROL

SCOPE

7 1 The procedures defined in this section are additional procedures or "spot checks" used to establish Quality Control. While the Quality Assurance organization defined in Section 3 provides for Quality Control through an incorporated system of checks and balances. This section will describe other methods to ensure the application of the Quality Control Program

REFERENCE SAMPLE TESTING PROGRAM

7.2 The laboratory shall participate in one or more proficiency testing programs. Two such programs are the Materials Reference Laboratory (AASHTO) and the Cement and Concrete Reference Laboratory (CCRL) administered by the National Bureau of Standards.

The samples shall be tested as indicated by AASHTO or ASTM. Computation and checking shall be performed as outlined in this manual. The test results will be returned to the agency for comparison with other testing laboratories

While the proficiency sample results do not indicate the exact properties of the standard specimens, they do give statistical information as to how the test results compare with a large number of other laboratories. The laboratory manager can use the results as procedural checks. Even though the laboratory results may not be in correlation with the values of the other labs, this does not indicate that the test results are incorrect.

Gross differences in data, however, should be noted by the Laboratory Manager and he should investigate as to whether or not proper procedures were followed. He should also consult with the Lead Technician and the Laboratory Technician who conducted the test.

Results of the consultation of the Laboratory Manager, Lead Technician and Technician may include acceptance of the test as reported, awareness that the documented procedures were not followed, or a need to actually modify the testing procedure.

It shall be noted specifically that the proficiency samples merely set up guidelines and the following Quality Control methods are designed to provide more exact or specific guidelines.

COMPARISON TO PUBLISHED RESULTS

7 3 Comparing actual laboratory tests and classifications to results published in textbooks and journals is a method frequently used for evaluating laboratory tests.

The procedures for evaluating tests with published results cannot be defined as one unique method. The procedure consists primarily of the laboratory researching and compiling data from textbooks and publications and determining accepted values for different properties of materials. These values are then compared to tested samples for accuracy.

In the event that the test results do not compare with expected results, the published standards should be checked, to ensure that the test is in fact being accurately compared to published data.

In the event the comparison does in fact show a possible testing error, the test shall be re-run under the direct supervision of the project engineer.

If the test still yields unsatisfactory results, equipment shall be recalibrated and thoroughly checked. The test will then be re-run.

In the event the results are still unacceptable, it will be necessary to re-evaluate the testing procedure, and/or apparatus. The re-evaluation will be done under the direction of the Laboratory Manager.

TEST REPORT REVIEW

7.4 The Laboratory Manager or Project Engineer will review all test reports prior to reporting to the client.

ATTACHMENT

McCLELLAND ENGINEERS EXAMPLE WORK SHEETS
MISSOURI ELECTRIC WORKS RI/FS

SIEVE ANALYSIS

McClelland engineers

DATE DEC 14 1983	PROJECT NAME	JOB NO 0401 1004
BORING NO	SAMPLE NO 1	PENETRATION (ft)
MATERIAL DESCRIPTION Tan Sa Cl		
DRY MASS OF SOIL BEFORE TEST 41.91 (g)	DRY MASS OF SOIL BEFORE SHAKING 1360 (g)	DRY MASS OF SOIL AFTER SHAKING 1325 (g)

U S Standard Sieve No	Weight Retained Cumulative	% Retained Cumulative	Opening Size (mm)	% Finer Cumulative	
2 in			50 800		
1-1/2 in			38 100		
1 in			25 400		
3/4 in			19 100		
1/2 in			12.700		
3/8 in			9 520		
No 4	0		4 760		
No 10	.17	0	2 000	100	
No 16	47	1	1 190	99	
No 20	—		0 840		
No 30	1 11	3	0 590	97	
No 40	1 37	3	0 420	97	
No 50	—		0.297		
No 70	2 32	6	0 210	94	
No 100	4 22	10	0 149	90	
No 140	—		0 105		
No 200	12 83	31	0 074	69	

REMARKS

TEST TYPE

ASTM D 422 63 (72)

