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Site Name Sinclair Refinery
Site No. 902003
County Allegany
Town Wellsville
Foilable Yes No
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report. HW902003. 1988-09. Project_Operation_Plan_Phase2_RI_FS. Vol 1

24

ARCO

Project Operations Plan

for

Completion of Phase II Remedial Investigation and Work Plan for Feasibility Study

at the

Sinclair Refinery Site Wellsville, New York

Volume I of II

Work Plan

Prepared By

Ebasco Services Incorporated

August 1988

ARCO Petroleum Products Company
515 South Flower Street
Los Angeles, California 90071
Telephone 213 486 1716

R. Walter Simmons
Manager
Superfund Operations and Divested Properties

August 30, 1988

Chief, Site Compliance Branch
Emergency and Remedial Response Division
U. S. Environmental Protection Agency, Region 2
26 Federal Plaza, Room 747
New York, New York 19278

Attn: Mr. Paul Olivo, Sinclair Refinery Site Project Manager

Dear Mr. Olivo:

Attached are three (3) copies of the Remedial Investigation Project Operations Plan (POP) for the Sinclair Refinery Site. Included in this document is the Feasibility Study Work Plan. The POP and the FS workplan are required by a Consent Order which requires ARCO to prepare an RIFS for the refinery portion of the Sinclair site in Wellsville, New York.

The POP also includes, as an attachment, the Pre-Excavation Sampling and Analysis Plan for the landfill Phase 1 remedial design. This plan is required by the Consent Decree which ARCO has signed, but which is not yet effective.

We would like to begin sampling on October 1, 1988 under both the POP and the Pre-Excavation Sampling and Analysis Plan. This early start date is needed in order to conduct the sampling before winter in upstate New York, and to allow the RIFS and the landfill remedial designs to be completed as scheduled. ARCO would greatly appreciate your expedited review and approval of these documents. Please call me if you have any questions.

Sincerely yours,

Walt Simmons

R. Walter Simmons

cc: Chief, New York/Caribbean Superfund Branch EPA
Chief, Environmental Enforcement Section, DOJ
Director, Division of Hazardous Waste Remediation, NYDEC
M. Dianne Smith, ARCO

ARCO

Project Operations Plan

for

Completion of Phase II Remedial Investigation and Work Plan for Feasibility Study

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Sinclair Refinery Site Wellsville, New York

FILE COPY

Originator ARCO/EBASCO

Reviewer [illegible] 9/88

Reviewer ________

Reviewer ________

Volume I of II
Work Plan

Prepared By

Ebasco Services Incorporated
August 1988

EXECUTIVE SUMMARY

The Atlantic Richfield Company, Inc. (ARCO) and the U.S. Environmental Protection Agency signed an Administrative Order on Consent, effective August 3, 1988, allowing ARCO to proceed with the completion of a Remedial Investigation and Feasibility Study (RI/FS) for the Sinclair Refinery Site in Wellsville, New York. As agreed in the Consent Order, the first step in the RI/FS process is to prepare a Project Operations Plan (POP) describing the work to be performed and the procedures to be used.

The POP is divided into two major sections, the Work Plan and the Field Operations Plan (FOP) which are provided in Volumes I and II of the POP. The Work Plan presents a review of the existing data regarding the site, a preliminary analysis of the data, a preliminary identification of potential remedial alternatives, and a description of the technical scope of work for the RI/FS along with a project schedule. A description of the responsibilities and the anticipated levels of effort of key staff and other project personnel involved in the RI/FS and their curricula vitae are also provided in the Work Plan.

The FOP includes three major sections including the Field Sampling and Analysis Plan (FSAP) with its associated Brossman Short Form, the Site Management Plan (SMP) and the Health and Safety Plan (HASP). The sections of the FOP provide direction for field operations, ensuring that field investigations are performed in a safe manner and at a level of quality appropriate for the project needs. The FSAP defines specific standard operating procedures to be followed during the field investigation activities. Number, types, locations and quality assurance/quality control requirements of samples are also described. The SMP provides a description of the responsibilities of site personnel, procedures to control access to potentially contaminated areas and other operational considerations. Health and safety considerations, including a contingency plan for unanticipated emergencies are described in the HASP.

During the period of 1984 to 1987, SMC Martin, under contract with the New York State Department of Environmental Conservation (NYSDEC), began a two phased Remedial Investigation at the site. This Work Plan describes the work required to complete Phase II of the Remedial Investigation. The RI field work described in the POP focuses on sampling in areas of potential concern. The analytical testing program is limited to specific chemicals or groups of chemicals previously detected at the site.

The field investigation program includes sampling of groundwater, soils, sediments and surface water in the vicinity of the old refinery area. No sampling is proposed at the former Off-Site Tank Farm (OSTF), an area where the previous studies did not indicate a potential risk to human health or the environment. In the area of the landfill, a limited groundwater sampling program has been proposed. This is included to verify the previous results showing that groundwater in this area is not significantly affected by the materials in the landfill.

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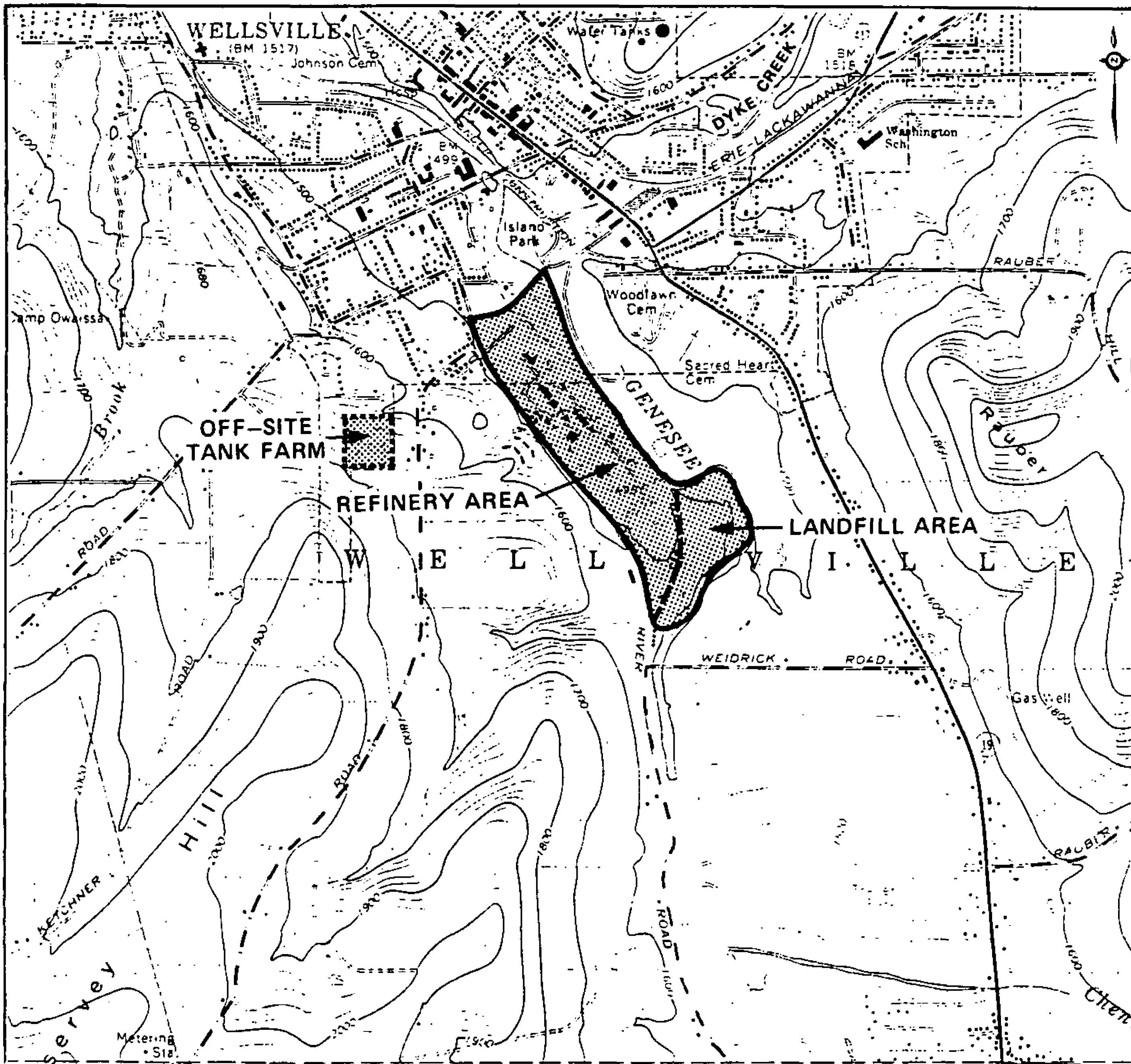
1.0 INTRODUCTION

The Atlantic Richfield Company, Inc. (ARCO) is submitting this Work Plan to the U.S. Environmental Protection Agency (EPA) as agreed in the Administrative Order on Consent on the Sinclair Refinery Site effective August 3, 1988. This Work Plan, along with the associated Field Operations Plan (FOP) are collectively referred to as the Project Operations Plan (POP). The FOP includes a Field Sampling and Analysis Plan (FSAP), Health and Safety Plan (HASP) and Site Management Plan (SMP).

The Sinclair Refinery Site is located in the Town and Village of Wellsville, New York (Figure 1-1). Wellsville is in South Central New York, approximately 10 miles north of the Pennsylvania-New York border. Refinery operations ceased in 1958 after a fire at the site. The site is currently occupied by the Alfred campus of the State University of New York as well as various industrial companies. The Sinclair Refinery Site was included in the National Priorities List in September, 1983. Following a Phase I RI/FS at the site, it was divided into two operable units, the refinery area, including the Off-Site Tank Farm (OSTF), and landfill area (Figure 1-1). A Record of Decision (ROD) for the landfill was signed in 1985. This Work Plan for the Sinclair Refinery Site addresses the 90-acre portion of the site where refinery operations were previously conducted, the Off-Site Tank Farm and groundwater in the vicinity of the landfill area (Figure 1-2).

This Work Plan presents ARCO's technical scope of work for the Remedial Investigation/Feasibility Study (RI/FS) as well as a detailed schedule for the performance of the work. A description of the responsibilities and the anticipated levels of effort of the professionals expected to play a significant role in the RI and the curricula vitae (Appendix A) of those individuals have also been included. ARCO has contracted with Ebasco Services Incorporated (Ebasco) to assist ARCO in performing the RI, and the key staff and other project personnel identified are Ebasco employees.

This Work Plan has been prepared in accordance with current EPA guidance. The following are several of the documents specifically applicable to preparation of an RI/FS, which were considered in preparing this Work Plan:



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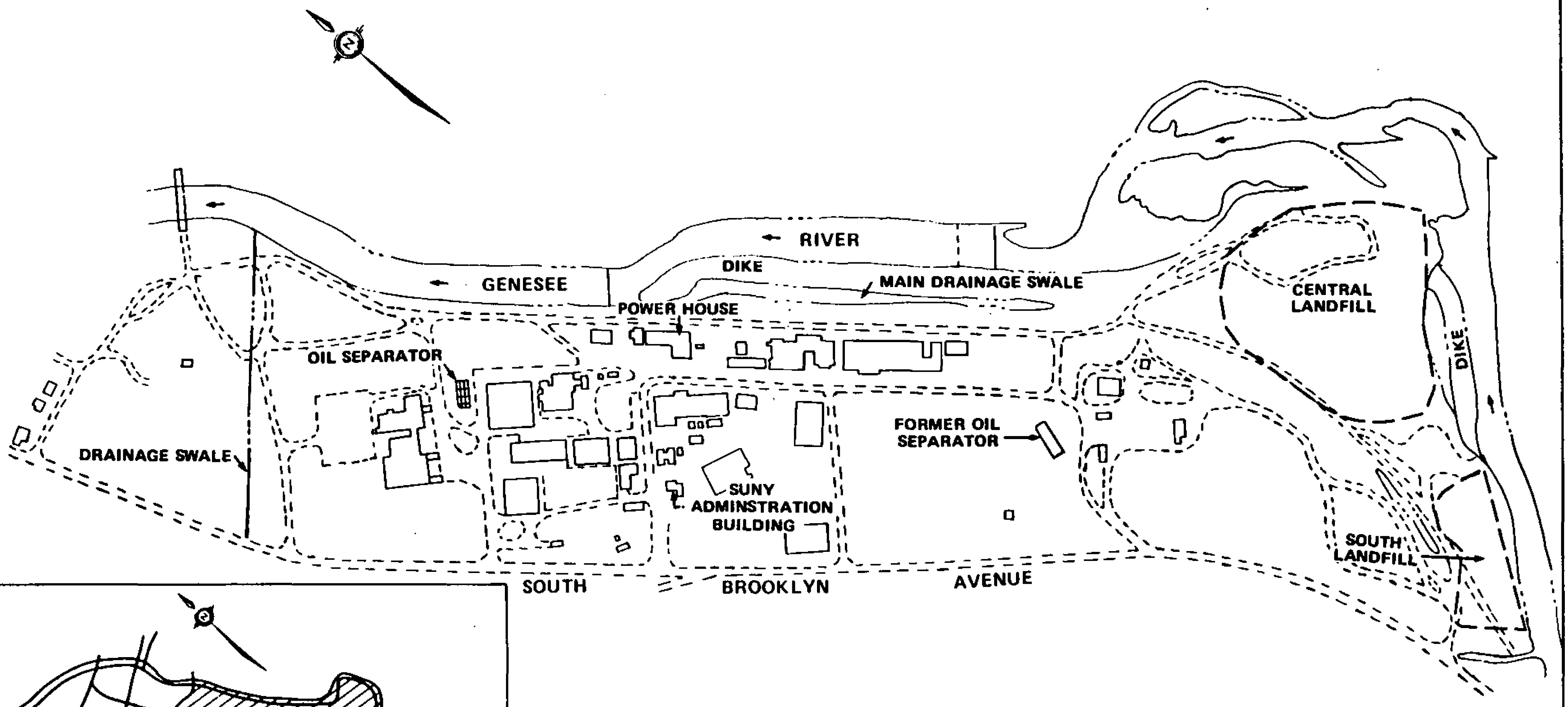
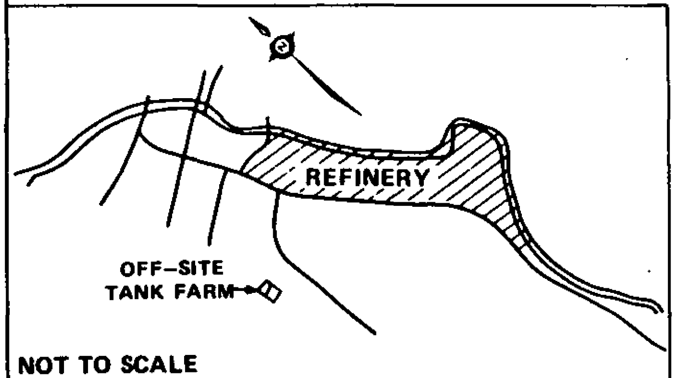
SINCLAIR REFINERY SITE
WELLSVILLE, NEW YORK

FIGURE 1–1

SITE LOCATION MAP

EBASCO SERVICES INCORPORATED





0 500 1000
SCALE IN FEET

ADAPTED FROM SMC MARTIN PHASE I SITE MAP

SINCLAIR REFINERY SITE
WELLSVILLE,NEW YORK

FIGURE 1–2

SINCLAIR REFINERY SITE MAP

EBASCO SERVICES INCORPORATED

- Guidance on Remedial Investigation Under CERCLA (EPA, 1985)

- Guidance on Feasibility Studies Under CERCLA (EPA, 1985a)

- Draft Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (EPA, 1988)

- Data Quality Objectives: Development Guidance for Uncontrolled Hazardous Waste Site Remedial Response Activities (EPA, 1986)

- Interim Guidance of Superfund Selection of Remedy (EPA, 1986a)

- Additional Interim Guidance for FT-87 Records of Decision (EPA, 1987)

This Work Plan contains 7 sections of which this Introduction is Section 1. Section 2 describes the site background. Section 3 presents a summary of existing data, an initial evaluation of the data, a preliminary scoping of the remedial alternatives and preliminary identification of the Applicable, or Relevant and Appropriate Requirements (ARARs). Section 4 presents the Data Quality Objectives (DQOs) for the Remedial Investigation sampling activities, and the approach to preparing the Work Plan. Sections 5 and 6 present a discussion of each task in the RI and FS respectively and the plan of work for this project, which has been divided into 11 major tasks. Section 7 of the work plan presents the project management approach, key staff and other project personnel, coordination of the various activities, and the schedule for this work.

2.0 SITE LOCATION, CURRENT CONDITIONS AND SITE HISTORY

2.1 SITE LOCATION

The Sinclair Refinery Site is located approximately one mile south of Wellsville, New York, in Allegany County, about ten miles north of the New York-Pennsylvania border. Situated on the Genesee River, the site can be viewed as three separate areas. The first, and largest of these, is the refinery area, approximately 90 acres in size. Next is the landfill area, located adjacent to the southern end of the refinery area. The landfill is also on the Genesee River, and is approximately nine to ten acres in size. Last is the Off-Site Tank Farm located west of the refinery area, on the west side of South Brooklyn Avenue (River Road) (see Figure 1-2), a fourteen acre area formerly used as a tank farm.

2.2 SITE HISTORY

The Sinclair Refinery Site has a history dating back to the late 1800's. During the late 1800's operations at the site were started by the Wellsville Refining Company. In 1924, the facility was purchased by the Sinclair Refining Company, who owned and operated the facility until a fire destroyed the facility in 1958 (SMC Martin, 1985). Products manufactured by the facility were made from New York and Pennsylvania crude oil, including crude brought in from wells several miles south of the refinery. Products included heavy oils and grease for lubrication, light oils for fuel, gasoline, lighter fluid, naptha and paraffin. When the Refinery closed, Sinclair transferred the majority of the property to the Village of Wellsville. The remaining property was turned over to the New York Refinery Project. Most of the structures, including the storage tanks at the tank farm, were removed by 1964 (SMC Martin, 1985). Some of the structures remained, including the oil separator, located on the north side of the site, near the river, and several refinery buildings including the power house. Some of the buildings were renovated by tenants of the existing industrial park, while others remain vacant (see section 2.3 for details of existing structures).

During refinery operations, the landfill area was used to dispose of waste materials from refinery processes, A general list of materials disposed of in the landfill includes the following: cloth filters used for straining oil from the contact plant; tank sludges from the solvent plant; Fullers Earth; cinders and ash from the boiler plant; oxidized tetraethyl lead; sludges from the oil separator; and spent acids disposed of in the pond (SMC Martin, 1985). The use of the landfill area was by no means limited to Sinclair, and it is known that the landfill continued to be used well into the 1980's by local companies and/or the Village of Wellsville (CDM, 1983).

During 1981 to 1982 a portion of the landfill was eroded by flooding of the Genesee River. This erosion exposed a section of the landfill ten feet in height and over 100 feet in length. This exposed section included stained earth and drums, some of which spilled into the Genesee River. The preceding events caused the site, and the landfill area in particular, to become the focus of public attention. Immediately following the flooding, local officials notified the New York State Department of Environmental Conservation (NYSDEC) of their concerns. On October 30, 1981, NYSDEC sent a field team to the site to sample several environmental matrices, including soil, river water, and sediment, for contamination (CDM, 1983). The results of this testing is found in the "Remedial Action Master Plan (RAMP)," (section 2.3) (CDM, 1983). Following this, the Sinclair Refinery Site was included in the National Priorities List (NPL) on September 8, 1983.

Additional investigations at the site were conducted by SMC Martin, Inc. for the NYSDEC. During these investigations over 200 samples from different matrices were taken. The draft Phase I Report was submitted by SMC Martin on March 15, 1985. Phase II investigations were started by SMC Martin during 1985 and 1986, with their last samples taken in November, 1986. During the writing of the Phase II report, NYSDEC terminated its contract with SMC Martin. This Work Plan presents the procedure for completion of the Phase II RI started by SMC Martin.

2.3 CURRENT CONDITIONS

Since the termination of refinery activities in 1958, the Site, with the exception of the landfill area, has become integrated into the local community and local economy. The refinery area has been redeveloped with very few of the refinery structures remaining. This area is currently occupied by a number of businesses and the State University of New York at Alfred (SUNY at Alfred). The Off-Site Tank Farm is not developed. The landfill area is not currently used.

One of the refinery structures remaining at the site is an old oil-water separator, referred to as the oil separator. The oil separator is a concrete basin covering an area of approximately 30 x 100 feet. The oil separator was part of the refinery storm water system used to provide gravity separation of oil and water in site runoff.

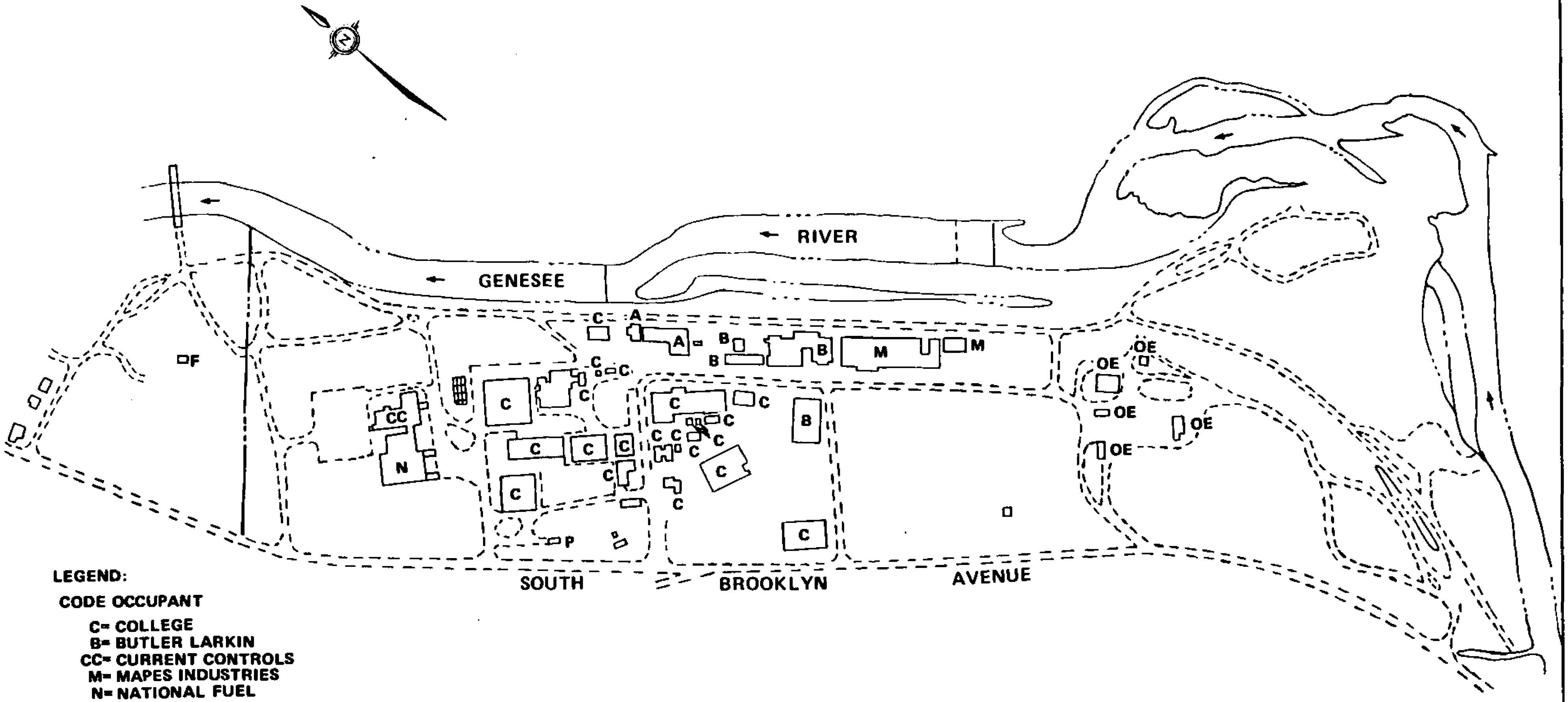
Five companies are currently using the site along with the University. The businesses operating at the site are Butler Larkin Company Inc.; Mapes Industries, Inc.; Otis Eastern Service, Inc.; Current Controls, Inc.; and National Fuel Co, Inc. Butler Larkin, Inc. is a manufacturer of drilling and completion equipment for oil, gas and water wells, and has its manufacturing facilities at the site. Mapes Industries, Inc. is a maker of toy chests, cribs, and other finished wood products, with production facilities at the site. Otis Eastern, Inc. is a drilling and construction company, having their main offices at the site. Current Controls, Inc. is a manufacturer of small electrical transformers and other electronic control devices, with manufacturing facilities on site. National Fuel Co, Inc. is the local natural gas supplier, with both their customer offices and vehicle maintenance facilities located at the site. The SUNY at Alfred campus is an agricultural and technical college, including shops for automobile repair instruction.

The Village of Wellsville maintains its domestic water treatment facility approximately one quarter mile south of the southern boundary of the South Landfill, upstream of the Sinclair Refinery Site. Wellsville also maintains a Fire Fighting Training School at the north end of the site.

The buildings occupied by each company are shown on Figure 2-1. The buildings used and types of structures are as follows. The SUNY at Alfred campus has approximately 21 buildings, of which eight are of brick construction, having been renovated from old refinery buildings. The remaining campus buildings are of corrugated aluminum and steel frame construction. Several of the campus buildings house shop facilities for automotive engine repair, body work, body painting, and other repair instruction facilities. Most of these buildings have extensive floor drain networks. Butler Larkin occupies seven buildings, of which two are brick, renovated refinery buildings, and the other five are corrugated aluminum and steel frame construction. Otis Eastern occupies six buildings, of which five are renovated refinery buildings, the sixth being aluminum and steel. The Wellsville Fire Academy has one small structure made of undetermined materials on the north border of the refinery site. National Fuel has one large aluminum and steel building on the northern portion of the site, as does Current Controls (an adjoining structure). Lastly, Mapes Industries occupies two modified refinery structures, one of them being a large brick structure, the other being a smaller building also of brick.

Several of the companies present on site generate significant heavy vehicle traffic. Specifically National Fuel and Otis Eastern have large numbers of heavy construction equipment present on their property most of the time. The college campus, due to the nature of its vocational program, also introduces vehicular traffic into the area, although much of this is passenger vehicles, not heavy equipment.

Several prior studies have been conducted at the Sinclair Refinery Site. The first, a preliminary evaluation, was conducted as part of the Remedial Action Master Plan (RAMP) in 1981 to identify sources of potential contamination at the site. Results of the chemical analyses performed during this study indicated levels of several compounds, including benzene, arsenic, lead and naphthalene, in sediment and surface water which exceeded background levels in the region. Partial remediation of contamination associated with the site has been implemented as a result of this investigation. Remediation measures included removal of exposed barrels and localized soil clean up.



LEGEND:

CODE OCCUPANT

C= COLLEGE
B= BUTLER LARKIN
CC= CURRENT CONTROLS
M= MAPES INDUSTRIES
N= NATIONAL FUEL
OE= OTIS EASTERN
F= FIRE ACADEMY
A= ABANDONED
P= PUMP HOUSE

0 500 1000
SCALE IN FEET

ADAPTED FROM SMC MARTIN PHASE I SITE MAP

SINCLAIR REFINERY SITE
WELLSVILLE,NEW YORK

FIGURE 2–1

OCCUPANTS OF CURRENT STRUCTURES

EBASCO SERVICES INCORPORATED

Subsequent studies were conducted in 1984-1986 as part of a two-phase (Phase I and Phase II) remedial investigation started by SMC Martin for NYSDEC and to be continued as outlined in this Work Plan. As a result of these studies, an extensive data base for chemical characterization of the site was generated. However, data gaps exist which preclude a detailed evaluation of spatial contamination trends at the site.

2.4 STATUS OF REMEDIAL INVESTIGATION

The Remedial Investigation of the Sinclair Refinery Site was begun by SMC Martin, working for the NYSDEC. The investigation was planned as a two phase RI, with Phase I focusing on the landfill with limited data gathering in the refinery area. The Phase II RI plan focused on providing supplemental information in the landfill area and an investigation of the refinery area, as well as an investigation of the OSTF.

2.4.1 Phase I Scope-of-Work

The Phase I RI, begun in 1984, culminated with the submission of a Draft Phase I Remedial Investigation report to the NYSDEC in March, 1985 (SMC Martin, 1985). The report discussed the field investigations performed and the results of those investigations, including the work in both the landfill and refinery areas on the site.

The investigation in the landfill area included:

- Twelve auger borings to depths of up to 26 feet with one soil sample taken for testing at each location

- Six test pits to depths of 13 feet with two soil samples taken for testing at each location

- Sampling ten drums exposed at the surface

- Five monitoring wells completed in the shallow aquifer with soil samples taken for testing and two rounds of water samples obtained and tested

In the refinery area, the investigation included:

- Twenty auger borings to depths of up to 50 feet with one soil sample taken for testing at each location

- Seventeen composite surface soil samples from various locations including 14 in the refinery area, 1 at the OSTF and 2 background samples

- Six monitoring wells completed in the shallow aquifer with soil samples taken for testing and two rounds of water samples obtained and tested.

Numerous other sampling programs were performed including a biological sampling program (terrestrial and aquatic), a geophysical testing program, river water and sediment sampling, an air and meteorological testing program and seep and sediment sampling programs.

Infiltration tests on the landfill, and tests to evaluate the hydraulic conductivity of the shallow aquifer were also performed.

Each of these studies were discussed in the draft Phase I report.

2.4.2 Phase II Status

The Phase II RI began in 1985 with the preparation of a Work Plan for the field investigation. The proposed Phase II investigation was based on the results of Phase I, and focused on obtaining information on potential source areas, identified, but not sampled in Phase I and potential contaminants of concern. The field investigations were proposed primarily in the refinery area, although some samples in the landfill and OSTF were also obtained. Additional background sampling was also performed.

The proposed additional characterization of the landfill included the installation and sampling of 17 wells in the landfill area including wells completed in the shallow and deep aquifers, the clay aquitard and the landfill material. Each new well was to be sampled once but the Phase I wells were not included in the sampling. Some soil sampling was also proposed in the landfill area. The hydraulic conductivity of the aquifer was also to be evaluated at the well location.

A focused investigation of the on-site sewer and piping systems was also proposed. This included sampling water and sediment in the sewer and soils near the sewers, outfall sampling, geophysical exploration to help define the locations of sewers, and tracer tests using dye to investigate flow patterns in the sewers.

Proposed sampling in the refinery area included the installation of 21 additional wells in the shallow and deep aquifers and the clay aquitard. Each of the wells were to be sampled, but existing Phase I wells were not to be resampled. A supplemental auger boring and surface soil sampling program was also proposed. Analytical testing of the surface samples was limited to metals, since the Phase I work had identified the presence of elevated levels of lead in several areas. Infiltration tests and pump tests were also proposed.

Work to complete characterization of the OSTF, background conditions and other site related media (drainage swales, Genesee River, sediments) were also proposed.

The field work and laboratory analysis to complete each of the above tasks was completed by late 1986. Some data analysis had apparently begun when the contract between the NYSDEC and SMC Martin was terminated.

In this Work Plan, ARCO describes a program to complete the analyses, begun by SMC Martin. Limited additional field programs are proposed to further define potentially contaminated areas identified in the Phase I and II work completed to date, and to obtain more data to assist in performing the risk assessment and feasibility study for the refinery area.

3.0 INITIAL EVALUATION

3.1 REVIEW OF EXISTING DATABASE

The following information was compiled from data available through studies conducted to date by SMC Martin and other available data sources.

3.1.1 Drainage and Surface Waters

The Sinclair Refinery Site is located in the Genesee River Basin. The site is bounded on the east and south by the Genesee River which flows north toward Rochester, New York where it empties into Lake Ontario. Dike Creek, a tributary to the Genesee, enters the river approximately 1/4 mile downstream of the site (Figure 1-1). Three smaller streams flow toward the northern portion of the site from the west. These streams have been diverted to underground culverts beneath the site which discharge to the Genesee. A fourth stream flows east into the Genesee River near the southern boundary of the site.

The Genesee River has undergone extensive modification for flood control by the U.S. Army Corps of Engineers since 1958. These modifications include channelization, bank stabilization, diversion and the installation of flow control dams and dikes. The most extensive flood control modifications occurred as a result of a flood in 1972.

During refinery operations surface water from the refinery site was diverted to underground sewers which flowed to the two oil separators on site. Locations of the main oil separator, in the northern portion of the site, and a second oil separator, now dismantled, in the southern portion of the site are shown on Figure 1-2. Water flowed from the separators through underground sewers to a drainage swale which ran parallel to the Genesee River. Two drainage swales, described as low lying marshy areas, are present adjacent to the site (see Figure 1-2). The main drainage swale runs north-south along the eastern edge of the site. A second swale is situated along the northern border of the site. Several seeps and outfalls flow to the main drainage swale.

3.1.2 Site Geology

Characterization of subsurface stratigraphy at the Sinclair Refinery Site is based on data obtained from the drilling of auger borings and monitoring wells, and geophysical surveying during Phase I and Phase II of the Remedial Investigation.

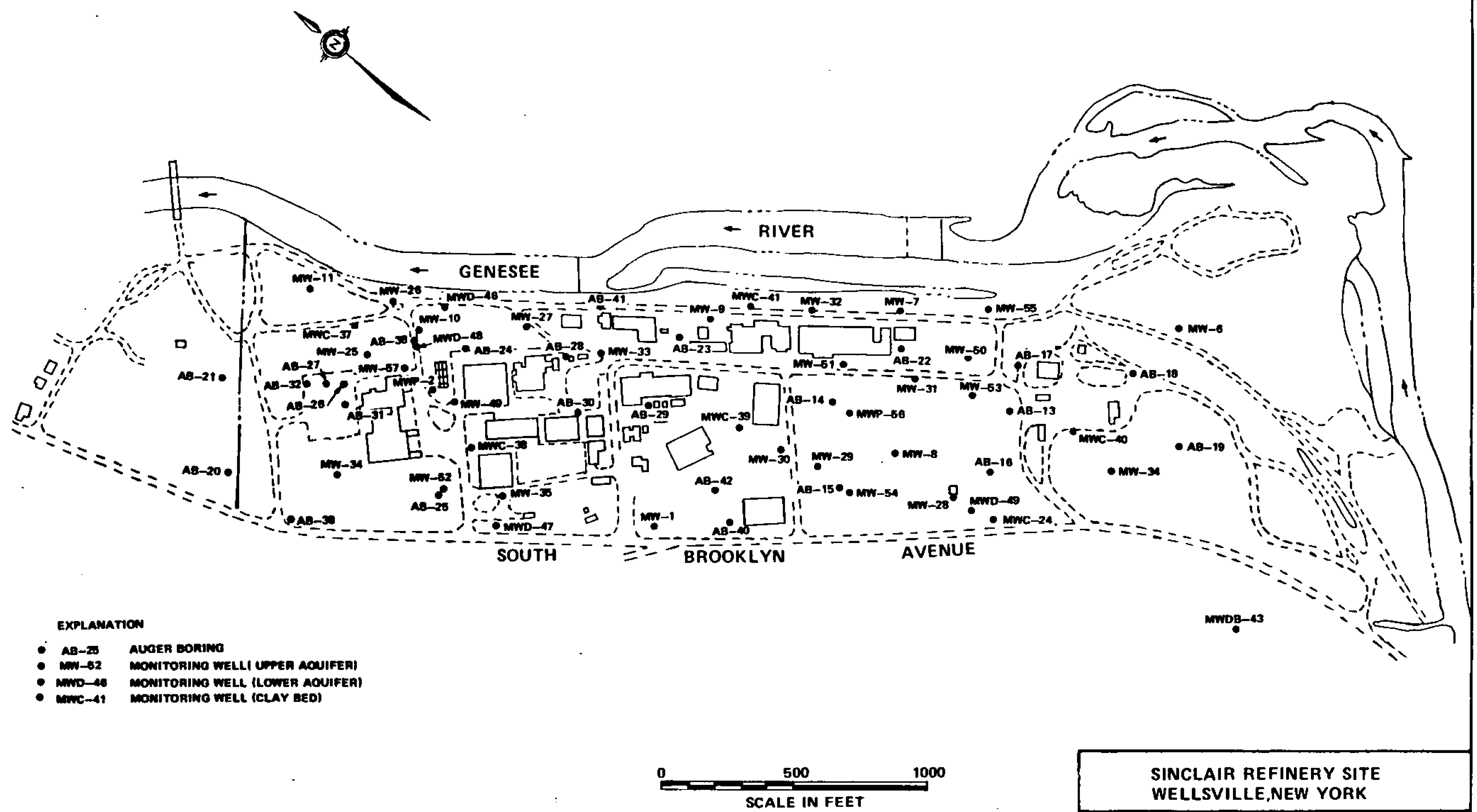
The unconsolidated deposits beneath the site are highly variable, comprised of sands, silts, clays, gravel and fill (SMC Martin, 1985). The fill material, is made up of silty sands, sandy clays and gravels. The fill is mixed, in places, with slag, concrete and construction debris. The fill is reportedly found within the central portion of the site. Thicknesses are highly variable, ranging from 0.5 to 8 feet. The fill was apparently emplaced in various locations on site for grading purposes. Fill appears to be absent in the northern and southern portions of the site.

The uppermost natural soils are fluvial in origin. These soils have been classified as sandy silts (ML), well-sorted and gravelly sands (SW), silty sands (SM) and sandy gravels (GW) (SMC Martin, 1985). Clay and gravel lenses, tens to hundreds of feet in horizontal extent, are associated with these deposits. A clay layer, approximately 5 feet thick, is found more consistently within the upper 10 feet of soils in the northwestern portion of the site. The variable distribution of soils observed on site (i.e., discontinuous lenses) is characteristic of the erosional and depositional processes associated with the dynamics of a meandering river. In general, fluvial deposits range in thickness from 12 to 23 feet across the site.

Glacial sediments lie below the fluvial deposits. While the exact boundary between glacial and fluvial sediments is difficult to distinguish in the field, the top of a prominent clay bed believed to be a glacioloacustrine deposit, marks the lower boundary of the fluvial sediments. In general, the contact of the clay is found at depths between 12 and 23 feet across the site. The clay bed varies between a high plasticity clay (CH) and a sandy or silty, low plasticity clay (CL) (SMC Martin, 1985). Thickness of the clay appears to vary, but is known only at a few locations across the site as few borings have penetrated its entire thickness. Borings which penetrated the entire thickness of clay are deep monitoring well borings (MWD-42, 47 and 49) shown in Figure 3-1. The five other deep wells (MWD-43, 44, 45, 46 and 48) were completed in the clay layer. Fifty feet of clay was encountered during the drilling of MWD-49, located in the southwestern portion of the site, along South Brooklyn Avenue (see Figure 2-2). MWD-49 encountered gravel, sand and silt below the clay. MWD-46 and MW-10, located downgradient of the northern oil separator, encountered more than 100 feet and 56 feet of clay, respectively (SMC Martin, 1986). These two borings were terminated before the entire thickness of the clay unit was determined.

In the northwestern portion of the site, the upper contact of clay appears to be at much greater depths. AB-25 was drilled to a depth of 50 feet without encountering any clay. MWD-47, just southwest of AB-25, encountered relatively thin (10 and 15 foot) clay beds at depths of 75 and 100 feet, respectively. Just east of MWD-47, however, MW-35 encountered over 10 feet of clay at a depth of 16 feet. A general decrease in grain size towards the surface in soils at AB-25 and MWD-47, as well as the abrupt change in elevation of the upper contact of the clay bed between MWD-47 and MW-35, suggests the presence of an ancient river channel in this portion of the site. While the clay bed appears to be deeply incised in this area, the presence of a relatively thin clay unit at great depth (75 feet) in MWD-47 suggests that the clay bed is not completely breeched.

