RFI WORK PLAN

MONSANTO NITRO PLANT
Revision No. 1

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Prepared for:

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1.0 INTRODUCTION

Roux Associates, Inc. was retained by Monsanto Chemical Group (Monsanto) to provide environmental investigative services for the Monsanto facility located in Nitro, West Virginia. Environmental investigations at the facility are being conducted under the Resource Conservation and Recovery Act (RCRA). This document constitutes a RCRA Facility Investigation (RFI) Work Plan. The RFI Work Plan has been prepared to fulfill requirements of the facility's RCRA Corrective Action and Waste Minimization Permit (USEPA ID No. WVD 039990965) issued on November 2, 1990 by the United States Environmental Protection Agency (USEPA).

The Permit applies to Solid Waste Management Units (SWMUs) on the facility subject to RCRA. The investigations required to be conducted at the site are specified in the facility's Permit. The Permit specifies 14 SWMUs to be investigated and the environmental media (ground water, soil, sediment, and surface water) to be investigated for the various SWMUs. The selection of the specific environmental media to be investigated is based on the RCRA Facility Assessment (RFA) previously conducted for the facility. The results of the RFA are described in the document titled "Phase II Revised RCRA Facility Assessment of the Monsanto Company; Nitro, West Virginia" dated December 4, 1986, prepared for the USEPA by A.T. Kearney, Inc. (RFA Report). Subsequent to the RFA Report, the specific requirements of the facility Permit were developed through discussions between USEPA and Monsanto. The specific SWMUs to be investigated were also identified in development of the Permit.

The RFA Report and facility Permit identify ground water as the principal environmental medium to be investigated. Ground-water investigations are specified by the Permit for all but one of the SWMUs, whereas investigations of other environmental media (soil, sediment, and surface water) are specified for only three of the 14 SWMUs. This scope of investigation is followed within this Work Plan.

As described within the Permit, the specific objectives of the RFI Work Plan are to:

a. Characterize the nature, extent, concentration and rate of migration of releases of hazardous waste or hazardous constituents from the SWMUs into ground water and surface water;

b. Identify actual or potential receptors;

c. Provide a detailed geologic and hydrogeologic characterization of the area surrounding and underlying the SWMUs;

d. Determine the need for and scope of corrective measures; and

e. Conduct investigations necessary to characterize environmental setting, sources, and extent of contamination.

Previous investigations indicate ground water across the site contains volatile organic compounds at concentrations exceeding Permit-specified levels. Many of the SWMUs are contiguous and cover large areas. The contaminants of concern are similar for many of the SWMUs. As described in the RFA Report, discrimination of specific potential sources for the ground-water impact was not possible. The environmental and hydrogeologic setting of the site, combined with the history of operations and the nature and proximity of the SWMUs, warrant development of separate Study Areas. This Work Plan proposes incorporation of the SWMUs into two Study Areas: the Process Area and the Waste Treatment Area. With this approach, the primary objective of the RFI will be to conduct Study Area-wide hydrogeologic and ground-water quality investigations. Since previous investigations indicate ground-water is impacted at concentrations above Permit-specified levels, a ground-water corrective action program is a likely outcome of the RFI. This Work Plan has been developed to obtain the information necessary to develop an appropriate ground-water corrective action.

This Work Plan is organized as follows. Section 1.0 is an introduction presenting the overall Work Plan premise and objectives. Background information including a brief description and history of the facility, its environmental setting, and surrounding land use is provided in Section 2.0. A description of Solid Waste Management Units and current conditions are provided in

Section 3.0. A summary of potential corrective measure technologies identified based on preliminary information is provided in Section 4.0. A Project Management Plan with a summary of the technical strategy, information on the project team, and a proposed schedule of activities is provided in Section 5.0. This section also includes a Community Relations Plan. The proposed Sampling and Analysis Plan including sampling locations and analytical procedures is provided in Section 6.0. Investigative methods and sampling procedures are described in Section 7.0. A Quality Assurance Project Plan is presented in Section 8.0. A site-specific Health and Safety Plan for the proposed activities is included in Section 9.0. Section 10.0 provides a description of interim and final reporting requirements, and release reporting.

A site plan showing the facility layout, topographic contours, existing monitoring wells, and proposed sampling locations is provided in Plate 1.

2.0 BACKGROUND INFORMATION

2.1 General Facility Description

The Monsanto Nitro Plant is located on the east bank of the Kanawha River, approximately one-half mile north of the City of Nitro in Putnam County, West Virginia. A site location map drafted from the United States Geological Survey (USGS) 7½ minute topographic quadrangle (Saint Albans) is included as Figure 1. A site map showing property boundaries and site improvements is provided as Plate 1.

The portions of the Nitro facility to be investigated comprise approximately 116 acres in area and is divided into two sections: the northern area (approximately 46 acres) is designated the Waste Treatment Area, and the southern area (approximately 70 acres) is designated the Process Area. Approximately 60 percent of the Site is currently covered by production and warehouse buildings, parking, or open storage.

As shown on Figure 1, Interstate Highway 64 bisects the facility separating the Waste Treatment Area from the Process Area. The facility is bordered to the east and northeast by commercial properties on State Route 25. The site is flanked to the south by industrial property currently owned and operated by FMC Corporation. The Kanawha River borders the property to the west and northwest.

Brief descriptions of the plant history; site topography and drainage; regional and site soils, geology and hydrogeology; and previous ground-water analytical results are presented in the following sections.

2.2 Plant History

In 1929 Monsanto acquired the Rubber Services Company who manufactured chloride, phosphate, and phenol compounds at the facility. Floatation agents, pickling inhibitors, anti-oxidants, anti-skinning, wetting agents, and oils were all added to the existing operations in the early 1930s. Monsanto continued to expand operations at the Nitro facility and accelerated its growth in the 1940s.

The manufacture of rubber chemicals was initially the majority of the Nitro Plant's operations, accounting for about 65 percent of the business. The Nitro Plant has diversified over the years and now produces animal nutrition chemicals in addition to rubber chemicals. Some of the end uses of these chemicals include vulcanization accelerators and a vulcanization inhibitor for the rubber industry; a poultry feed supplement; antioxidants for miscellaneous rubber products and general animal feed. A variety of chemical raw materials have been used including inorganic compounds, organic solvents, and other organic compounds.

2.3 Topography and Drainage

The site is located on an alluvial plain between Armour Creek and the Kanawha River. Topography in the vicinity of the plant ranges from mountainous (elevations in excess of 1,000 feet above mean sea level [MSL]) within two miles of the site, to flat (flood plain with elevations between 580 and 600 feet above MSL) (Figure 1). The Kanawha River, which forms the western and northern boundaries of the site, is maintained at an elevation of approximately 566 feet above MSL as part of the United States Army Corp of Engineers Flood Control Program. The topography on site is relatively flat with total relief of less than 10 feet except at the riverbank along the eastern and northern part of the site. The riverbank is a steep slope which has a drop in elevation of about 15 to 25 feet (Plate 1).

A low levee is present along the river in the Process Area preventing surface water runoff directly into the river. Surface water runoff is directed to the Facility Sewer System.

2.4 Site Soils

Throughout much of the site, surficial material is composed of fill. The fill material consists of gravel, construction debris, and displaced soil which is present to varying depths across the facility. Areas of the site which have not been filled are underlain by alluvial flood plain deposits typically composed of brown silt and clay.

2.5 Geologic Setting

The regional geology of the Kanawha River Valley consists of alluvial deposits within the river valley ranging in depth from 55 to 60 feet (Wilmoth, 1966). The alluvium is the result of river sedimentation processes and consists predominantly of brown to gray clay, silt and sand. The lithology encountered at the site consists of 20 to 30 feet of silt and clay overlying a medium brown sand which grades to a coarser gray sand down to bedrock.

Bedrock is commonly encountered at a depth of 55 feet below grade in the vicinity of the site and consists of gently folded sedimentary rocks of the Pennsylvanian-age Conemaugh Formation. The facility is located on the axis of a gently folded syncline. The Conemaugh Formation includes gray and brown sandstone, red and gray sandy shales and siltstones, thin beds of impure limestone, thin coal beds, and fire clay (Wilmoth, 1966).

Geologic cross-sections through the site are provided in Appendix A. As depicted in these cross-sections, the alluvial deposits consist of brown silt, brown sand, grey sand, and red clay. The bedrock consists of grey siltstone.

2.6 Hydrogeologic Setting

The alluvial deposits of the Kanawha River Valley contain the uppermost aquifer at the site. The depth to ground water generally varies from 15 to 20 feet below grade across the facility. Zones containing perched water are also reportedly present, due to the relative impermeability of fine-grained surficial soils.

Shallow ground-water flow in the alluvial deposits beneath the facility flows toward the Kanawha River across the majority of the site. Ground-water elevation contour maps constructed as part of previous investigations are reproduced in Appendix B. The northern portion of the site, where the Waste Treatment Area is located, exhibits flow both northward to the Kanawha River and north-northeastward towards Armour Creek, a nearby tributary of the Kanawha River (Figure 1). Both Armour Creek and the Kanawha River flow in a northward direction. Previous testing at the site (Geraghty and Miller, 1985) has indicated a hydraulic conductivity in the alluvial deposits on the order of 85 feet per day with an estimated ground-water flow

velocity of 1.5 feet per day. Transmissivities have been determined in the range of 1,300 to 2,700 gallons per day per foot.

Bedrock-penetrating wells generally have a higher reported hydraulic head than overburden wells, indicating that the bedrock aquifer has an upward component of flow. Under these conditions, the bedrock aquifer would discharge to the overlying alluvial deposits and the Kanawha River. This condition is typical of valley flow systems and indicates the Kanawha River is the ultimate discharge point for ground-water flow in the vicinity of the site.

There are no known supply wells in the vicinity of the site which draw water from the alluvial or bedrock aquifers. Water supplies in the region are derived from surface waters. Potable water for the Nitro plant is purchased from the West Virginia Water Company.

2.7 Existing Monitoring Well Network

Over 60 monitoring wells have been installed at the site as part of previous ground-water quality assessments. A summary of information on monitoring wells in the existing network is provided in Table 1. The locations of the existing monitoring wells are shown on Plate 1. At a number of locations, wells are installed as couplets or triplets with individual wells screened at varying depths. Most of the wells are screened within the alluvial aquifer, and the remaining wells are screened in the bedrock.

Monitoring wells designations contain a number followed by the letter "A", "B", or "C". The letter "A" indicates the well is screened in the upper part of the alluvial aquifer, and the letter "B" indicates the well is screened in the lower part of the alluvial aquifer. Many of the "A" and "B" screen intervals overlap and screen the same part of the alluvial aquifer. The letter "C" indicates the well is screened within the bedrock.

The monitoring wells in the Waste Treatment Area initially had designations beginning with "MW-". The designations were subsequently changed to "WT-" to avoid confusion with wells in the Process Area with identical numbers.

2.8 Summary of Previous Ground-Water Analytical Results

The monitoring wells at the site have been sampled during different sampling events conducted since their installation. During the different sampling events, a variety of parameters have been analyzed including volatile organic compounds, semivolatile organic compounds, metals pesticides, herbicides, polychlorinated biphenyls (PCBs) and other indicator parameters. Of these analytes, the previous results indicate volatile organic compounds are the most pervasive contaminants. A brief description of the results for volatile organic compounds (VOCs) for the Process Area and Waste Treatment Area is presented below for the most recent sampling event in each area.

Ground-water samples were collected by the Mark James Corporation of Powell, Ohio from eleven selected wells in the Waste Treatment Area in February 1992. A summary of VOC analytical results for this sampling event is provided on Page 1 of Table 2. Five of the eleven monitoring wells sampled contained VOCs. The total VOC concentration in these five wells ranged from 32 to 1,451 micrograms per liter ($\mu g/\ell$). The reported constituents included vinyl chloride, carbon disulfide, chloroform, trichloroethylene, benzene, toluene, chlorobenzene, ethylbenzene, and xylene. Maximum contaminant levels (MCLs) are exceeded in each of five wells where constituents were detected. Each of the monitoring wells described above is screened in the alluvial aquifer ("A" and "B" screen zones). Monitoring wells in the bedrock aquifer ("C" screen zone) were not sampled in this monitoring event. In an earlier monitoring event (February 1985), VOCs were detected in three of the five bedrock monitoring wells with total VOC concentrations between 1 and 6 $\mu g/\ell$. The reported constituents included chloroethane, chloroform, and xylene isomers. None of these constituents were above MCLs, where applicable.

Ground-water samples from the thirty select wells in the Process Area were collected in February 1985 by Geraghty and Miller, Inc. (G&M) of Annapolis, Maryland. This is the most recent monitoring of wells in the Process Area. A summary of VOC analytical results for this sampling event is provided on pages 2 and 3 of Table 2. Twenty four of the thirty monitoring wells had reported VOCs with total VOC concentrations ranging from 1 to 10,060 $\mu g/\ell$. The reported constituents included vinyl chloride, carbon tetrachloride, 1,2-dichloropropane, 1,1-dichloroethene, trans-1,2-dichloroethylene, trichloroethylene, benzene, tetrachloroethylene,

toluene, chlorobenzene, ethylbenzene, and xylene isomers. Twenty one of the twenty four wells with reported VOCs had concentrations of individual constituents above applicable MCLs. VOCs were reported for wells screened in both the "A" and "B" screen zones, but in general at greater concentrations in the shallower "A" horizon.

In other analysis, isophorone was reported present in samples from three wells at concentrations ranging between 20 and 250 $\mu g/\ell$. Phenols were reported present in seventeen wells across the facility at concentrations between 6 and 310 $\mu g/\ell$ except one well with a concentration of 1,780 $\mu g/\ell$. Pesticides and PCBs were not detected in any wells. The herbicides trichlorophenoxyacetic acid (2,4,5-T) and 2,4-dichlorophenoxyacetic acid (2,4-D) were reported present in seven wells at concentrations from 1 to 295 $\mu g/\ell$. Priority pollutant metals were detected in some wells at or very near concentrations near their detection limit.

3.0 SOLID WASTE MANAGEMENT UNITS (SWMUs)

Fourteen SWMUs are addressed in the RFI as specified in the facility's permit. Initially, 34 SWMUs were identified in the RFA Report. This list was subsequently reduced based on demonstrations that releases were not likely, or that they did not satisfy the regulatory definition of a SWMU.

As presented in Section 1.0 and further discussed in Section 5.0, this Work Plan proposes two Study Areas: the Process Area and the Waste Treatment Area. The environmental and hydrogeologic setting of the site, combined with the history of operations and the nature and proximity of the SWMUs warrant this grouping. The similarity of chemicals of concern at the SWMUs further support the Study Area grouping.

The Process Area includes the Facility Sewer System, Equalization Tanks, Past Disposal Area, Niran Residue Pits, Tepee Incinerator, and Building 46 Incinerator. The Waste Treatment Area includes the Wastewater Treatment Plant, Emergency Basin, Surge Basin, Equalization Basin, Limestone Bed, Waste Pond, Decontaminated 2,4,5-T Building, and City of Nitro Dump.

Descriptions of each SWMU are provided in the RFA Report and also the Fact Sheet prepared for the facility Permit. The above-referenced documents contain descriptions of start-up dates, closure dates, wastes managed, release controls, and information on potential releases. A brief description of each SWMU and its current condition is presented in the following subsections. SWMUs in the Process Area are described in Section 3.1, and SWMUs in the Process Area are described in Section 3.2. The locations of the SWMUs in the Process Area are shown on Plate 2, and the locations of the SWMUs in the Waste Treatment Area are shown on Plate 3.

3.1 SWMUs in the Process Area

3.1.1 Past Disposal Area

This unit occupied part of a triangular piece of land covering approximately 5.7 acres in the northern part of the Process Area adjacent to the Kanawha River. The unit contained the Niran Residue Pits and the Tepee Incinerator which are also designated as SWMUs. The area was closed in 1985 as part of a Consent Agreement with USEPA Region III (III-85-17-DC). The

area was regraded and covered with gravel. Separate-phase hydrocarbon is present on ground water in the vicinity of monitoring well MW-7A.

Currently the area is an open gravel-covered area, and part of the area is used for storage of parts and machinery. Surface water runoff is directed to a drainage swale on the eastern edge of the unit which drains to the Facility Sewer System. Surface water is present in the drainage swale at certain times depending on precipitation. Sediment accumulates to a limited degree in the drainage swale. Surface water is also present in the water-filled depression shown on Plate 1. The water-filled depression is located in the central part of the Past Disposal Area and contains standing water. The depression is associated with the concrete foundation of a former structure.

3.1.2 Tepee Incinerator

The Tepee Incinerator was located near the Kanawha River in the Past Disposal Area described above. The unit was operated from about 1958 to 1962, but its exact location and dimensions are unknown. The unit was used to burn plant trash and rubbish, and has since been demolished. No records were kept as to the precise nature or quantity of the material disposed at the unit. Waste materials containing hazardous constituents are not known to have been burned there, however. The area is currently a gravel-covered field.

3.1.3 Niran Residue Pits

These units were located along the Kanawha River in the Past Disposal Area. This area is presently an open, gravel-covered field. The units are no longer in existence, and the exact dates of operation are unknown. No records were kept as to the nature and quantities of hazardous materials disposed in this area.

3.1.4 Aboveground Equalization/Storm-Water Surge Tanks

This unit was constructed in 1990, and consists of four equally-sized 82-foot diameter steel tanks with a combined capacity of 4.8 million gallons. The tanks are used for storage of water, and provide a means to equalize flow and meter water into the facility's wastewater treatment system. Wastewater and storm water are pumped from a lift station into the tanks, from which the fluid flows by gravity to the Wastewater Treatment Facility. The tanks have a synthetic liner

beneath the tank bottom with leak detection capability. The tanks are rust-free and in good condition. There are no records of leaks from the tanks.

3.1.5 Facility Sewer System

The Facility Sewer System has been in operation since the plant began production around 1918. This unit drains process wastes, sanitary wastes, steam condensate, and stormwater runoff from the facility. The Facility Sewer System contains an extensive network of piping, the total length of which is estimated to be greater than 6,000 feet. The materials of construction of various segments consist of tile piping, epoxy-lined piping, cast iron piping, fiber-reinforced polyester piping, and vitrified clay piping. The system also contains lift stations and pump stations to transfer wastewater to the Wastewater Treatment Plant. Over the years of plant operations, various portions of the piping have been repaired or replaced as necessary. A schematic layout of the Facility Sewer System is provided in Plate 4.

3.1.6 Building 46-Incinerator

This unit was formerly used to incinerate hazardous wastes generated at the plant. It is located in the Production Area and is currently used for burning Santoquin residue, a nonhazardous waste. It has not accepted hazardous wastes since February, 1984. A Verification Investigation (VI) was conducted for the unit, the results of which are described in the document titled "Revised Final Verification Investigation Report, Building 46 Incinerator" prepared by Roux Associates, Inc., dated August 24, 1993. This report contains additional information on the unit. In the VI, several constituents were detected in soils above Practical Quantitation Limits (PQLs), but below the Permit-specified health-based levels. The unit has been incorporated into the RFI to obtain additional information on potential releases in the vicinity of the feed lines for the unit.

The area surrounding the Building 46 Incinerator is currently covered with gravel, including the area below the feed lines to the unit. In a recent inspection, surface indications of releases such as staining were not observed in the vicinity of the feed lines.

3.2 SWMUs in the Waste Treatment Area

3.2.1 City of Nitro Dump

This unit was an operating landfill of slightly less than five acres, approximately 50% of which is located on Monsanto property. The remainder of the unit is on property owned by the State of West Virginia, and was covered by construction of Interstate Highway 64. The unit was in use from about 1929 to 1956. A number of industries and municipalities used the unit to bury waste materials, of which the precise nature and quantity are unknown.

Previous surface soil sampling and analysis by USEPA indicated the presence of dioxin at some locations at the unit. In response, portions of the unit were clay capped and vegetated as part of a Consent Agreement with USEPA (III-86-6-DC). USEPA issued correspondence dated May 5, 1986 indicating approval of the remedial action and compliance with the requirements of the Consent Order.

The area is currently a grass-covered field.

3.2.2 Waste Pond

This unit was at one time a part of the Wastewater Treatment Facility. The unit was a 0.5 acre surface impoundment with the capacity to store approximately one million gallons of wastewater and sludge prior to treatment in the facility treatment plant. The pond was dug into the native soil and is not known to have been lined or covered. This unit began operation in 1973 and was closed in 1980 when it was clay-capped and vegetated. The area is currently a grass-covered field.

3.2.3 Decontaminated 2,4,5-T Building

This unit was associated with production or storage of 2,4,5-trichlorophenoxyacetic acid (2,4,5-T), a herbicide in which the compound 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) is sometimes found as an impurity. This building was decontaminated, demolished, and buried near the site of the Control Room for the Wastewater Treatment Plant. The unit was buried in 1970. The area is currently a grass-covered field.

3.2.4 Surge Basin

This unit was at one time a part of the Wastewater Treatment Facility. The unit is 360 feet long, 85 feet wide and has a capacity of 5 million gallons. The Surge Basin is lined with clay and began operations in 1963. The Surge Basin was used for storage of storm water overflow mixed with wastewater during times of peak flow. The wastewater was considered a hazardous waste until 1986, since at times it received wastewater which had the potential to exhibit the characteristic of corrosivity (i.e., pH greater than 12.5).

The Surge Basin was closed in 1986 following a RCRA Closure Plan. As part of closure, sampling was conducted at the bottom of the basin and indicated corrosive material was not present. The Surge Basin continued to be used as a part of the wastewater treatment facility as a non-RCRA, NPDES-permitted unit until 1990.

Currently, the Surge Basin remains an open basin but is not in use. The basin collects rainfall and contains residual sludge.

3.2.5 Equalization Basin

This unit was at one time a part of the Wastewater Treatment Facility. The unit was 540 feet long, 137 feet wide with a capacity of 5 million gallons and was lined with asphalt. This unit was located directly adjacent to the Emergency Basin (Section 3.2.7) and received a slow feed of wastewater from the Emergency Basin. The waste stream was considered hazardous due to corrosivity until 1986.

The Equalization Basin was closed in 1986 under a RCRA Closure Plan. The closure included sampling of bottom material which indicated corrosive material was not present (i.e., pH less than 12.5). The Equalization Basin continued to be used as a part of the wastewater treatment facility as a non-RCRA, NPDES-permitted unit until 1989. Residual sludges in the Equalization Basin were subsequently stabilized in 1989 to 1990. The stabilization included addition of a cement-based stabilizing agent. The area was then soil-capped and revegetated.

The area is mounded due to the volume of stabilizing agent added during closure. The area is currently a topographically raised area which supports vegetation.

3.2.6 Limestone Bed

The Limestone Bed began operation in 1977. This asphalt-lined unit received wastewater for pH adjustment. This unit was part of the Wastewater Treatment Facility and in December 1986 was closed and taken out of service. As part of closure, liquids and sludges were removed by pumping and treated at the wastewater treatment plant. Approximately 3,000 cubic yards of soil, sediment, and asphalt liner were then excavated. The area was backfilled with clean fill and gravel. The area is now an open gravel-covered field.

3.2.7 Emergency Basin

This unit was part of the Wastewater Treatment Facility and in October 1986 was closed under a RCRA Closure Plan. This unit received wastewater until 1986 that exhibited the characteristic of corrosivity (i.e., pH greater than 12.5), thereby making it a hazardous waste. The unit began operation in 1963 and was lined with asphalt. The unit was approximately 385 feet long and 395 feet wide and had a capacity of approximately 10 millon gallons. The Emergency Basin continued to be used as a part of the wastewater treatment facility until 1990. In 1990 sludges within the Emergency Basin were stabilized/solidified using a flyash and cement-based stabilizing agent. The Emergency Basin was then capped and vegetated.

The area is mounded due to the volume of stabilizing agent added during closure. The area is currently a topographically raised area which supports vegetation.

3.2.8 Wastewater Treatment Plant

This unit handles all wastewater carried by the Facility Sewer System including process wastewater, sanitary wastewater, and storm water runoff. This unit consists of the Activated Sludge Basin, Clarifier, and a lagoon. These units are listed in the 1990 NPDES permit application and perform the treatment received by the wastewater.

4.0 IDENTIFICATION OF POTENTIAL CORRECTIVE MEASURE TECHNOLOGIES

The Permit requires that the RFI Work Plan identify potentially applicable corrective measure technologies based on preliminary information, and identify data that needs to be collected to facilitate selection of a final corrective measure(s). The following section provides this information.

Preliminary information indicates that ground-water underlying broad areas of the facility contains regulated compounds at concentrations above permit-specified levels. Soil, sediment, and surface-water contamination are not known to be present. Potential corrective measure technologies for ground water can be identified based upon information presently available; however, it is premature to evaluate potential corrective measure technologies for soil, sediment, and surface water since the nature and extent of contamination within these media, if any, has not been determined. Investigations are proposed within this Work Plan to determine if contamination is present within these media.

A variety of remedial alternatives were reviewed based on the preliminary site information. These alternatives include capping and containment methods; on-site treatment; in-situ remediation techniques; removal with treatment or disposal; and source control measures. Potentially applicable technology types and process options were evaluated on the basis of engineering feasibility and reliability. The evaluation of engineering feasibility and reliability includes a consideration of such elements as commercial availability; historic use of the technology; size/space restrictions; life span and availability of materials/components; overall economic efficiency; and ease of operation, maintenance and repair.

The various alternatives which were reviewed are summarized in Table 4. Table 4 identifies which of the technologies were retained for potential application to impacted ground water. Table 4 contains a variety of technologies reviewed, and the technologies retained are indicated in the last column of Table 4. Those technologies that are not retained for potential application to impacted ground water, but which may be applicable for other media, if warranted are also in Table 4. The following technologies were retained as potential corrective measure

technologies to control ground-water contamination and remove potential sources of ground-water contamination:

- ground-water extraction to provide hydraulic control;
- natural remediation and monitoring;
- removal of lagoon sludges and liquids as a source control measure; and
- upgrading of the Facility Sewer System as a source control measure.

These technologies are described in the following subsections.

4.1 Ground-Water Extraction

Extraction wells are used to remove impacted ground water for treatment and to create a hydraulic barrier to control the migration of contaminants. This is accomplished by the construction and subsequent pumping of extraction wells that are screened in the aquifer of concern. In this alternative, extraction wells would be installed downgradient of the source(s) or along the downgradient boundary of the contaminant plume. Preliminary information indicates extraction wells would be required at regular intervals along the Kanawha River boundary of the site to prevent off-site migration. Extraction wells may also be required in the northern and northwestern part of the Waste Treatment Area to control possible migration towards Armour Creek. Existing monitoring wells could be retrofitted to become extraction wells, and additional extraction wells would be installed as necessary to provide complete hydraulic control. Pumps and piping would be installed to remove and transport the extracted ground water.

Following extraction, impacted ground water can be treated at the facility's Wastewater Treatment Plant. The treatment system employs aeration and activated sludge biological treatment to remove contaminants, and is already permitted to accept the extracted ground water. Residuals are burned at the Boiler House. The extraction system can be readily installed with commercially available equipment and equipment already present at the site.

Separate-phase hydrocarbon can be removed along with ground water from wells, where present, using commercially-available pumps. Phase separation involves the use of oil/water separators

to provide a space where, following extraction, water/ hydrocarbon mixtures can separate naturally by gravity. Oil/water separators are frequently incorporated in ground-water treatment systems when a nonaqueous phase liquid (NAPL) is present. The extracted ground-water and separate-phase hydrocarbon can be discharged to the oil/water separator of the existing wastewater treatment system. Alternatively, separate-phase materials could be removed directly from the well using a second pump and interface controls.

Ground-water extraction systems typically require long periods of time to reach ground-water cleanup goals. Several site-specific factors which will impede the effective recovery of ground water include:

- the low permeability and transmissivity of the upper geologic unit; and
- adsorptive and ion exchange reactions between the chemicals of concern and the aquifer solids.

Hydraulic control and long-term reduction of contaminant migration to the Kanawha River will be primary objectives of the extraction well system.

Additional investigations are required to provide information to design an effective ground-water extraction system. Ground-water quality investigations are required to determine the extent of contamination. Aquifer pumping tests are required to determine hydraulic parameters and zones of influence in order to select pumping rates and extraction well spacing. Existing monitoring wells considered for retrofitting require inspection and pumping tests to determine their suitability as extraction wells. Possible extraction well pumping rates and locations will be evaluated to maximize influence on ground water and minimize removal of Kanawha River water. These data will be collected as part of the RFI as described in Section 6.1.

Prior to start-up of full-scale ground-water extraction and treatment, additional analyses and pilot tests may be required to refine the wastewater treatment process. These analyses and pilot tests can be developed as a second phase based on the results obtained by implementation of this Work Plan.

4.2 Natural Remediation and Monitoring

Ground-water contamination at the site can be reduced through natural remediation processes. This alternative may be applicable based on a determination of no potential threat to human health and the environment. This response measure consists of leaving the site as is. Over time, natural attenuation resulting from adsorption, volatilization, flushing and biological degradation will result in a reduction of contaminant levels in ground water. Long-term monitoring may be required to demonstrate that contaminant concentrations are decreasing.

Hydrogeologic and ground-water quality investigations are required to define the nature and extent of contamination prior to implementing this alternative.

4.3 Removal of Sludges and Liquids

Sludges and liquids are present in several impoundments in the Waste Treatment Area. Liquids and sludges contained within the impoundments can be removed and treated with the facility's existing Wastewater Treatment Plant. The existing process includes aeration and activated sludge biological treatment. Solid residues of the treatment process can then be burned at the facility's Boiler House. This method can effectively destroy solids, liquids and gases using high temperature oxidation under controlled conditions. Burning can achieve the destruction and removal efficiencies necessary to meet regulatory requirements. Burning is especially effective for organic compounds.

This process is the currently used treatment for the facility's process wastes. The material in the impoundments are residual process wastes, and are amenable to treatment within this process. No additional treatability studies are required to implement this option.

4.4 Upgrading of Facility Sewer System

Process waste streams are currently directed to the Facility Sewer System for transfer to the Wastewaster Treatment Facility. Based on its age and materials of construction, leakage from the Facility Sewer System is considered a likely source of ground-water contamination. Potential leakage of process-related constituents could be eliminated as a source control measure by upgrading the Facility Sewer System. With this alternative, process waste streams would be directed to newly installed aboveground or secondarily-contained piping.The upgrading program

would be comprehensive, involving more than 6,000 feet of pipe, but could be phased so that the most concentrated waste streams are addressed first.

In order to implement this alternative, each process waste stream must be identified , as-built locations and construction details of the sewer system have to be confirmed, and an aboveground or secondarily-contained piping system must be designed. Alternatively, lining of the existing sewer system or a portion thereof could be considered. No additional pilot tests or bench tests are required to implement this alternative.

5.0 PROJECT MANAGEMENT PLAN

This section outlines the technical approach that will be used during the RFI, the schedule for RFI implementation, and the qualifications and responsibilities of the key personnel that will be implementing the RFI program at the Nitro facility. A Community Relations Plan is also included.

The specific program requirements outlined in this RFI Work Plan which will be followed include sampling and analysis, chain-of-custody, quality control/quality assurance, health and safety, and data management. The implementation of these program requirements is described in Sections 6.0 through 9.0. Any significant deviation from procedures contained in the RFI Work Plan will be submitted for review and approval prior to implementation.

5.1 Technical Strategy

The technical investigations in this Work Plan have been developed following the specifications of the facility Permit with the exceptions as noted within this subsection. As specified in the Permit, ground water is the principal environmental medium to be investigated. Previous investigations indicate that ground water at the facility is contaminated with volatile organic compounds. Site-wide hydrogeologic and ground-water quality investigations, therefore, will be conducted to provide additional information to facilitate development of an appropriate corrective action for this medium. Soil, sediment, and surface water will be investigated to a limited degree as specified in the Permit. Preliminary information does not indicate the presence of contamination in these media above permit-specified levels and suggests that previous closure actions have mitigated the environmental exposures associated with these media. These media will be investigated to screen for the presence of contamination above permit-established criteria.

A phased approach to the RFI is proposed. This Work Plan is developed for Phase I, and includes investigations of the media described above. A Phase II RFI Work Plan will be prepared, if necessary, to provide additional investigations of the soil, sediment and surface water media based on the findings of the Phase I RFI. Additional investigations needed to facilitate development of appropriate corrective actions for these media will also be conducted in Phase II, if required.

Preliminary information indicates that ground water is the primary environmental exposure pathway of concern. Although ground water is not used for drinking water, it discharges to the Kanawha River. Direct contact and ingestion of sediment or soil by the public is not a significant concern since the Monsanto Nitro facility is an industrial site with restricted access and most the site is either covered by structures, gravel, asphalt, or grass. The risk to surface water is mitigated because storm water runoff in the Process Area is drained to the Facility Sewer System and treated at the Wastewater Treatment Facility.

Fourteen SWMUs have been identified by the RCRA Permit as requiring evaluation. Many of the SWMUs are contiguous and cover large areas. For example, the Waste Treatment Area has a number of surface impoundments in close proximity, and the Process Area has an extensive network of sewer pipelines. The contaminants of concern are similar for many of the SWMUs. As described in the RFA Report, discrimination of specific potential sources for the ground-water impact was not possible. The environmental and hydrogeologic setting of the site, combined with the history of operations and the nature and proximity of the SWMUs, warrant development and investigation of Study Areas. Grouping the SWMUs into Study Areas will allow a determination of releases from all the units within a Study Area, and still allow the identification of appropriate corrective measures.

For purposes of the RFI, the SWMUs have been grouped into two Study Areas: the Process Area and the Waste Treatment Area. The Process Area includes the Facility Sewer System, Equalization Tanks, Past Disposal Area, Niran Residue Pits, Tepee Incinerator, and Building 46 Incinerator. The Waste Treatment Area includes the Wastewater Treatment Plant, Emergency Basin, Surge Basin, Equalization Basin, Limestone Bed, Waste Pond, Decontaminated 2,4,5-T Building, and City of Nitro Dump. Plate 2 depicts the Process Area and Plate 3 depicts the Waste Treatment Area.

The RFI will contain a comprehensive hydrogeologic investigation with each Study Area as a unit of investigation. Each Study Area will be treated as a whole, but within each Study Area media-specific investigations will be conducted for individual SWMUs as provided in the table in Section C.I.2.d of the Permit. Environmental media to be investigated for individual SWMUs are summarized in Table 3. Ground-water investigations are specified for each of the SWMUs,

except the Building 46 Incinerator where only soil investigations are specified. In addition, investigations of surface water, sediment, and riverbank soils are specified for the Past Disposal Area, Tepee Incinerator, and Niran Residue Pits. These media-specific investigations will be conducted as described within this Work Plan.

This Work Plan contains one exception to the media for investigation specified in the Permit. Soils investigations are specified in the Permit for the Facility Sewer System, but are not included in this Work Plan. A separate Work Plan will be prepared for this SWMU. Potential releases from the sewer system include leakage of wastewater and migration to ground water. Facility-wide ground-water investigations are planned in this RFI Work Plan, and the sewer system will be assessed with this investigation. The area where this unit is located contains an extensive number of process buildings and other structures, and excavation of the unit or associated soils is impractical. Corrective action for the system will likely include ground-water remediation and may include upgrading the sewer system components.

5.2 Schedule

The following schedule reflects anticipated time intervals expected for completion of the proposed investigation. Activities will commence upon approval of a final RFI Work Plan.

Project funding approval and contractor procurement will be completed within 12 weeks. Soil/sediment and surface-water sampling is estimated to be completed within 18 weeks. Soil borings/monitoring well installation and ground-water sampling will be completed within 22 weeks. Aquifer testing will be completed within 24 weeks.

Laboratory analysis and data evaluation will be completed within 36 weeks. A Draft RFI Report will be submitted to the USEPA within 52 weeks. A bar chart showing the proposed schedule is provided in Figure 2.

5.3 Project Team

Monsanto has retained Roux Associates, Inc. to manage the RFI. Roux Associates, Inc. will assemble a team of qualified environmental scientists and engineers to implement the environmental investigation program. The project will be managed from Roux Associates, Inc.'s West Deptford, New Jersey office. Laboratory analytical services will be provided by Kemron Environmental Services. Soil boring and well installation services will be provided by CTL Engineering, Inc. Key members of the proposed project team are described below. Professional profiles are provided in Appendix C.

Mr. Mark Tucker, P.G., Senior Hydrogeologist at Roux Associates, Inc., will serve as Project Manager. Mr. Tucker has 9 years of experience in environmental assessments, hydrogeologic investigations, and regulatory compliance. He has managed environmental investigations for industrial facilities, commercial hazardous waste disposal facilities, and CERCLA hazardous waste sites. He has developed and implemented RFI investigations for industrial facilities.

Mr. Neil R. Rivers, Principal Scientist at Roux Associates, Inc., will serve as Quality Assurance Manager. In this capacity, Mr. Rivers will provide technical oversight and review of project activities. Mr. Rivers will provide quality assurance/quality control review of project deliverables. Mr. Rivers has over 13 years experience in environmental investigations, site remediations, and agency negotiations.

Mr. Peter J. Palko, Senior Engineer at Roux Associates, Inc., will serve as Technical Advisor for the RFI. In this capacity, Mr. Palko will support the evaluation of data collected at the site, with particular emphasis on the continuing evaluation of potentially applicable corrective measures. Mr. Palko has over 5 years experience in the design and implementation of remedial actions for environmental projects.

Mr. Ernest Risha, Project Scientist at Roux Associates, Inc., will serve as Field Team Leader. Mr. Risha will provide coordination during field investigative activities regarding soil and ground-water sampling and well installation. Mr. Risha has 6 years experience in site assessments, RCRA sampling plan preparation and implementation, and field oversight.

Mr. Scott Anderson, Project Geologist at Roux Associates, Inc., will assist with implementation of the field investigation phase. Mr. Anderson has 5 years experience and has participated in hydrogeological studies including ground-water flow modeling, subsurface investigations, and report preparation.

Ms. Leslie Bucina, Laboratory Manager for Kemron Environmental Services, will coordinate the laboratory analytical services. Ms. Bucina has 12 years experience in laboratory analysis associated with industrial quality assurance and environmental investigations.

Mr. James Pogacnik, Drilling Services Manager for CTL Engineering, Inc. will coordinate the installation of soil borings and monitoring wells. Mr. Pogacnik has 12 years experience in well installation.

Key contacts for the facility regulatory agencies responsible for overseeing the RFI and contracted services are listed below:

Facility Contact:	Ms. Christine Weber Environmental Superintendent Monsanto Company No. 1 Monsanto Road Nitro, West Virginia 25143
USEPA Contact:	Mr. Denis Zielinski USEPA Region III 841 Chestnut Street Philadelphia, Pennsylvania 19107-4431
RFI Implementation:	Mr. Mark Tucker Roux Associates, Inc. 1222 Forest Parkway Suite 190 West Deptford, New Jersey 08066 (609) 423-8800
Analytical Laboratory:	Ms. Leslie Bucina Laboratory Manager Kemron Environmental Services 109 Starlite Park Marietta, Ohio 45750 (614) 373-4071

Drilling Contractor: Mr. James Pogacnik
Drilling Services Manager
CTL Engineering, Inc.
2860 Fisher Road
P.O. Box 44469
Columbus, Ohio 43204
(614) 276-8123

5.4 Community Relations Plan

A fact sheet has been prepared (Appendix D) to keep the surrounding community informed of the scope and objectives for the RFI at the Nitro facility. The fact sheet includes the location and general description of the site, a summary of proposed sampling activities for each media affected, and other work planned such as additional monitoring well installation, aquifer testing, and report preparation. The fact sheet will be provided to interested parties upon request.

6.0 INVESTIGATION, SAMPLING, AND ANALYSIS PLAN

This section contains an outline of the investigations to be conducted as part of the Phase I RFI. It includes the types of investigations to be conducted, sampling locations, rationale for selecting locations, and analysis to be performed. Detailed descriptions of sampling procedures, analytical methods, and quality assurance procedures are provided in Sections 7.0 and 8.0 of this Work Plan.

Investigations to be conducted at the site include ground-water investigations, soil investigations, sediment investigations, surface-water investigations, and riverbank soil investigations. These are described in Sections 6.1, 6.2, 6.3, 6.4 and 6.5, respectively.

6.1 Ground-Water Investigation

Ground-water investigations at the facility will include a site-wide hydrogeologic investigation; Study Area-specific investigations for the Waste Treatment Area and the Process Area and aquifer tests. The site-wide investigations focus on evaluation of geologic units underlying the site and verification of site-wide ground-water flow patterns. The Study Area-specific investigations focus on establishment of ground-water quality. Aquifer tests will be used to assess hydraulic parameters and estimate zones of capture for possible ground-water extraction systems. These investigations are described below.

6.1.1 Site-Wide Hydrogeologic Investigations

A site-wide hydrogeologic investigation will be conducted to provide information on geologic units underlying the site and site-wide ground-water flow patterns. Approximately 60 monitoring wells are currently present at the site and provide an extensive monitoring well network as shown on Plate 1. These monitoring wells will be used for the investigation along with additional monitoring wells installed in areas not presently monitored. The investigation will include an inspection of the existing monitoring wells, soil borings, installation of additional monitoring wells, surveying of top of casing elevations, and water level monitoring. These activities are described in more detail below.

The existing monitoring wells will be inspected to determine their ability to provide representative water level measurements and ground-water samples. The wells will be repaired or replaced, if warranted, to provide adequate ground-water monitoring points.

Soil borings will be installed at the locations of additional monitoring wells. Soil borings will be logged to provide information on subsurface conditions. This information, along with soil boring logs from previous investigations and descriptions from published reports, will be used to describe and characterize geologic conditions at the site.

Six additional monitoring wells will be installed to provide additional monitoring points in the existing monitoring well network. Each monitoring well will be screened from approximately 5 feet above the water table to 10 feet below the water table. The locations of these wells (designated MW-23A, MW-24A, WT-12A, WT-13A, WT-14A, and WT-15A) are shown on Plate 1. A discussion of the rationale for selecting these locations is provided in Sections 6.1.3 and 6.1.4, which describe Study Area-specific investigations.

A site-wide water level monitoring event will be implemented to gain a set of water level data to evaluate ground-water flow conditions. Water level measurements will be collected from the existing monitoring wells, the monitoring wells to be installed, and also off-site piezometers LF-1, LF-6, LF-9, PZ-2, PZ-3, and PZ-4. These piezometers are in an off-site area owned by Monsanto and are shown on Plate 1. The off-site piezometers are located northeast of the site and will provide information on the apparent ground-water divide between the Kanawha River and Armour Creek.

Surveying will be conducted to obtain top-of-casing elevations referenced to a common datum. A staff gauge on the Kanawha River will also be surveyed to provide information on the relationship between ground water and surface water.

6.1.2 Aquifer Pumping Tests

Aquifer tests will be conducted to determine hydraulic parameters and estimate zones of capture for a possible ground-water extraction system. If a ground-water extraction remedy is implemented, it will likely include pumping from wells along the Kanawha River boundary of

the site to provide hydraulic control at this downgradient boundary. Aquifer tests, therefore, will be conducted using monitoring wells in this area. The tests will include slug tests, step-drawdown tests, and 24-hour aquifer pumping tests. These are described in more detail below.

Slug tests are conducted by instantaneously changing the water level within a well and monitoring the return to static conditions. Slug tests will be conducted at a number of monitoring wells to determine their ability to be retrofitted as extraction wells in an extraction well system. The slug tests will provide information on the ability of individual wells to yield water. The slug tests will also provide information to evaluate variations in hydraulic conductivity across the site. Since individual slug tests involve observations at a single well and a relatively small volume of water, the test provides information on the portion of the aquifer immediately surrounding the well. Slug tests will be conducted for wells MW-3A, MW-3B, MW-4A, MW-4B, MW-5A, MW-5B, MW-6A, MW-6B, MW-7, MW-10, MW-12, MW-22A, MW-22B, WT-3, WT-5A, WT-5B, WT-7A, WT-7B, WT-13A, WT-14A, and TD-5.

Step-drawdown tests are conducted by pumping from a well at increasing rate steps, and monitoring changes in drawdown with respect to time. Step-drawdown tests will be conducted at one location in the Process Area (in the vicinity of MW-4B) and one location in the Waste Treatment Area (in the vicinity of WT-7B). Test wells will be installed at each location to be used as pumping wells in each test. The test wells will fully penetrate the alluvial aquifer. Each selected location includes nearby monitoring wells that can be used as monitoring points. The test wells will be installed approximately 50 feet from wells MW-4B and WT-7B. The step drawdown test will provide information on sustainable yield. This information will be used to select a pumping rate for the 24-hour aquifer pumping test and also to design pumping rates for a possible ground-water extraction system.

Long-term aquifer pumping tests are conducted by pumping at a constant rate and monitoring changes in drawdown to evaluate the effects of long-term pumping. Two 24-hour aquifer pumping tests will be conducted, using the same wells employed for the step-drawdown tests. Prior to implementing the tests, two piezometers will be installed in the vicinity of each well to be tested. The piezometers will be installed at distances of approximately 10 feet from the pumping wells in directions parallel and perpendicular to the Kanawha River. The 24-hour

aquifer pumping tests will provide information on hydraulic parameters and drawdown with distance. The tests will also provide information on radius of influence and zone of capture to design the possible ground-water extraction system.

6.1.3 Process Area Ground-Water Investigations

The Process Area will be treated as a unit for ground-water investigations. Two additional monitoring wells, MW-23A and MW-24A, are proposed for the Process Area. The proposed well locations are depicted on Plate 2. Well MW-23A will be installed at the southwestern corner of the Process Area to provide additional ground-water quality information in this area, and to provide a point to monitor upgradient background water quality. Monitoring well MW-24A will be installed downgradient of the Niran Residue Pits.

Monitoring wells surrounding the Process Area will be sampled to evaluate ground-water quality. The wells to be sampled include MW-1A, MW-1B, MW-2A, MW-2B, MW-3A, MW-3B, MW-4A, MW-4B MW-5A, MW-5B, MW-6A, MW-6B, MW-7, MW-8, MW-11A, MW-11B, MW-14, MW-15, MW-17A, MW-17B, MW-18A, MW-18B, MW-19A, MW-19B, MW-20A, MW-20B, MW-21A, MW-21B. MW-22A, MW-22B, MW-23A, AND MW-24A. These wells were selected based on their location along the perimeter of the Process Area and include upgradient and downgradient locations. The locations of these wells are shown on Plate 2. Ground-water samples collected from the monitoring wells will be analyzed for volatile organic compounds (VOCs), base/neutral/acid extractable semivolatile organic compounds (BN/AEs), metals, total organic carbon (TOC), total organic halogen (TOX), and pH using the analytical methods described in Section 8.9.

6.1.4 Waste Treatment Area Ground-Water Investigations

The Waste Treatment Area will also be treated as a unit for ground-water investigations. Four additional monitoring wells; WT-12A, WT-13A, WT-14A, and WT-15A; are proposed for the Waste Treatment Area. The proposed well locations are depicted on Plate 3. Monitoring well WT-12A will be installed upgradient of the City of Nitro Dump to monitor upgradient background water quality. Monitoring well WT-12A is an off-site well on property owned by the State of West Virginia. Access must be obtained to install this well. Monitoring wells WT-

13A and WT-14A will be installed downgradient of the City of Nitro Dump. Monitoring well WT-15A will be installed upgradient of the Waste Pond.

Monitoring wells surrounding the Waste Treatment Area and within the unit will be sampled to evaluate ground-water quality. These wells include WT-1, WT-2, WT-3, WT-4A, WT-4B, WT-5A, WT-5B, WT-6, WT-7A, WT-7B, WT-7C, WT-8A, WT-8B, WT-8C, WT-9A, WT-9B, WT-9C, WT-10A, WT-10B, WT-10C, WT-11A, WT-11B, WT-11C, WT-12A, WT-13A, WT-14A, WT-15A, TB-1, TB-3, TD-1, TD-3, and TD-5. The locations of these wells are shown on Plate 3. Ground-water samples collected from the above monitoring wells will be analyzed for VOCs, BN/AEs, metals, TOX, TOC, and pH. In addition, samples from monitoring wells in the vicinity of the City of Nitro Dump (WT-12A, WT-13A, and WT-14A) and wells in the vicinity of the Decontaminated 2,4,5-T Building (TB-1, TB-3, TD-1, TD-3, and TD-5) will also be analyzed for dioxins and dibenzofurans. The proposed analytical methods are described in Section 8.9.

6.2 Soil Investigation

As described in Section 5.1, soil will be investigated at the Building 46 Incinerator. This incinerator is part of the Process Area and is depicted on Plate 2. A soil investigation will not be conducted for the Facility Sewer System, since it will alternately be investigated by the ground-water investigation.

Soil samples will to be collected at the Building 46 Incinerator beneath the feed lines adjacent to the incinerator. A number of samples were collected as part of the Verification Investigation at this SWMU and USEPA has requested these additional samples from beneath the feed lines to complete the investigation. Two additional samples will be collected from a single soil boring.

Samples will be collected at two depths as was conducted for the VI. A shallow sample (10S) will be collected at approximately 0.0 to 0.5 feet below surficial gravel. A deeper sample (10D) will be collected at approximately 2.0 to 2.5 feet below surficial gravel. The locations of these samples are shown on Figure 3. Gravel overlying the proposed sampling point will be removed using a backhoe. Soil samples will be collected by hand augering. Soil borings will be screened

with an organic vapor meter (OVM) for the emissions of subsurface vapors. Samples will be analyzed for VOCs, BN/AEs and metals using the analytical methods described in Section 8.9.

6.3 Sediment Investigation

Sediment samples will be collected from the Process Area, in the vicinity of the Past Disposal Area. The Past Disposal Area includes the Tepee Incinerator and Niran Residue Pits SWMUs. Sediment sampling is required for these SWMUs in the Permit. Three samples will be collected to screen for the presence of impacted sediments in this area, since there are no previous investigations which indicate the sediments are contaminated. The sediment samples will be collected from the drainage swale located along the eastern part of the Past Disposal Area. The sample locations (designated SED1, SED2, and SED3) are depicted on Plate 2.

The sample locations were selected to provide representative samples of the sediments. Surface water runoff in the area is directed to this drainage swale. Runoff does not flow toward the Kanawha River. The drainage swale discharges to the Facility Sewer System at a catch basin near sample location SED3 as shown on Plate 2. The Past Disposal Area is covered with gravel and the drainage swale is the only area where sediment accumulates.

Grab samples will be collected from within 0.5 feet of the surface of the sediment. In a recent inspection, the depth of sediment was estimated to not exceed 0.5 feet. The sediment samples will be analyzed for VOCs, BN/AEs, and for metals using the analytical methods described in Section 8.9.

6.4 Surface-Water Investigation

Surface-water samples will be collected at two locations in the Process Area in the vicinity of the Past Disposal Area. Surface-water samples are required for the Past Disposal Area, Tepee Incinerator, and Niran Residue Pits. The Tepee Incinerator and Niran Residue Pits are located within the larger Past Disposal Area. Surface water is present in two places within this area: in the drainage swale during wet periods and in the water-filled depression shown on Plate 2. Samples will be collected from each of these areas to screen for the presence of contamination. Two samples will be collected from the drainage swale, and two samples will be collected from

the water-filled depression. The locations of the samples (designated SW-1, SW-2, SW-3, and SW-4) are shown on Plate 2.

The samples will be analyzed for VOCs, BN/AEs, metals, TOC, TOX, and pH using the methods described in Section 8.9.

6.5 Riverbank Soil Investigation

Riverbank soil samples will be collected at three locations along the Kanawha River near the Process Area. The sample locations (designated RB1, RB2, and RB3) are shown on Plate 2. Riverbank soil samples are required for the Past Disposal Area, Tepee Incinerator, and Niran Residue Pits. The sampling locations were selected for screening purposes, since contamination is not known or suspected to be present in this area.

Surface water runoff is directed toward the Facility Sewer System, and not to the Kanawha River. The sampling at the riverbank, therefore, is intended to investigate the possible migration of constituents by subsurface routes.

Soil samples at the riverbank will be collected by hand augers. The auguring will start at approximately 3 feet above the Kanawha River water level. The hand augurs will be advanced and soil samples will be collected at a depth of approximately 2.5 to 3.0 feet. The samples will be analyzed for VOCs, BN/AEs, and metals, using the analytical methods described in Section 8.9.

7.0 INVESTIGATION METHODS AND PROCEDURES

7.1 General Discussion of Field Sampling Procedures

Field activities will be conducted by personnel trained in sample collection procedures. In addition, each individual involved will be capable of calibrating any field equipment which may be utilized during drilling, well installation and sampling procedures. Equipment calibration will be conducted on the morning of use and will be documented in the field sampling logbook.

Samples will be collected in the anticipated, increasing degree of contamination and placed in pre-cleaned, laboratory-supplied containers. The samples will be collected, labeled with a unique designation, and wrapped in dedicated plastic bags. The samples will be placed in coolers and preserved on ice. Custody forms will be maintained for each sample shipment, and custody seals will be placed on each cooler prior to shipment. Trip and equipment field blanks along with duplicate samples will be collected when applicable for QA/QC purposes. The investigation to be conducted at the site is described in Section 6.0 including number of samples and rationale for selection of locations. The specific procedures to be used to conduct the investigations are described in the following subsections. The procedures related to ground water, soil, sediment, and surface water are described in Subsections 7.2, 7.3, 7.4, and 7.5, respectively. Equipment to be used in the investigations is listed in Subsection 7.6. Field equipment decontamination procedures are described in Subsection 7.7. Waste management procedures are described in Subsection 7.8.

7.2 Ground-Water Investigation Procedures

7.2.1 Monitoring Well Inspection

Existing monitoring wells will be inspected for the following to ensure their integrity and suitability for use during the RFI:

- well identification numbers;
- integrity of protective casing;
- presence of standing water adjacent to the well;
- presence of a locking well cap and padlock;
- status of the well casing and a clearly marked measuring point;

- presence of cracks in the concrete pad or grout seal; and
- well siltation.

Wells identified as deficient in any of the above areas will be repaired. This includes replacement of curb boxes, well caps, and padlocks, repair of the PVC casing, restoration of grout seals, and protective concrete pads and establishment of measuring points. Additionally, well depths will be compared to their appropriate logs to evaluate the presence of silt/clay in the boreholes.

If evidence exists that an unacceptable amount of sediment exists at the base of the well (greater than one foot) or that the well screen has become plugged, a well redevelopment program will be initiated. This will involve using an appropriately sized surge block to clean the well screen and a sand bailer to remove any sediments. The well will then be redeveloped using a low-flow submersible pump, removing residual fines until the water appears turbid-free. If the well is damaged beyond repair, the well will be replaced.

7.2.2 Monitoring Well Installation

A monitoring well installation program is proposed for evaluation of general ground-water quality. Wells will be installed by a licensed well driller. All appropriate permits will be secured prior to initiating drilling activities.

Prior to commencement of site activities, planned monitoring well locations will be identified and marked out using standard surveying flags. Each location will be documented with a hand drawn map in a standard water-resistant, field sampling logbook. Exact locations will be determined by field measurements relative to fixed structures. The locations will allow for physical obstacles and/or inaccessibility of locations.

Monitoring wells will be constructed in soil borings installed using standard hollow-stem augering techniques complete with continuous split-spoon sampling to the desired depth. The augers and associated tools will be washed with a non-phosphate detergent and rinsed using a steam or a high-pressure hot water rinse prior to arrival at the site and between each boring location.

Each boring will be advanced through surficial gravel, if present, using a nominal 6-inch outside diameter auger. A pre-cleaned, 2-inch outside diameter, stainless steel (carbon steel when applicable), split-spoon and pre-cleaned drill rods will then be lowered into the boring through the annular space of the auger. The split-spoon will be complete with a catch basket at its tip to prevent the soil sample from being lost back into the borehole. The spoon assembly will then be driven approximately 2 feet into the undisturbed soil using a standard 140 pound hammer. Blow counts will be recorded at 6-inch penetration intervals by the oversight geologist.

The spoon assembly will then be removed from the boring and separated from the drill rods. Using new, disposable, latex gloves, the geologist will place the split-spoon onto plastic sheeting and unscrew the drive and head shoes for sample inspection. The entire process will then be repeated with the advancement of the boring and continuous collection of split-spoon samples at each 2-foot interval until boring termination.

The split-spoons and soil coring device will be carefully opened as to minimize disturbance and to retain all of the soil in one-half of the barrel. Each sample will be immediately logged into the field sampling logbook by the geologist. Soils will be classified using the ASTM Classification Systems. Observations will include: color, soil texture, grain-size, moisture content, changes in horizon, staining, and odor. Field logs will be completed for each sample which, in addition to the above, will document:

- Date/Time/Weather
- Sampler's Name
- Sample Depth
- Depth to Water (if applicable)
- Soil Profile
- Sample Recovery
- Additional Field Measurements

Upon completion of the borehole, the wells will be installed using a pre-cleaned, 4-inch inside diameter PVC blank casing and well screen with threaded connections. Approximately fifteen feet of screen will be used in each well. The screened zone will bridge the encountered ground-

water table to allow for detection of separate-phase liquids if present. A filter pack extending one foot above the top of the screen will be placed in the annular space of the wells. A 2-foot thick bentonite-pellet seal will be tremied into place on the top of the gravel pack followed by an cement-bentonite grout mixture (94-8) to just below ground surface. Each well will be completed at the surface with a locking compression cap well seal and an outer protective steel casing surrounded by a 2-foot square protective concrete pad.

Following installation, each well will be developed to remove residual fines from the gravel pack and to ensure communication between each well and the surrounding aquifer. Each well will be developed until the water appears turbid-free. Upon completion, the wells will be surveyed to establish vertical and horizontal control. A staff gauge on the Kanawha River will also be surveyed. Elevations will be surveyed to the nearest 0.01 feet. The well designations assigned to each respective well will be permanently affixed to the well cover.

7.2.3 Ground-Water Sample Collection

Proper monitoring well purging and sampling procedures will be followed to ensure representative ground-water samples are collected at the site. Ground-water samples will be collected at least 14 days following the date of well installation and development. Sampling personnel will have copies of the sampling plan complete with observation well construction logs, analytical requirements and equipment lists.

Each well will be allowed to equilibrate prior to collection of water-level measurements. The depth to water and total depth of each well from the surveyor's mark will be measured to an accuracy of ± 0.01 foot using an electronic water-level meter. The meter will be cleaned prior to use and between each location with a non-phosphate detergent wash, potable water rinse, and distilled/deionized water rinse to avoid cross-contamination.

Using the depth-to-water and total well depth measurements, field personnel will calculate the volume of standing water in each well. The sampling crew will then purge three to five times the volume of standing water from each well. A pre-cleaned, low flow, stainless steel submersible or aboveground centrifugal pump (decontaminated using the above-described procedures), dedicated polypropylene rope, and drinking-water grade pipe will be used to

complete purging. Measurements of Ph, specific conductance, dissolved oxygen and temperature will be collected from the pump discharge point using properly calibrated meters. Care will be taken not to purge the well too quickly, resulting in unacceptable drawdown. Low-flow wells will be allowed to recover prior to sampling activities.

Information recorded in the field book will include:

- Well number and diameter
- Depth to water and depth to bottom
- pH, conductivity, temperature, and dissolved oxygen at initiation and completion of purging
- Start and stop time for purging
- Purge method/rate
- Total volume purged

Sampling will be accomplished with bottom-loading, Teflon® bailers with Teflon®/stainless steel leaders which will be thoroughly cleaned and wrapped in aluminum foil prior to use according to the procedures for sample equipment decontamination in Section 7.7.

Each bailer will be slowly lowered into the well (to prevent aeration of the water) until partially submerged. Then, following removal, the first bailer will be utilized for sample collection. New, non-absorbent, polypropylene cord will be used to lower the bailers, and clean disposable latex gloves will be worn while handling the sampling equipment and containers.

The samples will be collected in pre-cleaned, laboratory-supplied containers provided by the laboratory. Preservatives will be placed in the sample bottles at the laboratory prior to shipment to the site. Field personnel will record the following in the field sampling logbook:

- Sampler's names
- Start/stop time of sampling
- Sampling method
- pH, conductivity, temperature, and dissolved oxygen after sample collection
- Number of bottles
- Analyses requested
- Preservation
- Number of QA/QC samples collected

All samples collected for analysis will be directly transferred from the bailer to the respective laboratory bottles. The sampling containers will be filled in the following order (as appropriate):

- Volatile Organic Compounds
- Total Organic Halogen
- Total Organic Carbon
- Base-Neutral/Acid Extractables (Semivolatile Organics)
- Polychlorinated Dioxins and Polychlorinated Dibenzofurans
- Total Metals
- pH

Each sample container will be labeled by the on-site geologist with the sample designation (well number), time and date of collection, and the sampler's initials. The sample containers will be placed on ice in an insulated cooler and preserved to a temperature of approximately 4 degrees Celsius. A chain-of-custody form will be completed and maintained for all samples throughout collection, transport, and delivery. Field equipment blank and trip blank samples will be collected to provide quality assurance and quality control over sampling and analytical procedures as described in Section 8.11. Following collection of all samples, the coolers will be secured with numbered custody seals and shipped via next day delivery carrier service to the laboratory.

7.2.4 Aquifer Testing

Aquifer testing will be performed to confirm aquifer characteristics and provide information to design a ground-water extraction system. A series of slug tests, step-drawdown tests, and long-term constant-discharge rate tests will be performed. Each test is described in more detail below.

7.2.4.1 Slug Tests

The primary objective of the slug tests is to determine the hydraulic conductivity of the underlying aquifer in order to gain general understanding of the aquifer characteristics in the vicinity of the well tested. A secondary objective is to determine the ability of the well to yield water.

Prior to conducting the slug tests, the depth to water in each monitoring well will be measured with an electronic water-level indicator. Water-level data obtained from these measurements will be used to determine the depths to which the slug will have to be lowered in each well in order to be completely submerged. The slug tests will be conducted using a 36-inch section of concrete-filled polyvinyl chloride (PVC) pipe. Water-level changes will be measured with a precleaned pressure transducer and data logger. The transducer probe will be lowered into the selected wells to a depth of approximately seven (7) feet below the static water level and secured to the well casings with duct tape. The data logger will be programmed to record water-level fluctuations in the well at pre-selected time intervals. The data logger will be activated before the start of each slug test to monitor static water-level conditions.

Upon confirming static water-level conditions, the slug will be lowered into the well and submerged below the static water-level. The slug will be secured at the pre-determined depth and held in position until the water level recedes to near static conditions. Changes in the water level due to volume displacement by the slug are recorded by the transducer probe and data logger. Upon achieving equilibrium, the slug will quickly be removed from the water column, and the instantaneous change in the water level induced by removing the slug will simultaneously be recorded by the pressure transducer. Recovery to static conditions will be monitored by the pressure transducer and confirmed manually with the water-level indicator. Once recovery is

at least 80 percent complete, the data recorded by the transducer will be down-loaded and saved on a computer diskette.

During the course of each of the slug tests, water levels will be measured at five-minute intervals using an electronic water-level indicator. The water-level data obtained during each slug test will be compared to the water levels recorded by the data logger to ensure that the pressure transducers and data loggers are functioning properly. Plots of water level versus time will be constructed from the data to evaluate the ability of the well to yield water and calculate hydraulic conductivity.

7.2.4.2 Step-Drawdown Tests

Step-down tests will be conducted by pumping from the selected wells in stages at increasing pumping rates. The objectives of the step-drawdown tests are to determine sustainable yields and specific capacities.

Prior to conducting the tests, the pump will be calibrated by determining the relationship between the pump controller settings and measured discharge rates. The pump used during the testing will be a Grundfos Redi-Flow Pump or equivalent. The manufacturer's design pumping rate for this pump ranges between 0.5 gpm and 7 gpm. All equipment placed in the monitoring wells during the step-drawdown tests will be decontaminated using the procedures described in Section 7.7.

The step-drawdown test will be conducted by pumping at three incremental steps with increasing pumping rates. Discharge rates will be measured using a stopwatch and calibrated bucket. Pumping will continue in each step until drawdown levels have stabilized, or a duration of approximately two hours if drawdown levels have not stabilized. The pumping rate will then be increased to the next step without allowing the water level to recover. The anticipated pumping rates for the individual steps are 2, 4, and 6 gallons per minute (gpm). Manual depth-to-water measurements will be collected in the pumping well at 1-minute intervals for the first 10 minutes of each step and at 5-minute intervals thereafter. Plots of drawdown versus time will be prepared to evaluate sustainable yields and specific capacities.

7.2.4.3 24-Hour Constant-Discharge Pumping Test

Two 24-hour constant-discharge pumping tests will be conducted to determine aquifer hydraulic parameters and drawdown with distance relationships. This information will be used to predict radii of influences and zones of capture for extraction wells.

Manual depth-to-water measurements will be collected in the pumping well at 1-minute intervals in the first 10 minutes of the test, at 10-minute intervals from 10 to 100 minutes of pumping, and hourly thereafter. Nearby wells will be monitored prior to pumping and at 10-minute intervals from 10 to 100 minutes after pumping started, and hourly thereafter. A background site monitoring well will be monitored at approximately 1-hour intervals. In addition, pressure transducers with automated data loggers will be installed in select nearby wells to monitor water-level fluctuations.

The data generated from the 24-hour aquifer pumping tests will be analyzed in several different ways. Ground-water elevation contour maps will be constructed to evaluate real-time zones of influence. Hydraulic parameters will be evaluated as described below.

A semilogarithmic time-drawdown plot will be constructed for the 24-hour pumping test data. A best-fit line will be drawn through the points on the graph. The change in drawdown per log cycle, along with the pumping rate, will be substituted into the appropriate formula and a value for the aquifer's transmissivity will be calculated.

A semilogarithmic plot of distance versus drawdown will also be used to determine values for the transmissivity and storativity and to determine the zone of influence for the pumping well. Drawdowns for associated wells after 24 hours will also be plotted as a function of the distance from the pumping well on the logarithmic scale. The radius of influence will be determined from the distance-drawdown plot by finding the point where a straight line drawn through the point intercepts the zero drawdown line.

7.3 Soil Sampling

Pre-cleaned stainless steel hand augers and soil sampling tubes will be used to advance soil borings and collect soil samples from the Building 46 Incinerator SWMU and the riverbank.

The sampling location will be identified and logged, as described in Section 7.2.2 as appropriate, and the surficial covering (gravel or debris) will be removed exposing the underlying soil. The soil boring will be advanced to the designated depth interval using a hand auger, and the soil sample will be collected from the bottom of the boring using the soil sampling tube. Soil samples for laboratory analysis will be transferred directly from the soil sampling tubes to the appropriate sample container. New latex gloves will be worn by the samplers. Soil samples designated for VOC analysis will be collected first and transferred directly to the sample container using a stainless steel spoon. The sample will be compacted to eliminate free airspace. The remaining soil from the hand auger will be transferred to a stainless steel bowl and composited thoroughly with a spoon. Soil samples will then be placed into their appropriate containers. Following the collection of required samples, the soil removed from the boring will be containerized and disposed of in accordance with state, local and federal regulations.

7.4 Sediment Sampling

Grab sediment samples will be collected from 0 to 0.5 feet below the sediment surface in the middle of the drainage swale. The sediment samples will be collected using pre-cleaned stainless steel trowels, scoops, or spoons. Care will be taken to minimize disturbance and sample washing as it is retrieved through the liquid column if water is present. In areas of flowing water, downstream samples will be collected first. If surface water samples are to be collected in conjunction with sediment samples, surface water samples will be collected first. Upon collection, the sediment samples will be transferred from the sampling implement into the appropriate sample containers. Field logs will be completed for each sample as included in Section 7.2.2, as appropriate.

7.5 Surface Water Sampling

Surface water grab samples will be collected from just below the surface of the water near the bank of the surface water body. The samples will be collected using a pre-cleaned, laboratory-supplied, sample container without preservatives. Samples will be collected by hand, and new latex gloves will be worn at all times. If the site conditions require, the container may be attached to a telescoping aluminum rod. The container will be lowered below the water surface and allowed to fill. The sample will then be retrieved and transferred into the appropriate

sample container with preservatives. All relevant sample collections information will be include in the field sampling logbook. The order of sample collection is included in Section 7.2.3.

