WORK PLAN

FOR

ROME MGP SITE
IRM SOURCE CHARACTERIZATION

Prepared For:

NIAGARA MOHAWK POWER CORPORATION
SYRACUSE, NEW YORK

Prepared By:

ATLANTIC ENVIRONMENTAL SERVICES, INC.

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ATLANTIC PROJECT NO.: 1283-12-16

Project Manager:	**Prepared By:**	**Reviewed By:**
Paul Biscuti by JM	Martha Mayer	John Ripp
Paul Biscuti, P.E. Project Manager	Martha Mayer Principal Investigator	John Ripp Principal

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1.0 INTRODUCTION

This Work Plan describes activities proposed for the investigation of waste sources at the Kingsley Avenue manufactured gas plant (MGP) site in Rome, New York. The plan was prepared at the request of Niagara Mohawk Power Corporation (NMPC) by Atlantic Environmental Services, Inc. (Atlantic) and draws on an investigation of site history, current survey and mapping, and Atlantic's experience in characterizing other MGP sites. All proposed activities will be restricted to the site.

The technical approach for this Interim Remedial Measure (IRM) Waste Source Characterization Work Plan is extensively discussed in Atlantic's proposal (dated March 9, 1992) to NMPC. To reiterate, the objectives of this source characterization study are the following:

- to implement a field program that will quickly and decisively identify the major MGP source areas at the site;
- collect the necessary data to develop IRM plans; and
- present the project results in a report which alone will be the basis of an IRM.

Because of the similarity of wastes, gas making processes and unit operations, and general site layouts among former MGPs, obvious places exist where highly contaminated source materials are likely to be found. The approach in this Work Plan is to streamline the characterization of source materials on Kingsley Avenue site. The critical issue for this investigation program is expedited delineation of source and non-source areas. To accomplish this, modifications and adjustments to the sampling program will evolve based on comparison of results from visual observations, field screening for separate phase components and rapid turnaround analysis of polynuclear aromatic hydrocarbons (PAHs) in soil. Test pit excavation will be used to quickly map out obvious source areas in the unsaturated zone. Borings will be placed in areas unsuitable for test pits and to extend the source mapping into deep zones.

Therefore, this program is based on a streamlined design to efficiently map source areas. Because ground water characterization is intended for purposes of water disposal, and not aquifer characterization, detailed sampling and analytical methods will not be performed under this plan. The field and analytical procedures described in this plan are intended to achieve the greatest accumulation of source data in the shortest amount of time.

The plan is presented in the general chronological order of events to be completed at the site. Section 2.0 presents the site background in sufficient detail to support the program as identified in Sections 3.0 and 4.0. Sections 5.0 through 8.0 describe QA/QC procedures, schedule, and QA management.

2.0 SITE BACKGROUND

The Kingsley Avenue site is located in downtown Rome, New York on the Mohawk River, a short distance north of its confluence with the New York State Barge Canal. The regional site location is depicted in Figure 2-1.

2.1 Site Description

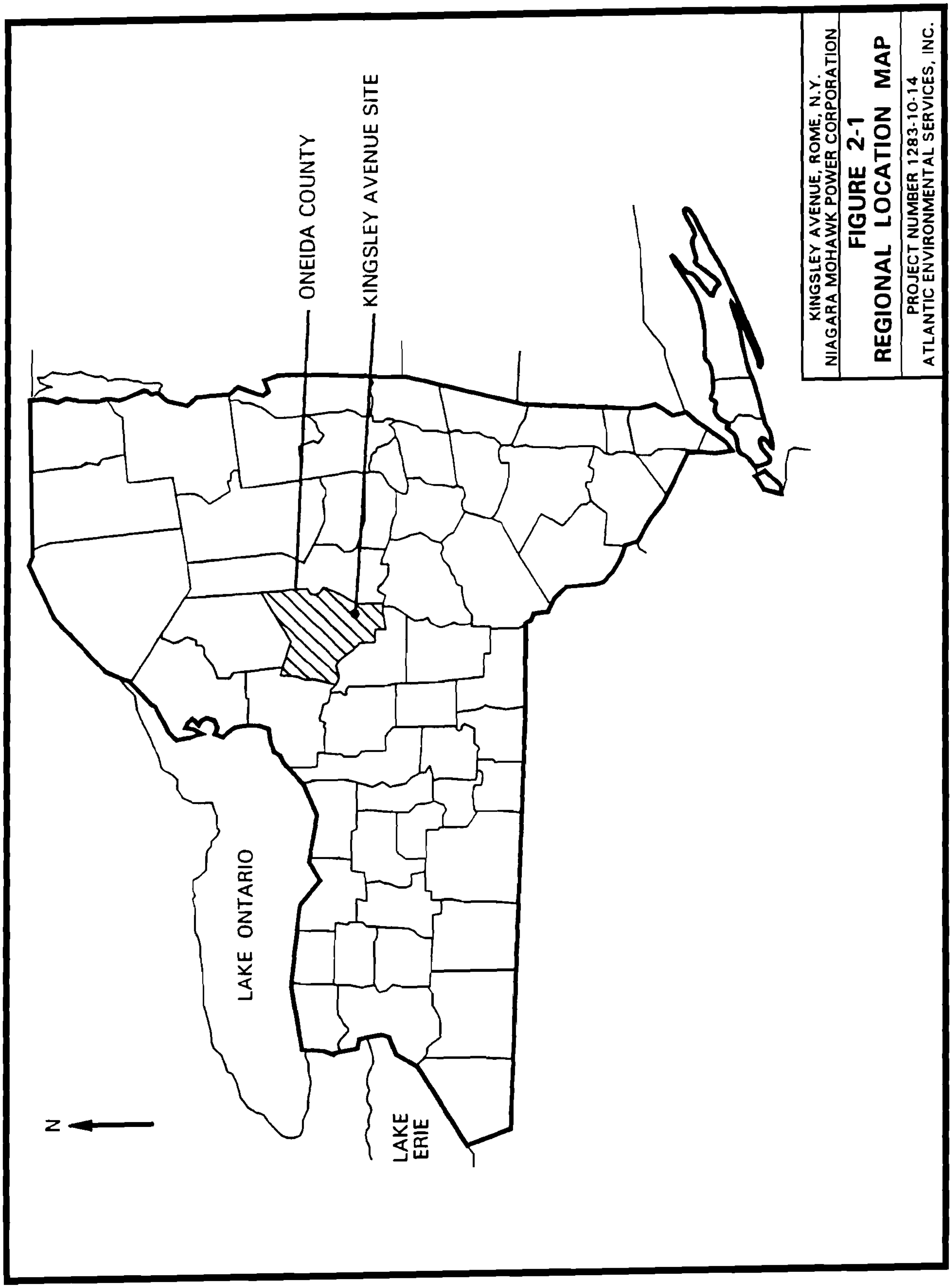
The Kingsley Avenue site borders a historic residential district (Figure 2-2). It is directly abutted by a rail corridor to the north, the Mohawk River to the west, an electric power substation and Department of Public Works (DPW) facility to the south. MGP operations covered 7 to 8 acres of the northern half of the 22 acre NMPC parcel. Two residential properties border the site entrance on Kingsley Avenue.

The area is a former flood plain situated on a peninsula formed by a meander of the river as it swings west, then south to join the New York State Barge Canal a short distance below the site. Essentially flat, the ground pitches slightly towards the river; the surface elevation is 430 feet. Steep banks drop to the nominal river level at 419 feet.

Currently, the property is surrounded by chain link fence. Access is through a gate at the end of Kingsley Avenue, which extends a short distance west from Mill Street (Figure 2-3).

A two-story brick building, which includes the former boiler, condenser and purifier house, is the only remaining intact structure related to gas production. Foundations of the retort house and coal trestles are visible along with other pads and footings.

An interior chain link fence surrounds a natural gas regulating station. Half of the relief holder pad is visible adjacent to the southern fence line. On the northern end of the site are traces of a rail spur and remains of wooden pole racks.



KINGSLEY AVENUE, ROME, N.Y.
NIAGARA MOHAWK POWER CORPORATION

FIGURE 2-1
REGIONAL LOCATION MAP

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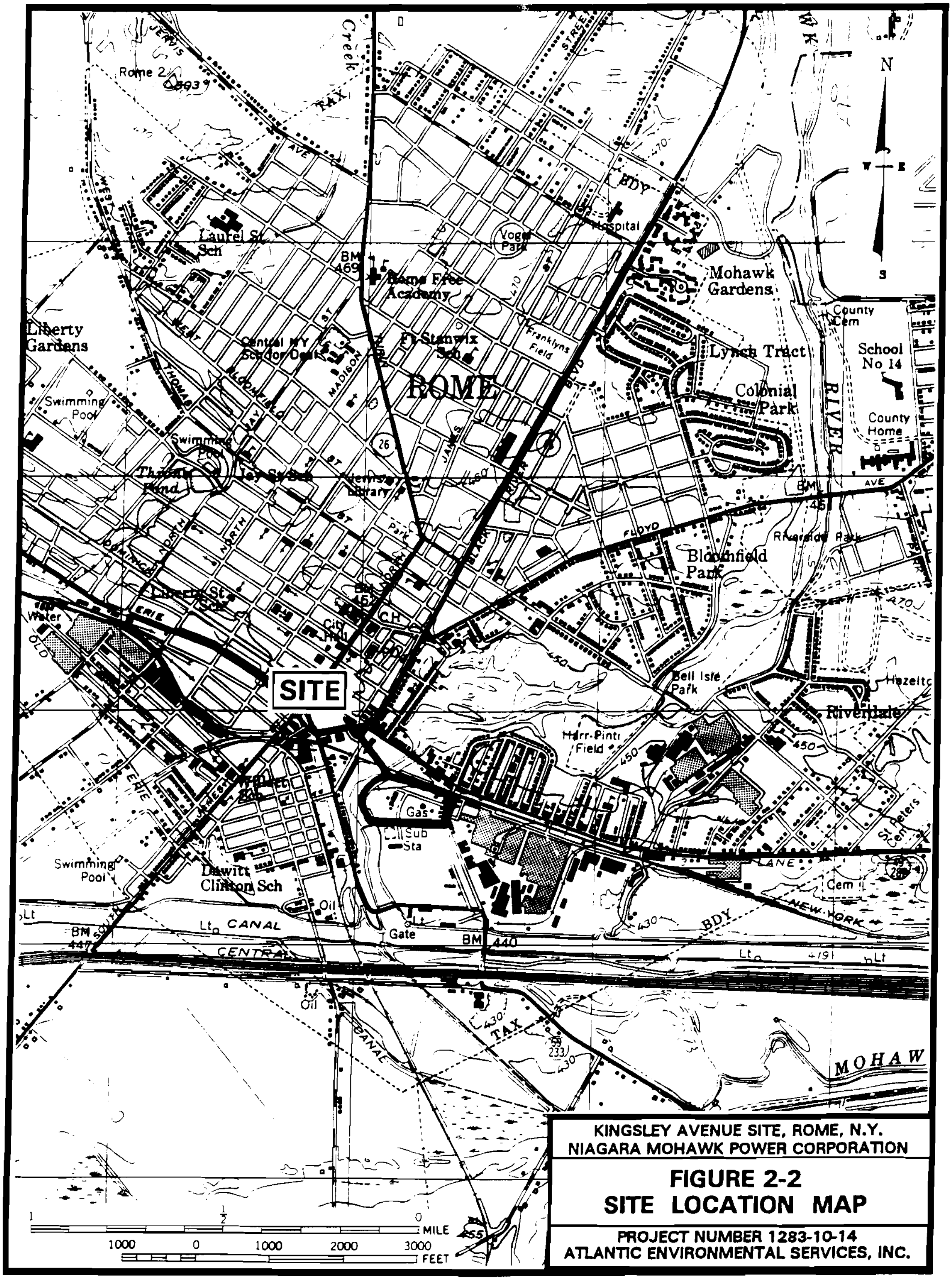

KINGSLEY AVENUE SITE, ROME, N.Y.
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FIGURE 2-2
SITE LOCATION MAP

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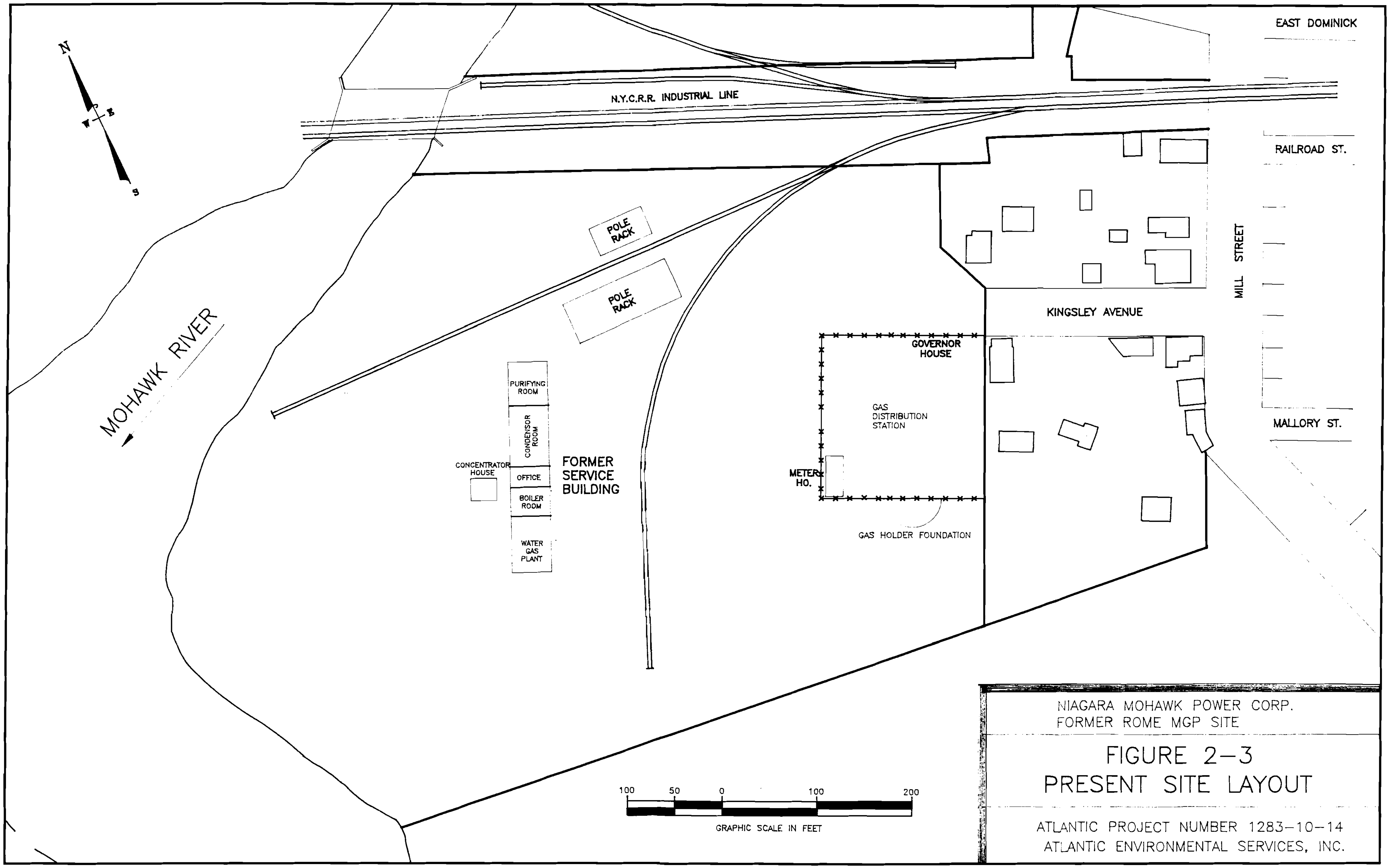

NIAGARA MOHAWK POWER CORP.
FORMER ROME MGP SITE

FIGURE 2-3
PRESENT SITE LAYOUT

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2.2 Site History

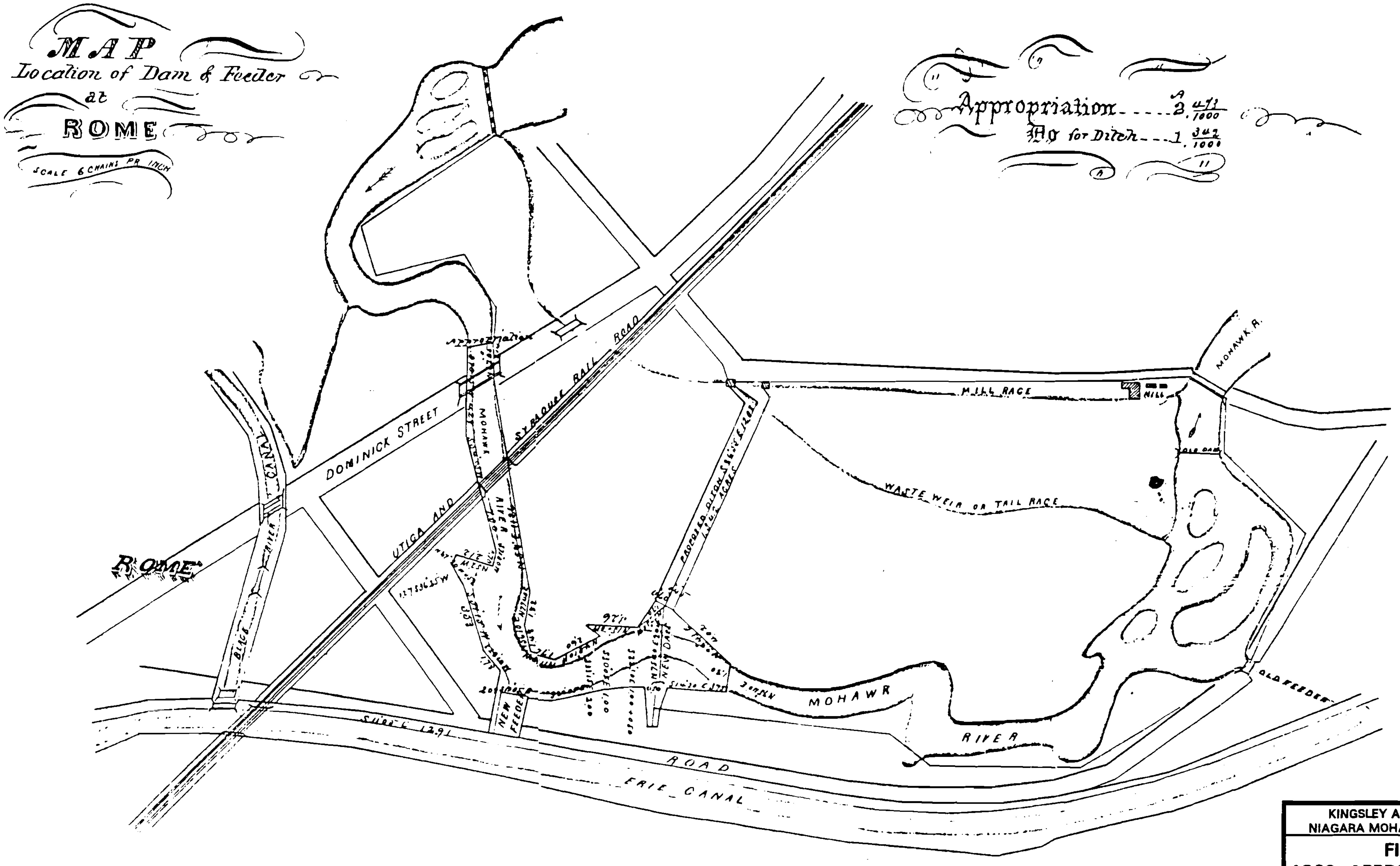
2.2.1 Property

The area in Rome south of Dominick Street which includes the MGP site was originally a low-lying flood plain enclosed in an eastward bend of the Mohawk River.

An 1860 appropriation survey (Figure 2-4) displays in the vicinity of the Kingsley Avenue site a then recently constructed dam and canal feeder, designed to shunt water from the Mohawk River into the Erie Canal. To this end, the state appropriated title to the riverbed, and to a parcel one chain (66 feet) in width extending across the peninsula. The state proposed to excavate a ditch on this parcel, for the apparent purpose of draining the adjacent ground. An 1873 "birds-eye view" depiction of the city (available from the Rome Historical Society) shows that this action was taken. Also present on the 1860 map are depictions of one mill race which served several aligned facilities, one tailrace for wastes, the "old" dam and "old" feeder canal.

In May 1873, Willey J.P. Kingsley acquired the parcel bounded northerly by the railroad and southerly by the "old canal feeder" (Figure 2-5, Table 2-1). The area between mill races was the later MGP site (Figure 2-5). Another "birds-eye view" of the city, undated but subsequent to the first, shows a large house situated in the middle of the present MGP site. In the early 20th century, a cotton mill operated along Mill Street east of the site, making use of the head races from the Mohawk River which crossed the site (Figure 2-6).

On December 31, 1915, Kingsley's widow and son sold the property to the Rome Gas, Electric Light and Power Company (the Company). A second gas plant for the city was then erected on the site. The first MGP was located on Madison Street adjacent to the Erie Canal. It was constructed in the early 1850s. The Kingsley property has been transferred intact to the



KINGSLEY AVENUE SITE, ROME, N.Y.
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FIGURE 2-4
1860 APPROPRIATION SURVEY

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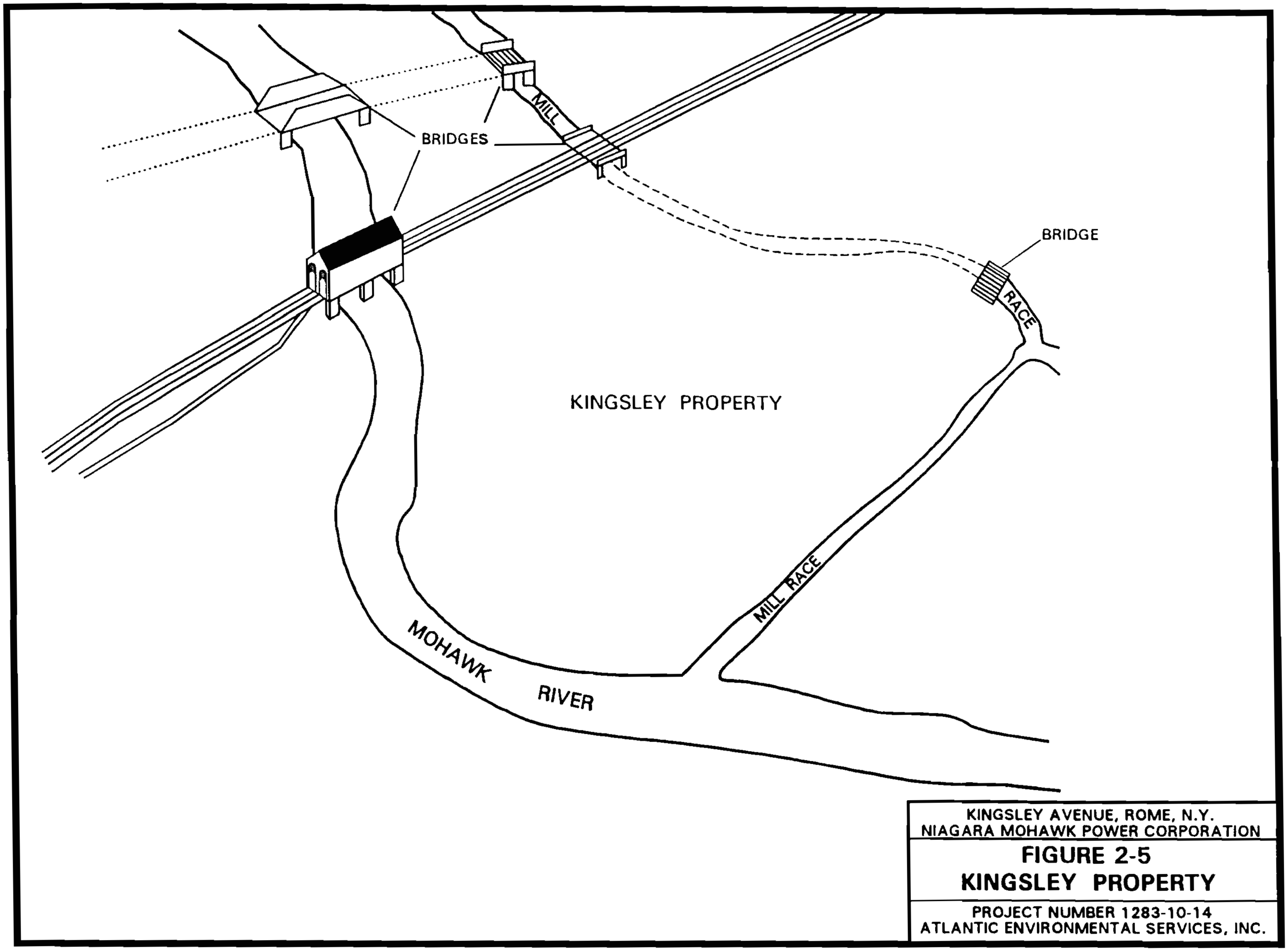

KINGSLEY AVENUE, ROME, N.Y.
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FIGURE 2-5
KINGSLEY PROPERTY

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ROME TABLE 2-1
SUMMARY OF LAND TRANSACTIONS

Parcel	Action	Grantor	Grantee	Date	Acres
Entire	Sale	William Hughes	Willey J.P. Kingsley	5/1/1873	12.7828
1	Sale	W.J.P. Kingsley and G. M. Kingsley	NYCHRRC	12/15/1873	.32
2	Sale	W.J.P. Kingsley	C. Loomis Allen	10/3/11	.29
R-O-W		C. Loomis Allen	W.J.P. Kingsley	10/5/11	-
3	Sale	W.L. Kingsley and Georgeanna Kingsley	RGELPC	12/31/15	11.618
3	Mortgage	RGELPC	Rome Trust Co.	12/1/16	-
3	Sale	RGELPC	NNYU	4/23/24	11.618
3	Mortgage	NNYU	ETCNY	5/2/21	-
3	Supplemental Mortgage	NNYU	ETCNY	7/1/25	-
3	Assignment	ETCNY	CNBNY	5/28/30	-

NYCHRRC -> New York Central and Hudson River Railroad Company
R-O-W -> Right-of-way
RGELPC -> Rome Gas Electric Light and Power Company
NNYU -> Northern New York Utilities, Inc.
ETCNY -> The Equitable Trust Company of New York
CNBNY -> Chase National Bank of New York

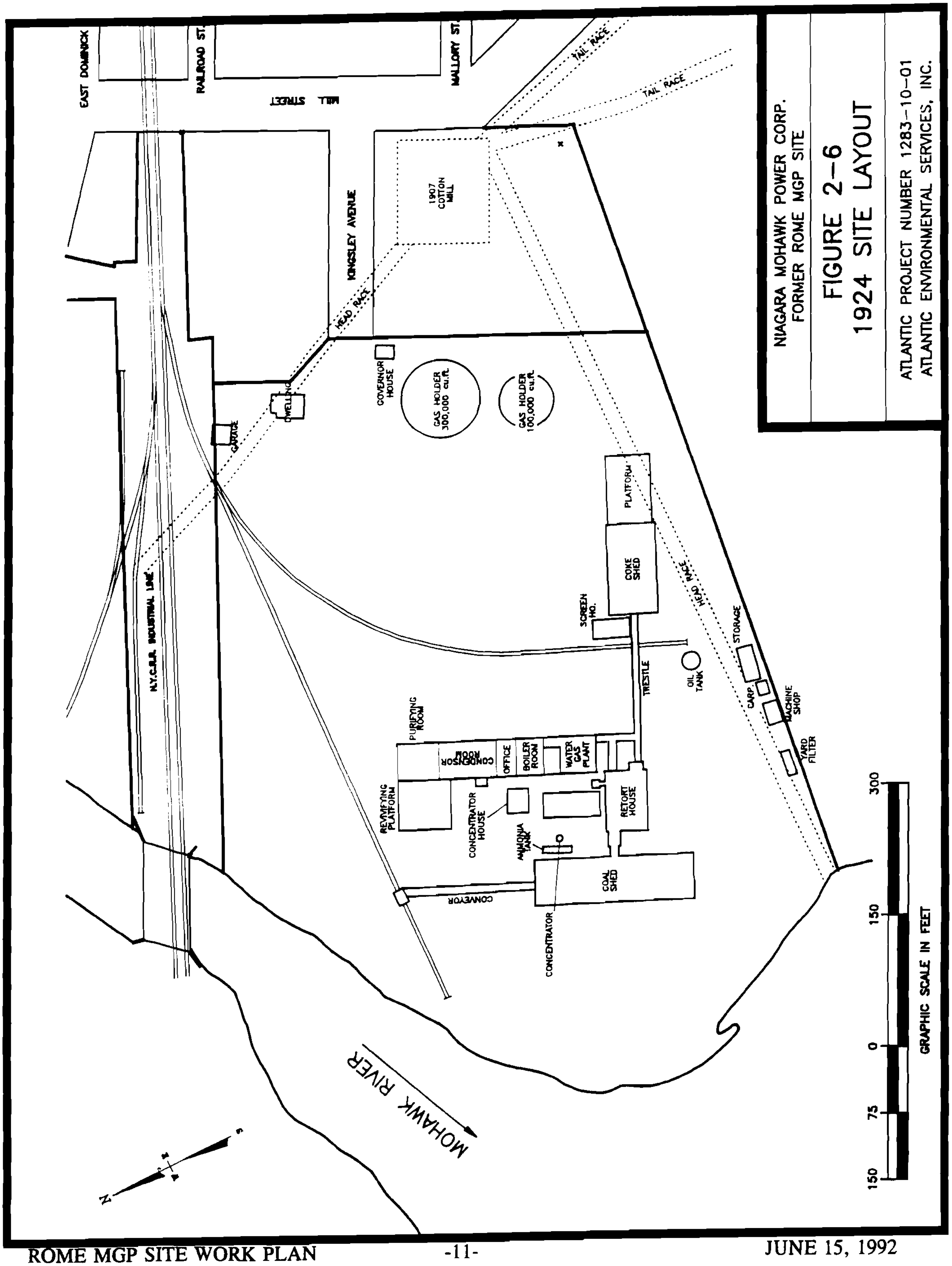

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FIGURE 2–6
1924 SITE LAYOUT

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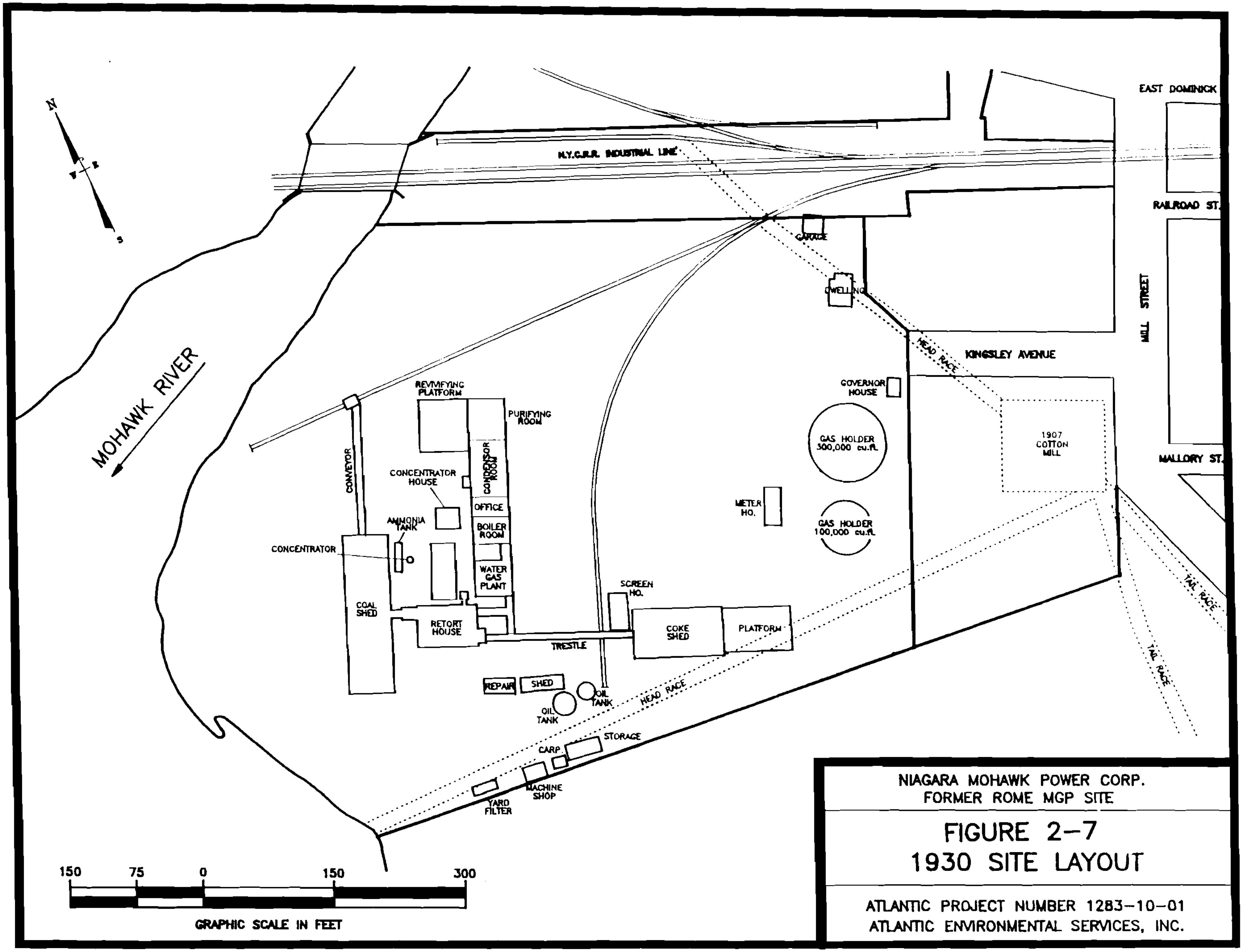
present (Table 2-1). In 1917, the Company owned forty miles of gas pipeline and serviced 3556 customers with 81 million cubic feet of coal gas and "Lowe Process" water gas. The percentage of this figure produced at Kingsley Avenue is not known.

