Site Operations Plan

Addendum No. 2

Pfohl Brothers Landfill

Phase II Remedial Investigation

Cheektowaga, New York
Site Number 9-15-043

Prepared for:

New York State
Department Of Environmental Conservation
50 Wolf Road, Albany, New York 12233

Thomas C. Jorling
Commissioner

Division Of Hazardous Waste Remediation

Michael J. O'Toole, Jr., P.E.
Director

Camp Dresser & McKee
New York, New York

CDM
environmental engineers, scientists,
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September 4, 1992

Mr. Robert W. Schick, P.E.
Chief, Remedial Action Section A
Bureau of Western Remedial Action
Division of Hazardous Waste Remediation
New York State Department of
Environmental Conservation
50 Wolf Road
Albany, New York 12233

Project: Pfohl Brothers Landfill RI/FS
NYSDEC No. D-001894
CDM No. 897-13-RI-SOP

Subject: Final Site Operations Plan and QA/QC Plan for Phase II Remedial Investigation

Dear Mr. Schick:

Camp Dresser & McKee (CDM) is pleased to submit 10 copies of the Final Site Operations Plan and Quality Assurance/Quality Control Plan for the Phase II Remedial Investigation at the Pfohl Brothers Landfill in Cheektowaga, New York. These Plans address Mr. White's comments outlined in his letter of June 8, 1992.

Subsequent to the preparation and approval of the Phase II Remedial Investigation Work Plan, dated January 29, 1992, Mr. White requested modification of the scope of work to include a drilling program in the southwestern section of Area C. The objective of this boring program was to provide a better delineation of the landfill boundary in this area. In response to this request, CDM developed a detailed boring program, which was subsequently approved by Mr. White, and incorporated into these planning documents. Further, it is our understanding from Mr. White that all analytical and data validation services for the Phase II work will now be performed by NYSDEC. Modifications to the enclosed documents have been made accordingly.

During the initial planning and development of the Phase II investigation, ground water remediation seemed likely and larger diameter (four-inch) shallow wells were proposed over the existing two-inch shallow wells. The intent of this plan was to allow the larger diameter wells to serve as recovery wells during the ground water remediation. Increasing the diameter of the shallow wells increases their plume capture abilities, via larger pumping rates. In addition, the ability to introduce larger pumps into the wells would improve pump test performance by stressing the aquifer to a greater degree, which would be very useful for plume capture remedial design. For these reasons, we recommended the use of four-inch shallow wells.

Since there is less certainty at this point as to whether or not ground water remediation will be required, it is more cost-effective to utilize two-inch casing and screen on each of the proposed new shallow wells. We have subsequently modified our shallow well specifications in the enclosed documents to include the smaller diameter casing and screen.

Should you have any questions, or require additional information, please do not hesitate to call.

Very truly yours,

CAMP DRESSER & McKEE

Lee Guterman
Project Manager

cc: A. Joseph White (NYSDEC)
R. Schwartz (CDM)

PFOHL BROTHERS LANDFILL
PHASE II REMEDIAL INVESTIGATION

SITE OPERATIONS PLAN
ADDENDUM NO. 2
09/04/92

Responsible Agency:

New York State Department of Environmental Conservation
Division of Hazardous Waste Remediation
50 Wolf Road
Albany, New York 12233

_____ _____
Remedial Project Manager (NYSDEC) Date

_____ _____
Quality Assurance Officer (NYSDEC) Date

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5.0 FIELD INVESTIGATIONS AND SAMPLING PROTOCOL

5.1 INTRODUCTION

The purpose of this addendum is to identify specific field activities and procedures necessary to perform the additional activities outlined in the Pfohl Brothers Landfill Supplemental Agreement No. 3, dated January 29, 1992. This document shall supplement the Final Site Operations Plan for the Pfohl Brothers Landfill project, dated July 1988 (hereafter referred to as the SOP). All guidelines and requirements outlined in the SOP remain in effect unless otherwise specified herein. Where appropriate, the following procedures shall be incorporated by reference into the final SOP.

This addendum to the SOP identifies the activities and procedures to be followed for performing the following activities under the Phase II remedial investigation:

- Mobilization
- Fracture Trace Analysis
- Soil Borings
- Monitoring Well Installation
- Water Level Measurements
- Ground water Sampling, and
- Surveying

5.2 FIELD ACTIVITIES

TASK 1: MOBILIZATION

As per NYSDEC, CDM will share the support facilities, (e.g., field trailer, telephone, portable toilet, and water storage equipment), with the remedial contractors currently engaged in the IRM.

During mobilization activities, CDM will:

- Locate the Federal Express, Emery, or other overnight delivery service office nearest the site and note hours of operation.
- Arrange for delivery of all decontamination equipment, personal disposable protective gear, sample shipping containers and field monitoring equipment.

TASK 2: FRACTURE TRACE ANALYSIS

Fault zones and fracture systems occurring in limestone formations have been found to be zones of increased permeability and to yield larger quantities of ground water than adjacent non-fractured limestone (Lattman and Parizek, 1964). Since they are zones of preferential ground water flow, fault/fracture systems in limestone would also be likely transport pathways for ground water contaminants and contamination plumes, if present.

Several studies conducted in the general vicinity of the site have noted the existence of joints and fracture systems in the Onondaga Limestone which underlies the site (LaSala, 1968; Staubitz and Miller, 1987). As indicated in the Phase I Remedial Investigation (RI) Report, however, the occurrence and orientation of fractures in the Onondaga Limestone within the immediate study area is unknown. The RI report also noted the presence of TCL organic and inorganic compounds in the bedrock aquifer at concentrations greater than ARARs (CDM, 1991). The objective of this task is to evaluate the presence, frequency and orientation of faults and fracture systems occurring in bedrock materials within the study area. Fracture systems identified and located from this task will be used in subsequent evaluations of bedrock aquifer hydraulics and contaminant migration.

SAMPLE TYPE, SAMPLE METHOD, SAMPLE CODE

Sample Type: NA
Sample Method: NA
Sample Code: NA

SAMPLE CONTAINER AND PARAMETERS

Not applicable to this activity.

FIELD EQUIPMENT

- o stereographic pairs of aerial photographs of the study area and surrounding region
- o USGS 7.5" topographic map(s) of the study area and surrounding region

- o markers suitable for writing on the aerial photographs
- o field notebook
- o stereoscope
- o paralax balance
- o 300′ measuring tape
- o Brunton Compass, or equivalent

PERSONAL PROTECTION

Level D personal protection will be required for field verification activities.

HEALTH AND SAFETY GUIDELINES

Refer to SOP.

TASK TEAM RESPONSIBILITIES

T. Oughton.....Aerial interpretation

M. Ehnot.....Field Verification

PREPARATORY ACTIVITIES

- o Obtain overlapping black and white aerial photographs of the region in and around the study area. The aerial photo coverage may need to extend as far east as the Buffalo Crushed Stone Company quarry, located approximately 1.5 from the site. A typical aerial photo scale for fracture trace analysis is 1:20,000 (one inch to approximately 1670 feet). A typical 9x9 inch aerial photograph would cover about 2.8 miles, however a 60 percent overlap is usually needed to obtain stereoscopic viewing, so several sets of aerial photos may be required. Older photos may be of greatest benefit in fracture trace analysis, due to the less extensive urban development which may have obscured the fracture trace features.
- o Obtain USGS 7.5" topographic maps of the study area.
- o Research the regional geology and obtain a good understanding of the thickness and the origin of unconsolidated overburden material in order to accurately interpret the photos.

SPECIFIC PROCEDURES

1. Obtain the aerial photographs which cover the area of interest. Separate the photographs into pairs which have a significant (approximately 60 percent) overlap of the area covered.

2. Set a pair of the aerial photographs on a clean level surface and align them approximately. If shadows are present in the photographs, preferable orient the photographs with the shadows falling toward the viewer.

3. Place a stereoscope over the photos, oriented with the individual lenses of the stereoscope aimed at the same feature on each photo. Look through the stereoscope and move the top photo slightly until the field of vision is in focus.

4. Using a wax pencil or other appropriate implement, mark the location of linear features directly on the maps. Mark any lineations or linear features (i.e., straight runs of rivers and streams, depressions or lineations in surface topography. Periodically check the mapped features by direct inspection of the aerial photographs, the topographic map and other maps available.

5. Repeat the above process on all sets of aerial photographs until the entire area of interest has been mapped. Limit viewing through the stereoscope to 30 minutes at a time.

6. Transfer the lineations onto another map (topographic or other aerial photograph) for later use in field verification.

7. Verify the locations of the mapped fracture trace features in the field. Look for man-made linear features which correspond to mapped fracture traces, including fences, powerlines, property boundaries, footpaths, roads and harvest patterns and note these on the map(s) Note natural linear features which may correspond to faults, fracture systems and/or joints, including depressions, straight stream channel or drainage segments, aligned sinkholes, and/or actual fractures and note these on the map(s). Record any other physical features which may be indicative of fracture trace features but were not identified in the aerial photograph mapping and locate on the map(s).

8. Evaluate the field verification study and revise the fracture trace mapping as appropriate.

9. Extend the fracture trace features across the site to identify potential zones of enhanced permeability and preferential flow. Pay particular attention to locations where fracture trace features intersect.

10. Prepare a summary report of the fracture trace mapping procedure, verification and findings.

TASK 3: HOLLOW STEM AUGER SOIL BORINGS

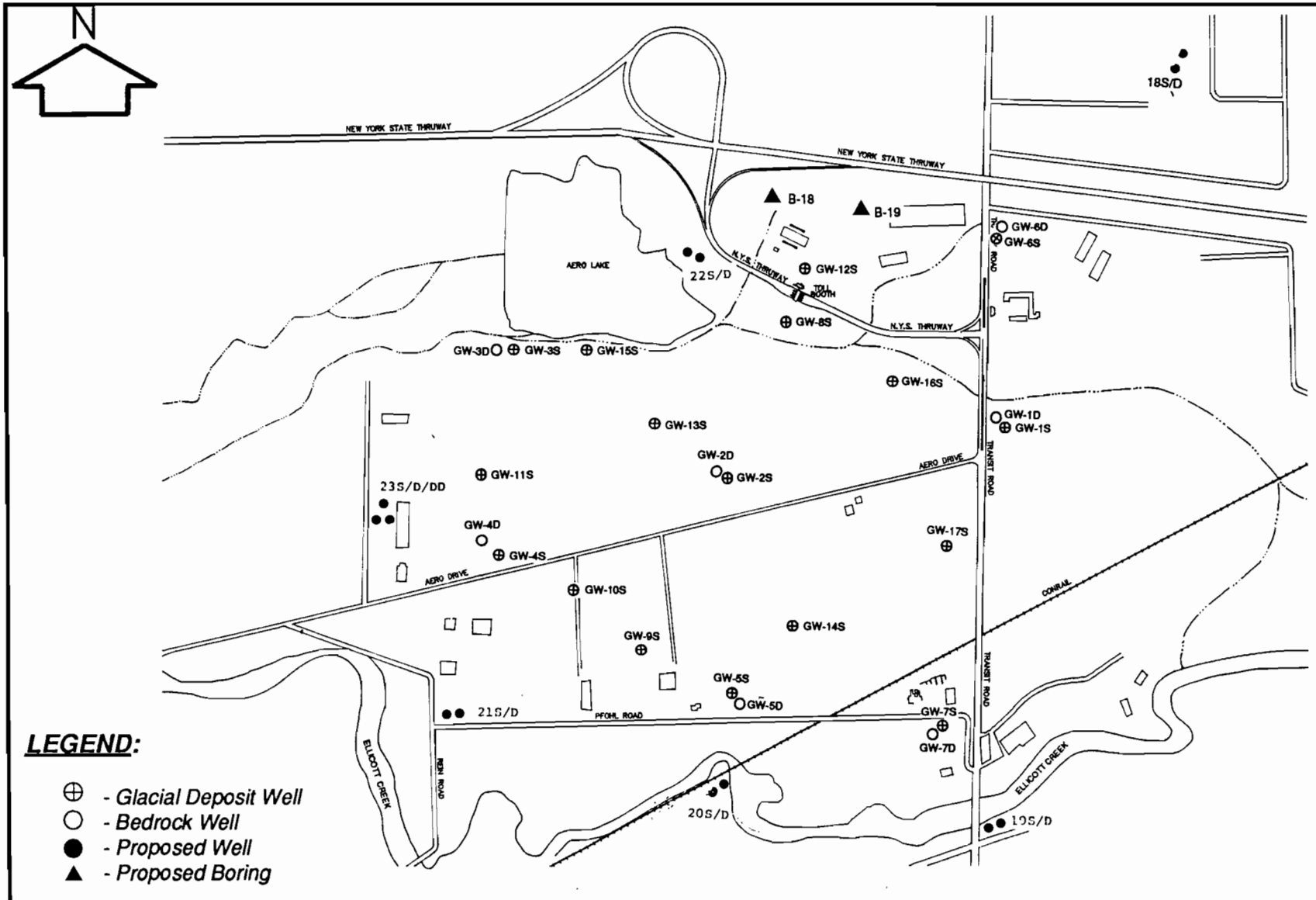
Two soil borings will be installed in Area A using a hollow stem auger (Figure 1). Split spoon samples will be collected at continuous intervals until bedrock is reached. Soils collected from each borehole will be visually examined and described. A total of two soil samples will be collected from each borehole; one sample will be collected from the unsaturated zone; a second soil sample will be collected from the saturated zone. Samples with visual evidence of contamination and/or the highest OVA readings will be selected for analysis. Each sample will be analyzed for TCL parameters, plus cyanide (see tables 1 and 2). Samples will be collected to identify the source of contaminants found in borings B-18 and B-19 and to further characterize the nature and extent of contamination in Area A.

SAMPLE TYPE, SAMPLE METHOD, SAMPLE CODE

Sample Type: Soil
Sample Method: Auger
Sample Code: B18-SS

SAMPLE CONTAINER AND PARAMETERS

Refer to Table 3.



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environmental engineers, scientists, planners & management consultants

Figure 1

Proposed And Existing Monitoring Wells And Proposed Borings

Pfohl Brothers Landfill, Cheektowaga, New York

Table - 1

Summary of Analytical Requirements

PARAMETER	MEDIA	ANALYTICAL METHOD REFERENCE	SAMPLE PRESERVATIVE	MAXIMUM HOLDING TIME
Volatile Organics	Ground water	NYSDEC 91-4	Cool, 4°C	7 days of VTSR
Semi-Volatiles	Ground water	NYSDEC 91-5	Cool, 4°C	5 days of VTSR.[1] Extracts analyzed within 40 days of VTSR.
Pesticides & PCBs	Ground water	NYSDEC 91-6	Cool, 4°C	Extraction of all samples must be started within 7 days of VTSR. Analysis must be completed within 40 days following the start of extraction.
Metals	Ground water	NYSDEC Exhibit D Part V 12/91 CLP	HNO_3 to pH <2	6 mos, except Hg of 26 days
Cyanide	Ground water	Method 335.2 CLP-M	NaOH to pH >12 Cool, 4°C	12 days
<u>Conventionals</u>				
Chloride	Ground water	EPA Method 325.3	Cool, 4°C	26 days
Sulfate	Ground water	EPA Method 375.4	Cool, 4°C	26 days
Bicarbonate (alkalinity)	Ground water	EPA Method 310.1[3] (titrimetric)	Cool, 4°C	12 days

Table - 1 (cont'd)

PARAMETER	MEDIA	ANALYTICAL METHOD REFERENCE	SAMPLE PRESERVATIVE	MAXIMUM HOLDING TIME
Volatile Organics	Soils	NYSDEC 91-1	Cool, 4°C	7 days of VTSR
Semi-Volatiles	Soils	NYSDEC 91-2	Cool, 4°C	5 days of VTSR.[2] Extracts analyzed within 40 days of VTSR.
Pesticides & PCBs	Soils	NYSDEC 91-3	Cool, 4°C	Extraction of soil samples by sonication must be started within 5 days and completed with 10 days of VTSR. Re-extractions must be started within 10 days and completed within 12 days of VTSR. Analysis of extracts within 40 days following the start of extraction.
Metals	Soils	NYSDEC Exhibit D Part V 12/91 CLP	Cool, 4°C	6 mos, except Hg of 26 days
Cyanide	Soils	Method 335.2 CLP-M	Cool, 4°C	12 days

(1) Extraction shall be started within 5 days and completed within 7 days of VTSR. Re-extraction must be performed within 10 days and completed within 12 days of VTSR.
(2) Sonication or Soxhlet procedures for extraction and concentration of soil samples for semi-volatile analysis shall be started within 5 days and completed within 7 days of VTSR. Re-extractions must be performed within 10 days and completed within 12 days of VTSR.
(3) Results to be reported as hydroxide alkalinity, carbonate alkalinity, and bicarbonate alkalinity.

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Table 2
SAMPLE SUMMARY

MEDIUM	SAMPLE LOCATION	EXAMPLE SAMPLE CODE	NUMBER OF SAMPLES	LABORATORY ANALYSIS
Soil	B-18	897-B18-SS-01	2	TCL & CN-
	B-19	897-B19-SS-02	2	TCL & CN-
QC Samples:			2 for MS & MSD	TCL & CN-
			1 Duplicate	TCL & CN-
SOIL	MW-18 S/D	897-MW18D-SS-01	2	
GROUND WATER	MW-1S MW-3S Through MW-8S	897-MW1S-GW-01	25	TCL & CN-, plus Conventionals (sulfate, chlorides & bicarbonate)
	MW-10S			
	MW-11S			
	MW-1D MW-18S			
	MW-2D MW-19S			
	MW-3D MW-20S			
	MW-4D MW-21S			
	MW-6D MW-22S			
	MW-7D MW-23S			
Plus 4 newly installed bedrock wells TBD*				
QC Samples:			3 MS &MSD	TCL & CN-
			2 duplicates	TCL & CN-
			5 trip blanks	VOA only
			5 field blanks	TCL & CN-

* To be determined in the field at the discretion of the project geologist.

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Table - 3

SAMPLE BOTTLE REQUIREMENTS

PARAMETER	MEDIA	TOTAL # SAMPLES	SAMPLE PRESERVATIVE	SAMPLE (Per) CONTAINER (Sample)	CONTAINER TYPE
Volatile Organics	Ground water	37	Cool, 4°C	2 - 40 ml VOA vials	B
Semi-Volatiles (inc. pesticides & PCBs)	Ground water	32	Cool, 4°C	2 - 80 oz. amber glass bottles	A
Metals	Ground water	32	Cool, 4°C HNO_3 to pH <2	1 - 1 liter polyethylene bottle	C
Cyanide		32	Cool, 4°C $NaOH$ to pH >12	1 - 1 liter polyethylene bottle	C
<u>Conventionals</u>					
Chloride	Ground water	25	Cool, 4°C	1 - 1 liter polyethylene bottle	C
Sulfate	Ground water	25	Cool, 4°C	(1)	
Bicarbonates	Ground water	25	Cool, 4°C	(1)	
Volatile Organics	Soil	7	Cool, 4°C	1 - 120 ml glass vials	D
Semi-Volatiles (Inc. Pesticides & PCBs)	Soil	7	Cool, 4°C	1 - 8 oz wide-mouth glass jar	F
Metals & Cyanide	Soil	7	Cool, 4°C	1 - 8 oz wide-mouth glass jar	F

(1) Analysis to be run on aliquot from chloride sample container.

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FIELD EQUIPMENT

All equipment for collecting samples will be provided by the drilling Subcontractor. Sample bottles, preservatives, laboratory deionized water, and shipping containers will be provided by the NYSDEC laboratory. CDM will have the following available:

- Personal protective gear and monitoring devices as required in the HASP
- Field notebook
- Disposable plastic scoops
- Stakes and flagging
- Spray paint or marking pencils
- Decontamination equipment (Refer to HASP)
- Camera and film
- Polyethylene sheeting
- 100-foot steel tape (engineer's scale)
- Munsell Color Chart
- Grainsize comparater
- Folding rule (engineers scale)
- Sample table
- Equipment wash bucket
- Equipment rinse bucket
- Decon solution
- Wrist watch
- Reinforced strapping tape
- Vermiculite

PERSONAL PROTECTIVE EQUIPMENT

These tasks will be performed in Modified Level D personal protection. For details on personal protective equipment, refer to Health and Safety Plan (HASP), Addendum No. 2.

Personal protection includes the following:

- Tyvek coverall or cloth coverall
- Safety glasses
- Hard hat
- Steel-toed and shank leather boots
- Neoprene gloves
- PVC surgical gloves
- Disposable latex booties

HEALTH AND SAFETY GUIDELINES

Refer to HASP, Addendum No. 2

TASK TEAM RESPONSIBILITIES

M. Ehnot .....Project Geologist/Health and Safety Coordinator

PREPARATORY ACTIVITIES

- Obtain property access from NYS Thruway Authority in advance of the intended day of drilling (contact Calvin Fechter or David Theilman at (716) 896-5050.
- Obtain all sample bottles, preservatives, and shipping containers from NYSDEC. Schedule sample analyses with NYSDEC analytical laboratory.
- Assemble all the necessary field equipment required to complete the task.
- Ensure all field measuring equipment has been calibrated and has received appropriate quality control checks.
- Inform local police, fire and hospital of the location and date that sampling will be conducted.
- Erect temporary fencing around all intrusive activity work sites prior to commencing work at those individual sites.
- Ensure that acceptable decontamination procedures for all sampling equipment is accomplished prior to beginning each activity:

  a. wash and scrub with Liquinox
  b. tap water rinse
  c. deionized water rinse (demonstrated analyte-free)
  d. air dry, and
  e. wrap in aluminum foil, shiny side out.

  Should any sticky substances or material which is hard to remove from split spoons be encountered, field personnel will modify the decon fluid to improve the effectiveness of the cleaning. At that time, the following procedure may be employed:

  a. wash and scrub with Liquinox
  b. tap water rinse
  c. rinse with HNO_3
  d. tap water rinse
  e. a methanol rinse followed by hexane rinse

f. deionized water rinse (demonstrated analyte-free)
g. air dry, and
h. wrap in aluminum foil, shiny side out.

- Ensure all heavy equipment is steamed cleaned upon entry to the site.
- Conduct a briefing on health and safety aspects of the site with the drilling Subcontractor.
- At least one week prior to initiating drilling, the Subcontractor must submit documentation that all personnel who will be involved in the field work are enrolled in a medical monitoring program and have received Health and Safety training.

All site personnel must read and become completely familiarized with the provisions of the SOP, Subcontract specifications, and Health and Safety Plan prior to the initiation of site activities. The Health and Safety Coordinator shall conduct a briefing with all Subcontractor personnel. During that briefing, exclusion and restricted areas will be identified and marked.

SPECIFIC PROCEDURES

1. Two borings will be drilled using the hollow stem auger method which allows the collection of undisturbed soil samples in advance of the borehole (Refer to Drilling Subcontractor Specifications). The drilling tools shall have a sufficient diameter to permit the passage of a minimum of 2-inch OD split-spoon sampler.

2. Split-spoon soil samples will be collected from ground surface to the top of bedrock at two-foot intervals.

3. The Subcontractor shall maintain a record of the number of free falling blows required to drive the sampler 6-inches of penetration. The Subcontractor shall exercise whatever caution is necessary to ensure the falling weight is not impeded in any way.

4. Drive the sampler through the specified 18-inch interval or to refusal, which ever comes first. Refusal is herein defined as 100 blows per 6-inch penetrations.

5. Record a description of the geology and waste material (if any) observed in the sample. Natural soils should be described in accordance with the Burmeister Classification System (as described in ASTM D2488).

6. Using a plastic scoop, remove rocks and roots and place the soil sample in the VOA jars. Homogenize the remainder of the sample and distribute to the remaining set of jars. Place samples in ice packed cooler. If there is insufficient sample for full analysis, prioritize sample collection as follows: semi-volatiles (exclusive of PCBs and pesticides), metals, volatiles and pesticides/PCBs.

7. Wash and rinse split spoon with liquinox and water before reusing.

8. Re-assemble split spoon.

9. Drill down to two feet below ground surface with auger.

10. Collect second split spoon sample from 2 to 4 feet below grade and repeat procedure described above. (A total of two soil samples will be collected and analyzed for full TCL parameters; one sample will be collected from the unsaturated zone; a second sample will be collected from the saturated zone. Samples with the highest OVA readings or exhibiting signs of contamination will be selected for analysis.

11. Continue same procedure until bedrock is encountered.

12. Backfill borehole with the drill cuttings.

14. Excess drill spoils will be drummed. The Subcontractor will clearly mark all drums with a permanent marker, indicating the boring location, contents and genesis as they are utilized. At the end of each workday, filled drums will be placed behind the fencing and then transported to the designated staging area upon completion of the borehole. Drums shall be placed on wooden pallets and covered by tarpaulin. The Subcontractor shall supply pallets and tarpaulin.

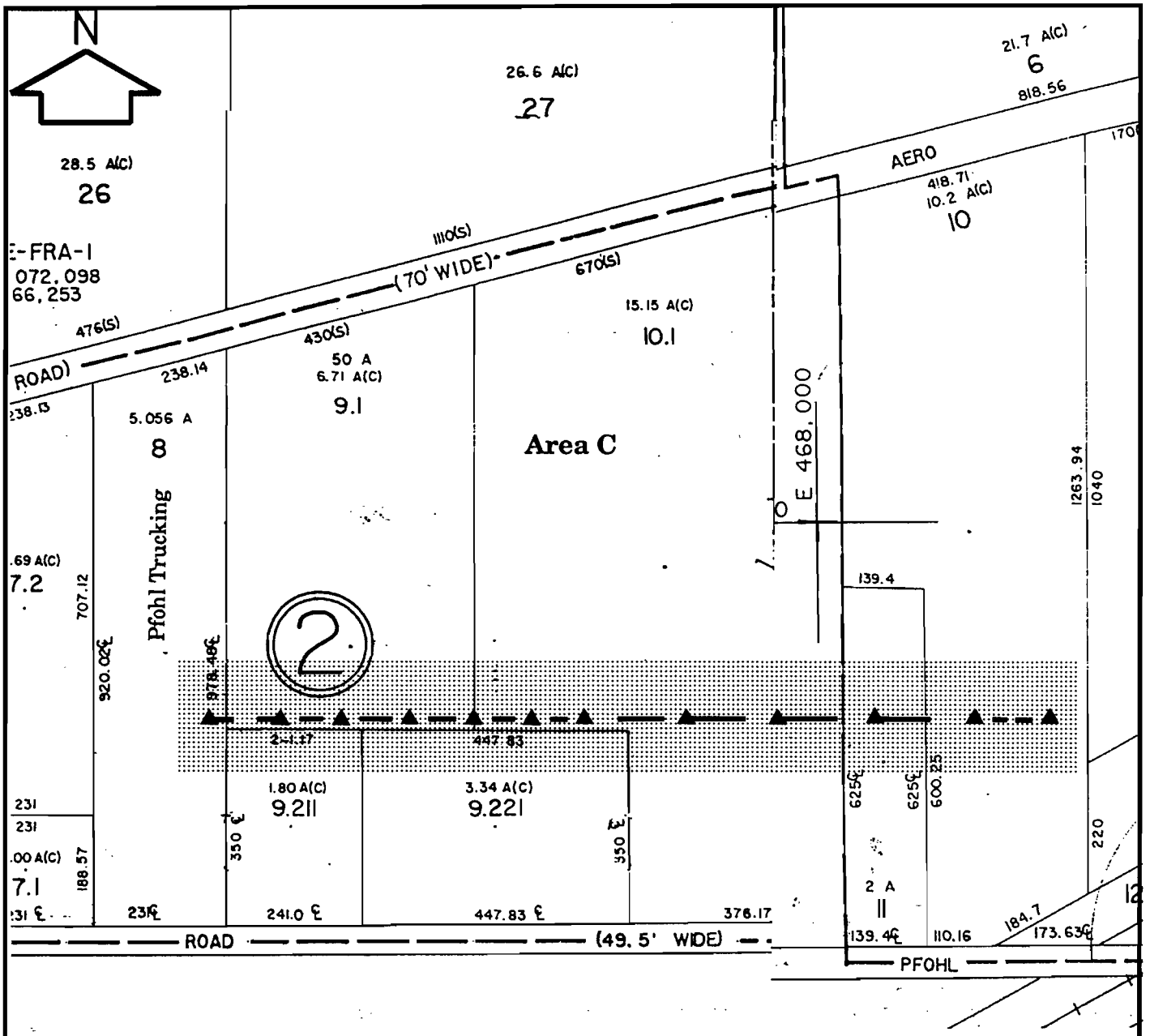
TASK 4: SOIL BORINGS IN AREA C

In order to define the southern-most boundary of the landfill, additional soil borings will be installed behind the homes on Pfohl Road and in the vacant lots between the homes (Figure 2). Two background soil borings will be drilled along Pfohl Road in order to distinguish between the fill material used in the construction of the homes and landfilled material.

The proposed investigative borings will be drilled starting from the eastern side of Area C (Block 2, Lot 10). The area immediately to the east of this parcel corresponds to the apparent active landfilling area in the 1960 aerial photograph in which operations extended close to the railroad tracks on the south side of the landfill. The initial boring will be drilled in a location of suspected landfilled material; the remaining borings will be drilled at prescribed intervals extending as far westward as Pfohl Trucking (Figure 2).

The initial set of investigative borings along residential properties will be drilled at 100-foot horizontal intervals along the northern property line or southern toe of the berm, if present on the lot, and will be increased to 200-foot horizontal intervals along the vacant lots. If the first boring drilled at the southern toe of the berm is indicative of landfilled material, the second boring on the lot will be moved to the south of the transect in order to locate the non-landfilled material. Each boring will be drilled to a depth of approximately 5 feet using a skid-mounted solid-stem auger. Based on the subsurface conditions observed in the 5-foot borehole, (i.e., no evidence of landfilled material is encountered), the borehole will be advanced an additional 5 feet to a maximum depth of 10 feet.

The initial set of borings along the vacant properties will be drilled at 200-foot horizontal intervals. The north/south orientation of these borings will be determined by the absence or presence of a berm. In those cases where a berm is present, the first borings will be drilled at the southern toe of the berm. In those cases where a berm is not present, the initial borings will be installed along an east-west transect that extends from the nothern-most residential property line that lies west of the vacant property. These intervals may be modified in the field, depending on site conditions.