7.6 Equipment List

Roux Associates, Inc. will utilize the following, or comparable, equipment during activities at the site:

- Air Monitoring Equipment:
  - Thermo Environmental Instruments Model 580B Organic Vapor Meter
  - Gastech Model 1314 Combustible Gas/Oxygen Meter

- Aquifer Testing Equipment:
  - Telog Instruments Series 2100 Data Loggers
  - QED Model 6000 Electronic Water Level Meter
  - Compac SLT 286 Portable Computer

- Surface and Ground-Water Sampling Equipment:
  - Keck Instruments Model SP-81 2" diameter Submersible Pump
  - Grundfos Redi-Flow 2" and 4" diameter Submersible Pumps
  - Horiba pH, Conductivity, and Temperature Meter
  - ORS Product Interface Probe
  - Orion Model 720 pH/ISE Meter

- Miscellaneous Equipment:

  Sampling
  - boring logs, site maps, chain-of-custody forms, custody seals
  - sample bottles of proper size, preservatives, and labels
  - water resistant, field sampling logbook and marker pens
  - 5000 KVA generator and gasoline supply
  - 1 liter Teflon® bottom-loading bailers with Teflon® leaders
  - stainless steel augers, spoons, mixing bowls, scoops, trowels, etc.
  - soil sampling tubes

- stop watch and calculator
- drinking-water grade purge piping
- non-absorbent polypropylene cord
- thermometer, pH meter buffers, conductivity standards
- hand tools
- clamps, valves, unions
- well keys
- 4-mil plastic sheeting
- packaging and duct tape
- plastic resealable bags
- disposable latex and nitrile gloves
- calibrated buckets
- coolers, ice, packing material
- fire extinguisher
- eye wash
- product bailer
- bolt cutters and extra padlocks
- extension cords
- Tygon tubing
- pocket transits
- spray paint
- surge blocks and PVC slugs
- sand bailers
- tape measures
- traffic cones

Decontamination

- non-phosphate, laboratory-grade detergent
- potable water
- paper towels, clean cotton rags
- distilled, deionized water
- aluminum foil

- acetone rinse
- hexane rinse
- 10% nitric acid rinse (1% when metal analysis is conducted)

7.7 Field Equipment Decontamination Procedures

The field equipment will be cleaned in the following order:

- Brush off equipment
- Wash with laboratory-grade glassware detergent and scrub to remove visual contamination
- Generous rinse with tap water
- Rinse with distilled/deionized, analyte-free water

If samples are to be analyzed for organics the above procedures will be supplemented by:

- Rinse with acetone (aqueous sampling equipment only)
- Total air dry
- Rinse with distilled/deionized, analyte-free water
- Wrap equipment with aluminum foil until use

If samples are to be analyzed for metals the soap and water wash will be supplemented by:

- Rinse with 10% nitric acid solution (1% when using stainless steel sampling equipment)
- Rinse with distilled/deionized, analyte-free water
- Wrap equipment with aluminum foil until use

7.8 Waste Management Procedures

Discarded materials, waste materials, or other objects will be handled in such a way as to preclude the potential for spreading contamination, creating a sanitary hazard, or causing litter

to be left on site. Potentially contaminated materials, e.g., soil, clothing, gloves, etc., will be bagged or drummed, as necessary, and segregated for disposal. Contaminated materials will be disposed in accordance with appropriate regulations based upon sampling and waste characterization analysis. Non-contaminated materials will be collected and bagged for appropriate disposal as normal domestic waste. Waste disposal operations will be carried out under the appropriate level of personal protection as provided in the Health and Safety Plan (Section 9.0).

Water generated during well development, aquifer testing, and equipment decontamination will be discharged to the Facility Sewer System.

8.0 QUALITY ASSURANCE PROJECT PLAN

8.1 Introduction

This Quality Assurance Project Plan (QAPP) outlines the measures that will be taken to ensure that the data generated during sampling activities are of quality sufficient to meet the data quality objectives of precision, accuracy and completeness. This QAPP presents the organization, objectives, functional activities and specific quality assurance (QA) and quality control (QC) activities associated with the RFI Work Plan. This QAPP also describes the specific protocols that will be followed for sampling, sample handling and storage, chain of custody, and laboratory and field analysis.

The QAPP has been prepared following guidance in the USEPA document titled, *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans QAMS-005/80*, dated December 29, 1980. The following sections discuss the Quality Assurance/Quality Control (QA/QC) measures which will be implemented during sampling and analytical activities.

The primary objective of the QAPP is to ensure that the data obtained accurately reflect actual conditions at the Nitro facility. Deviations from expected conditions will be noted, and appropriate corrective measures will be taken to maintain quality in the sample collection and analysis program.

8.2 Contents

The QAPP has been divided into sixteen subsections and includes the QAPP elements in the above-referenced USEPA guidance document with the exception of a title page. The main title page of this RFI Work Plan satisfies the title page requirements. Sections 8.1 and 8.2 provide an introduction and description of contents. Section 8.3 provides a brief description of the proposed activities. Section 8.4 details the designations and general responsibilities of the project team. A summary of the overall QA objectives for data management is provided in Section 8.5. The respective levels of data quality objectives which the RFI Work Plan will adhere to are also included in Section 8.5. Sample collection, handling and document custody procedures are explained in Sections 8.6 and 8.7. Field and laboratory equipment calibration procedures are detailed in Section 8.8.

Section 8.9 describes laboratory analytical procedures including analytical methodology and the proposed laboratory deliverables package. Data handling and validation along with a description of internal QC checks to be conducted are provided in Sections 8.10 and 8.11, respectively. Sections 8.12 describes the various types of QA auditing which will be conducted. Preventative maintenance procedures to be followed by the technical personnel and the analytical laboratory are provided in Section 8.13. Section 8.14 explains the various assessment procedures which will be followed to access the quality of the laboratory and field data collected. Procedures for correcting analytical and noncompliance problems are explained in Section 8.15. Finally, Section 8.16 discusses those QA reports which will be completed to track the laboratory and field activities during the course of the project.

8.3 Project Description

Soil, sediment, surface water and ground-water samples will be collected as part of the RFI. Aquifer testing in the form of slug tests, step-drawdown pump tests, and long-term constant-rate pumping tests will be performed to evaluate aquifer characteristics. The project is described is more detail in Section 6.0. The project schedule, including start and completion times, are described in Section 5.2 and shown in Figure 2. Assuming 90 days for review and approval of the revised RFI Work Plan, the RFI would commence on approximately July 10, 1994 with submittal of a Draft RFI Report on approximately July 9, 1995.

8.4 Project Organization and Responsibility

The overall management structure and a general summary of the responsibilities of project team members is presented below. An organizational chart is provided in Figure 4.

Project Manager

The Project Manager bears the primary responsibility for the successful completion of the work in accordance with the RFI Work Plan. This individual provides overall management for the execution of the RFI and directs the activities of the Field Team Leader, Laboratory Manager, and Drilling Services Manager. Responsibilities include coordination of all field activities, data review and interpretation, and report preparation. The Project Manager reports to Monsanto.

Field Team Leader

The Field Team Leader bears the primary responsibility for the successful execution of the field program. This individual directs the activities of technical staff in the field and assists in the interpretation of physical and chemical data, and report preparation. Responsibilities include the management of technical staff, and oversight of subcontractors such as the driller and laboratory. In addition, the Field Team Leader is the designated Site Health and Safety Officer (SHSO), and is responsible for the implementation of the Health and Safety Plan (HASP). The Field Team Leader reports to the Project Manager.

Laboratory Manager

The Laboratory Manager is responsible for sample container preparation, sample custody in the laboratory, and completion of the required analysis through oversight of the laboratory staff. The Laboratory Manager will ensure that quality assurance procedures are followed and that an acceptable laboratory report is prepared and submitted. The Laboratory Manager reports to the Project Manager.

Drilling Services Manager

The Drilling Services Manager is responsible for providing the appropriate labor, equipment and materials to conduct soil borings and install monitoring wells in accordance with the RFI Work Plan. The Drilling Services Manager also ensures that the appropriate drilling permits are secured and that boring/well logs are completed for the work done. The Drilling Services Manager reports to the Project Manager.

Quality Assurance Manager

The Quality Assurance Manager is responsible for conducting reviews, inspections, and audits to assure that the data collection is conducted in accordance with the RFI Work Plan. These responsibilities range from effective field equipment decontamination procedures, to proper sample collection, to review of all laboratory analytical data (including tentatively identified compounds, if analyzed) to ensure completeness and usefulness. The Quality Assurance Manager reports to the Project Manager.

8.5 Quality Assurance Objectives for Data Measurement

The overall QA objective is to develop and implement procedures for field sampling, laboratory analysis, and reporting that will provide results which maximize the likelihood that the data are collected, analyzed and documented such that it is representative and defensible. Specific procedures for sampling, chain of custody completion, instrument calibration, laboratory analysis, data reporting, internal quality control, audits, preventive maintenance of field equipment, and corrective action are described in subsequent sections of this QAPP.

8.5.1 QA Objectives for Laboratory Analytical Data

The fundamental QA objective with respect to accuracy, precision, and sensitivity of laboratory analytical data is to achieve the QC acceptance criteria of the analytical protocols. Accuracy, precision and completeness requirements will be addressed for all the data generated. Accuracy, the ability to obtain a true value, is monitored through the use of field and method blanks, spikes, and standards, and compared to federal and state regulations and guidelines. This will reflect the impact of matrix interferences. Precision, the ability to replicate a value, is monitored through duplicate (replicate) samples. It is assessed for each matrix. Corrective actions and documentation for substandard recoveries, or substandard precision, will be performed by the laboratory. Instrument sensitivity will be monitored to ensure the data quality through constant instrument performance. Detection limits depend on instrument sensitivity and matrix effects. Monitoring of instrument sensitivity is performed through the analysis of reagent blanks, near detection limit standards and response factors.

Laboratory procedures are provided in Appendix E along with the quality assurance objectives to assess data quality.

8.5.2 Data Quality Objectives

Data Quality Objectives (DQOs) are qualitative and quantitative statements which specify the quality of the data required to support decisions made as part of the RFI and are based on the end uses of the data to be collected. As such, different data uses may require different levels of data quality. There are five analytical levels which address various data uses and the QA/QC effort and methods required to achieve the desired level of quality. The levels are described in reference to USEPA's Contract Laboratory Program (CLP). These levels are listed below.

- Field Screening - (DQO Level I): This level provides the lowest data quality but the most rapid results. It is often used for health and safety monitoring at sites, initial site characterization to locate areas for subsequent analyses, and for engineering screening of alternatives (bench-scale tests). These types of data include those generated on the Site through the use of pH and conductivity meters, and other real-time monitoring equipment used in the field (such as PID meters).

- Field/Non-Chemical Laboratory Analyses - (DQO Level II): This level provides rapid results and better quality than in Level I. This level may include mobile lab/portable gas chromatograph generated data depending on the level of quality control exercised (e.g., soil gas survey), or off-site laboratory analyses requiring less stringent quality control criteria (e.g., geotechnical analyses).

- Engineering - (DQO Level III): This level provides an intermediate level of data quality and is used for site characterization. Engineering analyses may include mobile lab generated data and analytical lab methods (e.g., laboratory data used for delineation but without Full CLP quality control documentation).

- Confirmation - (DQO Level IV): This level provides the highest level of data quality and is used for purposes of risk assessment, evaluation of remedial alternatives, and potentially responsible party (PRP) determination. These analyses require full CLP analytical documentation, and data validation procedures in accordance with USEPA protocol.

- Non-Standard - (DQO Level V): This level 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 adaptation. The level of quality control is usually similar to DQO Level IV data.

Field measurements (e.g. water-level measurements, pH, conductivity, temperature, or air monitoring) will be conducted at DQO Level I. Soil, sediment, surface water and ground-water sampling and analysis will be conducted at DQO Level III.

8.6 Sample Collection Procedures

Field activities will be conducted and recorded by personnel fully trained in sample collection procedures as outlined in Roux Associates, Inc. Standard Operating Procedures and as described in Section 7.0. Boring logs, well sampling data forms, and sample chain of custody forms will be prepared for field tracking documents.

8.7 Sample Custody and Documentation Procedures

The possession and proper transfer of containers, samples, and sample-related information must be traceable from the time the containers are prepared in the laboratory, until the samples have been accepted for analysis, and after the samples have been analyzed and placed back in storage. The following sections summarize the general aspects of custody and how they will be applied and managed during the course of the project.

A sample or sample-related information (sample or evidence file) is under your custody if they:

- are in your possession;
- are in your view, after being in your possession;
- are in your possession and you place them in a secured location; or
- are in a secured, designated place.

8.7.1 Field Chain of Custody Procedures

The sample packaging and shipment procedures summarized below will ensure that the samples will arrive at the laboratory with the chain of custody intact.

(a) The Field Team Leader is responsible for the care and custody of the samples until they are transferred or properly dispatched. As few people as possible will handle the samples.

(b) All bottles will be labeled with the appropriate sample numbers and locations.

(c) Sample labels are to be completed for each sample using waterproof ink unless prohibited by weather conditions.

(d) Samples will be accompanied by a properly completed chain of custody form. The sample numbers and locations will be listed on the chain of custody form. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents transfer of custody of samples from the sampler to another person, to a mobile laboratory, to the permanent laboratory, or to/from a secure storage area.

(e) Samples will be properly packaged for shipment and dispatched to the appropriate laboratory for analysis, with a separate, signed custody record enclosed in each sample box or cooler. Shipping containers will be secured with strapping tape and custody seals for shipment to the laboratory.

(f) All shipments will be accompanied by the chain of custody record identifying the contents. The original record and yellow copy will accompany the shipment, and the pink copy will be retained by the sampler for returning to the sampling office.

(g) If the samples are sent by common carrier, a bill of lading (airbill) must be used. Receipts of bills of lading will be retained as part of the permanent documentation. Commercial carriers are not required to sign off on the custody form as long as the custody forms are sealed inside of the sample cooler and the custody seals remain intact.

8.7.2 Laboratory Chain of Custody Procedures

Laboratory custody procedures for sample receiving and log-in, sample storage, tracking during sample preparation and analysis, and storage of data are provided in Appendix E.

The Laboratory will ensure that chain of custody records are filled out upon receipt of the samples and will note questions or observations concerning sample integrity. The Laboratory will also ensure that sample-tracking records are maintained. These records will follow each sample through all stages of laboratory processing. The sample tracking records must show the date of sample extraction or preparation and the date of instrument analysis. These records will be used, in part, to determine compliance with holding time requirements.

8.7.3 Field Logbooks/Documentation

Field logbooks will be used to document data collecting activities performed in the field. As such, entries will be described in sufficient detail such that persons going to the site can reconstruct a particular situation without reliance on memory. A summary of field documentation requirements is presented below.

Field sampling logbooks will be bound field survey books or notebooks. Logbooks will be assigned to field personnel, but will be stored in a secure location when not in use. Each logbook will be identified by the project-specific document number.

The title page of each logbook will contain the following:

- logbook number;
- project name;
- project start date; and
- end date.

At the beginning of each day's entry, the date, start time, weather, objective of the activity, names of all sampling team members present, level of personal protection being used, and the signature of the person making the entry will be entered into the field sampling logbook. The names of visitors to the site, field sampling or investigation team personnel and the purpose of their visit will also be recorded in the field sampling logbook.

Any measurements made and the designations of samples collected will be recorded. Entries will be made in ink (if possible) and no erasures will be made. If an incorrect entry is made, the information will be crossed out with a single strike mark and initialed by the person making the correction. Whenever a sample is collected, or a measurement is made, a detailed description of the location of the station shall be recorded. The number of the photographs taken of the area, if any, will also be noted. Equipment used to obtain measurements will be identified, along with the respective records of calibration.

The equipment used to collect samples will be noted, along with the time of sampling, sample description, depth at which the sample was collected, sample volume, and number of containers. Sample identification numbers will be assigned prior to sample collection. Field duplicate samples, which will receive a separate sample identification number, will be noted under sample description (in the field logs but not the chain of custody).

8.7.4 Sample Collection Bottles and Holding Times

Sample collection bottles will be supplied by the laboratory and coordinated to arrive at the Site one day before the sampling day and no greater than two days following trip blank preparation by the laboratory. Sample bottles will be kept under constant chain of custody at all times. Sample collection bottles will be inspected by field personnel to ensure they were precleaned. Any containers with loose or missing caps will not be used. Extra containers will be included in the bottle order to replace any containers broken during shipment and/or to obtain additional samples if desired based on observations during sampling activities. QC sample containers along with a supply of deionized, analyte-free water will be obtained from the laboratory. Trip blanks will be prepared with laboratory-grade water at the sample container origin and will accompany the sample containers to the Site and back to the laboratory for analysis.

No preservatives are required for the soil samples except to cool and maintain with ice to approximately 4° Celsius. This will be accomplished by placing the sample containers in a cooler with ice immediately after the sample is collected. Any preservatives needed for the aqueous samples will be added at the laboratory prior to shipment. No preservatives will be added to the samples in the field. For each shipment of sample containers, the pH will be checked to ensure that the preservative is sufficient. The field team will be prepared to add preservative if it is found to be insufficient.

The samples will be shipped/transported at the end of each sampling day to the laboratory. The laboratory will perform each required analysis and/or extraction before the method holding time has expired. A summary of sample containers, preservations, and holding times is provided in Table 4.

8.8 Calibration Procedures and Frequency

This section describes procedures for maintaining the accuracy of all measurements and measuring equipment which are used for conducting field tests and laboratory analyses.

8.8.1 Field Instruments/Equipment

Field instruments and equipment used to gather, generate, or measure environmental data will be calibrated with sufficient frequency and in such a manner that accuracy and reproducibility of results are consistent with the manufacturer's specifications.

Equipment to be used during field sampling will be examined to confirm that it is properly operating. This includes reviewing the manufacturer's operating manual to ensure that all maintenance requirements are being observed. Backup instrumentation will be sent into the field where possible. Preventive maintenance procedures, as described in Section 8.13, will be conducted for equipment and instruments to ensure the accuracy of measurement systems, and to ensure the availability of spare parts and backup systems.

Calibration of field instruments will be performed daily or more frequently as conditions dictate. Field instrumentation may include a OVM, pH meter, water-level meter, a conductivity meter and electronic thermometer for water analyses. A three point calibration procedure utilizing buffer solutions of pH 4.0, pH 7.0, and pH 10.0 will be performed on pH meters. A similar three point calibration will be performed on the conductivity meters using 450, 1,500, and 4,500 microsiemen conductivity standards. The OVM will be calibrated with a 250 parts per million (ppm) isobutylene standard referenced to benzene. New calibration standards will be purchased for each applicable piece of field equipment prior to commencement of site activities. The expiration dates for the calibration standards will be reviewed prior to the commencement of site activities. Standards that will expire before the anticipated completion of field activities will be discarded and replaced. In the event that an internally calibrated field instrument fails to meet calibration/checkout procedures, it will be removed from service until the problem is resolved.

8.8.2 Laboratory Instruments

Records of calibration, repairs, or replacement will be filed and maintained by the designated laboratory personnel performing QC activities. These records will be filed at the location where the work is performed and will be subject to QA audits.

The laboratory calibration procedures and frequencies are specified in Appendix D.

8.9 Analytical Procedures and Quality Assurance and Quality Control

The following section discusses the Analytical Procedures and Laboratory Deliverables which will be conducted/completed during laboratory analytical activities. The protocol described is consistent with the USEPA's Test Methods for Evaluating Solid Waste: *Physical/Chemical Methods, 3rd Edition - Volumes 1A, 1B, 1C, II*, dated August 31, 1993.

8.9.1 Analytical Methods

The analytical methods and analytes for the RFI are specified in List 1, List 2, List 3, and List 4 of the RCRA Permit. These lists are reproduced in Appendix F. List 1 and List 2 contain volatile organic, and base-neutral/acid extractable semivolatile organic compounds. List 1 includes all the analytes in List 2 except nine compounds. List 2 is a more comprehensive list and will be used for the RFI where "VOC" and "BN/AE" are indicated in the workplan. List 3 includes metals and includes the specific analytes where "Metals" is indicated in the workplan. List 4 includes the dioxins and dibenzofurans. Each of the compounds of Lists 2, 3, and 4 will be analyzed. In addition, aqueous samples will be analyzed for total organic halogen and total organic carbon.

The analytical methods to be used for the analysis of soils, sediments, surface and groundwater are listed below with a brief discussion of the approach and specifications:

Volatile Organic Compounds by USEPA Method SW-846 8240

Soil and water samples will be analyzed by the SW-846 5030 purge and trap procedure.

Analytical acceptability for mass tuning for BFB criteria, all initial and continuing calibrations, internal standards, and sample surrogate recoveries will be in accordance with Method 8240 specifications.

Overall method accuracy is addressed in Table 1 of Appendix G, which presents acceptance limits for Laboratory Control Samples (LCS). Matrix accuracy and precision objectives are assessed by the analysis of project specific water and soil matrix spikes (MS) and matrix spike duplicates (MSD) with guidelines for acceptability presented in Table 13 of Appendix G. Laboratory specific method detection limits (MDL) and matrix specific practical quantitation limits (PQL) are presented for the target volatile organic compounds in Table 4 of Appendix G.

Semivolatile Organic Compounds by USEPA Method SW846 8270

Water samples will be extracted by SW-846 Method 3510 or 3520. Soils and sediments will be extracted by Method 3550.

Analytical acceptability for mass tuning for DFTPP criteria, initial and continuing calibrations, internal standards and surrogate recovery will be in accordance with Method 8270 specifications.

Overall method accuracy is addressed in Table 2 of Appendix G, which presents acceptance limits for laboratory control samples (LCS). Matrix accuracy and precision objectives are assessed by the analysis of project specific water and soil matrix spikes (MS) and matrix spike duplicates (MSD), with guidelines for acceptability presented in Table 14 of Appendix G. Laboratory specific method detection limits (MDL) and matrix specific practical quantitation limits (PQL) are presented for the semivolatile target compounds in Table 5 of Appendix G.

Extract cleanup (as necessary) will consist of gel-permeation chromatography by SW-846 Method 3640.

Metals by USEPA SW846 6010 and 7000 Series Methods

Water samples will be digested by SW-846 Method 3005 as preparation for analysis by Method 6010 (ICP). Water samples to be analyzed by 7000 series methods (GFAA) will be prepared by SW-846 Method 3020. All soils will be digested by SW-846 Method 3050.

Overall method accuracy is addressed in Table 3 of Appendix G, which presents acceptance limits for laboratory control samples (LCS). Matrix specific accuracy and precision will be assessed by the analysis of project specific matrix spikes (MS) and matrix spike duplicates (MSD) with guidelines for general acceptability presented in Tables 9 and 10 of Appendix G.

Project specific goals for method detection limits (MDL) and matrix specific practical quantitation limits are presented in Table 6 of Appendix G.

Total Organic Carbon by USEPA Method 9060

Total organic carbon by SW-846 Method 9060 is applicable to the analysis of surface and groundwater. General method performance data and guidelines are presented in Tables 3, 6 and 7 of Appendix G.

For this project, matrix specific precision will be assessed by the analysis of duplicate samples, and accuracy through the analysis of spiked samples. General quality control guidelines are presented in Table 7 of Appendix G.

The method detection limits (MDL) for surface and groundwater is presented in Table 6 of Appendix G.

Total Organic Halogen by USEPA Method SW-846 9020

Total organic halogen by SW-846 Method 9020 is applicable to the analysis of surface and groundwater. General method performance data and guidelines are presented in Tables 3, 6 and 8 of Appendix G.

For this project, matrix specific precision will be assessed by the analysis of duplicate samples, and accuracy through the analysis of spiked samples. General quality control guidelines are presented in Table 8 of Appendix G.

The method detection limits (MDL) for surface and groundwater is presented in Table 6 of Appendix G.

Polychlorinated Dioxins and Polychlorinated Dibenzofurans by USEPA Method SW-846 8280

Method 8280 analyses will be performed by the ENSECO-California (ENSECO-Cal) laboratory, located in West Sacramento, California.

The ENSECO-CAL laboratory quality assurance plan (QAPP) for Method 8280 is presented as Appendix H.

A summary of analytical methods is provided in Table 5.

The analytes in Lists 2, 3, and 4 are not an inclusive list of all chemicals used at the site. Compounds in these lists are representative of the hazardous constituents expected to be present, however. Analysis for these constituents is sufficient to determine if releases have occurred. A library search for tentatively identified compounds will not be conducted.

8.9.2 Analytical Costs

Analytical costs are expected to be in the range of $70,000 to $90,000.

8.9.3 Laboratory Deliverables

Laboratory deliverables from the selected laboratory will include the following:

- General Deliverable Data including:
  - Title Page
  - Table of Contents and Sample Identification Page
  - Chain of Custody Records (Field and Internal)
  - Method Summary
  - Case Narrative
  - Sample Storage Procedures
  - Method, Trip and Field Blank Results Summary
  - Surrogate Compound Recovery Results Summary
  - Matrix Spike/Matrix Spike Duplicate (MS/MSD) Results Summary

- Sample Data Section:
  - Compound Results
  - Quantitation Limits
  - Analysis Dates

- Internal Standards Summary Including Methodology Sources

8.9.4 Laboratory Generated Quality Control Check Samples

QC check samples are generated at the analytical laboratory. These types of samples serve as checks on the laboratory sampling and measurement systems and assist in determining the data quality with regard to laboratory accuracy and precision. The number and type of laboratory QC check samples varies with the intended data use and the level of contamination (i.e. samples analyte concentrations) expected.

Laboratory QC check samples may measure either method and/or instrument performance. Method (preparation) performance check samples (as described below) collectively measure the entire laboratory analytical data generation process, from sample allocating in the laboratory through the analysis and data reduction. Instrument (analysis) check samples measure the laboratory performance from the point where analysis begins, generally excluding any preparation/extraction effects, through the analysis and data reduction.

The laboratory will run the following internal QC check samples: method blanks, reagent blanks, replicates, spike samples, surrogates, internal standards, control samples, and analytical batch samples. Procedures and frequencies of laboratory QC checks are described in Appendix D.

8.10 Data Reduction, Handling, Validation, and Reporting

The following sections discuss the procedures to be used in data reduction, validation, and reporting. Analytical data will be obtained from the laboratory and will include: analytical results, QA/QC results, and laboratory-prepared quality control data.

As part of the quality assurance program, analytical data will be independently reviewed by Roux Associates, Inc. personnel. Any inconsistencies found with the laboratory data packages will be addressed with the laboratory.

8.10.1 Data Reduction

Data received from the laboratory will be summarized and tabulated to facilitate review of the results. Field blank data and trip blank data will be reported in tables along with the corresponding sample data. Data will be reported according to accepted practices of quality assurance. The Quality Assurance Manager will be responsible for ensuring that data has been received, reduced, and summarized in a timely and efficient manner. One complete hardcopy of the laboratory reports will be permanently maintained in the project files. Sample locations will be graphically shown on facility maps and included with the laboratory reports.

8.10.2 Data Validation

Data review procedures will be consistent with the standard USEPA analytical method chosen and will be in accordance with USEPA's document, *Laboratory Data Validation - Functional Guidelines for Evaluating Organic and Inorganic Analyses, Hazardous Site Evaluation Division, USEPA*, dated February 1, 1988 and December 1990; each revised by USEPA Region III in May 1, 1993 and April 1, 1993, respectively. The review performed will include an internal evaluation of holding times, method blank results, duplicate analyses, and surrogate recovery rates. These areas will be analyzed qualitatively and quantitatively using the prescribed evaluation techniques listed for each standard method.

USEPA Contract Laboratory Program (CLP) data validation guidelines and reporting values will be used as guidance during data review. Outliers, values outside the "expected" range of values will be reported along with documentation of the cause of the problem if encountered. Reported values below the method detection limit will be qualified with the value "J." Compounds reported in samples and detected in either the method, trip or equipment field blanks will be qualified with the value "B."

8.10.3 Data Reporting

The data collected will be arranged in a narrative format that is both clear and logical. The soil/sediment sample results will be presented in tabular form including the QA/QC-related sampling results and quantitation limits. All of the compounds specifically analyzed for will be listed along with compounds reported above detection limits during analysis. Applicable cleanup standards may also be included within each table. Other presentation methods such as compound isopleth maps or superimposing analytical results on a site sampling location map will be evaluated and used if practical.

Results obtained from monitoring well samples will be arranged in a format that is both clear and logical. Ground-water depths, gradients, and other values as well as analytical results will be presented in a usable format. Concentration trends over distances and/or time may also be included if found to be of particular use. Presentation methods such as compound isopleth maps or superimposing analytical results on a facility sampling location map will be evaluated and used if practical.

The practical quantitation limits (PQL) listed for the target analytes and compounds in Tables 4, 5, and 6 of Appendix G will be the standard reporting limits for this project. The presence of high levels of target and non-target analytes, or other forms of matrix interference could result in elevated reporting limits for selected analytes as the result of dilution or cleanup procedures.

8.11 Internal Quality Control Checks

Quality control (QC) measures are implemented throughout sample collection and analysis to help ensure that quality assurance goals are maintained. A primary goal of field QC is to monitor and document the quality of data gathered.

Field activities will be followed during all sample collection, with departures documented in the field sampling logbook. This method will allow accurate documentation of field activities for use if questions arise to a particular event. Photocopies of the field sampling logbook and daily logs will be made at the completion of field activities, and will be maintained as part of the project files.

8.11.1 Trip Blanks

Trip blanks will consist of a 40-mℓ vial filled with analyte-free, laboratory-supplied method blank water which originates with the sample container shuttle at the laboratory. Trip blanks will be kept under chain of custody and accompany the sample containers into the field from the laboratory, during sampling, and back to the laboratory. The trip blank will be analyzed for VOCs. The results will be used to assess potential sample contamination problems that may occur during bottle transport and to evaluate the integrity of the sample containers. Trip blanks will be collected at a frequency of one trip blank per shipment of sample containers or one every 20 samples, whichever is greater.

8.11.2 Equipment Field Blanks

Equipment field blanks will be collected by pouring laboratory-supplied water over or through pre-cleaned sampling tools and collecting the rinsate into a sample container with preservative. The equipment blank will be analyzed for the same parameters for which that day's field samples are evaluated. The equipment blank will allow the adequacy of equipment cleaning procedures to be evaluated and will be handled in the same manner as an actual sample. Equipment blanks will be collected at a frequency of one per 20 samples per sampling device or with each shipment, whichever is more frequent.

8.11.3 Matrix Spike/Matrix Spike Duplicate

Matrix spike/matrix spike duplicate (MS/MSD) samples provide criteria to evaluate sampling and/or analytical accuracy (MS) and precision (MSD). They also indicate problems with matrix interference. For each site-specific MS/MSD analyzed the sampler will select the sample for MS/MSD analysis. The field samples will either be run with batch QC (from the laboratory) or site-specific MS/MSDs. A MS/MSD will be analyzed with each batch of 20 samples for each sample matrix (aqueous and solid).

8.11.4 Field Duplicates

Field duplicates are individual portions of the same, or essentially the same field sample. Duplicates are independent samples collected in close proximity to one another such that they are essentially an equal representation of the parameter(s) of interest at a given point in space and time. When collected, processed, and analyzed by the same organization, duplicates provide

intra-laboratory precision information for the entire measurement system. Duplicates will be collected at a frequency of one per 20 samples for each matrix.

8.11.5 Split Samples

Split samples can be either internal or external field QC samples. External split samples are samples sent to different laboratories and subjected to the same environmental conditions and steps in the measurement process. They serve as an oversight function in assessing the analytical portion of the measurement system (particularly interlaboratory precision). The USEPA will be notified one week prior to initiation of sampling activities so that split samples may be collected.

8.11.6 Laboratory Quality Control

The laboratory will conduct quality control procedures as described in Appendix D. Laboratory control procedures include method blanks, surrogates, internal standards, reagent checks and calibration standards.

8.12 Project Audits

This section provides the types and content of the various audits and audit functions which will be applied to this project. Audits generally consist of four types: management audits, data quality audits, technical systems audits, and performance audits. These audits may be internal (performed by the same agency/organization generating the information) or external (performed by an outside agency/organization). The purpose of these audits is to establish and verify that the sampling and analysis activities are performed in accordance with the QAPP. Project audits will be conducted in the early stages of the project so implementation problems can be quickly identified and corrected. All audits will be unannounced to increase their effectiveness. As shown in Figure 2, a Field QA Audit will be conducted during sampling at the site.

Project audits will be conducted to provide information regarding:

- on-going assessment of the data quality;
- identification of areas with a need for improvement;

- verification of QA program implementation;
- assessment of applied resources to complete the assigned tasks, and;
- changes and/or variances to procedures necessitated by the actual field or laboratory conditions.

Evaluation of the specific and overall QA/QC objectives for this project will be conducted through the completion of management, data quality, technical systems, and performance audits. The specific content and frequency of audits anticipated for this project are described below.

8.12.1 Management Audits

Management audits will be performed to determine whether the management functions and responsibilities related to environmental measurements are performed in accordance with quality assurance procedures. Management audits will include a review of the QAPP implementation for this project in order to evaluate:

- the appropriateness of the sample analysis and frequency proposed;
- the sufficiency of the QA/QC samples proposed;
- the procedures for field and laboratory equipment maintenance;
- the field and analytical custody procedures;
- the procedures and schedules for conducting audits;
- the qualifications of contractors involved in the RFI; and
- the applicability of the Health and Safety Plan.

Management audits are an on-going function of the QA/QC procedures. Project-specific management audits for this project are the responsibility of the Quality Assurance Manager and will be implemented as required for each management function. The Quality Assurance Manager will review the management program and the other audit functions on a routine basis.

8.12.2 Data Quality Audits

Data quality audits will be performed to determine whether data derived are of known quality. Through the use of data validation information will be used to audit and evaluate:

- if a data set, or all the data sets of a particular project, met the DQOs;
- the quality of data reduced externally (if the Contractor performs their own data quality assessment); and
- deficiencies (if they exist) and to correct the cause(s), both technical and managerial.

Hardcopy data from the laboratories and/or contractors will be checked for completeness and accuracy as it is received (including reduced data) based on the validation program.

8.12.3 Technical Systems Audits

A technical system audit is a qualitative evaluation of all components of a specific measurement system to ensure their proper implementation. By reviewing each data collection system the audit verifies that the QA procedures are being adhered to. Technical systems audits will be performed to determine if the field and laboratory sampling and analytical systems are sufficient to generate data which will meet the stated DQOs. These audits will include at least one on-site examination of field activities for quality and conformance to the RFI and QAPP. Field audits will include a review of the following items:

- Decontamination
- Sampling Procedures
- Sample Handling
- Field Documentation
- Health and Safety Plan Implementation

Laboratory audits are conducted as part of the laboratory's certification requirements, and project-specific laboratory audits will not be performed.

8.12.4 Performance Audits

Internal performance audits of the laboratory will be conducted by the Laboratory QA Officer. The performance audits will be conducted on at least a quarterly basis. Blind QC sample in the form of duplicates will be prepared and submitted along with project samples to the laboratory throughout the project as described in Section 8.11.4. The Laboratory QA Officer will evaluate the analytical results of these blind samples to ensure the laboratory maintains an acceptable performance.

8.13 Preventative Maintenance Procedures

The preventative maintenance procedures described below are designed to prevent injury and loss of time and data due to faulty equipment/instrumentation. The purpose of preventative maintenance is to address potential problems before they occur and to help assure that equipment/measurement systems operate adequately when used for routine project activities.

8.13.1 Field Equipment/Instruments

The field instruments for this project include PIDs, electronic thermometers, pH meters, and conductivity meters. Specific preventative maintenance procedures to be followed for this and other field equipment are those recommended by the manufacturer.

Field instruments will be checked and calibrated in the office before they are shipped or brought to the site at the start of the project. These instruments will be checked and calibrated in the field on a daily basis before use. Calibration checks will be performed and will be documented in the field sampling logbook. Delicate instruments will be kept in their protective cases when not in use. Equipment which requires charging will be done so in a secure and heated location. Fresh batteries will be installed in the appropriate equipment before intrusive activities begin.

8.13.2 Laboratory Instruments

As part of their QA/QC Program, the laboratory will conduct a routine preventative maintenance program to minimize the occurrence of instrument failure and other system malfunctions.

These procedures are documented in Appendix D.

8.13.3 Documentation

Appropriate documentation of all equipment/instrument maintenance shall be maintained by the field and laboratory personnel and shall include what was done, date, time (if appropriate), next scheduled maintenance, equipment status, anomalies, and person performing maintenance. This documentation shall be entered into the field sampling logbook, or into specific maintenance log forms for off-site maintenance activities.

8.14 Data Measurement Assessment Procedures

The specific laboratory procedures for assessment of data are described in Appendix D.

8.15 Corrective Actions

Corrective action generally addresses the need to bring data generating systems back into conformance after some trigger or other criteria have shown the system to be out of conformance. The following paragraphs describe the mechanics of how corrective action will be managed and implemented during the course of this project.

Corrective actions may be required for two classes of problems: analytical and equipment functional problems, and noncompliance problems. Analytical and equipment functional problems may occur during sampling and sample handling, sample preparation, laboratory instrumental analysis, or data review. The need for laboratory analysis corrective actions is based on predetermined limits for acceptability. By conducting system and performance audits, the Laboratory will determine if the overall data generating systems are acceptable.

For noncompliance problems, a formal corrective action program will be determined and implemented at the time the problem is identified. The person who identifies the problem is responsible for notifying the Project Manager. If the problem is analytical in nature, information on these problems will be promptly communicated to the Laboratory QA Officer and method specific corrective actions will be implemented.

8.16 Quality Assurance Reports to Management

Quality assurance reports serve the purpose of identifying, tracking and summarizing any field and laboratory activities which occur during the project. These reports provide a means to

distribute the results of audits and to address the adequacy of the QAPP or deficiencies noted during project audits. These reports will be provided, along with recommendations for corrective measures, to the Project Manager throughout the project. The results of QA audits, corrective measures implemented, and the status of any ongoing QA issues will be summarized in the interim status reports as described in Section 10.2.

Quality Control reports will be either field or laboratory related. The laboratory reporting package will include a Quality Control description of conditions which may influence the data reported. Reports to laboratory management are described in Appendix D for ongoing laboratory operations. A project-specific report will be included in the case narrative of the laboratory deliverables.

The field activities will be documented in the field sampling logbook and daily activity log. Unusual conditions affecting sample collection, if encountered, will be reported in the field logbook. Deviations from the Work Plan will also be recorded. Verbal reports to the Project Manager will be made by the Field Team Leader in cases where field procedures may effect sample quality. Appropriate corrective actions will be taken, if necessary. Deviations from the RFI Work Plan will be documented in the field sampling logbook and described in the Draft RFI Report, along with an overview of data quality.

9.0 HEALTH AND SAFETY PLAN

The site-specific Health and Safety Plan (HASP) has been prepared in accordance with 29CFR 1910.120 and Roux Associates, Inc. standard operating procedures. It addresses activities associated with the Monsanto Chemical Company, Nitro, West Virginia facility and work and will be implemented by the designated Site Health and Safety Officer (SHSO) during site work.

Compliance with this HASP is required for Roux Associates, Inc. and subcontractor personnel who enter the work area during performance of site activities. Assistance in implementing this HASP can be obtained from the Roux Associates, Inc. Office Health and Safety Manager. The content of this HASP may undergo revision based upon additional information made available. Any changes proposed must be reviewed and approved by the Roux Associates, Inc. Health and Safety Manager or his/her designee.

In addition, Monsanto's "Plant Rules for Contractors" contains safety requirements and emergency response procedures. These rules must be followed by all personnel. This document is reproduced in Appendix I.

9.1 Health and Safety Personnel Designations

Office Health and Safety Manager (OHSM)

The OHSM serves to assure that the policies and procedures of the HASP are implemented by the SHSO. The OHSM is responsible for providing the appropriate monitoring and safety equipment and other resources necessary in implementing the HASP. The OHSM ensures that personnel designated to work on-site are qualified according to applicable USEPA, Occupational Safety and Health Administration (OSHA), and state requirements.

Site Health and Safety Officer

The Site Health and Safety Officer (SHSO) will be on site during field operations. The SHSO is responsible for health and safety activities and has the authority to make related decisions. In the event field conditions warrant modification to the HASP, a Field Change Request will be completed. The determination of hazard levels will be made by the SHSO. The SHSO has stop-work authorization which he or she will execute upon determination of an imminent safety

hazard, emergency situation, or other potentially dangerous situation. Authorization to proceed with work will be issued by the OHSM in consultation with the Project Manager. Assistant SHSOs may be designated, if required, but must be pre-qualified and approved by the OHSM.

9.2 Proposed Scope of Work

The HASP will regulate activities associated with the following tasks:

Oversight of contractors performing the following:

- Installation of monitoring wells
- Surveying

Completion of the following activities:

- Site inspection
- Soil/sediment sampling
- Surface water sampling
- Ground-water level measurement and sampling
- Aquifer tests

9.3 Hazard Assessment

- *Chemical Hazards*

  Possible historical releases of hazardous materials to soil and ground water, including VOCs, semivolatile organic compounds, metals and dioxins.

- *Ambient Air Hazards*

  Normal plant exposure, plant is anticipated to be operating during RFI activities. Residual chemicals in soil may volatilize upon exposure to the atmosphere during sampling activities.

- *Heat/Cold Stress*

  Normal summer temperatures to be encountered.

- *Noise*

  Normal plant operation.

- *General Safety Hazards*

  Existing Plant Site Safety Procedures will be followed.

  Low clearance, slip, trip, and fall hazards.

  Process/feed lines to incinerator are over several proposed sampling locations. Overhead lines may be hot (> 150°F).

- *Other*

  Electrical hazards associated with electrical equipment (generators, pumps, etc.).

  Equipment, drill rigs, etc.

9.4 Training Requirements

9.4.1 Basic Training

Site personnel who will perform work in areas where the potential exists for toxic exposure will be health and safety trained prior to performing work on site per 29CFR 1910.120(e). Training records will be maintained by the SHSO and OHSM.

9.4.2 Site-Specific Training

Training will be provided by the SHSO and FTL that will specifically address the activities, procedures, monitoring, and equipment for the site operations to site personnel and visitors. The training will include site and facility layout, hazards, emergency services at the site, and will detail provisions contained within this HASP. Evacuation routes will be known to all personnel before work begins. This training will also allow field workers to clarify anything they do not understand and to reinforce their responsibilities regarding safety and operations for their particular activity. Site-specific training will be documented as part of the project records.

In addition, safety orientation conducted by Monsanto is required for all personnel. This orientation includes the review of the procedures manual provided as Appendix I and the successful completion of a test to verify understanding of plant safety procedures.

9.4.3 Safety Briefings

Project personnel will be given briefings by the SHSO on a daily basis to further assist them in conducting their activities safely. Safety briefings will also be provided when new operations are to be conducted, changes in work practices must be implemented due to new information made available, and before work is begun at each project site. Records of safety briefings will be part of the project records.

9.4.4 Record Keeping Requirements

Record keeping requirements mandated by 29CFR 1910.120 will be followed. Specifically, all personnel training records, injury/incident reports, medical examination records and exposure monitoring records will be maintained by Roux Associates, Inc. for a period of at least 30 years after the employment termination date of each employee. The SHSO will maintain a daily written log of health and safety monitoring activities and monitoring results will become part of the project records.

9.5 Zones of Protection

Roux Associates, Inc. employs a three-zone approach to site operations when greater than Level D personal protection is required to control the potential spread of contamination. The zones are:

- Exclusion Zone
- Contaminant Reduction Zone
- The Support Zone

9.5.1 Exclusion Zone

The Exclusion Zone will include the sampling location area and will provide for full personnel and portable equipment decontamination. No personnel are allowed in the Exclusion Zone without:

- a buddy;
- the proper personal protective equipment;
- medical authorization;

- training certification.

For purposes of this project, the Exclusion Zone will include the 25-foot radius perimeter surrounding the work areas. The Exclusion Zone will include an equipment drop.

9.5.2 Contamination Reduction Zone

The Contamination Reduction Zone (CRZ) is established between the Exclusion Zone and the Support Zone. The CRZ will contain the contamination reduction corridor and will provide for full personnel and portable equipment decontamination. The CRZ is used for general site entry and egress in addition to access for heavy equipment for investigation activities. No personnel are allowed in the CRZ without the proper personal protective equipment. For the purposes of this project, the CRZ will include a 20-foot radius around the Exclusion Zone, not including the Exclusion Zone.

9.5.3 Support Zone

The Support Zone is considered the uncontaminated area and will contain the support facilities. Appropriate sanitary facilities and safety and support equipment will be located in this zone. The majority of site operations will be controlled from this location as well as site access of authorized persons. No potentially contaminated personnel or materials are allowed in this zone except appropriately packaged/decontaminated and labeled samples and drummed wastes.

9.6 Personal Protection

The level of protection to be worn by field personnel will be defined and controlled by the SHSO. Where more than one hazard area is indicated, further definition will be provided by review of site hazards, conditions, and operational requirements and by monitoring at the particular operation being conducted. Protection may be upgraded or downgraded by the SHSO.

The minimum level of protection for all site activities is level D. If a sustained organic vapor reading of greater than 5 ppm above background (as measured with an organic vapor meter) is observed in the breathing zone, the level of personal protection will be upgraded to Level C. If a sustained organic vapor reading of greater than 50 ppm above background is observed in

the breathing zone, work will be stopped and the area will be evacuated, and conditions will be reassessed.

Several areas at the site potentially contain residues and by-products associated with the manufacture of 2,4,5-trichlorophenoxyacetic acid (2,4,5-T). The compound 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) is sometimes found as an impurity in 2,4,5-T. Due to the potentially-carcinogenic and demonstrated mutagenic and teratogenic effects of 2,3,7,8-TCDD on humans, and previous USEPA health advisories, Level C personal protection will be the minimum level of protection for soil boring and monitoring well installation activities in the vicinity of the City of Nitro Dump where previous analytical data indicated the presence of 2,3,7,8-TCDD.

Task	Initial Level of Protection
Soil/Sediment Sampling	Level D
Monitoring Well Installation	Level D and Level C[1]
Surface Water/Ground-Water Sampling	Level D
Aquifer Tests	Level D

[1]Level C at City of Nitro Dump.

9.6.1 Respiratory Protection and Clothing

The type of respiratory protection and clothing to be worn in each level of protection indicated above includes the following:

Level D - Minimum for All Site Activities
Coveralls (as appropriate), Boots/shoes - chemical resistant with steel toes and shank, Safety glasses or goggles, Hard hat, Gloves
Level C
Full face, air purifying respirator complete with combined cartridges for organic vapors and particulates, Coveralls - disposable (Tyvek or Saranex), Hard hat, Gloves - chemical resistant (taped to Tyvek), Boots - steel toe and shank, chemical resistant complete with disposable covers (taped to Tyvek)

Daily respirator inspections will be conducted by the SHSO when operations requiring Level C protection are on-going. The SHSO will provide information regarding proper respirator maintenance and storage.

9.6.2 Safety Equipment

Basic emergency and first-aid equipment will be available at the Support Zone as appropriate. This will include first-aid kit, emergency eyewash, fire extinguisher, and other safety-related equipment. Emergency showers exist around the facility and will be clearly identified. Other safety equipment will be located at the site of specific operations, e.g., excavations, as appropriate.

9.6.3 Communications

- Telephones - located in various offices for communication with emergency support services/facilities.

- Hand Signals - by downrange field teams along with using the buddy system. These signals are important when working with heavy equipment.

- Walkie Talkies - to be carried by field teams, as necessary, for communication across the site.

9.7 Medical Surveillance Requirements

Medical surveillance specifies any special medical monitoring and examination requirements as well as stipulates that all Roux Associates, Inc. personnel and subcontractors are required to pass the medical surveillance examination or equivalent for hazardous waste work required by 29CFR 1910.120. As a minimum, the examination will include:

- Complete medical and work histories
- EKG
- Urinalysis
- Physical Exam
- Eye Exam

- Blood Chemistry (including metal analyses)
- Pulmonary Function Test
- Audiometry

The examination will be annual, at a minimum, and upon termination of employment with the company. Additional medical testing may be required by the OHSM in consultation with the company physician and the SHSO if an overt exposure or accident occurs, of if other site conditions warrant further medical surveillance.

9.8 Contamination Prevention

One of the most important aspects of decontamination is contamination prevention. Contamination prevention practices will minimize worker exposure and ensure valid sample results by precluding cross-contamination. Procedures for contamination prevention include the following:

- For Personnel
  - Do not walk through areas of obvious or known contamination;
  - Do not handle or touch contaminated materials directly;
  - Make sure all personal protective equipment (PPE) has no cuts or tears prior to donning;
  - Fasten all closures on suits, covering with tape, if necessary;
  - Take particular care to protect any skin injuries; and
  - Stay upwind of airborne contaminants.

- When Sampling/Monitoring
  - Do not place uncovered equipment directly on ground;
  - When required by the SHSO, cover instruments with clear plastic, leaving opening for sampling and exhaust ports; and
  - Bag sample containers prior to the placement of sample material.

- For Heavy Equipment
  - Care should be taken to limit the amount of contamination that comes in contact with heavy equipment;
  - If contaminated tools are to be placed on non-contaminated equipment for transport to the decontamination pad, plastic should be used to keep the equipment clean; and
  - Excavated soils should be contained and kept out of the way of workers.

All personnel and equipment exiting the Exclusion Zone will be thoroughly decontaminated. Safety briefings will explain the decontamination procedures for personnel and portable equipment for the various levels of protection. Heavy equipment will be decontaminated with a steam cleaner. Washings will be collected, handled, and/or drummed as appropriate, for proper waste disposal.

9.9 Air Monitoring

Air monitoring will be performed during intrusive activities by using a calibrated hand-held totalizing photoionization detector (PID) and a combustible gas indicator (LEL). Air monitoring will be performed downwind of sampling activities at the boundary of the exclusion zone. Wind direction will be noted by the field sampling team. Background measurements will also be collected.

The PID will be calibrated daily according to the manufacturer's instructions prior to use using an isobutylene/air mixture of known concentration. The LEL will be calibrated daily prior to use according to the manufacturer's instructions using a hexane/air mixture of known hexane concentration. Air monitoring data will be used to assess the need for upgrading the level of personal protective equipment used according to guidelines set forth in the site Health and Safety Plan. Calibrations will be noted in the field sampling logbook.

Personal breathing zone samples, 8-hour, time-weighted average (TWA) sampling, may be conducted if sustained organic vapor concentrations requiring Level C are present. The personal breathing zone samples will be collected according to NIOSH analytical methods and analyzed by an AIHA-certified laboratory.

9.10 Safety Considerations for Site Operations

Field sampling will be performed under the level of personal protection described in Section 9.6.1. In this section, nonmonitoring safety-related procedures are described.

Safety considerations during site walk-throughs precede all other field operations. The field team will maintain line of sight with each other at all times and regularly maintain communications with the Support Zone. Air monitoring will be performed by the walk-through team to alert the Support Zone personnel if a dangerous situation exists. Air monitoring will assist in prescribing levels of protection for future site operations, designating site layout, and identifying hazard areas, if any.

9.10.1 Heavy Equipment and Drill Rig Safety

The SHSO will be present on site during all invasive operations, including drilling, and will provide health and safety monitoring to ensure that appropriate levels of protection and safety procedures are followed.

Typical machinery to be found at the Site may include fork lifts, trucks, backhoes, and drill rigs. The equipment poses a serious hazard if not operated properly or if personnel near machinery cannot be seen by operators.

Drilling crews are confronted with all of these heavy equipment hazards. They must be responsible for good housekeeping around the rig because of the rods, auger sections, rope, and hand tools used for the operation. Maintenance is a constant requirement. Overhead and buried utilities require special precautions because of electrical and natural gas hazards. Electrical storms may seek out a standing derrick. The hoist or cathead rope poses specific hazards; always use clean, dry, sound rope. Keep hands away from the test hammer. Hearing loss, while not an immediate danger, is considerable over time. Use hearing protection.

9.10.2 Excavation and Backfill Operations

The SHSO will be present on site during excavation and backfill operations associated with removal of surface gravel at hand auger sampling locations. The SHSO will provide health and

safety monitoring to ensure that appropriate levels of protection and safety procedures are followed. The proximity of chemical, water, sewer and electrical lines will be identified by the FTL before any subsurface activity or sampling is attempted. Field personnel will keep within view of equipment operators at all times.

Proper containment and disposal practices will be followed in regard to the potential amount of waste generated during operations. The location of safety equipment and evacuation procedures will be established prior to initiation of operations according to this HASP. The use of hard hats, eye protection, and steel-toed boots will be required during excavation or other heavy equipment operations. Personnel will not be allowed to enter excavations greater than four feet deep. Contaminated equipment will be placed on liner material when not in use, or when awaiting and during decontamination. Communications with the Support Zone will be regularly maintained.

9.10.3 Sampling

Personnel must wear prescribed clothing, especially eye protection and appropriate gloves when sampling. Sample bottles may be bagged prior to sampling to ease decontamination procedures. The sampling team must be aware of emergency evacuation procedures described in this HASP and the location of emergency equipment, including spill containment materials, prior to sampling. Contamination avoidance will be practiced at all times. Personnel must use the buddy system and maintain communications with the Support Zone. In some situations, additional monitoring by the SHSO may be needed to confirm or establish the proper level of protection before the sampling team can proceed.

9.10.4 Sample Handling

Personnel responsible for the handling of samples will wear the level of protection described in Section 9.6. Samples will be identified as to their hazard and packaged to prevent spillage or breakage. Any unusual sample conditions will be noted. Lab personnel will be advised of high hazard levels and the potential contaminants present. This can be accomplished by a phone call to the lab coordinator and/or inclusion of a written statement with the samples. It may be necessary for the SHSO to review safety procedures in handling site samples to assist or assure that these practices are appropriate for the type of suspected contaminants in the sample.

9.10.5 Waste Disposal

Waste disposal operations will be monitored by the SHSO and performed under the appropriate level of personal protection. Personnel will wear the prescribed clothing, especially eye protection and chemical resistant gloves, when handling or drumming waste materials. Contamination avoidance will be practiced at all times.

9.10.6 Additional Safe Work Practices

Refer to the SHSO for specific concerns on each individual site task. The safety rules listed below must be strictly followed:

- Smoking, eating, drinking, etc. are not allowed during site activities.
- Always use the buddy system.
- Practice contamination avoidance, both on and off site.
- Plan activities ahead of time.
- Do not climb over/under obstacles.
- Be alert to your own physical condition.
- Watch your buddy for signs of fatigue, exposure, heat or cold stress, etc.
- Report all accidents, no matter how minor, immediately to the SHSO or FTL.
- Always maintain line of sight.
- Maintain a vehicle for emergency use and familiarize personnel with directions to the hospital.
- Wash hands and face before eating and drinking, etc.

A work/rest regimen will be initiated when ambient temperatures and protective clothing cause a stressful situation. Work will not be conducted without adequate light or without supervision.

9.11 Emergency Plan

As a result of the hazards on site and the conditions under which operations are conducted, the possibility of an emergency exists. An emergency plan is required by OSHA 29CFR 1910.120 to be available for use and is included below. A copy of this plan will be available as part of this HASP in the Support zone at each work site. In general, the emergency plan directs personnel to coordinate with existing plant emergency response and security personnel.

In the event of an emergency, the SHSO will call plant extension 2222, give their name and their location in the plant. The SHSO will inform the operator about the nature and type of emergency. The SHSO will implement the emergency plan whenever conditions at the site warrant such action. The SHSO will be responsible for assuring the evacuation, emergency treatment, emergency transport of site personnel as necessary, and notification of emergency response units, and the appropriate management staff.

9.11.1 Evacuation

In the event of an emergency situation, such as fire, explosion, significant release of particulates, etc., an air horn will be sounded for approximately ten seconds indicating the initiation of emergency procedures. All persons in both the restricted and non-restricted areas will evacuate and assemble near the Support Zone or other safe area as identified by the SHSO. The Site Emergency Coordinator will have authority to initiate proper action if outside services are required. Under no circumstances will incoming personnel or visitors be allowed to proceed into the area once the emergency signal has been sounded. The SHSO must see that access for emergency equipment is provided and that all combustion apparatus have been shutdown once the alarm has been sounded. Once the safety of all personnel is established, the facility fire department and other emergency response groups may be notified by the Plant Coordinator.

9.11.2 Potential or Actual Fire or Explosion

If the potential for a fire exists or if an actual fire or explosion occurs, the following procedures will be implemented:

- Immediately evacuate the area as described above
- Notify fire and police departments (Extension 2222)

Following this remaining personnel listed in the table below will be notified:

Type	Name	Telephone Number
Fire Department	Contact Plant Coordinator	Ext. 2222
Emergency Response	Contact Plant Coordinator	Ext. 2222
Police Department	Contact Plant Coordinator	Ext. 2222
Project Manager	Mark Tucker	(609) 423-8800

9.11.3 Personal Injury

Emergency first aid will be applied on site as deemed necessary to stabilize the victim. Notify Emergency Response (Plant Extension 2222), as necessary.

The SHSO will complete an Incident/Injury Report. The OHSM and PM will be notified if the injury requires hospitalization or replacement of the injured worker.

9.11.4 Overt Personnel Exposure

If an overt exposure to toxic materials occurs, the exposed person will be treated on site as follows:

Skin Contact: Wash/rinse affected area thoroughly with copious amounts of soap and water, then provide appropriate medical attention. An eyewash will be provided on site at the support zone. Eyes should be rinsed for at least 15 minutes upon chemical contamination.

Inhalation: Move to fresh air and/or, if necessary and appropriate, decontaminate and transport to the hospital.

Ingestion: Decontaminate and transport to emergency medical facility.

Puncture Wound or Laceration: Decontaminate and transport to emergency medical facility. SHSO will provide medical data sheets to medical personnel as requested.

9.11.5 Adverse Weather Conditions

In the event of adverse weather conditions, the SHSO will determine if work can continue without sacrificing the health and safety of on-site workers. Some of the items to be considered prior to determining if work should continue are the following:

- Heavy rainfall
- Potential for heat stress
- Potential for cold stress and cold-related injuries
- Limited visibility
- Potential for electrical storms
- Potential for malfunction of H&S monitoring equipment or gear
- Potential for accidents

9.11.6 Heat/Cold Stress Problems

The OHSM, SHSO, and FTL will be familiar with signs of heat/cold-related problems and first-aid and treatment of related illnesses.

Heat stress can occur at ambient temperatures of 70°F and at lower temperatures if the worker is wearing personal protective equipment. The OHSM will establish procedures to prevent, evaluate, respond to heat stress and related conditions. The potential for heat stress or related conditions will be based on ambient temperature, humidity, percent sunlight, and protective gear being worn. Work cycle will be modified to prevent heat stress or related conditions, including requiring rest cycles and consumption of cool liquids. Protective gear will be removed during the rest cycle to permit total body cool down.

Adverse climatic conditions of cold are important considerations in planning and conducting site operations. Ambient temperature effects can include physical discomfort, reduced efficiency, personal injury, and increased accident probability.

Persons working outdoors in temperatures at or below freezing may be frostbitten. Extreme colt for a short time may cause severe injury to the surface of the body, or result in profound generalized cooling. Areas of the body that have high surface-are-to-volume ratio such as fingers, toes, and ears, are the most susceptible. Another potentially serious form of could stress is hypothermia. Hypothermia results when the body loses heat faster than it can produce it.

10.0 REPORTING REQUIREMENTS

10.1 Draft RFI Report

During the course of the RFI Work Plan implementation a significant amount of site specific data will be generated. These data will be reduced and managed to prepare a complete and thorough report. The results of the investigations will be described in a Draft RFI Report as follows:

- Introduction
  - summary of RFI Work Plan and objectives

- Historical Information
  - summary of historical operations

- Environmental Setting
  - physical conditions of the site and surrounding area
  - surface drainage and topography
  - geology, hydrogeology, and soils discussion
  - USGS 7.5 minute site location map
  - evaluation of soil conditions including any physical/ structural results
  - evaluation of surface water and sediments
  - results of aquifer tests

- Contamination Characterization
  - ground water
  - soils
  - sediments/surface water
  - evaluation and extrapolation of each affected media
  - potential receptors
  - concentration trends

- Technical Review
  - reliability of laboratory analytical data
  - any significant events influencing sample results

- Findings/Recommendations
  - study area by study area discussion of results
  - changes in sampling protocols, if any
  - recommendation for further action including additional sampling, if deemed necessary

- Supporting Documentation
  - summary tables of analytical methods with quality assurance indicators
  - summary tables of analytical results
  - site base maps
  - sample location maps
  - soil sampling isopach maps
  - ground-water potentiometric and isoconcentration maps
  - stratigraphic cross-sections
  - soil boring and monitoring well records
  - aquifer tests support documentation
  - laboratory data deliverables packages
  - laboratory reports

10.2 Interim Status Reports

During the implementation of the RFI Work Plan, Interim Bimonthly Status Reports will be prepared for submission to the USEPA. Each Status Report will contain summaries of the following:

- Description of activities conducted and percentage of RFI Work Plan completed
- Summary of QA audits and status of any ongoing QA issues
- Summary of findings
- Contacts with state and local governments and public interest groups
- Problems or potential problems encountered

- Actions taken to rectify problems
- Changes in personnel
- Projected work for the next period

10.3 Release Reporting

If any air or ground-water contamination not previously identified is found off-site above health-based levels during implementation of the RFI Work Plan, the USEPA will be verbally notified within 24 hours and within 30 days receive written confirmation of the event. Individuals who may have been subject to the exposure incident will also be notified.

REFERENCES

Geraghty & Miller, Inc., "Groundwater Assessment - Waste-Water Treatment Plant," May 1985.

Geraghty & Miller, Inc., "Ground-Water Quality Investigation at the Monsanto Plant," October 1985.

Mark James Corporation, "1992 Annual Ground Water Quality Report."

Roux Associates, Inc., "Final Revised Verification Investigation Report," August 24, 1993.

USEPA, "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans, QAMS-005/80", December 29, 1980.

USEPA, "Laboratory Data Validation - Functional Guidelines for Evaluating Organic and Inorganic Analyses, Hazardous Site Evaluation Division", February 1, 1988 and December 1990, each revised by USEPA Region III in May 1, 1993 and April 1, 1993, respectively.

USEPA, "RCRA (Resource Conservation and Recovery Act) Facility Investigation (RFI) Guidance" Volumes I, II, III, and IV, May 1989.

USEPA, "Test Methods for Evaluating Solid Waste: Proposed Updates-Physical/Chemical Methods, 3rd Edition" - Volumes 1A, 1B, 1C, II, November 1992.

Wilmoth, 1966, "Ground Water in Mason and Putnam Counties, West Virginia" West Virginia Geologic and Economic Survey, Bulletin 32.

TABLES

Table 1. Summary of Monitoring Well Information; Monsanto Company; Nitro, West Virginia.

Well Designation	Installation Date	Installed by	Location	Total Depth (ft)	Screen Setting (ft)	Casing/Screen Type	Diameter (in)
Waste Treatment Area							
WT-7A	11/28/85	G&M	W. of Activated Sludge Basin	41.5	21.5-41.5	PVC/PVC	2
WT-7B	11/28/85	G&M	W. of Activated Sludge Basin	56.6	41.5-56.5	PVC/PVC	2
WT-7C	11/28/85	G&M	W. of Activated Sludge Basin	73	62-72	PVC/PVC	2
WT-8A	12/04/85	G&M	W. of Polishing Basin	39	19-39	PVC/PVC	2
WT-8B	12/04/85	G&M	W. of Polishing Basin	52	37-52	PVC/PVC	2
WT-8C	12/04/85	G&M	W. of Polishing Basin	70	60-70	PVC/PVC	2
WT-9A	2/5/92[1]	MJC	Between Equal Basin and Emergency Basin	50	30-50	PVC/PVC	4
WT-9B	2/5/92[1]	MJC	Between Equal Basin and Emergency Basin	68.5	48.5-68.5	PVC/PVC	4
WT-9C	2/6/92[1]	MJC	Between Equal Basin and Emergency Basin	80	72-80	PVC/PVC	4
WT-10A	1/15/85	G&M	S. of Emergency Basin	39	19-39	PVC/PVC	2
WT-10B	1/15/85	G&M	S. of Emergency Basin	54	39-54	PVC/PVC	2
WT-10C	1/15/85	G&M	S. of Emergency Basin	70	60-70	PVC/PVC	2
WT-11A	1/23/85	G&M	W. of Equal Basin	42	22-42	PVC/PVC	2
WT-11B	1/23/85	G&M	W. of Equal Basin	54	39-54	PVC/PVC	2
WT-11C	1/23/85	G&M	W. of Equal Basin	74	64-74	PVC/PVC	2
WT-1[1]	2/4/92	MJC	W. of Emergency Basin	33.5	13.5-33.5	PVC/PVC	4
WT-2	9/1/81	BCM	S. of Emergency Basin	53.5	16.5-53-3	PVC/PVC	4

NA = Information not available at this time.
[1]Monitoring well was was replaced by new monitoring well on 2/3/92 through 2/7/92 within 15 feet of original location.

Table 1. Summary of Monitoring Well Information; Monsanto Company; Nitro, West Virginia.

Well Designation	Installation Date	Installed by	Location	Total Depth (ft)	Screen Setting (ft)	Casing/Screen Type	Diameter (in)
Waste Treatment Area							
WT-3	9/14/81	BCM	E. of Surge Basin	55	15-55	PVC/PVC	4
WT-4A	9/14/81	BCM	E. of Limestone Bed	40	25-40	PVC/PVC	4
WT-4B	9/4/81	BCM	E. of Limestone Bed	58	41-58	PVC/PVC	4
WT-5A	9/12/81	BCM	E. of Digester	43	28-43	PVC/PVC	4
WT-5B	9/12/81	BCM	E. of Digester	58	43-58	PVC/PVC	4
WT-6	9/3/81	BCM	W. of Digester	53	18-53	PVC/PVC	4
TB-1	9/14/81	BCM	Adjacent to 2,4,5-TP Building	32	27-32	NA	NA
TB-3	9/16/81	BCM	Adjacent to 2,4,5-TP Building	32	27-32	NA	NA
TD-1	NA	NA	Adjacent to 2,4,5-TP Building	32	27-32	NA	NA
TD-3	NA	NA	Adjacent to 2,4,5-TP Building	30	27-32	NA	NA
TD-5	NA	NA	Adjacent to 2,4,5-TP Building	30	24.7-29.7	NA	NA

NA = Information not available at this time.

(1)Monitoring well was was replaced by new monitoring well on 2/3/92 through 2/7/92 within 15 feet of original location.

Table 1. Summary of Monitoring Well Information; Monsanto Company; Nitro, West Virginia.

Well Designation	Installation Date	Installed by	Location	Total Depth (ft)	Screen Setting (ft)	Casing/Screen Type	Diameter (in)
Process Area							
MW-1A	9/8/83	G&M	S. corner of Process Area	32	20-30	PVC/PVC	2
MW-1B	1/2/85	G&M	S. corner of Process Area	55	40-55	PVC/PVC	2
MW-2A	9/9/83	G&M	Along S. edge of Process Area	32	20-30	PVC/PVC	2
MW-2B	1/14/85	G&M	Along S. edge of Process Area	55	40-55	PVC/PVC	2
MW-3A	9/9/83	G&M	S.W. corner of Process Area	35	25-35	PVC/PVC	2
MW-3B	12/20/84	G&M	S.W. corner of Process Area	61	46-61	PVC/PVC	2
MW-4A	9/12/83	G&M	Along W. edge of Process Area	38	27.5-37.5	PVC/PVC	2
MW-4B	NA	G&M	Along W. edge of Process Area	61.5	41.5-61.5	PVC/PVC	4
MW-5A	8/31/83	G&M	Along W. edge of Process Area	33	23-33	PVC/PVC	2
MW-5B	NA	G&M	Along W. edge of Process Area	56	41-56	PVC/PVC	2
MW-6A	9/1/83	G&M	Along W. edge of Process Area	30	20-30	PVC/PVC	2
MW-6B	12/17/84	G&M	Along W. edge of Process Area	58	43-58	PVC/PVC	2
MW-7	10/1/83	G&M	N. corner of Process Area	30	20-30	PVC/PVC	2
MW-8	9/1/83	G&M	N. corner of Process Area	30	20-30	PVC/PVC	2
MW-9	9/8/83	G&M	S. of Process Area office	29	18-28	PVC/PVC	2
MW-10	9/7/83	G&M	S. of Process Area office	29.5	17-27	PVC/PVC	2
MW-11A	9/6/83	G&M	Along E. edge of Process Area	31	19-29	PVC/PVC	2
MW-11B	9/6/83	G&M	Along E. edge of Process Area	NA	38-48	PVC/PVC	2
MW-12	9/7/83	G&M	S. of Process Area office	29.5	18-28	PVC/PVC	2

NA = Information not available at this time.