Structures which comprised the MGP operation in 1924 included an office, water gas plant, condenser room and purifying room housed linearly in a brick building (Figure 2-6). A separate retort house (for coal gasification) with associated coal supply structures (conveyor shed) and coke product structures (throttle, shed, concrete platform) was present also. Structures ancillary to coal gas production such as a governor house, an ammonia tank, oil tank, machine shop, storage sheds, and gas holders (100,000 and 300,000 cubic foot capacities) completed the make-up of this industrial site. A concrete "revivifying platform" was located adjacent to the purifying house. Two rail spurs (coal supply and coke removal) traversed the site.

By 1930, superficial changes were evident (Figure 2-7), involving sheds and a repair shop, meter house, roadways and storage tanks. In 1949, the coal gas manufacturing operation was absent, however, a residence had been added on Kingsley Avenue adjacent to the eastern boundary of the site, near the gas holders.

Assets of Rome Gas, Electric Light and Power were transferred, in April 1923, to Northern New York Utilities. Although it is reported that subsequent to the transfer the Kingsley Avenue site was used solely as a gas regulator station, records for 1927 indicate that gas production in Rome reached peaks at 151 million cubic feet of coal gas and 17 million cubic feet of water gas (Brown's Directory). According to Brown's, holder capacity is listed at 650,000 cubic feet and relief capacity at 100,000 cubic feet, indicating that total volume figures were a composite of production from the Kingsley Avenue MGP and the Madison Street plant.

By 1930 the city was supplied with gas from a new facility in Watertown. Local gas



NIAGARA MOHAWK POWER CORP.
FORMER ROME MGP SITE

FIGURE 2-7
1930 SITE LAYOUT

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production apparently ceased; except perhaps for some emergency capacity. The retort house and relief holder were demolished between 1938 and 1941, while the main gas holder was not dismantled until 1959. The gas plant structure served as a service and maintenance facility until September 1987. The site is currently used as an unmanned gas regulator station, and for access to the electric substation.

The parcel comprising the electric substation south of the MGP site was acquired by Northern New York Utilities in 1924. When their successor, the Central New York Power Corporation, took title to the conterminous "old canal feeder strip" in 1941, the holdings reached the extent conveyed to NMPC in 1950.

Since coke was a product generated by the "Lowe process" method of water gas production, a coal gasification production process also operated at the Kingsley Avenue site. The following sections describe each of these processes.

2.2.2 Water Gas Process

To produce gas using water gas processes a supply of anthracite coal was shipped by train to the site and stored on the ground, near the railroad right-of-way. Gas oil was stored in a tank located in the southern part of the site. The water gas generators operated in the west central part of the site. Steam was passed through the burning coal to form hydrogen and carbon monoxide. This gaseous mixture then passed through a super-heater where oil was sprayed. The oil cracked into light fractions which mixed with the generator gas to form raw illuminating gas. This gas moved to a holder where condensation removed tar and water. The gas was then purified by washing with hydrocarbon wash oil for removal of naphthalene and light oil and moving through beds of lime and/or wood chips treated with iron oxides for removal of cyanide and sulfur. The clean gas was stored in distribution holders.

Principal wastes generated by this process included ash, oils and tars, and spent purifier waste. The chemical characteristics of the ash, oil and tar depended on the characteristics of feed stock. The tars produced varied with the weight of the oil used in the production process, i.e., relatively light tars developed from light oil, and heavy tars were produced by heavy oils.

Naphtha was commonly used as the carburetion oil in the early carbureted water gas process which began in the 1880s; tar production was from 1.7 to 3.5 percent of the original naphtha (Harkins, et al., 1988). With increased use of the naphtha fraction as fuel for the internal combustion engine, heavier, more viscous fractions were used for gas production. Tar production from the heavier oils was 12 to 18 percent (by volume) of the original carburetion oils. By the late 1940s even heavier fuel oils were used. Production of tar by-products increased to levels as high as 25 percent of the oil feed to the process. The tars generated by the carbureted water gas process did not contain phenolic compounds.

Tar/water emulsions commonly formed during water gas processes from condensation of the raw gas product in the presence of excess steam. The properties of the emulsions were governed by the nature of the coal or hydrocarbons with which they were formed. If water content was low ($\leq$ 25 percent) the emulsions could be used for fuels; if water content was high, the emulsions were commonly used as a dust suppressant when not handled as a waste product.

The light oil and naphthalenes were recovered from hydrocarbon wash oil via distillation and crystallization processes, respectively. The oil and naphthalenes were moveable by-products if markets existed. Otherwise, they were recycled as part of the wash oil.

Solid wastes generated by the water gas process included spent purifier wood chips and lime sludge. In addition to the target impurities, these washes contained hydrocarbons (tars and oils). While the wood purifiers were regenerated routinely, they comprised significant solid waste which was commonly used for fill on the MGP site.

Waste waters from the water gas process consisted largely of tar/oil/water which was treated in a separator then discharged to a local surface water body. The recovered tars and oils were combined with other by-products or managed as waste material.

2.2.3 Coal Gas Process

The coal carbonization process for gas production was more complex than water gas production; it produced gas with higher BTU content than water gas and valuable by-products such as coke, tars, and ammonia. In the early carbonization process bituminous coal was heated in retorts or beehive ovens. A former NMPC employee recalled use of beehive ovens at the Kingsley Avenue site. Generated gas was captured and subsequently purified and distributed. Remaining coke in the ovens was recovered and processed for sale. The generated gas contained tar, ammonia liquor, hydrogen sulfide, oils, naphthalene, sulphur and cyanide.

The gas moved through an air or water cooled apparatus after production where heavy tars and water condensed and were removed. Secondary removal of tar involved condensers. Additional removal of tar aerosols could have been achieved with extractors, precipitators or wood shavings. This step reduced the amount of tar entering the iron oxide purifier boxes, thereby extending the life of the purifier material.

Hydrogen Sulfide

Hydrogen sulfide was produced during coal carbonization in direct relation to the sulphur concentration in the coal. Early removal of hydrogen sulfide was accomplished with lime which also removed carbon dioxide. The process was not efficient and the spent lime could not be regenerated. As a result, a large amount of waste was produced. The development of iron oxide treatment reduced the amount of waste generated because the iron oxide medium (chiefly treated wood chips) could be renewed after use. Early revivification or reviving of the purifier medium was accomplished by manually removing the chips from purifier boxes, exposing them to air then replacing them in the purifier boxes. The Kingsley Avenue gas plant included a revivifying platform (Figure 2-5). The process could result in ignition of tars and chips because the regeneration of the oxide was exothermic. Later processes included automated addition of air to the gas mixture upon entry to the purifiers.

Cyanide

Cyanide impurities were either recovered as a product (rarely), or removed as a waste. The processes used for removal of hydrogen sulfide were also effective in removing cyanide because both are acid gasses. Cyanide as cyanogen was present in coal gas at concentrations between 0.12 and 0.20 percent. Early removal processes involved passage of the gas through beds of hydrated lime. Iron impurities in the lime would remove the cyanide, but the process was wasteful. Wood chips treated with iron oxide proved a more efficient remedy because the wood chips could be revived and reused before final disposal. The cyanide reacted with iron oxide or iron sulfide in the wood chips to form complex iron cyanides. The exhausted purifier wood chips were commonly disposed as fill in the vicinity of the gasification plant. A former NMPC employee who was not present during gas production times, recalls that "dark" oily soils characterized the roadway to the substation located south of the MGP facilities.

Tar

Tars produced during the coal carbonization process were useful either as recycled materials for the gasification plant, fuel or sealer for example, or as a marketable product. If recovered for marketing, the raw tars could be collected and sold to processors or fed to a tar processing operation at or near the gas plant.

2.3 Site Setting

This section describes the physiographic, climatic, geologic and hydrogeologic setting of the Kingsley Avenue MGP site. The information presented in this section has been obtained chiefly from the USGS Rome Quadrangle Map and *Roadside Geology of New York* (Van Direr, 1985).

2.3.1 Physiography and Climate

The Kingsley Avenue site is located approximately 2,000 feet north of the confluence of the Mohawk River and New York State Barge Canal in Rome, New York. The site stands on a flood plain formed by a river meander. Two small dams installed on the river for management of the Barge Canal are located between the site and confluence with the canal (Figure 2-3).

Rome is located in the Mohawk Valley climatological division (NOAA, 1990). Weather conditions are subject to seasonal fluctuations in temperature, precipitation, prevailing wind and air turbulence. Temperatures in Rome during 1990 ranged from -13°F to 93°F. Average annual precipitation is approximately 44 inches. Rainfall events occur throughout the year with an extended period of low occurrence from June to October. However, average total rainfall per month tends to peak during June and July. Based on a 30 year record (Northeast Regional Climate Center), the 24 hour rainfall expected with 50 percent probability during a two year period is 2.75 inches.

Wind frequency data collected at Griffiss Air Force Base in Rome, New York (two miles northeast of the site) over a ten year period (1967-1977) shows that predominant winds come from the east-southeast (11.9 percent) and west-northwest (12.9 percent). East, southeast and westerly winds are also prevalent, 6.5, 7.8, and 9.3 percent, respectively.

2.3.2 Geologic Setting

Rome is located in the vicinity of the early drainage system for the Great Lakes, which included the glacial Lake Iroquois and a much larger Mohawk River. The presently existing Oneida Lake, 15 miles west of Rome, is a shallow remnant of Lake Iroquois. The formation of the St. Lawrence drainage, due to receding glaciers resulted in the development of the broad Mohawk Valley as the Lakes' drainage shifted to the St. Lawrence. Because Rome is located near the outer limit of significant glacial advance and was subject to multiple geologic processes, e.g., outwash, sedimentation and erosion, a somewhat varied landscape exists over general bedrock features of Ordovician shale.

2.3.3 Hydrogeologic Setting and Water Use

Hydrogeologic information in the Rome area was derived from NMPC files, historic maps and the USGS 7.5 minute quadrangle map of Rome.

2.3.3.1 Ground Water

Surface soil at the Kingsley Avenue site is highly permeable. The surficial aquifer is unconfined and the water table depth is approximately ten feet. Head races previously crossed the site on the north and south sides. Now buried, the interaction of these features is unknown with relation to natural ground water levels and movement. Non-aqueous phase liquid (NAPL) was observed during a repair excavation in 1985 between the former service building and gas regulator.

2.3.3.2 Surface Water

The City of Rome and Griffiss Air Base receive potable water from the East Branch Fish Creek, which is about ten miles northwest of the site. The closest surface water body to the Kingsley Avenue site is the adjacent Mohawk River. River flows in the Rome area are controlled by releases from Delta Dam, which is located approximately 5.5 miles upstream from the site. Between Delta Dam and the site, the Mohawk River is approximately 165 feet wide; substrate is mostly gravel with some rubble. The gradient is 8 feet per mile. The controlled flow is generally in excess of 100 cfs. The confluence of the River and Barge Canal is immediately east of Guard Gate 7 on the Barge Canal. Guard Gate 6 is approximately 3.3 miles downstream. Between these gates, the River is a backwater area; most of the flow is intercepted by the Barge Canal. At Guard Gate 6, a city sewer discharge enters at an average rate of 14.5 cfs; combined with overflow from the barge canal, total flow in the river at Guard Gate 6 is approximately 50 cfs.

The New York State Barge Canal extends between Lake Ontario and Albany, New York. The Canal is a major transportation artery and recreational waterway. In Rome, the canal lies south of the highly developed parts of the city, including the Kingsley Avenue MGP site. Any drainage to the canal from the site would be via the Mohawk River or ground water; no direct connection exists.

2.4 Previous Investigations

Site inspections by NMPC during 1982 and 1986 involved reconnaissance level observations regarding site layout (1982) and evidence of gas manufacturing processes (1986). Blue-stained soil and rocks and characteristic purifier waste odors were noted west of the service building, and adjacent to the Mohawk River. In 1988, the NYSDEC sampled surface soils and waste materials in some of the areas observed during 1986. Results from analysis of these samples documented the presence of volatile and semi-volatile organic compounds associated with MGP washes, i.e., PAH semi-volatile compounds, phenols and volatile benzene, toluene and styrene. Elevated levels of cyanide and lead were also noted by NYSDEC.

During a water line repair in 1985 coal tar was observed in an excavation located between the service building and gas regulator.

3.0 FIELD MOBILIZATION

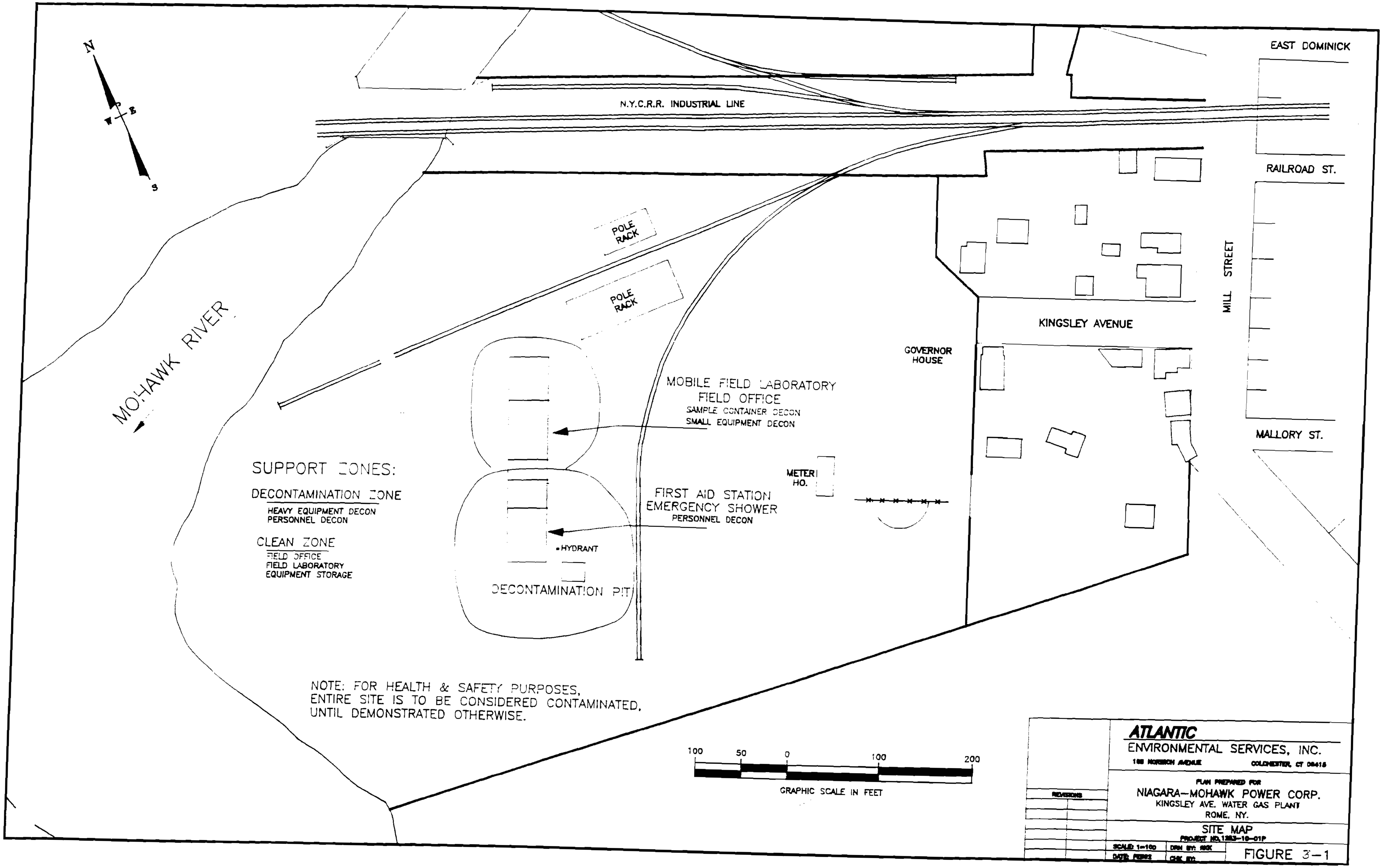
Upon approval of this Work Plan and subsequent authorization from NMPC, Atlantic will mobilize to the Kingsley Avenue site. Locations for the field laboratory (service building) and decontamination pad have been identified in consultation with NMPC staff (Figure 3-1). An improved area within the vacant service building will serve as a field office laboratory. It is estimated that field mobilization will be completed during the first of five days scheduled for test pit excavations. A site-specific Health and Safety Plan (HASP) has also been prepared for the Kingsley Avenue site as a separate document.

Mobilization will include the following elements, which are discussed separately in subsequent sections.

- Establish a decontamination area.
- Establish a field laboratory.
- Establish a waste storage area.
- Identify sampling locations and mark underground utilities.
- Mobilize heavy equipment to the site.
- Evaluate emergency procedures.
- Conduct onsite safety briefing.

3.1 Establish Decontamination Area

An equipment decontamination area will be established within the fenced perimeter of the NMPC facility. Final location of the decontamination area will be determined after consultation with the NMPC facility manager to ensure limited interference with routine onsite operations. Drilling equipment (drill rods, augers and core barrels) will be steam cleaned over a portable trough to collect wastewater. Immediately adjacent to the equipment decontamination area there will be facilities for boot and glove washing, disposable coverall removal and hand washing. Wastewater from equipment and personnel decontamination activities will be stored within a 1,000 gallon plastic storage tank which will be delivered to the site during the first two



SUPPORT ZONES:

DECONTAMINATION ZONE
HEAVY EQUIPMENT DECON
PERSONNEL DECON

CLEAN ZONE
FIELD OFFICE
FIELD LABORATORY
EQUIPMENT STORAGE

NOTE: FOR HEALTH & SAFETY PURPOSES, ENTIRE SITE IS TO BE CONSIDERED CONTAMINATED, UNTIL DEMONSTRATED OTHERWISE.

ATLANTIC
ENVIRONMENTAL SERVICES, INC.
188 NORWICH AVENUE COLCHESTER, CT 06415

PLAN PREPARED FOR
NIAGARA-MOHAWK POWER CORP.
KINGSLEY AVE. WATER GAS PLANT
ROME, NY.

SITE MAP
PROJECT NO.1283-10-01P

SCALE: 1=100
DATE: FEB92
DRN BY: MKK
CHK BY:

FIGURE 3-1

days of the investigation.

3.2 Establish A Field Laboratory

The designated space within the former NMPC service building will be secured as a field laboratory. Sample preparation and screening for NAPLs will take place in this building. The HNu Photoionization Detector (PID) used for organic vapor monitoring during the drilling and test pit programs will be stored and calibrated in the field laboratory. In addition, precleaned and prepreserved sample containers, deionized water, decontamination solutions and coolers will be stored in this area.

3.3 Establish Waste Storage Area

Waste liquids (waste steam cleaning water, decontamination solutions, well development water) will be stored in a 1,000 gallon plastic storage tank located at the decontamination pad. Drums used to contain solid wastes for offsite disposal will also be located at the decontamination pad. Waste management is described in detail in the Waste Management Plan.

3.4 Identify Sampling Locations

A site map depicting locations of underground utilities and proposed sampling locations is provided as Plate 1 of this Work Plan. The utility locations were derived from information compiled in conjunction with NMPC. Underground utilities were marked by NMPC gas and electric locators to facilitate establishment of sampling locations. Reference was made to city plans and maps for stormwater, sanitary sewer and potable water lines.

3.5 Mobilize Heavy Equipment to Site

A backhoe will be delivered to the site initially and parked in a designated parking area within the fenced perimeter of the NMPC facility. A drill rig will also be mobilized to the site and parked in the designated heavy equipment area. All small tools associated with drilling activities will be secured within locked equipment boxes on the drill rig.

3.6 Evaluate Emergency Procedures

Emergency procedures, specifically routes of emergency egress, will be evaluated. This will be done to ensure that routes of emergency egress from all boring and test pit locations cannot be temporarily blocked. A drive to Rome-Murphy Memorial Hospital will be conducted to verify that the route identified in the Health and Safety Plan (HASP) is the most efficient route and is understood by project personnel. Instructions will be posted within the field laboratory.

3.7 Conduct Onsite Safety Briefing

Prior to any field activities, a safety briefing will be conducted by the Atlantic site safety supervisor to review potential hazards, explain the HASP, obtain safety training and medical histories of all those working at the site, and to answer questions relative to planned activities. This safety briefing is explained in greater detail in the HASP (Section 4.2). A meeting will also be held to inform NMPC personnel on the nature and schedule of field activities. The NMPC facility manager will be updated on the schedule of field activities on a daily basis to minimize potential impacts to routine site operations.

4.0 FIELD INVESTIGATIONS

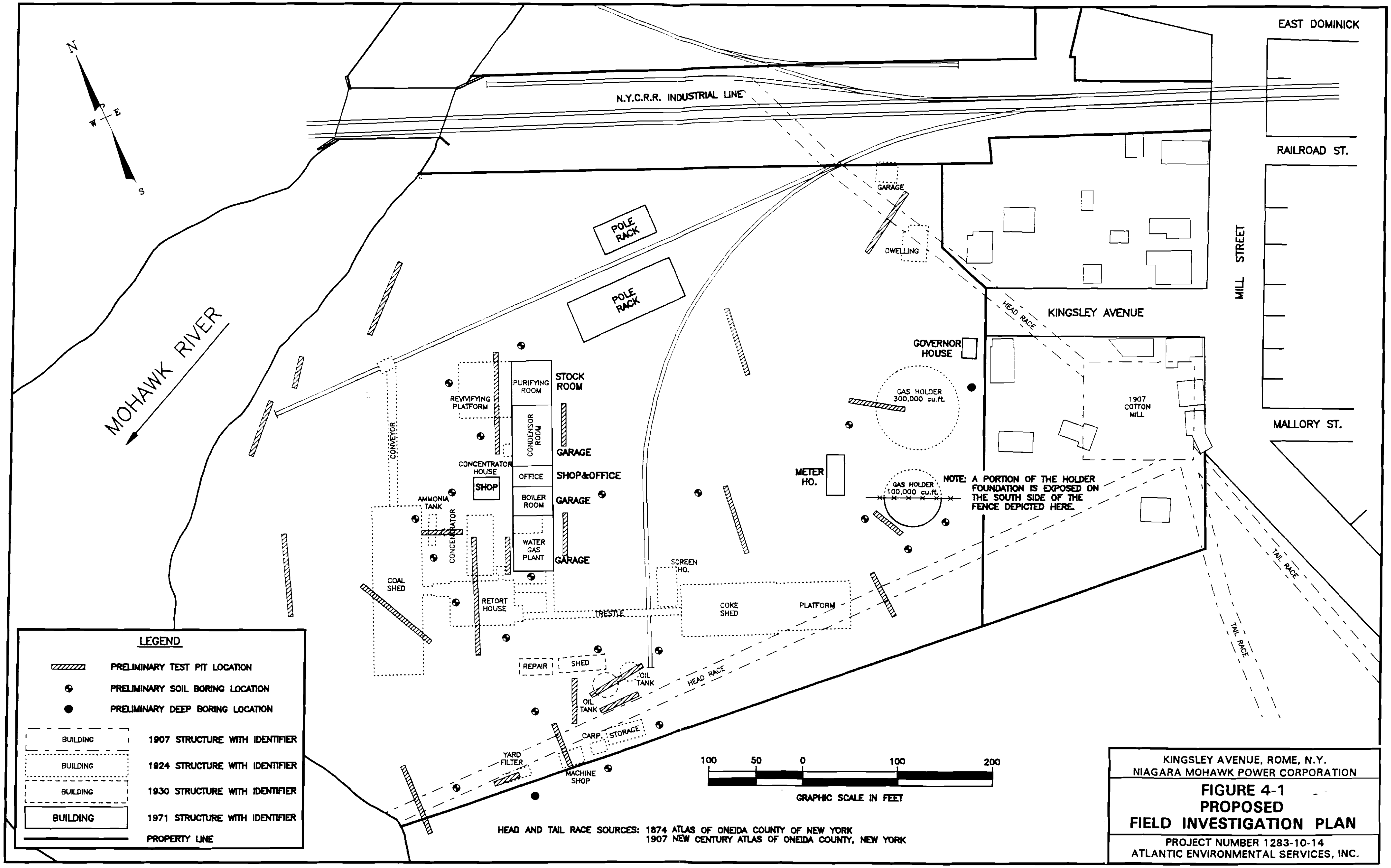
The field investigation program at Kingsley Avenue will consist of two types of investigations: test pits and borings. Sampling of environmental media will also be conducted during each type of investigation. A preliminary layout of the field investigation program is shown on Figure 4-1 and descriptions of these programs are provided in Sections 4.1 and 4.2 of this plan. This layout is based on an historic evaluation undertaken by Atlantic for purposes of this program. Final locations of all investigation points will be surveyed and mapped for presentation purposes. The environmental media to be sampled during the field investigation program include surface soils, subsurface soils, and ground water which are associated with the chemical mapping of source areas.

The objectives of the field program are to:

- determine the presence and areal extent of MGP related waste sources;
- identify potential pathways for transport/migration of contaminants;
- determine the site controlling geological and hydrological features; and
- provide site specific engineering data for evaluation of IRMs.

4.1 Test Pit Excavations

It has been Atlantic's experience that excavation of test pits is an efficient method for characterizing broad areas of MGP sites at shallow depths (five to twelve feet). As with any site investigation technique, test pits have limitations as well as advantages, but can prove to be a powerful component of a site characterization program. Test pits provide a great deal of information regarding subsurface structural and stratigraphic relationships which cannot be obtained in the "point" view afforded by test borings. The distribution of contaminants relative to buried structures and stratigraphic inhomogeneities can be laterally mapped and interpreted



HEAD AND TAIL RACE SOURCES: 1874 ATLAS OF ONEIDA COUNTY OF NEW YORK
1907 NEW CENTURY ATLAS OF ONEIDA COUNTY, NEW YORK

KINGSLEY AVENUE, ROME, N.Y.
NIAGARA MOHAWK POWER CORPORATION

FIGURE 4-1
PROPOSED FIELD INVESTIGATION PLAN

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ATLANTIC ENVIRONMENTAL SERVICES, INC.

from the three-dimensional perspective provided by test pits. The visual subsurface information can also be recorded on film or videotape for later study and evaluation. The primary drawbacks associated with test pit excavations include depth limitations due to slope stability and intersection with the water table and the inability to easily investigate under areas covered by concrete slab.

Atlantic anticipates five days of backhoe work, which will begin June 22, 1992. A minimum of 23 test pits will be excavated at the site. Proposed test pit locations are depicted on Figure 4-1. Table 4-1 presents a brief rationale for test pit locations identified on Figure 4-1. Final locations will be established subsequent to the location of all subsurface utilities. Additional test pits may be warranted based on findings at the planned test pits. The majority of test pits will be located in the western part of the site due to the concentration of former MGP structures in that area. Test pit excavation in the eastern part of the site will be near the former holders and in previously unused areas to confirm the absence of MGP wastes. Excavations along the southern boundary of the site will be concentrated near the locations of former MGP structures such as oil tanks, shops and sheds. Several test pits are planned for investigation of a head race which previously crossed the site.

Test pits will be excavated using a backhoe with a minimum reach of 12 feet. In paved areas saw cuts will be made prior to digging. The soils and waste products encountered in the pits will be logged and photographed according to Atlantic Procedure No. 1031. A videotaped record of each test pit excavation will be made. Field personnel will dress in modified Level D as described in the HASP.

Material excavated from test pits will be staged on plywood underlain by impervious plastic sheeting. Each backhoe bucket will be inspected visually and screened with an organic

TABLE 4-1
PLANNED TEST PIT INVESTIGATION RATIONALE
ROME IRM PROGRAM

Method	Location[a]	Rationale
Test Pit Excavation	Former MGP structure; one gas holder, one retort house, one concentrator, one revivifying house, one coal shed, two oil tanks, one yard filter, one machine shop.	Locate residuals wastes from MGP operation.
	Upgradient of one condenser room and one gas plant.	Extent of any residual wastes.
	Four areas downgradient from former MGP structures.	Extent of any residual wastes.
	Four former head race areas.	Determine if wastes migrate via the races.
	Two sides of surface purifier wastes.	Extent of any residual wastes.
	Two generally downgradient areas.	Extent of any residual wastes.

a) Refer to Figure 4-1

vapor meter. Clean excavated material will be staged to one side of the pit and contaminated material to the opposite side. If grossly contaminated material (e.g., soil with free flowing tar) is encountered, it will be placed back into the excavation after evaluation. Excavated soils will be backfilled into the test pit. Each test pit will be leveled at grade with clean material. When closed, the test pits will be finished with cold patch asphalt placed over compacted backfill. The backhoe will be completely decontaminated after completion of the final test pit, prior to leaving the site.

Samples with obvious source material in them will be screened using a field test for NAPL and then sent for rapid PAH determination. Fringe source areas will be defined using the same methods. The NAPL test involves a centrifuge method for NAPL screening is based on ASTM Method D-1796, Standard Test Method for Water and Sediment in Fuel Oils by the Centrifuge Method (Laboratory Procedure), 1990 and experience during remediation work at Site 24.

- Approximately 10 g of soil are placed in a 14 mm x 19 mm thin wall, UltraTube from Nalgene which has had a small 1/8" hold drilled in the bottom center, and which has had a thin layer of glass wool placed in the inside bottom. These tubes are a soft, translucent polyallomer. The sample will occupy approximately three fourths of the volume of the tube.

- The UltraTube with sample is then placed inside a 15 ml conical, graduated, polycarbonate centrifuge tube from Nalgene. These tubes are hard and transparent. The UltraTube will drop down approximately two thirds of the way into the centrifuge tube.
- The sample is then spun at 2,300 RPM (900 rcf for a 12" diameter swing) in a benchtop centrifuge for 15 minutes (longer periods can be used if there is a visual indication that coal tar can be recovered with extended time). Any water and mobile NAPL will collect in the conical centrifuge tube.
- Once the sample is removed, the volume of DNAPL, LNAPL, and water can often be estimated by visual inspection of the markings on the centrifuge tube. The UltraTube with the remaining sample is then discarded. The polycarbonate centrifuge tube often can be cleaned and reused by washing with Citraclean and rinsing with methanol.

Bulk samples of contaminated soil will be collected from test pits for treatability analyses using sampling protocol developed for this project. This procedure should result in TCLP analytical results being representative of materials handled during an IRM involving source removal. The protocol for this sampling effort is as follows:

- multiple bulk samples will be taken for up to three identified waste source areas;
- one composite sample from each waste source area will be obtained for analysis;
- bulk samples from a given waste source will be emptied onto plywood sheets and lightly overturned with a hand shovel; and
- bulk material will be allowed to sit for up to four hours prior to sampling.

4.2 Test Borings and Subsurface Soil Sampling

A total of 25 borings will be drilled and sampled at the Kingsley Avenue site. One boring will be completed as a monitoring well. The well installation details is presented in Section 4.3. The remaining borings will be grouted to the surface upon completion. The approximate locations of test borings and monitoring wells are illustrated on Figure 4-1. Table

4-2 presents a brief rationale for borings and monitoring wells identified on Figure 4-1. Exact locations will be determined in the field and will depend on accessibility, proximity of underground and overhead utilities, and test pit excavation information. Additional borings may be required to characterize contamination boundaries and will be drilled if feasible. At the conclusion of the boring program, the location and elevation of all borings will be surveyed.

