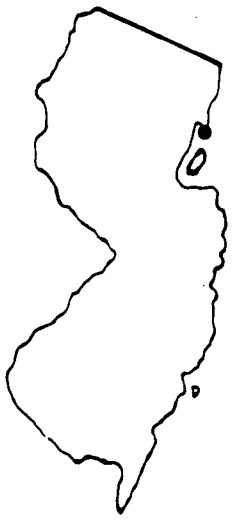
THE NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION

FEASIBILITY STUDY SYNCON RESINS SITE

KEARNY
HUDSON COUNTY
NEW JERSEY



HEALTH AND SAFETY PLAN AND FIELD SAMPLING PLAN

EBASCO

EBASCO SERVICES INCORPORATED

CONTROL DOCUMENT NO. HF-03

ASSIGNED TO Mr Russell Trice, Site Manager
Hazardous Site Mitigation Admin.
NJDEP
428 East State St, Trenton, NJ 08625

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EBASCO SERVICES INCORPORATED

HEALTH AND SAFETY PLAN

FOR

FEASIBILITY STUDY

AT THE

SYNCON RESINS SITE

KEARNY, HUDSON COUNTY, NJ

APPROVED BY	TITLE	DATE
T. GRANGER	Ebasco Project Manager	5/13/85
R. Trice	NJDEP Project Manager	5/14/85

TABLE OF CONTENTS

LIST OF EXHIBITS

This plan has been prepared in conformance with the Ebasco Health and Safety Program for Hazardous Waste Sites. It addresses all the activities associated with the feasibility study at Syncon Resin site and will be implemented during site investigation.

Compliance with this Health and Safety Plan* (HASP) is required of all workers subcontractors and third parties who enter this site. Assistance in implementing this Plan can be obtained from the Health and Safety Supervisor.

SITE - SYNCON RESINS SITE SITE NO. 005

PLAN DATE-DECEMBER 1984

	SITE MANAGER	HEALTH AND SAFETY OFFICER
Name	R. SHAPOT	L. MILITANA
Office Phone	(201) 460-6509	(212) 839-1047
Site Phone	(201) 465-0923	(201) 465-0923

EMERGENCY PHONE NUMBERS

Emergency phone numbers will be posted in the Command Post located onsite during all field operations. Contingency guidelines for emergency situations are provided in Section XIII.

Kearny Police Department	(201) 998-1313
First Aid/Rescue Squad	(201) 998-1313, (201) 997-75..
West Hudson General Hospital	(201) 991-3400
University Medical Center	(201) 456-5133
Univ. Med. Ctr. Ambulance	(201) 456-6290
Kearny Fire Department	(201) 991-1400
Department of Health (Kearny)	(201) 997-0600
National Response Center	(800) 424-8802
Poison Control Center	(800) 822-9761
H&S Supervisor (R. Schmitz)	(212) 839-1047
Ebasco Project Manager (T. Granger)	(212) 839-1095
NJDEP Site Manager (R. Trice)	(609) 984-3074
NJDEP "Hot Line"	(609) 292-7172

*Preliminary - portions or all of this plan may undergo revision based on the results of monitoring, and/or changes in work plans.

1.0 HEALTH AND SAFETY PERSONNEL

1.1 General

The following briefly describes the health and safety designations and general responsibilities and requirements which will be employed for the Syncon Resins Site. Health and Safety (H&S) personnel will be required to be present onsite during the conduct of all project-related work activities and will have stop-work authorization.

1.2 Health and Safety Supervisor

The Health and Safety Supervisor has overall project responsibility for development and implementation of this Health and Safety Plan (HASP) and conformance with project requirements. The Health and Safety Supervisor will be responsible for field audits of all health and safety related operations to check compliance with the procedures described herein and with the Corporate Health and Safety Program for Hazardous Waste Sites. This will be performed at a minimum of once or as required during the conduct of field operations. He will also be consulted when any changes to this plan or modification of any procedures are required or requested. Authorization for personnel to perform work onsite, i.e., relative to medical exams and training, must be cleared through him.

1.3 Health and Safety Officer

The Support Zone will be manned by a Health and Safety Officer or Site Manager during field operations. He will be responsible for implementing the HASP in the field, maintaining communications with

downrange teams, monitoring conformance with safety and emergency procedures, providing downrange team back-up, giving daily safety briefings and maintaining safety equipment. He will also be responsible for the set-up and execution of decontamination procedures. The Health and Safety Officer has stop-work authorization which he will execute upon his determination of unsafe conditions or other situations, e.g., weather conditions, where this action is appropriate. He, or an appropriately trained designee, will also be responsible for performing downrange site monitoring for specific operations as necessary when sufficient back-up personnel and Command Post staffing are provided.

1.0 LOCATION: The Syncon Resins hazardous waste site encompasses about 15 acres and is located in an industrial area along the Passaic River in Kearny, Hudson County, New Jersey (Figure 1). Lots 12, 13 and 13R of Block 289 make up the Syncon Resins Site. The site is at approximately 40° 44' latitude and 74° 06' longitude. The site is easily accessible through a gate located on Jacobus Avenue. The layout of the site is presented in Figure 2.

2.0 DESCRIPTION: The Syncon Resins Site is an uncontrolled hazardous site under the EPA's "Superfund" list. It is a former resin and varnish production facility which consisted of a reactor building containing stainless steel vessels, large bulk storage tanks, unlined lagoons, an unknown number of underground tanks and associated piping systems. Approximately 10,000 55-gallon drums of off-spec resins and solvents were stored at various locations onsite but have been removed. There are a number of large bulk storage tanks with contents of unknown origin and composition at the site. There are also two unlined lagoons on the site which were used for discharging process waste waters. Figure 2 provides a map of the general site layout with the locations of the above facilities indicated.

The site is underlain by the Brunswick formation (bedrock) at a depth of 60 to 100 feet. The Brunswick is overlain by 20 to 60 feet of varved silty clays and 5 to 40 feet of sands, gravels and miscellaneous fill.

As identified in the RAMP prepared by Camp, Dresser and McKee, Inc., the water table was encountered between three and five feet below the land surface at all test pit/monitoring well locations. The piezometric surface of the bedrock aquifer is seven feet lower than the water table. From these water level readings it has been concluded by NJDEP that there are separate aquifers beneath the site: a shallow aquifer consisting of the fill, sands and gravels,

and a deep aquifer in the bedrock. The aquifers are separated by the very low permeability silty clay.

Shallow groundwater flow is generally from the northeast area of the site towards the southwest and the Passaic River. Near Jacobus Avenue, shallow groundwater flows in a southerly direction owing to the topographic high near the 600,000-gallon tanks.

3.0 SITE HISTORY: The facility produced resin carriers for pigments, paints, and varnish products. The processes which produced these pigments were carried out in closed, stainless steel vessels. The processes included a water-cooled condenser whose cooling water was recycled in the system. Apparently much of the company's operations consisted of the reprocessing of off-specification resins purchased from other manufacturers. Disposal of most wastes generated at the site was through a hauler, S&W Waste, Inc.

The company ceased operations in 1981 and has filed for bankruptcy under Chapter 2 of the Bankruptcy Act. The receiver for the assets of Syncon Resins, Inc. has undertaken some site sampling and removal activity under orders from the U.S. Bankruptcy Court for the District of New Jersey. A Remedial Action Master Plan was prepared for the Syncon Resins Site by Camp Dresser and McKee, Inc., in November, 1982.

A variety of hazardous waste chemicals were handled at the Syncon Resins Site including solvents, waste oil, corrosives, organic liquids, solids, acids, alkalies, ketones, inorganic liquid and solids. The actual volume of these materials handled at the facility is not available. In the manufacture of synthetic resins and varnishes the following chemicals were used as raw material components:

- Ethylene diamine
- N-Butyl alcohol
- Ethyl acrylate
- Formaldehyde
- Maleic anhydride
- Paraldehyde
- Phthalic anhydride
- Toluene
- Toluene diisocyanate
- Xylene

In the production process, excess xylene or toluene were separated from the wastewater produced and reused in subsequent reactions. The wastewater was then pumped to a holding pond at the plant where additional xylene, toluene and mineral spirits were removed for reuse as reflux solvents. The remaining wastewater was pumped to an unlined leaching pond (lagoon), where it was allowed to evaporate or to percolate into the soil.

Drums containing wastes and raw products were randomly stored throughout the facility. Numerous drums were labeled flammable and combustible. Limited sampling has established the presence of xylene and toluene in the soil and in the two unlined lagoons. Information taken from the drums suggest the existence of hazardous materials including:

- Butyl acetate
- Maleic anhydride
- Caustic soda
- Vinyl acetate
- Vinyl toluene
- Phenolic varnish
- Acids

- Esters
- Corrosives
- Aluminum hydroxide
- Solvent wastes
- Waste oil
- Waste oil and solvents

EXHIBIT 1

SYNCON RESINS SITE

GENERAL LOCATION MAP

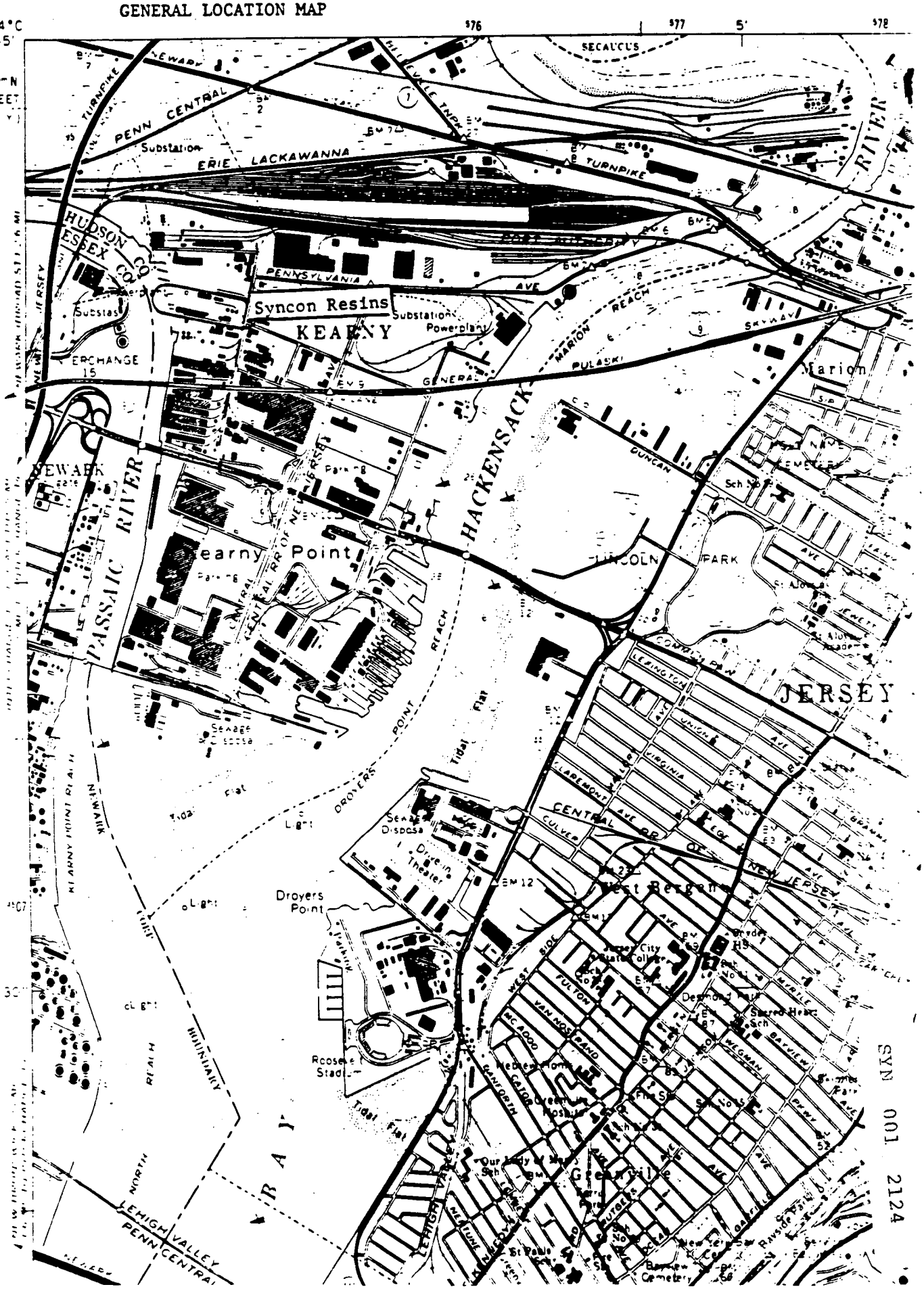

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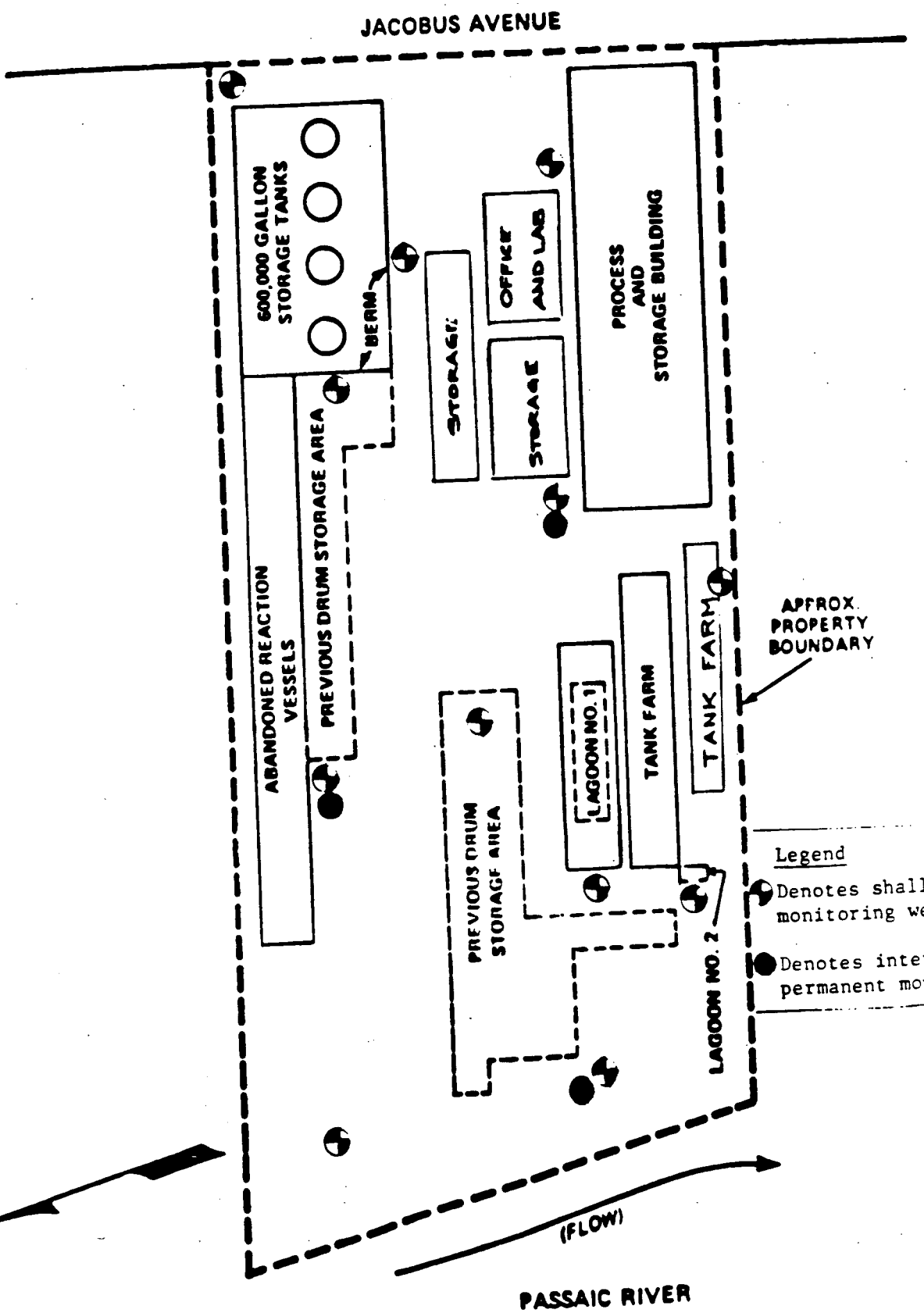
EXHIBIT 2
SYNCON RESINS SITE
SITE LAYOUT MAP



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It is instructive to review some of the incidents, accidents or actions that have occurred at the Syncon Resins Site in order to help assess potential hazards that may exist. This information should not be taken all-inclusive since it reflects that information available or selected for incorporation in this HASP during its development.

1. On 5 June 1980, a Hazardous Waste Investigation was performed. The Syncon Site was visited by Mr. Tom McGuiness of the NJDEP to investigate the complaint of storage and disposal practices at the site. No samples were taken at that time.

2. In June and November of 1981 USEPA conducted inspections of the site which revealed that the site was being used for the storage and disposal of hazardous waste.

3. On November 12, 1981 NJDEP conducted an inspection of the Syncon Resins Site and established that the use of the lagoons and the discharge of pollutants into the lagoons and onto the ground are violations of NJSA 58:10A-6A and NJAC 7:14-1 et seq.

4. In July 1982 operations were discontinued by Syncon Resins, Inc.

5. On 13 October 1982, D. Muldoon and T. Pedersen of Camp Dresser and McKee conducted a preliminary site survey and characterization at the Syncon Site. Personal protective equipment consisted of full-face respirators equipped with GMH-C dual cartridges, TYVEK coveralls, rubber boots and gloves. In spite of the protective equipment the CDM personnel experienced breakthrough of contaminants which included detectable odor and burning sensation in the face and in the eyes. When this occurred, a HNU PID did not indicate levels of volatile organics greater than 3 ppm which implies a detection limitation with this instrument.

1. WASTE TYPES:

A list of substances, identified in the RAMP for the Syncon Resins Site, found in groundwater and soil samples is presented in Tables 1 and 2. Additional lists of raw material components and materials that were contained in drums is presented in the site history in Section III-3. Below are some examples of compounds found at higher levels in Tables 1 and 2 and characteristics assigned to them.*

Substance	Toxicity	Ignitability/ Flammability	Reactivity/ Stability	Persistence
Benzo(a)Pyrene	high	nonflammable flash pt 200F	nonreactive	high
Chrysene	high	nonflammable flash pt 200F	nonreactive	high
Ethylbenzene	moderate	flash pt 80F	nonreactive	somewhat
Fluoranthene	slightly	nonflammable flash pt 200F	nonreactive	high
Lead	high	nonflammable flash pt 200F	nonreactive	high
Naphthalene	moderate	flash pt 80-140F	nonreactive	somewhat
PCB	high	nonflammable	nonreactive	high
Phthlates	slight	flash pt 140-200F	nonreactive	high
Pyrene	high	nonflammable flash pt 200F	nonreactive	high

* The information on the characteristics of chemicals associated with the Syncon Resins Site was obtained through "HAZARDLINE" which, among other data bases, is utilized by Ebasco for hazardous waste projects. These characteristics are based upon CERCLA definitions 40CFR300.81. A file of this information and other information sources will be maintained at the Command Post onsite.

Substance	Toxicity	Ignitability/ Flammability	Reactivity/ Stability	Persistence
Toluene	moderate	flash pt 80F	nonreactive	somewhat
Xylene	moderate	flash pt 80F	nonreactive	somewhat
Zinc	high	flash pt 140-200F	nonreactive	somewhat
Chromium (Hex)	high	nonflammable flash pt 200F	nonreactive	high
DDT	high	noncombustible flash pt 200 f	nonreactive	high
Maleic anhydride	moderate	flash pt 140-200F	reacts non-violently	somewhat

2. WASTE FORMS: Liquid X Solid X Sludge X Gas X

3. CHARACTERISTICS: Corrosive X Flammable X Radioactive ____

Toxic X Volatile X Reactive X Inert ____

4. CONTAINMENT: Drum X Pit X Tank X

Pond ____ Lagoon X Other UNKNOWN

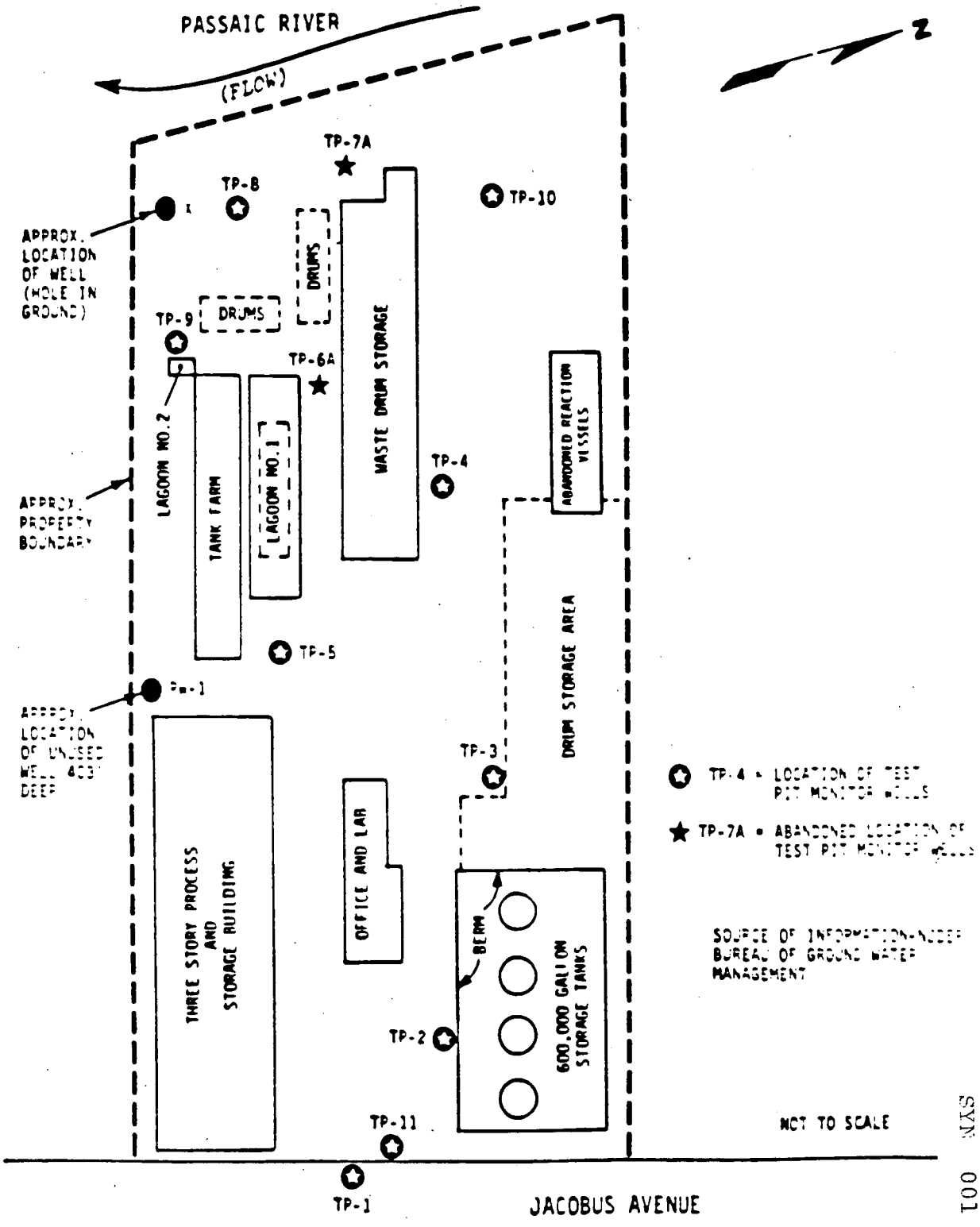
TABLE 1
SYNCON RESINS
SOIL SAMPLE ANALYSES[1/]

Parameter	TP-2[2/]	TP-3	TP-4	TP-5	TP-8	TP-9
Methylene Chloride	670	60			54	
Toluene		64			112	> 3,072
Phenols, Total (mg/kg)	0.26	<0.1	<0.1	0.21	0.10	2.0
Anthracene			400			
Benzo(a)Pyrene					1,433	
Chrysene	2,520		500		2,460	
Bis(2-Ethylhexyl)Phthalate	1,260					
Diethyl Phthalate			440			
Di-N-Butyl Phthalate			2,080		666	
Fluoranthene			4,440		666	
Pyrene	11,660		5,630		700	
henanthrene			1,950			
Naphthalene	2,403	1,825				
PCB 1242					9,733	33,000
PCB 1248					1,366	
4,4'-DDT					1,366	
4,4'-DDD						
Arsenic (mg/kg)			37	9	24	18
Chromium (mg/kg)		9	40	24	120	70
Copper (mg/kg)		19	36	23	80	35
Lead (mg/kg)			46	65	340	95
Mercury (mg/kg)		0.1	0.4	0.2	0.6	0.4
Nickel (mg/kg)			9	10	20	14
Zinc (mg/kg)	50	60	42	26	360	160
Cyanide (mg/kg)	0.24	<0.2	0.24	0.51	4.2	1.5

1/All values reported as mg/kg unless otherwise noted.
2/Reference Exhibit 2A for location on site.
SOURCE: NJDEP

EXHIBIT 2A

SYNCON RESINS SITE
PREVIOUS TEST PIT (TP) AND BEDROCK WELL (RW) LOCATION MAP



SOURCE: Camp, Dresser & McKee, Inc. Remedial Action Master Plan, Syncon Resins Site

TABLE 2

Analyses of Shallow Groundwater at Site

Compounds VO's	TP-1	TP-2	TP-3	TP-4	TP-5	TP-6	TP-9	TP-10	TP-11	RW-1 1/
Toluene		70ppb		880ppb	3ppb	2800 ppb	34.5%		2 ppb	
Benzene	10ppb	20ppb		3ppb		120 ppb	0.1%		3 ppb	130 ppb
ethyl benzene		14ppb		254ppb		140 ppb	0.8%			
p-xylene		20ppb		158ppb	23ppb	80 ppb	0.4%		2 ppb	
o-xylene		72ppb	3ppb	256ppb	62ppb	60 ppb	0.7%			
m-xylene		12ppb	4ppb	520ppb	300ppb	300 ppb	1.5%		6ppb	
chlorobenzene						86 ppb	0.6%			
o-chlorotoluene		36ppb					0.2%			
p-chlorotoluene		22ppb		6ppb			0.03%			
1,3,5 trimethylbenzene		54ppb					0.2%			
N-butylbenzene		18ppb		6ppb			0.1%			
hexachlorobutadiene		460ppb		10ppb			0.06%			
dibromochloromethane								1ppb		
tetrachloroethylene	1ppb	4ppb	1ppb			4 ppb		1ppb		1 ppb
p-dichlorobenzene		116ppb	2ppb	18ppb	13ppb				24ppb	
O-dichlorobenzene		162ppb	4ppb	168ppb	15ppb				24ppb	
methylene chloride										[illegible]
[illegible]roform										[illegible]
[illegible]bon tetrachloride										[illegible]
trichloroethylene										
1,2 dichloroethane			1ppb	1ppb						
sec-butylbenzene				8ppb						
1,2,4 trimethylbenzene		70ppb		34ppb						
cumene		24ppb								
styrene		6ppb								
p-bromofluorobenzene		24ppb								
p-cymene		24ppb							44ppb	
1,2,4 trichlorobenzene		72ppb							104ppb	
Naphthalene		200ppb								
(Totals) VO's	11ppb	1500ppb	17ppb	2324ppb	416ppb	3590ppb	39.19%	2ppb	211ppb	59[illegible]
pH	6.9	6.6	6.8		6.7	6.7	6.8	7.0	6.8	6.9
Cl (ppm)	44	40	11	68	29	78	22	33	19	2440
Cd (ppb)	2				2	2	6	6		2
Cr (ppb)	250	46	42	172		73	60	4933	56	
Cr (hex) (ppb)				15						
Pb (ppb)	886	88	154	142	82	480	239	1420	201	
PCB (ppb) water phase	23.4				14.7	230	630			0.4
(ppm) oil phase							739.7			
roleum hydrocarbons ppm	1.0	25.4		1.6	20.9				73.6	

1/Reference Exhibit 2A for location on site.

SOURCE: Camp, Dresser & McKee, Inc., Remedial Action Master Plan, Syncon Resins Site

The overall site hazard assessment is moderate to high due to the types of chemical used in the pigment/resins manufacturing and potential to come into contact with the unknown contents of various bulk storage tanks (confined spaces) during sampling. This judgement is based on the review of documentation provided by NJDEP. The wide variety of compounds used in these processes spans a range of toxic effects. Of major concern is the possible presence of suspect carcinogens (e.g., benzene, PCB's) and acute and chronic systemic toxics. A number of compounds may result in a high degree of toxicity when exposure occurs via inhalation, innoculation and ingestion routes. The toxic effects of these chemicals depend on whether acute or chronic exposures occur. At sufficient concentrations, possible effects of the materials onsite include the powerful irritant properties of certain vapors, narcotic effects, and corrosive actions. An additional hazard involves the unknown composition and properties of mixtures present. For example, solvent waste and waste oil contain numerous contaminants that may present a hazard due to interaction (e.g. synergism) between compounds. The highest degree of site hazard is associated with the entrance into confined spaces, e.g., tanks, for sampling where the potential for oxygen deficient, explosive or highly toxic atmospheres may exist. Definitive information on the contents of numerous storage tanks and process vessels at the site are not available at this time.

In addition, the presence of maleic anhydride and toluene diisocyanate on the site is suspected. The ACGIH assigned TLV's for these substances are quite low; 0.25 and 0.005 ppm respectively. Soil contamination is evident throughout the site as a result of open and leaking drums. It is likely that groundwater, surface water and surficial soil contamination has occurred, owing to unlined lagoons, leaking drums and unchecked surface runoff to the Passaic River. Caution to prevent dermal contact or inhalation should be exercised during field sampling operations.

An initial inspection of the site, prior to drum removal, indicated the presence of high ambient organic vapor concentrations. A strong acrylate odor was noted and breakthrough of full-face respirators equipped with GMC-H dual cartridges occurred. A burning sensation on the face and eyes was reported. A HNU Model 101 PID (10.2 eV lamp) recorded levels above 5 ppm in certain areas of the site but recorded levels less then 3 ppm when breakthrough occurred. This implies that the HNU PID may have detection limitations. Further air monitoring investigations will be necessary to establish present levels of air contaminants since the drums have been removed. An explosion/HC/O_2 meter and a radiological survey instrument did not show discernable readings above background in the open areas outside. Atmospheric oxygen levels in depressional areas such as the bermed areas around the 600,000 gallon tanks were adequate and danger of explosion was not detected at doorways to buildings or within the box trailers or abandoned reactor vessels on site. However, continuous monitoring and special caution should be utilized when conducting site investigation operations, especially those involving invasive work and entrance into confined spaces.

Additionally, special caution should be exercised due to the potential for contact during work in areas of known contamination which include:

- Areas where drums were stored and leakage has occurred;
- Intact bulk storage tanks, process reactors and associated piping;
- The two unlined waste lagoons; and,
- Numerous box trailers, abandoned reactor vessels and storage tank remnants;
- The waste disposal areas (e.g., areas near TP-8 (see Exhibit 2A) where high levels of PCBs and DDT were detected).

Basic Training Required:

- Completion of the basic Ebasco Health and Safety Training Program (see Ebasco Corporate Health and Safety Program for Hazardous Waste Sites).

Special Training Required:

- All personnel shall have respiratory protection training and fit testing.
- Specialized training for personnel involved with Level B operations particularly for SCBA inspection, maintenance and use.
- Safety briefings prior to initiation of any task work. This will include:
  - review of planned operations
  - chemical hazards present, form and warning properties
  - location of emergency and safety equipment
  - emergency response procedures
  - site and work zones
  - levels of protection (respiratory, clothing, etc.)
  - safety monitoring
  - communications (hand signals, 2-way radio, telephone)
  - decontamination procedures
  - emergency communications and facilities
  - evacuation procedures
- Review of this HASP and sign-off.

1. FIELD INVESTIGATION ZONES.

For field work at the Syncon Resins Site, a three zone approach will be utilized where practical (See Figure 3). The zones will be roped off or otherwise clearly indicated, and will include the Support Zone, the Contamination Reduction Zone (CRZ) and the Exclusion Zone. Site entrance and egress will be through controlled points established at the Support Zone. The Support Zone will contain the Command Post with appropriate facilities such as communications, first aid, eye wash and emergency drench system, hygiene facilities, etc. This zone will be manned at all times when field teams are operating downrange. Adjacent to the Support Zone will be the Contamination Reduction Zone (CRZ) which will contain the contamination reduction corridor (CRC) for the decontamination of equipment and personnel as well as the corridors for Exclusion Zone entrance and egress. This CRZ is separated from the Support Zone by the contamination control line. All areas beyond the CRZ will be considered the Exclusion Zone which is separated from the CRZ by the "Hotline".

Within the major Exclusion zone specific activity zones will be established around each individual site operation, for example, drilling or tank sampling. The Exclusion Zone will also contain the heavy equipment decon area. Individual hazardous locations within the site will be identified and isolated as necessary. These may include lagoons, former drum areas, sources of combustible gases or air contaminants, and other areas identified in the H&S Reconnaissance survey or from information sources. For well drilling operations a 30 foot radius around the drill rig will be established as a restricted area when practical. For all field operations only authorized personnel will be permitted to enter the Exclusion Zone and a log of personnel entering will be maintained at the Command Post. Access for emergency services to areas

conducting specific site operations will be established where necessary in order to provide for access to the various work locations.

The Contamination Reduction Zone is to be used for general site entry and egress in addition to access for heavy equipment for investigation activities. The Support Zone with the appropriate facilities, will be established near the east entrance.

2.0 PERSONAL PROTECTION

2.1 General

The level of protection to be worn by field personnel will be defined and controlled by the onsite Health and Safety Officer in conformance with Ebasco standard operating procedures. Selection of respiratory protection will be made based on assessment of a variety of factors including, but not limited to, the results of direct reading instruments. The use of Level C respiratory protection, (air purifying respirator) is based on sufficient oxygen being present (more than 19.5%) and measurements of organic vapors from 0.2 ppm to 5 ppm above background. If an Immediately Dangerous to Life and Health (IDLH) situation is present or if organic vapor levels exceed 5 ppm above background, the use of self-contained breathing apparatus is necessitated. This is also true if oxygen levels are below 19.5%. Level D protection will be the minimum level of protection to be utilized during the conduct of site activities and will be worn in the CRZ and support zone. This level of protection may be used only when organic vapor levels are measured at 0.2 ppm above background or less. If a situation arises where Level D may be worn in downrange areas, respirators will be available with personnel for immediate use. Basic levels of protection for general operations are provided below and are defined in this section. It should be noted that levels of

protection may be upgraded or downgraded, as appropriate, after the H&S Officer receives authorization from the H&S Supervisor. In any situation where downgrading of personal protection is sought, certain environmental conditions must be evaluated and met. These include, but are not limited to: low wind velocity, favorable wind direction relative to the location of an operation, non-invasive operations, and consideration of the potential for contact with fugitive dusts.

Task	Level of Protection
H&S Reconnaissance	C
Sampling Reconnaissance	D/C
Building Sampling (non-invasive)	C
Building Sampling (invasive)	C/B
Surveying Operations	D/C
Drilling Operations	C
Sampling Pipes, Vats, Tanks	C/B
Soil Sampling	C
Surface Water Sampling	C
Groundwater Sampling	C
Decontamination (CRC)	C
Geophysical Survey	D/C
Decontamination Heavy Equipment	C
Confined Space Entry	B
General Clean Area Work	D

2.2 Initial Level of Protection

Initial level of protection will be employed during the performance of the Health and Safety Reconnaissance. The team will enter unoccupied structures, facilities and spill locations generally in Level C protection. Work in certain areas may be performed in Level D protection as established by the H&S Officer and based upon results of monitoring and information gathered during the reconnaissance. The H&S Reconnaissance will allow for the

selection/confirmation of appropriate levels of protection for proposed site operations, sampling strategies and general safety planning. It should be noted that this Health and Safety Plan (HASP) allows for upgrading or downgrading of protection levels to conservatively preclude any potential for contamination of personnel while not sacrificing protection or efficiency. During the reconnaissance the team will also assess the integrity of structures and access to proposed sampling locations in consideration of the safety of these operations.

2.3 Personnel Protective Equipment

For Tasks requiring Level B Protection:

- o Open circuit, positive pressure-demand SCBA;
- o Chemical protective suit (e.g., Saran TYVEK)
- o Chemical protective hood;
- o Gloves, inner (surgical type);
- o Gloves, outer (chemical protective);
- o Boots (chemical protective), steel toe and shank;
- o Booties (chemical protective - optional);
- o Hard hat;
- o Voice amplifier (optional);
- o 2-way radio (intrinsically safe).

For Tasks requiring Level C Protection:

- o Full face air-purifying respirator;
- o Emergency escape respirator (carried when appropriate);
- o Chemical protective suit (e.g., saran or polycoated TYVEK);
- o Gloves, inner (surgical type);
- o Gloves, outer (chemical protective);
- o Boots (chemical protective), steel toe and shank;
- o Booties, (chemical protective - optional);
- o Hard hat (optional eye protection);
- o 2-way radio (intrinsically safe).