(1)Monitoring well was was replaced by new monitoring well on 2/3/92 through 2/7/92 within 15 feet of original location.

Table 1. Summary of Monitoring Well Information; Monsanto Company; Nitro, West Virginia.

Well Designation	Installation Date	Installed by	Location	Total Depth (ft)	Screen Setting (ft)	Casing/Screen Type	Diameter (in)
Process Area							
MW-13	9/13/83	G&M	Far S. of Process Area office	29	18-28	PVC/PVC	2
MW-14	9/2/83	G&M	Along N. edge of Process Area	29	18-28	PVC/PVC	2
MW-15	9/2/83	G&M	N.E. corner of Process Area	NA	10-20	PVC/PVC	2
MW-17A	1/31/85	G&M	Along S. edge of Process Area	40	30-40	PVC/PVC	2
MW-17B	2/4/85	G&M	Along S. edge of Process Area	56	36-56	PVC/PVC	4
MW-18A	2/5/85	G&M	Along S. edge of Process Area	40	30-40	PVC/PVC	2
MW-18B	2/5/85	G&M	Along S. edge of Process Area	55	40-55	PVC/PVC	2
MW-19A	1/2/85	G&M	S.W. corner of Process Area	40	30-40	PVC/PVC	2
MW-19B	1/2/85	G&M	S.W. corner of Process Area	62	47-62	PVC/PVC	2
MW-20A	1/29/85	G&M	Along W. edge of Process Area	40	30-40	PVC/PVC	2
MW-20B	1/29/85	G&M	Along W. edge of Process Area	57	42-57	PVC/PVC	2
MW-21A	1/10/85	G&M	Along W. edge of Process Area	40	30-40	PVC/PVC	2
MW-21B	1/11/85	G&M	Along W. edge of Process Area	58	43-58	PVC/PVC	2
MW-22A	1/8/85	G&M	N. corner of Process Area	40	30-40	PVC/PVC	2
MW-22B	1/9/85	G&M	N. corner of Process Area	60	45-60	PVC/PVC	2

NA = Information not available at this time.

(1)Monitoring well was was replaced by new monitoring well on 2/3/92 through 2/7/92 within 15 feet of original location.

Table 2. Summary of Historical Ground-Water Volatile Organic Compound Analytical Results. Monsanto Company; Nitro, West Virginia.

Parameter	Detection Limit	WT-4A	WT-4B	WT-5A	WT-7A	WT-7B	WT-8A	WT-9A	WT-9B	WT-10A	WT-10B	WT-11A	Trip Blank
DATE SAMPLED		11/92	11/92	11/92	11/92	11/92	11/92	11/92	11/92	11/92	11/92	11/92	11/92
Chloromethane	10	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Bromomethane	10	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Vinyl Chloride	10	22	17	BDL	10	14	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Chloroethane	10	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Methylene Chloride	5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Acetone	100	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Carbon Disulfide	5	BDL	BDL	BDL	BDL	BDL	BDL	120	BDL	BDL	BDL	BDL	BDL
1,1-Dichloroethylene	5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,1-Dichloroethane	5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
total-1,2-Dichloroethylene	5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Chloroform	5	BDL	BDL	BDL	BDL	29	BDL	16	BDL	BDL	BDL	BDL	BDL
1,2-Dichloroethane	5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
2-Butanone (MEK)	100	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,1,1-Trichloroethane	5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Carbon Tetrachloride	5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Vinyl Acetate	10	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Bromodichloromethane	5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,2-Dichloropropane	5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
cis-1,3-Dichloropropene	5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
2-Chloroethyl Vinyl Ether	10	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Trichloroethylene	5	44	15	BDL	14	17	BDL	390	BDL	BDL	BDL	BDL	BDL
Dibromochloromethane	5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,1,2-Trichloroethane	5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Benzene	5	BDL	BDL	BDL	51	120	BDL	42	BDL	BDL	BDL	BDL	BDL
trans-1,3-Dichloropropene	5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Bromoform	5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
4-Methyl-2-Pentanone	10	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
2-Hexanone	10	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Tetrachloroethylene	5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,1,2,2-Tetrachloroethane	5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Toluene	5	BDL	BDL	BDL	BDL	BDL	BDL	15	BDL	BDL	BDL	BDL	BDL
Chlorobenzene	5	14	BDL	BDL	120	15	BDL	750	BDL	BDL	BDL	BDL	BDL
Ethylbenzene	5	BDL	BDL	BDL	BDL	BDL	BDL	24	BDL	BDL	BDL	BDL	BDL
Styrene	5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
total Xylenes	5	6	BDL	BDL	13	8	BDL	94	BDL	BDL	BDL	BDL	BDL

Ground-water samples collected in Water Treatment Area in November 1992.
All concentrations expressed as micrograms per liter ($\mu g/\ell$) (ppb).
BDL = Below detection limit.

Table 2. Summary of Historical Ground-Water Volatile Organic Compound Analytical Results. Monsanto Company; Nitro, West Virginia.

Parameter	Detection Limit	MW-1A	MW-1B	MW-2A	MW-2B	MW-3A	MW-3B	MW-4A	MW-4B	MW-4GP	MW-5A	MW-5B	MW-6A	MW-6B	MW-8	MW-9
DATE SAMPLED		6/85	6/85	6/85	6/85	6/85	6/85	6/85	6/85	6/85	6/85	6/85	6/85	6/85	6/85	6/85
Chloromethane	1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Bromomethane	1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Vinyl Chloride	1	BDL	BDL	BDL	BDL	BDL	BDL	74	BDL	120	BDL	120	2,700	BDL	570	BDL
Chloroethane	1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Methylene Chloride	1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	30	4
Acetone	1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	78	BDL	BDL	BDL	BDL
Carbon Disulfide	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1-Dichloroethylene	1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,1-Dichloroethane	1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	10	BDL	BDL	BDL
trans-1,2-Dichloroethylene	1	BDL	BDL	370	BDL	20	BDL	550	24	510	66	260	130	BDL	500	40
Chloroform	1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	12	130	BDL	BDL	200	55
1,2-Dichloroethane	1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
2-Butanone (MEK)	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1,1-Trichloroethane	1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Carbon Tetrachloride	1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	420	BDL	BDL	BDL	BDL
Vinyl Acetate	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bromodichloromethane	1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,2-Dichloropropane	1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	4	BDL	BDL	BDL	BDL
cis-1,3-Dichloropropene	1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
2-Chloroethyl Vinyl Ether	1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Trichloroethylene	1	BDL	BDL	400	15	9,600	11	380	36	240	810	2,300	40	BDL	2,100	610
Dibromochloromethane	1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,1,2-Trichloroethane	1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Benzene	1	BDL	BDL	BDL	BDL	BDL	BDL	2	BDL	BDL	BDL	36	10	BDL	750	30
trans-1,3-Dichloropropene	1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Bromoform	1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
4-Methyl-2-Pentanone	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Hexanone	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Tetrachloroethylene	1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,1,2,2-Tetrachloroethane	1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Toluene	1	BDL	BDL	400	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	40	BDL	BDL	220
Chlorobenzene	1	BDL	BDL	150	BDL	440	BDL	7	BDL	3	BDL	180	BDL	BDL	BDL	BDL
Ethylbenzene	1	BDL	BDL	60	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Styrene	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
total Xylenes	1	BDL	BDL	300	4	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	100	13

Ground-water samples collected in Process Area in June 1985.
All concentrations expressed as micrograms per liter ($\mu g/\ell$) (ppb).
BDL = Below detection limit.
NA = Not analyzed.

Table 2. Summary of Historical Ground-Water Volatile Organic Compound Analytical Results. Monsanto Company; Nitro, West Virginia.

Parameter	Detection Limit	MW-11A	MW-11B	MW-13	MW-17A	MW-17B	MW-18A	MW-18B	MW-19A	MW-19B	MW-20A	MW-20B	MW-21A	MW-21B	MW-22A	MW-22B
DATE SAMPLED		6/85	6/85	6/85	6/85	6/85	6/85	6/85	6/85	6/85	6/85	6/85	6/85	6/85	6/85	6/85
Chloromethane	1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Bromomethane	1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Vinyl Chloride	1	BDL	BDL	240	BDL	BDL	270	BDL	21	BDL	96	BDL	BDL	21	BDL	BDL
Chloroethane	1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Methylene Chloride	1	BDL	BDL	4	BDL	BDL	BDL	21	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Acetone	1	BDL	BDL	75	BDL	BDL	40	7	BDL	BDL	15	BDL	BDL	20	BDL	BDL
Carbon Disulfide	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1-Dichloroethylene	1	BDL	BDL	15	BDL	BDL	70	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,1-Dichloroethane	1	BDL	BDL	BDL	BDL	BDL	310	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
trans-1,2-Dichloroethylene	1	BDL	BDL	2,500	BDL	BDL	720	3	53	6	460	BDL	130	220	BDL	BDL
Chloroform	1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	37	BDL	BDL
1,2-Dichloroethane	1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	56	24	34
2-Butanone (MEK)	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1,1-Trichloroethane	1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Carbon Tetrachloride	1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	12	BDL	BDL
Vinyl Acetate	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bromodichloromethane	1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,2-Dichloropropane	1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	15	BDL	BDL
cis-1,3-Dichloropropene	1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
2-Chloroethyl Vinyl Ether	1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Trichloroethylene	1	1	BDL	2,300	BDL	BDL	340	3	370	4	3,200	720	240	710	870	544
Dibromochloromethane	1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,1,2-Trichloroethane	1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Benzene	1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	21	50	24	29	53	48
trans-1,3-Dichloropropene	1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Bromoform	1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
4-Methyl-2-Pentanone	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Hexanone	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Tetrachloroethylene	1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	1	2
1,1,2,2-Tetrachloroethane	1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Toluene	1	BDL	BDL	35	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	1	BDL
Chlorobenzene	1	BDL	BDL	290	BDL	BDL	BDL	BDL	20	BDL	4	BDL	4	4	30	56
Ethylbenzene	1	BDL	BDL	41	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	1	BDL
Styrene	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
total Xylenes	1	BDL	BDL	135	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	5	3

Ground-water samples collected in Process Area in June 1985.
All concentrations expressed as micrograms per liter ($\mu g/\ell$) (ppb).
BDL = Below detection limit.
NA = Not analyzed.

Table 3. Media-Specific Investigations for Individual SWMUs. Monsanto Company; Nitro, West Virginia.

SWMU Number and Name	Media	Analytes
Process Area		
1. Tepee Incineration	Ground Water Surface Water; Sediment Riverbank Soil	VOC, BN/AE, Metals
8. Niran Residue Pits	Ground Water Surface Water; Sediment Riverbank Soil	VOC, BN/AE, Metals
9. Past Disposal Area	Ground Water Surface Water; Sediment Riverbank Soil	VOC, BN/AE, Metals
24. Building 46 Incineration	Soil	VOC, BN/AE, Metals
31. Facility Sewer System	Ground Water	VOC, BN/AE, Metals
35. Aboveground Equalization/Storm Water Surge Tanks	Ground Water	VOC, BN/AE, Metals
Waste Treatment Area		
4. City of Nitro Dump	Ground Water	VOC, BN/AE, Metals, PCDD, and PCDF
5. Waste Pond	Ground Water	VOC, BN/AE, Metals
6. Decontaminated 2,4,5-T Building	Ground Water	VOC, BN/AE, Metals, PCDD, and PCDF
17. Surge Basin	Ground Water	VOC, BN/AE, Metals
18. Equalization Basin	Ground Water	VOC, BN/AE, Metals
19. Limestone Bed	Ground Water	VOC, BN/AE, Metals
20. Emergency Basin	Ground Water	VOC, BN/AE, Metals
32. Wastewater Treatment Plant	Ground Water	VOC, BN/AE, Metals

VOC = Volatile organic compounds.
BN/AE = Base-neutral/acid extractable semivolatile organic compounds.
Metals = Total metals.
PCDD = Polychlorinated dioxins.
PCDF = Polychlorinated dibenzofurans.
Aqueous samples will be additionally analyzed for total organic halogen (TOX), total organic carbon (TOC), and pH.

Table 4. Screening of Potentially Applicable Remedial Alternatives to Address Ground Water. Monsanto Company; Nitro, West Virginia.

General Response Actions	Technologies/Process Options	Comments	Retained?
No Action/Institutional Options	No Action/Fencing for Soils	• Applicable if soils below health-based levels. • Restricts access to trespassing children, mitigating a potential exposure scenario. • Easily implemented and requires little maintenance. • Reliable if properly maintained. • Security fence already in place.	Yes
	No Action for Ground Water	• Permit-specified action level of MCLs limits feasibility. • Exposure pathway for ground water is incomplete. Use of ground water for drinking water is unlikely. • Migration of chemicals of concern to Kanawha River is possible.	No
	Natural Remediation with Monitoring	• Monitor the quality and flow direction of ground water to ensure that human health is protected. • Exposure pathway for ground water is incomplete. Use of ground water for drinking water is unlikely. • Evaluate migration of chemicals of concern to Kanawha River.	Yes
	Alternative Residential Water Supply	• Residential water supplies are not threatened, nor impacted.	No
Source Control	Remove Lagoon Contents - Treat On-Site	• Removes source of migration to ground water. • Liquids and sludges can be treated at facility's Wastewater Treatment Plant. • Residues can be burned at Boiler House. • On-site facilities are readily available. • Post-remediation soil sampling will be required.	Yes
	Upgrade Facility Sewer System	• Rehabilitate/replace sewer system to provide aboveground or secondarily contained conveyance area piping. • Removes source of migration to ground water.	Yes
Containment	Capping • asphalt cap • multilayered cap • synthetic cap • clay cap	• Not applicable if soils above health-based levels. • Reduces infiltration/contaminant leaching. • Eliminates dermal contact exposure pathway. • Proven technology, easily implemented. • Reduces surface runoff of impacted soils. • Layered asphalt cap provides durability, ease of maintenance with minimal change in elevations.	No[1]

[1]This technology has potential applicability to soils and will be reevaluated, if warranted, based upon results of the RFI.

Table 4. Screening of Potentially Applicable Remedial Alternatives to Address Ground Water. Monsanto Company; Nitro, West Virginia.

General Response Actions	Technologies/Process Options	Comments	Retained?
Containment (continued)	Vertical Barriers • slurry wall • sheet piling • grout curtain	• Ineffective unless keyed into a low permeability layer. Provides no substantive benefit from environmental or human health perspective. • No low permeability layer exists at locations appropriate for this technology.	No
Excavation/Treatment Disposal	Excavation of Soil	• Not applicable if concentrations below health-based levels. • Extensive site structures limit feasibility. • Short-term exposure risk during excavation and soil handling. Dust control requirements must be considered. • Can further reduce risks from human exposure.	No[1]
	Physical Treatment - Soil Washing • solvent washing • surfactants	• Residual solvents limit soil reuse options. • Concern for VOC emissions during operation of process. • Recovered leachate requires treatment/disposal. • Uses equipment commonly used in the mining industry. • Will require a sizeable area for soil treatment, leachate collection/ storage/treatment.	No[1]
	Physical Treatment - Ex-Situ Soil Vapor Extraction	• Effective for VOCs with high Henry's Constants, will not remove metals. Uses readily available equipment and is relatively easy to operate. • Treated soils may be backfilled. • Effective for heterogeneous soils. • Off-gas treatment is necessary to control VOC emissions during treatment.	No[1]
	Chemical Treatment - Ex-Situ Soil Oxidation/Reduction	• Degradation/immobilization of contaminants using ozone, hydrogen peroxide can be effective for organics in soils. • Limited effectiveness for heavy metals. • Not a proven technology and it is difficult to monitor the progress of remediation. • Off-gas treatment is necessary to control VOC emissions during treatment. Reactions can be explosive. • Handling of ozone and hydrogen peroxide requires special precautions.	No
	Biological Treatment • composting • landfarming	• Biodegradation is a slow process, and performance is unpredictable. • Not applicable for metals removal. • Effectiveness on chlorinated compounds is not demonstrated.	No

[1]This technology has potential applicability to soils and will be reevaluated, if warranted, based upon results of the RFI.

Table 4. Screening of Potentially Applicable Remedial Alternatives to Address Ground Water. Monsanto Company; Nitro, West Virginia.

General Response Actions	Technologies/Process Options	Comments	Retained?
Excavation/Treatment Disposal (continued)	Thermal Treatment - Incineration	• Burning of sludges can be conducted at facility in existing boiler. • Effective destruction of organic compounds. • Requires disposal of residual ash. • A destructive technology which reduces the volume, toxicity and mobility of contaminants.	Yes
	Thermal Treatment - Pyrolysis	• Effective destruction of organic compounds in the absence of oxygen. • Requires treatment of off-gas and disposal of residual ash. • Permitting and space requirements mitigate use as an on-site technology. Not available as a RCRA-permitted off-site disposal option. • A destructive technology which reduces the volume, toxicity and mobility of contaminants.	No
	Thermal Treatment - Thermal Desorption	• Effective removal of volatile organic compounds from soil, removal of some metals; further reducing risks associated with soils. • Not available as a RCRA-permitted off-site disposal option.	No[1]
In-Situ Treatment	Soil Vapor Extraction	• Effective for removal of VOCs with Henry's Constants, will not remove metals. • Off-gas treatment is necessary to prevent emissions of chlorinated VOCs. • Can be combined with ground-water pumping to increase area of influence.	No[1]
	Soil Flushing	• Injection of solvent and/or surfactant to enhance contaminant solubility can further reduce risks associated with soils. • Recovery of leachate is difficult; potential for mobilizing bound contaminants. • Certain surfactants have been shown to clog soil pores and preclude further flushing.	No
	Soil Vitrification	• Isolation of contaminants in a glassy, solid matrix through electrical melting will provide long-term exposure protection. • Presence of underground utilities and extensive process areas make it infeasible. • Recovery and treatment of off-gas necessary to control emissions. • A more durable process in that vitrified solids will not become recontaminated by VOC emissions from the saturated zone. • Poor effectiveness when contaminants are near the surface.	No

[1]This technology has potential applicability to soils and will be reevaluated, if warranted, based upon results of the RFI.

General Response Actions	Technologies/Process Options	Comments	Retained?
In-Situ Treatment (continued)	Soil Steam Stripping	• Effective for removal of VOCs from soil providing long term exposure protection, but low permeability of some soil zones will reduce effectiveness. • Off-gas treatment is necessary to control emissions. • Can be implemented with readily available equipment.	No
	Soil Treatment with Radio Frequency	• Use of radio wave energy to heat soils, volatilizing organics. • Presence of underground utilities limits implementability. • Provides long-term exposure protection by removal of organics. Short-term exposures are mitigated by collection and treatment of off-gases to control emissions.	No
Collection/Discharge of Ground Water	Ground-Water Extraction Wells	• Effective in containment/control of ground-water migration. • A long-term remedial approach; restricted by size of capture zone, permeability/transmissivity of geologic units; adsorptive and ion exchange reactions, and diffusion kinetics. • Installation and operation can be performed with readily available equipment and services. • Extracted ground water can be treated at facility Wastewater Treatment Plant.	Yes
	Extraction Trenches	• Allows for increased radius of influence and greater ground-water recovery rates, but will require high pumping rates to achieve influence across trench. • A long-term remedial approach; restricted by size of capture zone, permeability/transmissivity of geologic units; adsorptive and ion exchange reactions, and diffusion kinetics. • Short term exposure and safety risk associated with trench construction. Excavated soils will require treatment and disposal. • Difficult to install to depths of 55 feet.	No
	Enhanced Ground-Water Removal - Chemical Extraction	• Use of solvents/surfactants to mobilize contaminants. • Precise hydrologic control necessary to recover contaminants and residual solvents; not practical due to geologic properties of overburden and bedrock. • Heterogeneous overburden will result in channeling of extractants. • Clogging of injection wells is a common problem.	No

[1]This technology has potential applicability to soils and will be reevaluated, if warranted, based upon results of the RFI.

Table 4. Screening of Potentially Applicable Remedial Alternatives to Address Ground Water. Monsanto Company; Nitro, West Virginia.

General Response Actions	Technologies/Process Options	Comments	Retained?
Collection/Discharge of Ground Water (continued)	Enhanced Ground-Water Removal - Hydrofracture	• Use of pressure or explosive charges to create fractures in overburden and/or bedrock; increasing hydraulic conductivity. • Explosive processes not applicable for developed sites. • Potential for redirecting contaminant migration toward receptors by opening new fractures. Ability to control direction of fractures is limited.	No
	Discharge - On-Site Deep Well Injection	• Upward flowing ground water will significantly restrict this option. Bedrock aquifer is under flowing artesian conditions. • Will require a NJPDES - Discharge to Ground Water Permit.	No
	Discharge - On-Site Infiltration	• Can be used to enhance removal of contaminants in overburden. • Can be used to influence shall ground-water flow direction. • Limited by soil permeability/hydraulic conductivity.	No
In-Situ Treatment of Ground Water	Active Bioremediation	• Introduction of oxygen and nutrient hindered by heterogeneity and poor transmissivity of overburden. Potential for clogging of injection wells.	No
	Air Sparging	• Effective technology for enhancing removal of VOC from ground water. • Susceptible to iron fouling and clogging of injection well and surrounding media. • Hydraulic control still must be maintained.	No
	In-Situ Air Stripping	• Recently developed technology involving circulation of ground water within the extraction well to create a "stripping tower" within the well. • Allows for treatment at sites without the need for subsequent ground water discharge. • Requires treatment of off-gases which may result in generation of an aqueous scrub solution. • High concentrations of iron will result in clogging/fouling of extraction well.	No

[1]This technology has potential applicability to soils and will be reevaluated, if warranted, based upon results of the RFI.

Table 5. Analytical Information for Sample Analysis. Monsanto Company; Nitro West Virginia.

Parameter	Matrix	Glassware	Preservation	Holding Time	Methodology (SW-846, 3rd Edition, Vols. 1-ABCD)	Analytical Procedure
Volatile Organics Compounds (VOC)	Soil	4 oz, glass, wide mouth, with a cap that contains a two-sided teflon septum closure	Cool, 4°C	14 days	8240	GC/MS[3]-Purge and Trap
	Water	40 mℓ, glass vial, teflon-lined septum cap	Cool, 4°C HCl, to pH <2	14 days	8240	GC/MS[3]-Purge and Trap
Total Organic Carbon (TOC)	Soil	100 mℓ, glass, amber	Cool, 4°C	7 days	9060	Carbonaceous Analyzer
	Water	125 mℓ, glass, amber teflon-lined cap	Cool, 4°C H_2SO_4 to pH<2	28 days	9060	Carbonaceous Analyzer
Total Organic Halogens (TOX)	Soil	50 g, glass, amber	Cool, 4°C	7 days	9020 (modified)	Microcoulmetric-Titration Detector
	Water	250 mℓ, glass, amber	Cool, 4°C H_2SO_4 to pH<2	28 days	9020	Microcoulmetric-Titration Detector
Base-Neutral/Acid Extractables (BN/AE) (Semivolatile Organics)	Soil	8 oz, glass, wide mouth, teflon-lined cap	Cool, 4°C	14 days	8270	GC/MS[3]
	Water	4 x 1000 mℓ, amber glass, teflon-lined cap	Cool, 4°C	Extraction within 7 days, analysis within 40 days after extraction	8270	GC/MS[3]

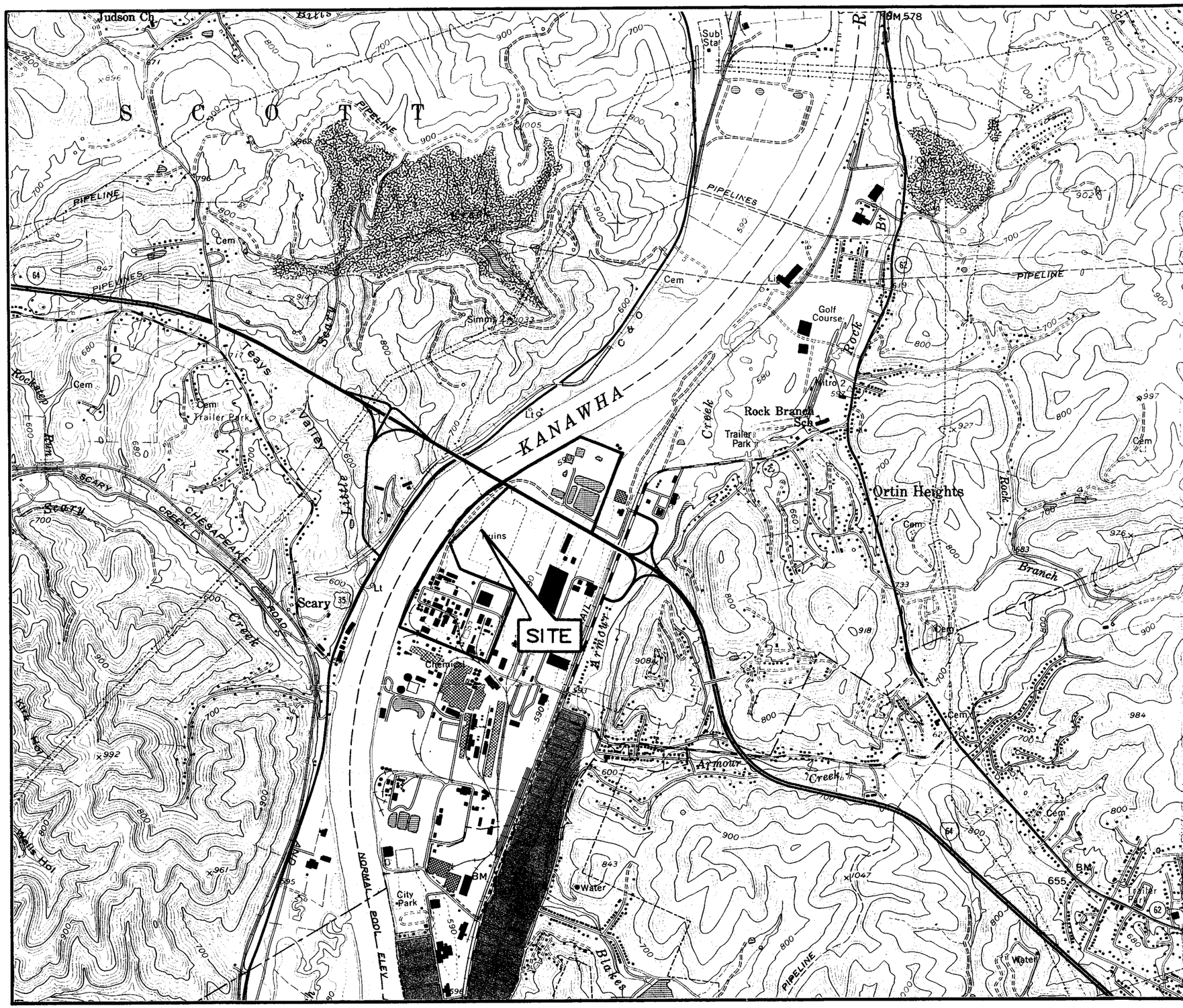
[1]Detection limits for specific metals vary.
[2]Analytical procedure dependent upon analyte.
[3]Gas Chromatography/Mass Spectrometry.
[4]Inductively Coupled Plasma.
[5]Atomic Absorption.
[6]Graphite Furnace Atomic Absorption.

Table 5. Analytical Information for Sample Analysis. Monsanto Company; Nitro West Virginia.

Parameter	Matrix	Glassware	Preservation	Holding Time	Methodology (SW-846, 3rd Edition, Vols. 1-ABCD)	Analytical Procedure
Polychlorinated Dioxins & Polychlorinated Dibenzofurans (PCDDs & PCDFs)	Soil	500 mℓ, wide-mouth, teflon-lined cap	Cool, 4°C dark	Extracted within 7 days, analyzed within 40 days after extraction	8280	GC/MS[3]
	Water	1ℓ, glass	Cool, 4°C	Extracted within 7 days, analyzed within 40 days after extraction	8280	GC/MS[3]
Metals[1,2] Includes: Antimony, Arsenic, Barium, Beryllium, Cadmium, Chromium, Lead, Mercury, Nickel, Selenium, Silver, Thallium	Soil	4 oz, glass, wide-mouth teflon-lined cap	Cool, 4°C	6 months (Hg 28 days)	6000 series (Hg 7000 series)	ICP[4] (Hg by Cold Vapor)
	Water	600 mℓ, glass or plastic, teflon-lined cap	Cool, 4°C, HNO_3 to pH<2	6 months (Hg 28 days)	7000 series	Flame/AA[5] (Ar, Pb, Se, Tl by GFAA[6]) (Hg by Cold Vapor)
pH	Water	50 mℓ, plastic	None	Immediate	Field pH Meter	NA

[1]Detection limits for specific metals vary.
[2]Analytical procedure dependent upon analyte.
[3]Gas Chromatography/Mass Spectrometry.
[4]Inductively Coupled Plasma.
[5]Atomic Absorption.
[6]Graphite Furnace Atomic Absorption.

FIGURES



N

QUADRANGLE LOCATION

SOURCE: U.S.G.S. SAINT ALBANS, W.VA., QUADRANGLE 1958
7.5 MINUTES SERIES (TOPOGRAPHIC)
PHOTOREVISED 1971
AND 1976

2,000' 0 2,000'

Title:

SITE LOCATION MAP

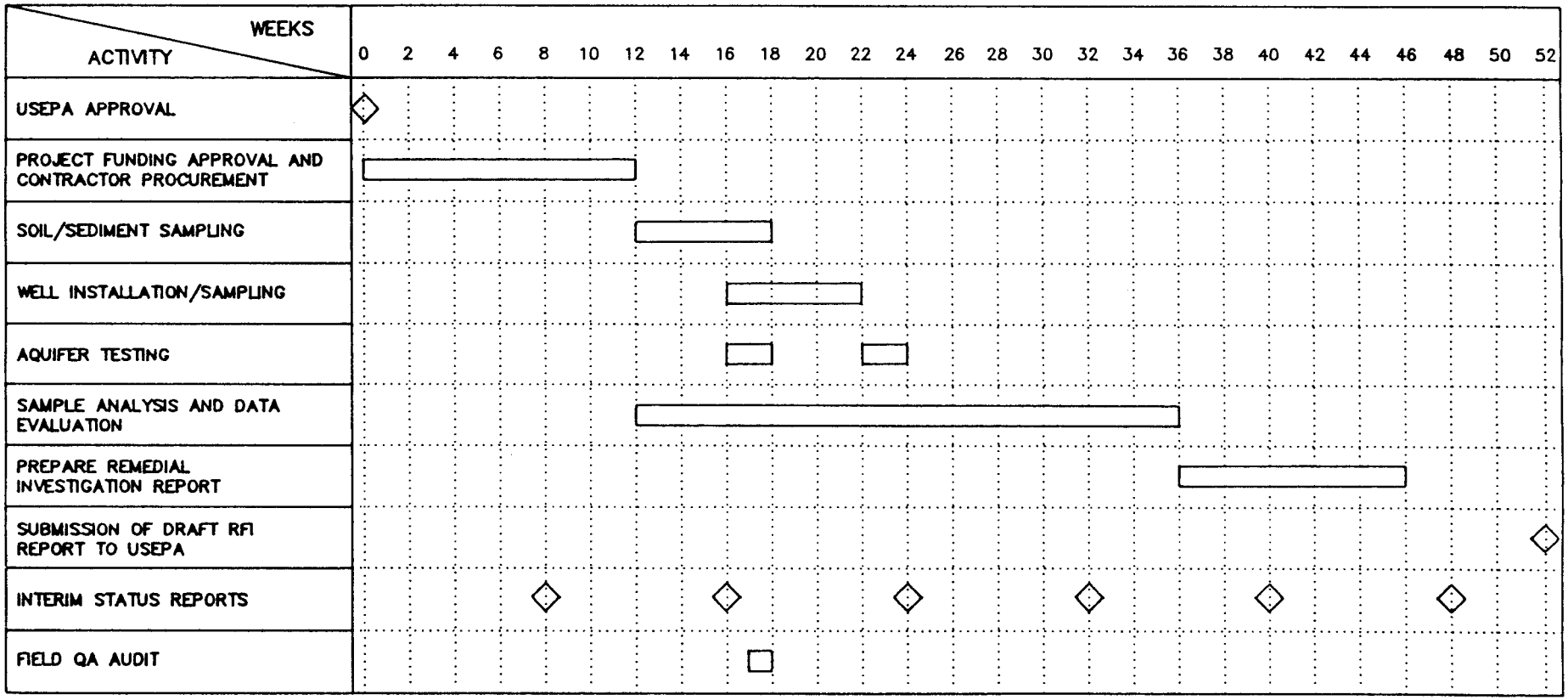
NITRO, WEST VIRGINIA

Prepared for:

MONSANTO COMPANY

ROUX ASSOCIATES INC
Environmental Consulting & Management

Compiled by: E.A.R.	Date: 09/93	Figure
Prepared by: A.M.B.	Scale: SHOWN	1
Project Mgr: M.S.T.	Revision:	
File No. 06619J		



LEGEND

PROJECT ACTIVITY SCHEDULE

PROPOSED MILESTONE

Title:

RFI WORKPLAN IMPLEMENTATION SCHEDULE

NITRO, WEST VIRGINIA

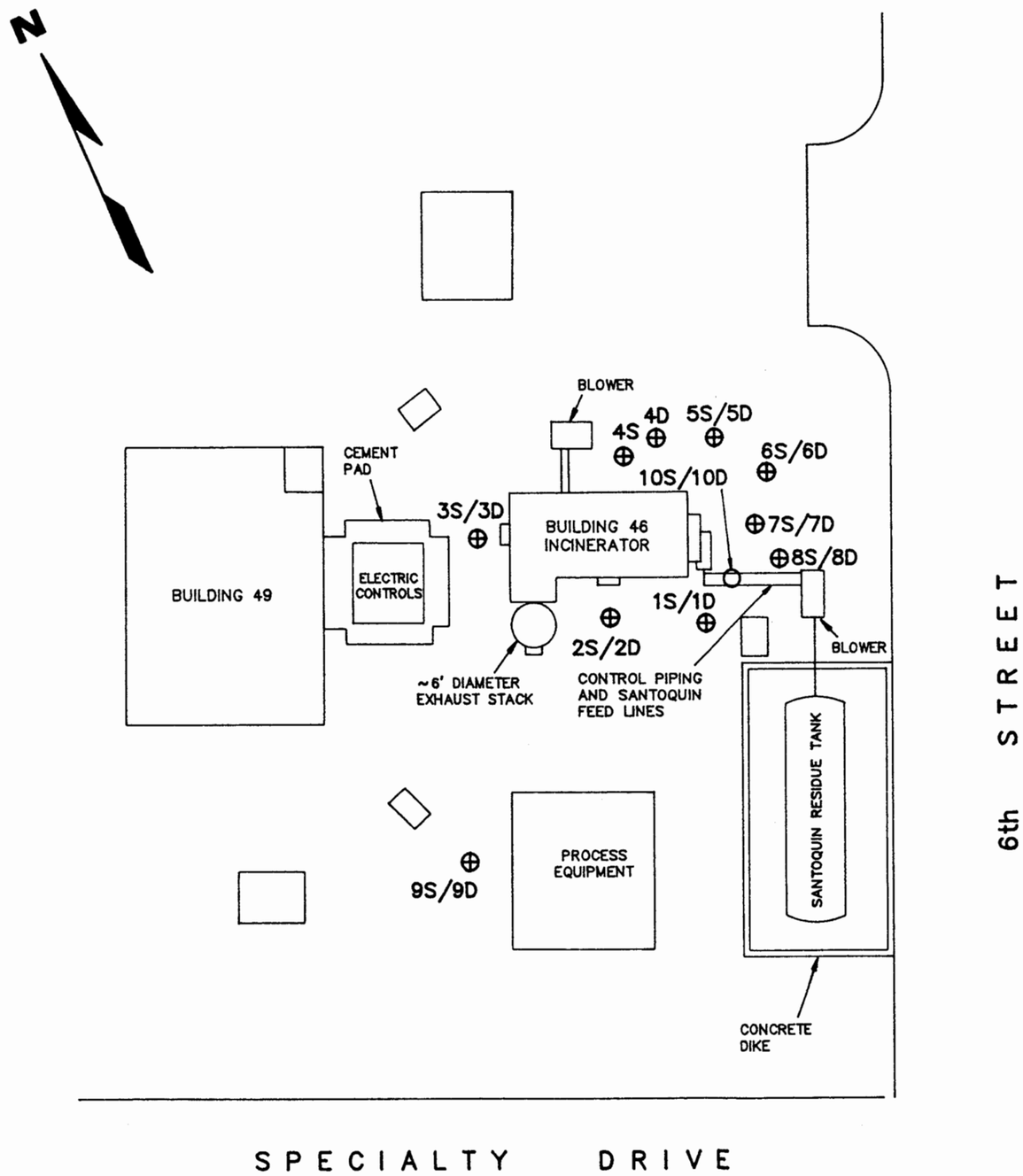
Prepared for:

MONSATO COMPANY

ROUX

ROUX ASSOCIATES INC
Environmental Consulting & Management

Compiled by: J.A.L.	Date: 04/94	Figure
Prepared by: M.J.V.	Scale: NONE	2
Project Mgr: M.S.T.	Revision:	
File No. 06619J-A02		



LEGEND

1S/1D ⊕ PREVIOUS SOIL SAMPLING LOCATION AND IDENTIFICATION

10S/10D ○ PROPOSED SOIL SAMPLING LOCATION AND IDENTIFICATION

S= SHALLOW SAMPLE
D= DEEP SAMPLE

20' 0 20'

Title:

SOIL SAMPLING LOCATIONS AT BUILDING 46 INCINERATOR

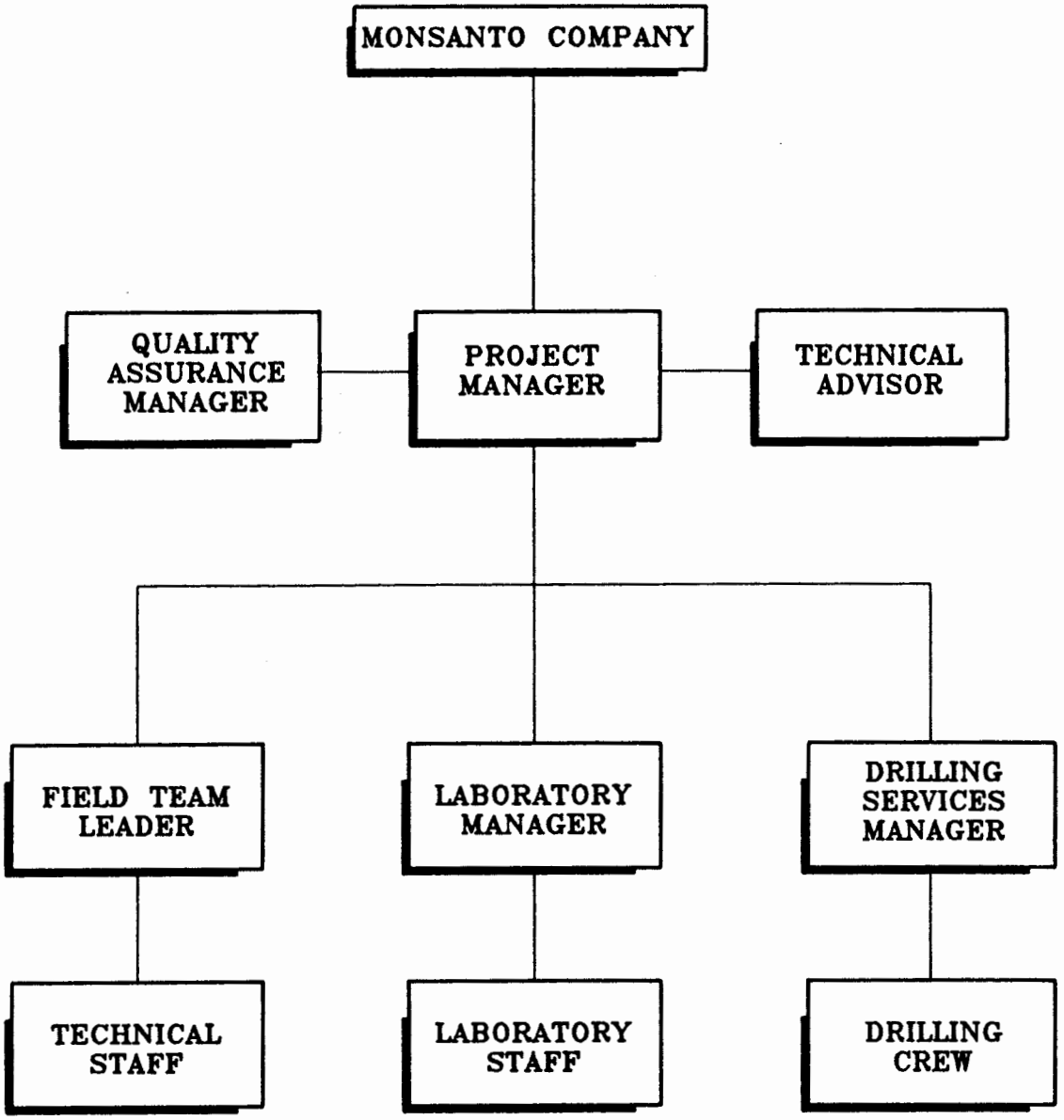
NITRO, WEST VIRGINIA

Prepared for:

MONSANTO COMPANY

ROUX
ROUX ASSOCIATES INC
Environmental Consulting & Management

Compiled by: M.S.T.	Date: 11/93	Figure
Prepared by: M.J.V.	Scale: SHOWN	3
Project Mgr: M.S.T.	Revision:	
File No. 06619J-B07		



Title:

PROJECT ORGANIZATION CHART

NITRO, WEST VIRGINIA

Prepared for:

MONSANTO COMPANY

ROUX

ROUX ASSOCIATES INC
Environmental Consulting & Management

Compiled by: M.S.T.	Date: 11/93	Figure
Prepared by: M.J.V.	Scale: SHOWN	4
Project Mgr: M.S.T.	Revision:	
File No. 06619J-A04		

APPENDICES

APPENDIX A

APPENDIX A

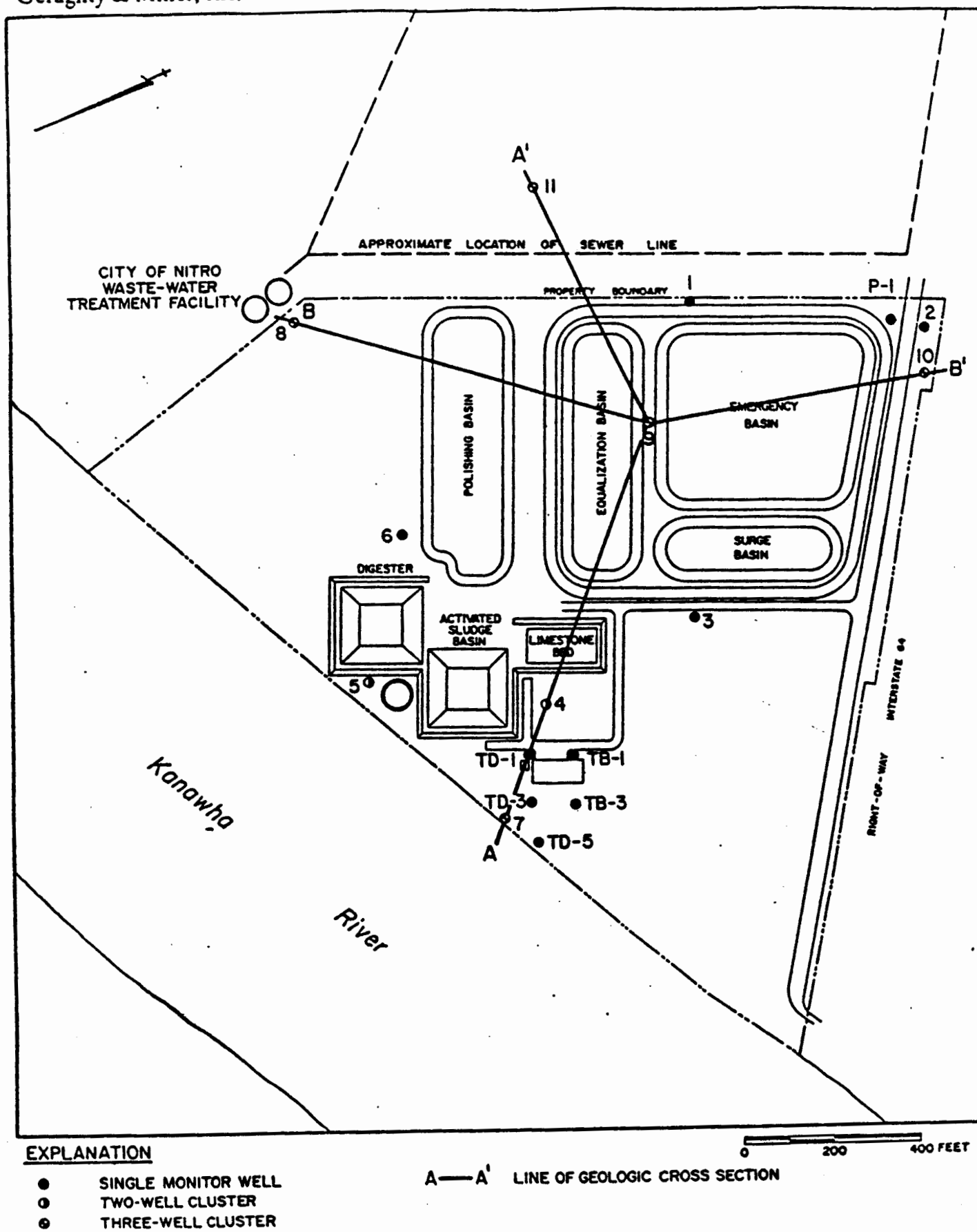
GEOLOGIC CROSS-SECTIONS

APPENDIX A-1

SITE LOCATION MAP INDICATING THE LOCATIONS OF THE GEOLOGIC CROSS-SECTIONS

REPRODUCED FROM "GROUND-WATER QUALITY ASSESSMENT OF THE MONSANTO WASTE-WATER TREATMENT FACILITY", GERAGHTY AND MILLER, INC., MAY 1985

Geraghty & Miller, Inc.



EXPLANATION

- ● SINGLE MONITOR WELL
- ◐ TWO-WELL CLUSTER
- ◉ THREE-WELL CLUSTER

A——A' LINE OF GEOLOGIC CROSS SECTION

Figure 3. Location of Monitor Well Sites at the Monsanto Treatment Facility, Nitro, West Virginia.

APPENDIX A-2

GEOLOGIC CROSS-SECTION A-A' AND B-B'

REPRODUCED FROM "GROUND-WATER QUALITY ASSESSMENT OF THE MONSANTO WASTEWATER TREATMENT FACILITY", GERAGHTY AND MILLER, INC., MAY 1985

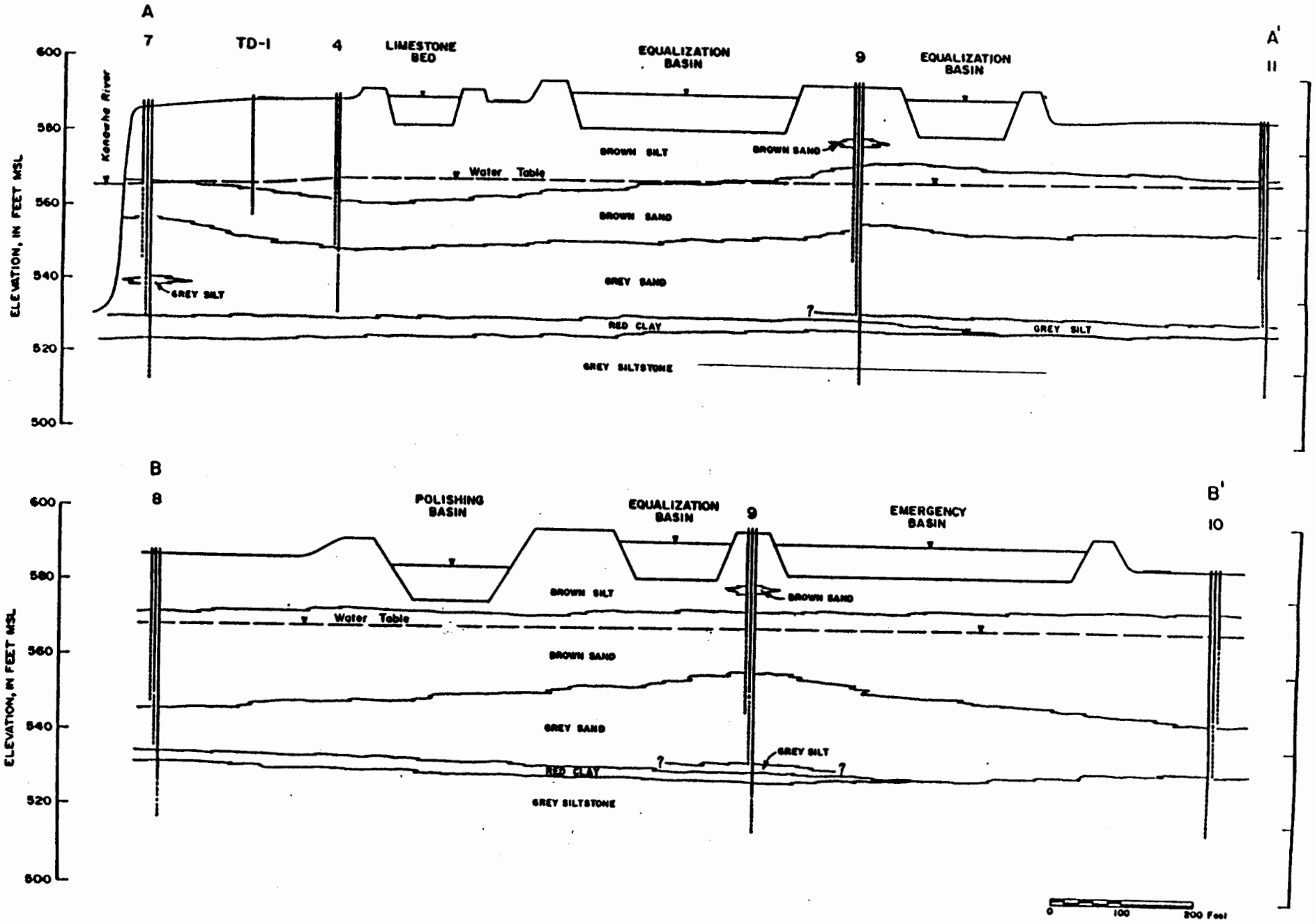


Figure 5. Inferred Geologic Cross Sections A-A' and B-B' at the Monsanto Treatment Facility, Nitro, West Virginia.

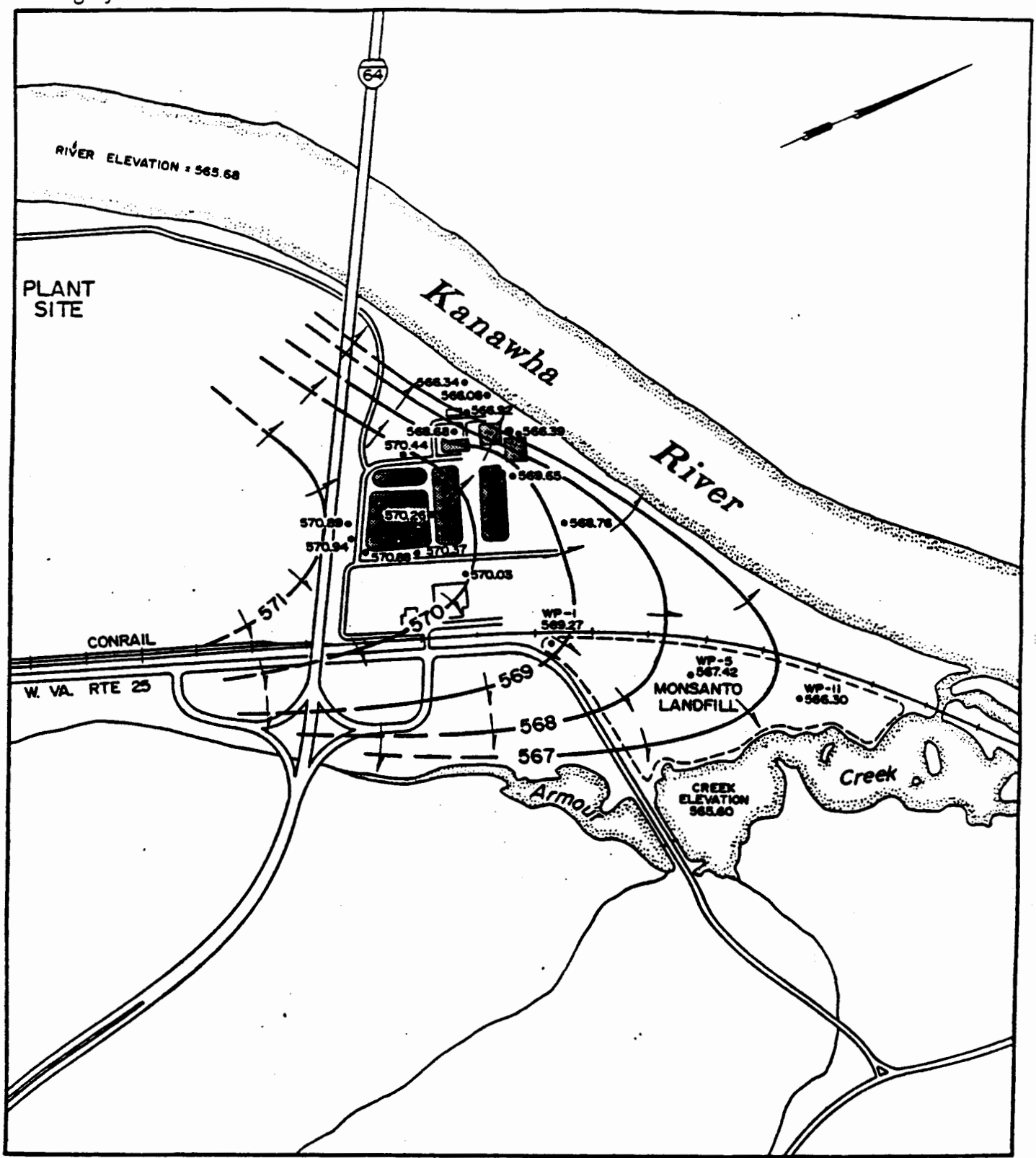
APPENDIX B

APPENDIX B

GROUND-WATER ELEVATION CONTOUR MAPS

APPENDIX B-1

REPRODUCED FROM GERAGHTY AND MILLER, MAY 1985, "GROUND-WATER QUALITY ASSESSMENT OF THE MONSANTO WASTEWATER TREATMENT FACILITY"



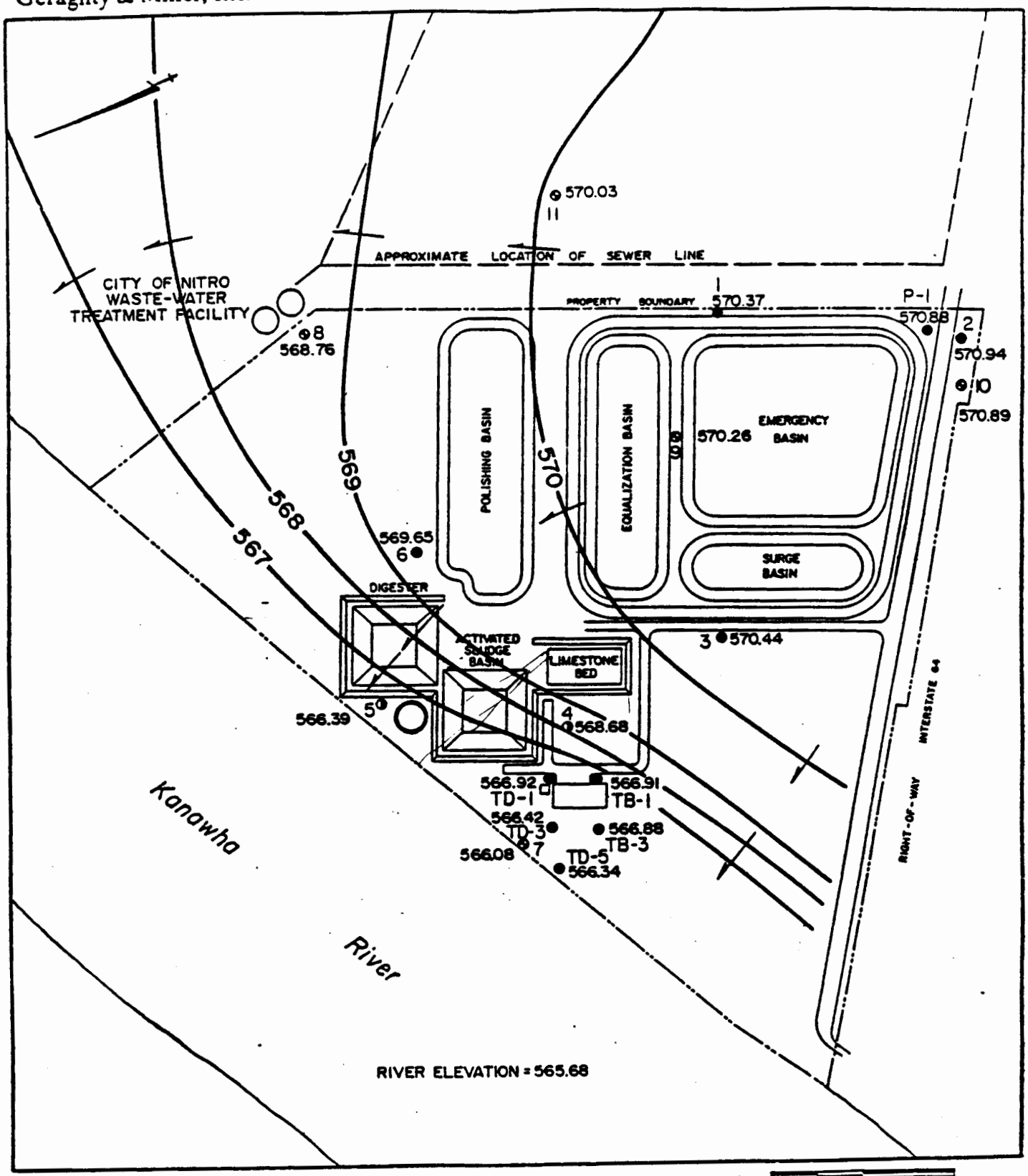
EXPLANATION

—570— WATER-TABLE CONTOUR, IN FEET MSL

570.03 WATER LEVEL ELEVATION, IN FEET MSL

GENERAL DIRECTION OF GROUND-WATER FLOW

Figure 6. Regional Water-Table Map Illustrating Horizontal Direction of Flow From Head Data Collected February 11, 1985 in the Area of Monsanto Treatment Facility, Nitro, West Virginia.



EXPLANATION

—570— WATER-TABLE CONTOUR, IN FEET MSL

570.03 WATER LEVEL ELEVATION, IN FEET MSL

GENERAL DIRECTION OF GROUND-WATER FLOW

Figure 7. Water-Table Map Illustrating Horizontal Direction of Flow From Head Data Collected February 11, 1985 in the Area of Monsanto reatment Facility, Nitro, West Virginia.

APPENDIX B-2

REPRODUCED FROM GERAGHTY AND MILLER, OCTOBER 1985, "GROUND-WATER QUALITY INVESTIGATIVE AT THE MONSANTO PLANT, NITRO, WEST VIRIGINIA"

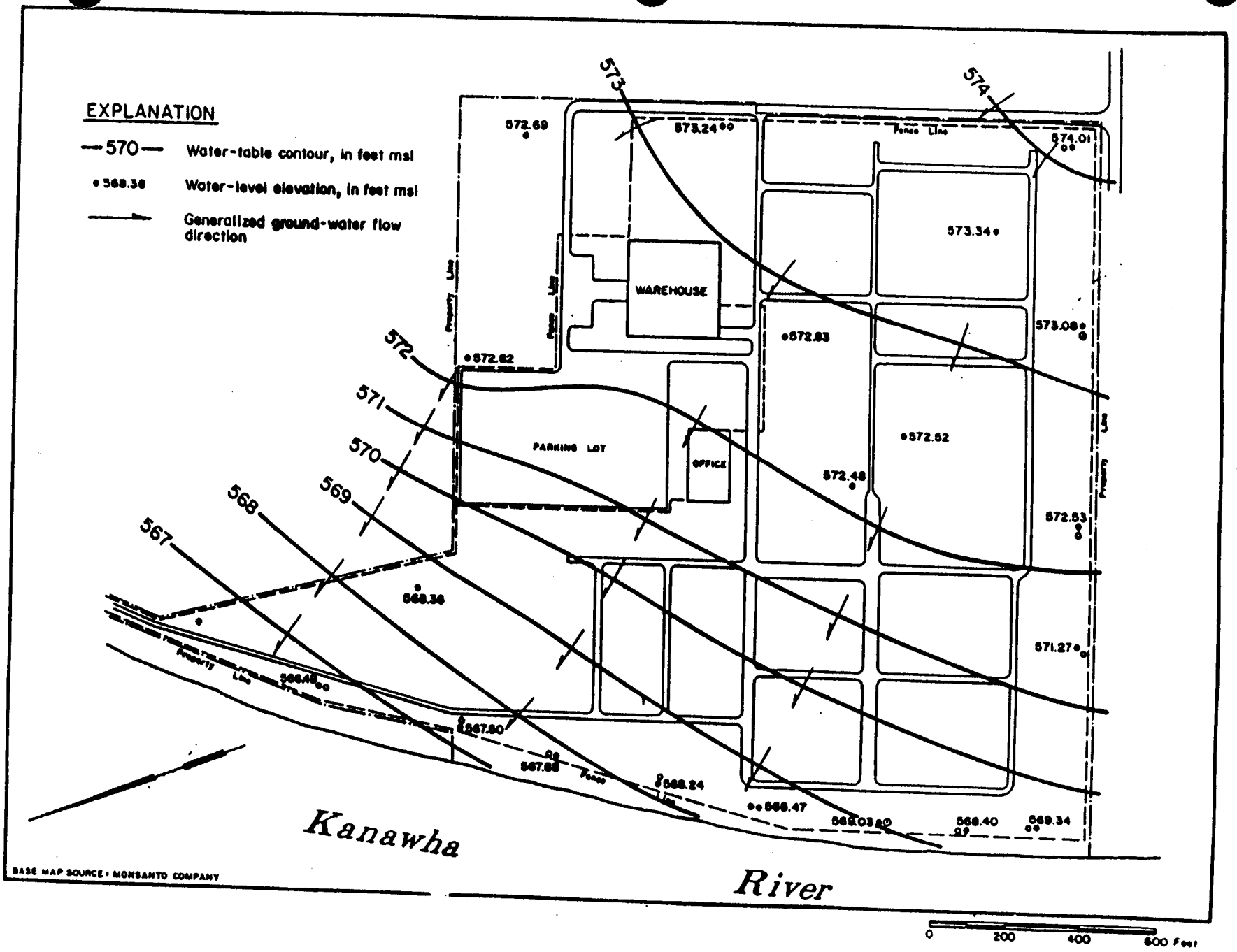


Figure 9. Water-Table Map Illustrating Direction of Flow from Shallow Well Head Data Collected May 13, 1985, at the Monsanto Plant, Nitro, West Virginia.

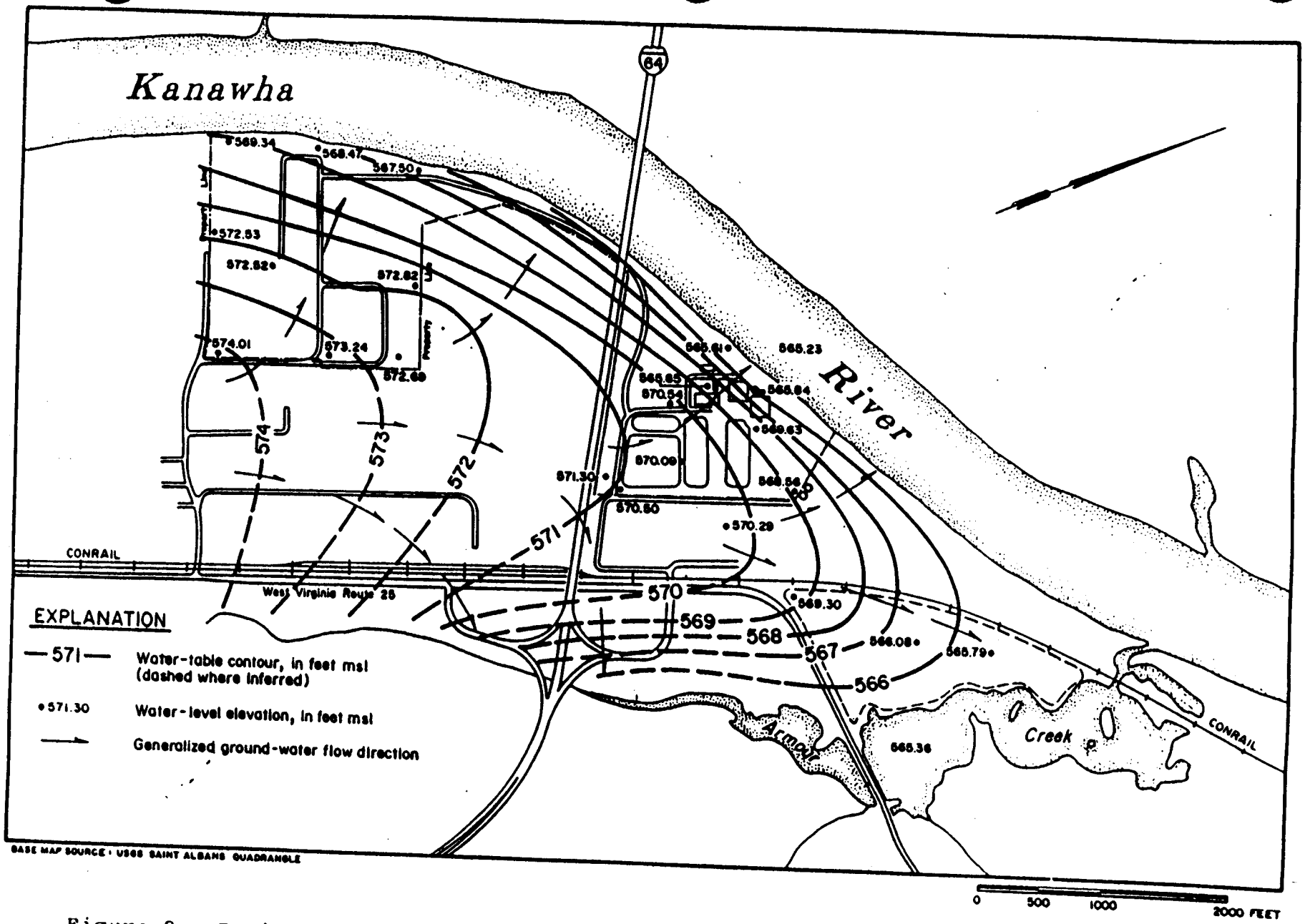
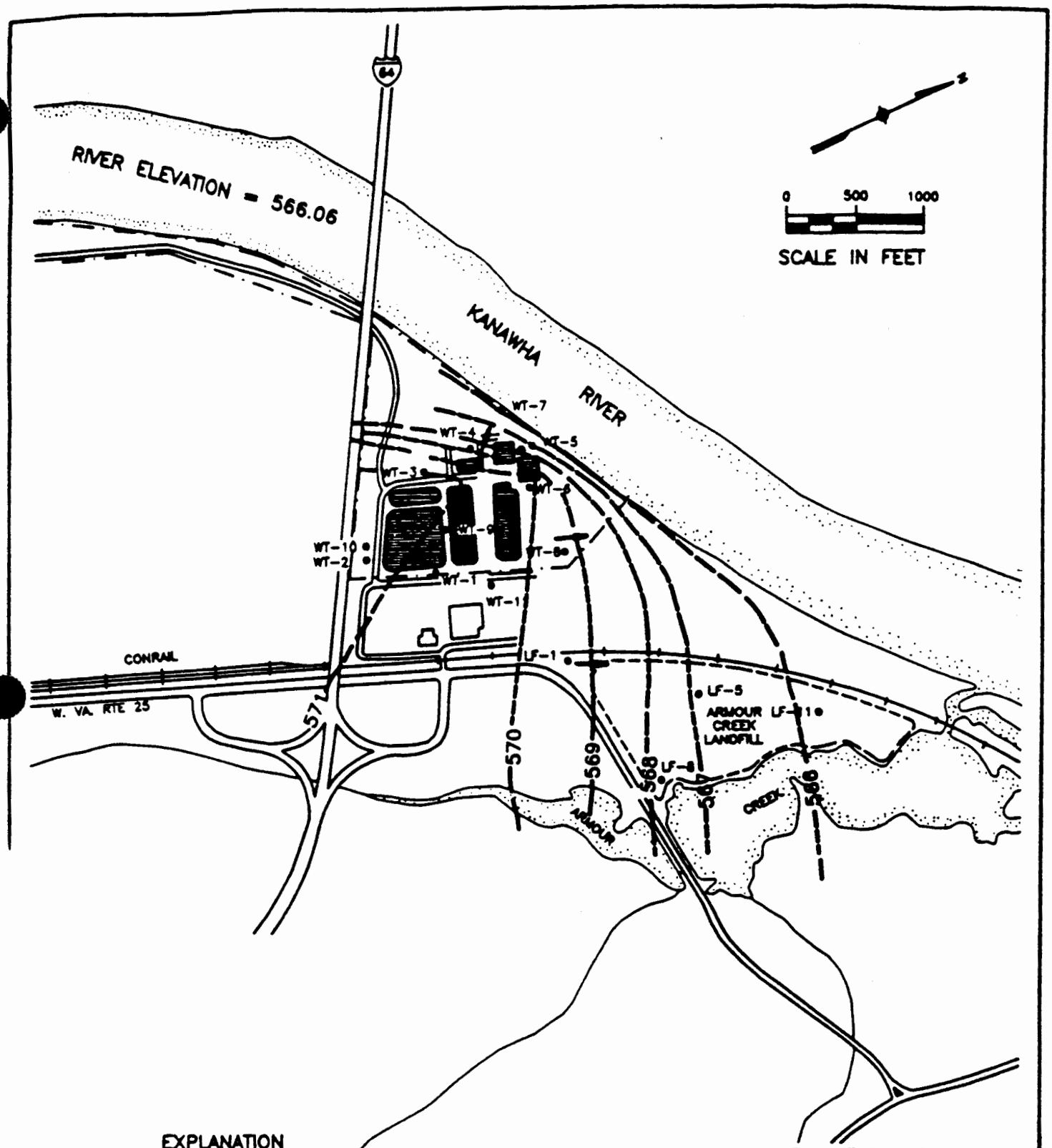


Figure 8. Regional Water-Table Map Illustrating Direction of Flow from Head Data Collected May 13, 1985, in the Area of Monsanto Facility, Nitro, West Virginia.