TABLE 4-2
PLANNED BORING INVESTIGATION RATIONALE
ROME IRM PROGRAM

Method	Location[a]	Rationale
Boring	Two gas holders.	Quantification of residual wastes.
	Eight areas in vicinity of former MGP structures.	Extent of any source areas and subsurface geology.
	Two deep borings.	Geology to bedrock.
	One head race.	Determine if residual wastes migrated or accumulated.
	Two mid-site areas.	Determine if residual wastes migrated or accumulated.
Ground Water Monitoring Well	One selected in field.	Quality of ground water likely to be encountered during IRM actions.

a) Refer to Figure 4-1

Drilling will proceed using hollow stem auger (HSA) methods. Each boring will be advanced to a depth of at least 25 feet or clean soils, or to auger refusal. When drilling inside structures, care will be taken not to penetrate the bottoms. Soil samples will be obtained in advance of augers using split-spoon samplers.

Each boring will be logged by an Atlantic geologist. Soil samples will be screened for organic vapor emissions according to Atlantic Procedure No. 1051, using an HNu photoionization detector, and will be field characterized visually and by odor. Potentially contaminated soil samples representative of source areas will be collected from the central portion of each soil core, away from the sampler walls to minimize potential cross-contamination. Samples which lack clear evidence of being a source will be screened in the field laboratory using the NAPL test.

Each soil sample will be logged and numbered according to the following scheme:

Example: KB123

Where:
K = Kingsley Avenue
B = Boring
12 = Location 12
3 = Sample 3

Samples to be shipped for laboratory analysis will be placed in a cooled ice chest for preservation and shipped to the laboratory by overnight courier within 24 hours of collection.

Based on experience at other MGP sites, modified Level D personnel protection is planned as described in the HASP. Split-spoon samplers will be decontaminated between sampling events in the following sequence:

1. Alconox and tap water wash;
2. tap water rinse;
3. methanol rinse; and
4. final distilled/deionized water rinse.

For heavy contamination, Citraclean (a tar cutting product) will be used also.

One field blank will be collected for each week of sampling to assess completeness of sampler decontamination. After the sampler has been decontaminated and prior to collecting the next sample, the sampler will be rinsed with deionized water and the rinsate collected as the field blank. Augers and drill rods will be steam cleaned between boring locations. Cuttings from wells will be contained and handled as specified in the Waste Management Plan. All test borings will be grouted to grade upon completion.

It is anticipated that approximately 100 soil samples will be collected from the test pit/boring program (including the monitoring well boring) for laboratory analysis (Table 4-3).

TABLE 4-3
ESTIMATED NUMBERS OF LABORATORY ANALYSES

	ROME
Test Pit Bulk Samples	
Engineering Analyses[1]	3
Chemical Analyses[2]	3
Fringe Boring Samples	
PAH Analysis[3]	100
NYS ASP Superfund TCL Organics[4]	5
Ground Water	
Engineering Analyses[5]	1
Chemical Analyses[6]	1
Waste Water	
Engineering Analyses[5]	1
Chemical Analyses[6]	1
Waste Soils	
Engineering Analyses	6
Chemical Analyses	6

NOTES:
1. Engineering Analyses: TCLP, RCRA hazardous characteristics, total petroleum hydrocarbons, total organic halogens, percent ash, BTU content, moisture content.
2. Chemical Analyses: RCRA Target Compound List Organics, RCRA Target Analyte List Inorganics.
3. PAH Analysis by gas chromatography developed under an EPRI research contract.
4. Gas chromatography/mass spectrometry
5. Engineering Analyses: pH, Biological Oxygen Demand, Chemical Oxygen Demand, Total Organic Carbon, Total Suspended Solids.
6. Chemical Analyses: RCRA Target Compound List Organics, RCRA Target Analyte List Inorganics.

The sampling-analysis strategy for soil samples is to collect approximately 25% of the total number of samples (25 samples) from areas which are visibly contaminated and/or display HNu readings greater than 50 ppm during screening. Analyses of these samples will be used to chemically characterize the wastes identified at the site. An attempt will be made to sample a variety of residues/wastes rather than to duplicate the same type of waste characterization (i.e., not every tarry soil encountered needs to be analyzed by a laboratory). The remaining 75% of the samples will be collected at inferred boundary zones of source contaminated areas to define vertical and lateral extent of source area contamination. PAH analysis (rapid turnaround) will be checked by analyses using NYS ASP Superfund protocols.

Soil samples will be analyzed for waste stream characterization, as necessary, involving the following parameters:

- TCLP
- RCRA TCL (including herbicides/pesticides and PCBs)
- flash point
- corrosivity
- reactivity
- TPH
- TOX
- percent ash
- BTU content
- grain size
- moisture content

4.3 Monitoring Well Installation

One monitoring well will be installed at the Kingsley Avenue site. Final placement of well will be contingent on access and proximity of overhead and underground utilities, and results from the subsurface soil investigations.

A shallow well will be installed in source material in order to characterize associated ground water for disposal purposes during an IRM. Since the well is not to be used for aquifer characterization, development will not be necessary. Remedial actions to address identified sources will likely require dealing with ground water, i.e., removing it, diverting it, storing it and, possibly, disposing of it.

4.4 Ground Water Sampling

One ground water sample will be collected during the IRM site characterization immediately after well installation. The ground water sample will be analyzed for disposal purposes involving RCRA TCL parameters, including pesticides and PCBs, RCRA TAL total metals and cyanide, and engineering parameters BOD, COD, pH, TOC and TSS.

All sample glassware will be precleaned by the laboratory prior to shipment to the site. The ground water sample will be shipped to the laboratory within 24 hours of sampling.

The water level with respect to the inner well casing will be measured to 0.01 feet. The static well volume will then be calculated according to the following formula:

Example: $V = 0.163Tr^2$

Where: V = Static volume of well in gallons
T = Linear feet of static water in well
r = Inside radius of well casing in inches

Prior to sampling, a minimum of three well volumes will be purged from the well. Evacuated water will be containerized and collected in the wastewater tank.

The ground water sample will be obtained from the using a peristaltic pump for analysis of semi-volatile organics and pesticides, PCBs and inorganics. A bailer will be used to collect the volatile sample. During all ground water sampling, field personnel will be equipped with modified Level D protection, as detailed in the site HASP. Higher levels of personnel protection will be available and used at the discretion of the site safety supervisor.

Each well sample will be labelled and numbered according to the following sequence:

Example: KG08

Where: K = Kingsley Avenue
G = Ground water
08 = Well (boring) number

5.0 SAMPLE PRESERVATION AND SHIPPING

All sampling glassware will be precleaned at the laboratory prior to shipment to the field. Preservatives will be added to the precleaned containers by the laboratory prior to shipment to the site. Soil samples will be collected in precleaned laboratory glassware and cooled to 4°C. The following preservation standards for water samples are extracted from Atlantic Procedure No. 1040 and will be used for sample preservation for aqueous samples as appropriate:

TARGET PARAMETERS	PRESERVATION
Volatiles, Pesticide and PCB Organics	Cool to 4°C
Semivolatile Organics	Cool to 4°C
Metals	HNO_3 to pH below 2
Cyanide	Cool to 4°C; NaOH to pH above 12
Phenols	Cool to 4°C; H_2SO_4 to pH below 12

Preservation technique and number of sample containers will be noted in the sampling log book. The Chain-of-Custody Form (as detailed in Atlantic Procedure No. 1041) will serve as final documentation of the preservation condition of all samples prior to shipment to the analytical laboratory. All samples will be shipped to the laboratory via Federal Express and each shipment will include appropriate QA/QC samples. The Quality Assurance Program Plan (QAPP) provides details regarding preservation and shipping.

6.0 RECORDKEEPING AND DOCUMENTATION

A specific recordkeeping and site documentation plan is planned at the (Kingsley Avenue) Site. The following specific documents will be incorporated into the recordkeeping procedure:

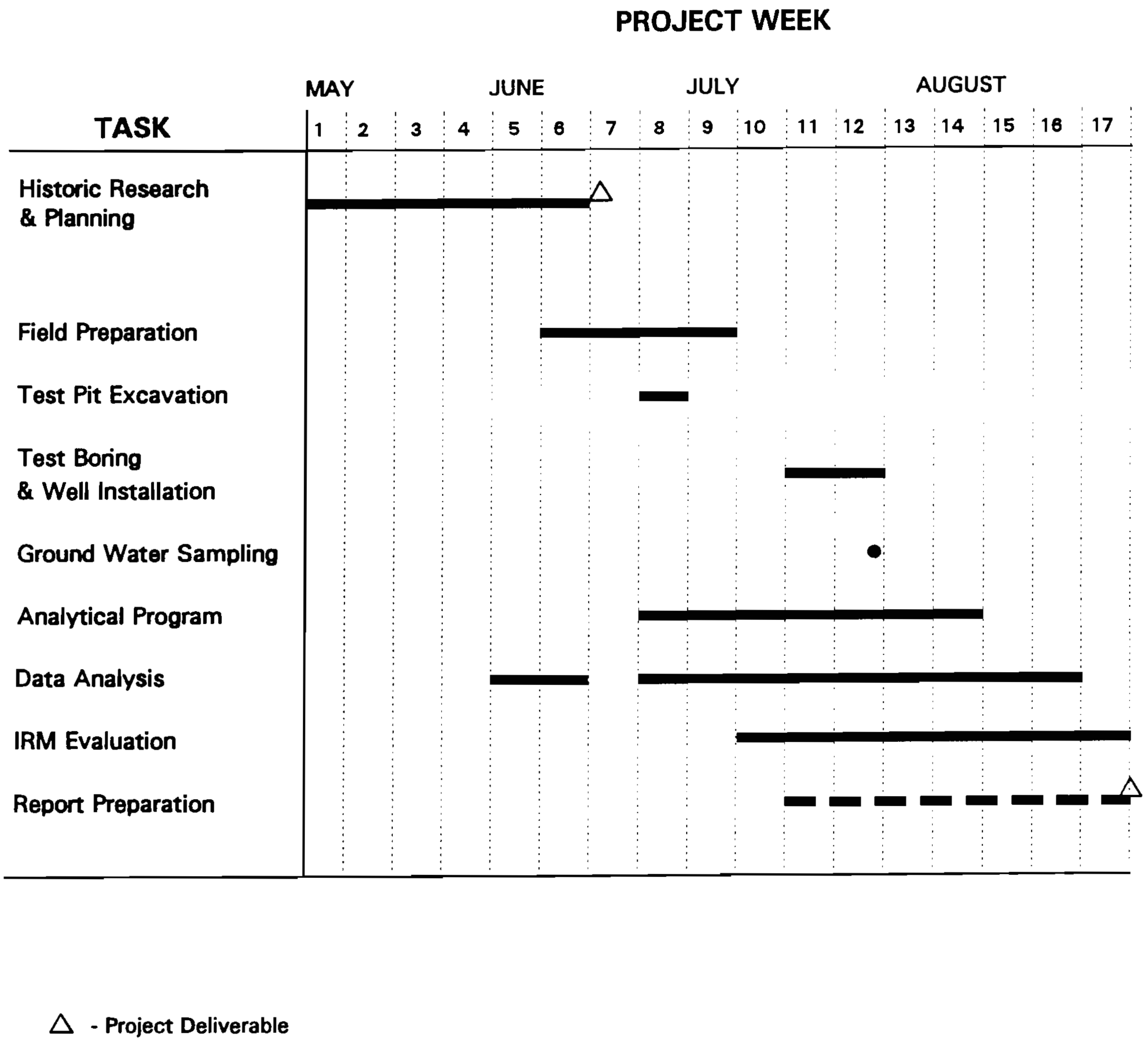
DOCUMENT	PURPOSE
Site Field Logs	Issued for each field task with a control number on it. These logs are waterproof and will be the principal document for recording field data.
Master Sample Log (MSL)	A page-numbered bound laboratory notebook that will remain in the site office to document every sample collected. At the end of each field sampling day, the field operations manager will log in all samples and list those sent to the analytical laboratory with the waybill number.
Chain-of-Custody Record	To track the possession of all samples from field to laboratory. Will be maintained with the master sample log.
Accident Report, Daily First Aid Report, Employer's First Report of Injury, and OSHA 100 Forms	Data sheets attached to the HASP and located in the site office that will document any accident occurring at the site during the field investigation.
Waybills	Once a sample shipment is accepted by the carrier, all waybill receipts will be maintained in a sealed envelope attached to the Master Sample Log (MSL). The MSL will also list which samples were shipped under specific waybill numbers.

At the conclusion of the field sampling, the site field logs and master sample log will be maintained in the project file at Atlantic's main office.

7.0 PROJECT SCHEDULE

Figure 7-1 presents Atlantic's proposed IRM Source Characterization schedule for the Kingsley Avenue site. The anticipated duration of the IRM investigation is approximately seventeen (17) weeks. Figure 7-1 also identifies project deliverable times.

Atlantic has planned for three weeks of field activity with an additional day for ground water sampling at least two weeks after well installation and development has been completed. Field mobilization will take place during the first day of the first week of field activity. Test pit excavations will be completed during the first week of the field program. Test boring, and monitoring well installation will begin at the start of the second week and be completed by the end of the third week of field activity.



KINGSLEY AVENUE SITE, ROME, N.Y.
NIAGARA MOHAWK POWER CORPORATION

FIGURE 7-1
PROJECT SCHEDULE

PROJECT NUMBER 1283-10-14
ATLANTIC ENVIRONMENTAL SERVICES, INC.

8.0 QUALITY ASSURANCE MANAGEMENT

This section presents those elements of project control which are necessary to ensure quality of the overall investigation at the (Kingsley Avenue) Site and outlines the procedures and guidelines Atlantic will follow to ensure the reliable collection and handling of sampling and analysis of data. The basic elements normally included in an EPA Quality Assurance Plan and/or Quality Assurance Project Management Plan are addressed in this section. Many of these elements are addressed in detail in previous sections of this plan, in the HASP (separate document), or in the appendices to this plan. In such cases, references to appropriate sections are made.

8.1 Project Description

The purpose of the (Kingsley Avenue) IRM investigation is to assess MGP and other potential waste source at the former MGP site for the purposes of designing a source remediation plan. Sections 3.0 and 4.0 present a detailed description of work planned and how it will be accomplished.

In summary, the proposed activities during the project will include the following:

- mobilization of staff and equipment to the site;
- excavation of at least 23 test pits;
- installation of one monitoring well;
- drilling and sampling of 25 test borings;
- chemical analysis of at least 3 bulk samples for the following: TCLP, RCRA characteristics, TPH, TOX, percent ash, BTU content, moisture content;
- chemical analysis of 100 subsurface soil samples for PAHs;
- acquisition of water table elevation data to evaluate ground water flow direction;

- chemical ground water samples for disposal characterization and to evaluate ground water quality at the site; and
- evaluation and interpretation of all data and preparation of a site characterization report.

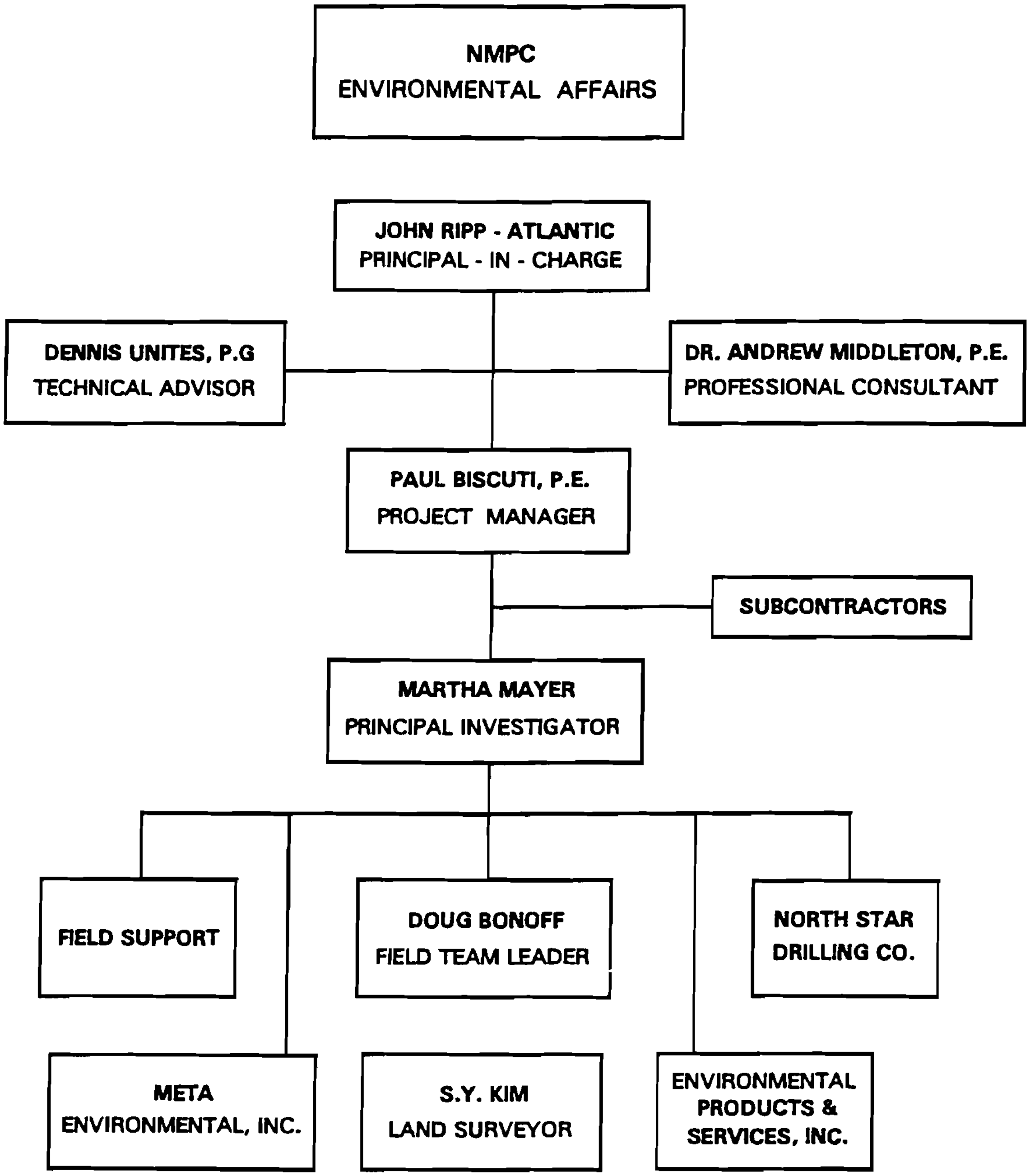
The location and number of samples, as well as the analyses to be performed, are defined in detail in preceding sections.

8.2 Project Organization And Responsibility

Atlantic will perform the quality assurance elements described in this section in accordance with EPA guidance to assure consistency through the program. Specific personnel have been identified who are responsible for implementing the quality control aspects of the project. Key positions, as identified in Figure 8-1, include the Project Manager, Technical Reviewers, Principal Investigator, and the Field GC Operator. The Project Manager will be responsible for all project activities and will have the ultimate responsibility to insure that all technical objectives are satisfied, as well as adhering to both schedule and budget. The Project Manager will be the primary point of contact for contractual matters between Atlantic and the NMPC Project Manager. He will also be responsible for preparing a monthly status report for NMPC for each month there is significant project activity.

The Technical Reviewers will insure that all project deliverables are reviewed and are of the highest technical quality. The Principal Investigator will be responsible for all field and laboratory activities, daily technical coordination and communication, and for preparation of project documents. This will also include responsibility for drilling and surveying subcontractors as well as Atlantic's technical staff.

Atlantic will subcontract drilling and analytical laboratory services. Proposed subcontractors to provide these services are:



KINGSLEY AVENUE SITE, ROME, N.Y.
NIAGARA MOHAWK POWER CORPORATION

FIGURE 8-1
ATLANTIC MANAGEMENT ORGANIZATION

PROJECT NUMBER 1283-10-14
ATLANTIC ENVIRONMENTAL SERVICES, INC.

• Drilling	North Star Drilling Cortland, New York
• Laboratories	META Environmental, Inc. Watertown, Massachusetts
	Energy and Environmental Engineering, Inc. East Cambridge, Massachusetts

With the exception of the subcontractors identified above, Atlantic proposes to complete all project work utilizing staff from the Colchester, Connecticut office. All key project personnel have significant experience in the investigation of former MGP sites. All Atlantic personnel have completed OSHA required safety training, including annual updates, and participate in the required medical monitoring program.

8.3 QA Objectives For Precision, Accuracy And Completeness

Environmental measurements have inherent limitations arising from equipment problems, procedural deviations, and changes in ambient conditions. Most environmental measurements are analyses made for extremely low concentrations of constituents and are subject to chemical interferences, instrument limitations and uncertainties that affect the accuracy of the determination. It is essential to minimize these variable factors so that the measurements accurately reflect the character of the sample collected.

All data gathered during the course of the (Kingsley Avenue) Site Study by Atlantic, and processed by the laboratory, will meet objectives of accuracy, precision, completeness, representativeness, and comparability. These characteristics are defined below:

- Accuracy - the degree of agreement of a measurement, X, with an accepted reference or true value, T, usually expressed as the difference between the two values, X-T, or the difference as a percentage of the reference or true value 100 (X-T)/T. Accuracy is a measure of the bias in a system.

- Completeness - a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under correct normal conditions.
- Representativeness - expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition.
- Comparability - expresses the confidence with which one data set can be compared to another.

Specific QA objectives for measurement parameters are outlined in the New York State Analytical Services Protocols (NYSASP) for analytical methods identified in Section 4.0. Limits of detection for individual analysis methods are discussed in the laboratory QA Manuals (Appendix B).

8.4 Sampling, Calibration And Analytical Procedures

Soils and ground water are the media to be sampled during the Kingsley Avenue site investigation. Location and number of samples are described in Section 4.0, and are based on historical site data, topography and surface features. Sampling locations will include known contaminated areas.

Specific procedures for sampling, chain-of-custody, preservation, decontamination, and sample shipping area are included in the Atlantic Technical Procedures (Appendix A).

All equipment calibration and maintenance will be performed in accordance with Atlantic Procedures (Appendix A) as applicable. Appendix B provides a description of laboratory procedures for calibration and maintenance of analytical instrumentation.

8.5 Sample Chain-of-Custody Procedures

Chain-of-custody procedures are intended to document sample possession from the time of collection to disposal, in accordance with federal guidelines. Field procedures for chain-of-custody are described in Atlantic Procedure No. 1041 (Appendix A). Laboratory procedures for chain-of-custody are described in the laboratory Quality Assurance Manual (Appendix B).

8.6 Data Reduction, Validation and Reporting

All analytical data generated during this project will be checked for validity. The results of this process will determine whether or not a sample has reportable data, is an outlier (beyond the limits of other similar data), should be re-sampled, or should not be reported.

The process is somewhat of a subjective nature in that the validity is based upon the review of the QA/QC samples. This will involve review of:

- surrogate spike recoveries;
- matrix spike recoveries;
- results of field duplicates; and
- analyses of field and trip blanks.

Surrogate spike recoveries will be reviewed in terms of quality control limits. Acceptable ranges for matrix spike recoveries will also be applied to the reported results. Atlantic will perform this validity check on a minimum of five (5) percent of the analytical data.

8.7 Internal Quality Control Checks

Internal quality control procedures for soil and water samples follow the guidelines of the New York State and the laboratory programs as presented in the laboratory Quality Assurance Manuals (Appendix B). These procedures and the procedures in NYSASP specify the number of laboratory blanks to be used, the number of calibration standards, the frequency with which the calibration standards must be run, the frequency with which laboratory duplicates must be run, and the frequency with which spike and referenced samples must be run.

9.0 IRM EVALUATION AND REPORT

Upon completion of the field and analytical program, all physical and chemical data obtained will be evaluated to delineate the waste source areas for the site. These delineations will account for areal and vertical distribution of the waste, and estimates of waste source volumes will be made. Waste source areas will be portrayed on the mapping developed for this project. The nature and extent of these waste sources will then be evaluated with regard to the physical and geohydrologic characteristics of the site to assess any interactive condition between the waste sources and ground and surface waters and subsequent release of contaminants to these waters. Understanding this interaction is an important first step in evaluating alternative IRMs intended to mitigate the release of contaminants, or to accomplish their removal.

Once the nature and extent of the waste sources and subsequent release/transport mechanisms are understood, Atlantic will evaluate potential IRMs. The primary focus of NMPC's IRM program is the removal of the waste sources with subsequent treatment and stabilization through recycling. Therefore, the initial IRM evaluation will focus on the feasibility of removing the waste sources and accomplishing the preferred method of treatment and recycling. Feasibility evaluations will include assessments of:

- excavation methods versus depth of waste sources;
- need for temporary soil retaining structures;
- water control requirements;
- conflicts with building structures or utilities;
- area requirements for construction operations;
- conflicts with onsite facility operations;
- requirements for construction waste management practices;

- health and safety protection requirements for service facility personnel;
- ability to achieve acceptance of waste streams for treatment at selected facilities;
- permitting requirements; and
- costs.

All assessment criteria dealing with onsite conditions will be undertaken in accordance with standard engineering and construction management practices. IRM permitting requirements, for both owner and contractor, will be evaluated in accordance with state, county and municipal regulatory programs governing execution of the work. The determination of acceptance of waste streams for treatment at selected facilities will be made through formal requests for acceptance by the facilities through evaluation of the representative waste samples and analytical profiles.

In the event that removal of waste sources proves infeasible or an IRM strategy utilizing a combination of removal and/or control techniques becomes appropriate, a feasibility evaluation of control technologies will occur using assessment criteria similar to those presented above. This evaluation will include technologies which control the release of chemicals from the waste source into ground and surface water (such as slurry containment walls, etc.), as well as technologies which prevent ground and surface waters from interacting with the waste sources (such as interceptor drains, etc.).

The evaluation of alternative IRMs will be presented, along with results of the field investigation program, in a single report. The report will include a brief site history of present site conditions, as well as a description of the field investigation and sampling and analysis program. Descriptions and conceptual drawings for alternative IRMs will be provided along with recommendations for IRM implementation.

For the recommended IRM, an evaluation will be completed on the degree of conformance of the program with the NYSDEC *Draft Cleanup Policy and Guidelines* (October 1991) and subsequent target environmental media standards.

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APPENDIX A

STANDARD FIELD PROCEDURES

ATLANTIC PROCEDURE NO. 1021

FIELD PROCEDURES FOR COLLECTION OF SUBSURFACE SOILS

Prepared By: John A Ripp Principal
JOHN A. RIPP TITLE

Reviewed By: Edmund J Burke Q.A. Manager
EDMUND J. BURKE, P.E. TITLE

Approved By: Paul Burgess Chief Engineer
PAUL BURGESS, P.E. TITLE

REVISIONS

NO.	DATE	PREPARED BY	REVIEWED BY	APPROVED BY
1.				
2.				
3.				
4.				

ATLANTIC ENVIRONMENTAL SERVICES, INC.
COLCHESTER, CONNECTICUT

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SECTION 1.0: PURPOSE

To insure a standard procedure for collection of subsurface soil samples during site contamination studies for the determination of chemical parameters.

SECTION 2.0: SCOPE

The following procedure describes the method, materials and documentation requirements for collection of subsurface soils from test pits and split spoon samplers for eventual analysis by a chemical laboratory.

SECTION 3.0: RESPONSIBILITY

Project Manager - First
Field Operations Manager - Second
Field Staff - Third

SECTION 4.0: SUPPORTING PROCEDURES

Atlantic Procedure No. 1041 Sample Chain-of-Custody Procedure

SECTION 5.0: REQUIRED FORMS

Field Notebook No. 351, published by J.L. Darling Corp., Tacoma, Washington

SECTION 6.0: PROCEDURE

6.1 Introduction

During a site investigation where test pits, exploratory borings, monitoring wells, test trenches and other forms of excavation are performed it is often planned that soils or buried waste materials are to be collected. For most drilling operations split spoon samples are used to collect discrete samples from known depths using samplers ranging in length from 2 feet to 5 feet. Usually not all samples from these split spoons are designated for analysis, therefore the containerization and handling of samples from split spoons may be different depending on their ultimate purpose.

Samples from test pits and test trenches may also be collected for chemical analysis. These samples can only be taken using a remote sampler from the side walls of each pit. Samples taken from the bucket of the backhoe are harder to identify especially regarding their actual vertical position beneath the ground surface.

The following is to be used as a general guide in collecting samples from either test pits or split spoons.

6.2 Split Spoon Sampling

After logging a split spoon sample following Atlantic Procedure No. 1030 the sample is then identified for either analysis by a laboratory or storage until further decisions are made. If the sample is to be stored, a clean glass jar, preferably new one liter size, will be used to store the sample. In many cases the driller will provide these to the field team. However in no case shall used or dirty soils jars be used to hold samples. If the driller does not have the proper jars, new clean "Mason type" jars may be used. A label must be affixed to these storage jars identifying the boring number, sample depth, date of sample and project number on it for future reference. If soil samples are to be sent for analysis then only properly cleaned or laboratory supplied sample containers are to be used.

The collector must take the following steps when preparing the samples:

1. Always follow designated safety precautions in terms of level of protection. At a minimum samples must always be handled using latex or chemical resistant gloves. This protects the collector and prevents cross-contamination between samples.

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Revision No.
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2. Do not use the top one to two inches of recovered sample in the split spoon. This usually consists of washings and cave-in soils from higher in the boring that fell into the bottom of the augers.
3. Use a properly cleaned stainless steel spoon (tablespoon size) to remove the soils from the split spoon.
4. When possible, try to fill each sample container so that no air space is allowed. This will prevent volatiles from escaping. If a number of containers are to be used then evenly divide the sample between containers.
5. Avoid getting soils on the threads of the soils containers. Use a clean paper towel to wipe off the threads to insure a good seal.
6. Fill out the sample labels on each jar including the following:

    - sample number
    - sample depth
    - date and time of sample
    - analysis
    - preservation
    - initials of the sample collector

7. Fill in the chain-of-custody form (Atlantic Form No. 1041) for each sample. If a confining layer is to be sampled to determine whether contamination from a shallower zone is migrating down, care should be exercised in collecting these samples. In many instances ground water will fill the auger and the split spoon will travel through the water before being pushed into a deeper zone, there is no guarantee that soils in the split spoon haven't been contaminated with standing water in the auger. To insure a "pure" sample, the drilling procedure may have to be modified to seal off the upper zone from the lower zone using casing and washing the interior of the casing clean. These operations must be detailed in the site sampling plan.

After each spilt spoon sample is collected Atlantic personnel will maintain custody and keep it refrigerated (when necessary) until shipment to the laboratory. The stainless steel sampling spoon is then decontaminated in accordance with Atlantic Procedure No. 1060 before the next sample is taken.

6.3 Sampling Soils from Test Pits

As mentioned before, soils designated for analysis must be collected directly from the side walls of the test pits. A remote sampler is basically a stainless steel scoop that can swivel so that it can be pushed against the side wall and hold soils in a trap at its base. The scoop is attached to a light weight telescoping aluminum rod which will have a maximum 10 foot reach.

The depth of sample must be noted in the field notebook. The sample is then handled the same as the split spoon samples following the same safety precautions. After the sample is taken, the remote sampling tool will be decontaminated before obtaining the next sample.

ATLANTIC PROCEDURE NO. 1023

FIELD PROCEDURES FOR COLLECTION OF GROUND WATER SAMPLES FOR HAZARDOUS WASTE DETERMINATION

Prepared By: John A. Ripp — Principal
JOHN A. RIPP — TITLE

Reviewed By: Edmund J. Burke — Q.A. Manager
EDMUND J. BURKE, P.E. — TITLE

Approved By: Paul Burgess — Chief Engineer
PAUL BURGESS, P.E. — TITLE

REVISIONS

NO.	DATE	PREPARED BY	REVIEWED BY	APPROVED BY
1.				
2.				
3.				
4.				

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COLCHESTER, CONNECTICUT

Procedure No. 1023
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SECTION 1.0: PURPOSE

To insure a standard procedure for collection of ground water samples for the identification of chemical constituents.

SECTION 2.0: SCOPE

The following procedure describes the logistics, chain of events, collection techniques and documentation requirements for collecting ground water samples designated for chemical analysis.

SECTION 3.0: RESPONSIBILITY

Project Manager - First

Field Supervisor - Second

Field Sampling Technicians - Third

SECTION 4.0: SUPPORTING PROCEDURES

Atlantic Procedure No. 1041 Sample Chain-of-Custody Procedure.

