DURACELL, INC.
NORTH TARRYTOWN, NEW YORK

ENGINEERING REPORT EVALUATING ON-SITE RESIDUES

CONFIDENTIAL

Report No. 7

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EXECUTIVE SUMMARY

Duracell, Inc. owns and operates a battery manufacturing plant located at 60 Elm Street, North Tarrytown, New York. In 1985 Duracell moved its manufacturing operation to another site and undertook an evaluation of the plant to identify feasible future uses. In October, 1985, Duracell concluded that the building should be demolished and the land placed on the market for sale.

Eder Associates Consulting Engineers, P.C. (EA) was retained during the evaluation to investigate plant conditions with respect to the potential presence and characteristics of residues on interior surfaces of the plant building and site soils. EA identified the presence of residues containing metals on interior surfaces of the building. On-site soils also showed the presence of the same metals. Environ Corporation was retained to perform a risk assessment and determine acceptable concentrations of metals on site soils. Environ considered several scenarios of future use for the site. They determined acceptable concentrations using the most conservative assessment assumptions including the most severe exposure scenarios.

Duracell plans to clean the building prior to demolition in accordance with solid waste disposal regulations. In addition, prior to placement of the land on the market for sale, Duracell will remove and dispose site soils containing metals in excess of the level determined to be appropriate to protect public health under all foreseeable future land uses.

This report presents results of the investigation and documents the remediation work to be performed.

I. INTRODUCTION

Background

Duracell, Inc. owns and operates a battery manufacturing plant located at 60 Elm Street, North Tarrytown, New York. Duracell has owned the plant since the late 1940's and has manufactured batteries using a variety of processes involving the blending and pelletizing such materials as zinc powder, mercury, mercuric oxide, silver oxide and lead compounds. The use of zinc, mercury and silver compounds ceased approximately ten years ago. Lead compounds have been used from the mid 1970's to the present.

Duracell has moved its manufacturing operations to another site and undertook an evaluation of the plant to identify feasible future uses including establishing alternative manufacturing operations, other corporate uses and divestiture of the property. In October, 1985 Duracell concluded that the building should be demolished and the land placed on the market for sale.

As part of the evaluation, EA was retained to investigate plant conditions with respect to the potential presence of residues, resulting from prior manufacturing operations, which may remain on the interior surfaces of the plant building and site soils. This report presents the findings of the investigation.

Summary

A sampling program for the interior of the plant building and on-site soils was performed. Past manufacturing activities involved the use of heavy metals. Samples were therefore analyzed for the presence of those heavy metals defined under the characteristic of EP toxicity.

The investigation identified a thin film of residue on interior surfaces of the plant building. The residue contains metals of which lead, mercury and zinc occur in the highest concentrations. Residues containing these metals have also accumulated in ductwork systems, air pollution control equipment, floor trenches and interior manholes. Liquids remaining in some storage tanks would be considered hazardous wastes if disposed.

Surface soil samples throughout the property show the presence of mercury and zinc. Mercury concentration in particular is higher than would be normally anticipated in soils. The highest concentrations occur in the southeast yard area of the property. The lead concentration of some surface soil samples in the yard area are also elevated.

The mercury content of soils generally decreases to values typically found in soils within a few feet of the surface. In the yard area, where surface soil mercury concentrations are highest, mercury concentrations decrease to typical values at a maximum depth of 25 feet. Lead concentrations also decrease to typical values within a few feet of the surface. Borings were driven to refusal and no groundwater was encountered. This data shows that metals in the soil have not penetrated to the groundwater.

Environ Corporation, Princeton, New Jersey was retained to perform a risk assessment and determine acceptable concentrations of metals on site soils. Environ considered several scenarios of future use for the site. Under an exposure scenario where the site would be developed as residences, the same land use as adjacent properties, the following acceptable soil metal concentrations were determined:

lead:	4860 mg/kg
mercury:	581 mg/kg

The most severe exposure scenario assumes that a day care center would be established on the site, resulting in small children, the most vulnerable segment of the population, being exposed for extended periods of time to the site soils. Environ further assumed the relatively rare condition that the day care center population would include a pica child, who has an increased tendency to consume non-food items such as soil. For this scenario, Environ determined the following acceptable soil metal concentrations:

lead:	485 mg/kg
mercury:	87 mg/kg

The presence of zinc was determined not to pose a health hazard.

Conclusions

Duracell plans to remove and dispose of the building. Available disposal sites for building demolition debris in its existing condition is limited. The most feasible alternative is to clean the building prior to demolition. Residues removed and materials used in the cleaning operations to be discarded must be analyzed to determine their characteristics and be disposed in accordance with applicable regulations. Demolition debris from the cleaned building can be disposed to local landfills permitted for the disposal of construction and demolition debris. Demolition and disposal of the building in its existing condition is not economically feasible primarily because of the cost of transportation and disposal to distant industrial and hazardous waste landfills.

Environ determined acceptable soil metal concentrations under several exposure scenarios. Removal of on-site soils, containing metals in excess of acceptable concentrations reflecting residential land use, is appropriate to protect the public health. Additional removal of soils, containing metals in excess of acceptable concentrations reflecting the most severe exposure scenario, will maximize protection of public health.

Remediation Program

It is Duracell's policy to achieve demolition and divestiture of the property in a manner which maximizes protection of public health and in accordance with solid waste management regulations. Duracell is prepared to undertake the following remediation program:

(1) Remove accumulated residues and materials from ductwork, equipment, floor trenches and manholes.

These materials will be disposed of in accordance with hazardous waste management regulations.

(2) Test clean the interior surfaces of a selected room of the building followed by surface sampling to document cleaning techniques and the results which can be achieved.

(3) Secure permission for disposal of the building demolition debris to a landfill approved for construction and demolition debris.

(4) Clean the surfaces of the building using the documented cleaning techniques.

(5) Sample interior surfaces of the building to document the results achieved.

(6) Demolition of the building and disposal in accordance with item 3.

(7) Removal of on-site soils containing metals in excess of acceptable concentrations reflecting the most severe exposure scenario.

The removed soils will be disposed of in accordance with solid and hazardous waste management regulations. Additional soil testing will be performed prior to removal to define areas of potentially hazardous wastes.

(8) Conduct a follow-up soil investigation in the excavated areas to demonstrate that affected soils have been removed.

(9) Replace of soils with clean fill.

II. EXISTING CONDITIONS

Site Description

Duracell, Inc. owns and operates a battery manufacturing plant located at 60 Elm Street, North Tarrytown, New York. A location map is presented in Figure 1 and a Plot Plan is presented in Drawing 1, following Section VI. The plant includes two parcels of property at the intersection of Elm Street and Andrews Lane. The plant building is located on the 1.6 acre parcel east of Andrews Lane and south of Elm Street. There is a paved 1.0 acre parking lot west of Andrews Lane. The properties are located on a bluff at an elevation of 50 feet above mean sea level, approximately 900 feet from the Hudson River. Grade elevation drops west and north of the properties to the river shore level.

The land at the base of the bluff to the north of the Duracell plant is undeveloped. A paved parking lot lies to the northwest, and there is a park to the west. Further to the north is park land. The General Motors assembly plant is located to the west along the banks of the Hudson River. Land use to the south and east of the plant, on the bluff and at the same elevation, is residential.

Facility Description

Duracell has owned these properties since the late 1940's and has manufactured batteries using a variety of processes. Prior to Duracell ownership, the properties were owned by Westchester Edison for use as a garage and vehicle maintenance facility.

A plot plan of the east property parcel is presented in Drawing 2, following Section VI. The plant building, constructed in phases from about 1910 through 1960, covers most of the property. The building is one story high, except for the northwest portion which is two story. The north central portion has an attic space. The only below grade construction is a boiler room.

FIGURE 1

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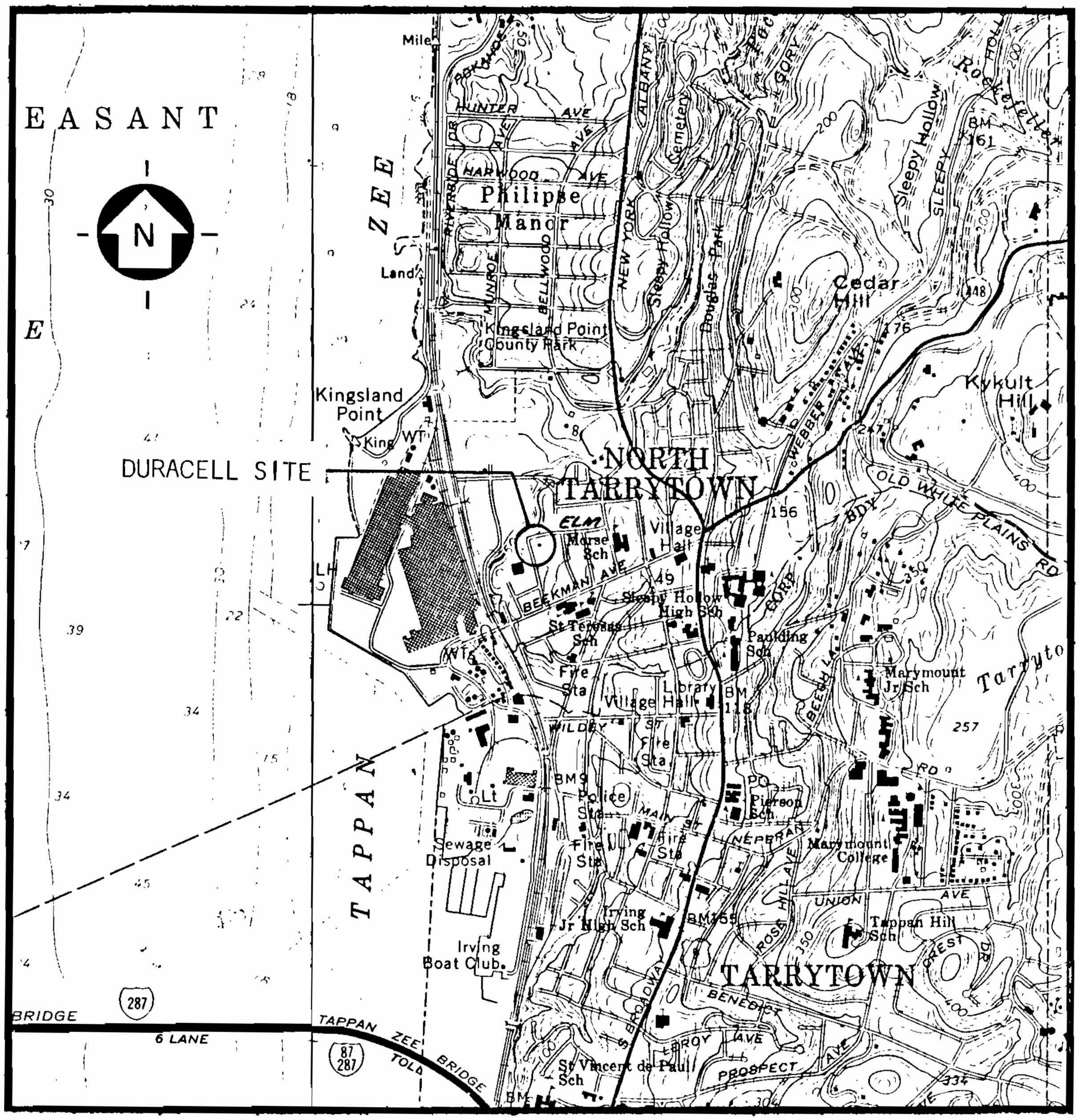
NORTH TARRYTOWN, NEW YORK



Scale 1" = 2400"

LOCATION MAP

The front yard set back along Elm Street is grassed with paved driveways and sidewalks. The side yard set back to the east is also a grassed area. A concrete pit is located along this setback. The property to the northeast is a residence owned by Duracell. A paved driveway entrance is located along the south property line. The south yard area is generally paved and includes a buried No. 2 fuel oil storage tank and metal shed.

Space uses of the plant include manufacturing, shipping and receiving, laboratory, offices and employee facilities. For this study, the plant interior is divided into 15 separate analysis areas defined by use and isolated by enclosure walls and generally served by separate air handling systems. The areas are designated on Drawing 2 and listed in Table 1. Designated uses are based on current practices. Some areas were used for different purposes in the past. For example area 6, which is presently a maintenance shop, was formerly used for manufacturing. Some areas, such as 4, 5, 11 and 15 were constructed in the last 10 years. Area 11, called the dry room, is an isolated temperature and humidity controlled room with airlocks. Area 15 is used to store RCRA listed hazardous waste.

There are 10 air handling units (AHU) served by roof mounted air cooled condensors. These are designated AHU 1 through 9. An additional AHU is located in room 56. AHU units 1 and 3 through 9 supply conditioned air to nearby rooms in a single area through supply air ducts. Air is returned directly to the unit through filters. AHU 2 provides conditioned air to rooms 28, 46 and 46A of area 7 and to part of area 3 through supply air duct 2 (SAD-2). Air is returned from the areas through return air duct 2 (RAD-2). Since rooms 28, 46 and 46A have different uses from area 3 and are otherwise isolated, they are considered a separate analysis area. Room 29, located between rooms 28 and 46, is isolated from area 7 and is considered part of area 3.

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TABLE 1

BUILDING ANALYSIS AREAS

Area	Use	Air Handling or Exhaust System
1	Offices	AHU-5 and 6
2	Offices	AHU-4
3	Manufacturing	AHU-1
	Maintenance Shop	AHU-2 (partial)
	Shipping	ED-4
	Locker and Showers	ED-5
4	Manufacturing	ED-6
5	Manufacturing	Exhaust to Baghouse & cyclones
6	Maintenance Shop	
7	Manufacturing	AHU-2 (partial)
	Laboratory	ED-3
8	Manufacturing	ED-2
9	Manufacturing	ED-1
10	Shipping	
11	Manufacturing	
12	Office	AHU 7, 8, 9
	Cafeteria	ED-7, 8
	Laboratory	
13	Attic	
14	Boiler Room	
15	Hazardous Waste Storage Facility	

NOTE: AHU = air handling system
ED = exhaust duct system

Area 11 consists of room 44, an isolated temperature and humidity controlled room with air locks, 44A and 44B. The air handling unit is located in room 56. The hung ceiling above room 44 is divided into supply and return air plenums. Air is returned into room 56, enters the air handling unit through filters and is returned to the supply air plenum. A crawl space is located above room 44. These rooms are analyzed as the following separate areas:

Area 11	room 44 and air locks - floor
Area 11A	room 44 - supply air plenum
Area 11B	room 44 - return air plenum and room 56
Area 11C	crawl space - floor

There are eleven exhaust duct systems serving manufacturing operations. These are designated ED-1 through 8. Three other systems exhaust through baghouses and cyclones. This does not include window exhaust fans, equipment such as ovens which exhaust outside, or ventilation shafts to the boiler room.

System ED-1, serving area 9, exhausts through a scrubber. This system was installed in the late 1970's.

The exhaust duct system serving area 5 exhausts through baghouses located in the areaway outside the buildings. A piped high vacuum system, also serving area 5, exhausts through cyclones located next to the baghouses. Ductwork and piping to the baghouse and cyclones had previously served area 11 prior to the construction of the dry room. Another exhaust duct system located in area 3 exhausts through a small baghouse located inside the building.

The plant is served by municipal sanitary sewers. Some building drains are shown on Drawing 2. A branched floor trench running north-south through area 3 discharges through a building drain at the northwall. Two other building drains are located along the west wall, one of which serves floor drains in area 8. The interconnection of building drains for wastewater and stormwater disposal is not completely defined, and the discharge of some miscellaneous floor drains and internal manholes are not known.

Storm water runoff in the front yard discharges through driveway drains into the sanitary sewer. Runoff from the south yard area flows to the east and percolates into the ground near the southeast corner of the plant building. Roof drains along the north and west walls presumably discharge to the sanitary sewer. Roof drains along the east and south walls discharge onto the ground. There are no known dry wells on the property.