For Tasks requiring Level D Protection:

- o Air purifying or emergency escape respirator (carried);
- o Coveralls or TYVEK suit;
- o Gloves (chemical resistant);
- o Boots/shoes (safety);
- o Booties (optional);
- o Hard hat with optional eye protection.

2.4 Safety Equipment

Basic emergency and first aid equipment will be available at the Support Zone and the CRC, as appropriate. It will include communications (telephone, walkie-talkies, air horns), first aid equipment, eye wash, emergency shower or drench system, hygiene facilities, fire extinguishers, stretchers and other safety related equipment. Also located in the Support Zone or the Contamination Reduction Zone (CRZ) will be a backup field team available in the event of an emergency incident involving the downrange field team. This will be especially important when Level B operations are conducted. In addition, the Command Post will be manned during all times when teams are downrange, communications will be maintained, and personnel will be available to assist in deconning procedures for personnel and equipment. Decontamination equipment will be located in the Contamination Reduction Corridor.

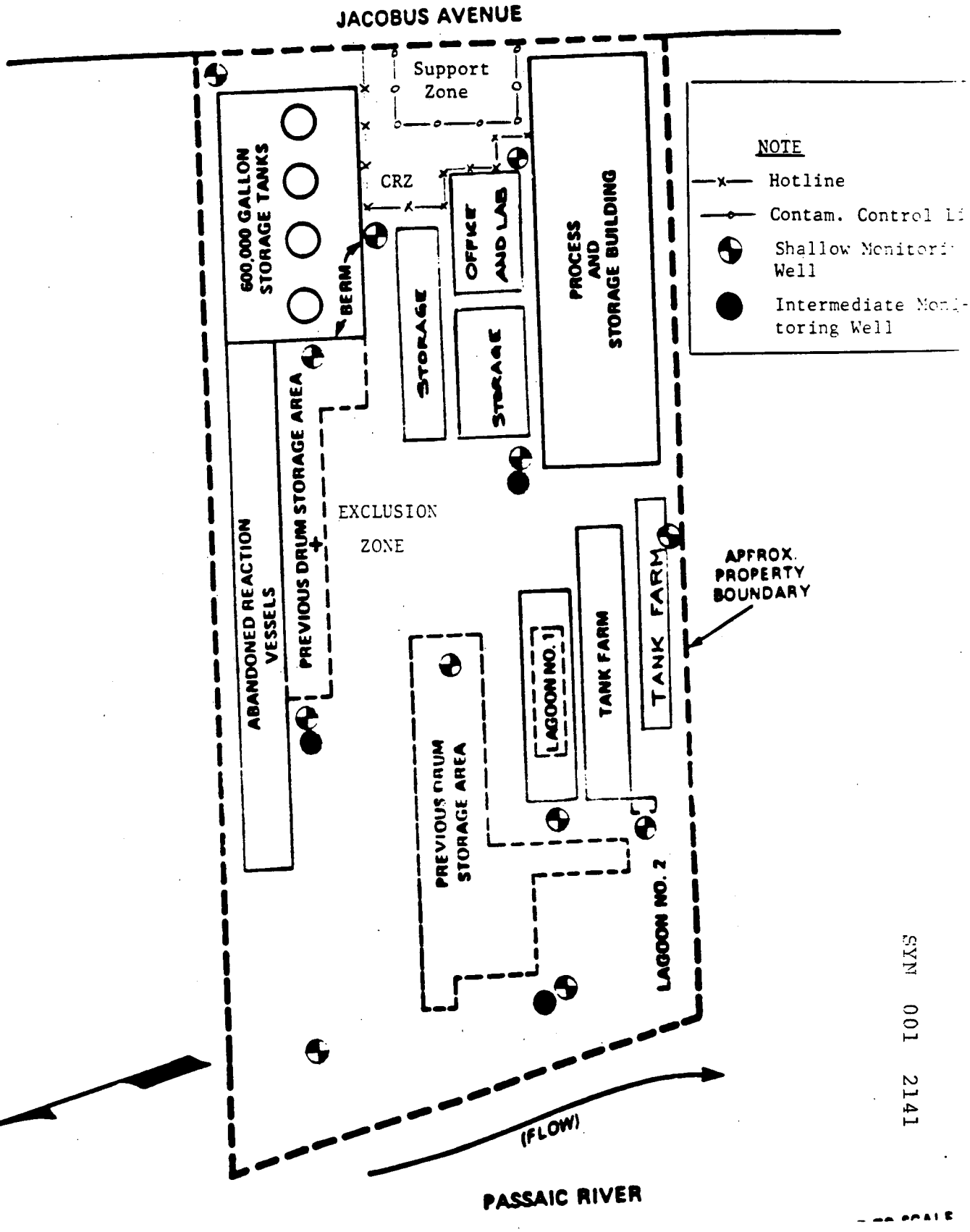
3.0 COMMUNICATIONS

- o Walkie-Talkies - Hand held units will be utilized by field teams for communication between downrange operations and the Command Post base-station.
- o Telephones - A telephone will be located in the Command Post trailer in the Support Zone for communication with emergency services/facilities.
- o Air horns - These will be carried by downrange field teams and also will be maintained at the Support Zone for initiation of emergency evacuation procedures (see Section XV).

- Hand signals - To be employed by downrange field teams while utilizing the buddy system.
- Voice Amplification System - Optional battery operated voice amplifiers may be used by teams in Level B protection if needed, and as necessary when downrange operations are conducted.

EXHIBIT 3

SYNCON RESINS SITE
SITE ZONATION



SYN 001 2141

1.0 SITE SAFETY MONITORING

All site environmental monitoring will be accompanied by meteorological monitoring of appropriate climatic conditions. Area and perimeter monitoring will accompany activities involving the potential release of contaminants.

1.1 Health and Safety Reconnaissance

Monitoring will be performed during the H&S Reconnaissance by the H&S Officer. This monitoring will confirm the level of protection to be utilized during the reconnaissance itself. It will also be used to establish the levels of protection for planned operations, especially those involving tank and building sampling. Monitoring will include investigation of the presence of combustible gases, volatile organics, oxygen levels in confined spaces, and presence of airborne toxic compounds. Instrumentation will include, but not be limited to, the MSA 260 Combustible Gas Indicator with Oxygen Meter, a Photoionization Detector and/or Flame Ionization Detector (FID). Colormetric detector tubes (MSA or Draeger) may be used as appropriate when indicated by the H&S Officer.

1.2 Well Drilling Operations

A H&S Officer will be present and provide monitoring during drilling operations. A PID and/or FID will be utilized to monitor the breathing zone, the borehole and all geological samples upon their retrieval. Drill cuttings will also be monitored. A Combustible Gas Indicator with oxygen alarm will be used to monitor the borehole for the presence of combustible gases. Monitoring of any fluids produced during well development will also be conducted. All drilling locations will be checked for the presence of underground utilities before operations begin.

1.3 Monitoring for Tank/Pipe/Vessel Sampling

Air monitoring will be performed before and periodically during operations, when tanks, pipes, vessels, etc. are to be sampled. Monitoring will be performed with a PID and/or FID for the presence of organic vapors and with a combustible gas indicator for the presence of a potentially explosive environment. Continuous monitoring will be employed when the sampling operation has the potential to release airborne contaminants or to create an explosive environment. In such a situation where the potential for offsite receptors to be exposed to released air contaminants that have otherwise been contained or stored, and such a release cannot be shut down or eliminated, perimeter monitoring, downwind of the source, will be employed. Specific sampling procedures and locations will be determined based on invasive actions being conducted on the safe and meteorological conditions at the time. When monitoring operations must be conducted in a confined space, initial entry will be made in Level B protection. A confined space is defined as any space or enclosure that has limited entry or egress; may have limited ventilation; may contain or produce life threatening atmospheres; and which is not intended for continuous employee occupancy. When monitoring has been performed and upon approval of the H&S Officer, downgrading of respiratory protection may be implemented. In situations where the definition of a confined space is marginal, special caution requiring monitoring for the presence of sufficient oxygen (more than 19.5%) will be performed before activities can be conducted in Level C.

Procedures for confined space entry, provided by CECOS, are provided in Appendix A to this HASP. All procedures to be utilized will be subject to the provisions and policies established in Ebasco's Corporate Health and Safety Program.

1.4 Monitoring During Building Sampling

Monitoring with a PID and/or FID will be used when the area to be entered has restricted or no ventilation and initially before any sampling operations commence. Monitoring will also be required to check for the presence of combustible gases and to establish oxygen levels for selection of appropriate respiratory protection. Area monitoring will be performed as part of the air monitoring program at the discretion of the H&S Officer and where monitoring with direct reading instruments indicates. No special continuous monitoring requirements will be employed for sampling buildings which are completely open to the air and when only surficial sampling is to occur.

2.0 PERSONNEL MONITORING PROCEDURES

Persons identified by the Site Manager, in consultation with the H&S Officer, will be selected to wear organic vapor dosimeters or portable sampling pumps with a variety of collection media employed. Such collection media may include, TENAX and XAD resins, charcoal or cassettes with silver membrane and glass fiber filters. This monitoring is very important for personnel repeatedly entering confined spaces or established toxic areas.

3.0 PERSONNEL MEDICAL MONITORING

All Ebasco and subcontractor personnel working on the site are required to have taken and passed their TOX 1 medical exam or equivalent and annual re-exam as per corporate policy established in Ebasco's Health and Safety Program for Hazardous Waste Sites. All personnel will also complete the medical data sheet provided in Section XVIII of the HASP. No other special monitoring will be employed unless: an incident involving an overt exposure occurs, personnel monitoring indicates the concentration of substances of type and level of particular concern, or the H&S Officer in consultation with the H&S Supervisor elects to perform such monitoring. If site work is to be conducted during warmer weather when heat stress may become a consideration, the H&S Officer will institute heat stress monitoring through the use of the Wet Bulb Globe Temperature (WBGT) Index establishing work-rest regimes, liquid intake and, where appropriate, pulse monitoring.

1.0 GENERAL SAFETY CONSIDERATIONS

Complete monitoring will proceed all sampling activities, with special awarness of meteorological conditions. For environmental sampling, avoid contact with materials. All field sampling will be performed under the level of protection described in Section VIII, and instituted by the Health and Safety Officer. The level of protection will be established by review of facility history, available data, and especially by the results of the Health and Safety Reconnaissance (see Section IX and below) performed for each building, facility or spill location.

1.1 Health and Safety Reconnaissance

Safety considerations during the H&S Reconnaissance are important since the H&S Reconnaissance will precede all other field operations. The H&S Reconnaissance will be conducted under Level C; however, Level D may be used in presently occupied areas and those openly exposed to the air, e.g., at the site entrance, provided there is sufficient support information to justify Level D protection. The recon team will maintain line of sight with each other at all times. Monitoring will be performed as indicated in Section IX and will be used to alert the recon team if a dangerous situation exists and will also be utilized to assist in prescribing levels of protection for future site operations. No containers, vessels, pipes, vats, etc., will be opened or confined spaces entered during the site recon. When buildings are to be entered, particular attention should be paid to the structural integrity of the building for the safety of the recon team and for future sampling operations. Any physical hazards will be noted and recorded and egress/evacuation routes checked.

1.2 Tank, Pipes and Vessels

CECOS Environmental, Inc. will perform tank and other vessel sampling. CECOS' Health and Safety program will be subject to review and approval by Ebasco and must, at a minimum, be as stringent as Ebasco policy and contain specific procedures for confined space entry and tank/pipe sampling (see Appendix A). Extreme caution should be given during sampling operations involving confined spaces including tanks, pipes, vats, etc., and areas where poor or no ventilaton exists. Level B protection will be employed in these situations. Other levels of personnel protection may be required and will be specified by the H&S Officer. Considerations should be given to spill potential, residues under pressure, presence of flammable/combustible materials, hazardousness of contaminants, etc. The buddy system will be utilized at all times and communications maintained with Command Post. Fully equipped backup personnel will be on stand-by in the CRC or other suitable location in case of an incident. Emergency evacuation routes and safe areas will be established and emergency signals confirmed before operations commence. Health and Safety personnel must be alerted prior to initiation of sampling and will observe the sampling team while they are conducting these operations.

1.3 Well Drilling and Sampling

A H&S Officer will be present during all drilling operations (geological sampling) and will ensure monitoring to verify that appropriate levels of protection and safety procedures are utilized. He need not be present during well development or sampling provided prescribed equipment is worn and appropriate procedures followed. The H&S Officer will audit these operations periodically to ensure compliance with safety procedures and practices. All drilling and associated operations will be performed with spark proof tools and intrinsically safe equipment

when the potential presence of combustible gases exists. The location of safety equipment and evacuation procedures will be established prior to initiation of operations. The use of salamanders or any other open flame devices is prohibited. For groundwater sampling from monitoring or observation wells, all wells will initially be opened at Level C protection. The well head will be monitored with a PID and/or FID and a Combustible Gas Indicator. If readings indicate Level C protection is required, installation and sampling will be done at Level C. If readings are consistent with Level D criteria, then installation and sampling can be performed at Level D. Wells may be vented and rechecked to downgrade sampling to Level D if criteria are met. This must be verified and approved by the site H&S Officer who will provide monitoring for verification and worker safety. Proposed locations for drilling will be checked for the presence of underground utilities before operations may begin.

1.4 Building Sampling

Prescribed clothing will be worn at all times. During building sampling, safety considerations will be given to access to proposed sampling locations within the building. Such consideratons will include structural integrity of the access point and the evacuation procedures and routes out of the location. Safety harnesses will be used where the potential for falling exists, as well as during entrance to confined spaces where appropriate. Monitoring will be performed during sampling operations and communication with the Command Post maintained.

The buddy system will be utilized at all times. Attention will also be given to the potential to damage existing utilities, if any, and penetrating pipes or similar structures during invasive

sampling techniques. Upgrading of protection levels will be employed when necessary, especially if any confined spaces must be entered. Buildings will generally be sampled in Level C protection, however, upgrading may be appropriate for sampling in confined locations or where monitoring data indicates the presence of organic vapors or low oxygen levels. The H&S Supervisor will be consulted by the H&S Officer before modifying any protection levels. Sufficient intrinsically safe light will be provided when conducting sampling operations in structures where no electric utilities are provided and insufficient natural light exists. Sampling teams will be fully aware of the location of all safety equipment and will be briefed as to use and other emergency procedures.

1.5 Soil, Surface Water, Liquid Waste Sampling

Sampling of soils, standing liquids, and other sampling in open areas will be performed in Level C protection; however, downgrading may be appropriate where indicated by the H&S Officer in consultation with the H&S Supervisor. Personnel must wear prescribed clothing at all times including eye protection, chemical resistant gloves and splash aprons (where appropriate) when sampling liquids. Do not lean over open drums, vats, basins without using a safety line and/or harness. Sample bottles should be bagged prior to sampling to ease decontamination procedures. Be aware of emergency evacuation procedures and the location of all emergency equipment, including spill containment materials, prior to sampling. Practice contamination avoidance at all times. Utilize the buddy system and maintain communications with Command Post.

2.0 Sample Handling/Shipping/Laboratory

Personnel responsible for the handling of samples will wear Level D protection including chemical resistant gloves and eye/face protection. Samples should be identified as to their hazard and packaged as to prevent spillage or breakage. Any unusual sample conditions should be noted. Lab personnel will be advised of sample hazard level and the potential contaminants present. This is to be accomplished when necessary by a phone call to lab coordinator and/or including a written statement with samples.

All personnel and equipment exiting Exclusion Zone will be thoroughly deconned. Figures 4 thru 6 illustrate decon procedures for field workers. Personnel will be available in the contamination reduction corridor to assist in decontamination of downrange field teams. A change trailer will be provided for field teams and will be located in the CRZ/Support zone.

Decontamination of heavy equipment will be performed in a separate location established as a restricted area within the Exclusion Zone. Heavy equipment decontamination will include provisions for minimizing accumulation of decon water and transport of mud from the decon area and wind screening provided to prevent the spread of air contaminants. The surface area of the pit shall be sufficient to accommodate the largest piece of machinery. An alternate location may be chosen if, in the judgement of the H&S Officer, it provides sufficient wind screening and isolation from field operations and the public, and provided no danger from the spread of airborne contamination exists. Equipment required includes a steam generator with high pressure water, waste containers, provision for wind screening, and rinse and washwater control.

All portable monitoring equipment will be bagged or contained in such a way as to allow for simple decontamination procedures. Decontamination equipment includes drums for disposal, wooden palats, galvanized steel basins, long handle bristle brushes and sponges, cleansing solutions, plastic bags and impervious lining material, hand pump sprayers, and material for demarcation of CRC and for establishing restricted areas around each specific activity being conducted. Personnel responsible for steam cleaning shall use Level C protective equipment and employ the buddy system. This area is off-limits to all non-essential personnel. Special consideration should be given to wind speed and direction and downwind areas should be kept free of personnel in order to avoid potential airborne contamination.

EXHIBIT 4

LEVEL B DECONTAMINATION PROCEDURES

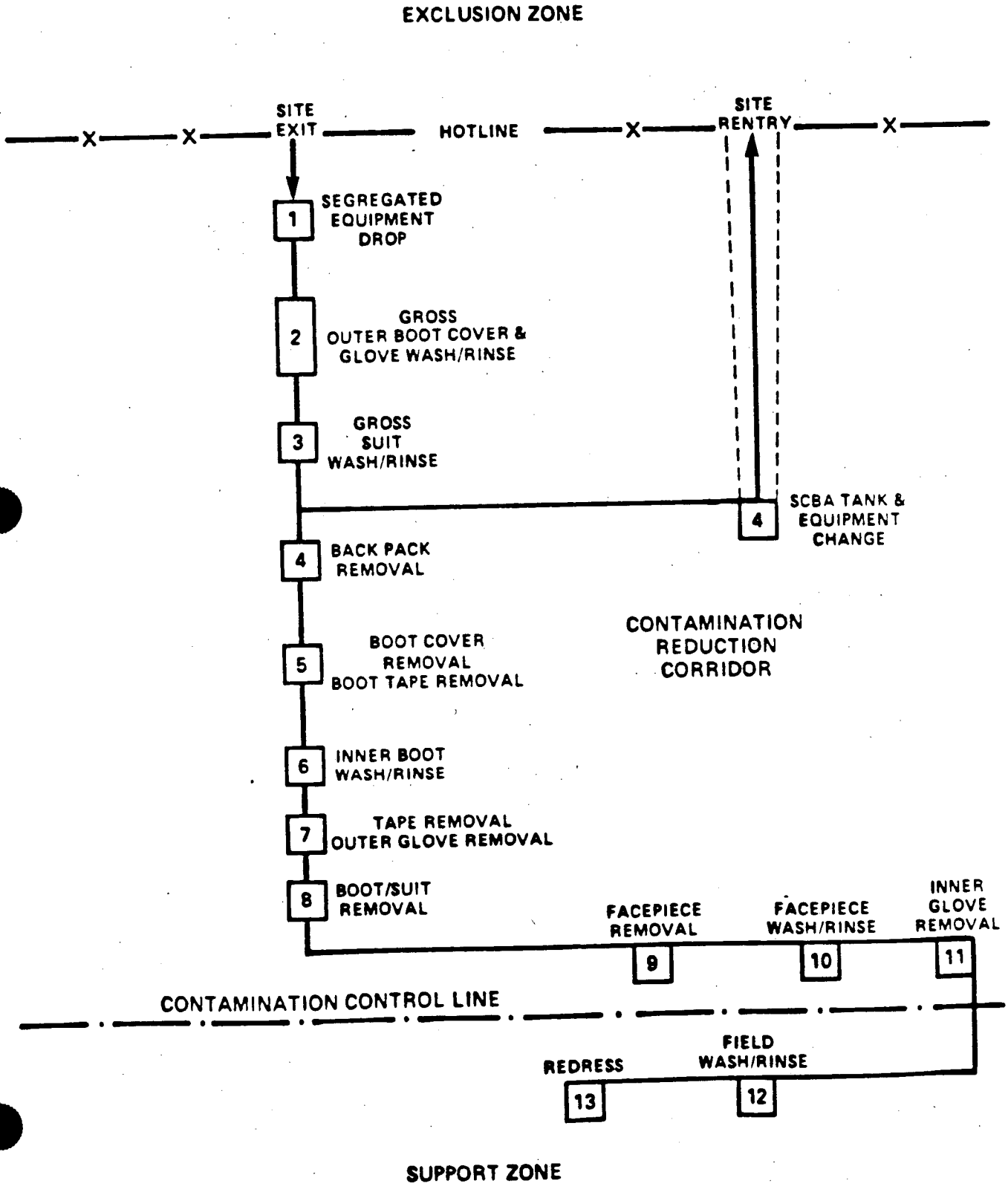


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EXHIBIT 5

LEVEL C DECONTAMINATION PROCEDURES

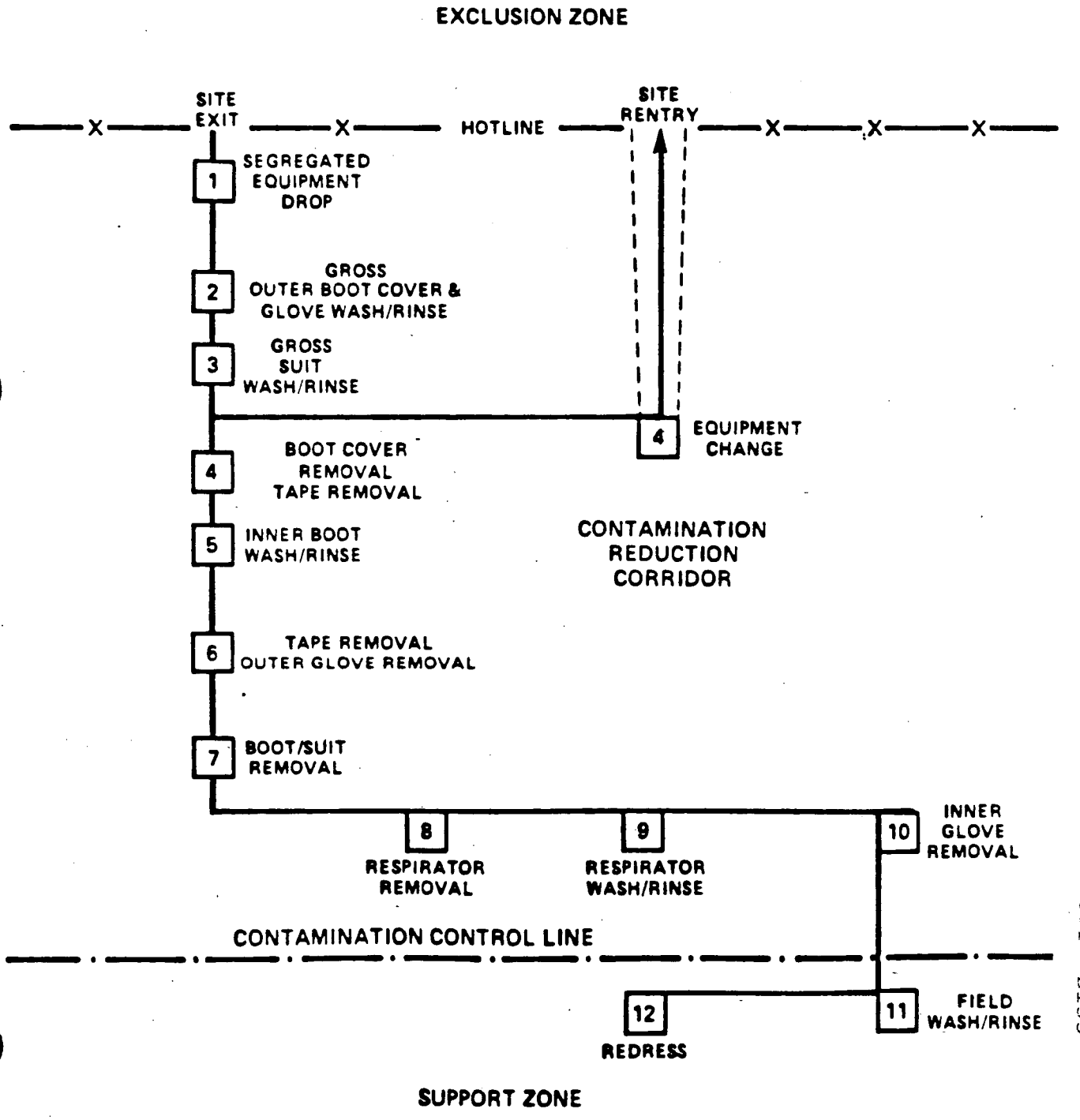
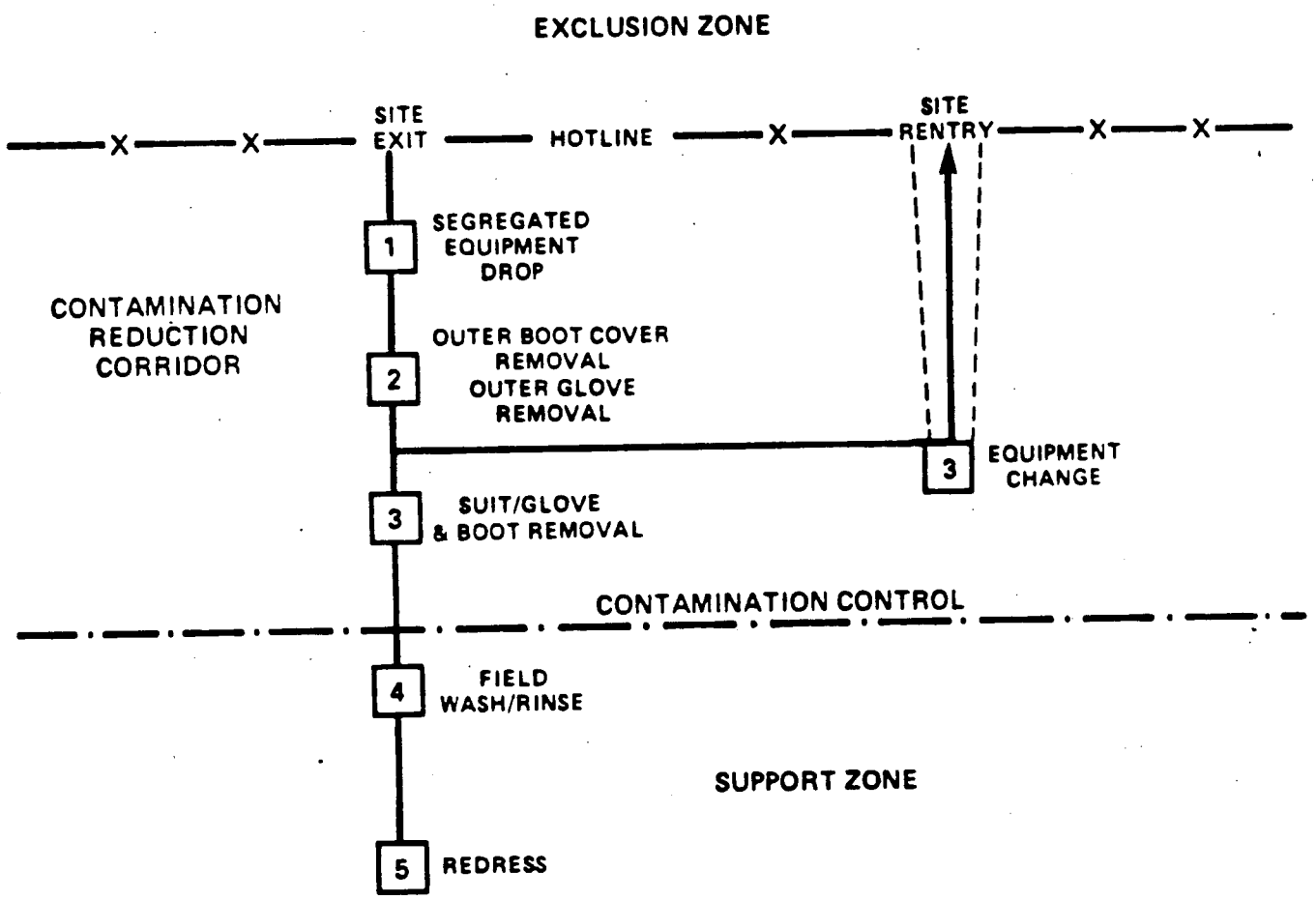


EXHIBIT 6

LEVEL D DECONTAMINATION PROCEDURES



All disposable protective clothing, gloves, boots, suits and cartridges will be collected and bagged/drummed as appropriate. Contaminated washwater and excavated materials will be collected and will be disposed of appropriately. As far as practical, dedicated or disposable equipment should be used for sampling; disposable equipment will be bagged and/or drummed for disposal as above. Drums used for disposal of contaminated materials will be properly labelled and secured. All potentially contaminated materials will be collected and appropriately stored upon termination of site operations.

The emergency/contingency procedures below will be posted in the Command Post where communicatins will be provided. All emergency phone numbers will also be posted. Any event listed below will be reported to the NJDEP Site Manager and the Ebasco Project Manager.

1. In the event of overt personnel exposure:

   Skin Contact: Use neutralizing agent, copious amounts of soap and water. Wash/rinse affected area for at least 15 minutes, decon then provide appropriate medical attention if necessary. Eyewash and emergency showers will be provided onsite at the CRZ.

   INHALATION: Move to fresh air and/or, if necessary, decon/transport to hospital.

   INGESTION: Decon/transport to hospital.

   INNOCULATION: Decon, transport for professional medical attention at hospital.

   Kearny Police (Ambulance): (201) 998-1313
   Ambulance (direct): (201) 997-7500
   West Hudson General Hospital: (201) 991-3400
   University Medical Center: (201) 456-5133
   University Med. Center Ambulance: (201) 456-6290
   NJDEP "Hot Line": (609) 292-7172

2. In event of personnel injury:

   Emergency first aid applied onsite as deemed necessary. Decon and transport the individual to nearest medical facility if needed. H&S Officer will supply medical data sheets to appropriate medical personnel as requested and complete accident report.

   Kearny Police (Ambulance): (201) 998-1313
   Ambulance (direct): (201) 997-7500
   West Hudson General Hospital: (201) 991-3400
   University Medical Center: (201) 456-5133
   University Med. Center Ambulance: (201) 456-6290
   NJDEP "Hot Line": (609) 292-7172

3. In event of potential or actual fire or explosion:
Immediate evacuation of site (air horn will sound for 15 second intervals) - Notify local fire and police department, NJDEP "Hot Line," and other appropriate emergency response groups if Lower Explosive Limit values are above 25% in ambient air.

Kearny Fire Department: (201) 991-1400
Kearny Police Department: (201) 998-1313
Department of Health: (201) 997-0600
NJDEP "Hot Line": (609) 292-7172

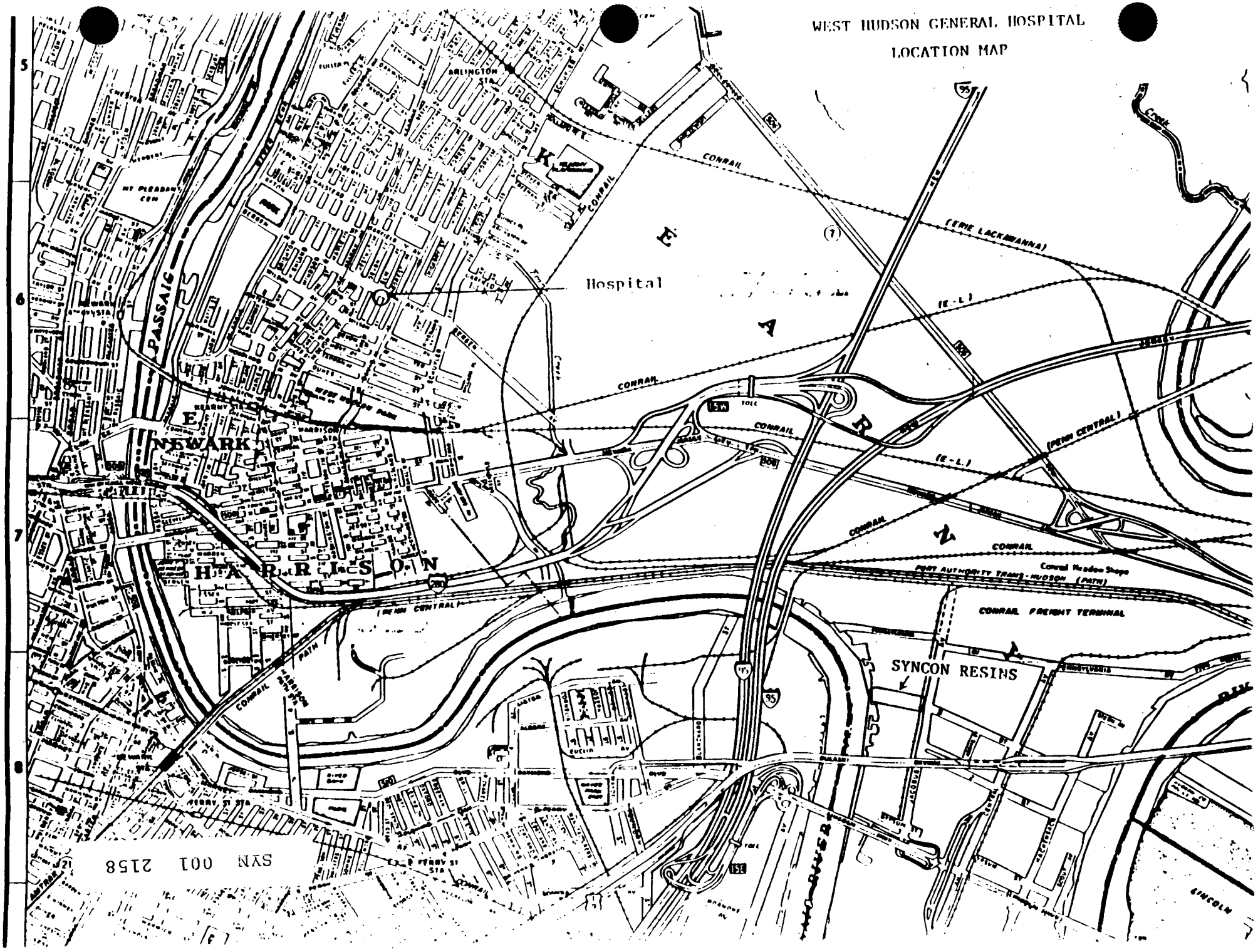
4. In event of potential or actual ionizing radiation exposure:
No indication for the presence of ionizing radiation.

5. In event of environmental incident (spread of contamination):
Secure spread of contamination if possible. Notify local authorities of possible evacuation of immediate area if spread of contamination will affect adjacent properties, adjacent waterbodies or if spread of contamination cannot be controlled or if monitoring at site perimeter with a PID and/or FID indicates organic vapors emitted from the source of spreading contamination are 0.2 ppm above background. Notify H&S Supervisor, Ebasco Project Manager and NJDEP Site Manager, emergency response groups, and National Response Center (NRC) when appropriate.

Kearny Police Department: (201) 998-1313
Kearny Department of Health: (201) 997-0600
Project Manager: (212) 839-1095
H&S Supervisor: (212) 839-1047
National Response Center (NRC): (800) 424-8802
NJDEP "Hot Line": (609) 292-7172

WEST HUDSON GENERAL HOSPITAL

LOCATION MAP



UNIVERSITY MEDICAL CENTER

LOCATION MAP

Primary Hospital: West Hudson General
206 Bergen Avenue
Kearny, NJ
(201) 991-3400

Back-up Hospital: University Medical Center
NJ College of Medicine
Bergen Street (between So. Orange Ave & W. Market St.)
Newark, NJ
(201) 456-5133

Directions to West Hudson General Hospital:

- Go south on Jacobus (.4 mi.) make left at first light onto Lincoln Highway - west (to Newark).
- Proceed across the Passaic River; road changes to Raymond Blvd. Stay left when Rd forks (.8 mi).
- Proceed 1.9 miles, (past River Bank Park) go under overpass and take left onto Market Street and immediate left onto Jackson Street.
- The Jackson Street Bridge crosses Raymond Blvd. and proceeds north to Harrison, NJ.
- Jackson changes to 4th Street Harrison and then changes to Kearny Ave in Kearny, NJ.
  (2.1 miles to Bergan Street from Jackon street Bridge)
- Right on Bergan Street; hospital is in third block (.2 mi).

Directions to University Medical Center in Newark:

- Go south on Jacobus (.4 mi) make left at first light onto Lincoln Highway - west (to Newark).
- Proceed across Passaic River; road changes to Raymond Blvd.
- Stay left when Rd forks (.8 mi).
- Raymond Blvd. intersects with Market Street at Pennsylvania Station .5 miles, stay left.
- Proceed under railroad station on Market Street; at fork in road (.8 mi) stay left on market st.
- At second for k (.6 mi) keep straight
- The University Medical Center will be visible on left.
- Make left on Bergan Past hospital; go approximately 3/4 block and find Emergency Entrance 2nd entrance on left.