SECTION 5.0: REQUIRED FORMS

Field Notebook No. 351 published by J.L. Darling Corp., Tacoma, Washington

SECTION 6.0: PROCEDURE

6.1 Selection of Sampling Locations

Ground water sampling locations in and around a project site are typically obtained from existing domestic, production and monitoring wells, and newly installed ground water monitoring wells which were part of the site hydro-geological investigation. The location of new ground water monitoring wells will be based upon the review of existing site hydrogeological data, the results of preliminary site surveys, and the initial estimates of the extent of the waste. The ground water sampling locations will be chosen by the project manager. At a minimum one upgradient and three downgradient water samples from the uppermost aquifer will be taken.

6.2 Equipment List

The following is to be considered a guide for groundwater sampling preparation.

1. Latex gloves, and any other personal safety equipment specified in the site health and safety plan.
2. Sample containers (depending on sample requirements of the analytical laboratory) may include for each location:
    - 4 each 1 liter glass jars with Teflon lined caps
    - 8 each 40 ml. glass vials with Teflon lined septas
    - 1 each 500 ml. plastic containers for metals analysis
    - 1 each 500 ml. plastic containers for mercury analysis

3. Device to measure water levels in wells to within .01 feet. Typically a cloth tape with a "plopper" or an electronic water level indicator is used.
4. Field Notebook No. 351
5. Sample bottle labels
6. Chain-of-custody forms
7. A large volume bailer or pump to evacuate the wells.
8. Dedicated Teflon bailer with stainless steel cable, or a peristaltic pump with dedicated Teflon tubing.

6.3 Sample Collection

Prior to the extraction of any ground water, the depth to water shall be measured to the nearest .01 feet. A cloth tape with a "plopper", or an electronic water sensing device (i.e. Slope Indicator Water Mark) shall be used for this purpose. The device used must be clean to avoid contamination of the well. The depth to water is typically measured from a reference point established on the top of the well casing. This value is recorded in the field notebook along with the length of casing stick-up above the ground surface. If both an inner and outer casing are present, the one used as the measurement reference point shall be identified (normally the inner), and any distance between the two, measured and recorded. If the depth of the well is unknown the bottom shall be sounded and the depth recorded.

Ground water samples are to be collected in a manner to be representative of the formation from which the samples were taken. To insure against sampling stagnant water in a well, a minimum of four well volumes must be evacuated from the well prior to sampling. In the case of monitoring wells that will not yield water at a rate adequate to be effectively flushed, one of the two following procedures must be followed. The first procedure includes purging water to the top of the screened interval at a sufficiently slow rate to prevent the exposure of the gravel pack or formation to atmospheric conditions. The sample is then taken at a rate that would not cause rapid drawdown. The second procedure would be to pump the well dry and allowed it to recover. The samples should be collected as soon as a volume of water sufficient for the intended analytical scheme reenters the well. Exposure of water entering the well for periods longer than 2 to 3 hours may render samples unsuitable and unrepresentative of water contained within the aquifer system. In these cases, it may be desirable to collect small volumes of water over a period of time, each time pumping the well dry and allowing it to recover. Whenever full recovery exceeds 3 hours, samples should be collected in order of their volatility as soon as sufficient volume is available for a sample for each analytical parameter or compatible set of parameters. Parameters that are not pH-sensitive or subject to loss through volatilization should be collected last.

Evacuation is accomplished by bailing with a large volume (1.5 liter) bailer, or by pumping. Whichever method is used, it must be assured that any materials (hose, bailer, tubing, pumps, rope, etc.) entering the well must be clean. If the same device is being used to evacuate a number of wells, the device must be cleaned with the appropriate cleaners between each well to prevent cross-contamination.

For pre-preserved sample containers the following procedure will be followed:

1. Prior to collecting any water samples, place a waterproof sample label on each container which specifies the following:

   Sample Number
   Date
   Time
   Preservative
   Project Number
   Initials of the Collector

   Fill in the information with a waterproof ink pen. This will prevent difficulty in filling out labels on a wet jar after it is filled.

2. Extract the ground water sample using either a dedicated Teflon bailer or a peristaltic pump with dedicated Teflon tubing. Latex gloves shall be worn during this procedure.

3. When using the peristaltic pump or bailer first fill the 40 ml. vials making sure no air is trapped in the vials. This sample is normally taken for volatile analysis and therefore should be sampled prior to further disturbance of water in the well.
4. Fill all the remaining jars directly from the pump discharge or bailer. With the containers containing preservative, avoid overflow since this will dilute the preservative.
5. If dissolved metals analysis are required an extra bottle (no preservative) will be filled and the metals container (pre-preserved with nitric acid) will remain empty. Only after the water sample is field filtered will it be poured into the pre-preserved metals container. This will constitute a sample for dissolved metals.
6. Place all sample containers into a sample shipping container, cool with ice packs and fill out the chain-of-custody form.
7. Detail in the field notebook the following:

   - sample identification number
   - location of the sample
   - time and date of sampling
   - personnel performing task
   - depth to water table, reference mark, casing(s) stick-up, and horizontal distance between inner and outer casing
   - Amount evacuated from well and device used for evacuation
   - Visual or sensory description of the sample (color, odor, turbidity, etc.)
   - Weather conditions both present and previous to sampling
   - Other pertinent observations

8. Make sure the well is secured after sampling.

Note:

1. It is understood that all sample containers and collection devices will be cleaned prior to field use following the appropriate cleaning procedures.
2. If sampling devices are to be dedicated to a particular sample location, they will be placed in a plastic bag after its use and marked or tagged

"DEDICATED TO PROJECT NO. ____________

SAMPLE LOCATION NO. ________________

ATLANTIC PROCEDURE NO. 1030

FIELD PROCEDURE FOR LOGGING SUB-SURFACE CONDITIONS DURING TEST BORINGS AND WELL LOGGING

Prepared By: John A. Ripp — PRINCIPAL
JOHN A. RIPP — TITLE

Reviewed By: Edmund J. Burke — QA MANAGER
EDMUND J. BURKE, P.E. — TITLE

Approved By: Paul Burgess — CHIEF ENGINEER
PAUL BURGESS, P.E. — TITLE

REVISIONS

NO.	DATE	PREPARED BY	REVIEWED BY	APPROVED BY
1.				
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3.				
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Procedure No. 1030
Revision No.
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SECTION 1.0: PURPOSE

To insure a standard procedure for the documentation of sub-surface conditions encountered during test borings and well drilling.

SECTION 2.0: SCOPE

The following procedure details a method for recording sub-surface conditions in test borings and well drill holes during site contamination, hydrogeological, and geotechnical investigations. An optional procedure for photographing samples is included.

SECTION 3.0: RESPONSIBILITY

Project Manager - First

Supervising Field Geologist/Engineer - Second

SECTION 4.0: SUPPORTING PROCEDURES

ASTM Designation D 1586 - Standard method for Penetration Test and Split-Barrel Sampling of Soils.

ASTM Designation D 2488 - Standard practice for Description and Identification of Soils (Visual-Manual Procedure)

SECTION 5.0: REQUIRED FORMS

Field Notebook No. 351 (published by J.L. Darling Corp., Tacoma, Wash.)

Atlantic Boring Log Form

SECTION 6.0: PROCEDURE

6.1 Predrilling Requirements

When conducting borings at any location, local or on-site buried utilities must be cleared through the appropriate engineering departments of each utility serving the area. At least a 48 hour notification shall be made to the utilities prior to drilling. The ticket number or call number given by the utility must be logged in the field notebook. This will protect the drilling supervisor from any liability associated with damaging a public utility.

The supervising geologist/engineer shall record the name of the drilling firm and the names of the driller and his assistant. The date, project location, project number, and weather conditions shall also be recorded.

An accurate time log of drilling activities shall be kept. This log shall be kept in the field notebook and shall include, at least the following:

- Time driller and rig on-site
- Time drilling begins
- Any delays in the drilling activities, and the cause of such delays.
- Time drillers leave the site.

6.2 Test Borings and Well Drilling Subsurface Sampling Methods

Test borings and monitoring well drilling can be conducted by a variety of drilling methods. The drilling method is not as critical to the documentation of the subsurface conditions as the soil and rock sampling techniques. However, the drilling method and type of drill rig shall be documented.

Where details of subsurface conditions are necessary, soil sampling shall be conducted using a split spoon penetration sampler driven with a 140 pound hammer at a height of 30 inches. The standard method of soil sampling as described in ASTM Designation D 1586 shall be used as a guide.

The supervising geologist/engineer shall record, at a minimum, the weight of the hammer, the length of the split spoon sampler, and the number of hammer blows on the spoon per 6 inches of penetration. Upon removal of the sampler the earth materials shall be logged in accordance with Section 6.3 of this document.

Rock sampling will be conducted using a double barrel core sampler. The supervising geologist/engineer shall record the length of the core barrel, the diameter of the barrel, the rate of penetration, and the down pressure torque and rotation of the sampler.

6.3 Logging of Unconsolidated Deposits

Vertical measurements in a boring shall be made from the original ground surface. Split spoon samples are typically taken in 2-foot intervals, or at changes in lithology through unconsolidated materials. The supervising geologist/engineer shall monitor drill cuttings and maintain communication with the driller (Re: down pressures, drilling rates, resistance, etc.) to determine where changes in lithology occur.

During the sampling, the hammer blows per 6 inches of sampler penetration, and the depth at which the sample was taken shall be recorded. Blow counts over 50 per 6 inches of penetration shall constitute sampler refusal. Upon extraction of the sampler moisture conditions on the drill rods shall be noted. Upon opening the sampler the percent recovery shall be recorded as the length of sample retained over the length of sampler penetration. Changes in lithology, color, or moisture conditions in the spoon are measured and recorded prior to emptying the spoon. If the sample is to be retained, a sample number is assigned and recorded in the field log and on the sample container. The sample container will also include the project name, boring number, location, depth, date, and person collecting the sample.

The supervising geologist/engineer will log the soil sample in the field notebook. The soil description shall include, at a minimum, the following information:

- Color

- Mineral or rock content

- Grain size, in order from most predominant to least predominate using the proportions;

  - Trace = 0 to 10%
  - Little = 10 to 20%
  - Some = 20 to 35%
  - And = 35 to 50%

- Density, descriptions based upon blow counts as follows:

  - Cohesionless Soils (primarily sand and gravel)

0 - 10 blows = Loose
10 - 30 blows = Medium Compact
30 - 50 blows = Dense
50 plus blows = Very Dense

  - Cohesive Soils (primarily silt and clay)

0 - 2 blows = Very soft
2 - 4 blows = Soft
4 - 8 blows = Medium
8 - 15 blows = Stiff
15 - 30 blows - Very stiff
30 plus blows = Hard

- Moisture Content

- Structure

- Other (mottling, odor, instrument readings, etc.)

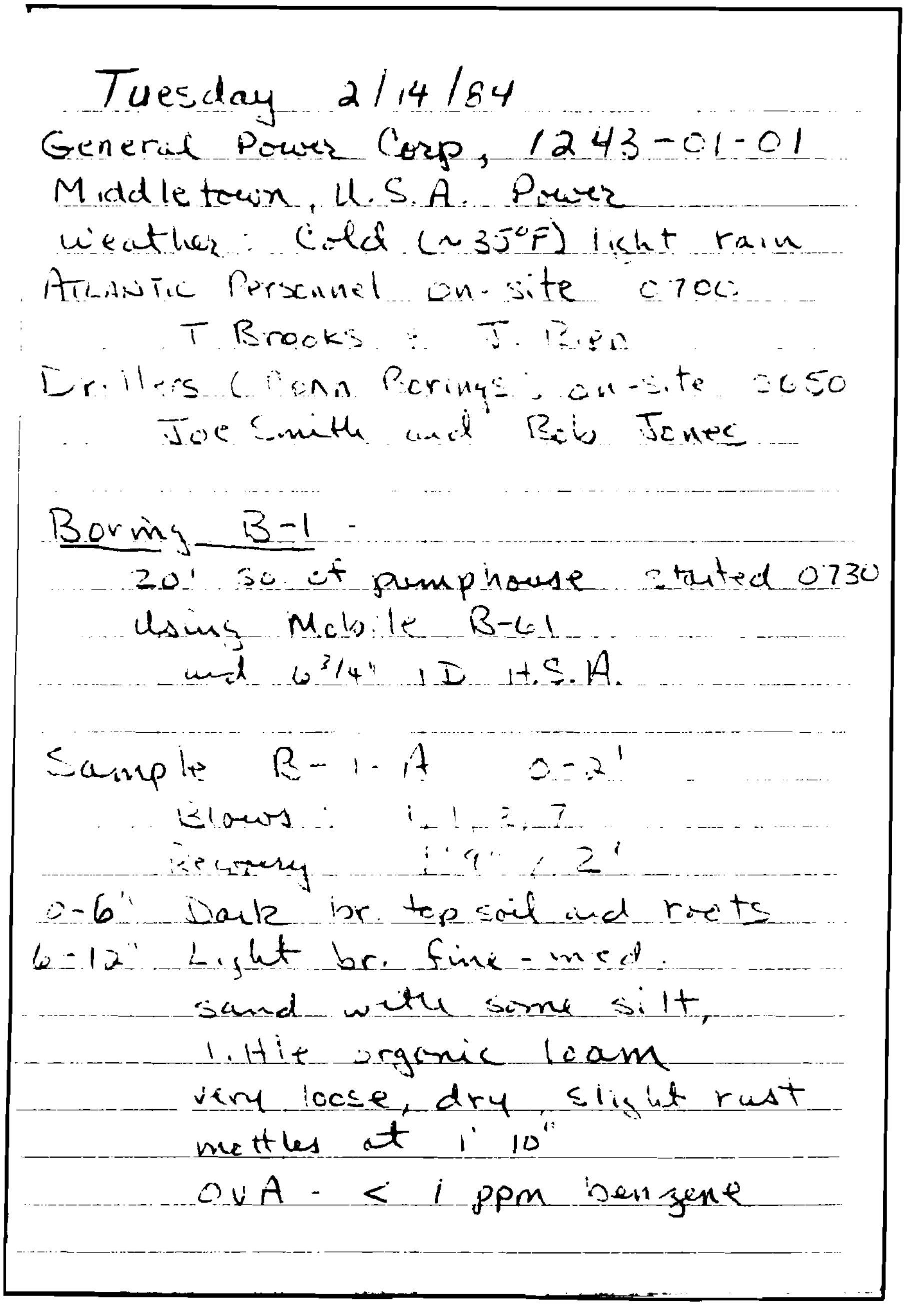
A sample soil log is shown in Figure 6-1.

When the technical specifications of a soil sampling program require soil descriptions to conform to the "Unified Soils Classification" the soils shall also be classified according to ASTM Standard Designation D 2488. Figure 6-2 shows this classification.

6.4 Logging Bedrock Cores

The supervising geologist/engineer on a drilling program is responsible for logging and recording geologic and geotechnical information from rock cores. The following information shall be included in a rock core run log:

- o The depth and length of the core run.
- o The coring rate, down pressure, torque and rotation speed. This information can be obtained from the driller.
- o The color of the core wash water. Any changes or loss of return water will be noted.
- o The recovery of the core run recorded as length of rock recovered over the length of the core run.
- o The Rock Quality Designation (RQD) of the run. RQD is reported as the sum of inches of all rock core pieces larger than four inches over the total number of inches in the run.
- o The rock type(s) and their location in the core run, rotating color, minerology, texture, fossil content, effervescence in HCL and any other data of geologic significance.
- o Any structure in the core, including fractures, clay seams, vuggs, bedding, fissility and any other data of geologic or geotechnical significance.



Tuesday 2/14/84
General Power Corp, 1243-01-01
Middletown, U.S.A. Power
weather: Cold (~35°F) light rain
ATLANTIC Personnel on-site 0700
T Brooks & J. Reed
Drillers (Penn Borings) on-site 0650
Joe Smith and Bob Jones

Boring B-1 -
20' so. of pumphouse started 0730
using Mobile B-61
and 6 3/4" ID H.S.A.

Sample B-1-A 0-2'
Blows: 1, 1, 2, 7
Recovery 1'9" / 2'
0-6" Dark br. top soil and roots
6-12" Light br. fine-med.
sand with some silt,
little organic loam
very loose, dry, slight rust
mottles at 1' 10"
OVA - < 1 ppm benzene

Figure 6-1
Example Boring Log

MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES
COARSE-GRAINED SOILS More than 50% retained on No. 200 sieve*	GRAVELS 50% or more of coarse fraction retained on No. 4 sieve	CLEAN GRAVELS	GW	Well-graded gravels and gravel-sand mixtures, little or no fines
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines
		GRAVELS WITH FINES	GM	Silty gravels, gravel-sand-silt mixtures
			GC	Clayey gravels, gravel-sand-clay mixtures
	SANDS More than 50% of coarse fraction passes No. 4 sieve	CLEAN SANDS	SW	Well-graded sands and gravelly sands, little or no fines
			SP	Poorly graded sands and gravelly sands, little or no fines
		SANDS WITH FINES	SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS 50% or more passes No. 200 sieve*	SILTS AND CLAYS Liquid limit 50% or less		ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
			OL	Organic silts and organic silty clays of low plasticity
	SILTS AND CLAYS Liquid limit greater than 50%		MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts
			CH	Inorganic clays of high plasticity, fat clays
			OH	Organic clays of medium to high plasticity
Highly Organic Soils			PT	Peat, muck and other highly organic soils

* Based on the material passing the 3-in. (75-mm) sieve.

Figure 6-2
Unified Soils Classification

Rock cores shall be stored in a core box in the exact sequence they were removed from the ground. Core runs will be separated by wooden blocks clearly marked with the depth of the run. The core box shall be marked with the project name, location, project number, boring number, data and the depths of the core runs in that box.

6.5 Photographing Rock and Soil Samples from Borings

Soil samples should be photographed while still in the split spoon sampler. If smearing of the sample has occurred a fresh exposure can be made by scrapping with a pen knife or other similar object. The spoon and sample should be placed in a good light preferable against a solid colored background. A ruler for scale, and a tag identifying the sample number, depth and project name or number written so as to be legible in the photograph. Any photographs taken must be recorded in the field notebook.

Rock core samples are photographed in the wooden core box. The rock should be wetted to enhance the color and textual changes in the rock. Due to the relatively large size of most core boxes the photographer (when possible) should stand up on a chair, tail gate, car bumper or other perch in order to photograph the box from directly above, and get the entire box in the camera's field view. Somewhere in the photograph must be an identifier tag indicating the project name or number, the boring number, the date, and the depths of the various core runs.

ATLANTIC PROCEDURE NO. 1031

FIELD PROCEDURES FOR LOGGING SUBSURFACE CONDITIONS IN TEST PIT EXCAVATIONS

Prepared By: John A. Ripp — Principal
JOHN A. RIPP — TITLE

Reviewed By: Edmund J. Burke — QA Manager
EDMUND J. BURKE, P.E. — TITLE

Approved By: Paul Burgess — Chief Engineer
PAUL BURGESS, P.E. — TITLE

REVISIONS

NO.	DATE	PREPARED BY	REVIEWED BY	APPROVED BY
1.				
2.				
3.				
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SECTION 1.0: PURPOSE

To insure a standard procedure for the documentation of subsurface conditions encountered during test pit excavations.

SECTION 2.0: SCOPE

The following procedure details a method for conducting and recording subsurface conditions in test pits during site contamination, hydrogeological, and geotechnical investigations. A standard procedure for photographing samples and excavations is also included.

SECTION 3.0: RESPONSIBILITY

Project Manager - First

Field Operations Manager - Second

Field Geologist/Soil Scientist - Third

SECTION 4.0: SUPPORTING PROCEDURES

None

SECTION 5.0: REQUIRED FORMS

Field Notebook No. 351, published by J.L. Darling Corp., Tacoma, Washington

SECTION 6.0: PROCEDURE

6.1 Safety Considerations

Test pit excavations are used to evaluate subsurface conditions of soils, groundwater and buried materials during certain types of field investigations. Since they are normally dug using heavy equipment (backhoe, Gradall etc.) and result in a deep pit in the ground the following safety rules will be applied.

1. All buried utilities will be cleared by calling and scheduling at least 48 hours in advance the local "DIG SAFE" service. Also Atlantic will confirm clearance of utilities by contacting the property owner and those people most familiar with the site. At the discretion of the Atlantic project manager Atlantic will use its cable location tool to verify the presence or absence of buried utilities.
2. The backhoe operator will take directions directly from the Atlantic supervisor. Hand signals will be used to communicate instructions mainly because background noise is often very loud.
3. No one will be allowed to enter a test pit greater than three feet in depth.
4. All spoils removed will be placed far enough away from the sides of the pit to prevent slumping into the pit.
5. Test pits will be terminated either at refusal, at the water table or when a buried utility line is uncovered.

6. In no case will an open excavation be left unattended. After logging the soil borings the test pit will be immediately backfilled.
7. During all excavation work the supervisor will make all attempts to stand in front of the operator and away from the bucket arm.

6.2 Logging of Soils

Vertical measurements in the excavation shall be made from the top of the test pit at a spot representative of the original grade. If ground water levels are to be measured over time, a reference point (wooden stake, nail, etc.) shall be established at the original grade. If the test pit is to be surveyed after backfilling, a flagged stake shall be established at the pit on ground representative or the original grade.

A fresh exposure of soil is made at the side of the pit (preferably facing the sun) in an area most representative of the overall soil profile. This exposure is made by having the backhoe take a smooth clean scrapping off the entire side wall.

The soil profile log is recorded in the field notebook. Each test pit log shall be preceded by the following general information.

- o Date
- o Client, and Atlantic Project Number
- o Location of Project Site
- o Weather Conditions

- o Time Excavation Started
- o Test Pit ID Number and Specific Location
- o Person Logging Pit

The soil profile is logged from the top down starting with the 'A' horizon (top soil). A metal or fiberglass tape or surveyors stadiarod should be used to measure all the soil horizons. The description of each horizon shall include the following information:

- o Textual description of grains (i.e., fine to medium). This is used mostly when describing sands and gravels.
- o The predominant grain size (clay, silt, sand, or gravel).
- o The secondary grain size using the proportions "trace" (0-10 percent), "little" (10-20 percent), "some" (20-35 percent", and "and" (35-50 percent).
- o The relative density and consistency of the soil using the descriptions for cohesionless soils (sands and gravels) of very loose, loose, medium, dense, and very dense. For cohesive soils (silts and clays) the consistency descriptions of very soft, soft, medium, stiff, very stiff, and hard shall be used.

- The moisture content of the soil using the relative descriptions dry, damp, wet, and saturated. A saturated soil will yield free water when squeezed.
- The structure of the soil, (i.e., blocky, granular, prismatic) if no structure is evident, make a note of it.
- Note the presence of absence of any mottling and the depth at which it starts and ends.
- Record the depth of seepage into the pit.
- Record the total depth of the pit and note if this was a refusal point where farther excavation was limited by rock, concrete or other tough surfaces.
- Describe any bedrock encountered in the excavation.

The above listed requirements for a test pit log are considered as a minimum. Any additional observations that are pertinent to the interpretation of the subsurface conditions should be recorded. Certain projects may require that specific data be recorded. Certain projects may require that specific data analysis be conducted in the test pit. These requirements shall be detailed in the site sampling plan and presented to the field personnel, in writing, prior to the commencement of the field operations.

6.3 Photographing Test Pit Excavations and Samples

Whenever possible, the subsurface conditions shall be documented with a photograph. Photographs should be taken with a 35mm camera on color slide film. The field personnel taking photographs shall log all photos in the field notebook.

Photographs of test pits should be taken in good light, preferable during mid-day when the sun is high. A flash attachment should be made available if ambient light is too weak. The photo should be taken of the side of the pit most exposed to sunlight. Prior to taking the photo, some sort of identification must be placed in the photo. This is best done by writing the test pit ID in bold letters on a clipboard and placing it within the field of view of the camera. Other forms of identification can be used (i.e., building in background, etc.) but must be documented in the test pit log. In all photos, an object must be placed in the photo for scale.

A scale is particularly useful in close-up photos.

ATLANTIC PROCEDURE NO. 1040-NY

SAMPLE PRESERVATION FOR SOLID AND LIQUID MATRICES FOR PROGRAMS CONDUCTED IN NEW YORK STATE

Prepared By: John A. Ripp Principal
JOHN A. RIPP TITLE

Reviewed By: James E Gould Engineer
JAMES E. GOULD TITLE

Approved By: Paul Burgess Principal
PAUL BURGESS, P.E. TITLE

REVISIONS

NO.	DATE	PREPARED BY	REVIEWED BY	APPROVED BY
1.				
2.				
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6-1 Sample Preservation and Holding Time Requirements 7

SECTION 1.0: PURPOSE

To insure a standard procedure for preservation of solid and liquid samples collected at a site for hazardous waste determination.

SECTION 2.0: SCOPE

The following procedure is established to provide a set of standards which follow recommended NYSDEC preservation techniques and holding times for various analytical groups as per the NYSDEC Analytical Services Protocol (ASP) published in 1989.

SECTION 3.0: RESPONSIBILITY

Project Manager - First

Field Operations Manager - Second

Field Staff - Third

SECTION 4.0: SUPPORTING PROCEDURES

Atlantic Procedure No. 1020 Field Procedures for Collection of Surface Soil Samples

Atlantic Procedure No. 1021 Field Procedures for Collection of Subsurface Soils

Atlantic Procedure No. 1022 Field Procedures for Collection of Surface Water and Sediment Samples for Hazardous Waste Determination

Atlantic Procedure No. 1023 Field Procedures for Collection of Groundwater Samples for Hazardous Waste Determination

Atlantic Procedure No. 1042 Shipping Procedure for Environmental Field Samples

SECTION 5.0: REQUIRED FORMS

1. Field Notebook No. 351. Published by the J.L. Darling Corp., Tacoma, Washington
2. Master Sample Log

SECTION 6.0: PROCEDURE

6.1 General Procedure

All sample preservations will be performed in the field as soon after sample collection as possible. In many instances sample containers supplied by the analytical laboratory will be pre-preserved so that no additional preservations will be required. In the event preservations are required, Atlantic personnel will use the following format:

1. For those water samples requiring target compound list (TCL), the procedures in Table 6-1 will be followed.

2. All glass or plastic containers must be cleaned prior to sampling according to appropriate cleaning procedures. In no case will sample containers be rinsed with a sample before the actual sample is containerized.

3. In no case shall methylene chloride or acetone be used as a cleaning agent in any glassware or field equipment used on a site investigation. Methylene chloride and acetone are listed wastes and if used, cleaning may cause errors in evaluating field data.

4. All soils samples collected for TCL analysis be placed in a one liter glass jar with teflon lined cap. This jar also must be cleaned prior to sampling according to appropriate cleaning procedure. To avoid losing volatile organics to the head space within a jar, all soil jars will be filled completely. Care must be taken to avoid getting soil on the threads of a sample jar. This can cause a faulty seal.

5. All samples will be held in insulated shipping containers and kept cool to a temperature of $4^{\circ}C$ until they are delivered to the analytical laboratory.

6. When samples are preserved in the field, the type of preservation will be listed on the label along with all other appropriate label information. Also the details of each sample will be logged in the Master Sample Log, maintained at the field office.

7. If Atlantic personnel plan to perform field preservations the analytical laboratory must be consulted to verify those particular procedures to be followed. In some instances different laboratories may require more sample volume than those listed or wish no preservative be used.

8. Table 6-1 is taken directly from the NYSDEC ASP. Soils rarely require preservation and the laboratory should always be consulted before collecting soil samples. Occasionally the NYSDEC may update the holding times and this can be found by calling the NYSDEC headquarters in Albany, New York.

9. All field preservations should be performed using proper safety precautions especially when handling acids and caustics. A reference for proper chemical handling techniques is found in <u>Basic Laboratory Skills</u> for Water and Wastewater Analysis by

Douglas W. Clark, New Mexico Water Resources Research Institute, Report No. 125, 1980. Also latex or chemical resistant gloves should be worn during all field preservations. Proper ventilation is necessary when performing preservations in enclosed areas.

6.2 Sample Preservation and Holding Time Requirements

Table 6-1 provides a schedule for sampling, preservation, and holding times for samples being analyzed for convention parameters and target compound list (TCL) parameters.

The laboratory shall adhere to the preservation procedures and holding times listed in Table 6-1 below unless specifically directed otherwise by the Bureau of Technical Services and Research. All holding times are from Verified Time of Sample Receipt (VTSR) at the laboratory.

The laboratory shall provide all necessary preservatives to properly stabilize the samples. The laboratory must adhere to all analytical holding times. Failure to do so will result in the imposition of any contract specified penalties.

TABLE 6-1

REQUIRED CONTAINERS, PRESERVATIVES, AND HOLDING TIMES

PARAMETER NAME	CONTAINER(1)	PRESERVATIVE(2),(3)	MAXIMUM HOLDING TIME(4)
AQUEOUS SAMPLES			
Bacteriological Tests:			
Total Coliform	Sterilized P,G	Cool, 4°C, 0.008% $Na_2S_2O_3$ (5)	6 hours
Fecal Coliform	Sterilized P,G	Cool, 4°C, 0.008% $Na_2S_2O_3$ (5)	6 hours
Fecal Streptococci	Sterilized P,G	Cool, 4°C, 0.008% $Na_2S_2O_3$ (5)	6 hours
Inorganic and Conventionals Tests:			
Acidity	P,G	Cool, 4°C	12 days
Alkalinity	P,G	Cool, 4°C	12 days
Ammonia	P,G	Cool, 4°C H_2SO_4 to pH<2	26 days
BOD_5	P,G	Cool, 4°C	24 hours
BOD_{20}	P,G	Cool, 4°C	24 hours
Bromide	P,G	Cool, 4°C	26 days
$CBOD_5$	P,G	Cool, 4°C	24 hours
COD	P,G	Cool, 4°C H_2SO_4 to pH<2	26 days
Chloride	P,G	Cool, 4°C	26 days
Color	P,G	Cool, 4°C	24 hours
Cyanide, Total	P,G	Cool, 4°C NaOH to pH>12	12 days

TABLE 6-1 (CONTINUED)

REQUIRED CONTAINERS, PRESERVATIVES, AND HOLDING TIMES

PARAMETER NAME	CONTAINER(1)	PRESERVATIVE(2),(3)	MAXIMUM HOLDING TIME(4)
AQUEOUS SAMPLES (continued)			
Cyanide, Amenable to Chlorination	P,G	Cool, 4°C NaOH to pH>12, 0.6 g ascorbic acid(5)	12 days(6)
Fluoride	P only	Cool, 4°C	26 days
Hardness	P,G	NNO_3 to pH<2	6 months
Kjeldahl Nitrogen	P,G	Cool, 4°C H_2SO_4 to pH<2	26 days
Organic Nitrogen	P,G	Cool, 4°C H_2SO_4 to pH<2	26 days
Metals(7), except Chromium+6 and Mercury	P,G	HNO_3 to pH<2	6 months
Chromium+6	P,G	Cool, 4°C	24 hours
Mercury	P,G	HNO_3 to pH<2	26 days
Nitrate + Nitrite	P,G	Cool, 4°C H_2SO_4 to pH<2	26 days
Nitrate	P,G	Cool, 4°C	24 hours
Nitrite	P,G	Cool, 4°C	24 hours
Oil and Grease	G only	Cool, 4°C H_2SO_4 to pH<2	26 days
Total Organic Carbon	P,G	Cool, 4°C H_2SO_4 to pH<2	26 days
Orthophosphate	P,G	Cool, 4°C	24 hours
Total Phenols	G only	Cool, 4°C H_2SO_4 to pH<2	26 days

TABLE 6-1 (CONTINUED)

REQUIRED CONTAINERS, PRESERVATIVES, AND HOLDING TIMES

PARAMETER NAME	CONTAINER(1)	PRESERVATIVE(2),(3)	MAXIMUM HOLDING TIME(4)
AQUEOUS SAMPLES (continued)			
Phosphorous, Total	P,G	Cool, 4°C H_2SO_4 to pH<2	26 days
Residue, Total	P,G	Cool, 4°C	5 days
Residue, Filterable	P,G	Cool, 4°C	24 hours
Residue, Non-Filterable	P,G	Cool, 4°C	5 days
Residue, Settleable	P,G	Cool, 4°C	24 hours
Residue, Volatile	P,G	Cool, 4°C	5 days
Silca	P only	Cool, 4°C	26 days
Specific Conductance	P,G	Cool, 4°C	26 days
Sulfate	P,G	Cool, 4°C	26 days
Sulfide	P,G	Cool, 4°C, add zinc acetate plus NaOH to pH>9	5 days
Surfactants (MBAS)	P,G	Cool, 4°C	24 hours
Turbidity	P,G	Cool, 4°C	24 hours
Organic Tests(8):			
Purgeable Halocarbons	G, teflon lined septa	Cool, 4°C	7 days
Purgeable Aromatics	G, teflon lined septa	Cool, 4°C	7 days
Acrolein and Acrylonitrile	G, teflon lined septa	Cool, 4°C, 0.008% $Na_2S_2O_3$ (5) adjust to pH 4-5(9)	7 days

TABLE 6-1 (CONTINUED)

REQUIRED CONTAINERS, PRESERVATIVES, AND HOLDING TIMES

PARAMETER NAME	CONTAINER(1)	PRESERVATIVE(2),(3)	MAXIMUM HOLDING TIME(4)
AQUEOUS SAMPLES (continued)			
Phenolics(10)	G, teflon lined septa	Cool, 4°C, 0.008% $Na_2S_2O_3$ (5)	5 days after VTSR until extraction; 40 days for analysis(12)
Benzidines(10,11)	G, teflon lined septa	Cool, 4°C 0.008% $Na_2S_2O_3$ (5)	5 days after VTSR until extraction(12)
Phthalate esters(10)	G, teflon lined septa	Cool, 4°C	5 days after VTSR until extraction; 40 days for analysis(12)
Nitrosamines(10,14)	G, teflon lined septa	Cool, 4°C 0.008% $Na_2S_2O_3$ (5) Store in dark	5 days after VTSR until extraction; 40 days for analysis(12)
PCBs(10)	G, teflon lined septa	Cool, 4°C	5 days after VTSR until extraction; 40 days for analysis(12)
Nitroaromatics and Isophorone(10)	G, teflon lined septa	Cool, 4°C 0.008% $Na_2S_2O_3$ (5) Store in dark	5 days after VTSR until extraction; 40 days for analysis(12)

TABLE 6-1 (CONTINUED)

REQUIRED CONTAINERS, PRESERVATIVES, AND HOLDING TIMES

PARAMETER NAME	CONTAINER(1)	PRESERVATIVE(2),(3)	MAXIMUM HOLDING TIME(4)
AQUEOUS SAMPLES (continued)			
Polynuclear Aromatic Hydrocarbons(10)	G, teflon lined septa	Cool, 4°C 0.008% $Na_2S_2O_3$ (5) Store in dark	5 days after VTSR until extraction; 40 days for analysis(12)
Haloethers(10)	G, teflon lined septa	Cool, 4°C 0.008% $Na_2S_2O_3$ (5)	5 days after VTSR until extraction; 40 days for analysis(12)
Chlorinated Hydrocarbons(10)	G, teflon lined septa	Cool, 4°C 0.008% $Na_2S_2O_3$ (5)	5 days after VTSR until extraction; 40 days for analysis(12)
Chlorinated Dioxins and Furans(10)	G, teflon lined septa	Cool, 4°C 0.008% $Na_2S_2O_3$ (5)	5 days after VTSR until extraction; 40 days for analysis(12)
Pesticides(10)	G, teflon lined septa	Cool, 4°C Adjust pH to 5-9(14)	5 days after VTSR until extraction; 40 days for analysis(12)
Radiological Tests:			
Alpha, beta and Radium	P,G	HNO_3 to pH<2	6 months

SOIL/SEDIMENT/SOLID SAMPLES

The same containers and holding times as listed for aqueous samples are to be used for soil/sediment/solid samples. Preservation for all analyses is limited to cooling to 4 C.