DATE

CHECKED BY

DATE

COMPUTED BY BB

DATE 12-17

TESTED BY

MEW Admin record AR104194

HYDROMETER ANALYSIS

McClelland engineers

ASTM D 422 63 (72)

DATE DEC 14 1988	PROJECT NAME		JOB NO 0401 100
BORING NO	SAMPLE NO /	PENETRATION	
MATERIAL DESCRIPTION Pk Fxs rc			

HYDROSCOPIC MOISTURE CORRECTION — Tare No	736	Air Dry Mass of Soil (g)	32.05
Wet Soil + Tare (g) 10.62	42.54	Corrected Mass of Soil (g)	31.48
Dry Soil + Tare (g) 10.43	42.35	% Passing No 10 Sieve	100 %
Tare (g)	31.92	Dry Mass after Washing & Shaking over No 200 Sieve	
Correction Factor	0.9821	% Passing No 200 Sieve	60
Hydrometer No	25556	Dispersing Agent	(Na PO$_3$)$_6$
Starting Date	17 . . 88	Amount (g/l)	40
Starting Time	9 15	Specific Gravity of Soil ☑ Assumed ☐ Measured	2.70

Elapsed Time T (min)	Hydrometer Reading, R'	Temp (°C)	Composit Correction (temp & men)	K	D (mm)	% Finer Total Specimen
0						
0 25						
0 50						
9 16 1	24	23	4.0		.0450	63
9 17 2	17	23	4.0		.0338	41
9 19 4	15	23	4.0		.0242	35
9 23 8	14	23	4.0		.0172	31
9 30 15	11.5	23	4.0		.0127	24
9 45 30	10.0	23	4.0		.0091	19
10 15 60	9.5	24	3.5		.0064	19
11 15 120	8.0	23	4.0		.0046	13
1 15 240	7.0	24	3.5		.0032	11
15 30 360	6.5	23	4.0		.0027	8
9 11 1440	6.0	23	4.0		.0013	6

MASS USED FOR SIEVE ANALYSIS OR MINUS NO 200 TEST 41.91 (g

REMARKS

TESTED BY DS/rc DATE 12-15-88

COMPUTED BY DATE 12-19-88

CHECKED BY DATE 12-19-88

MEW Admin record AR104195

MOISTURE CONTENT TESTS

McClelland engineers

ASTM D 2216 71 (Moist C
ASTM D 2488 69 (Classific

DATE	12-16
CHECKED BY	PM
DATE	12/16
COMPUTED BY	BB
DATE	12-15-88
TESTED BY	GS / VAC

DATE DEC 1[illegible] 198[illegible] PROJECT NAME

JOB NO 0401 100

Boring No	Sample No	Penetration (ft)	Est Cohesion, PR/TV (tsf)	Material Description	Tare No	Tare + Wet Soil (g)	Tare + Dry Soil (g)	Tare (g)	w (%
	1			Dk br - cl	996	56.34	49 25	21.79	36
	2			Dk [illegible] , [illegible]	945	50.67	45.68	31.98	3
	3			Br cl sa w/ [illegible]	797	61 25	56 31	32.48	21

REMARKS

MEW Admin record
AR104196

ASTM D 423 (Liquid Lim
ASTM D 424 (Plastic Lim

ATTERBERG LIMIT DETERMINATION

Sheet 1 of 1

McClelland engineers

DATE MAY 4 1989

PROJECT NAME

JOB NO 0501 2101

DATE 5-09
BB
CHECKED BY
DATE 5-09
BB
COMPUTED BY
DATE 5-?
TESTED BY

Boring No	—							
Sample No	89222							
Penetration (ft)	—							
Material Description	[illegible] + Fe [illegible]							
Check One: Slaked 16 hrs								
Check One: Nat w								
LIQUID LIMIT DETERMINATION								
Tare No	Dt-1	Dt-2						
Wet Soil + Tare (g)	11 72	12 32						
Dry Soil + Tare (g)	8 66	9.07						
Tare (g)	1 12	1 12						
Mass of Dry Soil (g)								
Mass of Water (g)								
Water Content (%)	44	44						
No of Blows (N)	20	20						
Liquid Limit (LL)		40						
PLASTIC LIMIT DETERMINATION								
Tare No	Dt-3							
Wet Soil + Tare (g)	12 [illegible]							
Dry Soil + Tare (g)	9 90							
Tare (g)	1 12							
Mass of Dry Soil (g)								
Mass of Water (g)								
Plastic Limit (PL)		30						
Plasticity Index (PI)		10						