APPENDIX B-3

REPRODUCED FROM MARK JAMES CORPORATION, 1992, "1992 ANNUAL GROUND-WATER QUALITY ASSESSMENT REPORT"



EXPLANATION

⟶	DIRECTION OF GROUNDWATER FLOW
567	LINE OF EQUAL GROUNDWATER POTENTIAL, FEET ABOVE MSL (DASHED WHERE INFERRED)
• WT-5	MONITORING WELL CLUSTER LOCATION
— · — · —	APPROXIMATE LIMITS OF MONSANTO PROPERTY

NOTE:
THIS MAP REPRESENTS THE GENERALIZED GROUND WATER FLOW PATTERNS WITHIN THE LOWER PORTION OF THE WATER TABLE AQUIFER ON FEBRUARY 19, 1992.

BASE MAP SOURCE: USGS SAINT ALBANS QUADRANGLE

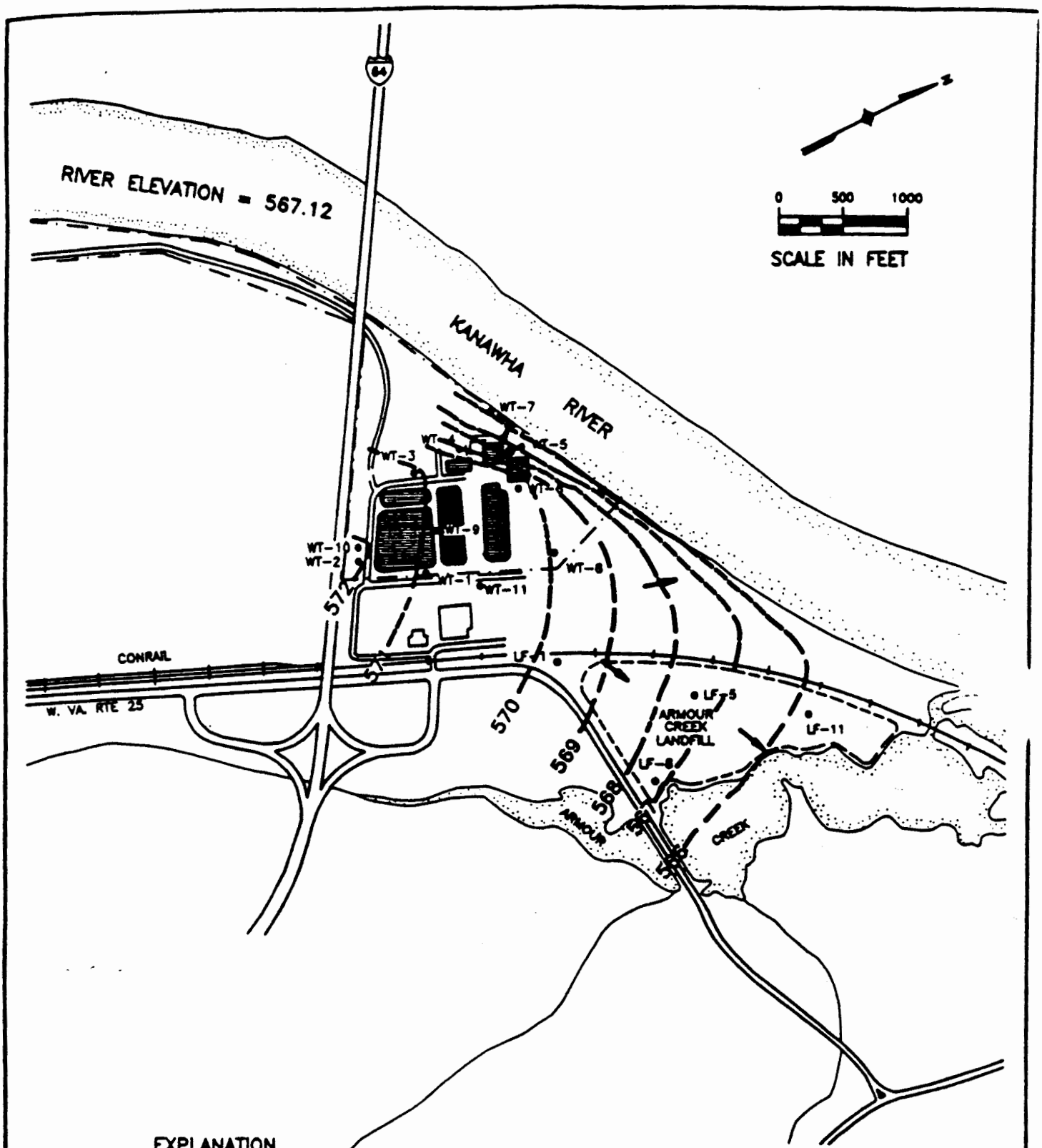
FIGURE 3
1ST QUARTER, 1992
GROUNDWATER FLOW

THE CHEMICAL GROUP
OF MONSANTO COMPANY
NITRO, WV

DRAWING NO.
1100-A3

The Mark James Corporation

1100-A3



EXPLANATION

- DIRECTION OF GROUNDWATER FLOW
- 567 — LINE OF EQUAL GROUNDWATER POTENTIAL, FEET ABOVE MSL (DASHED WHERE INFERRED)
- WT-5 — MONITORING WELL CLUSTER LOCATION
- APPROXIMATE LIMITS OF MONSANTO PROPERTY

NOTE:
THIS MAP REPRESENTS THE GENERALIZED GROUND WATER FLOW PATTERNS WITHIN THE LOWER PORTION OF THE WATER TABLE AQUIFER ON MAY 28, 1992

BASE MAP SOURCE: USGS SAINT ALBANS QUADRANGLE

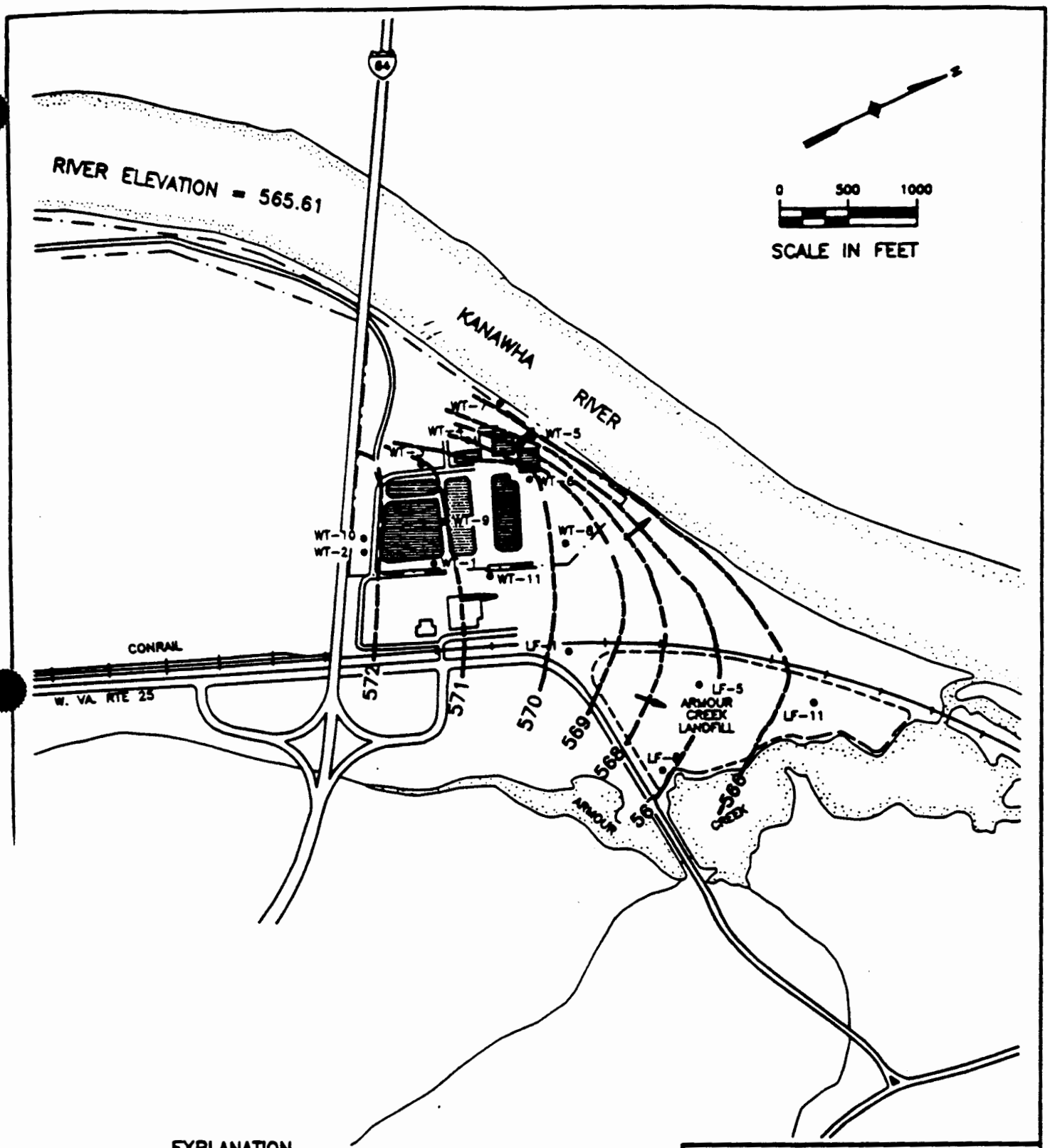
FIGURE 4
2ND QUARTER, 1992
GROUNDWATER FLOW

THE CHEMICAL GROUP
OF MONSANTO COMPANY
NITRO, WV

DRAWING NO.
1100-A4

The Mark James Corporation

1100-A4



EXPLANATION

	DIRECTION OF GROUNDWATER FLOW
567	LINE OF EQUAL GROUNDWATER POTENTIAL, FEET ABOVE MSL (DASHED WHERE INFERRED)
WT-5	MONITORING WELL CLUSTER LOCATION
	APPROXIMATE LIMITS OF MONSANTO PROPERTY

NOTE:
THIS MAP REPRESENTS THE GENERALIZED GROUND WATER FLOW PATTERNS WITHIN THE LOWER PORTION OF THE WATER TABLE AQUIFER ON SEPTEMBER 1, 1992

BASE MAP SOURCE: USGS SAINT ALBANS QUADRANGLE

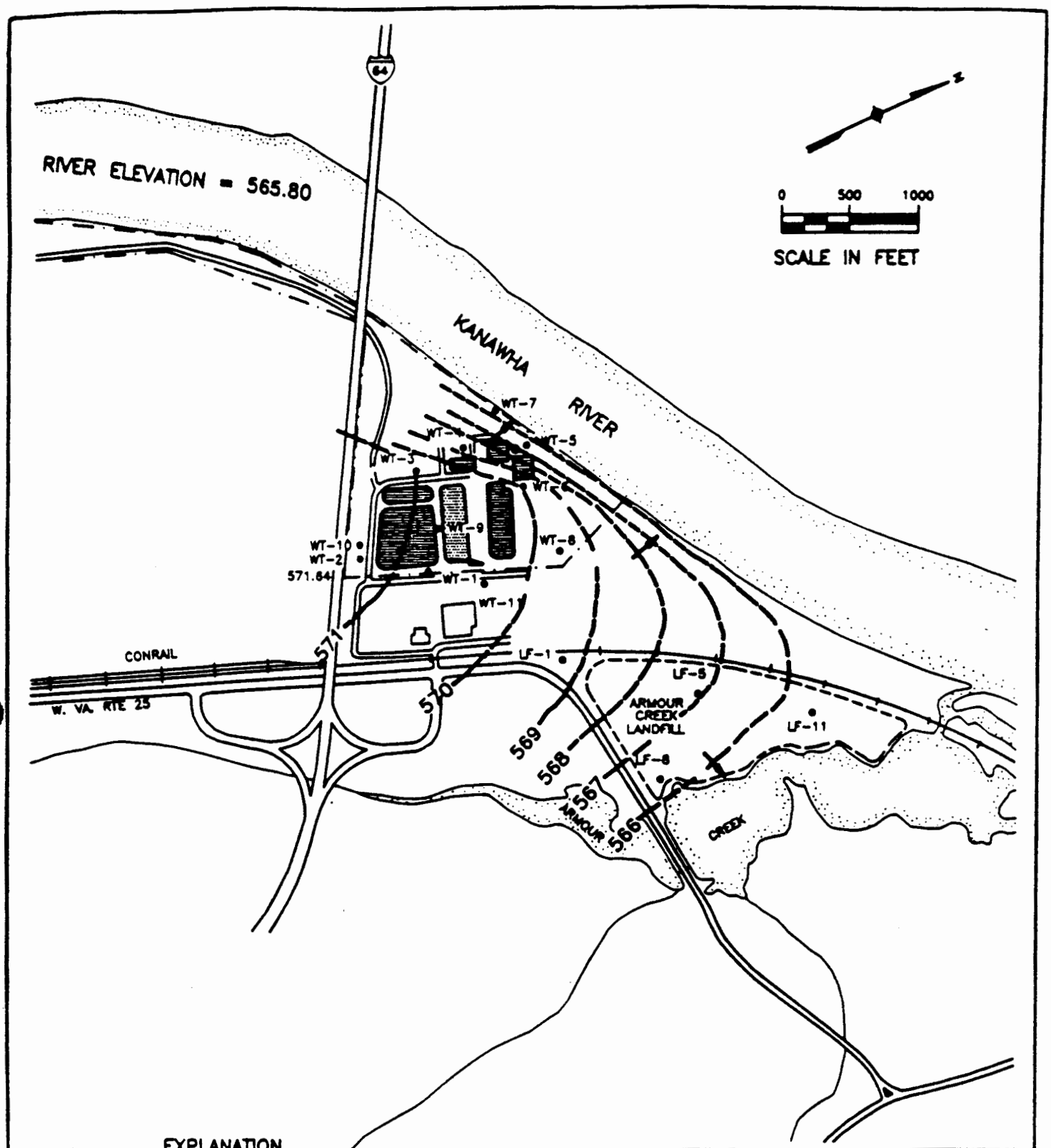
FIGURE 5
3RD QUARTER 1992
GROUNDWATER FLOW

THE CHEMICAL GROUP
OF MONSANTO COMPANY
NITRO, WV

DRAWING NO.
1100-A5

The Mark James Corporation

1100-A5



EXPLANATION

⟶	DIRECTION OF GROUNDWATER FLOW
—— 567 ——	LINE OF EQUAL GROUNDWATER POTENTIAL, FEET ABOVE MSL (DASHED WHERE INFERRED)
• WT-5	MONITORING WELL CLUSTER LOCATION
— · —	APPROXIMATE LIMITS OF MONSANTO PROPERTY

NOTE:
THIS MAP REPRESENTS THE GENERALIZED GROUND WATER FLOW PATTERNS WITHIN THE LOWER PORTION OF THE WATER TABLE AQIFER ON NOVEMBER 5, 1992.

BASE MAP SOURCE: USGS SAINT ALBANS QUADRANGLE

FIGURE 6
4TH QUARTER 1992
GROUNDWATER FLOW

THE CHEMICAL GROUP
OF MONSANTO COMPANY
NITRO, WV

DRAWING NO.
1100-A6

The Mark James Corporation

1100-A6

APPENDIX C

APPENDIX C

PROFESSIONAL PROFILES

Mark Tucker, P.G.
Senior Hydrogeologist

Technical Specialties:
Environmental site assessments, hydrogeologic investigations, and regulatory compliance.

Experience Summary:
9 years experience: Senior Hydrogeologist at Roux Associates, Inc.; Regional Hydrogeologist and Environmental Monitoring Manager at Chemical Waste Management, Inc.; and Associate Geologist at ICF Technology, Inc. Managed subsurface investigations for industrial clients, RCRA hazardous waste facilities, and CERCLA hazardous waste sites.

Credentials:
M.S., Geology, University of Pittsburgh, 1983
B.S., Geoscience and Biology, Indiana University of Pennsylvania, 1980

Professional Registrations and Affiliations:
Delaware Registered Professional Geologist (No. 519)
South Carolina Registered Professional Geologist (No. 1031)
New Jersey Certified UST Subsurface Evaluator (No. G0000427)
Geological Association of New Jersey
National Ground Water Association

Key Projects:
- Operated, maintained and monitored ground-water extraction system as part of RCRA corrective action for South Carolina facility.
- Conducted ECRA soil and ground-water investigations for industrial facility in southern New Jersey.
- Provided litigation support for major refinery in southeastern Pennsylvania.
- Managed RCRA ground-water monitoring programs.
- Prepared RCRA Part B permit application for hazardous waste landfill and surface impoundment facilities.
- Prepared work plans and implemented subsurface investigations as part of RCRA Facility Investigation (RFI).
- Conducted ground-water modeling to delineate extraction well capture zones and optimize pumping rates and extraction well configurations.
- Designed, installed, and operated ground-water interceptor trench system for separate-phase hydrocarbon removal.
- Prepared corporate Hazardous Material Response Plan for industrial client.
- Provided NJPDES-DGW permitting support and conducted ground-water contamination investigations for industrial septic system.
- Conducted environmental assessment activities for large explosives manufacturing facility in northern New Jersey.
- Conducted ground-water investigations for CERCLA hazardous waste site in Maryland.
- Conducted aquifer tests, capture zone analysis, and contamination investigations to support Water Allocation Permit Application for new public supply well.
- Conducted soil gas investigation and pilot venting study. Installed and operated soil venting system for gasoline spill in Delaware.
- Conducted investigations to assess migration of liquid hazardous waste disposed in deep coal mine in northeastern Pennsylvania.
- Conducted investigations at PCB-contaminated railyard and adjacent residential properties. Installed run-off control structures.
- Provided carbon filtration and air stripping for 31 contaminated drinking water wells in Maryland.
- Designed interceptor trench and extraction well system for ground-water contamination at solvent recycling facility in Ohio.
- Conducted geophysical surveys to locate and delineate buried drums at chemical manufacturing facility in Virginia. Oversaw excavation of 1,400 drums.
- Provided technical assistance for 3.5 million gallon oil spill in western Pennsylvania.
- Provided emergency response services for fire at chemical manufacturing facility.
- Provided UST management services at 40 facilities in New Jersey including tank removal, soil excavation and closure report preparation.
- Conducted hazard assessments for abandoned coal mine sites across Pennsylvania.

Neil R. Rivers
Principal Scientist

Technical Specialties:
Remedial investigations and feasibility studies at hazardous waste sites. Property transfer-related environmental assessments. Hazardous waste treatment and disposal technologies. Low temperature thermal desorption. Biological wastewater treatment.

Experience Summary:
13 years of experience: Principal Scientist for Roux Associates, Vice President at Environmental Compliance Services, Project Engineer at Roy F. Weston, and Technical Supervisor at NVF Company.

Credentials:
B.S. Biology, Widener University, 1980.
28 M.S. credits in Environmental Engineering.
Licensed Industrial Wastewater Treatment Operator.

Key Projects:

- Project Manager for an ECRA investigation and cleanup program at a petroleum distribution terminal in New Jersey. The remedial program included the treatment of 18,000 cubic yards of soil by thermal desorption, ground-water remediation, asbestos abatement and the installation of a storm water discharge system.
- Lead Project Engineer for a $1.4 million RI/FS at a wood treating site and for a $1.6 million RI/FS at a drum disposal site. Both projects were on the Superfund NPL. Site contaminants included polynuclear aromatics, pentachlorophenol, dioxins, acids and volatile organic compounds.
- Principal-in-Charge of oversight and auditing of hazardous waste site remedial activities. Prepared reports for the contractor's pollution liability insurance carrier based upon field audits and report evaluations.
- Principal-in-Charge of property transfer-related environmental evaluations.
- Project Manager for investigation and remediation projects at retail gasoline stations in Maryland and Pennsylvania. Designed, constructed and operated a ground-water treatment and recovery system.
- Lead Engineer responsible for the administration and technical review for a $40 million USEPA CERCLA project.
- Principal-in-Charge of environmental claims investigations for a national insurance carrier.
- Lead Project Engineer for the identification, evaluation, and ranking of environmental liabilities at over 100 U.S. Army facilities.
- Technical Supervisor managing the operation of an activated sludge waste water treatment system, a heavy metals precipitation/sedimentation treatment system, and a hazardous waste neutralization system.
- Lead Project Engineer for a remedial investigation/feasibility study focusing on PCB contamination of the Red Clay Creek in southeastern Pennsylvania.
- Presented seminars on the USEPA CERCLA program, environmental property transfer assessments, thermal desorption, underground storage tank release response, health and safety issues during hazardous waste site operations, and the reduction of environmental liabilities through management practices and insurance.
- Principal-in-Charge of studies evaluating the environmental risk associated with various hazardous waste treatment, storage and disposal facilities. Prepared recommendations to reduce potential environmental liability and assisted in implementation.
- Project Manager for the development of hazardous waste management guidance manuals for a major petroleum refining and distribution company. Prepared guidance manuals to direct oil company and contractor personnel in hazardous waste manifesting, TSDF selection, generator reporting and disposal tax filing.
- Lead Project Engineer for an environmental compliance audit at an agricultural chemicals research facility in Greenville, Mississippi.
- Project Manager for the Feasibility Study at an industrial site in New Jersey. Site contaminants include chlorinated VOCs and heavy metals. Remediation of a bedrock aquifer, wetlands, and soils will be required.

Peter J. Palko
Senior Engineer

Technical Specialties:
Geotechnical engineering; ground-water and soil investigation and remediation; treatment systems construction and design; production, monitoring, observation, and recovery wells; vertical turbine, submersible, and diaphragm pump design; UST investigations; and project management.

Experience Summary:
5 years experience: Senior Engineer and Project Engineer at Roux Associates; Senior Project Manager at W.C. Services. Senior project management responsibilities from bidding to project completion in well design and installation, treatment systems installation, hazardous waste cleanup projects, pump design and installation, construction management of storage towers, building construction, and mechanical and chemical feed systems.

Credentials:
B.S., 1988, Commerce and Engineering/Operations Management, Drexel University, Philadelphia, Pennsylvania.
NJ State Licensed Water Treatment Superintendent
NJ State Licensed Water Distribution Superintendent
OSHA 40-hour Health and Safety Training

Professional Affiliations:
South Jersey Water Superintendents Association
Institute of Industrial Engineers

Key Projects:
- Provided project management and engineering services at the Lipari Landfill in NJ which consisted of drilling and installing twenty-two, 6-inch diameter, stainless-steel extraction wells, eleven 6-inch diameter injection wells, one 250 gpm double cased production well for potable supply, and landfill perimeter monitoring wells. Involved in submersible pump installations and disposal of over 1,000 drums of hazardous waste including lab packing, approvals, loading, manifesting, and complete removal of six waste streams.
- Provided engineering and construction support services for a water treatment plant and distribution piping. Storm water collection system included over 1500 linear feet of 15-inch diameter reinforced concrete pipe with depths up to 10 feet below grade.
- Provided construction management for new pumping station that collected storm water flow from the Borough of Sayreville, New Jersey. Project included a sheeted detention area and three 10,000 gpm vertical turbine pumps.
- Provided project management and engineering services for a Fortune 500 industrial client during a Phase 1 Remedial Investigation of their Marcus Hook, PA site which included site supervision during the installation of monitoring wells and test pits.
- Project manager for a 150' recovery trench with 24" diameter sump and numerous perimeter monitoring wells.
- Responsible for full maintenance contract for a major chemical company site in Delaware.
- Provided project management and engineering for the installation of recovery wells, monitoring wells, and an on-site air stripping and carbon adsorption system at an Air Force Base in Niagara Falls, New York.
- Provided project management for an on-site recovery system at a NJ Turnpike rest stop which utilized pneumatic skimmers to remove free product to on-site tankers.
- Provided project management for two new 150' deep production wells in Medford Township, NJ equipped with vertical turbine pumps and a plant which treated iron, manganese, as well as organics.
- Provided project management for a new 800' observation well and numerous well head upgrades, new submersible pumps, well developments and well sealings for a major power utility in Salem, NJ.
- Provided project management for two new 1300' production wells into the Raritan Formation for Manchester Township, NJ and a 2050' production well for NJAWC in Brick Township, NJ.
- Provided project management and project engineering support for a project consisting of three triple-cased production wells and well houses with a new treatment plant consisting of eight 10½' diameter vertical-pressure filters, potassium permanganate and lime feed, sodium hypochlorite feed, backwash recycle system, and full distribution system between new wells and plant including sanitary sewer and force mains.
- Provided on-site project management for the installation of ten monitoring wells and borings utilizing auger, mud, and air rotary drilling methods for a large industrial client's site located in Mountainside, NJ.

Ernest Risha
Project Scientist

Technical Specialties:
Design, implementation, and construction of multiple technology, soil and ground-water remediation systems. Preparation and completion of environmental site assessment reports. Implementation of large-scale soil and ground-water investigation plans.

Experience Summary:
5 years of experience: Assistant Scientist, Staff Scientist, and Project Scientist with Roux Associates. Acted as Regional Health and Safety Officer. Performed site investigations under the jurisdiction of PADER, NJDEPE, DNREC, MADEP, NYSDEC, DHEC and IDEM.

Credentials:
B.S. Earth Science Education, The Pennsylvania State University - 1988

Assessment of Treatment Technologies - NWWA
Preliminary Design of Vapor Extraction Systems - University of Houston
Soil Vapor Extraction Technologies - USEPA
Field Monitoring Using Portable Gas Chromatography - University of Toledo
OSHA Health and Safety Training Courses
OSHA Supervisory Training Course

Professional Affiliations:
Association of Ground Water Scientists and Engineers

Key Projects:
- Supervised and coordinated field activities for a 700-site mercury remediation program for a natural gas distribution pipeline throughout West Virginia, Ohio, Pennsylvania, and New York.
- Project Manager for the preliminary investigation, design and implementation of a twin vacuum extraction system at a former oil distribution terminal in Malden, Massachusetts.
- Project Manager for the investigation, design and implementation of a ground-water pump and treat/vacuum extraction system at an operating retail gasoline station in Kreamer, Pennsylvania.
- Project Manager for the design and implementation of a vacuum extraction system at a former retail station in Athol, Massachusetts. Responsibilities also included preparation of an RI/FS.
- Technical Manager for the preliminary design of soil venting and ground-water remediation systems in Maryland, Pennsylvania, New York, Tennessee, New Jersey, Massachusetts, and Virginia.
- Project Coordinator for a full ECRA submission, including a proposed sampling plan at a refractory production facility in Sayreville, New Jersey.
- Project Coordinator for an environmental site assessment at an automotive fasteners facility located in Mountainside, New Jersey.
- Project Coordinator for an environmental site assessment at an abandoned heavy equipment distribution facility in Plainfield, New Jersey.
- Primary investigator at a hazardous waste facility in Bridgeton, New Jersey. Responsibilities included delineation of contaminant source and type, data interpretation, and report preparation.
- Field Manager for the removal of numerous USTs at a pigment manufacturing facility in Easton, Pennsylvania.
- Project Coordinator for environmental investigations at five retail stations throughout New York. Responsibilities include proposal preparation, data reduction, and interpretation, and recommendations for future remediation activities.
- Participated in numerous site investigations, soil gas surveys, monitoring well installations, UST removals, well sampling plans, and report preparations.

Scott Anderson
Project Geologist

Technical Specialties:

Environmental site assessments, hydrogeologic investigations, and remedial investigations.

Experience Summary:

4 years experience as Staff Geologist and Project Geologist at Roux Associates.

Credentials:

B.A. Geology, University of Delaware, 1989
New Jersey Certified Subsurface Evaluator and Closure No. 0001663
Registered Geologist; No. TN 1896, State of Tennessee
OSHA 40-hour Health and Safety, 1990

Key Projects:

- Coordinated and implemented a RCRA RFI workplan for manufacturing facility in South Carolina. Investigations included monitoring well installation, soil borings, exploratory trenching, soil sampling, surface-water sampling, and ground-water sampling.
- Coordinated ongoing RCRA corrective action program with extraction well system and quarterly RCRA ground-water monitoring. Prepared quarterly corrective action reports.
- Conducted ground-water modeling of zones of capture to optimize ground-water extraction system performance.
- Conducted operation oversight and prepared final report for remedial activities at an ECRA cleanup of a former metal machining plant in New Jersey.
- Assisted in preparation of an ECRA final report describing cleanup activities at a former plastics manufacturing facility in Kenilworth, New Jersey.
- Assisted in preparation of an EPA work plan for a former plastics manufacturing facility in Pennsylvania, regulated under CERCLA.
- Provided field support and operations oversight of ECRA regulated remediation activities at three petroleum distribution terminals in New Jersey.
- Prepared and provided on-site monitoring and sampling for several underground storage tank (UST) closure plans and closure reports.
- Designed and implemented aquifer and slug tests, including an aquifer test for the installation of a 1 million gallon per day municipal supply well.
- Performed soil-gas surveys to delineate potential environmental impact at several locations in New Jersey and South Carolina.
- Prepared and submitted computerized discharge monitoring reports part of NJDEPE compliance programs.
- Provided field support for a site assessment performed at an operating explosives manufacturing facility in New Jersey.
- Conducted oversight of installation, startup, and maintenance of a soil-venting system for an operating retail gasoline station in New Jersey.
- Provided compliance monitoring and assessment support of petroleum hydrocarbon impacted soils and ground water at a network of retail gasoline stations.

Leslie S. Bucina
Laboratory Manager

EDUCATION

B.S., WV Wesleyan College, 1981, Chemistry

Continuing Education:

Varian Basic Chromatography Course
Finnigan Incos 50 Operators Course
Finnigan Spectral Interpretation Course (GC/MS)
Finnigan Formaster Course (GC/MS)
Advanced Environmental Spectral Interpretation Course

EXPERIENCE

Ms. Bucina's responsibilities include supervision of the GC, GC/MS and the extraction groups. She reviews each case on an individual basis as a final quality check. Ms. Bucina has previously held positions as the GC/MS Group Leader, and as a GC/MS operator at KEMRON. She has over eleven years of analytical experience with an emphasis in quality control. Her industrial background includes experience in the medical device, pesticide, and paints and coatings industries. Instrumentation experience includes GC, UV, IR, HPLC, and GC/MS.

SELECTED PROJECT EXPERIENCE

- **GC/MS Group Leader:** Adiptic Acid. Performed method build for adiptic acid analysis.
- **GC/MS Group Leader:** Styrene. Helped run and performed data reduction and interpretation with a twenty-four hour turnaround time.
- **GC/MS Group Leader:** Ohio Bridge project. Performed sample and data work-up.
- **Organic Manager:** Union Carbide Corporation's Texas City project.
- **Organic Manager:** Performed polyaromatic hydrocarbon part per trillion study.

AFFILIATIONS

American Chemical Society

October 1992

APPENDIX D

APPENDIX D

COMMUNITY RELATIONS FACT SHEET

COMMUNITY RELATIONS FACT SHEET
RCRA Facility Investigation Work Plan
Monsanto Company
Nitro, West Virginia

Monsanto Chemical Company (Monsanto) is conducting an environmental investigation as required by a Resource Conservation and Recovery Act (RCRA) Corrective Action and Waste Minimization Permit (WVD 033990965) issued by the United States Environmental Protection Agency (USEPA) on November 2, 1990. A RCRA Facility Investigation Work Plan (RFI) has been prepared to investigate site-wide soils, sediments, surface water, and ground water at the facility located on the east bank of the Kanawha River, one-half mile north of the city of Nitro, West Virginia. The purpose of the investigation is to characterize hazardous constituents potentially present in soils and ground-water at the facility and to evaluate whether corrective measures are necessary.

The Nitro facility comprises approximately 110 acres and is divided into two sections; the northern area containing the waste-water treatment facilities and the southern area containing the office and process areas. Soil, sediment, surface water and ground-water samples will be collected to meet the requirements of the permit. Additional ground-water observation wells will be installed and sampled accordingly for the type of compounds previously used at the facility. Aquifer testing will be performed to confirm aquifer characteristics.

The sampling will be conducted in accordance with the RFI Work Plan approved by the USEPA. Questions regarding the planned investigation should be directed to the following contact person:

Ms. Christine Weber
Environmental Superintendent
Monsanto Chemical Company
No. 1 Monsanto Road
Nitro, West Virginia 25143
(304) 759-4334

The results of the investigation will be summarized in a report submitted to the USEPA. The information will be used to formulate additional sampling activities and/or remedial actions as appropriate.

APPENDIX E

APPENDIX E

LABORATORY QUALITY ASSURANCE PROJECT PLAN

QUALITY ASSURANCE PLAN
- LABORATORY -

Revision 4

Prepared by

KEMRON Environmental Services, Inc.
109 Starlite Park
Marietta, Ohio 45750

Issue Date
01 December 1992

KEMRON Environmental Services

COMPREHENSIVE QUALITY ASSURANCE PLAN

Prepared by:

KEMRON Environmental Services, INC.
109 Starlite Park
Marietta, Ohio 45750

Issue Date: 01 December 1992
Revision 4

David E. Vandenberg 12/15/92

David E. Vandenberg, Vice President, Midwest Region — Date

David L. Bumgarner 12/15/92

David L. Bumgarner, Director of Analytical Services — Date

David R. Sands 12/15/92

David R. Sands, Hazardous Waste & Site Investigations Manager — Date

Daniel A. Musgrave 12/15/92

Daniel A. Musgrave, QA/QC Coordinator — Date

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3.0 STATEMENT OF POLICY

KEMRON's commitment to providing quality services to our clients is embodied in KEMRON's corporate policy on quality assurance. Every level of management, the laboratory staff, and project scientists are committed to the quality assurance (QA) program described in this QA Plan.

Our goals are to (1) protect our clients' interests by providing them with fully documented, legally defensible data useable for sound environmental decisions; (2) shelter our company's two most important resources, our people and our reputation, by maintaining an environment that fosters excellence and; (3) guard against and correct performance shortcomings which could erode data or technical quality.

All of our work will be performed in an absolutely professional manner, and all data will be scientifically valid, of known precision and accuracy, and of a level of quality control (QC) to support the objectives of each environmental project.

This Comprehensive Quality Assurance Plan addresses the 16 basic elements recommended in EPA's "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plan" (QAMS-005/80). The QA Plan addresses each of the elements listed on page 1 of Section 2.0, and provides sound operating procedures for sampling, sample custody, laboratory analysis, data reduction and validation, methods for assessing precision and accuracy, and corrective action.

This program will be revised as needed to address special client or project requirements and to keep pace with developing technologies, good laboratory practices and quality management.

4.0 ORGANIZATION AND RESPONSIBILITY

KEMRON Environmental Services, Inc. has its corporate headquarters in McLean, Virginia. The corporate organizational chart for KEMRON Environmental Services, Inc. is given in Figure 4.1. KEMRON's laboratory in Marietta, Ohio (Ohio Valley Laboratory) is a full service environmental laboratory facility for analysis of groundwater, municipal and industrial waste water, soil and solid waste. Kemron also has industrial hygiene labs in Novi, Michigan and Huntington, New York. The Ohio Valley Laboratory's organizational chart is presented in Figure 4.2 along with a laboratory floor plan provided in Figure 4.3. KEMRON's Analytical Statement of Qualifications provides the qualifications and experience summaries for key professionals within KEMRON. The duties and responsibilities of all key positions at the Ohio Valley facilities are provided below.

Regional Vice President - The Vice President of the midwest region reports to the Executive Vice President and is responsible for the multiple operations in Cincinnati and Marietta, Ohio, and Novi, Michigan. The main areas of responsibility are strategic planning, business development, resource allocation, and profit and loss for the region as a whole. It is the Regional Vice President's responsibility to obtain and develop both financial and personnel resources in an effort to maintain quality services and to match resources with the market demands.

Laboratory Director - The Laboratory Director reports to the Regional Vice President and has overall responsibility for laboratory operations. Primary responsibilities include business development, production management, and quality control of all analytical services. Other responsibilities include management of all laboratory departments including the organic section (IR, GC, GC/MS), the inorganic section (wet chemistry, waste characterization, AA, and ICP) and the support services section, which includes sample management, account management and customer service. Other duties include special project management, oversight of the laboratory safety and waste management programs, and directing the activities of the Systems Administrator in charge of the local area network (LAN) and the Laboratory Information Management System (LIMS).

Quality Assurance Quality Control (QA/QC) Coordinator - The QA/QC Coordinator reports to the Regional Vice President and is independent of production responsibilities. The responsibilities of the QA/QC Coordinator include monitoring the day-to-day quality of all data produced by the laboratory, ensure and document the reliability of this data and to stop production of any data of suspect quality. Other duties include maintaining and reviewing all quality control data, auditing in

process QC functions to ensure compliance with the laboratory protocols, reviewing record keeping and ancillary documents, overseeing standard preparation for all sections of the laboratory, preparation and introduction of double blind samples, and maintaining updated SOP's.

Organic Laboratory Manager - The Organic Laboratory Manager reports to the Laboratory Director and is responsible for the daily operations of these laboratories: sample preparation (extraction), gas chromatography (GC), GC/MS, and TCLP. General responsibilities include departmental coordination, staff recruitment and development, scheduling and production, overall data review and validation, and review and approval of laboratory reports. Other duties include development and implementation of departmental SOPs and general programs for quality assurance/quality control, employee training, and safety and health.

Metals Laboratory Supervisor - The Metals Supervisor reports to the Laboratory Director. This person coordinates the production and quality control of all work involving preparation and analysis of samples by AA and ICP methodologies in accordance with company policies and Standard Operating Procedures (SOP). General duties include implementation of laboratory safety program in the metals department, implementation of the laboratory quality control program for metals analyzed in accordance with company SOPs and prudent laboratory practices, scheduling production of routine and non-routine work, supervising all technicians/analysts involved in sample preparation, standard preparation, and instrumental analyses. Other duties include the scheduling of routine maintenance and emergency service for departmental instrumentation, preparing daily work schedules for full and part-time employees, monitoring departmental backlogs, turnaround time, and priority analysis deadlines and reviewing and approving data generated by the metals department. The metals supervisor also maintains inventory and orders supplies for the department, coordinates the development of all new methods of analyses, evaluates staff and makes recommendations for staffing levels, assists in the training of technicians and analysts, and reviews the Quality Assurance Daily Report for the department.

Wet Chemistry Supervisor - The Wet Chemistry Supervisor reports to the Laboratory Director. This person coordinates the production and quality control of all work involving preparation and analysis of samples by conventional methodologies in accordance with company policies and Standard Operating Procedures (SOP). General duties include implementation of laboratory safety program in the Wet Chemistry department, implementation of the laboratory quality control program for conventional analysis in accordance with company SOPs and prudent laboratory practices, scheduling production of routine and non-routine work, supervising all

technicians/analysts involved in sample preparation, standard preparation, and instrumental analyses. Other duties include the scheduling of routine maintenance and emergency service for departmental instrumentation, preparing daily work schedules for full and part-time employees, monitoring departmental backlogs, turnaround time, and priority analysis deadlines and reviewing and approving data generated by the wet chemistry department. The wet chemistry supervisor also maintains inventory and orders supplies for the department, coordinates the development of all new methods of analyses, evaluates staff and makes recommendations for staffing levels, assists in the training of technicians and analysts, and reviews the Quality Assurance Daily Report for the department.

Gas Chromatography (GC) Group Leader - The GC Group Leader reports to the Organic Laboratory Manager. This person coordinates the production and quality control of all work involving preparation and analysis of samples by GC/ECD, GC/FID, GC/PID and GC/ELCD methodologies in accordance with company policies and Standard Operating Procedures (SOP). Specific duties include, but are not limited to, implementation of laboratory safety program in the GC department, implementation of the laboratory quality control program for volatile and semivolatile organics analyzed in accordance with company SOPs, scheduling production of routine and non-routine work, supervising all technicians/analysts, instrumental analyses, scheduling routine maintenance and emergency service for departmental instrumentation, preparing daily work schedules for employees, monitoring departmental backlogs, turnaround time, and priority analysis deadlines and reviewing and approving data generated by the GC department. The GC Supervisor also coordinates the development of all new analytical methods, evaluates staff and makes recommendations for staffing levels, specific duties, additional training, or disciplinary actions, assists in the training of technicians and analysts, prepares, generates, and reviews, the QA Daily Report for the GC department.

Gas Chromatography/Mass Spectrometry (GC/MS) Group Leader - The GC/MS Group Leader reports to the Organic Laboratory Manager. .This person coordinates the production and quality control of all work involving preparation and analysis of samples by volatile GC/MS and semivolatile GC/MS methodologies in accordance with company policies and Standard Operating Procedures (SOP). General duties include implementation of laboratory safety program in the GC/MS department, implementation of the laboratory quality control program for volatile and semivolatile organics analyzed in accordance with company SOPs and prudent laboratory practices. Other duties include scheduling production of routine and non-routine work, supervising technicians/analysts involved in standard preparation and instrumental analyses, scheduling routine maintenance and emergency service for

departmental instrumentation, preparing daily work schedules of full and part-time employees, monitoring departmental backlogs, turnaround time, and priority analysis deadlines and reviewing and approving data generated by the GC/MS department.

Extraction (EX) Group Leader - The Extraction Group Leader reports directly to the Organic Laboratory Manager. This Supervisor has the responsibility of supervising all organic extraction laboratory technicians. It is his responsibility to ensure that all samples for organics analysis are prepared in accordance with the appropriate USEPA methodology, that appropriate QC samples are prepared and that all samples are prepared within the appropriate regulatory holding times. Other responsibilities include preparation of samples for extractable organic analysis, methods development for unusual matrices, preparation of standards, sample cleanup as required, TCLP extraction procedures, ordering of supplies and standards for extraction laboratory, and maintenance of extraction lab documentation.

Computer Systems Administrator - The Systems Administrator reports to the Laboratory Director and is responsible for the local area network (LAN) hardware and software. General responsibilities include maintenance of the hardware for the network, programming and maintenance of the laboratory information management system (LIMS) (Radian SAM), and other office/laboratory software applications. Specific duties include application programming, troubleshooting, hardware repair, employee training, and internal consultation for systems problems and special projects. Special projects include programs for delivery of laboratory data in client specified data format on diskette, and special programs to improve the efficiency and productivity of the network and LIMS.

Support Services Supervisor - The Support Services Supervisor reports to the Laboratory Director and is primarily responsible for the non-analytical operations of the laboratory. General duties include supervision of sample container and sample kit preparation, sample logging, sample custody, sample disposal, the KEMRON courier services, and the customer service staff. Other responsibilities include supervision of the shipping/receiving staff and coordination of the laboratory waste management system.

Site Investigation and Hazardous Waste Manager - Reports to the Vice President and is responsible for personnel supervision, and project management with respect to all Hazardous Waste Management Programs, Site Investigation, Site Remediation, Underground Storage Tank Programs, Environmental Property Assessments, and all soil and water sampling programs. Other responsibilities include business

development, proposal writing, technical QA/QC responsibilities for site investigation, hazardous waste and field services, group profit and loss status and facilities management issues.

Project Manager - The project manager is responsible for overall supervision of the project, directing development of the Quality Assurance Project Plans (QAPP), and insuring full compliance with the QAPP. He maintains final authority for all activities conducted in connection with each project. Project Managers report directly to the SI/HW Manager.

Staff - The staff personnel consists of a site manager, sampling technicians and environmental scientists who will normally perform field sampling activities. These personnel are thoroughly trained in all sampling procedures and protocols as described in the CompQAP and QAPP. The site manager may either be the project manager or a designated assistant who is experienced in all aspects of environmental sampling guidelines. The site manager is responsible for the on-site activities of sampling technicians and field scientists in the performance of well installation and sampling operations. As a site manager, he is responsible for insuring all QAPP procedures, from QAPP procedures to the project manager of Quality Assurance Officer.

Figure 4-1
KEMRON Environmental Services
Corporate Organizational Chart
01 December 1992

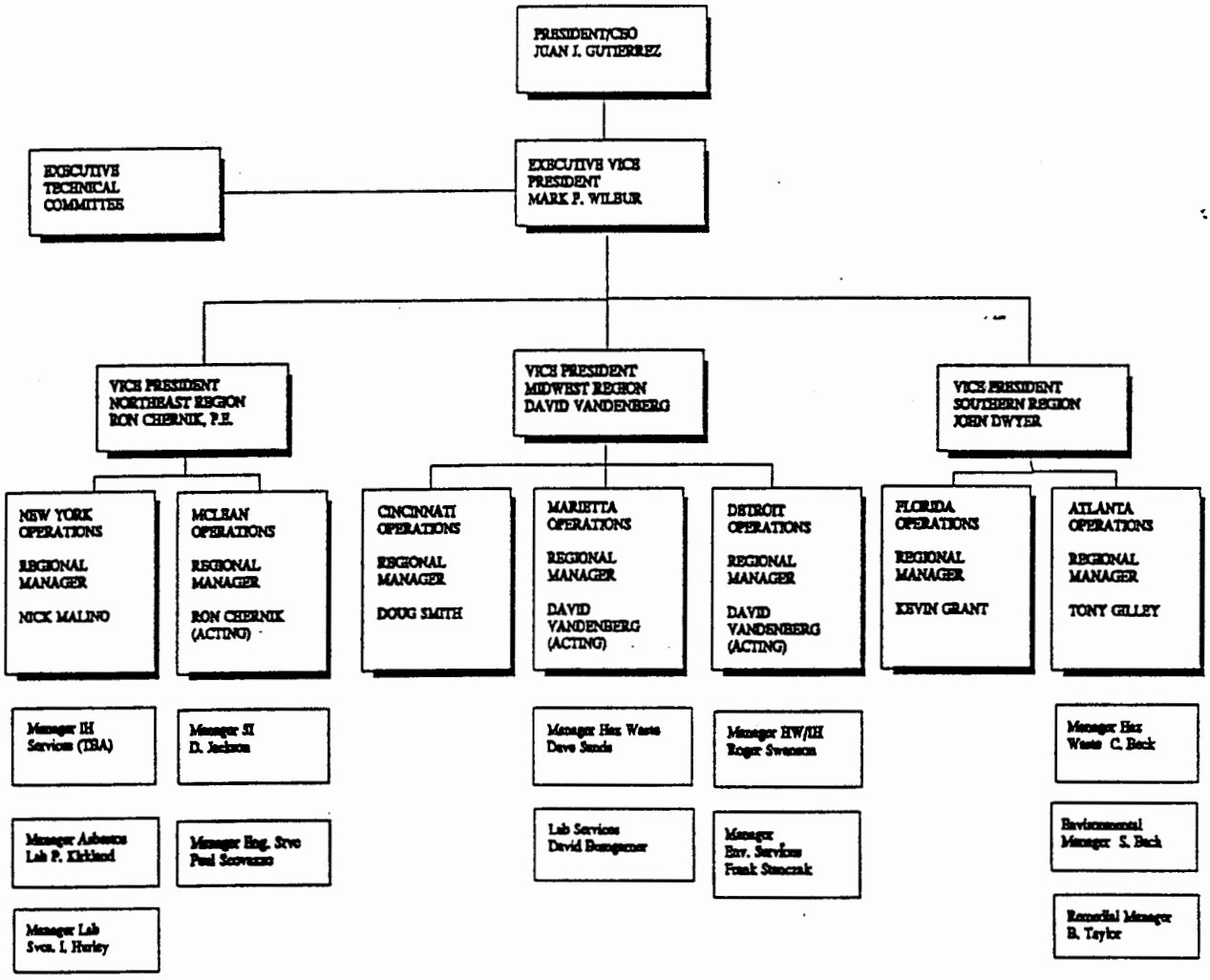


Figure 4-2
KEMRON Environmental Services
Ohio Valley Office Organizational Chart
01 December 1992

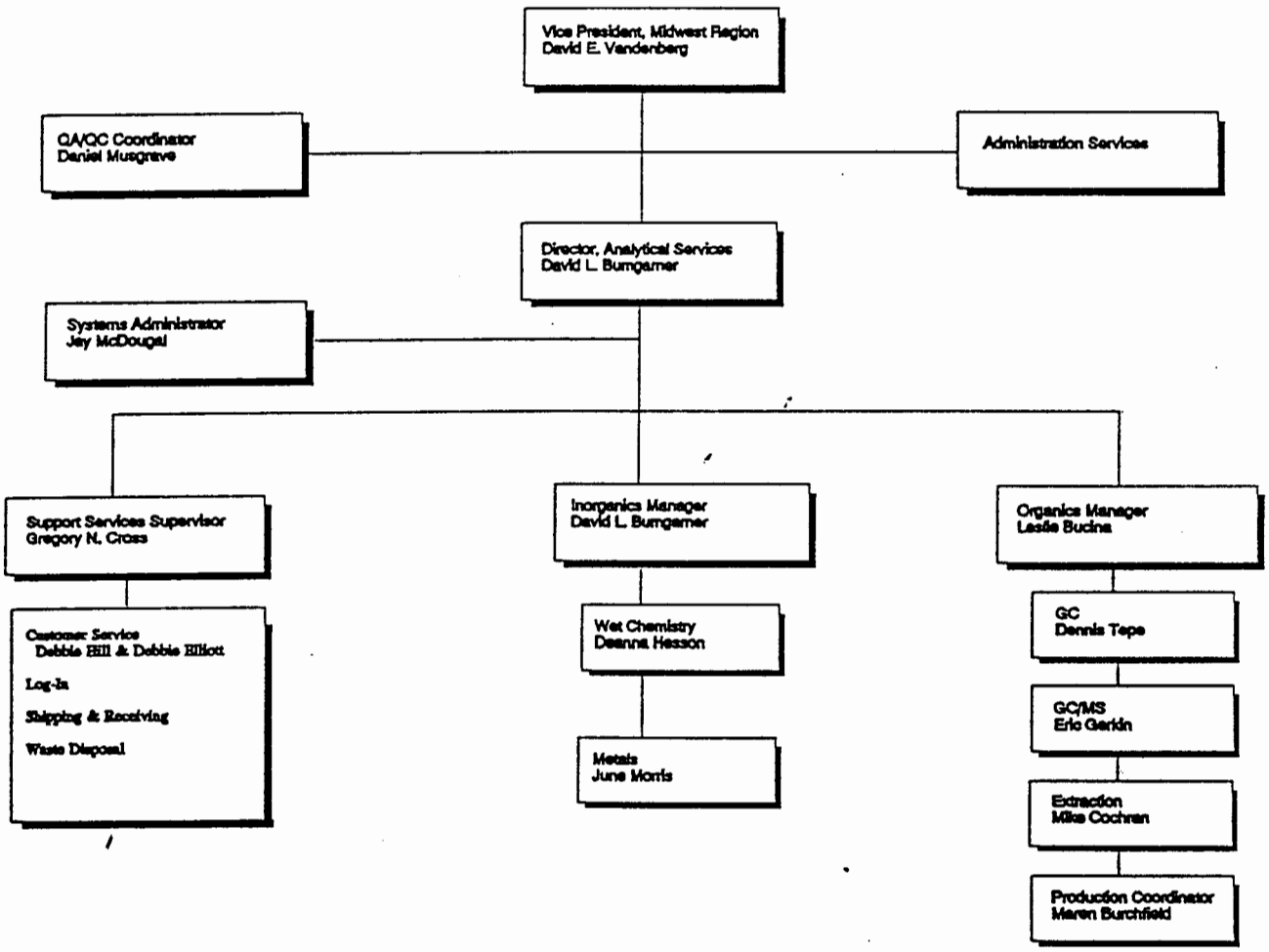
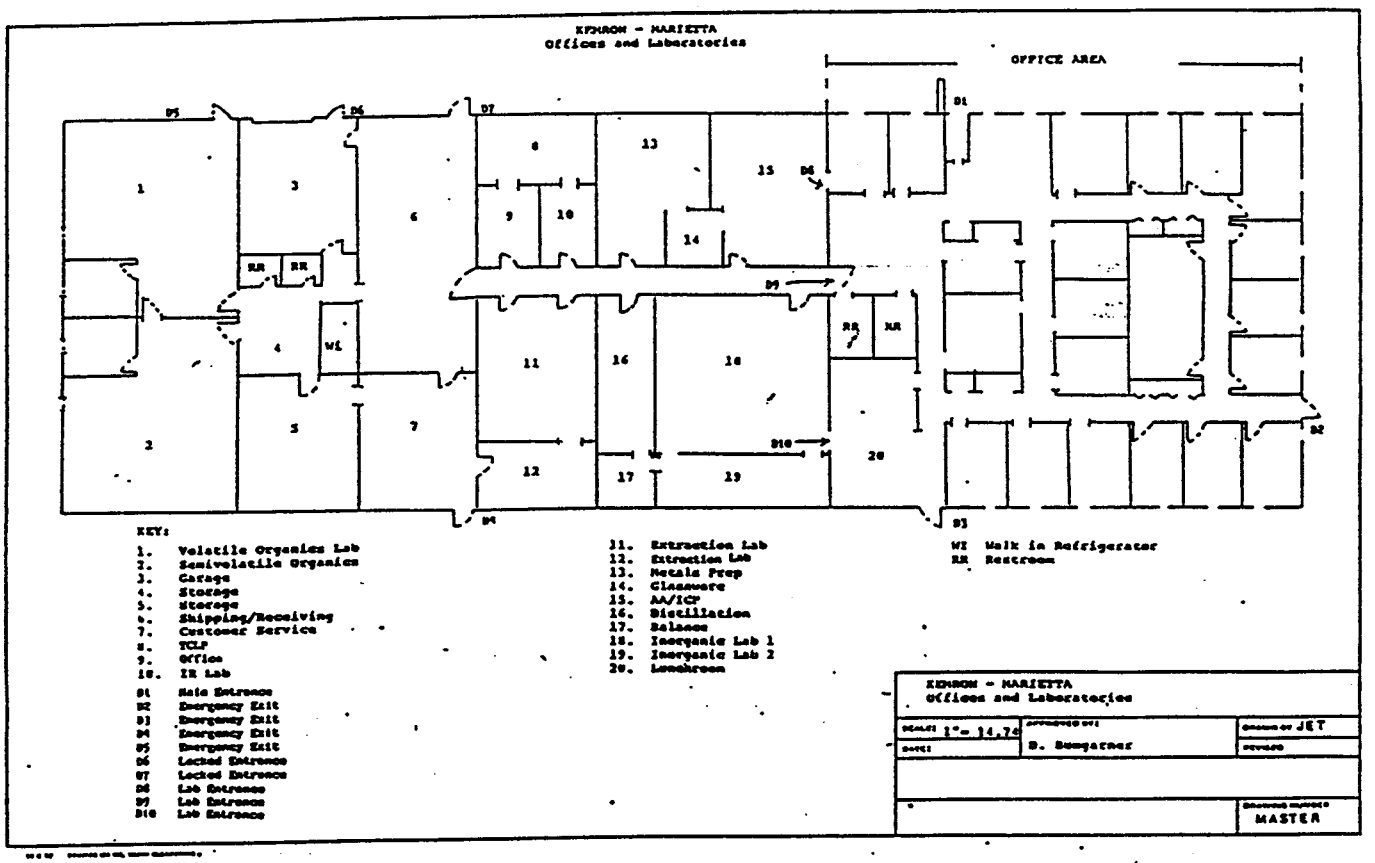


Figure 4-3
KEMRON Environmental Services
Ohio Valley Laboratory Floor Plan
01 December 1992



5.0 QUALITY ASSURANCE TARGETS FOR PRECISION, ACCURACY AND METHOD DETECTION LIMITS

KEMRON Environmental Services, in order to assure the highest level of quality and accuracy, has spent much time and effort in developing a comprehensive quality assurance program with the following QA objectives:

Precision (%RPD) - to equal or exceed the precision data generated by the applicable method validation studies on similar matrices; relative percent difference (% RPD) as derived from duplicate matrix spike results will be used to evaluate precision.

Accuracy (% recovery) - to equal or exceed the accuracy data generated by the applicable method validation studies on similar matrices; percent recovery (% R) as derived from the analysis of standard QC spikes will be used to evaluate accuracy. The standard QC spike is one or more of the compounds within the target parameter list for each method, with a concentration that falls around the midrange for the method or instrument detection limits.

Representativeness - to ensure that a set of data accurately depicts the distinguishing characteristics of the sample source; this is usually achieved through sample collection in accordance with statistically defined bounds of the population mean and variance, and by following existing sampling protocols.

Comparability - to achieve a performance level in terms of accuracy and precision for sample parameters in similar matrices, so that one set of data is comparable to another in terms of quality of measurement on a consistent basis. This assures that all KEMRON analyses fall within an acceptable range.

Method Detection Limit (MDL) - refers to the minimum amount detectable by the method of choice. This is determined statistically by 40 CFR part 136, Appendix B or SW-846, Chapter 1.

Practical Quantitation Limit (PQL) - refers to the practical limit at which any one parameter can be identified using a given method. The PQL is normally defined as 5 times the MDL and varies by sample matrix. (i.e. groundwater, waste water, soil, hazardous waste).

Completeness - refers to the percentage of measurements made which are judged to be valid. The completeness goal is the same for all data uses: that we achieve 95% completeness on our first analysis. Subsequently our goal is to achieve 100% completeness by resampling or doing additional analysis.

Tables 5-1 to 5-21 on the following pages provide a list of most of the parameters (inorganic and organic) analyzed by KEMRON. Each table provides the method used for sample preparation as well as the method used for analysis if there are two separate methods. These tables also provide the measures of accuracy and precision for each, along with the Practical Quantitation Limits (PQL) of each of the parameters listed. Table 5-1 is for field parameters. Tables 5-2 to 5-21 are all laboratory procedures.

The origin of the QA target data is at present a conservative estimate of what should be obtainable for the methods and instrumentation utilized. Guidelines were borrowed from EPA CLP requirements for surrogate, spike and duplicate analysis in developing these targets.

The PQL's reported are mostly taken from SW-846, third edition and are defined as approximately equal to five times the method detection limit (MDL). These PQL values were verified by KEMRON by determining the MDL according to the procedure obtained in 40 CFR, Part 136 Appendix B or SW 846, Chapter 1.

Conventions used in the preparation of the following 20 tables:

EPA = refers to methods found in any Environmental Protection Agency-approved source
SM = refers to methods found in Standard Methods
ASTM = refers to methods found in American Society for Testing and Materials
MDL = Method Detection Limit
PQL = Practical Quantitation Limit
MOD = Modified method
NA = not applicable
nd = not determined
D = detected; result must be greater than zero
ID = insufficient data

TABLE 5-1
KEMRON'S QA OBJECTIVES AND ANALYTICAL METHODS FOR FIELD ANALYSES

PARAMETER	EPA METHOD	% RECOVERY (ACCURACY)	% RPD (PRECISION)	METHOD DETECTION LIMIT (ug/L)	UNITS
pH	150.1	N/A	N/A	N/A	su
Temperature	170.1	N/A	N/A	N/A	°C
Specific Conductance	120.1	90-110	0-10	1	umho/cm@25

TABLE 5-2
KEMRON'S QA OBJECTIVES AND ANALYTICAL METHODS FOR CONVENTIONAL INORGANIC ANALYSES OF MUNICIPAL AND INDUSTRIAL WASTE WATER

PARAMETER	EPA METHOD	% RECOVERY (ACCURACY)	% RPD (PRECISION)	METHOD DETECTION LIMIT (mg/L)
Acidity	305.1	75-125	0-30	10
Alkalinity	310.2	75-125	0-13	10
Biochemical Oxygen Demand (BOD)	405.1	75-125	0-40	3
Boron	SM4500-B	75-125	0-30	0.1
Bromide	320.1	75-125	0-30	5
Chloride	325.2	90-110	0-23	2
Chemical Oxygen Demand (COD)	HACH*	80-120	0-30	5
Chromium, hexavalent (Cr^{+6})	SM3500CR-D	80-110	0-20	0.01
Coliform, Fecal	SM9222D	NA	NA	<1
Coliform, Total	SM9222B	NA	NA	<1
Color, Colorimetric Platinum-Cobalt	110.2	90-110	0-30	5
Cyanide, Amenable to Chlorination	335.1	ND	ND	0.01
Cyanide, Total	335.2	80-120	0-10	0.01
Fluoride, Potentionmetric Ion Selective	340.2	90-120	0-17	0.1
Hardness, Titrimetric (EDTA)	130.2	90-110	0-30	5
Nitrogen, Ammonia	350.1	75-120	0-40	0.1
Nitrogen, Total Kjeldahl (TKN)	351.2	75-110	0-15	0.1
Nitrate-Nitrite (as N)	353.2	75-120	0-20	0.05
Nitrite (as N)	354.1	75-120	0-20	0.01
Oil & Grease	413.1	80-120	0-10	1
Orthophosphate	365.2	70-120	0-15	0.05
pH	150.1	ND	ND	<1 > 13su
Phenol	420.1	90-110	0-15	0.005
Phosphorus, Total	365.4	75-125	0-25	0.1
Residue, Total	160.3	90-110	0-40	10
Residue, Dissolved (Filterable)	160.1	90-110	0-15	10
Residue, Suspended (Non-Filterable)	160.2	75-125	0-30	5
Residue, Total Volatile	160.4	NA	0-30	10
Specific Conductance	120.1	90-110	0-06	1uS/cm
Sulfate, Turbidimetric	375.4	75-125	0-15	2
Sulfide, Titrimetric (Iodine)	376.1	80-120	0-10	1
Sulfide, Colorimetric (Methylene Blue)	376.2	75-125	0-40	1
Silica, Dissolved (Colorimetric)	370.1	75-125	0-30	2
Surfactants, Methylene Blue Active (MBAS)	425.1	80-120	0-10	0.1
Total Recoverable Petroleum Hydrocarbons	418.1	80-110	0-30	1
Turbidity, Nephelometric	180.1	ND	0-40	0.1 NTU
Total Organic Carbon (TOC)	415.1	75-120	0-30	1
Total Organic Halogen (TOX)	SW 846 9020	75-125	0-35	0.02

* 40 CFR Part 136.3 Table 1B - Chemical Oxygen Demand, Method 8000, Hach Handbook of Water Analysis, 1979.

TABLE 5-3
KEMRON'S QA OBJECTIVES AND ANALYTICAL METHODS FOR
INORGANIC METALS ANALYSES OF
MUNICIPAL AND INDUSTRIAL WASTE WATER

PARAMETER	CAS #	EPA METHOD	% RECOVERY* (ACCURACY)	% RPD* (PRECISION)	METHOD DETECTION LIMIT (mg/L)
Aluminum (Al) - ICP	7429-90-5	200.7	87-127	0-20	100
- AA FLAME		202.1	75-125	0-20	100
Antimony (Sb) - ICP	7440-36-0	200.7	75-125	0-20	200
- AA FURNACE		204.2	75-126	0-17	20
Arsenic (As)- AA FURNACE		206.2	75-125	0-20	4
- AA HYDRIDE		206.3	85-115	0-19	4
Barium (Ba) - ICP	7440-39-3	200.7	86-120	0-14	10
- AA FLAME		208.1	75-125	0-20	200
- AA FURNACE		208.2	75-125	0-20	10
Beryllium(Be) - ICP	7440-41-7	200.7	90-117	0-10	10
- AA FLAME		210.1	75-125	0-20	10
- AA FURNACE		210.2	75-125	0-20	1
Boron (B) - ICP	7440-42-8	200.7	75-125	0-20	30
Cadmium (Cd) - ICP	7440-43-9	200.7	86-117	0-23	10
- AA FLAME		213.1	75-125	0-20	10
- AA FURNACE		213.2	81-119	0-22	0.5
Calcium (Ca) - ICP	7440-70-2	200.7	78-120	0-14	200
- AA FLAME		215.1	75-125	0-20	100
Chromium (Cr) - ICP	7440-47-3	200.7	83-118	0-14	20
- AA FLAME		218.1	75-125	0-20	50
- AA FURNACE		218.2	73-122	0-21	5
Cobalt (Co) - ICP	7440-48-4	200.7	77-121	0-11	20
- AA FLAME		219.1	75-125	0-20	50
Copper (Cu) - ICP	7440-50-8	200.7	74-120	0-13	20
- AA FLAME		220.1	75-125	0-20	20
- AA FURNACE		220.2	75-121	0-19	5
Iron (Fe) - ICP	7439-89-6	200.7	90-119	0-16	40
- AA FLAME		236.1	75-125	0-20	30
Lead (Pb) - ICP	7439-92-1	200.7	83-113	0-16	100
- AA FLAME		239.1	75-125	0-20	250
- AA FURNACE		239.2	76-115	0-17	5
Magnesium (Mg) - ICP	7439-95-4	200.7	76-115	0-12	500
- AA FLAME		242.1	75-125	0-20	10
Manganese (Mn) - ICP	7439-96-5	200.7	90-116	0-18	10
- AA FLAME		243.1	75-125	0-20	10

TABLE 5-3 (cont'd)
KEMRON'S QA OBJECTIVES AND ANALYTICAL METHODS FOR
INORGANIC METALS ANALYSES OF
MUNICIPAL AND INDUSTRIAL WASTE WATER

PARAMETER	CAS #	EPA METHOD	% RECOVERY* (ACCURACY)	% RPD* (PRECISION)	METHOD DETECTION LIMIT (ug/L)
Mercury (Hg) - VAPOR	7439-97-6	245.1	88-112	0-15	0.2
- VAPOR		245.2	75-125	0-20	0.2
Molybdenum (Mo) - ICP	7439-98-7	200.7	75-125	0-20	100
- AA FURNACE		246.2	88-110	0-10	5
Nickel (Ni) - ICP	7440-02-0	200.7	75-125	0-20	40
- AA FLAME		249.1	75-125	0-20	40
- AA FURNACE		249.2	87-111	0-20	5
Potassium (K) - ICP	7440-09-7	200.7	87-111	0-15	1000
- AA FLAME		258.1	76-126	0-21	500
Selenium (Se) - ICP	7782-49-2	200.7	75-125	0-20	400
- AA FURNACE		270.2	75-125	0-20	4
- AA HYRIDE		270.3	82-118	0-10	4
Silicon (Si) - ICP	7440-21-3	200.7	75-125	0-20	1000
Silver (Ag) - ICP	7440-22-4	200.7	83-125	0-13	10
- AA FLAME		272.1	75-125	0-20	10
- AA FURNACE		272.2	75-125	0-20	4
Sodium (Na) - ICP	7440-23-5	200.7	73-131	0-20	500
- AA FLAME		273.1	75-125	0-20	500
Thallium (Tl) - ICP	7440-28-0	200.7	75-125	0-20	1000
- AA FURNACE		279.2	80-122	0-16	5
Tin (Sn) - AA FLAME	7440-31-5	282.1	75-125	0-20	1000
- AA FURNACE		282.2	81-106	0-22	20
Titanium (Ti) - ICP	7440-32-6	200.7	83-115	0-13	30
- AA FURNACE		283.2	75-125	0-20	50
Vanadium (V) - ICP	7440-62-2	200.7	76-125	0-11	10
- AA FURNACE		286.2	75-125	0-20	10
Zinc (Zn) - ICP	7440-66-6	200.7	83-115	0-13	10
- AA FLAME		289.1	75-125	0-20	10

Where statistics are unavailable, targets default to CLP guidelines (75 - 125% and 0 - 20%) for matrix spike data.