Footnotes for Table 6-1

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

2. Sample preservation should be performed immediately upon 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 samples 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). The person offering such material for transportation is responsible for ensuring such compliance. For preservation requirements of Table 6-1, the Office of Hazardous Materials, Materials Transportation Bureau, Department of Transportation has determined that the Hazardous Materials Regulations do not apply to the following materials: Hydrochloric Acid (HCL) in water solutions at concentrations of 0.04% by weight or less (pH about 1.96 or greater); Nitric Acid (HNO_3) in water solutions at concentrations

of 0.15% by weight or less (pH about 1.62 or greater); Sulfuric Acid (H_2SO_4) in water solutions at concentrations of 0.35% by weight or less (pH about 1.15 or greater); and Sodium Hydroxide (NaOH) in water solutions at concentrations of 0.080% by weight or less (pH about 12.30 or less).

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 monitoring laboratory has data on file to show that specific types of samples under study are stable for the longer time, and has received written permission prior to analysis form the Regional Administrator under 40 CFR Part 136.3(e) AND from the Bureau of Technical Services and Research. Some samples may not be stable for the maximum time period given in the table. A monitoring laboratory is obligated to hold the sample for a shorter time if knowledge exists to show that this is necessary to maintain sample stability.

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

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 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 onsite before adding preservative for dissolved metals.

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

9. 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.

10. 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 five days before extraction and for 40 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).

11. If 1,2-diphenylhydrazine is likely to be present, adjust the pH of the sample to 4.0±0.2 to prevent rearrangement of benzidine.

12. This does not supercede the contract requirement of a 30 day reporting time.

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% sodium thiosulfate and adjust the pH to 7-10 with NaOH within 24 hours of sampling.

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15. The pH adjustment may be preformed upon receipt in the laboratory and may be omitted if the samples are extracted with 72 hours of collection. For the analysis of aldrin, add 0.008% sodium thiosulfate.

ATLANTIC PROCEDURE NO. 1052

OPERATION OF THE PHOTOVAC 10S50 PORTABLE GAS CHROMATOGRAPH

Prepared By: FRANCIS DUMONT — TITLE: Chemist

Reviewed By: Dennis Unites — DENNIS F. UNITES, P.G. — TITLE:

Approved By: John A. Ripp — JOHN A. RIPP — TITLE:

REVISIONS

NO.	DATE	PREPARED BY	REVIEWED BY	APPROVED BY
1.	4/16/92	F. Dumont	D. Unites	J. Ripp
2.				
3.				
4.				

ATLANTIC ENVIRONMENTAL SERVICES, INC.
COLCHESTER, CONNECTICUT

Procedure No. 1052
Revision No. 1
Date April 24, 1992
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SECTION 1.0: PURPOSE

To establish a standard procedure for the operation of the Photovac 10S50 Portable Gas Chromatograph.

SECTION 2.0: SCOPE

This procedure details the steps necessary for the operation of the Photovac 10S50 in regard to performing soil gas surveys.

SECTION 3.0: RESPONSIBILITY

First - Project Manager

Second - Field Team Leader

Third - Photovac Operator

SECTION 4.0: SUPPORTING PROCEDURES

Atlantic Procedure No. 1053 *Soil Gas Screening for Volatile Organics*

SECTION 5.0: PROCEDURE

5.1 Introduction

The Photovac 10S50 is a portable gas chromatograph (GC) which can be used in the performance of soil gas surveys. This procedure describes the necessary equipment needed for GC operation, the method for setting up the GC, and the method for introducing samples into the GC system.

5.2 Equipment Required

Equipment needed for GC operation includes:

- Photovac 10S50 portable gas chromatograph with CPSIL5 capillary column and isothermal oven;
- cylinder of zero or ultra-zero grade air with regulator;
- glass gas-tight syringes;
- sample standards;
- gas standard of 1 or 10 ppm benzene in air;
- AC power supply;
- AC/DC converter;
- flowmeter (two channel); and
- Photovac owner's manual.

5.3 Instrument Set-Up

The GC requires that certain "running" parameters be inputted into its computer memory prior to operation. Parameters which should be entered include:

- electronic gain - 50;
- slope sensitivity - 18, 14, 6 mV/second;
- chart speed - 0.5 cm/minute;
- window +/- 10 percent;
- minimum area - 100 mV seconds
- timer delay - 10.0 seconds;
- cycle time - 0 minutes;

- analysis time - dependent on compounds of interest but should be at least three times greater than Event 3 (backflush);
- Event 1 (sample pump) on at 8.0 seconds, off at 10.0 seconds;
- Event 3 (backflush) on at 0.0 seconds, off at 160.0 seconds;

Once set, the GC computer memory should retain these running parameters.

The "use" function is utilized to set the date and time. The "info" function is utilized to input information the operator wishes to have printed out with each chromatogram (i.e., site name, location, etc.).

Once the parameters are set up, the carrier gas reservoir is filled with air (zero or ultra-zero grade). The flow meter is attached to the detector "out" and auxiliary "out" fittings. The detector outflow should be adjusted to approximately 10 ml/minute using the column flow adjustment knob. The auxiliary outflow should be adjusted to approximately 12 ml/minute using the auxiliary out valve knob. The oven is then turned on to 40° C. The instrument is then allowed to warm up and stabilize for 30 to 45 minutes.

After allowing for warm up, the "Start/Stop" and "Enter" keys should be pressed. This causes the GC to perform a run without the injection of a sample. This is done to ensure that a stable electronic baseline is being drawn. An unsteady baseline can be due to insufficient warm up or a leak in the GC system. A baseline with peaks can be due to a contaminated GC column. If a stable baseline is not obtained after sufficient warm up, refer to the Operation's Manual for probable causes and repair procedures.

While the baseline sample is running, the "chart" mode is set to "on with set-up". This setting activates the chart recorder to print set-up information at the end of the run, including the offset.

The offset is a measure of how much the instrument must adjust the baseline to compensate for background noise and is checked after each run. The offset should not exceed 50 mV. A high offset is usually the result of a contaminated column or the use of an unsuitable carrier gas. Refer to the Operation's Manual if the offset is greater than 50 mV.

5.4 Sampling Introduction

Analysis of standards and samples can be performed once the machine is properly set up. Standards (refer to Procedure 1053) and samples can be introduced into the GC by the following steps:

- push "Start/Stop" followed by "Enter" keys
- allow pump to buzz on for two seconds and shut off
- immediately inject the standard or sample utilizing a gas tight syringe

SECTION 6.0: STORAGE

While the GC is not in use, a low flow rate (approximately 1 ml/minute) should be maintained through the column. This is done by allowing the carrier gas reservoir to run out or by hooking up the external carrier gas fitting to an outside tank regulated to 40 psi. This is done in order to prevent the buildup of contamination in the column during downtime.

Long-term storage of the GC can cause low battery power. Low battery power can result in the loss of the GC's memory and would necessitate re-inputting running parameters. Sufficient battery charge to ensure memory retention can be maintained by occasionally plugging the GC in and turning it on overnight.

SECTION 7.0: REFERENCES

Photovac 10S Operations Manual

ATLANTIC PROCEDURE NO. 1070

WELL DEVELOPMENT PROCEDURES FOR SMALL DIAMETER MONITORING WELLS

Prepared By: Curtis A. Kraemer — Senior Hydrogeologist
CURTIS A. KRAEMER — TITLE

Reviewed By: John A. Ripp — Principal
JOHN A. RIPP — TITLE

Approved By: Paul Burgess — Principal
PAUL BURGESS, P.E. — TITLE

REVISIONS

NO.	DATE	PREPARED BY	REVIEWED BY	APPROVED BY
1.				
2.				
3.				
4.				

ATLANTIC ENVIRONMENTAL SERVICES, INC.
COLCHESTER, CONNECTICUT

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SECTION 1.0: PURPOSE

To insure the natural hydraulic conductivity of the subsurface materials have been restored and all foreign sediment removed to ensure turbid-free ground water samples.

SECTION 2.0: SCOPE

The following procedure describes the methods for monitoring well development and the conditions for which the methods are best suited. The procedure also includes a method for determining whether the development is sufficient for monitoring wells used for RCRA ground water monitoring programs.

SECTION 3.0: RESPONSIBILITY

Project Manager - First
Field Operations Manager - Second
Field Staff - Third

SECTION 4.0: SUPPORTING PROCEDURES

Atlantic Procedure No. 1030 Field Procedures for Logging Subsurface Conditions During Test Boring and Well Logging

Atlantic Procedure No. 1060 Cleaning Procedure for Sampling Devices used in Environmental Site Investigations

Atlantic Procedure No. 1071 Field Procedures for Determination of In-Situ Hydraulic Conductivity with Single Well Hydraulic Tests

SECTION 5.0: REQUIRED FORMS

Field Notebook No. 351, published by J.L. Darling Corp., Tacoma, Washington (or equivalent)

SECTION 6.0: PROCEDURE

Well development is a means to restore the natural hydraulic conductivity of the subsurface materials surrounding a monitoring well and ensure a turbid-free ground water sample. There are a variety of well development techniques, all of which require reversals or surges in flow to avoid bridging by particles, which is common when flow is continuous in one direction. The in-situ ground water should be used for surging the well. If the well yields an insufficient quantity of water to use, an outside source of water (preferably tap water) may be used. If the source of the outside water is unknown (not tap water), a sample should be chemically analyzed to determine whether the water may have an impact on the in-situ water quality.

The following applies to all methods described below:

* All materials including submersible pumps, suction lines, surge blocks, and lines used to pump water or compressed air into a well should be decontaminated in accordance with Atlantic Procedure No. 1060.

* Field notes should be kept to record the following information;

initial static water level

method of well development

average discharge rate and corresponding drawdown

any measureable recovery or information regarding yield of monitoring well

any noticeable changes in ground water quality resulting from well development

* The well development should continue until the discharge runs sediment free after 20 strokes of the surge block. A clear glass jar of distilled water should be used as a reference. Discharge from the pump should be checked periodically by collecting some of the discharge in a clear glass jar and comparing to the distilled water reference.

6.1 Surge Block Method

This method is best suited for monitoring wells that will yield at least 1/2 gallons per minute (gpm) while being pump with a vacuum lift pump (centrifugal pump). It can be used on wells with yields of less than 1/2 gpm, but may require the introduction of water from an outside source.

A surge block is a piston-like device with an outside diameter that is just smaller than the inside diameter of the well and used with by stroking the block up and down in the well. On the downstroke water is forced outward into the subsurface materials, and on the upstroke water, silt and fine sand are pulled in through the screen. This results in sediment filling in the well screen, which must be periodically removed.

The surge block for 2-inch wells consists of two rubber stoppers with a 1/2-inch pipe passing through the rubber stoppers. The stoppers are held in place with washers and nuts; the nuts can be tightened or loosened to expand the stoppers to get a good fit inside the well. The surge block is attached to either 3/4-inch or 1-inch rigid polypropylene tubing. This tubing is rigid enough that it can be used to stroke the surge block. This tubing is then attached to a centrifugal pump with a valve on the discharge side to control the pumping rate from the well.

The surge block should be kept above the screen if sufficient water is above the well screen. If necessary, the block may be stroked in the well screen, however, care should be exercised so not to damage the well screen and the slot sizing. Periodically the surge block should be lowered to the bottom of the well to remove the sediment that has accumulated at the bottom.

The same methodology applies to wells with yields less than 1/2 gpm except that water may have to be introduced occasionally because the well may dewater. The discharged water from the well should be used if at all possible, if not, tap water is the next choice of an outside source of water. When developing the low yielding wells, keep the discharge rate to a minimum, and if necessary, stop pumping for a short period of time while stroking the surge block.

6.2 Overpumping/Backwashing Development Method

This method can be used for wells that yield either less than or more than 1/2 gpm. Any number of pieces of equipment can be used to develop wells with this method. In general, the method involves overpumping a well so that it dewaters the well and then introducing a slug of water back into the well. As mentioned at the beginning of the procedure, it is preferred to use the discharge water when backfilling into the well. If that is not available, tap water is the next preferred source of water.

Any means of pumping water quickly out of a well may be used to overpump the well, however, there should be some means of removing the sediment that has flowed into the well. To this end a centrifugal pump will both pump quickly (will lift water up to about 25 feet of head) and remove the sediment from the bottom of a well. Most forms of submersible pumps are not designed to pump solids and will quickly become inoperative.

Backwashing the well is performed either by pumping the water back into the well quickly or pouring the water back into the well.

6.3 Air Development Method

The air development method consists of lowering a line (usually solid pvc pipe) down into a well and, using compressed air, blowing air into the well that literally lifts the water up and out of the well. This method is not well suited for low yielding wells since one has to wait for the well to recover before purging more water. The one major disadvantage to this method is that most air compressors have trace amounts of petroleum mixed in the air to keep the equipment lubricated. These trace amounts of petroleum can easily compromise the quality of the water in the well. There are some compressors which filter the air so there is no petroleum mixed in, however, these are not commonly available.

There should be a "U" shaped fitting at the bottom of the line placed in the well. This will direct the air in an upward direction, rather than blowing the air down and, subsequently, out into the subsurface materials. Without this U-shaped fitting, fine-grained materials may be pushed into the well screen producing the opposite of the desired affect. It is important that the air compressor be adequately sized so that it will produce sufficient pressure to lift the column of water out of the well (the longer the column, the more pressure that is required).

6.4 Jetting Development Method

This method can be used for both high and low yielding wells. It involves the pumping of water into the well through "jetting" nozzles (pointed directly at the well screen) and simultaneously pumping the well. The pumping pulls water into the well, and the jetting pushes water out through a small length of screen at a high velocity. This provides both a reversal and surge of water through the well screen. This may require the use of an outside source of water, particularly in low yielding wells. If an outside source is required, it preferably should be tap water.

APPENDIX B

LABORATORY QA PLANS

META ENVIRONMENTAL

ENERGY AND ENVIRONMENTAL ENGINEERING

QUALITY ASSURANCE PROGRAM PLAN FOR THE ANALYSIS OF POLYNUCLEAR AROMATIC HYDROCARBONS IN SOIL BY MICROSCALE SOLVENT EXTRACTION WITH GC/FID

Prepared for:

Atlantic Environmental Services, Inc.
188 Norwich Avenue
Colchester, CT 06415

Prepared by:

META Environmental, Inc.
49 Clarendon Street
Watertown, MA 02172

June 08, 1992

Approved: ______________________ Date: ______________________
Project Manager

Approved: David McManus Date: 6/8/92
Quality Assurance Officer

Approved: ______________________ Date: ______________________
Atlantic Project Manager

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1. PROJECT DESCRIPTION

This Quality Assurance Program Plan (QAPP) is submitted by META Environmental, Inc (META) to Atlantic Environmental Services, Inc. (Atlantic) for the analysis of soil and water samples for polynuclear aromatic hydrocarbons (PAH) by microscale solvent extraction with gas chromatography/flame ionization detection (GC/FID). It provides guidance and specifications for all tasks of the analytical project.

2. PROJECT ORGANIZATION AND RESPONSIBILITIES

All technical aspects of the performance of the analysis will be the responsibility of the META Project Manager. Figure 2.1 provides the project organization chart. It will be the responsibility of the Quality Assurance Officer (QAO) to assure that all operations and results are of the highest quality. The QAO will report directly to the president of META.

The responsibilities of the individuals associated with this program are described below:

- The **Project Manager** has the overall responsibility for management of the tasks of the project. The responsibilities of the project manager are to:

  1. administer and supervise all requirements of the project to ensure meeting project objectives;
  2. directly formulate the work plan and initiate work plan revisions when approved;
  3. consult and work cooperatively with the Atlantic Project Manager;
  4. work with Task Managers in planning and conducting the tasks;
  5. implement corrective actions.

- The **Quality Assurance Officer** (QAO) is responsible for reviewing and advising on all aspects of methodology and QA/QC. The responsibilities of the QAO are to:

  1. assist the Project Manager in specifying QA/QC procedures;
  2. implement QA/QC procedures and techniques to assure that the laboratory achieves established standards of quality;
  3. evaluate data quality and maintain records on related QC charts and other

pertinent information;

4. monitor laboratory activities to determine conformance with authorized quality assurance policy, and to implement appropriate steps to ensure adherence to QA programs;
5. prepare quality assurance reports; and
6. design and ensure the implementation of corrective actions.

- The <u>Laboratory Supervisor</u> has the overall responsibility for the management of the analytical tasks of the project. The responsibilities of the Laboratory Supervisor are to:

    1. administer and supervise all requirements of the analytical tasks to ensure that project objectives are met and are on schedule;
    2. work with the Task Managers in planning and conducting project activities;
    3. generate and review work plans, analytical methods, QAPPs, progress reports, and analytical data prior to issue to the Task Manager or QAO;
    4. design and operate a field laboratory, if required;
    5. implement the QC operations specified in the QAPP, and report the results of QC operations to the QAO; and
    6. identify problem areas and institute corrective actions.

- The <u>Task Managers</u> are responsible for each task identified in the scope of work and assigned to them. The Task Managers report directly to the Project Manager. The responsibilities of the Task Managers are to:

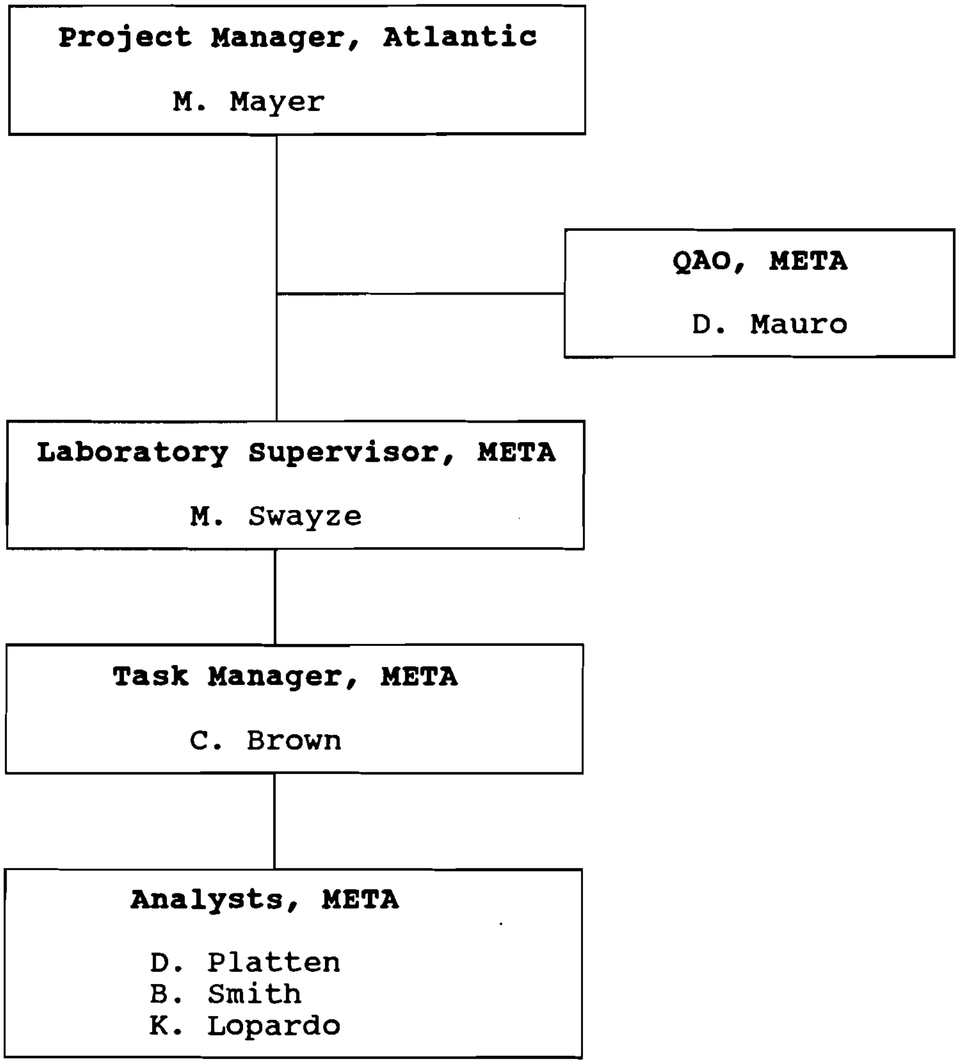
    1. assist in the planning for each phase of their tasks and in defining objectives and activities;
    2. implement work plan revisions related to their tasks;
    3. advise the Project Manager of progress, needs, and potential problems of their

tasks;

4. verify that sampling procedures, analytical procedures, and/or laboratory QC are being followed as specified;
5. review sample QC and report to the QAO;
6. maintain samples, records, logs, and data in accordance with the project QAPP; and
7. implement corrective actions as directed by the Project Manager.

Figure 2.1

Project Organization



3. QUALITY ASSURANCE OBJECTIVES

The analytical quality assurance objectives for this project are to provide analytical data of the highest quality. Data quality is assessed for precision, accuracy, completeness, representativeness, and comparability. This QAPP provides detailed descriptions of the quality control measures to be employed. For example, the routine analysis of replicate and spiked samples will provide precision and accuracy data for assessing the validity of analytical results. Procedures and tests appropriate for the quality assurance objectives established for Atlantic have been chosen and are included in the this QAPP.

In general, a system of careful monitoring and documentation, along with the use of quality equipment and established procedures, will be used to ensure high quality results. For example, the use of frequent blank analyses, instrument calibration, calibration checks, surrogate and matrix spikes, and replicate analyses help monitor analytical method performance.

The quality assurance objectives for this project are to:

- analyze sufficient laboratory quality control samples to allow an assessment of the contribution to variability in the data from the laboratory procedures; and
- produce documented, consistent, and technically defensible results.

Level of QA Efforts

Every attempt will be made to have all the data generated be valid. The precision of laboratory analysis will be evaluated using sample duplicates. Analytical accuracy will be monitored using recovery of analytes from surrogate spikes, matrix spikes, and independent check standards. These quality control measures and their frequency are summarized in Table 3.1. These QA efforts will assist in determining the reliability of the analytical data.

Accuracy and Precision

Accuracy is a measure of the degree of agreement between an analyzed value and the true or accepted reference value where it is known. Precision is a measure of the mutual agreement among individual measurements of the same parameter under similar conditions.

Completeness

Completeness is a measure of the amount of valid data obtained from the analytical measurement system, expressed as a percentage of the number of valid measurements that should have been or were planned to be collected. META will make every effort to generate valid data from all the samples received. However, realistically, some samples may be lost or results deemed questionable due to sample matrix effects or internal QC problems. META will make every effort to generate data that is at least 95% complete.

Representativeness

Representativeness is a measure of how closely the measured results reflect the actual concentration or distribution of the chemical compounds in the sample.

Comparability

Comparability is a measure of how closely sample data generated by the primary laboratory and method compares to data generated by another laboratory or method. META will ensure data comparability by operating within the linear range of the analytical instruments and by strict adherence to the analytical and QA/QC protocols defined in this QAPP.

Definition of QC Blank Sample Types

A laboratory equipment blank is a composite solvent rinsate of all the laboratory sample preparation equipment that comes into direct contact with the sample. This equipment includes culture tubes and caps, scintillation vials, KD receivers, pasteur pipettes, and extract vials. If any contamination is found, then individual rinsates must be performed. The laboratory equipment blank is an indicator of in-house contamination problems.

A solvent blank is an aliquot of each type of solvent used in the analytical process that has been spiked with surrogates and internal standard. It is an indicator of problems with contaminated solvents.

A method blank is an aliquot of clean water or soil that has been extracted under the same conditions as the samples. It is an indicator of problems with contaminants introduced during the sample preparation procedure.

Table 3.1

Quality Control Measures and Frequency
Polynuclear Aromatic Hydrocarbons by Gas Chromatography

Sample Type	Frequency*
Solvent Blank	One per week, or as necessary
Method (Extraction) Blank	One per extraction batch
Initial Calibration (5 levels of concentration)	Initially, and as needed
Continuing Calibration	At the beginning of each day and after every 15 samples
Surrogate Spike, Internal Standard	Added to every sample, blank, matrix spike, and matrix spike duplicate
Matrix Spike Sample	One per 20 samples
Laboratory Duplicate Sample	One per 20 samples
Independent Check Standard Sample	One per week

---

* As determined from the U.S. EPA Test Methods for Soils and Solid Wastes, SW-846, and by META Environmental, Inc.

Table 3.2

Quality Control Objectives
Polynuclear Aromatic Hydrocarbons by Gas Chromatography

Audit	**Control Limit***
Holding Times	Samples extracted within 14 days of collection; analysis within 40 days
QC Blanks	≤ 5X IDL for any target compound
Initial Calibration	≤ 30% RSD of RF for five levels concentration
Continuing Calibration	≤ 25% RPD of RF from initial calibration
Surrogate Standard	40 to 120% recovery of surrogates
Internal Standard Area	50 to 200% of closest standard area
Matrix Spike	40 to 120% recovery of spiked compounds
Laboratory Duplicate	≤ 50% RPD between results
Independent Check Standard	60 to 120% recovery of analytes

---

* As determined from the U.S. EPA Contract Laboratory Program Statement of Work for Organics Analysis (2/88), and by META Environmental, Inc.

4. SAMPLING PROCEDURES

Sampling will be the responsibility of Atlantic.

5. SAMPLE CUSTODY

The purpose of the chain of custody (COC) procedure is to document the transfer of custody for each sample from the time of collection throughout the analytical process to the time when the analytical results are completed and reported. The QAO and Laboratory Supervisor will jointly monitor the sample receipt, storage, and analysis process to ensure that proper chain of custody has been followed and documented.

Samples collected and analyzed at the META laboratory will be shipped to META with a chain of custody form. Once samples have arrived at META they will be recorded in a computerized database. The database will be used to generate analytical worksheets for each method for use by the analyst. Hard copies of the sample information and analytical worksheets will be produced and bound in a Sample Custody logbook. The Sample Receipt Record (Figure 5.2) assigns a unique, internal laboratory ID to each sample, records pertinent information regarding the condition of the shipped samples, and verifies that all samples listed on the COC were received. Additional information regarding sampling dates, dates of receipt, and sampling depths will be recorded in the database, but is not printed on the Sample Receipt Record. Samples will be stored in a secure area of META until disposal.

Figure 5.1

Sample Receipt Record

			SAMPLES RECEIVED				
SITE:				DATE SAMPLED:			
INITIALS:				DATE RECEIVED:			
	LAB ID		CONTAINER/				
SAMPLE ID		MATRIX	STORAGE		NOTES/COMMENTS		

6. DOCUMENTATION

Proper documentation will be used to account for all sample and standard preparation and analysis procedures. All logbook entries will be made in permanent ink, and mistakes will be crossed through with a single line and initialed.

Standards will be prepared as specified in Section 7. All prepared standards will be recorded in a paginated, spiral bound Standard Preparation logsheet (Figure 6.1).

The received samples will be entered into the sample extraction logsheets (Figure 6.2) in batches of twenty. A hard copy of the sheets will be printed and photocopied for use in each type of extraction performed, and will be stored in the corresponding section of the Sample Custody logbook. The samples will be listed in order by laboratory sample ID, and the field ID will not be present on the logsheets. This procedure assures that subjective judgements do not enter into the analytical process.

All soil samples will have a percent solids determination performed. The received samples will also be entered into the percent solids determination logsheet (Figure 6.3), and a hard copy will be printed and stored in the Sample Custody logbook.

All samples analyzed will be recorded in the appropriate analytical logbook. Samples analyzed for polynuclear aromatic hydrocarbons will be recorded in a paginated, spiral bound GC Run logbook (Figure 6.4).

Analytical results will be reported in a format of the client's designation. Documentation of QC Sample results will be provided upon request. All documentation (logbooks, raw data, and reports) will be stored in a secure place at META.

Figure 6.1

Standard Preparation Logbook

		STANDARD PREPARATION						
		Standard Name:						
Date:								
Analyst:								
				Aliquot		Final		Final Conc.
Compound/ Mix		Reference		or Weight		Volume (ml)		Units:

Figure 6.2

Sample Extraction Logbook

		SAMPLES EXTRACTED				
METHOD:						
	WT OR VOL	DATE	DATE	MATRIX and	FINAL	
SAMPLE ID	EXTD	EXTD(init.)	CONC(init.)	SURR SPIKE	VOLUME	NOTES
MB						
-DUP						
-SPK						

Figure 6.3

Percent Solids Determination Logbook

		PERCENT SOLIDS DETERMINATION				
		BEFORE DRYING			AFTER DRYING	
		WEIGHT	WEIGHT		WEIGHT	
SAMPLE ID		PAN	SAMPLE+PAN		SAMPLE+PAN	%SOLIDS
		A	B		C	
		C - A				
		%SOLIDS= ------- X 100				
		B - A				

Figure 6.4

Page____

GC RUN LOGSHEET

Date__________Initials_______

Batch OK? Troubleshooting or Maintenance Performed? Comments?

Sample #	GC Run #	Sample ID	uL Inj.	Notes/Comments

7. CALIBRATION PROCEDURES AND FREQUENCY

This section describes the calibration procedures and frequencies for the instrumentation which will be used in the analysis of polynuclear aromatic hydrocarbons. All materials used for instrument calibration, internal standards, matrix spike standards, and surrogate standards will be of the highest purity available and will be obtained from a suitable commercial source.

Polynuclear Aromatic Hydrocarbons by GC/FID

Calibration Standards

a. Prepare stock solutions using commercially available materials.

b. Prepare working solutions by dilution of the stock standards.

c. Verify the working standards by analysis of a calibration check standard prepared using either EPA QC concentrates or other independent standard.