REMARKS

MEW Admin record
AR104197

PERMEABILITY TEST
FALLING HEAD

HORIZONTAL ☐
VERTICAL ☑

McClelland engineers

DATE APR 25 1989	PROJECT NAME				JOB NO 0401 1007
BORING NO —	SAMPLE NO 1	PENETRATION — (ft)	PERMEAMETER NO 2	BURETTE DIAMETER 1057 (cm)	AREA a (cm²)

MATERIAL DESCRIPTION Bry Sa CL

SPECIMEN INFORMATION

Moisture Content, Initial	TARE NO	592	LENGTH L	410 (cm)	MASS OF MOLD + SPECIMEN	(g)
	TARE	3174 (g)	DIAMETER D	708 (cm)	MASS OF MOLD	(g)
	WET MASS + TARE	177.50 (g)	AREA A	39.369 (cm²)	MASS OF SPECIMEN	332.94 (g)
	DRY MASS + TARE	157 01 (g)	VOLUME V	161.41 (cm³)		
	MOISTURE CONTENT	18 0 (%)	WET UNIT WEIGHT	128.7 (pcf)	DRY UNIT WEIGHT	109 1 (pcf)

PERMEABILITY DATA

$$K_t = 2.3\left[\frac{aL}{A\,(t_1 - t_0)}\right]\mathrm{Log}_{10}\frac{h_0}{h_1}$$

K = Permeability (cm/sec)
a = Area of Burette (cm2)
A = Area of Mold (cm2)
L = Length of Mold (cm)
t_0 = Initial Time (sec)
t_1 = Time @ h_1 (sec)
h_0 = Initial Head (cm)
h_1 = Head @ t_1 (cm)

Date	Hour	Temp (°C)	Elapsed Time (min)	Pressure Differential (psi)	Head (cm)	Tail (cm)	ΔH (cm)	ΔT (cm)	h (cm)	K_t (cm/sec)	$K_{20°}$ (cm/sec
5/1/89	1630	23 3	0	5	5 5	19 1	0	0	352 15	$\times 10^9$	$\times 10^9$
5/2/89	0810	23 4	940		7 8	16 5	2 62	2 96	346 57	12 9	11 9
5/3/89	0813	23 4	1443		10 7	13 5	3.31	3 42	329 50	10 3	9 5
5/4/89	0758	23 5	1415		13 2	11.0	2 85	2.85	324,10	9 0	8.3
5/5/89	0920	23 7	1472		15 4	8 7	2 51	2 62	329 01	8 0	7 3
	psi										
Cell	80										
Head	75				1140	cm/cc					
Tail	75	70			1,100	cm/cc					

DATE 5-05

CHECKED BY

DATE 5/5/89

COMPUTED BY DJN

DATE 5/5/89

TESTED BY DJN

THERMAL CONDUCTIVITY TEST

McClelland engineers

DATE SEP 28 1988 PROJECT NAME

JOB NO 1388 3536

BORING NO 1

SAMPLE NO 16

PENETRATION 12.5 (ft

MATERIAL DESCRIPTION Gry & Brn CL Sa

TARE + WET WEIGHT 140.67 (g)

TARE + DRY WEIGHT 122 97 (g)

TARE #744 WEIGHT 31 71 (g)

MOISTURE CONTENT 19.4 (%)

DRY UNIT WEIGHT 109.7 (pcf)

HEIGHT 139 70 (mm)

DIAMETER 71 90 (mm)

MASS 1190.14 (g)

CURRENT i = 0 8 (A)