LEGEND:

- General Area Of Proposed Borings

- Primary Transect Line/Initial Line Of Soil Borings

200 100 0 200

scale feet

Figure 2

CDM

environmental engineers, scientists
planners & management consultants

Location Plan For Area C Borings

Pfohl Brothers Landfill, Cheektowaga, New York

A minimum of two additional rows of borings will be drilled north and south of the east-west transect until the southern boundary of the landfill is determined within a horizontal accuracy of ± 25-feet. Using this approach, an estimated 12 borings will initially be installed along the southern section of the landfill, with an estimated total number of 50 borings.

SAMPLE TYPE, SAMPLE METHOD, SAMPLE CODE

Sample Type: Soil
Sample Method: Auger
Sample Code: B18-SS

SAMPLE CONTAINER AND PARAMETERS

Soil samples will be collected in 8-oz. widemouth glass jars provided by the driller. No laboratory analyses will be performed on these samples.

FIELD EQUIPMENT

All drilling equipment will be provided by the driller. CDM will have the following equipment available:

- Personal protective gear and monitoring devices as required in the HASP
- Field notebook
- Disposable plastic scoop
- Decontamination equipment (Refer to HASP)
- Stakes and flagging
- Camera and film
- Tape Measure
- Tax Maps
- Polyethylene sheeting

PERSONAL PROTECTIVE EQUIPMENT

These tasks will be performed in Modified Level D personal protection. For details on personal protective equipment,

refer to Health and Safety Plan (HASP), Addendum No. 2. Personal protection includes the following:

- o Tyvek coverall or cloth coverall
- o Safety glasses
- o Hard hat
- o Steel-toed and shank leather boots
- o Neoprene gloves
- o PVC surgical gloves
- o Disposable latex booties

HEALTH AND SAFETY GUIDELINES

Refer to HASP, Addendum No. 2

TASK TEAM RESPONSIBILITIES

M. Ehnot .....Project Geologist/Health and Safety Coordinator

PREPARATORY ACTIVITIES

- o Obtain property access from residents along Pfohl Road.
- o Assemble all the necessary field equipment required to complete the task.
- o Ensure all field measuring equipment has been calibrated and has recieved appropriate quality control checks.
- o Inform local police, fire and hospital of the location and date that drilling will be conducted.
- o Erect temporary fencing around all intrusive activity work sites prior to commencing work at those individual sites.
- o Ensure all heavy equipment, including augers, are steamed cleaned before drilling the first boring.
- o Conduct a briefing on health and safety aspects of the site with the drilling Subcontractor.
- o At least one week prior to initiating drilling, the Subcontractor must submit documentation that all personnel who will be involved in the field work are enrolled in a medical monitoring program and have received health and safety training.

All site personnel must read and become completely familiarized with the provisions of the SOP, Subcontract specifications, and Health and Safety Plan prior to the initiation of site activities. The Health and Safety Coordinator shall conduct a briefing with all Subcontractor personnel. During that briefing, exclusion and restricted areas will be identified and marked.

SPECIFIC PROCEDURES

1. Establish corners and northern-most property lines of each residential lot along Pfohl Road and stake locations with 8-foot high markers and flagging.

2. Stake proposed locations of initial borings at approximately 100-foot horizontal intervals along the residential properties along the northern property line or southern toe of the berm, if present on the lot. Increase borehole spacing to approximately 200-foot horizontal intervals in the vacant lots. This first line of borings constitute the baseline east-west transect. Approximate locations of the initial borings are depicted in Figure 2. The north/south orientation of these borings will be determined by the absence or presence of a berm (refer to Step 3).

3. In those cases where a berm is present on a residential or vacant lot, the first borings will be drilled at the southern toe of the berm. In those cases where a berm is not present, the initial borings will be installed along the east-west transect that extends from the northern-most residential property line that lies west of the vacant property. These intervals may be modified in the field, depending on site conditions.

4. Identify two (2) background boring locations near Pfohl Road, and provide sufficient notification to appropriate property owners.

5. Drill soil borings to a depth of 10-feet using a solid-stem auger at each of the two background locations.

6. Inspect cuttings during drilling and continously monitor for VOCs in the air space immediately above the cuttings using an HNu.

7. Note observations in field notebook.

8. Using a disposable plastic scoop, collect a soil sample from the drill cuttings approximately every 2-feet and place in the sample container provided by the driller.

9. Photograph each sample and reference in field notebook.

10. Record a description of the geology, fill material, moisture, color, and any other physical observations of the subsurface soil.

11. Backfill boring with drill cuttings.

12. Beginning at the first boring location at the eastern-most end of the baseline transect, initiate drilling to a depth of 5-feet.

13. Repeat Steps 6 through 10.

14. Inspect sample from each 2-foot interval for the presence of fill, fly ash, wood, bricks, glass or other debris that have been observed in other borings previously installed within the landfill. Determine as to whether or not the sample is indicative of construction fill or landfilled material using the following criteria:

    -- Soil texture
    -- Absence or presence of typical landfilled material observed in other borings installed in the landfill
    -- HNu readings, and
    -- Comparison to the samples collected from the background borings.

15. If landfilled material is evidenced in the first 5-feet, backfill borehole with drill cuttings and move to next proposed boring location. However, if the sample appears free of landfilled material,

or cannot be distinguished from soil samples collected at a corresponding depth in the background borings, continue drilling to a total depth of 10-feet.

16. Repeat Steps 6 through 11.

17. Proceed in a westerly direction to the next proposed boring location along the east-west transect following Steps 12 through 16. Repeat this process until the first row of borings has been completed.

18. Locate and drill a second round of borings based on the following criteria and procedures:

    a. Initial Borings Judged to be Clean Fill:

    In this case, a second round of borings will be drilled 50-foot immediately north of the initial line of borings, parallel to the east-west transect, following the procedures outlined in Steps 12 through 16. Additional borings will continue to be drilled at 50-foot horizontal intervals to the north until the borings reveal evidence of landfilled material. At that point, at least one additional boring will be drilled midway (approximately 25-feet) between the last two borings in order to provide a more accurate delineation of the landfill boundary. Examine soils from the last boring to verify the absence of landfilled material. Backfill each boring with drill cuttings from the borehole.

    b. Initial Borings Judged to be Landfilled Material:

    In this situation, a second round of borings will be drilled 50 foot south of each boring, parallel to the east-west transect, following the procedures outlined in Steps 12 through 16. Additional borings will continue to be drilled at 50-foot horizontal intervals to the south until the borings appear free of landfilled material. At that point, at least one additional boring will be drilled midway (approximately 25-feet) between the last two

borings in order to provide a more accurate delineation of the landfill boundary. Examine soils from the last boring to verify the absence of landfilled material. Backfill each boring with drill cuttings from the borehole.

TASK 5: MONITORING WELL INSTALLATION

TCL inorganic or TCL organic contamination was found in every existing well that was installed during the Phase I Remedial Investigation. Therefore, it is necessary to expand the current network of monitoring wells in order to thoroughly define the nature and extent of contamination. Six well clusters (bedrock and overburden) and one deep bedrock well (Figure 1) will be installed around the landfill to further characterize the nature and extent of ground water contamination. Proposed well locations are based on the assumption that the porosity is persistent throughout the flow domain. As such, the well clusters are located hydraulically up gradient as well as down gradient from the landfill to further identify the nature and extent of contamination.

The hydraulic gradient measured in the overburden wells indicates that ground water flows in a radial direction from the site. Furthermore, organic and inorganic contaminants were found in the soils, and inorganic contaminants were found in the ground water at the background well location 6S/6D. Therefore, an additional well nest (18S/D) will be installed further up gradient to identify the source of contamination in well 6S/6D, and to establish background water quality.

This well pair will be installed in a small clearing at the east end of the Ramada Inn parking lot, adjacent to the former sewage treatment plant. Continuous split spoon samples will be collected until bedrock is reached. Full TCL analysis will be performed on one unsaturated soil sample with the highest OVA readings. The well nest will provide background water and soil quality data.

Well nest 19S/D will be installed south of Ellicott Creek and north and east of Genesee Street and Transit Road, respectively. The proposed wells

will provide down gradient information regarding contaminants found in wells 7S/7D, as well as hydraulic information on Ellicott Creek.

A well nest (20S/D) will be installed south of Ellicott Creek midway between Transit Road and Rein Road. The well nest will correspond with wells 5S/5D. These proposed wells will provide down gradient chemical information, in addition to hydraulic information, on Ellicott Creek.

Well nest 21S/D will be installed approximately 100 feet northeast of Rein and Pfohl Roads. The well nest will be located approximately midway between wells 4S/4D and Ellicott Creek, and will provide down gradient chemical information, in addition to hydraulic information, on Ellicott Creek.

A well nest (22S/D) will be installed northeast of Aero Lake, but south of the Thruway exit ramp to provide down gradient information for Area A. Ground water samples from the shallow well will identify contaminants released into Aero Lake from Area A. The connection (hydraulic and chemical) between Aero Lake and the bedrock aquifer can be observed by installing the bedrock well (23D).

A triple well nest (23S/D/DD) will be installed west of wells 4D and 11S, east of Scott Place. The proposed well nest will provide down gradient information. The deepest well (23DD) will be installed to examine the possibility of a sinking plume.

SAMPLE TYPE, SAMPLE METHOD, SAMPLE CODE

Sample Type: Soil
Sample Method: Auger
Sample Code: MW18-SS

SAMPLE CONTAINER AND PARAMETERS

Refer to Table 3.

FIELD EQUIPMENT

All equipment for collecting samples will be provided by the drilling Subcontractor. Sample bottles, preservatives, laboratory deionized water, and shipping containers will be provided by NYSDEC. CDM will make the following available:

- Personal protective gear and monitoring devices as required in the HASP
- Field notebook
- Disposable plastic scoops
- Stakes and flagging
- Spray paint or marking pencils
- Decontamination equipment (Refer to HASP)
- Camera and film
- Polyethylene sheeting

PERSONAL PROTECTIVE EQUIPMENT

These tasks will be performed in Modified Level D personal protection. For details on personal protective equipment, refer to Health and Safety Plan (HASP), Addendum No. 2.

Personal protection includes the following:

- Tvyvek coverall or cloth coverall
- Safety glasses
- Hard hat
- Steel-toed and shank leather boots
- Neoprene gloves
- PVC surgical gloves
- Disposable latex booties

HEALTH AND SAFETY GUIDELINES

Refer to HASP, Addendum No. 2

TASK TEAM RESPONSIBILITIES

M. Ehnot.....Project Geologist/Health and Safety Coordinator

PREPARATORY ACTIVITIES

- Obtain property access from NYS Thruway Authority in advance of the intended day of drilling (contact Calvin Fechter or David Theilman at (716) 896-5050.
- Ensure that all sample analyses are scheduled with NYSDEC analytical laboratory. Schedule delivery of laboratory bottles, preservatives, and shipping containers.
- Assemble all the necessary field equipment required to complete the task.
- Ensure all field measuring equipment has been calibrated and has received appropriate quality control checks.
- Locate the Federal Express, Emery, or other overnight delivery service office nearest the site and note hours of operation.
- Inform local police, fire and hospital of the location and date that sampling will be conducted.
- Erect temporary fencing around all intrusive activity work sites prior to commencing work at those individual sites.
- Ensure that acceptable decontamination procedures for all sampling equipment is accomplished prior to beginning each activity, as outlined under Task 3, Preparatory Activities.
- Ensure all heavy equipment is steamed cleaned upon entry to the site.
- Notify the NYSDEC analytical laboratory at least three weeks prior to the sampling date.
- Conduct a briefing on health and safety aspects of the site with the drilling Subcontractor.
- At least one week prior to initiating drilling, the Subcontractor must submit documentation that all personnel who will be involved in the field work are enrolled in a medical monitoring program and received health and safety training.

All site personnel must read and become completely familiarized with the provisions of the SOP, Subcontract specifications, and Health and Safety Plan prior to the initiation of site activities. The Health and Safety Coordinator shall conduct a briefing with all Subcontractor personnel. During that briefing, exclusion and restricted areas will be identified and marked.

SPECIFIC PROCEDURES

1. Mark out boring locations and check for underground utilities.

2. At each location, the deep well will be completed prior to the shallow well. Field equipment necessary to complete the task of subsurface soil sampling and overburden well installation includes:

--disposable plastic scoops
--folding rule (engineers scale)
--sample table
--equipment wash bucket
--equipment rinse bucket
--decon solution (alconox and deionized water)
--log book
--sample jars
--wrist watch
--health and safety equipment, e.g., HNu, OVA, tyveks, gloves, boats, etc.
--sample paper work, e.g., traffic reports, chain of custody, custody seals, etc.
--reinforced strapping tape
--vermiculite

Installation of Bedrock Monitoring Wells

1. At each bedrock well location, initial borings will be installed as outlined under Task 3, steps 1 through 11.

2. Six bedrock wells will be installed which extend an estimated 20′ into bedrock or an estimated 40 foot in total depth. (Refer to Subcontractor Drilling Specifications for more details). One additional bedrock well will be installed which extends an estimated 40 feet into bedrock, or an estimated 60 foot in total depth. The riser pipe shall be constructed above grade or by suspending pipe in the borehole and threading additional lengths as necessary, such that the complete well assembly is installed as a single unit. The Subcontractor shall install the well casing to the depth determined by the Engineer.

3. The casing shall be fabricated with centralizers at the top and bottom of the casing to ensure parallel alignment in the borehole. Once the casing has been set to the required depth, the Subcontractor shall grout the annulus with cement/bentonite grout by the pressure grouting method. After an amount of grout equivalent to the borehole volume has been pumped and there is evidence that the grout is simply filling in voids and crevices in the rock, the grouting method may be altered to the tremie grout method.

4. Where the annulus is sealed by the tremie method, the tremie pipe shall be initially set at the base of the hole to be filled and periodically raised as the hole fills with grout (grout mixture must be prepared in accordance with Subcontractor Drilling Specifictions). The tremie pipe shall remain submerged at all times during the grouting procedure.

5. A 24-hour period shall elapse prior to any further effort to advance the borehole through the surface casing by "NX" coring. During this time the continuity of the grout seal shall be inspected and additional grout applied to compensate for any observed settling.

6. The surface casing shall be fully flushed of residual drilling fluid prior to commencement of "NX" coring to greater depth. The drilling rig and accessories shall also be steam cleaned and all contact equipment flushed with potable water. "NX" coring shall then commence to an estimated depth of 20 or 40 feet into bedrock, or an estimated 40 to 60 foot in total well depth, whichever comes first.

7. When the bedrock surface is encountered during bedrock well drilling, the Subcontractor shall core the upper surface of the bedrock using an "NX" size diamond bit core barrel that will result in a 5 7/8-inch borehole after reaming is completed. The core hole will be advanced until twenty (20) feet of intact bedrock has been cored. At one location, the corehole will be advanced forty feet into bedrock. The Subcontractor shall advise the Engineer of the depths where water is encountered, the volume of water produced, and, in general, the competence of the rock encountered.

8. The rock coring shall be performed by a rotary drill rig equipped with hydraulic feed and a water pump capable of delivering sufficient volume and pressure to drill "NX" size core to the depth required.

9. Cores shall be pulled at intervals not exceeding five (5) feet unless it can be shown to the satisfaction of the Engineer that longer runs produce equal or better recovery and quality of core.

10. Cores shall be pulled at the first sign of blockage or grinding. If core recovery is poor, breakage excessive, the Subcontractor shall make every effort to improve the recovery and sample quality by changing bit types, alternating drilling rates, shortening runs, or by whatever other methods are required.

11. The Subcontractor shall provide an acceptable hinged and hasped core box. The Engineer will direct the placement of the cores in the boxes proceeding from left to right such that the top of the sample is placed in the left end of the compartment nearest the hinges on the box and each compartment is successively filled such that the bottom of the core appears in the right end of the box nearest to the hasp.

12. The Subcontractor shall assist the Engineer in packaging the core and shall be responsible for providing spacers for sections of the box not filled by cores, inserting wooden blocks showing depths of runs and core breaks and noting the depths of packing breaks on the cores and spacers. The Subcontractor shall also mark the outside of the core box as directed by the Engineer. All markings shall be made in indelible ink. The oriented core will subsequently be correlated with the results of the surficial mapping and fracture trace analysis.

13. Samples of overburden from one borehole at each well cluster location shall be collected and stored in new, wide-mouth, screen-top 8-ounce clear, clean, glass soil sample storage jars. The removal of the samples from the split-spoon sampler and placement into storage jars will be performed solely by CDM personnel.

14. Upon completion of the borehole, the Subcontractor shall secure the borehole until the protective casing and locking cap can be permanently installed. The jobsite shall be made secure by the Subcontractor at the end of each working day.

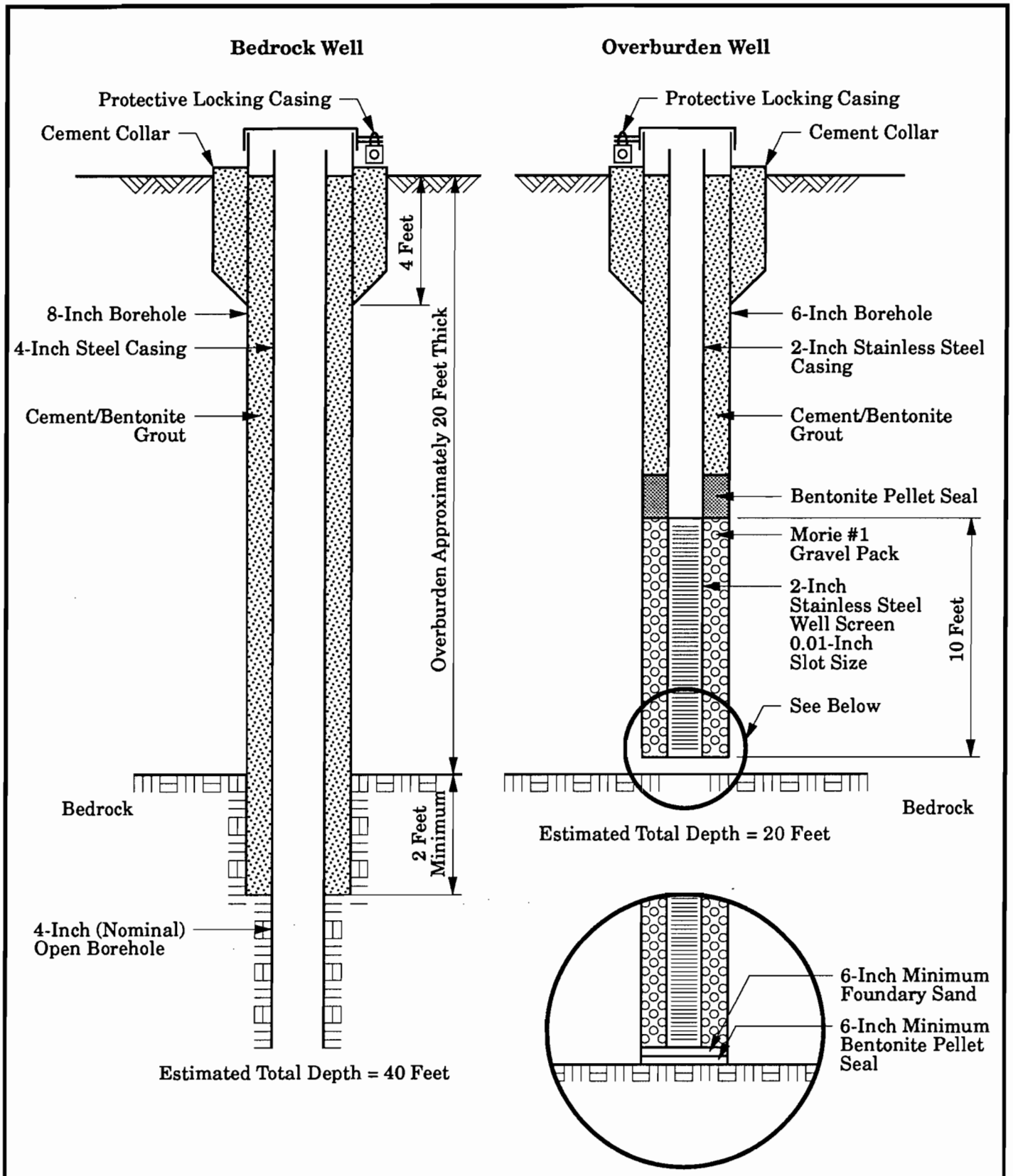
Installation of Shallow Monitoring Wells

1. Overburden wells shall be installed by auger or rotary methods adjacent to the bedrock wells (refer to Subcontractor Drilling Specifications for futher details). The overburden borings shall be advanced no further than two-feet above the bedrock surface. The bottom of the well must be sealed using a six-inch layer of foundary sand over six-inches of bentonite pellets.

2. Prior to the installation of the well materials, the Subcontractor shall take depth measurements to ensure the hole is fully open to the total depth. Should there be evidence of a soil plug within the augers or casing, the Subcontractor shall redrill that interval to remove the plug.

3. The well casing shall be new, Schedule #10, 316-stainless steel pipe, as manufactured by UOP Johnson, or equivalent. The pipe shall be 2-inch diameter, flush-joint and threaded and shall be provided in 2, 5 and 10-foot lengths (Figure 3).

4. Whenever possible, the Subcontractor shall assemble the screen and riser pipe above grade and install the well as a single unit. If the well depth prevents above grade assembly, the Subcontractor shall suspend sections of screen and riser pipe in the borehole and add additional lengths of threaded casing as necessary. Well screens shall be constructed of 2-inch diameter, 10-foot length of wire wrapped 316-stainless steel well screen. The slot size shall be .010-inch. All riser pipe and screen shall be clean, free of damage and void of all external dirt, grease and cutting oil prior to delivery to the site. The Subcontractor shall steam clean each section of pipe prior to installation. The steam cleaning shall be performed in the presence of the Engineer.



CDM

environmental engineers, scientists, planners & management consultants

Figure 3

Well Construction Schematic

Pfohl Brothers Landfill, Cheektowaga, New York

5. The assembled screen and riser shall be initially suspended 1-foot above the base of the borehole and gravel pack shall be poured along the outside of the riser pipe such that a continuous gravel pack forms beneath and around the screen extending no less than 3-feet above the top of the screen. The Subcontractor shall avoid resting the casing on the bottom of the hole where the weight of the above casing would be supported solely by the well screen.

6. The Subcontractor shall avoid retracting the augers above the depth of the hole filled by gravel, bentonite pellets, or cement grout at any given point. Should measurements indicate that a borehole collapse has occurred and that annulus seals are discontinuous, the Subcontractor shall remove all materials from the borehole, redrill the borehole, and reinstall the well components, as required and at the Subcontractor's expense.

7. If necessary, and per approval from NYSDEC, small quantities of potable water may be added, as needed, to advance the borehole, prevent soil heaving, or to facilitate placement of the borehole seals. The use of water as a drilling fluid will necessitate development of the well immediately upon completion. The Subcontractor is required to locate a supply of water and transport it to the site.

8. Immediately above the gravel pack, a 2-foot bentonite pellet seal shall be installed. The bentonite pellets shall be poured from grade along the outside of the riser pipe as the augers or casing are retracted.

9. Cement/bentonite grout shall be installed in the well annulus by the tremie method. Special precautions shall be taken to prevent grout from entering the inside of the riser pipe. The cement grout shall extend immediately above the bentonite pellet seal to grade. Following a 24-hour curing period, the grouting shall be inspected and additional grout applied to compensate for any settling which may have occurred.

10. The top of all assembled riser pipe shall be fitted with a slip-type vented stainless steel cap.

11. Each well shall be completed with a 5′ x 6" black protective steel casing. The cover shall be slip-type or hinged and hasped, and shall include a 1/4-inch drain hole drilled slightly above the ground surface to allow drainage of water between casings.

12. The protective steel casings shall be painted inside and outside with a rust-preventative primer coat and a final coat of rust preventative, as manufactured by Rustoleum, or equivalent. It is desirable for the Subcontractor to have this performed prior to bringing this item to the site.

13. The well number shall be stenciled and painted in contrasting color on top of the protective casing cover, or a label permanently affixed on some visible portion of the exposed casing showing the well number.

Well Development

1. Promptly following the completion of each well, the well shall be developed by use of bailer or centrifugal or submersible pump. The pump shall be cycled on and off until the discharge is clear and sediment free upon initial pump startup.

2. The well should be developed until a turbidity value of 50 NTU has been reached and the temperature, pH, and conductance have stabilized.

3. All development equipment shall be washed of all external dirt and grime prior to installation into the well. The pump used for development shall be immersed in a clean drum filled with approved potable water and the inner workings of the pump flushed for a period of 15 minutes.

4. All wells shall be sufficiently plumb and free of dents or protrusions to allow passage of a 3-3/4-inch diameter submersible pump to a depth equivalent to the bottom of the well.

5. The Subcontractor shall assist the Engineer in measuring pumping rates and water levels during the pumping. The specific capacity shall be measured at the commencement and conclusion of development.

6. The Subcontractor shall provide drums (type 17H or E) or other storage containers with a total volume which is 50 percent greater than the anticipated drilling waste per drill hole. The Subcontractor shall be responsible for sealing and transporting the drums to the drum storage area at the completion of each borehole.

TASK 6: WATER LEVEL MEASUREMENTS

In order to provide a better understanding of the hydraulic connection between the shallow (unconsolidated) and deep (bedrock) aquifer, and adjacent surface water (e.g., Ellicott Creek and Aero Lake), CDM will assist NYSDEC in the installation of three stream gauges and three water level recorders. One stream gauge each will be installed in Ellicott Creek, Aero Lake and Aero Lake outfall. Continuous water level recorders will be placed in each of three monitoring wells at the discretion of NYSDEC. In addition, monthly water level measurement will be collected by NYSDEC for a period of one year in all monitoring wells and at the three gauge stations. Water level data will be compiled by NYSDEC and submitted to CDM on computer disks. One initial round of water level measurements will be collected before sample collection.

SAMPLE TYPE, SAMPLE METHOD, SAMPLE CODE

Sample Type: NA
Sample Method: NA
Sample Code: NA

SAMPLE CONTAINER AND PARAMETERS

Not applicable to this activity.

FIELD EQUIPMENT

- o Staff gauge
- o Wrench
- o Carpenter's Level
- o Cement Drill & Bit
- o Bolt and Expansion sleeve
- o Continuous Water Level Recorders (WSL-2109-20-50, WSL-2109-05-35, and WSL-2109-05-25).

- o Lockable NEMA4X enclosures
- o B-P1 Replacement Battery
- o D-21/3 Dessicant (pack of 3)
- o IBM compatible lab top computer
- o Plastic tie wrap
- o Pliers
- o Screwdrivers (flathead and Phillips)
- o Electric Drill
- o Generator for Electric Drill
- o Perforated Steel Tape (50' roll)
- o 1/4" bolt and nut (3 inches in length)
- o Tape Measure
- o Duct Tape
- o Water Level Indicator

PERSONAL PROTECTIVE EQUIPMENT

These tasks will be performed in Modified Level D personal protection. For details on personal protective equipment, refer to Health and Safety Plan (HASP), Addendum No. 2.

Personal protection includes the following:

- o Tvyvek coverall or cloth coverall
- o Safety glasses
- o Steel-toed and shank leather boots
- o Neoprene gloves
- o PVC surgical gloves
- o Disposable latex booties

HEALTH AND SAFETY GUIDELINES

Refer to HASP, Addendum No. 2

TASK TEAM RESPONSIBILITIES

M. Ehnot.....Project Geologist/Health and Safety Coordinator

PREPARATORY ACTIVITIES

- o Purchase staff gauges and the water level recorders/data loggers 8 weeks in advance of the scheduled date for installation.
- o Upon receipt of the recorders, check to ensure all equipment is in included in the shipment and is in working order.

- Obtain all field equipment required for installation.
- Obtain permission from the Town of Cheektowaga to install gauge on the bridge.

SPECIFIC PROCEDURES

Staff Gauges

1. Emerse bottom of gauge in stream.

2. Use level to ensure staff gauge is plumb.

3. Using cement drill and cement bolt with expansion sleeve, secure staff gauge to bridge abutment or other permanent fixture.

4. Repeat Steps 1 through 3 at each of the stream gauge locations.

5. Arrange for Larsen Engineers to survey the elevation of the top of the staff gauge (nearest 0.01 feet) and the surface water relative to the NGS benchmark and the water level on the gauge at each of the three locations.

Continuous Water Level Recorders

1. Obtain static water level in well.

2. With the drill, carve out a small section of the riser pipe immediately under the well cap to insert the cable.

3. Depending on the sensitivity of the pressure transducer, calculate the depth at which the probe should be lowered into the water column (multiple the sensivity of probe, i.e., 5 psi, by 2.31 = 11 ft. This indicates that the probe should be lowered no more than 11 feet below the static water level). For 20 psi probes, the transducer should be lowered no greater than 46′ below the static water level.

4. Measure the length of cable to be fed into well (i.e., the transducer cable is 25′; the static water level is 10′ and the probe is to be

situated 9' below the static water level so a total of 19' of cable must be lowered into the well).

5. Using the example in Step #7, a mark should be placed at the 19' mark on the cable using a piece of duct tape.

6. Thread the cable through the small opening under the well cap and lower cable until the mark on the cable meets the lip of the well casing. Bend the cable over the casing. Using tie wraps, secure the cable to the casing.

7. Remove screws on the back of the enclosures. Attach steel perforated strap to casing using a 1/4" bolt and nut and thread two loose ends of the strap through the enclosure. Secure the strap to enclosure using the two screws at the back of the enclosure. Note: the length of strap should be approximately 10" longer than the diameter of the outer casing.

8. Program the data logger in accordance with the Specifications provided in Attachment 1.

9. Install battery. (Note: the data logger will begin to record data immediately upon installation of the battery).

10. Any problems or questions with equipment installation, contact Mr. Alex Gutierrez, Wehran Engineers, at (914) 343-0660.

TASK 7: GROUND WATER SAMPLING

Ground water samples will be collected from all (6) newly installed shallow wells, in addition to the existing (9) perimeter shallow wells. The existing wells would include 1S, 3S, 4S, 5S, 6S, 7S, 8S and 10S and 11S. One sample will be collected and analyzed from well 2D, in addition to selected off-site deep wells, including 1D, 3D, 4D, 6D, and 7D in which at least one TCL parameter was detected above background concentrations and/or ARARs. Ground water samples will be analyzed for TCL parameters, total

metals and a selected group of conventional parameters, which include sulfates, chlorides, and bicarbonate. Ground water from the newly installed bedrock wells (up to 4) will be collected and analyzed for TCL parameters, depending on the analytical results from the shallow wells and the vertical hydraulic gradients measured in the well pairs. If, for example, a downward hydraulic gradient is measured at a well pair and contaminants are detected in the shallow well, a recommendation will be made to sample ground water from the deeper well at that location. It is assumed that, in all, a total of 25 wells will be sampled for this phase of the investigation.