Evacuation Procedures: In the event of an emergency situation, such as fire, explosion, significant release of toxic gases, etc., an air horn will be sounded for approximately 15 seconds indicating the initiation of evacuation procedures. All personnel in both the restricted and non-restricted areas will evacuate and assemble near the Support Zone trailer or other safe area previously agreed upon and as identified by the H&S Officer onsite. The location should be upwind of the site as determined by the wind direction. For efficient and safe site evacuation and assessment of the emergency situation, the Ebasco Site Manager or his designee in consultation with the NJDEP Site Manager or OSC, if available, will have authority to initiate proper action if outside services are required or to initiate evacuation of adjacent properties and township notification, if required. Under no circumstances will incoming personnel or visitors be allowed to proceed into the area once the emergency signal has been given. The H&S Officer must see that access for emergency equipment is provided and that all combustion apparatus has been shut down once the alarm has been sounded. Evacuation routes for site operations, especially when building entrance is involved, will be described during safety briefings. Notification procedures necessitated by evacuation will be as indicated in Section XIII. Evacuation will be implemented if contaminated material previously contained or stored will spread onto adjacent properties or water bodies or if ambient air measurements for combustible gases exceed 25% of the Lower Explosive Limit or if continuous measurement of organic vapors exceeds 0.2 ppm above background at the site perimeters as measured with a PID or FID, and the release of organic vapors cannot be shut off or eliminated.

Personnel authorized to enter the Syncon Resins Site while Ebasco is conducting field operations must be certified by the Project Manager and the H&S Supervisor. Authorization will involve completion of appropriate training courses, medical examination requirements, and review of this HASP. A waiver system for non-Ebasco personnel may be employed which will also provide authorization. In either case, all personnel must utilize the buddy system or trained escort, and check in with the Site Manager and the H&S Officer at the Command Post.

1. Ebasco Team Personnel Authorized to Perform Work Onsite:

1.	_____	11.	_____
2.	_____	12.	_____
3.	_____	13.	_____
4.	_____	14.	_____
5.	_____	15.	_____
6.	_____	16.	_____
7.	_____	17.	_____
8.	_____	18.	_____
9.	_____	19.	_____
10.	_____	20.	_____

2. Other Personnel Authorized to Enter Site

1.	_____	6.	_____
2.	_____	7.	_____
3.	_____	8.	_____
4.	_____	9.	_____
5.	_____	10.	_____

Additional Health and Safety practices not previously specified in this plan.

Refer to H&S officer for specific concerns for each individual site task. Do not climb over/under tanks, or other obstacles and always employ buddy system. Practice contamination avoidance, on and off-site. Plan activities ahead of time, caution in regard to concurrently running activities. Also, due to the unknown nature of waste placement and utility locations at the site, extreme caution should be practiced during invasive activities. Apply immediate first aid to any and all cuts, scratches, abrasions, etc. Be alert to your own physical condition and watch your buddy for signs of fatigue, exposure, etc. A work/rest regimen will be initiated when ambient temperatures and protective clothing create a potential stress situation. No work will be conducted in the dark or without appropriate supervision. Task safety briefings will be held prior to onset of task work. Know your Health and Safety Plan.

This brief Medical Data Sheet will be completed by all onsite personnel and will be kept in the Command Post during the conduct of site operations. It is in no way a substitute for the Medical Surveillance Program requirements consistent with the Ebasco Corporate Health and Safety Program for Hazardous Waste Sites. This data sheet will accompany any personnel when medical assistance is required or if transport to hospital facilities is required.

Project Syncon Resins Site

Name _____ Home Telephone _____

Address _____

Age _____ Height _____ Weight _____

Name of Next of Kin _____

Allergies _____

Particular Sensitivities _____

Do You Wear Contacts/Glasses? _____

Provide a Checklist of Special Medical Conditions or prior exposures to hazardous chemicals _____

Name of Personal Physician _____ Telephone _____

Are you presently on any medication? _____

If yes, list here _____

o FIELD TEAM REVIEW

I have read and reviewed the Site-Specific Health and Safety Plan and understand the information contained therein and will comply with all provisions indicated.

Name _____

Employee Number _____

Date _____

Site/Project _____

By their signature, following, the undersigned certify that this Health and Safety Plan will be utilized for the protection of the health and safety of workers at

the Syncon Resins Site.

Health and Safety Supervisor _____ 5/13/85 Date

Project Manager _____ 5/13/85 Date

Manager, Health and Safety _____ 5-13-85 Date

Regional Vice President _____ Date

EBASCO SERVICES INCORPORATED

FIELD SAMPLING PLAN

FOR

FEASIBILITY STUDY AT THE

SYNCON RESINS SITE

KEARNY, HUDSON COUNTY, NJ

APPROVED BY:	TITLE	DATE
T Granger	Ebasco Project Manager	5/13/85
R Trice	NJDEP Project Manager	5/14/85

TABLE OF CONTENTS

APPENDICES

LIST OF TABLES

LIST OF EXHIBITS

NO.	TITLE
1	Map Showing Preliminary Monitoring Well Locations
2	NJDEP Unconsolidated Monitor Well Specification (Shallow Well)
3	NJDEP Unconsolidated Monitor Well Specification (Intermediate Well)

I. INTRODUCTION

Field investigations will be conducted to identify the presence of hazardous substances and develop and evaluate remedial alternatives to determine the most cost-effective and environmentally sound remedial action to be implemented at the Syncon Resins Site. The site encompasses about 15 acres along the Passaic River in an industrial area of Kearny, N.J. Objectives of current field investigations are:

- To determine the nature, spatial extent and severity of groundwater, saturated and unsaturated soils and air contamination at the site

- To determine the nature of hazardous substances contained in storage tanks and lagoons onsite.

- To determine the nature and extent of contamination of onsite structures and their structural integrity.

This document presents the field sampling plan which defines sampling philosophies, and procedures to be followed during all field investigations. Specifically, the field sampling plan addresses:

- Reconnaissance surveys that will be conducted to preliminarily identify soil/sediment/air contamination and finalize sampling locations (Section II);

- Number and type of samples (soil, sediment and surface water, air, leachate, groundwater, storage tank) (Section II);

- Sampling locations (Section II);

- Field and laboratory analyses to be performed on collected samples (Section III);

- Sampling procedures including sample containers, preservation methods, holding times and labelling and packaging of samples (Section IV);

- o Decontamination procedures that will be utilized to prevent cross-contamination of samples (Section V); and
- o Calibration procedures for field instrumentation (Section VI).
- o Drilling and soil sampling procedures (Appendix A).
- o Tank sampling procedures (Appendix D)
- o Structure dust sampling procedures (Section IV)
- o Building integrity evaluation procedures (Section IV).
- o Photogrammetric Specifications (Appendix B).
- o Chain-of-Custody Form, and Log of Boring Form (Appendix C).

Field investigations will be performed in accordance with the Field Sampling Plan, the Health and Safety Plan, and the Quality Assurance Project Management Plan (QAPMP). These plans have been properly referenced in the Field Sampling Plan, where appropriate.

II. FIELD RECONNAISSANCE AND SAMPLING LOCATIONS

A. Reconnaissance Survey

Ebasco's field investigations are sequenced to provide the required information quickly, efficiently, and at a minimum cost. The initial reconnaissance survey will qualitatively indicate the horizontal extent of contamination. Based on the survey results, the sampling locations will be finalized for soil, groundwater, waste and air samples.

Ebasco will conduct a reconnaissance survey prior to conducting any other field work to locate potential physical hazards, e.g., leachate seeps and lagoons, tank and drum locations, etc.; to establish locations of decontamination facilities for personnel and heavy equipment; and to identify any other site condition significant to the safe and efficient conduct of site work. Survey grids on approximately 100 foot centers will be established to provide uniform coverage of the site area. Air monitoring through the use of a photoionization and flame ionization detectors will be performed to establish the levels of volatile organic contaminants. The presence of combustible gases will be measured using a combustible gas indicator and oxygen meter.

Survey grids will be set up to provide coverage of the site area. The initial grid spacings will be on approximately 100 foot centers. A tighter grid spacing may be used to define the edges of areas showing anomalous values, as indicated by the reconnaissance survey. The surveys will be run along the regularly spaced grid lines and nodal points will be marked and labeled. End points of every fifth grid line will be surveyed by the surveyors (VEP) to provide control. Surveying activities will comply with NJDOT specifications (Appendix B). The survey instrument reading at each nodal point will be recorded and plotted on a site map, allowing areas of elevated contaminant levels to be quickly and easily delineated.

These reconnaissance survey methods will give real time data and will require little post-field interpretation. This will assist us in locating monitoring wells to best delineate the horizontal extent and levels of contamination. In conjunction with the reconnaissance survey, a visual inspection of the site will be conducted to locate and mark any surface runoff channels, seepage areas, or other anomalous conditions that would require further investigation.

B. Soil Investigation

Fifteen (15) soil borings with permanent wells will be established at the approximate locations indicated on Exhibit 1. These borings are located so as to best define the sources of the different contaminant plumes. The locations of the borings will be reconfirmed after assessing the results of the reconnaissance survey. Prior to any subsurface work, the area will be screened with a metal detector to aid in avoiding buried drums or other metal debris. Twelve (12) permanent well borings will extend approximately 17 feet below the land surface. Three (3) intermediate wells will extend 20-30 feet below the land surface.

These borings will be used to help determine the depths of contamination and the three dimensional groundwater flow direction. Continuous split-spoon sampling will be done from the surface to the bottom of the boring to provide a continuous boring log. Drilling and sampling methods will conform to the appropriate ASTM, NJDEP, and EPA standards, the QAPMP and this document. There are three well clusters to be installed at this site, each consisting of a shallow and intermediate well. Due to their close proximity, only the intermediate well will be continuously split-spooned and sampled for chemical analyses.

All split-spoon samples will be analyzed to detect volatile organics using a PID meter. The PID screening will assist in obtaining representative samples. Soil samples for chemical analyses will be taken from the unsaturated zone (approximately 3 to 4 feet thick) in all

borings. Discrete samples for each split-spoon in the unsaturated zone will be taken for a full priority pollutant scan. Immediate sampling of each split-spoon will minimize loss of the volatile fraction. The analytical results of the unsaturated soils will be used to characterize the contamination in the narrow dry horizon above the groundwater.

Saturated soil samples will be collected from the permanent well boring. The samples from this interval (approximately 12-15 feet thick for the shallow wells and 20-25 feet thick for the intermediate wells) will be composited upon sample collection. Soil samples six (6) inches in length and taken from the center of the split-spoon, and/or contaminated sections based on visual observation, and/or contaminated sections based on direct reading instruments (i.e., OVA, HNU, etc.), will be composited and mixed in a stainless steel container with a stainless steel mixing tool. The information from these samples will help determine potential contamination levels in groundwater that may not be detected by present techniques for analyzing water and yet may represent a health hazard (e.g., PCBs). In addition to the above samples, five (5) representative samples will be laboratory tested to determine the grain size distribution and to confirm field identifications.

Complete field geologic logs of all borings will be kept. These logs will include the following:

- physical characteristics and grain size distribution of samples (using the Unified Soil Classification),
- blow counts for driving the sampler,
- presence of any visible contaminants,
- color changes,
- groundwater level,
- thickness of individual units, and
- any other conditions encountered during drilling.

Ebasco will use Empire Soils as the subcontractor to perform the borings, obtain soil samples and install the permanent monitoring wells.

C. Groundwater Investigation

Four (4) inch diameter stainless steel casings and screens will be installed in all 15 permanent monitoring wells. For the 12 shallow wells, stainless steel well screens will extend a maximum of 2 feet above the water table and form a total length of 15 feet. For intermediate wells where the confining layer is thirty (30) feet or more below the surface, the bottom ten (10) feet of the well will be screened with stainless steel well screens. For intermediate wells where the confining layer is less than thirty (30) feet below the surface, the bottom five (5) feet of the well will have a stainless steel well screen. The wells will be developed in accordance with the NJDEP specifications shown in Exhibits 2 and 3, by pumping or surging subsequent to installation.

Water level measurements and sampling will be conducted after a lapse of at least 72 hours following development to allow the well to stabilize. To obtain current water level information, water level measurements will be made on wells using a battery-operated water level indicator Model 51453, manufactured by the Slope Indicator Company or comparable meter. The water level indicator will be decontaminated between wells according to procedures outlined in Section V.

Sampling will be conducted after water level measurements have been recorded in each well. Prior to sampling, 3 to 5 well volumes will be evacuated or the well will be bailed dry. Samples will be collected as soon as the well has recovered to a level sufficient for sampling (within 3 hours of the well evacuation). Stainless steel bailers will be used for well evacuation and sample collection. The bailers and sample lines will be cleaned, in the lab according to the procedures outlined in Section V, prior to use in the field. A dedicated bailer and line will be assigned to each well to avoid cross contamination during sampling. All water samples will be tested for pH, temperature, and conductivity in the field immediately following collection. To avoid sample contamination, no monitoring probe will be introduced into a sample being sent to the laboratory for analysis.

After sampling, a slug test or constant head test will then be performed on four of these wells to determine permeability of the site materials.

Using the derived site permeability in conjunction with hydraulic gradients, an analysis of the site groundwater flow and groundwater flow rates will be made and a projected rate of contaminant migration will be made. The effects of the tidal fluctuations from the Passaic River will be determined by a time series of water level measurements. The water levels within the permanent wells and the level of the river will be measured on an hourly basis over one tidal cycle.

This drilling, sampling and testing program will allow Ebasco to:

- Prepare a groundwater contour map, a site stratigraphic column, geologic cross-sections and depths of contamination.

- Determine levels and extent of contaminants in groundwater, contaminant behavior, direction and flow rate of groundwater, permeability of the unconsolidated sediments.

In addition to the installation of new monitoring wells, the abandoned unuseable monitoring wells will be located and sealed according to NJDEP regulations.

D. Surface Water and Sediment Investigation

It is highly unlikely that any meaningful data can be obtained from samples taken from the Passaic River. The heavily industrial nature of the site region will result in making a correlation between the analyses of site samples and river samples not feasible. However, leachate samples from the site will be collected and analyzed. Up to 5 leachate samples will be collected depending upon conditions found at the time of sampling. We will also collect 2 samples (1 liquid and 1 solid phase) from each on-site lagoon by dip sampling (liquid) and dredge (solid).

The leachate and lagoon liquid phase samples will be grab samples using clean Pyrex containers to obtain adequate volumes. The lagoon solid samples will be collected using a clean Ponar dredge. Chemical analyses of these samples are discussed in Section III. Sampling procedures, sample containers, preservation methods etc. to be utilized are presented

in Section IV. Samplers will be decontaminated prior and subsequent to sampling as per Section V of this plan.

E. Air Quality Investigation

Phase I

An initial project inspection of the site will be made by Ebasco Air Quality personnel to evaluate present site conditions.

A survey grid will be established to provide proper and uniform areal coverage of the site for the air monitoring program. Potential "hot spots" indicated by dead vegetation and discolored soil, existing monitoring wells and any other probable sampling locations such as large surface cracks, lagoons, standing water and bulk storage tank areas will also be identified. All such locations will be recorded on an aerial photo, survey grid or site map and will be physically marked on the ground using numbered stakes and flags. These will later be surveyed by VEP.

For those potential "hot spots" identified in the visual inspection of the site and for each grid point an organic vapor analyzer, photoionization analyzer, explosimeter-oxygen meter, and hydrogen sulfide meter will be used to determine hydrocarbon, combustible gas (including methane) and H_2S concentrations in the ambient air. This survey will provide the data necessary to determine the important point emission sources. A suitable site for a meteorological monitoring system will also be selected and the monitoring system will be placed in operation at this time. This monitoring will be conducted using a portable weather station recording wind direction, wind speed, temperature and precipitation. The equipment will provide real time meteorological data which will be used extensively during the Phase II air quality sampling program if implemented. Data will also be collected prior to the air sampling events in order to identify any prevailing flow patterns which should be accounted for in the selection of sample sites.

Onsite and offsite topography, vegetation and structures which could potentially effect the dispersion of contaminants will be identified. Background control locations where upwind sampling could take place will be established through careful consideration of adjacent roadways, nearby industry, the availability of vacant and developed land and the location of other sources of pollutants in the surrounding area. The locations of the meteorological station, possible background sampling sites and areas where field instrument readings were taken will be recorded on site maps and staked in the field. Sampling times and meter readings will also be recorded and combined with the meteorological data collected. The objective of this phase of the program will be to identify potential sources of hazardous air emissions at the site for further analysis.

Sampling with adsorbent media and low flow portable pumps will also be performed in Phase I to qualitatively and quantitatively identify the important gas phase air contaminants emitted from the site. The sampling will be conducted with two Tenax tubes and two carbon tubes at two offsite locations and three tenax tubes (plus one breakthrough tube) and three carbon tubes (plus one breakthrough tube) at three onsite locations for an 8-hour period. The location of the onsite samplers will be based on information obtained during the survey of the site with the portable field instruments (i.e., OVA, PID, H_2S meter).

Phase II

The objective is to determine the extent and nature of possible air contamination on- and off-site. An air quality sampling plan will be developed based upon the information obtained during the initial site investigation. The sampling plan will contain the location of possible point sources of emissions, the justification for selecting sampling and meteorological monitoring station sites, the schedule for conducting the field sampling, and a description of the analytical methods employed.

For those point sources identified from the survey of the site with the field instruments more detailed air sampling will be performed. The basis for establishing the nature of these sources is their relationship

to background levels, (i.e., the upwind air quality). The sampler locations for each day will be established from National Weather Service wind forecasts supplemented by the real time meteorological data provided by the portable weather station. A sampling station upwind from the site will be established to determine the background air quality while potentially contaminated sampling points will be located downwind of the emission sources identified in the initial site survey. The offsite monitors will be sited at locations of offsite workers who could be exposed to air contaminants from the site and also where the maximum combined impact of all site emissions is expected.

Particulate matter will be sampled using a pair of hi-Vol samplers, one standard and one with a 10 micrometer head which only collects particulate less than 10 micrometers in size. Each hi-Vol filter will be weighed to determine total loading and analyzed for inorganic (heavy metal) and organic constituents.

In order to obtain a recovery from the chemical analysis of the adsorbent media the wind must flow across the sources into the area of the samplers. Since the wind direction can vary widely during a day, the sampling will be performed during those weather conditions expected to exhibit steady wind direction if possible.

F. Hazardous Substance Inventory

During the entire course of the field investigation program, Ebasco will inventory all hazardous substances encountered at the site. The purpose of this inventory is to document by field log, photograph (35 mm color slides) and labelling any or all substances which may have caused, are still causing, or have the potential for causing contamination of the soil, groundwater, or surface waters of the area.

The result of this inventory will be a report tabulating all hazardous substances, giving location and data found with all relevant information collected on each item. Any chemical analyses performed on the unknown substance will also be included. A label or other identification will be

attached to all containers of such substances found in the field for easy future reference.

Each tank will be sampled when possible through existing penetrations such as valves, fill/drain pipes, man ways etc. The site visit enabled an initial estimate to be developed that approximately 110 tanks can be sampled by the aforementioned process. The remaining tanks will be sampled through "cold" tapped sampling ports or access openings in the tanks.

In addition to the sampling for waste characterization, estimates will be developed of the volume of material(s) in each tank, its phase or media and the general condition of each tank. It is noted that many of the tanks are presently protected and/or insulated with various materials and the possibility exists that some of these insulating materials may contain asbestos. Approximately 20 samples will be tested by x-ray diffraction for asbestos.

Waste compatibility testing will be performed on discrete samples taken from each of the estimated 149 tanks. Compatibility chemical analyses are listed in Section III. Based on the analytical results, samples will be composited in the laboratory (a maximum of 10 compatible wastes per composite sample) and screened for PCBs.

The sampling of tanks and vessels will be performed by CECOS. CECOS' sampling and entry procedures are supplied in Appendix D.

The results of the field sampling program provide the data base to determine the overall methodology for remedial action on the tanks and other vessels. Combined with the building survey for the process structures, the waste characterization will allow the development of a suite of alternatives for remedial action.

G. Structural Investigation

The implementation of a building structural and contamination survey requires meticulous attention to health and safety procedures.

Each structure will be evaluated during the reconnaissance survey by both a civil/structural engineer and the Health and Safety Officer. The location of all tanks, vats, water storage areas, piping etc. will be identified and access points noted. In addition, any building areas or structures found to be unsafe will be marked on plans and physically barricaded at the site. This survey will take place prior to other activities at or within buildings or structures.

The structural (non-destructive) evaluation will be accomplished by determining the status of main structural elements (columns, beams, load bearing walls, etc.) first and then the remainder. Masonry and steel will be evaluated for present conditions and anticipated remaining useful life.

The results of this study will provide a data base for the remedial action alternative study.

Each structure may have unique levels of risk dependent on use history and structural integrity. The contamination assessment, therefore, requires a detailed review of site history, including occupants, use, time sequencing of use, and structure blueprints. In addition, reagent purchase orders, reagent inventory lists, available laboratory data and disposal records will be reviewed to determine the type and quantity of chemicals purchased and stocked in the building, and the location of storage facilities within the structure. The record of chemical synthesis activity occurring at the facility and the location of that synthesis process will also be assessed. Disposal records, if any, will be reviewed to determine the type and quantity of waste present, and incompatability of materials.

US EPA approved sampling techniques for building contamination assessment have not been drafted (N. Barkley, US EPA MERL, Cincinnati, Ohio,

personal communication, May 1984). National Institute for Occupational Safety and Health (NIOSH) industrial hygiene standards for building contamination assessment involve dust sampling of areas where dust collects, e.g., rafters, bends in ventilation ducts, near the ground in corners and stairwells, tops of cabinets, window sills, etc.

Multiple dust samples will be collected from each of 5 major structures to form a single composite sample for each structure. Portable "Dustbuster" type vacuum devices will be used to take the composite samples. These devices make easy the sampling of areas where dust collects. They also make compositing an easy operation. One vacuum device will be dedicated for each major structure so no cross contamination will occur.

If composite dusts are found to be significantly contaminated, a more detailed sampling effort will be developed with NJDEP approval in order to provide sufficient information for the most cost-effective remediation. Dust samples will be treated as soil samples from the point of collection through chemical analysis. Composited dusts will be placed in wide mouth glass bottles which have been thoroughly cleaned.

III. CHEMICAL INVESTIGATIONS FOR AIR, WATER, SOIL, DUSTS AND WASTE

A. Analytical Measurements - Chemical Analyses

Described below are the types of chemical analyses that will be performed on various sample matrices collected in Task 2. These analyses are the offered services of our contract laboratories. There are five analyses that are used to determine priority organic pollutants and metals in soil, dusts, water and air. There are two radiological analyses that will be performed on ground samples, and there is a series of "compatibility tests that will be performed on waste samples.

1. Full priority pollutant analysis with a 40 peak forward library search: This is a GC/MS analysis for priority volatiles, acid extractables, base-neutral organics and pesticides. Priority metals are also included along with total phenols and cyanides. The library search is a 15/10/15 GC/MS peak survey for non-priority substances. Because of the cost, this analysis was recommended for samples which would describe areas of unknown contamination, especially if site-specific information indicates the possibility of heavy pollution in areas posing critical links to human exposure.

2. B/N, PCBs, Metals, CN^-, Phenols: Selected composite soil samples from the saturated zone in the monitoring wells will be analyzed for base/neutral extractables, PCBs, 13 metals, (antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, and zinc), cyanides and phenols. We will use this technique in conjunction with the full priority pollutant analysis for soils samples because of the significant cost savings this analysis represents.

3. VOA and Metals: The VOA is a GC/MS determination for a volatile organic priority compound and the metals is an AA determination for all priority metals. This analysis is proposed for the soil field blanks.

4. VOA: The VOA is a GC/MS determination for all volatile organic priority pollutants. This analysis will be performed on the trip blanks.

5. Gas phase organic analysis: Following sampling, the tenax and charcoal tubes are thermally desorbed onto a GC column, and then specific priority pollutant compounds are detected and quantified with an MS system. A twenty peak MS library search for non priority compounds will also be done. This analysis will be performed on air samples.

6. Total Gross Alpha: Gross alpha radiation measurements will be made on all groundwater samples.

7. Total Gross Beta: Gross beta radiation measurements will be made on all groundwater samples.

8. Waste Compatibility Tests

The following tests will be made on each waste material encountered on site prior to bench scale compatibility testing:

- Radiation Screen
- pH Determination
- Water Reactivity
- Redox Potential Determination
- Water/Hexane Solubility Determination
- Flammability Determination
- Specific Gravity Determination
- Cyanide Determination
- Sulfide Determination
- Peroxides Determination

Bench Scale Compatibility Tests

- Composite compatible samples (a maximum of 10 compatible wastes per composite sample)
- PCB analysis per composite

All the above mentioned chemical analyis will be conducted using the techniques in our Laboratory Standard Operating Procedures Manual (SOP Manual see QAPMP).

The waste sources will be tested for compatibility on a bench scale utilizing procedures in the following recommended guide.

. Chemical Manufacturers Association Guide to aid in the Bulking of Compatible Waste for Treatment and/or Disposal

The laboratory will incorporate the techniques delineated in a draft document prepared by ASTM in all bench scale compatibility testing.

In addition, the laboratory will utilize the information provided by J.T. Bakers Handbook on "The Management And Disposal Of Hazardous and Chemical Wastes" - Section 6.2 - Categorization of Hazardous Wastes and Section 6.3 - Guide to Compatibility of Chemicals.

B. Chemical Investigation

Tables 1 and 2 present a summary of the chemical analyses proposed for the Syncon Resins site. The Ebasco QA/QC Program will be applied during sampling, preservation and transportation while our subcontract analytical laboratories QA/QC program will be followed during laboratory testing as identified.

Soil and Water Investigations

1. Soils - Permanent monitoring wells (unsaturated): Two discrete samples, each consisting of the entire split-spoon volume, taken from the unsaturated region of twelve (12) permanent wells (9 shallow and 3 intermediate) will be analyzed by the full-scale priority pollutant analysis (Table 1).

2. Soils - Permanent well borings (saturated): One composite sample from the screen region of 12 (9 shallow and 3 intermediate) monitoring wells will be analyzed for PCBs, total metals, CN^- and phenols (Table 1).

3. Groundwater: Fifteen (15) water samples from the permanent wells will be analyzed for the full-scale of priority pollutants (Table 1).

4. Leachate: Three (3) leachate samples will be analyzed for the full-scale of priority pollutants (Table 1).

5. Building Dust and Floor Scrapings: Five (5) composite dust and scraping samples (1 per major structure) from the interior of the site buildings will be analyzed for the full-scale of priority pollutants. If any of the composite samples show significant contamination, additional testing will be performed according to Schedule C to characterize the actual areas of the structure, so we can determine the extent, nature and location of contamination. This information is required for an evaluation of the different remedial alternatives (Table 1).

6. Lagoons: Four (4) lagoon samples (one liquid and one sludge, from each of two lagoons) will be analyzed for the full-scale of priority pollutants (Table 1).

7. Duplicates: Five (5) solid and two (2) liquid matrix samples will be analyzed in duplicate for the full priority pollutant analysis (Table 1).

8. Field Blanks: We have assumed twelve (12) days of sampling for wells, two (2) days of sampling for lagoons, five (5) days of sampling for water, and five (5) days of sampling for buildings. Therefore, 19 field blanks will be analyzed for purgeable organics and metals and 5 field blanks will be

analyzed for all priority pollutants. Although only the purgeable fraction is required by the NJDEP for soil field blanks, we propose to measure metal contamination because metals have been found previously in high concentration in the site soil (Table 1).

9. Matrix Spikes: Two (2) water and five (5) soil matrix spikes will be analyzed for the full-scale of priority pollutants to determine the efficiency of the extraction procedures (Table 1).

10. Trip Blanks: Ten (10) shipments have been assumed and blanks will be analyzed for the full-scale of priority pollutants (Table 1).

Air Investigation

1. Tenax/Charcoal: Three (3) on-site and two (2) off-site locations will be sampled and analyzed for gas phase organics (Table 2). This will provide the needed information to assess area airborne contamination levels.

2. Duplicates: To determine the precision of air sampling techniques and analysis 2 duplicate tenax analysis will be conducted for the gas phases (Table 2).

3. Travel Blanks: Two travel blanks to accompany each shipment.

Waste Investigation

1. Discrete samples will be analyzed for radiation screen, pH, water reactivity, Redox potential, hexane/water solubility, flammability, specific gravity, CN^-, sulfide, and peroxides. Samples will be composited in the laboratory (a maximum of 10 compatible wastes per composite sample) and analyzed for PCBs.

IV. SEDIMENT/SOIL/WATER BUILDING SAMPLING PROCEDURES

Many water and soil samples are unstable, and therefore require preservation when the time interval between field collection and lab analysis is long enough to produce changes in either the concentration or the physical condition of the constituent(s) requiring analysis. While complete and irreversible preservation of samples is not possible, preservation does retard the chemical and biological changes that inevitably take place after the sample is collected.

Preservation techniques are usually limited to pH control, chemical addition(s) and refrigeration/freezing. Their purpose is to: (1) retard biological activity, (2) retard hydrolysis of chemical compounds/complexes, (3) reduce constituent volatility, and (3) reduce absorption effects.

Collection, preservation and handling of samples for the Syncon Resins site will be in complete accord with available EPA recommended procedures (see QAPMP). These methods are summarized in Table 3 and presented in detail in the following subsections. In accordance with procedures established with the laboratory, reagents required for sample preservation will be added to the sample container(s) by the laboratory prior to their shipment to the field.

A. Lagoon Sediment Samples

The following procedures apply to the collection of lagoon sediment samples.

1. Sediment samples will be collected wearing protective gear as specified by the Health and Safety Officer.

2. Sediment samples will be collected using a Ponar dredge.

3. Allow water to draw in from dredge and place samples in a stainless steel bucket and mix contents well with a clean stainless steel spoon.

4. Take a PID reading of each sample in bucket and record.

5. Fill clean 1-liter glass container and VOA glass container with composited sediment sample and seal the containers.

6. Fill out sample log, labels and chain of custody forms.

7. Maintain samples at approximately 4°C by placing in ice chest or other suitable container.

B. Boring Samples

The following procedures will be followed for collecting soil samples at boreholes.

1. Collect samples wearing protective gear as specified by the Health and Safety Officer.

2. Take PID reading of each sample immediately after opening the split spoon.

3. Geologically log the sample.

4. Remove soil from the split-spoon sampler using a clean stainless steel spoon and fill and seal sample bottles (1-liter amber glass container and a 40-ml amber glass container for VOA analysis) (unsaturated soil samples).

   Remove soil from the middle six (6) inches of the split-spoon sampler, and/or contaminated sections of the sampler based on visual observation, and/or contaminated sections based on direct reading instruments (i.e., OVA, HNU, etc.), using a clean stainless steel spoon (saturated soil samples).

5. Place samples in a stainless steel container and mix well with a clean stainless steel mixing tool (saturated soil samples).

6. Fill clean 1-liter glass container and seal containers (saturated soil samples).

7. Fill out sample log, labels and chain-of-custody form.

8. Maintain samples at approximately 4°C by placing in ice chest or other suitable container.

Soil sample storage and handling requirements will be in accordance with Test Methods for Evaluating Solid Waste. However, based on discussions with EPA, preservation methods developed for wastewater and aqueous sludge samples are not appropriate for soil samples. Therefore, preservation of soil/sediment samples will only consist of refrigeration at 4°C.

C. Water Samples

Two (2) lagoon water samples and three (3) leachate samples will be collected. The following sampling procedures will be utilized:

1. Wear protective gear as specified by the Health and Safety Officer.

3. Collect grab samples initially in clean Pyrex containers.

4. Transfer samples to sample containers and preserve as specified in Table 3. Water samples for total dissolved metals must be filtered per EPA methodology before being preserved.

5. Fill out sample log, labels and chain of custody forms.

All water samples will be prepared as summarized in Table 3 and detailed below.

1. VOA

- Use vials of 40-ml capacity or larger equipped with a screw cap having a hole in its center. Septum should be of Teflon-faced silicone. Collect duplicate samples at each site (i.e. field samples, trip and field blanks).

- Fill the sample bottle just to overflowing in such a manner that no air bubbles pass through the samples as the bottle is being filled.

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- o Seal the sample bottle, so that no air bubbles are entrapped in it. If preservative has been added, shake vigorously for 1 minute. Maintain the hermetic seal on the sample bottle until time of analysis.

- o Samples must be iced or refrigerated at 4°C from the time of collection until extraction.

- o All samples must be analyzed within 14 days of collection.

2. Base/Neutral and Acid Extractable Organics

- o Use amber-colored glass containers of 1-liter volume fitted with screw caps lined with Teflon. If amber bottles are not available, protect samples from light.

- o For sample collection, use conventional sampling practices, except do not prewash bottle with sample before collection.

- o Samples must be iced or refrigerated at 4°C from the time of collection until extraction.

- o Test the samples for residual chlorine using EPA methods 330.4 or 330.5.

- o If residual chlorine is present, add 80 mg of sodium thiosulfate per liter of sample.

- o Adjust pH to within range of 5 to 9 with sulfuric acid or sodium hydroxide. Record volume of acid or base used. Check pH with wide range pH paper.

- o Samples must be extracted within 7 days and analysis completed within 40 days of extraction.

3. Pesticides/Polychlorinated Biphenyls (PCBs)

- o Use amber-colored glass containers of 1-liter volume fitted with

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screw caps lined with Teflon. (If amber bottles are not available, protect samples from light).

- o While collecting the sample, use conventional sampling practices, except do not prewash bottle with sample before collection.

- o Adjust pH to within range of 5 to 9, if necessary, with sulfuric acid or sodium hydroxide. Record volume of acid or base used. Check pH with wide range pH paper.

- o Samples must be extracted within 7 days and analysis completed within 40 days of extraction.

4. Heavy Metals

- o Collect a minimum sample volume of 1-liter, filter the sample per EPA methodology, retain in a plastic container.

- o If acid is not added in laboratory, add 2 ml 10.0 N nitric acid (HNO_3) per liter of sample. Confirm that pH is less than 2 with narrow range pH paper.

- o Mix (shake) sample under one of the following conditions:

  - ventilated hood,

  - downwind and above breathing zone of sampler when oudoors and no respiratory protection is used, or

  - wearing respiratory protective equipment specified by the Health and Safety Officer.

- o Test drop of acidified sample on pH paper to confirm pH is less than 2. If pH is not less than 2, add acid dropwise, repeat previous two steps.

- o Cap and refrigerate sample at 4°C.

- o Analyze sample within 6 months.

- o Analyze for mercury within 28 days.

- o Analyze for hexavalent chromium within 24 hours.

5. Total Phenols

- o Place sample in vials of 40-ml capacity or larger equipped with screw cap.

- o If acid is not added in laboratory add sulfuric acid until sample pH less than 2 is attained. Mix (shake) sample either under a ventilated hood or downwind and above breathing zone of personnel and sampler when outdoors.

- o The sample should be kept at 4°C and analyzed within 28 days of collection.

6. Total Cyanides

- o Place sample in vials of 40-ml capacity or larger equipped with screw cap.

- o Pre-sample preservation is required to prevent oxidizing agents such as chlorine from decomposing most of the cyanides. To test for oxidizing agents, place a drop of the sample on potassium iodine-starch test paper (KI-starch paper); a blue color indicates the need for treatment. Add ascorbic acid to the sample, a few crystals at a time, until a drop of sample produces no color on the KI-starch paper. Then add an additional 0.6g of ascorbic acid for each liter of sample volume.

- o Testing for the presence of sulfides will also be performed. Test a drop of the sample on lead acetate paper, which indicates the presence of sulfides by darkening. If sulfides are present, treat sample with cadmium carbonate or cadmium nitrate,

precipitating yellow cadmium sulfide. Repeat addition of cadmium carbonate or cadmium nitrate until presence of sulfides is no longer indicated. Filter sample to remove precipitate.

- o If NaOH is not added by laboratory, preserve samples with 2 ml of 10 N sodium hydroxide per liter of sample (pH greater than 12) at time of collection.

- o Samples should be kept at 4°C and analyzed within 14 days. While the presence of sulfides reduces maximum holding time to 24 hours, the removal of sulfides will be accomplished as discussed above.

D. Groundwater Samples

Groundwater samples will be taken by the following procedures:

1. Obtain a water level measurement prior to sampling using an electronic water level indicator.

2. Lower bailer (cleaned in lab by procedures outlined in Section V) to the bottom of the screen for sample collection. All personnel handling the bailer will wear clean disposable gloves to avoid contamination of bailer or well.

3. Field measurement of pH, temperature, and conductivity will be taken both at start and finish of bailing operation.

4. Prior to sampling, three (3) to five (5) well volumes will be evacuated or the well will be bailed dry. Collect water sample as soon as the well has recovered to a level sufficient for sampling (within 3 hours if possible)

5. Sample groundwater with stainless steel bailer and pour contents of bailer in sample jar, except for a 1-liter volume which will be retained for heavy metal analysis (this one liter volume must be filtered per EPA methodology before preservation).

6. Fill out sampling log.

7. Maintain sample jar at approximately 4°C by placing it in an ice chest or other suitable container.

E. Building Dust Samples

Composite dust samples from within building structures will be taken according to the following procedures.

1. Before sampling dust survey entire structure for area where dust collects (rafters, bends in ventilaton ducts, corners near ground and stairwells, tops of cabinets, window sills and etc.) and mark each area to be sampled with chalk.