RESISTANCE R = 0 516 (Ω/in)

$Q = i^2 R =$ 0 330 (W/in)

Elapsed Time, t (sec)	Temperature, θ (°C)	Elapsed Time t (sec)	Temperature, θ (°C)	Elapsed Time t (sec)	Temperature θ (°C)
0	23.0	120	25 9	270	26 2
10	25.1	135	26 0	285	26 2
20	25 4	150	26 0	300	26 3
30	25 5	165	26 0	360	26 3
Δ 40	25 6	180	26 1	420	26 4
50	25 7	195	26.1	480	26 4
60	25 7	210	26.1	540	26 5
Δ 75	25 8	225	26 2	600	26 5
90	25 8	240	26 2	660	26 6
105	25 9	255	26 2	720	26 6

THERMAL CONDUCTIVITY $K' = 3.373 \times 10^{-3}$ (cal/cm sec °C) Note $K = \frac{Q}{4\pi} \cdot \frac{\Delta \ln t}{\Delta \theta}$, 1 cal/cm • sec • °C = 418 4 W/m • °C

REMARKS

MEW Admin record AR104199

DATE 9/26/88

CHECKED BY SC

DATE 9/30/88

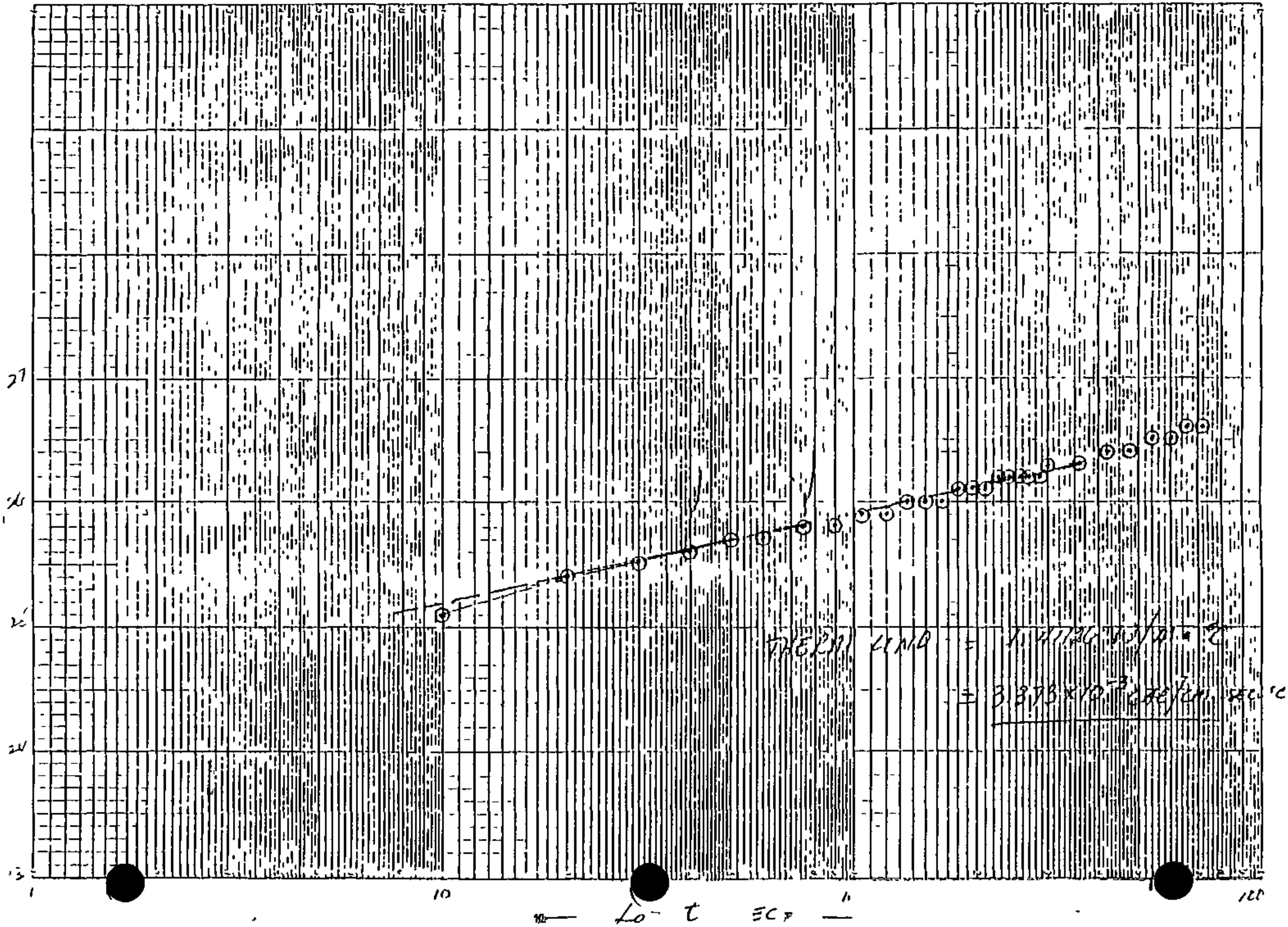
COMPUTED BY DBN

DATE 9/29/88

TESTED BY DBN

10 DIVISIONS PER INCH SHORT SIDE
THREE 3⅓ INCH CYCLES LONG SIDE

B-1 S-10 @ 135'



THERM COND = 1.4112 W/m °C

= 3.373 × 10^{-3} cal/cm sec °C

DENSITY TEST

McClelland engineers

DATE [illegible]. 1989 | PROJECT NAME | JOB NO 0501 [illegible]

DATE | CHECKED BY | DATE 4-2 | COMPUTED BY | DATE | TESTED BY

Boring No	WTP-29				
Sample No					
Penetration (ft)	12	16	18	22	24
Material Description	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Est. Cohesion, PR/TV (tsf)	[illegible]	[illegible]	.48	[illegible]	[illegible]
Height (mm)	[illegible]	[illegible]	[illegible]131	[illegible]	[illegible]
Diameter (mm)	[illegible]	[illegible]	57 10	[illegible]	[illegible]
Volume (cm³)	510 74	515 31	[illegible] 18	417 53	[illegible]
Wet Mass (g)	[illegible]	999 44	[illegible]	[illegible]	[illegible]
Wet Unit Weight (pcf)	116	121	117	137	118
	2 69	2 70	2 67	2 78	2.76