Manufacturing Activities

A variety of battery types have been manufactured at the plant, including:

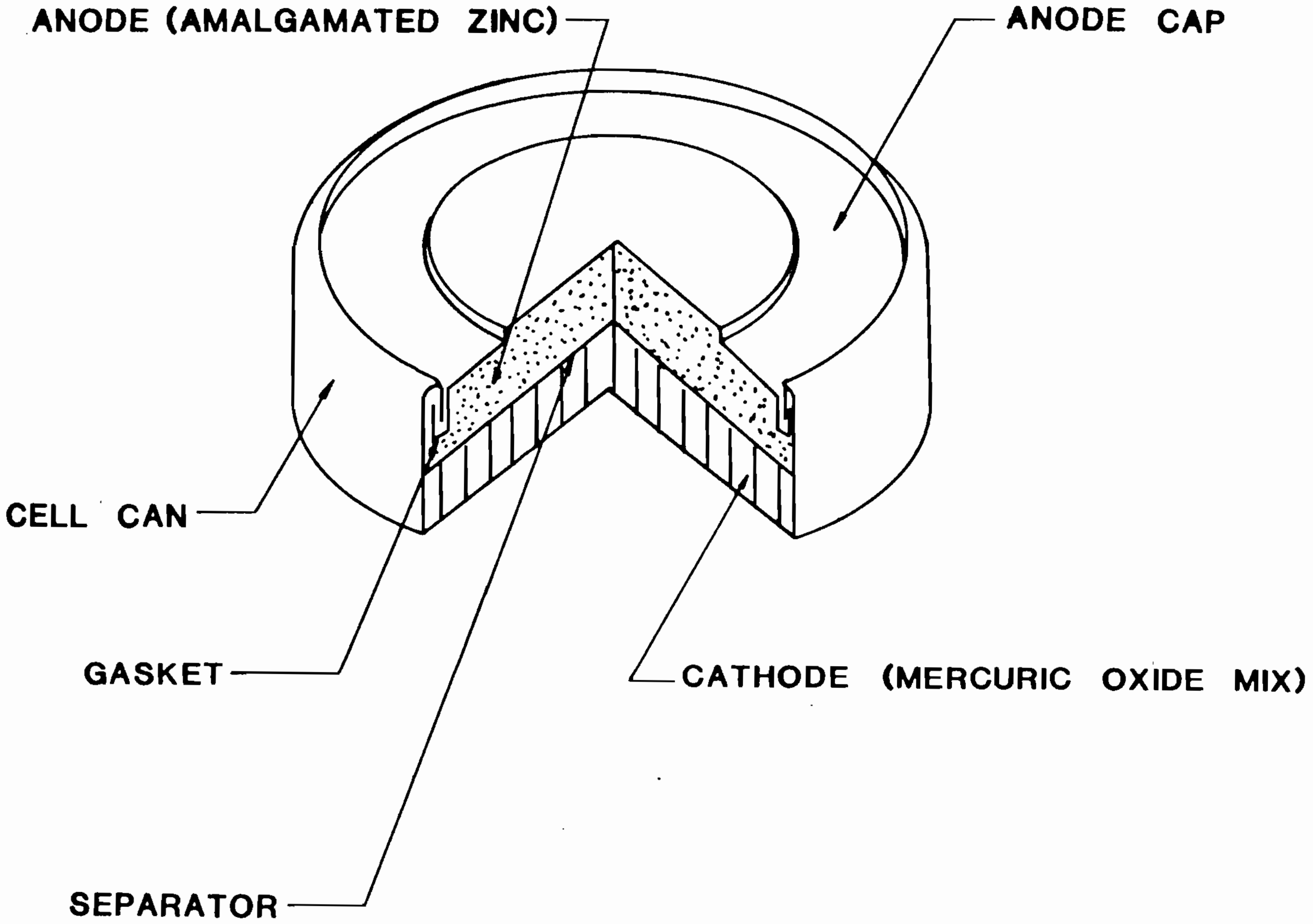
Type	Production Period
mercury-zinc cells	late 1940's to mid 1970's
silver oxide-zinc cells	mid 1960's to mid 1970's
lithium-SO_2 cells	mid 1970's to 1985
lithium solid cells	mid 1970's to early 1980's

Several other types of batteries were also manufactured in limited quantities for prototype and test purposes.

A battery consists of one or more cells each containing two electrodes, an anode and a cathode, and an insulating porous separator and electrolyte assembled in a protective case. Electrodes consist of an active material which undergoes electrochemical reaction, a current collector and a support.

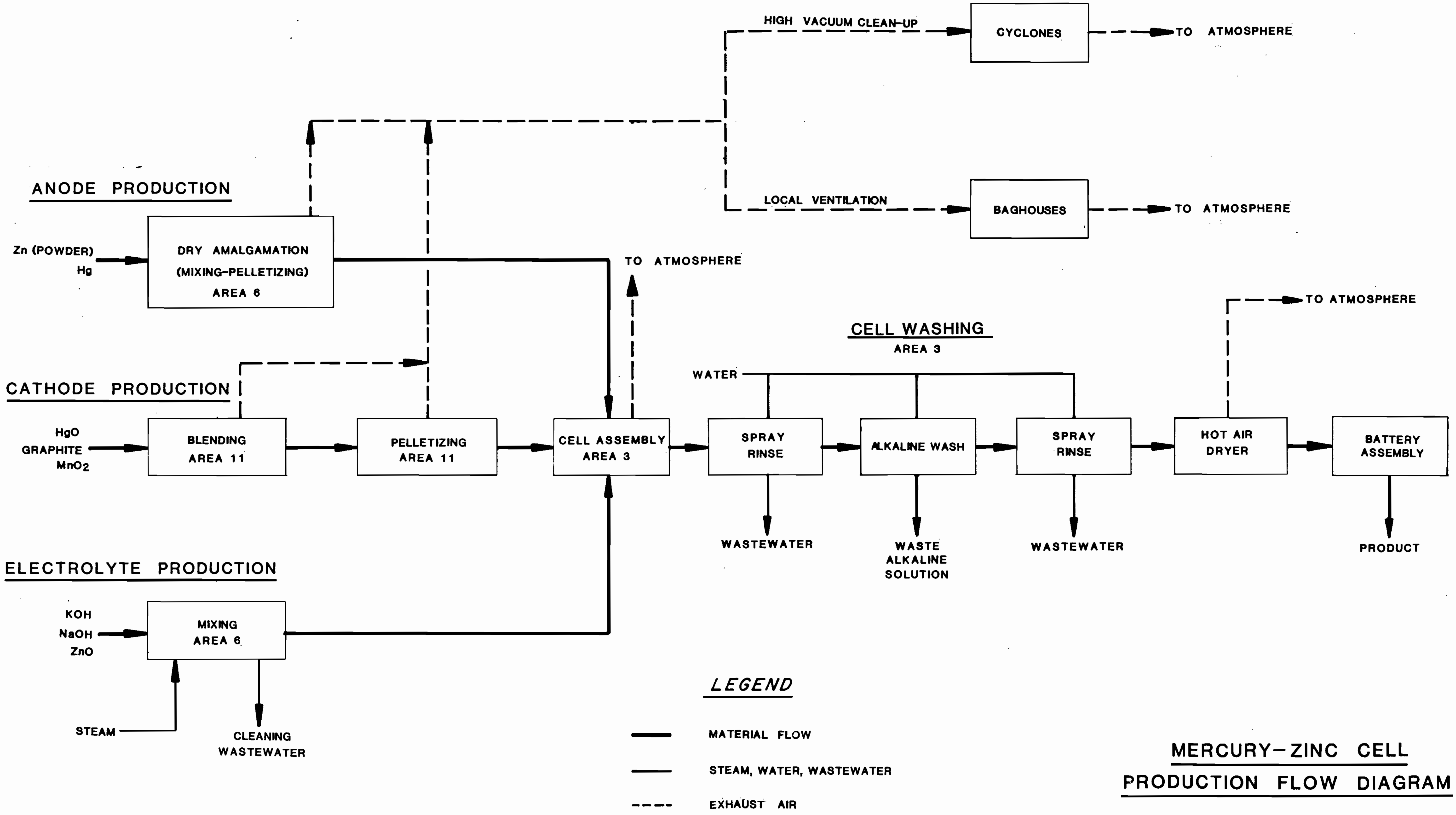
The earliest types of zinc batteries produced at the facility are illustrated in Figure 2. A production flow diagram is presented in Figure 3. The anode was amalgamated zinc produced by the dry amalgamation process. In this process, performed in Area 6, zinc

FIGURE 2



TYPICAL MERCURY-ZINC CELL

FIGURE 3



MERCURY–ZINC CELL
PRODUCTION FLOW DIAGRAM

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powder and metallic mercury were mixed and pressed into pellets. The pellets were collected in plastic containers which were sealed and transferred to the cell assembly area. After the 1950's, premixed granular zinc coated mercury was purchased and only pelletizing was performed on-site. The cathode was produced by blending mercuric oxide with graphite and manganese dioxide and pelletizing. Prior to the construction of the existing dry room, the blending and pelletizing operations were performed in area 11. The cathode pellets were pressed into cell cans and transferred to the cell assembly area. Metallic mercury was received in 15 pound flasks. Zinc, mercuric oxide, graphite and manganese dioxide for anode and cathode production were received in powder form packaged in cardboard containers. Dust control in areas 6 and 11 was provided by local ventilation exhausted through the existing outside baghouses.

Cell electrolyte was a mixture of sodium and potassium hydroxide and zinc oxide. Hydroxide solutions were received in 55 gallon drums. The materials were mixed in a steam kettle, cooled, pumped into 5 gallon containers and transferred to the cell assembly area. This mixing operation was also performed in area 6.

Cell assembly was performed manually on a conveyor line along the east wall of area 3. Areas 4 and 5, which were constructed at a later date, did not exist at this time. Anode pellets and electrolyte were manually added to the cell cans which were then sealed. Cells were then washed by rinsing, alkaline cleaning and final rinsing. Cleaned cells were dried and assembled into batteries and packaged for shipment. Rinse wastewater was discharged into the open grate floor trench in area 3. Dust control was provided by local ventilation exhausted to the atmosphere.

Equipment and dry spills were cleaned using a high vacuum system which discharged through the existing outside cyclones. Electrolyte production equipment was periodically cleaned by wet washing.

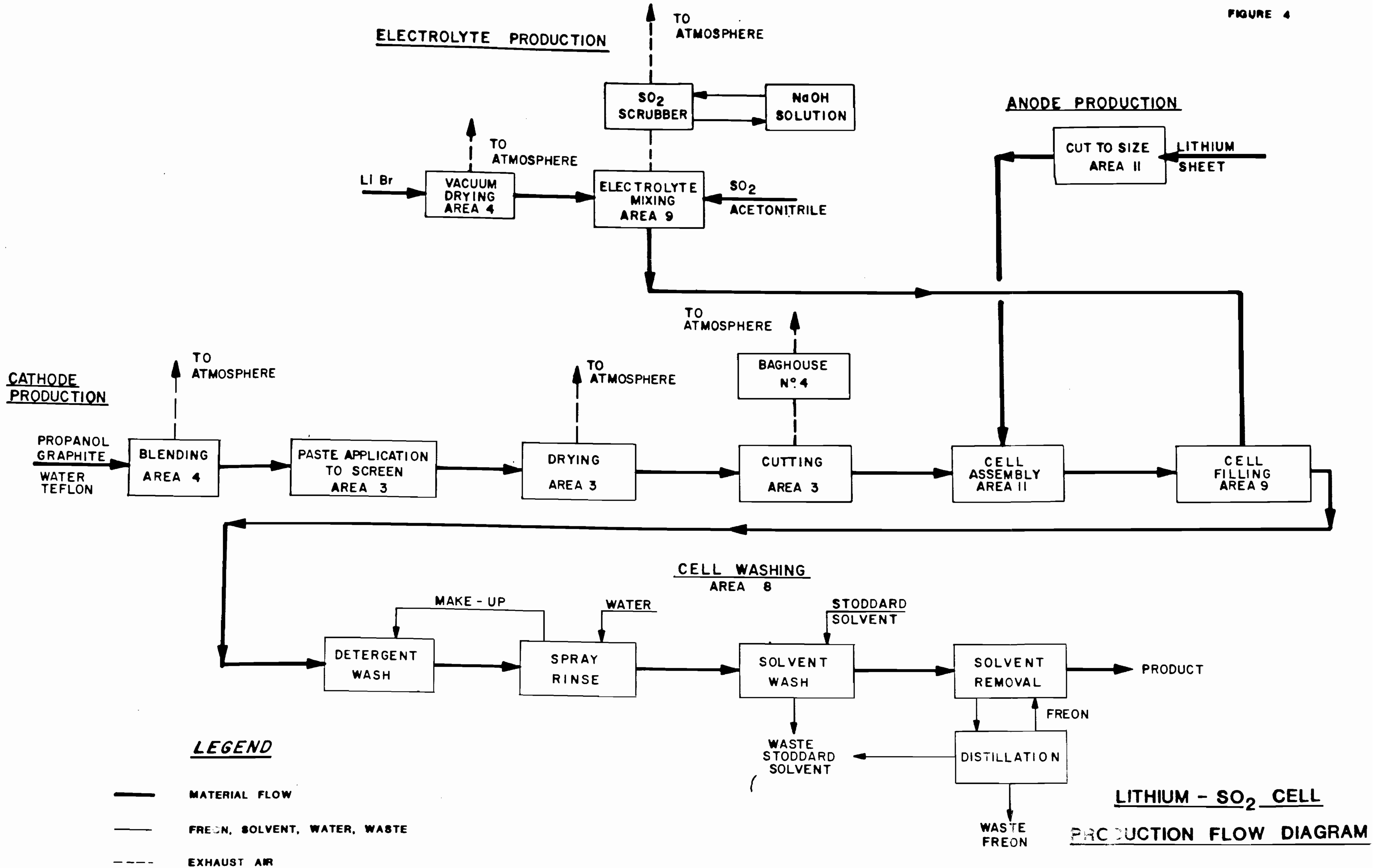
Silver oxide-zinc cells were produced in the same manner as mercury-zinc cells, except that silver oxide was used instead of mercuric oxide in cathode production.

Since about 1975, production has been limited to lithium type batteries. Since lithium reacts with water, the material must be handled under dry conditions. The dry room was constructed in area 11 to provide a humidity controlled environment for anode production. Other operations involving lithium are performed in environmentally controlled glove boxes or closed systems. Areas 4 and 5 were also constructed at this time for lithium battery manufacture.

A production flow diagram for lithium SO_2 cells is presented in Figure 4. Anode strips are cut from lithium sheets in the dry room. The cathode is produced by formulating a paste of graphite, propanol, water and teflon dispersant which is applied to an aluminum screen, dried and cut to size. Blending is performed in area 4 under local ventilation exhausted to the atmosphere. Application, drying and cutting is performed along the east wall of area 3. Gas and electric fired drying ovens discharge directly to the atmosphere. Dust control for the cutting operation is provided by local ventilation exhausting through baghouse No. 4. The cathodes are transferred to the dry room for installation with anodes into cell cans. The cans are capped and transferred to area 9 for filling with electrolyte.

Cell electrolyte consists of sulfur dioxide, SO_2, mixed in an organic solvent, acetonitrile, with an inorganic salt, lithium bromide. The salt is received in sealed containers and vacuum dried in area 4 to remove any residual moisture. The salt is transferred, in a helium filled glove box, from the shipping container into a closed drying vessel which is placed in a drying oven. A small pressure relief valve on top of the vessel is opened. The vacuum electric drying oven exhausts to the atmosphere. After the drying period, the glove box is again filled with helium and the relief valve is closed. The dry salt is then transferred from the drying vessel into a filling vessel. Salt losses to the atmosphere are negligible.