Borings drilled to bedrock during the remedial investigation are limited to the Off-Site Tank Farm located northwest of the Refinery Area. In these borings, bedrock was encountered between 9 and 27 feet. A seismic profiling survey conducted during Phase I of the RI indicates that bedrock below the site dips steeply (an apparent dip of 14°) to the east. Depth to bedrock (Figure 3-2), ranges from approximately 70 feet below South Brooklyn Avenue to more than 250 feet below the Genesee River (SMC Martin, 1985). Regional information suggests that the bedrock is comprised of sandstones, conglomerates and shales of Devonian age.

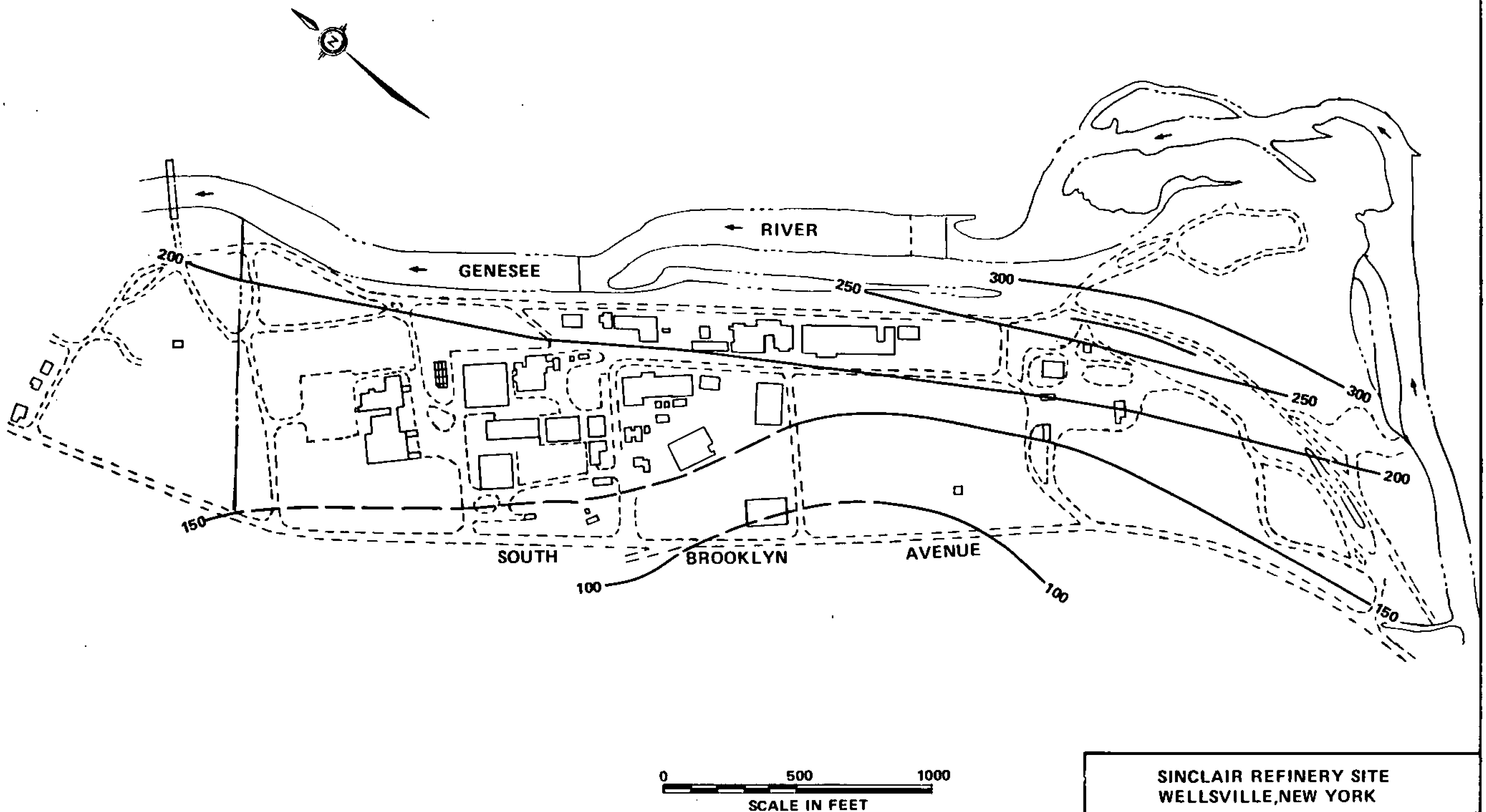


SINCLAIR REFINERY SITE
WELLSVILLE, NEW YORK

FIGURE 3-1
REFINERY AREA
MONITORING WELL AND AUGER BORING
LOCATIONS PHASE I AND PHASE II
REMEDIAL INVESTIGATION

EBASCO SERVICES INCORPORATED

ADAPTED FROM SMC MARTIN PHASE I SITE MAP



EXPLANATION

—150— DEPTH TO BEDROCK IN FEET

SOURCE:SMC MARTIN PHASE I RI (1985)

SINCLAIR REFINERY SITE
WELLSVILLE,NEW YORK

FIGURE 3–2

DEPTH–TO–BEDROCK AS INTERPRETED BY THE SEISMIC GEOPHYSICAL STUDY CONDUCTED BY SMC MARTIN

EBASCO SERVICES INCORPORATED

3.1.3 Site Hydrology

3.1.3.1 Refinery Area

During Phase I and Phase II of the Remedial Investigation, 57 monitoring wells were installed at the Sinclair Refinery Site (Figure 3-1). Site-specific hydrologic information presented below is based on data collected from these wells during this investigation by SMC Martin (SMC Martin, 1985, SMC Martin, 1987).

Strong correlations between river levels and water table elevations observed during field investigations suggests that the hydrology beneath the Sinclair Refinery Site is generally controlled by the Genesee River.

The hydrologic units beneath the site include an upper aquifer made up of shallow fluvial sediments. This aquifer is underlain by a significant confining layer (aquitard) comprised of the glaciolacustrine clay and one or more aquifers at depth. It is unclear at this time whether the glacial sediments below the clay comprise one or more hydrologic units because there has been limited deep investigation at the site.

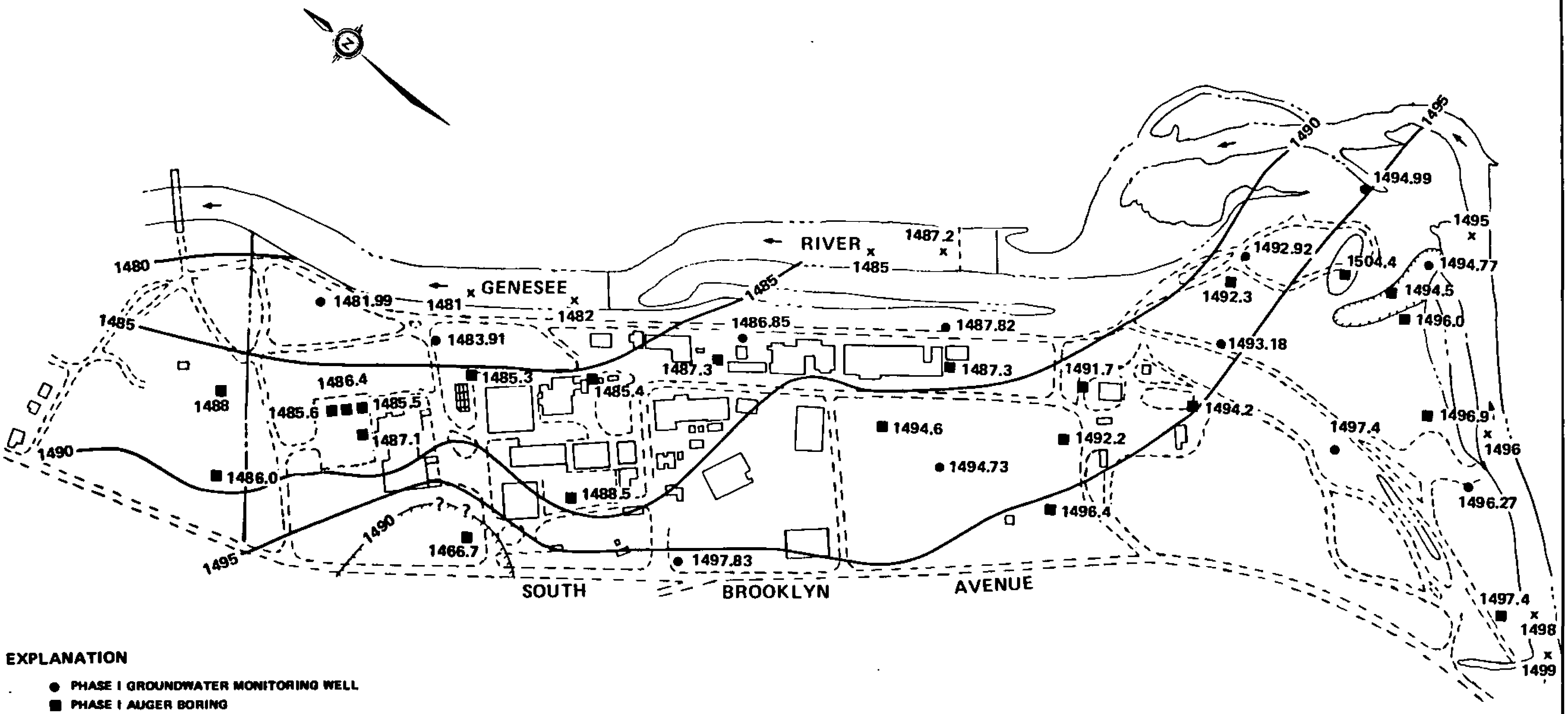
The upper aquifer is comprised of sands, silts, clays and gravels (see Section 3.1.2). It is an unconfined (water table) aquifer with reported water table elevations ranging from 3 to 10 feet below the ground surface (SMC Martin, 1985). Maximum water table fluctuations measured within a 3 1/2 month period (spring and summer of 1984) range from 0.40 to 2.72 feet. Because the largest fluctuations were observed in wells closest to the Genesee River, the Genesee appears to be a significant hydrologic boundary.

The top of clay defines the lower boundary of the upper aquifer. As previously discussed, this boundary is generally 12-23 feet below the surface. The saturated thickness of the upper aquifer generally ranges from 5 to 13 feet. In the northwest portion of the site, however, the deeply incised, buried river channel results in an aquifer thickness of more than 75 feet. SMC Martin (1985) notes that the water table may be depressed in this area as water levels in an open borehole (AB-25) were measured at 28.8 feet below the surface. Water table measurements from all the monitoring wells in this area are not available at this time.

Figure 3-3 presents a potentiometric surface map of the upper aquifer generated by SMC Martin from water level measurements taken during the Phase I investigation (11 monitoring wells and 23 auger boreholes). In general, groundwater contours are subparallel to the river indicating that groundwater flow is towards the river. Undulations in groundwater contours suggests the possibility of localized disturbances to this groundwater flow pattern. These localized disturbances may be caused by subsurface sewers and pipelines and/or the variable stratigraphy of the upper aquifer. The presence of seeps entering the main swale west of the river channel indicates that groundwater flow may be influenced by buried channels locally.

Gradients in the upper aquifer are relatively flat. Phase I observations indicate a general gradient of 0.013 ft/ft across the site. Additional wells installed during Phase II yield more detailed data on groundwater flow. Phase II draft documents (SMC Martin, 1987) report gradients of 0.0122 ft/ft and 0.0085 ft/ft across the northwest and southern portions of the site, respectively. A steeper gradient in the northwest portion of the site is thought to be due to a greater percentage of silts and clays in these soils. In general, water from the upper aquifer discharges to the Genesee River. However, a gradient reversal was reported by SMC Martin (1987) during a rise in river levels caused by a major storm event which occurred during the Phase II investigation.

Data on vertical flow gradients across the confining clay bed are limited because of the small number of wells at the site which are screened in the lower aquifer. Well MWD-49, in the southern portion of the site, is clearly screened in the lower aquifer. Water levels in MWD-49 are reported to be 3 to 6 feet higher than levels in nearby upper aquifer wells. This indicates that there is a significant upward vertical gradient across the confining layer in this portion of the site. These results are consistent with the interpretation that the river is a significant discharge boundary. Water levels



EXPLANATION

- ● PHASE I GROUNDWATER MONITORING WELL
- ■ PHASE I AUGER BORING
- x SPOT ELEVATION,RIVER BED , FEET ,msl .
- —1480— INTERPRETED GROUNDWATER ELEV.,FEET,msl

NOTES

1) WATER LEVELS OBTAINED IN MONITORING WELLS ON MAY 9,1984
2) WATER LEVELS WERE MEASURED IN AUGER BORINGS UPON COMPLETION OF THE SAMPLE BORING. IN SOME CASES, GROUNDWATER LEVELS MAY NOT HAVE REACHED EQUILIBRIUM AT THE TIME THE WATER LEVEL WAS MEASURED THEREFORE,INTERPRETION IS BASED PRIMARILY ON WATER LEVELS OBSERVED IN THE MONITORING WELLS. WATER LEVEL ELEVATIONS FROM THE AUGER BORINGS USED IN INTERPRETATION ARE ALSO SHOWN.

0 500 1000
SCALE IN FEET

SINCLAIR REFINERY SITE
WELLSVILLE,NEW YORK

FIGURE 3–3

WATER LEVEL ELEVATION MAP

EBASCO SERVICES INCORPORATED

SOURCE:SMC MARTIN PHASE I RI (1985)

measured in MWD-47 were not significantly different from nearby upper aquifer wells. However, well construction data does not clearly indicate that this well is discretely screened below the clay bed.

Assuming a minimum thickness of 50 feet for the clay bed and a head differential of 6 feet, as measured at MWD-49, the vertical gradient across the confining layer is 0.12 ft/ft. Because clays in the confining layer have extremely low hydraulic conductivities, flow across this confining layer is not expected to be significant.

Both in-situ permeability (slug) and pumping tests were conducted in the upper aquifer during the Phase I and II Remedial Investigation. Hydraulic conductivity values ranging from 5.3 to 87.6 ft/day (1.87×10^{-3} to 3.09×10^{-2} cm/sec) were calculated from slug test data in the refinery area (SMC Martin 1985; SMC Martin 1987). This range of hydraulic conductivities can be explained by the heterogeneity of upper aquifer soils as observed during the soil investigation. Phase I data yielded an average estimated groundwater flow velocity of 0.75 ft/day (2.65×10^{-4} cm/sec) across the refinery site. Velocities appear to be lower in the central portion of the site and higher adjacent to the river. SMC Martin (1985) estimated that it would take approximately 2.4 years for groundwater to flow from South Brooklyn Avenue to the Genesee River.

Pumping tests were conducted in the southern portion of the site at MWP-56 and in the northern portion, at MWP-57. The difference in optimum pumping rate (10 gpm for MWP-57 and 50 gpm for MWP-56) and resulting cones of depression (narrow and steep for MWP-57; shallow and broad for MWP-56) at the two pumping wells further emphasizes the heterogeneity of the upper aquifer. These differences correlate with the greater abundance of clays and silts in the northwest portion of the site (SMC Martin, 1987).

Use of the Boulton method for analysis of time-drawdown curves by SMC Martin (1987) yield transmissivity and hydraulic conductivity values for the upper aquifer ranging from 60 to 2074 ft^2/day and 5 to 122 ft/day (1.76×10^{-3} to 4.3×10^{-2} cm/sec), respectively. Specific yield values range from 0.0186 to 0.067. In general, SMC Martin found higher transmissivities and hydraulic conductivities in the vicinity of MWP-56 (to the south).

A more detailed analysis of pumping test data by Ebasco (1988) revealed differences in early and late pumping test results. This suggests that the interpretation of the pumping tests may represent an oversimplified view of the upper aquifer. In general, an increase in drawdown was observed during the latter part of each pumping test. Such a pattern may be interpreted to represent aquifer heterogeneity with an area of high transmissivity close to the pumping well and low transmissivity further away. However, the range of hydraulic conductivities was similar to those calculated by SMC Martin.

Infiltration tests performed during the Phase II investigation indicate that cover materials at the site possess a wide range of permeabilities. Average rates range from 6.12"/hr to 0.14"/hr (SMC Martin, 1987). Silty sands mixed with small amounts of gravel, found in the southeast portion of the site showed the highest infiltration rates. Organic-rich silty loam in the vicinity of the main oil separator had the next highest rates (1.9"/hr). In general, infiltration appears to be high in well-sorted sands prevalent in the southern portion of the site, and low in poorly sorted sediments found to the north.

3.1.3.2 Landfill Area

Groundwater flow beneath the landfill area appears to be influenced significantly by local topography and the varied nature and thickness of waste materials which have been landfilled (SMC Martin, 1985). In general, local groundwater gradients in the landfill may be twice that encountered in the refinery area.

The landfill is divided into two main areas, the central elevated landfill area (CELA) and the south landfill area (SLA). The CELA and SLA are separated by a one-acre area previously used as a borrow pit.

Groundwater flow in the SLA is believed to be to the north and east, toward the Genesee River. This is based on limited water level measurements taken during the Phase I remedial investigation. Although additional monitoring wells were installed in this area during the Phase II investigation, water level elevation data from these wells is not available at this time.

In the CELA, varied local topography results in a more complex groundwater flow pattern with both groundwater mounds and depressions mapped under the landfill (Figure 3-3). Water level measurements taken during the Phase I investigation suggest that groundwater flows from topographic highs to the north and south, into this topographic low. SMC Martin (1985) noted that groundwater in this area probably discharges to the nearby dike pool to the southeast. Flow in the northern portion of CELA appears to be to the north and east toward the river and main drainage swale.

In situ permeability (slug) tests at the landfill area estimated upper aquifer hydraulic conductivities ranging from 30.3 to 124 ft/day (1.07×10^{-2} to 4.37×10^{-2} cm/sec) (SMC Martin, 1985). Where local gradients could be determined, flow velocities have been estimated at a range of 0.5 to 1.75 ft/day. SMC Martin (1985) estimated that it would take approximately 1.2 years for groundwater to flow from the central portion of the aquifer beneath the landfill to the river.

3.1.4 Climate

The State of New York is divided into ten separate reporting divisions based on the National Oceanic and Atmospheric Administration's (NOAA) annual climatological data summaries. The Village of Wellsville lies in the center of the Western Plateau division. Climatological data for this division regarding average annual temperature has been compiled from 1957 through 1984 (CDM, 1983).

Climatological data regarding average annual precipitation has also been compiled specifically for the Village of Wellsville, from 1957 through 1984. The average annual temperature was 43.3° Fahrenheit during this period, with a minimum average annual temperature of 43.2°F in 1978 and a maximum average annual temperature of 47°F in 1959 (CDM, 1983). The average annual precipitation for the Village of Wellsville during the same period was 33.1 inches. The minimum annual precipitation was 26.4 inches in 1971 and the maximum annual precipitation was 50.1 inches in the following year, 1972 (CDM, 1983).

3.1.5 Population and Environmental Resources

The growth in population for the Village of Wellsville, New York has been estimated as negligible. The NYSDEC Bureau of Water Quality Management (NYSDEC 1985) predictions show zero to negative growth in the current population of 5,700 persons. The local population uses the refinery area and the Genesee River as a recreational and economic resource. The Village uses the river as its source of drinking water and has its intake pipe approximately 1/4 mile upstream of the refinery site.

3.1.6 General Sampling Techniques and Analyses

As a result of a data review, several data needs have been identified. One of the most significant needs results from the soil sampling technique employed. The technique of compositing of samples necessarily generates an average concentration. This technique, covering large sampling areas, facilitates identification of potential contaminants of concern. However, it does not allow an accurate evaluation of the areal extent of contamination and spatial variations in contaminant concentrations. Much of the sampling described in Section 5 of this Work Plan is focused on better delineation of potentially contaminated areas.

Ebasco has reviewed selected Phase II data packages utilizing current EPA data validation procedures described in EPA's 1986 Contract Laboratory Protocol, Standard Operating Procedures (SOP), HW-2 and HW-4. Several problems were identified in the existing data base. The main problems encountered were low matrix spike recoveries, poor duplication of individual sample results, poor recoveries for inorganics parameters, failure to meet initial calibration criteria, and critical information missing from data packages.

Ebasco has contacted NYSDEC to request the missing data. In general, data will be assumed valid unless otherwise demonstrated.

The following section summarizes the existing chemical data available regarding the site. The refinery area, off-site tank farm (OSTF) and landfill area (groundwater only) are discussed here. Landfill soils are not included in the investigation because an RI/FS and ROD for the landfill portion of the site have been completed.

3.1.7 General Chemical Characteristics

A large range of inorganic and organic compounds was detected in site soil and groundwater. Tables 3-1 to 3-10 contain the summarized results from these investigations. (The non-priority pollutant compounds detected are included in Appendix B.) Background levels were determined from upgradient off-site soil, river and groundwater sampling locations. These data are included in the tables as well. The typical range of background levels for metals (inorganics) in alluvial soils and all soils in the U.S. is also presented in the tables where appropriate. In general, site background samples contain no priority organics and have low levels of metals when compared to typical U.S. soils (Bowen, 1979; Kabata-Pendios and Pendios, 1984).

Metals are found in all site matrices. Concentrations of most metals detected are close to site background levels (usually within a factor of 2). In addition, most mean on-site soil concentrations fall within the range of alluvial soils in the U.S. However, lead was detected at elevated levels in surface soils relative to background concentrations.

Organic compounds were also found in all matrices. Organic compound distributions in site soils and groundwater show similar patterns, although maximum concentration locations are spatially offset. Figures 3-4 through 3-7 show the distribution of benzene, cyclohexane, and methyl cyclohexane. The most frequent locations of organic compound maxima coincide with the locations of the two oil separators. Many organic compounds are detected only once or twice in a given matrix, but at significant concentrations (100's of ppb)

TABLE 3-1

Refinery Monitoring Well Groundwater
Total Wells 25

Compound[k]	Refinery Ground Water: Range (ppb)	Refinery Ground Water: Frequency[a]	Refinery Ground Water: Geometric Mean (ppb)	Background Wells (4 Samples) (ppb)	Federal and NYS* MCLs[b] (ppb)	NYS Class GA Groundwater Stds (ppb)	Clean Water Act WQC[c] (ppb)
Metals							
Arsenic[i]	ND - 110	22/25	13.95	ND	50	25	0 (0.025)[f]
Cadmium	ND - 7	1/25		ND	10	10	10
Chromium[j]	ND - 18	4/25		ND	0.50 (+6)*	50 (+6)	50
Copper	ND - 133	6/25		ND		1000	1000 (organoleptic)[g]
Lead	ND - 76.6	3/25		ND	50	25	50
Nickel	ND - 53	7/25	6.77	ND			15.4
Selenium	ND - 43	2/25		ND-21.5		20	10
Silver	ND - 26	4/25		ND		50	50
Zinc[d]	320 - 18,000	25/25	1970	245-7350		5000	5000 (organoleptic)
Priority VOCs							
4-Methyl-2-pentanone	ND - 3300	6/25		ND			
Benzene[l]	ND - 730	17/25	19	ND	5*	ND	0 (0.67)
2-Hexanone	ND - 860	3/25		ND			
Carbon disulfide	ND - 6	1/25		ND			
Total Xylenes	ND - 1311	14/25	17	ND	5*		
Chlorobenzene	ND - 11	3/25		ND			488
1,1 Dichloroethane	ND - 43.5	1/25		ND			
1,1 Dichloroethylene	ND - 5.5	1/25		ND			0 (0.033)
Trans-1,2-dichloroethylene	ND - 2600	1/25		ND			
Cis-1,3-dichloropropane	ND - 6.5	1/25		ND	5*		
Ethylbenzene	ND - 830	10/25	4.6	ND	5*		2400
1,1,2,2-Tetrachloroethane	ND - 6.5	1/25		ND			0 (0.88)
Toluene	ND - 56.5	9/25	2.5	ND	5*		15,000
Trichloroethylene	ND - 155	1/25		ND	5*	10	0 (2.8)
Vinyl Chloride	ND - 245	1/25		ND	2*	5	0 (2.0)
1,1,1-Trichloroethane	ND - 113.5	2/25		ND	5*		19,000
Priority BNAs							
Nitrobenzene	ND - 1700	2/25		ND			19,800
Isophorone	ND - 41	5/25		ND			5200
Naphthalene	ND - 170	8/25	1.5	ND			
2,4-Dimethyl phenol	ND - 16	1/25		ND		400 (organoleptic)	

TABLE 3-1 (Cont'd)

Refinery Monitoring Well Groundwater

Compound[k]	Refinery Ground Water: Range (ppb)	Refinery Ground Water: Frequency[a]	Refinery Ground Water: Geometric Mean (ppb)	Background Wells (4 Samples) (ppb)	Federal and NYS* MCLs[b] (ppb)	NYS Class GA Groundwater Stds (ppb)	Clean Water Act WQC[c] (ppb)
Priority BNAs (Cont'd)							
Phenol	ND - 33	2/25		ND		1[e]	3500
4-Chloroaniline	ND - 120	1/25		ND			
2-Methylnaphthalene	ND - 340	14/25	8.5	ND			
Di-n-octyl phthalate	ND - 41	2/25		ND			
Benzo(a)pyrene	ND - 13	6/25		ND		ND	
Fluorene	ND - 30	4/25		ND			
N-Nitrosodiphenyl-amine	ND - 108	3/25		ND			
Phenathrene	ND - 90	4/25		ND			
Pyrene	ND - 24	3/25		ND			
Other Priority							
Phenolics	0 - 42.7	11/25	3.2	11.9 - 18.3		1[e]	

a) Total number of samples where compound was detected over total number of samples collected, excluding duplicates.
b) Safe Water Drinking Act MCLs and NYS MCLs. NYS MCLs are provided where they are more stringent. In addition to all specific levels shown, all principal organic contaminants have a proposed MCL of 5 ppb.
c) Clean Water Act Water Quality Criteria Adjusted for Drinking Water Only. Fed Reg 45:79318-79379.
d) These values are not reliable due to the use of galvanized steel for well riser and screen.
e) The standard for total phenolics is 1 ppb.
f) The criterion for all carcinogens is 0; the concentration in the parentheses corresponds to a carcinogenic risk of 10^{-6}.
g) Criteria designated as organoleptic are based on odor and taste effects, not human health effects. Health based WQC are not available for these chemicals.
h) These are given when available.
i) The median for arsenic is 21.1 ppb. The median for benzene is 48 ppb.
j) Chromium standards are for Cr^{+6}. Test results are for total chromium.
k) Compounds are listed when the detected range exceeds practical quantifiable limits as defined by USEPA Contract Lab Program - Information for Bid-Statement of Work - Organic 8/87 and Inorganic 12/87.

ND - Not detected

Note: Geometric mean was calculated for compounds detected in 7 or more samples. Blank entries for government standards indicate no standard available.

TABLE 3-2

Landfill Groundwater
(10 Samples - Wells 2, 3, 4, 5, 6, 13, 16, 19, 20, 21)

Compound[g]	Landfill Groundwater Range (ppb)	Landfill Groundwater Frequency	Background Wells (4 Samples) (ppb)	Federal and NYS* MCLs[b] (ppb)	NYS Class GA Groundwater Standards (ppb)	Clean Water Act WQC[c] (ppb)
Metals						
Arsenic	ND - 30	4/10	ND	50	25	0 (0.025)[e]
Nickel	ND - 320	5/10	ND			15.4
Selenium	ND - 8	2/10	ND-21.5		20	10
Silver	ND - 40	2/10	ND		50	50
Zinc[d]	ND - 5510	9/10	245-7350		5000	5000 (organoleptic)[f]
Priority VOCs						
1,1,2,2-Tetrachloro-ethane	ND - 12	1/10	ND			
Chlorobenzene	ND - 12	1/10	ND			488
Trans-1,2,-dichloro-ethylene	ND - 14	1/10	ND			
1,1,1-Trichloroethane	ND - 17	1/10	ND	5*		19,000
Priority BNAs	Not Detected					
Bis(2-ethylhexyl)-phthalate	ND - 19	1/10	ND			
Phenanthrene	ND - 10	1/10	ND			
Other Priority						
Total Phenolics	ND - 16	2/10	11.9 - 18.3		1	

a) Total number of samples where compound was detected over total number of samples collected, excluding duplicates.
b) Safe Water Drinking Act MCLs and NYS MCLs. NYS MCLs are provided where they are more stringent. In addition to all specific levels shown, all principal organic contaminants have a proposed MCL of 5 ppb.
c) Clean Water Act Water Quality Criteria Adjusted for Drinking Water Only. Fed. Reg 45:79318-79379
d) These values are not reliable due to use of galvanized steel pfor well riser and screen.
e) The criteria for all carcinogens is 0; the concentration in the parentheses corresponds to a carcinogenic risk of 10^{-6}.
f) Criteria designated organoleptic are based on odor and taste effects, not human health effects. Health based WQC are not available for these chemicals.
g) Compounds are listed when the detected range exceeds practical quantifiable limits as defined by USEPA Contract Lab Program-Information for Bid-Statement of Work - Organic 8/87 and Inorganic 12/87.

ND - Not detected.

Note: Blank entries for government standards indicate no standard available.

TABLE 3-3

Deep Well Groundwater
(4 Samples MWD 46 - 49)

Compound[e]	Deep Well Groundwater Range (ppb)	Deep Well Groundwater Frequency[a]	Background Wells 4 Samples (ppb)	Federal and and NYS* MCLS[b] (ppb)	NYS Class GA Groundwater Standards (ppb)	Clean Water Act WQC[c] (ppb)
Priority VOCs						
Total Xylenes	ND - 1000	1/4	ND	5*		
Benzene	ND - 5.9[E]	1/4	ND	5*	ND	0 (0.67)[d]
Toluene	ND - 50	1/4	ND	5*		1500
Ethylbenzene	ND - 36	1/4	ND	5*		2400
Note: All VOC detects at MWD-47						
Priority BNAs						
4-Chloroaniline	ND - 28	1/4	ND			
Benzo(a)pyrene	ND - 10	1/4	ND			
2-Methylphthalene	ND - 33	2/4	ND	2		
Naphthalene	ND - 28	2/4	ND			
Other Priority						
Total Phenolics	ND - 22.6	1/4	11.9 - 18.3	1		

ND = Not detected

E = Estimated value

a) Total number of samples where compound was detected over total number of samples collected, excluding duplicates.
b) Safe Water Drinking Act MCLs and NYS MCLs. NYS MCLs are provided where they are more stringent. In addition to all specific levels shown, all principal organic contaminants have a proposed MCL of 5 ppb.
c) Clean Water Act Water Quality Criteria Adjusted for Drinking Water Only. Fed Reg 45:79318-79379.
d) The criterion for all carcinogens is 0; the concentration in the parentheses corresponds to a carcinogenic risk of 10^{-6}.

e) Compounds are listed when the detected range exceeds practical quantifiable limits as defined by USEPA Contract Lab Program - Information for Bid-Statement of Work - Organic 8/87 and Inorganic 12/87.

Note: Blank entries for government standards indicate no standard available.

TABLE 3-4

Surface Soil Composite Samples

Compound[e]	Range	Frequency[a]	Median[f]	Geometric Mean[f]	Background Surface Soils	US Background[b] Alluvial Soils	US Background[c] All Soils
Metals (ppm)							
Antimony	ND - 182.3	3/24			ND[d]		0.2 - 10 (1.0)
Arsenic	ND - 31	14/24	12	13	7.9-19	2.1 - 22 (8.2)	0.1 - 40 (6.0
Chromium	ND - 29.5	23/24	15	13.8	ND - 14	15 - 100 (55)	5 - 1500 (70)
Copper	7.5 - 52	24/24	13	15	ND - 12	5 - 50 (27)	2 - 250 (30)
Lead	ND - 1190	23/24	19	20	ND - 33.2	10 - 30 (18)	2 - 300 (35)
Nickel	9.1 - 49	24/24	20.1	21.7	14.6 - 33	7 - 50 (18)	2 - 750 (50)
Zinc	41 - 224	24/24	44	46	32 - 67	20 - 108 (59)	1 - 900 (90)
Priority VOCs (ppm)							
Methyl chloride	ND - 100	2/14			ND		
Priority BNAs (ppm)							
Pyrene	ND - 2.8	2/14			ND		
Phenanthrene	ND - 1.0	1/14			ND		
Fluoranthene	ND - 2.5	2/14			ND		
Benzo(k)fluoranthene	ND - 5.0	2/14			ND		
Benzo(a)pyrene	ND - 3.6	2/14			ND		
Benzo(a)anthracene	ND - 7.5	4/14			ND		
Other Priority (ppm)							
Cyanides	0.66 - 6.1	14/14	1.65	1.6	ND - 0.61		
Phenolics	ND - 2.9	10/14	1.0	0.98			

ND - Not Detected

a) Total number of samples where compound was detected over total number of samples collected, excluding duplicates.

b) A. Kabata - Pendios and H. Pendios, 1984, Trace Elements in Soils and Plants. CRC Press Inc, Boca Raton, Florida. The value in () is the mean value.

c) H.J.M. Bowen, 1979, Environmental Chemistry of the Elements.

d) Antimony was detected in off-site subsurface soil samples at ND to 162ppm, but not in offsite surface samples.

e) Compouns are listed when the detected range exceeds practical quantifiable limits as defined by USEPA Contract Lab Program - Information for Bid-Statement of Work - Organic 8/87 and Inorganic 12/87.

f) Mean and medians are calculated for those compounds detected in 7 or more samples.

TABLE 3-5

Subsurface Soil Composite Samples

Compound[e]	Monitoring Well Borings Range	Monitoring Well Borings Frequency[a]	Auger Borings Range	Auger Borings Frequency[a]	Background Well Soils	US Background[b,d] Alluvial Soils	US Background[c,d] All Soils
Metals (ppm)							
Antimony			ND - 134.5	1/25	ND - 162	0.25 - 0.6	0.2 - 10 (1.0)
Arsenic	2.1-5.5	14/14	ND - 88	23/25	ND - 9.6	2.1 - 22 (8.2)	0.1 - 40 (6.0)
Copper	5.9-18	14/14	ND - 227	23/25	8.9 - 20.3	5 - 50 (27)	2 - 250 (30)
Lead	7.5-44	14/14	3.2 - 791	25/25	14 - 57.7	10 - 30 (18)	2 - 300 (35)
Nickel	9.1-26	11/11	10 - 39	20/20	7.1 - 39.7	7 - 50 (18)	2 - 750 (50)
Silver	ND-1.5	7/14	ND - 30.7	1/25	ND - 0.6		0.01 - 8 (0.05)
Zinc	21.5-97	14/14	16.3 - 158	25/25	18.4 - 95.4	20 - 108 (59)	1 - 900 (90)
Priority VOCs (ppb)							
2-Hexanone	ND - 440	2/25	ND		ND		
Toluene	ND - 910	2/25	ND - 5	1/25	ND - 6		
2-Butanone	ND - 53	1/25	ND		ND		
Chlorobenzene	ND - 370	2/25	ND		ND		
Carbon Disulfide	ND - 160[E]	6/25	ND		ND		
Benzene	ND - 260[E]	6/25	ND - 1.9[E]	1/25	ND		
Methyl Chloride	ND - 120	1/25	ND		ND		
Ethyl benzene	ND - 1100	1/25	ND		ND		
1,1,2,2-Tetrachloroethane	ND - 76	2/25	ND - 2100	1/25	ND		
Total Xylenes	ND - 6100[E]	3/25	ND		ND		
4-Methyl-2-pentanone	ND - 1300	1/25	ND		ND		
Priority BNAs (ppb)							
Benzo(a)pyrene	ND - 530[E]	3/25					
N-Nitrosodiphenylamine	ND - 330[E]	1/25	ND - 250[E]	1/25	ND		
2-Methylnapthalene	ND - 930[E]	5/25	ND - 250[E]	1/25	ND		
Fluoranthene	ND - 1600	5/25	ND - 1.6	1/25	ND		
Fluorene	ND - 660[E]	4/25			ND		
Naphthalene	ND - 2400	5/25			ND		
Phenathrene	ND - 2200	6/25	ND - 102[E]	1/25	ND		
Pyrene	ND - 2600	3/25			ND - 180[E]		
Other Priority (ppm)							
Cyanide	ND - .67	5/25	ND - 0.66	1/25			
Phenolics	ND - 1.4	3/25	ND - 1.8	9/25			

a) Total number of samples where compound was detected over total number of samples collected, excluding duplicates
b) From A. Kabata-Pendios and H. Pendios, 1984, Trace Elements in Soils and Plants, CRC Press Boca Raton, Florida
c) From H.J.M. Bowen, 1979, Environmental Chemistry of the Elements.
d) The range and (mean) are listed.
e) Compounds are listed when the detected range exceeds practical quantifiable limits as defined by USEPA Contract Lab Program - Information for Bid-Statement of Work - Organic 8/87 and Inorganic 12/87.

ND - Not Detected

E - Estimated Value

8326b

TABLE 3-6

Genesee River and Drainage Swale

Compound	River Sediments[d] Range	River Sediments[d] Frequency[a]	Drainage Swale Sediments[d] Range	Drainage Swale Sediments[d] Frequency[a]
Metals (ppm)				
Arsenic	2.4 - 98.3	12/12	ND - 7.4	6/8
Cadmium	ND - 1.2	1/12	ND - 21.6	1/8
Chromium	ND - 22	9/12	ND - 34.2	6/8
Copper	4.6 - 188	12/12	1.1 - 147	8/8
Lead	ND - 43	11/12	ND - 802	7/8
Mercury	ND - 0.1	2/12	ND	
Nickel	0.9 - 357	12/12	ND - 272	2/8
Silver	ND - 12	8/12	.047 - .24	8/8
Zinc	6.8 - 1030	12/12	43.5 - 172	8/8
Priority VOC (ppb)				
Trans-1,2-dichloro-ethene	ND - 67	1/12	ND	
2-Butanone	ND - 216	3/12	ND - 74	5/8
Vinyl Acetate	ND - 9.4	2/12	ND	
1,1,2,2-Tetrachloro-ethene	ND - 95	1/12	ND - 31	1/8
1,2-Dichloropropene	ND - 7.2	1/12	ND	
Benzene	ND - 11	3/12	ND - 120	6/8
cis-1,3-Dichloro-propene	ND - 3.7E	1/12	ND	
2-Hexanone	ND - 5.6	1/12	ND - 51	1/8
Toluene	ND - 5.6	2/12	ND - 4.7E	2/8
Chlorobenzene	ND - 58	1/12	ND - 31	1/8
Ethylbenzene	ND - 6.7	1/12	ND	
Total Xylenes	ND - 71	2/12	ND	
Carbon disulfide	ND - 68	3/8	ND	
Chlorethane	ND - 23	1/8	ND	
Priority BNAs (ppb)				
Dimethyl phthalate	ND - 480E	1/12	ND	
Diethyl phthalate	ND - 550E	2/12	65E - 1000	8/8
Phenanthrene	ND - 53	2/12	ND - 630E	4/8
Fluoranthene	ND - 130E	2/12	ND - 1200	5/8
Pyrene	ND - 88E	2/12	ND - 990	5/8

Sediments[e]

US Background Alluvial Soils	US Background All Soils[c]
2.1 - 22 (8.2)	0.1 - 40 (6.0)
	.01 - 2 (0.35)
15 - 100 (55)	5 - 1500 (70)
5 - 50 (27)	2 - 250 (30)
10 - 30 (18)	2 - 300 (35)
.02 - .15 (.05)	0.01 - 0.5 (0.06)
7 - 50 (19)	2 - 750 (50)
	0.01 - 8 (0.05)
20 - 108 (58.5)	1 - 900 (90)

TABLE 3-6 (Cont'd)

Genesee River and Drainage Swale Soils and Sediments

Compound	River Sediments Range	River Sediments Frequency[a]	Drainge Swale Sediments Range	Drainge Swale Sediments Frequency[a]	US Background Alluvial Soils	US Background All Soils[c]
Priority BNAs (Cont'd)						
Chrysene	ND - 47E	1/12	ND - 520E	4/8		
Benzo(k)fluoranthene	360E - 780E	4/12	ND - 590	6/8		
Benzo(a)Anthracene	ND - 330	4/8	ND			
Benzo(a)pyrene	ND - 860	3/8	ND			
Other Priority (ppb)						
Cyanide	ND - 146	9/12	.03 - .25	8/8		
Phenolics	ND - 1.9	2/12	ND			

a) Total number of samples where compound was detected over total number of samples collected, excluding duplicates.
b) A. Kabata-Pendios and H. Pendios, 1984, Trace Elements in Soils and Plants, CRC Press, Inc. Boca Raton, FL.
c) H.J.M. Bowen, 1979, Environmental Chemistry of the Elements.
d) No Background samples were taken.
e) Compounds are listed when the detected range exceeds practical quantifiable limits as defined by USEPA Contract Lab Program-Information for Bid-Statement of Work - Organic 8/87 and Inorganic 12/87.