2. Ensure that all sampling points are randomly distributed throughout entire area of structure.

3. Collect dust using vacuum device making sure that enough dust is collected for chemical analysis (100g).

4. Empty vacuum device into sample containers.

5. Fill out sampling log.

6. Maintain sample at approximately 4°C.

F. Building Integrity Evaluation

The intent of the Building Evaluation is to ascertain the overall condition of the building from a structural and utility standpoint, but also to evaluate the previous usage and its effect on the specific building systems. Such topics as foundation type and wall and roof structural integrity fall under the Structural inspection. Electricity, heat, plumbing and HVAC will be covered in the utilities section. The Systems analysis attempts to evaluate the specific activities which have occurred in each building and provide an assessment of that activity and its potential impact upon the clean up effort.

The Building Evaluation is handled using this two step approach. The Structural and Utilities Sections provide a detailed objective evaluation of the individual building condition. The Systems Section puts these objective findings into perspective, an overall evaluation based on usage.

BUILDING EVALUATION

ITEMS OF CONCERNS

STRUCTURAL
- Foundation type and condition
- Basement or crawl space access
- Flooring type and condition
  - Basement - 2nd Floor
  - 1st Floor
- Interior bearing or support wall type and condition
- Roof structure type and condition
- Roof access
- Roofing material type and condition
- Exterior wall type and condition
- Interior floor drainage (sump) collection
- Building drainage - treatment and storage and disposal
- Gen'l observation of bldg structural condition
- Window/door access-type and condition

UTILITIES
- Electric service - size, type and condition
- Plumbing - (sanitary) routing, treatment discharge, potential mixing
- Heat - size, type and condition
- HVAC - size, type and condition

SYSTEMS
- Interior vats for storage - size and condition
- Piping - size, condition and discharge location
- Interior room arrangement - location of laboratories, mixing locations, chemical storage, loading dock, etc.
- Ductwork for ventilation
  - Roof mounted vents
  - Interior air ducts
  - Exterior vents

G. Duplicates and Blanks

As discussed previously, various duplicates and blanks (trip and field) will be analyzed. Trip blanks will be provided by the laboratory. Field blanks will be generated according to the following procedures:

1. Have volume of analyte free distilled water available consistent with sample volumes required for chemical analysis.

2. Clean sampler (split-spoon and shelby tube for soils and sediments, pyrex containers for water) in the identical manner utilized for sampling events.

3. Pour distilled water over sampler with rinse water collected in clean stainless steel bucket.

4. Transfer rinse water to sample containers as described previously in Sections IV.A, IV.B, and IV.C.

H. Sample Identification and Shipment

As presented in the QAPMP, Section 7, all sample containers shall be marked and identified with legible sample labels which shall indicate the project name, sample location, the elevation or depth from which the sample was taken, the sample number, the date and time of sampling, preservatives utilized and other information that may be helpful in determining the character of the sample.

To maintain and document sample possession, chain-of-custody procedures will be followed (see QAPMP, Section 7). These are summarized below:

- The field sampler is personally responsible for the care and custody of the samples collected until they are properly transferred or dispatched.

- During sampling, blank samples will be prepared, as appropriate (with and without preservatives), in the same type of containers used to hold the samples.

- Logbooks and other records are always signed and dated.

- Sample labels shall be completed for each sample, using waterproof ink.

- The Site Task Leader determines whether proper custody procedures were followed during the field work and decides if additional samples are required.

- Samples are accompanied by a Chain-of-Custody Record (see Appendix C). When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the Record. This Record documents sample custody transfer from the sampler, often through another person, to the analyst in the laboratory.

- Samples will be packaged properly in suitable containers to protect against damage from shifting of samples in boxes or glass breakage. A separate custody record shall accompany each shipment (e.g., one for each field laboratory, one for samples shipped, driven, or otherwise transported to the laboratory). Shipping containers will be padlocked or sealed for shipment to the laboratory. The method of shipment, courier name(s), and other pertinent information is entered in the "Remarks" section on the custody record.

- Whenever samples are split with a source or government agency, a separate Receipt for Samples form (see Appendix C) is prepared for those samples and marked to indicate with whom the samples are being split. The person relinquishing the samples to the facility or agency should request the signature of a representative of the appropriate party acknowledging receipt of the samples. If a representative is unavailable or refuses to sign, this is noted in the "Received by" space. When appropriate, as in the case where the representative is unavailable, the custody record should contain a statement that the samples were delivered to the designated location at the designated time.

- All shipments will be accompanied by the Chain-of-Custody Record identifying its contents. The original Record will accompany the shipment, and the copy will be retained by the Site Task Leader.

- If sent by mail, the package will be registered with return receipt requested. If sent by common carrier or air, proper documentation should be maintained.

V. DECONTAMINATION OF EQUIPMENT

As presented below, all equipment involved in field sampling activities including drilling rigs, backhoes, downhole tools, augers, and soil and water samplers, will be decontaminated prior to and subsequent to sampling and boring events. Equipment leaving the site will also be decontaminated as called for in the Health and Safety Plan.

Drilling rigs, backhoes, rods, bits, etc. will be decontaminated by steam cleaning at a steam cleaning pit. The location of the steam cleaning pit is noted in the HASP. Split-spoon, Shelby tube, and grab samplers will be steam cleaned, rinsed with acetone and then rinsed with distilled water. Equipment contaminated with certain residues, e.g., tars and oils, may require soap scrubbing prior to any other cleaning.

Soil sediment and water sampling equipment including Pyrex containers and buckets will be thoroughly cleaned using the following procedures:

1) Potable water rinse
2) Alconox/Liquidnox detergent wash
3) Potable water rinse
4) Distilled deionized water rinse
5) Acetone (Reagent Grade) rinse
6) Distilled deionized water rinse.

As discussed previously in Section II, groundwater level measurements will be taken in the monitoring wells. To avoid cross-contamination, the probe and cable of the water level indicator will be washed in an Alconox/Liquidnox detergent solution and rinsed three times with distilled/deionized water at the decontamination area.

Personnel directly involved in equipment decontamination will wear proper protective clothing and respiratory equipment as specified in the Health and Safety Plan.

VI. CALIBRATION PROCEDURES AND FREQUENCY

This section describes the requirements for calibration, adjustment and maintenance of measuring and testing devices used in the field for performing tests. Devices shall be calibrated and adjusted at specified, predetermined intervals using equipment having known valid relationships to recognized standards.

Calibration activities shall be performed in accordance with the following instructions.

pH

Environmental Equipment, Inc.
pH Meter
Model HDK-1940*

Frequency (Daily) - start and end of each shift.

- o Place electrode system into container of buffer solution with a pH value nearest to estimated pH value of sample.
- o Immerse thermometer into buffer solution.
- o Wait a minimum of 2 minutes, then set temperature control to match thermometer indication.
- o Turn function selector to pH.
- o Adjust the standardize control until the meter indicates the pH of the buffer as determined from pH/temperature table.
- o Turn function selector off.
- o Remove electrode and thermometer and rinse with distilled water.

Temperature

Environmental Equipment, Inc.
Temperature Meter
Model HDK-1940*
Measured before each sample with a N.B.S. calibrated thermometer.

SYN 001 2206

Specific Conductivity

Environmental Equipment, Inc.
Specific Conductivity Meter
Model HDK-1940*

Daily - Check Zero with dry cups, calibrate using internal standard ("Test" button).

*Note: pH, Temperature, and specific conductivity meter have the same number because they come as one unit from the manufacturer.

Photoionization

Photoionization Detector
(HNU Model P1-101)

Frequency - prior to each use.

Calibration Procedure

- Attach 10.2eV probe, check battery indicator. Set Span Dial to 9.80. Check for proper functioning of probe fan and lamp. Allow meter to stabilize for 5 minutes.

- Attach regulator and hose to HNU Calibration Gas tank (isobutylene). Record tank pressure and concentration.

- Turn meter switch to 0-200 ppm scale. Open Cal Gas tank regulator and attach end of hose to probe.

- After 15 seconds, read and record meter reading at span dial setting of 9.80, report all readings as Total Hydrocarbon concentration as Benzene Equivalent in PPM's.

- If the meter reading is off from the calibration gas concentration by more than ± 5%, the meter must be adjusted by the following procedure:
  1. Remove instrument from its shell.
  2. Locate the pot in the middle of the upper portion of the circuit board. Adjust this pot until the meter reading equals the calibration gas concentration.
  3. Replace the instrument in its shell. Record any adjustments which were made.

Maintenance Procedure

Function		Frequency
o Factory check out and calibration	-	Yearly or when malfunctioning
o Clear Ionization Chamber	-	Monthly or as use and site condition dictate
o Clear UV Light Source Window	-	Bimonthly dictate
o Check and clean fan unit	-	Weekly areas dictate
o Wipe down readout unit and probe	-	After each use
o Recharge batteries	-	After each use

Combustible Gas

Combustible Gas Indicator/Oxygen Meter
Mine Safety Appliances
Model 260
Frequency - prior to each use

Calibration Procedure

- Turn meter on, allow time to stabilize, check battery.
- Adjust LEL reading to zero percent.
- Adjust Oxygen Meter to 20.8 percent.
- Attach regular and hose to calibration gas tank (propane).
- Attach calibration hose to meter port while opening valve, read and record tank pressure.
- Read LEL meter.

- o Consult calibration book for appropriate response curve (propane).
- o Record meter reading and curve value.
- o If explosimeter is off from calibration gas concentration by more than ± 5% the meter must be adjusted by the following procedure.

1. Remove the right side of the instrument.
2. Locate the explosimeter gain adjust pot on the circuit board. Adjust this pot until the meter reading equals the calibration gas concentration.
3. Replace instrument in its shell. Record any adjustments which were made.

Maintenance Procedure

Function	Frequency
o Factory Checkout and calibration	Yearly or when malfunctioning
o Replace catalytic filament	When malfunctioning
o Replace oxygen sensor	Biyearly or when malfunctioning
o Clean and repair internal sample liner	Monthly or as site condition
o Replace Particulate filter	Weekly or as site condition
o Wipe down readout unit and hose	After each use
o Recharge battery	After each use

Portable Sampling Pumps

Mine Safety Appliances
Model C-210 Low Flow and Fixed Flow Pump Model 1
Frequency - Periodically during use.

Air Sampling Pumps and Rotameters

Rotameters

Gilmont Instrument Inc.
Size #11 (0-250 cc/m) and Size 12 (0-2000 cc/m)

Calibration Procedure

Frequency - Upon initial receipt and prior to new sampling campaigns

o Check calibration of rotameter using a primary calibration device (Bubble Meter) in the following manner.

1. Attach sample pump inlet to outlet of Bubble Meter. Attach rotameter outlet to Bubble Meter inlet. Assure Rotameter inlet is open to atmosphere pressure.
2. Select sufficient number of points (10-15) over the rotameter flow range. At each point accurately measure the time required for bubble to traverse known volume of bubble meter. Use the average of 3 traverses to compute flow rate (Q) from

$$Q = V/Z -$$

where V = volume traversed
Z = time of traverse

Correct for evaporation behind the soap bubble if relative humidity is less than 50% by

$$\text{Vcount} = \text{Vmins.} \quad \frac{(\text{Patm} - \text{Pwater vapor press. at}) \ 25^{\circ} \text{C}}{\text{Patm}}$$

Correct to STP if significant differences in temp and pressure in present log.

$$V_{stp} = \text{V meas.} \left(\frac{\text{Press}}{\text{correct (760 mm Hg)}}\right) \left(\frac{298^{\circ}\text{K}}{t^{\circ}\text{K measured}}\right)$$

Accuracy of $\pm$ 1% is generally possible for flow ranges of 1 cc/min to 1 liter/min.

Plot Rotameter vs. Bubble Meter Flow at STP for field use.

SYM 001 2210

High flow Air Sampling Pumps
Fixed Flow Pump/Model 1
Mine Safety Appliances

Calibration Procedure

Frequency - Periodically during use

- o Turn on pump, check charge light and flow indicator. Turn off pump.
- o Attach sample train outlet to pump inlet. Attach rotameter outlet to sample train inlet. Assure rotameter outlet is open to atmosphere pressure.
- o Turn on pump and adjust to desired flow respective of each sampling train requirements. Remove rotameter, record time and flow.
- o Check pump flow with rotameter periodically (approximately every 2-3 hours) during sample period. Reset original flow rate if flow has changed. Record time and adjustments.
- o When shutting down, check flow with rotameter, check flow light indicator, turn off pumps, record final flows and times.
- o Conservatively calculate volume by multiplying average flow rates between checks by the time between checks and summing the individual volumes.

Low Flow Air Sampling Pumps
Model C-210
Mine Safety Appliances

Calibration Procedures
Primary Calibration
Frequency - upon intial receipt and for individual sample train requirements.

- o Attach sample train outlet to pump inlet. Attach Bubble Meter outlet to sample train inlet. Assure Bubble Meter inlet is open to atmosphere pressure.

- o Turn on pumps and adjust to desired flow respective of each sampling train requirements.

SYM 001 2211

- o Record counter reading and determine the number of counts required to traverse a known volume. Repeat calibration for one half and two times desired flow rate to establish linearity. Determine count rate in cubic centimeters per count respective of each sampling train requirements.

Field Calibration

- o Turn on pumps. Check charge light. Turn off pump.
- o Attach sample train outlet to pump inlet.
- o Record counter reading. Turn on pump. Set flow rate by setting counts per unit time.
- o Check pump flow by noting counts per unit time periodically (approximately every 2-3 hours) during sampling period. Reset original flow rate if flow has changed. Record time and adjustments.
- o When shutting down, check flow rate by noting counter per unit time. Turn off pump. Note final counter reading.
- o Sample volume can be calculated as in Section 8.5.6.2 or by multiplying the number of counts by the number of cubic centimeters per count. The smaller of the two volumes will be used to calculate worse case concentration.

Maintenance Procedure

Function		Frequency
Flush Rotameter with appropriate solvents and Dry.	-	Periodically or when float does not risk smoothly
Check and Clean pump sample liner, gaskets and seals.	-	Periodically or when leaking
Recharge batteries	-	After each use.

Terrain Conductivity

Terrain Conductivity Meter
Bison Instruments Inc.
Model No. EM-34

- Calibrated at factory
- Daily conduct and internal check to confirm meter is working properly.

Organic Vapor Analyzer

Century - Foxboro Incorporated
Model OVA-128 Survey Mode
Frequency - Prior to each use
Calibration Procedure

- Turn on electronics and zero instrument on X-10 scale, with the gas select dial set to 300.
- Turn on pump & hydrogen. Ignite flame. Check that instrument is in survey mode (both backflush & inject valve in up position).
- Introduce ultra pure air and zero instrument.
- Introduce a methane standard between 90 and 100 ppm. If meter reading is within $\pm$ 5% of the calibration gas concentration, instrument is field ready. Record meter readings control settings, source of standard and related information.
- If the meter reading is not within $\pm$ 5% of the calibration gas concentration, the meter must be adjusted by the following method:
  1. Remove instrument internals from instrument shell.
  2. With meter connected to standard, adjust R-32 trimpot on circuit board to make meter read to standard.
  3. Remove instrument from standard. Turn off hydrogen flame and adjust meter to 4 ppm with the zero adjust knob.
  4. Switch to X-1 scale and adjust R-31 trimpot to make meter read 4 ppm.
  5. Return to X-10 scale and adjust meter to 40 ppm with the zero adjust knob.
  6. Switch to X-100 scale and adjust R-33 trimpot to make meter read 40 ppm.

7. Replace instrument internals in instrument shell. Turn on and relight instrument. Record any adjustment and all pertinent information. Recheck zero and calibration.

Maintenance Procedure

Function	Frequency
o Clean electrical contacts	Monthly
o Replace charcoal filter	Weekly
o Check flow rate	Weekly
o Clean Burner chamber	Weekly
o Check Quad-rings	Weekly
o Check H_2 Regulator setting	Daily
o Check pumping system	Daily
o Clean particulate filters	Daily
o Wipe down probe and unit	After each use
o Recharge battery	After each use
o Recharge H_2 Supply (99.999% pure)	As necessary

High Volume Samplers

Brand - General Motor Works

Frequency-Prior to startup

All high volume samplers will be calibrated in accordance with "Reference Method for the Determination of Suspended Particulates in the Atmosphere (High Volume Method)".
Federal Register, 9/14/72 or 40CFR50 Appendix B.

Preventive Maintenance procedures for field instrumentation are summarized in Table 4.

REFERENCES

1. American Society for Testing and Materials. 1980. Standard practice method for soil investigation and sampling by auger borings. ANSI/ASTM D 1452-80. Philadelphia, Pa.

2. American Society for Testing and Materials. 1967. Standard method for penetration test and split-barrel sampling of soils. ASTM D 1586-67. Philadelphia, Pa.

3. US Environmental Protection Agency. 1983. Methods for chemical analysis of water and wastes. EPA-600/4-79-020. Environmental Monitoring and Support Laboratory, Cincinnati, Ohio.

4. US Environmental Protection Agency. 1982. Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater. EPA-600/4-82-057. Environmental Monitoring and Support Laboratory, Cincinnati, Ohio.

5. US Environmental Protection Agency. 1982. Handbook for Sampling and Sample Preservation of Water and Wastewater. EPA-600/4-82-029. Environmental Monitoring and Support Laboratory, Cincinnati, Ohio.

6. US Environmental Protection Agency. 1980. Samplers and Sampling Procedures for Hazardous Waste Streams. EPA-600/2-80-018. Municipal Environmental Research Laboratory, Cincinnati, Ohio.

7. US Environmental Protection Agency. 1982. Test methods for evaluating solid waste. SW-846, 2nd Edition. Office of Solid Waste and Emergency Response, Washington, DC.

8. US Environmental Protection Agency. 1979. Modified EMSL-Ci procedure to be used for low levels of volatiles in soils and sediments. USEPA Contract 68-01-6762.

TABLE 1

LABORATORY CHEMCIAL ANALYSIS OF SOILS AND WATERS

Sample Type	# of Samples	Full Priority Pollutant and Library Search	B/N, PCBs, Metals, CN^- Phenols	VOA, Metals	VOA	Gross (T,D,S)
Soils						
- Perm. well boring						
- unsaturated	24	+				
- saturated	12		+			
Groundwater	15	+				+
Leachate	3	+				
Bldg. Dust & Floor Scrapings	5	+				
Lagoons	4	+				
Duplicates						
soils	5	+				
waters	2	+				
Field Blanks						
soils	19			+		
waters	5	+				
Matrix Spikes						
soils	5	+				
waters	2	+				
Trip Blanks	10				+	
TOTAL	111	70	12	19	10	15

+ = test to be done

TABLE 2

LABORATORY CHEMICAL ANALYSIS OF AIR SAMPLES

Sample Type	# of Samples	Gas Phase Organic Analysis
On-site		
- tenax	3 (plus break through)	+
- charcoal	3 (plus break through)	+
Off-site		
- tenax	2	+
- charcoal	2	+
Duplicates		
- tenax	2	+
Travel Blank		
- tenax	2	+
- charcoal	2	+
TOTAL	18	18

+ = test will be done

REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES

Parameter No./Name	Container[1]	Preservation[2,3]	Maximum Holding Time[4]
INORGANIC TESTS:			
Acidity	P,G	Cool, 4°C	14 days
Alkalinity	P,G	Cool, 4°C	14 days
Ammonia	P,G	Cool, 4°C, H_2SO_4 to pH<2	28 days
Biochemical Oxygen Demand	P,G	Cool, 4°C	48 hours
Bromide	P,G	None required	28 days
Biochemical Oxygen Demand, Carbonaceous	P,G	Cool, 4°C	48 hours
Chemical Oxygen Demand	P,G	Cool, 4°C, H_2SO_4 to pH<2	28 days
Chloride	P,G	None required	28 days
Chlorine, Total Residual	P,G	None required	Analyze immediately
Color	P,G	Cool, 4°C	48 hours
Cyanide, Total and Amenable to Chlorination	P,G	Cool, 4°C, NaOH to pH>12, 0.6g ascorbic acid[5]	14 days[6]
Fluoride	P	None required	28 days
Hardness	P,G	HNO_3 to pH<2, H_2SO_4 to pH<2	6 months
Hydrogen Ion (pH)	P,G	None required	Analyze immediately
Kjeldahl and Organic Nitrogen	P,G	Cool, 4°C, H_2SO_4 to pH<2	28 days
Nitrate	P,G	Cool, 4°C	48 hours
Nitrate-Nitrite	P,G	Cool, 4°C, H_2SO_4 to pH<2	28 days
Nitrite	P,G	Cool, 4°C	48 hours
Oil and Grease	G	Cool, 4°C, H_2SO_4 to pH<2	28 days
Organic Carbon	P,G	Cool, 4°C, HCl or H_2SO_4 to pH<2	28 days
Orthophosphate	P,G	Filter immediately, Cool, 4°C	48 hours
Oxygen, Dissolved-Probe	G Bottle and top	None required	Analyze immediately
Oxygen, Dissolved-Winkler	G Bottle and top	Fix on site and store in dark	8 hours
Phenols	G	Cool, 4°C, H_2SO_4 to pH<2	28 days
Phosphorus (elemental)	G	Cool, 4°C	48 hours
Phosphorus, Total	P,G	Cool, 4°C, H_2SO_4 to pH<2	28 days
Residue, Total	P,G	Cool, 4°C	7 days
Residue, Filterable	P,G	Cool, 4°C	48 hours
Residue, Nonfilterable (TSS)	P,G	Cool, 4°C	7 days
Residue, Settleable	P,G	Cool, 4°C	48 hours
Residue, Volatile	P,G	Cool, 4°C	7 days
Silica	P	Cool, 4°C	28 days
Specific Conductance	P,G	Cool, 4°C	28 days
Sulfate	P,G	Cool, 4°C	28 days
Sulfide	P,G	Cool, 4°C, add zinc acetate plus sodium hydroxide to pH>9	7 days
Sulfite	P,G	None required	Analyze immediately
Surfactants	P,G	Cool, 4°C	48 hours
Temperature	P,G	None required	Analyze immediately
Turbidity	P,G	Cool, 4°C	48 hours
METALS:[7]			
Chromium VI	P,G	Cool, 4°C	24 hours
Mercury	P,G	HNO_3 to pH<2	28 days
Metals, except Chromium VI and Mercury	P,G	HNO_3 to pH<2	6 months

REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES (Continued)

Parameter No./Name	Container[1]	Preservation[2,3]	Maximum Holding Time[4]
ORGANIC TESTS:[8]			
Purgeable Halocarbons	G, Teflon-lined septum	Cool, 4°C, 0.008% $Na_2S_2O_3$[5]	14 days
Purgeable Aromatic Hydrocarbons	G, Teflon-lined septum	Cool, 4°C, 0.008% $Na_2S_2O_3$[5], HCl to pH<2[9]	14 days
Acrolein and Acrylonitrite	G, Teflon-lined septum	Cool, 4°C, 0.008% $Na_2S_2O_3$[5], adjust pH to 4-5[10]	14 days
Phenols[11]	G, Teflon-lined cap	Cool, 4°C, 0.008% $Na_2S_2O_3$[5]	7 days until extraction, 40 days after extraction
Benzidines[11]	G, Teflon-lined cap	Cool, 4°C, 0.008% $Na_2S_2O_3$[5]	7 days until extraction[13]
Phthalate Esters[11]	G, Teflon-lined cap	Cool, 4°C	7 days until extraction, 40 days after extraction
Nitrosamines[11,14]	G, Teflon-lined cap	Cool, 4°C, store in dark, 0.008% $Na_2S_2O_3$[5]	7 days until extraction, 40 days after extraction
PCBs[11] Acrylonitrile	G, Teflon-lined cap	Cool, 4°C	7 days until extraction, 40 days after extraction
Nitroaromatics and Isophorone[11]	G, Teflon-lined cap	Cool, 4°C, 0.008% $Na_2S_2O_3$[5], store in dark	7 days until extraction, 40 days after extraction
Polynuclear Aromatic Hydrocarbons[11]	G, Teflon-lined cap	Cool, 4°C, 0.008% $Na_2S_2O_3$[5], store in dark	7 days until extraction, 40 days after extraction
Haloethers[11]	G, Teflon-lined cap	Cool, 4°C, 0.008% $Na_2S_2O_3$[5]	7 days until extraction, 40 days after extraction
Chlorinated Hydrocarbons[11]	G, Teflon-lined cap	Cool, 4°C	7 days until extraction, 40 days after extraction
TCDD[11]	G, Teflon-lined cap	Cool, 4°C, 0.008% $Na_2S_2O_3$[5]	7 days until extraction, 40 days after extraction
PESTICIDES TESTS:			
Pesticides[11]	G, Teflon-lined cap	Cool, 4°C, pH 5-9[15]	7 days until extraction, 40 days after extraction
RADIOLOGICAL TESTS:			
1-5 Alpha, beta and radium	P, G	HNO_3 to pH<2	6 months

TABLE 1 Notes

(1) Polyethylene (P) or Glass (G).

(2) Sample preservation should be performed immediately upon sample collection. For composite chemical samples each aliquot should be preserved at the time of collection. When use of an automated sampler makes it impossible to preserve each aliquot, then chemical samples may be preserved by maintaining at 4°C until compositing and sample splitting is completed.

(3) When any sample is to be shipped by common carrier or sent through the United States Mails, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR Part 172).

(4) Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still be considered valid. Samples may be held for longer periods only if the permittee, or monitoring laboratory, has data on file to show that the specific types of samples under study are stable for the longer time, and has received a variance from the Regional Administrator.

(5) Should only be used in the presence of residual chlorine.

TABLE 3 Notes (Continued)

(6) Maximum holding time is 24 hours when sulfide is present. Optionally, all samples may be tested with lead acetate paper before pH adjustments in order to determine if sulfide is present. If sulfide is present, it can be removed by the addition of cadmium nitrate powder until a negative spot test is obtained. The sample is filtered and then NaOH is added to pH 12.

(7) Samples should be filtered immediately on-site before adding preservative for dissolved metals.

(8) Guidance applies to samples to be analyzed by GC, LC, or GC/MS for specific compounds.

(9) Sample receiving no pH adjustment must be analyzed within seven days of sampling.

(10) The pH adjustment is not required if acrolein will not be measured. Samples for acrolein receiving no pH adjustment must be analyzed within 3 days of sampling.

(11) When the extractable analytes of concern fall within a single chemical category, the specified preservative and maximum holding times should be observed for optimum safeguard of sample integrity. When the analytes of concern fall within two or more chemical categories, the sample may be preserved by cooling to 4°C, reducing residual chlorine with 0.008% sodium thiosulfate, storing in the dark, and adjusting the pH to 6-9; samples preserved in this manner may be held for seven days before extraction and for forty days after extraction. Exceptions to this optional preservation and holding time procedure are noted in footnote 5 (re: the requirement for thiosulfate reduction of residual chlorine) and footnotes 12, 13 (re: the analysis of benzidine).

(12) If 1,2-diphenylthydrazine is likely to be present, adjust the pH of the sample to 4.0±0.2 to prevent rearrangement to benzidine.

(13) Extracts may be stored up to 7 days before analysis if storage is conducted under an inert (oxidant-free) atmosphere.

(14) For the analysis of diphenylnitrosamine add 0.008% $Na_2S_2O_3$ and adjust pH to 7-10 with NaOH within 24 hours of sampling.

(15) The pH adjustment may be performed upon receipt at the laboratory and may be omitted if the samples are extracted within 72 hours of collection. For the analysis of aldrin, add 0.008% $Na_2S_2O_3$.

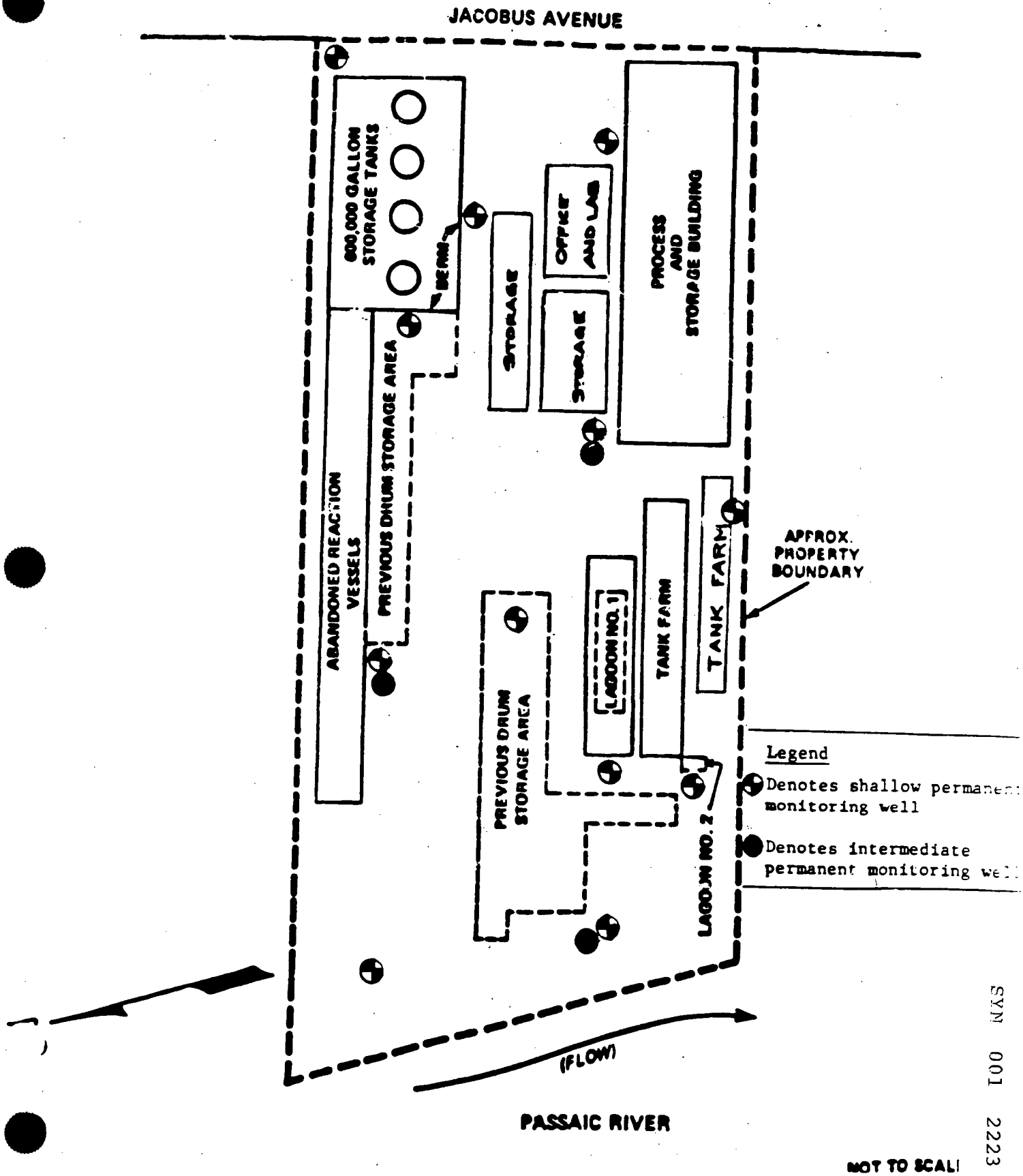
TABLE 4 Preventive Maintenance Procedures (Field Instruments)

INSTRUMENT	PROCEDURE	SCHEDULE
pH Meter	Battery check	Daily
	Replace probe in bottle, close breather hole to prevent loss of KCL	After each use
Conductivity Meter	Clean instrument, wipe cups and leads	After each use
	Replace battery	As needed
Combustible Gas Indicator/Oxygen Meter	Battery check	Charge fully after each use in field
Portable Sampling Pumps	Turn pump on, run out charge and fully recharge for 12 hours	Prior to initiation of fieldwork
Terrain Conductivity Meter	Conduct internal check	Daily
Photoionization Detector	Routine calibration	Prior to each days use
	Factory check-out and calibration	Yearly or when malfunctioning
	Wipe down read-out unit	After each use
	Clean UV light source window	Every two weeks or as use and site conditions dictate
	Clean the ionization chamber	Monthly
	Recharge battery	After each use

TABLE 4 (Cont'd) Preventive Maintenance Procedures (Field Instruments)

INSTRUMENT	PROCEDURE	SCHEDULE
OVA	Check particle filters	Daily
	Check quad rings	Weekly
	Clean burner chamber	Weekly
	Secondary calibration check	Prior to project start-up
	Primary calibration check	Monthly or if secondary check is off by more than ± 10%
	Leak check	Daily
	Check pumping system	Prior to project start-up
	Replace charcoal	After 120 hrs. of operation or when background readings are higher with the inject valve down than with the inject valve up in a clean environment
	Factory Service	At least annually

MAP SHOWING PRELIMINARY
MONITORING WELL LOCATIONS



SYN 001 2223

EXHIBIT 2

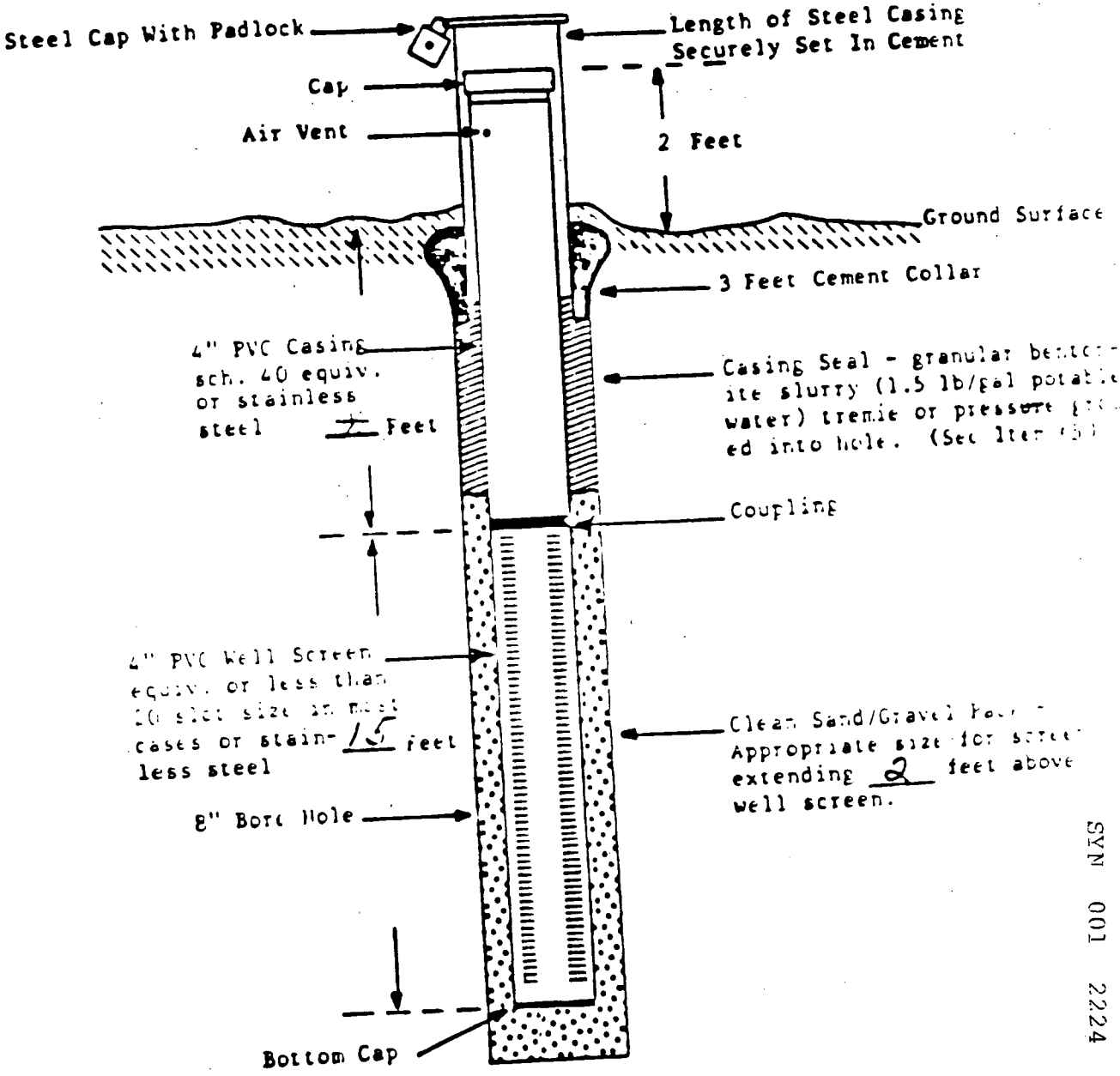
New Jersey Department of Environmental Protection
Unconsolidated Monitor Well Specifications*

Site Name: Syncon Resins

Location: Kearny - Hudson Co.

Date: 1/85 (REVISED)

Shallow Wells



NOT TO SCAL

SYN 001 2224

* Field Determined

REQUIREMENTS:

1. Notification to the NJDEP is required two (2) weeks prior to drilling.
2. State well permits are required for each monitor well constructed by the driller. Report "use of well" on well permit application. Permit number must be permanently affixed to each monitor well.