FIGURE 4



LITHIUM - SO_2 CELL

PRODUCTION FLOW DIAGRAM

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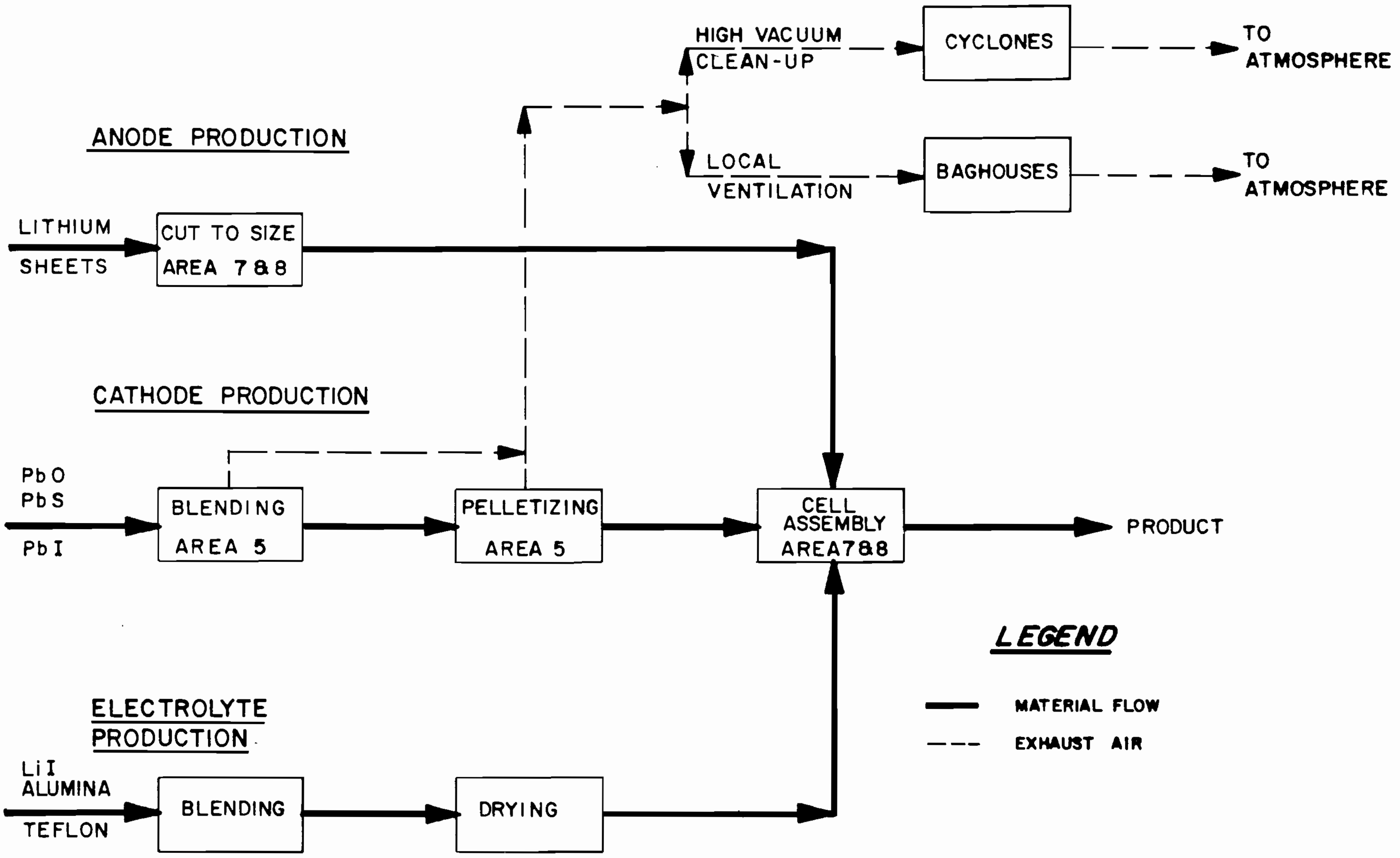
Electrolyte is mixed and cell cans are filled in a continuous closed system in area 9. SO_2 from liquid storage tanks is dispersed under pressure into acetonitrile. The salt is added to the electrolyte from the filling vessel. Finally, the cell cans are filled and sealed. Local ventilation exhausting through a scrubber is provided to capture fugitive amounts of SO_2 which may be lost along the fill line.

The cells are then washed in area 8, assembled into batteries and packaged for shipment. Washing is performed by dipping in a biodegradable detergent wash tank followed by spray rinsing and dipping in solvent and freon tanks. Rinse water is recirculated to the detergent dip tank. The solvent removes water from the cells and freon removes solvent carryover. When solvent becomes contaminated with water, the tank contents are drumed and handled as hazardous waste. Freon is reclaimed in a still. Condensed vapors from the still consisting of solvent and water are collected and handled as hazardous waste. Periodically, the freon bath is discarded and handled as hazardous waste. There is no wastewater discharge from the cell washing operations.

A production flow diagram for lithium solid cells is presented in Figure 5. Anodes are punched from lithium sheets in glove boxes in areas 7 and 8. The cathode is produced by blending and pelletizing lead oxide, lead sulfide and lead iodide with a teflon powder. These operations are performed in area 5. Local ventilation through the existing outside baghouse is provided. Small quantities of electrolyte are also produced by blending and drying lithium iodide, alumina and teflon dispersant in a glove box. The anodes, cathodes and electrolytes are assembled into cells and batteries inside glove boxes and sealed by laser welding. These cells are not washed and do not generate wastewater.

Equipment handling dry materials is cleaned using a high vacuum system discharging through the cyclones. The lithium-SO_2 battery electrolyte mixing and filling equipment is periodically disassembled for cleaning. The parts are dipped in sodium hydroxide baths. Waste solution is handled as a hazardous waste.

FIGURE 5



LITHIUM SOLID CELL PRODUCTION FLOW DIAGRAM

III. METHOD OF INVESTIGATION

Introduction

EA made an initial walk-through survey of the plant in February, 1985 to assess conditions and to develop a sampling program. The building was divided into analysis areas based on usage and mechanical and structural characteristics. The various analysis areas are described in the preceding section. The survey disclosed that residues had accumulated in such locations as floor trenches, manholes and inside ductwork. It was noted that manufacturing raw materials are stored in tanks and residues remain in air pollution control equipment. A thin film of residue has been deposited on interior surface areas such as floors, shelf areas such as window sills, and on ceiling level surfaces such as electrical fixtures, piping and exterior ductwork surfaces.

Sampling programs for the interior of the building and on-site soils were planned based on the survey. The sampling program for the building interior included:

- interior surfaces
- ductwork
- air handling unit filters
- miscellaneous residues

An initial phase of on-site soil sampling was implemented, and based on the results of this phase, additional soil sampling phases were planned and implemented. The initial results suggested possible contamination of building roof surfaces which were then also sampled. The sampling programs are described in the succeeding chapters of this section.

Prior manufacturing activities involved the use of heavy metals, and samples were analyzed for the heavy metals specified in the EP toxicity test (40 CFR 261.24):

- Arsenic
- Barium
- Cadmium
- Chromium
- Lead
- Mercury
- Selenium
- Silver

Zinc was also used in manufacturing operations. Since a drinking water standard for zinc has been promulgated, samples were also analyzed for this metal. There was concern that, as a result of past experimental production programs containing wastewater, cyanide may have been discharged to the outdoor underground concrete pit. The liquid remaining in the pit and adjacent soil samples were also analyzed for cyanides. Analysis for lithium and organic compounds was not performed because the use of these materials was limited to enclosed and closely controlled operations.

Sampling of interior surfaces, ductwork and equipment was performed between March 18 and 22, 1985. The initial phase of soil sampling was performed between March 25 and 29, 1985.

Interior Surface Sampling

The building was divided into fifteen analysis areas described in Section II of this report and identified on Drawing 2. Within each area, (a predetermined number of one-half square foot sampling areas) samples of residue on the floor were collected by wiping with kimwipe tissues wetted with distilled water. Within each area, wipe samples were taken in representative rooms. The number of floor wipe samples in a room was in proportion to room area. In areas where there is significant horizontal surface areas at the ceiling level on electrical fixtures, piping and ductwork, wipe samples were similarly taken.

Wipe samples are summarized in Table 2. Floor and ceiling wipe samples from each area were collected in separate zip-lock plastic bags. A blank sample of kimwipe wetted with distilled water was taken for quality control. Samples were delivered to the laboratory on the same day collected.

Application of the wipe sample methodology to the floor of area 1 is summarized in Table 3. This area is an office area consisting of 10 rooms located in the northeast portion of the buildings. The rooms included reception, offices and restrooms. A total of 16 wipe samples covering 8 square feet were taken in the area. In smaller rooms, only one wipe sample was taken. In room 5, which constitutes almost 50 percent of the total floor area, eight wipes, one-half of the total were taken. These wipe samples were collected in one bag designated A-1-F. Six wipes covering three square feet was also taken from piping and ductwork at the ceiling level of area 1. This sample was designated A-1-C. Other areas were similarly sampled.

In area 8 there is no piping and relatively little ductwork at the ceiling. Therefore, no ceiling samples were taken in this area. A combined floor and ceiling sample was taken in area 9. Area 10 is a high bay shipping, receiving and storage area. Offices 47 and 51, laboratory 46A, laboratories 48 and 49, and mechanical equipment room 56 have eight foot ceilings with roofs exposed to area 10. A residue about one inch thick on some of these roofs was sampled and designated 10A-1. The roof residue on rooms 47 and 51 was sampled using the wipe technique and designated 10A-2.

Only floor samples were taken in area 13, the attic. In area 14, the boiler room, a combined sample of residues on the floor and piping was taken. Area 15 is the hazardous materials and waste storage rooms. Since there is no piping or ductwork at the ceiling level, a separate ceiling sample was not taken.

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TABLE 2

AREA WIPE SAMPLING SUMMARY

Area	Wipe Area (sf) Floor	Ceiling
1	8	3
2	10	3
3	11-1/2	9-1/2
4	5	2-1/2
5	5	2-1/2
6	5	3
7	10	4-1/2
8	9-1/2	--
9	10*	--
10	10	--
10A-1	--	--**
10A-2	--	2-1/2 (roof)
11	5	--
11A	5	--
11B	6	--
11C	6	--
12	10	5-1/2
13	7	--
14	5	--
15	6	--

*Floor and ceiling combined.

** Bulk sample collected in jar.

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TABLE 3

FLOOR WIPE SAMPLING
AREA 1

Room	Floor Area (sf)	Number of Wipes
1	169	1
2	85	1
3	234	1
4	306	2
5	1044	8
6	126	None
7	112	1
8	266	1
9	91	None
10	91	1
	2524	16

Ductwork Sampling

Exhaust ductwork and return air ducts serving manufacturing operations were sampled. In addition, one supply air duct was sampled to evaluate the efficiency of the air handling unit filters. The internal surfaces of the duct work systems were sampled in the same manner as interior building surfaces. Samples along the length of the ductwork were taken as accessible. Table 4 presents a summary of the sampling.

With the exception of ED-1, exhaust duct systems discharge through the roof to the atmosphere. ED-1 discharges through the SO_2 scrubber. SAD-1 is the supply air duct from AHU-1 serving area 3. RAD-2 is the return air duct from areas 3 and 7 to AHU-2.

Exhaust ductwork serving areas 5 and 6 discharge through the outside cyclones and baghouses and one exhaust duct system in area 3 exhausts through baghouse 4. Since materials remaining in the equipment were directly sampled, these duct systems were not sampled.

Air Handling Unit Filter Sampling

The air handling unit filters were sampled by removing one filter panel and cutting a sample of the fiberglass filter element. The samples were placed in zip-lock bags for transport to the laboratory. Filter sampling is summarized in Table 5.

AHU-1 is located in room 26 and provides conditioned air to area 3 through supply air duct SAD-1, which was sampled. AHU-2, located in room 46, provides conditioned air to area 7 and part of area 3 through supply air duct SAD-2. Air is returned from these areas through return air duct RAD-2, which was also sampled. AHU-8, 9 and 10 serve area 12 on the second floor. Samples of the filters in each of these units were taken and combined. Other AHUs did not have filters in place and were therefore not sampled. There is no available documentation on filter replacement.

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TABLE 4

DUCT WIPE SAMPLING SUMMARY

Ductwork System	Area Served	Wipe Area (sf)
ED-1	9	1-1/2
ED-2	8,9	2
ED-3	7	3
ED-4	3	2
ED-5	3	6
ED-6	4	2-1/2
ED-7	12	2
ED-8	12	2
SAD-1	3	3
RAD-2	7	3

NOTES:

ED = exhaust duct
SAD = supply air duct
RAD = return air duct

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TABLE 5

AIR HANDLING UNIT FILTER SAMPLING SUMMARY

Air Handling Unit	Filter Area Sampled (sq in)
1	64
2	64
3	107
4	40
8, 9, 10	12

Miscellaneous Samples

There are several other locations where residues can accumulate. These include floor trenches and internal manholes. Various air pollution control equipment and tanks also contain residual materials.

Samples from these locations and equipment were taken for analysis. Sludge and solid samples were collected in precleaned glass bottles with metal screw-on caps. Liquid samples were collected in precleaned glass bottles and polyethylene bottles containing appropriate preservatives for the analysis being conducted.

The plant contains two floor trenches. A drainage trench runs north-south through area 3. It begins at the south end of the plant and drains toward the north end. A dam in the trench at the north end retains sediment in the trench. Dam overflow discharges to the sanitary sewer. Samples of bottom sludge were collected at three locations and combined in one sample container. A pipe trench runs east-west from the shower rooms in the south part of area 3 to the west wall of the plant. Wastewater is not normally discharged directly into the trench. Sand and debris on the bottom of this pipe trench was sampled between rooms 47 and 51. In addition, sand at the bottom of the manhole in room 26 of area 7 was sampled.

Samples of the materials remaining in baghouses 1, 2 and 3, the first cyclone located in the areaway, and in baghouse 4, located along the east wall of area 3, were taken.

Liquids remain in the SO_2 scrubber solution tank, located in room 34 along the west plant wall; the three potassium hydroxide (KOH) tanks, located in the areaway; and the concrete pit, located outside the east wall of the plant. The pit is full of clear water possibly due to the inflow of rainfall. Samples from each tank were obtained. Tank contents were not mixed during sampling. Samples several inches below the scrubber and pit liquid level were taken. A combined sample from the KOH tanks was taken by opening bottom drain valves.

Roof Sampling

The soil sampling program, described in the next subsection, showed the presence of metals. One possible source of these metals could have been atmospheric emissions through the various outlets of air pollution control equipment and exhaust systems. These emissions may have settled on roof surfaces and may be subsequently washed by runoff through downspouts discharging to the ground. A roof runoff sampling program was performed by EA on June 26 and June 28, 1985. Tap water was applied to the roof by hoses until runoff occurred. The runoff was collected in precleaned polyethylene bottles containing preservatives and delivered to the laboratory for analysis on the same day.

The nine sampling locations are shown in Drawing 3, following Section VI. Seven of the samples were taken at open scuppers or downspouts. One sample, RRO-1 was taken from accumulated water on the roof. Sample RRO-3 was collected at a point where a higher roof drains onto a lower roof.

Soil Sampling

The initial phase of on-site soil sampling, consisting of 27 boreholes, is shown on Drawing 2. Borehole locations were selected to investigate those areas where manufacturing related activities had occurred. These areas include the east side yard and southeast yard areas. Seventeen boreholes were located in the southeast yard to conform to an approximate grid while avoiding aboveground and buried structures and piping. An additional seven boreholes were located in the side yard along the east wall of the plant to identify potential contamination from the concrete pit and storm water runoff percolation. Three boreholes were located at the remaining corners of the property to define background conditions at the site. Boreholes were advanced to a depth of 15 feet.

Boreholes were driven and samples were obtained by Kendrick Enterprises, Ltd. of Monroe, New York, under the supervision of EA. Boreholes were advanced by driving a two foot long split spoon sampler to the selected depth. The spoon was withdrawn at approximately two foot intervals to obtain samples. The sample identification code is based on the borehole number and depth below grade at which sampling started. Thus the samples obtained represent soil conditions to about two feet below the indicated depth. Approximately two inches of the upper and lower portions of each sample was discarded.