ND - Not Detected
E - Estimated value

TABLE 3-7
Genesee River And Drainage Swale Water Samples

Compound[h]	Genesee River Range (ppb)	Genesee River Frequency[a]	Drainage Swale Range (ppb)	Drainage Swale Frequency[a]	Upstream River Water Samples (ppb)	Federal & NYS* MCLs[b] (ppb)	NYS Class GA Groundwater Samples (ppb)	Clean Water Act WQC[c] (ppb)
Metals								
Arsenic	ND - 89	2/26	ND		ND	50	25	0(0.025)[e]
Copper	ND - 55	7/26	ND - 48	2/3	ND		1000	1000 (organoleptic)[f]
Lead	ND - 51.5	4/26	58.3 - 155	3/3	ND-14	50	25	50
Mercury	ND - 2.2	2/26	ND		ND	2	2	10
Nickel	ND - 1316[g]	8/26	244 - 1622[g]	3/3	ND-460[g]			15.4
Zinc	ND - 81	11/26	121 - 330	3/3	ND-39		5000	5000 (organoleptic)
Priority VOCs								
Benzene	ND - 4.1^{E}	1/26	ND - 1.3^{E}	2/3	ND	5*	ND	0 (0.67)
2-Butanone	ND - 13	2/26	6.7^{E}-7.2^{E}	3/3	ND			
Chlorobenzene	ND - 10	2/26	ND		ND			488
Trans-1,2-Dichloro-ethene	ND - 28	5/26	ND		ND			
1,1,1-Trichloroethane	ND - 16	1/26	2.1^{E} - 370	3/3	ND	5*		19,000
Trichloroethene	ND - 13	1/26	ND		ND	5*	10	0 (2.8)
Priority BNAs								
2-Chlorophenol			ND - 92	1/3	ND		0.1 (organoleptic)	
4-Chloro-3-methylphenol			ND - 67	1/3	ND			
2,6-Dinitrotoluene			ND - 30.2	1/3	ND			
Pentachlorophenol			ND - 89	1/3	ND		21	1010
Butylbenzylphthalate	ND - 5^{E}	3/26	2.6^{E} - 47	3/3	ND			
Di-n-octyl phthalate			6.3^{E} - 15	3/3	ND			
Benzo(k)fluoranthene	ND - 10.2	1/26	ND - 11	1/3	ND			

a) Total number of samples where compound was detected over total number of samples collected , excluding duplicates.
b) Safe Water Drinking Act MCLs and NYS MCLs. NYS MCLs are provided where they are more stringent. In addition to all specific levels shown, all principal organic contaminants have a proposed MCL of 5 ppb.
c) Clean Water Act Water Quality Criteria Adjusted for Drinking Water Only.
d) The standard for total phenolics is 1 ppb
e) The criteria for all carcinogens is 0, the concentration in the parenthesis corresponds to a carcinogenic risk of 10^{-6}.
f) Criteria designated as organoleptic are based on odor and taste effects, not human health effects. Health based WQC are not available for these chemicals.
g) See text for explanation of these values.
h) Compounds are listed when the detected range exceeds practical quantifiable limits as defined by USEPA Contract Lab Program-Information for Bid-Statement of Work - Organic 8/87 and Inorganic 12/87.

TABLE 3-8

Seep and Outfall Sediment Samples

Compound[d]	Outfall Range	Outfall Frequency[a]	Seeps Range	Seeps Frequency[a]	Background Surface Soil	U.S. Background[b] Alluvial Soils	U.S. Background[c] All Soils
Metals (ppm)							
Arsenic	17-52	5/5	13-572	4/4	ND	2.1-22 (8.2)	0.1-40 (6.0)
Chromium	9.4-96	5/5	7.3-33	4/4	ND-11.4	15-100 (55)	1-1500 (70)
Copper	15-71	5/5	11-37	4/4	ND-59	5-50 (27)	2-250 (30)
Lead	37-666	5/5	21-116	4/4	ND-33.2	10-30 (18)	2-300 (35)
Mercury	ND-1.6	4/5	ND		ND	0.02-0.15 (0.05)	0.01-0.5 (0.06)
Nickel	24-46	5/5	5-74	4/4	14.6-21.7	7-50 (19)	2-750 (50)
Zinc	94-745	5/5	43-165	4/4	32-53.3	20-108 (59)	1-900 (90)
Priority VOCs (ppb)							
Toluene	ND-960	1/5	ND		ND		
Priority BNAs (ppb)							
Benzo(a) anthracene	ND		ND-1100	1/4			
Phenol	ND-7300	1/5	ND				
Other Priority (ppm)							
Cyanide	ND-6.7	4/5	<1-2.7	4/4	ND-0.61		
Phenolics	1.2-10	5/5	<1-16	4/4	ND		

ND = Not Detected

a Total number of samples where compound was detected over total samples collected, excluding duplicates.

b A. Kabata - Pendios and H. Pendios, 1984, Trace Elements in Soils and Plants. CRC Press Inc. Boca Raton, Florida. The value in ( ) is the mean value.

c HJM Bowen, 1979, Environmental Chemistry of the Elements.

d Compounds are listed when the detected range exceeds practical quantifiable limits as defined by USEPA Contract Lab Program - Information for Bid-Statement of Work - Organic 8/87 and Inorganic 12/87.

TABLE 3-9

Seep and Outfall Water Samples

Compound[e]	Outfalls Range	Outfalls Frequency[a]	Seeps Range	Seeps Frequency[a]	Upstream Water Non-Genesee	Federal and NYS* MCLs[b]	Clean Water Act WQC[c]
Metals (ppb)							
Arsenic	ND-13	2/3	ND-31	4/5	ND	50	0 (.025)d
Cadmium	ND-8	1/3	ND		ND	10	10
Chromium	ND-11	2/3	ND-11	1/5	ND-11	.50 (+6)	50
Copper	ND-16	2/3	ND-31	2/5	ND	1000	1000
Lead	ND-41	2/3	ND-27	3/5	ND-40	50	50
Nickel	ND-21	1/3	ND-630	2/5	ND		15.4
Zinc	ND-20	2/3	23-73	5/5	ND-87	5000	5000 (organoleptic)[f]
Priority VOCs (ppb)							
Ethylbenzene	ND-39	1/3	ND-200	1/5	ND	5*	2400
Benzene	ND		ND-120	1/5	ND-1.5	5*	0 (0.67)
Toluene	ND		ND-54	1/5	ND	5*	15,000
Priority BNA (ppb)							
Benzo(k)fluoranthene	ND		ND-10.2	1/5			

E - Estimated
ND - Not Detected

[a]Total number of samples where compound was detected over total samples collected, excluding duplicates.

[b]Safe Water Drinking Act MCLs and NYS MCLs. NYS MCLs are provided where they are more stringent. In addition to all specific levels shown, all principal organic contaminants have a proposed MCL of 5 ppb.

[c]Clean Water Act Water Quality Criteria Adjusted for Drinking Water Only Fed Reg 45:79318-79379.

[d]The criterion for all carcinogens is 0; the concentration in parentheses corresponds to a carcinogenic risk of 10^{-6}.

[e]Compounds are listed when the detected range exceeds practical quantifiable limits as defined by USEPA Contract Lab Program - Information for Bid-Statement of Work - Organic 8/87 and Inorganic 12/87.

[f]Criteria designated as organoleptic are based on odor and taste effects, not human health effects. Health based WQC are not available for these chemicals.

TABLE 3-10

Biota Survey

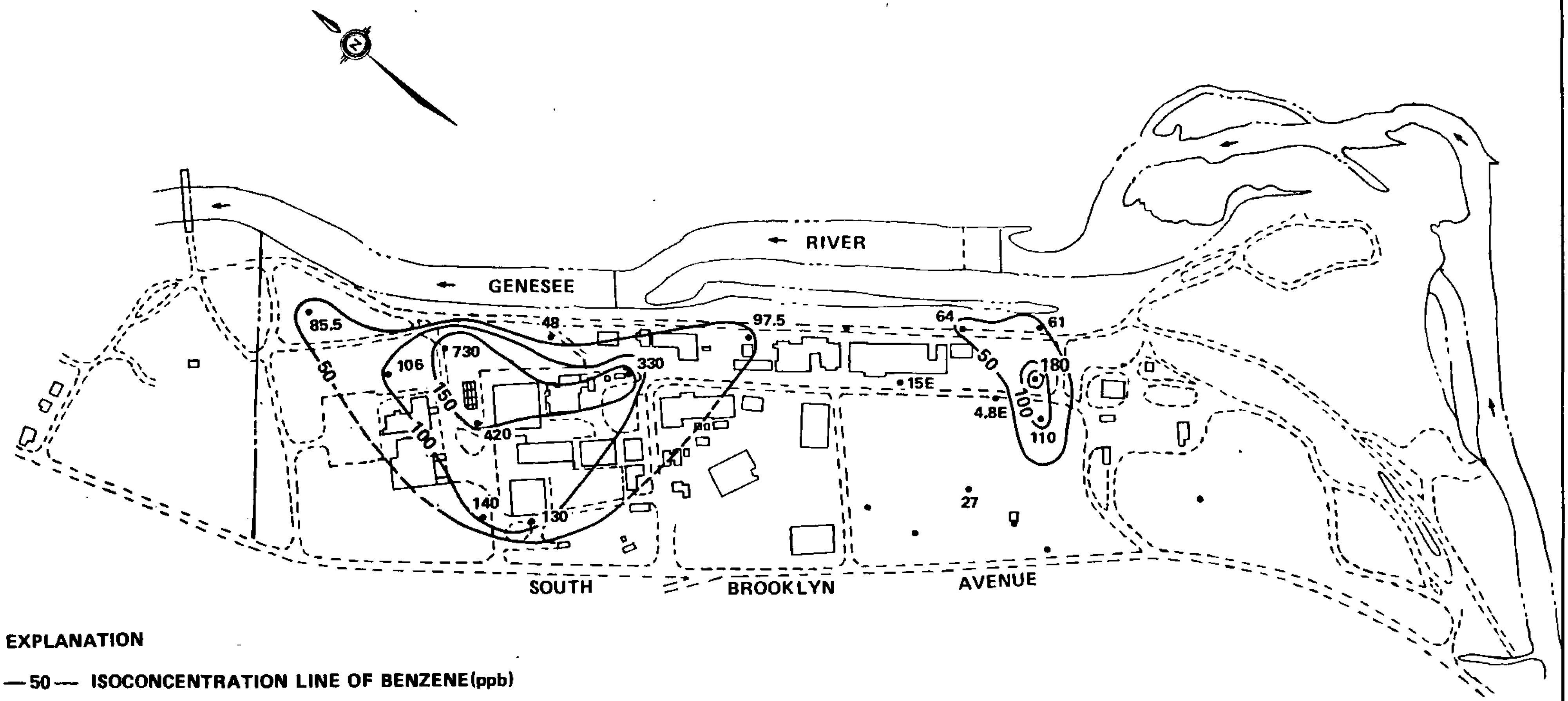
Nickel Concentration - Aquatic Biota
(ug nickel/g tissue)

Species	Location: Upstream	At-Site	Drainage Swale	Downstream
Crayfish	ND	.585	N/A	ND
Tadpole	1.70	3.11	1.40	4.88
Forage Fish	N/A	N/A	N/A	.123
Creek Chubs	.470	3.69	N/A	N/A
White Suckers	.900	6.17	N/A	.128
Sport Fish	ND	.461	N/A	1.05

Lead and Nickel Concentration - Terrestrial Biota
(ug nickel/g tissue)

Species/Location	Lead	Nickel
Meadow Voles/Off Site	ND	.466
Shorttail Shrews/On Site-Group I	.157	.452
Meadow Voles/On Site-Group I	.173	.787
Shorttail Shrews/On Site-Group II	.259	.212
Meadow Voles/On Site-Group II	.176	.470

N/A = No test data available for samples
ND = Not Detected



EXPLANATION

—50— ISOCONCENTRATION LINE OF BENZENE(ppb)

• 85.5 MONITORING WELL AND CONCENTRATION OF BENZENE IN ppb POINTS WITHOUT NUMBERS INDICATE NONDETECT LEVELS

0 500 1000
SCALE IN FEET

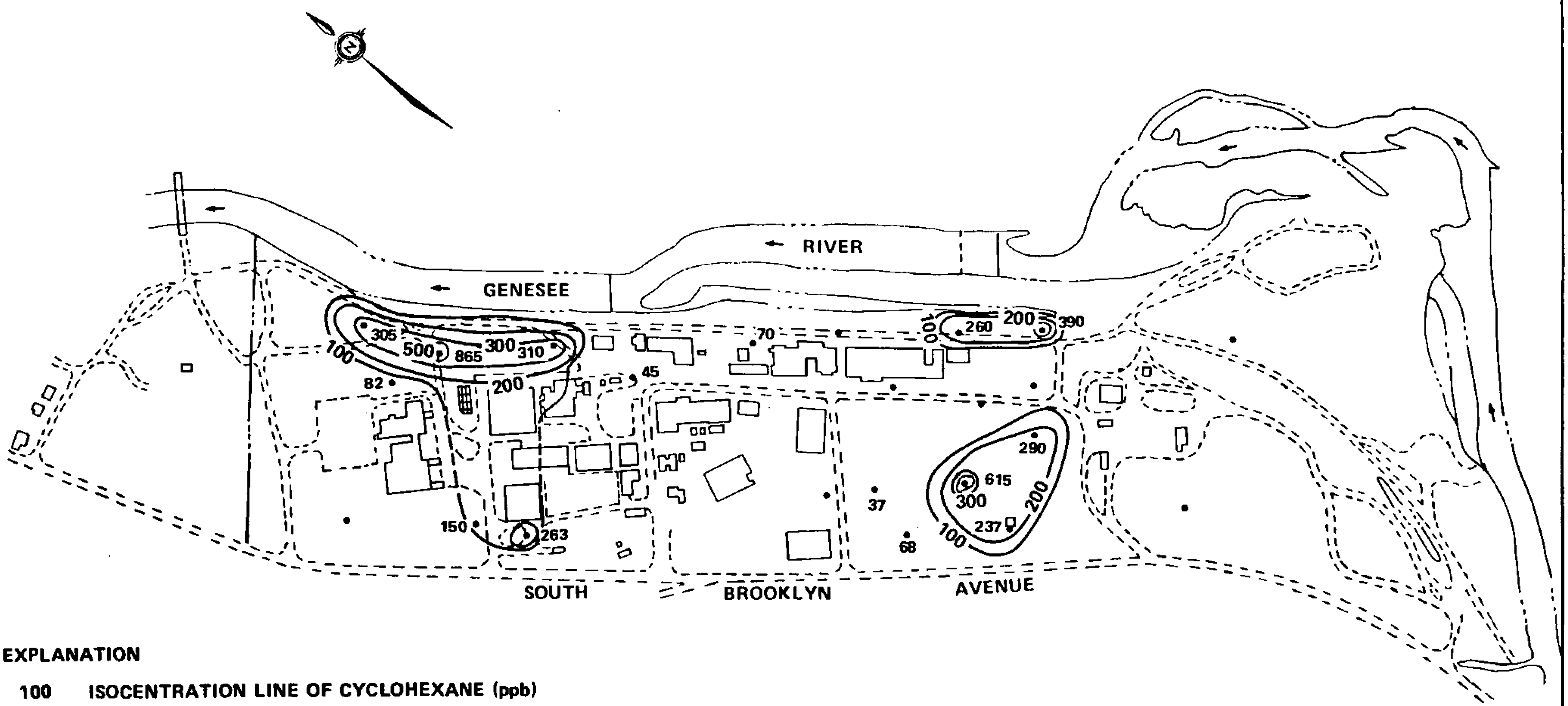
SINCLAIR REFINERY SITE
WELLSVILLE,NEW YORK

FIGURE 3–4

BENZENE LEVELS IN GROUNDWATER
(ppb)

EBASCO SERVICES INCORPORATED

ADAPTED FROM SMC MARTIN PHASE I SITE MAP



EXPLANATION

100 ISOCENTRATION LINE OF CYCLOHEXANE (ppb)

• 82 MONITORING WELL AND CONCENTRATION OF CYCLOHEXANE IN ppb POINTS WITHOUT NUMBERS INDICATE NONDETECT LEVELS

0 500 1000
SCALE IN FEET

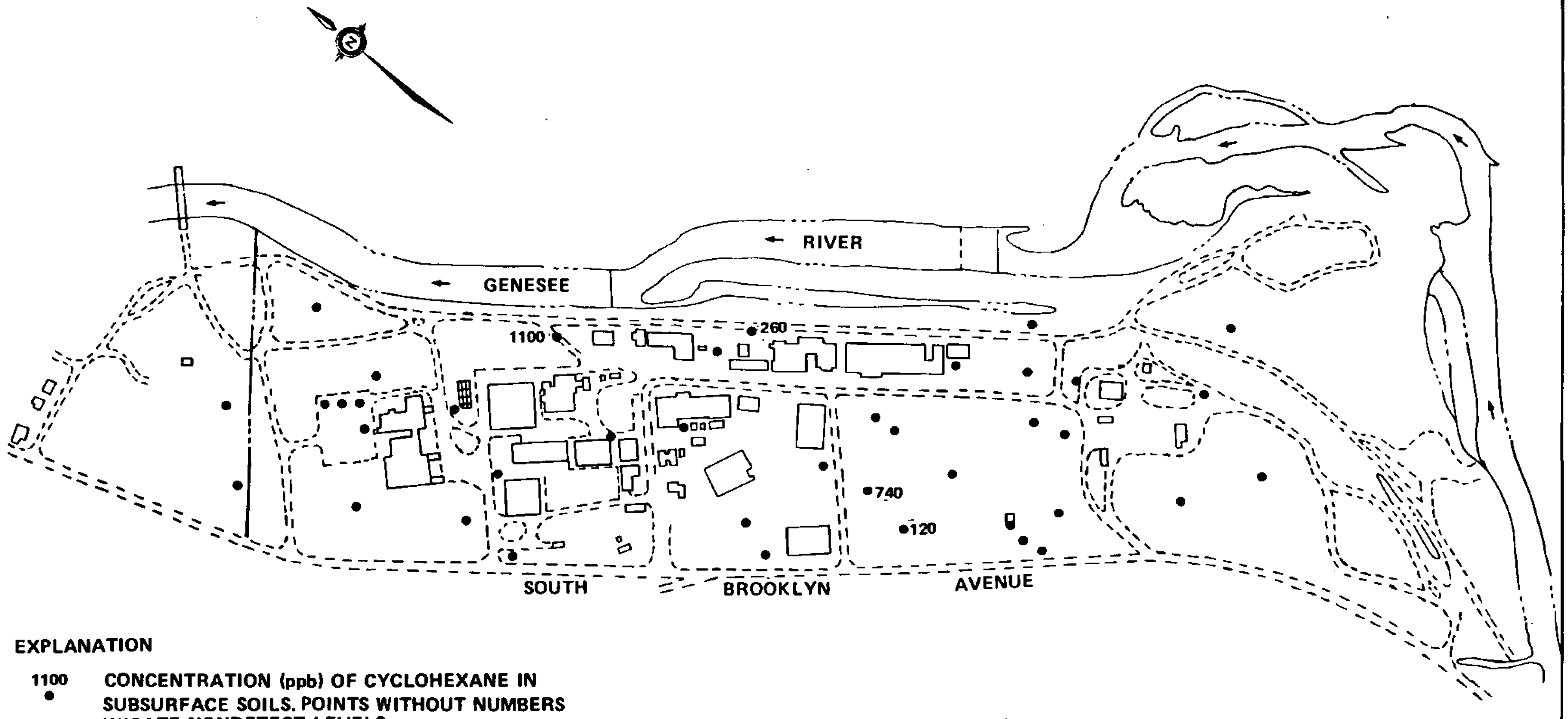
SINCLAIR REFINERY SITE
WELLSVILLE,NEW YORK

FIGURE 3–5

CYCLOHEXANE LEVELS IN GROUNDWATER (ppb)

EBASCO SERVICES INCORPORATED

ADAPTED FROM SMC MARTIN PHASE I SITE MAP



EXPLANATION

1100 • CONCENTRATION (ppb) OF CYCLOHEXANE IN SUBSURFACE SOILS. POINTS WITHOUT NUMBERS INICATE NONDETECT LEVELS

0 500 1000
SCALE IN FEET

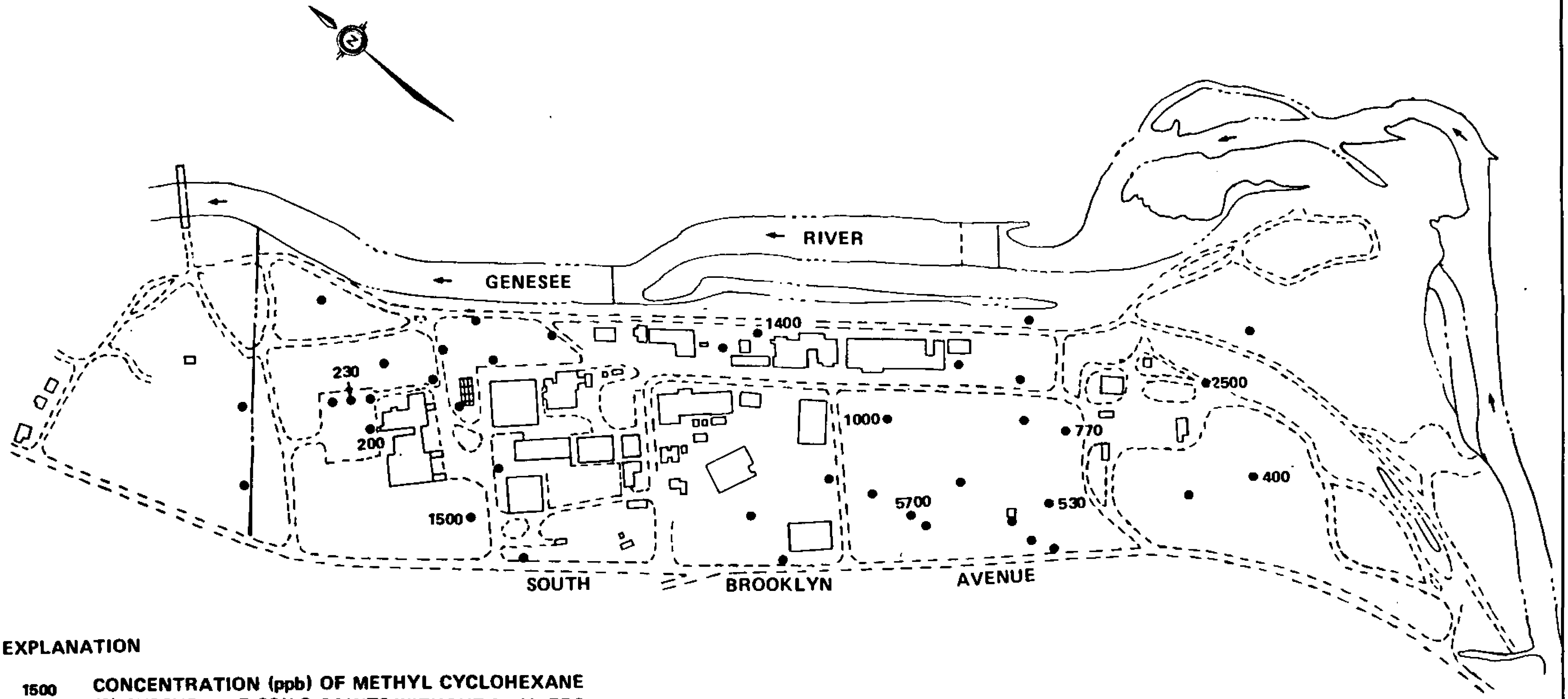
SINCLAIR REFINERY SITE
WELLSVILLE, NEW YORK

FIGURE 3–6

CYCLOHEXANE LEVELS IN SUBSURFACE SOILS (ppb)

EBASCO SERVICES INCORPORATED

ADAPTED FROM SMC MARTIN PHASE I SITE MAP



EXPLANATION

1500 ● CONCENTRATION (ppb) OF METHYL CYCLOHEXANE IN SUBSURFACE SOILS POINTS WITHOUT NUMBERS INDICATE NONDETECT LEVELS

ADAPTED FROM SMC MARTIN PHASE I SITE MAP

SINCLAIR REFINERY SITE
WELLSVILLE, NEW YORK

FIGURE 3–7

METHYL CYCLOHEXANE LEVELS IN SUBSURFACE SOILS (ppb)

EBASCO SERVICES INCORPORATED

relative to the non-detect background levels. These "hot spots" usually coincide with maxima of other, more commonly detected compounds. The background levels for almost all organic compounds was below detection limits.

The priority volatile organic compounds (VOCs) detected are dominated in both frequency and concentration by aromatics, particularly benzene, toluene, ethyl benzene and xylenes. The base/neutral/acid extractables (BNAs) are dominated by polynuclear aromatic hydrocarbons (PAHs). Tables 3-1 through 3-9 present the organic compound levels. Mean and median values describing selected contaminant distributions are also provided for some compounds.

Soil and groundwater samples collected at the OSTF had generally low to non-detectable levels of priority pollutant compounds. Non-priority compounds were detected only in soils, with essentially the same compounds detected in all six samples.

In general, elevated levels of contaminants detected at the site are confined to the shallow aquifer and surface soils. One deep monitoring well (MWD-47) on site showed levels of xylene (1000 ppb), toluene (50 ppb) and ethyl benzene (36 ppb). These values, however, appear anomalous since other wells in the area showed only low levels of contaminants relative to background wells. Data from wells screened in the clay layer have not been evaluated due to questionable well construction methods, leading to questions regarding whether the clay wells monitor the clay, the shallow aquifer, or a combination of the two.

3.1.8 Characterization of Oil Separator Area and Sewers

In addition to the "standard" sample matrices (i.e. soils, sediment, groundwater, surface water), additional features of the site were sampled in order to complete the site characterization. These include the abandoned oil separator located in the northern portion of the site and three sewer lines. These lines are located beneath the site but are easily accessed through manholes.

Samples from the floating oil phase within the open tanks of the oil separator were collected at two locations during the Phase II RI. These samples contained a number of priority volatile and BNA compounds including 2-butanone, benzene and trichloroethene. Lead, nickel, copper and arsenic were also measured in these samples. Non-priority VOCs were detected in only one of the two samples, but at elevated levels with respect to other site samples. The non-priority BNAs were generally at low levels with respect to the site.

Water samples collected from the three sewer lines beneath the site showed low levels of priority organic compounds (VOCs and BNAs) and elevated levels of metals. Non-priority compounds in sewer water samples were detected at levels similar to those found elsewhere on site. Sediment samples taken from the sewers showed elevated levels for many organic and inorganic priority contaminants relative to background.

3.1.9 Distribution and Concentrations of Contaminants

Sections 3.1.9.1 to 3.1.9.3 present detailed discussions of the distribution and concentrations of inorganics, VOCs, and BNAs on site. Contaminant distributions are presented by matrix in each section. Matrices sampled include groundwater (beneath the refinery and landfill areas), surface soils, subsurface soils, sediments and water from the main drainage swale, outfalls and seeps, ponded water north of the landfill dike, and sediments and water from the Genesee River. The OSTF is not discussed since contaminants were not detected or were at very low levels. Tables 3-1 to 3-9 summarize the data on the priority pollutants by matrix. The non-priority compounds data are compiled in Appendix B.

Data presented were collected during the Phase I and II RI. Soil sampling during these investigations generated a large volume of data. However, some of the data are difficult to use for risk assessment and feasbility study purposes. Specifically, surface soil samples were composited over very large (greater than 20,000 sq. ft.) areas of the site resulting in average contaminant concentrations. These can be used to identify potential contaminants of concern, but not to determine areal extent of contamination. Subsurface soil samples taken from auger borings and monitoring well borings were also composited, over large depth intervals, making the data difficult to use in evaluating the depth(s) at which the contamination may be present. In addition, intervals composited were those which SMC Martin noted as showing visible evidence of contamination and therefore indicate higher than average levels of contamination. Although surface and subsurface soil composites serve to identify areas and contaminants of concern, they do not furnish the horizontal and vertical distribution of contaminants required for both a risk assessment and feasibility study.

3.1.9.1 Inorganic Compounds Detected at the Sinclair Refinery Site

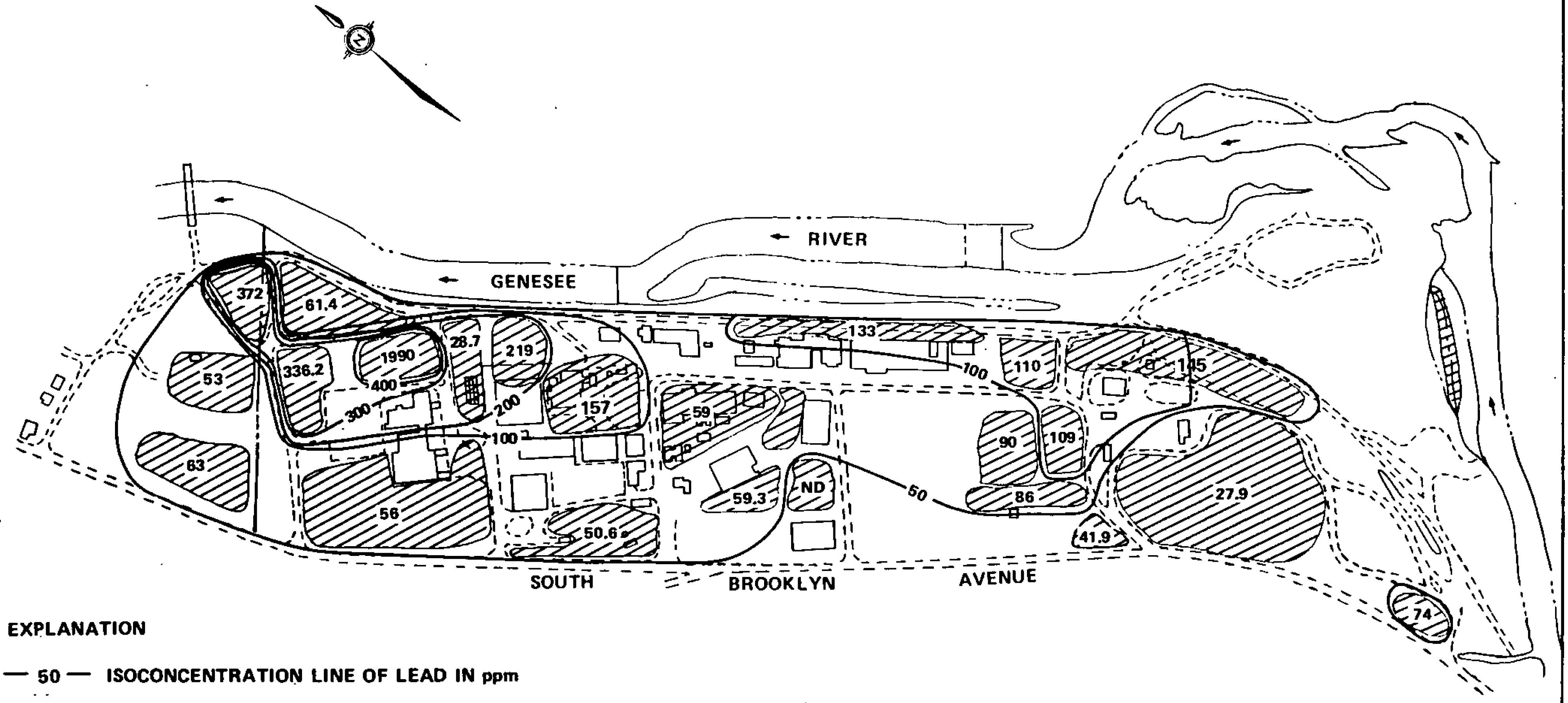
Groundwater: Nine EPA priority metals were detected in groundwater beneath the refinery area (Table 3-1). Arsenic was the metal most commonly detected (frequency of 22/25). Zinc was detected in every monitoring well, but those data are not considered significant since galvanized steel pipe, which includes zinc, was used for well screens and riser pipe. Of the metals detected, only arsenic, chromium, lead, nickel and selenium exceeded Federal, Clean Water Act (CWA) or NYS standards in any sample. Levels above standards were detected only once or twice for each compound. Levels detected for these metals range from non-detect (ND) to 110 ppb. Groundwater samples from the landfill monitoring wells (Table 3-2) had low levels of most metals (less than 40 ppb) at a low frequency of detection (4/10), except for nickel. Nickel was detected in 5 of the 10 wells in this area. Only lead and zinc were detected in the deep monitoring wells although the lead values are questionable, as noted in the SMC Martin data sheets, since the "duplicate analysis is not within control limits."

Surface Soils: Detectable levels of antimony, arsenic, chromium, copper, lead, nickel and zinc were present in surface soils on site (Table 3-4). On-site values detected for chromium, lead, nickel and zinc exceeded the range of their respective background levels, but of these, only lead and zinc were detected above the range for alluvial soils in the U.S. (Kabata-Pendios and Pendios, 1984). Of all metals detected, lead had the highest concentration (1190 ppm). The geometric mean (105 ppm) and the median value (88 ppm) of lead also exceed the typical range (10-30 ppm) reported for U.S. alluvial soils but fall within the range for all U.S. soils (2-300 ppm). Elevated levels of antimony were measured in three on-site locations as well as in a deep off-site location (Table 3-5) but were not detected throughout the remainder of the site. Figure 3-8 presents the distribution of lead in surface soils at the site.

Subsurface Soils: Detectable levels of antimony, arsenic, copper, lead, nickel, silver and zinc were measured in subsurface soils. The highest on-site concentration for copper and lead exceeded site background levels by over 100 ppm. Of copper and lead, only the range of lead exceeded the range of U.S. soils. The median values for all the metals fell within the U.S. soil range. Table 3-5 presents levels of metals detected in subsurface soils.

In general, the samples from the shallower borings (i.e. the auger borings) had more metals detected and higher metal concentrations, suggesting that the metals are confined to the uppermost soil layers.

Swale, Pond, Outfalls and Seeps: Samples from the swale, pond, outfalls, and seeps (Tables 3-6, 3-7, 3-8 and 3-9) showed levels of metals at ranges similar to those found in the site proper for all metals detected. In a few samples, copper, lead, nickel or zinc in sediments and soils from these areas exceeded the background levels for the site, but only lead exceeded the range for U.S. background soils. The pond water had low to non-detectable levels of metals for both water and sediment. Lead in the water samples from the swale exceeded the Federal MCLs. Nickel was also detected at apparently elevated levels in some seep and swale samples, but as described below, appear to be due to an anomolous sampling event.



EXPLANATION

— 50 — ISOCONCENTRATION LINE OF LEAD IN ppm

(30) AREAL EXTENT OF COMPOSITE SAMPLE AND CONCENTRATION IN ppm

0 500 1000
SCALE IN FEET

NOTE:
BACKGROUND SURFACE SOIL LEAD CONCENTRATIONS
US SOIL =10 TO 30 (18) ppm
SITE SOIL BKGD. =1.3–33 ppm

ADAPTED FROM SMC MARTIN PHASE I SITE MAP

SINCLAIR REFINERY SITE WELLSVILLE,NEW YORK
FIGURE 3–8 LEAD IN SURFACE SOIL COMPOSITE SAMPLES (ppm)
EBASCO SERVICES INCORPORATED

Genesee River: Sediments and water from the Genesee River had measurable levels of a number of metals (Tables 3-6 and 3-7). Arsenic, copper, lead, mercury, nickel and zinc were detected in the river water. All of these, plus other metals were detected in the river sediments. Of these only arsenic and zinc had any measured concentration in the sediments exceeding background ranges for the U.S (see Table 3-6). The concentration ranges of arsenic, lead and nickel in the river water exceeded the Federal CWA standards though they were seldom detected (arsenic 2 of 26 samples, lead 4 of 26 samples and, nickel, 8 of 26 samples).

The variation of nickel concentrations along the Genesee River during the Phase I and Phase II studies indicates that the nickel contamination in the river did not originate at the site. Measured nickel concentrations in the river showed significant variation between the Phase I and Phase II sampling. During the Phase I study, a suite of water samples was collected from the Genesee River just upstream of the site (SW-27) to the Wellsville water treatment plant downstream of the site (SW-14). Nickel was measured below detectable levels for nearly all 13 samples (one sample had nickel at 2.2 ppb). These samples were collected on 8/22/84. A year later, on 9/10/85, as part of the Phase II investigation, water samples were collected from the river and the main drainage swale. These samples showed elevated levels of nickel, with a maximum value of 1622 ppb in the drainage swale. On the same day however, a sample taken one quarter mile upstream of the site also contained high levels of nickel (490 ppb) relative to the previous year's measurements (non-detect). When two additional samples were collected a year later (SWB-40 and 41) on 11/6/86, nickel concentrations were below detectable levels. Thus the levels of nickel found in the river appear to be due to an anomolous sampling event.

In summary, the concentration of most metals in site soils is at or slightly above background levels. The level of lead is above background in several areas. The levels of most metals in the water around the site are at or slightly above background and some exceed the federal CWA standards for drinking water. The elevated levels of nickel measured in the Genesee River and the main drainage swale are presumed to be attributable to an anomolous sampling event as more recent data do not indicate the presence of nickel.

3.1.9.2 Volatile Organic Compounds (VOCs) Detected at the Sinclair Refinery Site

Groundwater: Volatile organic compounds detected in the shallow groundwater beneath the refinery area consist largely of aromatic compounds, in particular, benzene, ethyl benzene, toluene and xylenes. Ranges of levels detected vary from not detectable to 730 ppb, 830 ppb, 56.5 ppb and 1311 ppb for benzene, ethyl benzene, toluene and total xylenes, respectively. Ranges and geometric means of all of these compounds exceed the background ranges which are generally not detectable in background samples (see Table 3-1).

Maximum levels of VOCs are concentrated in the vicinity of the existing and removed oil separators. Figure 3-4 illustrates the distribution of benzene in shallow groundwater. In general, the areal extent and concentrations are greater near the existing (northern) oil separator.

Many other priority VOCs were detected in groundwater at low frequencies (see Tables 3-1 to 3-3). Aromatics and other VOCs have similar distributions of benzene although their areal extent tends to be less. VOCs (specifically xylene (1000 ppb), toluene (50 ppb) and ethyl benzene (36 ppb) were detected in only one deep monitoring well, MWD-47, located in the northern portion of the site adjacent to South Brooklyn Avenue.