OVER PLEA

The borehole must be a minimum of four (4) inches greater than the casing diameter. Wells must be gravel packed unless noted otherwise in Additional Requirement #8. Approved high grade sodium base, well sealant type, granular bentonite must be used to seal casing. Casing sealant and drilling fluids must be mixed with potable water. Wells must be developed upon completion for a minimum of one (1) hour or to obtain a turbid-free discharge.
The driller must maintain an accurate written log of all materials encountered in each hole, record all construction details for each well, the static water levels, and any tidal fluctuations (when applicable). This information must be submitted to the Office of Water Allocation as required by N.J.S.A. 58:4A.
If low level organic compounds are to be sampled for, only threaded or press joints (no glue joints) are acceptable for PVC.
A length of steel casing with a locking cap must be securely set in cement a minimum of three (3) feet below ground surface.
Top of casing (excluding cap) must be surveyed to the nearest hundreth foot (0.01) by a licensed surveyor. The casing must be permanently marked at the point surveyed. The well(s) should be numbered clearly on the casing. A detailed site map with the well locations and casing elevations must be submitted to Russell Trice - site manager.

NOTICE IS HEREBY GIVEN OF THE FOLLOWING:

a. Review by the Department of well locations and depths is limited solely to review for compliance with the law and Department rules;
b. The Department does not review well locations or depths to ascertain the presence of, nor the potential for, damage to any pipeline, cable or other structure;
c. The permittee (applicant) is solely responsible for safety and adequacy of the design and construction of wells required to be constructed by the Department;
d. The permittee (applicant) is solely responsible for any harm or damage to person or property which results from the construction or maintenance of any well; this provision is not intended to relieve third parties of any liabilities or responsibilities which are legally theirs.

ADDITIONAL REQUIREMENTS (IF CHECKED):

[ ] 1. Top of screen set 3 feet (above)/~~below~~ water table.
[X] 2. Split Spoon Samples Continuous (As stated in Field Sampling Plan) (Also refer to #7 Major Areas of Concern)
[ ] 3. Dedicated Bailer (Sampler) In Well(s) _____
[X] 4. Threaded or Press Joints No glue joints
[ ] 5. Five (5) Foot Casing Tailpiece Below Screen _____
[ ] 6. Centralizers On Screen _____
[ ] 7. Borehole Geophysical Log(s) _____
[X] 8. Other No use of Reverse air drilling fluids; wells must be installed by a licensed NJ driller; drilling permits for wells must be secured prior to drilling.

OTHER MATERIALS, DESIGNS AND CASING DIAMETERS MAY BE USED WITH PRIOR APPROVAL BY THE NJDEP.

SYN 001 2225

New Jersey Department of Environmental Protection
Unconsolidated Monitor Well Specifications*

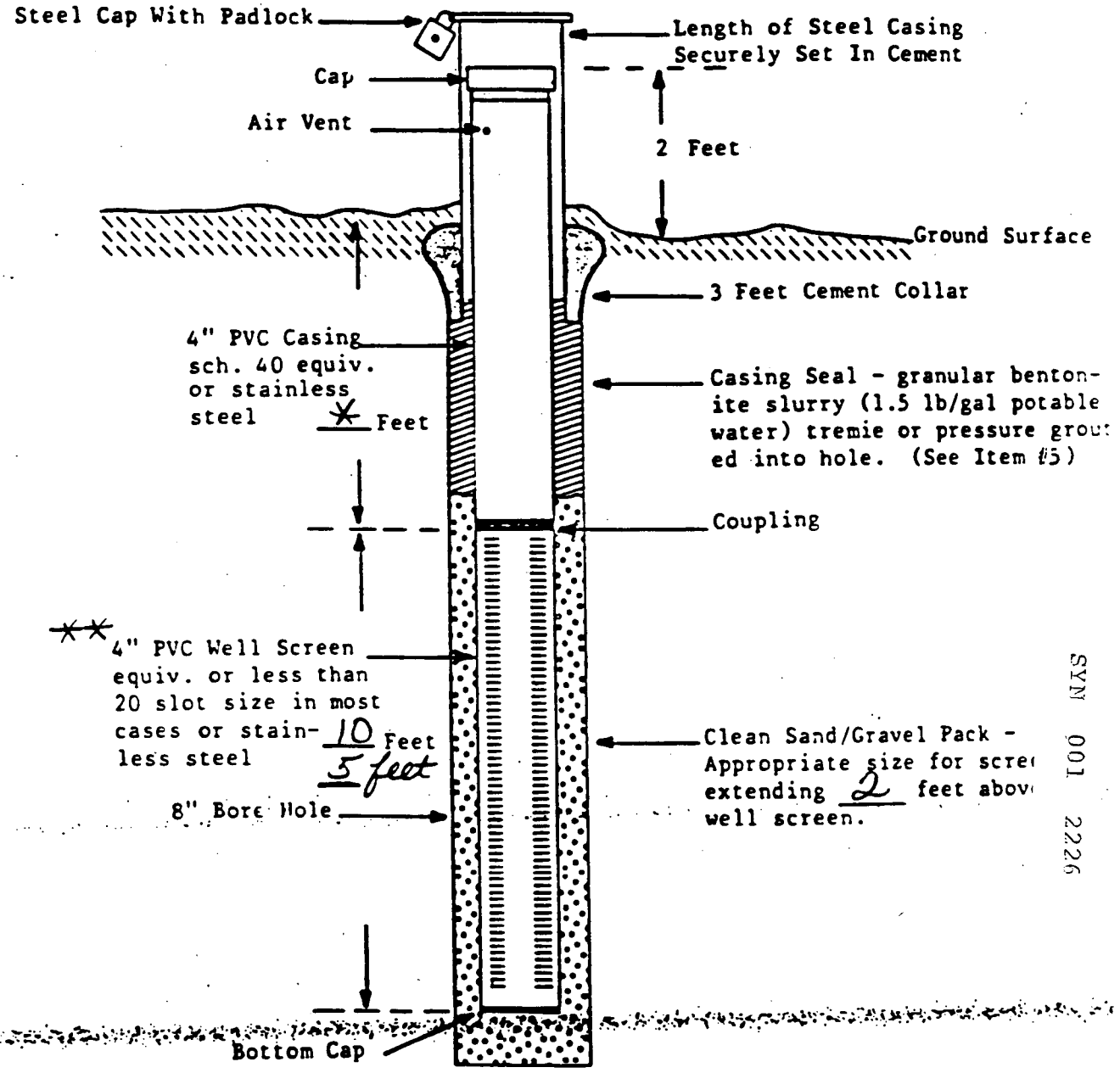
EXHIBIT 3

Site Name: Syncon Resins

Location: Kearny - Hudson Co.

Date: 3/85 (Revised)

Intermediate Wells—ONLY



SYN 001 2226

* Field Determined

** If the underlying clay layer is encountered at 30 ft or less the top of screen may be set 5 ft above the clay. NOT TO SCALE

QUIREMENTS: If the clay layer is encountered deeper than 30 feet the top of screen should be set 10 ft above the clay.

1. Notification to the NJDEP is required two (2) weeks prior to drilling.
2. State well permits are required for each monitor well constructed by the driller. Report "use of well" on well permit application. Permit number must be permanently affixed to each monitor well.

OVER PLEASE

3. The borehole must be a minimum of ~~four (4) inches~~ greater than the casing diameter.
4. Wells must be gravel pack unless noted otherwise in Additional Requirement #8.
5. Approved high grade sodium base, well sealant type, granular bentonite must be used to seal casing. Casing sealant and drilling fluids must be mixed with potable water.
6. All wells must be developed upon completion for a minimum of one (1) hour or to yield a turbid-free discharge.
7. The driller must maintain an accurate written log of all materials encountered in each hole, record all construction details for each well, the static water levels, and any tidal fluctuations (when applicable). This information must be submitted to the Office of Water Allocation as required by N.J.S.A. 58:4A.
8. If low level organic compounds are to be sampled for, only threaded or press joints (no glue joints) are acceptable for PVC.
9. A length of steel casing with a locking cap must be securely set in cement a minimum of three (3) feet below ground surface.
10. Top of casing (excluding cap) must be surveyed to the nearest hundreth foot (0.01) by a licensed surveyor. The casing must be permanently marked at the point surveyed. The well(s) should be numbered clearly on the casing. A detailed site map with the well locations and casing elevations must be submitted to _____ _____.
11. NOTICE IS HEREBY GIVEN OF THE FOLLOWING:

    a. Review by the Department of well locations and depths is limited solely to review for compliance with the law and Department rules;
    b. The Department does not review well locations or depths to ascertain the presence of, nor the potential for, damage to any pipeline, cable or other structure;
    c. The permittee (applicant) is solely responsible for safety and adequacy of the design and construction of wells required to be constructed by the Department;
    d. The permittee (applicant) is solely responsible for any harm or damage to person or property which results from the construction or maintenance of any well; this provision is not intended to relieve third parties of any liabilities or responsibilities which are legally theirs.

ADDITIONAL REQUIREMENTS (IF CHECKED):

☒1. Top of screen set 10 or 5 feet ~~above/below water table~~ above the Clay layer **.
☒2. Split Spoon Samples Continuous
☐3. Dedicated Bailer (Sampler) In Well(s) _____
☒4. Threaded or Press Joints no glue joints
☐5. Five (5) Foot Casing Tailpiece Below Screen _____
☐6. Centralizers On Screen _____
☐7. Borehole Geophysical Log(s) _____
☒8. Other (same as shallow well specifications)

SYN 100 2227

* OTHER MATERIALS, DESIGNS AND CASING DIAMETERS MAY BE USED WITH PRIOR APPROVAL BY THE NJDEP.

APPENDIX A

DRILLING, TESTING, AND INSTALLATION OF WELLS AT THE SYNCON RESINS

Definitions

Within the context of the work to be performed, the following definitions will apply:

Engineer: defines Ebasco Services Incorporated and its representatives, as consultant to the Owner

Contractor: defines Empire Soils Investigations, Inc. and its representatives including subcontractors, who will perform the work hereinafter specified

1.0 GENERAL

1.1 Bore-holes shall be made with heavy duty drilling equipment of a size and type designed to drill holes of the required sizes and depth specified herein. All equipment furnished and operated by the Contractor shall be in good condition and capable of performing work as specified. When required by Engineer, the Contractor shall immediately remove defective or improper equipment from the site and replace it with equipment acceptable to the Engineer.

1.2 The Engineer shall have the right to request the dismissal from the site of any Contractor personnel not exercising sufficient skill and care in drilling and sampling and their replacement with personnel acceptable to the Engineer.

1.3 The general area in which the monitoring wells are to be located is shown on the attached figure. Additional drawings may be furnished or approved hereafter by the Site Engineer to explain the work in greater detail.

1.4 The boring locations shown or implied on the figure are approximate. The exact location shall be determined in the field by the Site Engineer. In case of relocations or adjustments, the Site Engineer shall be consulted and his decisions shall be final.

1.5 The Contractor shall assist the Site Engineer in obtaining a detailed log for each test hole. This log shall include a description of all material sampled, the method of sampling, and any other pertinent drilling and testing information obtained as the work progresses.

1.6 The Contractor will be given 15 days notice prior to the commencement of work.

1.7 The quantities stated are approximate. The Engineer does not guarantee that these items or quantities will be performed. The Engineer reserves the right to delete items in their entirety, to increase or decrease the quantities, or otherwise vary the items and/or quantities, and the Contractor agrees to accept as full payment for any and all work performed pursuant to this contract the amount for each item which is based on the unit price quoted therefore in the Bid Schedule of Prices and the actual quantity of work performed under such item. No payment shall be made for any borings abandoned without prior written authorization.

1.8 Responsibilities of the Contractor

1.8.1 Any and all arrangements required to perform the specified services, including all drilling permits, well permits, etc. and clearances shall be the responsibility of the Contractor.

1.8.2 The Contractor shall be responsible for supplying all services (including labor), equipment and material required to perform the drilling, testing, and well installation program, as well as maintenance and quality control of such required equipment.

1.8.3 The Contractor shall be responsible for any and all work subcontracted and will ensure that said subcontractor(s) will abide by all aspects of this contract. The Contractor shall be responsible for supplying the complete requirements of this scope of work to all subcontractors.

1.8.4 The Contractor shall be responsible for the correctness of the procedures to be used, as well as for the accurate reporting of the results thereof, as described in this specification and as required by the Engineer.

1.8.5 The Contractor shall be responsible for restoring all areas used by him in his work to or close to their original condition, to the satisfaction of the Owner and/or Engineer.

1.8.6 The Contractor shall be required to report any major technical or analytical problems encountered in the field, which might preclude the successful performance of any items of this specification, to the Engineer within 24 hours.

1.8.7 The Contractor shall be required to send to the Engineer advance written notification for any changes in field procedures, describing and justifying such changes. No such changes shall be made to the procedures, unless requested or authorized in writing by the Engineer. In certain cases, prior written authorization may be waived by the Engineer, at his discretion, and the changes may be requested and/or authorized verbally. This waiver, however, will not release the Contractor of his obligation to follow-up with a written explanation for the aforesaid changes.

1.8.8 The Contractor shall be responsible for providing access to all drilling locations and for setting up all drilling and associated equipment at each location. The manner of access must be acceptable to the Site Engineer.

2.0 TECHNICAL PROCEDURES FOR DRILLING BORINGS

2.1 General

The purpose of these test borings is to: 1) determine the type, thickness, and certain physical and chemical properties of the soil and water which underlie the site, and 2) install permanent monitoring wells, according to NJDEP specifications. Soil samples are to be collected both for visual identification and for laboratory testing. Water samples are to be collected for chemical testing. The drilling rig including all attachments will be steam cleaned prior to and upon completion of field work. All downhole tools will be steam cleaned prior to the commencement of each boring and the split-spoon samplers will be steam and acetone cleaned with a final water rinse between samples.

2.2 Site Conditions

The Subsections 2.3, 2.4, 2.5, and 2.6 apply to all drilling in subsurface materials, including, but not limited to, sand, gravel, clay, silt, cobbles, boulders, and manmade fill.

2.3 Drilling by Hydraulic Rotary Method

Drilling will be performed by a hydraulic rotary drilling rig of appropriate size to accommodate the installation of four inch I.D. stainless steel, flush coupled screen and casing for groundwater sampling wells, or as approved by the Site Engineer. The procedures for performing hydraulic rotary soil investigations and sampling shall conform with the applicable ASTM standards: D2113-70, D1587-74, and D1586-67.

2.3.1 The hydraulic rotary drill may be advanced by any power-operated drilling machine having sufficient torque and ram range to rotate and force the bit to the desired depth, provided the machine is equipped with any accessory equipment needed to perform required sampling, or core. All drilling fluids must be approved by the Site Engineer.

2.3.2 The hydraulic rotary shall be advanced to the desired sampling depth and cleaned to the bottom of the hollow stem. Samples shall be taken continuously unless otherwise specified by the Site Engineer. Any required sampling shall be performed by rotation, pressing, or driving in accordance with the standard or approved method governing use of the particular sampling tool.

2.3.3 If refusal of drill bit is encountered, a five foot core run will be conducted to confirm bedrock.

2.3.4 When field conditions prevent the advancement of the hole, a new boring shall be drilled at a cost to be determined by the Site Engineer. The original boring shall be backfilled using a tremied bentonite slurry and a new boring started a short distance away at a location determined by the Site Engineer. No samples will be taken until the new boring reaches a depth at which the original boring was abandoned.

2.4 Drilling by Hollow-Stem Auger Method

If required by Engineer, drilling will be performed by a hollow-stem auger of appropriate size to accommodate the installation of 4 inch I.D. stainless steel pipe for groundwater sampling wells, or as approved by the Site Engineer. The procedures for performing hollow-stem auger soil investigation shall conform with the applicable ASTM Standards: D1587-74 and D1586-67.

2.4.1 The hollow-stem auger may be advanced by any power-operated drilling machine having sufficient torque and ram range to rotate and force the auger to the desired depth, provided the machine is equipped with any accessory equipment needed to perform required sampling, or core.

2.4.2 The hollow-stem auger shall be advanced to the desired sampling depth and cleared to the bottom of the hollow stem. Samples shall be taken continuously wherever possible. Any required sampling shall be performed by rotation, pressing, or driving in accordance with the standard or approved method governing use of the particular sampling tool. The sequence shall be repeated for each sample desired.

2.4.3 Hollow-stem auger will be used without the plug when operating below the water table or in other liquid formations. In such cases the hollow-stem auger shall be advanced to the desired sampling depth; then the hole shall be cleaned out in the same manner prescribed for casing cleanout. Then sampling will be performed as in any cased hole.

2.4.4 When drilling below the water table, it will be necessary to keep the hollow stem full of water at least to the level of the water table.

2.4.5 When gravelly or hard material is encountered which prevents advancing the auger, the auger shall be pulled out and either casing or hydraulic rotary methods shall be used.

2.4.6 If refusal of drilling is encountered, a five foot core run will be conducted to confirm bedrock.

2.4.7 At the option of the Site Engineer, when extra-hard materials prevent the advancement of the auger, a new boring shall be drilled. The original boring shall be backfilled and the new boring be started a short distance away at a location determined by the Site Engineer. No samples will be taken until boring reaches depth at which original boring was abandoned.

2.5 Drilling by Cased Hole Method

This method shall be applicable wherever the formation and the groundwater conditions are such as not to permit hollow-stem auger drilling, or as the Site Engineer directs. Casing for soil boring shall be extra heavy pipe; the minimum nominal diameter shall be 8 inches. Flush joint casing equipped with a cutting bit may be required to drill through boulders.

2.5.1 The casing shall be driven down in stages of not more than two (2) feet, after which the material shall be cleaned out by rotary drilling, by washpipe and chopping bit, or by some other method approved by the Site Engineer. Water shall generally be used for removing the loosened soil. A continuous record shall be kept of the blows per foot in driving the casing.

2.5.2 Simultaneous washing and driving of the casing will not be permitted, except when approved by the Site Engineer. The elevations between which water is used in driving the casing shall be recorded when this procedure is used.

2.5.3 The casing when driven shall be advanced by a three hundred (300) pound hammer falling freely through a height of thirty (30) inches.

2.5.4 It shall be the Contractor's responsibility when boulders or other obstacles are encountered to carry the drilling through or past

such obstacles to enable normal samples to be taken as required. The method or methods used will be subject to approval by the Engineer.

2.6 Drilling by Hand Auger Method

2.6.1 This method shall be applicable wherever the formation, total depth of sampling, and the site and groundwater conditions are such as to allow hand auger drilling. All hand auger borings will be performed according to ASTM D1452-80. Hand augers are to be provided by the Engineer.

2.6.2 Samples will be taken continuously unless otherwise specified by the Site Engineer. Any required sampling shall be performed by rotation, pressing, or driving in accordance with the standard or approved method governing use of the particular sampling tool.

3.0 SOIL SAMPLING

3.1 General

The sampling methods herein described will be used in accordance with the types of material encountered, and as approved or requested by the Site Engineer.

The following methods may be used as alternatives or in combination, as warranted by the field conditions and as approved by the Site Engineer.

3.2 Split-Spoon Sampling

During the boring process split-spoon samples shall be taken. The procedures shall conform to ASTM Procedure D1586-67 "Penetration Test and Split-Barrel Sampling of Soils." Soil samples shall be taken continously from ground surface to the bottom of the hole, unless otherwise requested or approved by the Site Engineer. When boulders or other obstacles are encountered which render ordinary sampling impractical, the normal sampling at that depth may be omitted with approval of the Site Engineer. At depths where samples are to be taken, the loose material

shall be removed from the hole, and an approved split-spoon sampler lowered into the hole. For sampling at a specified depth, an approved split-spoon sampler shall be lowered into the hole prior to drilling to that depth.

The sample spoon shall be of the standard type, having a two (2) inch O.D. and 1-3/8 inch I.D. as approved by the Site Engineer. If difficulty is experienced in retaining samples, the split-spoon sampler shall be equipped with a basket-type retainer. The bottom edge of the drive shoe shall be sharpened to form a cutting edge at its inside circumference. The beveled edge of the drive shoe shall be maintained in good condition and, when excessively worn, shall be satisfactorily reshaped. The drive shoe of the sampler shall be replaced if damaged in such a manner as to cause projections within the interior surface of the shoe. The sampler must be steam-cleaned, acetone washed, and distilled water rinsed before and after use. If hard to remove contaminants such as tar or oil are encountered, the sampler shall be soap scrubbed prior to steam cleaning. The sample shall be taken by mechanically driving the split-spoon sampler twenty-four (24) inches into the undisturbed material below the bottom of the casing. If approved by the Site Engineer, an eighteen (18) inch split-spoon sampler may be used. A record shall be kept of the number of blows for each six (6) inches of penetration. In hard materials requiring more than 50 blows per six inches of penetration, the blows for a smaller amount of penetration may be observed and recorded with a special note of the amount of penetration actually obtained. Refusal shall be considered reached when less than one foot of penetration has been achieved with 100 blows.

To obtain a consistent determination of the relative resistance of the various strata, the split-spoon sampler shall be driven by a 140 pound hammer having a free falling drop of thirty (30) inches. In no case will any deviation from maintaining a constant impact energy be permitted in obtaining the penetrating resistance.

Upon removal from the hole, all soil samples shall be placed in wide mouth, screw top, watertight, glass jars to be supplied by the

Contractor, or, for chemical analysis only, in a precleaned glass sample jar to be supplied by the chemical laboratory and promptly and clearly labeled for identification. Five samples will be analyzed by the Contractor to determine the grain size distribution of each sample.

3.3 Marking, Packing and Shipping of Soil Samples

3.3.1 All soil samples shall be marked and identified with legible, indelible labels which shall indicate the project, the number of the boring, the elevation or depth from which the sample was taken, the sample number, the date, and any other information that may be helpful in determining the character of the subsurface conditions.

3.3.2 All samples shall be properly packaged in suitable containers to protect against damage from shifting of samples in boxes or breakage of glass jars while in transit. All samples shall be protected from excessive heat and/or cold.

4.0 CLASSIFICATION OF SOIL SAMPLES

The Contractor shall assist the Site Engineer in performing the work described in Subsections 4.1.1 through 4.1.5. Soils shall be described and recorded in accordance with the Unified Soil Classification System. The soil description shall include at least the items described below.

In general, soil shall be considered either as granular or cohesive. A granular soil shall be considered basically either a gravel or a sand. Soil in either category shall be described as fine, medium or coarse. The supplementary texture of the granular material shall be given through the use of one adjective only. A cohesive soil shall be considered basically either a silt or a clay. The supplementary texture of the cohesive material shall be given through the use of one adjective only. The texture of either granular or cohesive soils may be modified to disclose the presence of organic materials or others, using measures as "trace," "little" or "some" to indicate the amounts. For soil with equal amounts of constituents, use "and," such as "sand and gravel."

4.1.2 Granular soils shall be defined in terms of compactness, as "loose," "medium dense," "dense" or "very dense." Cohesive soils shall be defined in terms of consistency, as "very soft," "soft," "medium," "stiff," "very stiff" or "hard," and in terms of plasticity.

4.1.3 The amount of moisture present in a soil sample shall be defined in terms of "wet," "moist" or "dry."

4.1.4 The basic color of a soil, as blue, brown, gray, red or yellow, shall be given and shall be modified if necessary by adjectives such as "light," "dark," "mottled" or "mixed."

4.1.5 In the description of the soil, its color shall be described first, followed by texture, composition, consistency and moisture. Example: light gray silty clay with trace of fine sand, medium plasticity, soft, and wet.

5.0 BORINGS LOGS

The Contractor shall assist the Site Engineer in accomplishing the work described in all Subsections of Section 5.

5.1.1 During the progress of each boring, the Contractor shall keep a continuous and accurate log of the materials encountered and a complete record of the operation. The Contractor shall record the number of blows required to drive the split-spoon sampler for each six (6) inches of penetration.

5.1.2 The Contractor shall use an appropriate "BORING LOG" Form. Boring logs shall include at least the data described below.

5.1.3 General

Dates and times of start and completion.

Names of Contractor, driller and inspector.

Identifying number of location of testing boring.

5.1.4 Soil Borings

Results of boring details of each hole arranged in tabular form giving full information on the vertical sequence, thickness and classification including degree of compactness of the materials penetrated.

Size and length of casing used in each borehole.

Height of drop and weight of hammer for taking drive samples and driving casing.

Number of blows required for each six (6) inch penetration of split-spoon sampler and for each twelve (12) inch penetration of casing. Methods and forces used to push sampler when not driven.

Depth limits, type and number of each sample taken. All samples shall be numbered consecutively.

Depth to groundwater table at each boring, and time of observation. Water level observations shall be made and recorded at first detection.

Loss or gain of drilling water or mud. Type of drilling mud, if it was used.

6.0 INSTALLATION OF MONITORING WELLS

6.1 Materials

6.1.1 A four inch I.D. monitoring well will be installed in each test boring according to the attached NJDEP specifications by a New Jersey licensed well driller. Well screens and casing sections will be

stainless steel. Slot size of screens shall be 0.020 inch. Pipes and screens shall be threaded, flush coupled. Protective steel casings shall be standard weight black steel pipe. All protective casings shall be equipped with a steel cap with a locking device. In addition, protection for well and protective casing will be supplied, where necessary, consisting of at least three, four inch I.D. pipes, driven at least 2 feet into the ground and projecting above the protective casing.

6.1.2 The monitoring well installation shall be made by placement of precleaned (steam and acetone washed with distilled water rinse) screen and pipe into the boring as directed by the Site Engineer. Filter sand shall be backfilled around the screen to a height 3 feet above the screen. A granular bentonite slurry of approximately 1.5 lb/gal. water shall be tremied or pressure grouted into hole from top of filter sand to within 3 feet of the surface. The upper 3 feet of the boring shall be grouted with concrete so that surface water cannot enter the well.

6.1.3 All well installations shall be numbered by steel-stamping the exposed portion of the steel pipe or encasement (not the cap) with the state well permit number. The numbers shall be a minimum of one-half inch in height. Exposed casings and caps will be painted with a permanent traffic orange paint.

7.0 PERMEABILITY TESTS

Falling-head or constant head permeability tests will be performed on at least five wells to determine hydraulic conductivity of screened interval of the subsurface strata. The duration of each test will be about one hour. The Contractor will provide all the necessary equipment, materials and personnel to conduct the tests.

8.0 INSPECTION

8.0.1 The Site Engineer's Field Inspector shall have the right, at all reasonable times, to inspect the Contractor's work, material, equipment,

or inspection procedures as applicable to the work covered by this Contract, to confirm that the specified requirements are being complied with. The Contractor shall provide all tools, instruments, etc., necessary to facilitate these inspections.

8.0.2 The Contractor shall cooperate with the Site Engineer in establishing when the various inspections or tests will be performed during the progress of the work. The Site Engineer shall designate which of these he is required to witness or participate in, and the Contractor shall furnish an agreed upon amount of notification prior to the start of each.

8.0.3 The Site Engineer shall discuss with the Contractor anything he notices that may lead to rejection of the work.

8.0.4 It is not intended that the presence or activity of the Site Engineer shall relieve the Contractor in any way whatsoever of his obligations under this Contract. Furthermore, the fact that the Site Engineer may inadvertently overlook a deviation from some requirements of this Contract shall not constitute a waiver of that requirement, nor of the Contractor's obligation to correct the condition when it is discovered, nor of any other obligation under this Contract.

9.0 MOBILIZATION AND DEMOBILIZATION

This term shall include the moving of men, equipment and materials to and from the project site as necessary to execute the drilling and testing work properly and in a timely fashion. It shall also include the furnishing and erection of any barricades, field installations, etc., necessary for the performance of the work as well as the final cleanup, and restoration of the site.

10.0 SITE RESTORATION

The Contractor shall restore the site to its original condition or as near as possible. This will include removing all debris resulting from the field program.

11.0 INFORMATION CONFIDENTIAL

Upon written request by the Engineer, information obtained by the Contractor in the conduct of drilling operations on this contract, including, but not limited to depth, formations penetrated, the results of coring, testing, and surveying, shall be considered confidential and shall not be divulged by the Contractor or his employees, to any person, firm, or corporation other than the Engineer's designated representative.

12.0 HEALTH AND SAFETY

The Contractor will abide by the procedure specified in the Engineer's site-specific Health and Safety Plan and any procedures required by the Site Health and Safety Officer or Site Engineer. All the subcontractor's employees working at the site should have taken and passed the medical examination to the satisfaction of Ebasco Health and Safety Manager.

13.0 DECONTAMINATION FLUIDS

Disposal of all decontamination fluids, including chemicals and rinse water will be as approved by the Site Engineer.

14.0 MEASUREMENT AND PAYMENT

Unless otherwise specified, measurement of quantities and payment therefore shall be made on the following basis:

14.1 For mobilization, payment shall be made at the contract unit price for each drill rig mobilized. Such payment shall constitute full compensation for the furnishing, moving on and off the site, setting up, and moving between drill holes of all equipment and supplies necessary for the completion of the work, all clearing and earthwork necessary for access to the test boring locations, all site cleanup and filling of drill holes, all groundwater observations, all records and reports, and all notification of, and coordination with, underground utility operators.

14.2 For soil boring and split-barrel sampling, measurement of the total lineal footage shall be made to the nearest half of a foot. Footage shall be measured from the ground surface or the bottom of a body of water to the deepest depth penetrated by soil drilling or sampling tools. Payment shall be made at the contract unit price for the actual quantity of such drilling and sampling performed and approved by the Engineer. Such payment shall constitute full compensation for drilling and sampling at the specified interval, including all labor and supplies.

14.3 For soil boring without split-barrel sampling, measurement shall be made as specified in Section 14.2. Payment shall be made at the contract unit price for the actual quantity of such drilling performed and approved by the Engineer. Such payment shall constitute full compensation for such drilling, including all necessary labor and supplies.

14.4 For permeability testing, measurement shall be made to the nearest five minutes of the actual total time spent by the driller in performing such testing as required by the Engineer. Measurement of the time for each test shall start when the driller begins to move to monitoring well and shall end when the driller has moved from the monitoring well. Payment shall be made at the contract unit price for the total actual time rounded to the nearest tenth of an hour. Such payment shall constitute full compensation for furnishing and operating all necessary equipment, including all labor and supplies.

14.5 For monitoring wells installed in drill holes as required by the Engineer, measurement to the nearest foot of the actual total lineal footage of such pipes shall be made. The portions of such pipes extending above the ground surface shall be included. Payment shall be made at the contract unit price for the actual total footage of monitoring wells and screens. Such payment shall constitute full compensation for furnishing and installing the pipes complete, including all labor, pipe, gravel, bentonite, sand, and other supplies unless specifically noted otherwise in Schedule of Payment.

14.6 For drill rig standby time, measurement shall be made to the nearest tenth of an hour of the total time during the Contractor's normal workday, exclusive of the lunch period, in which drilling is delayed by operations of the Engineer only. Payment for this time shall be made at the contract unit price.

14.7 For drill rig operating time, measurement shall be made to the nearest tenth of an hour. Payment for this time shall be made at the contract unit price.

14.8 No modification of contract unit prices shall be made because of variation between estimated quantities and the actual quantities of work performed.

15.0 INDEMNIFICATION

The Contractor agrees to protect, defend, indemnify and save Engineer and Owner harmless from and against all claims, demands and causes of action of every kind and character, without limit and without regard to the cause or causes thereof or the negligence of any party, arising in connection herewith in favor of Contractor's employees, Contractor's subcontractors, or their employees, on account of bodily injury, death, or damage to property.

APPENDIX B

PHOTOGRAMMETRIC SPECIFICATIONS

STATE OF NEW JERSEY

DEPARTMENT OF TRANSPORTATION

PHOTOGRAMMETRIC SPECIFICATIONS

A SECOND DRAFT

DECEMBER, 1983

BUREAU OF DESIGN STANDARDS
AND ECONOMIC DESIGN ANALYSIS
NJDOT, 1035 PARKWAY AVENUE
TRENTON, N.J. 08625

TABLE OF CONTENTS

Section Six - Map Details

SECTION ONE - INTRODUCTION

1.1 Scope and Application

Photogrammetry consists of the accurate measurement of man-made and natural land features through the production and use of aerial photographs and can be supplemented by field edit surveys which compensate for information not otherwise revealed by the photographs.

Once the photographs and related information become available, original map manuscripts can be compiled and final-drafted as maps, plans, related specialized drawings or other graphic representations of land features at the intended scales and contour intervals.

1.2 Project Area

Each project area shall be delineated on a U.S.G.S. sheet or comparable keymap to include the breadth and length of the project and its relationship to the surrounding terrain.

A one-inch wide band at the final map scale encompassing the project area shall also be compiled to insure complete coverage of the area.

1.3 Flying Period

Aerial photography shall be undertaken only when well-defined images can be obtained. Photography shall not be attempted when the ground is obscured by haze, snow, foilage, flooding conditions or when clouds or cloud shadows would appear on more than five (5) percent of the area of any one photograph. At the time of year during which aerial photographs must be taken, shadows caused by topographic relief and low sun angle shall be avoided whenever possible. Aerial photography shall not be undertaken when the sun angle is less than thirty (30) degrees above the horizon.

1.4 Negatives and Photographs

All photographic negatives shall become the property of the State. All photographs shall be clear, sharp, free of blemishes and of good quality in all respects. The scale, date, and project identification shall be evident thereon, and identifying numbers in sequence shall be indicated on all photographs.

The Contractor shall furnish two (2) sets of photographic contact prints on resin-coated paper showing sufficient overlap for stereoscopic study of the project area.

The Contractor shall furnish any additional photographic reproductions on semi-matte double weight paper designated by the State upon examination of the contact prints.

The Contractor shall furnish two (2) copies of a photographic index map of each project area, printed on resin-coated paper, to permit selections of prints on any part of a project in question.

1.5 Responsibility for Control Surveys

The Contractor shall provide all materials, supplies, equipment and personnel required for the satisfactory completion of all control surveys to the accuracies and precisions stipulated by the State. Unless stated otherwise, all field and office work shall be done by the Contractor, and only Professional Surveyors licensed by the State of New Jersey, Board of Professional Engineers and Land Surveyors shall be authorized to perform complete control surveys.

1.6 Basic Drafting Requirements

All maps and plan sheets shall be produced on tracing sheets made of dimensionally stable polyester type plastic having a minimum thickness of four thousandths (0.004) of an inch. Every feature and detail plotted thereon shall be sufficiently clear and accurate so that all subsequent reproductions will show clearly legible nomenclature and symbol definition at the prescribed scale.

The Contractor shall compile all planimetry and topography stipulated by the State onto map manuscripts by stereo-photogrammetric methods at the direct scale and contour interval prescribed by the State. The symbols used to represent planimetric and topographic features shall be in accordance with the Standard Legend utilized by the State.

The map manuscripts shall be available for inspection by the State at all times, and they shall be delivered to the State for field editing and the incorporation of any additional planimetric detail.

The Contractor shall obtain and neatly render on the maps the current names and political subdivision or corporate lines of adjoining states and all counties and municipalities. Also required are the current designations of all Federal, State and County roadways and the names of prominent bodies of water such as rivers and lakes. In addition to being legible and clear in meaning, all names and numbers so rendered shall not interfere with map features.

On projects with flights east and west, map sheets and plan sheets shall commence from the west end with sheet number one and progress eastward. On projects with flights north and south, map sheets and plan sheets shall commence from the south with sheet number one and progress northward.

1.7 Plan Index

The Contractor shall prepare an index of maps or plan sheets on tracing sheets made of dimensionally stable polyester-type plastic having a minimum thickness of four thousandths (0.004) of an inch. The index shall show the positions and relationships of all maps or plans sheets superimposed over a diagrammatic or photographic representation of the entire project. Sufficient data shall be indicated on the index to permit selection of individual sheets.

1.8 Method of Testing and Inspection

The Contractor shall submit one complete set of computations of all ground control data to the State for review before the analytical solution for stereo compilation is begun. The Contractor shall be advised of approval or rejection within thirty (30) calendar days after receipt of the computations by the State.

The Contractor shall submit three (3) blackline or blueline white check prints of each completed final map tracing sheet for review. The State will field-inspect and test the submitted check prints as promptly as possible. The completeness of planimetry and/or topography will be ascertained by means of a thorough field inspection. Contour accuracy will be tested by taking elevations of points crossed by a field traverse. In all cases, the State reserves the right to select the areas to be tested.

When a tracing sheet or check print is rejected based upon its percent of error being greater than the allowable value as stipulated by these Specifications, the Contractor shall review and revise the sheet as required to bring it within the permitted tolerance.

For either the initial or subsequent submissions, the State shall be allowed sixty (60) calendar days for each sheet after the receipt of the check prints for review. The Contractor shall be notified of approval or rejection within this period. If any sheet is rejected, the Contractor shall upgrade it to an acceptable level of accuracy and shall submit three (3) additional prints as before, at his own expense, within thirty (30) calendar days after notification of rejection.

After the initial review and rejection, all additional field inspections, tests or other checks made by the State will be at the Contractor's expense at the rate of one hundred dollars ($100.) per sheet for each additional rejection and subsequent check. All required corrections and resubmitted check prints shall be at the Contractor's expense.

The Contractor shall deliver tracing sheets by items or sub-items when notified of final approval of all tracing sheets by the State, except that, upon special State requests, the Contractor shall deliver a particular tracing sheet of an approved map or plan sheet.

1.9 Completion Time and Priorities

Contact photographs and indexes shall be delivered to the State within ten (10) calendar days after the flying period shown on the Proposal form and Contract, given permissible flying conditions. Failure to complete flying of all items and sub-items within the flying period without advance written authorization shall be cause for annulment of the Contract.

Unless stipulated otherwise by the State, the Contractor shall produce and submit check prints of the first six (6) final map tracing sheets to the State within seventy-five (75) calendar days of the last day of the flying period. Additional check prints must be submitted at the rate of ten (10) sheets over fourty-five (45) calendar days thereafter. Where two or more items are combined in one contract, time allowed will be figured either consecutively or by priority unless specified otherwise. Check prints shall be submitted in sequence.