SAMPLE TYPE, SAMPLE METHOD, SAMPLE CODE

Sample Type: Ground water
Sample Method: Bailing
Sample Code: MW9S-GW

SAMPLE CONTAINER AND PARAMETERS

Refer to Table 3.

FIELD EQUIPMENT

- o 2" submersible pump for purging bedrock wells
- o Safety line for pump
- o Generator, power cord
- o Polyethylene hose, hose clamps, gate valve, flow meter
- o Centrifugal pump for purging shallow wells, stop watch
- o Electric water level tape
- o Log book
- o Conductivity meter
- o PH/eH meter with flow through closed cell
- o 0.45 micron filter paper
- o D.O. meter
- o Thermometer
- o Nephelometer (turbidity)
- o Pre-cleaned teflon or stainless steel bailer with teflon-coated stainless steel leaders
- o Polypropylene cord for bailer
- o Sample bottles
- o Sample preservatives
- o Wash/rinse bucket
- o Decon solution (alconox, deoinized water, HNO_3, etc.)
- o Sample coolers and ice

- o Wrist watch
- o Sample paper work, e.g., traffic reports, chain of custody, custody seals, etc.
- o Reinforced strapping tape
- o Vermiculite

PERSONAL PROTECTIVE EQUIPMENT

These tasks will be performed in Modified Level D personal protection. For details on personal protective equipment, refer to Health and Safety Plan (HASP), Addendum No. 2.

Personal protection includes the following:

- o Tvyvek coverall or cloth coverall
- o Safety glasses
- o Steel-toed and shank leather boots
- o Neoprene gloves
- o PVC surgical gloves
- o Disposable latex booties

HEALTH AND SAFETY GUIDELINES

Refer to HASP, Addendum No. 2.

TASK TEAM RESPONSIBILITIES

Michael Ehnot.....Project Geologist/H & S Coordinator

SPECIFIC PROCEDURES

1. All sampling shall begin with upgradient wells and proceed to wells downgradient. Perimeter wells will be sampled last.

2. Measure water level in well (refer to SOP, page 5-61 for details). Measure depth of well and depth to water to calculate standing volume of water.

3. Lower appropriate pump in well and purge at least three volumes of water from the well. Discharge purge water into a drum.

4. Perform in-situ measurements of pH/EH, D.O.,turbidity and temperature after each well volume is purged at regular intervals (approximately 5 to 10 gallons).

5. Proceed with Steps 6 through 12 after three well volumes have been removed and after temperature, conductance and pH/eH have stabilized within 10% of previous reading.

6. Remove the pump assembly from the well.

7. Don a clean pair of surgical gloves, remove the bailer and check valve from the wrapping, and screw the checkvalve into the bottom of the bailer.

8. Attach a line securely to the bailer with a bowline and play out enough line to submerge the bailer.

9. Commencing with the first bailer, each sample container will be filled using the bottom-draining device at the base of the bailer. VOA samples will be collected first to reduce the chance of volatile substances being liberated during sample collection. Fill the vials such that a miniscus is formed on the neck and carefully cap the bottle. Invert the bottle and inspect bottle for air bubbles. If air bubbles are present, remove the cap and add more water to the vial. Place VOA samples immediately in the cooler, away from any source of VOC, such as the gas generator and centrifugal pump.

10. Repeat the procedure using the same bailer and the appropriate sample containers for extractable organics, inorganic and conventionals.

11. Suspend the bailer above the water level, tie-off cord and lock the well cap. Dedicate one bailer for each well.

12. Collect a total of two (2) additional water samples for each group of 20 samples or every 5 days, whatever comes first, to serve as matrix spike/matrix spike duplicates.

13. Lock the well.

14. Carefully package all sample bottles in their respective sample coolers, complete the necessary paperwork, and seal for shipment.

15. Ship all sample coolers to the NYSDEC analytical laboratory by overnight courier.

16. Repeat procedure on next well.

17. Record all relevant information in field notebook and on ground water data forms.

18. Transport all drums to site and discharge on decon pad.

TASK 8: SURVEYING

To establish horizontal and vertical control of the newly installed monitoring wells and staff gauges.

SAMPLE TYPE, SAMPLE METHOD, SAMPLE CODE

Sample Type: NA
Sample Method: NA
Sample Code: NA

SAMPLE CONTAINERS AND PARAMETERS

Not applicable to this activity.

FIELD EQUIPMENT

All equipment to perform this activity will be provided by the Subcontractor.

PERSONAL PROTECTIVE EQUIPMENT

These tasks will be performed in Modified Level D personal protection. For details on personal protective equipment, refer to Health and Safety Plan (HASP), Addendum No. 2.

Personal protection includes the following:

- o Tvyvek coverall or cloth coverall
- o Safety glasses
- o Steel-toed and shank leather boots
- o Neoprene gloves
- o PVC surgical gloves
- o Disposable latex booties

HEALTH AND SAFETY GUIDELINES

A decontamination area will be set up and maintained. All CDM and Subcontractor personnel exiting the work area will be required to decontaminate or dispose of all outer clothing prior to exiting the site. Refer to HASP, Addendum No. 2.

TASK TEAM RESPONSIBILITIES

M. Ehnot.....Technical Oversight/Health and Safety Coordinator

PREPARATORY ACTIVITIES

- o Arrange property access and obtain any necessary permits at least one week in advance of field work.

SPECIFIC PROCEDURES

1. Survey location of each new monitoring well (13) and tie into the National Geodetic Survey system through use of the existing survey control points.

2. Using a Total Station, establish horizontal and vertical control of each new ground water monitoring well.

3. Store all data, including ties to control points for future use.

4. Use the existing project baseline and benchmarks around the site to accurately measure angle and distance to each monitoring well.

5. Vertically and horizontally locate the three staff gauges.

6. Plot all well and staff gauge locations and elevations on a tax map of the study area.

(PBLF3/15)kk

ATTACHMENT 1

2100 Series
User's Manual

Telog Instruments, Inc.
535 Summit Point Drive
Henrietta, NY 14467
Phone: (716) 359-1110
FAX: (716) 359-9401

Telog Part No.: 2100-030.002 5/91

Table Of Contents

Chapter 1: Introduction

The Telog 2100 Series of Data Recorders are microprocessor-based products designed to collect, process and store data from a wide range of sources in a variety of environments. The recorders are designed to record data continuously. Recorders are always recording data. There is no on/off switch. The recorders are battery operated with a typical operating life between battery changes of at least a year. You can conveniently put recorders at the point of measurment without having to worry about long wiring connections. To retrieve the stored data, the 2100 Series products can be connected directly to a computer or to Telog's Data Transfer Unit (DTU). The DTU can later be interrogated by an IBM-PC or compatible computer. A computer software package supplied by Telog provides an inexpensive user-friendly interface that you can use to retrieve stored data or program the attached recorder.

This manual describes how to use your 2100 recorders and the 2100 Series Support Software effectively. It is assumed that the reader is familiar with the general operating procedures used in the MS-DOS operating system for the IBM-PC family of personal computers. For answers to specific questions regarding MS-DOS, you should refer to the system documentation supplied with your computer.

If you have any questions regarding the operation of any of Telog's products, we would urge you to read the manual first. If the answer cannot be found, call 716-359-1110 and ask for customer support.

Theory of Operation

The Telog Instrument's 2100 Series Data Recorders are battery-powered instruments designed to measure and record a large variety of input signals. Each recorder consists of a built-in microcomputer. In addition, each recorder has unique analog circuitry which provides the signal conditioning for the type of measurement being performed.

All single and dual channel 2100 Recorders, with the exception of the 2107, function in a similar manner. The operation of the 2107 Pulse Recorder/Event Recorder is described in a separate section below.

Once each second, a built-in real-time-clock signals the microprocessor to perform a number of functions involved in sampling and processing the input signal(s). For example, the 2105 Thermocouple Recorder performs thermocouple cold-junction compensation each second, linearizes the thermocouple signal, and stores the reading in solid state memory. After sampling the data, the recorder always monitors its serial communications port for activity. If the serial interface is active (detected by a proper sequence of characters being sent from a connected computer or Data Transfer Unit), then the recorder automatically selects the proper baud rate and waits to process commands received from the computer (or DTU).

After receiving specific commands, the recorder performs the requested function(s). By using Telog's Support Software, the user need not be concerned with the details of these commands.

Using the information transferred from the recorder, the Support Software performs the necessary computations to display graphs, store and print data. In addition, by processing user-entered prompts, the software sends the proper commands to the recorder to program a number of parameters including: recorder ID, time and date, recording rate, alarm levels, and statistics to record.

2107 Operation

The 2107 Pulse/Event Recorder operates in one of two user-programmable modes: pulse recording, or event recording. These two operating modes are mutually exclusive, meaning that when the 2107 is operating in the pulse recording mode, it cannot operate as an event recorder. Conversely, when recording events, the 2107 cannot measure pulse rates.

When operating as a pulse recorder, the 2107 records the number of pulses appearing at its input terminal each second. Pulse rates of up to 100 pulses per second can be recorded. When recording pulses, the 2107 can use either one byte or two byte counters to record the number of pulses occurring during the user-programmed totalizing period. In addition, a prescaler can be applied to the total number of pulses occurring within a totalizing period to divide down the pulse totals as required.

As an event recorder, the 2107 can record the time of changes that occur at its terminal connections. Low to high transitions (the opening of a switch) or high to low (the closing of a switch) can be monitored. The 2107 records the time of occurrence of these events to the nearest second. The most recent 2000 events can be recorded. Like other 2100 Recorders, only the most recent data is recorded. Newer 2107 models also provide a run-time accumulator which records total on and off time.

2126 Temperature/Humidity Operation

The dual channel 2126 Temperature/Humidity recorder operates in a similar fashion to single channel recorders, except for its sampling rate. The user can program the recorder to sample once each second, or at slower rates (as slow as once per minute). Once each second, the recorder wakes up and determines if it is time to take a sample. If not, the recorder checks its serial port for activity. If there is no activity, it immediately returns to its low-power mode. If a sample is to be taken, the temperature and humidity sensors are sampled and the readings are stored. At the end of the user-programmed averaging period, the recorder computes and stores the desired results into solid-state memory.

Alarm Logging Recorders

A number of newer recorders support a feature known as alarm logging. The alarm logging feature is discussed separately, in Chapter 6 on page 35.

Chapter 2: Installing the Software

This chapter provides information about how to start using the 2100 Series Data Recorders in conjunction with the IBM-PC compatible Support Software. We'll first discuss what hardware you need to get started. Then we'll give step-by-step instructions of how to get the Support Software up and running on your computer.

Software Registration

In the back of this manual, you will find a software registration form. Please take a few minutes to complete the form and mail it to us. We can only guarantee warranty service to those users who have registered their products. Also, having this information will permit us to notify you of any software upgrades. You may also have the opportunity to purchase new products at a discount. Please register now! Thank you.

System Requirements

The 2100 Support Software requires the following:

1. Telog Instruments' 2100 Series Support Software.

2. Telog Instruments' C-21F or C-21AT custom cable to interface recorder and DTU to your computer. The IBM-PC/AT requires the C-21AT; older XTs and PCs (and the newer PS/2s) require the C-21F cable.

3. IBM-PC/XT/AT or IBM-PS/2 or true compatible running MS-DOS version 2.11 or later with at least 640K of memory.

4. One double sided double density diskette (a hard disk is preferred).

5. A Graphics card (either a CGA card, an EGA card, a Hercules graphics card, or a compatible equivalent).

6. A compatible graphics monitor.

7. A serial communications port configured as COM1: or COM2:.

8. Optional: an IBM compatible graphics printer or an HP LaserJet II compatible laser printer connected to the LPT1: parallel port.

Quick Start

For those users unfamiliar with the MS-DOS operating system, the sections below provide additional details of how to get started. For those who are MS-DOS gurus, simply backup the 2100 Support Software disk, then insert your copy into drive A: and type "2100". If you want to install the software on your hard disk, simply copy the contents of the disk to a separate subdirectory, change to that directory and type "2100". Refer to later chapters for program details that are not obvious.

Software Installation

The IBM-PC compatible Support Software is supplied on either a 5.25 inch double-sided double-density floppy diskette or a 3.5 inch low-density floppy disk in MS-DOS format.

The files contained on your Telog Support Software disk include:

2100.BAT..... This is the start-up batch file.
2100-01.EXE.... This is the main program.
LOGO.LOG..... The logo
LOGOHERC.LOG....The logo for Hercules graphics screens
CONFIG.TLG..... System configuration file
QBHERC.COM..... Hercules graphics driver
SCLxx.SCL..... Various scaling factor files
UPDATE.DOC..... May or may not be present. This file contains any manual updates that may pertain to the latest software release.

The support software can be installed on a hard disk or run directly from a floppy disk. Users who wish to use a hard disk should skip to section on hard disk installation on page 5 instructions. Floppy disk users should continue with the next section .

Floppy Disk Installation

The software diskette does NOT contain the MS-DOS operating system. If you wish to make a bootable disk from the supplied disk, follow the instructions in your computer's system manual to make a system disk on a new disk. You can create a system disk from a new blank disk by using the /S option of the MS-DOS FORMAT command.

After creating a new system disk, copy the entire contents of the Telog Support Software disk onto your newly-made system disk using the COPY command. To copy the Telog disk in drive A: to a newly formatted disk in drive B: type:

COPY A:*.* B: <RETURN>

By copying all the files to your new system disk, you will have created a bootable version of the support software. If you don't want a bootable version, but wish to copy all necessary files to a work disk, you must copy **2100.BAT, 2100-01.EXE, CONFIG.TLG, QBHERC.COM, and all SCLxx.SCL** files to your working program disk. Place your original Telog Support Software disk in a safe place.

Hard Disk Installation

For users with hard disk systems, you will probably want to set up a subdirectory for the 2100 Support Software and run the program from that subdirectory. To set up a subdirectory on your hard disk, at the C:> prompt, type:

mkdir \2100 <CR>

Then change to the newly created subdirectory by typing:

chdir C:\2100 <CR>

Then you can copy the files from the Telog program diskette in drive A to your new subdirectory by simply typing:

COPY A:*.*

In order for the support software to run correctly, your working directory must contain **2100.BAT, 2100-01.EXE, CONFIG.TLG, QBHERC.COM, and all *.SCL files.** Once the files have been copied, place your original Telog Support Software disk in a safe place.

In the discussions that follow, it is assumed that hard disk users have their systems configured to be running from a \2100 subdirectory on drive C:.

Getting Started

To start the Support Software, either boot your newly created work disk or, if your system is already up, simply insert the program disk into the default disk drive and type **2100** followed by a carriage return.

The Support Software package is menu driven. By this we mean that you are normally presented with a screen containing a number of selections. Presumably, one of the selections matches the function that you wish to perform. By making the appropriate selection, the program then either presents another menu or a screen that allows you to enter a value of your choice. By making menu choices and entries as necessary, you can utilize all of the features available in the Support Software package.

If you do not have a graphics card that is compatible with either the IBM Color Graphics Adapter (CGA card), the Enhanced Graphics Adapter (EGA card), or the Hercules Graphics Card, the program will not permit you to proceed. **A CGA, EGA, Hercules graphics, or compatible equivalent graphics card is required for the 2100 Series Support Software.**

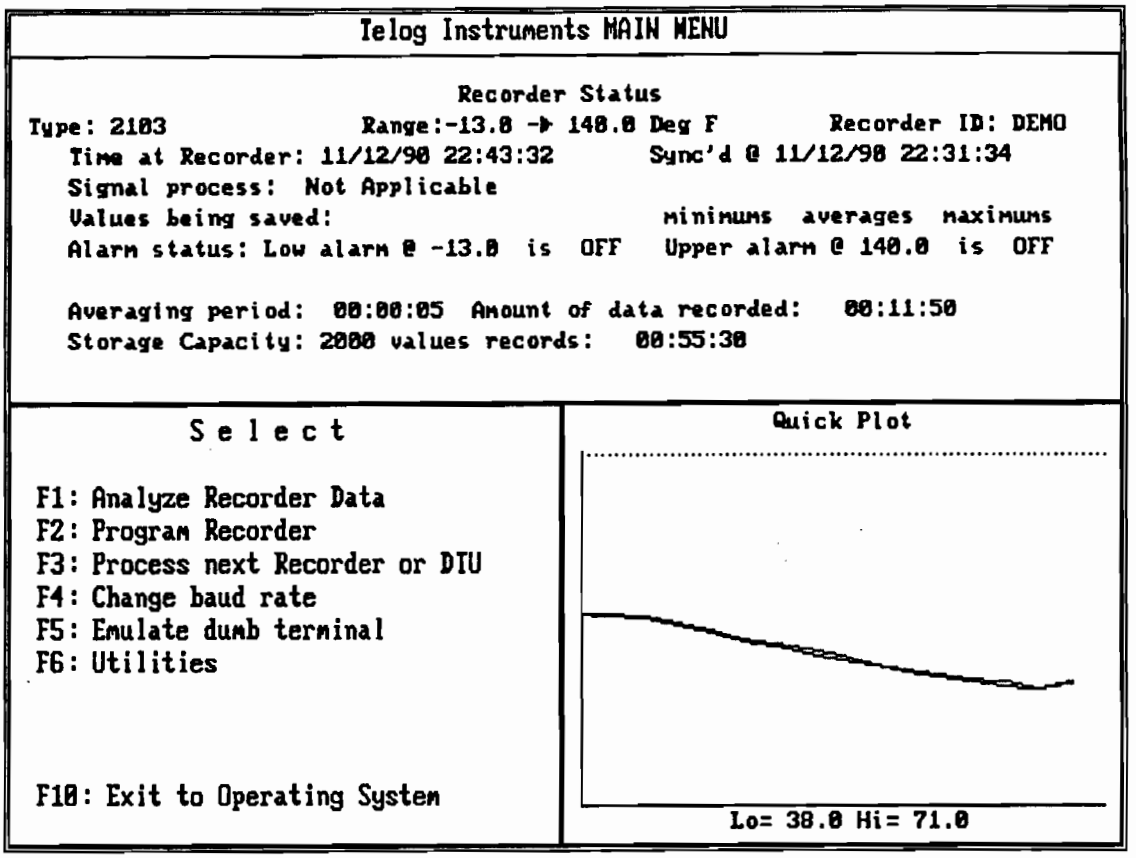
After starting the "2100" program, the first screen you'll see is the logo, copyright notice and software version followed in a few seconds, by the date and time programming screen.

```
Input date (MM/DD/YY): 06/04/90

PRESS RETURN TO ACCEPT CURRENT DATE
```

It is important that the computer's date and time be set correctly, since the computer's internal clock is used to reset the recorder's clock on request. If the displayed date is correct, just press **ENTER**, otherwise enter the current date then press **ENTER**. You can use the left and right arrow keys to edit your input. After entering the date, you are asked to enter the current time:

```
Input date (MM/DD/YY): 06/04/88
Input time (HH:MM:SS): 09:00:00

PRESS RETURN TO ACCEPT CURRENT TIME
```

The next few chapters provide details of how the 2100 Series Support Software works.

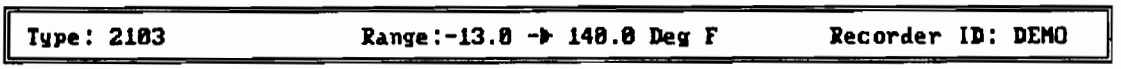


Single-Channel Recorder Status

The Main Menu screen, as you can see, contains a great deal of information. The top half of the screen in devoted to a summary of the current recorder status. The lower left of the screen presents your menu selections. The lower right displays a quick graphic summary of the attached recorder's data.

Below is a line-by-line description of the status information displayed for recorder types: 2101, 2102, 2103, 2104, 2105, 2108, 2109, 2123, and 2126. The dual channel recorders (the 2123 Dual Ambient Temperature Recorder and the 2126 Temperature/Humidity Recorder) and the 2107 Pulse/Event Recorder display different status screens which are described in separate sections on pages 12 and 15 respectively. The contents of some of the lines depends on the specific model of recorder. Newer models have a number of options which are explained below. If the feature is not available for your recorder, you can ignore that topic.

Line 1



Indicates the type of recorder attached (e.g. the 2101 Analog Voltage Recorder, the 2102 Current Loop Recorder, the 2103 Ambient Temperature Recorder, the 2104 RTD Recorder, etc.), the currently programmed range of the recorder, and the recorder's identity code (in the above example:1234). The range is displayed in the programmed units of measure. Programming of user units and scaling is discussed in detail in Chapter 11 of this manual. The ID code can be programmed to any four characters you like (we'll discuss programming the recorder in Chapter 5 on page 27).

Line 2

```
Time at Recorder: 11/12/90 22:43:32      Sync'd @ 11/12/90 22:31:34
```

Indicates the approximate time at the recorder and the time when the recorder was last programmed. The 'Time at Recorder' field is updated each time the computer reads the recorder status. If the recorder's time was set correctly during a previous programming session, then the time displayed should be within a few seconds of the current time.

The time displayed in the 'Last update' or 'Sync'd @' field corresponds to the time at which the recorder's real-time clock was updated by your computer. The label associated with the time can change, depending on the type of recording that you are doing. If you have synchronized your recorder, then the 'Last update' field will read 'Sync'd @' followed by the date and time at which you synchronized the recorder's clock. If your recorder has accumulators, then the field label will indicate the time at which accumulators were reset to zero. [Only newer recorder models have accumulators; these models include the 8K memory versions of the 2101, 2102, and versions of the 2107 with a model designator of -06 or greater.] See Appendix A for a list of recorder models and model designators.

Under normal conditions, you should only have to re-program the recorder's time perhaps once every six months or so, depending on how accurately you need to keep time. Thus you may wish to use the information on this line to help you schedule battery changes. It should be noted that the recorder and support software do NOT make any corrections for Daylight Savings Time. Therefore, if you have programmed the recorder's time during Standard Time, and analyze its data during Daylight Savings Time, the recorder will appear to be one hour slow. You can reprogram the recorder's clock without affecting stored data (with the exception of recorders with accumulators). Be sure to read the section in programming the recorder's clock on page 29 before doing so.

Line 3

```
Signal process:  Not Applicable
```

For applicable recorder types, this line indicates what type of signal processing is being performed by the recorder. Not Available indicates that the recorder being interrogated does not have signal processing capabilities. For recorders that support this feature, the available types of recorder-based processing are:

1. No processing; which is the default. The recorder takes a reading each second and uses the results to determine which values to save without performing any additional processing.

2. Square root extraction; (used in differential pressure applications, for example). Once each second, after a reading is taken, the recorder extracts the square root and uses that result for all subsequent processing. Data is passed to the system support software as a percentage of full scale.

With certain recorder types, an accumulator value will also be displayed. The accumulator is analogous to a car's odometer. In the case of the recorder, every second, the accumulator is incremented by the value of the current reading. The accumulator is reset to zero whenever you clear recorder data or reset the recorder clock. You can scale accumulators to meaningful engineering units by selecting the appropriate option from the Utilities section (see page 51).

Line 4

```
Values being saved:                          minimums  averages  maximums
```

Indicates which of the three available statistics are currently being saved. The 2100 Series Recorders can be programmed to compute and store any combination of the average, minimum, and maximum readings that occur during the programmed recording period. Note that for the 2107, you cannot select which statistics to save.

Line 5

```
Alarm status: Low alarm @ -13.0  is  OFF   Upper alarm @ 140.0  is  OFF
```

Indicates the programmable alarm levels and whether or not the external alarm signal will be activated when the input signal is out of bounds. When an alarm set point is disabled (indicated by the word OFF next to the set point), then the recorder does nothing if the signal is out of range. If the alarm set point is enabled (indicated by the word ON next to the set point), then the recorder will activate the alarm switch whenever the input signal is out of range. The alarm set point levels are indicated in the properly scaled units for the connected recorder.

The alarm levels have a resolution of one part in 255, regardless of the resolution of the recorder type. When programming alarm levels, input values are rounded to the nearest set point. Therefore, it is possible for you to enter engineering units that are rounded up or down by the software to the nearest available hardware set point.

For the 2107

You cannot program alarm levels for the 2107 Recorder; in fact, the alarm status line is not even displayed.

Line 6

```
Averaging period:  00:00:05  Amount of data recorded:   00:11:50
```

Indicates the length of the programmed recording period, displayed in HH:MM:SS format. The recorder performs calculations and stores data at a frequency indicated by the recording period. Data is always sampled once per second (except in the case of the 2126 Temperature/Humidity Recorder). In the above example, data is sampled each second, and calculations and data storage occur once each minute.

Also indicates how much data (in units of time) are currently stored in the recorder's memory. While there is memory available, the displayed value increments by the appropriate amount at the end of each recording period. After memory is full, the displayed value remains constant, since at the end of each recording period, the oldest data is discarded to permit the storage of the most recent data.

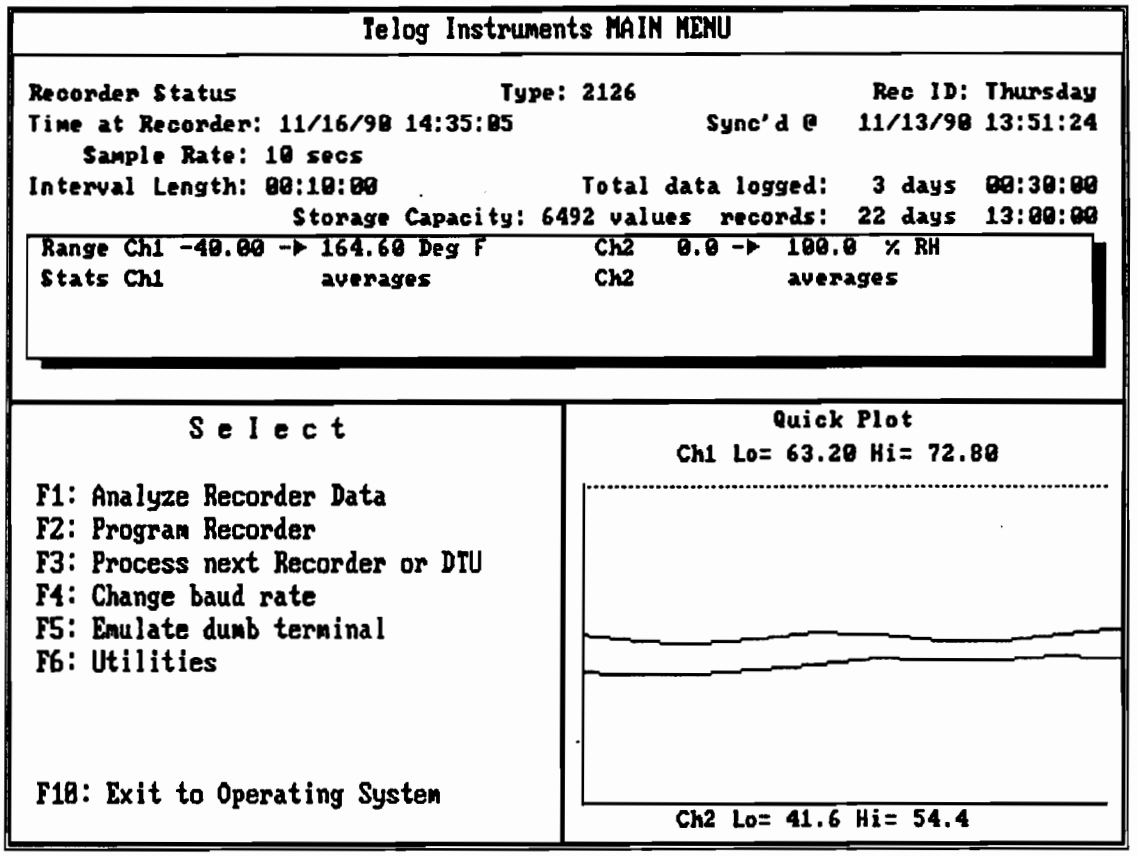
Line 7

```
Storage Capacity: 2000 values records:   00:55:30
```

Indicates the recording capacity of the connected recorder, both in the number of values that can be stored, and the total amount of recording time (before the oldest recorded values are over-written with the most recent data). The recording capacity can be programmed for recorders that have 8K of memory. At this time, recorder types with 8K of memory include types 2101, 2102, 2103, 2107, 2108, 2109, 2123, and 2126. Some older versions of the 2101s, 2102s and 2103s do not have 8K of memory and thus cannot have their recording capacities programmed. The support software detects which recorders (old 2101s for example, versus new 2101s) can have their recording capacities reprogrammed. These values are approximations and, depending on how many statistics are being stored, may vary slightly with respect to how much data can actually be collected.

The Dual Channel Recorder Status

For the 2123 Dual Ambient Temperature Recorder and the 2126 Temperature/Humidity Recorder a screen similar to the following is displayed:



The following is a line-by-line description of the recorder status information displayed for dual channel recorders. If you are using single-channel recorders only (210x) you may wish to skip this section.

Line 1

```
Recorder Status                Type: 2126                Rec ID: Thursday
```

Indicates where the status information is from (a recorder, a DTU, or a stored data file), the type of recorder attached (the 2123 Dual Channel Temperature recorder or the 2126 Temperature/Humidity Recorder), and the recorder's identity code (in the above example:TwoChanl). The ID code can be programmed to any eight characters you like (we'll discuss programming the recorder a little later; see page 27).

Recorder Status indicates that the current status information being displayed is directly from a recorder. The other two possibilities are **Saved Recorder Status**, which indicates that the status information is from a data file saved on disk (see page 25), and **Transferred Recorder Status**, which indicates that the status is from a DTU device (see Chapter 11).

Line 2

```
Time at Recorder: 11/16/90 14:35:05          Sync'd @  11/13/90 13:51:24
```

Indicates the approximate time at the recorder and the time when the recorder was last programmed. The 'Time at Recorder' field is updated each time the computer reads the recorder status. If the recorder's time was set correctly during a previous programming session, then the time displayed should be within a few seconds of the current time.

The time displayed in the 'Last update' field corresponds to the time at which the recorder's real-time clock was updated by your computer. The label associated with the time can change, depending on the type of recording that you are doing. If you have synchronized your recorder, then the 'Last update' field will read 'Sync'd @' followed by the date and time at which you synchronized the recorder's clock. If your recorder has accumulators, then the field label will indicate the time at which accumulators were reset to zero. [Some newer recorder models have accumulators]. See Appendix A for a list of recorder models and model designators.