Split spoon samplers and drive rods were steam cleaned prior to arrival on-site. The samplers and rods were washed with Alconox and rinsed with running tap water and distilled water prior to each borehole. Samplers were similarly washed between each use. Alconox solution was changed between each borehole. Distilled water, purchased from Electrified Water Company, East Orange, New Jersey, had been filtered through sand and activated carbon, demineralized, degased and steam distilled.

Soil samples were collected and transported in precleaned glass jars with metal caps. For quality control, samples of the tap water and distilled water runoff from equipment were collected in precleaned polyethylene bottles with preservatives.

The surface and bottom sample of each borehole and quality control samples were delivered to the laboratory for metal content analysis within 48 hours. Intermediate depth samples are stored at the offices of EA.

The results of the initial soil sampling indicated that elevated metal concentrations occurred in the southeast yard. Some boreholes in this area showed elevated metal concentrations both at the surface and to depths 15 feet. These results suggested the potential for off-site migration of metals.

A second phase soil investigation program consisting of the following components was then implemented:

(1) analysis of intermediate depth samples to verify the preceding results and define the depth of penetration;

(2) analysis of samples for EP toxicity;

(3) additional soil sampling below 15 feet where metal penetration to a depth of 15 feet was identified; and

(4) surface sampling along the east and south property lines to identify the areal extent of contamination.

The additional boreholes are indicated on Drawing 4, following Section VI. Boreholes 29 through 35 were advanced to refusal. Boreholes S-1 through S-18 were taken to a depth of two feet along the property line. Two additional boreholes, S-19 and S-20, were advanced at the northwest corner of the property in order to verify the results obtained at this location during the Phase 1 sampling program.

The additional boreholes were driven and surface sampling was performed by Kendrick Enterprises, Ltd. between May 30 and June 5, under the supervision of EA. Boreholes 19 and 20 were drilled on June 26. Sampling procedures were the same as those used in the initial phase.

Laboratory Procedures

Sample containers were furnished and laboratory analysis was performed by New York Testing Laboratories, Westbury, New York.

Glass jars for miscellaneous and soil samples were precleaned by the laboratory. Polyethylene bottles for liquid samples were precleaned and included the necessary preservatives as follows:

for metal analysis: HNO_3 to pH ≤ 2
for cyanide analysis: NaOH to pH ≥ 12

Liquid samples for pH and reactivity analysis were collected in glass jars without preservatives.

Analyses were performed in accordance with "Methods for Chemical Analysis of Water and Wastes", EPA-600/4-79-070, March 1983. The total weight of wipe samples was determined using a standard tare weight for a ziplock bag. Solids content of the samples was determined by the difference in weight after drying at 103°C for one hour. Samples were digested in accordance with Section 200, Part 4.1.3, except that nitric acid was used throughout the procedure instead of hydrochloric acid which would precipitate silver. Analysis procedures were in accordance with Table 6. EP toxicity was determined in accordance with EPA Regulations for Identifying Hazardous Waste 40 CFR 261, Appendix II - E.P. Toxicity Test Procedure.

The laboratory follows the Quality Assurance Procedures described in "Test Methods For Evaluating Solid Waste" SW-846, U.S. Environmental Protection Agency, April 1984. These procedures include duplication of sample analysis and the analysis of spiked samples and blanks.

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TABLE 6

LABORATORY ANALYSIS METHODS

Metal	Method	Atomic Absorption
Arsenic	206.2	Furnace Technique
Barium	208.1	Direct Aspiration
Cadmium	213.1	Direct Aspiration
Chromium	218.1	Direct Aspiration
Lead	239.1	Direct Aspiration
Mercury	245.1	Manual Cold Vapor Technique
Selenium	270.2	Furnace Technique
Silver	272.1	Direct Aspiration
Zinc	289.1	Direct Aspiration
Cyanides	335.3	Colorimetric, U.V.

IV. RESULTS

Introduction

This section presents the results of laboratory analysis of each type of sample, as follows:

- Interior Surfaces
- Ductwork
- Air Handling Unit Filters
- Miscellaneous Samples
- Roof Runoff
- Soils

Laboratory analysis reports are presented in Appendix A.

Interior Surfaces

Laboratory analysis of floor and ceiling wipe samples reports the total weight and metal content, mg/kg, of each sample. Areal concentrations are calculated by multiplying the total sample weight by the metal content and dividing by the wipe area (refer to Table 2). Areal concentrations are summarized in Table 7.

Metals occurring in the highest concentrations are lead, mercury and zinc. The results are summarized in Table 8. These metals were found throughout the plant buildings. Past activities have limited correlation with the presence of these metals.

The highest mercury concentration was identified on the ceiling surfaces of area 4. Both mercury and zinc are present in elevated concentrations on ceiling surfaces of area 6. This area was used for the production of mercury-zinc cell cathodes. Similar concentrations were also detected on the ceiling surfaces of area 7, which was not

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TABLE 7

AREA METAL CONCENTRATIONS

Area	Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver	Zinc
1 floor	<.0014	.99	.011	.034	.35	.11	<.0014	.015	3.0
ceiling	<.0014	.12	.030	.070	.78	1.2	<.0014	.073	4.0
2 floor	<.0010	.84	.0084	.0068	.27	.39	.0019	.015	1.3
ceiling	.0035	1.5	.046	.25	1.2	.56	.0058	.13	21.
3 floor	<.0015	1.2	.069	.18	8.6	1.1	.0043	.11	3.6
ceiling	.014	.24	.26	.30	2.2	3.7	.0046	.34	13.
4 floor	.34	1.7	.41	.13	10.	3.4	<.0014	.11	3.7
ceiling	4.4	.96	.81	.37	4.6	30.	<.0020	.15	7.1
5 floor	.010	2.1	.36	.079	220	6.9	.012	.15	4.6
ceiling	.014	.06	.15	<.0023	56.	.56	.0023	.058	.98
6 floor	.016	.59	.14	.063	1.8	.82	.0035	.24	13.
ceiling	.035	.71	.72	.15	11.	5.6	.010	.36	36.
7 floor	.033	.23	.054	.043	4.5	1.2	.0036	<.0015	6.2
ceiling	.0068	.13	.28	.072	2.2	4.5	<.0011	.19	34.
8 floor	.0044	1.3	.028	.061	1.7	.21	.0035	2.6	5.1
9 floor	.014	1.9	.060	.17	2.7	.61	.0013	< .0015	9.0
10 floor	.048	.64	.099	.13	4.0	1.9	.0016	.086	5.7
a.2	.0054	1.3	.059	.044	7.2	.64	.00045	.071	6.5
11	<.00053	.070	.038	.027	.38	.30	<.00053	.028	.81
a.	.0078	.050	.0024	.0068	.062	.076	<.00060	.011	2.2
b.	.0054	.074	.078	.022	.17	.11	.00066	.027	.61
c.	.017	2.7	.063	.044	1.4	2.4	.0010	.083	10.
12 floor	.0037	3.0	.047	.085	1.7	.97	<.0012	.27	5.5
ceiling	<.0021	1.0	.060	.10	.91	.35	<.0021	.037	44.
13 floor	.039	1.5	.13	.46	5.0	17.	.0060	.63	12.
14 floor	.076	2.7	.11	2.5	3.1	9.3	<.0021	.14	28.
15 floor	.097	1.2	.041	.62	5.5	2.6	<.0022	.29	31.

NOTES: All units are mg/sf

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TABLE 8

SUMMARY
AREA METAL CONCENTRATIONS

	Average	Range
Mercury		
floor	3.1	.1 - 17.
ceiling	2.6	.6 - 30.
Lead		
floor	5.9	.3 - 220.
ceiling	3.1	.8 - 55.
Zinc		
floor	6.4	.8 - 31.
ceiling	21.5	1. - 44.

NOTE: All units are mg/sf

identified with mercury zinc cell production.

Lead occurs in highest concentration in area 5. Lithium solid cell cathode production involving the blending and pelletizing of lead compounds was performed in this area.

High concentrations of mercury were identified in area 13, the attic, and area 14, the boiler room. Both areas were probably not cleaned very often. Lead and zinc were not substantially elevated in these areas, however.

Ductwork

Laboratory analysis of duct wipe samples reports the total weight and metal content, mg/kg, of each sample. Areal concentrations are calculated by multiplying the total sample weight by the metal content and dividing by the wipe area (refer to Table 4). Areal concentrations are summarized in Table 9. Several ductwork systems have notably high concentrations of metals.

Ductwork system ED-1, serving area 9 where lithium-SO_2 cells are filled with electrolyte, contains a considerable amount of sludge with high concentrations of several metals. Plant personnel report that this system has a high discharge, creating a negative pressure condition in the area. Contaminants drawn from other areas of the plant by induced air flow under the negative pressure condition may have accumulated in the sludge.

Ductwork system ED-2, serving area 8, where lithium solid cells were assembled in glove boxes, contains high concentrations of lead and zinc. The latter may be due to the lead based cathodes used in the batteries. The presence of zinc may be due to flakes of the ductwork which were collected with the sample.

Ductwork system ED-3, located in area 7, contains high concentrations of mercury. Return air duct RAD-2, which partially

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TABLE 9

DUCT WIPE SAMPLE ANALYSIS

Sample Designation	Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver	Zinc
ED-1	3.4	8.4	11.	150.	170.	660.	4.4	< .23	260.
ED-2	1.3	12.	3.8	7.4	210.	14.	.078	< .092	3.0×10^4
ED-3	.0065	.18	.059	.050	1.5	680.	< .00072	130.	72.
ED-4	.0065	.29	.073	.31	1.3	.85	< .00074	.074	30.
ED-5	.012	.048	.020	.11	.70	.36	< .0013	< .0016	.62
ED-6	.068	.19	.039	.042	1.5	1.6	.0010	.0032	20.
ED-7	.018	.70	.024	.28	2.2	.83	< .0013	< .0015	.81
ED-8	.0034	.44	.037	.032	1.6	.22	< .0013	< .0014	2.7
SAD-1	.00079	.028	.010	.037	.22	1.08	< .00087	.011	15.
RAD-2	.012	.41	.24	.072	2.4	16.	.0060	.067	61.

NOTE: All units are mg/sf

serves area 7, also showed elevated mercury concentrations. Both results confirm the wipe sampling of the area.

Other ductwork systems show lower concentrations of metals. In particular, supply air duct SAD-1, serving area 3, showed low concentrations of metals.

Air Handling Unit Filters

Laboratory analyses of filter samples are summarized in Table 10. All filter samples contain high concentrations of lead, mercury and zinc. These findings confirm the area wipe sampling results which showed the presence of these metals throughout the plant.

The filter from AHU-1 shows a high lead and mercury content. SAD-1, the supply air duct from AHU-1, shows a low metal content. This suggests that the AHU filters are effective in removing metal containing particulates.

Miscellaneous Samples

Laboratory analyses of miscellaneous sludge and solid samples from floor trenches, internal manholes and residual materials in air pollution control equipment are presented in Table 11. All samples contain high concentrations of lead, mercury and zinc. The residue in baghouses 1, 2 and 3 and the cyclone show a mercury content of about 65 percent by weight and silver content of about 1 to 10 percent by weight.

EP toxicity tests performed on these samples are summarized in Table 12. All samples, except the residue in manhole Area 7, are hazardous due to leachable mercury.

A sample of the sheetrock wall in area 3 was taken to determine whether the building itself would be a hazardous waste. The analysis shows that this wall is not a hazardous waste.

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TABLE 10

AIR HANDLING UNIT FILTER ANALYSIS

Sample Designation	Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver	Zinc
AHU-1	0.43	12.	3.7	5.4	230.	640.	0.85	7.8	210.
AHU-2	3.6	160.	35.	34.	1,100.	700.	2.6	16.	12,000.
AHU-3	< 0.78	37.	7.0	5.3	330.	480.	3.1	13.	480.
AHU-4	2.8	170.	32.	67.	1,400.	460.	1.1	11.	1,900.
AHU-8, 9, 10	1.1	110.	7.8	13.	660.	47.	1.1	8.4	540.

NOTE: all units are mg/kg (as received)

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TABLE 11

MISCELLANEOUS SAMPLE ANALYSIS

Sample	Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver	Zinc
East Floor Trench	< .20	14.	45.	19.	480.	120.	< .20	81.	8,200.
West Floor Trench	13.	690.	41.	20.	790.	430.	.24	74.	5,400.
Manhole Area 7	4.5	78.	16.	120.	1,100.	860.	< .24	290.	25,000.
Baghouse 1, 2 & 3	.7	140.	6.7	4.5	190.	650,000.	1.6	110,000.	1,000.
Baghouse 4	.23	< 2.3	.70	< 0.50	6.4	11.	< .23	6.9	18.
Cyclone	1.5	26.	28.	2.8	18,000.	660,000.	.20	64,000.	1,900.

Note: all units are mg/kg

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TABLE 12

MISCELLANEOUS E.P. TOXICITY SAMPLE ANALYSIS

Sample	Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver	Zinc
RCRA Limits	5.0	100.0	1.0	5.0	5.0	.2	1.0	5.0	--
East Floor Trench	.01	< 1.0	< .01	< .01	< .03	1.79	< .01	.13	.52
West Floor Trench	< .01	< 1.0	.02	< .01	.04	2.27	< .01	< .01	.26
Manhole Area 7	.01	< 1.0	< .01	< .01	< .03	.007	< .01	.01	1.00
Baghouse 1, 2 & 3	< .01	< 1.0	< .01	< .01	<.03	23.95	.02	.14	4.32
Baghouse 4	< .01	< 1.0	<.01	< .01	<.03	1.09	.01	< .01	.07
High Vac	< .01	<1.0	.20	< .01	.24	27.75	.01	< .01	3.66
Area 3 Sheetrock	< .01	< .05	< .01	< .01	<.03	< .01	< .01	< .01	.11

Laboratory analyses of liquids remaining in the SO_2 scrubber solution tank, KOH tanks and concrete pit are presented in Table 13. There liquids would be considered hazardous wastes if their metal content exceed the EP toxicity (RCRA) concentrations, or they exhibit the characteristic of corrosivity, i.e. pH outside the range of two to 12.

The KOH tank liquid exceeds RCRA limits for pH only. The scrubber tank liquid exceeds the RCRA limit for selenium only. The exceedance is small. The concrete pit liquid is in compliance with RCRA limits. No detectable cyanides are present in the concrete pit liquid.

Roof Runoff

Laboratory analysis of roof runoff samples is presented in Table 14. With the exception of sample RR-08, metal concentrations were below RCRA limits. Sample RR-08 is runoff from the south central roof area. The roof is a composition roof with gravel. During sampling, the hose water pressure loosened deposited particulates from the roof. The sample was turbid compared to other samples. Other roof areas are composed of roof with gravel, shingle or PVC membrane which would tend to collect particulates.

Soils

Laboratory analysis of soil samples are presented in the following tables:

Table	Sample Depth (ft below grade)
15	0 to 2
16	5 to 7
17	13 to 15
18	17 to 39

Borehole locations are shown on Drawings 2 and 4.