Detection of non-priority compounds in groundwater is dominated by cyclohexane (frequency of 17/24). Cyclohexane levels detected range from ND to 865 ppb. Cyclohexane and other non-priority VOCs show similar patterns to the priority VOCs. Figure 3-5 illustrates the distribution of cyclohexane in shallow groundwater beneath the refinery area. Tables B4 and B11 in Appendix B present the concentrations of all non-priority VOCs detected in groundwater beneath the site.

Groundwater beneath the landfill area showed little VOC contamination. Detection of priority VOCs occurred as single events in single wells. Only one non-priority VOC, cyclohexane, was detected in two locations.

Surface Soils: Methyl chloride was the only VOC (priority and non-priority) detected in surface soils (Table 3-4). The range of concentration varied from zero (in most samples) to 100 ppm. The background level was also zero (non-detect).

Subsurface Soils: Subsurface soil samples contained eleven priority pollutant VOCs, but at very low frequencies. Benzene was the most common priority VOC detected in only 7 out of 50 samples. Total xylenes had the highest measured value at 6100 ppb (estimated value). In general, more priority compounds were found in the monitoring well borings than in the auger borings. This may result from the consistently deeper depths from which samples were composited for the monitor well borings relative to the auger borings. Table 3-5 summarizes the ranges and frequencies of priority VOCs detected in subsurface soils.

Twelve non-priority VOCs were detected in subsurface soils at the site (Appendix B). Figures 3-6 and 3-7 present the distribution of two of these, cyclohexane and methylcyclohexane. In general, elevated levels of non-priority VOCs are found in a number of isolated locations across the site. The apparent "hot spot" distribution of these compounds does not appear to correspond with the locations of the two oil separators, unlike contaminant distribution in groundwater. In addition, the centers of contamination for both priority and non-priority compounds in the subsurface soils and the groundwater frequently do not align spatially as illustrated by Figures 3-5 and 3-6.

Swale, Pond, Outfalls and Seeps: Only four priority VOCs were detected in more than one water sample and 3 in any sediments taken from the swale, pond, outfalls and seeps. Benzene was the most commonly detected VOC, (3/11 in water, 6/17 in sediment) however, all priority VOCs were detected at low frequencies. Tables 3-7, 3-8 and 3-9 present the levels of these contaminants detected in these matrices. Non-priority VOCs detected in the water and sediment in the swale, pond seeps and outfalls are presented in Appendix B, Tables B5 to B8. These compounds occurred at relatively low frequencies.

Genesee River: As might be expected in view of rapid gas exchange, the Genesee River contained very few volatile compounds. Only 2-butanone, chlorobenzene, and trans-1,2-dichloroethane were detected more than once (frequencies 2/26, 2/26 and 5/26 respectively) in the water. The dominant aromatic volatiles, benzene, toluene and xylene were detected along with 2-butanone, trans-1,2-dichloroethane and vinyl acetate in river sediments but none at a frequency greater than 3/12. No non-priority volatiles were detected in the river water more than once. The river sediment samples contained 3 non-priority volatiles, cyclohexane, methyl cyclopentane hexane and 1-1 oxybis ethane each at a frequency of 2/12. Several other non-priority VOCs were detected once. All of these compounds were previously detected in other site matrices. Tables 3-6 and 3-7 give the ranges of VOCs detected in the river water and sediments.

(In summary, volatile organic compounds were found at highest concentrations and greatest frequency in groundwater and subsurface soils.) Those areas of the site where gas exchange should be a significant route for volatile transport (i.e., surface soil, swale area, river water) had low levels and frequencies of volatile organics. Priority aromatic compounds were found with the greatest frequency and highest concentrations of all volatiles in all matrices. The distribution of the various priority aromatic compounds in groundwater was similar for many of the compounds detected. The distribution of these compounds in soils was less consistent.

3.1.9.3 Base/Neutral/Acid Extractable Compounds (BNAs) Detected at the Sinclair Refinery Site

Groundwater: Fifteen priority pollutant BNAs were detected, the majority at low frequencies, in the shallow groundwater beneath the refinery area. 2-Methyl napthalene was detected most often (14/25). Napthalene and benzo(a)pyrene were the next most common at frequencies of 8/25 and 6/25, respectively. Nitrobenzene had the highest concentration (1700 ppb). In general, these compounds occur with multiple maxima which generally but not exactly correspond to the volatile compound maxima. Tables 3-1 to 3-3 present levels and frequency of detection for priority BNAs in the groundwater.

The list of non-priority BNAs detected in the shallow groundwater was quite extensive (21 compounds), however, only 7 occurred more than once. Compounds with higher frequencies (up to 6/24) are limited to the refinery area. A compound labelled ethyl benzene in a library search was the most common

(6/24). However, ethyl benzene is not a BNA compound and levels and areal extent of this library search compound did not match that of the priority list ethyl benzene analysis.

No priority BNAs were detected in groundwater beneath the landfill area. Total phenolics had a frequency of detection 2/10 but at levels within background ranges.

Of the ten non-priority BNAs detected in groundwater beneath the landfill, only eicosane was detected in two wells. 1,3,5-trimethyl benzene was detected in the highest concentration (35 ppb).

Surface Soils: Surface soil samples from the refinery area had very few BNAs detected relative to groundwater and subsurface soil samples. The priority BNA compounds detected included several polynuclear aromatic hydrocarbons and pyrene. Benzo(a)anthracene, was detected at the highest frequency (4/14) and the highest concentration (7.5 ppm). Cyanides and total phenolics were also detected at low concentrations at relatively high frequencies (14/14 and 10/14 respectively). Their highest concentrations were 6.1 ppm and 2.9 ppm, respectively. These results are all from the Phase I investigation. No Phase II BNA, cyanide, phenolics or VOC analyses were performed on surface soil because of the low levels detected in Phase I.

Non-priority BNAs occurred at similar frequencies but higher concentrations. The highest concentration measured was for docosane at 120 ppm. All non-priority BNAs detected in surface soils were also detected in subsurface soils. The BNAs detected were exclusively linear alkanes. Table B1 in Appendix B lists the non-priority BNA results for surface soil.

Subsurface Soils: The subsurface soil priority BNA detections included 8 different compounds at low frequencies (1-7/50). Eight BNAs were detected in the monitoring well borings while only four were detected in auger boring samples. The concentration of BNAs were generally higher in subsurface soils than in other matrices except the oil separator and sewers (see Section 3.1.8). The highest concentration measured for a BNA in subsurface soil was for pyrene at 2600 ppb. The majority of priority BNAs detected are polynuclear aromatic hydrocarbon (PAHs) although a number of phthalates were also detected. Cyanides and total phenolics were detected at low levels at low frequencies of 6/50 and 12/50 respectively.

Several non-priority compounds (linear alkanes) were detected at higher, though still low, frequencies (5/35 to 15/35) in subsurface soils. Branched alkanes were detected at much lower frequencies. Of the 18 non-priority BNAs detected, 12 were detected only once. The concentration of the non-priority BNA compounds were higher than the priority BNAs. Non-priority BNAs detected in subsurface soils are presented in Tables B2 and B3 in Appendix B.

Swale, Pond, Outfalls and Seeps: Sediment samples from the swale, outfalls and seeps contained priority BNAs similar to those found in subsurface soils (i.e. PAHs or phthalates). However, frequencies of detection while still low, were higher. Benzo(k) fluoranthene was the most commonly detected priority BNA in the sediments found in six of eight samples. The pond water and sediments had low to non-detectable levels. Only two BNAs were detected more than once in water samples. Tables 3-6 to 3-9 present the priority BNA results for the swale, seeps and outfalls.

An additional compound identified as methyl benzene, in the library search of nonpriority compounds, was detected in both the water and the soil and sediment samples. This compound is most likely not identified correctly since toluene (methyl benzene) is not a BNA compound and it was not detected at this location as part of the priority VOC analysis. Levels and frequencies of non-priority BNAs detected in these matrices can be found in Tables B5-B8 in Appendix B.

Genesee River: The river water and sediment samples contained low levels of fifteen priority BNA compounds. The most common was benzo(k)fluoranthene, detected in the sediments at a frequency of 4/12 and range of 360 to 780 (both estimated) ppb. Tables 3-6 and 3-7 list the range and frequency for priority BNAs in the river matrices.

Non-priority BNAs were mainly found in the sediments. Only the questionably identified compound, methyl benzene, occurred in the water. The non-priority compounds detected are listed in Tables B9 and B10 in Appendix B.

In summary, BNAs were detected in nearly all matrices. The majority of priority BNAs detected were PAHs. These compounds had the highest concentrations and frequencies. Phthalates were the next most commonly detected compounds. Monitoring well composite soil samples had the highest concentrations, followed by the drainage swale sediment and soil samples. Shallow groundwater contained measureable levels of PAHs. Nonpriority BNAs detected consisted largely of linear alkanes in the various soil matrices. Other BNA compounds detected in various matrices were frequently unique to that matrix. The site groundwater had a long list of single detect BNAs.

3.1.9.4 Biotic Levels at the Sinclair Refinery Site

The local biota was sampled as a part of the Phase I study conducted by M. Baker of New York for SMC Martin, Inc. This study collected fish, mice and other rodents for whole animal analysis for the EPA priority compounds. The analytical results are given in Table 3-10. No organic contaminants were detected in any of the analyses. Nickel and lead were detected at quantifiable levels in the terrestrial biota, specifically voles and shrews. Only nickel was quantifiable in the aquatic biota.

3.1.10 Summary of Contaminant Distribution and Identified Data Needs

This section discusses the implications of the data presented in Section 3.1. The matrices where contaminant concentrations are potentially of concern are discussed below. The contaminant levels at the Off-Site Tank Farm and the dike pond area are close to background and do not appear to present any potential problems. Based on the data these areas do not warrant additional sampling during the Phase II RI.

The site soils, groundwater, outfalls, seeps and the drainage swale contained contaminants at sufficiently high levels to warrant further review and sampling during the RI.

3.1.10.1 Soils

Based on available data, lead appears to be elevated in surface soils. No organic compounds were detected at levels of concern. The subsurface soils had comparatively high levels of VOCs and BNAs, particularly PAHs and aromatics. However, these compounds only present a potential problem to the extent that they may affect groundwater beneath the site. During the remaining sampling, the soils investigation will focus on areas identified as containing elevated lead levels in the surficial soils. Soils near the existing and former oil separator will also be sampled to evaluate potential contaminants in the soils. These areas represent potential sources of groundwater contamination.

The low frequency of contaminant detection and the contaminant distribution for many organic contaminants in subsurface soils at the site suggests that the soil contamination is localized and has not been spread by groundwater transport. In view of the long site history, this would suggest very high partition coefficients for many of the contaminants. However, there is no way to accurately predict these coefficients using the present data base. For most contaminants at the site, the partition coefficient (K_d) is strongly dependent on the soil particle size and total organic carbon content. K_d is essential in determininig the potential for leaching of compounds from contaminated solids in the vadose zone and migration of a compound in the aquifer. This parameter is site specific and is defined as:

$$K_d = \frac{\text{Total Compound Concentration in Solid Phase (ug/kg)}}{\text{Total Compound Concentration in Liquid Phase (ug/l)}}$$

K_d is related to the organic carbon content of the soil as follows:

$$K_d = (\text{Koc}) \times (\%\ \text{oc})$$

where Koc = organic carbon/water partition coefficient and % oc = percent organic carbon in the soil by weight.

Koc is a measure of a chemical's inherent thermodynamic tendency to partition between groundwater or soil water and the organic carbon associated with the soil particles. Values for Koc are available in the literature for most organic compounds.

Compounds with high Koc values tend to be immobile in organic rich soils and will be transported from contaminated areas only if the soil itself is transported. Thus, the soil organic carbon content is essential in characterizing organic compound movement and predicting future groundwater contaminant levels at the site. Although the relationship is not as well defined, the importance of the organic carbon content to the effective K_d for inorganics is well established (e.g. arsenic, Winka, 1985). Thus, the organic carbon content is needed for the calculation or estimation of K_d's for both organic and inorganic compounds.

The grain size analysis can be used to estimate soil surface area. This information is important in a qualitative estimate of K_d since this coefficient describes surface absorption. (i.e. more surface area yields a higher K_d). Neither organic carbon content nor grain size analysis are available in the present data base and should be obtained as part of the field investigation. These data will permit estimation of the partition coefficients which, in turn, will permit the estimation of future groundwater contaminant levels.

3.1.10.2 Groundwater

Groundwater beneath the refinery area contains levels of several priority VOCs and BNAs at levels above background and above federal and state standards. Many of these compounds (e.g. benzene, toluene) are mobile and are easily transported to the Genesee River via groundwater flow. In some samples, the landfill groundwater contained nickel at a level above federal and state standards.

The distribution of most organic contaminants in groundwater beneath the site show multiple contamination centers separated by zones of groundwater at background levels or levels below detection limits. This suggests that the groundwater contamination may stem from several discrete sources.

There is relatively poor spatial alignment between centers of groundwater contamination, and centers of subsurface soil contamination. Factors contributing to this discrepancy may include groundwater transport, poor well development, and poor subsurface soil data due to incomplete mixing of soil composites.

In view of the complex nature of the groundwater contamination it will be sampled again during the Phase II RI. This information will confirm the previous studies as well as provide a time history of groundwater contamination to evaluate natural decreases in contaminant levels. These new data will also help in evaluating contaminant plume extent and plume movement. This information is important to the accurate prediction of future groundwater contaminant levels and the risks to any potential future groundwater users.

3.1.10.3 Drainage Swale, Outfalls and Seeps

The water from these areas contains lead, nickel, benzene and its derivatives, 1,1,1 trichloroethane and several BNAs. These areas may play a role in transport of these compounds to the river. Sediments in these areas also contain several metals and BNAs.

VOC levels in the drainage swale, outfalls and seep waters are low relative to site groundwater. This may be due to limited VOC contamination in these areas or to rapid gas exchange when VOCs are transported to these areas. Metals and BNAs are present but at lower concentrations than in site groundwater.

Levels of inorganics in the soils and sediments from these areas is similar to that of the site soils. Lead and nickel are the dominant metals, reaching concentrations of 802 ppm and 272 ppm, respectively. The priority and non-priority BNA concentration ranges are generally similar or slightly lower than those for subsurface soils on site.

Soil and water samples from these areas will be collected and analyzed for VOCs, BNAs and metal to further define contaminants in this area. In addition, the sediments from these areas may act as a sink for the compounds transported to these areas by waterflow. The amount of contaminant absorbed by the sediments is dependent upon partition coefficients. Thus, the total organic carbon and particle size distribution analyses are needed for the sediments in these areas.

3.1.10.4 Genesee River

The waters and sediments of the Genesee River had the lowest levels and fewest number of contaminants of any of the site matrices. The range of some of the metals detected in the water column exceeded the Federal Clean Water Act standard but none of the median values exceeded the range, except for nickel which appears to be unrelated to the site. Although the river had lowest levels of contaminants it also has the greatest potential for impacting human population due to its areal extent. Thus, it is important to monitor the river and include it in a mass balance of contaminant transport from the site. The river sediments have the potential for contaminant absorption. It is important to obtain data on the total organic carbon content and the particle size distribution in order to predict the partition coefficient and the absorption capacity of these sedimants.

3.1.10.5 Summary of Contaminant Concerns at the Site

1. In the surface soils, lead is at high levels relative to background. These soils are in areas where they may potentially impact on human health. The lead appears to be largely confined to the surface layer.

2. In the site groundwater, a number aromatics and PAHs are present at elevated levels. Lead and arsenic were also present in a few samples at ranges outside Clean Water Act Standards.

3. In the drainage swale, outfalls and seeps, the levels of benzene derivatives, PAHs, non-priority BNAs and heavy metals are present at elevated levels.

4. Many hydrocarbons are scattered over the site, at high concentrations relative to background. These contaminants were detected largely in isolated areas in the subsurface soils and ground water.

3.2 PRELIMINARY RISK ASSESSMENT

This section presents a preliminary risk assessment of public health risks associated with the Sinclair Refinery Site. This assessment is based on results of the Phase I and partially completed Phase II Remedial Investigations conducted by SMC Martin as well as information pertaining to site history, hydrogeology, land use, and demography.

As summarized previously, data from the Phase I and Phase II investigations suggest that elevated levels of a number of compounds (including heavy metals, aromatic hydrocarbons and polynuclear aromatic hydrocarbons) are potentially present in several site matrices. Matrices of potential concern include refinery and landfill groundwater, site surface soils, and sediments and surface water from the main drainage swale.

The Off-Site Tank Farm (OSTF) does not appear to have compounds of concern based on a preliminary review of the data. As a result, no sampling of the OSTF is planned during completion of the RI. A more complete review of the data from the OSTF will be performed in the RI risk assessment.

3.2.1 The Selection of Potential Indicator Compounds

Data collected during the two phases of study permit ARCO to develop a preliminary list of compounds which may pose a potential risk to human health. A total of 17 compounds were selected. They are listed in Table 3-11 along with their corresponding site matrices. The metals, particularly lead, are a potential concern in the surface soils, the drainage swale, the seeps and the outfalls. Organic compounds, specifically aromatics and polynuclear aromatics, are a potential concern in the refinery groundwater and the drainage swale soil. The basis for selecting these compounds is strictly qualitative at present. Their preliminary selection is based on the following four criteria:

TABLE 3-11

Preliminary List of Indicator Compounds at the Sinclair Refinery Site

	Matrix				
	Refinery Ground-water	Landfill Ground-water	Surface Soil	Drainage Swale, Seeps and Outfalls Soil	Drainage Swale, Seeps and Outfalls Water
Compound					
Metals					
Antimony			X		
Cadmium				X	
Lead	X		X	X	X
Nickel		X			
Volatiles					
Benzene	X				
Ethyl Benzene	X				
Toluene	X				
Xylene	X				
Cyclohexane[1]	X				
1,1,1-Trichloroethane					X
BNA					
Benzo(a)anthracene			X		
Benzo(k)fluoranthene			X		
Benzo(a)pyrene	X		X		
Fluoranthene				X	
2-Methyl naphthalene	X				
Naphthalene	X				
4 Methyl-2-pentanone	X				

1 Non-priority volatile compound

1. frequency of detection;
2. measured concentrations relative to background levels and/or relevant groundwater and drinking water standards;
3. toxicity, and
4. the availability of toxicological criteria.

Exposure to these chemicals via different pathways will be evaluated in the RI. Exposure pathways considered to be of potential significance are outlined below.

3.2.1.1 Ground Water

The Phase I and Phase II chemical analyses of site groundwater indicated contamination by a number of compounds, specifically benzene and a number of its derivatives plus BNAs. The groundwater contamination will be examined only in terms of a future risk since there are no known users of groundwater on the site, or downgradient.

On the basis of the contamination described in Table 3-11, the potential exists for the future exposure to contaminants via future ingestion of groundwater if a well were to be drilled on the site. The potential also exists for future workers or students to be exposed to contaminants via inhalation or dermal contact while washing or bathing with the water. The magnitude of such exposures would depend on the amount of time spent washing or bathing, the fraction of contaminant absorbed through the skin, and the skin surface area of the individual(s) exposed. However, qualitative evidence suggests that the latter exposure pathways (inhalation and dermal absorption) present less risk of toxicity/or carcinogenicity than ingestion. These pathways will be evaluated in the RI risk assessment on the basis of previously existing data in conjunction with that collected for this investigation.

3.2.1.2 Surface Soils

The surface soil composite samples collected during Phase I and Phase II indicate areas of elevated lead levels in soils. Present use of the site includes several small industries and a SUNY campus. Therefore, the continued presence of these metals may represent a potential human health concern to workers and students through inhalation or incidental ingestion of site soils, especially in view of the fact that little of the site is paved or vegetated, consisting largely of unpaved parking lots.

An added concern results from the site's close proximity to an easily accessible section of the Genesee River and a local park. The site may easily be crossed or accessed by people wishing to reach the river or park. These individuals may potentially be subjected to a health risk via pathways similiar to those identified above for workers and students.

3.2.1.3 Drainage Swale and Outfalls

The water in these areas has been shown to contain elevated levels of lead, nickel and 1,1,1-trichloroethane. These areas are readily accessed by people and may present a human health risk via accidental ingestion, inhalation or skin absorption.

The soils in these areas have been shown to contain elevated levels of heavy metals and priority BNA's. The contaminants would have similar pathways and receptors to the water borne contaminants and will be evaluated as well.

3.2.1.4 River Water

The present levels of compounds in the Genesee River water and sediments do not present any risk to human health. The fate and transport modeling of site contaminants should provide quantifiable limits on the flux of these materials to the river. Because people may use the river for various purposes it is important to confirm the low contaminant levels found during the Phase II study. In the event that fate and transport modeling or samples collected during the completion of the Phase II RI indicate elevated levels of contaminants in the river, these pathways will be evaluated.

3.2.1.5 Consumption of Biota

The consumption of biota, specifically fish, from around the Sinclair Refinery site may be a potential pathway. However, the biota sampling report by M. Baker Jr. of New York for SMC Martin suggests that mean fish levels are not of concern. This will be further evaluated in the RI.

3.2.2 Data Requirements

Based on the potential exposure pathways at the site described above and on a review of the existing data base, the data needed for characterizing contamination in the study area are as follows:

1. The vertical distribution of contaminants in specific areas of concern is needed to discern the extent of contamination in surface soils. This will help narrow the regions which may require remediation.

2. The horizontal distribution of site contaminants within these areas is needed to better discern hot spots and provide a true contaminant range for risk analysis.

3. The percentage of organic carbon and the particule size distribution in the aquifer soil are needed to derive a partition coefficient (K_d) for the organic compounds in the groundwater. Most organic compounds have K_d's which are strongly dependent on soil organic carbon content. These data will also be used in the estimation of K_d's for inorganic compounds. This constant will determine the retardation of a contaminant by soils during groundwater transport.

4. An accurate determination of the groundwater flow from the site to the Genesee River is required. The flow rate will determine the rate at which contaminants will enter the river. Groundwater transport of contaminants to the river may impact the river water quality.

5. The organic carbon content and the sediment particle size distribution of the drainage swale and river sediments are needed to determine partition

coefficients in this area. These coefficients determine the ability of the sediments to absorb or buffer contaminants from the site outfall and seeps which enter these areas.

6. A complete round of groundwater samples is needed to confirm the groundwater data because of its poor replicate record. This data is also needed to establish a time history of groundwater contamination which will greatly assist the prediction of future levels and the risk they may pose to potential groundwater users.

3.3 SCOPING OF REMEDIAL ALTERNATIVES

3.3.1 Preliminary Remedial Response Objectives

Although the existing data base is inadequate to define if a threat to public health and the environment exists, several preliminary remedial response objectives may be formulated based on the preliminary risk assessment and previous site investigations.

On the basis of the existing data, eight remedial response objectives were identified to mitigate the potential risks associated with the site. These objectives include:

1. Minimize the human exposure to contaminants in the surface soils.

2. Minimize the transport of contaminants in the unsaturated subsurface soil into the saturated soil and groundwater.

3. Minimize the transport of contaminants in the groundwater into the Genesee River.

4. Minimize the transport of contaminants in the main drainage swale into the Genesee River.

5. Minimize the transport of contaminants in the underground piping system to the Genesee River.

6. Minimize the transport of contaminants in the main oil separator into the groundwater and Genesee River.

7. Assure that site conditions and remedial response action(s) meet the ARARs.

After data are gathered and evaluated in Tasks 3 through 7, the response objectives will be refined and developed or, as appropriate, eliminated. The RI will provide a basis for evaluation of these preliminary remedial response objectives. For example, if the extent to which natural and manmade barriers contain contaminants and the adequacy of the barriers (i.e., cap) are assessed, the potential for direct contact with contaminants can also be assessed. Completion of the RI, including assessment of chemical distribution and migration, will also allow better definition of the potential risk associated with direct contact with site contaminants.

3.3.2 Preliminary Identification of General Response Actions and Remedial Technologies and Alternatives

To meet the preliminary remedial response objectives, a set of general response actions were identified for each media. These general response actions fall into the following categories:

- No Action
- Containment
- Treatment and Disposal

For each remedial response action, potentially applicable remedial technologies have been identified. Table 3-12 summarizes the general response actions and potential remedial technologies and applicability to the following media.

- Groundwater
- Surface Soils
- Subsurface Soils
- Swale, Pond, Outfalls, Seeps (Sediments and Water)

TABLE 3-12

GENERAL RESPONSE ACTIONS AND POTENTIAL REMEDIAL TECHNOLOGIES APPLICABLE TO VARIOUS SITE MEDIA

General Response Action	Potential Remedial Technologies	Ground Water	Surface Soils	Subsurface Soils	Swale, Pond Outfalls, Seeps (Sediments/Water)	Genesee River (Sediments/Water)	Oil Separator	Sewers	Controlling Factors
No Action	o Fences/Warning Signs	X	X	X	X	X	X	X	Risk Assessment
	o Long-Term Monitoring	X	X	X	X	X	X	X	
	o Public Awareness Program	X	X	X	X	X	X	X	
	o Restrict Access and Use	X	X	X	X	X	X	X	
Containment	o Grouting/Sealing						X	X	Geohydrological conditions, soil and contaminant haracteristics, ARARs
	o Capping/Surface Sealing	X	X	X	X		X		
	o Impermeable Vertical Barriers	X		X	X		X		
Treatment/ Disposal	o Excavation/Disposal to central elevated landfill area (CELA)		X	X	X[1]	X[1]	X	X	Availability of CELA
	o Pumping/Treatment/Disposal	X			X[2]		X	X	Contaminant characteristics, ARARs
	o Chemical Precipitation	X			X[2]				
	o Air Stripping	X			X[2]				
	o Carbon Adsorption	X			X[2]				
	o UV Oxidation	X			X[2]				
	o In-Situ Fixation		X	X	X[1]				Soil/sediment and contaminant characteristics, ARARs
	o Excavation/Soil Washing		X	X	X[1]	X[1]			
	o Excavation/Solidification		X	X	X[1]	X[1]	X		
	o Excavation/Incineration		X	X	X[1]	X[1]	X		
	o Excavation/Biodegradation		X	X	X[1]	X[1]	X		
	o Enhanced Volatilization		X	X	X[1]	X[1]			
	o Super Critical Fluid Extraction						X		
	o In-situ Biodegradation		X	X					Contaminant characteristics, ARARs
	o Grit Blasting						X	X	
	o Solvent Washing/Steam Cleaning						X	X	
	o Discharge to POTW	X						X	

1 Sediment Fraction only
2 Liquid Fraction only

- Genesee River (Sediments and Water)
- Oil Separator
- Sewers

A preliminary description of remedial technologies that address these general response actions are presented in the following five subsections together with a preliminary evaluation of which media would be treated by each remedial technology category.

3.3.2.1 No Action

The No Action alternative will be evaluated to provide a comparative basis for other remedial alternative evaluations. In the No Action alternative, no remedial actions (containment or treatment and disposal) will be designed or implemented at the site. Implementation of the No Action alternative might include long-term monitoring, (e.g., groundwater and surface water etc.), and might include institutional controls (e.g., public awareness program or restricting access and use of portion(s) of the site). The No Action alternative will be evaluated for each media.

3.3.2.2 Containment

The containment alternatives would potentially include utilization of surficial impermeable barriers and caps to completely isolate the contaminated soil/sediment from rainfall runoff, surface water and groundwater. Containment alternatives such as capping or vertical hydraulic barriers might also apply to groundwater.

Grouting/sealing of sewers and other pipes and the main oil separator, creating a total enclosure to reduce contaminant migration from these sources, are also potential containment alternatives.

Surface sealing is essentially painting or coating surfaces to contain contaminants within the structure using resins. Surface sealing might also be evaluated for the oil separator.

3.3.2.3 Treatment/Disposal/Decontamination

Contaminated media (such as soils) at the site can be handled by either excavation and on-site or off-site treatment/disposal, or in-situ treatment. These remedial technologies include treatment of contaminated media to reduce or eliminate potential risk to public health and the environment. Several processes are currently available to accomplish this. Each is briefly described below.

Chemical fixation and solidification, which may apply to soils and sediments containing heavy metals, involves the addition of siliceous material combined with setting agents such as lime or cement to produce a stabilized and solidified product. Proprietary commercial fixation agents and processes could also be used for organically contaminated soils or sediments.

Soil washing involves chemical processes. The chemical process involves solvent extraction methodologies to remove contaminants (metals and organics) from the soil.

Soils incineration is a process in which one of a number of thermal technologies is utilized to accomplish different phases of thermal reactions leading progressively to complete oxidation of organic contaminants. Incineration may apply to soils containing petroleum hydrocarbons. However, since some of the soil at the site also contains heavy metals, technologies for air emission controls and disposal of treated soil would also need to be evaluated.

Excavation and biodegradation, commonly known as land farming, is a technique which is primarily used for treatment of non-halogenated organics such as petroleum hydrocarbons.

Enhanced volatilization (i.e. mechanical and thermal aeration) involves the contact of air with the heated, contaminated soils to transfer the volatile organics from the soil into the air system. Depending upon the concentrations of contaminants, the air stream could be combusted in an afterburner or passed through activated carbon for air pollution control to remove the volatilized contaminants.

Supercritical Fluids Extraction may be applied to oil separator sludge to extract organic contaminants by use of CO_2 or propane gas which have excellent dissolving characteristics when heated and compressed to or near their critical point. This process has been used on oil separator sludges.

The following remedial technologies would be evaluated for decontamination of the oil separator and other contaminated structures including sewers, if applicable.

Gritblasting is a surface removal technique in which an abrasive material is used for removal of contaminated surface layers. Hydroblasting uses a high-pressure water jet to remove contaminated debris from surfaces. These technologies would be evaluated for the oil separator.

Solvent washing technology consists of pressure-spraying fluorocarbon solvents (e.g., freon 113) onto contaminated surfaces followed by collection and purification of the solvent. Steam cleaning uses steam in place of the solvent to remove surface contamination only. Solvent washing could also be evaluated for decontamination of the separator.

3.3.2.4 In-Situ Treatment

Technologies capable of treating contaminated soil in place have been considered. These technologies include solidification and bioreclamation.

In-situ fixation uses a mechanical mixer/injector to introduce and mix fixation materials directly into the contaminated subsurface materials to fix the heavy metals within the solidified soil, thereby reducing the leachability of contaminants into the groundwater.

In-situ biodegradation is a technique for treating zones of contamination by microbial degradation. The basic concept involves altering environmental conditions by supplying bacteria oxygen and nutrients (i.e., nitrogen and phosphorus) to enhance microbial degradation of organic contaminants, resulting in the breakdown and detoxification of those contaminants.

3.3.2.5 Groundwater/Treatment and Disposal

The groundwater at the site, if determined to be contaminated and requiring remediation, could be pumped and treated on-site. On-site treatment technologies that would be applicable include: air stripping or chemical oxidation for removing volatile organics; carbon adsorption, chemical oxidation, biological treatment, and reverse osmosis for removing non-volatile organics; and chemical precipitation for removing heavy metals.

Air stripping which can be used to remove volatile organics from the groundwater is a mass transfer process in which volatile organics are transferred to the gaseous vapor phase and either released to the atmosphere in acceptable concentrations or removed from the vapor phase stream by a treatment system using carbon adsorption or thermal treatment.

Carbon adsorption which can be used to remove organics from groundwater, involves contacting a waste stream with the carbon, usually by flow through a series of packed bed reactors. The activated carbon selectively adsorbs hazardous constituents in the waste by a surface attraction phenomenon in which the organic molecules are attracted to the internal pores of the carbon granules.

Chemical precipitation might also be applied to contaminated groundwater and possibly to stormwater runoff from the site. It is a pH adjustment process in which acid or base is added to water to adjust the pH to a level where the contaminants are least soluble. Metals can then be precipitated from water as hydroxides, sulfides, carbonates or other insoluble salts. Precipitated metals can then be removed from the water by flocculation, clarification and filtration, if needed.

Ultra violet (UV) chemical oxidation can be applied to contaminated groundwater, to destroy volatile organic contaminants by using hydroxyl radicals (strong oxidizers) released from hydrogen peroxide in the presence of ultra violet light. Contaminants are converted in these reactions to carbon dioxide and water.

3.4 DETERMINATION OF APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)

As part of the RI, Federal and State regulations will be evaluated to determine if they are applicable or relevant and appropriate requirements (ARARs). This section provides a preliminary listing of the Federal and New York State environmental and public health requirements that are potentially applicable or relevant and appropriate to the Sinclair Refinery Site. In addition, this section presents a listing of other Federal and State criteria, advisories and guidance that could be used for evaluating the remedial alternatives. Lastly, brief discussions are presented on two key ARAR-related issues expected to affect the Sinclair Refinery Site, which will be fully evaluated during the RI/FS process: 1) the "petroleum exclusion" from CERCLA/SARA; and 2) the effect of RCRA Land Disposal Restrictions on the petroleum refining industry listed hazardous wastes.

3.4.1 Definition of ARARs

The requirements identified below may be "applicable or relevant and appropriate," requirements (ARARs) and "to be considered" material, based upon EPA's post-Superfund Amendments and Reauthorization Act of 1986 (SARA) interim guidance that addresses development and utilization of ARARs (52 Federal Register 32496, August 27, 1987 and OSWER Directives). ARARs and "to be considered" material are used primarily during the Feasibility Study to evaluate the remedial alternatives during initial screening and detailed evaluation.

SARA defines a potential ARAR for a given site as:

- any standard, requirement, criterion, or limitation under any federal environmental law and

- any promulgated standard, requirement, criterion, or limitation under a State environmental or facility siting law that is more stringent than any federal standard, requirement, criterion, or limitation.

The purpose of this definition is to ensure that CERCLA responses are consistent with both Federal and State environmental requirements.

Within these jurisdictional boundaries, ARARs are further defined according to the activity, contaminants, or location they are expected to affect. ARARs that relate to the level of pollutant allowed are called contaminant-specific; ARARs that relate to the presence of a special geographic or archeologic area are called location-specific; and ARARs that relate to a method of remedial response are called action-specific.

When ARARs do not exist for a particular chemical or remedial activity or when the existing ARARs are not protective of human health or the environment, other criteria, advisories and guidance known as "to be considered (TBCs) material" may be useful in designing and selecting a remedial alternative.

3.4.2 Consideration of ARARs During the RI/FS

Specifically, ARARs will be considered during the following intervals during the RI/FS Process.

(1) Scoping of the RI/FS. Identify contaminant-specific and location-specific ARARs on a preliminary basis.

(2) Site characterization phase of the Remedial Investigation, when the public health evaluation is conducted to assess risks at a site. Identify the contaminant-specific ARARs and "to be considered" material and location-specific ARARs more comprehensively and use them to help determine the cleanup goals.

(3) Development of remedial alternatives in the Feasibility Study. Identify action-specific ARARs for each of the proposed alternatives and consider them along with other ARARs and "to be considered" material.

(4) Detailed evaluation of alternatives. Examine all the ARARs and "to be considered" material for each alternative as a package to determine what is needed to comply with other laws and to be protective.

As the RI/FS process continues, more ARARs may be considered particularly as guidances are issued by the State of New York. Primary consideration should be given to remedial alternatives that attain or exceed the requirements found in ARAR regulations.

These ARARs will be used as a guide to establish the appropriate extent of site cleanup; to aid in scoping, formulating and selecting proposed treatment technologies; and to guide the implementation/operation of the selected action. At each interval, ARARs are identified and utilized by taking into account the following:

- o contaminants suspected to be at the site;
- o chemical analyses to be performed;
- o types of media to be sampled;
- o geology and other site characteristics;
- o use of the resource/media;
- o level of exposure and risk;
- o potential transport mechanisms;
- o purpose and application of the potential ARARs, and
- o remedial alternatives that will be considered for the site.

3.4.3 Preliminary Identification of ARARs for the Sinclair Refinery Site

3.4.3.1 Potential Applicable or Relevant and Appropriate Requirements

The National Contingency Plan (NCP) (40 CFR 300) and the SARA/CERCLA Compliance Policy guidance provide definitions for applicable or relevant and appropriate requirements. The following post-SARA definitional language appears in EPA's August 27, 1987 Interim Guidance on ARARs (52 Fed. Reg. 32496).

- Section 121(d) of CERCLA, as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), requires that Fund-financed, enforcement, and Federal facility remedial actions comply with requirements or standards under Federal and State environmental laws. The requirements that must be complied with are those that are applicable or relevant and appropriate to the hazardous substances, pollutants, or contaminants at a site or to the circumstances of the release.

- "Applicable requirements" means those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or State law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site.

  "Applicability" implies that the remedial action or the circumstances at the site satisfy all of the jurisdictional prerequisites of a requirement.

- "Relevant and appropriate requirements" means those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or State law that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site.

- o A requirement that is judged to be relevant and appropriate must be complied with to the same degree as if it were applicable. However, there is more discretion in this determination: it is possible for only part of a requirement to be considered relevant and appropriate, the rest being dismissed if judged not to be relevant and appropriate in a given case.

The RI will evaluate the following to determine if they are applicable or relevant and appropriate to the Sinclair Refinery Site.

1) Contaminant-Specific

Federal

- o Clean Water Act, Water Quality Criteria (Section 304)

- o Safe Drinking Water Act, National Primary Drinking Water Regulations, Maximum Contaminant Levels (MCLs) (40 CFR 141.11-141.16)

State of New York

- o New York Public Water Supplies Requirements, Maximum Contaminant Levels (MCLs) (10 NYCRR 5-1)

- o New York Standards for Raw Water Quality (10 NYCRR 170.4)

- o New York Standards for Protection of Human Health and Potable Water Supplies (6 NYCRR 701)

- o New York State Pollutant Discharge Elimination System (SPDES) standards/limitations (Article 7 of ECL, 6 NYCRR 750-758)

- o New York Groundwater Quality Standards (Article 17 of ECL, 6 NYCRR 703)

2) Location-Specific

Federal

- o Executive Orders on Floodplain Management and Wetlands Protection (CERCLA Floodplain and Wetlands Assessments) # 11988 and 11990
- o Clean Water Act Dredge and Fill Section 404 Requirements

State of New York

- o New York Standards for Construction in Flood Hazard Areas (6 NYCRR 500)

3) Action-Specific

Federal

- o RCRA Subtitle C Hazardous Waste Treatment Facility Standards (landfill, tanks, containers, etc.) (40 CFR 264 and 265)
- o RCRA Subtitle C Closure and Post-Closure Standards (40 CFR 264, Subpart G)
- o RCRA Groundwater Monitoring Requirements (40 CFR 264, Subpart F)
- o RCRA Subtitle D Non-Hazardous Waste Management Standards (40 CFR 257)
- o Safe Drinking Water Act, Underground Injection Control Requirements (40 CFR 144 and 146)
- o RCRA Land Disposal Restrictions (40 CFR 268) (On and Offsite Disposal of Excavated Soil)
- o DOT Rules for Hazardous Materials Transport (49 CFR 107, 171.1-171.500)

- Occupational Safety and Health Standards for Hazardous Responses (29 CFR 1904, 1910)

State of New York

- New York's General Prohibitions for Air Emissions (6 NYCRR Part 211) (Fugitive Dust Generated During implementation of remedy)
- New York SPDES Discharge to Groundwater Requirements (6 NYCRR 754)
- New York Discharge to Surface Water Requirements (6 NYCRR 754)
- New York RCRA-equivalent Hazardous Waste Management Regulations (6 NYCRR 370)

3.4.3.2 Potential "To Be Considered" Material

When ARARs do not exist for a particular chemical or remedial activity or when the existing ARARs are not protective of human health or the environment, other criteria, advisories and guidance known as "to be considered (TBCs) material" may be useful in designing and selecting a remedial alternative. The following criteria, advisories and guidance were developed by EPA, other Federal agencies and the State of New York.