Under normal conditions, you should only have to re-program the recorder's time perhaps once every six months or so, depending on how accurately you need to keep time. Thus you may wish to use the information on this line to help you schedule battery changes. It should be noted that the recorder and support software do NOT make any corrections for Daylight Savings Time. Therefore, if you have programmed the recorder's time during Standard Time, and analyze its data during Daylight Savings Time, then the recorder will appear to be one hour off. You can reprogram the recorder's clock without affecting stored data (with the exception of recorders with accumulators). Be sure to read the section on programming the recorder's clock on page 29 before doing so.

Lines 3 and 4

```
    Sample Rate: 10 secs
Interval Length: 00:10:00              Total data logged:   3 days  00:30:00
```

If present, Line 3 indicates the sample rate being used. For 2123s, this line is omitted. For 2126s, line 3 indicates the frequency with which samples are taken from the temperature and humidity sensors. The main advantage to using longer sampling rates is to lengthen battery life. If the recorder's clock is synchronized, then the time at which samples are taken is synchronized with the averaging period. Thus, if you select a one minute sample rate, the samples will be taken at exactly 00:00:00, 00:01:00, 00:02:00, and so on.

Line 4 indicates the length of the programmed recording interval and how much data (in units of time) are currently stored in the recorder's memory. Both are displayed in HH:MM:SS format. The recorder performs calculations and stores data at a frequency indicated by the recording interval. Data is always sampled once per second (except by the 2126). In the above example, data is sampled each second, and calculations and data storage occur once every five seconds. While there is memory available, the "Amount of Data recorded" value increments by the appropriate amount at the end of each recording interval. After memory is full, the displayed value remains constant, since at the end of each recording period, the oldest data is discarded to permit the storage of the most recent data.

Line 5

```
                Storage Capacity: 6492 values  records:  22 days  13:00:00
```

Indicates the recording capacity of the connected recorder, both in the number of values that can be stored, and the total amount of recording time (before the oldest recorded values are over- written with the most recent data). The recording capacity can be programmed for dual channel recorders.

The displayed capacity is an approximation and, depending on how many statistics are being stored, may vary slightly with respect to how much data can actually be collected.

Line 6

Indicates the currently programmed range of the recorder for each of its channels. The range is displayed in the programmed units of measure. Programming of user units and scaling is discussed in detail in Chapter 10 of this manual.

Line 7

Indicates which of the three available statistics are currently being saved by the recorder for each of its channels. The 2100 Series Recorders can be programmed to compute and store any combination of the average, minimum, and maximum readings that occur during the programmed recording period. It is also possible to disable one of the channels but not both.

Line 8 (Not available for the 2126; available for the 2123)

Alarm Ch1 Lo 50.00 ON Hi 80.00 ON Ch2 Lo -39.00 OFF Hi 164.00 OFF

Indicates the programmable alarm levels and whether or not the external alarm signal will be activated when the input signal is out of bounds. When an alarm set point is disabled (indicated by the word OFF next to the set point), then the recorder does nothing if the signal is out of range. If the alarm set point is enabled (indicated by the word ON next to the set point), then the recorder will activate the alarm switch whenever the input signal is out of range. The alarm set point levels are indicated in the properly scaled units for the connected recorder.

The alarm levels have a resolution of one part in 255, regardless of the resolution of the recorder type. When programming alarm levels, input values are rounded to the nearest set point. Therefore, it is possible for you to enter engineering units that are rounded up or down by the software to the nearest available hardware set point.

The 2107 Event Status

The following status screen is displayed when the 2107 is recording events.

```
                    Recorder Status
Type: 2107-8K          Event Capacity: 500      Recorder ID: DEMO
  Time at Recorder: 11/16/90 15:52:17  Last Update: 11/16/90 15:43:16
  Signal process: Not Applicable
  Types of Events Recorded:              Hi===>Lo Lo===>Hi
  Total time LOW:  00:00:03        Total time HI:   00:00:00


  Number of Events Recorded: 0000
```

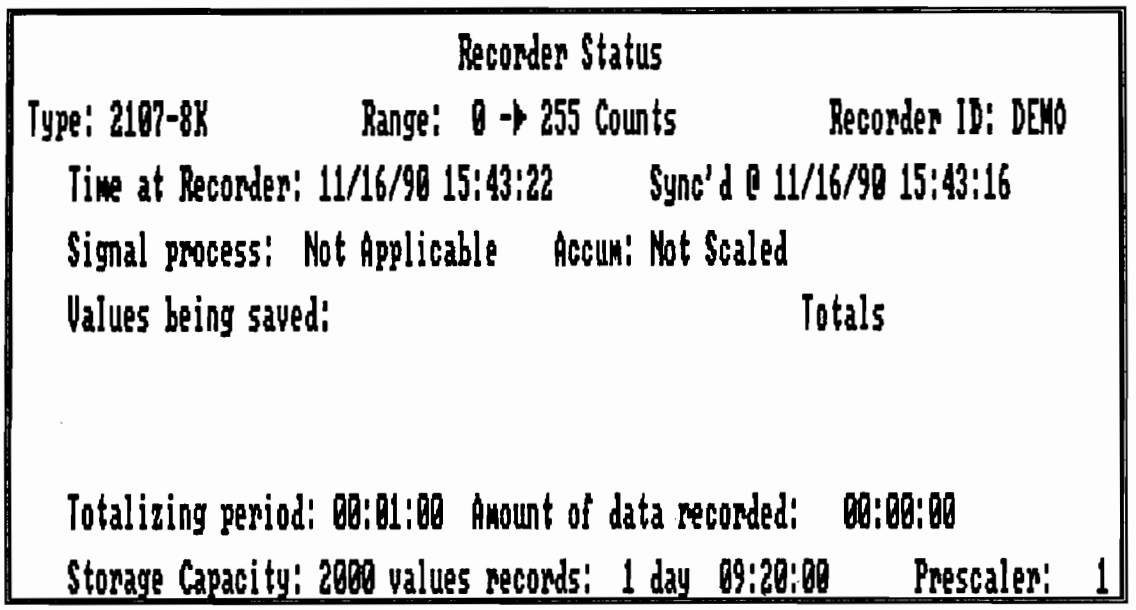
The above status screen is typical of the event recording mode of the 2107. Note that instead of statistics being saved, the type of events that are being recorded is displayed. You can program either low to high transitions or high to low transitions to be recorded, or both. Alarms levels can not be programmed for the 2107.

A newer feature of the 2107 Event Recorder has been the addition of the 'run-time' feature. This feature (not available on 2107 models of -05 or less) gives you information about how long the switch position has been in the open (Total Time Off) and closed (Total Time On) position. This offers a convenient means of measuring total run-time of, for example, a pump. The run-time information is maintained separately from the actual events being recorded, and is only reset when data is cleared or the recorder clock is reset. Each run-time counter can count up to 32 years of ON or OFF time.

The Number of Events Recorded field gives a count of the total number of Hi to Lo and Lo to Hi transitions recorded since the data was last cleared.

The 2107 Pulse Recording Status

The following status screen is displayed when the 2107 is operating in the pulse recording mode.



The type of information displayed is quite similar to that displayed for other 2100 Recorders except for the following: You cannot program alarms when recording pulse rates; you can only store period totals (no minimums and maximums are allowed); you can program a prescaler, which is used as a divisor by the recorder prior to storing a period total. A more detailed discussion of prescalers can be found on page 30.

The Current totalizing period is similar to the Current averaging period of other models (see page 14). At the end of the programmed period, the number of pulses which occurred since the end of the last period is recorded.

The accumulator provides a running total of pulse counts since the last time memory was cleared. Note that early models of the 2107 (with model designators of -05 or less), cannot provide the accumulator.

The Quick Plot

The QUICK PLOT displayed on the lower right of the screen is an unscaled graphic summary of the data contained in the recorder. More detailed data can be displayed from the Analyze Recorder menu selection. The purpose of the QUICK PLOT is to give you a quick summary of the data contained in the recorder without having to perform a detailed analysis. Thus, by just glancing at the QUICK PLOT, you may be able to tell if the attached recorder contains data that is of further interest. The upper and lower alarm levels are indicated by the dotted lines. The numbers displayed at the bottom of the graph indicate the lowest and highest readings in the stored data set (with a resolution of 1 part in 256). For example, if the recorder is saving minimums, then the displayed numbers are the lowest and highest minimums saved.

With dual-channel recorders, the quick plot displays both channels simultaneously. For users with EGA graphics, channel 1 is indicated by the light blue plot and channel 2 by the light green plot.

A QUICK PLOT is not available for data recorded by a 2107 operating in the event recording mode.

The Main Menu

After examining the recorder status, you can select from the Main Menu which consists of the following selections:

```
F1: Analyze Recorder Data
F2: Program Recorder
F3: Process Next Recorder or DTU
F4: Change the Baud Rate
F5: Emulate Dumb Terminal
F6: Utilities

F10: Exit to Operating System
```

The two main functions that you will probably perform most often are Analyze Recorder Data, and Program Recorder. The additional selections provide the necessary support for these two main options. Separate chapters in this manual discuss each of the main menu selections.

Chapter 4: Analyzing Data

In this chapter, we'll discuss the various functions that are provided by pressing the **F1:Analyze Recorder** selection of the Main Menu.

Analyze Recorder Menu

After pressing F1 from the Main Menu, the screen displayed at this point will be similar to the Main Menu screen. The recorder status, and the Quick Plot are still displayed. However, the menu selections are now the following:

ANALYZE RECORDER DATA

F1: Graph Recorder Data
F2: Display/Print/Export Recorder Data
F3: Obtain current reading
F4: Read recorder data from disk
F5: Save recorder data to disk

F10: Return to Main Menu

As you can see from the list of selections, this menu is where you get to see and manipulate the recorded data. For 2107 users, when the 2107 is operating in the event recording mode, you cannot display a high resolution graph of stored events; you can only Display/Print/Export Recorder Data.

Graph Recorder Data

Press the F1 function key for a graph of the data. At this point, the computer must read the data from the recorder. You'll have to wait a few seconds while data is being transferred. The speed of the data transfer of course depends on the selected baud rate. The higher the baud rate, the faster the transfer. We suggest that you use 9600 baud if you are directly connecting your computer to the 2100 Recorder since it provides the quickest response. To change baud rates, select **Change the Baud Rate** (refer to page 45) from the MAIN MENU.

A status line in the middle of the screen indicates what's happening. Once the data transfer is complete, the program prompts you to select among various scaling options to determine how the vertical scaling of the graph is to be handled unless you are using a dual-channel recorder, in which case you are prompted first for the channel you wish to plot. The scaling options are:

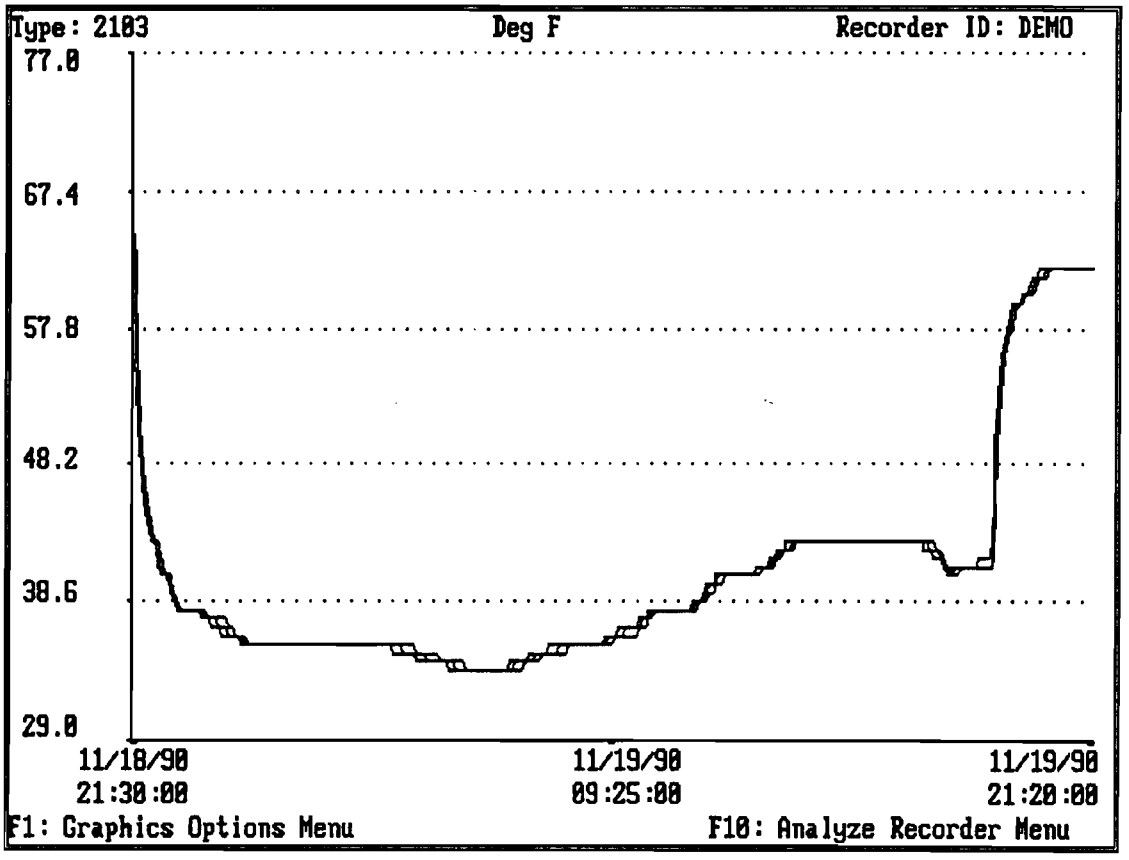
F1: Graph with predefined limits
F2: Auto-scale graph limits
F3: Redefine graph limits

The first option, **Graph with predefined limits**, only appears if you have previously defined graph limits for this particular recorder using the **Redefine graph limits** option. By selecting this option, the program uses the graph limits that were stored by you during a previous session. By selecting your own graph limits, you can produce graphs that have reproducible limits from one test to the next and among a number of different recorders.

The second option, **Auto-scale graph limits**, permits the program to determine automatically the proper vertical scaling. The advantages to auto-scaling are that it is fast, and always captures the entire data set on the screen. In addition, when you expand certain sections of the graph (as explained below), the graph is again auto-scaled to expand the vertical resolution to match the displayed data.

The third option, **Redefine graph limits**, permits you to enter a low and high limit (in engineering units) to be used by the graphing routine. After entering the lower and upper limit, you are asked if you want to make these limits permanent. If you answer yes, then the program will save these limits in a disk file, and will be able to access them automatically the next time this particular recorder's data is graphed. The limits that are saved become the option mentioned above; **Graph with predefined** limits. If you don't save the defined limits, then the first option mentioned above will not be available to you when you graph data from this specific recorder at a later time.

A sample graph is shown below.



After displaying the graph, which will take a few seconds, there are a number of options available for further analysis. These options are displayed on the screen by selecting F1 for GRAPHICS OPTIONS.

The graphic options available include:

```
F1: Print Graph
F2: See Data & set bounds
F3: Expand left half
F4: Expand middle
F5: Expand right half
F6: Previous graph
F7: Annotate graph
F10: Exit Graphic Options
```

Pressing **F1** a second time provides you with a hard copy of this graph if you have an IBM compatible dot-matrix graphics printer or an HP LaserJet II compatible laser printer connected to your computer through the parallel printer port (LPT1:). Pressing **F3** through **F6** expands or contracts the graph by a factor of two from the selected graph section. After expansion, you can view the previously displayed graph by selecting **F6**. After each expansion, you must select **F1** to re-display the graphics options if you wish additional expansions, or a printout. You can expand the graph up to 8 times. The computer will beep if no further expansions are allowed.

Pressing **F2** provides a means for the user to set start and stop times for use in the **Display/Print/Export Data** option of the Analyze Recorder Data Menu (F2 option), as well as, view the data on the screen. After pressing **F2**, the following options are displayed on the screen:

```
<= & Cntl <= move left
=> & Cntl => move right
HOME=far lft;END=far rgt
F10: Graphics Options
DATE: xx/xx/xx
TIME: xx:xx:xx
Min   Avg   Max
xx    xx    xx
```

In addition, **F1** and **F2** options are displayed at the bottom of the graph, permitting you to set start and stop times. Using the left and right arrow keys moves a data pointer that allows you to view the data one interval at a time. The data values are displayed below the appropriate heading (Min, Avg, or Max) in the display box, as well as, the time and date associated with each reading. Moving the data pointer left or right allows you to examine your data in detail. If you want to scan to the right or left more quickly, just hold down the CTRL key at the same time as using the arrow keys. Then the data pointer will move left or right in steps of 25 intervals. With the use of the HOME and END keys, the data pointer can be moved to the left and right edges of the graph quickly.

To set start and stop times for raw data printouts, simply press **F1** or **F2** respectively. Doing so will place a marker on the graph at the current position of the data pointer indicating the start or stop point that you have selected. If you change your mind and want a different start or stop point, simply move the data pointer to the desired point, then press **F1** or **F2** again. Note that after selecting both **F1** and **F2**, a third option **F3**: Expand is displayed. By pressing **F3**, the graph will be expanded to your selected start and stop markers. If you don't select a start or stop point, then when obtaining a raw data printout, the entire recorder data set will be used to generate the output. Pressing **F10** returns you to the Graphics Options Menu.

Pressing **F7: Annotate graph** permits you to write notes on the displayed graph. A cursor appears, which indicates where the next character will be written on the graph. You can use the **up** and **down** arrow keys, the **HOME** and **END** keys, and the **BACKSPACE** key to move the cursor to a desired location. You don't need to worry about over-writing your data by cursor movements. Only when you enter text is the graph overwritten. The information that you enter is NOT stored with the recorder data on disk and is lost as soon as you-display another graph. You can use this feature to document a graph before you obtain a hardcopy printout. Using the expansion options, you can zoom in on the data of interest, then examine the data using the **F2** option. Use the **F7 Annotate** feature to document points of interest on the graph. Use the **F1** option to obtain a hardcopy record of your results. After you're finished, press **F10** to return to the **Analyze Recorder Menu.**

Display/Print/Export Recorder Data

The high resolution graph provides a good picture of what the recorded data looks like. However, you may want to obtain an output of the actual numbers that have been recorded. The second selection (**F2: Display/Print/Export Recorder Data**) permits you to obtain a printout of the recorded data.

You can have the output displayed to the screen, printed out to a connected parallel printer, or sent to a disk file in spreadsheet-readable format. In all cases, the data is compressed by a programmable factor. By programming this factor, you can determine how many lines of data will be generated. It is possible for the 2100 Series Recorders to store up to 6515 data points. The 2107 and 2103 8K model can store up to 8140 data values. When storing one statistic, this corresponds to roughly 100 pages of printed data. By compressing the data, paper can be saved as well as time. Of course, by using a compression factor of 1, you can get a complete output of the raw data as it is stored in the recorder.

The compression factor indicates how many recorder data points have been 'averaged' together to produce a single line of output. For example, for a compression factor of 10, the computer displays or prints out a single line of data for every 10 recorder data intervals. When the recorder is programmed to store average, minimum and maximum values, then 10 averages are averaged together to produce the compressed average value; 10 minimums are compared to produce the lowest minimum reading of the 10 minimums, and similarly 10 maximums are compared to output the greatest maximum of the 10 maximums. The date and time that are displayed correspond to the **start time** of the first interval of the compressed intervals.

To get a look at the raw data, press **F2** from the **Analyze Recorder Menu.** The following menu will then be displayed:

```
F1: Print data to screen
F2: Print data to printer
F3: Export to Spreadsheet file
F4: Change comp. factor(default = 10)

Starting @ mm/dd/yy hh:mm:ss
Stopping @ mm/dd/yy hh:mm:ss

F10: Return to Analyze Recorder Menu
```

Pressing **F1** will send a printout to the screen. Pressing **F2** will send an identical printout to the printer. Pressing **F3** will send the output to a disk file (you are prompted for an output filename). This output file is in a format that is compatible with some spreadsheet programs, such as Lotus 1-2-3. The output file can then be 'imported' into 1-2-3, using the numeric option of the 1-2-3 File Import command. [See your spreadsheet documentation for further details.]

On recorders with an accumulator that has been scaled (see **Scaling Accumulators** on page 51), you will be asked if you would like a running total of the scaled accumulator with your output data. If you respond with **F1**, a column will be added to your report that shows the accumulator value up to the current time. **F2** will generate the report without this information.

Once started, you can terminate an output by pressing F10.

Start and stop times for all of the data to be printed using the above option menu are displayed below the **F4** selection. These start and stop times are set on the high-resolution graph of the data (from the **Analyze Recorder Menu**, press **F1** to display the graph, then **F1** for the Option Menu, then **F2** for the See Data & Set Bounds, then **F1** to set start time and **F2** to set stop time).

If you have not set start and stop margins using the pointers, then start and stop times default to print the entire recorder data set.

Pressing **F4** lets you change the compression factor. You are prompted to enter the desired compression factor. **F10** returns you to the above menu, where you can obtain a printout of the data using the new compression factor.

All of the output formats (generated by pressing **F1, F2,** or **F3**), use the programmed start and stop times, and the programmed compression factor.

A sample printout is shown on the next page. As you can see, the recorder status information is printed, followed by the actual data, compressed by the factor shown. The values printed are also represented in graphic format on the right side of the printout. [Output to spreadsheet readable *.PRN files do not have the graphic data representation.] For the single-channel recorders, a '-' is printed for the minimum value; a "*" is printed for an average; and a "+" is printed for a maximum value. If you are using a dual-channel recorder, a "(" is printed for Ch1 minimum, a "[" for Ch2 minimum, a ")" for Ch1 maximum, a "]" for Ch2 maximum, and a "1" or "2" for the channel averages. The placement of these symbols corresponds to the magnitude of the value, allowing you to determine the maximum or minimum values quickly.

```
                              Recorder Status
Type: 2103              Range:-13.0 -> 140.0 Deg F        Recorder ID: DEMO
   Time at Recorder: 12/10/90 21:06:19   Last Update: 12/10/90 21:06:06
   Signal process:  Not Applicable
   Values being saved:                          minimums  averages  maximums
   Alarm status: Low alarm @ -13.0  is  OFF   Upper alarm @ 140.0  is  OFF

   Averaging period:  00:05:00  Amount of data recorded:  2 days  07:30:00
   Storage Capacity: 2000 values records:  2 days  07:30:00


Output compressed by a factor of  12

  Date      Time   Min   Avg   Max  ____________________________________

12/08/90 13:36:01  65.0  66.2  66.8      - *+
12/08/90 14:36:01  65.6  66.0  66.2       -*
12/08/90 15:36:01  65.0  65.3  66.2      * +
12/08/90 16:36:01  64.4  64.8  65.0     -*
12/08/90 17:36:01  64.4  64.4  65.0     *+


                      F9: Pause     F10: Abort Output
```

Display Current Reading

The third selection, after returning to the Analyze Recorder Menu, allows you to obtain the current reading at the recorder.

The screen will display something similar to the following:

```
The current deg F is:

        62.5


F10: Return to Analyze Recorder Menu
```

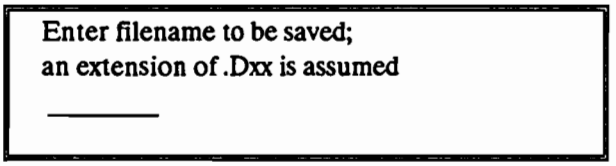
For a dual-channel recorder the current reading for both channels are labeled and displayed simultaneously.

The engineering units (if programmed by the user to be different from the default units) are displayed. In the above example, the 2103 Recorder is sending the current ambient temperature. To see the displayed reading change, you may want to vary the input signal to your recorder. Depending on baud rate, the screen is updated approximately once per second. If you display current readings frequently, you should realize that the battery life of your recorder will be greatly reduced. Pressing **F10** returns you to the **Analyze Recorder Menu.**

Saving Data to Disk

The next two Analyze Recorder Menu selections (**F4: Save recorder data to disk** and **F5: Read recorder data from disk**), let you save the current data and then analyze the stored data at a later time. It may be useful for archiving purposes to save important data. You can obtain a high resolution graph as well as a printout of raw data from the data stored on disk. It should be noted that the file format used to store data with this option is different from the file format used to export data to a spreadsheet file. The .PRN format requires substantially more disk space and is not readable by the 2100 Support Software.

Pressing **F4** from the **Analyze Recorder Menu** will result in the following display:



To save the data of the currently attached recorder, [you can also re-save an old data set that you may have re-scaled.] simply enter a filename of 8 characters or less (using the MS-DOS file naming conventions). To your filename, an extension of .Dxx is automatically appended. The 'xx' is determined by the type of recorder. For example, the file extension for a 2101 Recorder is D01; for a 2123, the file extension is D23; and so on. The data is then saved to the default data disk. [You can change the default data disk designation using the **Utility** option of the **Main Menu.**] You may designate an alternate drive by entering a drive designator preceding your filename. For example, entering **B:DATSAVE** would result in a file called DATSAVE.Dxx being created in the default directory of drive B:. If the file already exists, you must choose another filename. Support for pathnames is not currently available. After the data has been stored, the **Analyze Recorder Menu** returns to the screen.

Read Data from Disk

To recall stored data from disk, press **F5** from the **Analyze Recorder Menu.** The screen will display a directory of all *.D?? files contained on the default data disk drive. To recall a stored data file, you can use the up, down, right and left arrow keys to select the highlighted data file or you can enter the filename directly. For example, to recall the file DATSAVE.D01, simply enter **DATSAVE.D01** followed by a carriage return. You can also recall data rom another disk drive by preceding the filename with a disk drive designator, such as **C:DATSAVE.D01.** In any case, the designated file is read in, examined to verify that it is a valid data file, then loaded into memory. Once the data has been read from disk, you may obtain a high resolution graph of the data using the **F1: Graph Recorder Data** option of the **Analyze Recorder Menu,** and you can obtain a printout of the raw data using the **F2: Display/Print/Export raw data** option.

Each data file requires a minimum of approximately 3K bytes of disk space. Storing data from recorders with 8K memory sizes requires roughly 9K of disk space. Therefore, a standard 360K disk can hold up to one hundred 3K data files or about thirty- three 9K data files.

To return to the Main Menu, press F10.

Chapter 5: Program Recorder Menu

Selecting the second option from the **Main Menu** allows you to program the attached recorder.

```
F1: Analyze Recorder Data
F2: Program Recorder
F3: Process next Recorder or DTU
F4: Change the Baud Rate
F5: Emulate Dumb Terminal
F6: Configure System


F10: Exit to Operating System
```

Using the program menu, you can change all of the programmable parameters of the recorder. Depending on the parameter being re-programmed, the stored data in the recorder may or may not be cleared. Reprogramming the recording rate, synchronizing the recorder's clock, changing recorded statistics, or recording capacity requires that recorder data be cleared. You are always prompted by the software to verify the clearing of recorder data. Reprogramming other parameters does not affect stored data.

After selecting the program option, the following menu will be displayed:

```
F1: Change Recorder Status
F2: Clear recorded data
F3: Save current recorder config
F4: Restore saved recorder config
F10: Return to MAIN MENU
```

If you are programming the 2107, the following menu will be displayed:

```
F1: Change Recorder Status
F2: Clear recorded data
F3: Select 2107 Operating Mode
F4: Save current recorder config
F5: Restore saved recorder config
F10: Return to MAIN MENU
```

Changing Recorder's Status

If you are programming the 2107, see the section below describing the selection of 2107 operating modes. For all single-channel recorders, pressing F1 will display the following programming screen:

PROGRAM RECORDER: Change Recorder Status
Use up and down arrow key to move between fields

RECORDER STATUS
Type:2103 Range:-13.0=>139.0 Deg F Recorder ID:***1234***
Time at Recorder: 03/13/85 16:28:10 Last Update: 03/13/88 16:24:10
Signal Process: ***[model dependent]*** [Accum: Model dependent]
Values being saved: ***minimums averages maximums***
Alarm status: Low alarm @ ***15.0*** is ***ON*** Upper alarm @ ***97.5*** is ***OFF***

Averaging period: ***00:01:00*** Amount of data recorded : 11:06:00
Storage Capacity: ***2000*** values records: 11:06:00

And for dual-channel recorders, pressing F1 produces this screen:

PROGRAM RECORDER: Change Recorder Status
Use up and down arrow key to move between fields

Recorder Status Type: 2123 Rec ID: ***12345678***
Time at Recorder: 03/13/85 16:28:10 ***OK*** Last Update: 03/13/88 16:24:10
Recording Interval: ***00:01:00*** Amount of Data recorded: 19:32:00
Storage Capacity: ***6512*** values records: 2 days 06:06:00

Range Ch1 -40.00 - 164.60 Deg F Ch2 -40.00 - 164.60 Deg F
Stats Ch1 ***minimums averages maximum*** Ch2 ***minimums averages maximums***

Alarm Ch1 Lo ***0.00 ON*** Hi ***100.00 ON*** Ch2 Lo ***-40.00 OFF*** Hi ***164.00 OFF***

Those fields that are programmable for the attached recorder are displayed in highlighted fields. You can use the up and down arrow keys to move to the next or previous field. The current field is pointed to by a set of arrows. A prompt field is displayed at mid-screen to tell you the type of input expected for each field as you program it.

If you press F1, the status, as it is currently displayed on the screen, will be sent to the attached recorder. If changes that you have made in the displayed recorder status require that recorder data be cleared, you will be asked to verify your selections before the new parameters are sent to the recorder. As always, pressing F10 will abort any changes that you have made.

Programming Recorder ID

By programming the recorder ID, you can uniquely identify each of your 2100 Series Recorders. To reprogram the recorder's ID, simply move the arrows to the recorder ID field. The prompt line tells you that you can enter any four characters , and use the left and right arrows to edit your input. If you are using a dual-channel recorder you may program up to an eight character ID. You don't need to press ENTER. What you see on the screen whenever you press F1 is what will be programmed.

Reprogramming the Recorder's Clock

The field for reprogramming the recorder clock toggles among "Clock is OK", "Reset Clock", and "Synchronize". Toggling this field to "Reset Clock" will cause the computer to reprogram the recorder's real-time clock to the current time at the computer. Selecting "Synchronize" will synchronize recording intervals to the computer's calendar clock. For example, if you are programming one minute intervals, by synchronizing the recorder's clock, the recorder's intervals will start on whole minute boundaries. When the recorder's clock is not synchronized, intervals start at the time of programming the recorder. You are only permitted to synchronize recording intervals that are at least 5 seconds long.