Calibration Procedure

a. Analyze a five point initial calibration sequence using standards prepared as described above. Verify that the criteria specified in Table 3.2 have been met. If not, identify the source of the problem, perform instrument maintenance as necessary, and analyze another five point calibration sequence. If the instrument has had a five point initial calibration performed, this step may be skipped, provided that all criteria here or in part b. below are met.

b. Analyze a continuing calibration standard prepared as described above in Calibration Standards. If the calibration does not meet the criteria specified in Table 3.2, then identify the source of the problem, and perform maintenance as necessary. A new initial calibration sequence must be analyzed after instrument maintenance. Recalibrate the instrument response factors daily.

c. Analyze additional continuing calibration standards after every fifteenth sample. It is not necessary to recalibrate unless the compound percent differences exceed 25%.

8. ANALYTICAL PROCEDURES

The analytical procedures to be employed for this project are modifications of published procedures. The procedure for analysis of polynuclear aromatic hydrocarbons was developed based on the U.S. EPA procedure for the sonication extraction and analysis of nonvolatile and semivolatile (including polynuclear aromatic hydrocarbon) compounds (Methods 3550 and 8100), the U.S. EPA procedure for the liquid-liquid extraction of semivolatile organic compounds (Method 610), and the U.S. EPA CLP respectively. META has developed sample preparation and analysis SOPs for the modifications of these procedures, and they are presented in Figures 8.1, 8.2, and 8.3.

Figure 8.1

POLYNUCLEAR AROMATIC HYDROCARBONS IN SOIL BY MICROSCALE SONICATION EXTRACTION

1.0 Sample Preparation

1.1 Weigh 2 grams of soil into a tared glass scintillation vial or culture tube with a teflon or aluminum foil lined cap. Record the exact weight of the soil on the Sample Extraction Logsheet.

1.2 Add approximately 4 grams of anhydrous sodium sulfate (Na_2SO_4) to the scintillation vial. Homogenize the Na_2SO_4 and soil with a clean stainless steel spatula until the mixture is free flowing. Add more sodium sulfate as necessary.

1.3 Immediately add 10 mL of 1:1 (v/v) methylene chloride:acetone. Cap tightly and mix thoroughly by shaking. The sodium sulfate/sample slurry should be free flowing and not a consolidated mass. As necessary, break up large lumps with a clean stainless steel spatula. Do not use the sonicator probe tip to break up the sample! More Na_2SO_4 may be added if necessary.

1.4 Add 25 μg of surrogate standard (2-fluorobiphenyl) and if the sample is a matrix spike sample, add 25 μg of matrix spike standard.

1.5 Using the microtip, sonicate the sample for 2 minutes with the output control setting at 5, the mode switch on "1 second pulse", and the % duty cycle set at 50%. The soil/sodium sulfate slurry should appear fluffy and homogeneous, and sufficient solvent should be added such that the volume of the solvent is approximately equal to the volume of the solids. Alternatively, place the sample in a 20 mm culture tube with a Teflon-lined screw cap on a laboratory rotator and mix for at least 30 minutes.

1.6 Allow the solids to settle. Decant the solvent to a small glass funnel containing sodium sulfate over a plug of glass wool. Filter the sample extract into a precleaned culture tube. The solvent can also be transferred to the funnel with a pasteur pipet.

1.7 Perform two rinses of the soil by adding 5 mL of solvent, handshaking for thirty (30) seconds, removing the solvent layer, and filtering it to the previous extraction. Wash the Na_2SO_4 in the funnel with 1-2 mL of DCM/acetone and combine with wash with the sample extract. The sample extract may now be stored in the refrigerator away from direct light until concentration.

2.0 Sample Concentration (Modification of META SOP No. EM001-01)

2.1 Decant the filtered sample extract into a 15 mL Kuderna-Danish concentrator tube. Rinse the culture tube with 1 to 2 mL of DCM/acetone and add to the concentrator tube. Add one boiling bead. Attach a two ball micro-snyder column.

2.2 Pre-wet the Snyder column by adding 0.5 mL of DCM/acetone to the top of the column.

2.3 Place the K-D apparatus in a constant temperature hot water bath so that the concentrator tube is partially, but not completely, immersed. Adjust the temperature of the bath and the position of the apparatus so that the solvent boils evenly, and the micro-Snyder column balls chatter but the chambers do not flood with solvent (approximately 70 to 80°C).

2.4 Reduce sample volume to approximately 0.5 mL. Remove and allow to cool and drain for several minutes.

2.5 Rinse the Snyder column with 0.5 mL of DCM/acetone, and allow to drain for several minutes.

2.6 Remove the Snyder column.

2.7 Using a gentle, steady stream of nitrogen gas, reduce the extract volume to 1.0 mL. Transfer the concentrated extract to a small screw top vial with Teflon-lined septa. Rinse the concentrator tube with 0.5 mLs of DCM/acetone and transfer to the screw top vial. Using nitrogen gas and a 1000 uL gas-tight syringe, reduce final extract volume to exactly 1.0 mL.

2.8 Add 50 μg internal standard. Cap tightly, label, and store in freezer away from direct light source until ready for analysis.

Figure 8.2

POLYNUCLEAR AROMATIC HYDROCARBONS IN WATER BY MICROEXTRACTION

1.0 Sample Preparation

1.1 Measure 20 mL of sample into a 30 mL separatory funnel or measure 15 mL of sample into a culture tube. Record the volume on the Sample Extraction Logsheet.

1.2 Add 25 μg of surrogate standard mix and if the sample is a matrix spike sample, add 25 μg of matrix spike standard.

1.3 Add 3 mL of methylene chloride (DCM). Stopper and shake for at least 2 minutes. Allow the layers to separate.

1.4 Drain the DCM into a culture tube through 2 to 3 grams of anhydrous sodium sulfate in a pipet or small funnel.

1.5 Repeat 1.3 and 1.4 twice more shaking one minute each time. The sample extract may now be stored in the refrigerator away from direct light until concentration.

2.0 Sample Concentration (Modification of META SOP No. EM001-01)

2.1 Decant the filtered sample extract into a 15 mL concentrator tube. Rinse the culture tube with 1 to 2 mL of DCM and add to the concentrator tube. Add one boiling bead. Attach a two ball micro-snyder column.

2.2 Pre-wet the Snyder column by adding 0.5 mL of DCM to the top of the column.

2.3 Place the K-D apparatus in a constant temperature water bath at 80 °C so that the concentrator tube is partially, but not completely, immersed. Adjust the position of the apparatus so that the solvent boils evenly, and the micro-Snyder column balls chatter but the chambers do not flood with solvent.

2.4 Reduce sample volume to approximately 0.5 mL. Remove and allow to cool and drain for several minutes.

2.5 Rinse the Snyder column with 0.5 mL of DCM, and allow to drain for several minutes.

2.6 Remove the Snyder column.

2.7 Using a gentle, steady stream of nitrogen gas, reduce the extract volume to < 1.0 mL. Transfer the concentrated extract to a small screw top vial with teflon-lined septa. Rinse the concentrator tube with 0.5 mLs of DCM and transfer to the screw top vial. Using nitrogen gas and a 1000 uL gas-tight syringe, reduce final extract volume to exactly 0.5 mL.

2.8 Add 50 μg of internal standard. Cap tightly, label, and store in freezer away from direct light source until ready for analysis.

2.9 Alternatively, the sample extract can be reduced to a final volume of 1.0 mL under a gentle stream of nitrogen gas in a warm water bath (approx. 40 °C). Internal standard can than be added as in 2.8.

Figure 8.3

POLYNUCLEAR AROMATIC HYDROCARBONS BY GAS CHROMATOGRAPHY WITH FLAME IONIZATION DETECTION (GC/FID)

1.0 GC Operating conditions

1.1 Samples are analyzed by capillary column GC/FID operated in the splitless injection mode. The following GC conditions apply:

Column:	30 m x 0.32 mm DB-5 (J&W Scientific) Inlet Purge valve open after 0.5 minutes
Oven:	2.0 min. at 35 °C 8.0 °C to 290 °C hold for 15 minutes
Inj. port:	290 °C
Detector:	300 °C

1.2 One μL samples are injected using an autosampler.

2.0 Calculations

2.1 An internal standard (o-terphenyl) is added to each sample to give a final concentration in the extract of 50 μg/mL.

2.2 The concentration of each component is calculated using the internal standard method and based on the areas of the peaks of interest.

3.0 Quality Control

3.1 25 μg of a surrogate standard (2-fluorobiphenyl) is added to each sample prior to extraction. The recovery of the surrogate is monitored to determine the extraction efficiency. Samples with low surrogate recovery are re-extracted and re-analyzed.

3.2 The linearity of the detector is established prior to the analysis of samples by analyzing calibration standards at 3 to 5 levels of concentration which bracket the analytical range of interest.

3.3 The continued linearity of the system is checked periodically by the analysis of a continuing calibration check standard at 50 μg/mL.

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DATE: 901211
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9. DATA REDUCTION, VALIDATION AND REPORTING

The data reduction, validation, and reporting procedures are the same for the on-site and in-house laboratories.

Data Reduction

Analysis results will be reduced to the concentration units specified in the analytical procedures using the equations provided in the analytical references cited in Section 8. Results will be calculated on a dry-weight basis. Blank correction will not be performed, but blank analysis results will be documented. All calculations will be independently checked by the Laboratory Supervisor and the QAO.

Data Validation

The staff at META have an extensive background and technical expertise in the area of data validation. All data generated by the laboratory at META will be reviewed by persons with sufficient knowledge to identify questionable values. If it should become necessary to report a result or set of results that are deemed questionable by META, then those data will be clearly flagged as such.

Data Reporting

The data will be reported in the format specified by the client. All QC sample results will be made available, and can be summarized and reported upon request.

10. INTERNAL QUALITY CONTROL AND QUALITY ASSURANCE

Internal Quality Control

Quality Control (QC) is the system of tests and checks used by the analytical laboratory to ensure that data being generated conform to the Quality Assurance objectives. These checks are performed by the project participants under the guidance of the QAO. The QC procedures for the analysis of MAHs and PAHs are the same for the on-site and in-house laboratories.

META makes use of several types of QC samples to document the validity of the generated data. The following types of QC samples are routinely used:

1. Blank Samples - Blanks are used to assess the possible pathways through which samples could become contaminated. These include: sampling, transit, storage, and/or preparation. The blank sample types have been previously described in Section 3, and are briefly listed here:

    - Field Water Blank
    - Field Equipment Rinse Blank
    - Laboratory Equipment Blank
    - Solvent Blank
    - Method (Extraction) Blank

2. Initial and Continuing Calibration Verification - Verification samples are analyzed prior to and during each analytical sequence to assure calibration accuracy for each analyte.

3. Internal Standards - For PAH analyses, all samples, blanks, standards, and matrix spike samples are spiked with an internal standard just prior to sample analysis. Quantitation of target compounds is performed relative to the internal standard.

4. Surrogate Spikes - For PAH analyses, all samples, blanks, standards, and matrix spike samples are spiked with surrogate compounds prior to sample preparation in order to assess the behavior of actual components in individual samples during the entire preparative and analytical procedure. Surrogate standard compounds are chemically similar to the compounds of interest.

5. Matrix Spikes - At frequencies as specified in Table 3.1, samples are spiked with several

known compounds at known concentrations in order to evaluate any matrix effect of the samples on the analysis. Matrix spikes are performed using actual compounds of interest.

6. Duplicate Samples - At frequencies as specified in Table 3.1, a second aliquot of a sample is carried through the entire sample preparation and analysis procedure to verify the precision of the analytical method.

Reagents used in the laboratory are normally of analytical reagent grade or higher purity. All reagents are labeled with the date received and date opened. In addition, this information is recorded in a paginated, spiral bound Chemical Inventory logbook (Figure 10.1). The laboratory uses purchased distilled water, which is monitored through the analysis of method (extraction) blanks.

Internal Quality Assurance

To monitor quality, META conducts internal quality assurance audits at both its on-site and in-house laboratories. Items checked during an internal audit include:

1. QC Check Standards - Standards obtained from a different source than those used to calibrate the analytical system are analyzed to verify analytical performance.

2. Internal Laboratory Audits - The QAO will perform laboratory audits as necessary. This involves evaluation of:

   - sample storage
   - chain of custody
   - instrument maintenance
   - documentation
   - precision
   - accuracy

Any problems will be noted and corrective action initiated.

Figure 10.1

Chemical Inventory Logbook

Chemical ID	Vendor ID	Date Recvd	Lot #	Condition (Sealed)	Initial

- Initial and date all compound bottles in order to establish their order of use and to minimize the possibility of exceeding their useful shelf life.

11. PREVENTIVE MAINTENANCE

META performs routine system maintenance on all analytical equipment. Preventive maintenance and careful calibration help to assure accurate measurements from all laboratory instruments. In addition, regular preventive maintenance eliminates possible contamination of the analytical system.

Preventive maintenance procedures include such operations as the replacement of injection port septa and liners, the replacement of graphite ferrules and o-rings, clipping column ends, and cleaning the detector system. In addition, carrier gas purification traps and molecular sieve traps are used and changed regularly. Precision and accuracy data are examined for trends beyond control limits to determine evidence of instrument malfunction. Maintenance must be performed when the instrument begins to degrade as evidenced by the degradation of peak resolution, shift in calibration curves, decreased sensitivity, notable baseline rise, or failure to meet one or more of the QC criteria outlined in Table 3.2.

Any preventive maintenance performed on the analytical system is detailed in the Instrument Run logbook.

META's preventive maintenance procedures are the same for on-site and in-house laboratories.

QUALITY ASSURANCE PLAN

FOR

ENERGY AND ENVIRONMENTAL ENGINEERING, INC.

35 Medford Street
Somerville, Massachusetts 02143

Nicholas P. Corso Nicholas P. Corso	General Manager Laboratory Division
Stephen D. Mattingly Stephen D. Mattingly	Director, Quality Assurance

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3.0 INTRODUCTION

Energy and Environmental Engineering, Inc. (E3I) is an analytical testing laboratory and a research, development, and consulting company incorporated in the Commonwealth of Massachusetts. The company was founded in 1979 by Dr. James H. Porter expressly for the purpose of applying technology, economics, and policy to providing solutions to energy and environmental problems encountered in the national and international arena. Dr. Porter's expertise in the environmental sciences is evidenced by his membership on the U.S. Environmental Protection Agency's Science Advisory Board from 1976 to 1981.

E3I's Laboratory Division was established in 1985 to perform special analytical services in the chemical testing of samples from a major superfund site. Subsequently, E3I was encouraged to participate in the USEPA's Contract Laboratory Program and became the first "small, disadvantaged" (8a) business to qualify as a USEPA Contract Laboratory. In response to the large number of opportunities in New York State, we have qualified to participate in the NYSDEC CLP program. The E3I Laboratory Division provides a wide range of analytical and consulting services to both industry and government.

The following Quality Assurance Plan describes the policies, organization, objectives, quality control activities, and specific quality assurance functions employed at E3I, and demonstrates E3I's dedication to producing accurate, consistent data of known quality. The QA Plan follows the "Interim Guidelines and Specifications for Preparing Quality Assurance Plans" published by the USEPA, December, 1980.

4.0 QUALITY ASSURANCE POLICY STATEMENT

Energy and Environmental Engineering, Inc. is firmly committed to the production of valid data of known quality through the use of analytical measurements that are accurate, reliable, and complete. To ensure the production of such data, E3I has developed an extensive Quality Assurance/Quality Control Program that operates throughout the entire organization.

Quality Control is defined as an organized system of activities whose purpose is to provide quality data, while Quality Assurance is more broadly defined as a system of activities designed to ensure that the quality control program is actually effective. Quality Control is included as part of Quality Assurance. In supporting government regulatory and enforcement proceedings, a high degree of attention to quality is essential. Intense application of quality control principles and routine quality assurance audits are required.

The basic components of the E3I QA/QC Program are control, evaluation and correction.

Control ensures the proper functioning of analytical systems through the implementation of an orderly and well-planned series of positive measures taken prior to and during the course of analysis including quality control practices, training of personnel, routine maintenance and calibration of instruments, and frequent validation of standards.

Evaluation involves the assessment of data generated during the control process. For example, precision and accuracy are determined from the results of duplicates and spikes, and other check samples. Long-term evaluation measures include performance and systems audits conducted by regulatory agencies, as well as the E3I quality assurance group.

Correction includes the investigation, diagnosis and solution of any problem detected in an analytical system. Proper functioning of the system may be restored through method re-evaluation, analysis of additional check samples, trouble-shooting and repair of instrumentation or examination and comparison with historical data. Corrective actions are documented in confidential records.

The management at E3I considers Quality Assurance/Quality Control to be of paramount importance in the success of the company and fully supports the staff in the implementation of a sound and thorough Quality Assurance Program. Our E3I Quality Assurance Policy Statement is included as Figure 4-1.

FIGURE 4-1

Quality Assurance Policy Statement
Energy and Environmental Engineering, Inc.
June 1, 1987

The success of our Environmental Chemistry Services Division is directly related to client perception of the reliability and accuracy of the data we generate. From the moment an environmental sample arrives in our laboratory, each step it passes through in sample management, preparation, analysis and reporting will affect data reliability and accuracy. Thus, Quality Assurance and Control procedures have been imposed at each step and operation in our laboratory to ensure our clients' satisfaction. E3I is firmly committed to the effective implementation of these procedures.

It is incumbent on every employee at all operation and management levels to thoroughly understand and carry out said procedures.

Our Quality Assurance and Quality Control Program is the key to our success and, as a company policy, will be strictly enforced. The Director of Quality Assurance will direct and oversee this function, but we are all individually responsible for its execution.

James H. Porter

James H. Porter
President

Energy and Environmental Engineering, Inc.

5.0 QUALITY ASSURANCE MANAGEMENT, ORGANIZATION AND RESPONSIBILITY

Quality Assurance at E3I is a company-wide function that depends on cooperative working relationships and multi-level review. Responsibilities for QA/QC functions begin with the bench scientist and extend to the president of E3I.

The primary level of quality assurance resides with the bench scientist, who, after matriculation in the E3I training program, is responsible for: 1) precisely following the analytical methods and SOPs, 2) carefully documenting each step in the appropriate format, 3) conscientiously obtaining peer review as required, and 4) promptly alerting laboratory managers and/or QA staff members to problems or anomalies.

The manager of each analytical laboratory is responsible for the quality of the data generated by the scientists in that laboratory. The laboratory manager implements and monitors the specific QC protocols and QA programs within the laboratory to ensure a continuous flow of high quality data. It is the laboratory manager's responsibility to provide the bench chemists with ample resources including space, equipment, personnel and, especially, time, in order to accomplish top quality performance.

The organizational structure of the E3I laboratory includes a General Manager, a Director of Inorganics and a Director of Organics, each of whom is ultimately responsible for the quality of data generated by his respective group.

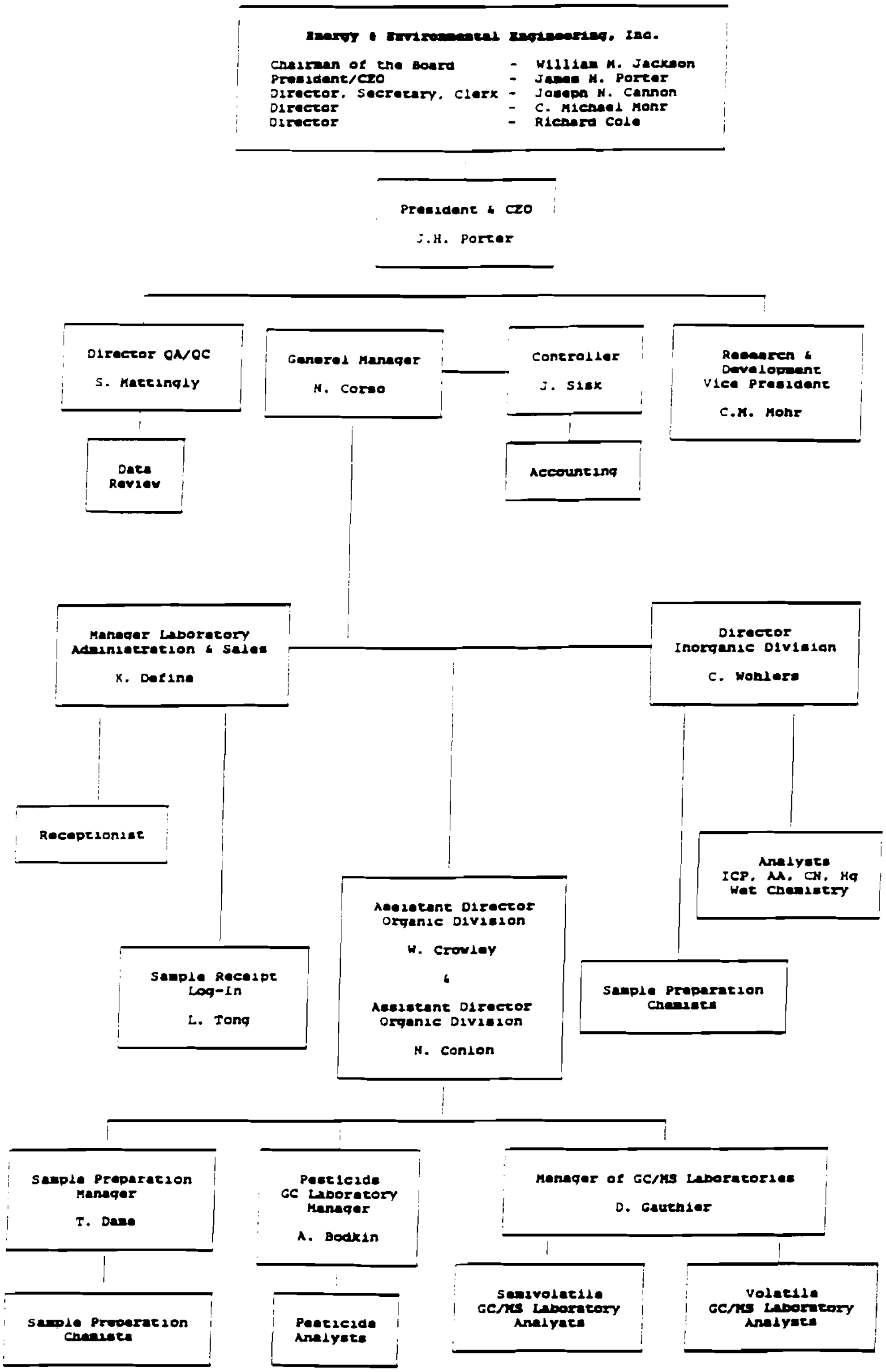
The overall Quality Assurance Program and associated activities are managed by the Director of Quality Assurance. While interacting on a daily basis with laboratory staff members, the QA Director remains independent of the laboratories and reports directly to the President of E3I. Laboratory compliance with the QA program is evaluated by the QA Director through informal and formal systems and performance audits. Remedial action is suggested if necessary.

With input from the appropriate staff members, the Director of Quality Assurance writes, edits and archives general and specific QA plans, QC protocols, safety procedures, and Standard Operating Procedures (SOPs). An essential element of the QA program is keeping records and archiving all information pertaining to quality assurance including QA/QC data, pre-award check sample results and scores, performance evaluation sample results and scores, state certifications of the laboratories, EPA and other audit team comments, recommendations and reports. The QA Director also plays an important role in the corrective action mechanism described in Section 16.

A semi-official QA function performed by the Director involves working with scientists and management to continually upgrade procedures and systems to make laboratory work more efficient.

Ultimately, the success of the QA Program depends on the cooperation and support of the entire organization. E3I's most valuable resource is its staff of dedicated professionals who take personal pride in the quality of their performance. An organizational chart of the E3I Laboratory Division, showing the position of Quality Assurance within E3I, is given in Figure 5-1.

FIGURE 5-1
E3I ORGANIZATIONAL CHART



6.0 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA IN TERMS OF PRECISION, ACCURACY, REPRESENTATIVENESS, COMPLETENESS AND COMPARABILITY

As part of the evaluation component of the QA Program, laboratory results are compared with certain data quality objectives. These objectives, in terms of precision, accuracy, representativeness, completeness and comparability, may be defined as follows:

- <u>Precision</u> - the agreement or reproducibility among individual measurements of the same property, usually made under the same conditions.
- <u>Accuracy</u> - the degree of agreement of a measurement with the true or accepted value.
- <u>Representativeness</u> - the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition.
- <u>Completeness</u> - a measure of the amount of valid data obtained from a measurement system compared with the amount that was expected to be obtained under correct normal conditions.
- <u>Comparability</u> - an expression of the confidence with which one data set can be compared with another data set in regard to the same property.

Quality Assurance objectives vary according to the specific project and the parameters requested. The accuracy, precision, and representativeness of data will be functions of the origins of the samples, the procedures used to analyze samples and generate data, and the specific sample matrices involved in each project. Quality control practices utilized in the evaluation of these data quality objectives include blanks, replicates, spikes, standards, check samples, calibrations and recoveries.

6.1 Precision and Accuracy

For each parameter analyzed, the QA objectives for precision and accuracy will be determined from: 1) published historical data; 2) method validation studies; 3) E3I experience with similar samples and/or 4) project-specific requirements, such as those stipulated by the USEPA in the CLP protocols.

6.2 Representativeness

Analytical data should represent the sample analyzed regardless of the heterogeneity of the original sample matrix. In most cases, representativeness is achieved by mixing the sample well before removing a portion for analysis. On occasion, multi-phase samples may require that each phase be analyzed individually and reported in relation to its proportion in the whole sample.

6.3 Completeness

Completeness is expected to be 100% in most cases and includes: 1) analysis of all samples; 2) generation and analysis of all required QC samples; 3) sufficient documentation of associated calibration, tuning, and standardization; and 4) records of data reduction processes, including manual calculations. Completeness is ensured by assigning to each project a specific project manager whose functions include sample management and tracking.

6.4 Comparability

The QA objective is generally 100% for comparability as well. To assure comparability, E3I employs established and approved analytical methods (e.g. USEPA protocols), consistent analytical bases (wet weight, volume, etc.) and consistent reporting units (ppm, ppb, etc.).

7.0 SAMPLING PROCEDURES

For most projects, outside sampling teams deliver or send samples to the E3I laboratories. When sampling by E3I personnel is required, the E3I sampling team follows the sampling procedures outlined in the EPA/OSW Test Methods for Evaluating Solid Wastes, SW 846, 3rd Edition, or procedures found in the EPA "Handbook for Sampling and Sample Preservation of Water and Wastewater." Safety during the sampling process is discussed in the E3I document "Safety Procedures for Sampling Personnel". Site-specific sampling plans are prepared at E3I for projects requiring them.

Appropriately prepared sample containers are supplied by E3I if a client so requests. When required, preservatives are added to the sample containers by E3I scientists. Table 7-1 provides the E3I Recommended Methods for Sampling and Preservation of Samples for Analysis. Maximum holding times, as specified in 40 CFR, Part 136, are included in the table.

TABLE 7-1
RECOMMENDED METHODS FOR SAMPLING AND PRESERVATION OF SAMPLES FOR ANALYSIS

Analysis	Vol Req'd	Container	Preservation	Holding Time Commercial	Holding Time CLP
Acids/Base/Neutral	1L	Amber glass	4°C	7 days	5 days
Acidity	100mL	P, G	4°C	14 days	12 days
Alkalinity	100mL	P, G	4°C	14 days	12 days
Bacteria	Varies	Sterile	4°C	6 hrs	6 hrs
BOD	1L	P, G	4°C	48 hrs	24 hrs
COD	100mL	P, G	H2SO4, pH<2	28 days	26 days
Chloride	50mL	P, G	None	28 days	26 days
Chlorine	200mL	P, G	Det. on site	Immed.	n/a
Chromium, VI	200mL	P, G	4°C	24 hrs	24 hrs
Coliform	100mL	Sterile	4°C	6 hrs	6 hrs
Color	50mL	P, G	4°C	48 hrs	24 hrs
Conductivity	100mL	P, G	4°C	28 days	26 hrs
Cyanides	500mL	P, G	NaOH, pH>12	14 days	12 days
Fluoride	300mL	P, G	None	28 days	26 days
Hardness	100mL	P, G	HNO3, pH<2	6 months	6 months
Herbicides	1L	Amber glass	4°C	7 days	5 days
Iodide	100mL	P, G	4°C	24 hrs	n/a
mBAS	250mL	P, G	4°C	48 hrs	24 hrs
Mercury	1L	Polyethylene	pH<2 w/HNO3	28 days	26 days
Metals (not Hg & Cr^{VI})	1L	Polyethylene	pH<2 w/HNO3	6 months	6 months
Microbiological	500mL	P, G	4°C	24 hrs	24 hrs
Nitrate	50mL	P, G	4°C	48 hrs	24 hrs
Nitrite	50mL	P, G	4°C	48 hrs	24 hrs
Nitrate/Nitrite	100mL	P, G	H2SO4, 4°C	28 days	26 days
Nitrogen, NH3	400mL	P, G	H2SO4, pH<2	28 days	26 days
Nitrogen, Org.	500mL	P, G	H2SO4, pH<2	28 days	26 days
Oil and Grease	1L	G	4°C H2SO4, pH<2	28 days	26 days
Pesticides/PCBs	1L	Amber glass	4°C	7 days	5 days
PHC-Fingerprint	1L	Amber glass	4°C	7 days	n/a
Sulfate	50mL	P, G	4°C	28 days	26 days
Sulfide	500mL	P, G	NaOH, ZnOAc	7 days	5 days
TDS	Varies	P, G	4°C	48 hrs	24 hrs
TOC	50mL	G	H2SO4, pH<2	28 days	26 days
Total phosphorus	50mL	P, G	H2SO4, pH<2	28 days	26 days
TPH	1L	G	HCl, 4°C	28 days	26 days
TS, TSS, TVS	Varies	P, G	4°C	7 days	5 days
Volatile Organics	2x40mL	VOA vial	4°C	14 days	7 days

---

[1] Table 7-1 is generally applicable to aqueous and soil samples. Commercial holding times begin on the date sampled. The holding times for CLP protocols begin on the verified time of sample receipt (VTSR). Containers and holding times for unlisted analyses are based on those of similar soil, sediments and water analyses and preserved at 4°C.

8.0 SAMPLE CUSTODY

8.1 Chain of Custody

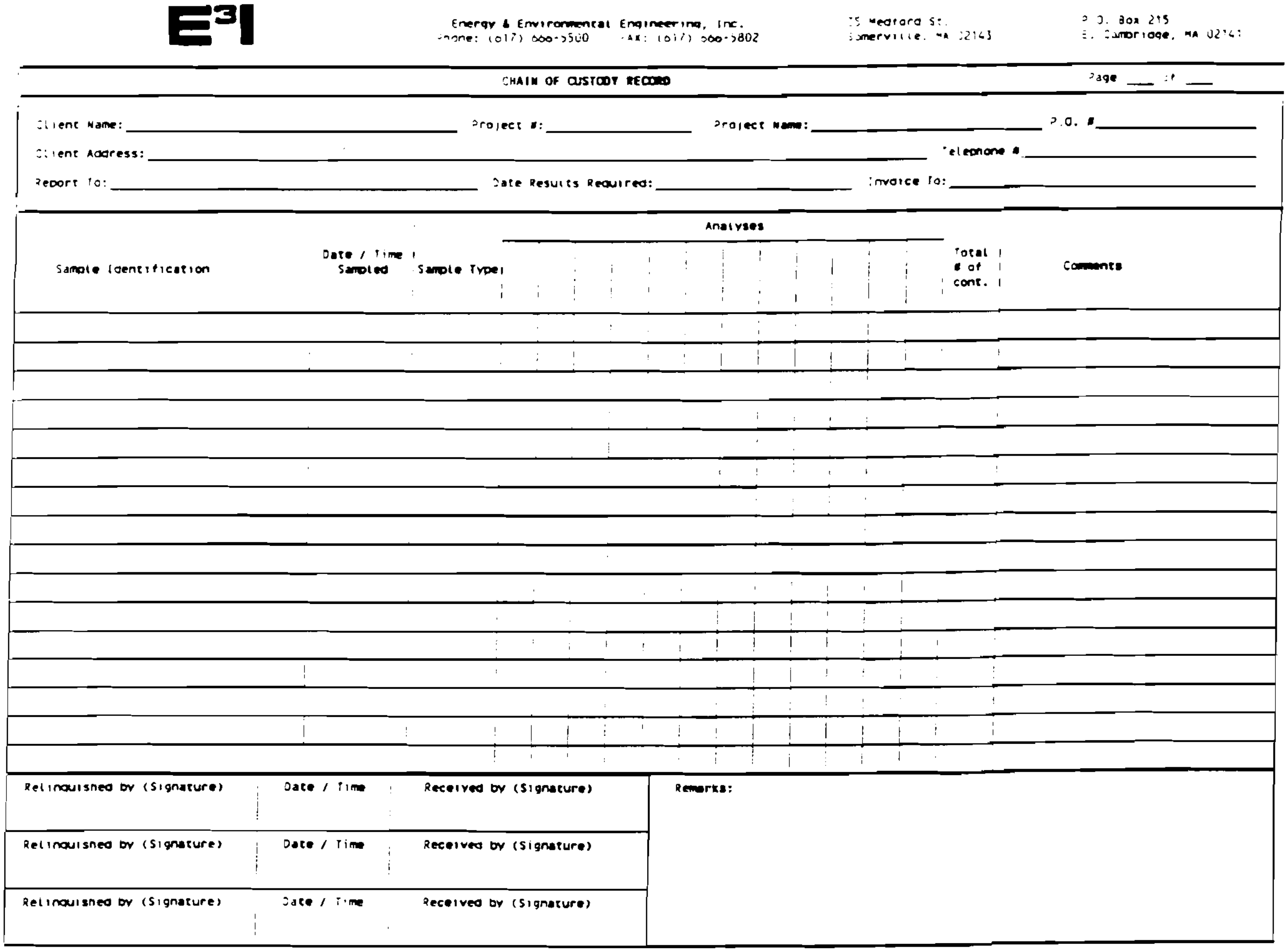
Samples are physical evidence collected from a facility or the environment. In hazardous waste investigations, sample data may be used as evidence in (EPA) enforcement proceedings. In support of potential litigation, laboratory chain-of-custody procedures have been established to ensure sample traceability from the time of receipt through completion of analysis.