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TABLE 13

MISCELLANEOUS TANK SAMPLE ANALYSIS

Analysis	RCRA Limits	KOH Tanks	Scrubber Tank	Concrete Pit
pH	2- 12	13.8	9.9	--
Reactivity	--	none	none	--
Arsenic	5.0	0.24	0.58	0.01
Barium	100.0	0.05	0.05	0.05
Cadmium	1.0	0.01	0.01	0.61
Chromium	5.0	0.79	0.01	0.01
Lead	5.0	0.48	0.03	0.03
Mercury	0.2	0.01	0.08	0.01
Selenium	1.0	0.01	1.21	0.01
Silver	5.0	0.10	0.05	0.01
Cyanide	--	--	--	0.02
Zinc	--	0.01	0.32	0.07

Note: all units are mg/l

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TABLE 14

ROOF RUNOFF ANALYSIS

Sample Designation	Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver	Zinc
RCRA Limits	5.0	100.0	1.0	5.0	5.0	.2	1.0	5.0	—
RRO-1	.003	<.05	< .003	<.01	.18	.09	.002	< .006	.55
RRO-2	.003	<.05	< .003	<.01	.16	.04	< .001	< .006	.96
RRO-3	< .001	<.05	< .003	<.01	<. 025	.002	< .002	< .006	.72
RRO-4	.001	<.05	< .003	<.01	.060	.01	< .002	< .006	.76
RRO-5	.011	.32	< .003	<.01	.893	.19	< .002	< .006	1.1
RRO-6	.002	<.05	< .003	<.01	.167	.008	< .002	< .006	.48
RRO-7	.007	<.05	< .003	<.01	.283	.008	< .002	< .006	.55
RRO-8	.14	4.3	.05	.383	19.28	11.2	.05	.488	11.0
RRO-9	.02	.44	< .003	<.01	1.5	.18	< .002	< .006	1.1

NOTE: All units are mg/l

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TABLE 15

METAL CONTENT OF ON-SITE SOILS
0 to 2 FEET BELOW GRADE

Sample Designation	Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver	Zinc
Borehole 2	4.5	34.2	< .14	3.8	44.0	18.3	< .23	< .28	45.7
Borehole 3	7.8	49.4	< .11	5.3	46.7	0.47	< .19	< .22	91.2
Borehole 4	14.4	47.9	< .14	12.6	95.8	17.2	< .23	< .28	141.
Borehole 5	9.6	44.5	1.5	10.7	64.3	20.7	< .19	< .23	207.
Borehole 6	5.5	45.9	< .14	4.4	23.9	3.5	< .23	< .27	47.5
Borehole 7	7.3	39.5	< .11	4.9	13.7	14.9	.37	< .22	39.3
Borehole 8	5.0	35.5	1.3	6.3	41.7	33.1	.40	< .28	360.
Borehole 9	10.9	48.3	< .12	4.7	32.8	44.9	< .20	< .24	362.
Borehole 10	5.2	28.2	< .14	5.9	70.4	8.8	< .20	< .28	127.
Borehole 11	6.8	55.0	.97	19.9	569.	114.	< .20	3.3	546.
Borehole 12	8.3	26.6	19.4	9.8	49.4	828.	.87	145.	4930.
Borehole 13	3.0	21.4	< .14	5.1	11.6	155.	< .20	1.4	225.
Borehole 14	9.8	55.2	4.7	4.9	16.5	25.2	< .19	< .23	147.
Borehole 15	3.6	24.0	< .11	4.4	6.8	5.4	< .18	< .22	40.5
Borehole 16	5.4	45.8	5.2	6.3	65.6	151.	< .20	7.1	569.
Borehole 17	6.7	43.3	< .14	4.3	39.2	12.0	< .23	< .28	50.1
Borehole 18	1.5	32.6	5.3	9.9	37.0	334.	.84	11.7	2440.
Borehole 19	4.9	32.1	< .18	5.4	17.8	59.8	< .20	< .24	80.2
Borehole 20	6.0	43.1	< .14	7.6	37.8	34.5	.77	< .28	42.0
Borehole 21	8.7	52.7	< .14	7.2	58.1	32.4	1.2	.62	40.9
Borehole 22	3.3	59.7	7.3	8.4	39.6	208.	.83	6.4	1020.
Borehole 23	1.9	31.4	18.9	7.3	47.6	491.	.76	11.7	1180.
Borehole 24	4.0	32.1	20.5	6.2	54.8	415.	1.0	14.5	983.
Borehole 25*	4.6	36.6	< .14	5.5	40.8	1590.	< .20	.92	135.
Borehole 26	13.6	121.	11.1	119.	1030.	5820.	< .18	281.	27500.
Borehole 27	7.4	48.9	< .14	5.7	36.6	16.1	1.5	< .28	37.3
Borehole 28	5.3	43.6	.53	5.7	56.4	455.	< .20	1.3	164.

NOTE: All units are mg/kg (as received)

* Sample depth 1 to 3 feet below grade

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TABLE 16

METAL CONTENT OF ON-SITE SOILS FIVE TO SEVEN FEET BELOW GRADE

Sample Designation	Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver	Zinc
Borehole 8	5.2	<5.0	36.9	<1.0	<2.5	3.3	1.7	<.60	31.8
Borehole 9	5.2	22.9	< .10	4.2	3.3	.11	.43	<.22	17.8
Borehole 11	6.3	< 5.0	< .30	<1.0	<2.5	16.1	1.7	<.60	30.9
Borehole 12A	7.4	--	< .14	4.1	17.9	9.1	3.6	.27	20.2
Borehole 13	.72	34.4	.25	15.1	8.9	251.	.78	5.1	1210.
Borehole 14	5.3	32.5	< .30	< 1.0	<2.5	5.1	1.2	<.60	29.8
Borehole 16	5.3	42.4	< .30	< 1.0	<2.5	.13	.75	<.60	27.0
Borehole 18	6.1	51.0	3.4	8.5	96.4	291.	.28	9.3	806.
Borehole 20	3.3	45.5	< .03	< 1.0	<2.5	3.1	.65	<.60	28.0
Borehole 21	6.5	24.8	< .03	< 1.0	<2.5	3.8	.19	<.60	50.8
Borehole 22	4.8	44.1	< .30	< 1.0	<2.5	8.1	.43	<.60	36.2
Borehole 23	9.7	--	1.0	2.7	23.6	13.6	3.5	1.6	102.
Borehole 24	11.3	--	.89	4.3	49.7	128.	2.2	8.5	1150.
Borehole 25	5.5	24.2	< .10	5.0	3.0	5.7	.29	<.22	30.4
Borehole 26	6.9	25.1	< .10	5.8	10.7	14.1	.68	<.22	90.8
Borehole 28	5.1	4.0	< .10	3.8	2.4	2.7	.56	<.22	18.2

Note: All units are mg/kg (as received)

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TABLE 17

METAL CONTENT OF ON-SITE SOILS
THIRTEEN TO FIFTEEN FEET BELOW GRADE

Sample Designation	Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver	Zinc
Borehole 2	.81	2.4	< .12	2.8	5.8	.10	< .20	< .24	18.1
Borehole 3	2.8	27.7	< .13	3.2	6.6	.08	< .21	< .26	20.0
Borehole 4	<.22	24.2	< .13	1.5	6.8	<.01	< .22	< .26	16.8
Borehole 5	3.8	25.6	< .14	3.9	7.0	.40	< .23	< .27	22.5
Borehole 6	2.7	37.8	< .12	5.3	5.7	.02	< .21	< .25	26.8
Borehole 7	0.98	21.0	< .15	2.3	6.5	< .01	< .24	< .29	15.1
Borehole 8	1.8	28.5	12.6	5.0	4.6	.59	1.6	< .28	19.3
Borehole 9	.87	19.6	9.4	2.4	7.7	74.8	< .22	< .26	25.2
Borehole 10	2.0	33.6	< .14	6.9	1.9	.09	.88	< .28	20.8
Borehole 11	2.5	36.3	< .14	6.2	7.4	1.8	< .20	< .28	35.4
Borehole 12	2.1	29.1	< .14	6.3	9.1	6.4	< .20	< .28	53.6
Borehole 13	3.1	15.4	< .14	5.6	5.2	73.3	< .20	< .23	116.
Borehole 14	3.2	33.0	.89	3.3	5.8	1.7	< .19	< .22	23.3
Borehole 15	2.7	26.5	< .12	3.5	5.9	.20	< .21	< .25	18.1
Borehole 16	.05	38.7	< .14	3.0	6.0	.33	< .23	1.2	17.9
Borehole 17	2.2	34.0	< .13	3.9	7.4	1.2	< .22	< .27	18.1
Borehole 18	3.4	23.8	.98	7.6	15.4	139.	1.5	3.7	1020.
Borehole 19	2.8	30.5	< .12	2.8	6.5	2.8	< .20	< .24	15.4
Borehole 20	1.5	21.8	< .14	4.4	2.5	4.6	1.3	< .28	18.1
Borehole 21	2.5	19.1	< .14	4.8	1.7	.92	1.7	< .28	19.2
Borehole 22	3.1	32.4	< .14	4.3	2.8	2.2	2.1	< .28	18.0
Borehole 23	2.2	27.1	< .14	4.7	3.9	4.1	1.2	< .28	524.
Borehole 24	1.2	18.4	.81	2.9	7.9	6.9	.43	.56	94.7
Borehole 25*	2.5	25.4	< .14	5.5	6.8	15.	3.2	< .28	2290.
Borehole 26	4.2	38.5	< .11	4.9	6.6	26.0	< .18	< .22	280.
Borehole 27	3.1	24.7	< .14	3.9	2.2	.24	1.5	< .28	16.2
Borehole 28	1.4	24.1	.33	4.5	8.1	490.	< .20	.74	68.7

NOTE: All units are mg/kg (as received)

* Sample depth 9 to 11 feet below grade

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TABLE 18

METAL CONTENT OF ON-SITE SOILS
17 TO 39 FEET BELOW GRADE

Sample Designation	Depth(ft)	Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver	Zinc
Borehole 29	18	8.0	< 1.6	<.10	5.1	2.5	17.1	.50	< .20	47.1
Borehole 29	24	6.0	15.6	<.10	4.5	1.4	1.0	.28	< .20	40.5
Borehole 29	34	12.0	< 1.6	<.10	11.6	5.0	.67	1.4	< .20	40.8
Borehole 30*	18	9.5	20.5	<.10	7.3	2.5	<.01	.07	< .20	32.8
Borehole 30	24	12.6	26.3	<.10	11.4	2.7	.03	1.2	< .20	46.9
Borehole 31	18	7.3	1.6	<.10	5.3	1.9	1.1	.20	< .20	32.3
Borehole 31	28	9.1	1.6	<.10	5.0	2.9	5.2	.13	< .20	36.6
Borehole 31	38	7.6	1.6	<.10	5.6	3.0	.05	.63	< .20	32.1
Borehole 32	18	4.4	34.7	16.3	4.2	1.2	.24	.26	<.17	5.2
Borehole 32	26	5.6	125.	<.10	6.5	1.3	<.01	.46	< .20	4.9
Borehole 32	34	6.0	38.2	<.10	5.5	3.6	.01	.52	< .20	4.6
Borehole 33	18	4.0	26.7	<.09	4.4	2.5	.01	.44	< .19	3.8
Borehole 33	28	3.8	21.3	<.09	5.7	2.7	<.01	< .06	< .18	3.9
Borehole 33	33	5.9	24.1	<.09	5.6	1.6	.05	.25	< .19	4.4
Borehole 34	18	15.5	57.4	<.10	10.0	4.9	<.01	1.3	< .20	9.6
Borehole 34	24	5.7	38.1	.23	4.7	3.6	6.3	.91	.36	11.1
Borehole 35	18	4.3	27.3	<.10	5.5	2.3	.01	.36	< .20	4.2
Borehole 35	28	4.0	20.9	<.10	4.3	2.3	4.7	.27	< .20	3.6
Borehole 35	38	3.7	19.0	<.10	180.	2.0	.57	.16	< .20	4.6

Note: all units are mg/kg (as received)
* Average of duplicate analysis

Soil samples taken at the surface show mercury and zinc present in the highest concentrations. Borehole 11 also shows a high concentration of lead. Borehole 26 shows higher concentrations of several metals. Samples taken in the southeast yard show higher metal concentrations than samples taken along the west and north side of the property.

Typical values for lead and mercury content of soils are (reference 1 following appendices):

mercury: .01-.64 mg/kg (dry weight)
lead: 15-1400 mg/kg (dry weight)

The mercury content of surface soil samples is higher than typical values at all locations except Borehole 3 at the northwest corner, furthest from the yard area. The two additional, samples S-19 and S-20 taken close to the location of Borehole 3, did not confirm this result. These samples show mercury concentrations of about 12 mg/kg as compared to 0.47 mg/kg for Borehole 3.

The lead content of surface soil samples is within typical values except at Boreholes 11 and 26. Lead content of soils is affected by traffic and the high value reported in the literature may have been due to this impact. Since Boreholes 11 and 26 are not located near the streets, the lead concentrations at these locations are considered higher than typical values.

Borehole 26 is located near air pollution control equipment. Spillage of residues collected by this equipment may have impacted the soil. Borehole 25, in the same location near the cyclones, also showed high mercury concentrations. Boreholes 11 and 12 are located in the area of storm water runoff percolation. Runoff from other areas may have affected soils at these locations.

Analysis of soil samples taken 13 to 15 feet below grade show that mercury concentrations at boreholes outside the southeast yard areas are close to typical values. Samples taken inside the southeast yard are also lower, but still higher than typical soil values. This area was further investigated to evaluate the depth of metal penetration by analyzing samples taken from five to seven feet below grade and obtaining deeper samples.

A comparison of mercury content with depth at boreholes located along the last property line and the southeast yard is presented in Table 19. At most boreholes, mercury concentration is reduced within six feet of the surface. Mercury concentrations 14 feet below grade are highest at Boreholes 9, 13, 18 and 28.

Deeper samples were obtained in the vicinity of these boreholes and at Borehole 26 where the surface soil metal concentration are highest. Table 20 summarizes the results of this additional sampling. Mercury concentration is significantly reduced at all boreholes within 19 feet of the surface. Mercury concentrations equal to typical soil values occur in the deepest samples.

EP toxicity analysis of the samples with the highest metal concentrations were performed. These analysis are presented in Tables 21, 22 and 23. The following samples would be considered hazardous wastes because of leachable mercury:

Borehole	Depth Below Grade (feet)
16	0 to 2
26	0 to 2 and 13 to 15
28	0 to 2

The results do not correlate with mercury content. Samples with mercury contents greater than those in surface samples from Boreholes 16 to 28 did not exhibit EP toxicity. On the other hand, the mercury content of the sample from Borehole 26 taken 13 to 15 feet below grade was low.

DURACELL, INC.
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TABLE 19

MERCURY CONCENTRATIONS OF ON-SITE SOILS
0 TO 15 FEET BELOW GRADE

Sample Designation	0 to 2	5 to 7	13 to 15
Borehole 8	33.1	3.3	.59
Borehole 9	44.9	.11	74.8
Borehole 11	114.	16.1	1.8
Borehole 12	828.	9.1	6.4
Borehole 13	155.	251.	73.3
Borehole 14	25.2	5.1	1.7
Borehole 16	151.	.13	.33
Borehole 18	334.	291.	139.
Borehole 20	34.5	3.1	4.6
Borehole 21	32.4	3.8	.92
Borehole 22	208.	8.1	2.2
Borehole 23	491.	13.6	4.1
Borehole 24	415.	128.	6.9
Borehole 25	1590.	5.7	15.1
Borehole 26	5820.	14.1	26.0
Borehole 28	455.	2.7	490.