Synchronization of a recorder requires that recorder data be cleared. Note that you can 'reset' a synchronized recorder without clearing data, but you cannot synchronize a recorder without clearing data.

In addition, if the recorder that you are programming has an accumulator, reprogramming the recorder's clock requires that the recorder's memory (including accumulators) be cleared.

Selecting Stored Statistics

You can select those statistics that will be computed and stored at the completion of each recording period. For example, if you have programmed a recording rate of 10 seconds, and select saving minimums and maximums, then every ten seconds, your 2100 Series Recorder will store the Minimum and Maximum values measured during the previous 10 seconds.

For a dual-channel recorder it is possible to disable one channel so no information is stored for that channel but not both channels.

The computer displays the amount of recording time the recorder can log data before the oldest data begins to be overwritten.

Programming Alarms

You will notice on the status line for alarms, that you can program the lower and upper alarm levels and turn the lower and upper alarms off and on. Whenever setting alarm set points you should remember that the lower alarm set point must always be less than the upper alarm set point. The prompt line provides this reminder. [You cannot set alarms for the 2107 Pulse Recorder.]

The alarm feature works as follows: Each second, the recorder checks to see if an alarm set point is enabled. If not, then the alarm switch is turned off. If an alarm set point is enabled (an alarm set point is enabled by turning that alarm ON and setting a set point level), then the recorder compares the set point with the current reading. If the current reading is out of range, then the alarm switch is turned on. The alarm switch stays on until either the signal returns to within range, or the alarm set point is disabled.

When programming alarm set point levels, you are not permitted to enter an invalid value.

Select Recording Period

By programming the recording rate, you are telling the recorder how often you want it to perform calculations and store that data into memory. For example, if you select a two minute recording period, the recorder will sample data once each second. At the end of a two minute period, the recorder will calculate the values to be stored in memory. After storing the selected values, the recorder then begins sampling for the next two minute period.

The computer displays the amount of recording time the recorder can log data before the oldest data begins to be overwritten.

Selecting Storage Capacity

Programming the storage capacity is possible only on recorder types that have 8K of memory. Current models with 8K include the 2101, 2102, 2103, 2107, 2108, 2109, 2123, and 2126. You may not need to use all of the available memory. The available capacities are 2K (corresponding to 1600 values), 4K (corresponding to 3200 values), and 8K (corresponding to 6515 values). As you make changes in the storage capacity, the recording time capacity changes accordingly.

The 2107 Prescaler

In programming the 2107, when it is operating in a pulse recording mode, you are permitted to enter a prescaler. The function of the prescaler is as follows: The 2107 totalizes the number of pulses occurring during a totalizing period. At the end of the totalizing period, the total number of pulses is divided by the prescaler to arrive at the value to be stored by the recorder. Normally, the prescaler defaults to 1. However, when you have pulse rates that are very high, or totalizing periods that are very long, it may be possible for an un-prescaled total to overflow the one or two byte counters used to store total counts. Judicious selection of a prescaler can greatly improve the 2107's flexibility.

For example, suppose that you have a flow meter that is providing an average pulse rate of 1500 pulses per minute. In addition, suppose that you want to record hourly totals for this flow. For this average pulse rate, you will not be able to use 2 byte counters without using a prescaler [since $1500 x$ $60 = 90{,}000$; the limit of a 2 byte counter is 65,535]. However, by using a prescaler of 2, your average rate will be divided by two before the recorder stores it. When processing the data, the support software automatically corrects for the prescaler factor, multiplying the raw data from the recorder by the prescaler to reproduce the actual counts measured by the recorder. The only limitation of using prescalers is that some of the resolution of the signal is irretrievably lost when the recorder performs the prescaling.

Re-programming the Recorder's Status

By pressing **F1**, the computer will send the new status to the recorder. If you have made any changes in the recorder's status which necessitate the clearing of the recorder's memory, you will be asked to verify your choice before the recorder's memory is cleared. After the recorder has been reprogrammed, the recorder's new status is displayed, along with the program recorder menu.

By pressing F2, all recorded data is cleared.

F1: Change Recorder Status
F2: Clear recorded data
F3: Save current recorder config
F4: Restore saved recorder config
F10: Return to MAIN MENU

You will be asked to verify your selection by pressing "Y" or "N" before the recorder's data is erased. If you respond with a "Y", then the attached recorder's data will be erased.

When its memory is full the 2100 Series Recorders automatically overwrite oldest data with the most recent data. Thus the clear data option need only be used when starting a new test. After clearing memory, the recorder status is updated and the Program Recorder Menu is re-displayed.

Selecting the 2107 Operating Mode

When programming a 2107, you can select its operating mode. The following menu will be displayed:

F1: Record positive-going events
F2: Record negative-going events
F3: Record pos & neg events
F4: Use 1 byte pulse counters
F5: Use 2 byte pulse counters
F10: Return to MAIN MENU

As the menu selections suggest, by selecting **F1**, **F2**, or **F3**, you can enable the event recording mode of the 2107. You will be prompted to make sure that you wish to proceed, since data must be cleared to change 2107 operating modes.

Pressing **F4** or **F5** enables the pulse recording mode of the 2107, using either 1 or 2 byte counters. One byte counters are able to record pulse totals of less than 255 counts per totalizing period. Two byte counters can record pulse totals of less than 65,535 counts per totalizing period. Again, when selecting modes of operation, you are prompted to verify your selection.

Saving Recorder Configurations

The next selection available allows you to save the current recorder configuration.

F1: Change Recorder Status
F2: Clear recorded data
F3: Save current recorder config
F4: Restore saved recorder config
F10: Return to MAIN MENU

Saving the recorder configuration is convenient if you are programming a large number of recorders in a similar way. Just program the first recorder the way you want, save its configuration, then use the **F4** option to restore the saved configuration to the next recorder.

After selecting **F3**, you are prompted to enter a filename where the configuration data will be stored. Just enter any valid MS-DOS filename. A file extension of .Cxx is automatically added to your entry, where the 'xx' corresponds to the recorder type. For example, saving the status of a 2101 yields a file name with the extension .C01. The file will be saved to the disk drive designated by the configure disk drive option of the **UTILITY MENU**. You may override this drive designation by your own drive designator. For example, entering **B:DEMO** will store the configuration file onto disk drive B:, regardless of the default selected in the **Utilities** option of the MAIN MENU.

The programmed parameters that are saved on disk are: recorder ID, clock synchronization, signal processing status, values being saved, alarm status, the averaging period, and scale factors.

For the 2107, saving its configuration saves the recorder ID, clock synchronization (for pulse recording mode), totalizing period (for pulse recording mode), scale factors (for pulse recording mode), the operating mode (event recording versus pulse recording mode), and prescaler (pulse recording mode).

Restoring Configurations

When selecting to restore a saved configuration (**F4**), you are prompted to enter the filename of the configuration that you wish to restore.

F1: Change Recorder Status
F2: Clear recorded data
F3: Save current recorder config
F4: Restore saved recorder config
F10: Return to MAIN MENU

You may choose to restore a configuration to any recorder of the original type. For example, if you had saved the configuration of a 2101-62 Analog Voltage Recorder (input range of 0-2 volts), then you may use that particular configuration file to restore the stored configuration to any 2101-62 type recorder. However, you may not use that configuration file to restore the configuration of, for example, a 2103 Ambient Temperature Recorder, or a 2101-61 Analog Voltage Recorder (input range of 0-1 volt).

Restoring a saved configuration automatically restores the values saved, the alarm status, the averaging period, and scaling factors. In addition, the date and time are automatically updated to the current time as indicated by the internal real-time clock of the computer. Clock synchronization is performed if required. When restoring a saved configuration, any current recorder data will be cleared, as well as, the recorder's accumulator(s).

Prior to restoring the recorder status, you are asked for a recorder ID to be programmed with the restored configuration. Simply enter the new ID, and press RETURN. The recorder status will then be restored to match the stored recorder configuration.

This concludes the discussion of the programmable features of the 2100 series recorders. Pressing **F10** returns to the **MAIN MENU.**

Chapter 6: Alarm Logging

A new feature available on some recorders (see the list below), permits you to use the recorders in an 'alarm logging' mode. When a recorder is 'alarm logging', data is recorded only when the input signal exceeds programmed threshold levels. When data is within normal boundaries, the recorder does not record. This feature is useful for monitoring exceedance conditions.

Alarm logging is currently available on the following single channel recorder types:

1. Analog voltage recorders; all ranges of the 2101

2. Current loop recorders; all ranges of the 2102

The system support software is able to detect if the EPROM of the recorder can support the alarm logging feature. If the recorder can log on alarm, a number of the displayed screens change, indicating those new parameters that must be programmed to take advantage of the alarm logging capability.

In the following discussion, we'll assume that you are familiar with how 2100 series recorders normally collect data. If you need to reacquaint yourself with those details, refer to page 1.

First, we need to define a few terms that will used in the following discussion.

1. When we say that an input signal exceeds a programmed **threshold** we are saying that signal that the recorder is measuring has either gone above the programmed upper alarm threshold, or below the programmed low alarm threshold.

2. When we talk about an **alarm event**, we are talking about the data recorded during the time that the input signal exceeds a programmed threshold. Alarm logging recorders can record up to 50 events. At the beginning of each event, the recorder stores a time stamp, and proceeds to record the requested statistics at the selected recording rate. At the end of the event, the recorder stores the stop time of the event, and also the amount of data stored.

3. Presumably, as a signal crosses a threshold level, it is possible for the signal to be slightly noisy. If we were to record as an event each toggle of the signal as it traverses the threshold level, we would needlessly record a large number of extraneous events. Ideally, we would like our measurement circuit to display some **hysteresis** to prevent this from happening. The term hysteresis means a delay in effectiveness in response to an input signal. In our context, we mean that as the input signal returns to normal, the recorder does not respond immediately to the signal's return to normal, but instead delays a programmed number of intervals before terminating the event.] Alarm logging recorders permit you to select the hysteresis effect by programming a hysteresis count. The hysteresis count is the number of recording intervals that the recorder will continue to record after the input signal has returned to within acceptable limits.

How alarm logging works

Every second, the recorder samples its input signal. The recorder compares the input signal to the alarm set points that you have programmed. If the signal is equal to or exceeds the programmed set point, then the recorder turns on its hardware alarm switch (assuming that it is enabled). If alarm logging is enabled for the set point, then the recorder will start to record data. When starting an 'event', the recorder first records the current time (sometimes called a time stamp). As soon as an event has started, the recorder will record at least one interval length of data. At the end of the recording interval, the recorder stores the statistics that you have selected. The recorder also decides whether to continue recording or to terminate the event. While the input signal exceeds the alarm set point, the recorder continues to record data.

An event is terminated by the recorder when the input signal has returned to within acceptable levels for a length of time that is equal to the [hysteresis count *x* interval length]. It should be noted that the recorder decides whether or not to decrement the hysteresis count only at the end of a recording interval. Thus, if the input signal is very close to the threshold, the hysteresis count may or may not be reset at the end of a recording interval. For this reason, you should be sure to select your hysteresis count and alarm set points judiciously.

When alarm logging is first enabled, previously stored data is cleared from the recorder. The recorder reserves table space for storing statistics for 48 events. Buffer space is also reserved for capturing two additional events that may occur during communications. As a result, the total recording capacity of an alarm logging recorder is less than a recorder that is not alarm logging. You'll only notice the difference when the recorder's memory capacity is set to the maximum.

Recording many events

An alarm logging recorder can record up to 48 events. What happens if you have 49, 50, or 51 events?

It is certainly possible for you to have a large number of very short events. In this instance, the recorder has plenty of memory to record event data, but the event table (memory set aside to store the start and stop times of the events) fills up rapidly. What happens when the event table is full, and the next event occurs? The recorder senses this (keeping track of the number of events, etc.) and releases the memory held by the oldest event in the event table. The oldest event is thus completely and irretrievably lost. Both the data associated with the event, and the event table entry are cleared. You can think of the event table as a FIFO (first in first out) buffer, where the oldest event is removed from memory as necessary to make room for the most recent event.

Recording long events

What happens if one of your events is very long and as a result, the recorder doesn't have enough memory to store older events?

In this situation, where you have an event that is very long, it is certainly possible for the recorder's memory to become full. How does the recorder store the most recent event data? Again, the recorder monitors the situation, and in order to make room for new data, begins to erase data from the oldest event data. Unlike the first situation, where an event is wiped out in a single stroke, when recorder memory is full, the oldest event data is only overwritten as needed to make room for the newest data. Thus, as the newest event slowly overwrites the oldest event, it is possible to analyze the data of the oldest event. However, the amount of data associated with the oldest event will not be equal to the event stop time minus the event start time. If it is necessary to completely overwrite all of the data of the oldest event, the recorder will do so. At that time, the oldest event is automatically removed from the event table.

Thus, an alarm recorder will provide you with the most recent 48 events, provided that the memory requirements for recording those events is within the capacity of the recorder. If the memory capacity is inadequate, then the recorder will provide the most recent events, the number being determined by the length of the events being recorded.

Differences in Alarm Logging Support Software

The latest release of the 2100 Series Support Software automatically provides support for alarm logging recorders. The main features of the software are described in Chapters 4 and 5. The main differences in the software support for alarm logging recorders relates to the areas of data analysis and recorder programming.

Analyzing Alarm Data

When analyzing recorder data, you will be presented with additional menu selections that permit you to select the events that you want to examine. When you encounter these screens, just use the arrow keys to select the event of interest before continuing. When displaying the high resolution graph of a selected event, you can examine the previous event or the next event by using the left and right arrow key, respectively. You should note that you cannot select the start and stop times for output reports when alarm logging; you can only select events.

Programming an Alarm Logging Recorder

Please refer to Chapter 5 for details of programming fields that are not related to alarm logging. When programming an alarm logging recorder, the function of a number of fields changes. There is also the addition of the 'hysteresis intervals' field.

The fields whose function is changed (although not obviously) is the enabling or disabling of the lower and upper alarms. Instead of being able to turn an alarm ON or OFF, you are provided with the additional option of LOG. If you select the LOG option, then when the input signal exceeds the programmed threshold level, the recorder will begin recording the event. You should note that you CANNOT enable LOG for one of the trigger levels, and simply turn the other trigger level ON. If the recorder is in the alarm logging mode (indicated by LOG being displayed in either the lower or upper alarm enable field), there are only two possibilities: OFF or LOG. Note that the recorder status displayed does NOT necessarily reflect this until after you have programmed the recorder. It is possible to display a configuration where, for example, the lower alarm is set to LOG and the upper alarm is set to ON. You may think that the recorder will not LOG on an upper alarm threshold. However, after programming the recorder, both fields will display LOG and the recorder will begin recording data upon lower or upper alarm events. [Unfortunately, the software is not able to read your mind, and thus cannot determine if you really want to LOG on alarm until you press the F1 key.]

As soon as alarm logging is selected, an additional field is displayed; the hysteresis interval count. The value in this field tells the recorder how many intervals to record after the signal has returned to normal.

For example, suppose you have the recorder programmed to save averages every minute. Suppose you have programmed the hysteresis count to be 5. Now suppose that the input signal has exceeded threshold. Let's say the event stayed above threshold for 6 minutes and 17 seconds, afterwhich it returned to normal levels. What data will be recorded?

First, at the beginning of the event, the recorder will store the start time of the event and begin storing data every minute for the next 6 minutes. At the end of the sixth minute, the input signal is still above threshold, so data is stored, and the hysteresis count is reset to 5. At the end of the seventh minute, the input signal is now within the normal range. The data is recorded. However, since the signal is now in the normal range, the hysteresis count is decremented. The recorder records the eighth minute of data; and the ninth; and the tenth; and the eleventh. At the end of the eleventh interval, the hysteresis count is finally zero, and the event is terminated. A total of eleven minutes of data would be recorded by the recorder.

The purpose of the hysteresis interval count is to prevent premature termination of an event. You can program the hysteresis count to be any number between 1 and 255.

Chapter 7: Process another Recorder or DTU

To analyze the next recorder or data transfer unit, you must select the **F3** option of the MAIN MENU.

F1: Analyze Recorder Data
F2: Program Recorder
F3: Process Next Recorder or DTU
F4: Change the Baud Rate
F5: Emulate Dumb Terminal
F6: Utilities

F10: Exit to Operating System

Pressing **F3** informs the computer that you wish to process another recorder or DTU. After **F3** is pressed, the computer sends the proper commands to terminate its communication link with the current recorder if a recorder is attached.

If you are processing a DTU, then you will be returned to the recorder selection screen, which permits you to select the next recorder to be analyzed.

If you are processing only recorders, then to process the next recorder you should do the following:

1. Press the F3 key to indicate that a new recorder or DTU is to be analyzed.
2. Disconnect old recorder from serial cable.
3. Select type of device to be interrogated.
4. Connect new recorder to serial cable.
5. Press RETURN to start communications with device.

After pressing F3, you will be prompted to select between processing a DTU or a recorder. Make the proper selection, and press **ENTER** after the connection is made. At this point, the process of analyzing the new recorder is identical to that followed for the original recorder.

For details of processing data from a Data Transfer Unit, see the next chapter.

Chapter 8: Processing the Data Transfer Unit

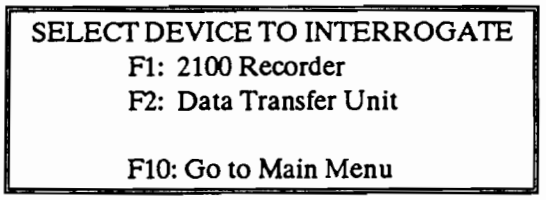
The Data Transfer Unit (DTU) is designed to transfer data from a 2100 Series Recorder located at a remote site to your office computer. The DTU has three modes of operation; mode 1 is used to collect data from the 2100 Series Recorders; mode 2 is used to transfer the collected data from the DTU to your computer; and mode 3 is used to display the current memory capacity of the DTU.

Modes 1 or 3 are activated by pressing and releasing the DTU push-button. This turns the DTU on. The DTU's LED lights green for several seconds. During this time, the DTU is attempting to communicate with an attached 2100 Series Recorder. If a recorder is detected, then the DTU sends the proper commands to the recorder to collect its data. The collection of data is signified by a rapid green flashing of the LED. If the transfer is successful, the LED flashes green for 3 seconds, then turns off. If no recorder is detected after approximately 10 seconds, then the DTU enters mode 3, and displays its current memory status. The older model 201 flashes red for each stored recorder data set, and green for each free memory bank available for additional recorder data. The current model 202 (which has 128K of RAM), flashes red a certain percentage of time followed by green for a certain percentage of time. The ratio of red to green indicates how much storage space is occupied with recorder data.

With the model 201, Modes 1 and 3 can be distinguished by the length of the LED flashes. During data transfer from a 2100 Series Recorder, the LED flashes relatively quickly. The entire data transfer (from pressing the button to the 3 second green LED that indicates a successful transfer) should take no longer than 10 seconds (except when interrogating recorders that have larger memory capacities). In mode 3, the LED flashes more slowly, at about once per second.

After collecting field data the DTU can be interrogated using the Support Software.

To process a data transfer unit, select F2 from the device selection menu.



The following screen will be displayed:

```
Connect Data Transfer Unit to Computer Serial Port
Use short DTU cable connected to 2100 Series Recorder Cable

Press Return to Continue


F10:  Go to Main Menu if no DTU attached
```

The DTU is designed to interface 2100 Series Recorders with its long cable, and a computer (via a Telog-supplied 2100 Series Recorder cable) with its short cable. After making the proper cable connection, press **ENTER**. [You should not press the DTU button, as this will cause the DTU to enter Mode 1 or Mode 3; it will not communicate properly with the computer.] The following screen will be displayed:

```
Reading Status, Please Wait

F10: To Abort and go to Main Menu
```

The screen will disappear as soon as the DTU status has been read. If the "ABORT" message does not disappear within a few seconds, check your connections. As soon as the DTU is turned on by the computer, its LED will light green. The following screen will be displayed:

```
The attached DTU contains : xx recorder data sets

MAKE YOUR SELECTION

F1:  Automatically process DTU data
F2:  Selectively process DTU data
F3:  Clear attached DTU's memory
F4:  Process another DTU or recorder


F10: Go to Main Menu
```

This is the main menu for DTU processing. The 'xx' indicates how many recorder data sets are contained within the attached DTU. The program prompts you at appropriate points. The normal mode of operation is to either select F1 or F2 for automatic or selective DTU processing.

For **Automatic Processing**, you are asked if you want filename prompting. If you want the computer to automatically generate data files, then you can answer no; if, however, you want the data files that will be generated to have meaningful filenames, you should answer yes. You will then be prompted for a filename after the intermediate processing of each recorder's data set. [The computer uses the recorder ID coupled with the currently programmed date as a filename. The filenames thus generated are not very descriptive.]

Using automatic processing, the computer will generate separate data files for each stored recorder's data set. These data files can then be analyzed at a later time in a manner identical to data files stored from individual recorders.

With **Selective Processing**, you will be presented with the following display which allows you to choose one data set at a time for immediate analysis.

Use up, down, pageup, pagedown keys followed by CR to select recorder. F10: Exit

Rec Type & ID	Start Time	Stop Time	Statistics	Avg Per
01 2101-71 1234	07/18/89 14:50:53	07/20/89 15:10:11	Min Avg Max	00:01:00
02 2107-8K 5678	07/18/89 15:10:02	07/20/89 15:14:49	Avg	00:00:30
03 2123 TwoChnl	07/18/89 15:30:11	07/20/89 16:03:51	1:[A] 2:[A]	00:00:10

The display provides basic status information about each recorder that has been processed by the DTU, such as, the recorder type, ID number, the start and stop times of the data, the type of data collected, and the averaging period. The type of data information has a different format for single and dual-channel recorders. For single-channel units the statistics collected are listed (Min, Avg, and Max). With dual-channel recorders, the type of statistics are listed for both channels using a code where "[" represents minimums, "A" averages, and "]" maximums. In the above example, entry 03 for the 2123 has recorded minimums, averages, and maximums for both channels.

Using the up and down arrow and page keys, the data set you wish to examine can be selected. The greater than and less than symbols located on the left and right borders of the display indicate your current choice. Pressing the **ENTER** key loads the selected data for analysis.

The functions available for selective analysis are identical to those available when analyzing data stored on disk. When you are ready to examine another data set, select **F3** (Process another recorder or DTU) from the main menu to return to the above display.

From the above display, **F10** causes you to exit from processing the current DTU's data and returns you to the DTU main menu also shown above. By selecting the **F3** option from this menu, you can clear the DTU memory making it ready for use in the next data transfer application. The data contained in the DTU can only be cleared by selecting the **F3** option. You are asked to confirm your selection before the DTU memory is cleared.

To process another DTU or recorder, select the **F4** option.

Differences between the 201 and 202 DTUs.

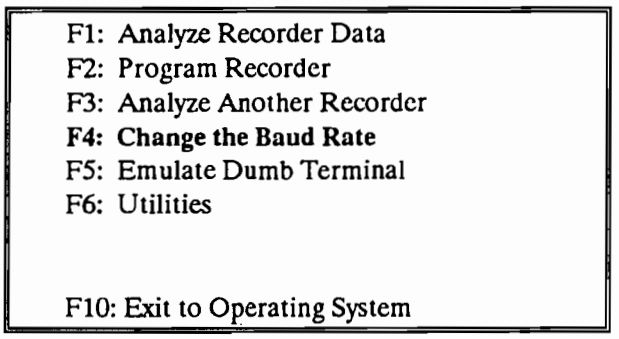
The main difference between the 201 and 202 data transfer units are the memory capacity. The 201 (which is no longer manufactured) has 32K of RAM; the 202 has 128K. As a result, displaying the number of data sets contained in the 202 would be very tedious if the same method of flashing a red LED for each stored data set and green for each free data set were used. Instead, the 202 uses a "percentage" full method, whereby the LED is turned on for a total of 10 seconds (to wake up a recorder), then an additional 5 seconds. During the additional 5 seconds, the percentage of RED on time relative to GREEN on time corresponds to how full the 202's memory is.

The total capacity of the 202 is 60 recorder data sets, for the 201, the capacity is 15 data sets. Depending on the type of 2100 recorder being interrogated, you may or may not be able to reach these limits. For example, the 2108 has a memory capacity of 8K. Since the 201 has only 32K, the 201 can hold 3 full 2108s. There is some overhead which prevents the 201 from being able to store four complete 8K data sets. Similarly, the 202 can hold 15 full 2108s.

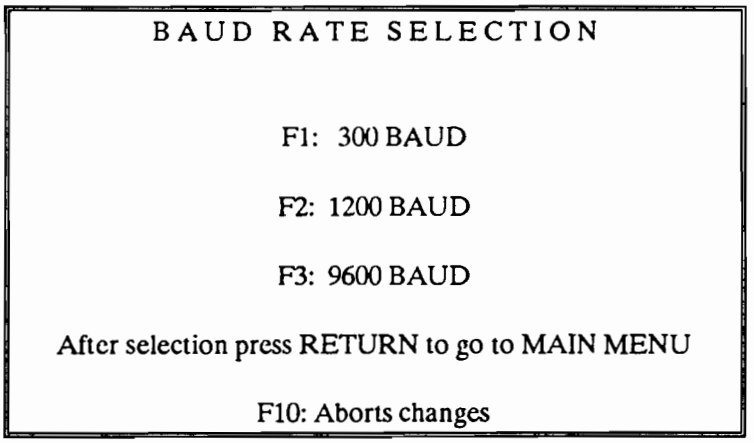
Another major difference between the 201 and 202 is that only the newer 202 supports data collection from Telog's dual-channel 2123 and 2126 and the four channel 2400 Series product family.

Chapter 9: Change the Baud Rate

Pressing **F4** from the **MAIN MENU** provides a screen where you can re-program the baud rate used by your computer for serial communications.



By pressing the appropriate function key, you can re-program the baud rate at which the computer communicates with the recorder. If a recorder is attached, the recorder is sent a "turn off" command prior to changing baud rates. This is done so that the recorder will be able to re-program its own baud rate when the computer sends the "wake-up" character sequence.

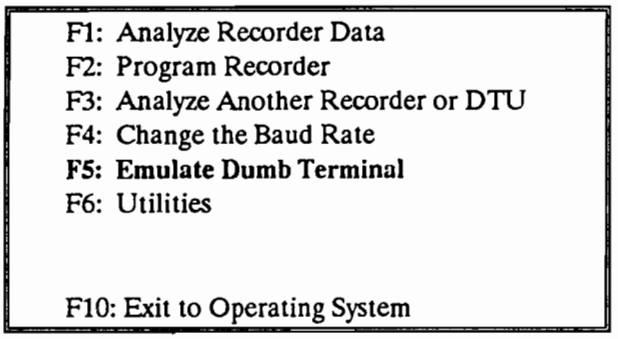


After pressing return, the program stores the new information into the CONFIG.TLG file and returns to the Main Menu. You must press ENTER to make the change in baud rate.

Communications with Data Transfer Units always take place at 9600 baud and is not selectable by the user.

Chapter 10: Emulate Dumb Terminal

Pressing **F5** from the **Main Menu** enters dumb terminal mode, where your computer acts like a computer terminal.

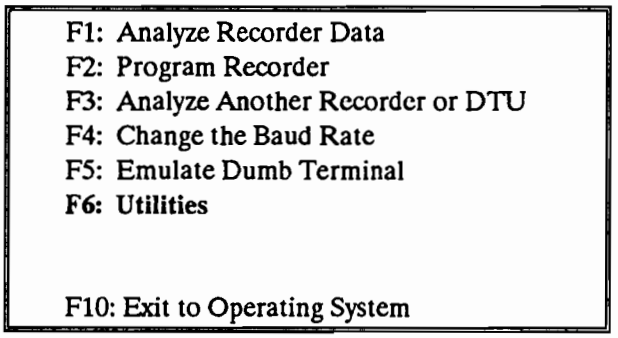


After pressing **F5**, the screen is cleared, and the message "F10: Return to Main Menu" is displayed at the bottom of the screen. While in dumb terminal mode, the computer sends characters input from its keyboard out the COM: port at the currently programmed baud rate. [For those of you interested in the technical details, the character format is 1 start bit, 8 data bits, and 1 stop bit; no parity.] Received characters are displayed on the screen as they are received.

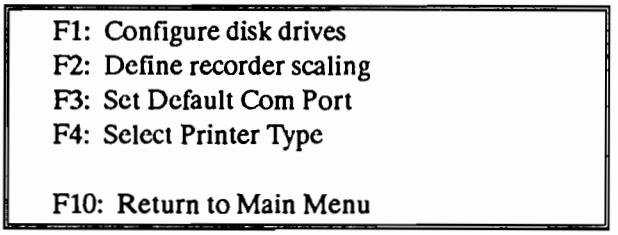
The dumb terminal mode has a number of uses but is used mostly for debugging communication problems that may occur during system setup. See Chapter 13, the trouble-shooting guide, for a discussion of other uses of the dumb terminal feature as an aid in analyzing apparent system malfunctions.

Chapter 11: Utilities

Pressing **F6** of the **Main Menu** permits you to configure your system and to scale your recorder to your own engineering units.



After pressing F6, the following menu is displayed:



Configure Disk Drives

The configure disk drives option (**F1**) permits you to define the disk drive designator for the storage and retrieval of *.Dxx, *.Cxx and xxREF.SCL files. These files are used to store data, configuration and scaling files. You are prompted to enter a disk drive designator for *.Dxx, *.Cxx, and xxREF.SCL files. The current default disk drives are displayed. After entering these three parameters, the program returns to the Utilities Menu.

Scaling Recorders

Pressing **F2** from the **Utilities** menu allows you to scale the connected recorder to your preferred units of measure. For recorders that have accumulators, you are also offered an option to scale those as well. In the next section, we'll present examples for scaling recorder data and for scaling accumulators.

The scale factors required to convert the recorder units into your engineering units are stored on disk. Each set of scale factors are keyed to the recorder's programmed ID. Thus, when the computer first communicates with a given recorder, the computer scans its scaling files (xxREF.SCL files) for a stored set of scale factors that correspond to the current recorder's ID code. If a set of scale factors are found, then all of the recorder's readings are automatically scaled to the indicated units. If no scale factors are found, then the recorder's data are displayed in 'machine' units (e.g. volts, milliamps, Deg F, etc.). Scaling for accumulators are handled in a similar fashion.