The National Enforcement Investigations Center (NEIC) of EPA considers a sample in custody under the following conditions:

1. It is in your actual possession, or
2. It is in your view, after being in your physical possession, or
3. It was in your possession and then you locked or sealed it to prevent tampering, or
4. It is in a secure area.

Chain of custody originates as samples are collected. Chain-of-custody documentation accompanies the samples as they are moved from the field to the laboratory with shipping information and appropriate signatures indicating custody changes along the way. A chain-of-custody record is included as Figure 8.1-1.

FIGURE 8.1-1
CHAIN-OF-CUSTODY RECORD



E3I

Energy & Environmental Engineering, Inc.
Phone: (617) 666-5500 FAX: (617) 666-5802

15 Medford St.
Somerville, MA 02143

P. O. Box 215
E. Cambridge, MA 02141

CHAIN OF CUSTODY RECORD Page ___ of ___

Client Name: ______ Project #: ______ Project Name: ______ P.O. # ______

Client Address: ______ Telephone # ______

Report To: ______ Date Results Required: ______ Invoice To: ______

Sample Identification	Date / Time Sampled	Sample Type	Analyses												Total # of cont.	Comments

Relinquished by (Signature)	Date / Time	Received by (Signature)	Remarks:
Relinquished by (Signature)	Date / Time	Received by (Signature)	
Relinquished by (Signature)	Date / Time	Received by (Signature)	

Laboratory chain of custody is initiated as samples are received and signed for by the Sample Custodian at E3I. Documentation of sample whereabouts continues as samples are signed in and out of the central storage facility for analysis in the several E3I laboratories using the Sample Control Record (Figure 8.1-2). After analysis, any remaining sample is held in the central storage area to await disposal. Prior to disposal of the samples, tags and other identification are removed and placed in the case file.

8.2 Laboratory Security

Samples at E3I are kept within secure areas during all stages of tenure, including the periods of time spent in preparation, analysis and storage.

The two laboratory areas, inorganics and organics, are designated as secure areas. The doors to these areas are kept locked and may be accessed by key. Authorized personnel only are allowed to enter the secure areas. Visitors to the laboratories must be accompanied by E3I staff members.

8.3 Duties and Responsibilities of the Sample Custodians

Duties and responsibilities of the Sample Custodian shall include but not be limited to:

8.3.1 Receiving samples.

8.3.2 Inspecting sample shipping containers for presence/absence and condition of:

  8.3.2.1 Custody seals, locks "evidence tape," etc.;

  8.3.2.2 Container breakage and/or container integrity.

8.3.3 Recording condition of both shipping containers and sample containers (bottles, jars, cans, etc.) in appropriate logbooks or on appropriate forms.

8.3.4 Signing Documents shipped with samples (i.e., airbills, chain-of-custody record(s), Sample Management Office (SMO) Traffic Reports, etc.).

FIGURE 8.1-2

SAMPLE CONTROL RECORD

E3I SAMPLE ID#	FRIG	#PER SAMPLE	LOGGED IN BY	DATE RECEIVED	REMOVED BY	DATE REMOVED	RETURNED BY	DATE RETURNED

8.3.5 Verifying and recording agreement or non-agreement of information on sample documents (i.e., sample tags, chain-of-custody records, traffic reports, airbills, etc.) in appropriate logbooks or on appropriate forms. If there is non-agreement, recording the problems, contacting the client for direction, and notifying appropriate laboratory personnel. (Client's corrective action directions shall be documented in the case file.)

8.3.6 Initiating the paper work for sample analyses on laboratory documents (including establishing case and sample files and inventory sheets) as required for analysis or according to laboratory standard operating procedures.

8.3.7 Labeling samples with laboratory sample numbers, and cross referencing laboratory numbers to client numbers and sample tag numbers.

8.3.8 Placing samples and spent samples into appropriate storage and/or secure areas.

8.3.9 Controlling access to samples in storage and assuring that laboratory standard operating procedures are followed when samples are removed from and returned to storage.

8.3.10 Monitoring chain of custody of samples in the laboratory.

8.3.11 Assuring that sample tags are removed from the sample containers and included in the central case or project file.

8.3.12 Accounting for missing tags in a memo to the file or documenting that the sample tags are actually labels attached to sample containers or were disposed of, due to suspected contamination.

8.3.13 Monitoring storage conditions for proper sample preservation such as refrigeration temperature and prevention of cross-contamination.

8.3.14 Returning shipping containers to the proper sampling teams.

8.3.15 Sending shipping containers, prepared sample bottles and sampling instructions to clients who request them.

8.4 Sample Receipt

Sample shipments are received at E3I by the designated Sample Custodian. In the case of a CLP project, the shipping containers are inspected and opened in the hood in the sample receipt area by the sample custodian who records the following information on the Sample Receipt Form (Figure 8.4-1) as he/she unpacks the coolers:

- o Presence/Absence of:
    1. Custody seals,
    2. Chain-of-custody records,
    3. Client forms (SMO forms or traffic reports),
    4. Airbills or bills of lading documenting shipment of samples, and
    5. Sample tags;
- o Condition of custody seal (intact, broken, absent) and shipping container;
- o Condition of sample bottles;
- o Cross-referencing of laboratory numbers to client numbers and sample tag numbers.
- o Resolution of problems or discrepancies with the Sample Management Office.

Following resolution of any problems or discrepancies, the Sample Custodian signs the Sample Receipt Form and originates a file for the set of samples, including in it the Sample Receipt Form, chain-of-custody records, and shipping information.

FIGURE 8.4-1
SAMPLE RECEIPT FORM

ENERGY AND ENVIRONMENTAL ENGINEERING, INC.
ANALYTICAL LABORATORIES

SAMPLE RECEIPT FORM

Date:

EPA Case ID Number:

	Present	Absent
Custody Seal................................		
EPA Chain-of-Custody Forms..................		
EPA Traffic Reports or SAS Packing List.....		
Airbills....................................		
Sample Tags.................................		

Condition of Custody Seal:
(intact, broken, absent)

Condition of Shipping Container (including temperature):

Condition of Sample Bottles: (describe briefly; if broken bottles are present, record SMO ID numbers)

Sample Tag ID / SMO ID / E3I ID

Verification of Agreement or Non-agreement of Information of Receiving Documents:

Resolution of Problems or Discrepancies with Sample Management Office:

Signature:

When the Sample Custodian is not available to receive samples, the sample container is signed for by another E3I staff member, and the time, date and name of the person receiving the container are recorded on the custody records. The samples are then stored under refrigeration in the sample receipt area, which is located within the secured laboratory. The samples are officially received and documented by the Sample Custodian or designee before the next business day.

8.5 Sample Log-in and Identification

8.5.1 Sample Identification

In order to maintain sample identity, each sample received at E3I is assigned a unique sample identification (sample ID) number.

After inspecting the samples, the Sample Custodian assigns each sample an E3I Sample ID Number. These numbers are chronologically sequential. E3I Sample Identification Numbers appear in the following format:

wwxxxx - yy - zzz

where

"ww"	represents the last two digits of the current year;
"xxxx"	represents a four digit project number which is assigned sequentially when a sample group (case) is received at E3I;
"yy"	represents the sample number within the group (case); and
"zzz"	represents an individual laboratory code.
e.g.:	870014-06-A

The E3I Sample Custodian assigns each sample a **wwxxxx-yy** identification number. The **zzz** suffixes are assigned within the individual laboratories and vary from one laboratory to another.

The E3I Sample ID Numbers are recorded on the Sample Receipt Form (Figure 8.4-1), in the computer Sample Receipt Log and on the Sample Information Form (Figure 8.5-1), where they are cross-referenced with SMO numbers, sample tag numbers and other client identifiers. Each sample is clearly labeled with its E3I Sample ID Number by the Sample Custodian. The same Sample ID Number appears on each sample preparation container and extract vial associated with the sample.

8.5.1.1 Sample Extract Identification

As described in Section 8.5.1, a sample extract is identified with the same unique sample identification number as the sample from which it derives. In addition, it bears one of the following notations:

PEST/PCB	for	pesticides/PCB fraction extract;
A	for	acid fraction extract;
B/N	for	base/neutral fraction extract; or
B/N/A	for	combined base/neutral and acid fraction extract.

8.5.1.2. Sample Digestate Identification

Similarly, a sample digestate is identified with the same unique sample identification number as the original sample. It is further identified by one of the following notations:

AA	for	atomic absorption analysis digestate;
ICP	for	inductively coupled plasma analysis digestate;
CN	for	cyanide analysis sample; or
Hg	for	mercury analysis digestate.

Sample identification is maintained during preparation by placing a tape label containing the sample ID and digestate notation on the beaker used for digestion of the sample. Following digestion, the same tape label is transferred to the sample digestate container when the sample is filtered into it.

FIGURE 8.5-1

E3I SAMPLE INFORMATION FORM

E3I SAMPLE ID #	CLIENT ID	ANALYSES REQUIRED	TEST CODE	FRIG	SAMPLES/ BOTTLE	COND

FIGURE 8.5-2

E3I PROJECT INFORMATION FORM

E3I PROJECT #	CLIENT NAME:
DATE RECEIVED: / /	CLIENT PROJECT/CASE #:
DATE DUE: / /	CLIENT P.O. #:

*QC REQUIREMENTS:

COMMENTS:

SAMPLE CUSTODIAN:

INITIALS: ______________ DATE: ________________

PROJECT MANAGER:

INITIALS: ______________ DATE: ________________

*QC NOTE: A = full CLP; B = CLP - no deliverables;
C = Commercial; D = Special QC (see project manager)

8.5.2 Sample Log-In

The sample log-in system at E3I consists of computerized entry into the sample receipt log. The information recorded includes:

- Project Number
- Client Name
- Client Address
- QC Requirements
- Date of Receipt
- Due Date
- Initials of E3I Project Manager
- Initials of Sample Custodian
- Comments
- E3I Sample Identification Numbers
- Client Sample Identification Numbers
- Sample Matrix
- Analyses Required
- Storage Refrigerator Identification
- Costs of Analyses

8.5.3 Sample Information

After completing the Sample Receipt Form and making entries in the sample receipt log, the Sample Custodian prints out sample data that was entered into the computer on several sample receipt documents. These forms include:

- Project Information Form,
- Sample Information Form,
- Project Completion Form,
- Sample Control Form,
- Sample Identification Labels, and
- Invoice Draft.

After signing and dating the Sample Information Form, the Sample Custodian notifies the project manager for the group of samples of the arrival of the samples. The project manager verifies that the information on the sample receipt documents is correct by signing and dating the Project Information Form. The original Sample Information Form is placed in the file for the case or project. The project file is originated by the Sample Custodian. Copies of the sample receipt documents, including chain-of-custody information, are distributed to the E3I project manager and appropriate laboratory.

8.6 Sample Storage

Samples at E3I are stored in a central storage facility within the secured organics laboratory. After sample receipt and log-in procedures are completed, the Sample Custodian places the samples in their original containers within the appropriate refrigerators in the sample storage area. Refrigerators labeled INORG 1 and INORG 2 are dedicated to inorganic samples;

refrigerators labeled ORG1, ORG2, ORG3, ORG4, and VOA1 are dedicated to organic samples. Only samples for volatile organics analysis (VOA) are stored in the VOA1 refrigerator. No other type of sample may be stored in this refrigerator. The sample storage area is for samples only, no standards or reagents are present.

Refrigerators are maintained at 4°C (±2°C). Twice daily the temperature is recorded in the temperature log (Figure 8.6-1) which is kept for each refrigerator by the Sample Custodian.

Access to the sample storage area is controlled by the Sample Custodian, who is responsible for monitoring sample custody. All transfers of samples into and out of storage are documented on a laboratory chain-of-custody form, the Sample Control Record (Figure 8.1-2). When an analyst removes a sample for preparation and/or analysis, the sample is signed out. Similarly, a sample is signed back in when the analyst returns it to storage prior to the end of his/her working day.

When analysis is complete, any remaining sample is retained in the central storage area until it may be removed for disposal. Broken or damaged samples are promptly disposed of in a safe manner. All disposals are documented in a manner compliant with RCRA regulations.

Sample Control Records are kept in Sample Receipt until samples are removed for disposal. At that time, disposal is documented and Sample Control Records are transferred into the central files.

8.6.1 Extract Storage

Acid and base/neutral extracts, which are contained in crimp-top or screw-cap vials with teflon-faced septa, are stored at 4°C (± 2°C) in the Semivolatiles Laboratory refrigerator. They are catalogued numerically by project number which approximates chronological order, according to date of receipt. Remaining portions of unspiked acid and base/neutral fraction extracts are held in addition to the combined extract, which has had internal standards added to it. EPA CLP extracts are stored separately from sample extracts of other clients.

FIGURE 8.6-1
TEMPERATURE LOG

E^3I ANALYTICAL LABORATORIES

TEMPERATURE LOG

DATE	TIME	TEMPERATURE	CORRECTIVE ACTION (IF REQUIRED)	ANALYST

Pesticide extracts are stored in the Organics Preparation Laboratory refrigerator at 4°C (± 2°C) in screw cap vials with teflon-faced septa. These extracts consist of the remaining 9 ml portions of aqueous sample pesticides extracts and 1:1 splits of soil sample pesticide extracts. They are chronologically ordered.

8.6.2 Digestate Storage

Prior to analysis, digestates and samples for cyanide analysis are stored in the areas described below.

Sample digestates prepared for AA analysis are stored together in designated drawers in the Inorganics Preparation Laboratory.

Sample digestates prepared for ICP analysis are stored together in designated drawers in the Inorganics Instrument Laboratory.

Samples for mercury analysis are usually prepared immediately before analysis. They are kept on the bench next to the mercury analyzer in the Cyanide and Mercury Analysis Laboratory.

Samples prepared for cyanide analysis are stored in designated drawers below the cyanide distillation bench in the Cyanide and Mercury Analysis Laboratory.

Following analysis, any remaining digestates for AA and ICP analyses are retained on shelving in the general storage section within the Inorganics Laboratory. The entire mercury digestate is consumed during analysis. Cyanide distillates are stored on shelving within the Cyanide and Mercury Analysis Laboratory.

8.7 Sample Tracking

When a sample is removed from storage, the reason and the analyst who has custody are documented on the Sample Control Record. This information indicates the location of the sample at any point in time. Additional documentation exists in each laboratory to verify the custody of the sample during preparation and analysis.

Chain of custody of a sample ensures that the sample is traceable from when it was taken in the field through laboratory receipt, preparation, analysis and finally, disposal. The primary chain-of-custody documents which may be used to locate a sample at any point in time are:

1. The Chain-of-Custody Form from the field describing the origin and transportation of a sample;
2. The Laboratory Sample Receipt Log and supporting log-in records, documenting acceptance of a sample by the E3I laboratory; and
3. The E3I Sample Control Forms, documenting the analyst who has custody and the reason for removal of a sample from storage.

9.0 CALIBRATION PROCEDURES AND FREQUENCY

9.1 Instruments

Instrument calibration establishes that the system is functioning correctly and at a level of sensitivity sufficient to meet required method detection limits. Routine calibration provides a means of rapid detection of instrument variance and possible malfunction, ensuring that data quality is maintained. Specific calibration and check procedures are given in the analytical methods referenced in Section 10. Frequency of calibration and concentration of standards are determined by the cited methods and special contractual requirements as well as manufacturer recommendations.

Standard calibration curves of signal response versus concentration are generated on each analytical instrument used for a project, prior to analysis of samples. A calibration curve of the appropriate linear range is established for each parameter that is included in the analytical procedure employed and is verified on a regular basis with check standards. In general, E3I adheres to the calibration criteria specified by the NYSDEC ASP 1989 for both organics and inorganics. For analyses outside of the CLP protocols, other specified calibration practices are stipulated and maintained.

The following are examples of calibration procedures for various instrumental systems.

GC - An initial calibration is performed using three different concentration levels for each parameter of interest. The initial calibration is done on each quantitation column and each instrument, and is repeated each time a new column is installed or another major change is made in the chromatographic system.

For CLP-type analyses, continuing calibration takes place at the beginning and once every ten samples throughout the seventy-two hour analytical sequence. The percent difference in calibration factors for each standard must not exceed 20% (15% for any standard compound used for quantification).

GC/MS - Initial calibration at five different concentration levels for each analyte is carried out for each system. Recalibration takes place whenever a major change occurs in the system, such as a column change in the GC or a source cleaning of the mass spectrometer. Continuing calibrations are repeated every twelve hours of instrument analysis time, and for CLP-type analysis, must have a percent difference of 25% or less in response factors for calibration check compounds.

Prior to analysis of any samples, GC/MS systems are tuned to USEPA specificiations for BFB and DFTPP, for volatile and semivolatile analyses respectively. Verification of tuning criteria occurs every twelve hours of instrument run time for all CLP-type analyses.

ICP - Mixed standards are used to perform the initial multi-level calibration. Calibration check standards prepared form stock solutions other than that used for standardization are analyzed every ten samples to verify instrument calibration. If the signal response of the check standard deviates by more than 10% from the initial calibration, the instrument is recalibrated. Calibration blank verifications are performed initially and periodically during analysis of samples.

AA - Several concentrations of individual standards are analyzed to establish the initial calibration curve for each metal. A calibration check standard is run every ten samples to verify calibration of the instrument. If a check standard falls outside the control limit of ± 10% from the initial calibration, the instrument is recalibrated. Again, calibration blank verifications are performed initially and periodically during analysis of samples.

9.2 Standards and Reagents

Primary sources of standard reference materials used for calibration, calibration checks, and accuracy control are the USEPA and National Bureau of Standards repositories. Reliable commercial manufacturers represent a secondary source. Certain projects, especially those involving pesticide registration, may necessitate the use of reference standards supplied by the client.

New standards are routinely validated against known standards that are traceable to EPA or NBS reference materials if possible.

Reagents used in the preparation of matrix spike, surrogate standard, and internal standard spiking solutions for EPA/CLP work are validated using standards obtained directly from EPA or traceable to EPA. Quality Control Check Samples from the EPA-EMSL Quality Assurance Branch in Cincinnati are routinely requested, received and analyzed by the E3I laboratories.

Standards are dated upon arrival. Any material exceeding its shelf life as described by the methods in Section 10.0 is discarded and replaced. Standards are periodically analyzed for concentration changes and visually inspected for signs of deterioration such as color change and precipitate formation. A Standards Preparation Logbook, which contains all pertinent information regarding the source and preparation of each analytical standard, is maintained by each of the E3I laboratories.

Solvents are examined for purity prior to use to insure there is no external source of contamination.

10.0 ANALYTICAL PROCEDURES

The analytical methods utilized by E3I are contained in the cited documents. A variety of EPA approved methods are used for analytical work. Work done for the EPA Contract Laboratory Program strictly adheres to the SOW methodologies (10) and (11). Analytical work for New York State Department of Conservation strictly adheres to the ASP methodologies (1). E3I uses other methodology as required by the specific projects or contracts. Additional methods are summarized in Table 10-1 and Table 10-2.

TABLE 10-1
INORGANIC ANALYTICAL METHODS SUMMARY

Parameter	Method Description	Method Reference[1]
Metals Analysis		
Aluminum	ICP	Method 200.7 (5)
Antimony	AA-GF	Method 204.2 (5)
Arsenic	AA-GF	Method 206.2 (5)
Barium	ICP	Method 200.7 (5)
Beryllium	ICP	Method 200.7 (5)
Cadmium	AA-GF	Method 213.2 (5)
Calcium	ICP	Method 200.7 (5)
Chromium	ICP	Method 200.7 (5)
Chromium^{+6}	Coprecipitation, ICP	Method 218.5 (5)
Cobalt	ICP	Method 200.7 (5)
Copper	ICP	Method 200.7 (5)
Iron	ICP	Method 200.7 (5)
Lead	AA-GF	Method 239.2 (5)
Magnesium	ICP	Method 200.7 (5)
Manganese	ICP	Method 200.7 (5)
Mercury	Cold Vapor AA	Method 245.1 (5)
Nickel	ICP	Method 200.7 (5)
Potassium	ICP	Method 200.7 (5)
Selenium	AA-GF	Method 270.2 (5)
Silver	ICP	Method 200.7 (5)
Sodium	ICP	Method 200.7 (5)
Thallium	AA-GF	Method 279.2 (5)
Vanadium	ICP	Method 200.7 (5)
Zinc	ICP	Method 200.7 (5)
Other metals as required	ICP	Method 200.7 (5)

AA - Atomic Absorption Spectrometry
AA-GF - Graphite Furnace Atomic Absorption Spectrometry
ICP - Inductively Coupled Argon Plasma Emission Spectroscopy

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[1] Metals analyses on a soil matrix begins with a modified acid digestion, Method 3050 (9). The soil analysis for mercury is Method 245.5 (5).

TABLE 10-1 (con't.)
INORGANIC ANALYTICAL METHODS SUMMARY

Parameter	Method Description	Method Reference Water	 Soil
Wet Chemistry			
Acidity	Titrimetric	Method 305.1 (5)	n/a
Alkalinity	Titrimetric	Method 310.1 (5)	n/a
Ammonia	Potentiometric	Method 350.3 (5)	(7)
Chloride	Titrimetric, Mercuric nitrate	Method 325.3 (5)	(7)
Conductivity	Specific conductance	Method 120.1 (5)	n/a
Corrosivity	Langlier index	Method 2330 (8)	n/a
Cyanide (amenable)	Chlorination, distillation, colorimetric	Method 335.1 (5)	n/a
Cyanide (total)	Distillation, colorimetric	Method 335.2 (5)	(10)
Cyanide (weak and dissociable)		Method 4500 (8)	n/a
Fluoride	Potentiometric, specific ion electrode	Method 340.2 (5)	n/a
Hardness	ICP, Calculation	Method 2340 (8)	n/a
Nitrate/Nitrite	Colorimetric, manual cadmium reduction	Method 353.3 (5)	(7)
Orthophosphate	Colorimetric	Method 365.2 (5)	(7)
pH	Electometric	Method 150.1 (5)	n/a
Phosphorous	ICP	Method 200.7 (5)	(7)
Solids			
-dissolved (TDS)	Gravimetric, dried at 180°C	Method 160.1 (5)	n/a
-suspended (TSS)	Gravimetric, dried at 103-105°C	Method 160.2 (5)	n/a
-total (TS)	Gravimetric, dried at 103-105°C	Method 160.3 (5)	n/a
-volatile (TVS)	Gravimetric, ignition at 550°C	Method 160.4 (5)	n/a
Sulfide	Titrimetric, iodide	Method 376.1 (5)	n/a
Sulfate	Turbidimetric	Method 375.4 (5)	n/a
Total Kjeldahl Nitrogen (TKN)	Digestion, distillation, potentiometric	Method 351.3 (5)	(7)

TABLE 10-2
ORGANIC ANALYTICAL METHODS SUMMARY

Parameter	Method Description	Method Reference Water	Method Reference Soil
Herbicides	Solvent extraction, derivatization, gas chromatography/ electron capture detection	Method 615 Modified (6)	Method 3540 or Method 3550 and Method 8150 Modified (9)
Pesticides/PCBs	Solvent extraction, gas chromatography/ electron capture detection	Method 608 Modified (6)	Method 3540 or Method 3550 and Method 8080 Modified (9)
Semivolatile Organic Acid/Base/Neutral Extractables	Solvent extraction, gas chromatography/ mass spectrometry	Method 625 Modified (6)	Method 3540 or Method 3550 and Method 8270 Modified (9)
Volatile Organic Compounds	Purge and trap, gas chromatography/mass spectrometry	Method 624 Modified (6)	Method 5030 and Method 8240 Modified (9)
Volatile Organic Compounds, Aromatic	Purge and trap, gas chromatography/mass spectrometry	Method 624 Modified (6)	Method 5030 and Method 8020 Modified (9)
Volatile Organic Compounds, Halogenated	Purge and trap, gas chromatography/mass spectrometry	Method 624 Modified (6)	Method 5030 and Method 8010 Modified (9)

TABLE 10-2 (con't.)
ORGANIC ANALYTICAL METHODS SUMMARY

		Method Reference	
Parameter	**Method Description**	**Water**	**Soil**
Extraction Procedure for Toxicity (EPTox)	EPTox extraction	Method 1310 (9)	Method 1310 (9
Solvents	Direct aqueous injection, gas chromatography/ flame ionization det.	Method D2908-74 (2)	n/a
Total Oil & Grease	Gravimetric	Method 413.1 (5)	Method 9070 (9
Total Oil & Grease	Extraction, IR	Method 413.2 (5)	Method 413.2 and Method 907 Modified (5 & 9
Total Organic Carbon (TOC)	Persulfate oxidation, IR detection	Method 415.2 (5)	Method 9060 (9
Total Petroleum Hydrocarbons	Extraction, IR	Method 418.1 (5)	Method 418.1 Modified (5)
Toxicity Characteristic Leaching Procedure (TCLP)	TCLP extraction	Method 1311 (4)	Method 1311 (4

IR - Infrared Spectophotometry

10.1 **Analytical References**

1) Analytical Services Protocol, Volumes 1-8, New York State Department of Environmental Conservation, September, 1989.

2) Annual Book of ASTM Standards. Part 31-Water. American Society for Testing and Materials, Philadelphia, PA, 1981.

3) Chemical Characteristics of Marine Samples, API Publication No. 4307, API, Washington, D.C.

4) Federal Register, Vol. 55, No. 61, March 29, 1990.

5) Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020, 3/83 Revision.

6) Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater, Appendix A, 40 CFR Part 136, Federal Register, Vol. 49, No. 209, 1984.

7) Methods of Soil Analysis, Part 2, Chemical and Microbiological Properties, Second Edition, American Society of Agronomy, Inc., Soil Science Society of America, Inc., Madison, WI, 1982.

8) Standard Methods for the Examination of Water and Wastewater, 17th Edition, APHA, Washington, D.C. 1989.

9) Test Methods for Evaluating Solid Waste-Physical/Chemical Methods, SW-846, 3rd Edition. Office of Solid Waste and Emergency Response, USEPA, Washington, D.C., 1986.

10) USEPA Contract Laboratory Program, Statement of Work for Organics Analysis, USEPA, 2/88 Revision.

11) USEPA Contract Laboratory Program, Statement of Work for Inorganics Analysis, USEPA, 7/88 Revision.

11.0 DATA REDUCTION, VALIDATION AND REPORTING

11.1 Data Reduction

Instrumental print-outs, terminal readings, chromatograms, strip chart recordings, and physical measurements provide raw analytical data that are reduced to concentrations of analytes through the application of appropriate equations. Equations are generally given within the analytical methods referenced in Section 10. Data reduction may be performed automatically by computerized data systems on the instruments, manually by scientists, or automatically by scientists using IBM-compatible personal computers programmed to perform data reduction calculations.

11.2 Data Validation

Data validation is an essential element of the QA evaluation component. Validation is the process of data review and subsequent acceptance or rejection based on established criteria. The following criteria are employed by E3I in the evaluation of data:

- Accuracy requirements,
- Precision requirements,
- Detection limit requirements,
- Completeness,
- Representativeness,
- Correctness (of manual and computer calculations),
- Contractual requirements, and
- Documentation requirements.

As in the case of EPA/CLP procedures, data acceptance limits may be defined within the method. The same windows are used for similar types of analyses if the sample matrix permits. As a tracking mechanism of data acceptability, quality control charts may be plotted for specific parameters determined in identical, homogeneous matrices. Control limits for methods development and research data may be statistically determined as analytical results are generated.

Validation includes data review at both the technical and editorial levels. Technical review evaluates the application of analytical protocols and resultant effects on the data generated. Editorial review assesses the content, lucidity, conciseness, and completeness of the data report.

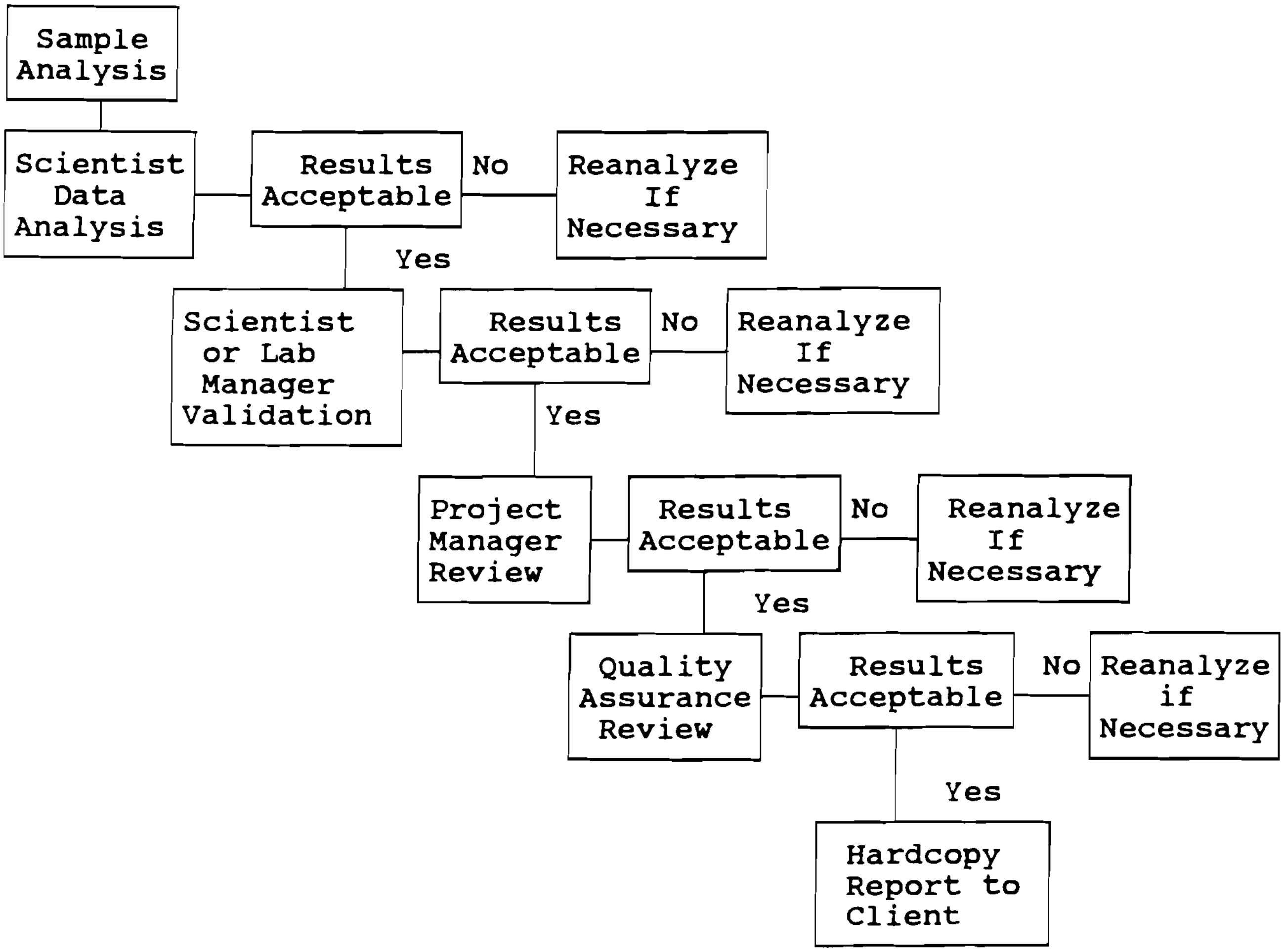
11.3 Data Reporting

Interpretation of raw data and calculation of results are performed by a scientist experienced in the analytical methodology. Upon completion of data reduction, the scientist signs for the reported results on the data report form. Another scientist, experienced in the same discipline, reviews and verifies the results, also signing the data report form. The laboratory manager, who is responsible for the data generated in that laboratory, often performs the second tier of review or may independently review data and completed report forms. Members of the QA staff also check the results on selected sets of data.