If the flight of any item is subjected to an authorized delay beyond the flight period for any reason, the last day of the flying period shall, nevertheless, be considered the final date for determining photograph and map delivery dates.

All remaining negatives shall be delivered to the State within thirty (30) calendar days after complete acceptance of all maps covered by the Contract.

All material shall be considered to be in the Contractor's possession until received and acknowledged as such by the State. The Contractor's submission or delivery date will be considered the date of receipt by the State.

1.10 Method of Payment

Payment shall consist of full compensation for all work completed and accepted by the State, for defrayment of all fees and other costs, for performance of extra work and alterations ordered by the State, and for submission and delivery to the State according to the Proposal form, the Contractor, and any subsequent Addenda and Change Orders. The Contract -

specified unit price times the actual quantity of each pay item accepted by the State, or the lump sum of each pay item accepted by the State, or the force account basis when applicable and authorized by the State, shall constitute the basis for payment.

The Contractor may request partial payments for work performed on items with lump sum prices. These requests may be submitted monthly and shall be made on voucher forms supplied by the State. Upon approval, payment shall then be meted out by the State on the following basis: Partial payments shall be equal to ninety percent (90%) of the amount arrived at by multiplying the percentage of work performed to date under the Contract by the lump sum price. The work performed to date shall be recounted in a progress report prepared by the Contractor and submitted to the State for approval.

Final inspection of materials received from the Contractor will be made by the State within ten (10) calendar days after the delivery date. Upon acceptance, the Contractor will be so notified in writing. The Contractor will then be authorized thereby to submit his final voucher.

SECTION TWO - AERIAL PHOTOGRAPHY

2.1 Aircraft and Crews

The aircraft shall be maintained and operated in accordance with the regulations of the Federal Aviation Administration and the Civil Aeronautics Board. The overall aircraft performance shall be adequate for the satisfactory completion of all photography items and sub-items stipulated by the Proposal form and Contract and according to the guidelines and accuracies contained in these Specifications.

Crews having a minimum 400 hours experience in flying precise photographic missions for aerial surveys shall be used. In addition, each crew shall have prior experience (50 hours minimum) with the same type of aircraft to which the crew is assigned.

2.2 Aerial Camera

2.2.1 Minimum Standards

Each camera and its corresponding magazines shall have been calibrated by the U.S. Geological Survey (USGS) within the past three years.

Any camera used on a project shall meet the following minimum standards as set forth by the USGS Calibration Certificate:

1. Radial Distoration: Average distoration for a given field angly is 10 micrometers or less.
2. Resolving Power: Area weighted average resolution is 60 cycles per millimeter or greater.
3. Principal Point of Autocollimation: Lines joining pairs of fiducial (collimation) marks shall intersect at an angle of ninety (90) degrees, plus or minus thirty (30) seconds of arc, and that intersection shall indicate the true location of the principal point of autocollination within twenty-five thousandths (0.025) of a millimeter or less.

4. Filter Parallelism: The two surfaces of all filters used on the camera shall be parallel to within ten (10) seconds of arc.

5. Magazine Platen: The platens of all camera magazines shall not depart from a true plane by more than thirteen (13) micrometers, that is, five ten thousandths (0.0005) of an inch.

6. Stereomodel Flatness: No test point in the stereo model shall have an average departure from flatness of more than twenty-five (25) micrometers at negative scale. The stereomodel flatness test results shall be provided for all camera-magazine combinations upon request.

7. Calibrated Focal Length: The measurement of calibrated focal length shall be accurate to within five thousandths (0.005) of a millimeter.

8. Shutter Calibration: Shutter efficiency shall be at least seventy-five percent (75%). Shutter speeds shall be accurate to within ten percent (10%) of indicated value.

2.2.2 Construction and Installation

Only rigidly constructed, single lens precision cartographic cameras exposing 9" x 9" negatives and having a nominal focal length of six (6) inches shall be used. The camera shall be equipped with a between-the-lens-elements shutter and a vacuum or pressure device for holding the film flat at the instant of exposure. The camera must produce at least four (4) fiducial

(reference) marks on each negative for accurately locating the principal point of the photograph. A total of eight (8) such marks (one in each corner and one on each side of the photographic exposure area) is preferable.

The camera shall be mounted on the aircraft so that all parts are within the outer structure and that the camera is permitted an unobstructed view. The viewing field shall be shielded from gases, oil, and air turbulence, but no window of glass, plastic or other material shall be interposed between the camera lens and the ground to be photographed.

2.2.3 Filter

An appropriate light filter with an antivignetting metallic coating shall be used. The two surfaces of the filter shall be parallel to within ten (10) seconds of arc. The optical characteristics of the filter shall be such that its addition and use shall not cause any unacceptable reduction in image resolution, and they shall not detrimentally alter the optical characteristics of the camera lens.

2.2.4 Fiducial Marks

A minimum of four (4) fiducial marks shall be shown, one at each corner of the format, and they shall be integral parts of the lens cone assembly. A total of eight (8) such marks is preferable with each mark of the second quartet appearing at the midpoint of each side of the format.

All fiducial marks shall produce well-defined images on aerial negatives and on calibration plates so as to permit point plotting on the images with a precision of twenty-five thousandths (0.025) of a millimeter or less.

2.3 Film

2.3.1 Film Type and Size

Only a fine-grain, high sensitivity, high-intrinsic resolving power photographic emulsion on dimensionally stable safety film base shall be used. Out-dated film shall not be used. Unexposed and exposed film shall be stored, handled and processed in accordance with the manufacturer's guidelines. The film shall be suitable for photographic reproductions with sufficient stereoscopic overlap for use in precision photogrammetric instruments to compile planimetric and/or topographic maps and to measure profile and cross section elevations and heights by photogrammetric means.

The film shall yield an image area of nine (9) inches by nine (9) inches for each exposed negative. The leader length and trailer length shall not be less than six (6) feet and three (3) feet, respectively.

2.3.2 Exposure

Film exposure shall be in accordance with the manufacturer's guidelines. The negatives shall be free from light streaks and static marks, and they shall have uniform tone and a degree of contrast permitting land features and ground details to show clearly in dark and light areas and especially so with respect to legibility in shadow areas. Negatives which fail to meet the above requirements may be considered unsatisfactory and be subject to rejection.

2.3.3 Development and Processing

Special care shall be taken to insure proper development and thorough fixing and washing in accordance with the film manufacturer's guidelines. Film shall not be wound tightly on drums and shall not be stretched, shrunk or distorted in any way during processing or drying. Film shall be free from finger marks, dirt or blemishes of any kind. Such defects and flaws which, in the opinion of the State, would interfere with the film's intended purpose, shall be cause for rejection.

2.3.4 Labeling

All exposures shall be labeled to read easily from left to right. The labeling shall be oriented so as to be read in the direction from project beginning to project end.

All lettering and numbering shall be legible and uniform in presentation and shall be rendered in symbols and characters one-fifth (1/5) of an inch in height and shall be executed as follows:

1. First and Last Exposures - The first and last exposures shall be labeled as follows:

   In the upper left-hand corner: Date of exposure, time, focal length, RF scale, and the flight height of the camera (aircraft) above the mean ground elevation or some set datum such as Mean Sea Level.

   In the upper right-hand corner: Project number, flight line number, and the identifying number of the exposure itself.

2. Intermediate Exposures - All intermediate exposures shall be identified in numerical sequence in the direction from project beginning to project end. Exposures shall be labeled in the upper right-hand corner as follows:

> Project number, flight line number, and the identifying number of the exposure itself.

The Contractor shall furnish the negatives on spools in suitable containers. Each container shall be labeled to show the corresponding municipalities and counties, the legislated route designation, photographic scale, date of exposure, and any applicable serial number of the first and last exposure of each strip.

2.4 Photography Methods and Guidelines

2.4.1 Flight Line

The Contractor shall design the flight lines to insure full stereoscopic photographic coverage. In general, flight lines shall be parallel to each other and to the length wise boundary lines of the areas to be photographed.

2.4.2 Weather and Sun Angle

Aerial photography shall be undertaken only when well-defined images can be obtained. Photography shall not be undertaken when the ground is obscured by haze, snow, foliage, flooding conditions, or when clouds or cloud shadows would appear on more than five percent (5%) of the area of any one photograph.

Aerial photography shall not be undertaken when the sun angle is less than thirty (30) degrees above the horizon. Shadows caused by topographic features and sun angle shall be cause for rejection.

2.4.3 Crab

Crab shall not exceed three (3) degrees in any negative. Any two or more consecutive photographs displaying crab in excess of five (5) degrees shall be rejected.

2.4.4 Tilt

Tilt shall not exceed four (4) degrees in any negative. Any two or more consecutive photographs displaying tilt in excess of five (5) degrees is unacceptable. Throughout the entire project, the average amount of tilt shall not exceed one (1) degree. Any tilt in excess of the above criteria shall be cause for rejection.

2.4.5 Overlap

Overlap shall be sufficient to provide full stereoscopic coverage at the area to be photographed. Where there is a change in direction of the flight line(s), photographs taken at the beginning of the next flight line or segment of the same flight line shall give complete stereoscopic coverage of the area contiguous to the forward and back sections.

Overlap shall be provided as follows:

1. Boundaries - All of the area appearing on the first and last negative in each flight line or flight line segment extending over a boundary shall be outside the boundary of the project area. Each strip of photographs shall extend over the boundary not less than fifteen percent (15%) or more than fifty-five percent (55%) of the strip width.

2. Endlap - End_lap shall average not less than fifty-seven percent (57%) or more than sixty-two percent (62%). End-lap of less than fifty-five percent (55%) or more than sixty-eight percent (68%) in one or more negatives may be cause for rejection. However, consideration shall be given if, in the case of a stereoscopic pair, end_lap exceeding sixty-eight percent (68%) was found to be unavoidable in areas of low elevation in order to attain the fifty-five percent (55%) minimum end_lap in adjacent areas of higher elevation.

3. Sidelap - Sidelap shall average thirty percent (30%), plus or minus ten percent (10%). Any negative having side_lap less than fifteen percent (15%) or greater than fifty percent (50%) may be rejected. However, consideration shall be given if the strip area to be mapped is found to be slightly wider than the area which can be covered in one flight strip. In that case, side-lap of up to seventy percent (70%) to take advantage of control is permissible.

2.4.6. Quality of Photography

Photography shall be executed so as to minimize image movement at the moment of exposure. Such exposure and the subsequent processing shall be such that all negatives shall be of high quality in showing all specified planimetric and topographic features at the scale stipulated by the State.

Negatives which are not clear and sharp in detail and in average contrast, and which are not free from static marks, stains and other blemishes which, in the opinion of the State, would interfere with their intended purpose, shall be rejected.

2.4.7. Scale of Negatives

The flight height above the average ground elevation or set datum shall be such that the negatives will yield photographic prints on paper or on dimensionally stable polyester-type plastic or on optically flat glass plates to the scale stipulated by the State. Negatives departing from the intended scale by more than five percent (5%) shall be rejected.

Unless specified otherwise by the State, the flight height shall be six times the value of the intended aerial negative scale. Accordingly, the photography (negative) scales and flight heights, together with the corresponding contour intervals, all recommended for the mapping scales generally employed by the State, are as follows:

Photogrammetry Scale and Flight Height Table

Mapping Scale:	1" = 30'	1" = 50'	1" = 100'	1" = 200'
Contour Intervals:	1'	1'	2'	5'
Photography Scale:	1" = 250'	1" = 350'	1" = 700'	1" = 1,400'
Flight Height:	1,200'	2,100'	4,200'	8,400'

2.5 Photogrammetric Ground Control

2.5.1 Datums

By definition, the horizontal datum is a rectangular plane coordinate system. Unless approved otherwise by the State, the Contractor shall reference all horizontal control to the New Jersey State Plane Coordinate System.

The vertical datum is normal to gravity. Unless approved otherwise by the State, the Contractor shall reference all vertical control to the National Geodetic Vertical Datum of 1929. (Mean Sea Level).

2.5.2 Ground Control Points

Horizontal control points shall be set up as station points in a closed traverse whenever practicable. If field conditions dictate otherwise, control points shall either be tied to the traverse from two different stations or have the angles and distances for single ties measured at least twice. Each control photograph shall be examined carefully in the field to insure that the object described in the photograph is indeed the corresponding object in the field.

Vertical control points shall be set up as turning points on differential level runs. Side shots used for photo control points are not acceptable. Trigonometric leveling is acceptable in lieu of differential leveling if field conditions so dictate. However, all distances shall be measured using electronic distance measuring devices in order to insure that the accuracies listed below can be obtained.

Recommended Accuracies

Standard Error* in Position or Elevation of Each Control Point Shall Not Exceed:

Mapping Scale	Horizontal	Vertical
1" = 30'	0.2 Ft.	0.05 Ft.
1" = 50'	0.3 Ft.	0.07 Ft.
1" = 100'	0.5 Ft.	0.10 Ft.
1" = 200'	1.0 Ft.	0.30 Ft.

*Note: "Standard Error" equals the square root of the following: the sum of the squares of the errors from "n" measurements, and that sum divided by "n".

2.5.3 Targetting Control Points

Control points can either be pre-targetted (prior to flight), or photo-identifiable points can be selected for use upon viewing existing aerial photographs. Unless approved otherwise by the State, the Contractor shall prepare and establish targets in the field for a permanent photographic record to be made by means of aerial photography.

Targets serve to make evident the locations of control points so that the existence and position of each point is easily and accurately discernable when its corresponding image is viewed in an aerial photograph. Targets also pinpoint supplemental control points which enable aerial photographs to be oriented within photogrammetric instruments for use in the stereoscopic compilation of map manuscripts.

Targets shall be placed in the median and shoulder zones of the roadway in question and on flat ground whenever practicable. Steep slopes, sharp ridges and ditches should be avoided. All targets shall be placed on contrasting background to be readily distinguishable in aerial photographs. Each target shall be placed with its center directly over and at the exact elevation of the hub, steel rod, or other appropriate manifestation of the control point in question. The target legs should not slope appreciably from the center.

Normally, target spacing shall be at the interval equal to one-fifth (1/5) the flight height. However, for those projects where the required flight height is 1,200' or less, targets shall be placed so that a least two (2) will appear in the overlap between adjacent photographs. Accordingly, unless approved otherwise by the State and as noted above, the following guidelines for sizes and center-to-center intervals of white targets are recommended:

Design Guidelines for White Targets

Mapping Scale:	1" = 30'	1" = 50'	1" = 100'	1" = 200'
Flight Height:	1,200'	2,100'	4,200'	8,400'
Maximum Interval:	360'	630'	1,260'	2,520'
Target Leg Thickness T:	6"	6"	8"	18"
Leg Length L (Tip to Tip):	2'	3'	5'	10'

The linear dimensions of a black target should be two to three times those tabulated above to allow for image-spread in the aerial negatives.

Target shape shall be in the shape of a symmetrical cross or "T" in that order of preference. The stem of the "T" shall be equal in length to one-half (1/2) the recommended leg length.

Targets shall be prepared by painting or printing them on cardboard, muslin or similar cloth, or they shall be constructed of lime placed on the ground, or they shall be painted on the roadway surface. In all cases, a cross or "T" template shall be used as a guide.

2.5.4. Photo-identifiable Control Points

Upon approval by the State, photo-identifiable control points may be used in lieu of targetting control points. The use of photo-identifiable control points may be authorized if existing aerial photographs are readily available and if the project area is urban or suburban in character where such points would exist in abundance.

Photo-identifiable control points shall be established on permanently fixed objects and shall be of sufficient clarity and definition as to provide the same quality and reliability in aerial photographs as targetted control points. Points that are indefinite or not permanent (e.g. bushes, logs, intersections of roadway centerlines at a large scale, building corners, etc.) are not acceptable.

Photo-identifiable control points shall be maintained at the maximum intervals or less as specified for the placement of new targets with respect to their corresponding flight heights. Such points shall be established in the central zone of the roadway in question and on flat ground whenever practical. In all other respects, requirements for these points shall correspond to the specifications affecting the layout of targetted control points.

SECTION THREE - PHOTOGRAPHIC PRINTS

3.1 Description

3.1.1. Prints.

This item shall consist of photographic prints made from aerial photography negatives.

3.1.2. Types of Prints.

The photographic prints shall be contacts, reductions, enlargements or such combinations thereof as stipulated by the State. The prints shall be made of the base materials as specified hereinafter in Article 3.2.1.

3.2 Materials

3.2.1. Base Materials.

Base materials of prints shall be of resin-coated photographic paper, or of dimensionally stable polyester-type plastic transparent film having a minimum thickness of four thousandths (0.004) of an inch, or as otherwise specified by the State.

3.2.2. Photographic Emulsion.

The photographic emulsion shall be fine grain and have suitable light sensitivity range and contrast for the making of prints on paper or film as specified. An outdated emulsion shall not be used.

3.2.3. Stability of Film and Paper.

Dimensionally stable photographic paper or film shall be used unless approved otherwise. The difference in shrinkage, expansion, or any linear distoration as measured in any two directions after processing and drying, shall not exceed one part in 400 in photographic paper and one part in 1,000 in photographic film. Such evident distoration shall be cause for rejection.

3.3 Requirements

3.3.1. Scale and Size

1. Contact Prints - Each contact print shall have the scale and size of the negative from which it is printed.
2. Enlargements - Each enlargement shall be made to the scale or to the diameters of enlargement specified by the State.

3. Reductions - Each reduction shall be made to the scale or to the fraction of contact size specified by the State.

3.3.2. Processing Quality.

Processing, including exposure, development and fixation, and washing and drying, of all photographic materials shall result in finished photographic prints having a fine grain quality, a normal, uniform density, and such tone and contrast that all photographic details shall show clearly in the dark and light tone areas as well as in areas with intermediate tones. Adequate grades of contact paper and proper laboratory procedures shall be used to achieve the best prints possible. Excessive variance in tone or contrast between individual prints shall be cause for rejection.

Contact prints shall be trimmed to neat and uniform dimensional lines along image edges and shall leave distinct the camera fiducial marks. Prints showing fiducial marks of inadequate clarity and definition, or prints omitting fiducial marks, shall be rejected.

All prints shall be clear and free from chemicals, strains, blemishes, uneven spots, air bells, light streaks or fog, and other defects which would, in the opinion of the State, interfere with their intended purpose. These prints shall be delivered to the State in a smooth, flat and usable condition.

3.3.3. Selection.

Upon examination of the contact prints, the State shall designate the negatives from which additional prints, photographic transpariencies, enlargements, reductions, or whatever combination(s) thereof, in accordance with the Contract requirements.

3.3.4. Labeling.

On the back of each print, whether a contact, reduction or enlargement, and in the same corner and position as the photograph number appears on the image side, there shall be imprinted the following: name and address of the Contractor, the legend "Property, State of New Jersey," and the approximate photographic scale.

3.4 Photographic Index.

This item shall consist of a sequential layout of aerial photographs designed to form a montage of the entire project area in a single overview. This montage is then photographically reproduced in accordance with the scale and format specified by the State.

3.4.1. Photographic Paper and Film.

To insure that photographic reproductions possess the attributes described in Article 3.3.2. for processing and quality, contact print paper with adequate contrast and quality shall be used in making prints to prepare the index, and the film and paper for copying and printing the index shall also have adequate contrast and quality and not be outdated.

3.4.2. Assembly.

The photographic index shall be assembled by stapling together prints made from acceptable negatives without the negatives being masked. The prints shall be trimmed to a neat and uniform edge along the photographic images without removing the fiducial marks.

The photographs shall be matched by overlapping corresponding images along the flight line. The photographs for each adjacent flight strip shall overlap in the same direction. Air base lengths shall be averaged in the course of matching successive pairs of photographic images along the flight line. Parallel and adjoining flight line assemblies shall be adjusted in length as warranted by incremental movement along the flight line, one photograph with respect to another, until all adjacent flight strip images can be matched as completely as is practicable throughout the entire project area. Upon completion, the assembly shall show clearly the film roll number and the identifying number of each photograph.

3.4.3. Labeling and Title Format.

Appropriate notations identifying several important and prominent geographic and cultural features shall appear on the index. The roll number of the film and the exposure number on every tenth (10th) photograph shall be accentuated by the use of a narrow, short-strip overlay of white paper on which the appropriate numbers have been printed. The flight line number shall be noted and accentuated at the end of each strip of photographs. All overlay lettering and numbering shall be neat and readable

on both the index assembly and its photographic copies and shall not interfere with the principal map features or with the symbols, nomenclature and numbers which are not accentuated on the individual photographs. A graphic scale bar shall be shown to denote the average scale of the index.

The legend, "State of New Jersey, Department of Transportation", the project designation with its corresponding location and project limits, the photography scale, focal length, flight height and date, the Contractor's identifying logo, a north arrow, and the graphic scale bar shall all be arranged in title format according to the layout as prescribed by the State. The complete title shall be photographically reproduced together with the index or portions thereof. The lettering of the title, as it appears in final form on the index, shall measure not less than one-tenth (1/10) of an inch in height and shall be clearly and easily legible.

3.4.4. Photographic Copying and Printing.

The assembly of photographs shall be copied onto photographic film so that prints can be made by the contact or projection method of printing at the Contractor's discretion. If the projection method is selected, the scale of the copy negative shall be not less than one-third (1/3) the scale specified for the photographic prints of the index.

Whenever the index cannot be fully copied on one negative, it shall be reproduced sequentially on as many negatives as necessary. Each negative of a segment of the index shall photographically overlap the image on the preceding negative by at least two inches as measured on the final scale of the index.

3.4.5. Size and Scale.

All prints of the index shall be made on dimensionally stable polyester-type plastic having a minimum thickness of four thousandths (0.004) of an inch and measuring twenty-two (22) inches by thirty-six (36) inches.

All such prints shall be made to a scale no smaller than one-half (1/2) the contact scale of the aerial photography, unless otherwise specified by the State.

3.5 Furnishing and Delivery.

The Contractor shall furnish and deliver two (2) sets of contact prints of all exposures on resin-coated photographic paper to the State. The Contractor shall similarly furnish and deliver any additional photographic reproductions so designated by the State.

SECTION FOUR - GROUND SURVEYS FOR PRIMARY CONTROL

4.1 General Description.

Ground control consists of a system of points for a given project whose positions are known and referenced to a ground coordinate system such as the New Jersey Plane Coordinate System and whose images can be positively identified in corresponding aerial photographs. Such control is established by means of field surveys and provides the means for orienting and scaling the photographs to the ground.

4.2 Materials and Equipment.

All materials and equipment required for satisfactorily completing all control surveying work shall be furnished by the Contractor unless stipulated otherwise by the State. Said equipment shall be fully capable of accomplishing the control surveying to the accuracies specified by the State.

4.3 Liaison.

Prior to executing any ground surveys, the Contractor or his authorized representative shall meet with the designated State representatives for the following purposes:

1. To consider the scope of the work and to review the location and suitability of all known existing horizontal and vertical control points in or within the useful proximity of the project area.
2. To set forth and concur on the methods and procedures which will satisfy all the ground control requirements of the Project.

4.4 Ground Control.

All ground surveying and related analytical work required to execute primary or basic control surveys shall be accomplished by the Contractor in accordance with the procedures and accuracies as specified by the State. All control points shall be set from and closed on existing U. S. Coast and Geodetic Survey monuments and bench marks or New Jersey Geodetic Survey triangulation or traverse stations which are the direct result of second or higher order accuracy surveys. All primary or basic control surveys must begin and close on two separate existing control points, or, if approved by the State, shall be closed-circuit in character. Those control points which are used as origin, intermediate check, and closure points shall be points comprising closed primary traverses and closed level circuits. Primary or basic control surveys shall measure accurately each required control point, and accuracy checks shall be made on the surveying work as a whole.

Control points consisting of monuments or station markers and bench marks which are set by the Contractor shall be numbered consecutively from the beginning of the Project to the end for each traverse and level run. Each traverse shall be identified with a letter designation starting with the first letter of the alphabet, and each level run shall receive a letter designation starting with the last letter of the alphabet and working backwards.

Semi-permanent monuments, station markers, and bench marks shall be set along the traverse routes at the minimum rate of one (1) intervisible pair per mile of traverse length. These control points shall not be placed in roadway or shoulder pavement unless such placement has been approved by the State. Control points can also be set by chiseling crosses in concrete structures or rock outcrops.

All monuments or station markers, bench marks and any other control points placed by the Contractor shall be tied and referenced in the field.

4.4.1. Permanent Monuments or Survey Station Markers.

Materials. Permanent monuments or survey station markers in first and second order surveys shall be bronze or brass plugs or aluminum alloy tablets set in iron pipes, in copper-coated steel rods, in concrete monument foundations, or cemented in large solid rocks or boulders. The State shall furnish the Contractor with such plugs or tablets as required. The head of the plugs or tablets will be approximately three inches (3") in diameter. All other necessary parts shall be furnished by the Contractor.

In third-order surveys, permanent monuments and station markers shall be either pins of three-quarter inch (3/4") or more in diameter and not less than two feet (2') long, or they shall be as specified in the preceding paragraph.

Reference marks shall consist of nails or spikes driven into large trees or utility poles or of lead plugs drilled in walls, abutments, solid rock outcrops and like objects which are permanent in character, or they may consist of steel T-bars.

Control. All permanent monuments and station markers and their references shall be set where they will not be disturbed by normal land use. Wherever practicable, such markers shall be placed near some easily recognizable feature and in an accessible location. Such placement shall be preferably established outside future construction sites but within the right-of-way boundaries of the proposed project. At least three (3) references shall be accurately placed so that the markers may be recovered or reset readily on any subsequent field surveys. Ties to the references must be measured with a steel tape so that it will be possible to make an accurate intersection of three pre-determined measurements to facilitate recovering each control point. Such references shall be of the semipermanent type and shall be so located as to be visible from and accessible to the station marker to which it applies. Semi-permanent reference marks may consist of spikes driven into trees, well-established fence lines, and durable marks set in rock outcrops, footings, buildings walls and the like. Where such suitable features

are not available, a steel T-bar, which is no less than three feet (3') long with a special distinctive cap in which the reference cross has been imprinted, shall be set to serve in its place.

In the field notes, the Contractor shall clearly sketch to scale and otherwise describe the surveyed position of each permanent station marker together with its reference data. The Contractor shall also record any azimuth marks for those markers which are not intervisible for subsequent plotting on the maps. The bearing on the New Jersey Plane Coordinate grid shall be noted between each station marker and its adjacent visible markers. The New Jersey Plane Coordinates for each permanent station marker shall also be recorded.

Each existing and new project permanent survey station marker shall be appropriately identified in its correct New Jersey Plane Coordinate position on the maps and shall be numbered, named and/or stationed in the format stipulated by the State. The following data shall accompany the record of each marker on the maps: the number designation, the New Jersey Plane Coordinates and, if a previously existing marker, the contract designation under which it was either set or last reset and was surveyed. Except for the horizontal position and classification number, all identification data for each marker shall be recorded on the maps as marginal inserts.

Each marker position shall be indicated by a symbol in the overlap portion within each aerial photograph of the applicable stereoscopic pair. Said symbol shall consist of a photographic image showing a circle rendered thereon in the correct New Jersey Plane Coordinate position.

A description card shall be prepared containing the following information:

(1) Name, number or station.

(2) Order of accuracy.

(3) New Jersey Plane Coordinates.

(4) New Jersey Geodetic Survey-based elevation, if measured.

(5) Name of Contractor or agency making the control survey.

(6) Date the monument or station marker was set.

(7) Complete description of location and type of marker.

(8) Sketch showing distance, true bearing and New Jersey Plane Coordinate grid bearing to each adjacent station marker, control point and reference point.

4.4.2. Survey Bench Marks.

Materials. Survey bench marks shall be bronze or brass plugs or aluminum alloy tablets either set in iron pipes, copper-coated steel rods, or concrete monument foundations, or cemented in large solid rocks or boulders. Iron or other pins less than three feet (3') long shall not be used. All plugs or tablets shall be furnished by the State; all other necessary parts shall be furnished by the Contractor. The heads of the plugs or tablets shall be approximately three inches (3") in diameter.

When permanent or semi-permanent objects cannot be found to serve as references for bench mark ties, references shall then consist of lead or copper nails plugging holes drilled in either concrete, large boulders or rock outcrops, or three-quarter inch (3/4") or larger diameter metal pins at least three feet (3') long as field circumstances dictate.

Control. All bench marks shall be set where they will not be disturbed by normal land use. Wherever practicable, such bench marks shall be placed near some easily recognizable feature and in an accessible location. At least two (2) references shall be accurately placed so that the bench marks may be recovered or reset readily on any subsequent field survey(s). Ties to the references must be measured with a steel tape so that it will be possible to make an accurate intersection of three set measurements to facilitate recovering each bench mark. Such references shall be of the semipermanent type and shall be so located as to be visible from and accessible to the bench mark to which it applies. Semipermanent reference marks may consist of spikes driven into trees, well-established fence lines, and durable marks set in rock outcrops, footings, building walls and the like. Where such suitable features are not available, a steel T-bar, which is no less than three feet (3') long with a distinctive cap in which the reference cross has been imprinted, shall be set to serve in its place.

The number and New Jersey Geodetic Survey-based elevation of each new project bench mark set by the Contractor shall be

stamped by him on the plug or tablet. All elevations shall be referenced to the National Geodetic Vertical Datum (a.k.a. Mean Sea Level) of 1929.

Existing bench marks serving as origin or closing ties in the ground control surveys may be appropriated as project bench marks whenever they are in position to serve as such. In the field notes, the Contractor shall sketch to scale the position of each existing bench mark used, and he shall record the identifying number and description of that bench mark. The Contractor shall not mark, stamp or otherwise deface or distrub any existing bench mark.

Each bench mark utilized for the project within the mapped area shall be identified on the maps by a symbol in the correct New Jersey Plane Coordinate position. Near that symbol, the identifying number and New Jersey Geodetic Survey-based elevation of that bench mark shall be correctly and clearly recorded. In addition, the position of each bench mark shall also be represented by the same symbol in the overlap portion within each aerial photograph of the applicable stereoscopic pair of such photographs. Said symbol shall consist of a photographic image showing a circle rendered in the correct New Jersey Plane Coordinate position on the photograph.

4.4.3. Semipermanent Survey Station Markers.

Materials. Semipermanent station markers shall consist of either: tacks set in ordinary survey hubs (2" x 18") which have been driven flush with the ground; a cross in a lead or copper nail plugging a

hole drilled in concrete, a rock outcrop or a large boulder; a cross in the top of a 3/4" x 18" T-bar of galvanized steel that has been driven flush with the ground or to a depth of ten inches (10") below the surface of the ground when in an open field; or a metal pipe, 1/2" to 1" in diameter, and 18" to 24" long and solid metal pins, 3/4" or more in diameter, of similar length.

Control. Semipermanent station markers shall be set at as many instrument set-up points in the required surveys as practicable. Where feasible, they shall also be set at points targeted on the ground before photography for certainty in identification of supplemental control points to be used in photographic control during the photogrammetric compilation process.

In the field notes, the Contractor shall sketch to scale and shall fully identify and otherwise describe all semipermanent station markers. These markers shall be survey-tied from primary or basic control survey points to objects that are visible on aerial photographs, or they shall have a suitable photographic target centered over them on the ground before aerial photographs are taken.

Each semipermanent station marker within the mapped area shall be appropriately identified on the maps and shall be stationed or numbered in the format stipulated by the State. Such identification shall be with respect to the New Jersey Plane Coordinate System.

4.4.4. Primary Horizontal Control.

The Contractor shall establish at least one primary closed traverse and/or triangulation or trilateration network as needed throughout and generally parallel to the longer dimension of the Project. Unless specified otherwise by the State, the traverse closure shall not exceed the lesser of either one part in twenty thousand (1:20,000) of the total traverse length, or 1.67 feet times the square root of the total traverse length in miles.

Each and every horizontal control station shall be an integral part of its respective traverse, and all such stations shall be so set upon with angular and distance measuring equipment that each angle and distance is observed directly from station to station and not computed from an alternate point. Each control station is set in the field with a semi-permanent station marker consisting either of a tack on top of an ordinary survey hub sized 2"x2"x18" which is driven flush with the ground or of a cross marked on a nail plugging a hole drilled in a concrete structure or rock outcrop, as field circumstances dictate.

All station markers shall either be intervisible or require that an azimuth mark be established for each non-intervisible station marker. The azimuth mark shall be placed between three hundred feet (300') to one thousand feet (1,000') away from the station marker to insure that a bearing determined by an instrument set over the marker and sighted on the azimuth mark shall not vary from the true bearing by more than fifteen seconds (15") of arc.

Cultural features which are permanent, suitable and easily identifiable shall be acceptable as azimuth marks. If such objects are not available, azimuth marks shall be identified as such from spikes driven into large trees and poles, metal plugs in drilled holes and crosses chiseled in concrete structures and rock outcrops, as field circumstances dictate.

All primary horizontal control points and stations shall be field-referenced with at least three (3) well placed ties.

All angles shall be turned with a one-second direct reading Theodolite, and approved methods shall be employed to guarantee the following results:

The angular difference between the highest and lowest angle formed by the pointings shall not be greater than six (6) seconds. The angular adjustment at azimuth check points shall not exceed lesser of ten (10) seconds times the number of stations used for carrying azimuth, or three (3) seconds per station.

All horizontal control positions shall be adjusted to the North American Datum of 1927, and New Jersey Plane Coordinates shall be computed for each horizontal control point. All azimuths shall be ascertained and recorded with respect to the New Jersey State Plane Coordinate System grid lines unless an alternate reference system is approved by the State.

4.4.5. Primary Vertical Control.

The Contractor shall establish at least one primary closed level circuit as needed throughout and generally parallel to the longer dimension of the Project. Each level circuit shall be established by following conventional procedures of differential leveling. No trigonometic leveling shall be permitted, and no "spur" or "hanging" vertical points shall be accepted.

All primary or basic vertical control shall be extended from and closed on United States Coast and Geodetic Bench Marks of seconds or higher order accuracy and shall be of third order accuracy. All vertical control positions shall be referenced to the Mean Sea Level Datum 1929 Adjustment, unless approved otherwise by the State. All vertical control circuits required for the Project other than the primary circuit (s) shall begin and close on the level network of primary elevation control set and surveyed by the United States Coast and Geodetic Survey unless approved otherwise by the State.

Semi-permanent bench marks shall be set at the approximate rate of one for each mile of bench level route and shall not be set further apart vertically than two hundred (200) feet difference in elevation. Such bench marks shall be of second order accuracy unless specified otherwise by the State.

At least two (2) well-placed ties shall be required to field-reference each vertical control point established by the Contractor.

Second-order Vertical Accuracy shall be defined as having a minimum error vertical closure of Thirty-five thousandths of a foot (.035) times the square root of the length of the level circuit in miles. All branch level lines shall be properly adjusted to minimize if not to eliminate any error contained therein.

4.5 Survey Traverse for Cadastral Surveys

This Article shall apply when cadastral (property boundary) surveys are required in conjunction with the compilation of large scale maps. Cadastral surveys are to be tied in with ground surveying to the primary control points as represented by station markers. These markers comprise the primary control traverse to be surveyed and shall otherwise be intervisible and spaced as specified by the State.

In areas where the width of the survey area is increased, additional traverses shall be surveyed as needed. Wherever multiple flight strips are essentail for accomplishing the required mapping, a traverse shall be surveyed lengthwise along the approximate center of each strip. All such traverses shall be executed as closed traverses within the primary horizontal control of the Project.

All resulting survey data shall be noted and drawn on the map (s) and shall include each instrument point, each survey origin/closure set of ties to primary control, and the distances and New Jersey State Plane Coordinate bearings of each traverse segment. Closure ties shall either be shown to scale at their location on the map (s) or they shall be marginal inserts

wherever their corresponding principal control points lie outside the mapped area. Each control point and each instrument point shall be plotted accurately and designated by its New Jersey State Plane Coordinates.

4.6 Locating Monuments on Maps

The location of each monument set and otherwise utilized by the Contractor shall be indicated on the maps in conjunction with its corresponding identifying data: number designation, its New Jersey Plane Coordinates, the elevation, if any, and information tieing the monument to a primary survey line or other appropriate field established reference (s) to facilitate future recovery. Except for showing to scale the positions of those monuments actually situated within the areas covered by the maps, all annotations shall be recorded in marginal inserts. Whenever existing control monuments are taken from previous mapping contracts, whether prepared for the State or another agency or client, the original contract project designation and its corresponding "as-built" data shall be noted on the maps.

4.7 Supplemental Control Surveys

Whenever supplemental control is to be established from ground surveys, the Contractor shall execute those surveys so that corresponding aerial photographs can be correctly positioned and oriented onto precision photogrammetric mensuration instruments. These instruments shall be capable of providing measurements to a precision of one (1) micrometer, and they shall be so calibrated over the measuring range of the Project to an accuracy sufficient to achieve a root mean square error of no more than two (2) micrometers. The Contractor shall utilize only fully analytical aerial triangulation methods to establish supplemental photo control. Semi-analytic or analog methods shall not be permitted.