1) Federal

- Safe Drinking Water Act National Primary Drinking Water Regulations, Maximum Contaminant Level Goals (MCLGs)
- Proposed Maximum Contaminant Levels (50 Federal Register 46902-46933, November 13, 1985)
- Proposed Maximum Contaminant Level Goals (50 Federal Register 46936-47022, November 13, 1985)
- USEPA Drinking Water Health Advisories

- USEPA Health Effects Assessment (HEAs)

- TSCA Health Data

- Toxicological Profiles, Draft, Agency for Toxic Substances and Disease Registry, U.S. Public Health Service

- Policy for the Development of Water-Quality-Based Permit Limitations for Toxic Pollutants (49 Federal Register 9016)

- Cancer Assessment Group (National Academy of Science) Guidance

- Groundwater Classification Guidelines

- Groundwater Protection Strategy

- Waste Load Allocation Procedures

2) State of New York

- Underground Injection/Recirculation of Groundwater, Technical Operating Guidance, April 11, 1987.

- New York Department of Health's Proposed Contaminant Levels for Volatile Organics in Drinking Water Proposed MCLs (Expected Final January 1989)

3.4.4 Key ARAR-Related Issues

This subsection focuses on key ARAR-related issues expected to affect the Sinclair Refinery Site which will be fully evaluated during the RI/FS process. These are the CERCLA/SARA "petroleum exclusion" and the RCRA Land Disposal Restrictions on the petroleum refining industry listed hazardous wastes.

3.4.4.1 CERCLA/SARA "Petroleum Exclusion"

The CERCLA/SARA remediation program address releases of "hazardous substances". The definition of "hazardous substances" specifically excludes "petroleum, including crude oil or any fraction thereof" which is not otherwise specifically listed or designated as a hazardous substance (CERCLA Section 101 (14)). Crude oil and petroleum products are complex mixtures. Some of the constituents of these mixtures may be hazardous substances if found alone. However, the presence of a hazardous substance in crude oil or petroleum products does not remove the petroleum exclusion even if the crude oil or product were leaked or spilled. Certain petroleum refining industry waste streams are designated as "hazardous substances", and would be subject to CERCLA/SARA.

Where contamination of groundwater or soils is identified, the RI will attempt to differentiate between contamination caused by wastes that are not excluded, from contamination caused by leaks or spills of petroleum products that are excluded from the CERCLA hazardous substance definition.

3.4.4.2 RCRA Land Disposal Restrictions on Petroleum Refining Industry Listed Hazardous Wastes

The Hazardous and Solid Waste Amendments of 1984 (HSWA) require EPA to promulgate regulations that restrict the land disposal of hazardous wastes. Several petroleum refining industry waste streams are RCRA listed hazardous wastes, and thus are subject to land disposal restrictions. These wastes are as follows:

- K046-Dissolved Air Flotation (DAF) Float from the Petroleum Refining Industry
- K049-Slop Oil Emulsion Solids from the Petroleum Refining Industry
- K050-Heat Exchanger Bundle Cleaning Sludge from the Petroleum Refining Industry
- K051-API Separator Sludge from the Petroleum Refining Industry
- K052-Tank Bottoms (Leaded) from the Petroleum Refining Industry

Remediation of any site conditions resulting from the presence of these waste streams may be subject to land disposal restrictions placed on these wastes by EPA. The above mentioned petroleum refining industry wastes are so-called "First Third" listed wastes. The Land Disposal Restrictions were proposed for the "First Third" wastes in the April 8, 1988 Federal Register (53 Fed. Reg. 11747). (Final provisions and effective dates are expected to be available in August 1988.)

Remedial Investigation activities will provide information on the presence of these wastes or other materials which may be subject to land disposal restrictions. If such materials are present at the site, detailed evaluation of alternatives will include ARAR analysis of the effect of the RCRA Land Disposal Restrictions.

4.0 WORK PLAN RATIONALE

4.1 DATA QUALITY OBJECTIVES (DQO)

Data quality objectives are based on the concept that different data uses may require different levels of data quality. Data quality can be defined as the degree of uncertainty in the data with respect to precision, accuracy, and completeness. The five levels of data quality are:

(1) Screening (Level 1): This provides the lowest data quality but the most rapid results. It is often used for health and safety monitoring at the site, preliminary comparison to ARARs, initial site characterization to locate areas for subsequent and more accurate analyses, and for engineering screening of alternatives (bench-scale tests). These types of data include those generated on-site through the use of HNu, pH, conductivity, and other real time monitoring equipment at the site.

(2) Field Analyses (Level 2): This provides rapid results and better quality than in Level 1. Analyses include mobile lab generated data.

(3) Engineering (Level 3): This provides an intermediate level of data quality and is used for site characterization. Engineering analyses may include mobile lab generated data and some analytical lab methods (e.g., laboratory data with quick turnaround used for screening but without full quality control documentation).

4) Confirmational (Level 4): This provides the highest level of data quality and is used for purposes of risk assessment, engineering design, and cost analyses. These analyses require full CLP analytical and data validation procedures in accordance with EPA recognized protection.

5) Non-Standard (Level 5): This refers to analyses by non-standard protocols, for example, when exacting detection limits, or analysis of an unusual chemical compound is required. These analyses often require method development or adaption. The level of quality control is usually similar to Level 4 data.

ARCO will primarily generate Level 1 and 4 analytical data at the Sinclair Refinery Site. The Level 1 data to be generated includes field OVA or HNu readings gathered at test pits and trenches and during other routine field activities. Field measurements of parameters such as pH, temperature or specific conductivity are also examples of Level 1 data. This type of data may be used to demonstrate the adequacy of well development/purging procedures or in the case of HNu or OVA readings, to help protect the health and safety of workers.

Laboratory analytical testing of environmental samples from the Sinclair Refinery Site will be performed to obtain Level 4 data. Testing for VOC's will be performed to obtain detection limits in the range of one to two ppb for individual compounds. The other compounds to be analyzed will be at the standard detection limits in the Contract Laboratory Protocols (CLP).

Level 5 alt method

The analytical data gathered during previous investigation at the site will be assumed to be Level 4 data which has had appropriate Quality Assurance/Quality Control (QA/QC) verification, unless review of the data and QA/QC packages, show that the data is invalid or otherwise unsuitable for use in the RI/FS process.

4.2 WORK PLAN APPROACH

A two-phase remedial investigation conducted by SMC Martin for NYSDEC in 1984 and 1986 generated an extensive data base for site characterization of the Sinclair Refinery and Landfill Sites. The existing data base has been reviewed and evaluated during the development of the RI/FS Scope of Work.

The primary objectives of the RI is to gather all of the information necessary to characterize the refinery area and the groundwater portion of the landfill area for the evaluation of risks associated with the site and remediation of the site. Characterization of landfill soils is considered complete, as evidenced by the signing of a ROD for remediation of the landfill. No additional data will be collected at the Off-Site Tank Farm as investigation of this area during the Phase II RI suggests that this area does not present any potential for public health or environmental risk.

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The proposed work effort outlined in this Work Plan has been specifically designed to avoid direct overlap of data collected and technical results generated during the Phase I and II Remedial Investigation. This Work Plan is intended to utilize all existing data while supplementing the existing data base. For example, soils data from the refinery area are presently not available in sufficient detail for the purposes of a risk assessment and feasibility study because soil samples taken during the Phase I and II RI were composited over large horizontal and vertical distances. The soil investigation proposed in this Work Plan will utilize the Phase I and II RI data to target a more detailed and selective soil sampling program. Other data gaps identified in the existing data base include current contamination plume delineation, direction of groundwater flow out of the landfill and characterization of potential contamination sources. The RI will attempt to fill these data gaps by means outlined in the following sections of this Work Plan.

5.0 TASK PLAN FOR REMEDIAL INVESTIGATION

5.1 TASK 1 - PROJECT PLANNING

The project planning task (corresponding to Tasks 1, 2 and 3 of the Statement of Work in the Consent Order) involves several subtasks which must be performed in order to develop the plans and corresponding schedule necessary to execute the RI/FS. These subtasks include performing a detailed analysis of existing data, review of existing project plans, site visit(s), preliminary risk assessment, preliminary identification of remedial alternatives, determination of data quality objectives, determination of applicable or relevant and appropriate regulations (ARAR) and an RI scoping meeting with EPA. All of these activities culminate in the preparation of the project plans.

The project plans include preparation of a detailed Project Operations Plan (POP), as specified in the administrative consent order. Consistent with the consent order, and based on discussions with EPA, the POP consists of an RI/FS Work Plan and a Field Operations Plan (FOP). The FOP consists of three subsections: the Field Sampling and Analysis Plan (FSAP) with the Brossman short form, the Site Management Plan (SMP), and the Health and Safety Plan (HASP). These plans were prepared concurrently with the RI/FS Work Plan and are issued in a separate volume. A brief description of each subsection of the FOP is included below.

The FSAP will provide <u>detailed procedures for each field activity</u>. Specifically, the FSAP will address:

- Standard Operating Procedures (SOPs) for Field Investigations including Sampling, Monitoring, and Field Instrument Calibration
- Number, Location, and Types of Samples
- Analyses to be Performed on Each Sample
- Chain-of-Custody Procedures

- o Sample Packaging and Shipment Procedures

- o Decontamination Procedures

- o QA/QC of Field Sampling and Procedures for Field Changes and Corrective Action

- o Responsibilities of Site Personnel

- o Parameters to be Analyzed and Analytical Methods

Each SOP or QA/QC protocol will be prepared in accordance with EPA Region II guidelines and the site-specific Health and Safety Plan (HASP).

The QA/ QC portions of the FSAP have been prepared in accordance with EPA Region II procedures and Section 10 of the EPA publication entitled Test Methods for Evaluating Solid Waste (SW-846), using the "Brossman Short Form". The form requires information such as sample quality objectives, detection limits, preservation techniques, laboratory testing protocols and laboratory accuracy and precision goals.

The form also requests information on data validation. All chemical data generated by laboratories for Ebasco, will be validated by an Ebasco chemist using EPA's (Contact Laboratory Program) Standard Operating Procedures HW-2 and HW-4, as well as Ebasco's own data validation guidelines. ch.

The existing file documents, "Standard Operating Procedures for Collection of Environmental and Hazardous Substance Samples" (SMC Martin, 1984) and "Quality Assurance Plan for the Investigation of the Sinclair Refinery Site - Wellsville, New York" (SMC Martin, 1984a), were reviewed by Ebasco prior to development of the FSAP. Both file documents were considered to be either too generic or not applicable to the specific activities proposed by Ebasco for the supplemental field investigation. The FSAP also includes accepted procedures, which have changed since 1984 when the existing plans were developed.

The SMP describes site control, field investigation activities (site operations) and the corresponding field operations schedule. The site control section describes how approval to enter the areas of investigation will be obtained, along with the site security control measures and the field office/command post for the field investigation. The logistics of all field investigation activities are also described. These are particularly significant in this case due to the current state of site development and usage.

The site operations section includes a project organizaton chart and delineates the responsibilities of key field and office team members. The resumes of all professionals expected to participate in the RI, together with a description of their responsibilities are also included in the SMP.

The last section includes a field operations schedule, showing the proposed scheduling of each major field activity.

The HASP includes site-specific information, a hazard assessment, training requirements, monitoring procedures for site operations, safety procedures, disposal procedures, and other sections required by EPA. The HASP also includes a contingency plan which addresses site specific conditions which may be encountered.

Ebasco reviewed the file document entitled "Health and Safety Plan-Sinclair Refinery Site Investigation - Wellsville, New York" (SMC Martin, 1984b) prior to developing the HASP for the site. The HASP prepared by Ebasco includes updated site-specific information and corresponds to the site operations which Ebasco has proposed for the field investigation.

5.2 TASK 2 - COMMUNITY RELATIONS

EPA will perform all activities associated with Community Relations (Task 11 in the Statement of Work in the Consent Order), including preparing fact sheets, conducting public meetings and preparing a responsiveness summary for the Record of Decision (ROD). ARCO and its Contractor will, upon EPA request, provide support as needed.

5.3 TASK 3 - FIELD INVESTIGATION

This task (corresponding to Task 4 in the Statement of Work for the Consent Order) includes all efforts related to implementing a field investigation at the site. The objectives of the field investigation are to:

- further delineate the areal and vertical extent of soils potentially contaminated with lead;
- further delineate the groundwater contamination plume(s) beneath the site that were identified in Phase I and II and determine the source(s) of the plume(s);
- characterize soil contamination (if any) in the vicinity of suspected sources (e.g., oil separators);
- gather data to support a public health risk assessment, and
- gather data to adequately evaluate potential remedial action technologies/alternatives.

The field investigation will consist of the following subtasks:

1. Subcontracting
2. Mobilization and Demobilization
3. Groundwater Sampling
4. Soil Sampling
   - 4a. auger borings
   - 4b. test pits
5. Sediment Sampling
6. Surface Water Sampling
7. Well Decommissioning
8. Site Survey
9. Monitoring Well Installation (Contingency)

Table 5-1 presents a summary of the analytical program associated with the field investigation.

TABLE 5-1

SUMMARY OF PROPOSED ANALYTICAL PROGRAM
SINCLAIR REFINERY SITE
WELLSVILLE, NEW YORK

	Number of Sample Locations[1]	Samples Per Locations[5]	Analysis: Lead Only	TCL[2] Metal	TCL[3] Volatiles	TCL[4] BNAs	Total Organic Carbon	Grain Size Analysis	Oil and Grease
Groundwater Samples									
Refinery Area: Shallow Wells	27	1	-	12	27	12	-	-	-
Deep Wells	1	1	-	-	1	-	-	-	-
Landfill Area: Shallow Wells	5	1	-	-	5	-	-	-	-
Background Area: Shallow Wells	2	1	-	1	2	1	-	-	-
Total Groundwater Samples			-	13	35	13	-	-	-
Other Water Samples									
o Genesee Surface Water	3	1	-	3	-	-	-	-	-
o Seeps, Outfalls, Ponded Water	6	1	-	6	6	6	-	-	-
Total Other Water Samples			-	9	6	6	-	-	-
Soil Samples									
o Soil Borings	25	3	60	15	-	-	6	6	-
o Drainage Swale Borings	3	3	-	9	9	9	3	3	-
o Test Pits/Trenches	32	1	-	16	16	16	-	-	32
Total Soil Samples			60	40	25	25	9	9	32
Sediment Samples									
o Genesee River	3	1	-	3	3	3	3	3	-
Total Sediment Samples			-	3	3	3	3	3	-

1 Number of samples location is approximate. Numbers may increase as described in text, based on field conditions.
2 TCL metals including lead.
3 Including 10 tentatively identified compounds (TICs)
4 Including 20 tentatively identified compounds (TICs)
5 Does not include blanks and duplicates

5.3.1 Subcontracting (Subtask 1)

This subtask will include the letting of subcontracts to perform the field investigation. The following subcontracts will be required to support the field investigation:

- A surveying subcontract for the surveying of sample locations and new monitoring well locations (if installed) upon completion of the field investigation
- A drilling subcontract for auger boring drilling and soil sampling, test pit excavation and monitoring well installation and development, if necessary
- A laboratory subcontract for chemical analysis of soil, sediment and water samples (The laboratory will be one or more of the following: CompuChem, Aquatech, ENSECO, Versar or ETC.)

5.3.2 Mobilization and Demobilization (Subtask 2)

This subtask will consist of field personnel orientation, equipment mobilization, and the staking of sampling locations.

Each field team member will attend an orientation meeting to become familiar with the history of the site, health and safety requirements, and field procedures.

Equipment mobilization will entail obtaining all sampling equipment needed for the field investigation. Utility hookups and the set up of a field office trailer will also be part of the mobilization effort.

Sample locations will be staked at the beginning of the site operations. These locations will be measured from existing landmarks.

Demobilization will be performed at the completion of each phase of field activities as necessary. Equipment demobilization may include but will not be limited to sampling equipment, drilling subcontractor equipment, health and safety decontamination equipment, and field office trailer and utility hookups.

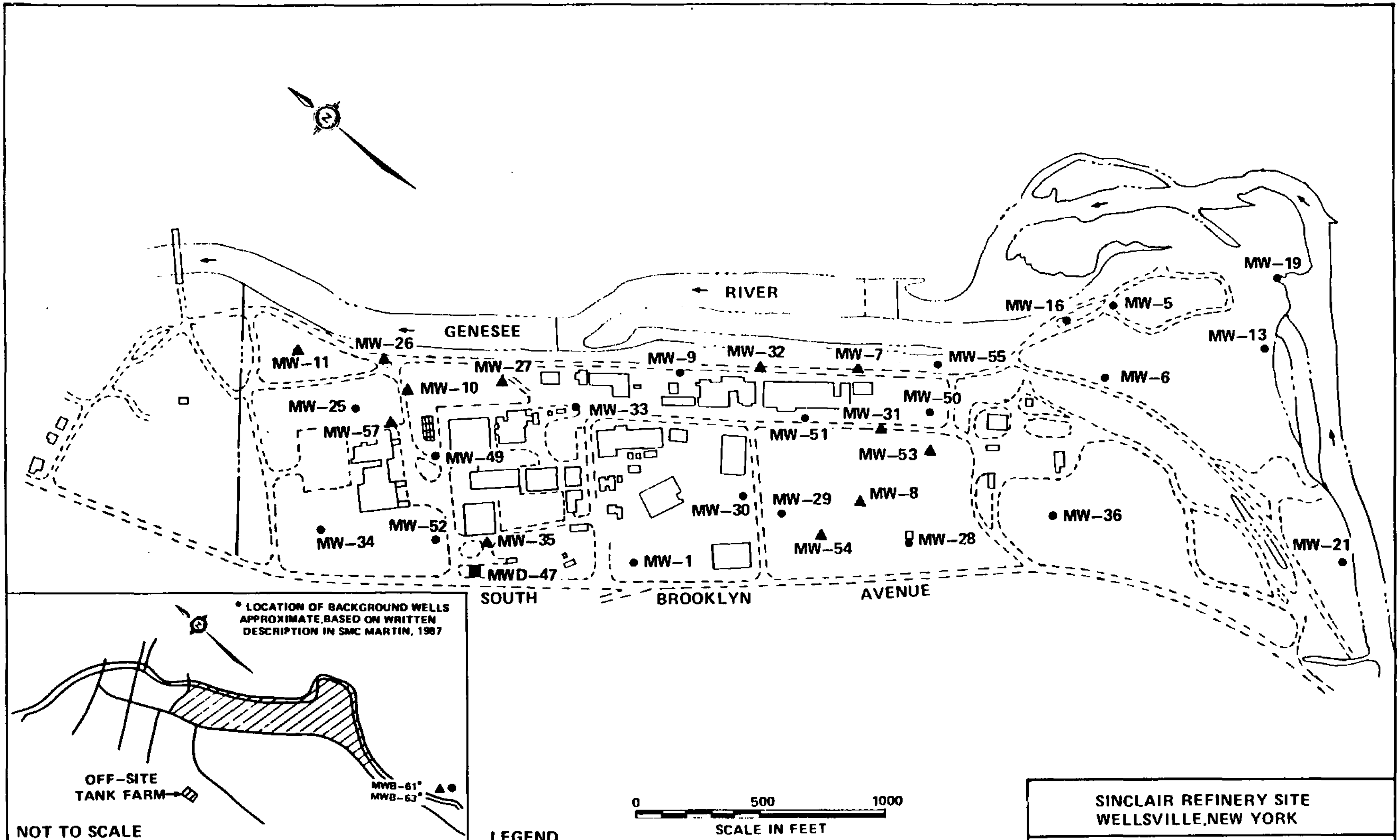
5.3.3 Groundwater Sampling (Subtask 3)

The objective of the groundwater sampling program is to determine the nature and current extent of groundwater contamination beneath the refinery and landfill sites in order to evaluate potential risks and the feasibility of potential remedial action alternatives.

One deep and thirty-four shallow monitoring wells, previously installed during the Phase I and II RI, will be sampled. Well locations are presented in Figure 5-1. The shallow wells include 27 refinery area shallow wells, 5 landfill area wells and 2 background wells.

MWD-47, the deep monitoring well (screened at 100-105 feet), is included in this sampling program since anomalously high levels of VOCs were detected in this well during previous investigations (SMC Martin, 1986a). If VOC concentrations at this location are confirmed during this sampling, two additional deep monitoring wells downgradient (to the north and northeast) of MWD-47 may be installed and sampled in order to assess the extent of deep aquifer contamination in this area. Section 5.3.9 of this work plan describes the monitoring well installation program that is presented on a contingency basis.

In order to insure that water samples obtained from each well are sediment-free, each well will be redeveloped prior to sampling. Wells will be redeveloped by the pump and surge method, utilizing centrifugal or submersible pumps. Wells will be redeveloped for a minimum of two hours or until water is free of sand and silt size particles.



LEGEND

MW-11 ▲ SHALLOW WELL WITH SAMPLE ANALYZED FOR VOCs

MW-34 ● SHALLOW WELL WITH SAMPLE ANALYZED FOR VOCs,BNAs AND METALS

MWD-47 ■ DEEP WELL WITH SAMPLE ANALYZED FOR VOCs

ADAPTED FROM SMC MARTIN PHASE I SITE MAP

SINCLAIR REFINERY SITE
WELLSVILLE,NEW YORK

FIGURE 5-1

GROUNDWATER SAMPLING LOCATIONS

EBASCO SERVICES INCORPORATED

Three to five well volumes will be purged from each well prior to sampling. A stainless steel or teflon bailer will be used to collect the samples. Specific conductance, pH, and temperature will be measured at the start of purging operations and periodically during purging. Stabilization of these parameters from successive purged volumes indicates that the groundwater within the well is at equilibrium with the aquifer.

Groundwater samples will be analyzed by an EPA and NYSDOH-approved laboratory. All samples will be analyzed for TCL VOCs. Approximately 50% of the shallow well samples will also be analyzed for TCL BNAs and metals. No samples will be analyzed for pesticides, PCBs, phenolics or cyanide as these parameters have not been detected in previous investigations at the site or were detected at very low concentrations in isolated samples. Samples chosen for expanded TCL analysis are those at locations where elevated levels of contaminants were previously detected. In addition, samples from a number of wells which did not indicate comparatively high contaminant levels will also undergo the expanded analysis as a confirmation of those non-detect results.

A minimum of two rounds of groundwater level measurements will be taken during the field investigation to confirm existing potentiometric surface maps. Water level measurements will include all existing wells at the site except clay layer wells. The direction of groundwater flow in or out of the landfill area, is of particular interest.

5.3.4 Soil Sampling (Subtask 4)

The objective of the soil sampling program is to determine the nature and extent of soil contamination in those areas which have been identified as areas of potential contamination based on data collected during Phase I and Phase II of the RI. Soil samples collected during this field investigation will be obtained from auger borings and test pits, as described below.

5.3.4.1 Soil Borings (Subtask 4a)

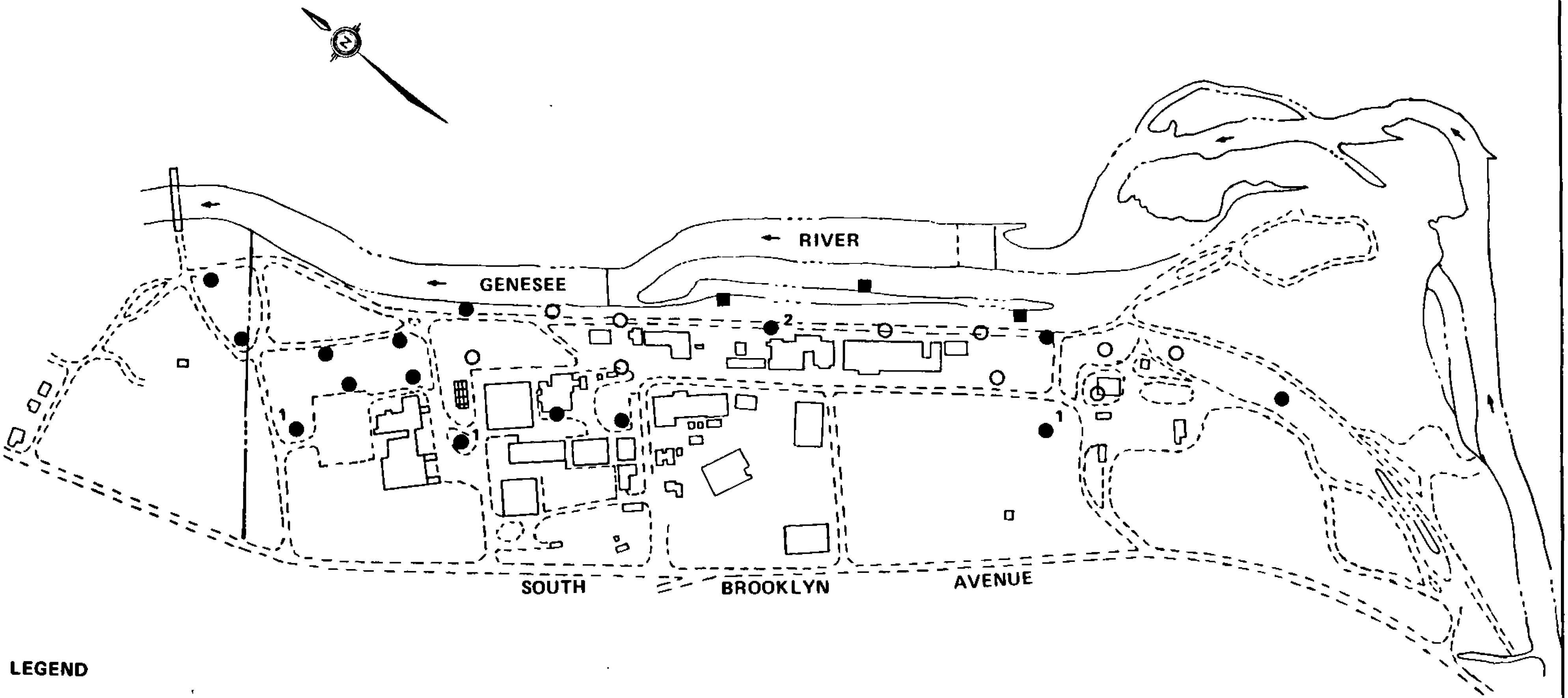
Large-scale compositing of surface soils during the remedial investigation resulted in the preliminary identification of areas with elevated levels of inorganic (primarily lead) contamination (see Section 2.3.3.1). The proposed soil boring soil sampling program is designed to delineate the extent of this contamination in near surface soils, on a finer scale.

Twenty-eight soil borings are planned for this portion of the investigation. Twenty five of the sampling locations, presented in Figure 5-2, have been placed in those areas of elevated concentrations of lead. An additional three soil borings are planned for the main drainage swale (Figure 5-2), because Phase I and II RI results indicate above background levels of both organic and inorganic contaminants in this area. These soil borings will serve to confirm these results and to better define the extent of potential contamination.

Three samples per boring for a total of 84 samples will be collected. Samples will be collected from the 0-6 inch, 2-4 foot and 8-10 foot intervals. A stainless steel scoop may be used to collect the 0-6 inch samples. Hollow stem augers with a 2-inch outer diameter (OD) split spoon sampler will be used to obtain the 2-4 foot and 8-10 foot samples.

Chemical analyses will be performed by an EPA and NYSDOH-approved laboratory. Sixty soil samples will be analyzed for lead only. Approximately 20% (15) of the soil samples (see Figure 5-2) will be analyzed for full TCL metals. This will demonstrate that lead is the only metal of concern in on-site soils. Soil samples from the main drainage swale borings (a total of 9) will be analyzed for full TCL parameters minus pesticides, PCBs, phenolics and cyanide.

The nine soil samples will also be analyzed for total organic carbon (TOC), and grain size distribution (see Figure 5-2). These analytical results will be used to determine partitioning coefficients for contaminants of concern as required for fate and transport modeling. Samples that will undergo this analysis include the three surface samples from the main drainage swale, so that the ability of this area to act as a buffer zone between the site and the Genesee River can be evaluated. The six samples from the site area to undergo these analyses will include both shallow and deep samples.



LEGEND

- ● SOIL BORING SURFACE SAMPLE ANALYZED FOR TCL METALS. REMAINING SAMPLES ANALYZED FOR LEAD ONLY
- ○ SOIL BORING, SAMPLES ANALYZED FOR LEAD ONLY
- ■ SOIL BORING SAMPLES ANALYZED FOR TCL BNAs, VOCs AND METALS. 0–6 INCHES SAMPLE WILL ALSO BE ANALYZED FOR TOC AND GRAIN SIZE

1. 8 TO 10 FOOT SAMPLE WILL ALSO BE ANALYZED FOR TOC AND GRAIN SIZE
2. 0–6 INCH, 2–4 FEET, AND 8 TO 10 FEET SAMPLE WILL ALSO BE ANALYZED FOR TOC AND GRAIN SIZE

ADAPTED FROM SMC MARTIN PHASE I SITE MAP

SINCLAIR REFINERY SITE
WELLSVILLE, NEW YORK

FIGURE 5–2

SOIL BORING LOCATIONS

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Analytical results from the 0-6 inch soil samples will be used primarily to support that portion of the risk assessment which addresses the soil ingestion and dust inhalation pathways. Deeper soil sample results will be used primarily to delineate the areal and vertical extent of soil contamination required to support the feasibility study.

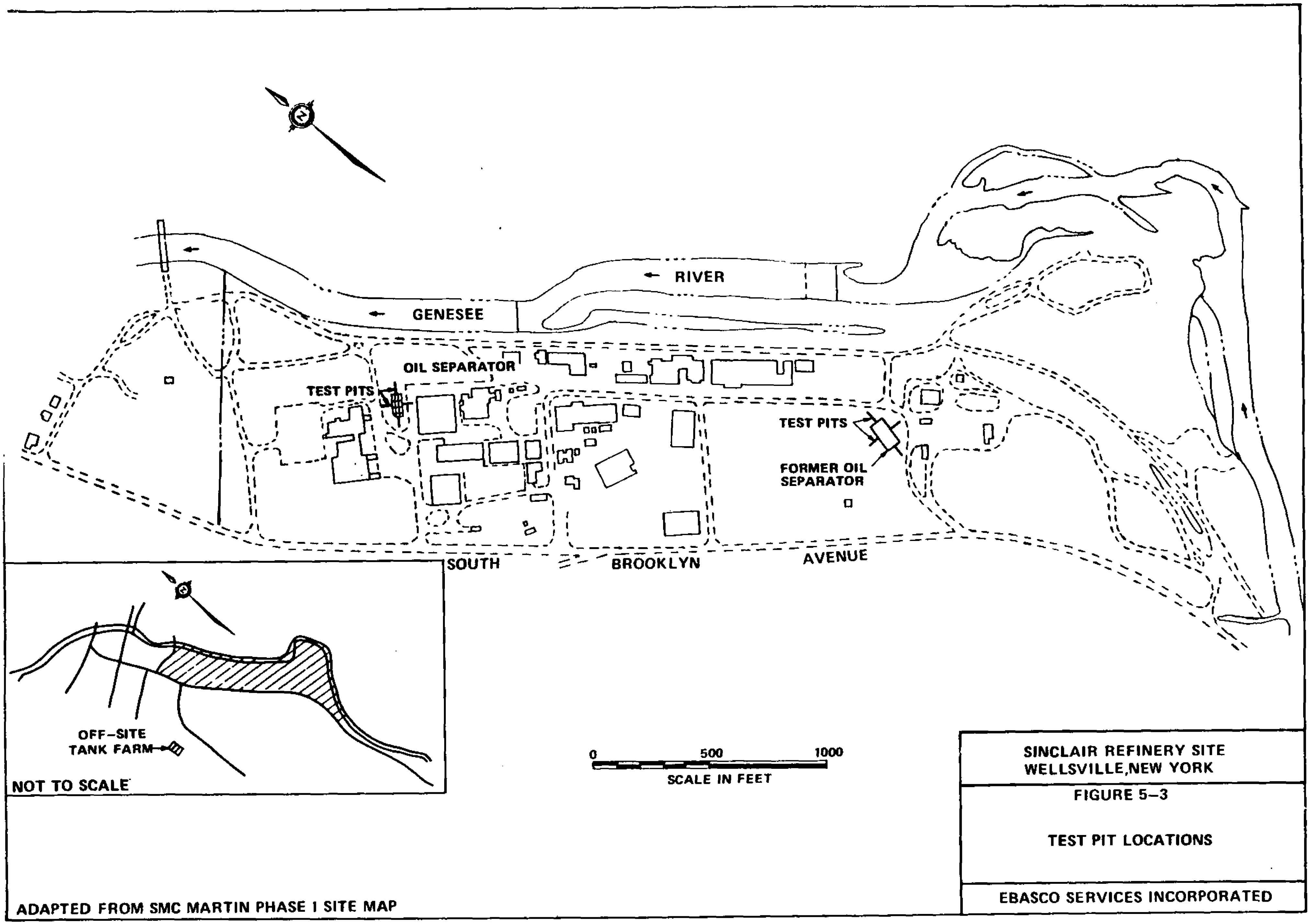
5.3.4.2 Test Pits (Subtask 4b)

In order to determine the nature of soils in the immediate vicinity of the existing oil separator and the oil separator which was on the southern portion of the site (removed), a test pit program is included as part of the field investigation. Test pits have been chosen over soil borings because they allow for a better characterization of soils and a more accurate determination of areal extent of contamination in the vicinity of these potential contaminant sources.

A total of 8 test pits, one on each side of the two rectangular oil separators, are proposed. Figure 5-3 presents the locations of the proposed test pits. Test pits will be excavated to a depth of 5 to 6 feet. An average of 4 samples per test pit, for a total of 32 samples, will be collected for chemical analysis. Samples will be taken in areas of visible contamination and/or in different stratigraphic horizons. Half (16) of the samples will be analyzed for TCL VOCs, BNAs and metals and oil and grease (O&G). The other half (16) will be analyzed for oil and grease only.

5.3.5 Sediment Sampling (Subtask 5)

Sediment samples will be collected during the field investigation in order to confirm contaminant levels detected during the Phase I and II Remedial Investigation. Sediment samples will be obtained at three locations in the Genesee River (Figure 5-4). One sample per location for a total of three samples will be collected. Samples will be collected with a stainless steel scoop and sent to an EPA and NYSDOH-approved laboratory for full TCL analysis minus pesticides, PCBs, phenolics and cyanide. The samples will also be analyzed for TOC and grain size distribution.



SINCLAIR REFINERY SITE
WELLSVILLE, NEW YORK

FIGURE 5–3

TEST PIT LOCATIONS

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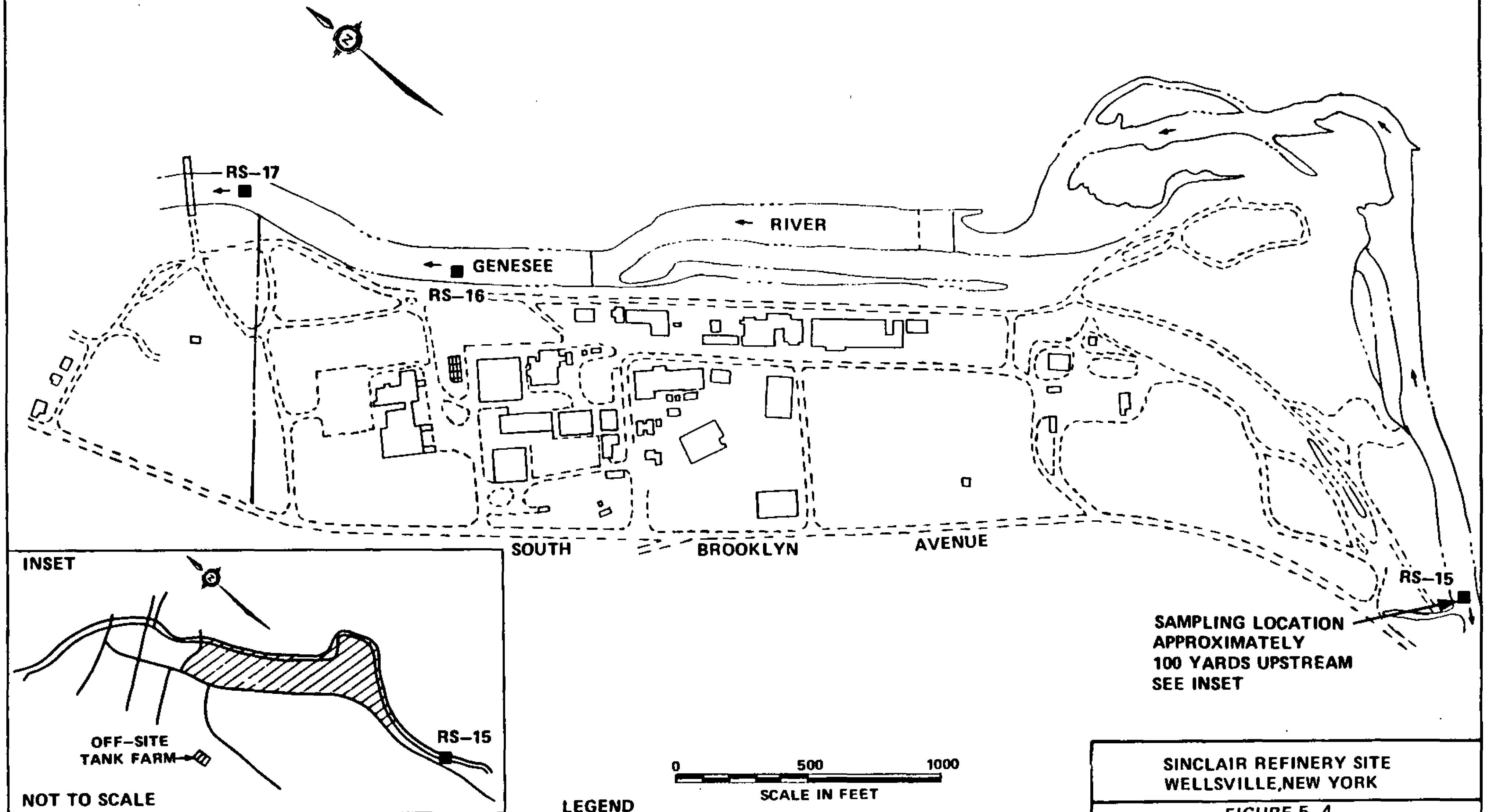

LEGEND

RS-15 ■ SEDIMENT SAMPLING LOCATION TO BE ANALYZED FOR METALS, BNAs, VOCs, TOC AND GRAIN SIZE

ADAPTED FROM SMC MARTIN PHASE I SITE MAP

SINCLAIR REFINERY SITE
WELLSVILLE, NEW YORK

FIGURE 5-4

SEDIMENT SAMPLING LOCATIONS

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5.3.6 Surface Water Sampling (Subtask 6)

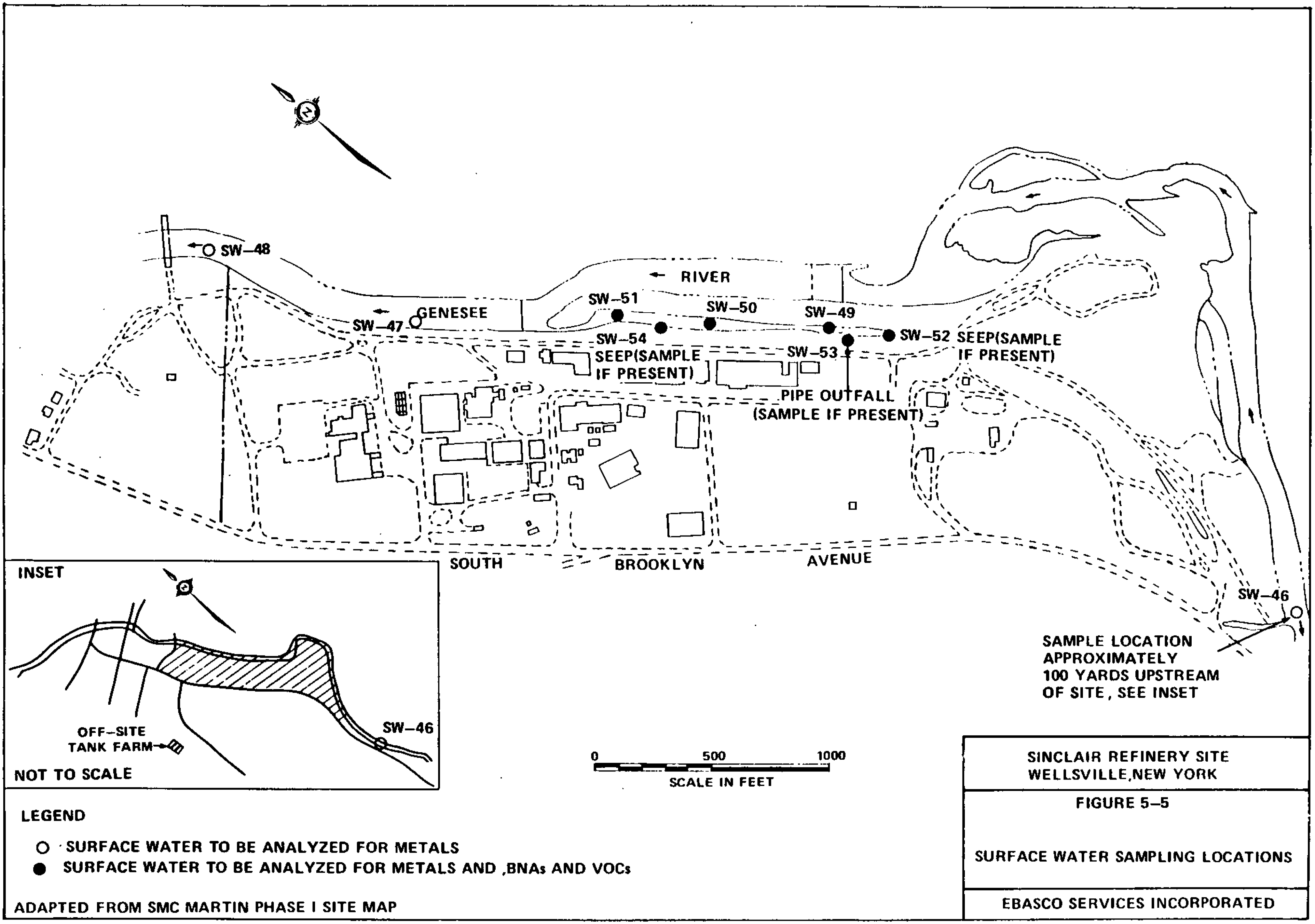
In order to assess the impact of the refinery and landfill areas on the Genesee River and the potential risks associated, a surface water sampling program is included as part of this field investigation.