At a minimum, each data point is checked by two scientists experienced with the analytical methodology. Records are maintained for all data, even for those results that are rejected as invalid.

A flow chart showing the data reduction, validation, and reporting process is given in Figure 11-1.

FIGURE 11-1
DATA REPORTING PROCESS



12.0 LABORATORY QUALITY CONTROL CHECKS

E3I analytical and field procedures are based on sound quality control methodology, which derives from three primary sources:

1. Standards for Good Laboratory Practice,
2. Specific EPA and other approved analytical methods, and
3. "Handbook for Analytical Quality Control in Water and Wastewater Laboratories" (EPA 600/4-79-019).

In the application of established analytical procedures, E3I employs, at a minimum, the QC protocols described in the references found in the Analytical Methods section. Specific projects may require additional quality control measures, due to such factors as difficult sample matrices or use of innovative techniques. For those projects E3I will recommend and implement, subject to client approval, the QC measures necessary to produce data of known quality.

Each of the E3I laboratories has an individual QC program which includes, but is not limited to, the practices described below.

12.1 **Detection Limits**

Detection Limits are developed quarterly for all CLP target compounds.

12.2 **Personnel Training**

Chemists beginning employment at E3I are first trained under the E3I Safety Training Program. Before performing any work, a chemist is required to read the appropriate protocols and become familiar with the laboratory equipment. The chemists begin a training period during which they work under strict supervision. Independent work is only permitted after the chemist successfully completes a proficiency review.

12.3 **Control Charts**

Control charts are used by the QA Director and laboratory managers to statistically determine inhouse matrix spike recovery windows and Out-Of-Control Conditions.

The matrix spike, matrix spike duplicate and matrix spike blanks are tabulated quarterly for organic and inorganic CLP, Target Compound List (TCL) analytes. Control charts plot the concentration recoveries of matrix spike compounds over time. They include warning levels (± 2 standard deviations) and control levels (±3 standard deviations).

Inhouse acceptable matrix spike recoveries for individual TCL analytes are based on the control levels on the control charts. On a weekly basis, matrix spike samples and blanks are compared to the control charts of the preceding quarter.

An Out-Of-Control Condition is defined by any one of the following:

- any one point is outside the control limits,
- any three consecutive points are outside the warning limits,
- any eight consecutive points are on the same side of the center line,
- any six consecutive points are such that each point is larger (or smaller) than its immediate predecessor, or
- any obvious cyclic pattern is seen in the points.

An Out-Of-Control Condition generally requires a reanalysis. If the reanalysis of a matrix spike sample, not demonstrating a matrix effect, or a matrix spike blank demonstrates a second Out-Of-Control Condition, a Corrective Action Report (Section 16) is issued to the appropriate project managers and clients, if necessary.

12.4 General QC Protocols - Organics Laboratory

- Trip blanks and holding blanks, when applicable, to detect contamination during sample shipping, handling and storage.
- Method blanks, at a minimum of one in every 20 samples, to detect contamination during analysis.
- Volatile organic method blanks are analyzed once during each day's analytical sequence.
- One matrix spike of an analytical sample or laboratory water or soil every 20 samples, to determine accuracy.
- One matrix spike duplicate of an analytical sample or laboratory water or soil every 20 samples, to determine precision.
- Sample spikes and spike duplicates, as requisitioned, to determine accuracy and the presence of matrix effects.
- QC check samples periodically, to document accuracy.
- Performance evaluation samples from EPA and state agencies, to verify continuing compliance with EPA QA/QC standards.
- Surrogate standards and calculation of recoveries, to determine matrix effects.
- Internal standards for GC/MS (gas chromatography/mass spectrometry) analysis, to account for sample-to-sample variation.
- GC (gas chromatography) analysis of EPA traceable standards to verify working standard accuracy and instrument performance.
- Initial multi-level calibration of instruments, to establish calibration curves.
- Daily calibration of instruments.
- Tuning of GC/MS systems once every 12 hours to EPA specifications, for consistency in data generation.
- Control limits, to determine acceptability.

12.5 General QC Protocols - Metals Laboratory

- Analysis by ICP (inductively coupled plasma spectroscopy) for most metals.
- Analysis by Zeeman GFAAS (graphite furnace atomic absorption spectroscopy) for low concentrations of selected metals.
- Calibration blanks and preparation blanks to detect instrumental or laboratory contamination.
- Initial calibration verification for AA analysis with NBS Standard, recalibration if check falls outside NBS indicated limits.
- Calibration verification standards prepared from stock solution other than that used to prepare standards at least every 20 samples, to verify instrument calibration.
- Calibration verification control limits of 10%, recalibration if check standard deviates by more than 10% from previous calibration.
- One laboratory control standard every 20 samples to determine accuracy.
- One matrix spike every 20 or fewer samples, to determine accuracy.
- One matrix spike duplicate every 20 or fewer samples, to determine precision and matrix effects for AA and ICP analyses.
- Linear range for ICP is developed quarterly.
- Annual inter-element correction factors are developed for ICP.
- Full compliance with CLP protocols where required.

General QC Protocols - Classical Chemistry Laboratory

- One procedural blank per sample batch (minimum of 1 per 20 samples), to detect contamination during analysis.
- One independently obtained check sample every 20 samples, to determine accuracy.
- One matrix spike every 20 samples, to determine accuracy and matrix effects, as appropriate.
- One matrix duplicate every 20 samples, to determine precision and matrix effects, as appropriate.
- Check samples periodically, to document accuracy.
- Initial multi-level calibration, to establish calibration curves, as appropriate.
- Calibration checks, to verify calibration:
  - CN - every 10 samples
  - Hg - every 10 samples
- Control limits to determine acceptability.

13.0 QUALITY ASSURANCE SYSTEMS AUDITS, PERFORMANCE AUDITS AND FREQUENCY

As a participant in several certification programs and various contracts, the E3I laboratory is frequently subjected to rigorous performance evaluations and on-site inspections by the EPA, other regulatory agencies and commercial clients. The E3I Quality Assurance staff performs routine internal audits of the laboratory as well. The audits ensure that all laboratory systems including sample control, analytical procedures, data generation, and documentation meet contractual requirements and comply with good laboratory practice standards.

13.1 Systems Audits

The EPA Contract Laboratory Program provides for complete, on-site, systems audits of contract laboratories by a team of auditors on a regular basis. E3I has already undergone several such EPA inspections during the term of our CLP contract. In addition, several clients as well as the New York State Department of Conservation have conducted rigorous examinations of our operations.

The director of the laboratory approval program for the Department of Environmental Protection, formerly the Department of Environmental Quality Engineering in the Commonwealth of Massachusetts inspected the E3I laboratory facilities as part of the certification process.

Table 13.1-1 provides a list of recent systems audits of the E3I laboratories.

In addition, the E3I laboratories are audited routinely by QA staff members in order to detect any sample flow, analytical, or documentation problems and to ensure adherence to the good laboratory practices as described in E3I laboratory operating manuals. The items covered in an internal systems audit at E3I are outlined on a general basis in Figure 13.1-1.

TABLE 13.1-1
E3I SYSTEMS AUDITS

	Auditor	Date
1.	USEPA, CLP - Inorganics Laboratory	January 27, 1987
2.	USEPA, CLP - Organics (preliminary)	May 4, 1987
3.	Massachusetts DEQE -general inspection	May 5, 1987
4.	USEPA, CLP - Organics Laboratory	September 3, 1987
5.	USEPA, CLP - Inorganics Laboratory	September 23, 1987
6.	U.S. Army Corps of Engineers, New England Division, general inspection	December 10, 1987
7.	USEPA, CLP - Organics & Inorganics	February 9, 1988
8.	American Council of Independent Laboratories (ACIL) - general inspection	September 27, 1988
9.	Cambridge Analytical Associates, Inc. for MWRA - Organics Laboratory	January 4, 1989
10.	Metcalf & Eddy - informal inspection Organics & Inorganics	January 5, 1989
11.	USEPA, CLP - Inorganics Laboratory	February 28, 1989
12.	Martin Marietta Energy Systems/ HAZWRAP - Organics & Inorganics	March 20, 1989
13.	New York Department of Environmental Conservation - Organics & Inorganics	April 27, 1989
14.	USEPA, CLP - Organics & Inorganics	November 7, 1990
15.	USEPA, CLP - Inorganics	February 2, 1990
16.	USEPA, CLP - Organics	April 9, 1990

17.	USEPA, CLP - Inorganics	May, 1990
18.	NUS, - Organics & Inorganics	June 11, 1990
19.	USEPA, CLP - Inorganics	September 22, 1990

FIGURE 13.1-1
AUDIT OUTLINE

- Laboratory Audit - General Considerations
  - Sample Flow Through Lab
  - Chain of Custody
    - Usual
    - Strict
  - Sample Storage
    - Controlled Access
    - Proximity to Chemical Storage
    - Physical Conditions, e.g., Temperature
    - Holding Times
  - Sample Work-up and/or Analysis
    - SOPs
    - Logbooks
      - Standards Preparation
      - Instruments - Sample Analysis
      - Calibration/Tune
      - Standards Analyses
      - Check Samples
      - Balance
      - Temperature
    - Notebooks
      - Dates
      - Signature
      - Filled Pages
      - Initialed Errors with Single-line Crossouts
      - Units Recorded
    - QC Samples
      - Blanks
      - Spikes
      - Duplicates
      - Surrogates
      - Control Charts
  - Data File Storage
    - Hard Copies
    - Other Media - Magnetic Tape, Disk
  - Laboratory Safety
  - Organization, Order
- Sampling
  - Container Preparation
  - Preservative(s)
  - Techniques
- QA Access - Corrective Action Forms

13.2 Performance Audits

The E3I laboratories are also subjected to frequent performance evaluations. Table 13.2-1 lists recent E3I performance evaluations.

New York State Department of Conservation requires successful analysis of performance evaluation samples for non-potable water samples twice yearly. Certification is dependent upon continued demonstration of acceptable performance

E3I also participates in the Water Supply (WS) and Water Pollution (WP) Series of Performance Evaluations sponsored by the Quality Assurance Branch of the EPA. Successful analyses of these samples are required as part of the laboratory certification process for the environmental agencies of several states.

Performance is monitored internally on a daily basis at E3I through the use of surrogate standards. Check samples obtained from EPA-EMSL, Cincinnati, QA Branch, and from independent commercial sources are employed routinely in each of the E3I laboratories and ensure continuing high level performance.

TABLE 13.2-1
E3I PERFORMANCE EVALUATIONS

	Agency/Program	Parameter(s)	Date
1.	USEPA-CLP Pre-Award	TCL-Inorganics	November, 1986
2.	USEPA-CLP Pre-Award	TCL-Organics	February 17, 1987
3.	USEPA-EMSL/Water Pollution Study 19 (WP 019)	VOA, Pesticides, Metals, Inorganics	October 5, 1987
4.	USEPA-EMSL/Water Supply Study 21 (WS 021)	VOA, Pesticides, Metals, Inorganics	November 16, 1987
5.	USEPA-CLP QB1, FY88	Inorganics	November 25, 1987
6.	USEPA-CLP QB2, FY88	Inorganics	February 24, 1988
7.	USEPA-CLP QB2, FY88	Organics	March 2, 1988
8.	USEPA-EMSL/Water Pollution Study 20 (WP 020)	VOA, Pesticides, Metals, Inorganics	April 11, 1988
9.	USEPA-EMSL/Water Supply Study 22 (WS 022)	VOA, Pesticides, Metals, Inorganics	May 24, 1988
10.	USEPA-CLP QB3, FY88	Inorganics	May 24, 1988
11.	USEPA-CLP QB3, FY88	Organics	June 7, 1988
12.	USEPA-CLP QB4, FY88	Inorganics	August 23, 1988
13.	USEPA-CLP QB4, FY88	Organics	September 6, 1988
14.	USEPA-EMSL/Water Pollution Study 21 (WP 021)	VOA, Pesticides, Metals, Inorganics	October 3, 1988
15.	USEPA-EMSL/Water Supply Study 23 (WS 023)	VOA, Pesticides, Metals, Inorganics	November 21, 1988
16.	USEPA-CLP QB1, FY89	Inorganics	November 28, 1988
17.	USEPA-CLP QB1, FY89	Organics	November 29, 1988
18.	Cambridge Analytical Associates/MWRA	VOA, B/N/A, Pesticides	December 16, 1988
19.	Martin Marietta Energy Systems/HAZWRAP	VOA, B/N/A, Pesticides, Metals	February 8, 1989
20.	USEPA-CLP QB2, FY89	Inorganics	February 26, 1989
21.	USEPA-CLP QB2, FY89	Organics	March 6, 1989
22.	USEPA-EMSL/Water Pollution Study 22 (WP022)	VOA, Pest., PCBs Metals, Inorganics	April 10, 1989

TABLE 13.2-1 (continued)
E3I PERFORMANCE EVALUATIONS

Agency/Program	Parameter(s)	Date
23. USEPA-EMSL/Water Supply Study (WS024)	VOA, Pesticides Metals, Inorganics	June 2, 1989
24. USEPA-CLP QB3, FY89	Inorganics	May 18, 1989
25. USEPA-CLP QB3, FY89	Organics	May 25, 1989
26. USEPA-CLP QB4, FY89	Organics	August 24, 1989
27. USEPA-CLP QB4, FY89	Inorganics	August 28, 1989
28. USEPA-CLP QB1, FY90	Inorganics	November 21, 1989
29. USEPA-CLP QB1, FY90	Organics	November 23, 1989
30. USEPA-EMSL/Water Pollution Study (WS025)	VOA, Pesticides, Metals, Inorganics	November 24, 1989
31. USEPA-CLP QB2, FY90	Inorganics	February 14, 1990
32. USEPA-CLP QB2, FY90	Organics	March 1, 1990
33. NYS DOH: Non-Potable Water	Organics & Inorganics	March, 1990
34. USEPA-EMSL/Water Pollution Study (WP024)	Organics & Inorganics	April 16, 1990
35. USEPA-EMSL/Water Supply Study (WS026)	Organics & Inorganics	June 8, 1990
36. USEPA-EMSL/Water Pollution Study (WP025)	Organics & Inorganics	October 30, 1990
37. USEPA-EMSL/Water Supply Study (WS027)	Organics & Inorganics	November 30, 1990
38. NYS DOH: Non-Potable Water	Organics & Inorganics	January, 1991
39. USEPA-EMSL/Water Pollution Study (WP026)	Organics & Inorganics	April 29, 1991
40. USEPA-EMSL/Water Supply Study (WS028)	Organics & Inorganics	June 4, 1991
41. NYS DOH: Non-Potable Water	Organics & Inorganics	August 26, 1991

14.0 PREVENTATIVE MAINTENANCE

Preventive maintenance is a routine practice at E3I for each analytical instrument. Scheduled preventive maintenance minimizes instrument downtime and consequent interruption of analysis. The laboratory personnel at E3I are familiar with the routine and non-routine maintenance requirements of the instruments they operate. This familiarity is based on conventional education, hands-on experience, and academic and manufacturer training courses. An example logbook page for GC/MS routine maintenance is presented as Figure 14-1.

E3I maintains an inventory of replacement parts required for preventive maintenance and spare parts that often need replacement, such as electron multipliers for GC/MS systems and the more mundane fuses and ferrules.

In the case of a downed instrument, the problem is diagnosed as quickly as possible. If necessary, replacement parts are ordered and repairs performed by skilled in-house personnel. A service call can also be placed with the manufacturer. For example, Hewlett-Packard maintains an analytical service center within a few miles of E3I. Instrument problems and repairs are documented in logbooks kept in each laboratory; an example is given in Figure 14-2.

FIGURE 14-1

GC/MS ROUTINE MAINTENANCE FOR SEMIVOLATILES

GC/MS ROUTINE INSTRUMENT MAINTENANCE FOR SEMI-VOLATILES

ENERGY & ENVIRONMENTAL ENGINEERING.INC. (E3I)

DATE	OPER	INSTR. ID	SEPTUM CHANGED	LINER CHANGED	NEW O-RING	===COLUMN MAINTENANCE=====		OTHER	COMMENTS
						FRONT-END	DETECTOR-END		

FIGURE 14-2

GC/MS NON-ROUTINE INSTRUMENT MAINTENANCE

GC/MS NON-ROUNTINE INSTRUMENT MAINTENANCE

ENERGY & ENVIRONMENTAL ENGINEERING, INC. BNA004

Instrument: ________

Date Reported: __________ By: _________

Date Resolved: __________ By: _________

Comments on Repair: ________________________

____

____

PROBLEM SITE:

____ GC

____ Gas Line

____ Detector

____ Other (DESCRIBE)

____

____

DESCRIPTION OF PROBLEM:

RESOLUTION:

15.0 SPECIFIC ROUTINE PROCEDURES USED TO ASSESS DATA PRECISION, ACCURACY, AND COMPLETENESS

Precision, accuracy, and completeness are discussed in Section 6 as well.

15.1 Precision

Precision is frequently determined by the comparison of replicates, where replicates result from an original sample that has been split for identical analyses. Standard deviation, s, of a sample is commonly used in estimating precision.

$$\text{Sample standard deviation } s = \sqrt{\frac{1}{n-1} \sum_{i=1}^{n} (x_i - \bar{x})^2}$$

where a quantity x (e.g., a concentration) is measured n times with a mean, x.

The relative standard deviation, RSD (or sample coefficient of variation, CV), which expresses standard deviation as a percentage of the mean, is generally useful in the comparison of three or more replicates (although it may be applied in the case of n=2).

$$\%RSD = 100\ (s/x)$$

or

$$CV = 100\ (s/x)$$

where:
RSD = relative standard deviation, or
CV = coefficient of variation
s = standard deviation
$\bar{x}$ = mean

In the case of duplicates -- samples that result when an original sample has been split into two for identical analyses -- the percent difference (%D) between the two samples may be used to estimate precision.

$$\text{RPD or } \%D = \frac{D_1 - D_2}{(D_1 + D_2)/2} \times 100$$

where: RPD or %D = percent difference
D_1 = first sample value
D_2 = second sample value (duplicate)

15.2 Accuracy

The determination of accuracy of a measurement requires a knowledge of the true or accepted value for the signal being measured. Accuracy may be calculated in terms of bias as follows:

$$\text{Bias} = X - T$$
$$\%\text{Bias} = 100\,(X - T)/T$$

Where: X = average observed value of measurement
T = "true" value

Accuracy also may be calculated in terms of the recoveries of analytes in spiked samples

$$\%\text{Recovery } (\%\text{REC}) = \frac{SSR - SR}{SA} \times 100$$

where: SSR = spiked sample result
SR = sample result
SA = spike added

15.3 Completeness

Determining whether a data base is complete or incomplete may be quite difficult. To be considered complete, the data set must contain all QC check analyses verifying precision and accuracy for the analytical protocol. Less obvious is whether the data are sufficient to achieve the goals of the project. All data are reviewed in terms of goals in order to determine if the data base is sufficient.

Where possible, the percent completeness for each set of samples is calculated as follows:

$$\%\text{completeness} = \frac{\text{valid data obtained}}{\text{total data planned}} \times 100$$

16.0 CORRECTIVE ACTION

An essential element of the QA Program, Corrective Action provides systematic, active measures to be taken in the resolution of problems and the restoration of analytical systems to proper functioning.

Corrective actions for laboratory problems are described in E3I laboratory operating manuals. Personal experience often is most valuable in alerting the bench scientist to suspicious results or malfunctioning equipment. Specific QC procedures are designed to help analysts determine the need for corrective actions (See Section 11, Data Reduction, Validation, and Reporting). Corrective actions taken by scientists in the laboratory help to avoid the collection of poor quality data.

Examples of conditions that may warrant corrective actions are given below:

1. Tuning or calibration of instruments outside of specifications.
2. QC data for precision and accuracy outside of acceptance limits.
3. Undesirable trends in concentration, surrogate and spike recoveries, response factors or relative percent difference.
4. Abnormal variation in detection limits.
5. Check sample results out of range.

Problems not immediately detected during the course of analysis may require more formalized, long-term corrective action. The essential steps in the corrective action system are:

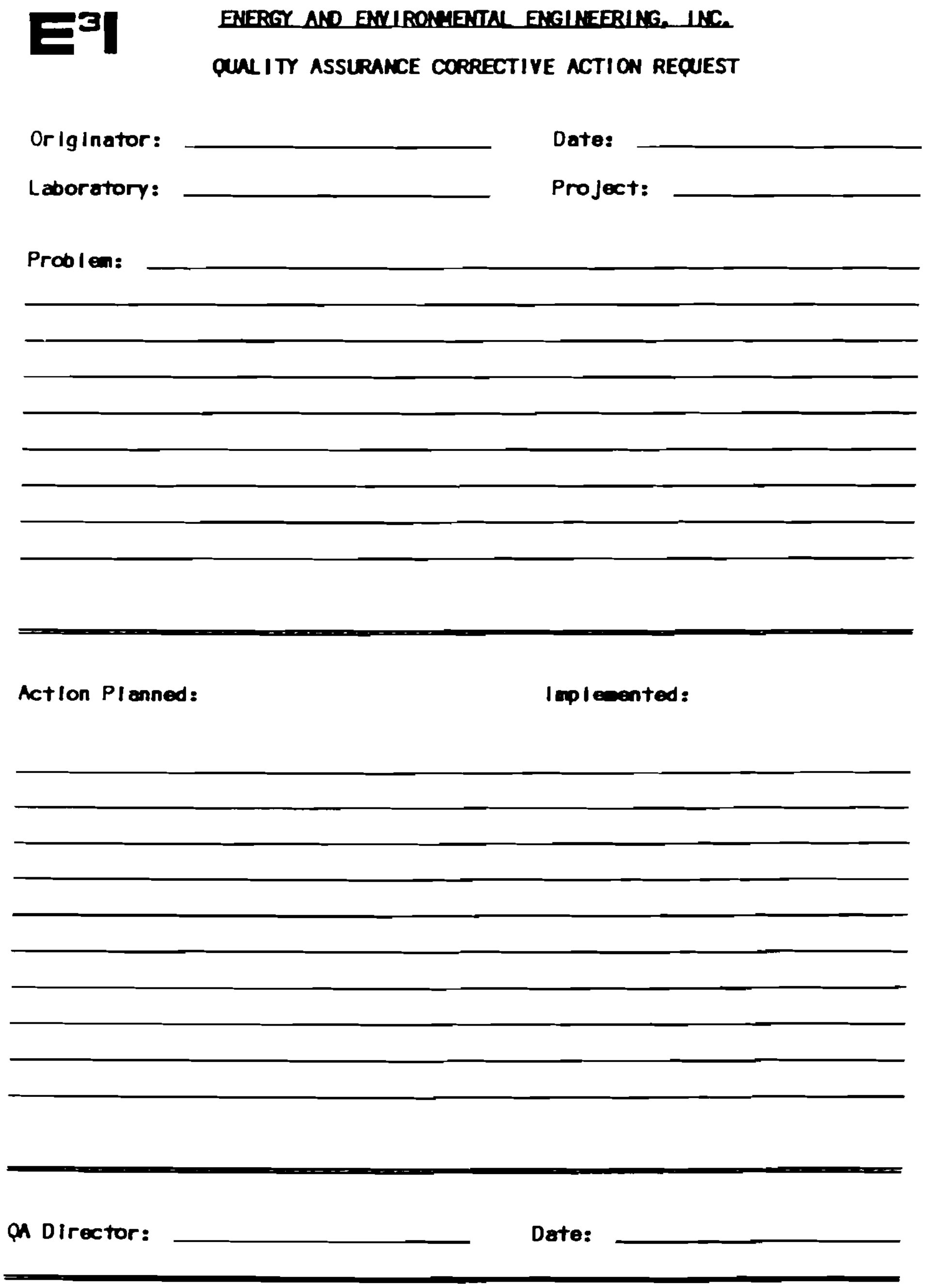
1. Identify and define the problem.
2. Assign responsibility for investigating the problem.
3. Investigate and determine the cause of the problem.

4. Determine a corrective action to eliminate the problem.
5. Assign and accept responsibility for implementing the corrective action.
6. Establish effectiveness of the corrective action and implement it.
7. Verify that the corrective action has eliminated the problem.
8. Document the actions taken and those planned.

This scheme is generally accomplished through the use of Corrective Action Request Forms (Figure 16-1) available to all E3I staff members. Using this form, any laboratory scientist or project member may notify the QA Director of a problem. The QA Director initiates the corrective action by relating the problem to the appropriate laboratory managers and/or project managers who investigate or assign responsibility for investigating the problem and its cause. Once determined, an appropriate corrective action is approved by the QA Director. Its implementation is later verified through a laboratory audit.

Information contained on Corrective Action forms is kept confidential within E3I and is generally limited to the individuals involved. Severe problems and difficulties may warrant special reports to the President of E3I who will ensure that the appropriate corrective actions are taken.

FIGURE 16-1
E3I QUALITY ASSURANCE CORRECTIVE ACTION REQUEST FORM



E3I

ENERGY AND ENVIRONMENTAL ENGINEERING, INC.

QUALITY ASSURANCE CORRECTIVE ACTION REQUEST

Originator: ____________ Date: ____________

Laboratory: ____________ Project: ____________

Problem: ____________

Action Planned: Implemented:

QA Director: ____________ Date: ____________

17.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

The E3I Director of Quality Assurance submits a QA report each quarter to the President of E3I and the General Manager of the Laboratory Division. The report contains detailed information on QA activities during the previous three months including:

1. Summary of systems audits.
2. Performance evaluation samples analyzed, and scores received.
3. Status of certifications.
4. Laboratory QA/QC reviews.
5. Problems and corrective actions.
6. Comments and recommendations.

In the case of a severe problem or difficulty, a special report is prepared by the QA Director and submitted in a timely manner to the management.

18.0 SAFETY

E3I maintains an extensive safety program managed by an aggressive Safety Committee. Responsibilities include many aspects which comply with the Right-to-Know Laws. Training includes:

- o Training seminar with information on basic safety instruction, location of safety equipment, etc.,
- o Safety manual,
- o Centralized MSDS information,
- o Maps with safety equipment noted and all exits, and
- o Posted safety rules.

APPENDIX C

WASTE MANAGEMENT PLAN

WASTE MANAGEMENT PLAN

Performance of the field investigation will result in the generation of solid and liquid waste which must be handled in accordance with NMPC Waste Management procedures. This Waste Management Plan identifies the materials expected to be encountered during the field investigation and provides a coordinated methodology for the handling, collection, transport and ultimate disposal of the material.

1. WASTE SOURCES

Manufactured gas plant operations typically resulted in the incidental production of a variety of waste tars, sludges and oils, which are currently referred to as "coal tar". These wastes often times leaked into the ground from containment structures, or were periodically collected and dumped onto the ground's surface. The introduction of the coal tar washes into the subsurface environment often results in the contamination of soils and ground water with which the wastes may have come into contact.

Coal tar contamination, as exposed by site investigation activities, may be visually detected as a dark stain on soil particles or sheen on porewater. A pungent hydrocarbon odor may be apparent. Increasingly contaminated soils have pore spaces and interstices filled with black tars of varying viscosity. Gross contamination may exist as pure coal tar, or as a slurry of tars and soil particles.

A second waste by-product of manufactured gas production consists of a mixture of wood chips and iron oxide which was used as a purification medium. The spent purifier waste was commonly dumped on vacant areas of the site and accumulated into thick beds. Degradation and exposure result in a spongy, soil-like surficial material with a high ferric cyanide content. Other waste materials, such as bottom ash and lime scrubber residue, were commonly mixed with the purifier waste and have degraded into a slimy, paste-like substance. These waste sources may also have resulted in the contamination of soils and ground water.

2. GENERATED FIELD INVESTIGATION WASTE

Contaminated solid and liquid material will be encountered throughout the field investigation. Test pit excavation will most likely uncover coal tar contaminated soils, and soil boring produces ''cuttings'' of subsurface material while associated split-spoon samples produce residual subsurface material once samples are collected. Ground water will likely be reached during test pit excavation and soil boring.

Equipment that comes into contact with contaminated material, such as the backhoe bucket and arm, drill augers and casings, and split-spoon samplers, must be decontaminated between test pits and borings, if heavily soiled. This requires steam cleaning and, in extreme cases, solvent washing and rinsing. The cleaning fluids and decontamination pad bottom sludges constitute a waste source which must be contained, handled and disposed of in accordance with this plan.

The development and purging of monitoring wells brings volumes of water to the surface and could result in the generation of potentially contaminated ground water which requires containment, handling and disposal. Under New York State technical guidance (Technical Operations Guideline 1.6.1) regarding site investigations, development and purge water may be returned to the ground in the vicinity of the well.

A recent interpretation (May 7, 1992) of this guideline by NYSDEC Water Quality Division provided the following criteria regarding application of T.O.G 1.6.1:

- no runoff to adjacent waterbodies or waterways;
- returned ground water comes from the same aquifer that is being sampled/pumped (if collected from an isolated, lower aquifer, it should be determined to be cleaner than water found in the upper aquifer);

- grossly contaminated ground water should be contained.

Investigation of the former MGP site will generate solid wastes in the form of personnel protective equipment (PPE), tyvek suits, protective gloves and foot covers, which come in contact with coal tar and purifier wastes. Cleaning materials (rags, paper towels) will contribute to the solid wastes generated during the study.

3. WASTE MANAGEMENT PROCEDURES

Proper management of waste material begins with minimizing the amount of material that must be handled. To this end, test pits will be limited in length, width and depth to the extent necessary to fulfill the rationales listed in the Work Plan, Table 2-1 and 2-2. Similarly, borings will be limited in depth by the same considerations. Open test pits and borings will be backfilled and sealed promptly, and will in no case be left unattended.

Material excavated from test pits will be stockpiled on plywood underlain by impervious plastic. Each backhoe bucket will be visually inspected and screened with an Organic Vapor Analyzer (OVA). Clean material will be staged apart from contaminated material, preferably on the opposite side of the test pit. Bulky debris (derelict piping, concrete slabs, etc.) will be further isolated for possible study and appropriate replacement/disposal.

After evaluation and documentation, test pits will be backfilled first with contaminated material and then sealed with remaining and any needed clean material. The pit will be compacted to the density of the surrounding surface area. Test pits excavated within paved areas will be finished by Atlantic with cold patch asphalt over a compacted subgrade. Atlantic personnel will remove all plywood and plastic and return the location to its original appearance.

Cuttings from soil borings will be handled in a manner similar to that for test pit soils: clean material will be removed to one side of the boring as it rises on the auger flights. Visual inspection and organic vapor analyzer screening will allow distinction of contaminated material, which will be stockpiled on the side of the boring opposite to the clean cuttings.

Soil boring protocols designed to prevent cross-contamination through a confining layer will be followed. In particular, deep borings will be advanced by use of spun casing to avoid downward displacement of contaminated material. Borings located within gasholders will not penetrate the foundation or pad.

Upon completion of sample collection and documentation, the boring will be backfilled (assuming that confining layer was not breached) first with any contaminated material and then with clean material. Remaining voids and the top of boring will be grouted to grade. Any subsidence of the cap will be re-grouted until stable.

Contaminated solids remaining after sampling and backfilling will be contained in 55-gallon drums with any sludges generated from the decontamination facility. Drums will be stored adjacent to the decontamination facility in an area dedicated to waste storage. Drums will be labelled with material source and description, and will remain closed when not in use.

A decontamination facility will be constructed onsite for the purpose of decontaminating equipment used during the field investigation. The decontamination facility will be constructed from impervious plastic laid within and over an earthen berm to contain all liquids. The facility will have a sump at one end from which wastewater will be pumped to a large capacity plastic water tank placed within the berm.

Well development and purge water will be discharged in the vicinity of the well, as appropriate. When necessary, contaminated development and purge water will be pumped or surged directly into 55-gallon drums for temporary storage and transfer to the water storage tank. Atlantic personnel will use best professional judgment to contain ground water.

Soiled PPE and cleaning materials will be placed in a 55-gallon drum specifically designated for that purpose. Disposal of the drum contents will be coordinated with NMPC waste management procedures.

Removal

After completion of the investigation, contained materials will be tested as required for hazardous characteristics. In coordination with Niagara Mohawk's Environmental Affairs Unit, contractors will be selected for removal, transport and disposal of all wastes.

A prime consideration throughout the Remediation Investigation, will be the sensitive nature of waste management and handling as perceived by public attention and media scrutiny. Operations will be conducted with an eye towards discretion and professional appearance.