TABLE 5-4
KEMRON'S QA OBJECTIVES AND ANALYTICAL METHODS FOR PURGEABLE HALOCARBONS ORGANIC ANALYSES OF MUNICIPAL AND INDUSTRIAL WASTE WATER

PARAMETER	CAS #	EPA CFR METHOD	% RECOVERY (ACCURACY)	% RPD (PRECISION)	METHOD DETECTION LIMIT (ug/L)
Bromodichloromethane	75-27-4	601	42-172	0-40	0.5
Bromoform	75-25-2	601	13-159	0-40	0.5
Bromomethane	74-83-9	601	D-144	0-40	1.0
Carbon tetrachloride	56-23-5	601	43-143	0-40	0.5
Chlorobenzene	108-90-7	601	38-150	0-40	0.5
Chloroethane	75-00-3	601	46-137	0-40	1.0
2-Chloroethyl vinyl ether	110-75-8	601	14-186	0-40	1.0
Chloroform	67-66-3	601	49-133	0-40	0.5
Chloromethane	74-87-3	601	D-193	0-40	1.0
Dibromochloromethane	124-48-1	601	24-191	0-40	0.5
1,2-Dichlorobenzene	95-50-1	601	D-208	0-40	1.0
1,3-Dichlorobenzene	541-73-1	601	7-187	0-40	1.0
1,4-Dichlorobenzene	106-46-7	601	42-143	0-40	1.0
Dichlorodifluoromethane	75-71-8	601	45-140	0-40	1.0
1,1-Dichloroethane	75-34-3	601	47-132	0-40	0.5
1,2-Dichloroethane	107-06-2	601	51-147	0-40	0.5
1,1-Dichloroethene	75-35-4	601	28-167	0-40	0.5
trans-1,2-Dichloroethene	156-60-5	601	38-155	0-40	0.5
1,2-Dichloropropane	78-87-5	601	44-156	0-40	0.5
cis-1,3-Dichloropropene	10061-01-5	601	22-178	0-40	0.5
trans-1,3-Dichloropropene	10061-02-6	601	22-178	0-40	0.5
Methylene chloride	75-09-2	601	25-162	0-40	2.0
1,1,2,2-Tetrachloroethane	79-34-5	601	8-184	0-40	0.5
Tetrachloroethene	127-18-4	601	26-162	0-40	0.5
1,1,1-Trichloroethane	71-55-6	601	41-138	0-40	0.5
1,1,2-Trichloroethane	79-00-5	601	39-136	0-40	0.5
Trichloroethene	79-01-6	601	35-146	0-40	0.5
Trichlorofluoromethane	75-69-4	601	21-156	0-40	0.5
Vinyl chloride	75-01-4	601	28-163	0-40	1.0

TABLE 5-5
KEMRON'S QA OBJECTIVES AND ANALYTICAL METHODS FOR PURGEABLE AROMATICS ORGANIC ANALYSES OF MUNICIPAL AND INDUSTRIAL WASTE WATER

PARAMETER	CAS #	EPA CFR METHOD	% RECOVERY (ACCURACY)	% RPD (PRECISION)	METHOD DETECTION LIMIT(ug/L)
Benzene	71-43-2	602	39-150	0-40	1.0
Chlorobenzene	108-90-7	602	55-135	0-40	1.0
1,2-Dichlorobenzene	95-50-1	602	37-154	0-40	1.0
1,3-Dichlorobenzene	541-73-1	602	50-141	0-40	1.0
1,4-Dichlorobenzene	106-46-7	602	42-143	0-40	1.0
Ethyl Benzene	100-41-4	602	32-160	0-40	1.0
Toluene	108-88-3	602	46-148	0-40	1.0

TABLE 5-6
KEMRON'S QA OBJECTIVES AND ANALYTICAL METHODS FOR ORGANOCHLORINE PESTICIDE AND PCB ORGANIC ANALYSES OF MUNICIPAL AND INDUSTRIAL WASTE WATER

PARAMETER	CAS #	EPA CFR METHOD	% RECOVERY (ACCURACY)	% RPD (PRECISION)	METHOD DETECTION LIMIT (ug/L)
Aldrin	309-00-2	608	26-143	0-38	0.05
alpha-BHC	319-84-6	608	51-145	0-43	0.05
beta-BHC	319-85-7	608	51-130	0-28	0.05
delta-BHC	319-86-8	608	56-138	0-78	0.05
gamma-BHC (Lindane)	58-89-9	608	54-134	0-20	0.05
Chlordane (technical)	57-74-9	608	45-119	0-40	1.0
4,4'-DDD	72-54-8	608	59-179	0-30	0.10
4,4'-DDE	72-55-9	608	64-152	0-23	0.10
4,4'-DDT	50-29-3	608	42-168	0-22	0.10
Dieldrin	60-57-1	608	23-171	0-20	0.10
Endosulfan I	959-98-8	608	37-123	0-22	0.05
Endosulfan II	33213-65-9	608	21-117	0-20	0.10
Endosulfan sulfate	1031-07-8	608	31-117	0-30	0.10
Endrin	72-20-8	608	56-154	0-28	0.10
Endrin aldehyde	7421-93-4	608	21-115	0-40	0.10
Heptachlor	76-44-8	608	40-139	0-37	0.05
Heptachlor epoxide	1024-57-3	608	51-135	0-20	0.05
Toxaphene	8001-35-2	608	41-126	0-40	1.0
PCB 1016	12674-11-2	608	50-114	0-40	0.50
PCB 1221	11104-28-2	608	15-178	0-40	0.50
PCB 1232	11141-16-5	608	10-215	0-40	0.50
PCB 1242	5369-21-9	608	39-150	0-40	0.50
PCB-1248	12672-29-6	608	38-158	0-40	0.50
PCB-1254	11097-69-1	608	29-131	0-40	1.0
PCB-1260	11096-82-5	608	8-127	0-40	1.0

TABLE 5-7
KEMRON'S QA OBJECTIVES AND ANALYTICAL METHODS FOR POLYNUCLEAR AROMATIC HYDROCARBON ORGANIC ANALYSES OF MUNICIPAL AND INDUSTRIAL WASTE WATER BY GC/FID

PARAMETER	CAS #	EPA CFR METHOD	% RECOVERY (ACCURACY)	% RPD (PRECISION)	METHOD DETECTION LIMIT (ug/L)
Acenaphthene	83-32-9	610	28-138	0-23	1.0
Acenaphthylene	208-96-8	610	22-142	0-22	1.0
Anthracene	120-12-7	610	51-134	0-20	1.0
Benzo(a)anthracene	56-55-3	610	42-147	0-20	5.0
Benzo(a)pyrene	50-32-8	610	41-153	0-45	5.0
Benzo(b)fluoranthene	205-99-2	610	36-176	0-30	5.0
Benzo(g,h,I)perylene	191-24-2	610	19-156	0-29	5.0
Benzo(k)fluoranthene	207-08-9	610	37-149	0-30	5.0
Chrysene	218-01-9	610	44-142	0-21	5.0
Dibenzo(a,h)anthracene	53-70-3	610	14-106	0-50	5.0
Fluoranthene	206-44-0	610	52-147	0-20	1.0
Fluorene	86-73-7	610	43-141	0-21	1.0
Indeno(1,2,3-cd)pyrene	193-39-5	610	16-166	0-64	5.0
Naphthalene	91-20-3	610	D-143	0-40	1.0
Phenanthrene	85-01-8	610	54-140	0-22	1.0
Pyrene	129-00-0	610	53-148	0-20	1.0

TABLE 5-8
KEMRON'S QA OBJECTIVES AND ANALYTICAL METHODS FOR
PURGEABLE ORGANIC ANALYSES OF
MUNICIPAL AND INDUSTRIAL WASTE WATER

PARAMETER	CAS #	EPA CFR METHOD	% RECOVERY (ACCURACY)	% RPD (PRECISION)	METHOD DETECTION LIMIT (ug/L)
Benzene	71-43-2	624	87-120	0-23	5.0
Bromodichloromethane	75-27-4	624	80-118	0-20	5.0
Bromoform	75-25-2	624	66-113	0-32	5.0
Bromomethane	74-83-9	624	62-115	0-22	10.0
Carbon tetrachloride	56-23-5	624	57-131	0-29	5.0
Chlorobenzene	108-90-7	624	85-119	0-14	5.0
Chloroethane	75-00-3	624	60-138	0-40	10.0
2-Chloroethylvinyl ether	110-75-8	624	D-305	0-40	10.0
Chloroform	67-66-3	624	82-124	0-22	5.0
Chloromethane	74-87-3	624	43-129	0-33	10.0
Dibromochloromethane	124-48-1	624	75-114	0-30	5.0
1,2-Dichlorobenzene	95-50-1	624	76-109	0-16	5.0
1,3-Dichlorobenzene	541-73-1	624	79-109	0-17	5.0
1,4-Dichlorobenzene	106-46-7	624	80-109	0-14	5.0
1,1-Dichloroethane	75-34-3	624	71-149	0-50	5.0
1,2-Dichloroethane	107-06-2	624	87-118	0-32	5.0
1,1-Dichloroethene	75-35-4	624	66-138	0-31	5.0
trans-1,2-Dichloroethene	156-60-5	624	77-127	0-31	5.0
1,2-Dichloropropane	78-87-5	624	76-134	0-40	5.0
cis-1,3-Dichloropropene	10061-01-5	624	80-146	0-40	5.0
trans-1,3-Dichloropropene	10061-02-6	624	48-106	0-40	5.0
Ethyl benzene	100-41-4	624	75-153	0-13	5.0
Methylene Chloride	75-09-2	624	72-160	0-33	5.0
1,1,2,2-Tetrachloroethane	79-34-5	624	78-124	0-17	5.0
Tetrachloroethene	127-18-4	624	87-121	0-57	5.0
Toluene	108-88-3	624	86-115	0-14	5.0
1,1,1-Trichloroethane	71-55-6	624	85-120	0-14	5.0
1,1,2-Trichloroethane	79-00-5	624	86-127	0-21	5.0
Trichloroethene	79-01-6	624	83-129	0-24	5.0
Trichlorofluoromethane	75-69-4	624	37-142	0-24	5.0
Vinyl chloride	75-01-4	624	47-128	0-18	10.0

TABLE 5-9
KEMRON'S QA OBJECTIVES AND ANALYTICAL METHODS FOR BASE/NEUTRALS AND ACID ORGANIC ANALYSES OF MUNICIPAL AND INDUSTRIAL WASTE WATER

PARAMETER	CAS #	EPA CFR METHOD	% RECOVERY (ACCURACY)	% RPD (PRECISION)	METHOD DETECTION LIMIT (ug/L)
Acenaphthene	83-32-9	625	43-117	0-25	10.0
Acenaphthylene	208-96-8	625	62-101	0-29	10.0
Anthracene	120-12-7	625	76-111	0-20	10.0
Benzidine	92-87-5	625	0-75	0-70	50.0
Benzo(a)anthracene	56-55-3	625	76-131	0-31	10.0
Benzo(b)fluoranthene	205-99-2	625	56-109	0-34	10.0
Benzo(k)fluoranthene	207-08-9	625	64-116	0-25	10.0
Benzo(a)pyrene	50-32-8	625	59-100	0-20	10.0
Benzo(g,h,I)perylene	191-24-2	625	49-111	0-69	10.0
Benzyl butyl phthalate	85-68-7	625	24-120	0-42	10.0
Bis(2-chloroethyl)ether	111-44-4	625	67-97	0-22	10.0
Bis(2-chloroethoxy)methane	111-91-1	625	57-104	0-29	10.0
Bis(2-ethylhexyl)phthalate	117-81-7	625	53-110	0-33	10.0
Bis(2-chloroisopropyl)ether	108-60-1	625	58-112	0-36	10.0
4-Bromophenyl phenyl ether	101-55-3	625	69-105	0-20	10.0
4-Chloro-3-methylphenol	59-50-7	625	45-117	0-28	10.0
2-Chloronaphthalene	91-58-7	625	18-136	0-26	10.0
4-Chlorophenyl phenyl ether	7005-72-3	625	65-108	0-21	10.0
2-Chlorophenol	95-57-8	625	48-115	0-29	10.0
Chrysene	218-01-9	625	60-109	0-24	10.0
Dibenzo(a,h)anthracene	53-70-3	625	50-118	0-65	10.0
Di-n-butylphthalate	84-74-2	625	21-89	0-60	10.0
1,3-Dichlorobenzene	541-73-1	625	34-115	0-43	10.0
1,2-Dichlorobenzene	95-50-1	625	30-115	0-36	10.0
1,4-Dichlorobenzene	106-46-7	625	32-115	0-46	10.0
3,3'-Dichlorobenzidine	91-94-1	625	4-144	0-120	20.0
2,4-Dichlorophenol	120-83-2	625	11-123	0-18	10.0
Diethylphthalate	84-66-2	625	D-105	0-41	10.0
2,4-Dimethylphenol	105-67-9	625	49-96	0-24	10.0
Dimethyl phthalate	131-11-3	625	D-37	0-188	10.0
2,4-Dinitrophenol	51-28-5	625	D-222	0-25	50.0
2,4-Dinitrotoluene	121-14-2	625	34-110	0-26	10.0
2,6-Dinitrotoluene	606-20-2	625	52-123	0-28	10.0

TABLE 5-9 (cont'd)
KEMRON'S QA OBJECTIVES AND ANALYTICAL METHODS FOR
SEMIVOLATILE ORGANIC ANALYSES OF
MUNICIPAL AND INDUSTRIAL WASTE WATER

PARAMETER	CAS #	EPA CFR METHOD	% RECOVERY (ACCURACY)	% RPD (PRECISION)	METHOD DETECTION LIMIT (µg/L)
Di-n-octyl phthalate	117-84-0	625	47-115	0-40	10.0
Fluoranthene	206-44-0	625	65-113	0-20	10.0
Fluorene	86-73-7	625	73-115	0-26	10.0
Hexachlorobenzene	118-74-1	625	47-103	0-20	10.0
Hexachlorobutadiene	87-68-3	625	28-83	0-28	10.0
Hexachlorocyclopentadiene	77-47-4	625	D-144	0-55	10.0
Hexachloroethane	67-72-1	625	26-110	0-48	10.0
Indeno(1,2,3-cd)pyrene	193-39-5	625	53-125	0-63	10.0
Isophorone	78-59-1	625	48-110	0-22	10.0
2-Methyl-4,6-dinitrophenol	534-52-1	625	D-185	0-35	50.0
Naphthalene	91-20-3	625	54-107	0-31	10.0
Nitrobenzene	98-95-3	625	51-112	0-23	10.0
2-Nitrophenol	88-75-5	625	23-130	0-26	10.0
4-Nitrophenol	100-02-7	625	D-148	0-22	50.0
N-Nitrosodimethylamine	62-75-9	625	47-117	0-29	10.0
N-Nitrosodiphenylamine	86-30-6	625	138-237	0-32	10.0
N-Nitrosodi-n-propylamine	621-64-7	625	35-124	0-31	10.0
Pentachlorophenol	87-86-5	625	36-137	0-28	50.0
Phenanthrene	85-01-8	625	72-108	0-20	10.0
Phenol	108-95-2	625	13-132	0-43	10.0
Pyrene	129-00-0	625	42-139	0-43	10.0
1,2,4-Trichlorobenzene	120-82-1	625	29-98	0-35	10.0
2,4,6-Trichlorophenol	88-06-2	625	16-140	0-20	10.0

TABLE 5-10
KEMRON'S QA OBJECTIVES AND ANALYTICAL METHODS FOR
INORGANIC CONVENTIONAL ANALYSES OF
GROUNDWATER AND SOLID WASTE

PARAMETER	SW-846 METHOD	% RECOVERY (ACCURACY)	% RPD (PRECISION)	WATER MDL (mg/L)	SOIL/SLUDGE MDL (mg/Kg)
Chloride	9252	75-125	0-30	2	8
Corrosivity	1110	NA	0-30	<1(MMPY)	NA
Ignitability	1010	NA	<0°C	<1	NA
Nitrate (as N)	9200	75-120	0-20	0.05	NA
Oil & Grease	413.1	80-120	0-10	1	NA
Oil & Grease	9071/418.1	85-115	0-40	NA	<25
Oil & Grease	413.2	85-115	0-40	<1	NA
Oil & Grease	3550/418.1	85-115	0-40	NA	<25
pH	9040	ND	ND	<1,>13su	<1,>13su
Phenolics	9065	90-110	0-15	0.005	0.1
Specific Conductance	9050	90-110	0-6	1us/cm	1us/cm
Sulfate	9038	70-125	0-15	2	8
Sulfide	9030	80-120	0-10	1	50
Total & Amenable Cyanide	9010 *	80-120	0-10	0.01	0.5
Total Coliform	9131	NA	NA	<1	NA
Total Organic Carbon (TOC)	9060	75-120	0-30	1	10
Total Organic Halides (TOX)	9020	75-125	0-35	0.02	NA
Total Petroleum Hydrocarbons (TPH)	9071/418.1	85-115	0-40	NA	<25
Total Petroleum Hydrocarbons (TPH)	418.1	85-115	0-40	<1	NA
Total Petroleum Hydrocarbons (TPH)	3550/418.1	85-115	0-40	NA	<25

* Method 9010 is applicable to aqueous samples.

TABLE 5-11
KEMRON'S QA OBJECTIVES AND ANALYTICAL METHODS FOR
INORGANIC METALS ANALYSES OF
GROUNDWATER AND SOLID WASTE

PARAMETER	CAS #	EPA SW-846 METHOD *	% RECOVERY (ACCURACY)	% RPD (PRECISION)	WATER MDL	SOIL MDL
Aluminum (Al) - ICP	7429-90-5	3005/6010	108-81	0-13	100	5,000
- AA FLAME		3005/7020	75-125	0-20	100	5,000
Antimony (Sb) - ICP	7440-36-0	3005/6010	108-83	0-13	200	10,000
- AA FURNACE		3020/7041	75-125	0-10	20	1,000
Arsenic (As) - ICP	7440-38-2	3005/6010	75-125	0-20	400	20,000
- AA FURNACE		3005/7060	75-125	0-20	4	200
- AA HYDRIDE		3005/7061	116-83	0-10	4	200
Barium (Ba) - ICP	7440-39-3	3005/6010	118-84	0-10	10	500
- AA FLAME		3005/7080	75-125	0-20	200	10,000
Beryllium(Be) - ICP	7440-41-7	3005/6010	109-84	0-12	10	500
- AA FLAME		3005/7090	75-125	0-20	10	500
- AA FURNACE		3020/7091	75-125	0-20	1	50
Boron (B) -ICP	7440-42-8	3005/6010	110-81	0-20	500	25,000

* Methods 3005 and 3020 are applicable to aqueous samples. Solid analyses are performed as per Method 3050.

TABLE 5-11(cont'd)
KEMRON'S QA OBJECTIVES AND ANALYTICAL METHODS FOR
INORGANIC METALS ANALYSES OF
GROUNDWATER AND SOLID WASTE

PARAMETER	CAS #	EPA SW-846 METHOD *	% RECOVERY (ACCURACY)	% RPD (PRECISION)	WATER MDL (ug/L)	SOIL MDL (ug/Kg)
Cadmium (Cd) - ICP	7440-43-9	3005/6010	78-113	0-10	10	500
- AA FLAME		3005/7130	75-125	0-20	10	500
- AA FURNACE		3020/7131	74-123	0-20	0.5	25
Calcium (Ca) - ICP	7440-70-2	3005/6010	91-108	0-10	200	10,000
- AA FLAME		3005/7140	75-125	0-20	100	5,000
Chromium (Cr) - ICP	7440-47-3	3005/6010	83-117	0-10	20	1,000
- AA FLAME		3005/7190	75-125	0-20	50	2,000
- AA FURNACE		3020/7191	72-129	0-10	5	250
Cobalt (Co) - ICP	7440-48-4	3005/6010	87-112	0-20	20	1,000
- AA FLAME		3005/7200	75-125	0-20	20	1,000
- AA FURNACE		3020/7201	75-125	0-20	20	1,000
Copper (Cu) - ICP	7440-50-8	3005/6010	84-115	0-10	20	1,000
- AA FLAME		3005/7210	78-123	0-12	5	250
Iron (Fe) - ICP	7439-89-6	3005/6010	85-109	0-10	40	2,000
- AA FLAME		3005/7380	83-113	0-20	30	2,000
Lead (Pb) - ICP	7439-92-1	3005/6010	84-110	0-11	100	5,000
- AA FLAME		3005/7420	75-125	0-20	250	10,000
- AA FURNACE		3020/7421	77-123	0-12	5	250
Magnesium (Mg) - ICP	7439-95-4	3005/6010	89-103	0-10	500	25,000
- AA FLAME		3005/7450	75-125	0-20	10	500
Manganese (Mn) - ICP	7439-96-5	3005/6010	84-105	0-10	10	500
- AA FLAME		3005/7460	75-125	0-10	10	500
Mercury (Hg) - VAPOR	7439-97-6	7470	88-116	0-20	0.2	250
- VAPOR		7471	75-125	0-10	0.5	250
Molybdenum (Mo) - ICP	7439-98-7	3005/6010	79-121	0-20	100	5,000
- AA FLAME		3005/7480	75-125	0-20	2	100
- AA FURNACE		3020/7481	88-110	0-20	2	100
Nickel (Ni) - ICP	7440-02-0	3005/6010	82-112	0-20	40	2,000
- AA FLAME		3005/7520	75-125	0-10	40	2,000
Potassium (K) - ICP	7440-09-7	3005/6010	85-115	0-20	1000	50,000
- AA FLAME		3005/7610	76-126	0-11	500	25,000
Selenium (Se) - ICP	7782-49-2	3005/6010	75-125	0-20	400	20,000
- AA FURNACE		3005/7740	75-125	0-20	4	200
- AA HYDRIDE		3005/7741	83-119	0-20	4	200
Silicon (Si)	7440-21-3	3005/6010	78-121	0-10	1	50,000
Silver (Ag) - ICP	7440-22-4	3005/6010	78-121	0-20	10	2,000
- AA FLAME		3005/7760	77-121	0-12	4	200
Sodium (Na) - ICP	7440-23-5	3005/6010	73-131	0-20	500	25,000
- AA FLAME		3005/7770	92-113	0-20	1000	50,000
Thallium (Tl) - ICP	7440-28-0	3005/6010	75-125	0-20	5000	25,000
- AA FURNACE		3020/7841	76-126	0-10	5	250
Tin (Sn) - AA FLAME	7440-31-5	3005/7870	81-106	0-20	1000	50,000
Vanadium (V) - ICP	7440-62-2	3005/6010	84-115	0-20	10	500
- AA FLAME		3005/7910	75-125	0-20	10	500
- AA FURNACE		3020/7911	75-125	0-20	10	500
Zinc (Zn) - ICP	7440-66-6	3005/6010	81-115	0-10	10	500
- AA FLAME		3005/7950	75-125	0-20	10	500

* Methods 3005 and 3020 are applicable to aqueous samples. Solid analyses are performed as per Method 3050.

TABLE 5-12
KEMRON'S QA OBJECTIVES AND ANALYTICAL METHODS FOR HALOGENATED VOLATILE ORGANIC ANALYSES OF GROUNDWATER AND SOLID WASTE

PARAMETER	CAS #	EPA SW-846 METHOD	% RECOVERY (ACCURACY)	% RPD (PRECISION)	WATER MDL (ug/L)	SOIL MDL (ug/kg)
Bromodichloromethane	75-27-4	5030/8010	42-172	0-40	0.5	0.5
Bromoform	75-25-2	5030/8010	13-159	0-40	0.5	0.5
Bromomethane	74-83-9	5030/8010	D-144	0-40	1.0	1.0
Carbon tetrachloride	56-23-5	5030/8010	43-143	0-40	0.5	0.5
Chlorobenzene	108-90-7	5030/8010	38-150	0-40	0.5	0.5
Chloroethane	75-00-3	5030/8010	46-137	0-40	1.0	1.0
2-Chloroethyl vinyl ether	110-75-8	5030/8010	14-186	0-40	1.0	1.0
Chloroform	67-66-3	5030/8010	49-133	0-40	0.5	0.5
Chloromethane	74-87-3	5030/8010	D-193	0-40	1.0	1.0
Dibromochloromethane	124-48-1	5030/8010	24-191	0-40	0.5	0.5
1,2-Dichlorobenzene	95-50-1	5030/8010	D-208	0-40	1.0	1.0
1,3-Dichlorobenzene	541-73-1	5030/8010	7-187	0-40	1.0	1.0
1,4-Dichlorobenzene	106-46-7	5030/8010	42-143	0-40	1.0	1.0
Dichlorodifluoromethane	75-71-8	5030/8010	45-140	0-40	1.0	1.0
1,1-Dichloroethane	75-34-3	5030/8010	47-132	0-40	0.5	0.5
1,2-Dichloroethane	107-06-2	5030/8010	51-147	0-40	0.5	0.5
1,1-Dichloroethene	75-35-4	5030/8010	28-167	0-40	0.5	0.5
trans-1,2-Dichloroethene	156-60-5	5030/8010	38-155	0-40	0.5	0.5
1,2-Dichloropropane	78-87-5	5030/8010	44-156	0-40	0.5	0.5
cis-1,3-Dichloropropene	10061-01-5	5030/8010	22-178	0-40	0.5	0.5
trans-1,3-Dichloropropene	10061-02-6	5030/8010	22-178	0-40	0.5	0.5
Methylene chloride	75-09-2	5030/8010	25-162	0-40	2.0	2.0
1,1,2,2-Tetrachloroethane	79-34-5	5030/8010	8-184	0-40	0.5	0.5
Tetrachloroethene	127-18-4	5030/8010	26-162	0-40	0.5	0.5
1,1,1-Trichloroethane	71-55-6	5030/8010	41-138	0-40	0.5	0.5
1,1,2-Trichloroethane	79-00-5	5030/8010	39-136	0-40	0.5	0.5
Trichloroethene	79-01-6	5030/8010	35-146	0-40	0.5	0.5
Trichlorofluoromethane	75-69-4	5030/8010	21-156	0-40	0.5	0.5
Vinyl chloride	75-01-4	5030/8010	28-163	0-40	1.0	1.0

TABLE 5-13
KEMRON'S QA OBJECTIVES AND ANALYTICAL METHODS FOR
AROMATIC VOLATILE ORGANIC ANALYSES OF
GROUNDWATER AND SOLID WASTE

PARAMETER	CAS #	EPA SW-846 METHOD	% RECOVERY (ACCURACY)	% RPD (PRECISION)	WATER MDL (ug/L)	SOIL MDL (ug/Kg)
Benzene	71-43-2	5030/8020	39-150	0-40	1.0	1.0
Chlorobenzene	108-90-7	5030/8020	55-135	0-40	1.0	1.0
1,2-Dichlorobenzene	95-50-1	5030/8020	37-154	0-40	1.0	1.0
1,3-Dichlorobenzene	41-73-1	5030/8020	50-141	0-40	1.0	1.0
1,4-Dichlorobenzene	106-46-7	5030/8020	42-143	0-40	1.0	1.0
Ethyl Benzene	100-41-4	5030/8020	32-160	0-40	1.0	1.0
Toluene	108-88-3	5030/8020	46-148	0-40	1.0	1.0
Xylenes (Total)	1330-20-7	5030/8020			1.0	1.0

TABLE 5-14
KEMRON'S QA OBJECTIVES AND ANALYTICAL METHODS FOR ORGANOCHLORINE PESTICIDES AND PCB ORGANIC ANALYSES OF GROUNDWATER AND SOLID WASTE

PARAMETER	CAS #	EPA SW-846 METHOD *	% RECOVERY (ACCURACY)	% RPD (PRECISION)	WATER MDL (ug/L)	SOIL MDL (ug/Kg)
Aldrin	309-00-2	3510/8080	26-143	0-38	0.05	1.65
alpha-BHC	319-84-6	3510/8080	51-145	0-43	0.05	1.65
beta-BHC	319-85-7	3510/8080	51-129	0-28	0.05	1.65
delta-BHC	319-86-8	3510/8080	56-138	0-78	0.05	1.65
gamma-BHC (Lindane)	58-89-9	3510/8080	54-134	0-18	0.05	1.65
Chlordane (technical)	57-74-9	3510/8080	45-115	0-40	1.0	33
4,4'-DDD	72-54-8	3510/8080	59-179	0-30	0.10	3.3
4,4'-DDE	72-55-9	3510/8080	64-152	0-23	0.10	3.3
4,4'-DDT	50-29-3	3510/8080	42-168	0-22	0.10	3.3
Dieldrin	60-57-1	3510/8080	23-171	0-20	0.10	3.3
Endosulfan I	959-98-8	3510/8080	37-123	0-22	0.05	1.65
Endosulfan II	33213-65-9	3510/8080	21-117	0-18	0.10	1.65
Endosulfan sulfate	1031-07-8	3510/8080	31-117	0-30	0.10	3.3
Endrin	72-20-8	3510/8080	56-154	0-28	0.10	3.3
Endrin aldehyde	7421-93-4	3510/8080	21-115	0-40	0.10	3.3
Heptachlor	76-44-8	3510/8080	40-139	0-37	0.05	1.65
Heptachlor epoxide	1024-57-3	3510/8080	51-135	0-17	0.05	1.65
Methoxychlor	72-43-5	3510/8080	26-196	0-19	0.50	16.5
Toxaphene	8001-35-2	3510/8080	40-125	0-40	1.0	33
PCB 1016	12674-11-2	3510/8080	50-110	0-40	0.50	16.5
PCB 1221	11104-28-2	3510/8080	15-175	0-40	0.50	16.5
PCB 1232	11141-16-5	3510/8080	10-210	0-40	0.50	16.5
PCB 1242	5369-21-9	3510/8080	40-150	0-40	0.50	16.5
PCB-1248	12672-29-6	3510/8080	40-155	0-40	0.50	16.5
PCB-1254	11097-69-1	3510/8080	30-130	0-40	1.0	33
PCB-1260	11096-82-5	3510/8080	10-125	0-40	1.0	33

TABLE 5-15
KEMRON'S QA OBJECTIVES AND ANALYTICAL METHODS FOR POLYNUCLEAR AROMATIC HYDROCARBON ORGANIC ANALYSES OF GROUNDWATER AND SOLID WASTE

PARAMETER	CAS #	EPA SW-846 METHOD *	% RECOVERY (ACCURACY)	% RPD (PRECISION)	WATER MDL (ug/L)	SOIL MDL (ug/Kg)
Acenaphthene	83-32-9	3510/8100	28-138	0-23	1.0	33
Acenaphthylene	208-96-8	3510/8100	23-142	0-22	1.0	33
Anthracene	120-12-7	3510/8100	31-134	0-20	1.0	33
Benzo(a)anthracene	56-55-3	3510/8100	42-147	0-20	5.0	165
Benzo(a)pyrene	50-32-8	3510/8100	41-153	0-45	5.0	165
Benzo(b)fluoranthene	205-99-2	3510/8100	36-176	0-30	5.0	165
Benzo(g,h,i)perylene	191-24-2	3510/8100	19-157	0-29	5.0	165
Benzo(k)fluoranthene	207-08-9	3510/8100	37-149	0-30	5.0	165
Chrysene	218-01-9	3510/8100	44-142	0-21	5.0	165
Dibenzo(a,h)anthracene	53-70-3	3510/8100	14-106	0-50	5.0	165
Fluoranthene	206-44-0	3510/8100	52-147	0-20	1.0	33
Fluorene	86-73-7	3510/8100	43-141	0-21	1.0	33
Indeno(1,2,3-cd)pyrene	193-39-5	3510/8100	16-166	0-64	5.0	165
Naphthalene	91-20-3	3510/8100	D-144	0-40	1.0	33
Phenanthrene	85-01-8	3510/8100	54-139	0-22	1.0	33
Pyrene	129-00-0	3510/8100	53-148	0-20	1.0	33

* Method 3510 is applicable to aqueous samples. Solid analyses are performed as per Method 3550.

TABLE 5-16
KEMRON'S QA OBJECTIVES AND ANALYTICAL METHODS FOR CHLORINATED HERBICIDE ORGANIC ANALYSES OF GROUNDWATER AND SOLID WASTE

PARAMETER	CAS #	EPA SW-846 METHOD *	% RECOVERY (ACCURACY)	% RPD (PRECISION)	WATER MDL (ug/L)	SOIL MDL (ug/Kg)
2,4-D	94-75-7	8150	40-140	0-40	1.0	33.0
2,4-DB	94-82-6	8150	40-140	0-40	1.0	33.0
2,4,5-T	93-76-5	8150	40-140	0-40	0.2	6.6
2,4,5-TP (Silvex)	93-72-1	8150	40-140	0-40	0.2	6.6
Dalapon	75-99-0	8150	10-160	0-40	6.0	198.0
Dicamba	1918-00-9	8150	10-150	0-40	0.3	9.9
Dichlorprop	120-36-5	8150	10-150	0-40	0.7	23.1
Dinoseb	88-85-7	8150	10-150	0-40	0.07	2.3
MCPA	94-74-6	8150	10-150	0-40	200.0	6600.0
MCPP	93-65-2	8150	10-150	0-40	200.0	6600.0

TABLE 5-17
KEMRON'S QA OBJECTIVES AND ANALYTICAL METHODS FOR
VOLATILE ORGANIC ANALYSES OF
GROUNDWATER AND SOLID WASTE

PARAMETER	CAS #	EPA SW-846 METHOD	% RECOVERY (ACCURACY)	% RPD (PRECISION)	WATER MDL (ug/L)	SOIL MDL (ug/Kg)
Acetone	67-64-1	5030/8240	30-165	0-40	100.0	100.0
Benzene	71-43-2	5030/8240	87-120	0-12	5.0	5.0
Bromodichloromethane	75-27-4	5030/8240	80-118	0-20	5.0	5.0
Bromoform	75-25-2	5030/8240	66-113	0-32	5.0	5.0
Bromomethane	74-83-9	5030/8240	62-115	0-22	10.0	10.0
2-Butanone	78-93-3	5030/8240	35-160	0-40	100.0	100.0
Carbon disulfide	75-15-0	5030/8240	45-165	0-40	5.0	5.0
Carbon tetrachloride	56-23-5	5030/8240	57-131	0-29	5.0	5.0
Chlorobenzene	108-90-7	5030/8240	85-119	0-14	5.0	5.0
Chloroethane	75-00-3	5030/8240	60-138	0-40	10.0	10.0
2-Chloroethyl vinyl ether	110-75-8	5030/8240	D-305	0-40	10.0	10.0
Chloroform	67-66-3	5030/8240	82-124	0-22	5.0	5.0
Chloromethane	74-87-3	5030/8240	43-129	0-33	10.0	10.0
Dibromochloromethane	124-48-1	5030/8240	75-114	0-30	5.0	5.0
1,1-Dichloroethane	75-34-3	5030/8240	71-149	0-50	5.0	5.0
1,2-Dichloroethane	107-06-2	5030/8240	87-118	0-32	5.0	5.0
1,1-Dichloroethene	75-35-4	5030/8240	66-138	0-20	5.0	5.0
trans-1,2-Dichloroethene	156-60-5	5030/8240	77-127	0-31	5.0	5.0
1,2-Dichloropropane	78-87-5	5030/8240	76-134	0-40	5.0	5.0
cis-1,3-Dichloropropene	10061-01-5	5030/8240	80-146	0-40	5.0	5.0
trans-1,3-Dichloropropene	10061-02-6	5030/8240	48-106	0-40	5.0	5.0
Ethyl benzene	100-41-4	5030/8240	75-153	0-13	5.0	5.0
2-Hexanone	591-78-6	5030/8240	45-150	0-40	10.0	10.0
Methylene Chloride	75-09-2	5030/8240	72-160	0-33	5.0	5.0
4-Methyl-2-pentanone	108-10-1	5030/8240	40-160	0-40	10.0	10.0
Styrene	100-42-5	5030/8240	40-160	0-40	5.0	5.0
1,1,2,2-Tetrachloroethane	79-34-5	5030/8240	78-124	0-17	5.0	5.0
Tetrachloroethene	127-18-4	5030/8240	87-121	0-57	5.0	5.0
Toluene	108-88-3	5030/8240	86-115	0-18	5.0	5.0
1,1,1-Trichloroethane	71-55-6	5030/8240	85-120	0-14	5.0	5.0
1,1,2-Trichloroethane	79-00-5	5030/8240	86-127	0-21	5.0	5.0
Trichloroethene	79-01-6	5030/8240	83-129	0-14	5.0	5.0
Vinyl acetate	108-05-4	5030/8240	40-170	0-40	10.0	10.0
Vinyl chloride	75-01-4	5030/8240	47-128	0-18	10.0	10.0
Xylenes (Total)	1330-20-7	5030/8240	40-135	0-40	5.0	5.0

TABLE 5-18
KEMRON'S QA OBJECTIVES AND ANALYTICAL METHODS FOR SEMIVOLATILE ORGANIC ANALYSES OF GROUNDWATER AND SOLID WASTE

PARAMETER	CAS #	EPA SW-846 METHOD*	% RECOVERY (ACCURACY)	% RPD (PRECISION)	WATER MDL (ug/L)	SOIL MDL (ug/Kg)
Acenaphthene	83-32-9	3520/8270	43-117	0-25	10.0	165
Acenaphthylene	208-96-8	3520/8270	62-101	0-29	10.0	165
Anthracene	120-12-7	3520/8270	76-111	0-20	10.0	165
Benzoic acid	65-85-0	3520/8270	15-110	0-40	50.0	825
Benzo(a)anthracene	56-55-3	3520/8270	76-131	0-31	10.0	165
Benzo(b)fluoranthene	205-99-2	3520/8270	56-109	0-34	10.0	165
Benzo(k)fluoranthene	207-08-9	3520/8270	64-116	0-25	10.0	165
Benzo(g,h,i)perylene	191-24-2	3520/8270	49-111	0-69	10.0	165
Benzo(a)pyrene	50-32-8	3520/8270	59-100	0-26	10.0	165
Benzyl alcohol	100-51-6	3520/8270	15-110	0-40	10.0	165
Bis(2-chloroethoxy)methane	111-91-1	3520/8270	57-104	0-29	10.0	165
Bis(2-chloroethyl)ether	111-44-4	3520/8270	67-97	0-22	10.0	165
Bis(2-chloroisopropyl)ether	108-60-1	3520/8270	58-112	0-36	10.0	165
Bis(2-ethylhexyl)phthalate	117-81-7	3520/8270	53-110	0-33	10.0	165
4-Bromophenyl phenyl ether	101-55-3	3520/8270	69-105	0-20	10.0	165
Butyl benzyl phthalate	85-68-7	3520/8270	24-120	0-42	10.0	165
4-Chloroaniline	106-47-8	3520/8270	D-150	0-40	10.0	165
4-Chloro-3-methylphenol	59-50-7	3520/8270	45-117	0-28	10.0	165
2-Chloronaphthalene	91-58-7	3520/8270	18-136	0-26	10.0	165
2-Chlorophenol	95-57-8	3520/8270	48-115	0-29	10.0	165
4-Chlorophenyl phenyl ether	7005-72-3	3520/8270	65-108	0-21	10.0	165
Chrysene	218-01-9	3520/8270	60-109	0-24	10.0	165
Dibenzo(a,h)anthracene	53-70-3	3520/8270	50-118	0-65	10.0	165
Dibenzofuran	132-64-9	3520/8270	25-120	0-40	10.0	165
Di-n-butylphthalate	84-74-2	3520/8270	21-89	0-60	10.0	165
1,2-Dichlorobenzene	95-50-1	3520/8270	30-115	0-36	10.0	165
1,3-Dichlorobenzene	541-73-1	3520/8270	34-115	0-43	10.0	165
1,4-Dichlorobenzene	106-46-7	3520/8270	32-115	0-46	10.0	165
3,3'-Dichlorobenzidene	91-94-1	3520/8270	4-144	0-120	20.0	330
2,4-Dichlorophenol	120-83-2	3520/8270	11-123	0-18	10.0	165
Diethylphthalate	84-66-2	3520/8270	D-105	0-41	10.0	165
2,4-Dimethylphenol	105-67-9	3520/8270	49-96	0-24	10.0	165
Dimethyl phthalate	131-11-3	3520/8270	D-37	0-188	10.0	165
4,6-Dinitro-2-methylphenol	534-52-1	3520/8270	D-180	0-40	50.0	825
2,4-Dinitrophenol	51-28-5	3520/8270	D-222	0-25	50.0	825
2,4-Dinitrotoluene	121-14-2	3520/8270	34-110	0-26	10.0	165
2,6-Dinitrotoluene	606-20-2	3520/8270	53-123	0-28	10.0	165
Di-n-octyl phthalate	117-84-0	3520/8270	47-115	0-40	10.0	165
Fluoranthene	206-44-0	3520/8270	65-113	0-20	10.0	165
Fluorene	86-73-7	3520/8270	73-115	0-26	10.0	165
Hexachlorobenzene	118-74-1	3520/8270	47-103	0-17	10.0	165

* Method 3520 is applicable to aqueous samples. Solid analyses are performed as per Method 3550.

TABLE 5-18 (cont'd)
KEMRON'S QA OBJECTIVES AND ANALYTICAL METHODS FOR
SEMIVOLATILE ORGANIC ANALYSES OF
GROUNDWATER AND SOLID WASTE

PARAMETER	CAS #	EPA SW-846 METHOD	% RECOVERY (ACCURACY)	% RPD (PRECISION)	WATER MDL (ug/L)	SOIL MDL(ug/Kg)
Hexachlorobutadiene	87-68-3	3520/8270	28-83	0-28	10.0	165
Hexachlorocyclopentadiene	77-47-4	3520/8270	D-144	0-55	10.0	165
Hexachloroethane	67-72-1	3520/8270	26-76	0-48	10.0	165
Indeno(1,2,3-cd)pyrene	193-39-5	3520/8270	53-125	0-63	10.0	165
Isophorone	78-59-1	3520/8270	48-110	0-22	10.0	165
2-Methylnaphthalene	91-57-6	3520/8270	35-125	0-40	10.0	165
2-Methylphenol (o-Cresol)	95-48-7	3520/8270	D-150	0-40	10.0	165
4-Methylphenol (p-Cresol)	106-44-5	3520/8270	D-150	0-40	10.0	165
Naphthalene	91-20-3	3520/8270	54-107	0-31	10.0	165
2-Nitroaniline	88-74-4	3520/8270	D-150	0-40	50.0	825
3-Nitroaniline	99-09-2	3520/8270	D-150	0-40	50.0	825
4-Nitroaniline	100-01-6	3520/8270	D-150	0-40	50.0	825
Nitrobenzene	98-95-3	3520/8270	51-112	0-23	10.0	165
2-Nitrophenol	88-75-5	3520/8270	23-130	0-26	10.0	165
4-Nitrophenol	100-02-7	3520/8270	1-148	0-22	50.0	825
N-Nitrosodiphenylamine	86-30-6	3520/8270	138-237	0-32	10.0	165
N-Nitrosodi-n-propylamine	621-64-7	3520/8270	35-124	0-31	10.0	165
Pentachlorophenol	87-86-5	3520/8270	36-137	0-28	50.0	825
Phenanthrene	85-01-8	3520/8270	72-108	0-20	10.0	165
Phenol	108-95-2	3520/8270	13-132	0-43	10.0	165
Pyrene	129-00-0	3520/8270	42-139	0-43	10.0	165
1,2,4-Trichlorobenzene	120-82-1	3520/8270	29-98	0-35	10.0	165
2,4,5-Trichlorophenol	95-95-4	3520/8270	25-135	0-40	50.0	825
2,4,6-Trichlorophenol	88-06-2	3520/8270	16-140	0-14	10.0	165

*Method 3520 is applicable to aqueous samples. Solids are extracted as per Method 3550.

TABLE 5-19
KEMRON'S QA OBJECTIVES AND ANALYTICAL METHODS FOR
APPENDIX IX VOLATILE ORGANIC ANALYSES OF
GROUNDWATER AND SOLID WASTE

PARAMETER	CAS #	EPA SW-846 METHOD*	% RECOVERY (ACCURACY)	% RPD (PRECISION)	WATER MDL (ug/L)	SOIL MDL (ug/Kg)
Acetone	67-64-1	5030/8240	30-165	0-40	100.0	100.0
Acetonitrile	75-05-8	5030/8240	45-145	0-40	100*	100*
Acrolein	107-02-8	5030/8240	60-140	0-40	100*	100*
Acrylonitrile	107-13-1	5030/8240	60-145	0-40	100*	100*
Allyl chloride	107-05-1	5030/8240	25-140	0-40	100.0	100.0
Benzene	71-43-2	5030/8240	87-120	0-12	5.0	5.0
Bromodichloromethane	75-27-4	5030/8240	80-118	0-20	5.0	5.0
Bromoform	75-25-2	5030/8240	66-113	0-32	5.0	5.0
2-Butanone	78-93-3	5030/8240	35-160	0-40	100.0	100.0
Carbon disulfide	75-15-0	5030/8240	45-165	0-40	5.0	5.0
Carbon tetrachloride	56-23-5	5030/8240	57-131	0-29	5.0	5.0
Chlorobenzene	108-90-7	5030/8240	85-119	0-14	5.0	5.0
Chloroethane	75-00-3	5030/8240	60-138	0-40	10.0	10.0
2-Chloroethylvinylether	110-75-8	5030/8240	D-305	0-40	10.0	10.0
Chloroform	67-66-3	5030/8240	82-124	0-22	5.0	5.0
Chloroprene	126-99-8	5030/8240	10-140	0-40	5.0	5.0
Dibromochloromethane	124-48-1	5030/8240	75-114	0-30	5.0	5.0
1,2-Dibromo-3-chloropropane	96-12-8	5030/8240	55-140	0-40	5.0	5.0
1,2-Dibromoethane	106-93-4	5030/8240	50-150	0-40	5.0	5.0
trans-1,4-dichloro-2-butene	110-57-6	5030/8240	60-140	0-40	5.0	5.0
Dichlorodifluoromethane	75-71-8	5030/8240	65-140	0-40	5.0	5.0
1,1-Dichloroethane	75-34-3	5030/8240	71-149	0-50	5.0	5.0
1,2-Dichloroethane	107-06-2	5030/8240	87-118	0-32	5.0	5.0
1,1-Dichloroethene	75-35-4	5030/8240	66-138	0-20	5.0	5.0
trans-1,2-Dichloroethene	156-60-5	5030/8240	77-127	0-31	5.0	5.0
1,2-Dichloropropane	78-87-5	5030/8240	76-134	0-40	5.0	5.0
cis-1,3-Dichloropropene	10061-01-5	5030/8240	86-146	0-40	5.0	5.0
trans-1,3-Dichloropropene	10061-02-6	5030/8240	48-106	0-40	5.0	5.0
Ethyl benzene	100-41-4	5030/8240	75-153	0-13	5.0	5.0
Ethyl methacrylate	97-63-2	5030/8240	45-140	0-40	5.0	5.0
2-Hexanone	591-78-6	5030/8240	45-150	0-40	10.0	10.0
Methacrylonitrile	126-98-7	5030/8240	10-110	0-40	5.0	5.0
Methyl bromide	74-83-9	5030/8240	62-115	0-22	10.0	10.0
Methyl chloride	74-87-3	5030/8240	43-129	0-33	10.0	10.0
Methylene bromide	74-95-3	5030/8240	10-170	0-40	5.0	5.0
Methylene Chloride	75-09-2	5030/8240	72-160	0-33	5.0	5.0
Methyl iodide	74-88-4	5030/8240	35-150	0-40	5.0	5.0
Methyl methacrylate	80-62-6	5030/8240	45-130	0-40	5.0	5.0
4-Methyl-2-pentanone	108-10-1	5030/8240	40-160	0-40	10.0	10.0
Propionitrile	107-12-0	5030/8240	10-110	0-40	5.0	5.0
Styrene	100-42-5	5030/8240	35-175	0-40	5.0	5.0
1,1,1,2-Tetra-chloroethane	630-20-6	5030/8240	60-140	0-40	10.0	10.0
1,1,2,2-Tetrachloroethane	79-34-5	5030/8240	78-124	0-17	5.0	5.0
Tetrachloroethene	127-18-4	5030/8240	87-121	0-57	5.0	5.0
Toluene	108-88-3	5030/8240	86-115	0-18	5.0	5.0
1,1,1-Trichloroethane	71-55-6	5030/8240	85-120	0-14	5.0	5.0
1,1,2-Trichloroethane	79-00-5	5030/8240	86-127	0-21	5.0	5.0
Trichloroethene	79-01-6	5030/8240	83-129	0-14	5.0	5.0
Trichlorofluoromethane	75-69-4	5030/8240	37-142	0-24	5.0	5.0
1,2,3-Trichloropropane	96-18-4	5030/8240	60-140	0-40	5.0	5.0
Vinyl acetate	108-05-4	5030/8240	40-170	0-40	10.0	10.0
Vinyl chloride	75-01-4	5030/8240	47-128	0-18	10.0	10.0
Xylenes (Total)	1330-20-7	5030/8240	40-135	0-40	5.0	5.0

* Screen only

TABLE 5-20
KEMRON'S QA OBJECTIVES AND ANALYTICAL METHODS FOR
APPENDIX IX SEMIVOLATILE ORGANIC ANALYSES OF
GROUNDWATER AND SOLID WASTE

PARAMETER	CAS #	EPA SW-846 METHOD	% RECOVERY *(ACCURACY)	% RPD (PRECISION)	WATER MDL (ug/L)	SOIL MDL (ug/Kg)
Acenaphthene	83-32-9	3520/8270	43-117	0-25	10.0	165
Acenaphthylene	208-96-8	3520/8270	62-101	0-29	10.0	165
Acetophenone	98-86-2	3520/8270	30-140	0-40	10.0	165
2-Acetylaminofluorene	53-96-3	3520/8270	25-125	0-40	10.0	165
4-Aminobiphenyl	92-67-1	3520/8270	35-140	0-40	10.0	165
Aniline	62-53-3	3520/8270	26-116	0-52	10.0	165
Anthracene	120-12-7	3520/8270	76-111	0-20	10.0	165
Aramite	140-51-8	3520/8270	D-100	0-40	10.0	165
Benzo(a)anthracene	56-55-3	3520/8270	76-131	0-31	10.0	165
Benzo(b)fluoranthene	205-99-2	3520/8270	56-109	0-34	10.0	165
Benzo(k)fluoranthene	207-08-9	3520/8270	64-116	0-25	10.0	165
Benzo(g,h,i)perylene	191-24-2	3520/8270	49-111	0-69	10.0	165
Benzo(a)pyrene	50-32-8	3520/8270	59-100	0-26	10.0	165
Benzyl alcohol	100-51-6	3520/8270	15-110	0-40	10.0	165
Bis(2-chloroethoxy)methane	111-91-1	3520/8270	57-104	0-29	10.0	165
Bis(2-chloroethyl)ether	111-44-4	3520/8270	67-97	0-22	10.0	165
Bis(2-chloroisopropyl)ether	108-60-1	3520/8270	58-112	0-36	10.0	165
Bis(2-ethylhexyl)phthalate	117-81-7	3520/8270	53-110	0-33	10.0	165
4-Bromophenyl phenyl ether	101-55-3	3520/8270	69-105	0-20	10.0	165
Butyl benzyl phthalate	85-68-7	3520/8270	24-120	0-42	10.0	165
p-Chloroaniline	106-47-8	3520/8270	D-150	0-40	10.0	165
Chlorobenzilate	510-15-6	3520/8270	D-150	0-40	10.0	165
p-Chloro-m-cresol	59-50-7	3520/8270	45-117	0-28	10.0	165
2-Chloronaphthalene	91-58-7	3520/8270	18-136	0-26	10.0	165
2-Chlorophenol	95-57-8	3520/8270	48-115	0-29	10.0	165
4-Chlorophenyl phenyl ether	7005-72-3	3520/8270	65-108	0-21	10.0	165
Chrysene	218-01-9	3520/8270	60-109	0-24	10.0	165
m-Cresol	108-39-4	3520/8270	D-150	0-40	10.0	165
o-Cresol	95-48-7	3520/8270	D-150	0-40	10.0	165
p-Cresol	106-44-5	3520/8270	D-150	0-40	10.0	165
Diallate	2303-16-4	3520/8270	D-120	0-40	10.0	165
Dibenzo(a,h)anthracene	53-70-3	3520/8270	50-118	0-65	10.0	165
Dibenzofuran	132-64-9	3520/8270	25-120	0-40	10.0	165
Di-n-butylphthalate	84-74-2	3520/8270	21-89	0-60	10.0	165
1,2-Dichlorobenzene	95-50-1	3520/8270	30-115	0-36	10.0	165
1,3-Dichlorobenzene	541-73-1	3520/8270	34-115	0-43	10.0	165
1,4-Dichlorobenzene	106-46-7	3520/8270	32-115	0-46	10.0	165
3,3-Dichlorobenzidene	91-94-1	3520/8270	4-144	0-120	20.0	330
2,4-Dichlorophenol	120-83-2	3520/8270	11-123	0-18	10.0	165
2,6-Dichlorophenol	87-65-0	3520/8270	40-140	0-40	10.0	165
Diethylphthalate	84-66-2	3520/8270	D-105	0-41	10.0	165
Dimethoate	60-51-5	3520/8270	D-150	0-40	10.0	165
p-Dimethylaminoazobenzene	60-11-7	3520/8270	D-150	0-40	10.0	165
7,12-Dimethylbenz(a)anthracene	58-97-6	3520/8270	D-150	0-40	10.0	165
3,3'-Dimethylbenzidine	119-93-7	3520/8270	D-200	0-40	10.0	165
a,a-Dimethyl phenyl ethylamine	122-09-8	3520/8270	10-135	0-40	10.0	165
2,4-Dimethylphenol	105-67-9	3520/8270	49-96	0-24	10.0	165
Dimethyl phthalate	131-11-3	3520/8270	D-37	0-188	10.0	165
m-Dinitrobenzene	99-65-0	3520/8270	35-125	0-40	10.0	165

*Screen Only

TABLE 5-20 (cont'd)
KEMRON'S QA OBJECTIVES AND ANALYTICAL METHODS FOR
APPENDIX IX SEMIVOLATILE ORGANIC ANALYSES OF
GROUNDWATER AND SOLID WASTE

PARAMETER	CAS #	EPA SW-846 METHOD	% RECOVERY *(ACCURACY)	% RPD (PRECISION)	WATER MDL (ug/L)	SOIL MDL (ug/Kg)
4,6-Dinitro-o-cresol	534-52-1	3520/8270	D-180	0-40	50.0	825
2,4-Dinitrophenol	51-28-5	3520/8270	D-222	0-25	50.0	825
2,4-Dinitrotoluene	121-14-2	3520/8270	34-110	0-26	10.0	165
2,6-Dinitrotoluene	606-20-2	3520/8270	53-123	0-28	10.0	165
Di-n-octyl phthalate	117-84-0	3520/8270	47-115	0-40	10.0	165
Diphenylamine	122-39-4	3520/8270	D-150	0-40	10.0	165
Disulfoton	298-04-4	3520/8270	D-150	0-40	10.0	165
Ethyl methane sulfonate	62-50-0	3520/8270	D-150	0-40	10.0	165
Famphur	52-85-7	3520/8270	D-150	0-40	10.0	165
Fluoranthene	206-44-0	3520/8270	65-115	0-20	10.0	165
Fluorene	86-73-7	3520/8270	73-115	0-26	10.0	165
Hexachlorobenzene	118-74-1	3520/8270	47-103	0-17	10.0	165
Hexachlorobutadiene	87-68-3	3520/8270	28-83	0-28	10.0	165
Hexachlorocyclopentadiene	77-47-4	3520/8270	D-144	0-55	10.0	165
Hexachloroethane	67-72-1	3520/8270	26-76	0-48	10.0	165
Hexachlorophene	70-30-4	3520/8270	D-150	0-40	10.0	165
Hexachloropropene	1888-71-7	3520/8270	35-125	0-40	10.0	165
Indeno(1,2,3-cd)pyrene	193-39-5	3520/8270	53-125	0-63	10.0	165
Isodrin	465-73-6	3520/8270	D-150	0-40	50.0	825
Isophorone	78-59-1	3520/8270	48-110	0-22	10.0	165
Isosafrole	120-58-1	3520/8270	20-160	0-40	10.0	165
Kepone	143-50-0	3520/8270	D-150	0-40	10.0	165
Methapyrilene	91-80-5	3520/8270	D-150	0-40	10.0	165
3-Methylcholanthrene	56-49-5	3520/8270	D-150	0-40	10.0	165
Methyl methanesulfonate	66-27-3	3520/8270	D-150	0-40	10.0	165
2-Methylnaphthalene	91-57-6	3520/8270	35-125	0-40	10.0	165
Naphthalene	91-20-3	3520/8270	54-107	0-31	10.0	165
1,4-Naphthoquinone	130-15-4	3520/8270	D-150	0-40	10.0	165
1-Naphthylamine	134-32-7	3520/8270	D-150	0-40	10.0	165
2-Naphthylamine	91-59-8	3520/8270	D-150	0-40	10.0	165
2-Nitroaniline	88-74-4	3520/8270	D-150	0-40	50.0	825
3-Nitroaniline	99-09-2	3520/8270	D-150	0-40	50.0	825
4-Nitroaniline	100-01-6	3520/8270	D-150	0-40	50.0	825
Nitrobenzene	98-95-3	3520/8270	51-112	0-23	10.0	165
2-Nitrophenol	88-75-5	3520/8270	23-130	0-26	10.0	165
4-Nitrophenol	100-02-7	3520/8270	1-148	0-22	50.0	825
N-Nitrosodi-n-butylamine	924-16-3	3520/8270	D-150	0-40	10.0	165
N-Nitrosodiethylamine	55-18-5	3520/8270	D-150	0-40	10.0	165
4-Nitroquinoline-1-oxide	56-57-5	3520/8270	D-150	0-40	10.0	165
N-Nitrosodimethylamine	62-75-9	3520/8270	47-115	0-29	10.0	165
N-Nitrosodiphenylamine	86-30-6	3520/8270	138-237	0-32	10.0	165
N-Nitrosodi-n-propylamine	621-64-7	3520/8270	35-124	0-31	10.0	165
N-Nitrosomethylethylamine	10595-95-6	3520/8270	D-150	0-40	10.0	165
N-Nitrosomorpholine	59-89-2	3520/8270	D-150	0-40	10.0	165
N-Nitrosopiperidine	100-75-4	3520/8270	D-150	0-40	10.0	165
N-Nitrosopyrrolidine	930-55-2	3520/8270	D-150	0-40	10.0	165
5-Nitro-o-Toluidine	99-55-8	3520/8270	D-150	0-40	10.0	165
Parathion	56-38-2	3520/8270	D-150	0-40	10.0	165
Pentachlorobenzene	608-93-5	3520/8270	D-150	0-40	10.0	165

*Screen Only

TABLE 5-20 (cont'd)
KEMRON'S QA OBJECTIVES AND ANALYTICAL METHODS FOR
APPENDIX IX SEMIVOLATILE ORGANIC ANALYSES OF
GROUNDWATER AND SOLID WASTE

PARAMETER	CAS #	EPA SW-846 METHOD	% RECOVERY *(ACCURACY)	% RPD (PRECISION)	WATER MDL (ug/L)	SOIL MDL (ug/Kg)
Pentachloroethane	76-01-7	3520/8270	25-125	0-40	10.0	165
Pentachloronitrobenzene	82-68-8	3520/8270	25-140	0-40	10.0	165
Pentachlorophenol	87-86-5	3520/8270	36-137	0-28	50.0	825
Phenacetin	62-44-2	3520/8270	5-150	0-40	10.0	165
Phenanthrene	85-01-8	3520/8270	72-108	0-20	10.0	165
Phenol	108-95-2	3520/8270	13-132	0-43	10.0	165
p-Phenylenediamine	106-50-3	3520/8270	D-150	0-40	10.0	165
Phorate	298-02-2	3520/8270	D-150	0-40	10.0	165
2-Picoline	109-06-8	3520/8270	D-150	0-40	10.0	165
Pronamide	23950-58-5	3520/8270	D-150	0-40	10.0	165
Pyrene	129-00-0	3520/8270	42-139	0-43	10.0	165
Pyridine	110-86-1	3520/8270	D-150	0-40	10.0	165
Safrole	94-59-7	3520/8270	D-150	0-40	10.0	165
1,2,4,5-Tetrachlorobenzene	95-94-3	3520/8270	25-125	0-40	10.0	165
2,3,4,6-Tetrachlorobenzene	58-90-2	3520/8270	10-130	0-40	10.0	165
Tetraethyldithiopyrophosphate	3689-24-5	3520/8270	D-150	0-40	10.0	165
Thionazin	297-97-2	3520/8270	D-150	0-40	10.0	165
o-Toluidine	95-53-4	3520/8270	D-150	0-40	10.0	165
1,2,4-Trichlorobenzene	120-82-1	3520/8270	29-98	0-35	10.0	165
2,4,5-Trichlorophenol	95-95-4	3520/8270	25-135	0-40	50.0	825
2,4,6-Trichlorophenol	88-06-2	3520/8270	16-140	0-14	10.0	165
0,0,0-Triethylphosphorothioate	126-68-1	3520/8270	D-150	0-40	10.0	165
sym-Trinitrobenzene	99-35-4	3520/8270	10-150	0-40	10.0	165

TABLE 5-21
KEMRON'S QA OBJECTIVES AND ANALYTICAL METHODS FOR TOXICITY CHARACTERISTIC LEACHING PROCEDURE ANALYSES OF GROUNDWATER AND SOLID WASTE EXTRACTS

PARAMETER	CAS #	EPA SW-846 METHOD	% RECOVERY (ACCURACY)	% RPD (PRECISION)	WATER MDL (ug/L)
Arsenic (As) - ICP	7440-38-2	3010/6010	75-125	0-20	100
Barium (Ba) - ICP	7440-39-3	3010/6010	75-125	0-20	10.0
Benzene	71-43-2	5030/8240	87-120	0-12	5.0
gamma-BHC (Lindane)	58-89-9	3510/8080	54-134	0-18	0.05
Cadmium (Cd) - ICP	7440-43-9	3010/6010	75-125	0-20	10
Carbon tetrachloride	56-23-5	5030/8240	57-131	0-29	5.0
Chlordane (technical)	57-74-9	3510/8080	45-115	0-40	1.0
Chlorobenzene	108-90-7	5030/8240	85-119	0-14	5.0
Chloroform	67-66-3	5030/8240	82-124	0-22	5.0
Chromium (Cr) - ICP	7440-47-3	3010/6010	75-125	0-20	200.0
m-Cresol	108-39-4	3520/8270	D-150	0-40	10.0
o-Cresol	95-48-7	3520/8270	D-150	0-40	10.0
p-Cresol	106-44-5	3520/8270	D-150	0-40	10.0
2,4-D	94-75-7	3510/8150	40-140	0-40	10.0
1,4-Dichlorobenzene	106-46-7	3520/8270	32-115	0-46	10.0
1,2-Dichloroethane	107-06-2	5030/8240	87-118	0-32	5.0
1,1-Dichloroethene	75-35-4	5030/8240	66-138	0-20	5.0
2,4-Dinitrotoluene	121-14-2	3520/8270	34-110	0-26	10.0
Endrin	72-20-8	3510/8080	56-154	0-28	0.1
Heptachlor	76-44-8	3510/8080	40-139	0-37	0.05
Hexachlorobenzene	118-74-1	3520/8270	47-103	0-17	10.0
Hexachlorobutadiene	87-68-3	3520/8270	28-83	0-28	10.0
Hexachloroethane	67-72-1	3520/8270	26-110	0-48	10.0
Lead (Pb) - ICP	7439-92-1	3010/6010	75-125	0-20	100
Mercury (Hg) - VAPOR	7439-97-6	7470	75-125	0-20	0.5
Methoxychlor	72-43-5	3510/8080	26-196	0-19	0.50
Methyl Ethyl Ketone	78-93-3	5030/8240	35-160	0-40	100.0
Nitrobenzene	98-95-3	3520/8270	51-112	0-23	10.0
Pentachlorophenol	87-86-5	3520/8270	36-137	0-28	50.0
Pyridine	110-86-1	3520/8270	D-150	0-40	10.0
Selenium (Se) - ICP	7782-49-2	3010/6010	75-125	0-20	100
Silver (Ag) - ICP	7440-22-4	3010/6010	75-125	0-20	40
2,4,5-TP (Silvex)	93-72-1	3510/8150	40-140	0-40	2.0
Tetrachloroethene	127-18-4	5030/8240	86-115	0-57	5.0
Toxaphene	8001-35-2	3510/8080	40-125	0-40	1.0
Trichloroethene	79-01-6	5030/8240	37-142	0-14	5.0
2,4,5-Trichlorophenol	95-95-4	3520/8270	25-135	0-40	50.0
2,4,6-Trichlorophenol	88-06-2	3520/8270	16-140	0-14	10.0
Vinyl chloride	75-01-4	5030/8240	47-128	0-18	10.0

Solid wastes are extracted by the TCLP extraction procedure 1311. The TCLP extracts are prepared (extracted) by 3510 or 3520. Non-aqueous liquids are prepared by waste dilution (3580).