NOTE: All units are mg/kg (as received)

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TABLE 20

MERCURY CONCENTRATIONS OF ON-SITE SOILS TO 39 FEET BELOW GRADE

Average Depth Below Grade (ft)	Boreholes 9 & 32	Boreholes 12 & 33 to 34	Boreholes 28 & 34 to 30	Boreholes 13 & 29	Boreholes 18 & 31	Boreholes 26 & 35
1	44.9	828.	455.	155.	334.	5820.
6	.11	9.1	2.7	251.	291.	14.1
14	74.8	6.4	490.	73.3	139.	26.0
19	.24	.01	.01	17.1	1.1	.01
25	--	6.3	6.3	1.0	--	--
27	.01	--	--	--	5.2	4.7
29	--	.01	--	--	--	--
35	.02	.05	--	.67	--	--
39	--	--	--	--	.05	.57

NOTE: All units are mg/kg (as received)

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TABLE 21

EP TOXICITY ANALYSIS OF ON-SITE SOILS 0 TO 2 FEET BELOW GRADE

Sample Designation	Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver	Zinc
RCRA Limits	5.0	100.0	1.0	5.0	5.0	.2	1.0	5.0	--
Borehole 9	< .01	.28	<.01	<.01	<.03	< .01	< .01	<.01	5.32
Borehole 11	< .01	.24	.05	.01	<.03	.02	< .01	<.01	122.1
Borehole 12 A	< .01	< .05	<.01	<.01	<.03	.03	< .01	<.01	1.13
Borehole 13	< .01	.15	<.01	<.01	<.03	.01	< .01	<.01	.14
Borehole 16	< .01	.21	.04	.01	<.03	.26	< .01	<.01	3.16
Borehole 18	< .01	.27	.09	<.01	<.03	.05	< .01	<.01	59.60
Borehole 22	< .01	.46	.13	<.01	<.03	.03	< .01	<.01	10.37
Borehole 23	< .01	< .05	<.01	<.01	<.03	.06	< .01	<.01	.47
Borehole 24	< .01	< .05	<.01	<.01	<.03	< .01	< .01	<.01	.37
Borehole 25	.01	.20	<.01	<.01	<.03	.06	< .01	<.01	.49
Borehole 26	< .01	.26	.08	<.01	.23	18.0	< .01	.12	37.46
Borehole 28	.01	.33	<.01	<.01	<.03	.78	< .01	<.01	1.19

NOTE: All values in mg/l

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TABLE 22

EP TOXICITY ANALYSIS OF ON-SITE SURFACE SOILS 5 TO 7 FEET BELOW GRADE

Sample Designation	Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver	Zinc
RCRA Limits	5.0	100.0	1.0	5.0	5.0	.2	1.0	5.0	--
Borehole 11	<.01	< .05	< .01	< .01	< .03	<.01	< .01	< .01	.05
Borehole 12A	<.01	.11	< .01	< .01	< .03	<.01	< .01	< .01	.12
Borehole 13	<.01	.28	< .01	< .01	< .03	<.01	< .01	< .01	6.9
Borehole 16	<.01	< .05	< .01	< .01	< .03	<.01	< .01	< .01	.10
Borehole 18	<.01	.19	.02	< .01	< .03	.18	< .01	< .01	11.5
Borehole 22	<.01	< .05	< .01	< .01	< .03	<.01	< .01	< .01	.20
Borehole 23	<.01	.16	.02	< .01	< .03	<.01	< .01	< .01	1.00
Borehole 24	<.01	.18	.03	< .01	< .03	<.01	< .01	< .01	8.4
Borehole 25	<.01	--	< .01	< .01	< .03	<.01	< .01	< .01	.25
Borehole 26	<.01	.11	< .01	< .01	< .03	.06	< .01	< .01	.68
Borehole 28	<.01	< .05	< .01	< .01	< .03	<.01	< .01	< .01	.02

NOTE: All values in mg/l

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TABLE 23

EP TOXICITY ANALYSIS OF ON-SITE SURFACE SOILS 13 TO 15 FEET BELOW GRADE

Sample Designation	Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver	Zinc
RCRA Limits	5.0	100.0	1.0	5.0	5.0	.2	1.0	5.0	—
Borehole 9	< .01	.22	.06	< .01	<.03	< .01	< .01	<.01	.17
Borehole 11	< .01	.37	<.01	< .01	<.03	< .01	< .01	<.01	3.38
Borehole 12A	< .01	.20	<.01	< .01	<.03	.05	< .01	<.01	.19
Borehole 13	< .01	.16	<.01	< .01	<.03	< .01	< .01	<.01	1.97
Borehole 18	< .01	.25	.03	< .01	<.03	.06	< .01	<.01	8.63
Borehole 22	< .01	.23	<.01	< .01	<.03	< .01	< .01	<.01	.42
Borehole 23	< .01	.29	<.01	< .01	<.03	< .01	< .01	<.01	6.85
Borehole 24	< .01	.27	<.01	< .01	<.03	< .01	< .01	<.01	1.42
Borehole 25*	< .01	.15	<.01	< .01	<.03	< .01	< .01	<.01	12.78
Borehole 26	< .01	.28	<.01	< .01	<.03	.48	< .01	<.01	1.59
Borehole 28	< .01	.14	<.01	< .01	<.03	.04	< .01	<.01	.23

NOTE: All values in mg/l

*Sample obtained at nine feet below grade

Duplicate EP toxicity tests on selected samples were performed. The results are summarized in Table 24 and generally confirm the preceding results. The additional testing also indicated that surface soil at Borehole 25 exceeds the EP toxicity limit for mercury.

Laboratory analysis of surface soil samples taken along the east end south property line are presented in Table 25. Metal concentrations are higher than those of on-site samples reported in Table 15.

Quality Control

The analyses of quality control samples are presented in Tables 26 through 28. Table 26 presents the results of the wipe sample blank and soil sampling equipment rinse waters. Table 27 presents duplicate analyses results of soil samples. Table 28 presents the recovery of spiked samples.

The wipe sample blank consisted of the number of wetted kimwipes which would be used to wipe three square feet. This blank sample was prepared inside the plant buildings on March 20th between area wipe samplings. Laboratory analysis of this sample reports total weight and metal content mg/kg. Areal concentrations are calculated by multiplying the total sample weight by the metal contents and dividing by three square feet. A few metals were present in the blank, although at low levels compared to area and duct wipe samples (refer to Tables 7 and 9). It is concluded that the sampling methodology did not contribute to cross contamination of samples.

The rinse runoff from soil boring and sampling equipment was also sampled to demonstrate the cleanliness of equipment before use. No significant concentrations of metals were measured in the runoff.

Duplicate analyses were performed on samples BH28-13, BH20-18, S15 and RR02. Three of the duplicate analyses were generally in agreement with the exception of the barium and lead analyses, for sample S15.

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TABLE 24

DUPLICATE EP TOXICITY ANALYSIS
MERCURY CONCENTRATIONS

Sample Designation	Depth Below Grade (ft)	First* Test	Duplicate* Test
Borehole 25	1 to 3	0.06	1.05
	9 to 11	0.01	0.0035
Borehole 26	0 to 2	18.00	24.10
	13 to 15	0.48	13.80
Borehole 28	13 to 15	0.04	0.002

*NOTE: All values are mg/l

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TABLE 25

METAL CONTENT OF ON-SITE SURFACE SOILS ALONG PROPERTY LINE

Sample Designation	Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver	Zinc
S-1	14.1	132.	4.4	72.1	1350.	159.	1.1	100.	688.
S-3	14.2	79.5	6.0	32.7	299.	136.	1.2	2.7	1590.
S-5	11.5	137.	10.9	35.4	762.	989.	1.0	1.8	1500.
S-7	10.5	78.5	5.0	19.0	610.	152.	.47	3.3	961.
S-9	6.3	73.7	2.6	11.9	391.	118.	5.2	1.8	311.
S-11	12.5	105.	4.9	26.2	634.	116.	.60	3.7	655.
S-13	12.4	78.2	3.6	15.0	378.	79.7	.46	2.4	759.
S-15	15.5	151.	6.2	173.	1380.	172.	.98	7.2	846.
S-17	13.5	53.6	3.9	10.4	237.	113.	1.2	2.0	276.

Note: all units are mg/kg (as received)
Sample Depth 0 to 2 feet below grade

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TABLE 26

QUALITY CONTROL SAMPLE ANALYSIS

		Soil Sampling Rinse Waters*			
		Phase 1		Phase 2	
Analysis	Wipe Sample Blank (mg/sf)	Tap Water	Distilled Water	Tap Water	Distilled Water
Arsenic	<.004	<.01	<.01	<.001	.003
Barium	<.044	<.05	<.05	<.05	<.05
Cadmium	.009	.003	<.06	<.003	<.003
Chromium	<.009	<.01	<.01	<.01	<.01
Lead	.034	<.03	<.03	<.025	<.03
Mercury	.006	<.01	<.01	.003	.003
Selenium	<.004	<.01	<.01	<.001	<.001
Silver	<.005	.01	<.01	<.006	<.006
Zinc	.13	.07	<.003	.08	<.003
Cyanides	--	--	<.02		

*NOTE: Units are mg/l

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TABLE 27

QUALITY CONTROL DUPLICATE ANALYSIS

Analysis	BH 28 13	BH 28$^{(1)}$ 13 Dup.	BH 30$^{(1)}$ 18	BH 30$^{(1)}$ 18 Dup.	S 15$^{(1)}$	S 15$^{(1)}$ Dup.	RR02$^{(2)}$	RR02$^{(2)}$ Dup.
Arsenic	1.43	8.51	9.53	--	15.49	--	.003	.007
Barium	24.11	--	19.11	21.85	151.01	72.57	< .05	< .05
Cadmium	.33	< .15	< .10	< .10	6.20	5.99	< .003	< .003
Chromium	4.45	3.87	7.75	6.85	173.19	--	< .01	< .01
Lead	8.05	21.12	1.98	2.98	1375.41	599.74	.16	.17
Mercury	490.	.44	< .01	< .01	172.10	170.08	.04	.05
Selenium	<.20	1.71	.07	--	.98	--	< .001	< .001
Silver	.74	< .29	< .20	< .20	7.21	7.35	< .006	< .006
Zinc	68.66	27.38	32.79	32.80	845.73	818.74	.96	.95

NOTE:

(1) Values are mg/kg (as received)
(2) Values are mg/l

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TABLE 28

QUALITY CONTROL, PERCENT SPIKE RECOVERY

	BH 26 0	BH 11 13	BH 22 13	BH 12A 13	BH 12A 0	BH 23 0	BH 24 5
Arsenic	100	--	--	104	116	--	110
Beryllium	97	78	82	--	--	--	--
Barium	--	--	--	--	96	95	99
Cadmium	98	98	91	--	100	98	103
Chromium	89	93	91	--	99	116	106
Lead	98	98	102	--	88	96	98
Mercury	--	--	100	--	--	66	99
Selenium	100	--	--	98	94	92	104
Silver	99	130	98	--	104	109	102
Zinc	84	--	--	--	100	100	--

The results reported for BH 28 were not in good agreement. The duplicate analysis of sample BH-28 was performed several months after the original analysis. The inconsistency of the results may be due to sample changes during storage before performing the second analysis. The duplicate analyses for the other samples were performed at the same time.

The results of the spiked samples analysis show that almost all the parameters obtained close to 100% recovery.

V. ANALYSIS

Introduction

This investigation has shown that lead, mercury and zinc are present throughout the plant building and on-site soils. Residues containing these metals had accumulated inside ductwork, on air handling unit (AHU) filters, and in floor trenches and manholes. Materials captured by and remaining in air pollution control equipment also contained these and other metals. Manufacturing raw materials, which would be considered hazardous wastes if discarded, remain in storage tanks. A thin film of residue containing the metals remains on surfaces of the building. On-site soils contain elevated concentrations of lead and mercury, particularly in the southeast yard area.

Duracell proposes to clean the building by removing the accumulated residues, manufacturing raw materials and film of residue from the building surfaces. Residues removed and materials used in the cleaning operation will be disposed to approved solid waste disposal facilities. The building would then be demolished and disposed of to a landfill approved for the disposal of demolition debris.

On-site soils contain lead, mercury and zinc which may affect future uses of the land. Environ Corporation, Princeton, New Jersey was retained to perform a risk assessment to determine acceptable concentrations of metals on site soils considering feasible scenarios for future use of the site. Their report is presented in Appendix B of "Engineering Report Evaluating Off-Site Residues", October 1985 by Eder Associates Consulting Engineers, P.C.

The soil sampling data shows that concentrations decrease to levels characteristic of typical soils at a depth below grade not exceeding 25 feet. The data suggests that the metals have not penetrated into the groundwater.

Risk Assessment

Environ considered several scenarios for future use for the site. Conversion to residential use, the same as adjacent properties, would result in a higher exposure potential to site soils as compared to continued use for industrial purposes. Under residential use, small children, the most vulnerable segment of the population, would be in contact with the soil during time spent outdoors. Environ determined acceptable soil metal concentrations for exposure conditions reflecting the present use of adjacent properties as follows:

lead:	4860 mg/kg
mercury:	581 mg/kg

To evaluate the most severe exposure scenario, Environ considered a day care center on the site. This maximizes the amount of time a child would spend in contact with the soil. In addition, Environ assumed that the day care center population would include a pica child, a relatively rare condition involving an increased tendency to consume non-food items such as soil. For this scenario, the acceptable soil metal concentrations are:

lead:	485 mg/kg
mercury:	87 mg/kg

In order to assure a significant margin of safety, Environ assumed the presence of a highly toxic organic form of mercury, methyl mercury. The form of mercury used in battery manufacturing was primarily mercuric oxide, a less toxic form. Inorganic mercury does not normally undergo conversion in the soil to the more toxic organic form.

Environ also determined that exposure to lead and mercury through ingestion of vegetables grown on soil containing less than the acceptable metal concentrations is unlikely. Environ concluded that the presence of zinc does not pose a potential risk. Zinc is an essential trace element for humans. Even under the most severe exposure scenario, a child would be exposed to only a small fraction of the amount considered necessary to meet nutritional requirements.

Areas with a surface soil mercury concentration exceeding 87 mg/kg are shown in Drawing 5, following Section VI. The designated areas also include the boreholes where the surface soil lead concentrations exceed 485 mg/kg.

Soil mercury concentrations in excess of 87 mg/kg, in general, do not extend more than six feet below grade. At some locations in the southeast yard, mercury concentrations above 87 mg/kg extend up to 18 feet below grade. Lead concentrations in excess of 485 mg/kg do not extend more than about four feet below grade.

Groundwater Impact

Soil boring depths ranged from 26 to 40 feet below grade. Samples recovered were generally fine to coarse sands. Groundwater was not encountered although one sample at 38 to 40 feet below grade was wet.

Groundwater probably occurs in the underlying bedrock and not in the overlying sand deposits. According to the Geologic Map of New York (1970), bedrock at the site consists of metamorphic rocks of the Fordham Gneiss. Groundwater occurrence and movement in the gneiss is limited to very small openings along joints and fractures. These small openings do not permit the movement of large volumes of groundwater and, therefore, the Fordham Gneiss is not considered to be a major source of groundwater.

In two borings, the unconsolidated-surficial deposits at the site ranged in thickness from 16 feet (BH-32A) to 38 feet (BH-33). These deposits are probably part of a river terrace consisting of sand and gravel, with the coarser grains found near the bedrock surface. The split spoon sample from 38 feet in BH-33 was wet and may indicate that there is a thin saturated zone lying on the bedrock surface which would be characterized as a perched water table.

Metal concentrations in the soil decrease to background levels 10 or more feet about groundwater. This data suggests that percolation of metals into the groundwater has not occurred.

Groundwater at the site is not an identified source of water supply. Potential future impacts on the groundwater from metal percolation should not affect its use for that purpose.

VI. REMEDIATION PROGRAM

It is Duracell's policy to achieve demolition of the building and divestiture of the property in a manner which maximizes protection of public health and in accordance with solid waste management regulations. Duracell plans to clean the building prior to demolition and dispose the demolition debris to local landfills permitted for the disposal of construction and demolition debris. Residues removed and materials used in the cleaning operations to be discarded will be analyzed to determine their characteristics and will be disposed in accordance with applicable regulations.

Demolition and disposal of the building in its existing condition is not considered feasible because of the limited number of available disposal sites. A survey was performed to identify potential disposal sites for the building in its existing condition. No landfill approved for the disposal of construction and demolition debris would accept such wastes if they were mixed with any quantity of hazardous wastes. Ocean disposal would be acceptable only if there were no other disposal alternatives and it was demonstrated that no environmental impact would result. Landfills approved for the disposal of industrial wastes generally have limited available disposal capacity and would not be amenable to accepting large quantities of demolition debris. These landfills would not, in any case, accept any hazardous wastes. The nearest landfill which would accept the demolition debris of the building in its existing condition is the CECOS facility located in Niagara, New York. If the debris were acceptable for disposal as an industrial waste, the disposal cost would be $45/ton. If the debris were classified as a hazardous waste, the disposal cost would be about $160/ton including applicable taxes. Because of these disposal costs combined with demolition and transportation costs, this alternative is not considered financially feasible.