Scaling Recorder Data

When you select the Scale recorder data option, the following menu is displayed:

```
Units and scaling to be entered for
recorder ID: XXXX. Enter up to eight
characters for YOUR units: _____
```

After entering your new units, and pressing ENTER, the screen displays:

```
Units and scaling to be entered for
recorder ID: XXXX. Enter up to eight
characters for YOUR units: XXXXXXXX
A slope and offset will be computed
from 2 points entered by you.
Enter pt.#1 _____ Volts
```

You are prompted to enter the two pairs of points that will determine the MX + B equation that is used to calculate the scaling of your units. The first point corresponds to one of the machine units' points. After entering the first point, you are prompted to enter the user units that correspond to the entered machine units.

```
Units and scaling to be entered for
recorder ID: XXXX. Enter up to eight
characters for YOUR units: XXXXXXXX
A slope and offset will be computed
from 2 points entered by you.
Enter pt.#1 xxxxx Volts
          _____ User Units
```

After entering the first pair of points, you are then prompted in a similar manner to enter the second pair of points.

For example, if you were interested in converting the 2103 Ambient Temperature Recorder, which normally displays its readings in Fahrenheit, into a recorder that displays its readings in Celcius, then you could enter the following:

```
Units and scaling to be entered for
recorder ID: XXXX. Enter up to eight
characters for YOUR units: Deg C
A slope and offset will be computed
from 2 points entered by you.
Enter pt.#1 32    Deg F
= 0    Deg C
Enter pt.#2 212   Deg F
= 100   Deg C
```

After entering these points, your 2103 would display all its readings in Deg C. The status section of the screen is updated to show your new range, and alarm levels.

The programmed scale factors are saved on disk (keyed to the recorder type and ID), so that the next time you request data from this particular recorder, the data will automatically be scaled to the units that you have programmed.

To reset a recorder's scaling to its original factory setting, simply enter a set of points that produce a slope (M) of 1 and an offset of 0 (B). For example, to reset the 2103 to measure Fahrenheit, simply enter 0 deg F = 0 deg F; and for the second set of points enter 10 deg F= 10 deg F.

Scaling Accumulators

Scaling the recorder's accumulator (accumulators are available on newer models of the 2101, 2102, and the 2107), is similar to the scaling of recorder data detailed above. You are asked to enter two sets of points, from which a slope and offset are computed. However, the value of the two sets of points that you enter depend on the totalized units of measure. These 'accumulator' units may or may not be closely related to the scaling of your engineering units; it depends on your application.

For example, if you are measuring a flow, your engineering units may be scaled into a rate of gallons/day or gallons/hour or gallons/minute. Presumably, you will want to scale your accumulator to provide you with the total number of gallons at any given time. To do so, you need to provide the software with the value of your engineering units that corresponds to 1 second's worth of flow.

Let's go through a specific example to see how this works. Assume that you are measuring a flow using Telog's 2102-42 (0-20 mAmp range) Current Loop Recorder. Let's also assume that a full scale reading corresponds to a flow rate of 5 million gallons per day. What we mean here is that if the 2102 were to record a full scale of 20 mAmps for an entire day, then a total of 5 million gallons would have flowed past the flow meter. We also need to know the zero point. In this case, let's assume that zero flow corresponds to 4 mAmps. To scale accumulators correctly, we need to enter two sets of points. We now have enough information; we just need to manipulate it a little bit. The zero point is easy; all you need to do for the first point is to enter 4 mAmps = 0 gallons.

Determining the second point is a little trickier. We need to compute the number of gallons that flow per second for a known milliamp reading at the recorder. We know that 20 milliamps for an entire day represents a total flow of 5 million gallons. Since there are 86,400 seconds in a day, this then corresponds to a total flow per second of 5,000,000/86,400 = 57.8704 gallons per second. This would be the second set of points that we enter: 20 mAmps = 57.8704 gallons.

The reason that you must reduce your flow rate to a 1 second value is to match the sampling rate of the recorder. Consider our example. If the flow recorder sees a 20 milliamp signal during a single 1 second sample, we know that a total of 57.8704 gallons flowed past the flow meter at that second.

From these two points, the accumulator can be properly scaled to provide you at any given time the total number of gallons that have flowed. Entering the two sets of points for scaling accumulators is analogous to the entry of points to determine recorder scaling described above.

Setting Default Communication Port

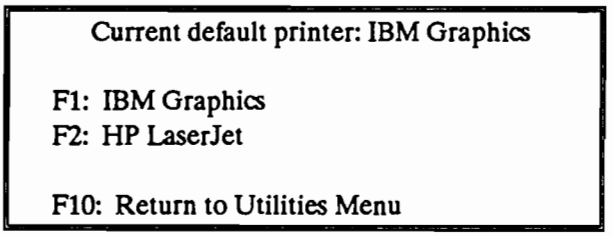
For users with two communications ports, it may be desirable to select which of the two ports will be used by the 2100 Series Software to communicate with the 2100 Series Recorders and the DTUs. Selecting this option of the utilities menu allows you to select between COM1: and COM2: for communicating with the recorders and DTU. The current default selection is displayed.

If you don't have two communication ports, then DO NOT change this configuration; the software will attempt to communicate with non-existent hardware. Also, if your computer has only a single communications port, it must be configured as COM1: (not COM2:) for the software to operate properly. As shipped from the factory, the support software assumes that COM1: will be used.

Pressing **F10** from the Utilities Menu returns you to the **Main Menu.**

Select Printer Type

If you choose **F4** for Select Printer Type, you will be presented with a list of printers that are currently supported by the software, as well as, your current configuration as shown below:



By selecting the function key that corresponds to your printer, the software will be configured to generate output that is compatible with that printer. Currently the IBM Graphics, HP LaserJet, and compatible printers are supported.

Pressing **F10** returns you to the **Utilities Menu.**

Chapter 12: Recorder Information

In this chapter, we'll discuss general recorder information, such as external power connections, changing batteries, and alarm connections. In addition, we'll provide information that is specific to each model type, such as sensor types, input connections, and operating ranges.

External Power

The 2100 series recorders can be powered from an external DC voltage source by using the terminals marked power on the recorder label. The source voltage can range from 10-28 VDC. If you supply external power, then the internal batteries supply backup power.

> WARNING: Do not connect AC power to any 2100 recorders! Doing so will damage the recorder and void any warranty!

Changing Recorder Batteries

To change batteries, you must first use a Phillips screwdriver to remove the four screw that secure the top cover to the base of the recorder. Once removed, the batteries are most easily changed by using a small flat-blade screwdriver to pry the batteries out of their holders. To insert the new battery, use the screwdriver to pry open the battery terminal as the battery is inserted. Be sure to observe the correct polarity.

To retain programming during a battery change, you should change batteries within approximately 20 seconds. The order in which the batteries are removed and replaced is not important. If the battery change is performed within 20 seconds, the original data and programming will be retained. The internal clock will, however, have lost 20 seconds.

After the batteries have been changed, replace the top cover and secure the screws.

Changing DTU Batteries

The batteries that run the DTU should be able to provide sufficient power for roughly 3000 to 5000 data transfers, depending on how much data is in a recorder and how long the DTU is left on during the transfer of the data to the computer. The shelf life of the DTU's batteries is over 5 years. In the absence of data transfers or interrogations, data stored in the DTU should be maintained in memory for that period of time.

Before you change the batteries, be sure that you have saved any data of importance that the DTU contains. **Changing DTU batteries will result in a complete loss of any data stored in the DTU.** To change the batteries, unscrew the end cap and carefully slide the printed circuit board toward the cable-end of the DTU. Using a small flat-blade screw driver, pry the old batteries out of the DTU's battery holders. Again, using the small screwdriver to pry open the battery holder as necessary, insert the new batteries. The DTU will normally go through its mode 3 operation when new batteries are inserted. If not, you should be able to press the DTU button to verify the DTU's status. After the batteries have been changed, just slide the circuit board back into the enclosure and secure the end cap.

Note: In older DTUs, over tightening the end cap can flex the circuit board and pull the battery holder away from the battery causing loss of power.

Recorder Alarm Connection

The 2100 series recorders (except for the 2107 and 2126) are equipped with a programmable alarm switch that is activated when the input signal diverges from the programmed levels. When the input signal is within the programmed levels the switch remains open. However, if the signal should deviate from those levels, the switch will close and remain closed until the input signal returns to within the programmed range or the alarm is disabled.

The connections for the alarm are shown on the recorder label. When the alarm is activated, the switch provides a path to recorder ground not exceeding 10 ohms. A maximum current of 100 mA at 30 VDC can be applied across the alarm terminal with the alarm load in series. The switch is rated at 1 Megohm when open (i.e. alarm not active).

For information on alarm programming procedures see page 29 of the manual.

Recorder Specific Information

The following is a discussion of the operation and special considerations for each of the 2100 series recorders. For a complete list of recorder types and models refer to Appendix A.

2101 Analog Voltage Recorder

Telog's standard 2101 Analog Voltage Recorders measure from zero to the maximum voltage specified. However, bipolar devices are also available and are noted with a "B" next to the model designator. A list of current 2101 Recorders and their input ranges follows:

2101-41	0 to 10 mV
-42	0 to 20 mV
-45	0 to 50 mV
-45B	-50 to 50 mV
-51	0 to 100 mV
-52	0 to 200 mV
-55	0 to 500 mV

-55B -500 to 500 mV
-61 0 to 1 V
-62 0 to 2 V
-62.5B -2.5 to 2.5 V
-65 0 to 5 V
-65B -5 to 5 V
-71 0 to 10 V
-72 0 to 20 V

The input connections are made at the positive (+) and negative (-) voltage terminals shown on the recorder label. The voltage is measured with respect to the negative terminal. If the voltage exceeds the specified range, the recorder will store the maximum value within its range for that entry. 2101s are rated at +/- 50 volts peak maximum input voltage with an input impedence of 2 megohms.

All voltage recorders have a resolution of 0.1% of full scale, and a rated accuracy of +/- 0.2% of full scale.

2102 Current Loop Recorder

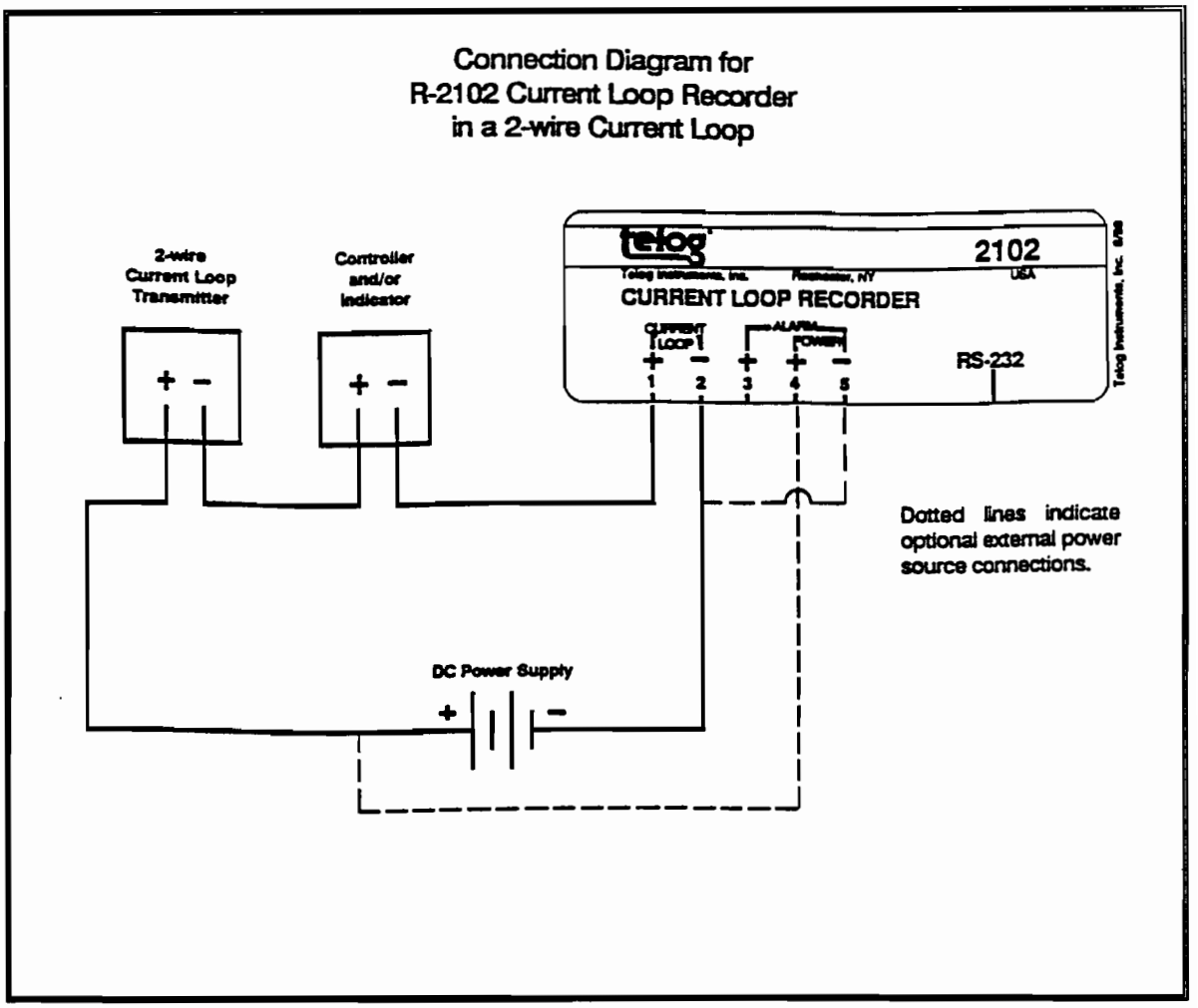
Both unipolar and bipolar Current Loop Recorder are available. A list of current devices and input ranges follows:

2102-31 0 to 1 mA
-31B -1 to 1 mA
-35 0 to 5 mA
-42 0 to 20 mA
-45 0 to 50 mA

Battery operation of the 2102 Current Loop Recorder means that, generally, it can be placed anywhere in a current loop without adverse effects. However, in some applications, caution is required in recorder installation to avoid erratic operation. These are as follows:

1. Internal Power Operations: A ground loop can exist between the recorder and a grounded power supply when the recorder's zinc-aluminum enclosure touches ground. This is because the 2102 Recorder circuit is grounded to its enclosure. Formation of a ground loop can be avoided by isolating recorder enclosure from ground by placing it on a block of wood or other nonconductive material.

2. External Power Operations: When powered from the loop power supply, the recorder input should not rise more than 3 volts above the power supply ground. This can be avoided by placing the recorder at the most negative point in the current loop (i.e. toward the negative (-) side of the power supply with no load between the power supply and recorder as shown on the next page.



Current loop recorders have a resolution of 0.1% of full scale, and a rated accuracy of +/- 0.2% of full scale with a maximum voltage drop of 1 volt.

2103 Ambient Temperature Recorder

The 2103 is currently available in two models; a narrow temperature range unit that can be used with either an internal or external temperature probe, and a wide temperature range that can only be used with an external probe.

Narrow range:	-40 to 164.6	deg F
Wide range:	-40 to 215.75	deg F

The 2103 Ambient Temperature Recorder is available with either an external or an internal temperature sensor. External sensors should be connected to the positive (+) and negative (-) terminals marked on the recorder label (red lead to positive and black to negative). External sensors are serialized and calibrated at the factory. They are not interchangeable.

All 2103s have a resolution of 0.1% of full scale. The accuracy is .33 deg C between the temperatures of 0 to 50 deg C and .7 deg C between -40 and 60 deg C.

2104 RTD Recorder

RTD Recorders can measure over a broader temperature range than the Ambient Temperature Recorders described above. There are two 2104 models available. The 2104-01 has a range of -200 to 400 degrees C and the 2104-02 has a range of -200 to 800 degrees C.

Either two, three, or four-wire RTD can be connected to the recorder. For three and four-wire RTDs, automatic lead-wire compensation is performed. Note: with four-wire RTDs, the fourth wire should be left unconnected.

Both 2104 models have a resolution of 0.1% of full scale, and an accuracy of +/- 0.2% of full scale

2105 Thermocouple Recorder

Telog has Thermocouple Recorders which support J, K, T, and E type thermocouples for recording over a large range of temperatures. Below is a list of the types of thermocouples supported and temperature ranges for all current models.

2105-01 - Type J; Range: -200 to +1400 deg F
-02 - Type K; Range: -200 to +2500 deg F
-03 - Type J; Range: -20 to +180 deg C
-04 - Type T; Range: -160 to +750 deg F
-05 - Type E: Range: -23 to +1000 deg C

All 2105s have a resolution of 0.1% of full scale, and an accuracy of +/- 0.2% of full scale.

2107 Event/Pulse Recorder

The 2107 can be programmed to operate as an Event Recorder or a Pulse Recorder. As an Event Recorder the 2107 can record one event per second. If more than one event occurs, the 2107 will record the event as a pulse occurring at the nearest second previous to the first transition. The input signal should be from 1 to 3 VDC minimum with a maximum of +/- 32 VDC. The recorder has a threshold at +2.5 VDC and has an input impedance of 470K ohms.

As a pulse recorder, the 2107 can count a maximum of 100 pulses per second. In addition, the 2107 can be programmed to provide either one byte or two byte counters capable of counting a total of 255 or 65,535 pulses per recording period respectively. For larger totals the counters can be scaled by a user programmed prescaler.

The input has a 10 μA contact current and a +5 volts open circuit voltage. Minimum pulse width is 7 mS and there is a 3 mS contact bounce filter.

2108 Potentiometric Recorder

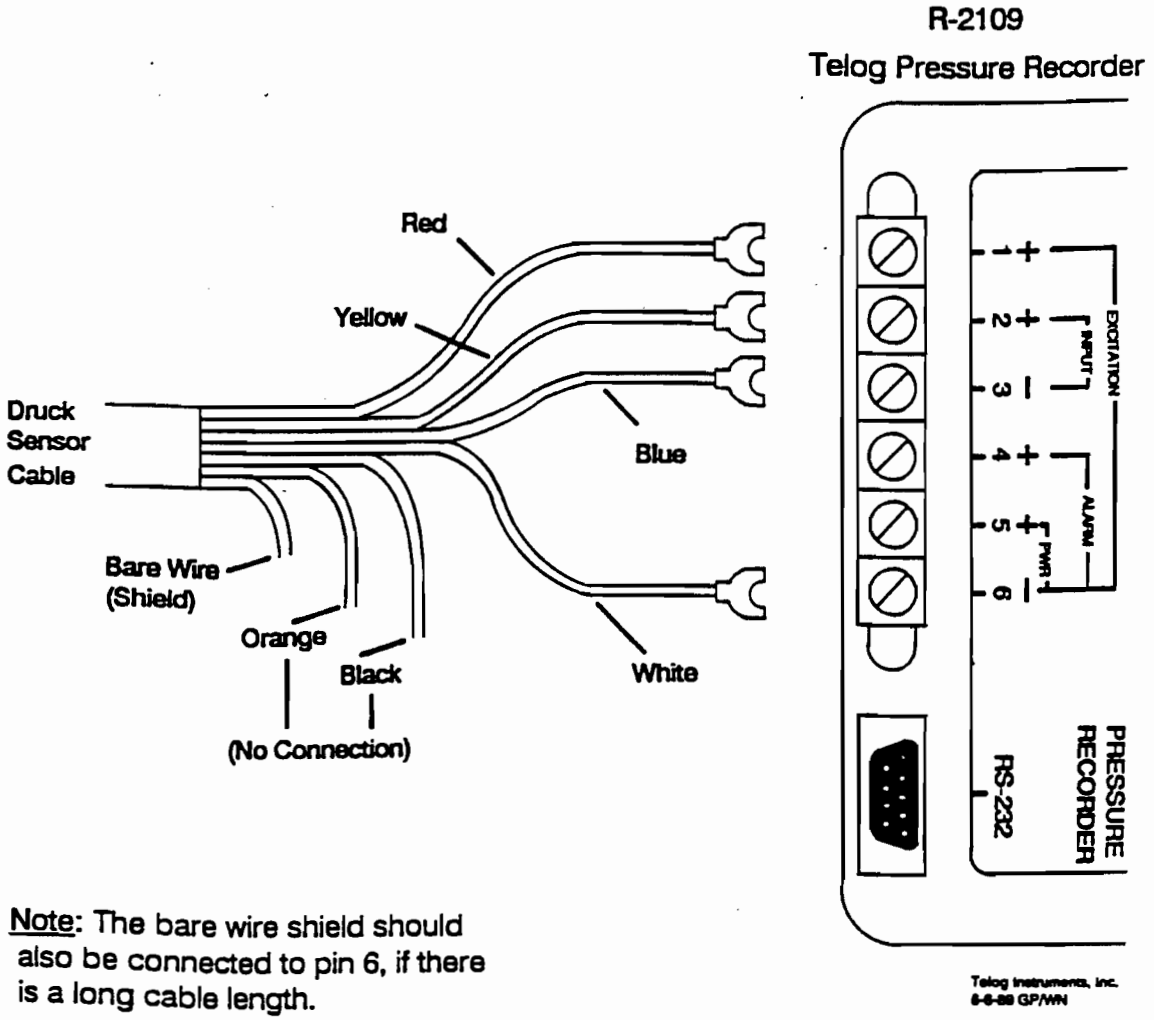
Potentiometers can be measured by the 2108 without the need for additional hardware by connecting the potentiometer directly to the three terminals of the recorder. The recorder uses a ratiometric method of measurement, and can automatically handle resistance ranges from 1K ohms to 50K ohms. Since the recorder must power the potentiometer, battery life will be somewhat reduced.

The 2108 has a resolution of 0.1% and accuracy of +/- 0.2% of full scale.

2109 Pressure Recorder

The 2109 is a Pressure Recorder that can take measurements from a differential strain gauge pressure transducer without the need for additional hardware. Shown on the next page is a diagram for connecting a pressure sensor to the 2109.

Pressure Sensor Connection Diagram



Note: The bare wire shield should also be connected to pin 6, if there is a long cable length.

Users of the 2109 recorder should be aware of the fact that there are two different hardware configurations of the recorder. The standard configuration is used for the R-2109 recorder. In this configuration, the internal power regulator that is used to regulate externally supplied DC voltage can accept a voltage input range of 10-28 volts. However, for WLS-2109 systems, the internal power regulator can only accept an external voltage of 10-14 volts. The difference is due to the fact that the WLS-2109 system is designed to be externally powered by Telog's battery pack. The 10-14 volt design uses a micro-power regulator. The 10-28 volt design does not, and thus consumes much more power.

Note that the WLS-2109 system is supplied with a dessicant pack. The purpose of the dessicant pack is to prevent condensation in the vent tube of the pressure sensor. When shipped from the factory, the dessicant pack is fully 'charged' (a deep blue color). You should periodically check the color of the dessicant to be sure that it is still able to dry out the WLS enclosure. You can 'recharge' a dessicant pack simply by baking it in a conventional oven at 300 degrees F for several hours. Note that if the dessicant pack is not able to maintain a dry atmosphere inside the WLS enclosure, water may be trapped in the pressure sensor's vent tube. **Trapped water can damage the pressure sensor and void its warranty.**

Since the recorder must supply the power for sensor excitation, battery life will be somewhat reduced. Telog requires that the transducer input impedance (nominal bridge resistance) must be 300 ohms or greater.

Dual Channel Recorders

Two dual channel recorders are supported. The specific recorders are discussed below in more detail.

2123 Dual Ambient Temperature Recorder

For users with more than one temperature to measure, Telog provides the 2123 Dual Ambient Temperature Recorder with the capability of recording two different temperatures simultaneously.

Currently one model of the 2123 is available. Both channels have a temperature range of -40 to 164 degrees F with the same resolution and accuracy of the 2103 described above.

2126 Temperature/Humidity Recorder

The 2126 Temperature/Humidity Recorder is packaged in a different enclosure that other 2100 recorders. There are no external connections available, except for the RS-232 cable. In addition, instead of using lithium batteries, the 2126 uses a standard 9 volt alkaline battery. To change the battery, loosen the four enclosure screws, remove the top cover, and replace the battery.

The channel specifications are as follows:

Temperature	Measurement range:	-28 to 74 deg C
	Resolution:	0.12 deg C
	Accuracy:	+/- .4 @ 0 to 40 deg C
		+/- .6 @ -20 to 74 deg C
Humidity	Measurement range:	5 to 95 %RH
	Resolution:	0.1%
	Accuracy:	+/- 2% @ 0 to 40 deg C

+/- 3% @ -20 to 60 deg C

Chapter 14: Troubleshooting

In the event of an apparent failure of the 2100 Series Recorder to operate properly, the following information should help you pinpoint the problem.

The possible causes of a problem include:

1. Bad connections, communications link, or cable.
2. Improper computer configuration.
3. Use of a non-compatible "IBM-PC compatible" computer.
4. Displaying incorrect units and scaling.
5. Disconnecting recorder at inappropriate time.
6. Dead or low DTU or recorder batteries.
7. Malfunction of computer.
8. Malfunction of recorder.

The first step in troubleshooting is to check your cable connections to verify that the cable is connected to your computer's serial port. If you are using a modem, then you should verify that you are communicating properly. [Dumb terminal mode may be helpful for this purpose.]

Improper Computer Configurations

If you have more than one person using the support software, it is possible for one person to configure your computer in a way that is not compatible with your own configuration. For example, if you are running your system on a hard disk, and decide to store your data files on your hard disk, but your coworker, who also uses the software, configures the system to store data files on your floppy disk, then the system will try to find stored data files on a nonexistent floppy drive.

Similar problems can occur when you configure your communication ports. If you run a number of different application programs, it is possible that the hardware configuration required by those programs may be different from those required by Telog's software. You may need to consult your system's hardware documentation for details about how to configure your system properly. If you have a single communications port it **must** be configured as COM1:.

Compatibility Problems

If you have a non-compatible 'compatible' (the third item in the above list), then solving your problem may be more complicated. Many manufacturers of IBM-PC "compatible" equipment claim that many software packages will run on their machines. Telog Instruments cannot test all compatibles on the market. If your computer runs most IBM compatible software (e.g. Wordstar, WordPerfect, Windows, Lotus 1-2-3, Flight Simulator, etc.), and you have the minimum configuration described in the "System requirements" section then it will likely run the Telog Support Software.

Many IBM computers are sold with various graphics display options. There are five widely used graphics "standards" available for the IBM-PC. These "standards" are known by various names, which creates additional confusion. The five standards are: 1) the IBM monochrome graphics card, which is used in conjunction with a monochrome monitor; 2) the IBM color graphics card, which can be used with either an GB color monitor or a composite monitor; 3) the Hercules graphics card; 4) the IBM Enhanced Graphics Adapter (EGA) card and ; 5) the IBM VGA graphics standard.

Telog Support Software requires that you have either a CGA card (color graphics adapter), or a Hercules graphics card, or an EGA card (enhanced graphics adapter) with a compatible display monitor. The monochrome graphics card does not support graphics and is thus not supported. Telog Support software will run on systems with a VGA card, although performance is limited to EGA mode.

Scaling Errors

If your software is displaying incorrectly scaled engineering units (item 4 from the above list), you may have inadvertently deleted or modified any of the ??REF.SCL files that were used when the recorder was last programmed. The support software maintains recorder scaling information on disk (not in the recorder), thus if the disk on which scaling information has been stored is not available, then the displayed scaling information will not be what you expect. The solution is to use the *.SCL disk that was used during the last programming session or to re-program your units using the **F2** option of the Utilities Menu.

Communication Failures

If you accidentally disconnect the recorder from the computer while the software is communicating with the recorder (communications occur whenever you are requesting data, current readings, or programming the recorder), you should be able to immediately reconnect the cable without causing any problems. If you leave the recorder disconnected for too long, however, it is possible for communications fail. The first step in troubleshooting is to leave the recorder disconnected from the computer for at least 2 minutes. This allows the recorder to reset itself. Remember that the recorder stays on for 2 minutes after the receipt of the last character from the computer. Waiting for 2 minutes will permit the recorder to reset its communication parameters. You should then reconnect the recorder and try to re-establish communications. Waiting two minutes before reconnecting the cable should correct most problems.

If the support software appears to hang when attempting to communicate with a recorder, first try pressing the **ESC** or **F10** key. If that is not effective, then halt the program by pressing **CTRL-Alt-Del**. Then restart the program by typing "2100" followed by a carriage return. If the program hangs when waking up a recorder, it is usually caused by an incorrect hardware configuration; usually two COM ports being assigned the same port address. Such a configuration is invalid. Refer to your hardware documentation to correct the problem.

Using Dumb Terminal Mode

If at this point the recorder-computer system is still not working, then dead recorder batteries are a possibility. If the data that is stored in the recorder is of special interest, you may wish to try establishing communications using the dumb terminal option in the MAIN MENU.

To use the dumb terminal mode to communicate with the recorder you should again wait at least 2 minutes to allow the recorder to reset itself. Then make the necessary cable connections between the recorder and the computer. Before entering dumb terminal mode, change your baud rate (using the **F4** option of the main menu) to 1200 baud. Then enter dumb terminal mode by pressing **F5** from the MAIN MENU. At this point your computer will bchave just like a dumb terminal. All keys that you press are sent to the recorder.

To wake-up the recorder (which is normally in a low power mode) you must send it the proper character sequence. The character sequence that must be sent is a string of CTRL-H's. This can be done by holding down the **CTRL** key and the **H** key simultaneously. The recorder should respond within 60 seconds by sending a string of "OK"s. If you see an "OK" displayed on the screen, then the recorder is operating properly. When this happens, you can then press **F10** to return to the main menu. If recorder status is not displayed on the top half of the screen, then you must press **F3** to inform the software that you want to process another recorder.

If the above wake-up procedure is not successful, then a battery change is recommended. See the section on changing the recorder batteries in Appendix B.

Battery and DTU Problems

Problems encountered when transferring data from a recorder to the DTU and from the DTU to a computer are generally caused by marginal batteries either in the recorder or in the DTU. Battery voltages can be checked in the DTU by removing the end cap and sliding the printed circuit board out of the enclosure. Battery voltages in the recorder can be checked by removing the four Phillips head screws on the top of the recorder's enclosure. Recorder battery voltages should be at least 2.8 Volts per battery. DTU battery voltages should be at least 2.9 Volts (when the DTU is off).

Chapter 15: Technical Support

Telog Instruments warrants their products to be free from defects in material and workmanship for a period of (1) year from date of delivery. Should you encounter a hardware or software problem with any of Telog's products and need assistance beyond what this manual can supply, we encourage you to call or write our Customer Support Service with the information listed in the Technical Support Checklist below.