SYN 001 2292

4.7.1 Horizontal Control

A minimum of three (3) horizontal control points is required for each stereoscopic model although a fourth point is recommended as a check, and these points shall be as far apart as is feasible within each model. Each model point shall be an image of an existing object in the field, or it shall be part of a finite photographic pattern which is readily identifiable on the ground and in the photographs, or it shall be the photographic target of a station marker. The X and Y coordinates of horizontal control shall be computed subsequently for each supplemental control point with respect to the New Jersey State Plane Coordinate System.

4.7.2 Vertical Control

In each stereoscopic model, there shall be at least six (6) vertical control points, one of which shall be near the center of the model and approximately half way between the principal point of the first aerial photograph and its corresponding image on the adjacent photograph. The other four points shall be spaced for optimum use of the model and preferably in or near each corner of the model. Wherever cross sections are to be measured photogrammetrically, there shall be at least three (3) additional vertical control points spaced appropriately throughout the measuring and mapping area of each model. The elevation (or Z coordinate) of vertical control, as referenced to the Mean Sea Level Datum of 1929, shall be ascertained for each supplemental point.

4.7.3 Supplemental Photo Control

If so elected by the Contractor, analytical aerotriangulation methods may be employed to generate supplemental control points and to compute the required corresponding coordinate data.

The process is initiated with the precise marking of glass photographic diapositives to be used for mapping compilation at those locations where supplemental control is required. All point marking shall be done using a precision stereoscopic marking device. Such marks shall not be smaller than forty (40) micrometers nor larger than one hundred (100) micrometers, appropriate in size to the scale of the photographs and the stereoscopic plotting instruments. Marks shall be drilled clearly through the emulsion of the diapositive, and excess waste shall be removed carefully from the surface prior to the mensuration operation.

Each diapositive shall be placed in a mono or stereo comparator which shall then be used to measure the locations of the supplemental control points and the field surveyed control points relative to the photo-coordinate system formed from the fiducial marks on that diapositive. The measurements of both sets of control points, the X, Y and Z ground coordinates of the field surveyed control points, and the camera calibration data, shall be entered together into a computer which will then generate the ground coordinates for the supplemental control points.

The computer software utilized shall contain a fully analytical block aerotriangulation program. As a minimum, this program shall incorporate the capability to give appropriate weight factors to the control points on an individual basis and to correct for film deformation, atmospheric refraction, earth curvature and lens distortion.

4.8 Documentation

4.8.1 Field Notes

The field notes of all horizontal and vertical control surveys shall be fully indexed and kept in securely bound notebooks. The notes shall be uniform in character and recorded in such a manner as to be easily and correctly interpretable by anyone having a knowledge of surveying. In addition, each page of field notes shall contain the Project designation, the names of the survey crew personnel, the date of the survey, a brief description of weather conditions, and a record of the field book number and page number.

The field notes shall contain descriptions and sketches of the existing primary control used for origin and closure as well as data on the primary and supplemental control of the entire Project. The results of the primary control survey (s) executed by the Contractor shall be accurately tabulated and adjusted to conform with the requirements specified by the State under Articles 4.4.1 and 4.4.2 of these Specifications. These notes shall be subsequently transferred onto reproducible sheets for inclusion in the control report.

Upon completion of the work, the Contractor shall forward all field notes and all computation and adjustment sheets to the State.

4.8.2 Control Report

The Contractor shall prepare and furnish to the State two (2) bound copies of a control report containing all the pertinent data on primary control for the Project. The control report shall be prepared on 8½"x11" sheets and shall consist of a narrative section, a copy of the computation and adjustment sheets, the descriptions and sketches of

all control points and their field ties together with references to the control network for the entire Project, and a control diagram index drawn approximately to scale and covering the entire Project in a single overview.

The original computations and adjustments and the original descriptions and sketches shall be prepared on 8½"x11" sheets and furnished to the State in a separate bound report.

Narrative The narrative section shall clearly and concisely report on the existing primary control utilized for the origin and closure of each primary traverse and level circuit established by the Contractor. A clear explanation shall also be provided covering the methods used to produce the Project primary control survey in conjunction with the closure ties, the actual closures achieved, and the manner in which the closure errors were distributed within the adjustments. Relevant details shall be correlated with the control diagram and the information contained therein where appropriate.

Control Diagram The control diagram shall complement the narrative section of the control report. It shall be prepared to a scale no smaller than two thousand feet to the inch (1" = 2,000') and shall show clearly the arrangement of the existing and Project primary controls. The control diagram may be rendered on an existing topographic or other key map as a base plan for plotting each control point, or it may be prepared separately as a sketch. The control diagram shall consist of the following:

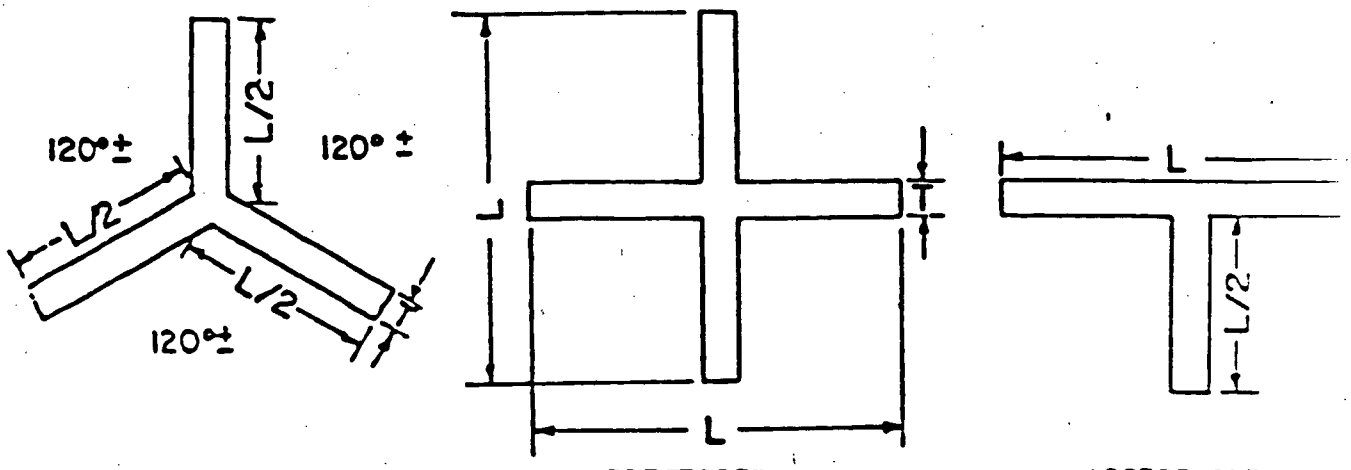
(1) Where applicable, the actual boundaries of the separate map sheets shall be drawn on the control diagram and referenced thereon according to the ~~map~~ sheet numbers assigned to them for the Project;

(2) The existing primary control points situated in or accessibly near the Project area and recovered for use as origin and closure points;

(3) All azimuth marks and their locations, as well as all station markers and bench marks used to establish any and all traverses, triangulation and trilateration nets, and all bench marks and level circuits; and

(4) An appropriate title and legend for the Project designation, a north arrow showing the direction of orientation of the control diagram, the symbols used, and a graphic scale applicable to the control diagram.

RECOMMENDED TARGET SIZE



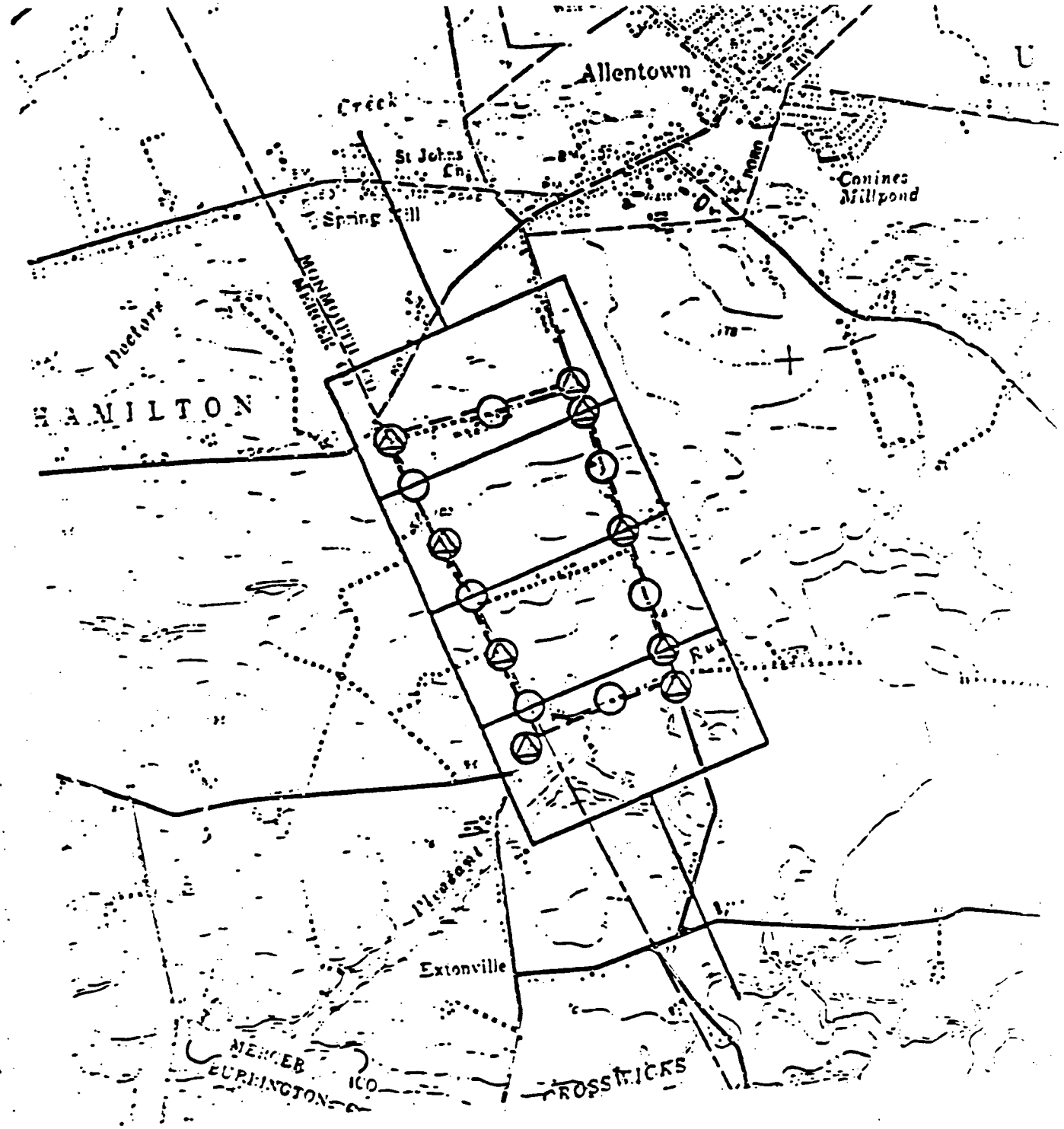
ACCEPTABLE PREFERRED ACCEPTABLE

Photography Scale And Flight Height Guidelines

Mapping Scale:	1" = 30'	1" = 50'	1" = 1000'	1" = 200'
Contour Intervals:	1'	1'	2'	5'
Photography Scale:	1" = 250'	1" = 350'	1" = 700'	1" = 1,400'
Flight Height:	1,200'	2,100'	4,200'	8,400'

Design Guidelines for White Targets

Mapping Scale:	1" = 30'	1" = 50'	1" = 100'	1" = 200'
Flight Height:	1,200'	2,100'	4,200'	8,400'
Maximum Interval:	360'	630'	1,260'	2,520'
Target Leg Thickness, T:	6"	6"	8"	18"
Leg Length, L (Tip to Tip):	2'	3'	5'	10'



⊙ — Target for Horizontal & Vertical Control

○ — Target for Vertical Control Only

TYPICAL TARGET PLAN - FULL FIELD CONTROL

SYM 001 2299

SECTION FIVE - PHOTOGRAMMETRIC MAPPING

5.1 Compilation

The Contractor shall compile one or more maps, consisting totally or in part, of map manuscripts, base plans, profiles, cross sections, or such comperable engineering documents as may be stipulated for the Project by the State. Compilation shall be accomplished by employing a precise stereoscopic plotting instrument in which sequential exposures of aerial photographs are precisely oriented to form a three-dimensional optical model, ~~which viewed through the instrument's binocular eyepieces~~. From this model, the Contractor's photogrammetrist shall sight on and trace planimetric and/or topographic features which the plotting instrument shall then render automatically onto a map manuscript at the horizontal and/or vertical scale (s) specified by the State.

5.2 Area

The area to be mapped shall be as outlined on the Project key map and shall include any revisions or increases, or exclude decreases, as may be subsequently specified by the State while the mapping is in progress.

5.3 Map Manuscript

Map manuscripts shall be drawn on sheets made from a dimensionally stable polyester-type plastic having a minimum thickness of ~~three~~ four thousandths of an inch (0.00~~3~~4"). All map detail shall be clearly and accurately depicted so that the manuscript shall be capable of producing finished maps which fulfill all specificati requirements. All manuscripts prepared under this Project shall be available for inspection by the State at all times. Reproducible sepia or mylar copies of the manuscripts shall be submitted to the State prior to finalizing by the Contractor for such field editing and selection of additional labeling of planimetric detail as the State may require. The manuscript scale and the scale of the finished maps shall be the same.

5.4 Topographic Maps for Design

5.4.1 Plane Coordinate Grid Lines.

Grid lines representing the New Jersey State Plane Coordinate System shall be delineated on all map manuscripts and finished maps. Grid lines shall be drawn as solid lines at a spacing of five inches (5"). Numerical values for grid lines shall be labeled at the top, bottom and sides of each sheets, approximately one inch (1") inside the border and immediately adjacent to their corresponding grid lines.

Whenever the State stipulates that ground control surveys shall not be tied to survey monuments of the New Jersey State Plane Coordinate System, an alternate system of plane coordinates shall be established by the Contractor, subject to approval by the State, and it shall be made readily distinguishable from the New Jersey State Plane Coordinate System.

5.4.2 Match Lines, Title Blocks and North Arrows.

Match lines shall be provided on all map sheets so that each sheet may be joined accurately to those adjacent.

A title block shall be placed on each map sheet to the size and layout as required by the State.

A New Jersey Plane Coordinate north arrow shall be suitably placed and oriented on each map sheet.

5.4.3 Currency of Data.

All maps prepared by the Contractor shall be up-to-date with regard to all planimetric and topographic features as of sixty (60) days prior to the acknowledged date of delivery to the State.

MAP SCALE STRINGERS, all

finished maps shall contain the planimetric features which are identifiable on and interpretable from corresponding aerial photographs. Such features shall include, but not necessarily be limited to the following: buildings, commercial agricultural fields, orchards, cemeteries, parks, golf courses and other recreational areas; utility transmission lines, poles, towers, fence lines and logged-off areas, roads, railroads, billboards, underground cables, pipelines, sewers and other utility facilities; quarries, borrow pits, ledge rocks, cliffs, wooded areas, individual trees and decorative shrubs that can be recognized as such at the specified scale, rock and other walls; swales, creeks, rivers, tributary systems, canals and channels, ditches, reservoirs and ponds, pools, wells, falls, aqueducts, lakes, the ocean, bays, swamps, bogs, marshes, floodplains, fords, ferry slips and any other pertinent details of land features.

Each water course and drainageway shown on the map shall be an accurate depiction of its actual counterpart in the field. All such water courses shall be denoted by a dash-and-three-dot symbol in all well-defined drainage features as indicated by the contours. Streams and drainage ditches averaging more than one-tenth of an inch (0.10") wide at map scale shall be shown by two symbolized lines spaced and properly delineated in correct position to represent the respective water edges; all other streams and ditches shall be represented by a single symbolized line. All water courses shall be stopped at a distance of one hundred feet (100') from the ridge lines, and water courses under two hundred feet (200') in length or which measure less than one inch (1") at map scale, need not be shown.

SYN 001 2302

Buildings, bridges and similar dimensionable objects shall be correctly outlined and oriented, and they shall be drawn to actual scale size except that horizontal dimensions smaller than representable by one tenth of an inch (0.10") at map scale shall be symbolized at one tenth of an inch (0.10") in size. Minor irregularities in building outlines not representable by one twentieth of an inch (0.05") at map scale shall be ignored. Large buildings such as schools, institutions, barns, warehouses, factories and industrial plants should be cross-hatched for clarity.

Structures such as bridges, trestles, tunnels, piers, warves, smokestacks, silos, towers, abutments and wingwalls, retaining walls, viaducts, dams, power plants transformer and other substations, transportation terminals and airfields, oil, water and other storage tanks, petroleum refineries and any other such items shall be shown.

All corporate (city, township, county, state and any other political subdivision) lines shall be shown. The Contractor shall be responsible for ascertaining the current and correct locations of these lines and accurately delineating them onto their corresponding maps. The same responsibility shall apply to rivers, streams, railroads, all State, Federal, Interstate and County roadways, principal travelled streets and other features of comparable importance.

Curbed roadways shall be shown with pairs of solid lines spaced at one fortieth of an inch (0.025") at map scale, representing the curbing, and defining each roadway edge where curbing exists. All uncurbed paved roadways without shoulders shall be shown with single solid lines defining each pavement edge. Uncurbed roadways with shoulder areas shall be represented with uniformly dashed lines denoting the pavement edge wherever shoulder pavement is encountered. Trails shall be indicated by a single, uniformly dashed line representing the centerline of each trail.

SYN 001 2303

On maps to scale of 1" = ~~100'~~ 50' or larger, there shall be shown where they occur, in addition to all the aofrementioned land use features, parking strips and lots, driveways, hydrants, gasoline pumps and islands, manholes, inlets and catch basins, water and gas meter box covers, culverts, wells, distinct hedges, ornamental bushes and shrubs, trees, signs, steps, lamp posts, luminaires, traffic signals and their corresponding control boxes, junction boxes, below-ground pools and fountains, large, permanent-type above-ground pools and any other such features if identifiable on aerial photographs.

The outlines of wooded areas shall be carefully and accurately delineated and shown in correct position. Special care shall be given to show tree lines adjacent to roads, railroads and prominent water courses. The cleared widths of overhead transmission line Rights-Of-Way shall also be shown in correct position.

5.4.5 Topographic Details.

When topographic maps are required by the State, such maps shall contain all representable topographic features so designated by the State which are identifiable on or interpretable from the corresponding aerial photographs. Where they occur, such features shall include, but not necessarily be limited to the following: all drainageways of draws, creeks, rivers and tributary streams, springs, falls and rapids, ponds and lakes, swamps, marshes, bogs and floodplains; also any ledge rock cliffs and other topographic features which the State shall require for layout and design purposes shall be represented on the maps.

On maps whose scales are 1" = 100' or larger, there shall be shown and identified as such where they occur, large surface boulders and rock outcrops protruding from the ground, correctly located and outlined, whose minimum representable plan view dimensions at map scale are no less than one-tenth of an inch (0.10") in size. Their heights above ground shall also be indicated.

Contours. Within accuracy requirements, contours shall be delineated to represent the exact shape of the ground and its true elevation above Mean Sea Level. Solid line contours shall be shown on the final maps in all areas where the ground can be clearly seen on the three-dimensional optical (stereoscopic) model. When the ground is obscured, the Contractor either shall show the corresponding contours with dashed lines, or he shall utilize spot elevations as determined photogrammetrically in locations where the ground is visible.

Spot Elevations. Photogrammetrically ascertained spot elevations shall be shown on the final maps in proper position at water level on the shorelines of pertinent bodies of water, on hilltops, in saddles, at the low point of depressions, the at-grade intersections of principal travelled ways such as highways, main streets, railroad crossings and the like, and on the centerline at each end of bridges and other comparable structures. Where contours are more than three inches (3") apart at final map scale, spot elevations shall be shown at sufficient intervals so that they are not separated by more than two inches at final map scale from the nearest spot elevation or contour.

Underground Utilities. When required by the State, the Contractor shall research all data on any underground utilities within the project limits and shall show them on the corresponding maps as to type, size and location. Such utilities may include, but not necessarily be limited to cables, and conduits, drainage basins, pipelines, subway systems, underground septic, fuel and other storage tanks, runoff and sewer systems whose recorded invert elevations shall be accurate to the nearest tenth of a foot (0.10'), and any springs, wells and reservoirs, denoting type, size and location. A reference providing the source of data of all underground utilities shown on each sheet shall be reported along the lower edge and inside the border of that sheet.

SYN 001 2305

Drainage. The following data shall be obtained in the field and shown on the maps for all drainage system structures: type, size, material, inlet and outlet invert elevations. With the exception of flowline data, the same data shall be obtained for all pertinent bridge and drainage system structutes situated beyond the project limits which would still influence the design of the proposed roadway structures. All invert elevations shall be accurately ascertained and recorded on the maps to the nearest tenth of a foot (0.10').

5.4.6 Plan Production Specifications.

All maps required by the State shall be rendered on reproducible sheets consisting of dimensionally stable polyester-type plastic having a minimum thickness of ~~three~~ four thousandths of an inch (0.00~~3~~4").

Layout Prerequisites. On projects with east-west flights, the corresponding map sheets shall begin at the western terminus of the project and be numbered consecutively from west to east. On projects with north-south flights, the corresponding map sheets shall begin at the southern terminus and be numbered consecutively from south to north.

The Contractor shall prepare the map manuscript stipulated by the State in such a way that all weights and gauges of symbols, size and style of type and/or lettering arrangement, and all treatment of marginal annotations, sketches and diagrams incorporated thereon shall conform to the prerequisites set forth in these specifications. Such compilation maps shall serve as source documents for the preparation of base maps which shall be sufficiently lucid and reliable and which otherwise shall fulfill all specification requirements so that all subsequent contract prints made there from shall contain neat, legible nomenclature and precise symbol definition at the prescribed scale.

SYN 001 2306

Professional standards of draftsmanship shall be maintained throughout the preparation of all map and plan sheets. Each line, whether solid or symbolized in format, shall be uniform in width and tone for its entire length. The width of fine lines shall not be less than one two-hundredth of an inch (0.005"), and that of heavy lines shall not be greater than one twentieth of an inch (0.050"). All ground features representable with lines and symbols shall be drawn or scribed with the aid of a straight-edged, curved or other specialized template where appropriate. All graphic representations employed to denote major ground features shall be in accord with the standard map symbols and plan nomenclature adopted by the State.

Contours. Where required by the State, all contour lines shall be uniformly drawn or scribed as a solid line except for those areas where the ground is obscured in the aerial photographs. In such ground-hidden places, the contours shall be represented by uniformly dashed lines having the same thickness as solid line contours. In addition, the Contractor shall make use of photogrammetrically ascertained spot elevations at any locations where the ground is visible in the aerial photographs. Contours shall not be drawn or scribed through letters or numbers which are smaller than a quarter of an inch (0.25") in height at map scale.

To render index contours distinguishable from intermediate contours, every fifth contour shall be drawn or scribed as a heavier line, solid or dashed where appropriate. Each resulting index contour shall be identified and labelled according to its actual elevation above Mean Sea Level. Whenever index contours are closer to each other than a quarter of an inch (0.25") at map scale and the ground between them is a uniform slope, intermediate contours may be omitted. But the intermediate slope is not uniform, such an omission will not be permissible and the contours are shown at changes in ground slope.

Lettering. The current and correct names of corporate and political entities, prominent water courses, principal roadways and streets, railroads, major schools and institutions, parks, cemeteries and other ground features of like importance shall all be ascertained by the Contractor. All such names, numbers and any accompanying notes and references shall be professionally lettered onto the maps. The same care shall be given in lettering all official highway designations, existing utility lines, invert elevations, grid line coordinates, baselines, monuments, bench marks and related station markers. All lettering shall be neat and clear in meaning and shall not obstruct any map features or symbols.

Inspection and Editing. All map manuscripts and finished maps shall be available for inspection by the State at all times. When required by the State, said maps shall be delivered to the State for field-editing. The size and type of all planimetric features identifiable from aerial photographs, and the size, type and location of such features not identifiable on or discernable from aerial photographs, shall be furnished by the State for incorporation onto the maps prior to finalization by the Contractor.

5.4.7. Finished Maps.

All finished maps shall be rendered on dimensionably stable polyester-type plastic having a minimum thickness of ~~three~~ four thousandths of an inch (0.00$\frac{4}{}$"). Such maps shall be reproducible by any of the standard printing processes so that lines, all other map detail and descriptive material will be neat, clear and legible. These map sheets shall be approximately 4.5 ft. long by 2.5 ft. wide between the inside border lines unless prescribed otherwise by the State. On the other hand, for a given project, the State may direct that the maps be prepared in rolls of various lengths with a 30 in. maximum width.

On the top and bottom edges and on the right end, there shall be not less than a one half inch (0.50") margin; on the left end, not less than one inch (1.00"), unless the marginal dimensions are specified otherwise by the State. On large projects where the finished maps are numerous, the sheets shall be oriented on a north-south, east-west block layout, if practical.

The State shall provide the information that is to appear in the title box of each sheet; in turn, the Contractor shall submit a sample sheet to the State for review containing all margin borders and title box data. The Contractor shall also submit an overall sheet layout of the entire project for review showing the orientation and location of each final map prior to the commencement of work on the final map sheets.

5.4.8. Index Maps.

An index map shall be prepared to show the position and orientation of each map sheet in the project with respect to all other map sheets. All map sheets shall be diagrammatically represented by the Contractor on one index sheet at a scale commensurate with the size of the index sheet specified by the State.

The index map shall show all main roadways, coordinate grid lines, and sufficient information to permit a visual recognition of the location and orientation of the entire project with respect to the surrounding terrain. Data shall also be adequate thereon to permit the selection of individual sheets.

The index map shall be rendered on dimensionally stable, polyester-type plastic base a minimum thickness of ~~three~~ *four* thousandths of an inch (0.00$\frac{4}{}$"). It shall be reproducible by any of the standard printing processes so that lines, all other map detail and descriptive material will be neat, clear and legible.

On the top and bottom edges and on the right end, there shall be not less than a one half inch (0.50") margin; on the left end, not less than one inch (1.00") unless the marginal dimensions are specified otherwise by the State.

5.5. Map Accuracy Specifications

5.5.1. Horizontal Accuracies.

Planimetry. Ninety percent (90%) of all planimetric features which are well-defined on the aerial photographs shall be plotted so that their positions on the completed maps shall be accurate to within at least one fortieth of an inch (0.025") of their true positions, and none of the features shall be misplaced on the finished maps by more than one twentieth of an inch (0.050") from their true positions. Such true positions shall be ascertained by executing precise field surveys which originate and close on station markers established from the primary ground control survey(s).

Grid Lines. The plotted position of each plane coordinate grid line shall not vary by more than one hundredth of an inch (0.01") from its true location on the corresponding map manuscript.

Horizontal Control. Each horizontal control point shall be plotted within the plane coordinate grid in which it should lie to an accuracy of one hundredth of an inch (0.01") of its true position as pinpointed by the corresponding plane coordinates.

5.5.2. Vertical Accuracies.

Contours. Ninety percent (90%) of all elevations derived from solid-line contours shall not deviate from true elevation by more than half a contour interval; the remaining ten percent (10%) shall be accurate to within a whole contour interval. In checking elevations taken from the contour map, the apparent vertical error may be decreased by assuming a horizontal displacement of one-fortieth of an inch (0.025").

In areas where the ground is obscured when consecutive aerial photographs are viewed stereoscopically through a photogrammetric instrument, contours shall be plotted as accurately as conditions permit. In places where the ground is visible, any photogrammetrically measured spot elevations shall be fully utilized in establishing such contours whenever possible. Contours generated under these conditions shall be represented by uniformly dashed lines.

Spot Elevations. Ninety percent (90%) of all plotted spot elevations shall be accurately positioned to within one fourth a contour interval; the remaining ten percent (10%) shall be accurate to within half a contour inter

5.5.3. Special Requirements.

The State may require that all stipulated planimetric and topographic feat be delineated and otherwise plotted on the maps, regardless of whether they can or cannot be seen on the aerial photographs when viewed through a photogrammetric instrument. In this case, the Contractor shall complete compilation of the required maps by executing and utilizing the notes fro ground field surveys in order to comply with the contract specifications.

SYN 001 2311

SECTION SIX - MAP DETAILS

6.1 Two Hundred (200) Scale, Five-Foot (5') Contours

6.1.1. Scale.

The final scale shall be one inch equals two hundred feet (1" = 200'). There shall be a difference of five feet (5') between intermediate contours, and a difference of twenty-five feet (25') between index contours.

6.1.2. Map Sheet Requirements.

The final map sheet shall be prepared using a dimensionally stable, polyester-type plastic having a minimum thickness of ~~three~~ four thousandths of an inch (0.00~~3~~4"). Each sheet shall be not more than 5 feet - 0 inch long and 2 feet - 6 inches wide between the outside borders. The gross width shall be uniform for all sheets, and the gross length shall be uniform for each item or sub-item and one inch longer (½ inch margin on each end) than the net length of the longest sheet as indicated on the Item Map. The net width shall be 26½ inches unless specified otherwise. When inside border lines of consecutive sheets are at right angles to the base, they shall be shown as match lines. Otherwise, match lines shall be provided so that each sheet may be joined accurately to those adjacent. In either case, the words, "Match Line to Sheet No. _____ of _____" shall appear along the outside of the match line

6.1.3. Contents.

General. Each map sheet shall show all the cultural features in accordance with the attached MAP SCALE STANDARDS - PLANIMETRIC DETAIL sheets where applicable to the 1" = 200' scale maps. It will be the Contractor's responsibility to show each required cultural feature in the position, orientation, shape and dimensions on the map sheet according to the following specifications:

SYN 001 2312

Buildings with one or more horizontal dimensions of 50 feet or more shall be drawn to scale. Buildings with one or more horizontal dimensions of 25 to 50 feet shall be shown 25 feet by 25 feet. Buildings with one or more horizontal dimensions of 15 to 25 feet shall be shown 15 feet by 15 feet. Buildings with no horizontal dimension greater than 15 feet need not be shown. The common walls of attached buildings of varying heights shall be shown.

As an aid to orientation, all fence lines, walls and hedges which are identifiable as such on the aerial photography and which are not adjacent to highways, streets or trails, shall be shown as the physical limitations of the map sheet permit.

Roads shall be shown with solid lines defining each pavement edge and spaced the distance between curbs, hard surface edges or travel path, as the case may be. Trails shall be indicated by a single, uniformly dashed line representing the centerline of each trail.

Power-transmission or communication lines, which are constructed on private Right-Of-Way and are cross-country in nature, shall be shown. Where identifiable as such, towers and utility poles shall also be shown.

Drainage. When so defined by the contour layout, drainage lines shall be shown by a dash-and-three-dot symbol in all drainage features when such features are at least one quarter of a mile (0.25 mile) in length. All drainage lines shall be stopped at a distance of at least one hundred feet (100') from the ridge lines. Streams averaging more than twenty-five feet (25') wide shall be

represented with double lines in the form of dash-and-three dot format, one line for each shore. The shoreline of small ponds shall also be represented by this symbol, and the interior of these ponds shall be shown lightly cross-hatched. Large ponds, lakes, reservoirs and the like shall be lightly cross-hatched one inch inside the shoreline. Where drainage is known to exist which would otherwise be indicated by depression contours, any culverts or comparable drainage structures which can be identified as such on the aerial photographs, or are otherwise known to exist, shall be shown on the map.

Relief Datum shall be Mean Sea Level, and relief shall be shown by five-foot (5') contour lines. Each twenty-five foot (25') contour shall be accentuated and numbered with its corresponding elevation above Mean Sea Level. Elevations of all saddles, high and low spots, road intersections, railroad and roadway intersections, shall be shown to the nearest foot (1.0'±). In depressions where drainage is indicated by structures, the contours shall not be shown as depression contours.

Coordinates Grid lines shall be shown as continuous solid lines from inside border to inside border at 1,000 foot intervals. They shall conform to the criteria of the New Jersey Plane Coordinate System and shall be labeled at the top, bottom and sides of each map sheet approximately one inch inward from the inside border. The plotted position of each New Jersey Plane Coordinate grid line shall not vary from the true grid position by more than one hundredth of an inch (0.01") on each manuscript.

SYN 001 2314

6.1.4. Accuracies.

Cultural Features Except for symbolized buildings, the plotted positions of 90 percent of the cultural features shown shall be within five feet (5') of their actual corresponding position in the field as located with respect to the New Jersey Plane Coordinate System and to Mean Sea Level. In no instance shall any error be greater than ten feet (10').

Contours 90 percent of all contour lines shall be correctly plotted to within one half the contour interval (2.5 feet), and the remaining 10 percent shall not be in error by more than a whole contour interval (5.0 feet) unless specified otherwise by the State. ~~[illegible] ground is completely obscured in the aerial photographs~~. A contour which can be brought within these tolerances by shifting its plotted position by one fortieth of an inch (0.025") will be accepted as being correctly plotted.

Spot Elevations 90 percent of all spot elevations shall be accurately plotted to within one fourth the contour interval (1.25 feet), and the remaining 10 percent shall not be in error by more than one half the contour interval (2.50 feet).

6.2. One Hundred (100) Scale, Two-Foot (2') Contours

6.2.1 Scale

The final scale shall be one inch equals one hundred feet (1" = 100'). There shall be a difference of two feet (2') between intermediate contours, and a difference of ten feet (10') between index contours.

SYN 001 2315

6.2.2. Map Sheet Requirements

The final map sheet shall be prepared using a dimensionally stable, polyester-type plastic having a minimum thickness of ~~three~~ four thousandths of an inch (0.00~~3~~4"). Each sheet shall be not more than 5 feet - 0 inch long and 2 feet - 6 inches wide between the outside borders. The title information shall appear in the lower margin.

General Each map sheet shall show all the cultural features in accordance with the attached MAP SCALE STANDARDS - PLANIMETRIC DETAIL sheets where applicable to the 1" = 100' scale maps. It will be the Contractor's responsibility to show each required cultural feature in the position, orientation, shape and dimensions on the map sheet according to the following specifications:

Buildings with one or more horizontal dimensions of 20 feet or more shall be drawn to scale. Smaller buildings with one or more horizontal dimensions between 10 and 20 feet shall be shown 10 feet by 10 feet. Buildings with no horizontal dimensions greater than 10 feet need not be shown. The common walls of attached buildings of varying heights shall be shown.

As an aid to orientation, all fence lines, walls and hedges which are identifiable as such on aerial photographs and which are not adjacent to highways, streets or trails, shall be shown as the physical limitations of the map sheet permit.

SYN 001 2316

Regularly aligned roads shall be plotted using straight-edged and uniformly curved drawing templates, and the rendering of such drawings shall be executed with special care. Freehand or irregular-curve drawing shall be permitted only on meandering roads or trails of irregular alignment.

Power-transmission and communication lines, which are constructed on private Right-Of-Way and are cross-country in nature, shall be shown. Where identifiable as such, towers and utility poles shall also be shown.

Drainage When so defined by the contour layout, drainage lines shall be shown by a dash-and-three-dot symbol in all drainage features when such features are at least one quarter of a mile (0.25 mile) in length. All drainage lines shall be stopped at a distance of at least fifty feet (50') from the ridge lines. Streams averaging more than ten feet (10') wide shall be represented with double lines in the dash-and-three-dot format, one line for each shore. The shoreline of small ponds shall also be represented by this symbol, and the interior of these ponds shall be shown lightly cross-hatched. Large ponds, lakes, reservoirs and the like shall be lightly cross-hatched one inch inside the shoreline. Where drainage is known to exist which would otherwise be indicated by depression contours, any culverts or other comparable drainage structures which can be identified as such on the aerial photographs, or are otherwise known to exist, shall be shown on the map.

Wooded Areas Woodland outlines shall be carefully and accurately delineated. A cleared band of actual width shall be shown along all transmission and communication lines. Woodland outlines must be in exact position, especially where the boundary is a road, railroad, transmission or major communication line Right-Of-Way.

Relief Datum shall be Mean Sea Level and relief shall be shown by two-foot (2') contour lines. Each ten-foot (10') contour shall be accentuated and numbered with its corresponding elevation above Mean Sea Level. Contour numbers shall be shown at intervals not to exceed ten inches. Elevations of all saddles, high and low spots, road intersections, railroad and roadway intersections, shall be shown to the nearest half-foot ($0.5'^{\pm}$). In depressions where drainage is indicated by structures, the contours shall not be shown as depression contours.

Coordinates Grid lines shall be shown as continuous solid lines from inside border to inside border at 500-foot intervals. They shall conform to the criteria of the New Jersey Plane Coordinate System and shall be labeled at the top, bottom and sides of each map sheet approximately one inch inward from the inside border. The plotted position of each New Jersey Plane Coordinate grid line shall not vary from the true grid position by more than one hundredth of an inch (0.01") on each manuscript.

6.2.3. Accuracies.

Cultural Features Except for symbolized buildings, the plotted positions of 90 percent of the cultural features shown shall be within two and a half feet (2.5') of their actual corresponding

positions in the field as located with respect to the New Jersey Plane Coordinate System and to Mean Sea Level. In no instance shall any error be greater than five feet (5.0').

Contours 90 percent of all contour lines shall be correctly plotted to within one half the contour interval ($1.0' \pm$), and the remaining 10 percent shall not be in error by more than a whole contour interval ($2.0' \pm$) unless specified otherwise by the State. A contour which can be brought within these tolerances by shifting its plotted position by one fortieth of an inch (0.025") will be accepted as being correctly plotted.