Protection of public health under foreseeable future uses of the property would be best attained by eliminating contact with soil having metal concentrations exceeding acceptable values. Remedial plans for meeting this objective include encapsulating and removing the soils. Encapsulation could be accomplished by paving or otherwise capping the site. The integrity of the remediation would be preserved by incorporating restrictions into the property deed to prevent future excavation and penetration of the cap. This investigation indicates that groundwater impact has not occurred. The cap would ensure that percolation of rainfall and downward migration of soil metals would not occur. Capping the site would restrict possible future use and would require post-closure care to ensure integrity. Soil removal, although initially more costly, achieves the objective without the need for post-closure.

Duracell proposes to remove soils with metal concentrations exceeding acceptable values corresponding to the most severe exposure scenario in order to maximize protection of public health.

Building Cleaning

The program for building cleaning includes removal of:

(1) attic insulation;
(2) loose roofing gravel from area 10 roof;
(3) sludges and debris in floor trenches and manholes;
(4) residues remaining in baghouses and cyclones;
(5) air handling unit filters;
(6) exhaust duct systems and return air ducts; and
(7) liquids remaining in storage tanks.

Materials identified as hazardous wastes would require handling, shipping and disposal in accordance with hazardous waste management regulations. These include items 3, 4 and 7. Filters and ducts containing high levels of metals will be handled as hazardous wastes. Testing of other materials is required to determine the appropriate handling and disposal procedures. Materials which are determined not to be hazardous wastes can be disposed of to industrial waste landfills.

Following removal of residues, the following equipment will be cleaned:

(1) cyclones and baghouses;
(2) fans connected to duct systems; and
(3) air handling units.

Finally, interior surfaces of the plant building will be cleaned using a combination of vacuum cleaning and power washing. To document cleaning techniques and the results that can be achieved, a test room will be selected for cleaning. After cleaning the building, sampling will be performed to document the results achieved.

Prior to implementing the cleaning program, a health and safety plan will be developed to ensure the protection of workers and minimize the release of suspended residues to the environment. Implementation of the plan during the work will be documented.

Soil Removal

It is proposed to remove all on-site soils with a mercury and lead concentration exceeding 87 and 485 mg/kg respectively. Surface soils with metal concentrations exceeding these levels are located in the southeast yard area and are shown in Drawing 5.

Mercury and lead concentration decrease rapidly with depth below grade. Analysis of the data presented in Tables 15 through 18 shows that mercury concentrations decrease to acceptable levels at the following depths below grade:

Borehole	Depth Below Grade (ft)
11	2.5
12	5.5
13	13.5

Borehole	Depth Below Grade (ft)
16	3.5
18	16.0
22	4.0
23	5.5
24	9.0
25	6.0
26	6.0
28	18.5

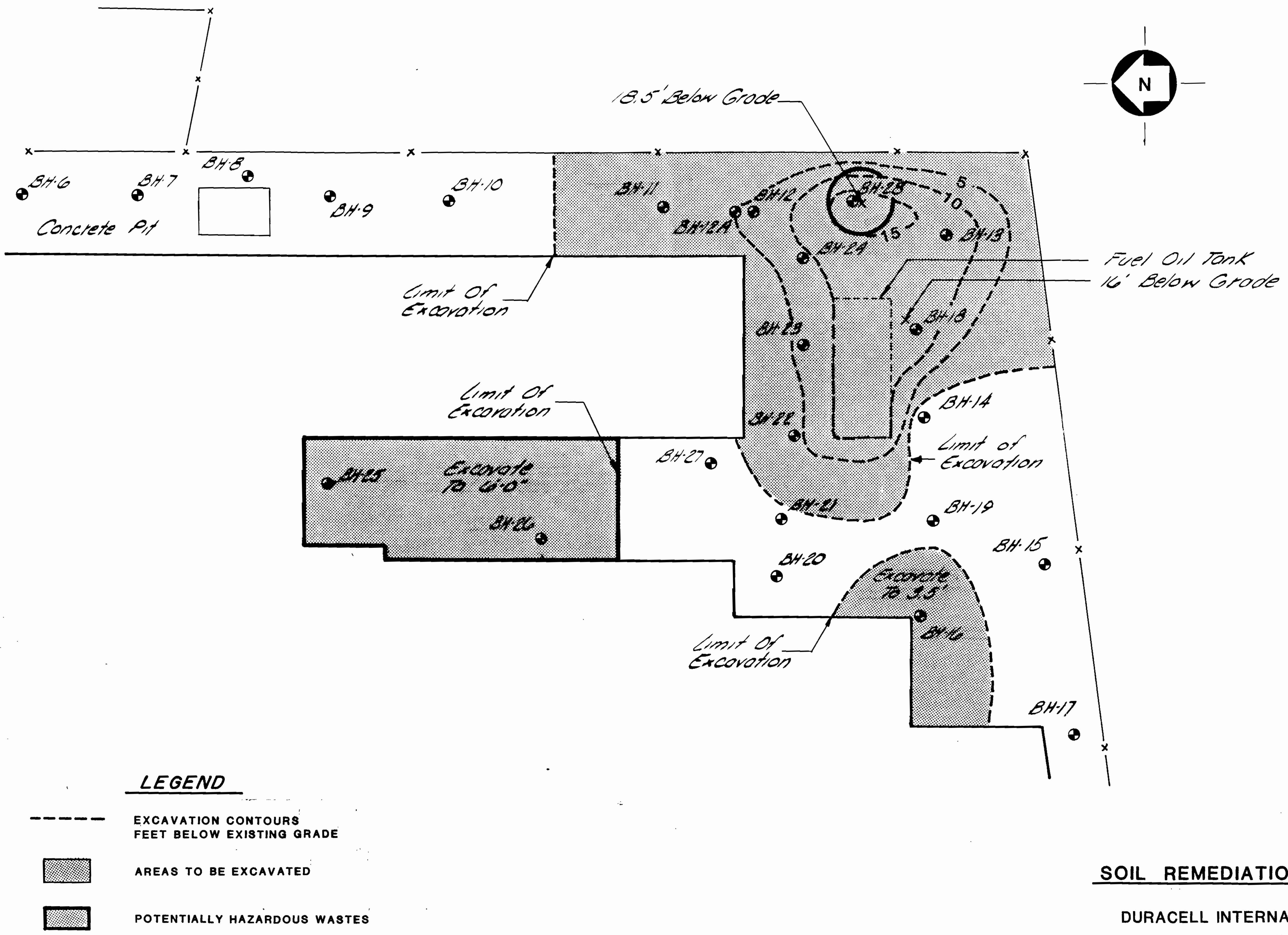
Lead concentration in soils at Boreholes 11 and 26, which exceeded acceptable levels at the surface, decreased below these levels at the indicated depths.

The proposed soil removal program is shown in Figure 6. Equipment located in the areaway, the storage shed and the fuel oil storage tank will be removed. Three areas are to be excavated. In the southeast yard area, soil will be excavated from 2-1/2 feet below grade to a maximum depth of 18.5 feet below grade. Soil in the areaway will be excavated to a depth of six feet. The west area, around Borehole 16, will be excavated to a depth of 3.5 feet. A total of approximately 900 cubic yards of soil weighing about 1200 tons will be removed.

Some excavated soils may have to be handled and disposed of as hazardous wastes. Soil samples taken at Borehole 28, near the east boundary line, at Boreholes 25 and 26 in the areaway, and at Borehole 16, in the west area to be excavated, exhibit EP toxicity. Further investigation will be performed to confirm these results and verify the extent of soils exhibiting EP toxicity.

Soil samples taken in the vicinity of Borehole 28 did not exhibit EP toxicity. Some of these samples, from Boreholes 12, 23 and 24 show comparatively high concentrations of mercury. Further investigation in this area is required to verify the extent of soils with EP toxicity.

Figure 6



SOIL REMEDIATION PROGRAM

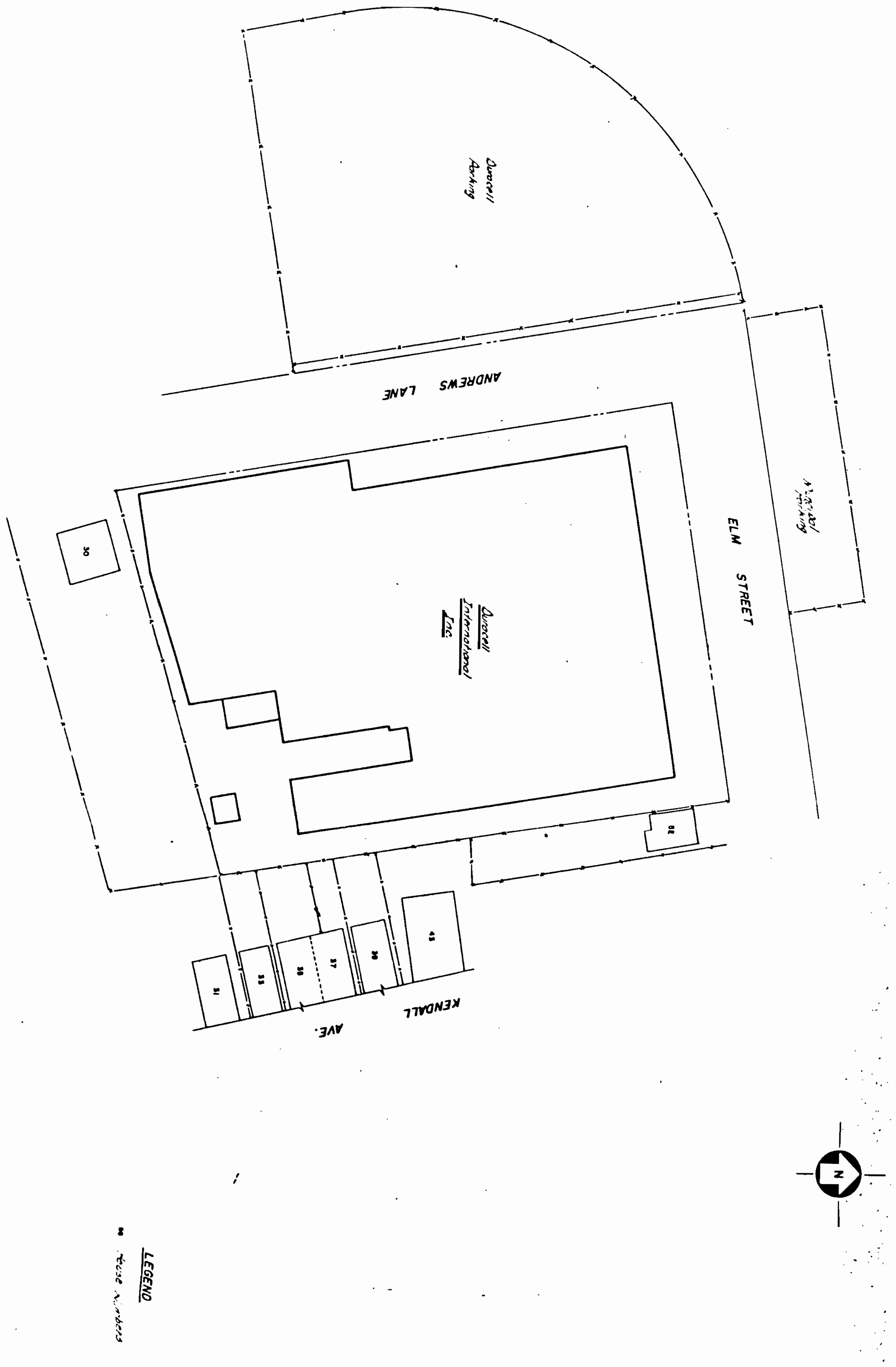
DURACELL INTERNATIONAL INC.
NORTH TARRYTOWN, NEW YORK

In the areaway, surface soil samples taken at Boreholes 25 and 26 show EP toxicity. Soil samples taken 5 to 7 feet below grade at these boreholes did not show EP toxicity. However, the sample taken 13 to 15 feet below grade at Borehole 26 exhibits EP toxicity although the mercury concentration is low. Further investigation will be performed to confirm the depth of soils exhibiting EP toxicity.

The surface soil sample taken at Borehole 16 shows a low metal content, compared to other samples with EP toxicity. Soil samples taken below and in the vicinity of this sample did not exhibit EP toxicity. Further investigation will be performed to confirm the presence of soils with EP toxicity at this location.

Soils excavated from the areaway, near Boreholes 25 and 26, and surface soils excavated in the vicinity of Borehole 28 to a depth of five feet, will probably be considered hazardous. These areas are shown in Figure 6. The estimated quantity of soils exhibiting hazardous waste characteristics is about 280 cubic yards weighing 380 tons.

Prior to implementing the removal program, a health and safety plan will be developed to ensure the protection of workers and minimize the release of resuspended soil. Implementation of the plan during the work will be documented. Following removal, soil sampling will be performed to verify that the remaining soils are within remediation values. After this demonstration, the excavated area will be backfilled with clean fill.



73

PROJECT
ON-SITE RESIDUE EVALUATION STUDY
DURACELL INTERNATIONAL, INC.
NORTH TARRYTOWN, NEW YORK

TITLE
PLOT PLAN

eder associates consulting engineers, p.c.
88 Forest Avenue, Locust Valley, New York, 11560

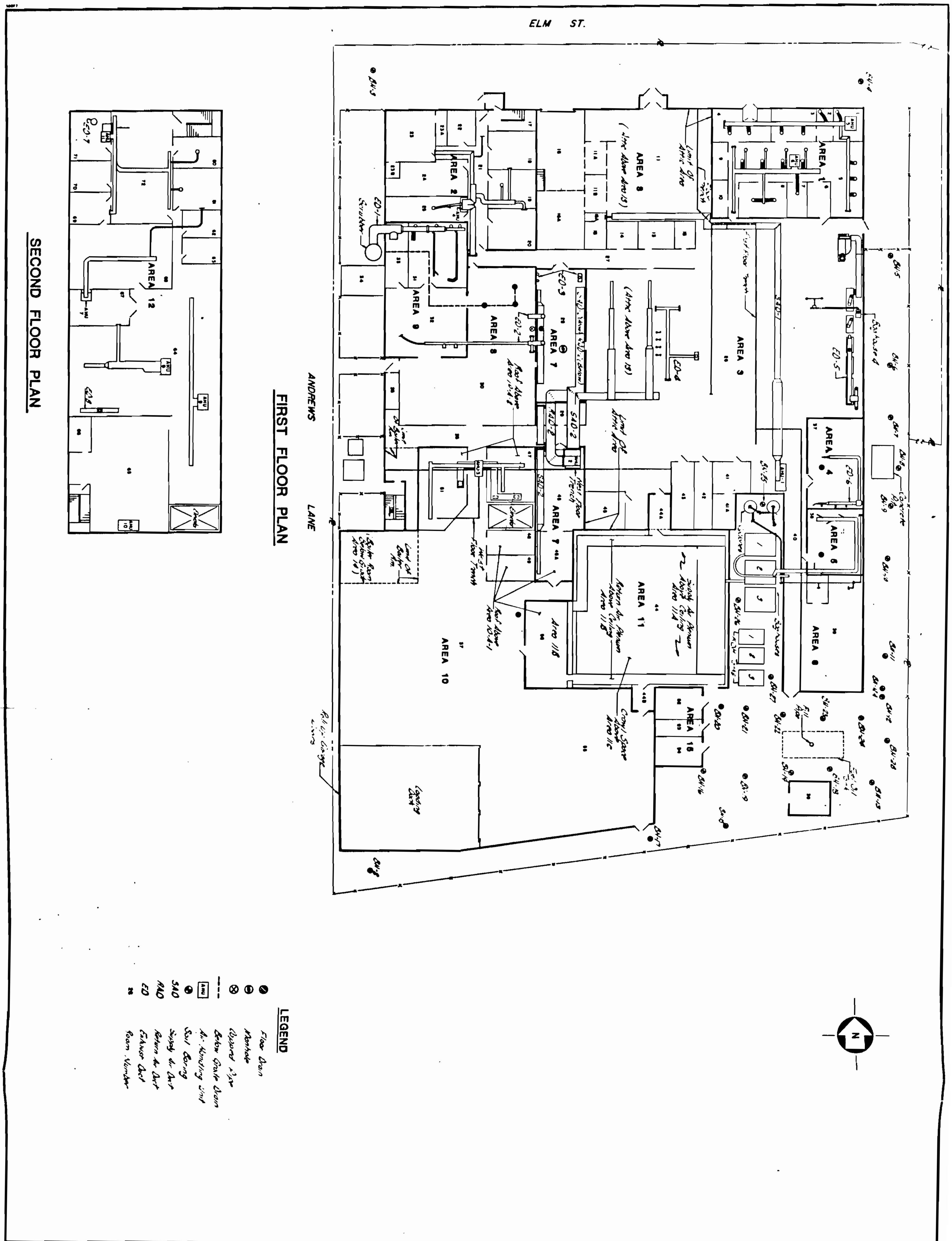
DRAWN BY FAD	SCALE 1"=30'
DESIGNED BY JBH	PROJECT No 425-1
APPROVED BY GJR	DWG. No 1
DATE October 1981	

ON-SITE RESIDUE EVALUATION STUDY

DURACELL INTERNATIONAL, INC.
NORTH TARRYTOWN, NEW YORK

eder associates consulting engineers, p.c.