Mail
Telog Instruments, Inc.
Attn: Technical Support
P.O. Box 240
West Henrietta, N.Y. 14586

FAX
You can also FAX the information about your problem.
FAX number: (716) 359-9401

Phone
(716) 359-1110

Technical Support Checklist

Before contacting Telog Instruments for technical assistance, please try to re-create the problem to provide us with an exact sequence of events. If the problem recurs, contact us by mail, FAX, or phone with the following information:

1. Telog Instruments product information: product name and serial number, and the software version number.

2. System information: Computer brand and model, type of video card, other additional hardware installed, MS-DOS version number, and any memory resident programs being used.

3. Errors: Write down the exact wording of any error messages received from Telog's Support Software or the MS-DOS operating system.

Obtaining Service

To obtain repair service on any Telog product, you must first obtain a Return Mail Authorization Number (RMA) by contacting the Telog Customer Service Department. The product should then be shipped to the factory, transportation prepaid, with a written description of the malfunction and the RMA number noted. Telog will repair or replace, at its option, a product that is returned within the warranty period and is determined to be defective by Telog. If Telog determines that the defect or malfunction has been caused by misuse, alteration, or abnormal conditions of operation or handling, Telog will repair the product and bill you for the reasonable cost of repair. If the warranty period has expired, Telog will submit an estimate of the repair costs before work is started, if requested. When the repair work as been completed, the product will be returned to you transportation prepaid.

Appendix A : List of Supported Devices

201 - Data Transfer Unit (15 data set capacity)

202 - Data Transfer Unit (60 data set capacity)

2101-xx - Analog Voltage Recorder (2K and 8K recorders)

-41	0-10 mV
-42	0-20 mV
-45	0-50 mV
-45B	-50 - +50 mV
-51	0-100 mV
-52	0-200 mV
-55	0-500 mV
-55B	-500 - +500 mV
-61	0-1 V
-62	0-2 V
-62.5B	-2.5 - +2.5 V
-65	0-5 V
-65B	-5 - +5 V
-71	0-10 V
-72	0-20 V

2102-xx - Current Loop Recorder (2K and 8K recorders)

-31	0-1 mA
-31B	-1-+1mA
-35	0-5 mA
-42	0-20 mA
-42C	4-20mA
-45	0-50 mA

2103-xx - Ambient Temperature Recorder (2K and 8K recorders)

-01 - Range: -13 - +140 deg F
-02 - Range: 40 - +104 deg F
-03 - Range: -40 - +88 deg F
-04 - Range: -13 - +140 deg F
-05 - Range: -40 - +215.75 deg F
-06 - Range: -40 - +164.6 deg F
-07 - Range: 55 - 75 deg F

2104-xx - RTD Recorder

01 - Range: -200-+400 C
02 - Range: -200-+800 C

2105-xx - Thermocouple Recorder

01 - Type J; Range: -200 - +1400 deg F

02 - Type K; Range: -200 - +2500 deg F
03 - Type J; Range: -20 - +180 deg C
04 - Type T; Range: -160 - +750 deg F
05 - Type E; Range: -23 - +1000 deg C

2107 - Pulse/Event and Run-time Recorder

2108 - Potentiometric Recorder

2109 - Pressure Recorder

2123 - Dual Ambient Temperature Recorder
Range: -40 - 164 deg F

2126 Temperature/Humdity Recorder

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Attachment 2

Quality Assurance/Quality Control Plan

PFOHL BROTHERS LANDFILL

MODIFIED BROSSMAN QA/QC SHORT FORM
FOR THE COLLECTION OF ENVIRONMENTAL SAMPLES

PHASE II REMEDIAL INVESTIGATION
09/04/92

Responsible Party:

New York State Department of Environmental Conservation
Division of Hazardous Waste Remediation
50 Wolf Road
Albany, New York 12233

_____ _____
Remedial Project Manager (NYSDEC) Date

_____ _____
Quality Assurance Officer (NYSDEC) Date

TABLE OF CONTENTS

1. Project Name: Pfohl Brothers Landfill

2. Project Requested By: New York State Department of Environmental Conservation
Bureau of Western Remedial Action
Division of Hazardous Waste Remediation

3. Notice to Proceed: March 6, 1992

4. Project Officer: A. Joseph White, P.E.
Remedial Action Section A

5. Quality Assurance Officer: Maureen Serafini

6. Project Description:

A. Background

The Pfohl Brothers Landfill operated between 1932 and 1969. The disposal of hazardous materials, including phenol tars, waste solvents, paints, thinners, pine tar pitch, rubber, and scrap metals, has been documented at the site. The estimated size of the Pfohl Brothers Landfill is 120 + acres.

In March 1988, NYSDEC contracted Camp Dresser & McKee (CDM) to perform a Remedial Investigation/Feasibility Study (RI/FS) of the site.

The results of this investigation indicated that the landfill represents a source of a wide range of organic and inorganic contaminants, including 2,3,7,8-TCDD. Drainage ditches surrounding the site are also contaminated with similar constituents.

The unconsolidated aquifer underlying the site is contaminated and there is evidence that some contaminants have reached the bedrock aquifer both on and off-site.

B. Objective and Scope

The objective of the Phase II remedial investigation is to gain a better understanding of the boundaries of the landfill, local hydrogeology, and the extent of ground water contamination.

The Phase II RI will involve the installation of additional borings in Area A of the landfill to gain a better understanding of the nature and extent of contamination. Additional borings will be installed along the southern portion of Area C in order to more accurately determine the landfill boundaries. Ground water wells will be installed at various off-site locations in both the unconsolidated and bedrock aquifers to gain a better understanding of ground water flow direction, interconnection between the two aquifers, and ground water quality. The data obtained from this investigation will be used to supplement data collected from the Phase I RI to determine the full nature and extent of ground water contamination.

C. Data Usage

The data collected during this investigation will be used for site characterization and potential evaluation of additional remedial alternatives to address offsite contamination.

D. Monitoring Network Design and Rationale

The proposed sampling plan calls for the collection of 56 environmental samples (excluding QA/QC samples).

The proposed sample locations for the monitoring wells and soil borings in Area A are shown on Figure A-1. Proposed soil boring locations in Area C are shown on Figure A-2. A brief explanation of the types of samples and purpose of collection is provided below:

Subsurface Soils

- Approximately fifty soil borings will be installed along the southern portion of Area C. Borings will be installed to a maximum depth of 10-feet using a skid-mounted drill rig. Drill cuttings from each borehole will be examined to determine the presence or absence of landfilled material. Two background soil borings will also be installed along the north side of Pfohl Road. No laboratory analyses will be performed on soil samples collected under this task.

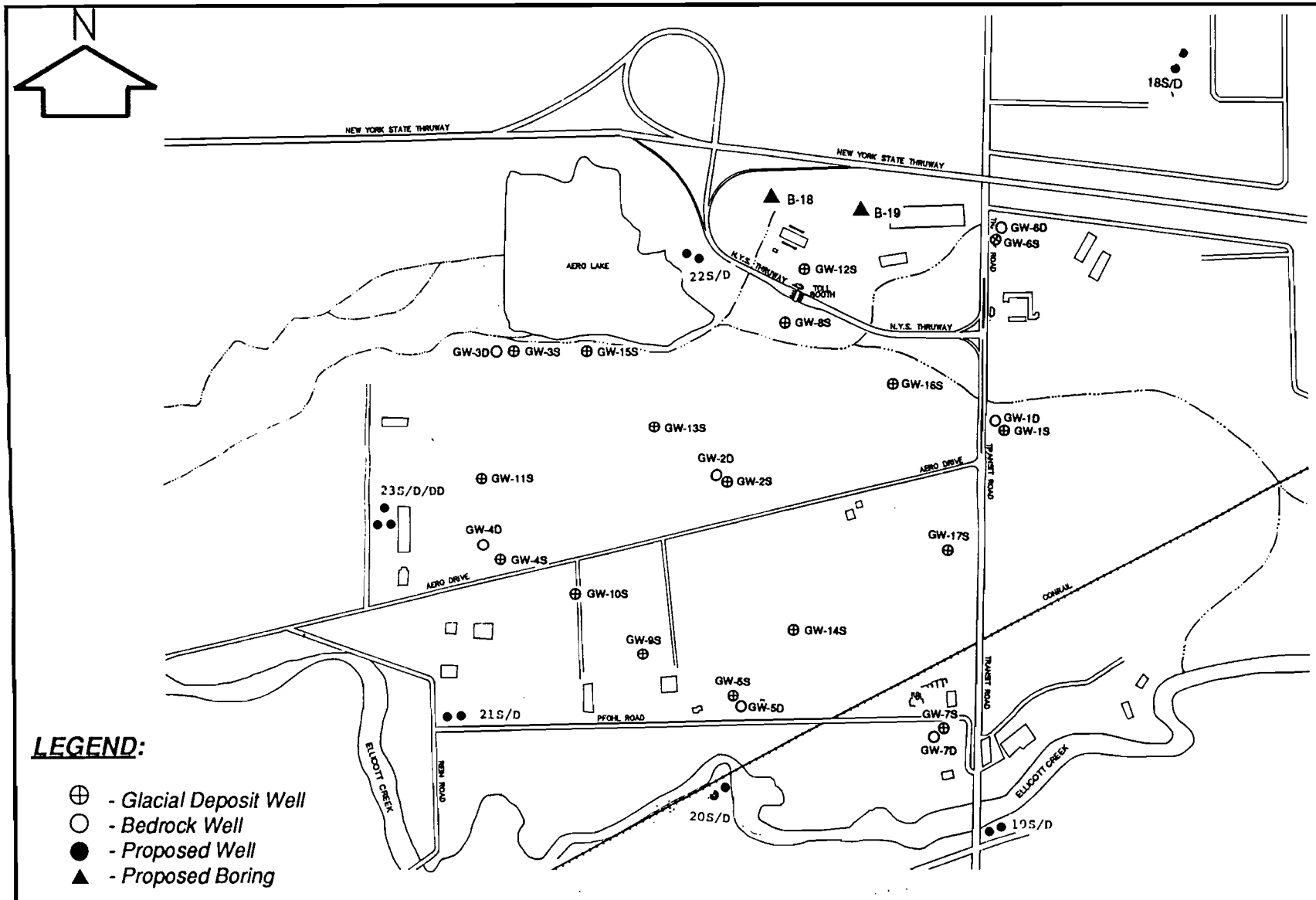
- Two shallow borings will be drilled in Area A of the landfill. At each boring location in Area A, two split-spoon samples will be collected from each borehole and analyzed for TCL parameters. One sample will be collected from the unsaturated zone; a second soil sample will be collected from the saturated zone.

- At monitoring well location MW-18S/D, two soil samples will be collected to serve as background. One sample will be collected in the 0 to 2-foot sampling interval; a second sample will be collected in the unsaturated zone.

Ground Water

- Six nested wells (bedrock and overburden) and one deep bedrock well will be installed around the landfill to further characterize the nature and extent of ground water contamination. Proposed well locations are based on the assumption that the porosity is constituent throughout the flow domain. Proposed wells are located hydraulically upgradient as well as downgradient from the landfill to further identify the nature and extent of contamination.

- The hydraulic gradient measured in the overburden wells indicates that ground water flows in a radial direction from the site. Furthermore, organic and inorganic contaminants were found in the soils, and inorganic contaminants were found in the ground water at the background well location 6S/6D. Therefore, an additional well nest (18S/D) will be installed further upgradient to identify the source of contamination in well 6S/6D, and to establish background water quality.



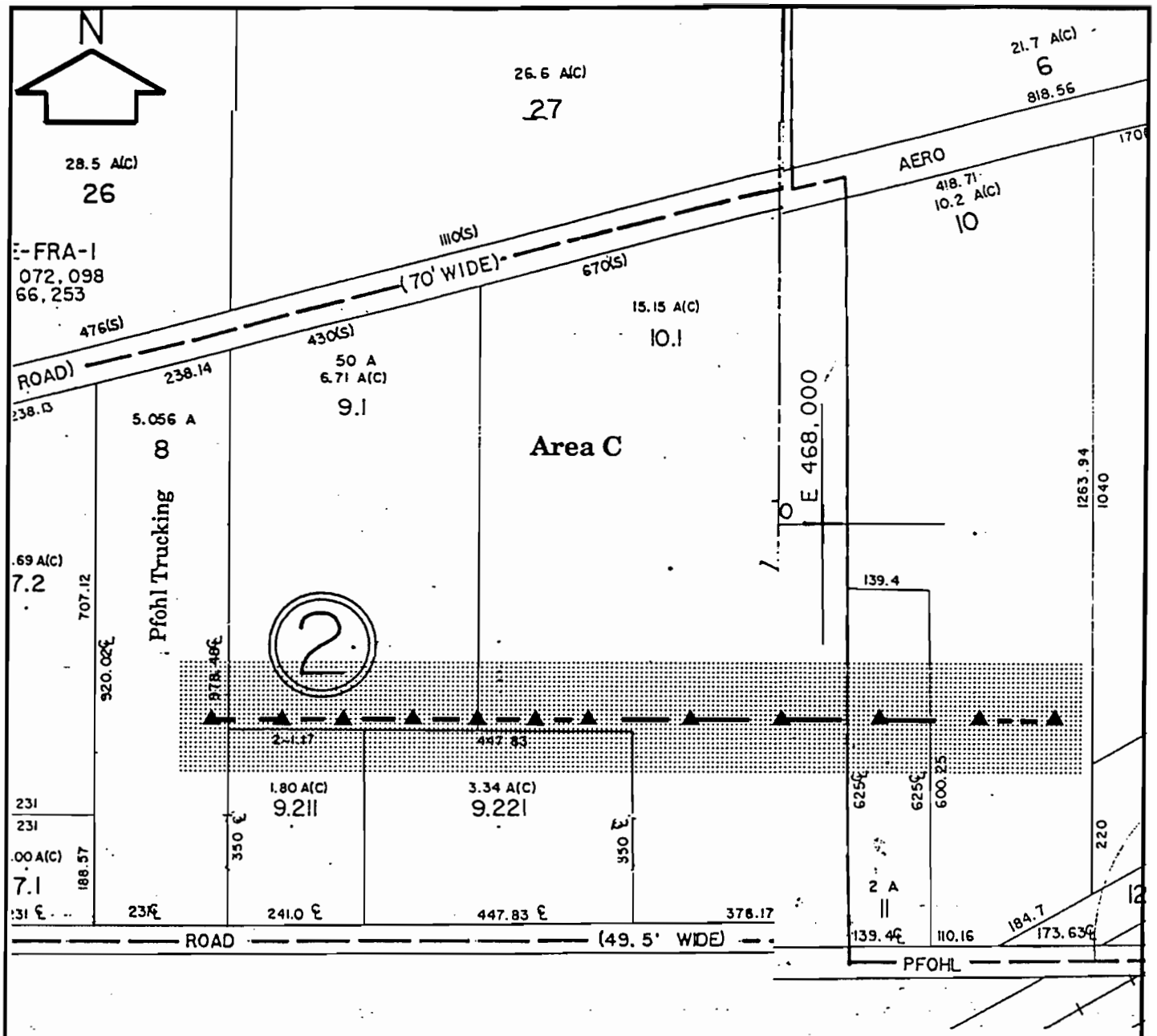
CDM

environmental engineers, scientists, planners & management consultants

Figure A-1

Proposed And Existing Monitoring Wells And Proposed Borings

Pfohl Brothers Landfill, Cheektowaga, New York



LEGEND:

- General Area Of Proposed Borings

- Primary Transect Line/Initial Line Of Soil Borings

200 100 0 200

scale feet

CDM

environmental engineers, scientists
planners & management consultants

Figure A-2

Location Plan For Area C Borings

Pfohl Brothers Landfill, Cheektowaga, New York

- Well pair 6S/6D will be installed in a small clearing at the east end of the Ramada Inn parking lot, adjacent to the former sewage treatment plant. Continuous split spoon samples will be collected until bedrock is reached. Full TCL analysis will be performed by NYSDEC on one unsaturated soil sample. The well nest will provide background water and soil quality data.

- Well nest 19S/D will be installed south of Ellicott Creek and north and east of Genesee Street and Transit Road, respectively. The proposed wells will provide downgradient information regarding contaminants found in wells 7S/7D, as well as characterizing the hydraulic influence of Ellicott Creek on the water bearing zones.

- A well nest 21S/D will be installed approximately 100 feet northeast of Rein and Pfohl Roads. The well nest will be located approximately midway between wells 4S/4D and Ellicott Creek, and will provide downgradient chemical information, as well as characterizing the hydraulic influence of Ellicott Creek on the water bearing zones.

- A well nest (22S/D) will be installed northeast of Aero Lake, but south of the Thruway ramp to provide downgradient information for Area A. Ground water samples from the shallow well will identify contaminants released into Aero Lake from Area A. The connection (hydraulic and chemical) between Aero Lake and the bedrock aquifer can be observed by installing the bedrock well (23D).

- A triple well nest (23S/D/DD) will be installed west of wells 4D and 11S, east of Scott Place. The proposed well nest will provide downgradient information. The deepest well (23DD) will be installed to examine the possibility of a sinking plume.

- Each well will be constructed of stainless steel materials. The overburden wells will be completed with well screens and riser pipe, the bedrock wells will be completed as open boreholes in the rock with stainless steel riser pipe casing off the unconsolidated aquifer. These wells will be sampled using teflon bailers.

- Ground water samples will be collected from all newly installed shallow wells, in addition to the existing 9 perimeter shallow wells. The existing wells would include 1S, 3S, 4S, 5S, 6S, 7S, 8S, 10S and 11S. One sample will be collected and analyzed from well 2D, in addition to selected off-site deep wells, including 1D, 3D, 4D, 6D,and 7D in which at least one TCL parameter was detected above background concentrations and/or ARARs. Ground water samples will be analyzed for TCL parameters, including total metals and conventional parameters, which include sulfates, chlorides, and bicarbonate. Ground water from the newly installed bedrock wells (up to 4) will be collected and analyzed for TCL parameters, depending on the analytical results from the shallow wells and the vertical hydraulic gradients measured in the well pairs. All sample analyses will be performed by the NYSDEC analytical laboratory.

Quality Assurance

- o Matrix spike and matrix spike duplicate analysis will be performed by the laboratory on at least one sample in twenty for each sample with the same concentration and matrix or each 7 calendar day period during which samples in a Case were received (whichever is most frequent). Triple sample volumes will be collected for each MS/MSD sample.

A summary of QA/QC sample requirements is presented in Table A-1.

E. Monitoring Parameters and Frequency of Collection

- o Each sampling station will be sampled once.

- o Soil samples collected from borehole MW-18S/D, B-18 and B-19 will be analyzed by the NYSDEC analytical laboratory. Volatile organic analysis will be performed using NYSDEC 91-1; semi-volatile analysis will be performed using NYSDEC 91-2; and pesticides and PCBs will be analyzed using NYSDEC 91-3. Analysis of total metals will performed using NYSDEC 1991 CLP Analytical Services Protocol, Exhibit D, Part V. Method 335.2, CLP-Modified will be used for cyanide analysis.

- o No soil samples will be collected and analyzed from borings installed in Area C or the ground water monitoring wells.

- o Ground water samples will be analyzed using CLP analytical procedures for the analysis of low concentration water samples. Volatile organic analysis will be performed using NYSDEC 91-4: semivolatiles will be analyzed using NYSDEC 91-5; and pesticide and PCB analysis will be performed using NYSDEC 91-6. Analysis of total metals will be performed using NYSDEC 1991 CLP Analytical Services Protocol, Exhibit D, Part V. Method 335.2, CLP-Modified will be used for cyanide analysis.

- o All ground water samples will be analyzed for chlorides, sulfate and bicarbonates. EPA Method 325.3 will be utilized for chloride analyses; EPA Method 375.4 will be utilized for sulfate analysis; and bicarbonate analysis will utilize EPA Method 310.1, which will be reported as hydroxide alkalinity, carbonate alkalinity, and bicarbonate alkalinity.

F. Analytical Methodologies, Sample Preservation and Holding Times (see Table A-2)

G. Summary of Analytical Requirements (see Tables A-2)

7. Project Fiscal Information:

Access to this information must be arranged through, and be by explicit consent of, responsible officials of NYSDEC and officers of Camp Dresser & McKee.

Table A-1
SAMPLE SUMMARY

MEDIUM	SAMPLE LOCATION	EXAMPLE SAMPLE CODE	NUMBER OF SAMPLES	LABORATORY ANALYSIS
Soil	B-18	897-B18-SS-01	2	TCL & CN-
	B-19	897-B19-SS-02	2	TCL & CN-
QC Samples:			2 for MS & MSD	TCL & CN-
			1 Duplicate	TCL & CN-
SOIL	MW-18 S/D	897-MW18D-SS-01	2	
GROUND WATER	MW-1S MW-3S Through MW-8S	897-MW1S-GW-01	25	TCL & CN-, plus Conventionals (sulfate, chlorides & bicarbonate)
	MW-10S			
	MW-11S			
	MW-1D MW-18S			
	MW-2D MW-19S			
	MW-3D MW-20S			
	MW-4D MW-21S			
	MW-6D MW-22S			
	MW-7D MW-23S			
Plus 4 newly installed bedrock wells TBD*				
QC Samples:			3 MS &MSD	TCL & CN-
			2 duplicates	TCL & CN-
			5 trip blanks	VOA only
			5 field blanks	TCL & CN-

* To be determined in the field at the discretion of the project geologist.

PBLF.P4

Table A - 2

Summary of Analytical Requirements

PARAMETER	MEDIA	ANALYTICAL METHOD REFERENCE	SAMPLE PRESERVATIVE	MAXIMUM HOLDING TIME
Volatile Organics	Ground water	NYSDEC 91-4	Cool, 4°C	7 days of VTSR
Semi-Volatiles	Ground water	NYSDEC 91-5	Cool, 4°C	5 days of VTSR.[1] Extracts analyzed within 40 days of VTSR.
Pesticides & PCBs	Ground water	NYSDEC 91-6	Cool, 4°C	Extraction of all samples must be started within 7 days of VTSR. Analysis must be completed within 40 days following the start of extraction.
Metals	Ground water	NYSDEC Exhibit D Part V 12/91 CLP	HNO_3 to pH < 2	6 mos, except Hg of 26 days
Cyanide	Ground water	Method 335.2 CLP-M	NaOH to pH > 12 Cool, 4°C	12 days
Conventionals				
Chloride	Ground water	EPA Method 325.3	Cool, 4°C	26 days
Sulfate	Ground water	EPA Method 375.4	Cool, 4°C	26 days
Bicarbonate (alkalinity)	Ground water	EPA Method 310.1[3] (titrimetric)	Cool, 4°C	12 days

PBLF.P1

Table A-2 (cont'd)

PARAMETER	MEDIA	ANALYTICAL METHOD REFERENCE	SAMPLE PRESERVATIVE	MAXIMUM HOLDING TIME
Volatile Organics	Soils	NYSDEC 91-1	Cool, 4°C	7 days of VTSR
Semi-Volatiles	Soils	NYSDEC 91-2	Cool, 4°C	5 days of VTSR.[2] Extracts analyzed within 40 days of VTSR.
Pesticides & PCBs	Soils	NYSDEC 91-3	Cool, 4°C	Extraction of soil samples by sonication must be started within 5 days and completed with 10 days of VTSR. Re-extractions must be started within 10 days and completed within 12 days of VTSR. Analysis of extracts within 40 days following the start of extraction.
Metals	Soils	NYSDEC Exhibit D Part V 12/91 CLP	Cool, 4°C	6 mos, except Hg of 26 days
Cyanide	Soils	Method 335.2 CLP-M	Cool, 4°C	12 days

(1) Extraction shall ba started within 5 days and completed within 7 days of VTSR. Re-extraction must be performed within 10 days and completed within 12 days of VTSR.
(2) Sonication or Soxhlet procedures for extraction and concentration of soil samples for semi-volatile analysis shall be started within 5 days and completed within 7 days of VTSR. Re-extractions must be performed within 10 days and completed within 12 days of VTSR.
(3) Results to be reported as hydroxide alkalinity, carbonate alkalinity, and bicarbonate alkalinity.

PBLF.P2

8. Schedule of Tasks and Projects

A schedule of activities is provided in Figure A-3.

9. Project Organization and Responsibility

The following is a list of key project personnel and their corresponding responsibilities:

Lee Guterman (CDM)	Project Manager
Mike Ehnot (CDM)	Project Geologist/H&S Coordinator
A. Joseph White (NYSDEC)	NYSDEC Representative
Louis Tortora* (CDM)	Performance (field) Audit
Louis Tortora* (CDM)	Systems Audit

* May be performed by his designee

10. Data Quality Requirements and Assessments:

The criteria of completeness is a measure of the amount of valid data obtained from the measurement system compared with the amount that was expected under normal conditions. This criteria is expressed as a percentage. One-hundred percent complete data is desired. The acceptability of the data will be based on the results of the validation process performed by NYSDEC.

Samples collected during the field investigations will be analyzed by the NYSDEC analytical laboratory using the NYSDEC 1991 Analytical Services Protocol (ASP). The sensitivities required for ground water and soil analyses are provided on tables A-3 and A-4.

The quality assurance requirements for accuracy, precision, and sensitivity of analysis will be the responsibility of NYSDEC. All QA/QC requirements outlined in the NYSDEC ASP (12/91) will be adhered to.

11. Sample Container Requirements (see Table A-5)

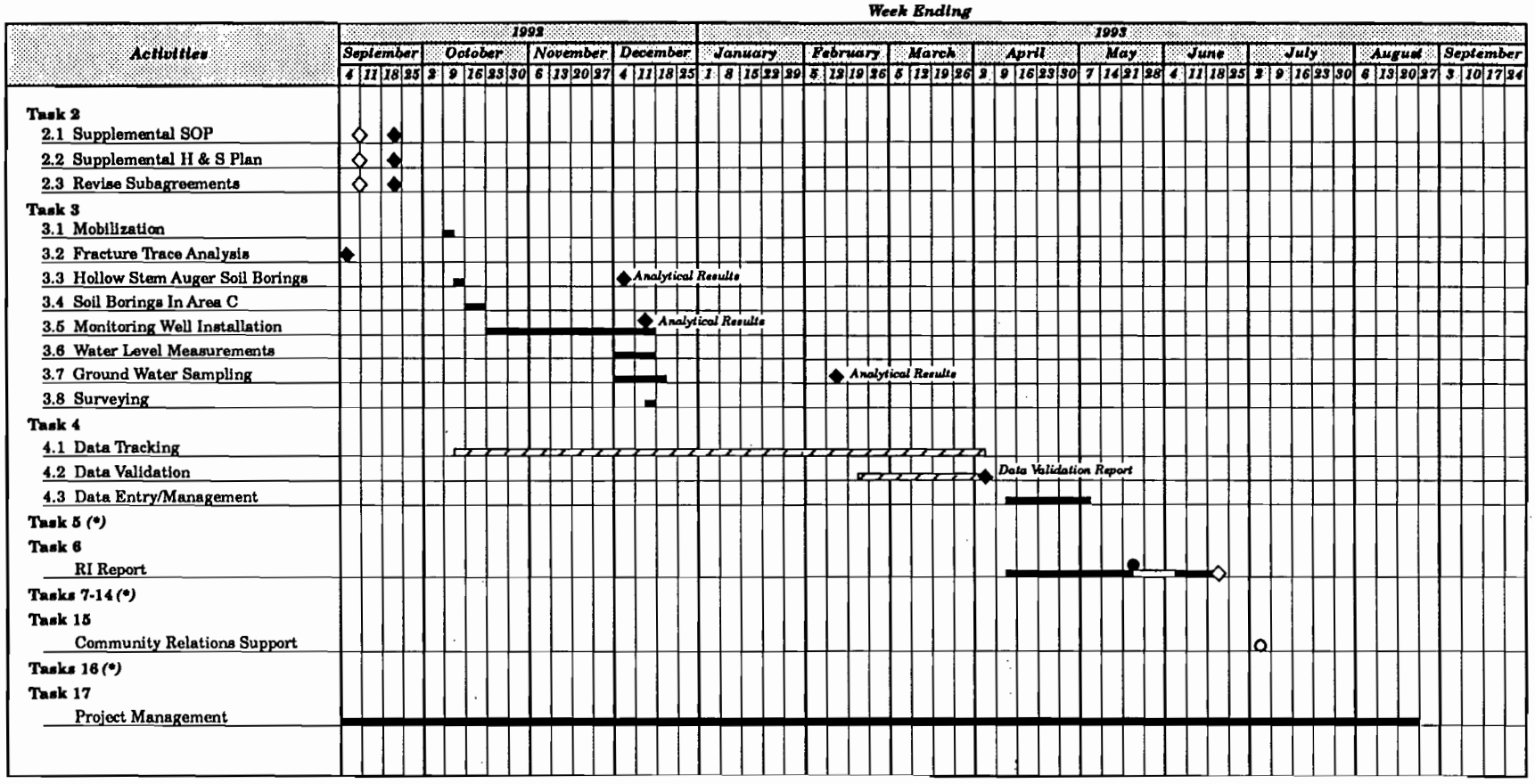
12. Sampling Procedures:

Detailed procedures for the collection of samples are provided in the accompanying Site Operations Plan (SOP).

13. Sample Custody Procedures

The sample custodian will ensure that each sample to be shipped for laboratory analysis has the following documents accompanying the sample shipment:

- Airbills or airbill stickers
- Custody Seals
- CDM Chain-of-Custody Records
- NYSDEC Contract Laboratory Sample Information sheets
- Sample tags or labels



LEGEND:

- Projected Duration
- Draft Deliverable
- NYSDEC Review
- Final Deliverable
- DEC Approval
- Public Meeting
- (*) Not included under the Phase II RI.
- To Be Performed By NYSDEC

CDM

environmental engineers, scientists, planners & management consultants

Figure A-3

Schedule Of Activities
Phase II Remedial Investigation

Pfohl Brothers Landfill, Cheektowaga, New York

TABLE A-3

Superfund-CLP Low Concentration Organics Target Compound List (TCL) and Contract Required Quantitation Limits (CRQL)

	Volatiles	CAS Number	Quantitation Limits* Low Water µg/L
1.	Chloromethane	74-87-3	1
2.	Bromomethane	74-83-9	1
3.	Vinyl chloride	75-01-4	1
4.	Chloroethane	75-00-3	1
5.	Methylene chloride	75-09-2	2
6.	Acetone	67-64-1	5
7.	Carbon Disulfide	75-15-0	1
8.	1,1-Dichloroethene	75-35-4	1
9.	1,1-Dichloroethane	75-35-3	1
10.	cis-1,2-Dichloroethene	156-59-4	1
11.	trans-1,2-Dichloroethene	156-60-5	1
12.	Chloroform	67-66-3	1
13.	1,2-Dichloroethane	107-06-2	1
14.	2-Butanone	78-93-3	5
15.	Bromochloromethane	74-97-5	1
16.	1,1,1-Trichloroethane	71-55-6	1
17.	Carbon tetrachloride	56-23-5	1
18.	Bromodichloromethane	75-27-4	1
19.	1,2-Dichloropropane	78-87-5	1
20.	cis-1,3-Dichloropropene	10061-01-5	1
21.	Trichloroethene	79-01-6	1
22.	Dibromochloromethane	124-48-1	1
23.	1,1,2-Trichloroethane	79-00-5	1
24.	Benzene	71-43-2	1
25.	trans-1,3-Dichloropropene	10061-02-6	1
26.	Bromoform	75-25-2	1
27.	4-Methyl-2-pentanone	108-10-1	.5
28.	2-Hexanone	591-78-6	5
29.	Tetrachloroethene	127-18-4	1
30.	1,1,2,2-Tetrachloroethane	79-34-5	1

TABLE A-3 (cont.)