TABLE 5-22
ANALYTICAL METHOD REFERENCES
FOR KEMRON QA TABLES 5-1 TO 5-20

Method 110.2 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 120.1 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 130.2 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 150.1 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 160.1 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 160.2 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 160.3 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 160.4 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 170.1 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 180.1 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 200.7 - "Inductively Coupled Plasma - Atomic Emission Spectrometric Method for Trace Element Analysis of Water and Wastes, Method 200.7," 40 CFR ch. 1 (7-1-85 Ed.), Appendix C to Part 136.
Method 202.1 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 202.2 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 204.1 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 204.2 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 206.2 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 206.3 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 208.1 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 208.2 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 210.1 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 210.2 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 212.3 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 213.1 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 213.2 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 215.1 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 218.1 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 218.2 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 219.1 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 219.2 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 220.1 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 220.2 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 236.1 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 236.2 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 239.1 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 239.2 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 242.1 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 243.1 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 243.2 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 245.2 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 245.5 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 246.1 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 246.2 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 249.1 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 249.2 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 258.1 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 270.2 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 270.3 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 272.1 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 272.2 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 273.1 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 273.2 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 279.1 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.

TABLE 5-22 (cont'd)
ANALYTICAL METHOD REFERENCES
FOR KEMRON QA TABLES 5-1 TO 5-20

Method 279.2 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 282.1 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 282.2 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 286.1 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 286.2 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 289.1 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 289.2 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 305.1 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 310.1 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 320.1 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 325.3 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 335.1 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 335.2 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 340.2 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 350.2 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 351.3 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 353.3 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 354.1 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 365.2 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 370.1 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 375.4 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 376.1 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 376.2 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 405.1 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 413.1 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 420.1 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 415.1 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 418.1 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 425.1 - "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA-600/4-79-020, 3-1-83.
Method 450.1 - "Total Organic Halide," U.S. Environmental Protection Agency, Method 450.1 Interim, November, 1980.
Method 601 - 40 CFR Part 136 (7-1-89 Ed.), Appendix A.
Method 602 - 40 CFR Part 136 (7-1-89 Ed.), Appendix A.
Method 608 - 40 CFR Part 136 (7-1-89 Ed.), Appendix A.
Method 610 - 40 CFR Part 136 (7-1-89 Ed.), Appendix A.
Method 624 - 40 CFR Part 136 (7-1-89 Ed.), Appendix A (a capillary column modified version).
Method 625 - 40 CFR Part 136 (7-1-89 Ed.), Appendix A (a capillary column modified version).
Method 909 - "Standard Methods for the Examination of Water and Wastewater," APHA-AWWA-WPCF, 16th Edition.
Method 1010 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 1110 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 2015 - ASTM, D2015-77.
Method 3010 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 3020 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 3050 - Test Methods for Evaluating Solid Waste Sw 846, Third Edition, 1986.
Method 3510 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 3520 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 3550 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 3580 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 5030 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 6010 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 7020 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 7040 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 7041 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 7060 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 7061 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 7080 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.

TABLE 5-22 (cont'd)
ANALYTICAL METHOD REFERENCES
FOR KEMRON QA TABLES 5-1 TO 5-20

Method 7090 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 7091 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 7130 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 7131 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 7140 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 7190 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 7191 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 7200 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 7201 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 7210 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 7380 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 7420 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 7421 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 7450 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 7460 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 7470 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 7471 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 7480 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 7481 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 7520 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 7610 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 7740 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 7741 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 7760 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 7770 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 7840 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 7841 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 7870 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 7910 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 7911 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 7950 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 7740 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 7741 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 8010 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 8020 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 8080 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 8100 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 8150 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 8240 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 8270 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 9010 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 9020 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 9030 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 9038 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 9040 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 9041 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 9045 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 9050 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 9060 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 9065 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 9071 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 9131 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 9200 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Method 9252 - Test Methods for Evaluating Solid Waste SW 846, Third Edition, 1986.
Hach Method - Hach COD System, Hach Chemical Company (See Federal Register, April 21, 1980, page 26811).

6.0 SAMPLING PROCEDURES

The primary objective of KEMRON sampling events is the collection of samples which when analyzed will consistently generate accurate, precise and representative data. By developing comprehensive standard sampling procedures and training personnel in the procedures, this objective can be met. Detailed sampling protocols have been developed by KEMRON for sampling of all types of environmental media. Following the standard sampling procedures ensures sample integrity and the highest degree of quality control throughout the sampling event.

6.1 General Sampling Guidelines

Standard Operating Procedures (SOPs) have been developed by KEMRON for potential sample sources. The SOPs are based upon State and USEPA guidance documents. SOPs are available to and reviewed by all field personnel. Following are general guidelines to be used in the collection of environmental samples:

1. Sample containers which are prepared in the laboratory may contain measured volumes of preservative. Such containers should not be rinsed prior to filling with sample.

2. Sample containers for volatile organic analyses (VOA), pH, and TOX must be completely filled with no headspace. All other sample analyte containers should be filled to approximately 95% capacity.

3. VOA samples must be collected in a manner which minimizes disturbance of the sample and potential for volatilization. Fill vials until a convex meniscus forms, then carefully place the septum cap on the vial. Invert the vial and check for the presence of air bubbles.

4. Field sampling equipment must always be appropriately decontaminated before and after use.

5. During the collection of all environmental samples, appropriate personal protective gear must be worn. Gloves and safety glasses are the minimum acceptable level of PPE to be worn when samples are collected.

6. Use pre-cleaned, laboratory prepared glassware for the collection of samples, whenever possible.

6.2 KEMRON Sampling Containers

The measurement of trace constituents in environmental samples demands methods capable of maximum precision and sensitivity. The selection and proper care of laboratory glassware and sample containers is an important part of the quality control program to eliminate errors due to contamination from improper cleaning procedures.

Only laboratory prepared containers contructed of materials which are compatible with and non-reactive with the material to be sampled will be used. Whenever possible, KEMRON uses commercial sample containers which are certified pre-cleaned to EPA standards. These containers are shipped in sealed boxes with custody seals. Glassware may be certified cleaned according to Protocol A, B, or C described below. Sample containers prepared by KEMRON follow washing procedures equivalent to these protocols.

Protocol A
1. Laboratory-grade detergent wash and rinse.
2. Acid, deionized water, and solvent rinse.
3. Oven drying, capping, and packing under quality control conditions.

Protocol B
1. Laboratory-grade detergent wash and rinse.
2. Multiple deionized water rinses.
3. Oven drying, capping, and packing under quality control conditions.

Protocol C
1. Laboratory-grade detergent wash and rinse.
2. Acid rinse.
3. Multiple deionized water rinses.
4. Oven drying, capping, and packing under quality control conditions.

Table 6-4 lists the container type and volume required for each sample type.

6.3 Sample Preservation

Use of cooling, pH control, and chemicals to retard biological activity or to stabilize the chemical species of a sample is known as preservation. Sample kits prepared by the laboratory include sample containers prepared with the appropriate type and

volume of preservative for the analyte of interest. Addition of preservative to samples in the field is not required when using the prepared kits. This procedure minimizes the potential for incorrect or inadequate sample preservation.

The most common form of preservation is cooling the sample to 4° C using ice or refrigeration. Other common preservatives used include:

1. Hydrochloric acid - diluted 1:1 with deionized water.
2. Nitric acid - dilute 1:1.
3. Sulfuric acid - dilute 1:4
4. Sodium hydroxide - 50% solution.
5. Sodium thiosulfate - for dechlorination.

Table 6-4 lists the preservation techniques employed by KEMRON for each sample type.

6.4 Sample Documentation

6.4.1 Sample labels

When using laboratory prepared sample kits, prelabeled and preserved sample containers are provided. Each sample collected by KEMRON is clearly labeled using water proof ink with the following information:

1. Client name.
2. Date and time of collection.
3. Sample source.
4. Preservative required.
5. Name(s) of sampler.
6. Analyses requested.
7. Sample identification.

6.4.2 Field records

Sampling personnel must maintain complete and accurate records of all field activities. Bound field notebooks and/or field logs specific to the media sampled are completed during each sampling project. All pertinent information on the sampling event is included in the field record. Refer to the appropriate SOP in section 6.7 for sample specific information requirements.

6.4.3 Chain-of-custody

All samples must be accompanied by a completed chain-of custody form when shipped or hand delivered to the laboratory. Information required on the chain-of-custody includes:

- Sample date and time.
- Name(s) of sampler(s).
- Sample ID.
- Project name and number.

- Analyses requested.
- Number of sample containers.
- Signature and date of all individuals who have custody of the samples.

6.5 Sampling Equipment Decontamination

All field sampling equipment will be appropriately pre-cleaned prior to leaving the base of operations. Use phosphate free detergent, hot tap water, and analyte free rinse water for this cleaning following the procedure specified for analytes of interest. Cleaned equipment should be wrapped or enclosed to maintain cleanliness during transport to the field for use. Adequate quanitities of sampling equipment should be provided for each sampling event to minimize the need for field decontamination.

Decontamination procedures for sampling equipment may include:

1. Phosphate-free detergent and tap water wash.
2. Rinse with tap water.
3. For equipment to be used for trace metals sampling, rinse with 1:1 reagent grade nitric acid solution. **Do not rinse stainless steel sampling equipment with nitric acid.**
4. Rinse thoroughly with deionized water.
5. Rinse with isopropanol or methanol.
6. Thoroughly rinse with analyte-free water (if available).
7. Air dry.
8. Wrap securely to prevent contamination if equipment is to be stored or transported.

Information on specific decontamination procedures are provided in each sampling SOP. Special decontamination procedures will be implemented as necessary, based upon contaminants encountered.

Equipment which is heavily soiled may require steam cleaning and/or high pressure washing. Drilling equipment and other heavy equipment used in field sampling activities will likely require this type of cleaning.

If equipment cannot be adequately decontaminated, it will be discarded.

6.6 Field Waste Disposal Practices

Field generated waste is disposed of as required by project specifications and in accordance with applicable local, state, and federal requirements. Wastes commonly generated include drill cuttings, drilling fluids, well development water, well purge water, decontamination fluids, and contaminated personal protective equipment.

Based upon site and project specific requirements, liquid wastes may be containerized for characterization and disposal or discharged directly to an appropriate discharge location. Solid wastes may be containerized and left on-site for disposal or, if appropriate, disposed as general refuse.

Prior to initiating any sampling activity the waste handling requirements should be determined to ensure timely disposal in compliance with regulatory requirements.

6.7 Standard Operating Procedures for Environmental Sampling

Appendix B presents table's of content for our SOPs for a variety of sampling activities. Included are sections on sampling waste water, surface water, ground water monitoring wells, potable water, soil and sediments, and containers. These SOPs are followed by KEMRON personnel for the collection of all samples unless site specific protocol are provided by the client.

7.0 SAMPLE CUSTODY

In recognition of the critical nature of sample custody protocol, KEMRON Environmental Services has implemented stringent standard operating procedures, designed to ensure sample integrity and thorough documentation. This section provides a clear description of sample traceability from sampling kit to final sample disposition.

7.1 Sampling Kits

Kemron Environmental Services, Inc., at the client's request, will provide sampling kits, KEM-KITS, to the client. Additional information on KEM-KITS can be found under Section 6 of this SOP.

7.2 Field Custody Protocol (Also see Section 6.1.3)

A vital component of KEMRON's quality assurance program is to ensure that a clear and detailed record is kept of all samples and sampling activity. Field records are kept in bound field notebooks and on standard monitoring well sampling forms, as well as custody forms. These books are kept in the appropriate project files. Water-proof ink is used to label samples as protection against loss of information due to accidental erasure. Waterproof ink is also used, when applicable, for field notebook entries and field sampling logs. KEMRON's sample custody protocol requires that the following information be kept in the project field notebook.

a. Sample date

b. Specific description of sample location. This will include a monitoring well number in the case of groundwater sampling. For soil sampling, sample points will be sketched on a site map and confirmed via surveying. For surface water and sediment sampling, the drum number, (if labeled), drum location, suspected contents, and phase of drum materials (liquid, solid or sludge) will be noted, as well as which layer or layers within the drum were sampled.

c. Name(s) of sampler(s) will be identified.

d. A description of weather conditions and general site conditions

(disturbed soils, standing water, ongoing activities, etc.) will be provided.

e. A description of the sampling equipment used, including method for purging monitoring wells must be indicated.

f. The specific field ID number for a sample will be recorded as well as the sample sequence number, which is the order in which a particular sample was taken with respect to all other samples retrieved at the site.

g. Time of sample collection must be noted.

h. Components or constituents of sample to be analyzed are to be noted.

i. Signature(s) of sampler(s) will be provided.

j. Types of preservatives and, if necessary, the results of field checks (pH, etc.) must be recorded.

k. Field measurement data (such as OVA reading, pH, specific conductance) will be recorded.

7.3 Sample Transport

Samples are transported to KEMRON's laboratory by one of three modes:

7.3.1 On some projects, KEMRON will have responsibility for preparation of sample bottles, sample kit assembly and delivery of sample kits to the project site. KEMRON will also pick up the samples at the project site and transport them to the laboratory. KEMRON drivers will follow these established protocols:

a. The driver will carry proper KEMRON identification, which they will be prepared to display before entering project sites.

b. The KEMRON driver will sign the Chain-of-Custody forms when picking up the samples.

c. The driver is responsible for the integrity and security of samples while in their custody.

d. The driver must secure the vehicle at all times when it is necessary to stop and be away from the vehicle for any reason during the transportation of samples to the laboratory.

e. All samples collected or picked up by KEMRON personnel are delivered immediately to the Sample Custodian in the sample logging station. The Shipping and Receiving entrance is to be used for such deliveries.

7.3.2 UPS or Other Common Carrier - Transporters are directed to the Shipping and Receiving entrance and the samples are delivered to the Sample Custodian.

7.3.3 Client Deliveries - Clients may deliver samples in person via the designated Receiving entrance, but must be escorted while within the facility.

7.4 Normal Laboratory Custody

The National Enforcement Investigations Center (NEIC) of EPA defines custody of evidence in the following manner:

a. It is in your possession, or

b. It is in your view, after being in your possession, or

c. It was in your possession and then you locked or sealed it to prevent tampering, or

d. It is in a secure area

For the purpose of sample custody, KEMRON Environmental Services maintains that the laboratory in its entirety is a secure area, and all samples received and logged into the laboratory remain in the custody of the Sample Custodian, Supervisor or Analyst, until time of disposal. Extended Laboratory Custody is available for special projects.

7.5 Extended Laboratory Custody (Optional)

In order to satisfy more stringent Chain-of-Custody requirements, the following standard operating procedures can be implemented by KEMRON Environmental Services, Inc. upon the request of the client.

a. Samples will be stored in a secure area

b. Refrigerators, freezers and other designated sample storage areas will be securely maintained or locked

c. Only the designated Sample Custodian or supervisory personnel will have keys to locked sample storage units until removed for sample preparation or analysis.

d. Samples will remain in secure sample storage units until removed for sample preparation or analysis.

e. All transfers of samples into and out of storage will be documented on the Sample Control Record. These records will be maintained in the project case files. (See Fig. 7-5)

f. After a sample or extract has been removed from storage, the analyst is responsible for the custody of the sample.

7.6 Sample Log-In

The Sample Custodian is solely responsible for logging all samples into the Sample Analysis Management (SAM) computer system, maintaining the KEMRON logbook, signing the Chain-of-Custody and sample receipt forms, initiating paperwork for report files and analytical worksheets, reporting all problems, inconsistencies, or anything questionable to the Project Manager, placing all samples in storage, monitoring conditions in sample storage areas, maintaining records for laboratory Chain-of-Custody and maintaining sample inventory and disposal schedule.

7.6.1 Receipt & Inspection

The Sample Custodian will receive all incoming samples. The Custodian will open the shipping containers and note the presence/absence of Chain-of-Custody forms and seals, airbills, or bills-of-lading. The Custodian will examine the shipping container to verify the integrity of the sample(s) and examine the sample documentation and identification to assure it is correct and the proper preservative has been used. If inspection indicates samples were damaged in transit, the shipping container will be moved to the hood in Log-In, assessments of the damage will be made and the Support Services

Supervisor and the Project Manager will be notified. The client will be immediately contacted and determination of the degree of hazard will be made. If damage is minimal and the client requests it, an attempt to salvage the sample(s) will be made if it can be done safely. In the event of damaged hazardous samples, KEMRON's Spill Response Team will be notified per the Chemical Hygiene Plan.

Samples received after hours, when the Sample Custodian is absent, will be placed in the walk-in refrigerator. The person receiving the shipping container will sign for the container, and place the dated forms on the Custodian's desk. The Sample Custodian will log in the samples on the next business day. The logbook will indicate the actual date and time received and the original receipt of documentation will be attached to the Chain-of-Custody form.

7.6.2 Inspection

The Sample Custodian will compare the Chain-of-Custody forms and labels to verify agreement of information contained therein. If discrepancies are found, they will be noted in the Sample Analysis Management (SAM) system. The KEMRON Project Manager will be immediately notified. Written documentation of all problem resolutions will be placed in the project/case file. If there are no problems with the samples received, the Sample Custodian files the signed Chain-of-Custody form in the project/case file. After the sample is logged in, it will be immediately stored under the proper conditions.

Sample labels or other sample documents that appear to be contaminated due to sample breakage or other problems will be dried under a fume hood and be separately sealed in plastic bags prior to being placed in case files. The KEMRON Project Manager must also be notified.

7.6.3 Logging Procedures

As a new KEMRON work order is initiated in the SAM computer system, the Sample Custodian will enter the following information about the project shipment. They will also begin a new entry in the KEMRON hard-bound logbook as backup.

a. KEMRON Work-Order Number (Assigned by SAM)

b. Client Sample Identification

c. Date and Time of Sample Collection

d. Project #/Work ID #/Sample ID #

e. Container size/type/matrix/condition/storage location/preservative

f. List of analyses

g. Date Received/Date Due

h. Mode of transportation/Sampler's name

i. Notation of problems or discrepancies

In order to maintain sample identity, each sample received will be assigned a unique sample I.D. number. The SAM system will assign the unique nine-digit KEMRON Sample Number at the time of log-in, as shown in the following example:

EXAMPLE: N212001-01

The first seven digits identify a group of related samples and become the work order number and report number. The two-digit number after the dash identifies a specific sample in the work order. These numbers are used by KEMRON for continuous identification of the sample from receipt to completion of analysis. Sample containers (i.e. bottles and extract vials) will be clearly identified with the appropriate sample number. The sample labeling process is accomplished by the SAM system to print the required number of computer labels. On those projects where it is necessary to distinguish fractions or containers of the same sample source, alpha suffixes to further identify the sample bottles will be added to the number.

EXAMPLE: N212001-01A Volatile Organics Fraction
N212001-01B PCB Fraction

Extract vial numbers and metal digests will correspond to the KEMRON sample number from which they originated. These numbers will also be recorded on sample tracking documentation.

7.7 Sample Storage

Samples and extracts will be stored in uniquely identified refrigerators which are in secure areas of the laboratory. Each storage unit (i.e. refrigerator) has been assigned a unique identification number which is referenced in the logbook for each sample it contains.

The Sample Custodian or designated assistant will make a daily check of the temperature of each refrigerator in the log-in area and maintain a record book. This record book will be reviewed on a monthly basis by the Support Services Supervisor to note any trends or inconsistencies. The acceptable range for sample storage is 4 degrees Celsius, + or - 2 degrees. The Sample Custodian will notify the Support Services Supervisor of any refrigerator temperature problem which cannot be corrected by simple thermostat adjustment. A list of emergency repair numbers for the refrigeration units is attached to the walkin refrigerator's exterior.

7.8 Sample Distribution and Tracking

Both the preparation and the analysis of samples will be documented using special forms (logbooks). Each analyst will have permanent laboratory notebooks which will contain analytical information in sufficient detail to enable tracking. Once analysis is complete, the analyst will return the unused sample to the Sample Custodian area. The sample is then returned to the main cooler. Figure 7-5 provides a sample of the KEMRON sample control record form.

Samples and extracts will be returned to their original storage units after completion of analyses. Samples which have exceeded their regulated holding period will be placed in the Sample Archive Room. They are routinely stored in this area for a minimum of 30 days after the due date for the analytical report. They are then disposed per protocol listed in KEMRON's "Waste Management SOP".

It is important to note that samples received for analysis of volatile organic compounds (VOA) are segregated from other samples. Standards are also segregated from ALL samples in designated storage units.

7.9 Sample Security

The main walkin sample storage refrigerator is equipped with a lock. The unit is kept locked and the area is monitored by the Sample Custodian or the Laboratory Supervisors. Only selected personnel have access (by key) to the sample storage unit. All samples, extracts and digests will be stored in segregated areas.

7.10 Laboratory Building Security

All access doors to the building, with the exception of the main entrance to the reception area, remain locked. Only select KEMRON employees have keys to the access doors to the building. The main entrance is unlocked only on business days between the hours of 8:00 AM and 5:00 PM.

7.10.1 Employee Access

a. All employees must enter the building through the main entrance. Keys are required except during normal business hours. Employees may exit through the main entrance when it is locked without the use of a key, but keys are required for re-entry.

b. At the end of the work day, employees must sign out and exit through the main entrance.

7.10.2 Visitors, Vendors and Deliveries

a. All visitors to the office or laboratory must enter the main lobby through the main entrance and sign in with the receptionist. Visitors must be escorted at all times and in all areas of the facility.

b. Vendors and delivery personnel are directed to use the door to the Shipping and Receiving area. Access to this door is controlled by the KEMRON employee on duty and, upon entrance, the visitor must be escorted at all times.

7.11 Sample Subcontracting/Shipping

For certain projects, it may be necessary for KEMRON to subcontract some

analyses. Samples to be analyzed will be shipped to the contracted laboratory using the KEMRON KEM-KIT. To prevent sample breakage, only EPA-approved sample containers will be used. Freezer packs will be included in each KEM-KIT to serve as a separation divider for the samples and to increase the cooling capacity. In order to maintain the temperature of samples at 4 degrees Celsius, + or - 2 degrees, wet ice will be supplied by the client when required. Each shipping kit will contain the following:

a. Corrugated partitions to hold sample bottles

b. Freezer pack(s)

c. Chain-of-Custody form / Log-out form

Each styrofoam box will be placed in a KEMRON KEM-KIT corrugated box. The corrugated box top will be sealed with KEMRON Chain-of-Custody tape.

7.12 Electronic Data Security

Data integrity is insured through daily backups and multi-level security. Access to the specific user privileges can be individually controlled.

Each user has their own user name and password which allows certain privileges. Several pieces of hard copy documentation are generated for verification, but are unsigned. Signatures on the client's final report indicate that all of these forms have been reviewed. Reports are signed by the appropriate laboratory supervisors after reviewing all of the paper documentation from the labs.

These hard copy forms contain all of the data regarding a group of samples, and are kept in a folder. When the information in the folder is not consistent with information in the computer, a problem has been identified. As a rule, data is not electronically transferred to the client through modems or networks; however, KEMRON can provide copies of final reports on floppy disks. Since our existing software is licensed from another company, we do not maintain records on its documentation. Any minor modifications to our software has been documented at the beginning of the program source code. This can be read, but not modified, by all users of the software.

Data entry will be verified by printing a review sheet. This sheet is to be compared to the sheet(s) from which the data was entered. This is done for every set of results (every test run). Software and equipment are tested by constant data verification. Data regarding samples is to be checked for accuracy four times, as follows:

a. When the samples are logged in

b. When permission is given to begin work on the samples and paper documentation associated with the samples is distributed, called transmittal

c. When the results are entered

d. When the client's report is generated

Figure 7-1
KEMRON ENVIRONMENTAL SERVICES
MONITORING WELL SAMPLE LOG

Client/Facility:_____

Well ID:_____

Well Locked:_____ Yes_____ No

Bailer Present:_____ Yes_____No

Well Datum Marked:___Yes___ No

Bailer Pre-Cleaned:_____ Yes_____ No

Datum:_____ MSL _____ Local Benchmark

Dedicated Pump:_____ Yes_____ No

Well Datum Elevation:_____ (FT)

Product Level:_____ (0.01 FT)

Well Volume:_____ (Gallons)

Corrected Potentiometric Surface Elevation:_____ (FT)

Purge Volume:_____ (Gallons)

Floaters:_____ Yes_____ No

Sinkers:_____ Yes_____No

Water Table Elevation:_____(FT)

pH:_____(Units)

Calibrated:_____/_____(Date/Time)

Specific Conductivity:_____(umbos/cm)

Calibrated:_____/_____(Date/Time)

Temp:_____(°C)

Calibrated:_____/_____(Date/Time)

Bottles Labeled:_____ Yes_____ No

Sampling Completed:_____/_____ (Date/Time)

Bailer Returned & Well Locked:_____ Yes_____ No

Custody Form Completed:_____ Yes_____ No

Samples Iced:_____ Yes_____ No

Coolers Sealed:_____ Yes_____ No

Sealed No:_____

Carrier:_____

Date/Time:_____/_____

Collector:_____
Signature

Date/Time:_____/_____

NOTES:_____

Figure 7-2
KEMRON CHAIN-OF-CUSTODY RECORD

KEMRON
ENVIRONMENTAL SERVICES

№ 54012

CHAIN-OF-CUSTODY RECORD

Page _____ of _____

Project Contact:

Turn Around Requirements:

Project No.: Project Name:

Sampler (print): Signature:

Sample I.D. No.	Comp*	Grab	Date	Time	Protocol CWA	Protocol SW846	NUMBER OF SAMPLES	Hold																ADDITIONAL REQUIREMENTS

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

Relinquished by: (Signature)	Date	Time	Received for Laboratory by: (Signature)	Date	Time	Remarks:

*Homogenize all composite samples prior to analysis

White – Lab Yellow – Office Pink – Field

Figure 7-3
SAM System Log Sheet Printout

00-005 Log Sheet Marietta, Ohio ;12/4/1992

Project: Groundwater Analyses
Shipped by: Fed Ex
Sampled by: Richard Roe

Client ID: ABC_59999
ABC Company
Somewhere, USA

Received On: 12/03/92 Due Date: 12/24/92
Written by: DOE Contact: D_HILL
Atten: John Doe

Frac ID	Category	Sample ID	Date Collected
01A-01F	WATER	MW 1A	12/02/92 14:00:00
03A-03F	WATER	MW 4A	12/02/92 16:00:00
05A	WATER	Trip Blank	12/02/92 17:00:00
02A-02F	WATER	MW 2B	12/02/92 14:45:00
04A-04F	WATER	MW 5A	12/02/92 17:00:00

Frac ID	Location/Type	Test Codes
01A-04A	*	COND_F PH_F TEMP_C
05A	v1 (2)40g HCL	M8240
01B-04B	wy4 250p H2SO4	TOC
01C-04C	wr3 1000p HNO3	AG AS BA CD CR DIGEST HG PB_FU SE
01D-04D	v1 (2)40g HCL	M8240
01E-04E	wg8 (2)1000g 4c	M8270
01F-04F	wg8 (2)1000g 4c	M8080

Frac ID	Comments
01A	Cond: 350 pH: 7.8 Temp: 12c
03A	Cond: 450 pH: 7.5 Temp: 13c
02A	Cond: 500 pH: 7.2 Temp: 13c
04A	Cond: 600 pH: 7.0 Temp: 14c

Figure 7-4
The KEMRON SAM System
(Sample Analysis Management system)

Figure 7-4
The KEMRON SAM System
(Sample Analysis Management system)

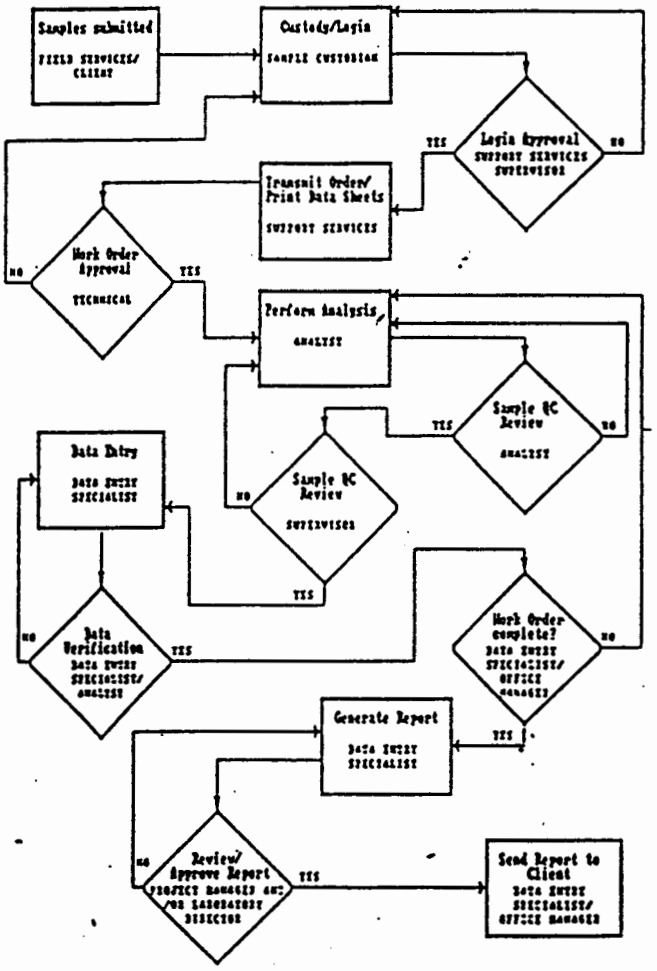


Figure 7-5
KEMRON SAMPLE CONTROL RECORD FORM
SAMPLE CONTROL RECORD

Refrigerator No.

KEMRON

Kemron Sample Number	Removed By	Date/Time Removed	Reason	Date/Time Returned

Figure 7-6
KEMRON KEM-KIT LOG SHEET

Sample Code:_____

Samples/kit:_____

Analysis/Type/Volume/Preservative: - No. of bottles/sample

A. CLP Organics
1. CLP Volatiles/Glass/40ml vial/HCL/4°c _____
2. CLP Semi-Vol/Glass/1000ml/4°c _____
3. CLP Pest-PCB/Glass/1000ml/4°c _____

B. CLP Inorganics (+CNA)
1. CLP Metals/Plastic/1000ml/HNO3 _____
2. CLP CN_T/Plastic/1000ml/NaOH _____
3. CN_Amenable/Plastic/1000ml/NaOH _____

C. General Parameters
1. pH/Glass/40ml vial/4°c _____
2. General/Plastic/1000ml/4°c/Cond, TDS,F,SO4,Silica,Alk,Cl _____
3. Tin, total/Plastic/250ml/HNO3 _____
4. TOC/Glass/40ml/H2SO4 _____
5. NH3/Plastic/1000ml/H2SO4 _____

Comments/ Remarks:_____

Packed by: _____ Date/Time:_____
Received by:_____ Date/Time:_____
Seal Intact?_____

Sampled By:_____ Date/Time:_____
Observed By:_____ Date/Time:_____
Received By:_____ Date/Time:_____

cc: KEMRON/ ORMET

Figure 7-7
KEMRON BOTTLE LABEL

KEMRON

Client: _____
Sample Source: _____
Date: ___/___/___ Time: _____
Taken By: _____
Parameters _____
_____
_____
Preservative _____

8.0 ANALYTICAL PROCEDURES

KEMRON carries out analyses of all samples in accordance with EPA-approved methods. Whenever EPA-approved methodology does not exist for a particular parameter, ASTM methods or other literature methods are used.

All parameters for which KEMRON commonly tests are presented in section 5.0. Tables 5-1 to 5-20 present all parameters, along with their CAS numbers, the method of digestion, extraction or analysis, the accuracy, the precision and the PQL or MDL. The only exception is the Foxboro Organic Vapor Analyzer, a field screening method given below.

Field pH readings are made using an electronic meter according to EPA Method 150.1. Specific conductivity is also measured with an electronic meter according to EPA Method 120.1. Temperature readings are made with a standard mercury-filled glass thermometer using EPA Method 170.1.

The HNU GP101 is a portable photo ionization detector designed for field screening of organic vapor constituents. The PID is often used initially in a survey mode to check wells, soils borings or tank pit excavations from possible contamination. KEMRON's standard procedure for use of the PID as a field screening instrument is included as section 6.7 of this document.

8.1 Selection of Glassware

The measurement of trace constituents in water demands methods capable of maximum precision and sensitivity. The selection and proper care of laboratory glassware and sample containers play an important role in our quality control program, since the very sensitive analytical systems are subject to errors from improper choice of apparatus, as well as the contamination effects due to improper cleaning procedures.

Laboratory vessels serve three functions: storage of reagents and samples, measurement of solution volumes, and confinement of reactions. Listed below are some guidelines for the proper selection of laboratory glassware:

a. Borosilicate glass, i.e., "Pyrex" or "Kimax," is the mainstay of the laboratory. Other special types of glass are generally not required for the analyses given in "Methods for Chemical Analysis of Water and Wastes".
b. "Soft glass" should not be used.

c. The analytical method usually states whether or not borosilicate type glassware is acceptable. A notable example is the analysis of boron, where the reactions are carried out in Vycor dishes.
d. Unless otherwise stated, borosilicate glass or polyethylene bottles are acceptable for storage of reagents used in inorganic analyses.
e. Storage of standards used in atomic absorption analyses should be in a polyethylene container, except where noted in the method, i.e., silver.
f. Storage of reagents and standards used in trace organic analyses (IR, GC, GC/MS) will be in borosilicate glass only.

8.1.1 Volumetric Glassware

The precision of volumetric work depends in part on the precision with which volumes of samples and other reagents can be measured. By common usage, accurately calibrated glassware for precise measurement of volume has become known as volumetric glassware. Glassware that meets Federal Specification for Volumetric Glassware is designated as Class A. Except for NBS certified glassware, Class A is the most precise grade and is available in buret, volumetric flasks, and volumetric pipettes. Class A glassware must be used in the following laboratory procedures:

a. Preparation of all primary standards require Class A volumetric flasks.
b. Preparation and dilution of stock standards require Class A flasks and Class A pipettes.
c. All standardizations require the use of Class A buret, volumetric flasks, and pipettes.
d. Class A glassware will be used at all times as specified in the standard analytical method.

8.1.2 Cleaning Requirements

Table 8-1 summarizes the general cleaning procedures to be used for all laboratory glassware and reusable sample bottles (glass). All glassware must be scrupulously cleaned in order to remove any possibility of contamination of the sample. (NOTE: Under no circumstances are sample containers for trace level inorganic or organic analyses ever cleaned and reused.)

TABLE 8-1
LAB GLASSWARE CLEANING PROCEDURES

Analysis/Parameter	Cleaning Procedure (in order specified)
Extractable Organics (including Pesticides and Herbicides)	1-7, 13, 15,
Purgeable Organics	1-7,
Trace Metals - glass	1-4, 12, 4
plastic	1-4, 11, 4
Nutrients	1-4
Minerals, COD, BOD, Radiochemistry, Cyanide, Phenols	1-4
Residues	1-4, 14
Petroleum Hydrocarbons	1-7,
Oil & Grease	1-8, 13

Cleaning Procedures (bottles and septa):

1. Remove all labels using sponge or acetone.
2. Wash with hot tap water and a brush to scrub inside of glassware, stopcocks, and other small pieces, if possible, using a suitable laboratory-grade detergent.
   - Organics - Liquinox, Alconox or equivalents
   - Inorganic anions - Liquinox or equivalent
   - Inorganic cations - Liquinox, Acationox, Micro or equivalents
   - Bacteriologicals - must pass an inhibitory residue test
3. Rinse thoroughly with hot tap water.
4. Rinse thoroughly with deionized water.
5. Rinse thoroughly with 25% H_2SO_4 (Sulfuric Acid).
6. Rinse 3 times with deionized water.
7. Rinse thoroughly with pesticide grade Methanol.
8. Rinse thoroughly with pesticide grade Hexane.
9. Rinse or soak with 1:1 HCL (Hydrochloric acid).
10. Rinse or soak with >10% HNO_3 (Nitric acid).
11. Bake at 105 °C for 3-4 hours.
12. Bake at 180 °C for 3-4 hours (prior to use as per method).
13. After use, rinse with last solvent used.
14. Store inverted or capped with suitable material or suitable container stopper.
15. Last step (prior to use) should be a rinse with the solvent used in analysis.

TABLE 8-2
REAGENT STORAGE

REAGENT	METHOD OF STORAGE
Hydrochloric Acid (HCl)	Stored in original containers in a vented cabinet designed for acid storage.
Sulfuric Acid (H_2SO_4)	Stored in original containers in a vented cabinet designed for acid storage.
Nitric Acid (HNO_3)	Stored in original containers in a vented cabinet designed for acid storage.
Acetic Acid ($C_2H_4O_2$)	Stored in original containers in a vented cabinet designed for acid storage.
Phosphoric Acid (H_3PO_4)	Stored in original containers in a vented cabinet designed for acid storage.
Ammonium Hydroxide (NH_4OH)	Stored in original containers in a vented cabinet designed for base storage.
Acetone (C_3H_6O)	Stored in original containers in a vented cabinet designed for flammable materials.
Chloroform ($CHCl_3$)	Stored in original containers in a vented cabinet designed for volatile organics storage.
Methanol (CH_3OH)	Stored in original containers in a vented cabinet designed for flammable materials.
Toluene (C_7H_9)	Stored in original containers in a vented cabinet designed for volatile organics storage.
Benzene (C_6H_6)	Stored in original containers in a vented cabinet designed for volatile organics storage.
Methylene Chloride (CH_2Cl_2)	Stored in original containers in a vented cabinet designed for volatile organics storage.
Ethyl Ether ($C_4H_{10}O$)	Stored in original containers in a vented cabinet designed for volatile organics storage.
Hexane (C_6H_{14})	Stored in original containers in a vented cabinet designed for organics storage.
Propyl Alcohol (C_3H_8O)	Stored in original containers in a vented cabinet designed for flammable materials.
Isopropyl Alcohol (C_3H_8O)	Stored in original containers in a vented cabinet designed for flammable materials.
Pyridine (C_5H_5N)	Stored in original containers in a vented cabinet designed for flammable materials.
Ethyl Acetate ($C_4H_8O_2$)	Stored in original containers in a vented cabinet designed for flammable materials.
Freon-113	Stored in original containers in a vented, glass enclosed, liquid-liquid continuos extraction sample prep area.

8.2 Reagent Storage

All reagent storage at KEMRON is done in such a way that safety is always considered first. All flammable compounds are stored in a flammable cabinet. Volatile reagents are always stored and used in a well-ventilated area. Table 8-2 gives a complete list of reagents used at KEMRON and the method with which they are stored. Reagents which are used in the digestion/extraction/analysis process are certified as an ultra pure grade by the manufacturer with certification papers kept on file. Other reagents used for such things as glassware washing are of reagent grade or better. All chemicals and reagents are labeled with the date received and date opened.

8.3 Waste Disposal

KEMRON is an environmental firm that makes every effort to be environmentally conscious. Since all laboratory work with chemicals eventually produces waste, we are aware of our moral and regulatory obligations to utilize sound waste management policies and procedures. Therefore, the disposal of waste at our facility is an issue of great importance and one which has been given much attention. The specifics of KEMRON's waste management system are included in the "Waste Management SOP", a copy of which may be reviewed upon request. The Table of Contents for this SOP may be found in Appendix B.

9.0 CALIBRATION PROCEDURES AND FREQUENCY

9.1 Instrumentation

Since the modern analytical laboratory depends heavily upon instrumentation, their calibration, operation and maintenance must be a primary concern in the production of satisfactory data. Below is a list of the instruments commonly used by KEMRON in the analysis of the parameters listed in Section 5.0.

Analytical balances
Sartorius B-610

Sartorius B-610 OVRD

Mettler H54AR

Mettler PV-3600

Mettler AE-160

Mettler PC-2200

Auto Analyzer
Bran & Leubbe TRAACS Model 800

Block Digestor
Bran & Luebbe Model BD-40

Bomb Calorimeter
Parr Model 2901EB

COD Reactor
Hach Model 16500-10

Conductivity meter
YSI Model 31

Flashpoint Apparatus
Precision Scientific 74537

Infrared (IR) Spectrophotometer
Perkin-Elmer Model 1310

Oxygen Meter
YSI Model 57

pH/Selective-ion meters
Sargent Welch Model 8400

Orion Model 701A

Total Organic Carbon (TOC) Analyzer
Astro Model 2001

Total Organic Halide (TOX) Analyzer
Two Dohrmann Model MC-1 (DX-20)

Turbidimeter
Hach Model 2100A

Visible, Ultra Violet (UV) Spectrophotometers

Shimadzu Model UV-120-02

Atomic Absorption (AA) Spectrophotometer
Varian 400Z

Microwave Digestion
CEM 2000

Atomic Absorption (AA) Spectrophotometer
Varian Spectra AA-40 with the DS-15 data station and PSC-76 programmable auto sampler

Graphite Furnace Atomic Absorption (GFAA) Accessory
Varian GTA-96 Graphite Tube Atomizer with the Varian Spectra AA - 40 Spectrometer, the DS-15 data station and PSC-76 programmable auto sampler

Cold Vapor Atomic Absorption (CVAA) Accessory
Varian VGA-76 Vapor Generator with the Varian Spectra AA - 40 spectrometer, the DS-15 data station and PSC-76 programmable auto sampler

Inductively Coupled Plasma (ICP)
Leeman Labs PS4 with the Data Spec software system

Gas Chromatographs (GC)
Hewlett-Packard (HP) 5890 GC with dual Electron Capture Detectors (ECD), dual HP 7673A auto samplers and a HP Chem Station data system.

Hewlett Packard (HP) 5890 GC with dual Electron Capture Detectors (ECD), dual HP7673A auto samplers and dual HP3396A Integretor Data Systems.

Hewlett-Packard (HP) 5890 GC with dual Flame Ionization Detector (FID), an HP 7673A auto sampler and an HP 3396A Integrator data system.

Hewlett-Packard (HP) 5890 series II GC with a tandem OI 4430 Photoionization Detector (PID) and an OI 4420 Electrolytic Conductivity Detector (ELCD). This instrument is equipped with a Tekmar LSC 2000/ALS 2016 purge and trap system with sample heaters and is controlled by an HP Chem Station data system.

Hewlett Packard (HP) 5890 series II GC with tandem OI 4430 Photoionization Detector (PID) and Flame Ionization Detector (FID). This instrument is equipped with a Tekmar LSC 2000/ALS 2016 purge and trap system with sample heaters and is controlled by an HP Chem Station data system.

Gas Chromatograph/Mass Spectrometers (GC/MS)
Two Finnigan MAT Incos-50 Quadrupoles with Hewlett-Packard (HP) 5890 GC's and HP 7673A auto samplers with Data General 10 computers and Incos 50 MS/DS software version 9.0.

Three Finnigan MAT Incos-50 Quadrupoles with Varian 3400 GC's and Tekmar LSC 2000/ALS 2016 purge and trap systems with sample heaters. These systems are equipped with Data General 10 computers and Incos 50 MS/DS software version 9.0.

Other miscellaneous equipment includes:

TCLP waste characterization apparatus:
Millipore Pressure Filtration Unit
Millipore ZHE Hazardous Waste Filtration Unit
Associated Design Rotary Agitators - 12 Units
Environmental Express Rotary Agitators - 10 Units
Associated Design Rotary Agitators - 6 Units
Associated Design Zero Headspace Extractors - 11 Units
Refrigerators, freezers various makes - 13 Units

Ovens, various makes - 8 Units

Incubators - 3 Units

Water Baths - 3 Units

Organimation Nitrogen Evaporator

Sonicators - 2 Units

Instrument Log Books: Every analytical instrument in the laboratory which requires calibration and/or maintenance to generate reliable data must have a logbook. The instrument logbook will begin with the initial installation and setup procedures performed by the company field engineers. Daily operational notes, problems, routine maintenance procedures, instrument zero and calibration set points, calibration data and repair notes will be a permanent part of the instrument log. Ovens, refrigerators and incubators used for sample storage or preparation will also have their temperatures recorded in a bound and numbered notebook. The temperatures will be recorded daily at a minimum and more if necessary.

9.2 Standard Receipt and Traceability

Once standards are received, they are immediately brought to the group area in which they are to be used. At this point, the group leader or analyst will place the standard in its proper storage area. Organic standards (GC and GC/MS) will be stored in a freezer with the temperature maintained at or below 4 °C. This will include volatile and semivolatile compounds. Volatile standards will be stored separately from samples. Material Safety Data Sheets (MSDS) provided with all

standards, will be stored in a notebook and will be freely available to any analyst. Other certification sheets will be kept on file within each lab division and stored for future reference. Since much of the important information is provided on the label, (manufacturer, lot number, concentration, purity, formula, compound name and health information), it also serves as a good source of information.

9.3 Standard Sources and Preparation

The accuracy of data produced from analytical instrumentation depends to a large degree on the quality of calibration standards. KEMRON uses only fully documented procedures, such as SW-846 methods, to assure that calibration standards are prepared to the highest level of quality available for a particular analyte. Concentrated stocks are prepared only with the highest purity standards available. Only standards that are traceable to NIST standards will be used.

A record of the preparation of concentrated stock standards will be maintained for each parameter. When a primary standard or concentrated stock standard is prepared, a number is assigned to that standard, and the date, analyst, compound, Lot No., purity, net weight, weight adjusted for purity, dilution volume and actual concentration are recorded. When a standard solution is prepared from a neat compound, if the entire sample is used the label is removed from the container and attached to the standards form.

Each group within the lab has its own standard preparation log which is kept in a bound form. These forms have room for all the data listed above as well as space for other information (i.e., disposal date, signature and witness) where necessary. As each standard log book becomes full, it is the job of the QA/QC Coordinator to produce a new one. The QA/QC Coordinator is also responsible for assuring the log forms are filled out properly, that new personnel have been instructed in the proper procedure for filling out the standards forms, and that the log books are maintained properly.

When the parent stock is purchased through a commercially prepared source, these standards (i.e., 1000 ppm metal standards for atomic absorption), will have the vendor, concentration and lot number of this stock recorded onto the standard.

Once the stock standards are prepared they are then diluted to prepare intermediate-level standards and/or final working standards using volumetric glassware. The choice of the correct glassware is very important (see Section 8.0). It is in the

intermediate stage that more than one parameter is mixed in the right concentration for the final mix. This dilution must also be documented in the same manner as the concentrated stocks.

Table 9-1 gives a list of the standard sources and preparation for the different instruments operated at KEMRON, in both the laboratory and field operations. Figures 9-1 to 9-7 are copies of the different standards preparation forms used by KEMRON by various groups within in the laboratory.

TABLE 9-1
STANDARD SOURCES AND PREPARATION

Instrument Group	Standard Sources	Concentration Received	Source Storage	Preparation from Source	Lab Stock Storage	Preparation Frequency
Gas Chromatography (GC)	Supelco Chem Service Accustandard Ultra Scientific VWR Baxter	Neat/Solution Neat/Solution Neat/Solution Neat/Solution Neat/Solution Neat/Solution	Freezer Freezer Freezer Freezer Freezer Freezer	Primary stocks are prepared from source stocks	Freezer	Semi-annually
				Intermediate stocks (if applicable) are prepared from primary or source stocks	Freezer	Weekly
				Working stocks are prepared from intermediates	Freezer	Daily
Gas Chromatography/ Mass Spectrometry (GC/MS)	Supelco Chem Service Accustandard	Neat/solution > 1000 ppm Mixtures	Freezer Freezer	Primary stocks are prepared from source stocks	Freezer	Semi-annually
				Intermediate stocks (if applicable) are prepared from primary or source stocks	Freezer	Semi-annually
				Working stocks are prepared from intermediates or from standards received in solution	Volatiles/Freezer Semivotiles/ Refrigerator	Volatiles-monthly Semivolatiles Semiannually or as needed
Atomic Absorption - flame/hydride	Johnson Matthey/ Aesar	Solutions 10000 ppm and 1000 ppm	Room Temp.	Primary stocks are prepared from source stocks	Room Temp.	Annually
	Inorganic Ventures	Mixtures & Solutions < 100 ppm	Room Temp.	Intermediate stocks (if applicable) are prepared from primary or source stocks	Room Temp.	Semi-annually or as needed
				Working stocks are prepared from intermediates	Room Temp.	Daily or as needed
Atomic Absorption - furnace	Johnson Matthey/ Aesar	Solutions 10,000 ppm and 1000 ppm	Room Temp.	Primary stocks are prepared from source stocks	Room Temp.	Annually
	Inorganic Ventures	Mixtures & Solutions < 100 ppm	Room Temp.	Intermediate stocks (if applicable) are prepared from primary or source stocks	Room Temp.	Semi-annually or as needed
				Working stocks are prepared from intermediates	Room Temp.	Daily or as needed
Inductively Coupled Plasma	Johnson Matthey/ Aesar	Solutions 10,000 ppm and 1000 ppm	Room Temp.	Primary stocks are prepared from source stocks	Room Temp.	Annually
	Inorganic Ventures	Mixtures & Solutions < 100 ppm	Room Temp.	Intermediate stocks (if applicable) are prepared from primary or source stocks	Room Temp.	Semi-annually or as needed
				Working stocks are prepared from intermediates	Room Temp.	Daily or as needed

TABLE 9-1 (cont'd)
STANDARD SOURCES AND PREPARATION

Instrument Group	Standard Sources	Concentration Received	Source Storage	Preparation from Source	Lab Stock Storage	Preparation Frequency
Total Organic Carbon (TOC)	Baxter	Neat	Room Temp.	Primary stocks are prepared from source stocks	Room Temp.	Annually
				Working stocks are prepared from primaries	Room Temp.	Annually
pH Meters	VWR Scientific	pH = 4,7,10 Premixed	Room Temp.	Used as Received	Room Temp.	Semi-annually
Turbidimeters	Hach	Pre-mixed 4 Gelex Standards NTU 0-1 NTU 1-10 NTU 10-100 NTU 100-1000 scale	Room Temp.	Used as Received	Room Temp.	
		Check Standard Primary (Formazin)		Prepared from 4000 NTU Stock	4°C	Annually
Specific Conductivity Meter	Baxter Scientific	Neat	Room Temp.	Stock 14,130 umho/cm Working Standard: 1413 umho/cm	4°C	Semi-annually

TABLE 9-2
STANDARD SOURCES AND PREPARATION FOR FIELD INSTRUMENTS

Instrument Group	Standard Source	How Received	Source Storage
Conductivity Meter	Baxter	KCl Solutions 1413 & 1000	Room Temp
pH Meter	VWR	Buffer Solution pH = 4,7,10 pre-mixed	Room Temp
OVA	CSP, Scientific	Methane Calibration Gas - 100 ppm.	NA

Initial calibrations will be checked periodically with standards of different values. This will serve as an additional check on the validity of the standards most commonly used to calibrate the instruments.

Figure 9-1
Standards Form for the Inorganic/Wet Lab

PREPARATION OF CONCENTRATED STOCK STANDARDS Pg _____

NO. S _____ PARAMETER _____ ADT _____

COMPOUND _____ LOT # _____ PURITY _____ % WT _____
COMPOUND _____ LOT # _____ PURITY _____ % WT _____
COMPOUND _____ LOT # _____ PURITY _____ % WT _____

TOTAL VOLUME: _____ CONCENTRATION: _____

EXPIRATION DATE: _____

PREPARATION OF INTERMEDIATE STOCK STANDARDS Pg _____

NO. I _____ PARAMETER _____ ADT _____

PARENT STOCK S_____ PARENT STOCK CONCENTRATION _____

ALIQUOT OF PARENT STOCK: _____ FINAL VOLUME _____

CONCENTRATION: _____

EXPIRATION DATE: _____

PREPARATION OF QA SOLUTIONS Pg. ____

NO. Q _____ PARAMETER _____ ADT _____

COMPOUND _____ LOT # _____ PURITY _____ % WT _____
COMPOUND _____ LOT # _____ PURITY _____ % WT _____
COMPOUND _____ LOT # _____ PURITY _____ % WT _____

TOTAL VOLUME: _____ CONCENTRATION: _____

ADDITIONAL DILUTION:

ALIQUOT: _____ VOLUME _____

FINAL CONCENTRATION: _____

EXPIRATION DATE: _____

Figure 9-2
Standards Form for the Metals Group
(ICP/AA-Stock Solutions)

KEMRON

Solution Standards
ICP/AA

Notebook No. MES-2
Page No.: 1

Dilution Solvent:_____

Date:_____

Analyst:_____

Element	Expiration Date	Manufacturer and Lot Number	Concentration (ppm)	Aliquot Volume (ml)	Dilution Volume (ml)	Final Concentration (ppm)	Aliquot Volume (ml)	Dilution Volume (ml)	Final Concentration (ppm)	Analyst/Date/Time

Prepared By:_____ Date:_____ Witnessed By:_____ Date:_____

Figure 9-3
Standards Form for the Metals Group
(ICP/AA-Working Solutions)

KEMRON

Solution Standards
ICP/AA

Notebook No. [illegible]
Page No.: [illegible]

Solution No.: _____
Dilution Solvent: _____
Expiration Date: _____

Date: _____
Analyst: _____

		Standard #1:			Standard #2:			Standard #3:			Standard #4:			Standard #5:		
Element	Source Solution Page No.	Aliquot Volume (ml)	Final Volume (ml)	Concentration (ppm)	Aliquot Volume (ml)	Final Volume (ml)	Concentration (ppm)	Aliquot Volume (ml)	Final Volume (ml)	Concentration (ppm)	Aliquot Volume (ml)	Final Volume (ml)	Concentration (ppm)	Aliquot Volume (ml)	Final Volume (ml)	Concentration (ppm)

Prepared By: _____ Date: _____ Witnessed By: _____ Date: _____

Figure 9-4
Neat Compound Standards Form for the Volatile Organic GC and GC/MS Group

1

Notebook No: N #22

KEMRON

Environmental Service

Neat Compound Standards
Volatile Organic GC & GC/MS

Solution:_____ Expiration Date:_____ Solution Type:____

Dilution Solvent:_____ Manufacturer:_____ Lot#:_____

Parent Compound	Parents Compound Number	Purity of Parent Compound (%)	Parent Compound weight (mg)	Dilution Volume (mL)	Final Concentration (ug/mL)

*Corrected for purity if compound is less than 95% pure

Comments:_____

Prepared by:_____ Date:_____

Witnessed by:_____ Date:_____

Disposed by:_____ Date:_____

Figure 9-5
Standards Form for the Volatile Organic GC and GC/MS Group

1

Notebook No: S-02

KEMRON

Environmental Service

Solution Standards
Volatile Organic GC & GC/MS

Solution:_____ Expiration Date:_____ Solution Type:____

Dilution Solvent:_____ Manufacturer:_____ Lot#:_____

Parent Solution	Parents Solution Number	Concentration of Parent Solution (ug/mL)	Aliquot Volume (mL)	Final Volume (mL)	Final Concentration (ug/mL)

Comments:_____

Prepared by:_____ Date:_____

Witnessed by:_____ Date:_____

Disposed by:_____ Date:_____

Figure 9-6
Neat Compound Standards Form for the Semivolatile Organic GC and GC/MS Group

1

Notebook No: N #02

KEMRON

Environmental Service

Neat Compound Standards
Semi-Volatile Organic GC & GC/MS

Solution:_____ Expiration Date:_____ Solution Type:____

Dilution Solvent:_____ Manufacturer:_____ Lot#:_____

Parent Compound	Parents Compound Number	Purity of Parent Compound (%)	Parent Compound weight (mg)	Dilution Volume (mL)	Final Concentration (ug/mL)

*Corrected for purity if compound is less than 85% pure

Comments:_____

_____

Prepared by:_____ Date:_____

Witnessed by:_____ Date:_____

Disposed by:_____ Date:_____

Figure 9-7
Standards Form for the Semivolatile Organic GC and GC/MS Group

1

Notebook No: GCS #3

KEMRON

Environmental Service

Solution Standards
Semi-Volatile Organic GC & GC/MS

Solution:_____ Expiration Date:_____ Solution Type:____

Dilution Solvent:_____ Manufacturer:_____ Lot#:_____

Parent Solution	Parents Solution Number	Concentration of Parent Solution (ug/mL)	Aliquot Volume (mL)	Final Volume (mL)	Final Concentration (ug/mL)

Comments:_____

_____

Prepared by:_____ Date:_____

Witnessed by:_____ Date:_____

Disposed by:_____ Date:_____

9.4 Instrument Calibration

KEMRON's instrument calibration protocols meet or exceed the requirements specified in the EPA or SW-846 method employed. Details by instrument type are provided in this section.

9.4.1 Gas Chromatography
- ECD (Pesticides/PCB's/Herbicides)
- FID (Polynuclear Aromatic Hydrocarbons)
- PID (Aromatic Volatile Organics)
- ELCD (Halogenated Volatile Organics)

1. Initial calibration is a 5-point standard curve of all target compounds, (concentrations are in detector linear range) performed on failure of any continuing calibration standard.

2. Curves are checked by calculating the %RSD for all compounds which must be less than 20%.

3. Initial calibration:

   a. Run solvent blank to determine cleanliness of system
   b. Initial calibration
   c. Check linearity of components and determine acceptance/rejection.
   d. Analyze 10 samples (includes reagent blanks, spikes and duplicates)
   e. Run QC Check Standard - Must be within 15% D
   f. Continue with steps d and e for entire run

4. Daily continuing calibration:

   a. Run solvent check
   b. Run continuing calibration (CC) Standard - Must be within 15% D
   c. Analyze 10 samples (includes reagent blanks, spikes and duplicates)
   d. Analyze QC check standard - Must be within 15% D
   e. Continue with analysis steps c and d for entire run
   f. If CC or QC check standard fails, entire run must be stopped, problems investigated and corrections made and the CC rerun. If the CC standard still does not meet criteria an initial calibration must be run

9.4.2 Gas Chromatography/Mass Spectrometry
- Volatile Organic Analysis
- Semivolatile Organic Analysis

1. Initial calibration is a 5 point standard curve of target compounds, (concentrations are in detector linear range) performed on failure of any continuing calibration standard.

2. Curves are checked by calculating the %RSD for the CCC compounds which must be less than 30.0%. The SPCC compounds must have an average RRF of 0.050 or greater, for semivolatiles and an average RRF of 0.300 or greater for volatiles (0.250 for Bromoform)

3. Initial calibration:

   a. Run BFB or DFTPP. Achieve acceptance criteria based on Key Ion and Abundance Tables 9-3 and 9-4.
   b. Initial calibration
   c. Check initial calibration
   d. Analyze samples for 12 hours from the time BFB or DFTPP was run

4. Daily continuing calibration:

   a. Run BFB or DFTPP. Achieve acceptance criteria based on Key Ion and Abundance Tables 9-3 and 9-4.
   b. Run continuing calibration (CC) standard.
   c. Check to see if CC meets criteria.
   d. If not, make necessary corrections in GC/MS system and run CC again.
   e. If standard passes, run samples for 12 hours from the time BFB or DFTPP was run.
   f. At end of 12 hours or next day, repeat steps a through e.

TABLE 9-3
KEY IONS AND ABUNDANCE CRITERIA FOR BFB

Mass	Ion Abundance Criteria
50	15 to 40% of m/z 95
75	30 to 60% of m/z 95
95	base peak, 100% relative abundance
96	5 to 9% of m/z 95
173	less than 2% of m/z 174
174	greater than 50% of m/z 95
175	5 to 9% of m/z 174
176	greater than 95% but less than 101% of m/z 174
177	5 to 9% of m/z 176

TABLE 9-4
KEY IONS AND ABUNDANCE CRITERIA FOR DFTPP

Mass	Ion Abundance Criteria
51	30 to 60% of m/z 198
68	less than 2% of m/z 69
70	less than 2% of m/z 69
127	40 to 60% of m/z 198
197	less than 1% of m/z 198
198	base peak, 100% relative abundance
199	5 to 9% of m/z 198
275	10 to 30% of m/z 198
365	greater than 1% of m/z 198
441	present, but less than m/z 443
442	greater than 40% of m/z 198
443	17 to 23% of m/z 442

9.4.3 Atomic Absorption - Flame/Hydride

1. Initial calibration is a 5-point standard curve of the metals in question, (Concentrations are in detector linear range) performed before each sample run.

2. Calculation is by computer software using linear regression.

3. Sequence of events for analytical run.

   a. Run solvent blank to determine cleanliness of system
   b. Initial calibration
   c. Verify calibration with Initial Calibration Verification (ICV) standard. Must be within 10% of true value.
   d. Run preparation blank.
   e. Run QC Check Standard - Must be within 10% of true value.
   f. Analyze 9 samples & continuing calibration verficiation (CCV) - Must be within 10% of true value.
   g. Repeat step F for rest of samples and complete analytical run with a final CCV.
   h. If ICV, CCV, or QC check standard fails criteria, analysis must be stopped, corrections or adjustments made, recalibrate (reslope if applicable) and the prior 9 samples reanalyzed that preceeded the failed standard.

9.4.4 Atomic Absorption - Furnace

1. Initial calibration is a minimum 4-point standard curve of all metals in question, (Concentrations are in detector linear range) performed before each sample run.

2. Calculation is by computer software using linear regression.

3. Sequence of events for analytical run.

   a. Run solvent blank to determine cleanliness of system
   b. Initial calibration
   c. Verify calibration with Initial Calibration Verification (ICV) standard. Must be within 10% of true value.
   d. Run preparation blank.
   e. Run QC Check Standard - Must be within 10% of true value.
   f. Analyze 9 samples & continuing calibration verficiation (CCV) - Must be within 10% of true value.
   g. Repeat step F for rest of samples and complete analytical run with a final CCV.
   h. If ICV, CCV, or QC check standard fails criteria, analysis must be stopped, corrections or adjustments made, recalibrate (reslope if applicable) and the prior 9 samples reanalyzed that preceeded the failed standard.

9.4.5 Inductively Coupled Plasma

1. Initial calibration is a 3-point standard curve of all metals in question, (Concentrations are in detector linear range) performed daily.

2. Calculation is by computer software using linear regression.

3. Sequence of events for routine batch calibration:

   a. Run solvent blank to determine cleanliness of system
   b. Initial calibration
   c. Verify calibration with Initial Calibration Verification (ICV) standard - Must be within 10% of true value.
   d. Run preparation blank
   e. Run QC Check Standard - Must be within 10% of true value.
   f. Run Continuing Calibration Verification (CCV) - Must be within 10% of true value.
   g. Run interference check standard.
   h. Begin sample analysis with a CCV frequency of 10%.

i. End analytical run with CCV.
j. If ICV, CCV or QC check standard fails criteria, analysis must be stopped, corrections or adjustments made, recalibrate (or update if applicable) and the prior samples reanalyzed that preceeded the failed standard.

9.4.6 pH Meters

1. The pH meter is recalibrated before each use or after 2 hours of use. The following sequence is used for recalibration:

a. Turn meter on (let meter warm up 2-3 minutes)
b. Select pH mode using the MODE key.
c. CALIBRATE? press ENTER/YES
d. AUTO? press ENTER/YES (if you choose "no" the meter must be calibrated manually.)
e. STANDARD 1 TEMP? press 20
f. READ STANDARD 1 press ENTER/YES
g. WAIT
h. STANDARD 2 TEMP? Press 20
i. READ STANDARD 2 press ENTER/YES
j. ISOPOINT? press CLEAR/NO
k. Record the slope in the book
l. SAMPLE TEMP? press 20
m. READ SAMPLE press ENTER/YES once
n. When reading stabilizing record the pH
o. Remove probe and rinse, place in other samples.
p. If meter reads READ SAMPLE, press ENTER/YES.
q. When finished with meter, turn it off.

NOTE: The meter is calibrated on pH 7 & 4, or pH 7 & 10. Choose the correct buffers so as the samples are bracketed.

9.4.7 Turbidimeters

1. The Turbidimeter is calibrated before each use. The following sequence is used for recalibration:

a. Choose correct range
b. Place standard into meter.
c. Adjust meter to correct value.

d. Read samples

9.4.8 Analytical Balances

The most important piece of equipment in any laboratory is the analytical balance. The accuracy of data related to weight-prepared standards can be no better than that of the analytical balance. For this reason, proper care and use of the analytical balance must be of highest priority. The following section describes the standard operating requirements at KEMRON for the calibration and care of analytical balances.

a. Analytical balances are mounted on a heavy, shock-proof table, constructed of either marble or concrete, and placed in an area of low traffic. The balance level is checked daily and adjusted when necessary.

b. Balances must be protected from extreme temperature and humidity change. A beaker of silica gel desiccant should be placed in the balance and changed frequently.

c. When not in use, the beam should be raised from the knife edges, and all weights returned to the beam.

d. All spills on the pan or inside the balance must be avoided, and the balance must be kept scrupulously clean at all times.

e. Balances will be checked and adjusted at least twice a year by a company serviceman or balance specialist. A service contract and maintenance schedule is also recommended.

Calibration:

Class S-1 weights are used for daily calibration of the analytical balance and the top loader balances. The analytical balance is calibrated daily with 4 weights (1mg, 5mg, lg and 50g). The top loader balances are calibrated with 2 weights (10g and 100g). The absolute error should not exceed 0.02%.

Class S weights (traceable to NBS) are used to check the S-1 weights semiannually.

All balances are inspected and calibrated by a professional service twice a year.

The Balance Logbook:
Maintenance and service records should be entered in the logbook. The daily calibration

records should include the date, time, the initials of the operator, and the weights for at least two standard checks using the procedure described earlier.

9.5 Standardization of Titrating Solutions

Table 9-7 gives a listing of the reagents used as titrants. All solutions are purchased pre-standardized by the manufacturer. The manufacturer's certificate of analysis provides the following information:

1. Nominal Concentration (Normality)
2. Concentration Limits
3. Lot Number
4. Primary Standard (Certified traceable to NIST)

As a daily quality control check on the commercial solutions, the laboratory verifies the certified values through the analyses of a laboratory control sample. If the results of this analysis indicates a problem, i.e. an out of control situation, then re-standardization against primary standards is required. Alternatively, the out-of-specification solutions are discarded and fresh solutions are obtained as replacements.

9.6 FIELD INSTRUMENT CALIBRATION PROCEDURES

A record of calibrations made at the base of operations will be kept in the equipment room. A record of field calibrations will be logged into the project field book. Automatic samplers will be calibrated either daily or prior to each use to insure that the precise volume is being collected. Calibration of automatic samplers will be achieved using a graduated container of suitable volume. Initial calibrations will be checked periodically with standards of different values. This will serve as an additional check on the validity of the standards most commonly used to calibrate the instruments.

9.6.1 Calibration of OVA: KEMRON will use an organic vapor analyzer (OVA) equipped with chromatographic column field monitoring of volatile organic compounds. Primary electronic calibration of instrument circuits for methane is performed at the factory. Periodic calibration of the instrument for field service is conducted using known concentrations of methane-in-air samples.

The calibration is accomplished using the following procedure:

a. Place the instrument in normal operation with Calibrate Switch set at X10 and Gas Select control set to 300.
b. Use the Calibrate Adjust Knob to adjust the meter reading to zero.
c. Introduce a methane sample of a known concentration (between 90 and 100 ppm not to exceed 100 ppm) and adjust trimpot R-32 so the meter reading corresponds to the known sample.
d. The instrument gain is now set for methane if the panel mounted gain adjustment (Gas Select) is set at a reference number of 300.
e. Turn off the Hydrogen Supply Valve to put out the flame.
f. Leave Calibrate Switch on X10 position and use Calibrate Adjust (zero) Knob to adjust meter reading to 4 ppm.
g. Place Calibrate Switch in X1 position and using trimpot R-31 adjust meter reading to 4 ppm.
h. Move Calibrate Switch in X10 position again. Use Calibrate Adjust (zero) Knob to adjust meter to a reading of 40 ppm.
i. Move Calibrate Switch to X100 position and use trimpot R-33 to adjust meter reading to 40 ppm.
j. Move Calibrate Adjust (zero) Knob to adjust meter reading to zero.
k. Unit is now balanced from range to range, calibrated to methane, and ready to be placed in normal service.

Carbon filter units will be used with the OVA when necessary to determine the presence of background methane at the site. The portable GC column can also be utilized to differentiate a variety of volatile organic compounds from a single sample.

9.6.2 Calibration of Specific Conductivity Meter: The specific conductivity meter is a self-contained conductance meter which operates in the range of 0-1,990 uhmos. The instrument has an accuracy of 0.5% at 199 and 1,900 uhmos. Calibration of the instrument is checked using two known standards of 100 and 1,000 uhmos prior to field use to test the accuracy of the instrument. The actual temperature of the sample should be measured when the conductivity reading is made. The meter reading should then be converted to specific conductance at 25 degrees C, using the information in the manufacturer's instruction manual.