Surface water samples will be taken from three locations along the Genesee River. Figure 5-5 shows these locations which are upgradient of the site (SW-46), downgradient of the site (SW-48) and in the portion of the river adjacent to the main oil separator (SW-47). Up to six samples from seeps, outfalls, and ponded water associated with the main drainage swale will also be collected. Approximate seep, outfall and ponded water sampling locations are also presented in Figure 5-5.

Surface water samples from the river will be analyzed for TCL metals by an EPA and NYSDOH-approved laboratory. TCL VOC analysis is excluded from this portion of the sampling program as volatile compounds are not expected in surface waters and BNAs were not detected at significant levels. Swale, seep, and outfall samples will be analyzed for TCL BNAs, metals and VOCs. The pH, temperature, and specific conductivity of these samples will be measured in the field during sampling. Measurements of discharge from active outfalls along the river will be approximated at the time of sampling.

5.3.7 Well Decommissioning (Subtask 7)

During the Phase II RI, 12 monitoring wells screened in the clay bed were installed on or near the site (Figure 5-6). Because of questionable construction (well construction data sheets suggest that some of the wells do not discretely monitor the clay bed i.e., the bentonite seal is above the upper clay/shallow aquifer contact) and the potential for these wells to be pathways in which contaminants can move from the upper aquifer towards the lower, the existing clay monitoring wells will be decommissioned during the field investigation. The uncertanity in the validity of the data from these wells negates the potential usefulness of the data and therefore, the wells should be closed.



SINCLAIR REFINERY SITE
WELLSVILLE,NEW YORK

FIGURE 5-5

SURFACE WATER SAMPLING LOCATIONS

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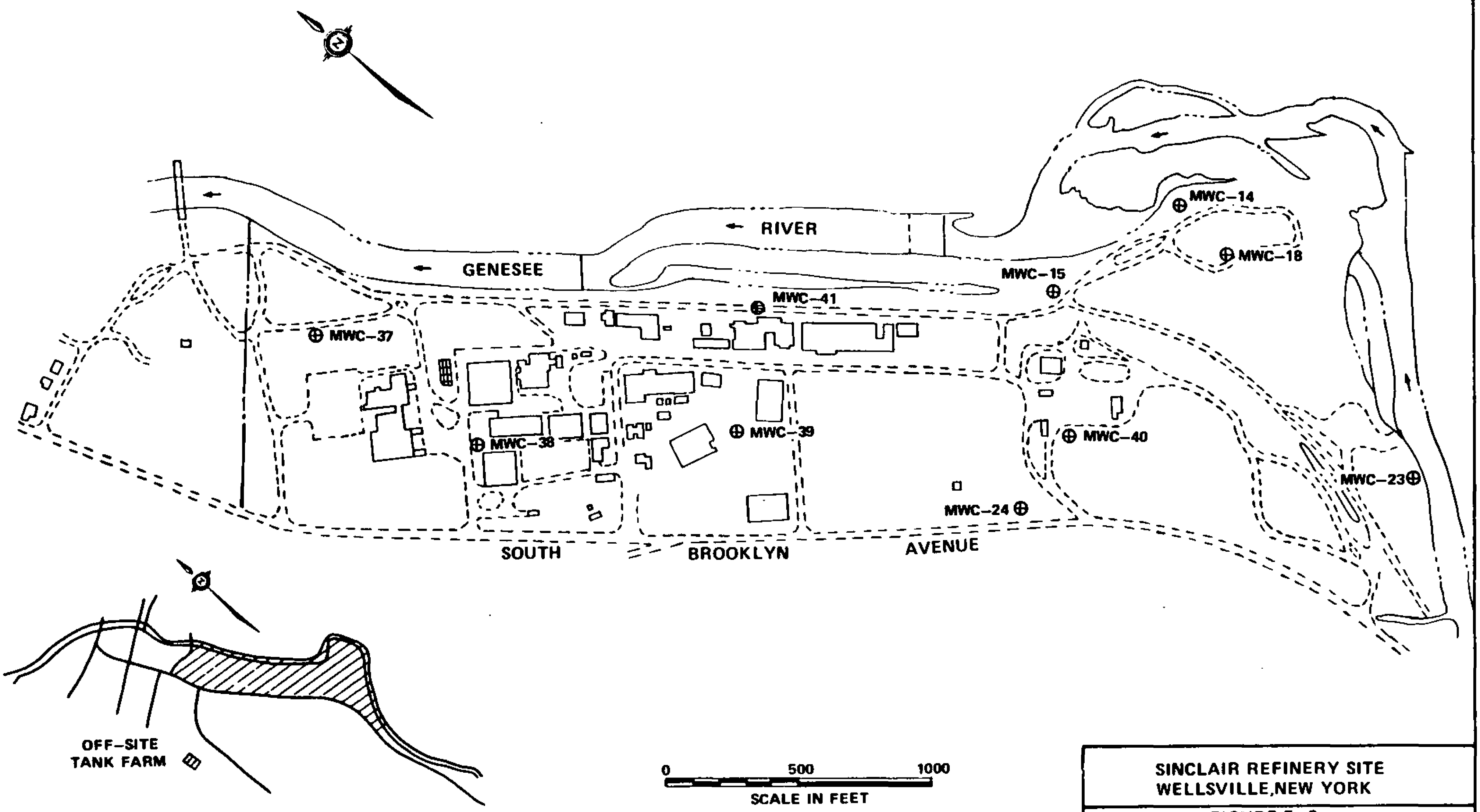

MWC-37 ⊕ CLAY WELLS

NOTE: THE LOCATION OF MWCB-42 AND 62 HAVE NOT BEEN IDENTIFIED. IF LOCATED, THEY WILL ALSO BE DECOMMISSIONED

ADAPTED FROM SMC MARTIN PHASE I SITE MAP

SINCLAIR REFINERY SITE WELLSVILLE,NEW YORK
FIGURE 5–6
CLAY WELLS TO BE DECOMMISSIONED
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Decommissioning of the clay wells will involve the removal of outer protective casings and subsequent drilling with hollow stem augers. Hollow stem auger drilling will serve to free the screen and riser pipe so that it may be pulled from the well and to hold the borehole open for grouting. A bentonite-grout mixture will be pumped into the borehole through the augers with a tremie pipe.

Two of the clay wells, MWCB-42 and MWCB-62 were installed off site to serve as background wells. Records reviewed to date have not identified these well locations. If the wells cannot be located, they will not be decommissioned.

5.3.8 Site Survey (Subtask 8)

Upon completion of field operations, final sampling locations and monitoring well locations and well casing elevations (if new wells are installed - See Subtask 9) will be established by a licensed surveyor. A site map with sampling locations will be prepared.

5.3.9 Monitoring Well Installation (Subtask 9 - Contingency)

During the Phase II RI, one monitoring well screened at depth (MWD-47, screened at 100-105 feet) in the northwestern portion of the site showed levels of xylene (1000 ppb), toluene (50 ppb) and ethylbenzene (36 ppb) (see Section 3.1.9). Because these values appear to be anomalous (other deep wells and shallow wells in the area showed little contamination), investigation of the deep aquifer during this field program is presented on a contingency basis pending confirmation of these contaminant levels.

MWD-47 will be sampled for TCL VOC analysis at the start of field operations. If significant levels of VOC contaminants are detected during this sampling, further investigation of the deep aquifer will be initiated as described below.

The monitoring well installation program, included in this Work Plan on a contingency basis, is designed to investigate the extent of deep groundwater contamination in the vicinity of MWD-47 should significant levels of contamination be detected in this well during this investigation. The program will consist of the installation of two deep monitoring wells downgradient (northeast) of MWD-47. Figure 5-7 presents the location of these tentatively planned monitoring wells.

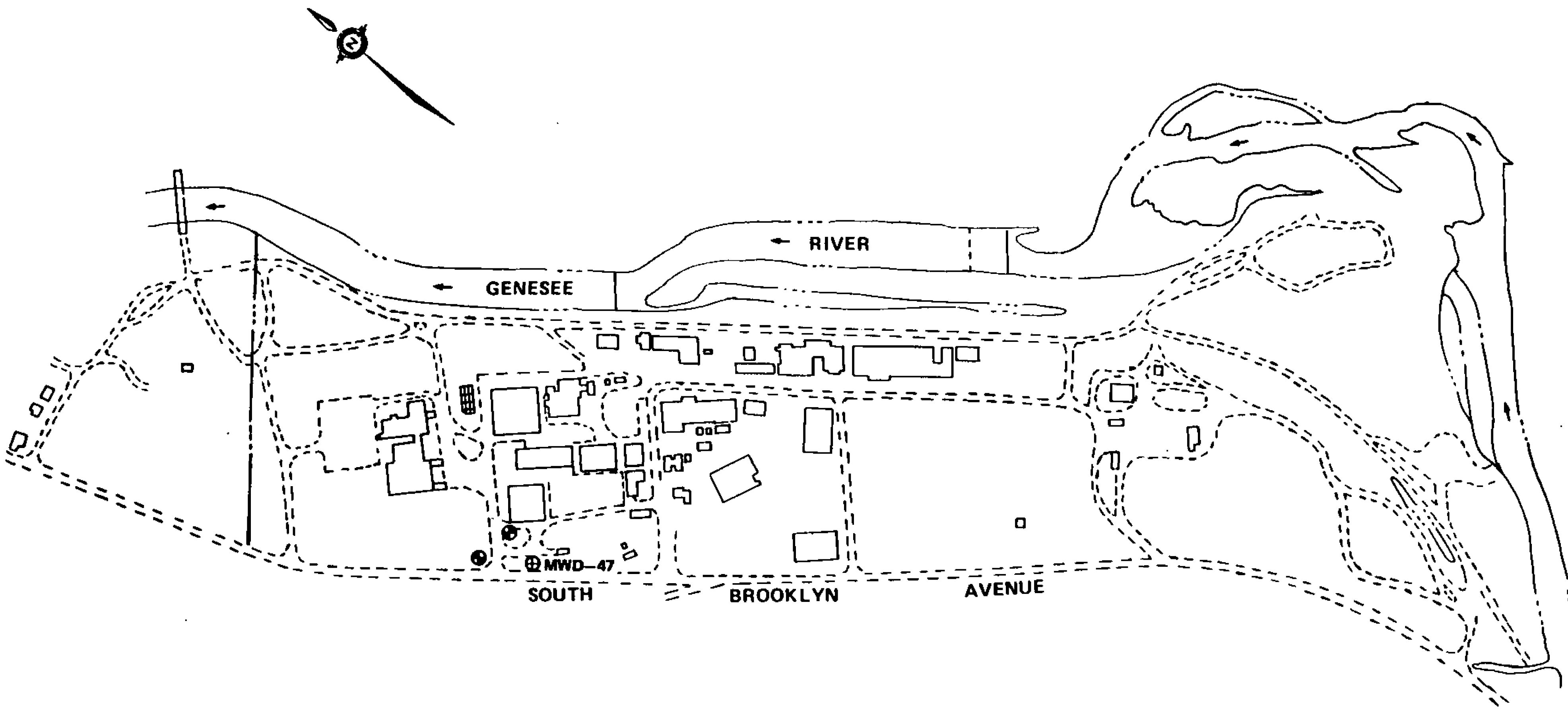
Monitoring wells will be drilled with hollow stem augers to 120 feet or 10 feet below clay, whichever is shallower. Split-spoon samples will be collected every 5 feet for geologic characterization and locating of the clay bed. Wells will be 2 inch OD and constructed of stainless steel screen and riser pipe. Five to fifteen foot well screens will be set just below the clay bed. Precautions will be taken to insure that the bentonite seal above the screen is set below the upper clay contact. If no clay is encountered during drilling, well screens will be set, as in MWD-47, at 100-105 feet.

Following installation, the wells will be developed by pumping and surging. Development will continue until water is free of sand and silt sized particles.

5.4 TASK 4 - SAMPLE ANALYSIS/VALIDATION

All environmental samples gathered as part of Task 3 will be subjected to a laboratory testing and data validation program (corresponding to Task 5 in the Statement of Work in the Consent Order). The data validation portion of the program will verify that the analytical results were obtained following the protocols specified in the QA/QC Short Form (Brossman) and are of sufficient quality to be relied upon in performing the risk assessment, performing the selection of and screening of potential remedial action alternatives, and to support the Record of Decision (ROD).

All samples obtained and analyzed by ARCO will be subjected to data validation by ARCO, using the EPA procedures provided in EPA's (CLP) SOW HW-1 and HW-2 as well as Ebasco's own data validation guideline LS-4. The results of the data validation will be presented to EPA as an Appendix to the RI report. Additionally, ARCO may choose to verify the data validation of existing results obtained by SMC Martin for NYSDEC. A preliminary review of some of the data validation packages from those studies have indicated that some of the results may not be usable because of problems with laboratory procedures. If the sampling proposed in this POP shows similar results to the previous



0 500 1000
SCALE IN FEET

MWD-47 ⊕ EXISTING WELL
PROPOSED WELL

SINCLAIR REFINERY SITE
WELLSVILLE,NEW YORK

FIGURE 5-7

PROPOSED DEEP WELL LOCATIONS
(CONTINGENCY)

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ADAPTED FROM SMC MARTIN PHASE I SITE MAP

sampling, this task may not be implemented. However, if significantly different results are found, the data validation of prior sampling results will likely be implemented to see if the differences can be accounted for.

The samples to be taken and the parameters to be analyzed for each sample are described in Task 3 (Section 5.3) of this work plan. The analytical testing methods, levels of detection and similar information is provided in the Brossman Short Form, a part of the Field Operations Plan.

5.5 TASK 5 - DATA EVALUATION

Data collected during prior Phase I and II sampling programs and data from this phase of Remedial Investigation will be assembled, reviewed, and carefully evaluated to satisfy the objectives of the investigation (as described in Task 5 of the Statement of Work in the Consent Order). When possible, the data evaluation task will be performed concurrently with Tasks 3, 4, and 6, with the goal of preparing the Remedial Investigation Report (Task 8).

The data collected to characterize the site will be organized and analyzed to identify the extent and nature of contamination, determine groundwater flow direction(s), and identify potential on-site source(s) of the contaminants. Field data and data resulting from laboratory analysis will be entered into a data base. Boring logs will be prepared for all completed borings, and stratigraphic information developed from the site borings will be displayed as cross sections or fence diagrams of the site. Water level elevations measured at the wells will be used to develop plot(s) of the piezometric surface in the shallow and deep aquifer and variations in flow directions within the aquifers. Both the horizontal and vertical hydraulic gradients will be evaluated.

The water quality data will be evaluated and mapped to illustrate the areal extent of contaminant plume(s) detected. The breakdown products of contaminants detected will be considered to help evaluate potential sources of the contaminants and their environmental behavior. Groundwater modeling may be performed if needed to support the risk assessment or feasibility study.

Maps of the SMC Martin (Phase I and II) and supplemental sampling locations will be prepared for each media sampled (i.e., soil, biota, sediments, surface water, etc.) to assist in the analyses. Tables comparing the results of the various phases of the Remedial Investigation will be prepared and evaluated. Where differences are observed, field and laboratory procedures, the passage of time and other factors will be evaluated to try and account for the differences. The results of the evaluation will be discussed in the Remedial Investigation Report.

5.6 TASK 6 - ASSESSMENT OF RISKS

5.6.1 Public Health Evaluation

A Public Health Evaluation will be conducted (as described in Tasks 5 and 7 of the Statement of Work in the Consent Order) to determine the extent to which contaminants at the Sinclair Refinery Site may present risks to public health or the environment. This quantitative assessment will evaluate conditions at the site in the absence of any further remedial actions (i.e., it will constitute an assessment of the "No Action" remedial alternative). Evaluation of the No-Action alternative is required under Section 300.68(f)(v) of the National Contingency Plan (NCP). By conducting such an assessment, it will be possible to determine if remedial actions are required for any areas of the site. In addition, the baseline assessment will also provide a basis for determining the reduction in risk resulting from remediation. The baseline assessment will be based on the RI environmental monitoring data and data from the Phase I and Phase II studies conducted by SMC Martin. The main steps in this assessment will be performed in accordance with the latest EPA policy and guidance on risk assessment in general (EPA 1986a,b,c) and for Superfund Sites in particular (EPA 1986d).

The Public Health Evaluation will consist of the following five steps:

1 Selection of chemicals of concern;

2 Identification of potential exposure pathways;

3 Estimation of contaminant concentrations at potential exposure points;

4 Comparison of projected chemical concentrations to applicable or relevant and appropriate federal and state requirements, criteria, and guidelines (ARARs), and

5 Quantitative characterization of risks.

5.6.1.2 Selection of Indicator Chemicals

The first task in the evaluation will be the selection of chemicals considered most likely to pose risks to human health and the environment for detailed analysis in the risk assessment. The selection process will include a review of historic and new environmental monitoring data for surface soils, groundwater, river, swale and outfall water and sediment, and other potential source locations.

Factors that will be considered in selecting constituents of concern will include the presence of chemicals in background samples and in laboratory, field, and trip blanks, the magnitude and extent (e.g., frequency of detection) of contamination, the environmental mobility and persistence of the chemicals, and their relative toxicities. A key element in this selection process is a comparison of site concentrations to background levels in appropriate media; naturally occurring chemicals present at background concentrations will not be considered to be site-related and will not be evaluated in the assessment. In addition, chemicals present in blanks at similar concentrations (i.e., laboratory and field contaminants) will not be selected for the detailed analysis. If fewer than 15 chemicals are found at the site, a quantitative risk analysis will be performed for all of the detected pollutants posing potential risks to health and the environment. If a greater number of compounds are detected during the investigation, 10-15 indicator chemicals will be selected for the risk analysis. These chemicals will be selected on the basis of their relative concentrations, mobility, persistence, and toxicities. A preliminary list of indicator compounds is given in Section 3.2.

5.6.1.3 Identification of Potential Exposure Pathways

In this step, human activity patterns near the Sinclair Refinery Site will be qualitatively evaluated and combined with chemical source, release, and transport media information to identify potential exposure pathways under both present and future site and land use conditions.

An exposure pathway is defined by four elements: (1) a source and mechanism of chemical release to the environment; (2) an environmental transport media (e.g., air, groundwater) for the released chemical; (3) a point of potential contact of humans or biota with the contaminated medium (the exposure point); and (4) an exposure route (e.g., drinking water or soil ingestion) at the exposure point. All four of the elements must be present for an exposure pathway to be considered "complete." In the public health evaluation, only complete exposure pathways are evaluated.

The list of potential contaminant sources includes, but is not limited to: the abandoned oil separator, refinery sewers, surface soils, site groundwater; swale and outfall sediments; swale and outfall water; river water and river sediments. Contaminants from these sources may migrate through the environment by infiltration, percolation, surface runoff and volatilization. For each combination of release source and transport medium, points at which the exposures to human and/or ecological receptors may occur will be identified. Available information indicates that the following receptors and points of exposure may be the most likely to be relevant at this site: users of the site (workers, students), nearby residents, recreational users of the Genesee River, future users of groundwater if the aquifer is ever developed, aquatic life, and flora or fauna in the vicinity of the site. Contaminant concentrations to which these receptors may potentially be exposed will be estimated according to the methodology presented below.

5.6.1.4 Estimation of Exposure Point Concentrations

After potential exposure pathways have been identified, concentrations for each constituent of concern will be estimated at each of the exposure point locations. Annual average concentrations of substances will be estimated for each environmental medium (groundwater, surface soil, sediments or surface water) through which potential exposures could occur.

Estimating concentrations at each exposure point will involve quantification of the following factors: 1) the amounts of chemicals that could be released to the environment over time by the various sources identified in the exposure pathway analysis; 2) prediction of the environmental transport and fate of each chemical of concern in the identified medium; and 3) where the data permit, derivation of time-dependent concentrations at the points of exposure. Deriving these concentrations may require the estimation of percolation through soils, volatilization from on-site soils or surface waters, entrainment of contaminated on-site soil and dust, groundwater flow, surface water flow, and/or sediment transport. Where exposure point concentrations cannot be determined directly from monitoring data, transport models will be used to predict contaminant migration to surface water, groundwater and sediments. For each chemical and each exposure pathway, the outcome of this subtask will be a long-term environmental concentration at the exposure point.

To provide bounds on the uncertainty of estimates of exposures and risks, two cases will be evaluated for each pathway scenario. The first will represent a "best estimate" based on the most representative contaminant concentrations (e.g., geometric or Windsorized mean) in selected media and realistic exposure conditions. The second, a "plausible maximum," will be based on maximum detected concentrations and upperbound, but still plausible, estimates of potential exposures.

5.6.1.5 Comparison to ARARs

EPA's guidelines indicate that the projected concentrations of the chemicals of concern at exposure points should be compared to applicable or relevant and appropriate federal and state standards, criteria, and guidelines (ARARs) to estimate the degree and extent of risk to public health and the environment (including plants, animals, and ecosystems).

At the present time, the Safe Drinking Water Act, Maximum Contaminant Levels (MCLs) and Clean Air Act National Ambient Air Quality Standards (NAAQS) are the only relevant/applicable federal ambient health standards. State water quality standards promulgated under the Clean Water Act and state groundwater standards are also relevant and applicable. Standards or guidelines promulgated by New York will also be considered as potential ARARs. Other guidelines that may be used are Maximum Contaminant Level Goals (MCLGs) and the health advisories that EPA's Office of Drinking Water has developed for numerous chemicals in drinking water.

5.6.1.6 Quantitative Risk Assessment

A quantitative risk assessment will be conducted for all the selected chemicals of concern if, as is expected, ARARs are not available for all of the selected contaminants in all relevant environmental media.

To quantitatively assess the potential for adverse health effects associated with a site, the magnitude of potential human exposures to the selected contaminants of concern must be estimated. Intakes by potentially exposed populations (via inhalation, ingestion, or dermal absorption) will be calculated separately for each chemical in each environmental medium (e.g., air, groundwater, surface water, biota, and soil) for all selected pathways of exposure. Chemical intakes for each human exposure scenario will be estimated based on the frequency and duration of exposure and the assumed rate of media intake (e.g., amount of water ingested per day). Intakes are expressed as the amount of a chemical taken into the body per unit body weight per day (mg/kg/day) and are referred to as chronic daily intakes (CDIs). The CDI is averaged over a lifetime for carcinogens (EPA 1986a) and over the assumed exposure period for noncarcinogens. Parameter values used to estimate CDIs will be based on site-specific considerations where possible and information published in the scientific literature. Assumptions supporting these estimates will be clearly outlined and documented to the extent possible. As described previously, parameter values will be selected to render estimates for both average and plausible maximum exposure scenarios. If necessary, the exposure of nonhuman receptors will be estimated based on sampling results in conjunction with relevant models suggested in the scientific literature. Environmental concentrations that have been associated with adverse effects in the field or laboratory studies will be identified when available.

Critical toxicity values (i.e., numerical values derived from dose-response information for individual chemicals) will be used in conjunction with the intake estimates to characterize potential risks. EPA's Integrated Risk Information System (IRIS) will be used as the primary source of critical human toxicity values. Several different types of critical toxicity values may be used, including the following:

1) the reference dose (RfD) for chronic exposure to evaluate noncarcinogenic effects, and

2) the carcinogenic potency factor (CPF) to evaluate carcinogenic effects.

o <u>Noncarcinogens</u>

The RfD values represent levels of exposure below which adverse health effects are unlikely to occur. They are derived by applying safety factors to no-observed-effect levels from animal studies and/or epidemiological studies.

To assess noncarcinogenic risks the CDI will be compared to the RfD. Where the CDI exceeds the RfD, an unacceptable public health risk will be assumed to exist. In accordance with EPA guidelines (EPA 1986d), a hazard index will be used to assess the risks of exposure to multiple noncarcinogenic chemicals. This index sums the ratios of the CDI to the RfD over all the selected chemicals present. This assumes that the risks due to exposure to multiple chemicals are additive, an assumption that is probably valid for compounds which have the same target organ or cause the same effect. If the hazard index results in a value greater than unity, the compounds in the mixture will be separated by critical effect and separate hazard indices will then be derived for each effect.

Throughout the risk assessment process, intakes and risks associated with oral, dermal absorption, and inhalation exposure pathways will be estimated separately. However, the possible effects of multimedia exposure will be evaluated by summing the hazard indices across those exposure pathways that could occur to the same population. This will assure that acceptable levels are not being exceeded by combined intakes when multiple exposure pathways exist.

- <u>Potential Carcinogens</u>

For potential carcinogens, the carcinogenic potency factor (CPF), defined as the slope of a calculated dose-response curve, will be used to estimate excess lifetime cancer risks at low dose levels. This factor is estimated from the upper 95 percent confidence limit of the slope of the dose-response curve derived from a linearized extrapolation model. Risk will be directly related to intake at low levels of exposure using the equation:

$$\text{Risk} = \text{CDI} \times \text{CPF}$$

This equation is valid only for risks below 10^{-2} (one in one hundred) because of the assumption of low-dose linearity. For sites where this model estimates excess carcinogenic risks of 10^{-2} or higher, an alternative model may be considered. Cancer risks for chemical mixtures will be assumed to be additive, unless information is available that suggests antagonism or synergism. Thus, the result of the assessment will be an upper 95 percent confidence level of the total excess lifetime carcinogenic risk for each exposure point. Cancer risks will be summed across exposure pathways where relevant.

5.6.2 Environmental Assessment

An environmental assessment will be performed for the Sinclair Refinery Site with the objective to ascertain existing and potential future environmental impacts of the site if no remedial action is taken. The results of this analysis will then be used in the development and evaluation of remedial alternatives.

A primary methodology to be utilized in assessing aquatic environmental impacts is a comparison of site water concentration levels to water quality criteria for the protection of aquatic life. These aquatic life criteria, based primarily on toxicity, are listed within US EPA Ambient Water Quality Criteria Documents (US EPA, 1980). These data will be combined with the biota sampling done in the Phase I study to qualitatively determine the aquatic impact.

To evaluate terrestrial environmental impacts, published toxicity information concerning the various chemical constituents to terrestrial organisms will be considered in tandem with observations and inventories of biota made in the Phase I and Phase II investigations. If warranted, concentrations of numerous on-site contaminated matrices will be extrapolated to probable contaminant concentrations at or within the organism (i.e., extrapolation allowing for dilution, organism uptake, bioaccumulation, etc). Whenever possible, the level of detail will be consistent with EPA's Endangerment Assessment Handbook (1985b).

5.7 TASK 7 - TREATABILITY STUDY/PILOT TESTING

The preliminary scoping of remedial alternatives, presented in Section 3.3 of this Work Plan, considered certain conventional and innovative technologies which may be applicable to the site. Treatability studies/pilot testing (Task 8 in the Statement of Work in the Consent Order) are typically conducted during the RI phase of an RI/FS project. In this case, however, a substantial amount of geohydrologic and chemical data have been collected during Phase I (1984) and Phase II (1986) which seem to indicate that remediation, if any, could consist of conventional techniques such as excavation of "hot spots" and disposal of the material in the central elevated landfill area (CELA). Conventional techniques such as this would not require any treatability study/pilot testing.

Based on certain significant data gaps such as the need for collecting discrete samples to adequately characterize vertical and horizontal soil contamination in several areas of the site, it would be premature to speculate as to which remedial technologies might be recommended, and which, if any, would require treatability study/pilot testing. Ebasco proposes to complete the field investigation presented in Section 5.3 of this Work Plan, analyze the resulting data, conduct the Risk Assessment, and then determine whether the technologies remaining as potential remedial alternatives need to be tested in order to evaluate and develop technical feasibility, reliability and cost information for their application to this site.

5.8 TASK 8 - REMEDIAL INVESTIGATION REPORT

After completion of Tasks 3, 4, 5 and 6, a draft Remedial Investigation (RI) Report (Task 6 in the Statement of Work in the Consent Order) will be prepared and submitted to EPA for review. The report will follow the latest EPA formats as described in EPA guidance documents such as the 1985 "Guidance on Remedial Investigation Under CERCLA" and the 1988 draft "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA". A draft outline of the report, adapted from the 1988 guidance is shown on Table 5-2. This outline should be considered a draft and subject to some revision, based on the data obtained. Each section of the report will be subdivided to discuss different areas or operable units at the site.

The report will include discussion of the Phase I and II data as well as the data and analyses performed as part of this Remedial Investigation with respect to the refinery portion of the site and the groundwater in the area of the landfill.

When the draft RI report is completed, it will be submitted to the EPA for review and comment. Within 20 business days of receipt of EPA's written comments ARCO will revise the report and submit the amended report to EPA. When the EPA determines that the report is acceptable, the report will be deemed the Final RI Report.

TABLE 5-2

SINCLAIR REFINERY SITE RI REPORT FORMAT

Executive Summary

1 Introduction
- 1.1 Purpose of Report
- 1.2 Site Background
  - 1.2.1 Site Description
  - 1.2.2 Site History
  - 1.2.3 Previous Investigations
- 1.3 Report Organization

2 Study Area Investigation
- 2.1 Surface Features (topographic mapping, etc.) (natural and manmade features)
- 2.2 Contaminant Source Investigations
- 2.3 Surface-Water and Sediment Investigations
- 2.4 Geological Investigations
- 2.5 Soil Investigations
- 2.6 Groundwater Investigations
- 2.7 Ecological Investigations

3 Physical Characteristics of the Study Area
- 3.1 Surface Features
- 3.2 Meteorology
- 3.3 Surface Water Hydrology
- 3.4 Geology
- 3.5 Soils
- 3.6 Hydrogeology
- 3.7 Demography and Land Use
- 3.8 Ecology

4 Nature and Extent of Contamination
  - 4.1.1 Sources
  - 4.1.2 Soils
  - 4.1.3 Groundwater
  - 4.1.4 Surface Water and Sediments

5 Contaminant Fate and Transport
- 5.1 Potential Routes of Migration (i.e., air, groundwater, etc.)
- 5.2 Contaminant Persistence
  - 5.2.1 If they are applicable (i.e., for organic contaminants). Describe estimated persistence in the study area environment and physical, chemical and/or biological factors of importance for the media of interest.
- 5.3 Contaminant Migration
  - 5.3.1 Discuss factors affecting contaminant migration for the media of importance (e.g., sorption into soils, solubility in water, movement of groundwater, etc.)

TABLE 5-2

SINCLAIR REFINERY SITE RI REPORT FORMAT

5.3.2 Discuss modeling methods and results if applicable.

6 Baseline Risk Assessment
6.1 Public Health Evaluation
6.1.1 Exposure Assessment
6.1.2 Toxicity Assessment
6.1.3 Risk Characterization
6.2 Environmental Assessment

7 Summary and Conclusions
7.1 Summary
7.1.1 Nature and Extent of Contamination
7.1.2 Fate and Transport
7.1.3 Risk Assessment
7.2 Conclusions
7.2.1 Data Limitations and Recommendations for Future Work
7.2.2 Recommended Remedial Action Objectives

Appendices

A. Analytical Data QA/QC Evaluation Results
B. Risk Assessment Models

6.0 WORK PLAN FOR FEASIBILITY STUDY

Based on the results of the Remedial Investigation outlined in Section 5.3, and the useable portions of existing data collected during previous field investigations, a Feasibility Study (FS) will be performed for the Sinclair Refinery Site. This FS will consist of three tasks:

Task 9 - Remedial Alternatives Screening;
Task 10 - Remedial Alternatives Evaluation;
Task 11 - Feasibility Study Report

Throughout the FS process, references such as the following will be used: "Guidance on Feasibility Studies Under CERCLA" (EPA 1985a), "The National Oil and Hazardous Substance Pollution Contingency Plan: Final Rule, NCP" (EPA 1985c), "Compendium of Costs of Remedial Technologies at Hazardous Waste Sites" (EPA, 1985d) and J.W. Porter's December 1986 and July 1987 Memoranda "Interim Guidance on Superfund Selection of Remedy", and "Guidance for Conducting RI/FS under CERCLA" (EPA, 1988), as well as technology-specific guidance and evaluation documents as appropriate.

The overall objective of the FS is to develop and evaluate remedial alternatives that would enable ARCO to recommend a remedial action that is:

- Protective of human health and the environment;
- Cost effective;
- In accordance with SARA, and
- In accordance, to the extent practicable, with the NCP.

6.1 TASK 9 - REMEDIAL ALTERNATIVE SCREENING

After data from the existing data base and those collected during the RI are evaluated, (Task 3 through 7), the preliminary remedial response objectives presented in Section 3.3.1 will be refined and developed or, if appropriate, eliminated. Based on the then established remedial response objectives and the results of the risk assessment (Task 6), the initial screening of remedial alternatives (Task 5 in the Statement of Work in the Consent Order) will be performed according to the procedures recommended in "Guidance on Feasibility Studies under CERCLA" (EPA, 1985a), "Interim Guidance on Superfund Selection of Remedy" (EPA, 1986) and "Guidance for Conducting RI/FS under CERCLA" (EPA, 1988).

According to later guidances (EPA, July 1987a; EPA, 1988), development of alternatives will be performed concurrent with the RI. This Work Plan includes a preliminary identificaton and discussion of alternatives, although the process of identifying and screening potential alternatives will be ongoing throughout the RI, as new technological and/or site-specific data emerge. The subtasks comprising Task 9 will accomplish the following objectives:

- o Development of remedial response objectives and general response actions;
- o Identification and screening of remedial technologies, and
- o Development and screening of remedial alternatives.

6.1.1 Development of Remedial Response Objectives and General Response Actions

Based on the data collected in the RI along with other existing data, the remedial response objectives will be developed. Prior to the development of these objectives, any significant site problems and contaminant pathways will be identified. Considering these problems and pathways, the remedial response objectives which would eliminate or minimize substantial risks to public health and the environment will be developed further, including a refinement of the ARARs with consideration given to site-specific conditions. Based on the response objectives, general response actions will be delineated to address each of the site problem areas and to meet the clean up goals and objectives. These response actions will form the foundation for the screening of remedial technologies. General response actions considered will include the "no action" alternative as a baseline against which all other alternatives can be compared.

6.1.2 Identification of Applicable Technologies and Development of Alternatives

Based on the remedial response objectives and each identified general response action, potential treatment technologies and their associated containment or treatment and disposal requirements will be identified. A pre-screening of these potential treatment technologies for suitability as part of a remedial alternative will be conducted.

Technologies will then be eliminated which may prove extremely difficult to implement, may not achieve the remedial objective in a reasonable time, or are not applicable and not feasible based on the site-specific conditions. A preliminary identification of technologies has been completed and the results can be found in Section 3.3 - Scoping of Remedial Alternatives. However, this preliminary identification will be finalized based on the results of the RI and the established remedial response objectives. The revised list of potential remedial technologies/alternatives will be developed as part of Task 9.

The development of alternatives requires combining appropriate remedial technologies such as those listed in Table 3-12 in a manner that will satisfy the site remediation strategies or response objectives established in Section 3.0 and refined based on the results of the RI.

As required by SARA, treatment alternatives will be developed in each of the following categories:

- An alternative for treatment that would eliminate, or minimize to the extent feasible, the need for long-term management (including monitoring) at the site;

- Alternatives that would use treatment as a primary component of an alternative to address the principle threats at the site;

- An alternative that relies on containment, with little or no treatment but is protective of human health and the environment by preventing potential exposure and/or by reducing mobility; and

- A No-Action alternative.

6.1.3 Screening of Remedial Alternatives

The list of potential remedial alternatives developed above will be screened (Task 8 in the Statement of Work in the Consent Order). The objectives of this effort is to reduce the number of technologies and alternatives for further analysis while preserving a range of options. This screening will be accomplished by evaluating alternatives principally on the basis of effectiveness and implementability and cost as specified in the most recent EPA guidance document (EPA 1988). These screening criteria are briefly described below:

- Effectiveness Evaluation

  The effectiveness evaluation will consider the capability of each remedial alternative to protect human health and the environment. Each alternative will be evaluated as to the protection it would provide, and the reductions in toxicity, mobility or volume of contaminants which it would achieve.

- Implementability Evaluation

  The implementability evaluation will be used to measure both the technical and administrative feasibility of constructing, operating and maintaining a remedial action alternative. In addition, the availability of the technologies involved in a remedial alternative will also be considered.

Innovative technologies will be considered throughout the screening process if there is a reasonable belief that they offer potential for better treatment performance or implementability, few or lesser adverse impacts than other available approaches, or lower costs than demonstrated technologies.

- <u>Cost Evaluation</u>

  Cost evaluation will include estimates of capital costs, annual operation and maintenance (O&M) cost, and present worth analysis. These conceptual cost estimates are order-of-magnitude estimates, and will be prepared based on:

  - Preliminary conceptual engineering for major construction components, and

  - Unit costs of capital investment and general annual operation and maintenance costs available from EPA documents (EPA, 1985d and EPA, 1985e) and from Ebasco in-house files.