Superfund-CLP Low Concentration Organics Target Compound List (TCL) and Contract Required Quantitation Limits (CRQL)

	Volatiles (cont.)	CAS Number	Quantitation Limits* Low Water µg/L
31.	1,2-Dibromoethane	106-93-4	1
32.	Toluene	108-88-3	1
33.	Chlorobenzene	108-90-7	1
34.	Ethyl Benzene	100-41-4	1
35.	Styrene	100-42-5	1
36.	o/p-Xylene	95-47-6/106-42-3	1
37.	m-Xylene	108-38-3	1
38.	1,3-Dichlorobenzene	541-73-1	1
39.	1,4-Dichlorobenzene	106-46-7	1
40.	1,2-Dichlorobenzene	95-50-1	1
41.	1,2-Dibromo-3-chloropropane	96-12-8	1
42.	Vinyl acetate	108-05-4	1

TABLE A-3 (cont.)

Superfund-CLP Low Concentration Organics Target Compound List (TCL) and Contract Required Quantitation Limits (CRQL)

	Semivolatiles	CAS Number	Quantitation Limits* Low Water µg/L
1.	Phenol	108-95-2	5
2.	bis(2-Chloroethyl) ether	111-44-4	5
3.	2-Chlorophenol	95-57-8	5
4.	2-Methylphenol	95-48-7	5
5.	2,2'-oxybis(1-Chloro-propane) #	108-60-1	5
6.	4-Methylphenol	106-44-5	5
7.	N-Nitroso-di-n-propylamine	621-64-7	5
8.	Hexachloroethane	67-72-1	5
9.	Nitrobenzene	98-95-3	5
10.	Isophorone	78-59-1	5
11.	2-Nitrophenol	88-75-5	5
12.	2,4-Dimethylphenol	105-67-9	5
13.	bis(2-Chloroethoxy) methane	111-91-1	5
14.	2,4-Dichlorophenol	120-83-2	5
15.	1,2,4-Trichlorobenzene	120-82-1	5
16.	Naphthalene	91-20-3	5
17.	4-Chloroaniline	106-47-8	5
18.	Hexachlorobutadiene	87-68-3	5
19.	4-Chloro-3-methylphenol	59-50-7	5
20.	2-Methylnaphthalene	91-57-6	5
21.	Hexachlorocyclopentadiene	77-47-4	5
22.	2,4,6-Trichlorophenol	88-06-2	5
23.	2,4,5-Trichlorophenol	95-95-4	20
24.	2-Chloronaphthalene	91-58-7	5
25.	2-Nitroaniline	88-74-4	20
26.	Dimethyl phthalate	131-11-3	5
27.	Acenaphthylene	208-96-8	5
28.	2,6-Dinitrotoluene	606-20-2	5
29.	3-Nitroaniline	99-09-2	20
30.	Acenaphthene	83-32-9	5

Previously known by the name bis(2-Chloroisopropyl) ether

TABLE A-3 (cont.)

Superfund-CLP Low Concentration Organics Target Compound List (TCL) and Contract Required Quantitation Limits (CRQL)

	Semivolatiles (cont.)	CAS Number	Quantitation Limits* Low Water µg/L
31.	2,4-Dinitrophenol	51-28-5	20
32.	4-Nitrophenol	100-02-7	20
33.	Dibenzofuran	132-64-9	5
34.	2,4-Dinitrotoluene	121-14-2	5
35.	Diethylphthalate	84-66-2	5
36.	4-Chlorophenyl phenyl ether	7005-72-3	5
37.	Fluorene	86-73-7	5
38.	4-Nitroaniline	100-01-6	20
39.	4,6-Dinitro-2-methylphenol	534-52-1	20
40.	N-nitrosodiphenylamine	86-30-6	5
41.	4-Bromophenyl phenyl ether	101-55-3	5
42.	Hexachlorobenzene	118-74-1	5
43.	Pentachlorophenol	87-86-5	20
44.	Phenanthrene	85-01-8	5
45.	Anthracene	120-12-7	5
46.	Di-n-butyl phthalate	84-74-2	5
47.	Fluoranthene	206-44-0	5
48.	Pyrene	129-00-0	5
49.	Butyl benzyl phthalate	85-68-7	5
50.	3,3'-Dichlorobenzidine	91-94-1	5
51.	Benz(a)anthracene	56-55-3	5
52.	Chrysene	218-01-9	5
53.	bis(2-Ethylhexyl)phthalate	117-81-7	5
54.	Di-n-octyl phthalate	117-84-0	5
55.	Benzo(b)fluoranthene	205-99-2	5
56.	Benzo(k)fluoranthene	207-08-9	5
57.	Benzo(a)pyrene	50-32-8	5
58.	Indeno(1,2,3-cd)pyrene	193-39-5	5
59.	Dibenz(a,h)anthracene	53-70-3	5
60.	Benzo(g,h,i)perylene	191-24-2	5

TABLE A-3 (cont.)

Superfund-CLP Low Concentration Organics Target Compound List (TCL) and Contract Required Quantitation Limits (CRQL)

	Pesticides/Aroclors	CAS Number	Quantitation Limits* Low Water µg/L
1.	alpha-BHC	319-84-6	0.01
2.	beta-BHC	319-85-7	0.01
3.	delta-BHC	319-86-8	0.01
4.	gamma-BHC (Lindane)	58-89-9	0.01
5.	Heptachlor	76-44-8	0.01
6.	Aldrin	309-00-2	0.01
7.	Heptachlor epoxide	1024-57-3	0.01
8.	Endosulfan I	959-98-8	0.01
9.	Dieldrin	60-57-1	0.02
10.	4,4'-DDE	72-55-9	0.02
11.	Endrin	72-20-8	0.02
12.	Endosulfan II	33213-65-9	0.02
13.	4,4'-DDD	72-54-8	0.02
14.	Endosulfan sulfate	1031-07-8	0.02
15.	4,4'-DDT	50-29-3	0.02
16.	Methoxychlor	72-43-5	0.10
17.	Endrin ketone	53494-70-5	0.02
18.	Endrin aldehyde	7421-36-3	0.02
19.	alpha-Chlordane	5103-71-9	0.01
20.	gamma-Chlordane	5103-74-2	0.01
21.	Toxaphene	8001-35-2	1.0
22.	AROCLOR-1016	12674-11-2	0.20
23.	AROCLOR-1221	11104-28-2	0.20
24.	AROCLOR-1232	11141-16-5	0.40
25.	AROCLOR-1242	53469-21-9	0.20
26.	AROCLOR-1248	12672-29-6	0.20
27.	AROCLOR-1254	11097-69-1	0.20
28.	AROCLOR-1260	11096-82-5	0.20

TABLE A-4

Superfund Target Compound List (TCL) and Contract Required Quantitation Limits (CRQL)

	Volatiles	CAS Number	Quantitation Limits* Water µg/L	Low Soil µg/Kg	Med Soil µg/Kg	On Column (ng)
1.	Chloromethane	74-87-3	10	10	1200	(50)
2.	Bromomethane	74-83-9	10	10	1200	(50)
3.	Vinyl chloride	75-01-4	10	10	1200	(50)
4.	Chloroethane	75-00-3	10	10	1200	(50)
5.	Methylene chloride	75-09-2	10	10	1200	(50)
6.	Acetone	67-64-1	10	10	1200	(50)
7.	Carbon Disulfide	75-15-0	10	10	1200	(50)
8.	1,1-Dichloroethylene	75-35-4	10	10	1200	(50)
9.	1,1-Dichloroethane	75-35-3	10	10	1200	(50)
10.	1,2-Dichloroethylene(total)	540-59-0	10	10	1200	(50)
11.	Chloroform	67-66-3	10	10	1200	(50)
12.	1,2-Dichloroethane	107-06-2	10	10	1200	(50)
13.	2-Butanone	78-93-3	10	10	1200	(50)
14.	1,1,1-Trichloroethane	71-55-6	10	10	1200	(50)
15.	Carbon tetrachloride	56-23-5	10	10	1200	(50)
16.	Bromodichloromethane	75-27-4	10	10	1200	(50)
17.	1,2-Dichloropropane	78-87-5	10	10	1200	(50)
18.	cis-1,3-Dichloropropene	10061-01-5	10	10	1200	(50)
19.	Trichloroethene	79-01-6	10	10	1200	(50)
20.	Dibromochloromethane	124-48-1	10	10	1200	(50)
21.	1,1,2-Trichloroethane	79-00-5	10	10	1200	(50)
22.	Benzene	71-43-2	10	10	1200	(50)
23.	trans-1,3-Dichloropropene	10061-02-6	10	10	1200	(50)
24.	Bromoform	75-25-2	10	10	1200	(50)
25.	4-Methyl-2-pentanone	108-10-1	10	10	1200	(50)
26.	2-Hexanone	591-78-6	10	10	1200	(50)
27.	Tetrachloroethene	127-18-4	10	10	1200	(50)
28.	Toluene	108-88-3	10	10	1200	(50)
29.	1,1,2,2-Tetrachloroethane	79-34-5	10	10	1200	(50)
30.	Chlorobenzene	108-90-7	10	10	1200	(50)
31.	Ethyl Benzene	100-41-4	10	10	1200	(50)
32.	Styrene	100-42-5	10	10	1200	(50)
33.	Total Xylenes	1330-20-7	10	10	1200	(50)

* Quantitation Limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment, calculated on dry weight basis, as required by the protocol, will be higher.

TABLE A-4(cont.)

Superfund Target Compound List (TCL) and Contract Required Quantitation Limits (CRQL)*

	Semivolatiles	CAS Number	Quantitation Limits* Water µg/L	Low Soil µg/Kg	Med Soil µg/Kg	On Column (ng)
34.	Phenol	108-95-2	10	330	10,000	(20)
35.	bis(2-Chloroethyl) ether	111-44-4	10	330	10,000	(20)
36.	2-Chlorophenol	95-57-8	10	330	10,000	(20)
37.	1,3-Dichlorobenzene	541-73-1	10	330	10,000	(20)
38.	1,4-Dichlorobenzene	106-46-7	10	330	10,000	(20)
39.	1,2-Dichlorobenzene	95-50-1	10	330	10,000	(20)
40.	2-Methylphenol	95-48-7	10	330	10,000	(20)
41.	2,2'-oxybis(1-Chloro-propane) #	108-60-1	10	330	10,000	(20)
42.	4-Methylphenol	106-44-5	10	330	10,000	(20)
43.	N-Nitroso-di-n-propylamine	621-64-7	10	330	10,000	(20)
44.	Hexachloroethane	67-72-1	10	330	10,000	(20)
45.	Nitrobenzene	98-95-3	10	330	10,000	(20)
46.	Isophorone	78-59-1	10	330	10,000	(20)
47.	2-Nitrophenol	88-75-5	10	330	10,000	(20)
48.	2,4-Dimethylphenol	105-67-9	10	330	10,000	(20)
49.	bis(2-Chloroethoxy) methane	111-91-1	10	330	10,000	(20)
50.	2,4-Dichlorophenol	120-83-2	10	330	10,000	(20)
51.	1,2,4-Trichlorobenzene	120-82-1	10	330	10,000	(20)
52.	Naphthalene	91-20-3	10	330	10,000	(20)
53.	4-Chloroaniline	106-47-8	10	330	10,000	(20)
54.	Hexachlorobutadiene	87-68-3	10	330	10,000	(20)
55.	4-Chloro-3-methylphenol	59-50-7	10	330	10,000	(20)
56.	2-Methylnaphthalene	91-57-6	10	330	10,000	(20)
57.	Hexachlorocyclopentadiene	77-47-4	10	330	10,000	(20)
58.	2,4,6-Trichlorophenol	88-06-2	10	330	10,000	(20)
59.	2,4,5-Trichlorophenol	95-95-4	25	800	25,000	(50)
60.	2-Chloronaphthalene	91-58-7	10	330	10,000	(20)
61.	2-Nitroaniline	88-74-4	25	800	25,000	(50)
62.	Dimethyl phthalate	131-11-3	10	330	10,000	(20)
63.	Acenaphthylene	208-96-8	10	330	10,000	(20)
64.	2,6-Dinitrotoluene	606-20-2	10	330	10,000	(20)
65.	3-Nitroaniline	99-09-2	25	800	25,000	(50)
66.	Acenaphthene	83-32-9	10	330	10,000	(20)

Previously known by the name bis(2-Chloroisopropyl) ether

TABLE A-4 (cont.)

Superfund Target Compound List (TCL) and Contract Required Quantitation Limits (CRQL)

	Semivolatiles	CAS Number	Quantitation Limits* Water µg/L	Low Soil µg/Kg	Med Soil µg/Kg	On Column (ng)
67.	2,4-Dinitrophenol	51-28-5	25	800	25,000	(50)
68.	4-Nitrophenol	100-02-7	25	800	25,000	(50)
69.	Dibenzofuran	132-64-9	10	330	10,000	(20)
70.	2,4-Dinitrotoluene	121-14-2	10	330	10,000	(20)
71.	Diethylphthalate	84-66-2	10	330	10,000	(20)
72.	4-Chlorophenyl phenyl ether	7005-72-3	10	330	10,000	(20)
73.	Fluorene	86-73-7	10	330	10,000	(20)
74.	4-Nitroaniline	100-01-6	25	800	25,000	(50)
75.	4,6-Dinitro-2-methylphenol	534-52-1	25	800	25,000	(50)
76.	N-nitrosodiphenylamine	86-30-6	10	330	10,000	(20)
77.	4-Bromophenyl phenyl ether	101-55-3	10	330	10,000	(20)
78.	Hexachlorobenzene	118-74-1	10	330	10,000	(20)
79.	Pentachlorophenol	87-86-5	25	800	25,000	(50)
80.	Phenanthrene	85-01-8	10	330	10,000	(20)
81.	Anthracene	120-12-7	10	330	10,000	(20)
82	Carbazole	86-74-8	10	330	10,000	(20)
83.	Di-n-butyl phthalate	84-74-2	10	330	10,000	(20)
84.	Fluoranthene	206-44-0	10	330	10,000	(20)
85.	Pyrene	129-00-0	10	330	10,000	(20)
86.	Butyl benzyl phthalate	85-68-7	10	330	10,000	(20)
87.	3,3'-Dichlorobenzidine	91-94-1	10	330	10,000	(20)
88.	Benz(a)anthracene	56-55-3	10	330	10,000	(20)
89.	Chrysene	218-01-9	10	330	10,000	(20)
90.	bis(2-Ethylhexyl)phthalate	117-81-7	10	330	10,000	(20)
91.	Di-n-octyl phthalate	117-84-0	10	330	10,000	(20)
92.	Benzo(b)fluoranthene	205-99-2	10	330	10,000	(20)
93.	Benzo(k)fluoranthene	207-08-9	10	330	10,000	(20)
94.	Benzo(a)pyrene	50-32-8	10	330	10,000	(20)
95.	Indeno(1,2,3-cd)pyrene	193-39-5	10	330	10,000	(20)
96.	Dibenz(a,h)anthracene	53-70-3	10	330	10,000	(20)
97.	Benzo(g,h,i)perylene	191-24-2	10	330	10,000	(20)

* Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the Laboratory for soil/sediment, calculated on dry weight basis as required by the Protocol, will be higher.

Superfund Target Compound List (TCL) and Contract Required Quantitation Limits (CRQL)*

	Pesticides/Aroclors	CAS Number	Quantitation Limits* Water µg/L	Soil µg/Kg	On Column (ng)
98.	alpha-BHC	319-84-6	0.05	1.7	5
99.	beta-BHC	319-85-7	0.05	1.7	5
100.	delta-BHC	319-86-8	0.05	1.7	5
101.	gamma-BHC (Lindane)	58-89-9	0.05	1.7	5
102.	Heptachlor	76-44-8	0.05	1.7	5
103.	Aldrin	309-00-2	0.05	1.7	5
104.	Heptachlor epoxide	1024-57-3	0.05	1.7	5
105.	Endosulfan I	959-98-8	0.05	1.7	5
106.	Dieldrin	60-57-1	0.10	3.3	10
107.	4,4'-DDE	72-55-9	0.10	3.3	10
108.	Endrin	72-20-8	0.10	3.3	10
109.	Endosulfan II	33213-65-9	0.10	3.3	10
110.	4,4'-DDD	72-54-8	0.10	3.3	10
111.	Endosulfan sulfate	1031-07-8	0.10	3.3	10
112.	4,4'-DDT	50-29-3	0.10	3.3	10
113.	Methoxychlor	72-43-5	0.50	17.0	50
114.	Endrin ketone	53494-70-5	0.10	3.3	10
115.	Endrin aldehyde	7421-36-3	0.10	3.3	10
116.	alpha-Chlordane	5103-71-9	0.05	1.7	5
117.	gamma-Chlordane	5103-74-2	0.05	1.7	5
118.	Toxaphene	8001-35-2	5.0	170.0	500
119.	AROCLOR-1016	12674-11-2	1.0	33.0	100
120.	AROCLOR-1221	11104-28-2	1.0	67.0	200
121.	AROCLOR-1232	11141-16-5	1.0	33.0	100
122.	AROCLOR-1242	53469-21-9	1.0	33.0	100
123.	AROCLOR-1248	12672-29-6	1.0	33.0	100
124.	AROCLOR-1254	11097-69-1	1.0	33.0	100
125.	AROCLOR-1260	11096-82-5	1.0	33.0	100

* Quantitation Limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the Laboratory for soil/sediment, calculate on dry weight basis, as required by the Protocol, will be higher.

TABLE A-4(cont.)

SUPERFUND-CLP INORGANICS

Superfund Target Compound List (TCL) and Contract Required Quantitation Limit

Parameter	Contract Required Quantitation Level (µg/L)
1. Aluminum	200
2. Antimony	60
3. Arsenic	10
4. Barium	200
5. Beryllium	5
6. Cadmium	5
7. Calcium	5000
8. Chromium	10
9. Cobalt	50
10. Copper	25
11. Iron	100
12. Lead	3
13. Magnesium	5000
14. Manganese	15
15. Mercury	0.2
16. Nickel	40
17. Potassium	5000
18. Selenium	5
19. Silver	10
20. Sodium	5000
21. Thallium	10
22. Vanadium	50
23. Zinc	20
24. Cyanide	10

Table A - 5

SAMPLE BOTTLE REQUIREMENTS

PARAMETER	MEDIA	TOTAL # SAMPLES	SAMPLE PRESERVATIVE	SAMPLE (Per) CONTAINER (Sample)	CONTAINER TYPE
Volatile Organics	Ground water	37	Cool, 4°C	2 - 40 ml VOA vials	B
Semi-Volatiles (inc. pesticides & PCBs)	Ground water	32	Cool, 4°C	2 - 80 oz. amber glass bottles	A
Metals	Ground water	32	Cool, 4°C HNO_3 to pH <2	1 - 1 liter polyethylene bottle	C
Cyanide		32	Cool, 4°C NaOH to pH >12	1 - 1 liter polyethylene bottle	C
Conventionals					
Chloride	Ground water	25	Cool, 4°C	1 - 1 liter polyethylene bottle	C
Sulfate	Ground water	25	Cool, 4°C	(1)	
Bicarbonates	Ground water	25	Cool, 4°C	(1)	
Volatile Organics	Soil	7	Cool, 4°C	1 - 120 ml glass vials	D
Semi-Volatiles (Inc. Pesticides & PCBs)	Soil	7	Cool, 4°C	1 - 8 oz wide-mouth glass jar	F
Metals & Cyanide	Soil	7	Cool, 4°C	1 - 8 oz wide-mouth glass jar	F

(1) Analysis to be run on aliquot from chloride sample container.

PBLF.P3

To maintain a record of sample collection, transfer between personnel, shipment, and receipt by the laboratory, a Chain-of-Custody (see Figure A-4) and the Contract Lab Sample Information Sheet (Figure A-5) will be completed for each sample cooler that is shipped to the laboratory. Each time the samples are transferred to another custodian, signatures of the person relinquishing the sample and receiving the sample, as well as the time and date, should document the transfer.

The team member performing the sampling is personally responsible for the care and custody of the samples collected until they are transferred or dispatched properly. In follow-up, the sampling team leader reviews all field activities to confirm that proper custody procedures were followed during the field work. The top original signature copy of the Chain-of-Custody is enclosed in plastic and secured to the inside of the cooler lid. A copy of the custody record is retained for CDM's files.

Each sample submitted for analysis will be properly documented to ensure timely, correct and complete analysis for all parameters requested, and to support use of analytical data in potential enforcement actions.

14. Calibration Procedures and Preventive Maintenance

Each piece of equipment used in activities affecting quality is calibrated and maintained periodically to assure accuracy within specified limits. At a minimum, calibration and maintenance procedures conform with the manufacturer's specifications. The manufacturer's specifications for each piece of equipment are available to CDM personnel upon request.

All equipment used in analysis or sampling has a documented maintenance and/or calibration procedure. These procedures are available to all personnel.

Calibration procedures and frequency of calibration for field equipment is an integral component of each instrument's Standard Operating Procedure. The relevant procedures are outlined in Section 7.0 of the SOP, dated July 5, 1988.

The NYSDEC laboratory is responsible for maintaining calibration and maintenance schedules for each piece of laboratory equipment.

15. Documentation, Data Reduction and Reporting

A. Documentation:

Field data will be entered into a bound notebook. All entries will be made in ink. No erasures will be permitted. If an incorrect entry is made, the data will be crossed out with a single strike mark and initialed. Each page shall be numbered, initialed, signed, and dated by the individual responsible for recordkeeping. All relevant data which includes sample code, location, names of

FIGURE A-4

CHAIN OF CUSTODY RECORD

Camp Dresser & McKee Inc. **CDM**

PROJECT NAME _____ PROJECT NUMBER _____

Field Log Book Reference No. _____

SAMPLE NUMBER	DATE	TIME	SAMPLE LOCATION	SAMPLE TYPE	ANALYSES: EXTR. ORG.	ANALYSES: VOA	ANALYSES: PEST. /PCB	ANALYSES: TRACE METALS	NUMBER OF CONTAINERS	LOG BOOK PG. NO.	REMARKS

SAMPLED BY (SIGN) _____ / _____ / _____

RELINQUISHED BY (SIGN)	RELINQUISHED BY (SIGN)	RELINQUISHED BY (SIGN)	RELINQUISHED BY (SIGN)	RELINQUISHED BY (SIGN)
① _____	② _____	_____	④ _____	⑤ _____
DATE/TIME (/)	DATE/TIME (/)	DATE/TIME (/)	DATE/TIME (/)	DATE/TIME (/)
RECEIVED BY (SIGN)	**RECEIVED BY (SIGN)**	**RECEIVED BY (SIGN)**	**RECEIVED BY (SIGN)**	**RECEIVED BY (SIGN)**
① _____	② _____	③ _____	④ _____	⑤ _____
DATE/TIME (/)	DATE/TIME (/)	DATE/TIME (/)	DATE/TIME (/)	DATE/TIME (/)

METHOD OF SHIPMENT	SHIPPED BY (SIGN)	RECEIVED FOR LABORATORY BY (SIGN)	DATE/TIME
_____	_____	_____	(/)

LEGEND: Original: Return to Sample Traffic Control Center
Copies: Ship with Samples

FIGURE A-5

Contract Lab Sample Information Sheet

74-18.1 (4/91)—Be

Return This Sheet to Room 301, 50 Wolf Road, Albany, New York 12233-3502

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

CONTRACT LAB SAMPLE INFORMATION SHEET

Part I

Print legibly

CAUTION (check if applicable)

☐ Lab Personnel are expected to use caution when handling DEC samples, however, please use special precautions when handling this sample since it is believed to contain significant concentrations of hazardous and/or toxic material(s).

Place QA Label Here

CHECK THE BOX PRECEDING THE REQUESTED ANALYSIS

PRIORITY POLLUTANTS (Water Part 136)—SPDES

- ☐ 2. 13 PP Metals
- ☐ 3. Volatiles—(USEPA 624 GC/MS)
- ☐ 6. Pesticides/PCB's (USEPA 608-GC)
- ☐ 4. Acids Base/Neutrals (USEPA 625-GC/MS)
- ☐ 5. Cyanide
- ☐ 9. BOD
- ☐ 7. Halogenated Volatiles (USEPA 601-GC)
- ☐ 8. Aromatic Volatiles (USEPA 602-GC)
- ☐ 12. TSS
- ☐ 10. pH
- ☐ 11. COD
- ☐ 15. Ammonia
- ☐ 13. Settleable Solids
- ☐ 14. TKN
- ☐ 16. Reactive Phosphorus
- ☐ 16. Nitrate/Nitrite
- ☐ 17. Total Phosphorus
- ☐ 21. Total Phenols
- ☐ 19. Oil/Grease
- ☐ 20. TOC
- ☐ 80. PCB's congener method
- ☐ 22. Other _____
- ☐ 59. PCB's at 0.065 ug/L
- ☐ 64. Total Solids
- ☐ 62. CBOD
- ☐ 65. Volatiles (USEPA 524.2 GC/MS)

CONTRACT LABORATORY PROTOCOLS

- ☐ 23. (ALL)—Water—Includes 24-28
- ☐ 29. (ALL)— Soil/Sediments—Includes 30-34
- ☐ 24. Base/Neutral/Acid (B/N/A)—Water—GC/MS (ASP 89-2)
- ☐ 30. B/N/A—Soils/Sediment—GC/MS (ASP 89-2)
- ☐ 25. Volatile Organic Analysis VOA—Water—GC/MS(ASP 88-1)
- ☐ 31. VOA—Soils/Sediments—GC/MS (ASP 89-1)
- ☐ 26. Pesticides/PCB's—Water—GC(ASP 89-3)
- ☐ 32. Pesticides/PCB's—Soils/Sediment—GC (ASP 89-3)
- ☐ 27. Metals—23 in Water
- ☐ 33. Metals—23 inSoil/Sediment
- ☐ 28. Cyanide—Water
- ☐ 34. Cyanide—Soils/Sediment
- ☐ 66. Dioxin-Water (ASP 89-4)
- ☐ 67. Dioxin-Soil/Sediment (ASP 89-4)
- ☐ 35. Other _____

HAZARDOUS WASTES/RCRA ANALYSIS SW-846

- ☐ 36. EP Toxicity
- ☐ 37. EP Toxicity (Metals Only)
- ☐ 38. Ignitability
- ☐ 39. Corrosivity
- ☐ 40. VOA—(USEPA 8240-GC/MS)
- ☐ 41. BNA—(USEPA 8270-GC/MS)
- ☐ 42. Pesticides/PCB's (USEPA 8080)
- ☐ 43. TCLP
- ☐ 44. TCLP (Metals Only)
- ☐ 45. Reactivity
- ☐ 46. Dioxin (USEPA 8280)
- ☐ 47. Appendix IX
- ☐ 48. Other _____
- ☐ 63. Percent Solids
- ☐ 68. Metals—17 Hazardous

MUNICIPAL SLUDGE

- ☐ 49. RSGB-01 ☐ 50. RSSR-01 ☐ 51. RSGR-01 ☐ 52. RSRB-01 ☐ 53. RSRI-01 (EP Toxicity-Metals only + RSRR-01)
- ☐ 54. RSRO-01 ☐ 55. RSSB-01 ☐ 56. RSRR-01 ☐ 57. RSRR-02 ☐ 58. Other _____

COLLECTED BY:	TELEPHONE NUMBER:	REGION NO:

CONTRACT LAB:	COUNTY:	SAMPLING DATE:	MILITARY TIME:

SAMPLE MATRIX:

☐ Air ☐ Soil/Sediment ☐ Groundwater ☐ Surface Water ☐ Wastewater ☐ Other (Specify) _____

CASE NUMBER	SDG NUMBER	SAMPLE NUMBER	CHECK FOR MS/MD	TYPE OF SAMPLE:
			☐ This Sample	☐ Grab ☐ Composite ☐ Term ____ hrs

☐ Check if there will be more samples with this SDG sent in this calendar week

Report via Category B, unless checked ☐

SAMPLING POINT:	Check if field duplicate ☐	Outfall Number	Check if sampling is part of inspection ☐
	SPDES NUMBER/REGISTRY NUMBER		FLOW GPD MGD

sampling personnel, and date, will also be provided in a separate sampling trip report. This report will be transmitted to NYSDEC.

B. Data Reduction and Reporting:

Hardcopies of the analytical data will be used to input data into CDM's Infraworks Hazardous Waste RI/FS Module (HazMOD). HazMOD is a computer program designed to assist in the management and display of information relating to the site.

16. Data Validation

Data validation will be performed by NYSDEC.

17. Performance and Systems Audits

A performance field audit may be performed for this project. A systems audit may also be performed upon project completion. These audits will follow the CDM QA audit procedures.

18. Corrective Action

When a nonconformance or deficiency is identified during a formal or routine performance or systems audit, the auditor will inform the Division's Quality Assurance Manager who will require corrective action to be initiated. The auditor will also be responsible for ensuring that the corrective action has indeed been taken and that it adequately addresses the nonconformance. A Nonconformance Report Form (see figure 13-1 in SOP) will be filed for all non-laboratory related deficiencies. The auditing team leader shall document the completion of the audit when the auditor is satisfied that any deficiencies identified during the audit have been addressed through corrective actions.

19. Reports

The Remedial Investigation report produced for this project will follow CDM's standard QA/QC protocol and appropriate review control gates.

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