Tare No	[illegible]	[illegible]	[illegible]		[illegible]
Wet Mass (g)	[illegible]	[illegible]	93 11	[illegible]	[illegible]
Dry Mass (g)	91 50	103 63	79.83	89.19	94.69
Tare (g)	[illegible]	[illegible]	31 73	[illegible]	[illegible]
Water Content (%)	34	30	38	36	31
Dry Unit Weight (pcf)	86	93	91 -	101	90
porosity	.484	.447	.453	.419	.479

REMARKS

VIOLATIONS

SCOPE

8.1 This section describes the procedures used to handle any violations of the procedures defined in this manual, the Laboratory Procedures Manual, the Data Processing Procedures Manual, the Calibration Procedures Manual and any undocumented changes to computer programs.

CONTROL

8.2 Control of non-conforming procedures is essential to preventing practice of and identifying conditions leading to non-conformance. The Laboratory Manager is ultimately responsible for control of the Quality Assurance Program.

RECOMMENDING ACTION

8.3 The laboratory's technical staff will review non-conforming items, and will evaluate the causes of non-conformities. If it leads itself to correction, they will recommend action to correct the cause. Such recommendations shall be directed to the Laboratory Manager for revision.

In the event that this action is necessary, the Laboratory Manager will consult with his staff who will in turn evaluate and report back to him their views and opinions.

RECORDS

8.4 Sufficient records shall be prepared as tests are conducted to furnish documentary evidence of the quality of test results and the activities affecting quality.

The records will be maintained by the Senior Laboratory Testing Clerk. They shall be maintained in an orderly manner which allows access for retrievability.