Spot Elevations 90 percent of all spot elevations shall be accurately plotted to within one fourth the contour interval (0.5 foot) and the remaining 10 percent shall not be in error by more than one half the contour interval (1.0 foot).

6.3. Fifty (50) Scale, One-Foot (1') Contours
and
Thirty (30) Scale, One-Foot (1') Contours

6.3.1. Scale.

The final scale shall be either one inch equals fifty feet (1" = 50') or one inch equals thirty feet (1" = 30') as specified by the State.

Although references throughout Article 6.3 will be made with respect to the 1" = 50' scale, said references shall be construed to apply to the 1" = 30' scale as well.

There shall be a difference of one foot (1') between intermediate contours, and a difference of five feet (5') between index contours.

6.3.2. Map Sheet Requirements.

The final map sheet shall be prepared using a dimensionally stable, polyester-type plastic having a minimum thickness of three thousandths of an inch (0.003"). Unless specified otherwise by the State, each sheet shall be not more than 5 feet - 0 i-

SYN 001 2319

long and 3 feet - 6 inches wide between the outside borders. The title information shall appear in the lower right-hand corner with a roll number and a project number in the upper left-hand corner.

[SEE BELOW FOR NEW PARAGRAPH TO BE INSERTED HERE]

The Contractor shall be required to complete two types of maps of the same project area to fulfill the 1" = 50' scale (or 1" = 30' scale) mapping requirements unless stipulated otherwise by the State:

1" = 50' scale Planimetric Map

1" = 50' scale Topographic Map

Each map shall be identical in size and material and shall conform to the requirements hereinbefore noted.

General. Each map sheet shall show all the cultural features in accordance with the attached MAP SCALE STANDARDS - PLANIMETRIC DETAIL sheets where applicable to the 1" = 50' scale maps. It will be the Contractor's responsibility to show each required cultural feature in the position, orientation, shape and dimensions on the map sheet according to the following specifications:

All structures with one or more horizontal dimensions of five feet (5') or more shall be drawn to scale and represented by the outlines of their foundations. Such appurtenances as porches and steps shall be shown. The common walls of attached buildings of varying heights shall be shown. Structures of a temporary nature, such as picnic tables and construction contractor's sheds, shall not be shown.

When so stipulated by the State, the final sheets to be incorporated into an official set of Contract Plan sheets shall be not more than thirty-six inches (36") long and twenty-two inches (22") wide between the outside borders. The Title Block shall appear in the lower right-hand corner.

All fence lines, walls, hedges, curbs, utility poles, and trees with crown diameters greater than ten feet (except in wooded areas) that are identifiable as such an aerial photographs, shall be shown.

Regularly aligned roads shall be plotted using straight-edged and uniformly curved drawing templates, and the rendering of such drawings shall be executed with special care. Freehand or irregular-curve drawing shall be permitted only on meandering roads or trails of irregular alignment.

All roads, walks, drives, railroad tracks and trails shall be shown to scale. Curbed roadways shall have each pavement edge represented with solid double lines wherever there is curb. Paved roadways without curb or designated shoulder areas shall be represented with single solid lines defining each pavement edge. Uncurbed roadways with designated shoulder areas shall be represented with uniformly dashed lines denoting the pavement edge wherever shoulder pavement is encountered. Trails shall be indicated by a single, uniformly dashed line denoting the travel path.

All power-transmission and communication lines shall be shown to scale, together with their accompanying tower bases where encountered.

Drainage When so defined by the contour layout, drainage lines shall be shown by a dash-and-three-dot symbol in all drainage features when such features are at least one quarter of a mile (0.25 mile) in length. All drainage lines shall be stopped at a distance of at least fifty feet (50') from the ridge lines. Streams averaging more than five

feet (5') wide shall be represented with double lines in the dash-and-three dot format, one line for each shore. The shoreline of small ponds shall also be represented by this symbol, and the interior of these ponds shall be shown lightly cross-hatched. Large ponds, lakes, reservoirs and the like shall be lightly cross-hatched one inch inside the shoreline. Where drainage is known to exist which would otherwise be indicated by depression contours, any culverts or other comparable drainage structures which can be identified as such on the aerial photographs, or are otherwise known to exist, shall be shown on the map.

Wooded Areas Woodland outlines shall be carefully and accurately delineated. A cleared band of actual width shall be shown along all transmission and communication lines. Woodland outlines must be in exact positions, especially where the boundary is a road, railroad, transmission or communication line Right-Of-Way. Free-standing trees with crown diameters of ten feet or greater shall also be shown.

Relief Datum shall be Mean Sea Level and relief shall be shown by one-foot (1') contour lines. Each five-foot (5') contour shall be accentuated and numbered with its corresponding elevation above Mean Sea Level. Contour numbers shall be shown at intervals not to exceed ten inches. Elevations of all saddles, high and low spots, road intersections, railroad and roadway intersections, shall be shown to the nearest tenth of a foot ($0.1'^{\pm}$). In depressions where drainage is indicated by structures, the contours shall not be shown

as depressed contours. Where elevations are interpolated because the ground is obscured in the aerial photographs, the corresponding contours shall be represented by uniformly dashed lines.

Coordinates Grid lines shall be represented as continuous solid lines from inside border to inside border at 500-foot intervals. They shall conform to the criteria of the New Jersey Plane Coordinate System and shall be labeled at the top, bottom and sides of each map sheet approximately one inch inward from the inside border. The plotted position of each New Jersey Plane Coordinate grid line shall not vary from the true grid position by more than one hundredth of an inch (0.01") on each manuscript.

6.3.3. Accuracies

Cultural Features Except for symbolized buildings, the plotted positions of 90 percent of the cultural features shown shall be within one foot (1.0') of their actual corresponding positions in the field as located with respect to the New Jersey Plane Coordinate System and to Mean Sea Level. In no instance shall any error be greater than two feet (2.0').

Contours 90 percent of all contour lines shall be correctly plotted to within one half the contour interval (0.5 foot), and the remaining 10 percent shall not be in error by more than a whole contour interval (1.0 foot) ~~However, the allowable error may be doubled wherever the ground is completely obscured in the aerial photographs.~~ unless specified otherwise by the State. A contour which can be brought within these tolerances by shifting its plotted position by one fortieth of an inch (0.025") will be accepted as being correctly plotted.

Spot Elevations 90 percent of all spot elevations shall be accurately plotted to within one fourth the contour interval (0.25 foot) and the remaining 10 percent shall not be in error by more than one half the contour interval (0.50 foot).

As stipulated by the State, spot elevations may be required at the following locations:

(1) At 50-foot intervals along the centerlines of roadways and of medians where they exist.

(2) At 50-foot intervals along the edges of roadway pavements and paved shoulders or gutter lines.

(3) In between contour lines that are more than 50 feet apart horizontally.

(4) On the grates of inlets and catch basins and on other drainage structures.

(5) At the ground and top of curbs on overpass-underpass structures.

(6) At other locations when so directed.

SECTION SEVEN - DELIVERY AND PAYMENT

7.1 Materials to be delivered:

(1) Two complete sets of 9" x 9" contact photographs providing full stereoscopic coverage of the project area.

(2) Two 20" x 24" photographic index maps.

(3) One set of all field notes, computation and adjustment sheets, and monument and other control description sheets for all field surveys completed on the project including a control map.

(4) One complete set of annotated contact prints showing all analytically generated supplemental control used on the project.

(5) One bound copy of all computer print-out sheets showing the analytical aero-triangulation supplemental control values.

(6) One complete set of maps, as stipulated and at the scale(s) specified by the State, on tracing sheets made of dimensionally stable polyester-type plastic having a minimum thickness of three thousandths of an inch (0.003").

(7) One overall index sheet showing the positions and relations of all map sheets covering the entire project, on dimensionally stable polyester-type plasting having a minimum thickness of three thousandths of an inch (0.003").

7.2 Performance Schedule

Using whatever guidelines are provided elsewhere within these Specifications, the State and the Contractor shall develop a mutually agreeable schedule for the delivery of the materials to be produced. This schedule shall be consistent with sound photogrammetric production concepts and procedures and with the State's need for the mapping.

SYM 001 2325

7.3 Basis for Payment

Payment shall consist of full compensation for all work completed and accepted by the State, for defrayment of all fees and other costs, for performance of extra work and alterations ordered by the State, and for submission and delivery to the State according to the Proposal, the Contract and any subsequent Addenda and Change Orders.

Using whatever guidelines are provided elsewhere within these Specifications, the Contractor and the State shall mutually agree on the terms by which progress payments and the final payment shall be made for the completed work.

EXHIBIT 1

MARGIN DATA
FOR
100S-2C AND 200-5C MAPPING

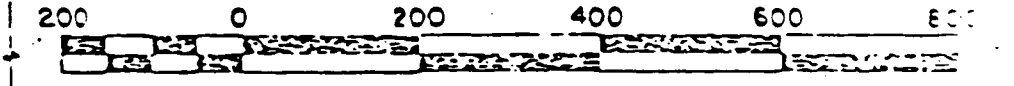
A Prepared By

PREPARED BY
XYZ MAPPING COMPANY

JOHNSTOWN NEW JERSEY

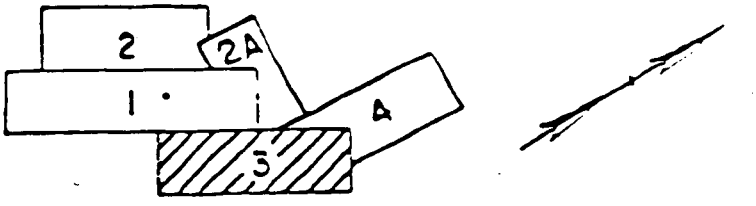
MAPPING COMPILED FROM PHOTOGRAPHY
DATED APRIL 1962

B Scales



SCALE 1" = 200'
1000 FOOT GRID BASED ON NEW JERSEY GRID SYSTEM
1927 N.A. DATUM
CONTOUR INTERVAL 5'
DATUM IS MEAN SEA LEVEL

C Index To Adjoining Sheets



SYN 001 2327

D Project Title & Sheet Number

INTERSTATE ROUTE 78
SPRINGFIELD & HASBROUCK HEIGHTS

SHEET 3 OF 5

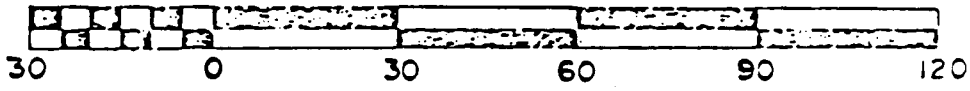
EXHIBIT 11

STATE OF NEW JERSEY
DEPARTMENT OF TRANSPORTATION
BUREAU OF SURFACE DESIGN

TOWNS OF BERKELEY HEIGHTS & SPRINGFIELD
INTERSTATE ROUTE 78

PROJECT NO. 130-133

MAPPING COMPILED FROM PHOTOGRAPHY DATED APRIL 1975



SCALE : 1" = 30'

TOPOGRAPHIC MAP

500 FOOT GRID BASED ON NEW JERSEY GRID SYSTEM

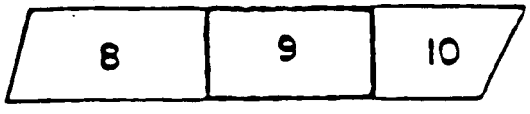
1927 N. A. DATUM

PHOTOGRAMMETRY BY

X.Y.Z. ASSOCIATES INC.

JOHNSTOWN, N.J.

INDEX TO ADJOINING SHEETS



SYN 001 2328

SAMPLE TITLE FOR 30 SCALE

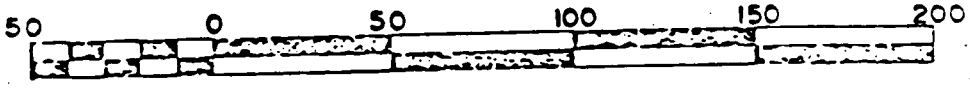
TOPOGRAPHIC MAPS

STATE OF NEW JERSEY
DEPARTMENT OF TRANSPORTATION
BUREAU OF SURFACE DESIGN

TOWNS OF BERKELEY HEIGHTS & SPRINGFIELD
INTERSTATE ROUTE 78

PROJECT NO. 130-133

MAPPING COMPILED FROM PHOTOGRAPHY DATED APRIL 1975



SCALE : 1"=50'

PLANIMETRIC MAP

500 FOOT GRID BASED ON NEW JERSEY GRID SYSTEM

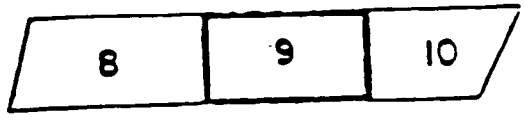
1927 N. A. DATUM

PHOTOGRAMMETRY BY

X.Y.Z. ASSOCIATES INC.

JOHNSTOWN, N.J.

INDEX TO ADJOINING SHEETS



SAMPLE TITLE FOR 50 SCALE

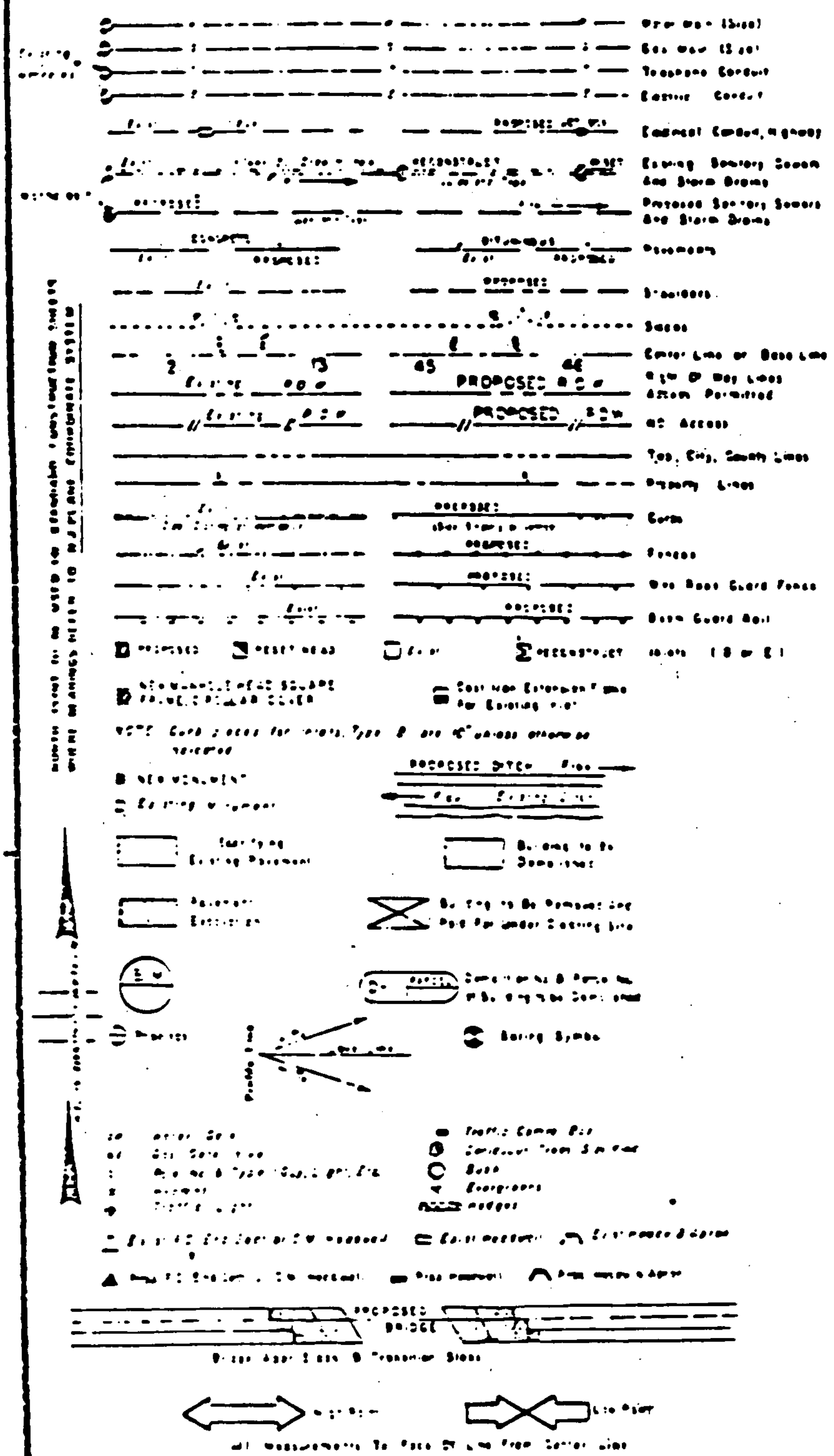
PLANIMETRIC MAPS

SYN 001 2329

EXHIBIT

NEW JERSEY DEPARTMENT OF TRANSPORTATION

STANDARD LEGEND



SYN 001 2330

STANDARD ACCURACY FOR PHOTOGRAMMETRIC MAPPING

SCALE	1" = 200'	1" = 100'	1" = 50' & 1" = 30'	As determined
CONTOUR INTERVALS	Five Feet - Accentuate each 25-ft. contour.	Two Feet - Accentuate each 10 - ft. contour.	One Foot - Accentuate each 5-ft. contour.	As determined
CULTURAL FEATURES	90% shall be within 5' of actual positions; 10% shall not exceed 10' of the actual position.	90% shall be within 2½' of actual position; 10% shall not exceed 5' of the actual position.	90% shall be within 1' of actual position; 10% shall not exceed 2' of the actual position.	90% shall be located within 1/40th of the map scale; 10% shall not exceed 1/20th of the map scale in actual position.
CONTOURS Note: Contours may be shifted by 0.025 inch in order to obtain the vertical requirements	90% shall not exceed ½ contour interval (2.5') of actual elevation; 10% shall not exceed one contour interval (5.0') of actual elevation.	90% shall not exceed ½ contour interval (1.0') of actual elevation; 10% shall not exceed one contour interval (2.0') of actual elevation.	90% shall not exceed ½ contour interval (0.5') of actual elevation; 10% shall not exceed one contour interval (1.0') of actual elevation.	90% shall not exceed ½ contour interval of actual elevation 10% shall not exceed one contour interval of actual elevation.
SPOT ELEVATIONS	90% shall not exceed ½ contour interval (1.25') of actual elevation; 10% shall not exceed ½ contour interval (2.5') of actual elevation.	90% shall not exceed ½ contour interval (0.50') of actual elevation; 10% shall not exceed ½ contour interval (1.0') of actual elevation.	90% shall not exceed ½ contour interval (0.25') of actual elevation; 10% shall not exceed ½ contour interval (0.5') of actual elevation.	90% shall not exceed ½ contour interval of actual elevation; 10% shall not exceed ½ contour interval of actual elevation.
MAXIMUM SHEET SIZE	5'-0" Long x 2'-6" Wide	5'-0" Long x 2'-6" Wide	10'-0" Long x 3'-6" Wide	As determined

EXHIBIT VI

MAP SCALE STANDARDS

(ALL NOTED PLANIMETRY TO BE SHOWN EXCEPT AS INDICATED)

METRIC DETAIL	1"=30' & Larger	1"=50'	1"=100'	1"=200'
...s and Runways				
Athletic Fields			(7)	(1)
Billboards				
Borrow Pits				
Boulders and Rocks	(5)	(5)	(3)	(1)
Bridges and Viaducts				(8)
Buildings				
Bushes and Shrubs	(6)	(6)		(1)
Canals and Creeks				
Catch Basins and Inlets			(1)	(1)
Cemeteries				
Churches				
Crib and other Retaining Walls			(2)	(3)
Culverts			(9)	(9)
Curbs			(1)	(1)
Dams				
Ditches and Channels				(4)
Drains				
Drives			(11)	(11)
Fences			(2)	(4)
Ferry Slips				
Field Roads				(2)
Flood Plains (Boundaries)				
Fords				
F...ations				
...mps and Islands			(1)	(1)
...1 Courses				
Greenhouses				
Guiderails and Attenuators			(2)	(1)
Hedges			(2)	(4)
High Tension Lines				
House Trailers (Permanent)				(8)
Hydrants			(1)	(1)
Lakes and Ponds				
Lamp Posts (Private)			(1)	(1)
Light Poles			(1)	(1)
Mail Boxes			(1)	(1)
Manholes			(1)	(1)
Marshes and Swamps				
Mines				(2)
Nurseries and Orchards				
Parking Areas and Lots				(2)
Parking Meters			(1)	(1)
Patios and Porches			(1)	(1)
Piers, Warves and Docks				
Pipe lines (Utility)				(4)
Poles (Utility)			(4)	(4)
Pools (Inground)				
Quarries				
Radio Towers				
R... oads - Rails			(12)	(12)
...oads: Switches, Signal ...es, Power Stanchions, Bumpers			(1)	(1)

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EXHIBIT VI

MAP SCALE STANDARDS

(ALL NOTED PLAINMETRY TO BE SHOWN EXCEPT AS INDICATED)

PLAINMETRIC DETAIL	1"=30' & Larger	1"=50'	1"=100'	1"=200'
Rapids				
Recreation Areas and Parks				
Reservoirs				
Rivers and Tributaries				
Roads			(1)	(1)
Road Shoulders			(2)	(2)
Rock Outcrop				
Ruins				
Schools			(2)	(1)
Sidewalk			(7)	(3)
Signs				
Silos				
Smokestacks				
Springs			(10)	(1)
Steps				
Storage Tanks				
Streams				
Substations (Transformers)				
Towers			(1)	(1)
Traffic Lights				(1)
Trails				
Transportation Terminals			(5)	(3)
Trees (Individual)				
Trestles				
Tunnels				
Utility Valve and Meter Caps (As Specified)			(3)	(3)
			(2)	(3)
Walls				
Waterfalls			(1)	(1)
Wells				
Woods (Boundaries)				

FOOTNOTES:

(1) Details not to be shown at this scale.
(2) Prominent only.
(3) Landmark only.
(4) Cross-country only.
(5) Shown if over ten feet in diameter.
(6) Ornamental only.
(7) Large only.
(8) Larger than one-car garage.
(9) On drainage plan only.
(10) For large public buildings only.
(11) Prominent - over one inch at map scale.
(12) Centerline track only.

SYN 001 2333

SECOND DRAFT

GLOSSARY

Accuracy: The degree of agreement between a measured value and the true value.

Aerial Negative: The original photo image produced by aerial photography onto reproducible film and used to produce prints and/or positive photographs.

Aerial Photographs Oblique: Photographs taken at any angle below the horizon except 90° and used primarily for environmental analyses and outside presentations.

Aerial Photograph Vertical: An aerial photograph with the camera's longitudinal axis as close to truly vertical as possible.

Air Base: The line, or length of the line, joining two adjacent camera stations.

Altitude: Vertical distance above the reference elevation or datum--usually Mean Sea Level-- of an object or point in space.

Analytics: The densification of horizontal & vertical control using measurements made on aerial photographs in a computational solution.

Antivignetting Filter: A filter used with wide-angle photography to produce uniform lighting over the whole photograph.

Attitude: The angular orientation of a camera with respect to some external reference system.

Azimuth Line: A radial line from the Principal Point of a photograph to a similar point in an adjacent photograph in the same flight line.

Basic Control: A system of horizontally and/or vertically established and monumented control points over the entire extent of the roadway project. Such points are established at a one-to two-kilometer spacing to serve as closure points for all other project surveys.

Bench Mark: A monumented point of known elevation.

Cadastral: Pertaining to extent, value and ownership of land. Cadastral maps show property corners and property lines.

Camera Axis: A line through the camera's rear nodal point which is perpendicular to the film plane.

Camera Station: The point in space where the forward node of the camera lens was located at the instant the exposure was made.

C-Factor: (Also called Contouring Factor) The ratio of the flight height to the smallest contour interval which a photogrammetric system can consistently compile on a map manuscript to the required accuracy.

Comparator: A precise instrument which measures two-dimensional plane coordinates, usually on an aerial photograph.

Compilation: The production of a map or base plan from aerial photographs and geodetic control data using photogrammetric instruments.

Contact: A method of printing copies of photographs in which a translucent photograph is placed in contact with photosensitive material and exposed, thereby producing an exact image of the original photograph.

Contour: A theoretical line tangent to the earth's surface at a known elevation; also, a line "locating" this elevation on a map or plan.

Contrast: The degree of difference between the lightest and darkest areas of a photograph.

Control: A system of horizontally and/or vertically established monumented points used to reference mapping features. There are four classifications of precision (the first order being the highest) depending upon the overall precision and quality of the methods and instruments involved.

Control, Ground: Control brought about by conventional field survey methods as opposed to aerial survey methods. This control is used to complement photogrammetric work and to compensate for any deficiencies resulting from the latter.

Control, Horizontal Ground: This control positions and identifies ground points by survey ties or plane coordinates.

Control, Vertical Ground: This control locates points vertically relative to a reference datum such as mean sea level.

Control Point: On a photograph, any identified station or reference point used in fixing the attitudes and/or positions of one or more related photographs.

Coordinates: A reference grid system designed to define the positions of points on a photograph or plan sheet. In photogrammetry, the coordinate axes are usually either the fiducial axes, or the principal line and the photograph parallel. If a three-dimensional system is used, the origin is either the principal point or the perspective center.

Cover: In mapping, vegetation over a terrain.

Crab: The condition caused by failure to correctly position the camera with respect to the airplane's line of flight. This results in the angular displacement of the photographic axis relative to the flight line.

Culture: In mapping, man-made features.

Deformation: A change or difference in the position of a point on a photograph, negative, manuscript or print from its true position which is caused by differential shrinkage or expansion of the film or paper.

Develop: To process exposed photographic material and thereby reveal the latent image contained thereon.

Diapositive: A positive photographic transparency, usually glass, designed for use in a precision photogrammetric instrument.

Displacement: Any shift in the position of a point, line or feature on a photograph.

Displacement Due to Relief: An unavoidable characteristic of aerial photography which results in high elevation points appearing further from the center and in low elevation points appearing closer to the center of aerial photographs than is evident from their true positions.

Distortion: A change or difference in the position of a point on a photograph from its true position caused by an aberration or combination of aberrations in the camera lens.

Dodging: Selectively shading or masking a portion of a photograph during copying to soften the contrast. Automatic Dodging selectively varies illumination over the photograph in proportion to the average density of each area on the photograph.

Electronic Distance Measuring Instrument or Device: A mechanism which transmits and receives a modulated electromagnetic signal and, by monitoring and compiling phase differences between the modulations of transmitted and reflected or retransmitted signals, translates the raw data into a readout of distance between the mechanism and the reflector or retransmitter.

Elevation: The vertical distance between a point and Mean Sea Level.

Fiducial Marks: Indicators produced on each border of the negative at the moment of exposure and used to locate the photograph's principal point.

Flight Altitude: The vertical distance of an aircraft above Mean Sea Level.

Flight Height: The vertical distance between an aerial camera and the average terrain elevation.

Flight Line or Flight Strip: Either the flight path of the airplane carrying the camera or the strip of photographs produced from a single flight.

Flight Plan: The aerial photography operational procedure in which the project objectives and the performance criteria are specified.

Focal Length: The distance from the plane of infinite focus to the center of a lens.

Geodetic Survey: A survey which takes into account the curvature of the earth's surface.

Geoid: An equipotential surface (a surface of equal gravity) coincident with Mean Sea Level.

Grid: A uniform system of rectilinear horizontal lines superimposed onto aerial photographs, mosaics, maps, plan sheets and other representations of the earth's surface; used in identifying the positions of points.

Inertial Surveying: A system that uses accelerometers, gyroscopes and a computer to sense the earth's rotation and orient itself with respect to north-south and to east-west as well as to the direction of gravity as it is moved from point to point.

Interpretation: The result of stereoscopic examination of aerial photographs augmented by data and imagery from other sources to obtain qualitative information about the terrain, cover and culture which may influence the location of a highway.

Manuscript or Base Map: The original master reproducible upon which the data gathered from the aerial photographs has been compiled.

Map - Index: (1) A small scale map showing such data as larger-scale topographic quadrangles or geodetic control. (2) A map showing the locations and numbers of flight strips and photographs.

Map - Photogrammetric: An orthographically projected rendering of existing land features produced with a stereo-plotting instrument.

Map - Planimetric: A reproducible copy of the manuscript showing the shape and horizontal position of natural and man-made (cultural) features with no regard for elevation or measurable relief.

Map - Topographic: A reproducible copy of the manuscript showing the shape and the horizontal and vertical position of natural and man-made features. Elevations and measurable ground relief are usually delineated by Contours and by Spot Elevations at prominent locations.

Mean Sea Level: The average of the heights of the sea surface at all stages of tide. In photogrammetry, the value normally considered as Mean Sea Level is the National Geodetic Vertical Datum of 1929.

Model: The area produced by the end lapping of two successive aerial photographs. The product of two photographs depicting the same ground area but taken from two different positions of exposure and resulting in a three-dimensional image when observed through a stereoscopic viewer.

Mosaic: A large sequential composite of individual photographs showing a continuous overview of a project site from beginning to end.

Mosaic - Controlled: Wherein each photograph was sealed and rectified relative to horizontal ground control and matched to adjacent photographs as perfectly as possible.

Nodal Point: A camera lens has two such points; an incident (frontal) point and an emergent (rear) point. These points lie on the optical axis of the lens and have the property that any light ray directed toward the incident point passes through the emergent point and emerges on the other side of the lens in a direction parallel to direction of the incident ray.

SYN 001 2340

Oblique Photograph: photograph taken with the axis of the camera intentionally directed between the vertical and the horizontal.

Orthographic: Characterized by perpendicular lines or right (90°) angles.

Orthophotograph: A photographic reproduction in which each image has been extrapolated into its map (orthographic projection) position.

Overlap: The amount by which two adjacent photographs show the same area and usually expressed as a percentage. In aerial photographs, the overlap in the same flight line is called the end lap and the overlap in adjacent parallel flight lines is called the side lap.

Panels: Ground Control Points which are readily identifiable in aerial photographs. Also referred to as Targets.

Parallax: An apparent change in position of an object or of one object relative to another when viewed from different points of observation. Also, the change in position of an image from one aerial photograph to the next as a result of the aircraft's motion.

Photogrammetry: The science of obtaining accurate measurements through the use of photographs.

Photographic Index: A mosaic of individual adjacent photographs in their proper relative position and re-photographed at a reduce scale with accompanying designations.

Plane Coordinate System: A horizontal reference system consisting of equally spaced perpendicular and parallel grid lines used to locate and establish the position of any point. Such positions are established relative to the origin point and principal axes of this system. The two primary systems employed in New Jersey are the U. S. Coast and Geodetic Survey and the New Jersey Geodetic Plane Coordinate System, and generally all first and second order accuracy traverse and triangulation stations should be tied into one of these systems unless the State has approved otherwise.

Precision: The degree of refinement with which an operation is performed.

Principal Point: The intersection of two lines drawn through opposite Fiducial Marks on the aerial photograph. The theorectical intersection of the camera's line-of-sight axis (as vertical or "plumb" as possible) with the ground.

Print: A photographically produced copy of a transparency. Also called a contact print.

Print-Check: A blue or black line copy of an original transparency used as a working copy to check the accuracy of the original and to perform related engineering work thereon.

Print-Contact: A print made with a transparency in contact with a sensitized surface.

Print-Cronapaque: A mylar-type, emulsion-coated material with a very low coefficient of expansion and extreme durability upon which the contact print or an enlargement of the original may be produced.

Print-Paper: An emulsion-coated, high grade paper used for the same purposes as the Cronapaque Print, but available in single or double weights and gloss, semi-matte or matte finishes.

Print-Ratio: A print on which the scale has been changed from that of the original transparency by projection printing.

Rectification: The production of a truly vertical photographic print from a tilted aerial negative.

Scale: The ratio of a distance on an aerial photograph, map or plan sheet to its actual counterpart on the ground. The photographic scale is generally taken as "f/h" where "f" is the principal distance of the camera and "h" is the height of the camera above mean ground elevation. Scale may be expressed as a ratio (1:24,000), a representative fraction (1/24,000), or an equivalence (1 inch = 2,000

Scribing: A method of drafting employing a scriber which removes a pigment from a mylar as it traces a line thereon, hence exposing a transparent line on the mylar. Upon completion, the mylar serves as a negative original from which copies can be readily made.

Spot Elevations: Reported elevations of high, low and other prominent points. The precise location of these points is generally denoted by a small "x" next to the reported value of the elevation.

Stereocomparator: A comparator used in stereoscopically measuring images on adjacent aerial photographs.

Stereoplotter: An instrument designed to produce stereoscopic images or models from which very precise topographic maps can be compiled by utilizing electro-mechanical components of the instrument.

Stereoscopy: The science of producing three-dimensional images by viewing the overlap area of two photographs through a binocular viewer. The overlapping photographs were produced with the camera at a slightly different location or perspective of one exposure from the other.

Stereotriangulation: Triangulation is a procedure dealing with locating and establishing a position by means of bearings from two fixed points a known distance apart. The application of this procedure in photogrammetry utilizes a stereoscopic plotting instrument to obtain successive orientations of stereoscopic photographs into a continuous strip. The spatial solution for the extension of horizontal and for vertical control using strip coordinates may be made by either graphical or computational procedures. Also referred to as Aerial Analytical Triangulation.

Supplemental Control: One or more surveys between basic or primary control points to establish any additional points needed to complete the required mapping.

Target: A symmetrical pattern in high contrast to the background against which it is placed; used in locating and working with a control point from an aircraft and especially with its corresponding image in an aerial photograph.

Tilt: The departure of the camera's line of sight from vertical.

Topography: The configuration of a surface including its relief (usually represented by Contours and Spot Elevations) and the positions of its natural and man-made features as shown on a map or plan.

Total Station: A vertical and horizontal angle-measuring instrument with an electronic distance-measuring device either attached to or integral with the telescope and containing decoders which convert angle measurement to digital form. Such instruments immediately make data available on slopes, horizontal distances, and differences in elevations; they may also compute horizontal coordinates and actual elevations. Some are equipped to record all data on computer-compatible data storage copies.

APPENDIX C

CHAIN-OF-CUSTODY FORM

AND

LOG OF BORING FORM

CHAIN OF CUSTODY RECORD

PROJ. NO.	PROJECT NAME
SAMPLERS: (Signature)	

STA. NO.	DATE	TIME	COMP.	GRAB	STATION LOCATION	NO. OF CONTAINERS							REMARKS

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature)	Date / Time	Remarks	

SYN 001 2347

LOG OF BORING

BORING NO. ____
SHEET ____ OF ____

PROJECT ____ DRILLER ____

COORDINATES N - ____ TOTAL DEPTH ____ TYPE OF BORING ____

E - ____ GROUND WATER LEVEL & DATE TAKEN ____ ____

ELEVATION ____ DATE COMPLETED ____ LOGGED BY ____

DATE STARTED ____

DEPTH (FEET)	ELEVATION (FEET)	BLOWS @	SAMPLE NO. AND TYPE	PERCENT RECOVERY	PERCENT R. Q. D.	GEOLOGY	CLASSIFICATION	DESCRIPTION	REMARKS

SYN 001 2348

APPENDIX D

TANK SAMPLING

TANK SAMPLING

- Tank sampling and sampling in confined spaces is treated as a "special hazard." Strict health and safety procedures apply to these operations and are detailed in the Health and Safety Plan (Appendix A).

- Access to tanks, which are not open or do not have covers or lids, will be done by CECOS personnel by means of removal of the manway with non-sparking tools.

- Those tanks which have no manways will be opened by an operation called wet tapping - which is a method of drilling into the metal using oil or wetting agent to minimize sparks during the cut. A hole will be made only big enough to draw the necessary sample. This equipment is run by an air compressor and has a slow rotation while in operation.

SAMPLING EQUIPMENT

- Dedicated or disposable equipment will be used whenever possible. This equipment will not be reused or kept for any reason, and will be disposed of along with disposable clothing worn by the crew. In obtaining samples, disposable glass thieves will be used where possible. These glass thieves will be broken and disposed of after use as contaminated waste. Other reusable sampling equipment described below is subject to decontamination prior to its use.

- Liquids will be sampled using a bacon bomb; this is a canister which can be lowered into the tank on a rope or chain. Once the bomb touches bottom a shaft moves up allowing the sample to flow into the canister. Once the bomb is moved off the bottom, the shaft will close so the sample cannot drain out.

- A sludge dredge manufactured by Wildco Instruments will be used to sample tanks with sludge materials. The dredge will be inserted into the tank access, lowered to the bottom and obtain a sample of the sludge material will be obtained by dredging the tank bottom. Samples will be deposited and properly marked in sample jars.

- Solids in tanks will be sampled using a hand trowel, deposited and marked appropriately in sample jars.

DECONTAMINATION OF SAMPLING EQUIPMENT

- When reusable sampling equipment is used, a liquid detergent/hexane wash procedure will be used between samples to decontaminate the sampling equipment. In this wash procedure the implement is first washed with a liquid detergent solution. The implement is then rinsed consecutively with hexane and distilled water. Three rinses are used to ensure the implement is completely decontaminated. The sampling device is then ready for use.

- Other non-disposable sampling equipment such as Air Compressor, Electromagnetic drill etc. will be decontaminated by hexane wash, steam cleaning or bagged and transported to a decontamination facility.