9.6.3 Calibration of pH: Only electronic portable pH meter with temperature compensation will be used. pH paper will be used to test the approximate pH value of a sample, which will assist in selecting appropriate buffer solutions for calibration.

The pH meter will be checked for any mechanical or electrical problems, weak batteries, or defective electrodes prior to field work. The slope of the meter shall also be checked initially with three fresh standard buffer solutions (usually between 2 and 12 with a 7 solution always used). Daily field calibration of the meter is required using two buffer solutions bracketing the expected pH value of the sample. The meter should be re-checked against two buffer solutions following each analysis. **It is very important to thoroughly rinse the meter electrodes after contact with all samples and buffer solutions.** This will help prevent cross contamination of buffer solutions. A supply of fresh buffer solution should always be available in the field. Recalibration will be necessary if inconsistent results are obtained such as duplicate analyses which do not agree within 0.1 standard units. In the case of low specific conductance, and meter drift, add 1 ml of 1 M KCl solution to each 100 ml of sample, swirl sample and read pH.

Actual calibration procedures may vary somewhat depending upon the model type and manufacturer's recommendations. The critical steps in calibration are utilization of two buffered solutions and compensation for solution temperature.

9.6.4 Calibration of Thermometer: The instrument used is annually compared to a thermometer certified traceable to NIST. All glass mercury filled thermometers should be inspected before each field trip to insure there are no cracks on the glass or air bubbles in the mercury column. Cross checks and duplicate field readings should agree within 0.5 degrees C.

9.6.5 Field Quality Control Samples: Field analyses for pH and specific conductance also include the analysis of a quality control standards. These standards are prepared or obtained independently from the calibration standards and are used to verify proper instrument and operator performance. The QC samples are initially analyzed after calibration and approximately every four hours thereafter.

TABLE 9-5
INITIAL CALIBRATION PROCEDURES AND SCHEDULES FOR ALL KEMRON MAJOR ANALYTICAL INSTRUMENTS

Instrument	Standard Source	# of Standards in the Initial Calibration	Acceptance/Rejection Criteria Initial Calibration	Calibration Frequency
Gas Chromatography-ECD Pesticides/PCB's/ Herbicides	Chem Service US EPA	5	< 20% RSD	failure of continuing calibration
Gas Chromatography-FID Polynuclear Aromatic Hydrocarbons	EM Science	6	< 20% RSD	failure of continuing calibration
Gas Chromatography-PID Aromatic Volatile Organics	Chem Service	5	< 20% RSD	failure of continuing calibration
Gas Chromatography ELCD Halogenated Volatile Organics	Supelco	5	< 20% RSD	failure of continuing calibration
Gas Chromatography/ Mass Spectrometry Volatile Organics	Supelco Chem Service	5	< 30% RSD of CCC compounds min 0.30 average RRF for SPCC cmpds min 0.25 average RRF for Bromoform	failure of continuing calibration
Gas Chromatography/ Mass Spectrometry Semivolatile Organics	Chem Service	5	< 30% RSD of CCC compounds min 0.05 average RRF for SPCC cmpds	failure of continuing calibration
Atomic Absorption/ flame/hydride/cold vapor	Johnson Matthey	5	Corelation Coefficient < .995	daily & when failure of continuing calibration
Atomic Absorption furnace	Johnson Matthey	4	Corelation Coefficient < .995	daily & when failure of continuing calibration
Inductively Coupled Plasma	Johnson Matthey	3	Corelation Coefficient < .995	daily & when failure of continuing calibration
pH Meters	VWR	2	Set to read standard value	before every use or 2 hrs
Turbidity Meter	Hach	1	Set to read standard value	Before every use

TABLE 9-6
CONTINUING CALIBRATION PROCEDURES AND SCHEDULES FOR ALL KEMRON MAJOR ANALYTICAL INSTRUMENTS

Instrument	Standard Source	# of Standards in Cont. Calibration	Acceptance/Rejection Criteria Continuing Calibration	Calibration Frequency
Gas Chromatography-ECD Pesticides/PCB's/ Herbicides	Chem Service US EPA	1	± 15% D	every 10 samples
Gas Chromatography-FID Polynuclear Aromatic Hydrocarbons	EM Science	1	± 15% D	every 10 samples
Gas Chromatography-PID Aromatic Volatile Organics	Chem Service	1	± 15% D	daily
Gas Chromatography-ELCD Halogenated Volatile Organics	Supelco	1	± 15% D	daily
Gas Chromatography/ Mass Spectrometry Volatile Organics	Supelco Chem Service	1	± 25% D of CCC compounds min 0.30 average RRF for SPCC cmpds min 0.25 average RRF for Bromoform	every 12 hours
Gas Chromatography/ Mass Spectrometry Semivolatile Organics	Chem Service	1	± 25% D of CCC compounds min 0.05 average RRF for SPCC cmpds	every 12 hours

TABLE 9-7
STANDARDIZATION OF TITRATING SOLUTIONS

Parameter	Titrating Solution	Primary Standard	Frequency of Standardization
Acidity	NaOH	KHP NIST traceable	Prestandardized by the manufacturer
Alkalinity	H_2SO_4	TRIS NIST traceable	Prestandardized by the manufacturer
Sulfide	Sodium Thiosulfate	Potassium Dichromate NIST traceable	Prestandardized by the manufacturer
Hardness	EDTA	Chelometric calcium carbonate A.P.H.A. specifications	Prestandardized by the manufacturer

Note all titration solutions are purchased pre-standardized.

10.0 PREVENTATIVE MAINTENANCE

10.1 Routine Maintenance Activities

All of KEMRON's instruments undergo routine maintenance, cleaning, and inspection on a daily, weekly, or monthly basis, according to the manufacturer's recommendation, and/or the requirements of the standard methods employed. Maintenance logs and instrument maintenance checklists are kept, noting problems and the steps taken to correct them. Records are kept on repairs requiring non-KEMRON service repairmen.

Table 10-1 provides a complete list of the preventative maintenance for all major laboratory instrumentation. Table 10-2 provides a complete list of the preventative maintenance for major field instrumentation.

10.2 Documentation

Each instrument has its own log book, which contains a record of any maintenance or repairs performed.

10.3 Contingency Plan

In the event of a major instrument failure, most of KEMRON's instrumentation has a back-up. There are three volatile and two semivolatile GC/MS's, as well as, two ECD GC's, two FID detectors, and two PID detectors. There are two pH meters and two spectrophotometers. In addition, the Varian AA Spectrophotometer can serve as backup for the Leeman ICP. This instrumentation is listed in section 9 page 2 of 23. In the event that no backup is available and the sample has holding time left, the sample will be held until repairs have been completed. If the sample is getting close to its holding time, the sample will be subcontracted out to another certified laboratory, or a new sample will be requested from the client. This choice will be left up to the client. KEMRON, under no circumstance, will analyze samples out of holding time, without client notification.

Site Managers will work closely with Project Managers and Group Leaders to insure that an adequate supply of field equipment is available. In the event of an equipment failure in the field, provisions will be made to have rental equipment on stand-by for shipment to field personnel.

TABLE 10-1
LABORATORY INSTRUMENTATION PREVENTATIVE MAINTENANCE

Equipment	Activity	Frequency
Gas Chromatographs	Change septum	Daily
	Change liners	Daily
	Check carrier gas	Daily
	Change carrier gas	As needed (when pressure = 50psi)
	Change in-line filters	Quarterly or as need arises
	Remove first foot of capillary column	As need arises
	Clean ECD	Quarterly or as need arises
	Replenish Electrolytic Conductivity Detector Solvents	Weekly
	Change ion exchange resin	Every 60 days
	Replace nickel tubing	Quarterly or as need arises
	Clean Nitrogen-Phosphorous Detector	Quarterly or as need arises
	Bake out column	Weekly or as needed
	Check system for gas leaks	At each column change
	Sylonize injection port liners	Every liner
Gas Chromatograph/ Mass Spectrometers	Clean mass spectrometer source	Quarterly or as needed
	Change septum	Daily
	Change liners	Daily
	Check carrier gas	Daily
	Change carrier gas	As needed (when pressure = 50psi)
	Change in-line filters	Quarterly or as need arises
	Remove first foot of capillary column	As need arises
	Replace nickel tubing	Quarterly or as need arises
	Bake out column	Weekly or as needed
	Check system for gas leaks	At each column change
	Sylonize injection port liners	Every liner
Atomic Absorption -flame	Clean burner head	Daily
	Check aspiration tubing	Daily
	Clean optics	Every 3 months
	Check gas	Daily
	Check optics	Annual (on contract)
Atomic Absorption -furnace	Clean furnace windows	Daily
	Check plumbing connections	Daily
	Change graphite tube	Every 50 samples
	Check gases	Daily
	Check optics	Annual (on contract)
Inductively Coupled Plasma	Clean nebulizer	Weekly
	Clean torch	Weekly
	Change tubing	Weekly
TRAACS 800	Clean flowcell	Daily
	Change tubing	As needed

TABLE 10-1 (cont'd)
LABORATORY INSTRUMENTATION PREVENTATIVE MAINTENANCE

Equipment	Activity	Frequency
pH Meters	Clean probe	Before every use
TOC Meter	Change tubing	As necessary
	Clean detector	As necessary
Specific Conductivity Meters	Clean probe	Before every use
	Check cell constant	Before every use
	Replenish/replace probe	As necessary
	Redetermine cell constant	Yearly
DO Meter	Clean probe	Before every use
	Check membrane	Before every use
	Change membrane	Once a month or as necessary
Analytical Balance	Check pans and compartment	After every use
	Check alignment and balance	Before every use
	Cleaning/calibration/service	Semiannually
Ovens	Temperature monitoring	Daily
Refrigerators	Temperature monitoring	Daily
Incubators	Temperature monitoring	Daily

TABLE 10-2
FIELD INSTRUMENTATION PREVENTATIVE MAINTENANCE

Equipment	Activity	Frequency
Foxboro OVA	Battery Charging	Daily
	Sample Wand Cleaning	Daily
	GC Column back flush	After Each Sample
	Inspection and Cleaning of Primary Filter, Secondary Filter, Mixer/Burner Assembly Filter, Exhaust Flame Arrestor, Sampling Wand Assembly, and Sampling Fixtures.	Quarterly
Conductivity Meter	Battery Check and Replacement (if needed)	Monthly
	Probe replatinization/ replacement	As needed
pH Meter	Electrode Replacement	Per Manufacturer's Guidelines
	Battery Check	Weekly
	Battery Replacement	As needed
Water Level Meter	Battery Check and Replacement (if needed)	Monthly
	Tape and Probe Cleaning	After Each Field Trip
Oil/Water Interface Probe	Battery Check and Replacement (if needed)	Monthly
	Tape and Probe Cleaning	After Each Field Trip

11.0 QUALITY CONTROL CHECKS, ROUTINES TO ASSESS PRECISION, ACCURACY AND CALCULATION OF METHOD DETECTION LIMIT

11.1 Personnel

KEMRON has a Quality Assurance/Quality Control (QA/QC) Coordinator responsible for implementing standard quality control procedures. The main responsibility of this full-time position is to develop and implement standard operating procedures for the KEMRON laboratories. As a staff function independent of laboratory production, the QA/QC Coordinator works closely with the Laboratory Supervisors and personnel on every facet of data quality.

11.2 Field Quality Control Checks

KEMRON utilizes field blanks, trip blanks, duplicate samples, and equipment blanks for field QC samples for the sampling of water, soil and solid wastes. Details on field QA/QC procedures are included in KEMRONs sampling and analysis SOPs. See Appendix B for field SOP Table of Contents.

11.3 Analytical Methods

A very important element in KEMRON's QA/QC program is strict adherence to standard analytical methods. Whenever it is possible to do so, KEMRON will use only EPA approved methods for analytical investigations. The QA/QC elements described in Section 11.4 are designed to meet requirements of the EPA methodology listed in Tables 5-2 through 5-21. However, if method QA/QC requirements are more stringent than KEMRONs program outlined herein, our laboratories will comply with the specific method requirements.

11.4 Analytical Batch Quality Control Samples.

An analytical batch is defined as twenty samples, or less, of the same type of matrix prepared and analyzed as a group. The following analytical quality control samples will be associated with each analytical batch if the control procedure is applicable to the analysis.

11.4.1 Method reagent blank - A reagent or media blank is analyzed with each batch as a check on method contamination.

11.4.2 Quality control check standards (Laboratory Control Samples) are

mid-scale standards analyzed for set parameters with each batch. These QC checks are prepared separately and are independent of the standards used for calibration.

11.4.3 Matrix Spikes are analyzed with each batch of twenty samples, or less, of a similar matrix. If a set contains samples of different matrices, a spike will be analyzed for each matrix type.

11.4.4 Duplicate samples or matrix spike duplicates of laboratory and field replicates are also analyzed to validate the precision of the analysis. If a set contains samples of different matrices, then a duplicate or matrix spike duplicate will be analyzed for each matrix type.

11.4.5 Performance evaluation samples will be analyzed in a blind audit quarterly. These samples are commercially available for all lab sections.

Control charting procedures for these quality control samples are described in more detail in Section 11.5. Acceptance criteria and corrective action measures are outlined in Section 13 (Corrective Action), Tables 13-1 through 13-4.

11.5 Statistics and Control Charting

11.5.1 Statistical Approach

KEMRON has established its statistical approach to quality control based on the following standards:

1. Handbook for Analytical Quality Control in Water and Wastewater Laboratories, EPA-60014-79-019, March 1979.

2. Standard Methods for the Examination of Water and Wastewater, 18th Edition, APHA/AWWA/WEF, Methods 1010, 1020, 1030.

3. Good Laboratory Practices in Laboratories Engaged in Sampling and Analysis of Water, American Society of Testing and Materials (ASTM), D3856-88.

4. Test Methods for Evaluating Solid Waste - Physical/ Chemical Methods, SW-846, 3rd Edition, Chapter 1.

11.5.2 General Control Charting Procedure

After sufficient data become available for a parameter, control charts and control limits are developed for laboratory control samples, duplicate analyses, and matrix spike analyses. In constructing an initial control chart, twenty or more consecutive data points are necessary. The time required to generate such a chart will vary with the frequency of the analysis (daily, weekly, monthly, etc.). Once these twenty data points are gathered, two control charts are constructed:

1. Accuracy Control Chart (X-Chart)

2. Precision Control Chart (R-Chart)

The second phase in the control charting process involves gathering twenty or more additional data points. This data is charted using the limits established by the previous twenty or more data points. This is done not only to control the accuracy and precision of current analysis, but also serves as a basis for constructing a new control chart for subsequent data. This method ensures continued evaluation of laboratory and personnel performance.

11.5.3 X-Charts are constructed for these analyses:

1. Laboratory Control Sample (LCS)

2. Matrix Spike (MS)

11.5.4 R-Charts are constructed for these analyses:

1. Duplicates

2. Matrix Spike/Matrix Duplicate (MS/MSD)

Example KEMRON control charts are presented in Figures 11-1 to 11-6 at the end of this section.

11.6 Additional KEMRON Quality Control Procedures

11.6.1 Quality assurance daily reports are prepared. Whenever samples are analyzed, the quality control sample results are entered into the

laboratory database. Reports are generated daily for review by the QA/QC Coordinator, and for management in general. Copies of the quality assurance daily report are available to the client by request. An example of the daily report is presented in Figure 11-1.

11.6.2 Individual analyst notebooks are kept. Each chemist maintains a bound and numbered laboratory notebook which includes records of method development and parameter data in tabular form. Bench sheets are often used to supplement these books, when voluminous data are compiled. Data from the chemist's notebook and/or bench sheets are reviewed daily by a supervisor prior to entry into the final database.

11.6.3 Individual parameter files (raw data and final results) for each parameter are maintained in two files within the laboratory. After initial review of bench sheets, the raw data are entered into spreadsheets for calculation, and followed by automated storage in the parameter database. Hard copy printouts of raw and final results are placed in notebooks, along with a copy of the pages from the chemist's notebook and/or bench sheets. The data, therefore, are easily accessible by computer terminal or parameter notebook.

11.6.4 Independent audits are performed. In addition to the analysis of its own quality assurance standards, KEMRON participates in external quality assurance programs. Quality assurance samples are acquired from EPA, APG or private firms and analyzed as unknowns by our analysts on a quarterly basis. A report summarizing this performance is available upon request by our clients.

11.7 Gas Chromatography/Mass Spectrometry QC Procedures

11.7.1 Daily GC/MS Performance Checks:

On each day that semivolatile analyses are performed by Method 625 (8270), the GC/MS is checked to see if acceptable performance criteria are achieved for DFTPP. If these criteria are not met, the GC/MS system is tuned and the test repeated.

On each day that volatile analyses are performed by Method 624 (8240),

the GC/MS is checked to see if acceptable performance criteria are met for BFB. The instrument is tuned as necessary until the EPA-established criteria are met.

11.7.2 Calibration Curves: On each day that GC/MS analyses are performed, the instrument response factors are updated by the analysis of standards covering the concentration range. A minimum of three standards will be analyzed, and one standard must be prepared at a concentration approaching the method detection limit (MDL).

Alternatively, an initial calibration curve (a working curve) is established with 5 standards covering the concentration range. If each parameter meets EPA's QA acceptance criteria for precision and accuracy of response factors, analyses may proceed for a set of samples. A daily continuing calibration standard is run to verify that the response factors from the working curve are still valid.

11.7.3 Internal Standards: EPA recommended internal standards are spiked into every blank, standard, and sample and are used to calculate the relative response factor for each compound of interest. The specific internal standards that KEMRON uses are listed below by fraction:

Internal Standard	Fraction
Bromochloromethane	VOA
1,4-Difluorobenzene	VOA
Chlorobenzene-d5	VOA
1,4-Dichlorobenzene-d4	BNA
Naphthalene-d8	BNA
Acenapthene-d10	BNA
Phenanthrene-d10	BNA
Chrysene-d12	BNA
Perylene-d12	BNA

11.7.4 Surrogate Compounds: Every method blank, standard, and sample extract is also spiked with method-specified concentrations of the suggested surrogate compounds. The

percent recovery for each surrogate is determined, and the results are used to monitor system performance and possible matrix interferences. A table listing the percent recovery of surrogate compounds is provided in the laboratory report for every sample. Listed below are the surrogate compounds KEMRON currently uses in its laboratories:

Surrogate	Fraction
1,2-Dichloroethane-d4	VOA
Toluene-d8	VOA
4-Bromofluorobenzene	VOA
2-Fluorophenol	BNA-Acids
Phenol-d5	BNA-Acids
2,4,6-Tribromophenol	BNA-Acids
Nitrobenzene-d5	BNA-Base Neutrals
2-Fluorobiphenyl	BNA-Base Neutrals
p-Terphenyl-d14	BNA-Base Neutrals

11.7.5 Method Blanks: A sample consisting of laboratory reagent water is analyzed to monitor the analytical system for contamination. In the purge-and-trap procedure (VOA), a method blank is included each day that samples are analyzed. For the semivolatile fractions, a method blank is set up each day that extractions are performed. The method blank extract is spiked with the same internal standards and surrogate standards as the samples, and is analyzed along with the samples in the batch. As a quality control sample, the results are used in conjunction with other control data to validate overall system performance and data quality.

11.7.6 Matrix Spike and Matrix Spike Duplicate: To evaluate and document data quality in various matrices, an ongoing program of analyzing matrix spikes in duplicate is employed at a minimum frequency of 5% of all samples. By spiking two aliquots of the same sample with identical standard mixtures, it is possible to monitor the precision and accuracy of the analytical method. This practice supplies more information than

the routine analysis of laboratory or field replicates. The analysis of field duplicates is also routinely practiced; however, the frequency of analysis will be no less than 1 in 20 or 5% but may be more in accordance with the individual project objectives and sampling plans.

11.7.7 Laboratory Control Samples: Analysis of quality control (QC) check standards is practiced to demonstrate overall laboratory capability and instrument performance. This analysis will be performed on one in every twenty samples (5%). When results of sample spikes indicate atypical method performance or matrix interference, the results of the QC check standard are used to confirm that the measurements were performed in an in-control mode of operation. The check standard consists of spiking laboratory reagent water (free of interferences) with a known mixture of the parameters of interest.

11.7.8 Standard Library Search Procedures: As an optional feature, our laboratories are equipped to perform semiquantitative analyses for compounds not on the standard EPA analyte lists, using the library search technique. This procedure involves comparing the mass spectrum of the unknown peak to the standard spectra of the NIST Library. Our standard search will include the ten largest peaks (areas) of unknowns in the volatile fraction (Method 624/8240), and the twenty largest peaks in the semivolatile fractions (Method 625/8270). Both forward and reverse fitting procedures are routinely employed. Our laboratory reports provide both instrument raw data, including mass spectra of the best three fits, and a summary table consisting of scan number, tentatively identified compound, the reverse fit, and estimated concentrations. Concentrations are determined semiquantitatively by comparing the areas of the compound to the nearest internal standard and using a response factor of one.

11.8 Gas Chromatography QC Procedures

11.8.1 Reagents and Solvents: Only the highest quality reagents and solvents available are used in organic residue analyses.

11.8.2 Standards and Calibration: Prior to analysis of each group of 10

samples, the gas chromatograph is calibrated with a continuing check standard at a concentration near the method detection limit (MDL). Periodically it is necessary to recalibrate by assessing the linearity of a curve obtained by analyzing a series of five standards at different concentrations.

11.8.3 Method Blanks: A method blank is incorporated into every batch of samples to monitor the analysis system for contamination. Laboratory pure reagent water is taken through the same preparation and analysis procedure as the samples.

11.8.4 Laboratory Control Samples: A quality control reference standard is analyzed with every batch of samples. A suitable matrix (i.e., sample water) is spiked with a standard mixture representative of the components of interest. These standards are obtained from the U.S. EPA, commercial sources, or are prepared internally using a matrix miscible solvent such as methanol. The results of analyses are reported with the samples in the batch, and a database and statistics are maintained to ensure the precision and accuracy of the method.

11.8.5 Matrix Spikes and Spike Duplicates: Matrix spikes are analyzed in duplicate. Two aliquots of a sample matrix are spiked with the QC mixture and the percent recoveries are calculated for each compound. Results of the matrix spike duplicate analyses provide information about the precision and accuracy of the method in various matrices. This analysis will be performed at a frequency of one sample in twenty or 5% of the samples.

11.8.6 Confirmation Techniques: When results of gas chromatographic analyses are reported above the regulatory limit and/or detection limit of the method, one of the following qualitative confirmation techniques is used:

a. The analysis is repeated using a second GC column with a different liquid phase (polarity) than the primary column. The retention times or relative retention times of the suspected compounds are compared to those of standards.

b. The original sample/extract is analyzed by Gas Chromatograph/Mass Spectrometry (GC/MS), and the mass spectrum of the suspected compounds are compared to known spectra. This technique is required to resolve any controversies.

11.9 Routine Methods Used to Assess Precision and Accuracy

Section 5.0 qualitatively discussed precision, accuracy, and completeness, and Tables 5-1 through 5-21 gave numerical estimates for each parameter measured. Precision was estimated as relative percent difference (RPD). On a routine basis, a list of duplicate sample results with a range is generated. The relation between RPD and the range is as follows:

$$RPD = \frac{\text{range}}{(\text{result 1} + \text{result 2})/2} \times 100\%$$

where:
range = the absolute value of $R_1 - R_2$

In addition, a reference laboratory control standard result is compared to that of a known standard. This, along with the matrix spike recoveries, gives the estimates of accuracy. The accuracy measure of % Recovery is defined as follows:

$$\%\ \text{Recovery} = \frac{\text{amount recovered}}{\text{amount spiked}} \times 100\%$$

Table 11-1 provides the methods used to generate precision and accuracy targets. This includes methods, concentration levels and Method References.

11.10 Method Detection Limits and Practical Quantitation Limits

a. All Method Detection Limits (MDL) are obtained by definition of MDL's and procedures outlined in 40 CFR part 136, Appendix B.

b. Practical Quantitation Limits (PQL) are defined as the smallest concentration of analyte that can be reported to a known level of confidence. KEMRON normally estimates the PQL to be five times the MDL.

11.11 External Performance Evaluation (PE) Studies

KEMRON currently participates semiannually in three blind performance evaluation studies:

- US - EPA Water Supply Studies (WS)
- US - EPA Water Pollution Studies (WP)
- New York State Department of Health (NYSDOH) Environmental Laboratory Approval Program (ELAP)

For each of the programs, it is our internal policy to evaluate each departments performance and prepare corrective action plans for all unacceptable results. The performance summaries of the WS,WP and NYSDOH/ELAP studies and our corrective action plans are made available to clients and state agencies upon request.

TABLE 11-1
METHODS USED TO GENERATE PRECISION AND ACCURACY TARGETS

Analysis	Purpose	Concentration Level	Applicable Methods
Laboratory Control Sample (LCS)	Accuracy	Mid Level	Wet Chemistry AA (200, 7000 series) ICP (200.7, 6010) GC (600, 8000 series) GC/MS (600, 8000 series)
Matrix Spikes	Accuracy	Mid Level	Wet Chemistry AA (200, 7000 series) ICP (200.7, 6010) GC (600, 8000 series) GC/MS (600, 8000 series)
		Low Level	GFAA (200, 7000 series) GC/ECD (600, 7000 series) GC/MS (600, 8000 series)
Sample Duplicates	Precision	Mid Level	Wet Chemistry Minerals by AA, ICP Other methods if applicable
Matrix Spike Duplicates	Precision and Accuracy	Mid Level	AA (200, 7000 series) ICP (200.7, 6010) GC (600, 8000 series) GC/MS (600, 8000 series)

Figure 11-1
X-CHART
LABORATORY CONTROL SAMPLE
Inorganics

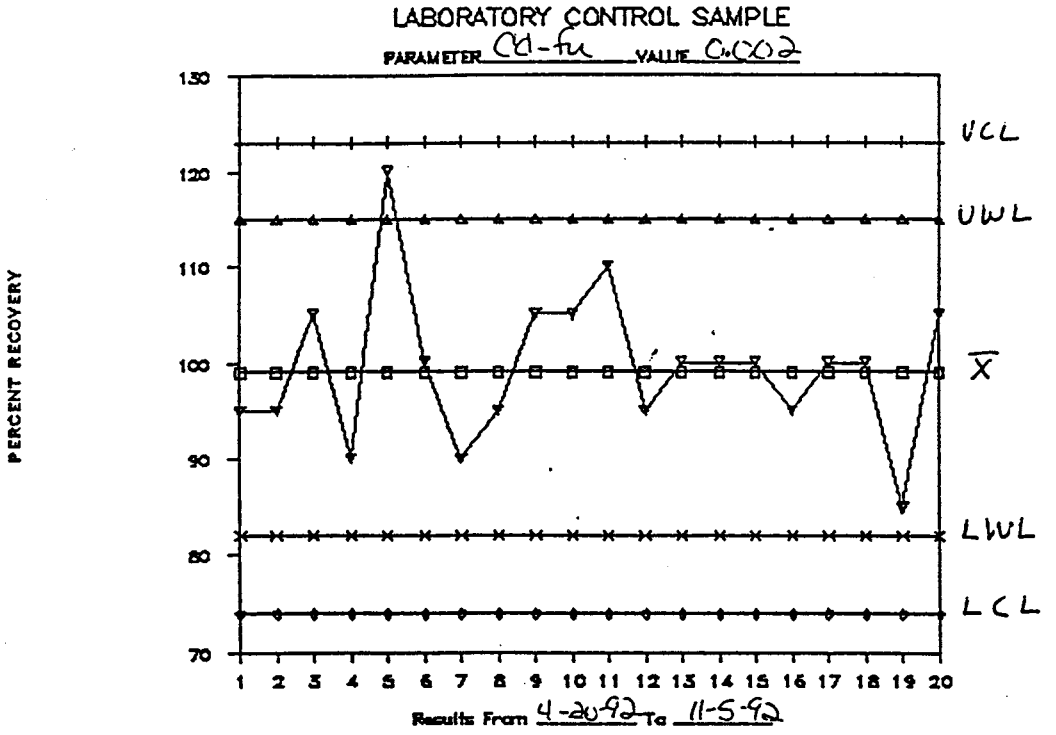


Figure 11-2
X-CHART
LABORATORY CONTROL SAMPLE
Organics

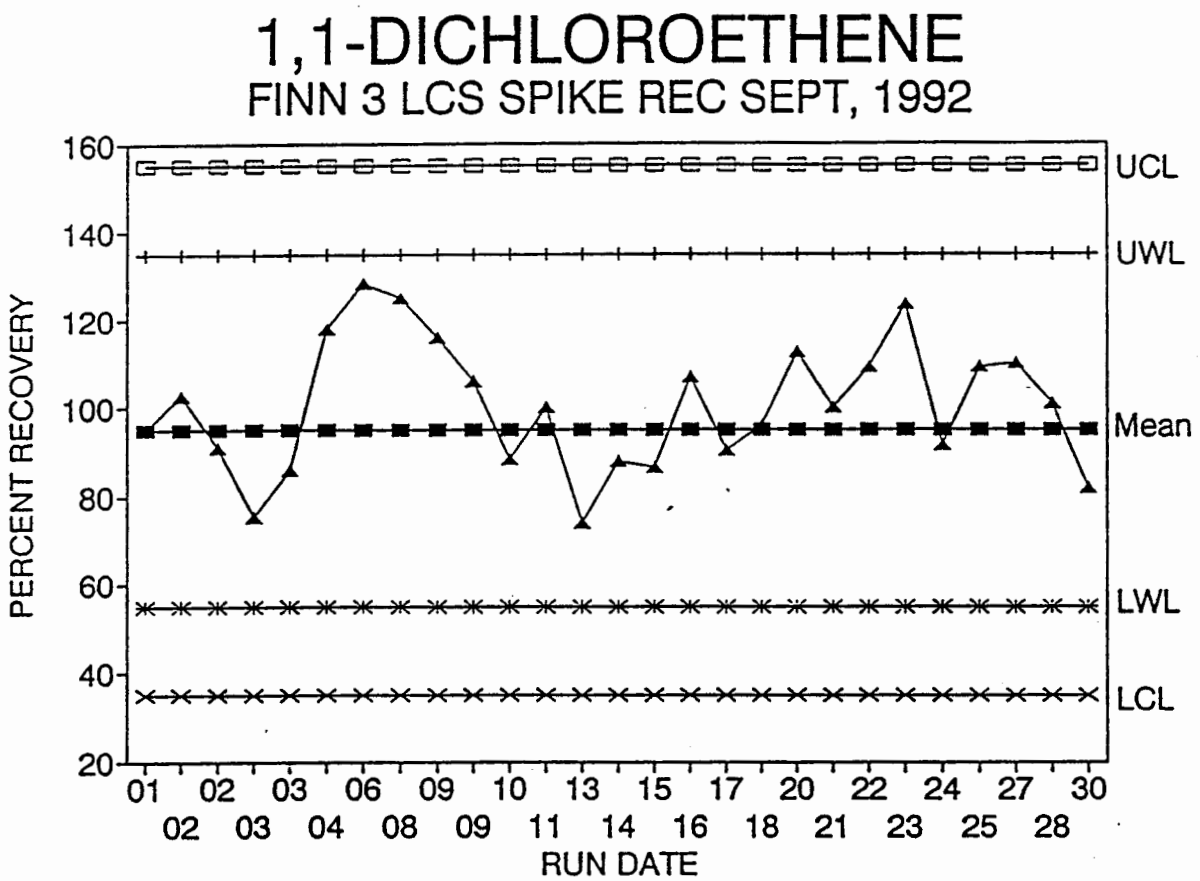


Figure 11-3
X-CHART
Matrix Spike
Inorganics

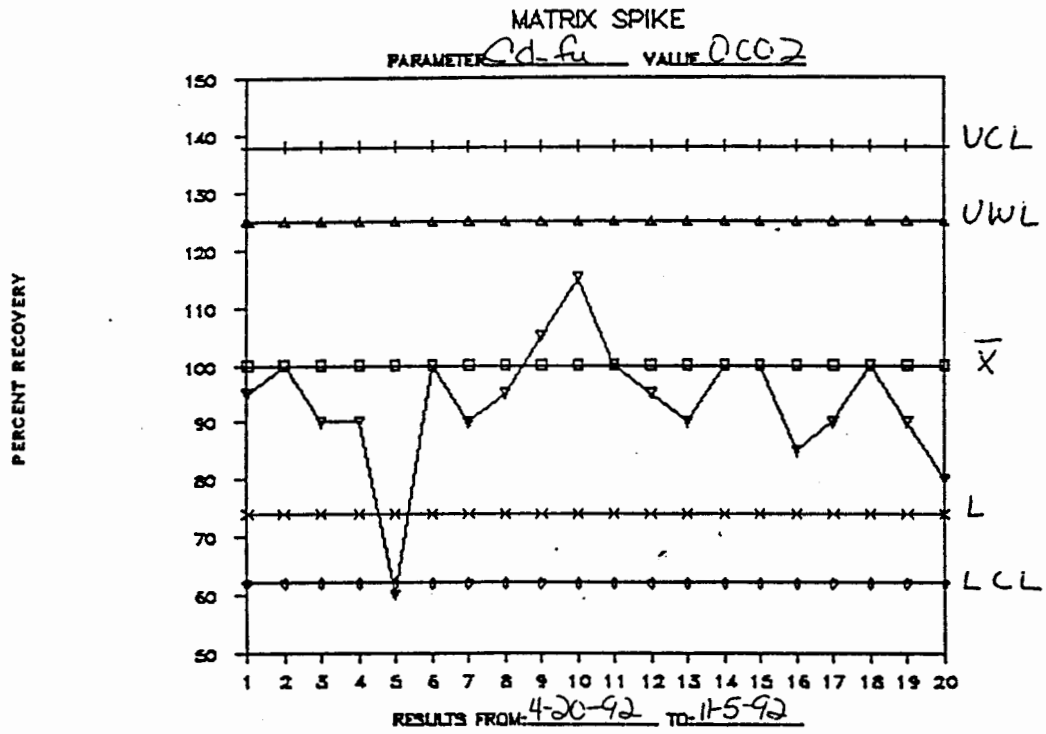


Figure 11-4
X-CHART
Matrix Spike/Matrix Spike Duplicate
Organics

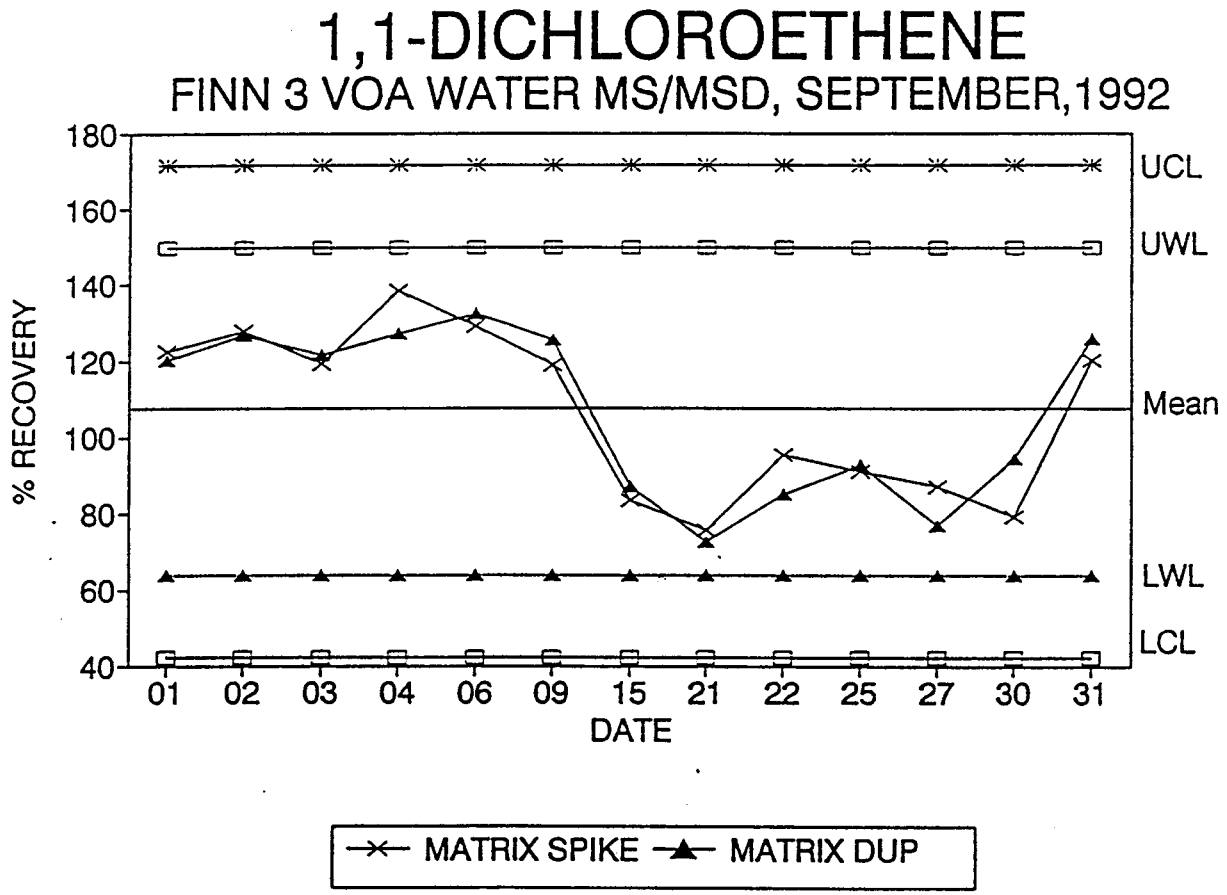
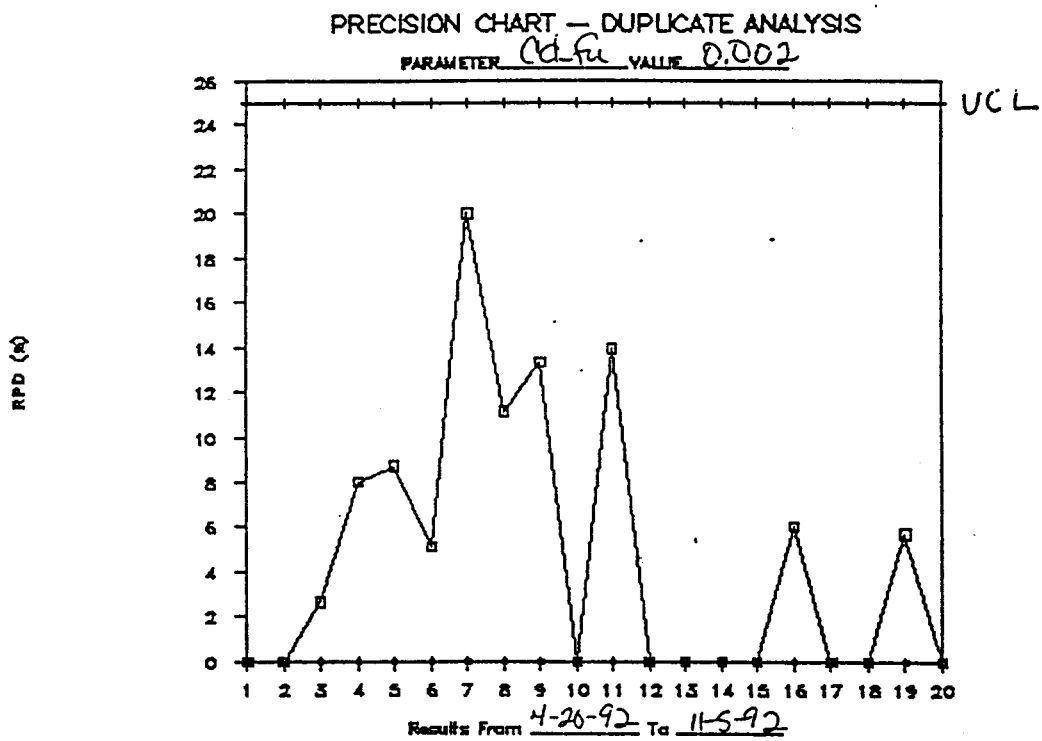


Figure 11-5
R-CHART
Inorganics



12.0 DATA REDUCTION, VALIDATION AND REPORTING

12.1 Laboratory Data Reduction:

KEMRON follows the data reduction and validation procedures given in the EPA's approved methods (40 CFR Part 136).

KEMRON automates data calculation and reduction as much as possible by using IBM-compatible personal computers and electronic spreadsheet software. Most analyses have been programmed to allow for raw data entry and editing at the keyboard, with integrated software performing calculations, and permanent database generation. Data-entry errors are checked by comparing the raw data printouts to the chemist's original work, and the common sources of error in data reduction are eliminated entirely. Raw and final data are stored on internal fixed disk, with either magnetic tape or flexible disk as backup. Eventually, all analyses will be programmed into the laboratory database, but until such time, one of the following procedures may also be used to calculate test results:

1. Data from simple analytical procedures such as gravimetric and titrimetric procedures are converted into final form by means of Lotus spreadsheet program.

2. Atomic absorption spectrophotometers are calibrated to display direct concentrations whenever possible. Some analyses, such as mercury, require the analyst to construct calibration curves using absorbance vs. concentration. Other determinations, such as those using standard additions, require manual computation with calculators to generate final results.

3. All KEMRON gas chromatographs (GC) and gas chromatograph/mass spectrometer (GC/MS) are equipped with programmable data systems which generates results in applicable units and is ready for review by the laboratory supervisor.

The responsibilities of the analyst vary from group to group. For that reason, they are broken down according to the following:

a. Organic analysts will run samples, document runs, maintain QA/QC analysis,check internal standards/surrogates, prepare any chromatographs, tune the instrument (GC/MS) and prepare the data package. They are also

responsible for archiving the data (either on magnetic tape or hard copies).

b. Inorganic analysts will run samples, document runs, maintain QA/QC analysis (i.e., QA and spikes) and prepare the data package. They are also responsible for archiving the data in a hard copy form.

Analysts are required to maintain a laboratory notebook. In addition, instrument log books are maintained for each instrument. Chart identification is done manually for inorganic groups. Chromatograph identification is done manually by the GC group, and done by computer for the GC/MS group. Computer record file identification is done based on the client name and a progressive number. Work sheets and spreadsheets are customized forms prepared on Lotus 1-2-3 or Symphony software. Data entry is accomplished by either a data entry clerk or the analyst.

When analyses are completed by the analyst, raw data and final results are immediately reviewed by the Laboratory Supervisor. Raw data from the chemist's notebooks or bench sheets include all the analytical variables compiled for samples, replicates, blanks, standards, and matrix spikes.

12.2 Laboratory Data Validation:

Each analyst is responsible for checking calibration integrity. The Group Leader is responsible for checking raw data entry and calculations of each analyst, extraction/instrument/analytical logs, instrument calibration integrity, and internal chain of custody weekly. Before data is submitted to a client it will be reviewed by the laboratory supervisors and laboratory section managers. The project manager will review all data, supporting documentation, and obvious anomalous values. Any obvious anomalous values may be reviewed by the QA/QC Coordinator or Laboratory Director.

General data validation criteria are as follows:

1. Instrument calibration must meet method criteria summarized in Section 9.0

2. Method blanks must be within an acceptable range (does not exceed method detection limit in most cases.)

3. Laboratory control samples must be within an acceptable range. (±2 standard deviations for advisory limits and ±3 standard deviations for

control limits).

4. Sample spikes should meet advisory limits as specified in Section 11.0 for percent recovery.

5. Duplicates or spike duplicates should meet advisory limits as specified in Section 11.0 for %RPD.

Other validation techniques include:

1. Comparison of results to historical data and general credibility

2. Anion/cation balance for inorganic analytes

3. Parameter correlation data such as BOD/COD, conductivity/dissolved solids, hexavalent chromium/total chromium, and other relationships

4. Significant figures

12.3 Data Reporting

KEMRON utilizes Radian Corporations's Sample and Analysis Management (SAM) system to generate all final reports. Data entry is accomplished by either a data entry clerk or the analyst. Inorganic data is entered in batches by analyte. Rough drafts of entered data are printed and compared to the handwritten version. Organic data are entered by sample. Once all data entry has been verified a final draft report is generated. This draft is reviewed by the section supervisor and the Project Manager or Laboratory Director. Figure 12-1 provides a sample of a KEMRON final report.

12.4 Data Storage

1. Field Data Storage:

   All project materials, including field notes, log books, reports, laboratory data, proposals, etc. are kept in project specific files for the duration of the project. Most project files are archived within three years of the project completion date. All reports are kept on computer word processing discs or tapes indefinitely. Archived project files are labeled by project number and are usually stored on the premises of in

a storage warehouse.

2. Laboratory Data Storage:

Hardcopy printouts of the KEMRON LIMS logsheets are permanently bound and are archived for at least ten years.

Computer records from the KEMRON LIMS are maintained on the system for six months and are then archived on magnetic tape. Two backup copies of the system are maintained on magnetic tape at all times. The backup and archive tapes are stored in a fireproof safe at the laboratory.

Hardcopies of each workorder are maintained in filing cabinets in the filing room and stored for a period of three to five years depending on contractual agreements.

Inorganics raw data, including analyst notebooks, bench sheets, computer printouts and instrument logs, are store alphabetically by parameter in the individual laboratories for a period of five years.

Extraction lab logbooks and bench sheets are maintained chronologically and stored in the laboratory for five years.

Gas Chromatography (GC) data is stored as hardcopy in the individual workorder files. GC/MS data is stored as hardcopy for three-five years in the workorder files, and on magnetic tape for at least one year.

FIGURE 12-1
SAMPLE KEMRON FINAL ANALYTICAL REPORT

Page 1 KEMRON REPORT Work Order # EX-TR-A02
Received: 09/20/90 10/25/90 10:35:22 Work Not Complete

REPORT TO: ABC Company
123 Main Street
Somewhere, USA 10000

PREPARED BY: KEMRON ENVIRONMENTAL SERVICES
109 STARLITE PARK
MARIETTA, OHIO 45750

CERTIFIED BY

ATTEN: Dr. John P. Doe

ATTEN PHONE: (614) 373-4071

CONTACT: JAY

CLIENT: ABC 59999 SAMPLES 1
COMPANY: ABC Company
FACILITY: Somewhere, USA

ANALYTICAL METHODS AND DOCUMENTATION ARE FOUND AT THE END OF THIS REPORT. ALL RESULTS ON SOILS/SLUDGES ARE REPORTED "AS RECEIVED" UNLESS OTHERWISE SPECIFIED.

WORK ID: Effluent #12A
TAKEN: Kemron
TRANS: Kemron
TYPE: Environmental
P.O. #: ABC999999
INVOICE: under separate cover

SAMPLE IDENTIFICATION		TEST CODES and NAMES used on this work order	
01	Effluent 001	AG	Silver, Total
		AL	Aluminum, Total
		AS	Arsenic, Total
		BA	Barium, Total
		CN	Cyanide, Total
		CR	Chromium, Total
		CU	Copper, Total
		MBAS	Surfactants (MBAS)
		M624	Volatile Organics
		M625_A	Acid Extractables
		M625_B	Base-Neutral Extractables
		PB	Lead, Total
		PHENOL	Phenolics, Total
		SB	Antimony, Total
		ZN	Zinc, Total

Page 2 KEMRON REPORT Work Order # EX-TR-A02
Received: 09/20/90 Results by Sample

SAMPLE ID Effluent 001 SAMPLE # 01 FRACTIONS: A
Date & Time Collected 09/20/90 Category WATER

AG <0.25 mg/L Ag	AL 1.3 mg/L Al	AS 0.01 mg/L As	BA 7.5 mg/L Ba	CN <0.01 mg/L CN	CR 0.05 mg/L Cr
CU 6.4 mg/L Cu	MBAS 5 mg/L LAS	PB 0.005 mg/L Pb	PHENOL 0.30 mg/L Phenol	SB 0.02 mg/L Sb	ZN 13 mg/L Zn

FIGURE 12-1 (cont'd)
SAMPLE KEMRON FINAL ANALYTICAL REPORT

Page 3
Received: 09/20/90

KEMRON REPORT
Results by Sample

Work Order # EX-TR-A02

SAMPLE ID Effluent 001

FRACTION 01A TEST CODE M624
Date & Time Collected 09/20/90 12:05:05

NAME Volatile Organics
Category WATER

ANALYST: WSN
INSTRMT: FINN2

FILE #: 2OF2467
INJECTED: 09/30/90 FACTOR: 1 UNITS: ug/L VERIFIED: LSB

CAS#	COMPOUND	RESULT	DETLIMIT
74-87-3	Chloromethane	BDL	10.0
74-83-9	Bromomethane	BDL	10.0
75-01-4	Vinylchloride	BDL	10.0
75-00-3	Chloroethane	BDL	10.0
75-09-2	Methylenechloride	BDL	5.0
107-02-8	Acrolein*	BDL	100.0
75-69-4	Trichlorofluoromethane	BDL	10.0
75-35-4	1,1-Dichloroethene	BDL	5.0
75-34-3	1,1-Dichloroethane	BDL	5.0
107-13-1	Acrylonitrile*	BDL	100.0
156-60-5	Total1,2-Dichloroethene	BDL	5.0
67-66-3	Chloroform	BDL	5.0
107-06-2	1,2-Dichloroethane	BDL	5.0
71-55-6	1,1,1-Trichloroethane	BDL	5.0
56-23-5	Carbontetrachloride	BDL	5.0
75-27-4	Bromodichloromethane	BDL	5.0
78-87-5	1,2-Dichloropropane	BDL	5.0
10061-02-6	trans-1,3-Dichloropropene	BDL	5.0
79-01-6	Trichloroethene	BDL	5.0
71-43-2	Benzene	BDL	5.0
124-48-1	Dibromochloromethane	BDL	5.0
79-00-5	1,1,2-Trichloroethane	BDL	5.0
10061-01-5	cis-1,3-Dichloropropene	BDL	5.0
110-75-8	2-Chloroethylvinylether	BDL	10.0
75-25-2	Bromoform	BDL	5.0
79-34-5	1,1,2,2-Tetrachloroethane	BDL	5.0
127-18-4	Tetrachloroethene	BDL	5.0
108-88-3	Toluene	BDL	5.0
108-90-7	Chlorobenzene	BDL	5.0
100-41-4	Ethylbenzene	BDL	5.0
541-73-1	1,3-Dichlorobenzene	BDL	5.0
106_46_7	1,4-Dichlorobenzene	BDL	5.0
95_50_1	1,2-Dichlorobenzene	BDL	5.0

Page 4
Received: 09/20/90

KEMRON REPORT
Results by Sample From Above

Work Order # EX-TR-A02

SAMPLE ID Effluent 001

FRACTION 01A TEST CODE M624
Date & Time Collected 09/20/90 12:05:05

NAME Volatile Organics
Category WATER

SURROGATES

1,2-Dichloroethane-d4	98% Recovery
Toluene-d8	95% Recovery
p-Bromofluorobenzene	100% Recovery

NOTES AND DEFINITIONS FOR THIS REPORT
DET LIMIT = DETECTION LIMIT
BDL = BELOW DETECTION LIMIT
* = SEMI-QUANTITATIVE SCREEN ONLY

FIGURE 12-1 (cont'd)
SAMPLE KEMRON FINAL ANALYTICAL REPORT

Page 5 KEMRON REPORT Work Order # EX-TR-A02
Received: 09/20/90 Results by Sample

SAMPLE ID Effluent 001 FRACTION 01A TEST CODE M625_A NAME Acid Extractables
Date & Time Collected 09/20/90 12:05:05 Category WATER

ANALYST: SPL EXTRACTED: 09/30/90 FILE #: 2OF4569
INSTRMT: FINN1 INJECTED: 09/30/90 FACTOR: 1 UNITS: ug/L VERIFIED: LSB

CAS#	COMPOUND	RESULT	DETLIMIT
59-50-7	4-Chloro-3-methylphenol	BDL	5.0
95-57-8	2-Chlorophenol	BDL	5.0
120-83-2	2,4-Dichlorophenol	BDL	5.0
105-67-9	2,4-Dimethylphenol	BDL	5.0
51-28-5	2,4-Dinitrophenol	BDL	25.0
534-52-1	2-Methyl-4,6-dinitrophenol	BDL	25.0
88-75-5	2-Nitrophenol	BDL	5.0
100-02-7	4-Nitrophenol	BDL	25.0
87-86-5	Pentachlorophenol	BDL	25.0
108-95-2	Phenol	BDL	5.0
88-06-2	2,4,6-Trichlorophenol	BDL	5.0

SURROGATES
2-Fluorophenol 99% Recovery
Phenol-d5 103% Recovery
2,4,6-Tribromophenol 95% Recovery

NOTES AND DEFINITIONS FOR THIS REPORT
DET LIMIT = DETECTION LIMIT BDL=BELOW DETECTION LIMIT NA = NOT ANALYZED

Page 6 KEMRON REPORT Work Order # EX-TR-A02
Received: 09/20/90 Results by Sample

SAMPLE ID Effluent 001 FRACTION 01A TEST CODE M625_B NAME Base-Neutral Extractables
Date & Time Collected 09/20/90 12:05:05 Category WATER

ANALYST: SPL EXTRACTED: 09/30/90 FILE #: 2OF4877
INSTRMT: FINN1 INJECTED: 09/30/90 FACTOR: 1 UNITS: ug/L VERIFIED: LSB

CAS#	COMPOUND	RESULT	DETLIMIT
83-32-9	Acenaphthene	BDL	5.0
208-96-8	Acenaphthylene	BDL	5.0
120-12-7	Anthracene	BDL	5.0
92-87-5	Benzidine	BDL	25.0
56-55-3	Benzo(a)anthracene	BDL	5.0
205-99-2	Benzo(b)fluoranthene	BDL	5.0
207-08-9	Benzo(k)fluoranthene	BDL	5.0
50-32-8	Benzo(a)pyrene	BDL	5.0
191-24-2	Benzo(ghi)perylene	BDL	5.0
85-68-7	Benzyl butyl phthalate	BDL	5.0
111-44-4	Bis(2-chloroethyl)ether	BDL	5.0
111-91-1	Bis(2-chloroethoxy)methane	BDL	5.0
117-81-7	Bis(2-ethylhexyl)phthalate	BDL	5.0
108-60-1	Bis(2-chloroisopropyl)ether	BDL	5.0
101-55-3	4-Bromophenyl phenyl ether	BDL	5.0
91-58-7	2-Chloronaphthalene	BDL	5.0
7005-72-3	4-Chlorophenyl phenyl ether	BDL	5.0
218-01-9	Chrysene	BDL	5.0
53-70-3	Dibenzo(a,h)anthracene	BDL	5.0

FIGURE 12-1 (cont'd)
SAMPLE KEMRON FINAL ANALYTICAL REPORT

Page 7 KEMRON REPORT Work Order # EX-TR-A02
Received: 09/20/90
Continued From Above
SAMPLE ID Effluent 001 FRACTION 01A TEST CODE M625_B NAME Base-Neutral Extractables
Date & Time Collected 09/20/90 12:05:05 Category WATER

ANALYST: SPL EXTRACTED: 09/30/90 FILE #: 2OF4877
INSTRMT: FINN1 INJECTED: 09/30/90 FACTOR: 1 UNITS: ug/L VERIFIED: LSB

CAS#	COMPOUND	RESULT	DETLIMIT
84-74-2	Di-n-butylphthalate	BDL	5.0
95-50-1	1,2-Dichlorobenzene	BDL	5.0
541-73-1	1,3-Dichlorobenzene	BDL	5.0
106-46-7	1,4-Dichlorobenzene	BDL	5.0
91-94-1	3,3-Dichlorobenzidine	BDL	10.0
84-66-2	Diethyl phthalate	BDL	5.0
131-11-3	Dimethyl phthalate	BDL	5.0
121-14-2	2,4-Dinitrotoluene	BDL	5.0
606-20-2	2,6-Dinitrotoluene	BDL	5.0
117-84-0	Di-n-octyl phthalate	BDL	5.0
206-44-0	Fluoranthene	BDL	5.0
86-73-7	Fluorene	BDL	5.0
118-74-1	Hexachlorobenzene	BDL	5.0
87-68-3	Hexachlorobutadiene	BDL	5.0
77-47-4	Hexachlorocyclopentadiene	BDL	5.0
67-72-1	Hexachloroethane	BDL	5.0
193-39-5	Indeno(1,2,3-cd)pyrene	BDL	5.0
78-59-1	Isophorone	BDL	5.0
91-20-3	Naphthalene	BDL	5.0
98-95-3	Nitrobenzene	BDL	5.0
62-75-9	N-Nitrosodimethylamine	BDL	5.0
621-64-7	N-Nitrosodi-n-propylamine	BDL	5.0
86-30-6	N-Nitrosodiphenylamine	BDL	5.0
85-01-8	Phenanthrene	BDL	5.0
129-00-0	Pyrene	BDL	5.0
120-82-1	1,2,4-Trichlorobenzene	BDL	5.0

SURROGATES

Nitrobenzene-d5	97% Recovery
2-Fluorobiphenyl	101% Recovery
2,4,6-Tribromophenol	89% Recovery
p-Terphenyl-d14	90% Recovery

NOTES AND DEFINITIONS FOR THIS REPORT
DET LIMIT = DETECTION LIMIT BDL = BELOW DETECTION LIMIT NA = NOT ANALYZED ND = NOT DETECTED

Page 8 KEMRON REPORT Work Order # EX-TR-A02
Received: 09/20/90
Test Methodology

TEST CODE AG	NAME Silver, Total	EPA Method 200.7 (ICP) or 272.1 (AA - Direct Aspiration)
TEST CODE AL	NAME Aluminum, Total	EPA Method 200.7 (ICP) or 202.1 (AA - Direct Aspiration)
TEST CODE AS	NAME Arsenic, Total	EPA Method 206.3 (AA Vapor Hydride)
TEST CODE BA	NAME Barium, Total	EPA Method 200.7 - (ICAP) or 208.1 (AA - Direct Aspiration)
TEST CODE CN	NAME Cyanide, Total	EPA Method 335.2 Distillation-Spectrophotometric
TEST CODE CR	NAME Chromium, Total	EPA Method 200.7 (ICP) or 218.1 (AA - Direct Aspiration)
TEST CODE CU	NAME Copper, Total	EPA Method 200.7 (ICP) or 220.1 (AA - Direct Aspiration)
TEST CODE M624	NAME Volatile Organics	EPA Method 624 GC/MS - Purge and Trap
TEST CODE M627_A	NAME Acid Extractables	EPA Method 625 GC/MS - Acid Extractables
TEST CODE M627_B	NAME Base-Neutral Extractables	EPA Method 625 GC/MS - Base Neutral Extractables
TEST CODE MBAS	NAME Surfactants (MBAS)	EPA Method 425.1 Calorimetric
TEST CODE PB	NAME Lead, Total	EPA Method 200.7 (ICP) or 239.1 (AA - Direct Aspiration)
TEST CODE PHENOL	NAME Phenolics, Total	EPA Method 420.1 Spectrophotometric Manual 4-AAP with distillation
TEST CODE SB	NAME Antimony, Total	EPA Method 200.7 (ICP) or 204.1 (AA - Direct Aspiration)
TEST CODE ZN	NAME Zinc, Total	EPA Method 200.7 (ICP) or 289.1 (AA - Direct Aspiration)

13.0 CORRECTIVE ACTION

13.1 Field Activities: The purpose of KEMRON's internal corrective action protocol is to investigate and resolve any quality control problems related to field sampling procedures, sample custody, and sample analysis such as identification of contaminated field or laboratory trip blanks, or field-measured pH and Conductivity data beyond the precision and accuracy limits for duplicate samples. Corrective action may also be initiated as a result of data comparison studies and/or system or performance audits.

In the event of a QA problem, KEMRON's project manager will review the sampling procedures utilized in the field to determine if the sample integrity was compromised. The investigation would include interviews with the site geologist and other site personnel, review of field notes, and examination of chain-of-custody documents. Corrective actions will include notification to all personnel involved with the project.

Corrective action for field activities might include resampling of one or more wells in question with a senior individual (such as the QA/QC Coordinator) who oversees sampling procedures. If a field-induced problem is suspected, the procedures used for field analyses, field sampling, field or office decontamination, sample labeling, and packing and shipping may require modification. If the necessary modifications appear to have solved the problem then additional corrective action will not be taken.

KEMRON's Field Project Manager will work with the Laboratory Quality Assurance Coordinator when an incident of questionable analytical results or internal QC data occurs. An example would be if a field blank or trip blank showed significant levels of constituents or if a sample duplicate was out of control. He will work with the laboratory staff to resolve any problems and implement appropriate corrective action.

13.2 Laboratory Activities: Criteria levels that require corrective action and the corrective actions to be taken are outlined in Tables 13-1 to 13-7.

Analysts assess each QC analysis they perform. If the result is not acceptable it will be brought to the attention of the Group Leader. The Group Leader will recommend a corrective action to the section manager. The section manager, along with the QA/QC Coordinator will then be responsible for the implementation of the corrective action measures.

13.2.1 Out of Control Criteria - Corrective Action

An out-of-control situation exists when the results of the blank, standard, sample replicate, or spike recovery analyses are beyond the acceptance limits (usually three standard deviations, or 99% confidence level). If either the blank or reference standard is out of control, the data from that analytical run are judged invalid. An investigation to find the cause of the problem is undertaken by the analyst and Laboratory Supervisor and a Quality Assurance Action Report (Figure 13-1) is initiated. After the problem has been corrected, as verified by acceptable performance on blanks and standards, the analyses for the batch in question are repeated.

13.2.3 Warning Criteria - Corrective Action

A situation also demanding corrective measures exists when quality assurance data for blanks, standards, sample replicates or matrix spikes are reported beyond the warning limits (two standard deviations), or a trend or shift is observed for the reference standard. In this case, samples need not be re-analyzed, provided the data are within acceptance limits.

A Quality Assurance Action Report is initiated by the analyst and Laboratory Supervisor, and corrective action must be taken before another batch of samples is analyzed by that method. If the situation reoccurs with the next batch of samples, an out-of-control situation exists. Whenever replicate analysis (precision) data or matrix spike recovery (accuracy) data are out of acceptance limits, comprehensive corrective action (batch re-analysis) may not be necessary. Often, these problems can be attributed to matrix effect. If the remaining QC data (method blank and reference standard) are in control or the chromatograph confirms matrix interference, the only corrective action implied is re-analysis of the sample in question. This only verifies the matrix effect or other specific interference problems. Whenever a matrix effect is confirmed, the method of standard addition is used for quantification, if applicable, to the analysis method.

13.3.3 Performance Audit - Corrective Action

Both systems and performance audits, internal or external, may result in a corrective action being taken (see Section 14.0). If the laboratory fails any parameter in either of these categories, a corrective action will be taken.

Figure 13-2 is a sample of the Performance Audit Corrective Action Form. The QA/QC Coordinator will be notified using the form, who will in turn give a copy to the Laboratory Director and the Regional Manager.

Figure 13-3 is an sample of a Performance Audit Corrective Action Report to management, which was prepared for an internal audit.

The KEMRON laboratory facility is willing to follow Federal and State recommended corrective action procedures that may be initiated as a result of any system or performance audits by either of these agencies.

Figure 13-1
KEMRON QUALITY ASSURANCE ACTION REPORT

1. Date:
2. Laboratory:
3. Supervisor:
4. Analyst:
5. Parameter:

6. Blank Result: UCLb:
   Standard Result: UCLx: LCLx:
   Duplicate Results: / UCLr:
   Spike Level: Percent Rec: UCLs: LCLs:

7. Analysts's description of problem:

8. Comments of QA/QC Coordinator:

9. Action taken to solve problem:

10. Were analyses repeated?

    A. If so, give results for: Reagent Blank -
       Standard -

    B. If not, reason:

Figure 13-2
KEMRON PERFORMANCE AUDIT CORRECTIVE ACTION FORM

PE Program:_____

Analyte:_____

Analyst:_____

		Acceptable Range
Result (Level 1):	_____	_____ - _____
Result (Level 2):	_____	_____ - _____

Reason for Error:

Corrective Action:

Figure 13-3
KEMRON PERFORMANCE AUDIT CORRECTIVE ACTION REPORT TO MANAGEMENT

1. Dissolved Solids at 180°C (mg/L)

KEMRON RESULT: 1130 ACCEPTABLE RANGE: 1140-1400

This was probably a random error which is very difficult to explain. This sample was run in duplicate, with results of 1118 and 1144 mg/L. The average was recorded. If the higher number would have been recorded, it would have been in the correct range. To correct this problem, a new stock standard was prepared.

2. Arsenic (ug/L)

KEMRON RESULT: 64.9 ACCEPTABLE RANGE: 65.0-109.0

The error here lies in calibration drift or error, since if this response is rounded up it falls within the acceptable range. To obtain acceptable results when the limits are this tight requires that the entire analytical system be optimized. New standards have been prepared and the calibration curve has been checked.

3. Aroclor 1254 (ug/L)

KEMRON RESULT: 0.73 ACCEPTABLE RANGE: 0.11-0.49

This concentration is below the detection limit for our GC. Therefore no corrective measures were taken.

4. Carbon Tetrachloride (ug/L)

KEMRON RESULT: 10.0 ACCEPTABLE RANGE: 15.0-126.0

Since Kemron's result here is low, it would, appear that this was a purging error within the Tekmar system, most likely involving the trap, or concentration of the standards. To correct this error, the trap as well as the standards have been replaced with fresh ones.

Figure 13-3 (con't)
KEMRON PERFORMANCE AUDIT CORRECTIVE ACTION REPORT TO MANAGEMENT

5. Dibenzofuran (ug/L)

KEMRON RESULT: BDL ACCEPTABLE RANGE: 6.9-37.0

We did get a result in the correct range (16 ug/L) with closer inspection for the compound. An operator error occurred here, from not reporting the compound as a hit with the appropriate concentration. In the future, as always, we will endeavor to assure that data is transcribed correctly.

Prepared by:_____
Daniel A. Musgrave
QA/QC Coordinator

Reviewed by:_____
David L. Bumgarner
Director, Analytical Services

Table 13-1
Quality Control Criteria
Wet Chemistry and Conventionals
TOC, TOX
Automated Wet Chemistry

CONTROL ITEM	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
Initial Calibration	Per run	COC > 0.990	Recalibrate
Method Blank	Every batch	≤ MDL	Investigate, reanalyze batch as needed
Laboratory Control Samples	Every batch	Control Limits*	Investigate, reanalyze batch as needed
Matrix Spike	Every batch	Control Limits*	Reanalyze spike as needed
Sample Duplicate	Every batch	RPD < UCL	Reanalyze sample as needed

*Control limits are established at ±3 standard deviations.