6.2 TASK 10 - DETAILED EVALUATION OF REMEDIAL ALTERNATIVES

The remedial alternatives which pass the initial screening will be further evaluated (Task 9 in the Statement of Work in the Consent Order). The evaluation will conform to the requirements of the NCP, in particular, Section 300.68 (h), Subpart F, and will consist of a technical, environmental and cost evaluation as well as an analysis of other factors, as appropriate. The detailed evaluation will follow the process specified in the "Guidance on Feasibility Studies Under CERCLA" (EPA 1985a), as updated in J.W. Porter's December 1986 and July 1987 Memoranda on "Interim Guidance on Superfund Selection of Remedy", and "Guidance for Conducting RI/FS under CERCLA" (EPA, 1988).

In the latter guidances (EPA, 1987; EPA, 1988), a set of nine evaluation criteria have been developed which are to be applied in the evaluation of each Remedial Alternative.

Table 6-1 presents the nine evaluation criteria and the factors considered for each evaluation criteria. A brief description of each criteria is provided:

- <u>Short-Term Effectiveness</u>

This criterion addresses the effects of the alternative during the construction and implementation phase until the remedial actions have been completed and the selected level of protection has been achieved. Each alternative is evaluated with respect to its effects on the community and on-site workers during the remedial action, environmental impacts resulting from implementation, and the amount of time until protection is achieved.

- <u>Long-Term Effectiveness</u>

This criterion addresses the results of a remedial action in terms of the risk remaining at the site after the response objectives have been met. The primary focus of this evaluation is to determine the extent and effectiveness of the controls that may be required to manage the risk posed by treatment residuals and/or untreated wastes. The factors to be evaluated include the magnitude of remaining risk (measured by numerical standards such as cancer risk levels), and the adequacy, suitability and long-term reliability of management controls for providing continued protection from residuals (i.e., assessment of potential failure of the technical components).

- <u>Reduction of Toxicity, Mobility, and Volume</u>

This criterion addresses the statutory preference for selecting remedial actions that employ treatment technologies that permanently and significantly reduce toxicity, mobility or volume of the contaminants. The factors to be evaluated include the treatment process employed, the amount

Table 6-1

DETAILED EVALUATION CRITERIA

- SHORT-TERM EFFECTIVENESS
  - Protection of community during remedial actions
  - Protection of workers during remedial actions
  - Time until remedial response objectives are achieved
  - Environmental impacts

- LONG-TERM EFFECTIVENESS
  - Magnitude of risk remaining at the site after the response objectives have been met
  - Adequacy of controls
  - Reliability of controls

- REDUCTION OF TOXICITY, MOBILITY AND VOLUME
  - Treatment process and remedy
  - Amount of hazardous material destroyed or treated
  - Reduction in toxicity, mobility or volume of the contaminants
  - Irreversibility of the treatment
  - Type and quantity of treatment residuals

- IMPLEMENTABILITY
  - Ability to construct technology
  - Reliability of technology
  - Ease of undertaking additional remedial action, if necessary
  - Monitoring considerations
  - Coordination with other agencies
  - Availability of treatment, storage capacity, and disposal services
  - Availability of necessary equipment and specialists
  - Availability of prospective technologies

- COST
  - Capital costs
  - Annual operating and maintenance costs
  - Present worth analysis

TABLE 6-1

DETAILED EVALUATION CRITERIA

- COMPLIANCE WITH ARARs
  - Compliance with chemical-specific ARARs
  - Compliance with action-specific ARARs
  - Compliance with location-specific ARARs
  - Compliance with appropriate criteria, advisories and guidances

- OVERALL PROTECTION OF HUMAN HEALTH AND ENVIRONMENT

- STATE ACCEPTANCE

- COMMUNITY ACCEPTANCE

of hazardous material destroyed or treated, the degree of reduction expected in toxicity, mobility and volume, and the type and quantity of treatment resuiduals.

o <u>Implementability</u>

This criterion addresses the technical and administrative feasibility of implementing an alternative and the availability of various services and materials required during its implementation. Technical feasibility considers construction and operational difficulties, reliability, ease of undertaking additional remedial action (if required), and the ability to monitor its effectiveness. Administrative feasibility considers activities needed to coordinate with other agencies (e.g., state and local) in regards to obtaining permits or approvals for implementing remedial actions.

o <u>Cost</u>

This criterion addresses the capital costs, annual operation and maintenance costs, and present worth analysis.

Capital costs consist of direct (construction) and indirect (nonconstruction and overhead) costs. Direct costs include expenditures for the equipment, labor, and material necessary to perform remedial actions. Indirect costs include expenditures for engineering, financial, and other services that are not part of actual installation activities but are required to complete the installation of remedial alternatives. Annual operation and maintenance costs are post-construction costs necessary to ensure the continued effectiveness of a remedial action. These costs will be estimated to provide an accuracy of +50 percent to -30 percent.

A present worth analysis is used to evaluate expenditures that occur over different time periods by discounting all future costs to a common base year, usually the current year. This allows the cost of remedial action alternatives to be compared on the basis of a single figure representing the amount of money that would be sufficient to cover all costs associated with the remedial action over its planned life. As suggested in the EPA's guidance

(March 1988), a discount rate of 5 percent will be considered unless the market values indicate otherwise during the performance of the FS.

- Compliance With ARARs

This criterion is used to determine how each alternative complies with applicable or relevant and appropriate Federal and State requirements, as defined in CERCLA Section 121.

- Overall Protection of Human Health and the Environment

This criterion provides a final check to assess whether each alternative meets the requirement that it is protective of human health and the environment. The overall assessment of protection is based on a composite of factors assessed under the evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.

- State Acceptance

This criterion evaluates the technical and administrative issues and concerns the State of New York may have regarding each of the alternatives. ARCO will incorporate comments from NYSDEC and NYSDOH, if any.

- Community Acceptance

This criterion incorporates public concerns into the evaluation of the remedial alternatives.

After each of the remedial alternatives has been assessed against the nine criteria, a comparative analysis will be performed. This analysis will compare all the remedial alternatives against each other for each of the nine evaluation criteria.

Based on this comprehensive analysis, ARCO will recommend the most suitable remedial action that is:

- Protective of human health and the environment;
- Cost effective;
- In accordance with SARA, and
- In accordance, to the extent practicable, with the NCP.

6.3 TASK 11 - FEASIBILITY STUDY (FS) REPORT

An FS report will be prepared (Task 10 in the Statement of Work in the Consent Order) to summarize the activities performed and to present the results and associated conclusions for Tasks 1 through 10. The report will include a summary of laboratory treatability findings, a description of the initial screening process and the detailed evaluations of the remedial action alternatives studied. The FS report will be prepared and presented in the format specified in "Guidance for Conducting RI/FS under CERCLA" (EPA, 1988).

The FS Report will be comprised of an executive summary and four sections. The executive summary will be a brief overview of the FS and the analysis underlying the remedial actions which were evaluated.

The FS will contain the following four sections

- Introduction and Site Background;
- Technology identification;
- Remedial alternatives identification, and
- Development of cost estimates.

A discussion of each component is presented below.

The introduction will provide background information regarding site location and facility history and operation. The nature of the problem, as identified through the various studies, will be presented. A summary of geohydrological conditions, remedial action objectives, and nature and extent of contamination addressed in the RI Report will also be provided.

The feasible technologies for site remediation will be identified for general response actions, and the results of the remedial technologies screening.

Remedial alternatives will be developed by combining the technologies identified in the previous screening process. The results of initial screening of remedial alternatives, with respect to effectiveness, implementability and cost, will be described.

A detailed description of the cost and non-cost features of each remedial action alternative passing the initial screening of the previous section will be presented. The detailed evaluation of each remedial alternative with respect to nine evaluation criteria, 1) short-term effectiveness, 2) long-term effectiveness, 3) reduction of mobility, toxicity and volume, 4) implementability, 5) cost, 6) compliance with ARARs, 7) overall protection of human health and the environment, 8) state acceptance and 9) community acceptance will be presented. A comparison of these alternatives will also be presented.

Based on this comprehensive analysis, ARCO will recommend the most suitable remedial action alternative that is:

- Protective of human health and the environment;
- Cost effective;
- In accordance with SARA, and
- In accordance, to the extent practicable, with the NCP.

7.0 PROJECT MANAGEMENT APPROACH

7.1 ORGANIZATION AND APPROACH

The proposed project organization is presented on Figure 7-1. The resumes of the individuals identified below are included in Appendix A. ARCO has designated Mr. R. Walter Simmons as the Project Coordinator, responsible for oversight of the implementation of the Consent Order. The Project Coordinator will interface with EPA's Project Officer, Mr. Paul Olivo.

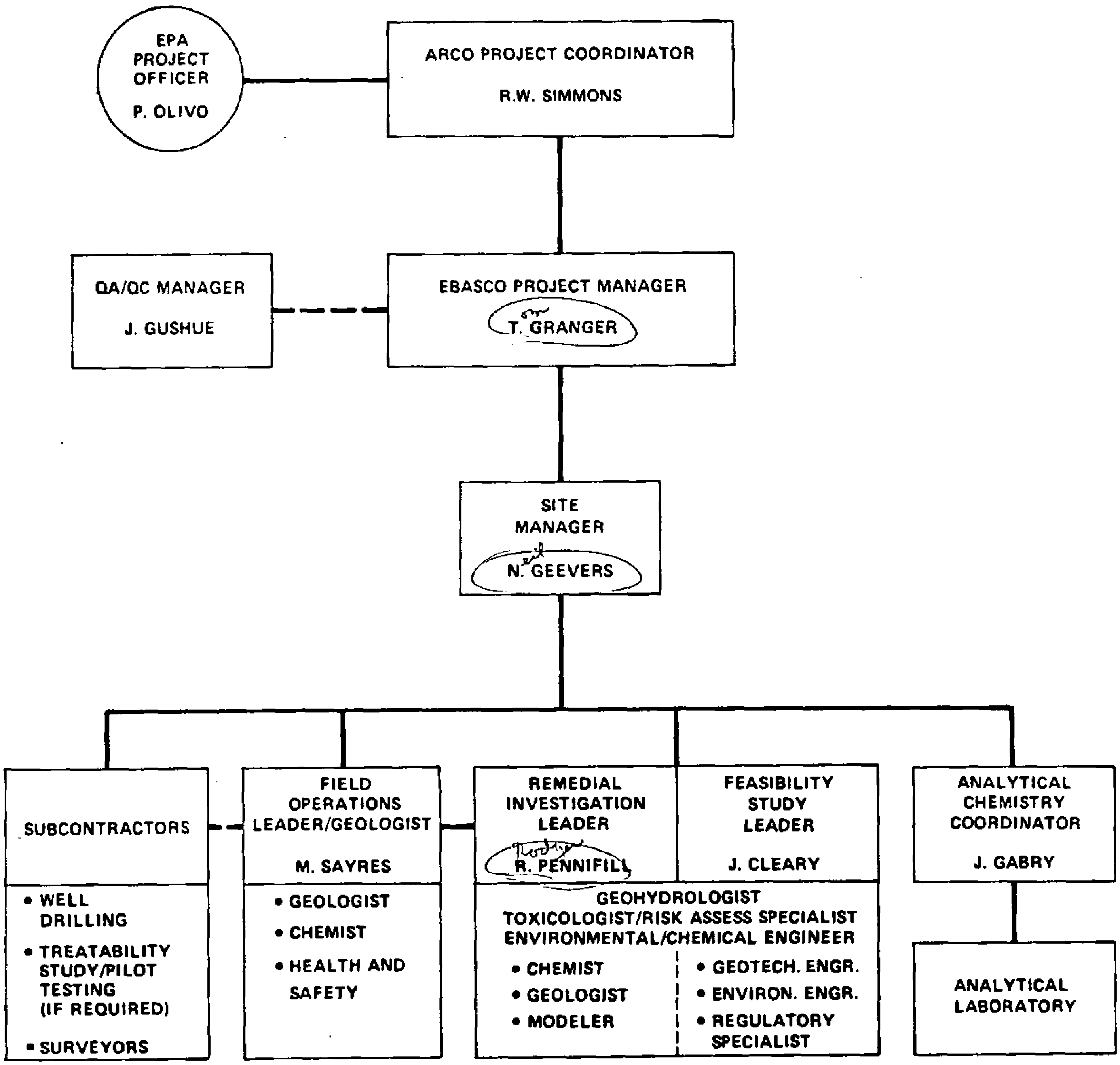
Mr. Thomas Granger is Ebasco's Project Manager for the Sinclair Refinery Site RI/FS Project. In this position, he will be responsible for interfacing with ARCO. The Project Manager will coordinate all aspects of the project from cost/schedule to technical output, including quality control. Mr. Granger's level of effort will be approximately 25% throughout the project.

The Quality Assurance/Control Manager is a corporate position responsible for overall project quality, including development of the project QA/QC plan, review of specific task quality plans, review of laboratory, vendor and subcontractor plans and procedures, and auditing of specific tasks at established intervals. The Quality Assurance Control Manager reports directly to the Project Manager. The designated Quality Assurance/Quality Control Manager is Mr. John Gushue. Mr. Gushue's level of effort will be variable depending on work in progress.

The Site Manager has primary responsibility for plan development and implementation of the remedial investigation and feasibility study, including coordination among the RI and FS leaders and support staff, development of bid packages, acquisition of engineering or specialized technical support, and all other aspects of the day-to-day activities associated with the project. The Site Manager identifies staff requirements, directs and monitors site progress, ensures implementation of quality procedures and adherance to applicable codes and regulations, and is responsible for performance within the established budget and schedule. The Site Manager reports directly to the Project Manager. Mr. Neil Geevers is the Site manager for the Sinclair Project. His level of effort will be approximately 75% during the project.

FIGURE 7-1

PROJECT ORGANIZATION



The Remedial Investigation Leader reports to and will work directly with the Site Manager to develop the POP and will be responsible for the implementation of the field investigation, the analysis, interpretation and presentation of data acquired relative to the site, and preparation of the RI report (Task 8). The RI leader for this site is Mr. Roger Pennifill. His level of effort will be approximately 50% during the RI.

The Feasibility Study leader will work with the Site Manager and RI Leader to develop the RI/FS Work Plan and will be responsible for the preparation of the Feasibility Study. The FS Leader will work closely with the RI Leader to ensure that the field investigation generated the proper type and quantity of data for use in the initial screening of remedial technologies/alternatives (Task 9), detailed evaluation of remedial technologies/alternatives (Task 10), development of requirements for and evaluation of treatability study/pilot testing, if required,(Task 7) and associated cost analysis. The Feasibility Study Report (Task 11) will be developed by the FS Leader. The FS Leader reports directly to the Site Manager. The FS Leader for Sinclair is Mr. Joseph Cleary. His level of effort will be approximately 50% during the FS.

The Field Operations Leader (FOL) will work with the RI Leader to ensure that the field investigation accomplishes its objectives. The FOL is responsible for on-site management for the duration of all site operations including the activities conducted by Ebasco such as sampling, and the work performed by subcontractors such as well drilling and surveying. The FOL will provide consultation and decide on factors relating to sampling activities and changes to the field sampling program. The FOL will be in constant communi- cation with the RI Leader to ensure efficient/effective implementaion of the Work Plan. All site personnel will report to the FOL while on the site. The FOL for the Sinclair Project is Ms. Mindy Sayres. Her level of effort will be full time during the field investigation.

The Analytical Chemistry Coordinator will ensure that the subcontracted analytical laboratory(ies) will perform analyses as described in the FSAP. The chemistry coordinator will be responsible for assuming that proper collection, packaging, preservation and shipping of samples is performed in accordance with EPA guidelines. The Analytical Chemistry Coordinator is Dr. Jon Gabry. His involvement will be variable depending on the work in progress.

The task numbering system for the RI/FS effort is described in this Work Plan. The Tasks are numbered as follows:

Task 1:	Project Planning
Task 2:	Community Relations
Task 3:	Field Investigations
Task 4:	Sample Analysis/Validation
Task 5:	Data Evaluation
Task 6:	Evaluation of Risks
Task 7:	Treatability Study/Pilot Testing
Task 8:	Remedial Investigation Report
Task 9:	Remedial Alternatives Screening
Task 10:	Remedial Alternatives Evaluation
Task 11:	Feasibility Study/Report

Each of these tasks have been scheduled and will be tracked separately during the course of the RI/FS work. Monthly progress reports will be prepared and submitted to EPA by the tenth day of every month. As specified in the Consent Order, the progress reports shall address at a minimum the following items:

1. <u>Progress Made This Period</u> - Description of progress made during the reporting period, including problem areas encountered, and recommendations for resolving those problems.

2. <u>Anticipated Problem Areas and Recommended Solutions</u> - Anticipated problems and recommendations for resolution, including technical and scheduling problems.

3. <u>Problems Resolved</u> - Results obtained relating to previously identified problem areas.

4. Deliverables Submitted - Deliverables completed and submitted, and dates of those submittals; deliverables anticipated to be submitted, and dates of anticipated submittals; and reasons if respondents believe due dates may need to be revised. Any delays should be explained fully.

5. Upcoming Events /Activities Planned - Important upcoming dates, including sampling events, meetings, etc., major tasks to be performed within the next reporting period.

6. Key Staffing Changes - Any changes in personnel assigned to the work, including but not limited to consultant, contractor or subcontractor personnel.

7. Percentage Complete - Levels of technical completion achieved, reported as percent completed.

8. Data - Copies of daily contractor reports and all monitoring and testing data, as well as all QA/QC documentation, regardless of whether the necessary QA/QC has been completed.

9. Community Contacts/Concerns - Significant contacts with community officials or groups regarding the project and description of any significant concerns expressed by such persons.

Project progress meetings will be held, as needed, to evaluate project status, discuss current items of interest, and review major deliverables such as the POP, RI and FS reports.

7.2 QUALITY ASSURANCE AND DOCUMENT CONTROL

The site-specific quality assurance requirements will be in accordance with the Quality Assurance Project Plan for the REM III Program as approved by EPA, and in accordance with the Brossman Guidance.

Document Control Aspects of the program pertain to controlling and filing documents. Ebasco has developed a program filing system (Administrative Guideline Number PA-5) that conforms to the requirements of the Environmental Protection Agency to ensure that the documents are properly stored and filed. This guideline will be implemented to control and file all documents associated with the site's RI/FS. The system includes document receipt control procedures, a file review and inspection system, and security measures.

7.3 PROJECT SCHEDULE

The Project Schedule for the Sinclair Refinery RI/FS is presented in Figure 7-2 (in enclosed plastic pouch). The schedule allows 12 months for completion of the Final Draft of the RI/FS from the date EPA approves the POP and assumes that timely review and approval of documents is obtained from EPA.

The schedule incorporates time periods imposed by the Consent Order, such as the three week period for data validation.

The schedule for this project is based on assumptions for durations and conditions of key events occuring on the critical and non-critical pathways. These assumptions are as follows:

- The schedule for the field investigation is dependent on expedited review and approval of the POP by EPA.
- The schedule is based on a three week review period for EPA of the draft POP and one week for approval of the final POP.
- The schedule assumes that ARCO is able to obtain access agreements with all of the current property owners and current site users.
- The schedule assumes that the EPA oversight contractor is able to mobilize on October 10, 1988.

- The duration of the field activities is based on two to three field teams performing simultaneous site operations and that the oversight contractor will be able to provide a sufficient number of staff personnel for this effort.

- The field schedule assumes normal weather conditions for the months of October and November. If field work is postponed to start in November or December, field work schedules will increase in length.

- Data validation of samples obtained by the oversight contractor will be completed within the weeks specified in the Consent Order, if that data is to be incorporated in the RI Report.

- If EPA Endangerment Assessment is to be included in the FS report, it must be supplied to ARCO by July 28, 1989.

- Submittal of the Draft FS is contingent on EPA approval of the Preliminary FS within four weeks.

REFERENCES

(Bowen, 1979); H.J.M. Bowen, "Environmental Chemistry of the Elements", 1979.

(CDM, 1983); Camp Dresser & McKee Inc., "Draft Remedial Action Master Plan, Sinclair Oil Refinery", March 4, 1983.

(Ebasco, 1988); Ebasco Services. Letter from Yoram Ekstein to Mindy Sayres "Hydrogeologic Tests at Sinclair Refinery, Wellsville, New York", August 4, 1988.

(EPA, 1985); United States Environmental Protection Agency, "Guidance on Remedial Investigations Under CERCLA", June, 1985, EPA/540/6-85/002.

(EPA, 1985a); United States Environmental Protection Agency, "Guidance on Feasibility Studies Under CERCLA", June, 1985, EPA/540/6-85/003.

(EPA, 1985b); United States Environmental Protection Agency, "Endangerment Assessment Handbook", 1985 TR-693-24B.

(EPA, 1985c); United States Environmental Protection Agency, "National Oil and Hazardous Substance Pollution Contingency Plan; Final Rule, NCP", 50 Federal Register 47912, November 20, 1985.

(EPA, 1985d); United States Environmental Protection Agency, "Compendium of Costs of Remedial Technologies at Hazardous Waste Sites," September, 1985,

(EPA, 1985e); United States Environmental Protection Agency, "Handbook Remedial Action at Waste Disposal Sites," June, 1985, EPA 1625/6-85/006.

(EPA, 1986); United States Environmental Protection Agency, J. Winston Porter, "Interim Guidance On Superfund Selection of Remedy", Memorandum, December, 1986, Document Number 93.55.0-19.

(EPA, 1986a); Unites States Environmental Protection Agency, "Guidelines for Estimating Exposures", 1986, Fed. Reg. 51:34042-34054

(EPA, 1986b); Unites States Environmental Protection Agency, "Guidelines for Carcinogen Risk Assessment", September 24, 1986 Fed. Reg. 51:33992-34003.

(EPA, 1986c); United States Environmental Protection Agency, "Guidelines for Assessing Chemical Mixtures", 1986, Fed. Reg. 51:34014-34025.

(EPA, 1986d); United States Environmental Protection Agency, "Superfund Public Health Evaluation Manual", Office of Emergency and Remedial Response, Washington, D.C., October 1986, EPA 540/1-86/060.

(EPA, 1987); United States Environmental Protection Agency, "Data Quality Objectives for Remedial Response Activities", March 1987, EPA/540/6-87/004.

(EPA, 1987a); United States Environmental Protection Agency, J. Winston Porter, "Additional Interim Guidance for FY-87 Records of Decision", in Superfund Report Newswatch, Vol 1. No. 17 September 16, 1987.

(EPA, 1988); United States Environmental Portection Agency, "Guidance for Conducting Remedial Investigation and Feasibility Studies Under CERCLA", Draft, March, 1988, OSWER Directive 9335.3-01.

(Kabata-Pendios, 1984) A. Kabata-Pendios and H. Pendios, "Trace Elements in Soils and Plants", 1984, CRC Press, Boca Raton, Florida.

(NYSDEC, 1985); New York State Department of Environmental Conservation, Bureau of Water Quality Management, "Population Projections, September 30, 1985", 1985.

(SMC Martin, 1984); SMC Martin, Inc., "Standard Operating Procedures for Collection of Environmental and Hazardous Substance Samples, Volume 3," March, 1984.

(SMC Martin, 1984a); SMC Martin, Inc., "Quality Assurance Plan for the Investigation of the Sinclair Refinery Site - Wellsville, New York," March, 1984.

(SMC Martin, 1984b); SMC Martin Inc., "Health and Safety Plan - Sinclair Refinery Site Investigation - Wellsville, New York," 1984.

(SMC Martin, 1985); SMC Martin. Inc., "Draft Phase I Remedial Investigation Sinclair Refinery Site, Wellsville, New York", March 14, 1985.

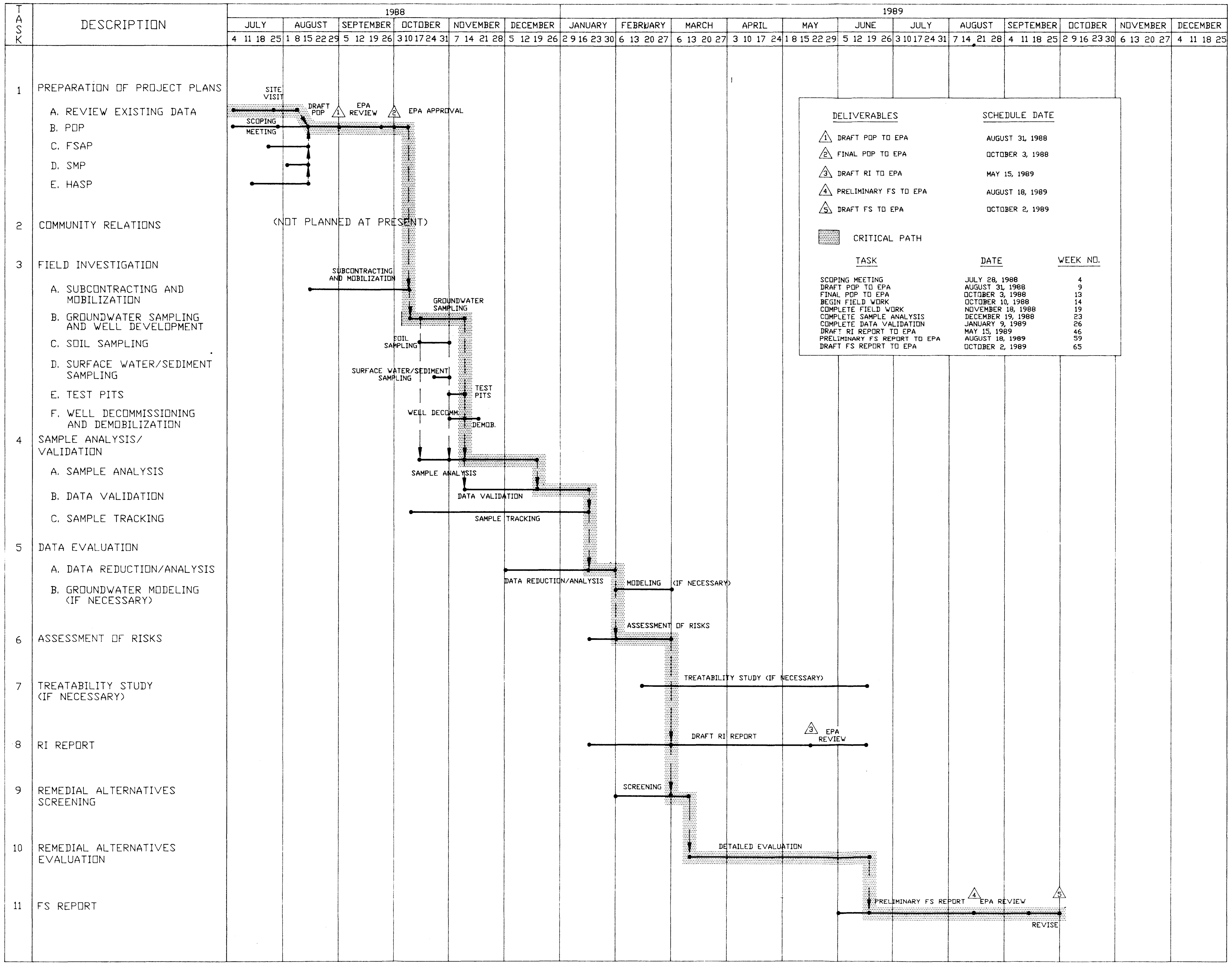
(SMC Martin, 1986); SMC Martin, Inc. "Boring Logs" Various Dates, 1984, 1985, and 1986.

(SMC Martin, 1986a); SMC Martin Inc, "Preliminary Draft Chemical Analyses", 1986.

(SMC Martin, 1987); SMC Martin, Inc., Incomplete Draft "Remedial Investigation Report", handwritten and partially typed, 1987.

FIGURE 7-2

SINCLAIR REFINERY SITE
PROJECT OPERATIONS PLAN FOR
COMPLETION OF PHASE II REMEDIAL INVESTIGATION
AND WORK PLAN FOR FEASIBILITY STUDY
SCHEDULE AND DELIVERABLES



APPENDIX A

APPENDIX A

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THOMAS GRANGER
MANAGER - ENVIRONMENTAL PROJECTS

SUMMARY OF EXPERIENCE (Since 1974)

Mr. Granger has fourteen years experience conducting and managing environmental and hazardous waste projects. Mr. Granger's experience covers hazardous waste sites, alternate fuel programs and power generation projects. These efforts have included site characterization, treatability studies, technology assessment, licensing and permitting strategies, evaluation of alternatives, environmental assessments, engineering design and specification, and construction supervision. Mr. Granger was the Project Manager for the design and construction phases of the PJP Landfill Remediation which received the Award for Engineering Excellence in 1987 from the Consulting Engineers Council of New Jersey.

EDUCATION - M.E., Environmental Engineering and Sciences, Manhattan College - 1980
- B.C.E., Civil (Sanitary) Engineering, Manhattan College - 1974

REPRESENTATIVE EBASCO EXPERIENCE (Since 1974)

Hazardous Waste Services Project Manager

Responsible for overall coordination of design and construction of interim remedial measure for extinguishment of fire at Superfund listed hazardous waste site in New Jersey. Duties included organizing and planning work which involved site investigation, identification and evaluation of alternatives, design of the final IRM recommendation and management of $20 million construction effort. Responsibilities also included technical quality of work, interface with client and support of Community Relations Program.

Management of Remedial Design for PCB cleanup at Superfund listed site in New York State. Remediation involves an emerging innovative technology to remove and dechlorinate PCBs from contaminated soils and restore site to useful condition as a residential area. Project includes site investigation to support design effort, bench-scale and pilot scale treatability studies for development of commercial scale process design and site remedial action and restoration specification.

THOMAS GRANGER

REPRESENTATIVE EBASCO EXPERIENCE (Cont'd)

Responsible for day-to-day management and technical quality of work for private sector and governmental lead remedial investigation/feasibility studies for Superfund listed hazardous waste sites in several states. Duties include organizing and planning the work, establishing schedules and budgets, working with the QA officer to develop the Quality Assurance Plan and audits schedule, working with the H&S officer to develop the site-specific Health & Safety Plan, providing management interface with subcontractors and arranging for timely procurement and application of resources needed to complete the project. Responsibilities also include interface with the client and government agencies, and management of the Community Relations Plan in support of the client.

Environmental Services - Project Manager

Responsible for day-to-day management of a multidisciplinary team conducting an Environmental Compatibility Study for a transmission line in Connecticut. Duties include schedule and budget control and interface with client. Responsible for project and progress reports and the technical quality of work in compliance with Connecticut Siting Council (CSC) guidelines. Professional witness providing testimony at CSC hearing on project.

Hazardous Waste Sites - Task Leader

Responsibilities include identification and implementation of waste treatability studies, selection of remedial response objectives, development of remedial alternatives. Contributes to preliminary engineering and cost estimates for preferred alternatives, evaluates alternatives and conceptual design of preferred systems.

Environmental Services - Project Leader

As Project Leader, has identified regulatory requirements and coordinated monitoring programs, provided interface with engineering disciplines regarding control system design, and with the client and regulatory agency regarding a Third Party Environmental Impact Statement, PSD permit application and ER preparation. Additional management activities have included scheduling and budget control, contract negotiation, subcontractor supervision and report preparation.

REPRESENTATIVE EBASCO EXPERIENCE (Cont'd)

Environmental Engineer

Completed laboratory water, wastewater, and solid waste treatability studies to recommend a plant-wide waste management program for a Minnesota utility. Specified, selected and supervised on-site water quality monitoring programs, including coordination and supervision of laboratory subcontractors. Responsible for waste management related environmental assessments for major utility and industrial projects in Texas, Kentucky, Louisiana, Washington, Maryland, Minnesota, Iowa, Ohio and New York.

REPRESENTATIVE EBASCO PROJECT EXPERIENCE

Projects include:

Hazardous Waste

Maxey Flats Steering Committee	Remedial Investigation/Feasibility Study of Maxey Flats low-level radioactive waste disposal site.
U.S. Environmental Protection Agency	Remedial Design for PCB cleanup at Wide Beach Development Site
New Jersey Department of Environmental Protection	Design and Construction of IRM for PJP Landfill Site
New Jersey Department of Environmental Protection	Remedial Investigation/Feasibility Study for Syncon Resins Site
Confidential Client	Feasibility Study for Former Coal Gasification Plant Coal Tar Site
New Jersey Department of Transportation	Remedial Investigation of site of Route 1 & 9 roadway improvement
Howard Needles Tammen & Bergendoff	Remedial Investigation of former explosives manufacturing facility site

Environmental Services

Houston Natural Gas/ Texaco Inc.	Coal Gasification Environmental, Health and Safety Feasibility Study Ascension Parish, Louisiana - 12,0000 ST/D

THOMAS GRANGER

PUBLICATIONS

Granger, T, M Kuo, M Verdibello 1987 "A Burning Wasteland Reclaimed," Civil Engineering Magazine, August.

Granger, T, R Quig 1983. "Coal Conversion-Environmental Planning," Encyclopedia of Environmental Science and Engineering Second Edition Gordon and Breach Science Publishers.

Granger, T, J Lekstutis, M S Brown 1981. "An Environmental Regulatory Challenge to the Synfuels Industry," Presented at Coal Technology 81, Houston, Texas, November.

Lekstutis, J, T Thompson, T Granger 1981. "Waste Stream Synthesis and Control in Coal Gasification Processes," Presented at 54th Annual WPCF Conference, Detroit, Michigan, October.

Weber, J C, J Lekstutis, T Granger 1981. "An Effective Plan and Strategy for Licensing Coal Gasification Facilities," Presented at 54th Annual WPCF Conference, Detroit, Michigan, October.

Lekstutis, J, T Granger 1980. "Coal Conversion - Planning for its Implementation and Opportunities," Presented at 51st Annual Ebasco Executive Conference, Marco Island, Florida, October.

El-Baroudi, H, V Velez, D Mirchandani and T Granger 1978. "Compliance of Bottom Ash Sluice Systems to Federal EPA Regulations," Presented at 6th Annual WWEMA Conference, St. Louis, Missouri, April.

REPRESENTATIVE EBASCO PROJECT EXPERIENCE (Cont'd)

W.R. Grace/DOE	Ammonia from coal, Feasibility Study, Baskett Kentucky-1200 ST/D
United Illuminating Co.	RESCO 115 kV Tie Project - Environmental Compatibility Study
Louisiana Power & Light Co.	Coal-Fired Units-2-800 MW Units and Transmission Line on a grass roots site - Third Party EIS
Houston Lighting & Power Co.	Chemical Effluent Compliance Plans for ten generating stations totaling 10,000 MW
	Freestone Project - Water and Wastewater Management Study
	W.A. Parish Auxiliary Cooling Water System Modifications
Niagara Mohawk Power Corp.	Lake Erie Generating Station Site Selection Study and Water Management Study
Minnesota Power & Light Co.	Clay Boswell Unit Nos. 1-4 Water, Wastewater and Solid Waste Treatability Study
Iowa Public Service Co.	George Neal Unit No. 4 Environmental Report and Water Management Study
The Dayton Power & Light Co.	Killen Station Environmental Report
Potomac Electric Power Co.	Dredge spoils disposal study

PRIOR EXPERIENCE

Tippetts, Abbett, McCarthy, Stratton

Assisted in study of turbine efficiency at Tarbela Dam, Pakistan, a major hydroelectric facility.

CORNELIUS (NEIL) A. GEEVERS
Environmental Engineer

SUMMARY OF EXPERIENCE (Since 1979)

Six years experience in environmental engineering, including conceptual design, pilot-scale testing, sampling and analysis, technical evaluations, and permitting of waste treatment systems for a variety of industries. Conducted field investigations of physical-chemical and biological waste water treatment processes including design, construction and monitoring of pilot plants. Performed technical evaluations of hazardous waste management programs and equipment, groundwater monitoring, process troubleshooting, and waste minimization studies. Responsible for providing engineering support, managing project tasks, and interface with corporate environmental and legal departments, clients, operating personnel, and state and federal regulators.

EDUCATION - M.S., Environmental Engineering, Duke University Graduate School, 1985
- B.S., Environmental Engineering/Chemistry, Stevens Institute of Technology, 1981

PROFESSIONAL AFFILIATIONS - Air Pollution Control Association, Member
Water Pollution Control Federation, Member

REPRESENTATIVE EXPERIENCE (Since 1979)

Ebasco Services Inc. - Envirosphere Division
Environmental Engineer (1987 to Present)

Responsible for evaluating and developing thermal destruction and waste water treatment systems for remediation of uncontrolled hazardous waste sites. Typical project tasks include site investigations, feasibility studies and conceptual design.

Developed and evaluated alternate potable water supply systems as part of a Focused Feasibility Study for the American Thermostat site in South Cairo, NY. Alternatives were evaluated on the basis of effectiveness, implementability and cost.

Responsible for preliminary design of wastewater treatment system to handle aqueous waste streams resulting from the first operable unit of the Bog Creek Farm site remediation in Howell Township, NJ. Bench-scale treatability study results are being used to develop preliminary design criteria for chemical precipitation, sedimentation, air stripping, chemical oxidation and carbon adsorption unit operations. Also helped evaluate innovative treatment technologies such as enhanced volatilization and soil washing for use as the second operable unit at this site.

CORNELIUS (NEIL) A. GEEVERS

REPRESENTATIVE EXPERIENCE (Cont'd)

Involved in the development of an EPA Guidance Manual on Data Quality Objectives for Remedial Design/Remedial Action Activities at Superfund Sites which will assist project team members in specifying an appropriate data collection program to support these activities.

Estimated excavation requirements, including soil, roadway and concrete, for cleanup of a contaminated roadway in New Jersey. Work entailed correlating survey data to analytical sampling results from Remedial Investigation and proposed action levels to recommend procedures for handling of excavated material.

Westinghouse - Environmental Technology Division
Senior Engineer (1985 - 1987)

Responsible for process engineering design and evaluation of water and hazardous waste treatment technologies, including the Westinghouse mobile Pyroplasma system. Worked on RI/FS projects and RCRA, TSCA, Clean Air, and Clean Water Act permit applications.

Compiled all of the information necessary to submit an EPA RCRA Research, Development, and Demonstration permit application to conduct hazardous waste treatment experiments with an innovative high-temperature electric arc pyrolysis system. Developed the sampling and analysis program, contingency plan, technical description of proposed experiments, and closure plan.

Served as primary interface with corporate environmental and legal departments, other engineers, clients, operating personnel, and state and federal regulators.

Duke University - Civil and Environmental Engineering Dept.
Graduate Student (1984 - 1985)

Returned to graduate school full-time in order to obtain a Masters degree in Environmental Engineering. Completed courses in Hazardous Waste Management, Design of Water and Waste Water Treatment Systems, Air Pollution Control, Unit Operations, Engineering Management and Project Evaluation, and Environmental Law. Published thesis entitled "Estimating Polymer Requirements in Centrifuges" which recommended improvements for sludge dewatering equipment evaluation and operation.

Brown and Caldwell Engineers
Engineer (1981 - 1984)

Responsible for field investigations of physical-chemical and biological waste water treatment processes, sampling and laboratory analysis, data reduction, and design calculations. Completed more than 20 projects for clients in the following industries: chemicals, pulp and paper, food, cosmetics, pharmaceuticals, electronics, and medical products.

CORNELIUS (NEIL) A. GEEVERS

REPRESENTATIVE EXPERIENCE (Cont'd)

Conducted pilot plant investigation to develop design and performance criteria for sludge thickening, aerobic digestion, recessed-plate pressure filtration, and tertiary clarification systems for the waste water treatment system at a chemical plant in New Jersey. Designed, constructed, and monitored the pilot plant.

Other projects include sampling of groundwater monitoring wells, environmental audits, process troubleshooting, energy conservation studies and waste minimization surveys.

Lever Brothers - R&D Center
Engineering Trainee (1979 - 1980)

Developed a waste management program which enabled an R&D laboratory and pilot test facility to comply with RCRA and other state regulations. Characterized waste sources and types, established handling, storage and disposal procedures.