No	REVISIONS	DATE	BY



ON-SITE RESIDUE EVALUATION STUDY

DURACELL INTERNATIONAL, INC.

NORTH TARRYTOWN, NEW YORK

eder associates consulting engineers, p.c.

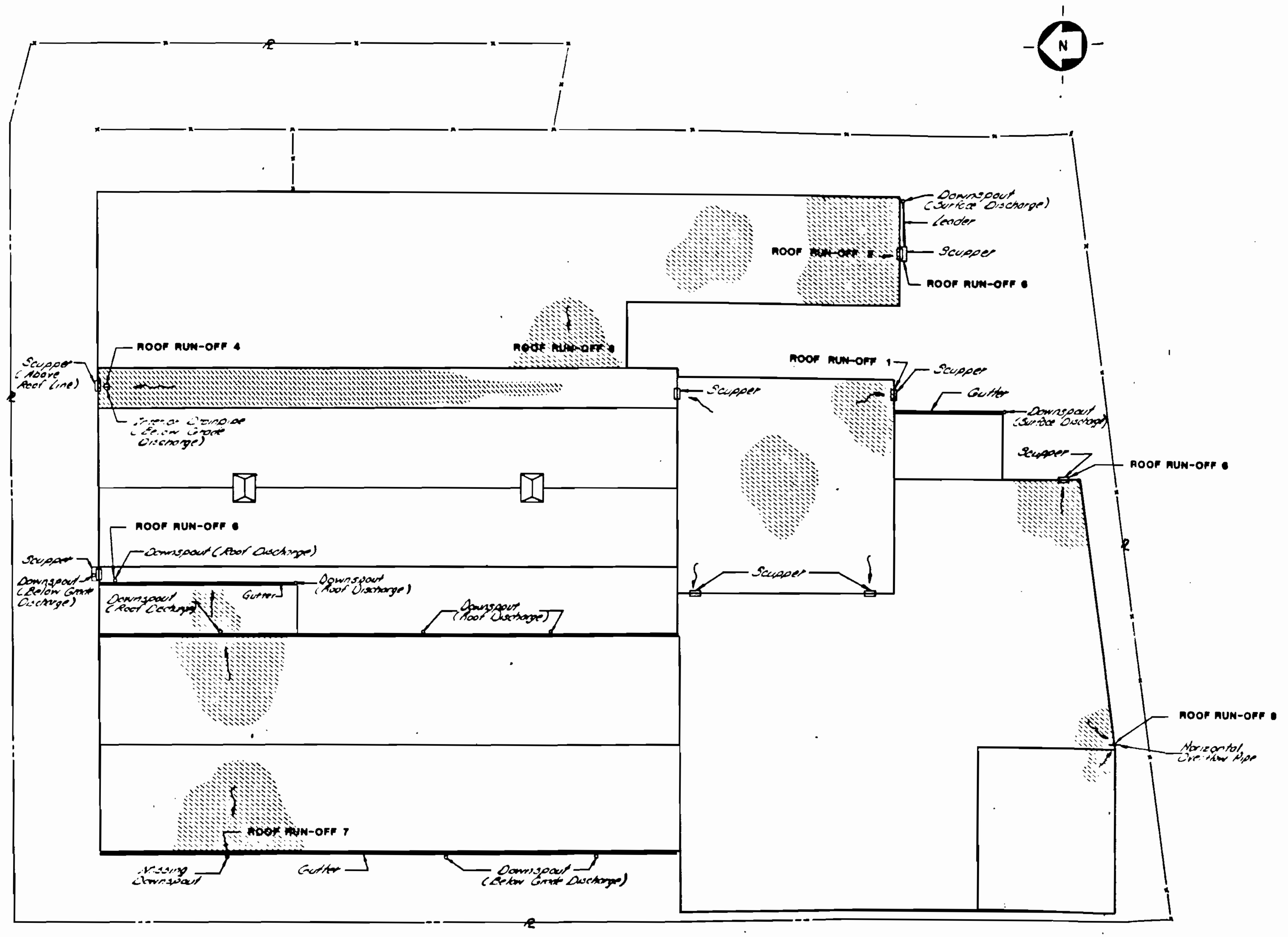
No	REVISIONS	DATE	BY

PROJECT
ON-SITE RESIDUE
EVALUATION STUDY
DURACELL INTERNATIONAL, INC.
NORTH TARRYTOWN, NEW YORK

TITLE
BUILDING & SAMPLING PLAN

eder associates consulting engineers, p.c.
85 FOREST AVENUE, LOCUST VALLEY, NEW YORK, 11560

DRAWN BY FAD	SCALE 1/16" = 1'0"
DESIGNED BY JBW	PROJECT No 405-1
APPROVED BY GAR	DWG No 2
DATE [illegible]	



ROOF PLAN

LEGEND

▨ Approximate Run-Off Area

NO	REVISIONS	DATE	BY

ON-SITE RESIDUE EVALUATION STUDY

DURACELL INTERNATIONAL, INC.

NORTH TARRYTOWN, NEW YORK

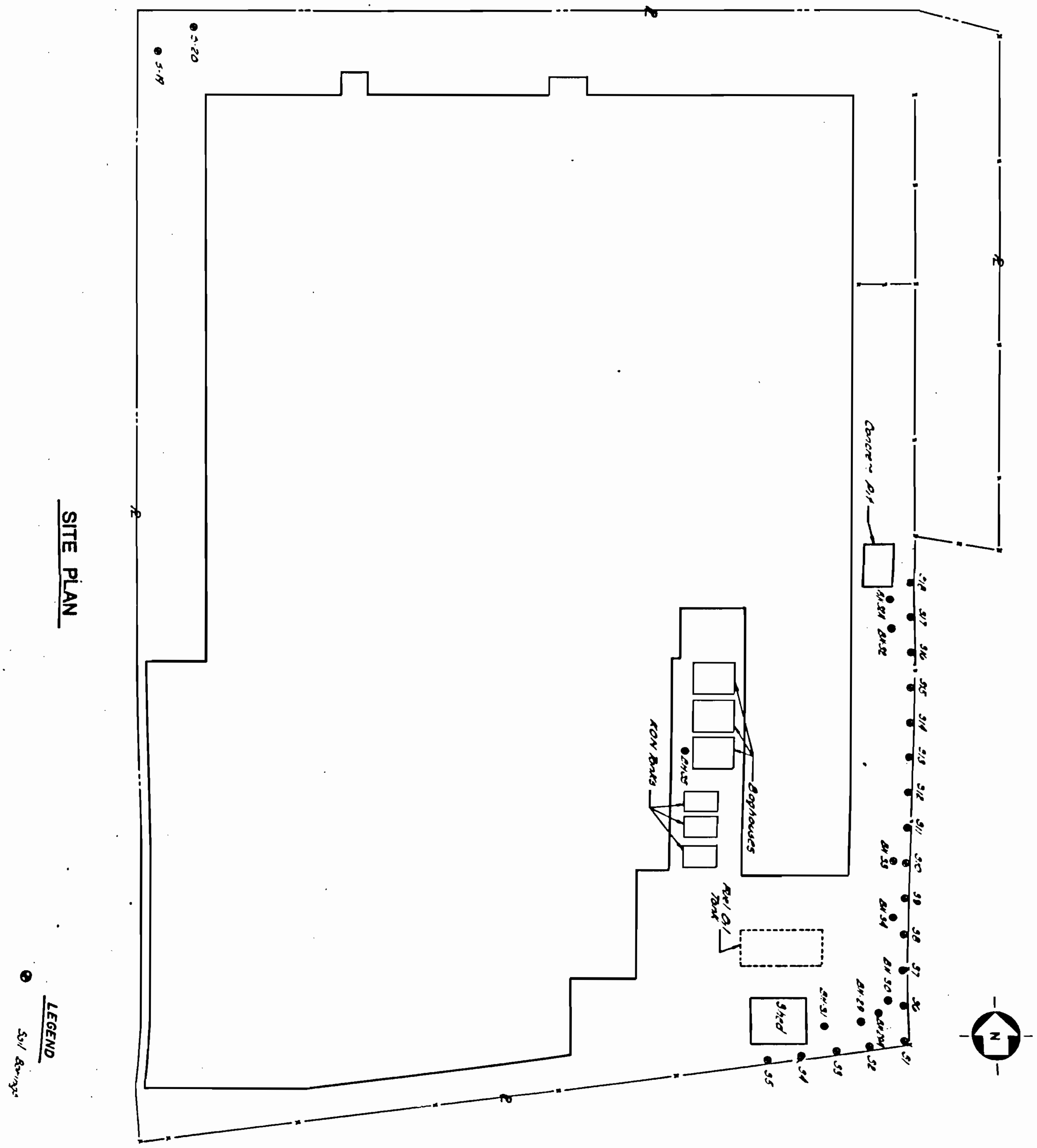
eder associates consulting engineers, p.c.

PROJECT
ON-SITE RESIDUE
EVALUATION STUDY
DURACELL INTERNATIONAL, INC.
NORTH TARRYTOWN, NEW YORK

TITLE
ROOF SAMPLING
LOCATIONS

eder associates consulting engineers, p.c.
85 FOREST AVENUE, LOCUST VALLEY, NEW YORK, 11560

DRAWN BY AFG	SCALE [illegible]
DESIGNED BY JBH	PROJECT NO 425-1
APPROVED BY GAR	DWG. NO 3
DATE October 1985	



SITE PLAN

ON-SITE RESIDUE EVALUATION STUDY

DURACELL INTERNATIONAL, INC.
NORTH TARRYTOWN, NEW YORK

eder associates consulting engineers, p.c.

REVISIONS

NO.	DATE	BY

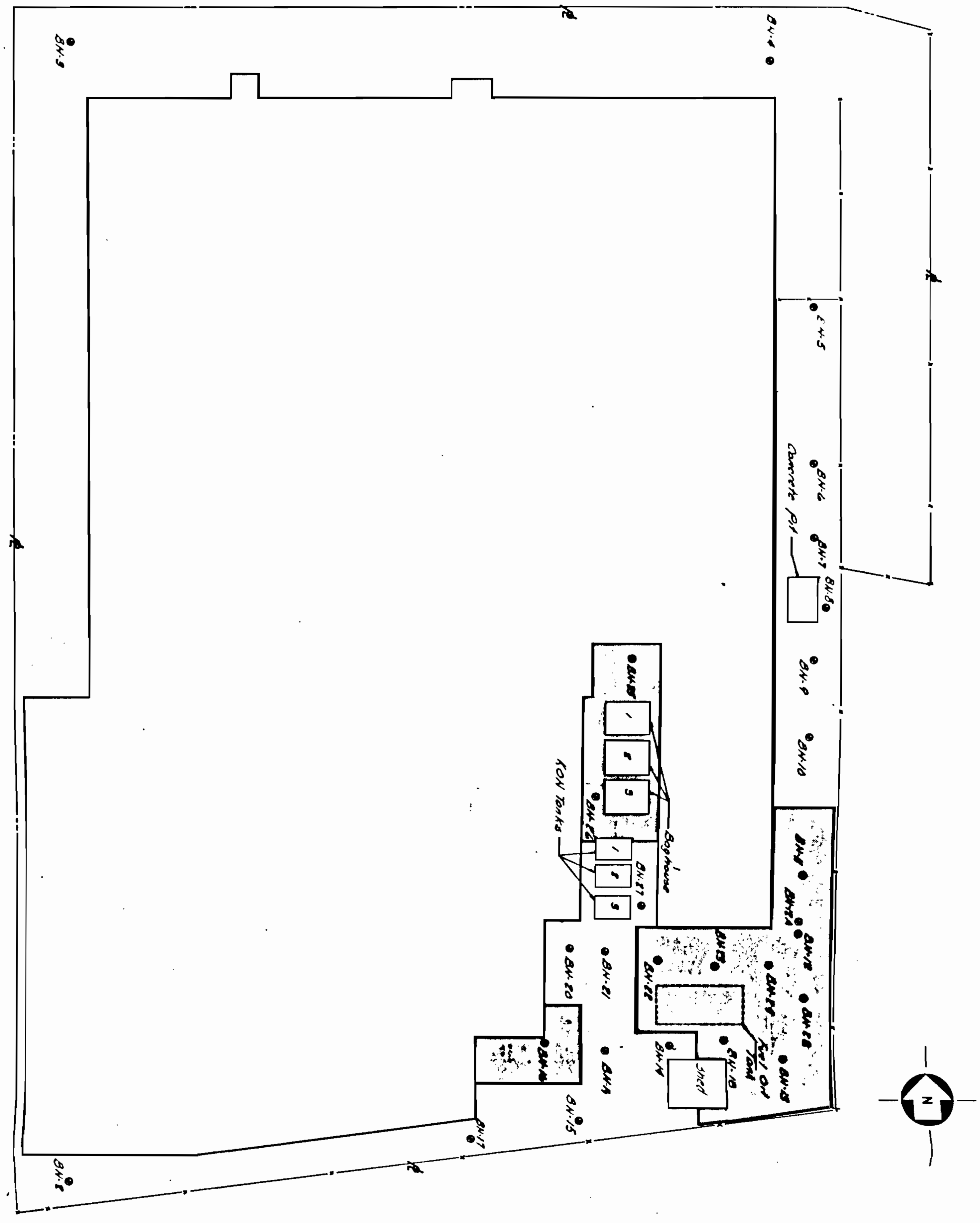
PROJECT
ON-SITE RESIDUE
EVALUATION STUDY
DURACELL INTERNATIONAL, INC.
NORTH TARRYTOWN, NEW YORK

TITLE
PHASE II
BORE HOLES

eder associates consulting engineers, p.c.
85 FOREST AVENUE, LOCUST VALLEY, NEW YORK, 11560

DRAWN BY AJG	SCALE 1/16" = 1'-0"
DESIGNED BY JBH	PROJECT NO. 465.1
APPROVED BY GAK	DWG. NO. 4
DATE October 1985	

SITE PLAN



LEGEND

●	Soil Borings
☐	Area Of Elevated Surface Soil Mercury Content

PROJECT	ON-SITE RESIDUE EVALUATION STUDY DURACELL INTERNATIONAL, INC. NORTH TARRYTOWN, NEW YORK
TITLE	ON-SITE SOIL CONTAMINATION
	eder associates consulting engineers, p.c. 85 FOREST AVENUE, LOCUST VALLEY, NEW YORK, 11560
DRAWN BY MSA	SCALE 1/16" = 1'0"
DESIGNED BY JBN	PROJECT № 925-1
APPROVED BY GAR	DWG. № 5
DATE October, 1985	

ON-SITE RESIDUE EVALUATION STUDY

DURACELL INTERNATIONAL, INC.

NORTH TARRYTOWN, NEW YORK

eder associates consulting engineers, p.c.

№	REVISIONS	BY