HONORS AND AWARDS

Dean's List, Stevens Institute of Technology

JOSEPH G. CLEARY
Water and Waste Management
Principal Environmental Engineer

SUMMARY OF EXPERIENCE (Since 1972)

Total experience - Fourteen years experience in environmental engineering consulting including: industrial and municipal water and wastewater treatment process development and process design; sludge handling and disposal; surface water quality investigations and modeling analysis; hazardous waste remedial investigation/feasibility studies and remedial design; spill prevention and control plans; advanced waste treatment evaluations; urban stormwater management; laboratory, pilot scale, and full scale wastewater treatability studies; and field sampling, monitoring, and site investigations.

PROFESSIONAL AFFILIATIONS - Water Pollution Control Federation
New Jersey Water Pollution Control Federation
Chi Epsilon
Registered Professional Engineer in New York and New Jersey

EDUCATION - M.E., Environmental Engineering, Manhattan College - 1973
- B.C.E., Civil Engineering, Manhattan College - 1971

REPRESENTATIVE ENVIROSPHERE PROJECT EXPERIENCE (Since 1986)

Principal Engineer, Water and Waste Management

Remedial Investigation/Feasibility Study (RI/FS) for Combe Fill North Landfill for New Jersey Department of Environmental Protection (NJDEP). Responsibilities included: screening and detailed evaluation of remedial alternatives for the landfill site including RCRA landfill closure and capping, ground water diversion barriers, ground water pumping and treatment, alternate water supply, and on-site disposal in a secure landfill; preparation of Feasibility Study report; and presentation of study results at the public meeting.

Remedial Design for Wide Beach Development Site for EPA REM III Contract. Responsibilities included preparation of Work Plan and Field Operations Plan for supplemental remedial investigations, soil and ground water treatment studies, and the remedial design of the remedial actions for the site.

JOSEPH G. CLEARY

PRIOR EXPERIENCE (13 Years)

HydroQual Inc., Mahwah, New Jersey
Associate and Project Manager (6 years)

Worked with HydroQual Inc. from inception in May 1980 as an Associate of the firm and as a Project Manager on a variety of environmental engineering projects including wastewater treatment, hazardous waste, and surface water quality modeling. Responsibilities included both technical and administrative management of projects; supervision of engineers, scientists, and field technicians; manpower scheduling and budget management; technical report preparation and presentations to clients and regulatory agencies; and proposal preparation and business development.

Representative project experience includes:

- Alfred Crew/Hazen and Sawyer for New Jersey Department of Environmental Protection (NJDEP) Sharkey Farms Landfill RI/FS

  Project Manager for surface water, sediments, and leachate site investigations and treatment evaluations. Coordinated all sample collection, laboratory analysis, QA/QC review, preparation of Field Sampling Plan, QA/QC Project Management Plan, field sampling teams, data validation and reduction, and evaluation of remedial alternatives including leachate and ground water treatment.

- Confidential Industrial Client

  Served as Project Manager to evaluate hydrogeologic information and chemical sampling data from remedial investigations to evaluate the potential remedial actions and client's potential liability as a potential responsible party in ongoing litigation in New York State.

- Alfred Crew Consulting Engineers for NJDEP

  Served as Project Manager on Palermo, Upper Township, Cape May County contaminated well field site. Prepared Field Sampling Plan, supervised sampling of 40 homes on individual wells, investigated potential responsibile parties, and evaluated point-of-use and centralized ground water treatment remedial alternatives.

- Confidential Industrial Client

  Served as Project Manager to develop a conceptual process design for a wastewater treatment system to remove specific organics. Bench scale treatability studies were conducted to evaluate air stripping, carbon adsorption, and chemical oxidation.

JOSEPH G. CLEARY

PRIOR EXPERIENCE (Cont'd)

- Township of Middletown, New Jersey

  Served as Project Manager on wastewater treatment plant expansion from 6 to 12 mgd. Developed process design for expansion, supervised pilot and full scale treatability studies, reviewed final plans and specifications developed by design consultants, performed startup and process monitoring of sludge handling and disposal facilities including anaerobic digestion and composting, and provided consulting services on industrial pretreatment, treatment plant operations, and odor control.

- Stearns-Roger Engineering Corp., Denver, Colorado, for Gulf Oil Co.

  Served as Project Manager for development of process design for SRC II coal gasification wastewater treatment and reuse system. Project included: on-site sampling, waste characterization, and treatability studies on Texaco gasifier pilot unit, leaching studies on the gasifier solid wastes, and bioassays on treated effluents.

- Kaiser Aluminum Chemical Corporation, Louisiana and West Virginia Plants

  Served as Project Manager on surface water quality investigations to evaluate the impact and fate of specific contaminants in industrial wastewater discharged to the Mississippi River, and cyanide in contaminated ground water discharged to the Ohio River. Projects included: water quality surveys, dye dispersion studies, sedimentation experiments, and use of three-dimensional steady state and time variable water quality models.

- U.S. Environmental Protection Agency, Washington, D.C.

  Served as Project Manager on providing technical assistance to EPA Headquarters on the technical review of advanced wastewater treatment projects and combined sewer overflow projects relative to water quality impact analysis and proposed treatment levels for EPA funding approvals.

- City of Erie, Pennsylvania

  Served as Project Manager on the process design for upgrading a 60 mgd combined industrial-municipal wastewater treatment plant. Extensive full scale treatment system evaluations were conducted for each treatment and sludge handling process including sludge incineration.

- Town of Cary, North Carolina and State of Indiana

  Served as Project Manager on reaeration studies of Crabtree Creek in North Carolina and the Calumet River in Indiana using ethylene gas modified tracer technique. Coordinated field testing and on-site GC analysis to develop dissolved oxygen reaeration rates for several sections of these two rivers.

JOSEPH G. CLEARY

PRIOR EXPERIENCE (Cont'd)

Hydroscience Inc., Westwood, New Jersey
Engineer/Project Engineer/Project Manager (7 years)

Worked in Process Engineering Group on in plant waste characterizations, industrial wastewater treatment process designs, water quality modeling, urban stormwater management, spill prevention and control, and basin planning and facility planning projects. Conducted numerous bench scale, pilot scale, and full scale treatability studies, treatment plant trouble shooting and performance audits, equipment evaluations, surface water sampling investigations, and mobile laboratory monitoring.

Representative project experience includes:

- E.I. Dupont de Nemours Co., LaPorte, Texas

  Served as Project Engineer for development of process design for a herbicide manufacturer wastewater treatment system expansion and upgrading to biological nitrification treatment. Responsibilities included: supervision of on-site field laboratory, pilot scale treatability studies, and laboratory treatability studies including biological oxidation and PACT systems and development of process design.

- Shell Chemical Co., Houston, Texas

  Served as Project Engineer on field sampling, pilot plant studies, and equipment evaluations for a petrochemical plant wastewater treatment system upgrading. Project included: oil and suspended solids removal, biological treatment, sludge dewatering, and incineration.

- U.S. Environmental Protection Agency, Washington, D.C.

  Served as Project Engineer and coauthored the NPDES BMP Guidance Document for permit writers and reviewers. Project included an extensive review of the Best Management Practices (BMPs) and spill prevention practices used by industry to control the release of toxic and hazardous compounds to surface waters and the development of a manual to assist permit writers in reviewing BMP and SPCC plans.

PUBLICATIONS

"Best Management Practices for Control of Toxic and Hazardous Materials." Stuewe, C.W., J.G. Cleary, and H.M. Thron, Jr. Published In the Proceedings of the 34th Industrial Waste Conference, May 1979, Purdue University. Ann Arbor Science Publishers Inc., 1980.

JOSEPH G. CLEARY

PUBLICATIONS (Cont'd)

"A Review of the Criteria for Evaluating a BMP Program." Cleary, J.G., G.J. Kehrberger, and C.W. Stuewe. Presented at the 1980 National Conference and Exhibition on the Control of Hazardous Material Spills. May 1980.

"NPDES Best Management Practice Guidance Document." Prepared for U.S. Environmental Protection Agency, Industrial Environmental Research Laboratory, Cincinnati, Ohio, by J.G. Cleary et al., Hydroscience, Inc., EPA-600/9-79-045. December 1979.

"A Review of BMP Alternatives." Kehrberger, G.J. and J.G. Cleary. Presented at the 53rd Annual Conference Water Pollution Control Federation, Las Vegas, Nevada, September-October, 1980.

"Treatment and Reuse of Gasifier Wastewater," Cleary, J.G. and J. Gruzdis. Presentation at American Water Works Association, Water Reuse Symposium II, Washington D.C., August, 1981.

"Treatability of Gasifier Wastewaters and Leaching Characteristics of Solid Wastes," Cleary, J.G. and E.J. Donovan. Presentation at Symposium on Water Management and Pollution Control for Coal Gasification, American Chemical Society, New York, New York, August 1981.

ROGER A. PENNIFILL
Principal Geologist

SUMMARY OF EXPERIENCE

Technical and project management experience in geological engineering and hydrogeology as related to radioactive and hazardous waste management. Primary responsibilities have included design and implementation of site characterization plans, analysis of risk posed by contaminated sites, groundwater flow and contaminant transport modeling and analysis of regulatory compliance at industrial facilities.

EDUCATION - B.S., Virginia Polytechnic Institute - Geology, 1974
M.S., University of Idaho - Geological Engineering, 1978

PROFESSIONAL MEMBERSHIP - Association of Engineering Geology

PROFESSIONAL REGISTRATION - Virginia, Certified Professional Geologist

REPRESENTATIVE EBASCO PROJECT EXPERIENCE (Since 1987)

Principal Geologist

Involved in RI/FS report preparation and radiologic waste disposal projects.

Experience includes: Preparation and review of the RI and FS reports for the CERCLA designated Maxey Flats Disposal Site. Included was technical review of technology and alternative evaluations, and preparation of supporting documentation for the RI and FS reports.

Participated in the preparation of the low-level radioactive waste alternative technology assessment study performed for the Department of Energy. Project responsibilities included interdisciplinary coordination of the safety analysis report, and assuring that the documentation complied with the regulatory guidance in NUREG-1199.

PRIOR EXPERIENCE (5 Years)

Dames & Moore (Pearl River, New York)

Project Manager (3 years)

Managed projects involving the characterization and assessment of hydrogeologic conditions and contaminants at hazardous and radiologic waste sites and conducted environmental audits at commercial properties.

PRIOR EXPERIENCE (Cont'd)

Primary responsibility for the management and preparation of a license application to the NRC for the on-site disposal of thorium contaminated waste under the provisions of 10 CFR 20.302.

Managed the Phase 2 investigation of a New State Superfund site in Niagara Falls, New York. The program included groundwater, soil, and air sampling and a geophysical (seismic) site survey.

Performed ground-water and contaminated transport modeling at sites containing hazardous and radiologic wastes in Ohio and New York. Several 1-D and 2-D flow models were utilized.

Conducted and managed environmental audits of commercial facilities for prospective purchasers and current owners to assist them in identifying potential environmental hazards associated with the sites. Audit components included reviews of local, state and federal records, interviews, and on-site observations and sampling.

U.S. Nuclear Regulatory Commission (Washington, D.C.)

Project Manager/Geotechnical Engineer (4 years)

Managed and participated in radiologic waste disposal and remediation projects.

Experience Includes:

Supervised the review of designs, environmental impact statements and site selection documents for the remediation and stabilization of abandoned uranium mill tailings (UMTRA) sites.

Managed technology development contracts in the fields of site characterization, geotechnical quality control, facility design and construction, and synthetic liners for low-level radioactive waste and uranium mill tailings facilities.

Soil Testing Services, Inc. (Fairfax, Va.)

Assistant Project Engineer (1 year)

Wrote geotechnical engineering reports relating to foundation design, supervised field data collection and performed soil property laboratory testing.

ROGER A. PENNIFILL

PRIOR EXPERIENCE (Cont'd)

Schlumberger Well Services (Sacramento, Calif.)

Field Engineer (1 year)

Interpreted results from and supervised the operation of a wireline logging truck for geophysical logging of oil, gas and geothermal wells.

PUBLICATIONS

Site Suitability, Selection and Characterization: Branch Technical Position Paper; Siefken, Pangburn, Pennifill, and Starmer; U.S.N.R.C., NUREG-0902, November, 1982.

Near-Surface Disposal Facility Design and Operation: Branch Technical Position Paper; Pangburn and Pennifill; U.S.N.R.C., November, 1982.

Onsite Disposal of Radioactive Wste, Volume 31: Estimating Potential Groundwater Contamination; Goode, Neuder, Pennifill, and Ginn; U.S.N.R.C., NUREG-1101 Vol. 3, November, 1986.

MINDY SAYRES
Associate Geologist

SUMMARY OF EXPERIENCE

Ms. Sayres has participated in a wide range of geologic and geotechnical projects in both industry and the academic community. Specific project experience includes hydrogeologic evaluation for the siting of a high-level nuclear waste repository, supervision of monitoring well installation and subsequent chemical sampling in hazardous waste sites, rock excavation inspection and geologic field mapping and analysis.

PROFESSIONAL AFFILIATIONS - Geological Society of America
Sigma Xi

EDUCATION - M.A., Geology, Queens College of CUNY - 1986
- B.A., Geology, State University of New York at Oneonta - 1979

SPECIAL TRAINING - Certification of Completion of REM III Health and Safety Training Course - NUS, Pittsburgh, PA - 1986

REPRESENTATIVE ENVIROSPHERE EXPERIENCE (Since November 1986)

Greenwood Chemical (REM III): Field Operations Leader supervising an interim investigation which included soil boring and sampling, bulk density testing and lagoon and stream sampling.

Brewster Well Field (REM III): Field Operations Leader of a Supplemental RI/FS. Responsibilities included the design of the geologic/hydrologic portion of the field investigation and subsequent generation of the Work Plan, Field Operations Plan and Drilling Specifications Document as well as the supervision of all field activities. Field activities included a preliminary soil gas investigation, soil boring and sampling, monitoring well installation and groundwater sampling and OVA headspace screening of soil samples.

Bog Creek Farm Site (REM III): Site geologist supervising drilling (mud and hollow stem auger) of test borings and monitoring wells. Responsibilities included soil identification and classification (USC and Burmister Systems), chemical sampling of water and soils, daily measurements of stream flow through rectangular and V-notch weirs and participation in a constant rate injection test.

New Jersey Route 1 & 9: Site geologist responsible for the direction of drilling crews conducting test borings and observation well installation, soil identification and classification, and engineering and chemical sampling of soils.

MINDY SAYRES

PRIOR EXPERIENCE

Woodward-Clyde Consultants (January-November 1986)

Ms. Sayres's experience includes work in nuclear waste management where she participated in the evaluation of the hydrogeology of crystalline rocks in the northeastern United States for the siting of a high-level nuclear waste repository. This work included computer generation of hydrologic data maps as input to finite element groundwater flow models, technical report writing and editing with coordination of accompanying graphics and the development of extensive quality assurance procedures and work plans under DOE guidelines.

Geotechnical experience at Woodward-Clyde includes rock excavation inspection, seismograph monitoring for rock blasting and pile driving, pre-construction surveys and compacted fill inspection/density testing.

Maine Geological Survey (1984)

As a field geologist for the survey, Ms. Sayres has gained extensive experience in geologic mapping and tectonic analysis.

HONORS

Associate Member Sigma Xi
Dean of Graduate Studies (Queens College) Special Fellowship
Grants: Geological Society of America
Sigma Xi

JON C. GABRY
Environmental Chemist/Health Scientist

SUMMARY OF EXPERIENCE (Since 1979)

Total Experience - Eight years experience in environmental chemistry and ecological analyses. Experience includes supervisory/managerial positions. One year experience in the chemical (surfactant) industry.

PROFESSIONAL AFFILIATIONS - American Association for the Advancement of Science
Atlantic Estuarine Research Study

EDUCATION - Ph.D., Ecology, Rutgers University - 1984. Thesis: "Long Term Effects of Overboard Dredge Disposal on a Marine Benthic Community."
MS, Biology, Rutgers University - 1981
BS, Biology, Pennsylvania State University - 1978
Certificate in Marine Science, Pennsylvania State University - 1978
BS, Pennsylvania State University, 1977, Premedicine (Minor: Chemistry)

CONTINUING EDUCATION - GC/MS Short Course "Environmental Applications of Gas Chromatographic Mass Spectrometry," 1987, Indiana University

REPRESENTATIVE ENVIROSPHERE PROJECT EXPERIENCE (Since 1985)

Environmental Chemist/Health Scientist

Responsible for reviewing and evaluating environmental chemical data and assessing human health effects resulting from multimedia exposures to toxic chemicals. Also responsible for providing technical expertise and direction where appropriate, and for evaluating and recommending analytical protocols for laboratory services bid packages. Specific experience includes:

Performed the analysis of chemical data on eight Superfund sites. This analysis included data validation, reduction and presentation into a final report. In conjunction with this activity, a detailed risk assessment of the chemical constituents present at each site was generated for five of these Superfund sites. Briefly, the risk assessment involved the following activities: analyzing site specific chemical data to indicate those chemical constituents of concern; identifying those human exposure pathways of importance; modeling the environmental transport and subsequent intake of the chemical constituents of concern; and determining the potential public health impacts resulting from the modeled chemical exposures. The analysis included evaluating acute/chronic toxic effects (including carcinogenicity). For one of the Superfund sites mentioned previously, participated in the environmental assessment of the site.

JON C. GABRY

REPRESENTATIVE ENVIROSPHERE PROJECT EXPERIENCE (Cont'd)

This entailed a detailed ecological assessment of the site prior to remediation, and for during and post-implementation of the remedial alternatives selected. Two of the aforementioned Superfund sites involved mixed waste (radiological and organic/inorganic contaminants). At one of the Superfund sites, developed and validated a rapid soil extraction/ cleanup procedure for analyzing PCBs. The new procedure is currently being incorporated in a compendium of EPA approved analytical methods.

Developed sampling and analytical protocols, evaluated data, performed a risk assessment and prepared a final report for a private industrial client. The project principally addressed an odor problem occurring within the facility from non-point source contaminants. Identifications of potential sources of the contaminants were accomplished by utilizing comparative analytical techniques.

Performed an evaluation of bioaccumulation factors (BCFs) of selected pesticides and metals for the U.S. Army. This evaluation was utilized to develop probabilistic stochastic ranges of BCFs in various fish species for incorporation into an exposure pathway model. The exposure pathway model was subsequently used to assess potential human health risks.

Completed a detailed site investigation and risk assessment report for a private utility company's ash landfill (fly and bottom ash) site.

Supervisor, EPA Region II Data Validation Support

Developed REM III data validation support services for EPA Region II. Supervises professional and technician level staff performing data validation. Provides technical expertise where appropriate.

Regional Laboratory Sample Coordinator, EPA Region II

Coordinates laboratory services and sample tracking within EPA Region II for all REM III projects. Developed the sample tracking software and wrote the software user's manual utilized in all REM III EPA regions. Drafts bid packages and requests for special analytical services for CLP and/or REM III Team Laboratory Services. Wrote analytical deliverables requirements for all REM III Team Laboratories. Maintains sample bottle repository within Region II for CLP jobs. Supervises regional laboratory services staff. Provides technical assistance where appropriate.

JON C. GABRY

PRIOR EXPERIENCE (7 Years)

Princeton Testing Laboratory
Assistant Laboratory Manager (2 months)

Supervised all aspects of the organic laboratory sections' operations. Performed non-routine chemical analysis when required and trained entry level chemists/technicians. Increased productivity 90 percent.

Princeton Testing Laboratory
Senior Organic Chemist (10 months)

Responsible for trace organic analysis of pesticides, polychlorinated biphenyls, volatile organics and non-routine organic chemical analysis. Supervised and trained chemical technicians. Developed and wrote standardized laboratory methods and computer programs for the data acquisition systems. In charge of laboratory automation and computer interfacing. Performed GC (FID, HECD, ECD, PID, NPD), GC/MS, HPLC and UV analysis on a variety of sample matrices.

Onyx Chemical Company
Quality Control Chemist (1 year)

Responsible for wet and instrumental analysis of raw materials, in-process and final product samples. Directed operators on in-process adjustments via in-lab formulations. Performed UV, GC and LC analysis when required.

Rutgers University, Camden
Graduate Research Assistant (5 years)

Responsible for the benthic invertebrate section of the NJDEP Overboard Disposal Project granted to Rutgers University. Directed the collection and taxonomic identification of all benthic samples. Wrote computer programs and technical reports to NJDEP. Supervised undergraduate employees. Compiled a list of polychaete species found in New Jersey and their biogeographical distributions. Studied the reproductive biology of *Asabellides oculata* and an exoskeletal disease in *Callinectes sapidus*. Designed, constructed and field tested a low velocity current meter.

JON C. GABRY

PUBLICATIONS

Durand, J B, J Gabry and K Schick. 1979. Overboard Disposal of Dredge Material, Second Annual Report prepared for NJDEP.

Durand, J B, J Gabry and K Schick. 1980. Overboard Disposal of Dredge Material. Third Annual Report prepared for NJDEP.

Durand, J B, J Gabry. 1981. Overboard Disposal of Dredge Material. Fourth Annual Report prepared for NJDEP.

Durand, J B, J Gabry and B Spillane. 1982. Overboard Disposal of Dredge Material. Fifth Annual Report prepared for NJDEP.

Durand, J B, and J Gabry, 1984. Overboard Disposal of Dredge Material. Final Report prepared for NJDEP. Rutgers University CCES publication, 186p.

Gabry, J C and J Singerman. 1987. A Rapid Soil Extraction and Cleanup Procedure for Polychlorinated Biphenyls (PCBs). Proceedings, Hazardous Material Control Research Institute Superfund 1987 Conference.

Papers Presented:

"Benthic community responses to overboard dredge disposal in Absecon Bay, New Jersey," Atlantic Estuarine Research Society, April, 1983.

"The effects of dredging and overboard disposal on the benthic communities of Absecon Bay, New Jersey," Rutgers University Colloquium Series, March, 1983.

"A rapid soil extraction and cleanup procedure for polychlorinated biphenyls," Hazardous Materials Control Research Institute Superfund 1987 Conference, November, 1987.

JOHN M. GUSHUE
Supervising QA/QC Engineer

SUMMARY OF EXPERIENCE (Since 1973)

Registered Professional Quality Engineer with over 11 years experience in Quality Assurance and Quality Control.

PROFESSIONAL AFFILIATIONS - American Society for Quality Control
American Nuclear Society

REGISTRATIONS - Professional Quality Engineer - California

EDUCATION - M.B.A., Pace University (in progress)
- B.A., Philosophy/Physical Sciences, Don Bosco College - 1968

CONTINUING EDUCATION - Mathematics/Computer Science Coursework, Boston College - 1968
- Electrical Technology Coursework, Wentworth Institute - 1969
- Electrical Engineering Coursework, Northeastern University - 1970

REPRESENTATIVE EBASCO PROJECT EXPERIENCE (Since 1978)

Quality Assurance

Developed and implemented the Quality Assurance (QA) Programs for field investigations associated with feasibility studies at several sites; prepared numerous QA programs for nuclear power stations as stipulated by the Nuclear Regulatory Commission and Nuclear Industry standards; prepared procedures for the implementation of these programs in such areas as document control, design control, audits and records; conducted QA/QC audits to evaluate the implementation of the QA program laboratory and engineering facilities; determined the adequacy of subcontractor QA programs; actively pursued the resolution and corrective action for numerous nonconforming conditions affecting various equipment and services for industrial facilities and hazardous waste sites/laboratories; reviewed project criteria, specifications and drawings for the inclusion of quality criteria suitable for site/project requirements; performed audits of nuclear activities in accordance with ANSI N45.2.12 while qualified as a lead auditor in accordance with ANSI N45.2.23.

JOHN M. GUSHUE

REPRESENTATIVE EBASCO PROJECT EXPERIENCE (Cont'd)

Quality Control

Performed audits of field sampling program at several Superfund sites, site inspection programs at power generating stations, and inspection services provided by equipment manufacturers; evaluated the performance of subcontractors for compliance to established QA Programs and standard operating procedures.

Administrative Responsibilities

Quality Assurance Officer responsible for QA program at several hazardous waste sites; Project Quality Assurance Engineer responsible for directing the total QA program of the architect/engineer for several nuclear power stations; provided technical supervision to twenty Quality Assurance Engineers; maintained budget controls for QA staffs located at job sites and at the home office; performed staffing responsibilities for site and engineering office.

PRIOR EXPERIENCE (5 Years)

Stone & Webster Engineering Corporation, Boston, MA
Quality Assurance Engineer (4 years)

Responsible for auditing the implementation of Quality Assurance Programs at several Nuclear and Fossil Power stations. Particular emphasis given to electrical systems. Performed statistical analysis of audit data for use by upper management. Prepared detailed procedures to implement the requirements of the established QA program, including requirements for sampling, data collection, retention and retrievability.

Avionics Research, Plainview, NY
Quality Control Engineer (1 year)

Responsible for performing field inspections at Indian Point Nuclear Power Station. Prepared inspection program based upon industry standards such as: 10CFR50, Appendix B, IEEE, IPCEA and ANSI.

APPENDIX B

APPENDIX B

8326b

TABLE B1
Surface Soil Composite Samples
(14 Samples: SS-3 - 16)

Compound	Range	# Estimated	# ND
Non-Priority VOCs	Not Detected		
Non-Priority BNAs (ppm)			
Docosane	ND - 120	4	10
Eicosane	ND - 34	3	11
Heptadecane	ND - 68	2	12
Hexadecane	ND - 32	2	12
Octadecane	ND - 60	2	13
Pentadecane	ND - 25	1	13

ND - Not Detected

TABLE B2

Monitoring Well Boring Composite Subsurface Soil Samples
(18 Samples: MW1, 7-11, 25-30, 31-36)

Compound	Range[a]	Frequency
Non-Priority VOCs (ppb)		
Cyclohexane	ND-1100	3/18
Methyl cyclohexane	ND-1900	2/18
4-Methyl-1-pentanol	ND-350	1/18
2-Methyl-1-pentene	ND-510	1/18
3,4,4-Trimethyl-4-pentene*	ND-520	2/18
2-Methyl propanol	ND-5600	1/18
3-Pentanone	ND-2300	2/18
Butanoic acid, methylester	ND-2700	2/18
Butanoic acid, 2 methyl-methylester	ND-770	1/18
Hexane	ND-920	2/18
Non Priority BNAs (ppb)		
Eicosane	ND-2400	2/18
Heptadecane	ND-2600	2/18
Hexadecane	ND-1700	1/18
Octadecane	ND-1700	1/18
Mol. Sulfur	ND-660	1/18

* The molecular structure of this compound does not exist. Most likely there is a typographical error in the recorded data.

ND - Not Detected

a - The concentrations of all compounds are considered estimated.

TABLE B3

Auger Boring Composite Subsurface Soil Samples
(27 Samples: AB13-32, AB35, AB37-42)

Compound	Range[a]	Frequency
Non-Priority VOCs (ppb)		
Cyclohexane	ND-120	1/27
Methyl cyclohexane	ND-5700	9/27
4-Methyl-1-pentanol	ND-460	3/27
2-Methyl-1-pentene	ND-200	2/27
3,4,4-Trimethyl-4-pentene*	ND-1500	10/27
Hexane	ND-780	4/27
Heptane, 2-methyl	ND-810	1/27
Ethane,1-1 oxybis	ND-14	2/27
Non-Priority BNAs (ppb)		
Docosane	ND-47000	8/27
Eicosane	ND-5600	13/27
Heptadecane	ND-21000	12/27
Octadecane	ND-9600	7/27
Pentadecane	ND-2400	5/27
1,3,5-Trimethyl benzene	ND-3100	1/27
Molecular Sulfur	ND-2900	2/27
Hexane, 3-ethyl-2-methy	ND-11000	1/27
Octane, 3-methyl	ND-9500	1/27
Nonane	ND-14000	1/27
Nonane, 2-methyl	ND-7600	1/27
Nonane, 3-methyl	ND-8900	1/27
Decane	ND-16000	1/27
Pentadecane, 2,6,10,14-tetramethyl	ND-5600	2/27
Hexadecane, 2,6,10,14 tetramethyl	ND-2100	1/27
Heptane-2,4-dimethyl	ND-4400	1/27
2-Pentanone-4-hydroxy-4-methyl	ND-38000	3/27

a - The concentrations of all compounds are considered estimated.
ND - Not detected
* - The molecular structure of this compound does not exist. Most likely there is a typographical error in the recorded data.

TABLE B4

Refinery Monitoring Well Groundwater
(Total Wells 24) Samples: MW 1, 7-11, 25-36, 49-55

Compound	Range[a]	Frequency
Non-Priority VOCs (ppb)		
Cyclohexane	ND-865	17/24
Pentane	ND-210	5/24
2-Methyl pentane	ND-62	2/24
3-Methyl pentane	ND-36	2/24
Methyl cyclopentane	ND-270	6/24
2-Methyl-butane	ND-160	4/24
1-Propene	ND-30	1/24
Hexane	ND-340	4/24
Butane	ND-220	2/24
2-Methyl butene	ND-160	4/24
1,2,4-Trimethyl benzene	ND-1500	1/24
Methyl cyclohexane	ND-660	5/24
4-Methyl-1-pentanol	ND-103	5/24
Methyl-1-pentene	ND-660	2/24
3,4,4-Trimethyl-4-pentene*	ND-38.5	5/24
Xylenes	ND-1311	5/24
2-Methyl-1-pentene	ND-1150	3/24
3-Methyl cyclohexane	ND-39	1/24
Cyclopentene	ND-28	1/24
2-Methyl butene	ND-210	1/24
Non-Priority BNAs (ppb)		
Heptadecane	ND-32	2/24
Octadecane	ND-17	1/24
1,3,5-Trimethyl benzene	ND-11.8	2/24
Furan, 2,5-diethyltetrahydro	ND-50	1/24
Ethyl benzene	ND-770	6/24
1-Methyl naphthalene	ND-36	1/24
1,4-Pentadiene, 2,3,3-trimethyl	ND-36	1/24
Oxirane, 2-ethyl-3-propyl	ND-27	1/24
2-Butenol	ND-19	1/24
1,3-Propane diamine, N-methyl	ND-9.9	1/24
Azetidine	ND-12	1/24
1-Methyl ethyl benzene	ND-73	2/24
Propyl benzene	ND-42	3/24
1-Methyl propyl benzene	ND-40	1/24
Tetrachloroethene	ND-200	5/24
1-Ethyl-4-methyl cyclohexane	ND-20	1/24
Ethyl cyclohexane	ND-21	1/24
Butyl tetracyclate	ND-40	1/24

TABLE B4 (Cont'd)

Refinery Monitoring Well Groundwater
(Total Wells 24) Samples: MW 1, 7-11, 25-36, 49-55

Compound	Range[a]	Frequency
Non-Priority BNAs (Cont'd) (ppb)		
1,2-Benzene dicarboxylic acid, dionyl ester	ND-71	1/24
2,3-Dihydro, 1-H indene	ND-34	2/24
3-Methyl octane	ND-610	1/24

ND - Not detected
a - The concentrations of all compounds are considered estimated.
* - The molecular structure of this compound does not exist. Most likely there is a typographical error in the recorded data.

TABLE B-5

Seep and Outfall Water Samples

Compound	Outfalls Samples: SP1,SP2,SP3 Range	Frequency[a]	Seeps Samples: SP20,SP22, SP24,SP26,SW38 Range	Frequency
Non-Priority VOCs (ppb)				
4-Methyl-1-pentanol			ND-96	2/5
Cyclohexane	ND-23	1/3	ND-630	2/5
Methylcyclohexane	ND-28	2/3	ND-460	2/5
2-Methyl-1-pentene	ND-28	2/3	ND-810	2/5
3,4,4-Trimethyl-4-pentene[b]			ND-26	2/5
Non-Priority BNAs (ppb)				
Eicosane	ND-5.4	1/5		
Heptadecane	ND-5.4	1/5		
Octadecane	ND-9.5	1/5		
Pentadecane	ND-7.2	1/5		
1,3,5-Trimethylbenzene	ND-18	1/5	ND-85	2/5
Octacecanoic Acid, Butyl ester			ND-44.6E	1/5

ND = Not Detected

[a] Total number of samples where compound was detected over total samples collected, excluding duplicates.

[b] The molecular structure of this compound does not exist. This error probably results from a typographical error in the SMC Martin reports.

TABLE B-6

Seep and Outfall Sediment Samples

Compound	Outfalls 5 Samples: SP32, SP33, SP34, SP35, SP36 Range	Frequency[a]	Seeps Samples: SP21, SP23, SP25, SP27 Range	Frequency[a]
Non-Priority VOCs (ppb)				
Cyclohexane	ND-940	2/5		
Methyl cyclohexane	ND-11000	2/5	ND-4000	1/4
4 Methyl-1-pentanol	ND-510	2/5	ND-760	1/4
2-Methyl-1-pentene	ND-1700	2/5	ND-920	1/4
3,4,4-Trimethyl-4-pentene[b]	ND-8500	2/5	ND-1200	1/4
Non-Priority BNA (ppb)				
1,3,5-Trimethyl benzene	ND-1000	1/5		
Docasane			ND-280,000	1/4
Hexadecane			ND-7,800	1/4
Octadecane			ND-7,900	1/4
Pentadecane			ND-11,000	1/4

ND = Not Detected

a) Total number of samples where compound was detected over total samples collected, excluding duplicates.

b) The molecular structure of this compound does not exist. This error probably results from a typographical error in the SMC Martin reports.

TABLE B7

DRAINAGE SWALE SEDIMENTS AND SOILS

Compound	Drainage Swale Sediments Samples RS10, RS11, SS26 Range[a]	Frequency
Non-Priority VOCs (ppb)		
Hexane	ND-23.7	1/3
Methane, thiobis	ND-147.6	1/3
Methyl cyclopentane	ND-188	1/3
3-Methyl pentene	ND-50	1/3
Cyclobutanone, 2,2-dimethyl	ND-48.8	1/3
Cyclohexane, ethenyl	ND-24.5	1/3
2,3-Dimethyl pentane	ND-29.3	1/3
3-Methyl cyclohexane	ND-32.1	1/3
Methyl cycloheptane	ND-182	1/3
2,4,4-Trimethyl-2-pentene	ND-22.8	
1,2,4-Trimethyl cyclopentane	ND-26.2	1/3
1,1,3-Trimethyl-cyclohexane	ND-126.2	1/3
1,1-Oxybis ethane	ND-710	1/3
1,1,2-Trichloro-1,1,1-trifluoro-ethane*		
Furan		
1,3-Pentadiene		
Non-Priority BNAs (ppb)		
Methyl benzene	ND-1400	1/3
Acetone	ND-1200	1/3
2-Pentanone, 4-hydroxy-4-methyl	ND-28000	2/3
Molecular Sulfur	600E-6200	3/3
2-Propanone	ND-1000	1/3
Trimethyl hexane isomer	ND-2330	1/3
Cyclopropane carboxaldehyde	ND-218	1/3
2,2,4,6,6-Pentamethylheptane	ND-870	1/3
3-Methyl-5-propyl-nonane	ND-1100	1/3
7-Oxabicyclo[4,1,0] heptane		
Toluene		
Tetrachloroethene		

ND - Not detected
a - The concentrations of all compounds are considered estimated.
* - The molecular structure of this compound does not exist. Most likely the
typographical error in the recorded data.

Drainage Swale Soils
SS21 - SS25

Range[a]	Frequency
ND-15.8	4/5
ND-440	1/5
ND-36.4	1/5
ND-8.9	1/5
ND-5.2	1/5
ND-1200	1/5
ND-810	1/5
ND-28000	4/5
ND-1200	2/5
ND-1000	2/5
ND-330	1/5
ND-1100	1/5
ND-1400	1/5

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TABLE B8

Drainage Swale Water Samples
(3 Samples - SW 30, 31, 32)

Compound	Range	# Estimated	# ND
Non-Priority VOCs	Not Detected		
Non-Priority BNAs (ppb)			
Benzothiazole	ND - 13.5	1	2
Octadecanoic acid butyl ester	ND - 181	1	2
Docosane	ND - 19.3	1	2
Octacosane	ND - 17.2	1	2
1,2 Benzene dicarboxylic acid, dimonyl ester	ND - 18.4	1	2
Hexatriacontane	ND - 51.5	1	2
Pentacosane	ND - 23.1	1	2
Methyl benzene	13.9 - 28	3	0
2-Furan carboxaldehyde	ND - 20.7	2	1
7-Oxabicyclo[4,1,0] heptane	ND - 13.2	2	1
Butyl ester of hexadecanoic acid	ND - 149.3	1	2
1-Methyl-5-5' bitriazole	ND - 28.8	1	2
2,5 Cyclohexadiene-1,4	ND - 8.9	1	2
1,2 Benzenedicarboxylic acid monopenter ester	ND - 93.6	1	2

ND = Not detected

TABLE B9

River Sediments
(12 Samples - RS1-RS9, RS12, RS13, RS14)

Compound	Range	# Estimated	# ND
Non-Priority VOCs (ppb)			
1,1'-Oxybis ethane	ND - 448	2	10
Hexane	ND - 569	4	8
Cyclohexane	ND - 325	2	10
Methylcyclopentane	ND - 341	1	11
3-Methylpentane	ND - 300	1	11
2-Methylpentane	ND - 479	1	11
Methylcyclohexane	ND - 1157	1	11
Heptane	ND - 1149	1	11
Non-Priority BNAs (ppb)			
7-Oxabicyclo[4,1,0] heptane	ND - 970	1	11
2-Propanone	ND - 1100	1	11
Molecular Sulfur	ND - 1500	1	11
Heptacosane	ND - 700	1	11
Methylbenzene	ND - 1240	1	11
Dodecane	ND - 910	1	11
Formic acid, propyl ester	ND - 460	1	11
Docosane	ND - 2.8	1	11

ND = Not detected

TABLE B10
River Water
(26 Samples: SW1-SW6, SW14-SW21, SW23-SW27, SW35-SW38)

Compound	Range	# Estimated	# ND
Non-Priority VOCs (ppb)			
Methylene chloride	ND - 7.4	1	25
1-Propene	ND - 9.5	1	25
2-Menthylpropane	ND - 8.6	1	25
2-Menthyl-1-pentene	ND - 34	1	25
2-Menthyl-1-propene	ND - 21.4	1	25
1-Butyne	ND - 5.1	1	25
Non-Priority BNAs (ppb)			
Octacecanonic acid, butyl ester	ND - 44.6	1	25
Menthyl benzene	ND - 33.9	2	24
Tetrachloroethene	ND - 14	1	25
2-Furane carboxaldehyde	ND - 25	1	25
7-Oxabicyclo[4,1,0] heptane	ND - 14	1	25
2-Cyclohexene-1-one	ND - 9.7	1	25
Benzoil, 2-hydroxy	ND - 27	1	25
Toluene	ND - 9	1	25
Naphthalene	ND - 95.3	1	25

ND = Not detected

TABLE B11

LANDFILL MONITORING WELLS
(10 Samples: Wells 2-6, 13, 16, 19-21)

Compound	Range	# Estimated	# ND
Non Priority VOCs (ppb)			
Cyclohexane	ND - 26	2	8
Methylcyclohexane	ND - 100	1	9
Methyl-1-pentene	ND - 17	1	9
3,4,4-Trimethyl-4-pentene	ND - 35	1	9
1,2,3-Trimethylbenzene	ND - 25	1	9
Non Priority BNAs (ppb)			
Eicosane	ND - 18	2	8
1,3,5-Trimethylbenze	ND - 35	1	9
Cyclohexanone	ND - 5	1	9
Pentacosane	ND - 19	1	9
Tetracosane	ND - 18	1	9
Tridecane	ND - 18	1	9
Tetradecane	ND - 14	1	9
Heneicosane	ND - 9	1	9
Dodecane	ND - 14	1	9
Hexadodecane	ND - 18	1	9

ND = Not detected