Table 13-2
Quality Control Criteria
Total Metals - ICP
Metals - ICP
EPA 200.7 / SW 6010

CONTROL ITEM	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
Initial calibration	Daily	COC > 0.995	Repeat calibration
Calibration check standard	10%, or minimum of 1 per batch element of interest	Measured value within 10% of true value for	Repeat calibration
Method blank	5%, or minimun of 1 per batch	< MDL	1-Repeat test-average results. 2-Evaluate system 3-Repeat batch as necessary
Laboratory Control Sample (LCS)	5%, or minimum of 1 per batch	Control Limits*	Investigate, Repeat batch as necessary
Matrix spike	5%, or minimum of 1 per batch	±25% Error	1-Flag data 2-For TCLP tox metals, analyze using method of standard additions
Matrix spike duplicate	5%, or minimum of 1 per batch	RPD <20%	Flag data
ICP interference check	Run at beginning middle, and end of daily run	80-120% of true value for EPA check sample elements	1-Repeat calibration 2-see lab manager
LOD check	Quarterly	None	Used to verify current LOD

* Control Limits are established at ±3 standard deviations

Table 13-3
Quality Control Criteria
Metals - Atomic Absorption
Flame AA, GFAA, CVAA

CONTROL ITEM	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
Initial calibration	Daily	COC > 0.995	Repeat calibration
Calibration check standard	10%, or minimum of 1 per batch	± 10% Error	Repeat calibration
Method blank	5%, or minimum of 1 per batch		1-Repeat test - average results 2-Evaluate system 3-Repeat batch as necessary
Laboratory Control Sample (LCS)	5%, or minimum of 1 per batch	Control Limits*	Investigate, Repeat batch as necessary
Matrix spike analyses	5%, or minimum of 1 per batch	±25% Error	1-Flag data 2-for TCLP metals, analyze using method of standard additions
Matrix spike duplicate	5%, or minimum of 1 per batch	RPD <20%	Flag data
MDL check	Quarterly	None	Used to verify current MDL

*Control Limits are established at ± 3 standard deviations

Table 13-4
Quality Control Criteria
Chlorinated Herbicides
SW8150

CONTROL ITEM	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
Initial Calibration	Initially and upon failure of two consecutive continuing check samples	Ave CF < 20% RSD	Recalibrate Instrument
Continuing Calibration	Every ten samples (including method blanks and QC)	+/- 15% differance	Recalibrate Instrument
Method Blank	One per batch (20 samples maximum per batch)	Target compounds < MDL	Re-extract entire batch associated with blank
Laboratory Control Sample (LCS)	One per batch (20 samples maximum per batch)	Within desiginated ranges*	Re-extract entire batch associated with LCS
Matrix Spike	One per batch (20 samples maximum per batch)	Within desiginated ranges*	Reanalyze, re-extract spike sample as needed, flag data
Matrix Spike Duplicate	One per batch (20 samples maximum per batch)	Within desiginated ranges*	Reanalyze, re-extract spike sample as needed, flag data
Surrogate Compound	No surrogate is is currently in use	N/A	N/A

*Control Limits are established at ± 3 standard deviations

Table 13-5
Quality Control Criteria
8080/608/PCB/PESTICIDES SOIL AND WATER SAMPLES

CONTROL ITEM	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
Initial Calibration	Initially and upon failure of two consecutive continuing check samples	Ave Cf <20% RSD	Recalibrate Instrument
Continuing calibration	Every ten samples (including method blanks and QC)	+/- 15% differance	Recalibrate Instrument
Method Blank	One per batch (20 samples maximum per batch)	Target compounds < MDL	Re-extract entire batch associated with blank
Laboratory Control Sample (LCS)	One per batch (20 samples maximum per batch)	Within desiginated ranges*	Re-extract entire batch associated with LCS
Matrix Spike	One per batch (20 samples maximum per batch)	Within desiginated ranges*	Reanalyze, re-extract spike as needed, flag data
Matrix Spike Duplicate	One per batch (20 samples maximum per batch)	Within desiginated ranges	Reanalyze, re-extract spike as needed, flag data
Surrogate Compound	Surrogate is placed in each sample, blank, and QC	Within designated ranges	Re-extract only those samples with poor surrogates

*Control Limits are established at ± 3 standard deviations

Table 13-6
Quality Control Criteria
8030/8020/601/602/BETX/GRO SOIL AND WATER SAMPLES

CONTROL ITEM	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
Initial Calibration	Initially and upon failure of two consecutive continuing check samples	Ave Cf <20% RSD	Recalibrate Instrument
Continuing calibration	Every ten samples (including method blanks and QC)	+/- 15% differance	Recalibrate Instrument
Method Blank	One per batch (20 samples maximum per batch)	Target compounds < MDL	Re-run blank before continuing
Laboratory Control Sample (LCS)	One per batch (20 samples maximum per batch)	Within desiginated ranges*	Re-run LCS before continuing
Matrix Spike	One per batch (20 samples maximum per batch)	Within desiginated ranges*	Re-run spike
Matrix Spike Duplicate	One per batch (20 samples maximum per batch)	Within desiginated ranges*	Re-run spike
Surrogate Compound	Surrogate is placed in each sample, blank, and QC	Within designated ranges	Re-run only those samples with poor surrogates

*Control Limits are established at ± 3 standard deviations

Table 13-7
Quality Control Criteria
Method 8100
Polyaromatic Hydrocarbons

CONTROL ITEM	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
Initial Calibration	Initially and upon failure of two consecutive Continuing Check samples	Ave Cf <20% RSD	Recalibrate Instrument
Continuing calibration	Every ten samples (including method blanks and QC	+/- 15% differance	Recalibrate Instrument
Method Blank	One per batch (20 samples maximum per batch)	Target Compounds < MDL	Re-extract entire batch associated with blank
Laboratory Control Sample (LCS)	One per batch (20 samples maximum per batch)	Within desiginated ranges*	Re-extract entire batch associated with LCS
Matrix Spike	One per batch (20 samples maximum per batch)	Within desiginated ranges*	Reanalyze, re-extract spike as needed, flag data
Matrix Spike Duplicate	One per batch (20 samples maximum per batch)	Within desiginated ranges	Reanalyze, re-extract spike as needed, flag data
Surrogate compound	Surrogate is placed in each sample, blank, and QC	Within desiginated ranges	Re-extract only those samples with poor surrogates

*Control Limits are established at ± 3 standard deviations

Table 13-8
Quality Control Criteria
Volatile GC/MS Analysis 8260/624

CONTROL ITEM	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
Initial Calibration	When Continuing Calibration is out of control	%RSD for CCC's <30%. RF for SPCC's >0.300 (0.25 for Bromoform)	Stop analysis, investigate, reanalyze
Continuing Calibration	Every 12 hours	RF for SPCC's same as initial. CCC's must be less than 25% difference	Stop analysis, investigate, reanalyze Run new initial calibration curve
Method Blank	Every 12 hours 1 per sample set	All target analytes below PQL	Stop analysis, investigate, reanalyze
LCS	Every 12 hours. 1 per sample set or 5%	Selected spike, analytes must fall within acceptable % recovery ranges	Stop analysis, if 5 or more analytes are out of range, reanalyze
MS/MSD	Water-5% Soil -5%	% Recovery and % RPD must be within acceptable ranges	Investigate, reanalyze, unless obvious matrix problems are evident
Sample duplicate	As clients request or as needed	Surrogate recovery within ranges. Consistent with sample results.	Reanalyze
Surrogates	All standards and samples run	% recovery must be within acceptable ranges	Reanalyze unless obvious matrix interference can be proven.

Table 13-9
Quality Control Criteria
Semivolatile GC/MS Analysis 8270/625

CONTROL ITEM	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
Initial Calibration	When Continuing Calibration is out of control or when system conditions have been altered	%RSD for CCC's <30% RF for SPCC's >0.05 All others less than 75	Stop analysis, investigate, reanalyze
Continuing Calibration	Every 12 hours	RF for SPCC's the same as initial calibration CCC's must be less than <25% difference	Stop analysis, investigate, reanalyze Run new initial calibration curve
Method Blank	Per Extraction Batch	All target analytes below PQL	Investigate, reanalyze, reextract if necessary
LCS	Per Extraction Batch or 5%	Selected Spike Analytes must fall within designated % Recovery ranges	Stop Analysis, if 5 or more analytes are out of range, investigate reanalyze
MS/MSD	Water-5% Soil -5%	% Recovery and % RPD must be within acceptable ranges	Investigate, reanalyze, unless obvious matrix problems are evident
Sample duplicate	At client's request or as needed	Surrogate recovery within range consistent with sample results	Reanalyze
Surrogate Compound	All Standards and samples run	% recovery must be within acceptable ranges	Investigate, reanalyze Reextract if necessary

14.0 PERFORMANCES AND SYSTEMS AUDITS

14.1 Laboratory Systems Audits:

KEMRON Environmental Services strives for excellence. To that end, KEMRON is willing to participate in any Federal or State performance evaluation testing programs or system audits. In addition, KEMRON is always open to audit requests by any Federal or State agency or client. Overall system and performance audits of major departments will be performed on a quarterly basis by the QA/QC Coordinator. Internal systems audits of the KEMRON facility occur on a quarterly basis and are conducted by the QA/QC Coordinator. Figure 14-1 gives a sample of an internal system audit form.

External systems audits of the KEMRON facility occur on a regular basis. These include annual audits by the West Virginia Department of Natural Resources (WVDNR), the Ohio Environmental Protection Agency (OEPA), and the New York Department of Health (NYDOH). KEMRON has applied for A_2LA accreditation and is waiting for its final assessment.

14.2 Performance Audits:

Internal performance audits are conducted on a quarterly basis and are conducted by the QA/QC Coordinator. These audits will be blind studies with only the QA/QC Coordinator knowing the certified values. Under no circumstances will the certified values be released to the lab until analysis values have been turned in. These in-house performance evaluations are conducted using commercial reference samples from Environmental Resource Associates (ERA) or Analytical Products Group (APG). The quarterly audits consist of blind or double blind samples, for Volatiles, Pesticides, PCB's, Acids, Base Neutrals, Hardness, Minerals, Grease and Oil, Demand, Nutrients, Cyanide & Phenol, Trace Metals, Total Residual Chlorine, and BETX.

In addition to an internal performance audit KEMRON participates in several government external and private performance evaluation testing programs include the following:

New York, Dept. of Health ELAP	- Semi-annually
EPA Water Pollution Study	- Semi-annually
EPA Water Supply Study	- Semi-annually
APG or ERA	- Quarterly

Figure 14-1
KEMRON INTERNAL SYSTEM AUDIT FORM

KEMRON Laboratory Check List

I. Sample Receipt and Storage Area

ITEM	YES	NO	COMMENTS
Are written Standard Operating Procedures (SOP) developed for receipt and storage of samples?			
Is the appropriate portion of the SOP available to the analyst at the sample receipt/storage area?			
Are samples that require preservation stored in such a way as to maintain their preservation.			
Are volatile samples stored separately from semi-volatile samples?			
Are adequate facilities provided for storage of samples, including cold storage?			
Is the temperature of the cold storage recorded daily in a logbook?			
Are the sample receipt/storage and temperature logbooks maintained in a manner consistent with GLP?			
Has the supervisor of the individual maintaining the notebook personally examined and reviewed the notebook periodically, and signed his/her name therein, together with the date and appropriate comments as to whether or not the notebook is being maintained in an appropriate manner?			

Additional Comments:

Figure 14-1 (cont'd)
KEMRON INTERNAL SYSTEM AUDIT FORM

Kemron Laboratory Check List

II. Sample Preparation Area

ITEM	YES	NO	COMMENTS
Is the laboratory maintained in a clean and organized manner?			
Are contamination-free areas provided for trace level analytical work?			
Are exhaust hoods provided to allow contamination-free work with volatile materials?			
Is the air flow of the hoods periodically checked and recorded?			
Does the laboratory have a source of distilled/demineralized water?			
Can the laboratory supervisor document that trace-free water is available for preparation of standards and blanks?			
Is the analytical balance located away from draft and area subject to rapid temperature changes?			
Has the balance been calibrated within on year by a certified technician?			
Is the balance routinely checked with class S weights before each use and the results recorded in a logbook?			
Is the appropriate portion of the SOP available to the analyst at the sample preparation area?			
Are reagent grade or higher purity chemicals used to prepare standards?			
Are fresh analytical standards prepared at a frequency consistent with good QA?			
Are reference materials properly labled with concentrations, date of preparation, and the identity of the person preparing the sample?			
Is a standards preparation and tracking logbook maintained?			
Do the analysts record bench data in a neat and accurate manner?			
Are standards stored separately from sample extracts?			
Is the temperature of the refrigerator/freezer recorded daily?			

Additional Comments:

Figure 14-1
KEMRON INTERNAL SYSTEM AUDIT FORM

KEMRON Laboratory Check List

III. GC - GC/MS Instrumentation

ITEM	YES	NO	COMMENTS
Are written Standard Operating Procedures (SOP) developed for all methods used in this area?			
Is the appropriate portion of the SOP available to the analyst at the various instruments?			
Is the laboratory maintained in a clean and organized manner?			
Are contamination-free areas provided for trace level analytical work?			
Are exhaust hoods provided to allow contamination-free work with volatile materials?			
Is the air flow of the hoods periodically checked and recorded?			
Does the laboratory have a source of distilled/demineralized water?			
Can the laboratory supervisor document that trace-free water is available for preparation of standards and blanks?			
Are fresh analytical standards prepared at a frequency consistent with good QA?			
Are reference materials properly labled with concentrations, date of preparation, and the identity of the person preparing the sample?			
Is a standards preparation and tracking logbook maintained?			
Are standards stored separately from sample extracts?			
Is the temperature of the refrigerator/freezer recorded daily?			
Is there a calibration protocol in use by the operator?			
Are calibration results kept in a permanent record?			
Do the analysts record bench data in a neat and accurate manner?			
Is preventative maintenance applied?			
Is a permanent service record maintained in a logbook?			
Is an electronic data storage service available?			
Is there evidence that at least one GC or GC/MS system can be reasonable expected to be operating acceptably at any given time?			

Additional Comments:

Figure 14-1
KEMRON INTERNAL SYSTEM AUDIT FORM

KEMRON Laboratory Check List

IV. AA/ICP Instrumentation

ITEM	YES	NO	COMMENTS
Are written Standard Operating Procedures (SOP) developed for all methods used in this area?			
Is the appropriate portion of the SOP available to the analyst at the various instruments?			
Are contamination-free areas provided for trace level analytical work?			
Are exhaust hoods provided to allow contamination-free work with corrosive materials?			
Is the air flow of the hoods periodically checked and recorded?			
Does the laboratory have a source of distilled/demineralized water?			
Can the laboratory supervisor document that trace-free water is available for preparation of standards and blanks?			
Are fresh analytical standards prepared at a frequency consistent with good QA?			
Are reference materials properly labled with concentrations, date of preparation, and the identity of the person preparing the sample?			
Is a standards preparation and tracking logbook maintained?			
Are standards stored separately from sample extracts?			
Is the laboratory maintained in a clean and organized manner?			
Is there a calibration protocol in use by the operator?			
Are calibration results kept in a permanent record?			
Is preventative maintenance applied?			
Is a permanent service record maintained in a logbook?			
Is there evidence that at least one AA/ICP system can be reasonably expected to be operating acceptably at any given time?			

Additional Comments:

Figure 14-1
KEMRON INTERNAL SYSTEM AUDIT FORM

KEMRON Laboratory Check List

V. Data Handling and Review/QC Checklist

ITEM	YES	NO	COMMENTS
Are written Standard Operating Procedures (SOP) developed for data review?			
Is the appropriate portion of the SOP available to data review personnel?			
Are data calculations spot-checked by a second person?			
Do records indicate corrective action that has been taken on rejected dats?			
Have standard curves been adequately documented?			
Are in-house quality control charts maintained for analysis (i.e. internal standard control charts)?			
Do QC records show corrective action when analytical results fail to meet QC criteria?			
Do supervisory personnel review the data and QC results?			

Additional Comments:

15.0 QUALITY ASSURANCE REPORTS

15.1 Laboratory Quality Assurance Reports:

On a quarterly basis the QA/QC Coordinator will prepare and distribute a quality assurance report. This report will be distributed to the Laboratory Director and the Regional Vice President. It will be the sole responsibility of the QA/QC Coordinator to collect and prepare the QA report which will include the following topics:

a. An assessment of the QA objectives for the lab. This assessment will include an evaluation of the measurement of the data accuracy, precision and the Practical Quantitation Limit (PQL) or Method Detection Limit (MDL), and control charts.

b. The results of the quarterly internal system and performance audits as well as the results of any external system or performance audit.

c. Any significant quality assurance or quality control problems along with the recommended solutions for the problem.

d. This report must also include the results of any corrective action that has been taken by either the Group Leader, Section Leader or the QA/QC Coordinator.

e. This report will contain information concerning the status of SOP revisions.

APPENDIX A
DEFINITIONS

The following definitions are used in the production of this Comprehensive Quality Assurance Plan.

Analytical Batch:

The basic unit for analytical quality control. The analytical batch is defined as samples which are analyzed (or sampled together) with the same method sequence, the same lots of reagents, and with the same treatment common to all samples. The samples must have been analyzed (or collected) within the same specified time period or in continuous sequential time periods. Samples in each batch should be of similar composition.

Audits:

A systematic check to determine the quality of operation of some function or activity.

Performance Audits:

Quantitative data are independently obtained for comparison with routinely obtained data in a measurement system. Examples of these audits are EPA performance evaluation programs, commercial performance evaluation programs, split sampling programs involving at least two laboratories, and blind spike samples.

Systems Audit:

These are qualitative in nature and consist of an on-site review and evaluation of a laboratory or field operation quality assurance system and physical facilities for sampling, calibration and measurements.

Calibration:

Process by which the correlation between instrument response and actual value of a measured parameter is determined.

Calibration Curve:

A curve which plots the concentration of known analyte standards against the instrument response to the analyte. Also known as a Standard Curve.

Calibration Standard:

Solutions or dilutions of a substance or material with a verifiable accuracy, which are used to evaluate the sample property of an unknown sample. In analytical terms, these standards are used to establish a calibration curve or standard instrument response factors.

Continuing Calibration Standard:

Standards that are analyzed during an analytical set to verify the accuracy of the calibration curve.

Internal Standard:

A compound having similar chemical characteristics to the compounds of interest, but which is not normally found in the environment or does not interfere with the compounds of interest. A known and specified concentration of the standard is added to each sample prior to analysis. The concentration in the sample is based on the response of the internal standard relative to that of the calibration standard and the compound in the standard.

Confidence Level:

The statistical probability associated with an interval of precision (or accuracy) values in a QC chart. The values of confidence intervals are generally expressed as percent probability. It is a commonly accepted convention that the result being tested is significant if the calculated probability is greater than 99 percent.

Data Quality:

The totality of features and characteristics of data that bears on its ability to satisfy a given purpose. The characteristics of major importance are accuracy, precision, completeness, representativeness, and comparability. These characteristics are defined as follows:

Accuracy:

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

Precision:

A measure of mutual agreement among individual measurements of the same

property, usually under prescribed similar conditions. Precision is best expressed in terms of the standard deviation. Various measures of precision exist, depending upon the "prescribed similar conditions."

Representativeness:

Expresses the degree to which data accurately and precisely represents, a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition.

Comparability:

Expresses the confidence with which one data set can be compared to another.

Completeness:

Completeness refers to the percentage of measurements made which are judged to be valid. The completeness goal is the same for all data uses: that we achieve 95% completeness on our first analysis. Subsequently our goal is to achieve 100% completeness by resampling or doing additional analysis.

Data Quality Objectives:

A set of specifications that the environmental data must meet in order to be acceptable for its intended use in a program area. DQO's are commonly established for limits of detection and quality of data (precision, accuracy, representativeness and comparability).

Detection Limits:

The smallest concentration/amount of an analyte of interest that can be measured with a stated probability of significance. Detection limits must be further defined as:

Method Detection Limit:

The smallest concentration of an analyte of interest that can be measured and reported with 99 percent confidence that the concentration is greater than zero. The MDL's are determined from the analysis of a sample in a given matrix containing the analyte at a specified level. Determination of MDL's must be done by procedures determined in Appendix B of 40 CFR, Part 136. Equivalent procedures to determine MDL's must be approved by DER.

Practical Quantitation Limit:

The smallest concentration of an analyte of interest that can be reported with a specific degree of confidence. PQL's shall be determined in the same way as MDL's by using the procedures outlined in Appendix B of 40 CFR, Part 136. The standard deviation (sd) derived from the procedure will be used to calculate the PQL: PQL = 10 sd, which corresponds to an uncertainty of ±30 percent in the measures value at the 99 percent confidence level.

Instrument Detection Limit:

The smallest amount of an analyte of interest that generates an instrument response (signal) under prescribed conditions, so that the magnitude of the signal is larger than the absolute uncertainty (error) associated with it.

Environmental Sample:

Means any sample from a natural source or source that reasonably may be expected to contribute pollution to or receive pollution from groundwaters or surface waters of the State. This includes, but is not limited to: receiving waters; waters used to define natural background conditions; soils; sediments; industrial, domestic or municipal discharge effluents; chemical storage or handling facilities; waste disposal facilities or areas; industrial or agricultural chemical handling or application areas; surface water run-off; and facilities for the handling or applying of chemicals for weed or insect control.

Parameter Group:

Is defined as a group of samples that have been preserved in the same manner, prepared by similar protocols and analyzed using instruments of similar technology (also known as analyte group). Examples of parameter groups are:

Volatiles (EPA methods 601, 602, and 624)
Pesticides (EPA methods 608, 614, 622)
Trace Metals (All metals except mercury)
Nutrients (Total Kjeldahl Nitrogen, Nitrate-Nitrite, Total Phosphorus)

Performance Evaluation Samples:

A sample submitted for analysis whose composition and concentration are known to the submitter but unknown to the analyst. Also known as a Blind Sample.

Daily Assurance:

A system of activities whose purpose is to provide the producer or user of environmental data the assurance that it meets defined standards of quality with a stated level of confidence.

Quality Assurance Plans (QAP):

An orderly assembly of detailed and specific procedures which delineates how data of a known and accepted quality is produced.

Comprehensive Quality Assurance Plan (COMQAP):

A QA plan that outlines all the capabilities of the specified organization, the routinely-used quality control measures, the routine QA targets for precision and accuracy, and documentation, calibration and maintenance activities necessary to produce data of a known and acceptable quality.

Quality Assurance Project Plans (QAPP):

A QA plan that is written for a specific project outlining specific QA targets and data quality objectives as well as protocols and QC measures needed to meet the project specific objectives.

Research Quality Assurance Plans (RQAP):

A special type of Quality Assurance Project Plan which is generally written as a requirement of a direct contract with a State or Federal Government Branch.

Quality Control:

The overall system of activities whose purpose is to document and control the quality of environmental data so that it meets the needs of the users.

Quality Control Measures:

1) Blanks: An artificial sample of an analytical matrix designed to monitor the introduction of artifact into the system.

   a) Field Quality Control Blanks

      1) Field Blanks: Blanks of analyte-free water prepared on-site by filling sample containers with the water, adding appropriate preservatives, sealing the containers, and completing the documentation. These blanks should be prepared during the middle to end of a sampling event by filling sample containers with water from the equipment decontamination water transport containers. They are to be treated, stored, transported, and analyzed in the same manner as the sample group for which it was intended. These blanks may be submitted for all water parameter groups.

2) Equipment Blanks: Blanks of analyte-free water that are prepared on-site by pouring the equipment decontamination water through decontaminated field equipment. Appropriate sample containers for each analyte group must be used, reservatives added if required, and documentation must be completed. These blanks are to be stored, transported and analyzed with the intended parameter groups. At least one equipment blank is required for each water and solid matrix analytical group, and must be collected at the beginning of the sampling episode. If field decontamination is performed on-site, additional equipment blanks must be submitted for all water and solid matrix analytical groups.

3) Trip Blanks: These blanks are required for volatile organic compound (VOC) water samples only. Blanks of volatile organic-free water are prepared by the organization providing the sample containers. These are transported to the site with the empty VOC sample containers, and shipped to the analyzing laboratory in the same containers. They remain unopened for the entire trip. Proper labeling and documentation must be completed. A trip blank must be submitted for each cooler that transports VOC samples.

(b) Laboratory

1) Method Blank: A blank of an analyte-free matrix that is processed (digested, extracted, etc.) and analyzed with a specified sample set.

2) Reagent Blank: An aliquot of analyte-free water or solvent that is analyzed with a sample set.

2) Spiked Samples: These are samples fortified to a known and validated concentration of analyte. Percent recoveries are calculated for each compound in the spike.

a) Field

1) An environmental sample fortified to a known and validated concentration in the field. These may be submitted as blind spike (laboratory does not know they are spiked) or as identified field spikes.

b) Laboratory

1) Reagent Spikes: Samples of an analyte-free matrix (deionized

water, sand, soil, etc.) that are fortified to a known and validated concentration of analyte(s) before sample preparation.

2) Sample (Matrix Spikes): Environmental sample selected from a set (not blanks) that is fortified to a known and validated concentration of analyte(s) before sample preparation. The concentration of each analyte in the spiking solution should be approximately 3-5 times the level expected in the sample.

3) Surrogate Spikes: A compound having similar chemical characteristics to the compounds of interest, but which is not normally found in environmental samples. Known concentrations of these compounds are added to all samples in the set before sample preparation.

3) Replicate Sample:

Samples that have been collected at the same time from the same source (field replicates) or aliquots of the sample that are prepared and analyzed at the same time (laboratory replicates).

2. Duplicate samples Samples that are one type of a replicate sample. The analytical results from replicates are used to determine the precision of a system. If the concentration of analytes in the sample is below detectable limits, Duplicate Spike Samples may be used to determine precision.

3. Blind Replicates (Duplicates) Samples that are replicates that have been collected(field replicate) or prepared (laboratory replicate) and are submitted and analyzed as separate samples (analyst does not know they are replicates).

4) Quality Control Checks:

Standards or samples from an independent source that are analyzed at a specific frequency.

a) Quality Control Check Standards: Standard solutions from a source other than normal calibration standards that are certified and traceable. These standards are used to check the accuracy of a calibration curve.

b) Quality Control Check Samples (also known as Reference Materials): Samples obtained from an independent source for which the level(s) of analytes have been validated. These samples are prepared and analyzed with a sample set of similar matrix. IF these samples have been obtained from the National Institute of Standards and testing (formerly

National Bureau of Standards), they are referred to as Standard Reference Materials.

5) Split Samples:

Replicate of the same sample that is given to two independent laboratories for analysis.

Sample Custody

All records and documentation required to trace a sample from point of origin to disposal after analysis. These records must include, but are not limited to:

1) Field notebooks;
2) Field sample ID tags;
3) Laboratory transmittal forms (if applicable);
4) Laboratory sample receipt logs;
5) Sample extraction/preparation logs or worksheets;
6) Analytical (instrument) logs or worksheets;
7) Calibration and quality control data associated with a sample set;
8) Instrument maintenance logs;
9) Sample disposition logs; and
10) Final reports.

Legal Chain of Custody is a special type of sample custody in which all events associated with a specific sample must be documented in writing. In addition to the records described above, chain of custody records must include the following:

1) Sample transmittal forms or tags that have adequate spaces for the dated, original signatures of all individuals who handle the sample (or cleaned sample containers if obtained from a contracted laboratory) from time of collection (or container receipt) to laboratory delivery.

2) Laboratory sample storage logs that identify date, time, and individuals who remove samples from storage.

3) Secure, limited access storage areas.

Sample Matrix

This means that characteristic of an environmental laboratory sample, associated with its physical and chemical properties, which defines how such a sample is handled when subjected to the intended analytical process. The following samples matrices (major matrix groups), defined below should be used in QA plans whenever specifying data quality objectives:

Reagent Water:

A sample of water which conforms to ASTM grades II, III or IV.

Drinking Water:

Includes finished (treated) or raw source water designated as potable water. Such resources may be from surface or ground water.

Surface Water:

Includes fresh or saline waters from streams, canals, rivers, lakes, ponds, bays and estuaries (natural or manmade).

Groundwater:

Includes all waters found below ground in confined or unconfined aquifers.

Wastewater:

Includes any influent or effluent associated with domestic or industrial waste treatment facilities.

Chemical Waste:

Includes sludges and residuals from domestic or industrial wastewater processing, and liquid or solid chemicals no longer used for their intended purpose.

Soil/Sediment:

Surface or subsurface soils and sediments of fresh or salt water origin.

Biological Tissue:

Includes tissue of plant or animal origin. The most common of these are shellfish, finfish, and aquatic plants.

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APPENDIX F

ANALYTE LISTS FROM RCRA PERMIT

LIST 1

VOLATILES & SEMIVOLATILES

HAZARDOUS CONSTITUENT	CAS NO.	HBN SOIL mg/kg	HBN WATER mg/l	PQL SOIL mg/kg	PQL WATER mg/l	SUGGESTED METHOD
Acetone	67-64-1	1E+3	4E0	1E-1	1E-1	8240
Acrolein	107-02-8	2E+2	5E-1	5E-3	5E-3	8240
Acrylonitrile	107-13-1	2E-2	6E-5	5E-3	5E-3	8240
Benzene	71-43-2	5E-1	5E-3	5E-3	5E-3	8260 (8240)
Bis(2-chloroethyl) ether *syn.* Dichloroethyl ether	111-44-4	1E-3	3E-5	3E-1	1E-2	8270
Bis(2-chloroisopropyl) ether *syn.* Dichloroisopropyl ether	108-60-1	6E+2	1E0	3E-1	1E-2	8270
Bis(2-ethylhexyl) phthalate *syn.* Diethylhexyl phthalate	117-81-7	1E0	3E-3	3E-1	1E-2	8270
Bromodichloromethane	75-27-4	3E+2	7E-1	5E-3	5E-3	8260 (8240)
Bromoform *syn.* Tribromomethane	75-25-2	3E+2	7E-1	5E-3	5E-3	8260 (8240)
Butyl benzyl phthalate	85-68-7	1E+3	7E0	3E-1	1E-2	8270
Carbon disulfide	75-15-0	1E+3	4E0	5E-3	5E-3	8240
Carbon tetrachloride	56-23-5	1E-1	5E-3	5E-3	5E-3	8240
p-Chloroaniline	106-47-8	6E+1	1E-1	3E-1	1E-2	8270
Chlorobenzene	108-90-7	3E+2	1E-1	5E-3	5E-3	8260 (8240)
p-Chloro-m-cresol	59-50-7	9E+1	2E-1	3E-1	1E-2	8270
Chloroform	67-66-3	2E0	6E-3	5E-3	5E-3	8260
2-Chlorophenol	95-57-8	8E+1	2E-1	3E-1	1E-2	8270
m-Cresol	108-39-4	1E+3	2E0	3E-1	1E-2	8270
o-Cresol	95-48-7	1E+3	2E0	3E-1	1E-2	8270
p-Cresol	106-44-5	1E+3	2E0	3E-1	1E-2	8270
o-Dichlorobenzene	95-50-1	1E+3	6E-1	1E-2	1E-2	8260 (8270)
p-Dichlorobenzene	106-46-7	1E+3	7.5E-2	5E-3	5E-3	8260 (8270)
3,3'-Dichlorobenzidine	91-94-1	5E-2	8E-5	1E0	2E-2	8270
Dichlorodifluoromethane	75-71-8	1E+3	7E0	5E-3	5E-3	8260 (8240)
1,1-Dichloroethane	75-34-3	2E-1	4E-4	5E-3	5E-3	8260 (8240)
1,2-Dichloroethane	107-06-2	2E-1	5E-3	5E-3	5E-3	8260 (8240)
1,1-Dichloroethylene	75-35-4	2E-1	7E-3	5E-3	5E-3	8260 (8240)
trans-1,2-Dichloroethylene	156-60-5	3E+2	1E-1	5E-3	5E-3	8260 (8240)
2,4-Dichlorophenol	120-83-2	5E+1	1E-1	3E-1	1E-2	8270
1,2-Dichloropropane	78-87-5	2E-1	5E-3	5E-3	5E-3	8260 (8240)
cis-1,3-Dichloropropene	10061-01-5	9E-2	2E-4	1E-2	1E-2	8240
trans-1,3-Dichloropropene	10061-02-6	9E-2	2E-4	1E-2	1E-2	8240
Diethyl phthalate	84-66-2	1E+3	3E+1	3E-1	1E-2	8270
2,4-Dimethylphenol	105-67-9	9E0	2E-2	3E-1	1E-2	8270
Dimethyl phthalate	131-11-3	1E+3	4E+2	3E-1	1E-2	8270
2,4-Dinitrophenol	51-28-5	3E-1	7E-2	2E0	5E-2	8270
2,4-Dinitrotoluene	121-14-2	2E-2	5E-5	3E-1	1E-2	8270
Di-n-octyl phthalate	117-84-0	3E+2	6E-1	3E-1	1E-2	8270
Ethylbenzene	100-41-4	1E+3	7E-1	5E-3	5E-3	8260 (8240)
Hexachlorobenzene	118-74-1	9E-3	2E-5	3E-1	1E-2	8270
Hexachlorobutadiene	87-68-3	2E-1	4E-4	5E-3	5E-3	8260 (8120)
Hexachlorocyclopentadiene	77-47-4	1E+2	2E-1	3E-1	1E-2	8270
Hexachloroethane	67-72-1	1E0	3E-3	3E-1	1E-2	8270
Methyl bromide *syn.* Bromomethane	74-83-9	2E+1	5E-2	1E-2	1E-2	8260 (8240)
Methyl chloride *syn.* Chloromethane	74-87-3	1E0	3E-3	1E-2	1E-2	8260 (8240)
Methylene chloride *syn.* Dichloromethane	75-09-2	2E0	5E-3	5E-3	5E-3	8240
Methyl ethyl ketone *syn.* 2-Butanone	78-93-3	1E+3	2E0	1E-1	1E-1	8240
Methyl isobutyl ketone *syn.* 4-Methyl-2-pentanone	108-10-1	1E+3	2E0	1E-1	1E-1	8240
Naphthalene	91-20-3	1E+3	1E+1	3E-1	1E-2	8270

HBN = Health Based Number
PQL = Practical Quantitation Limit

VOLATILES & SEMIVOLATILES

HAZARDOUS CONSTITUENT	CAS NO.	HBG SOIL mg/kg	HBG WATER mg/l	PQL SOIL mg/kg	PQL WATER mg/l	SUGGESTED METHOD
Nitrobenzene	98-95-3	8E0	2E-2	3E-1	1E-2	8270
N-Nitrosodiphenylamine	86-30-6	2E0	7E-3	3E-1	1E-2	8270
N-Nitrosodi-n-propylamine	621-64-7	2E-3	5E-6	3E-1	1E-2	8270
Pentachlorophenol	87-86-5	5E+2	2E-1	2E0	5E-2	8270
Phenol	108-95-2	1E+3	2E+1	3E-1	1E-2	8270
Pyrene	129-00-0	5E+2	1E0	3E-1	1E-2	8270
1,1,1,2-Tetrachloroethane	630-20-6	7E-1	1E-3	5E-3	5E-3	8260 (8240)
1,1,2,2-Tetrachloroethane	79-34-5	9E-2	2E-4	5E-3	5E-3	8260 (8240)
Tetrachloroethylene	127-18-4	2E-1	5E-3	5E-3	5E-3	8260 (8240)
Toluene	108-88-3	1E+3	2E0	5E-3	5E-3	8260 (8240)
1,2,4-Trichlorobenzene	120-82-1	1E+3	7E-1	1E-2	1E-2	8260 (8270)
1,1,1-Trichloroethane	71-55-6	1E+3	2E-1	5E-3	5E-3	8260 (8240)
1,1,2-Trichloroethane	79-00-5	2E-1	6E-4	5E-3	5E-3	8260 (8240)
Trichloroethylene	79-01-6	1E0	5E-3	5E-3	5E-3	8260 (8240)
Trichlorofluoromethane	75-69-4	1E+3	1E+1	5E-3	5E-3	8260 (8240)
2,4,5-Trichlorophenol	95-95-4	1E+3	4E0	2E0	5E-2	8270
2,4,6-Trichlorophenol	88-06-2	9E-1	2E-3	6E-1	1E-2	8270
Vinyl chloride	75-01-4	1E-1	2E-3	1E-2	1E-2	8240
Xylene (total)	1330-20-7	1E+3	1E+1	5E-3	5E-3	8260 (8240)

LIST 2

VOLATILES & SEMIVOLATILES

HAZARDOUS CONSTITUENT	CAS NO.	IBW SOIL mg/kg	IBW WATER mg/l	PQL SOIL mg/kg	PQL WATER mg/l	SUGGESTED METHOD
Acetone	67-64-1	1E+3	4E0	1E-1	1E-1	8240
Acrolein	107-02-8	3E+2	5E-1	5E-3	5E-3	8240
Acrylonitrile	107-13-1	2E-2	6E-5	5E-3	5E-3	8240
Benzene	71-43-2	5E-1	5E-3	5E-3	5E-3	8260 (8240)
Benzo[a]anthracene	56-55-3	1E-1	2E-4	9E-3	1E-4	8310
Benzo[b]fluoranthene	205-99-2	9E-3	2E-5	2E-2	2E-4	8310
Benzo[k]fluoranthene	207-08-9	2E0	4E-3	2E-2	2E-4	8310
Benzo[a]pyrene	50-32-8	1E-3	3E-6	2E-2	2E-4	8310
Bis(2-chloroethyl) ether *syn.* Dichloroethyl ether	111-44-4	1E-3	3E-5	3E-1	1E-2	8270
Bis(2-chloroisopropyl) ether *syn.* Dichloroisopropyl ether	108-60-1	6E+2	1E0	3E-1	1E-2	8270
Bis(2-ethylhexyl) phthalate *syn.* Diethylhexyl phthalate	117-81-7	1E0	3E-3	3E-1	1E-2	8270
Bromodichloromethane	75-27-4	3E+2	7E-1	5E-3	5E-3	8260 (8240)
Bromoform *syn.* Tribromomethane	75-25-2	3E+2	7E-1	5E-3	5E-3	8260 (8240)
Butyl benzyl phthalate	85-68-7	1E+3	7E0	3E-1	1E-2	8270
Carbon disulfide	75-15-0	1E+3	4E0	5E-3	5E-3	8240
Carbon tetrachloride	56-23-5	1E-1	5E-3	5E-3	5E-3	8240
p-Chloroaniline	106-47-8	6E+1	1E-1	3E-1	1E-2	8270
Chlorobenzene	108-90-7	3E+2	1E-1	5E-3	5E-3	8260 (8240)
p-Chloro-m-cresol	59-50-7	9E+1	2E-1	3E-1	1E-2	8270
Chloroform	67-66-3	2E0	6E-3	5E-3	5E-3	8260
2-Chlorophenol	95-57-8	8E+1	2E-1	3E-1	1E-2	8270
Chrysene	218-01-9	1E-1	2E-4	2E-2	2E-3	8310
m-Cresol	108-39-4	1E+3	2E0	3E-1	1E-2	8270
o-Cresol	95-48-7	1E+3	2E0	3E-1	1E-2	8270
p-Cresol	106-44-5	1E+3	2E0	3E-1	1E-2	8270
Dibenz[a,h]anthracene	53-70-3	2E-4	7E-7	2E-2	3E-4	8310
o-Dichlorobenzene	95-50-1	1E+3	6E-1	1E-2	1E-2	8260 (8270)
p-Dichlorobenzene	106-46-7	1E+3	7.5E-2	5E-3	5E-3	8260 (8270)
3,3'-Dichlorobenzidine	91-94-1	5E-2	8E-6	1E0	2E-2	8270
Dichlorodifluoromethane	75-71-8	1E+3	7E0	5E-3	5E-3	8260 (8240)
1,1-Dichloroethane	75-34-3	2E-1	4E-4	5E-3	5E-3	8260 (8240)
1,2-Dichloroethane	107-06-2	2E-1	5E-3	5E-3	5E-3	8260 (8240)
1,1-Dichloroethylene	75-35-4	2E-1	7E-3	5E-3	5E-3	8260 (8240)
trans-1,2-Dichloroethylene	156-60-5	3E+2	1E-1	5E-3	5E-3	8260 (8240)
2,4-Dichlorophenol	120-83-2	5E+1	1E-1	3E-1	1E-2	8270
1,2-Dichloropropane	78-87-5	2E-1	5E-3	5E-3	5E-3	8260 (8240)
cis-1,3-Dichloropropene	10061-01-5	9E-2	2E-4	1E-2	1E-2	8240
trans-1,3-Dichloropropene	10061-02-6	9E-2	2E-4	1E-2	1E-2	8240
Diethyl phthalate	84-66-2	1E+3	3E+1	3E-1	1E-2	8270
2,4-Dimethylphenol	105-67-9	9E0	2E-2	3E-1	1E-2	8270
Dimethyl phthalate	131-11-3	1E+3	4E+2	3E-1	1E-2	8270
2,4-Dinitrophenol	51-28-5	3E+1	7E-2	2E0	5E-2	8270
2,4-Dinitrotoluene	121-14-2	2E-2	5E-5	3E-1	1E-2	8270
Di-n-octyl phthalate	117-84-0	3E+2	6E-1	3E-1	1E-2	8270
Ethylbenzene	100-41-4	1E+3	4E0	5E-3	5E-3	8260 (8240)
Fluoranthene	206-44-0	1E+2	2E-1	3E-1	1E-2	8270
Hexachlorobenzene	118-74-1	9E-3	2E-5	3E-2	5E-4	8120
Hexachlorobutadiene	87-68-3	2E-1	4E-4	5E-3	5E-3	8260 (8120)
Hexachlorocyclopentadiene	77-47-4	1E+2	2E-1	3E-1	1E-2	8270

VOLATILES & SEMIVOLATILES

HAZARDOUS CONSTITUENT	CAS NO.	IRM SOIL mg/kg	IRM WATER mg/l	PQL SOIL mg/kg	PQL WATER mg/l	SUGGESTED METHOD
Hexachloroethane	67-72-1	1E0	3E-3	3E-1	1E-2	8270
Indeno[1,2,3-cd]pyrene	193-39-5	9E-2	2E-4	3E-2	4E-4	8310
Methyl bromide *syn.* Bromomethane	74-83-9	1E+2	5E-2	1E-2	1E-2	8260 (8240)
Methyl chloride *syn.* Chloromethane	74-87-3	1E0	3E-3	1E-2	1E-2	8260 (8240)
Methylene chloride *syn.* Dichloromethane	75-09-2	2E0	5E-3	5E-3	5E-3	8240
Methyl ethyl ketone *syn.* 2-Butanone	78-93-3	1E+3	2E0	1E-1	1E-1	8240
Methyl isobutyl ketone *syn.* 4-Methyl-2-pentanone	108-10-1	1E+3	2E0	1E-1	1E-1	8240
Naphthalene	91-20-3	1E+3	1E+1	5E-3	5E-3	8260
Nitrobenzene	98-95-3	8E0	2E-2	3E-1	1E-2	8270
N-Nitrosodiphenylamine	86-30-6	2E0	7E-3	3E-1	1E-2	8270
N-Nitrosodi-n-propylamine	621-64-7	2E-3	5E-6	3E-1	1E-2	8270
Pentachlorophenol	87-86-5	5E+2	2E-1	2E0	5E-2	8270
Phenanthrene	85-01-8	9E-1	2E-3	3E-1	7E-3	8310
Phenol	108-95-2	1E+3	2E+1	3E-1	1E-2	8270
Pyrene	129-00-0	5E+2	1E0	3E-1	1E-2	8270
1,1,1,2-Tetrachloroethane	630-20-6	7E-1	1E-3	5E-3	5E-3	8260 (8240)
1,1,2,2 Tetrachloroethane	79-34-5	9E-2	2E-4	1E-4	1E-4	8310
Tetrachloroethylene	127-18-4	2E-1	5E-3	5E-3	5E-3	8260 (8240)
Toluene	108-88-3	1E+3	2E0	5E-3	5E-3	8260 (8240)
1,2,4-Trichlorobenzene	120-82-1	3E+2	7E-1	1E-2	1E-2	8260 (8270)
1,1,1-Trichloroethane	71-55-6	1E+3	2E-1	5E-3	5E-3	8260 (8240)
1,1,2-Trichloroethane	79-00-5	2E-1	6E-4	5E-3	5E-3	8260 (8240)
Trichloroethylene	79-01-6	1E0	5E-3	5E-3	5E-3	8260 (8240)
Trichlorofluoromethane	75-69-4	1E+3	1E+1	5E-3	5E-3	8260 (8240)
2,4,5-Trichlorophenol	95-95-4	1E+3	4E0	2E0	5E-2	8270
2,4,6-Trichlorophenol	88-06-2	9E-1	2E-3	6E-1	1E-2	8270
Vinyl chloride	75-01-4	1E-1	2E-3	1E-2	1E-2	8240
Xylene (total)	1330-20-7	1E+3	1E+1	5E-3	5E-3	8260 (8240)

LIST 3

INORGANICS

HAZARDOUS CONSTITUENT	CAS NO.	HRS SOIL mg/kg	HRS WATER mg/l	PQL SOIL mg/kg	PQL WATER mg/l	SUGGESTED METHOD
Antimony	7440-36-0	3E+1	1E-2	2E+1	3E-2	6010(s) 7041(w)
Arsenic	7440-38-2	5E-1	5E-2	3E+1	1E-2	6010(s) 7060(w)
Barium	7440-39-3	1E+3	5E0	1E0	2E-2	6010
Beryllium	7440-41-7	2E-1	8E-6	2E-1	3E-3	6010
Cadmium	7440-43-9	4E+1	5E-3	2E0	1E-3	6010(s) 7131(w)
Chromium	7440-47-3	4E+2	1E-1	4E0	1E-2	6010(s) 7191(w)
Lead	7439-92-1		5E-2	2E0	1E-2	6010(s) 7421(w)
Mercury	7439-97-6	2E+1	2E-3	1E-1	2E-3	7470
Nickel	7440-02-0	1E+3	7E-1	3E0	5E-2	6010
Selenium	7782-49-2	2E+2	5E-2	4E+1	2E-2	6010(s) 7740(w)
Silver	7440-22-4	2E+2	5E-2	4E0	2E-3	6010(s) 7761(w)
Thallium	7440-28-0	6E0	3E-3	2E+1	1E-2	6010(s) 7870(w)

LIST 4

DIOXINS & DIBENZOFURANS

HAZARDOUS CONSTITUENT	HBN SOIL mg/kg	HBN WATER mg/l	PQL SOIL mg/kg	PQL WATER mg/l	SUGGESTED METHOD
2,3,7,8-TCDDioxin	4E-6	2E-10	2E-3	1E-5	8280
2,3,7,8-PeCDDioxins	8E-6	4E-10	2E-3	1E-5	8280
2,3,7,8-HxCDDioxins	4E-5	2E-9	2E-3	1E-5	8280
2,3,7,8-HpCDDioxins	4E-4	2E-8	2E-3	1E-5	8280
OCDDioxins	4E-3	2E-7	2E-3	1E-5	8280
2,3,7,8-TCDFuran	4E-5	2E-9	2E-3	1E-5	8280
1,2,3,7,8-PeCDFuran	8E-5	4E-9	2E-3	1E-5	8280
2,3,4,7,8-PeCDFuran	8E-6	4E-10	2E-3	1E-5	8280
2,3,7,8-HxCDFurans	4E-5	2E-9	2E-3	1E-5	8280
2,3,7,8-HpCDFurans	4E-4	2E-8	2E-3	1E-5	8280
OCDFurans	4E-3	2E-7	2E-3	1E-5	8280

APPENDIX G

APPENDIX G

PROJECT-SPECIFIC LABORATORY QUALITY ASSURANCE/QUALITY CONTROL DATA

TABLE 1
KEMRON'S ACCURACY AND PRECISION
OBJECTIVES FOR VOLATILE ORGANICS ANALYSES
OF LABORATORY CONTROL SAMPLES

PARAMETER	CAS #	EPA SW-846 METHOD	% RECOVERY (ACCURACY)
Acetone	67-64-1	5030/8240	30-165
Acrolein	107-02-8	5030/8240	60-140
Acrylonitrile	107-13-1	5030/8240	60-145
Benzene	71-43-2	5030/8240	37-151
Bromodichloromethane	75-27-4	5030/8240	35-155
Bromoform	75-25-2	5030/8240	45-169
2-Butanone	78-93-3	5030/8240	35-160
Carbon disulfide	75-15-0	5030/8240	45-165
Carbon tetrachloride	56-23-5	5030/8240	70-140
Chlorobenzene	108-90-7	5030/8240	37-160
Chloroform	67-66-3	5030/8240	51-138
Dichlorodifluoromethane	75-71-8	5030/8240	65-140
1,1-Dichloroethane	75-34-3	5030/8240	59-155
1,2-Dichloroethane	107-06-2	5030/8240	49-155
1,1-Dichloroethene	75-35-4	5030/8240	D-234
trans-1,2-Dichloroethene	156-60-5	5030/8240	54-156
1,2-Dichloropropane	78-87-5	5030/8240	D-210
cis-1,3-Dichloropropene	10061-01-5	5030/8240	D-227
trans-1,3-Dichloropropene	10061-02-6	5030/8240	17-183
Ethyl benzene	100-41-4	5030/8240	37-162
Methyl bromide	74-83-9	5030/8240	62-115
Methyl chloride	74-87-3	5030/8240	43-129
Methylene Chloride	75-09-2	5030/8240	D-221
4-Methyl-2-pentanone	108-10-1	5030/8240	40-160
1,1,1,2-Tetrachloroethane	630-20-6	5030/8240	60-140
1,1,2,2-Tetrachloroethane	79-34-5	5030/8240	46-157
Tetrachloroethene	127-18-4	5030/8240	64-148
Toluene	108-88-3	5030/8240	47-150
1,1,1-Trichloroethane	71-55-6	5030/8240	52-162
1,1,2-Trichloroethane	79-00-5	5030/8240	52-150
Trichloroethene	79-01-6	5030/8240	71-157
Trichlorofluoromethane	75-69-4	5030/8240	37-142
Vinyl chloride	75-01-4	5030/8240	D-251
Xylenes (Total)	1330-20-7	5030/8240	40-135

TABLE 2
KEMRON'S ACCURACY AND PRECISION
OBJECTIVES FOR SEMIVOLATILE ORGANIC ANALYSES
OF LABORATORY CONTROL SAMPLES

PARAMETER	CAS #	EPA SW-846 METHOD*	% RECOVERY (ACCURACY)
Benzo(a)anthracene	56-55-3	3520/8270	33-143
Benzo(b)fluoranthene	205-99-2	3520/8270	24-159
Benzo(k)fluoranthene	207-08-9	3520/8270	11-162
Benzo(a)pyrene	50-32-8	3520/8270	17-163
Bis(2-chloroethyl)ether	111-44-4	3520/8270	12-158
Bis(2-chloroisopropyl)ether	108-60-1	3520/8270	33-166
Bis(2-ethylhexyl)phthalate	117-81-7	3520/8270	8-158
Butyl benzyl phthalate	85-68-7	3520/8270	D-152
p-Chloroaniline	106-47-8	3520/8270	D-150
p-Chloro-m-cresol	59-50-7	3520/8270	45-117
2-Chlorophenol	95-57-8	3520/8270	23-134
Chrysene	218-01-9	3520/8270	17-168
m-Cresol	108-39-4	3520/8270	D-150
o-Cresol	95-48-7	3520/8270	D-150
p-Cresol	106-44-5	3520/8270	D-150
Dibenzo(a,h)anthracene	53-70-3	3520/8270	D-277
1,2-Dichlorobenzene	95-50-1	3520/8270	32-129
1,3-Dichlorobenzene	541-73-1	3520/8270	D-172
1,4-Dichlorobenzene	106-46-7	3520/8270	20-124
3,3-Dichlorobenzidene	91-94-1	3520/8270	D-262
2,4-Dichlorophenol	120-83-2	3520/8270	39-135
Diethylphthalate	84-66-2	3520/8270	D-114
2,4-Dimethylphenol	105-67-9	3520/8270	49-96
Dimethyl phthalate	131-11-3	3520/8270	32-119
2,4-Dinitrotoluene	121-14-2	3520/8270	39-139
Di-n-octyl phthalate	117-84-0	3520/8270	4-146
Hexachlorobenzene	118-74-1	3520/8270	D-152
Hexachlorobutadiene	87-68-3	3520/8270	24-116
Hexachlorocyclopentadiene	77-47-4	3520/8270	D-144
Hexachloroethane	67-72-1	3520/8270	40-113
Indeno(1,2,3-cd)pyrene	193-39-5	3520/8270	D-171
Naphthalene	91-20-3	3520/8270	21-133
Nitrobenzene	98-95-3	3520/8270	35-180
N-Nitrosodiphenylamine	86-30-6	3520/8270	138-237
N-Nitrosodi-n-propylamine	621-64-7	3520/8270	D-230
Pentachlorophenol	87-86-5	3520/8270	14-176
Phenanthrene	85-01-8	3520/8270	52-115
Phenol	108-95-2	3520/8270	5-112
Pyrene	129-00-0	3520/8270	52-115
1,2,4-Trichlorobenzene	120-82-1	3520/8270	44-142
2,4,5-Trichlorophenol	95-95-4	3520/8270	37-144
2,4,6-Trichlorophenol	88-06-2	3520/8270	16-140

*Methods 3510 and 3520 are applicable to aqueous samples. Solids are extracted as per method 3550.

TABLE 3
KEMRON'S ACCURACY AND PRECISION
OBJECTIVES FOR INORGANIC
ANALYSES OF LABORATORY CONTROL AND DUPLICATE SAMPLES

PARAMETER	CAS #	EPA SW-846 METHOD *	% RECOVERY (ACCURACY)	% RPD (PRECISION)
Antimony (Sb) - ICP	7440-36-0	3005/6010	88-110	0-07
Arsenic (As) - ICP	7440-38-2	3005/6010	82-120	0-06
- AA FURNACE		3005/7060	80-123	0-12
Barium (Ba) - ICP	7440-39-3	3005/6010	85-111	0-07
Beryllium(Be) - ICP	7440-41-7	3005/6010	89-104	0-05
Cadmium (Cd) - ICP	7440-43-9	3005/6010	88-110	0-03
Chromium (Cr) - ICP	7440-47-3	3005/6010	92-108	0-04
Lead (Pb) - ICP	7439-92-1	3005/6010	87-109	0-09
- AA FURNACE		3020/7421	83-112	0-10
Mercury (Hg) - VAPOR	7439-97-6	7470	77-113	0-10
		7471	75-125	1-10
Nickel (Ni) - ICP	7440-02-0	3005/6010	90-112	0-06
Selenium (Se) - ICP	7782-49-2	3005/6010	79-117	0-12
- AA FURNACE		3005/7740	83-115	0-13
Silver (Ag) - ICP	7440-22-4	3005/6010	82-115	0-04
Thallium (Tl) - ICP	7440-28-0	3005/6010	80-120	0-20
- AA FURNACE		3020/7841	84-107	0-11
Total Organic Carbon		9060	71-124	0-32
Total Organic Halides		9020	69-135	0-20

* Methods 3005 and 3020 are applicable to aqueous samples. Solid analyses are performed as per Method 3050.

TABLE 4
KEMRON'S DETECTION AND QUANTITATION LIMITS FOR
VOLATILE ORGANIC ANALYSES OF
GROUNDWATER AND SOLID WASTE

PARAMETER	CAS #	EPA SW-846 METHOD *	MDL (ug/L)	WATER PQL (ug/L)	SOIL PQL (ug/kg)
Acetone	67-64-1	5030/8240	5.77	100	100
Acrolein	107-02-8	5030/8240	9.25	100	100
Acrylonitrile	107-13-1	5030/8240	7.97	100	100
Benzene	71-43-2	5030/8240	0.43	5	5
Bromodichloromethane	75-27-4	5030/8240	1.18	5	5
Bromoform	75-25-2	5030/8240	0.86	5	5
2-Butanone	78-93-3	5030/8240	8.05	100	100
Carbon disulfide	75-15-0	5030/8240	2.10	5	5
Carbon tetrachloride	56-23-5	5030/8240	1.29	5	5
Chlorobenzene	108-90-7	5030/8240	1.14	5	5
Chloroform	67-66-3	5030/8240	2.51	5	5
Dichlorodifluoromethane	75-71-8	5030/8240	X	5	5
1,1-Dichloroethane	75-34-3	5030/8240	0.54	5	5
1,2-Dichloroethane	107-06-2	5030/8240	0.81	5	5
1,1-Dichloroethene	75-35-4	5030/8240	1.13	5	5
trans-1,2-Dichloroethene	156-60-5	5030/8240	2.23	5	5
1,2-Dichloropropane	78-87-5	5030/8240	0.47	5	5
cis-1,3-Dichloropropene	10061-01-5	5030/8240	0.46	5	5
trans-1,3-Dichloropropene	10061-02-6	5030/8240	1.06	5	5
Ethyl benzene	100-41-4	5030/8240	1.34	5	5
Methyl bromide	74-83-9	5030/8240	1.67	10	10
Methyl chloride	74-87-3	5030/8240	1.37	10	10
Methylene Chloride	75-09-2	5030/8240	2.75	5	5
4-Methyl-2-pentanone	108-10-1	5030/8240	6.23	10	10
1,1,1,2-Tetrachloroethane	630-20-6	5030/8240	7.34	10	10
1,1,2,2-Tetrachloroethane	79-34-5	5030/8240	1.33	5	5
Tetrachloroethene	127-18-4	5030/8240	3.06	5	5
Toluene	108-88-3	5030/8240	1.88	5	5
1,1,1-Trichloroethane	71-55-6	5030/8240	2.40	5	5
1,1,2-Trichloroethane	79-00-5	5030/8240	0.78	5	5
Trichloroethene	79-01-6	5030/8240	0.85	5	5
Trichlorofluoromethane	75-69-4	5030/8240	2.72	5	5
Vinyl chloride	75-01-4	5030/8240	0.86	10	10
Xylenes (Total)	1330-20-7	5030/8240	3.07	5	5

X = Currently not available.

TABLE 5
KEMRON'S DETECTION AND QUANTITATION LIMITS FOR
SEMIVOLATILE ORGANIC ANALYSES OF
GROUNDWATER AND SOLID WASTE

PARAMETER	CAS #	EPA SW-846 METHOD *	WATER MDL (ug/L)	WATER PQL (ug/L)	SOIL PQL (ug/kg)
Benzo(a)anthracene	56-55-3	3520/8270	2.25	10.0	165
Benzo(b)fluoranthene	205-99-2	3520/8270	2.78	10.0	165
Benzo(k)fluoranthene	207-08-9	3520/8270	1.73	10.0	165
Benzo(a)pyrene	50-32-8	3520/8270	4.90	10.0	165
Bis(2-chloroethyl)ether	111-44-4	3520/8270	3.17	10.0	165
Bis(2-chloroisopropyl)ether	108-60-1	3520/8270	3.11	10.0	165
Bis(2-ethylhexyl)phthalate	117-81-7	3520/8270	2.12	10.0	660
Butyl benzyl phthalate	85-68-7	3520/8270	2.26	10.0	165
p-Chloroaniline	106-47-8	3520/8270	5.31	10.0	165
p-Chloro-m-cresol	59-50-7	3520/8270	4.18	10.0	165
2-Chlorophenol	95-57-8	3520/8270	1.63	10.0	165
Chrysene	218-01-9	3520/8270	1.78	10.0	165
m-Cresol	108-39-4	3520/8270	2.09	10.0	165
o-Cresol	95-48-7	3520/8270	2.09	10.0	165
p-Cresol	106-44-5	3520/8270	2.09	10.0	165
Dibenzo(a,h)anthracene	53-70-3	3520/8270	3.56	10.0	165
1,2-Dichlorobenzene	95-50-1	3520/8270	1.31	10.0	165
1,3-Dichlorobenzene	541-73-1	3520/8270	1.19	10.0	165
1,4-Dichlorobenzene	106-46-7	3520/8270	1.85	10.0	165
3,3-Dichlorobenzidene	91-94-1	3520/8270	5.00	20.0	330
2,4-Dichlorophenol	120-83-2	3520/8270	2.35	10.0	165
Diethylphthalate	84-66-2	3520/8270	4.22	10.0	165
2,4-Dimethylphenol	105-67-9	3520/8270	3.39	10.0	165
Dimethyl phthalate	131-11-3	3520/8270	3.60	10.0	165
2,4-Dinitrotoluene	121-14-2	3520/8270	2.83	10.0	165
Di-n-octyl phthalate	117-84-0	3520/8270	0.76	10.0	165
Hexachlorobenzene	118-74-1	3520/8270	4.42	10.0	165
Hexachlorobutadiene	87-68-3	3520/8270	2.18	10.0	165
Hexachlorocyclopentadiene	77-47-4	3520/8270	1.12	10.0	165
Hexachloroethane	67-72-1	3520/8270	0.90	10.0	165
Indeno(1,2,3-cd)pyrene	193-39-5	3520/8270	0.81	10.0	165
Naphthalene	91-20-3	3520/8270	2.40	10.0	165
Nitrobenzene	98-95-3	3520/8270	3.07	10.0	165
N-Nitrosodiphenylamine	86-30-6	3520/8270	4.62	10.0	165
N-Nitrosodi-n-propylamine	621-64-7	3520/8270	2.78	10.0	165
Pentachlorophenol	87-86-5	3520/8270	4.09	50.0	825
Phenanthrene	85-01-8	3520/8270	4.07	10.0	165
Phenol	108-95-2	3520/8270	1.86	10.0	165
Pyrene	129-00-0	3520/8270	3.66	10.0	165
1,2,4-Trichlorobenzene	120-82-1	3520/8270	2.73	10.0	165
2,4,5-Trichlorophenol	95-95-4	3520/8270	2.45	50.0	825
2,4,6-Trichlorophenol	88-06-2	3520/8270	2.78	10.0	165

*Methods 3510 and 3520 are applicable to aqueous samples. Solids are extracted as per method 3550.

TABLE 6
KEMRON'S DETECTION AND QUANTITATION LIMITS FOR
INORGANIC ANALYSES OF
GROUNDWATER AND SOLID WASTE

PARAMETER	CAS #	EPA SW-846 METHOD *	MDL (ug/L)	WATER PQL (ug/L)	SOIL PQL (ug/kg)
Aluminum (Al) - ICP	7429-90-5	3005/6010	23.5	100	5,000
Antimony (Sb) - ICP	7440-36-0	3005/6010	24.8	200	10,000
Arsenic (As) - ICP	7440-38-2	3005/6010	43.6	100	5,000
- AA FURNACE		3005/7060	1.4	4	200
Barium (Ba) - ICP	7440-39-3	3005/6010	1.42	10	500
Beryllium(Be) - ICP	7440-41-7	3005/6010	1.1	10	500
Cadmium (Cd) - ICP	7440-43-9	3005/6010	1.55	10	500
Chromium (Cr) - ICP	7440-47-3	3005/6010	3.11	20	1,000
Lead (Pb) - ICP	7439-92-1	3005/6010	11.6	100	5,000
- AA FURNACE		3020/7421	0.47	5	250
Mercury (Hg) - VAPOR	7439-97-6	7470	0.05	0.2	--
		7471	--	--	250
Nickel (Ni) - ICP	7440-02-0	3005/6010	5.15	40	2,000
Selenium (Se) - ICP	7782-49-2	3005/6010	39.2	100	5,000
- AA FURNACE		3005/7740	2.4	4	200
Silver (Ag) - ICP	7440-22-4	3005/6010	5.78	10	2,000
Thallium (Tl) - AA FURNACE	7440-28-0	3020/7841	1.1	5	250
Total Organic Carbon		9060	600	1000	10,000
Total Organic Halogen		9020	10	20	NA

* Methods 3005 and 3020 or 3015 are applicable to aqueous samples. Solid analyses are performed as per Method 3050

Table 7
Quality Control Criteria
Total Organic Carbon

CONTROL ITEM	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
Initial Calibration	Per run	COC > 0.995	Recalibrate
Method Blank	Every batch	≤ MDL	Investigate, reanalyze batch as needed
Laboratory Control Samples	Every batch	81-124%*	Investigate, recalibrate, reanalyze batch as needed
Matrix Spike	Every batch	71-125%*	Reanalyze spike as needed
Sample Duplicate	Every batch	RPD <32	Reanalyze sample as needed

*Control limits are established at ±3 standard deviations.

Table 8
Quality Control Criteria
Total Organic Halide

CONTROL ITEM	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
Initial Calibration	Per run	COC > 0.995	Recalibrate
Method Blank	Every batch	≤ MDL	Investigate, reanalyze batch as needed
Laboratory Control Samples	Every batch	69-135%*	Investigate, reanalyze batch as needed
Matrix Spike	Every batch	67-132%*	Reanalyze spike as needed
Sample Duplicate	Every batch	RPD <20	Reanalyze sample as needed

*Control limits are established at ±3 standard deviations.

Table 9
Quality Control Criteria
Metals - Atomic Absorption
Flame AA, GFAA, CVAA

CONTROL ITEM	FREQUENCY	ACCEPTANCE	CORRECTIVE **CRITERIA ACTION**
Initial calibration	Daily	COC > 0.995	Repeat calibration
Calibration check verification (ICV)	10%, or minimum of 1 per batch	90 - 110%	Repeat calibration/Reslope
Initial Calibration Blank (ICB)	After ICV	< MDL	Stop and repeat
Method blank	5%, or minimum of 1 per batch	≤ MDL	1-Repeat test - average results 2-Evaluate system 3-Repeat batch as necessary
Laboratory Control Sample (LCS)	5%, or minimum of 1 per batch	Control Limits* (80 - 120% min.)	Investigate, Repeat batch as necessary
Matrix spike analyses	5%, or minimum of 1 per batch	75 - 125%	1-Flag data 2-for TCLP + EPTox metals, analyze using method of standard additions
Matrix spike duplicate	5%, or minimum of 1 per batch	RPD <20%	Flag data

*Control Limits are established at ± 3 standard deviations

Table 10
Quality Control Criteria
Total Metals - ICP
Metals - ICP
EPA 200.7 / SW 6010

CONTROL ITEM	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
Initial calibration	Daily at beginning of analytical run	COC > 0.995	Repeat calibration
Initial Calibration Verification (ICV)	After calibration	90 - 110%	Repeat calibration/Reslope
Initial Calibration Blank	After ICS	< MDL	Stop and reanalyze
Method blank MDL see 3.	5%, or minimum of 1 per batch	≤ MDL	1-Repeat test-if ≤ MDL Confirm by 3rd analysis if > 2-Evaluate system 3-Repeat batch as necessary
Laboratory Control Sample (LCS)	5%, or minimum of 1 per batch	Control Limits* (80-120% min)	Investigate, Repeat batch as necessary
Matrix spike	10%, or minimum of 2 per batch	75-125%	1-Flag data 2-For TCLP EP_TOX metals, analyze using method of standard additions
Duplicate	10%, or minimum of 2 per batch	RPD <20%	Flag data
ICP interference check	Run at beginning and end of each run	80-120% of true value for EPA check sample elements	1-Check sample introduction 2-Repeat calibration 3-See lab manager

* Control Limits are established at ±3 standard deviations

Table 11
Quality Control Criteria
Volatile GC/MS Analysis 8260

CONTROL ITEM	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
Initial Calibration	When Continuing Calibration is out of control	%RSD for CCC's <30%. RF for SPCC's >0.300 (0.25 for Bromoform)	Stop analysis, investigate, reanalyze
Continuing Calibration	Every 12 hours	RF for SPCC's same as initial. CCC's must be less than < 30% difference	Stop analysis, investigate, reanalyze Run new initial calibration curve
Internal Standard Area	All samples	Area factor of two of last continuing calibration internal standard area	Reanalyze
Method Blank	Every 12 hours 1 per sample set	All target analytes below PQL	Stop analysis, investigate, reanalyze
LCS	Every 12 hours. 1 per sample set or 5%	Selected spike, analytes must fall within acceptable % recovery ranges (See table 1)	Stop analysis, if 5 or more analytes are out of range, reanalyze
MS/MSD	Water - 5% Soil - 5%	% Recovery and % RPD must be within acceptable ranges (See table 13)	Investigate, reanalyze, unless obvious matrix problems are evident
Surrogates	All standards and samples run	% recovery must be within acceptable ranges (See table 13)	Reanalyze unless obvious matrix interference can be proven.

Table 12
Quality Control Criteria
Semivolatile GC/MS Analysis 8270

CONTROL ITEM	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
Initial Calibration	When Continuing Calibration is out of control or when system conditions have been altered	%RSD for CCC's <30% RF for SPCC's >0.05 All others less than 75% RSD	Stop analysis, investigate, reanalyze
Continuing Calibration	Every 12 hours	RF for SPCC's the same as initial calibration CCC's must be less than <30% difference	Stop analysis, investigate, reanalyze Run new initial calibration curve
Internal Standard Area	All samples	Area factor of two of last continuing calibration internal standard area	Reanalyze
Method Blank	Per Extraction Batch	All target analytes below PQL	Investigate, reanalyze, reextract if necessary
LCS	Per Extraction Batch or 5%	Selected Spike Analytes must fall within designated % Recovery ranges (See table 2)	Stop Analysis, if 5 or more analytes are out of range, investigate reanalyze, reextract if necessary.
MS/MSD	Water-5% Soil-5%	% Recovery and % RPD must be within acceptable ranges (See table 14)	Same as above unless obvious matrix problems are evident
Surrogate Compound	All Standards and samples run	% recovery must be within acceptable ranges (See table 14)	Investigate, reanalyze Reextract if necessary

TABLE 13
Quality Control Performance Criteria
for Matrix Spikes/Matrix Spike Duplicates and Surrogates

	Matrix Spike/Duplicate				Surrogate	
	% Recovery		% RPD		% Recovery	
	Water	Soil	Water	Soil	Water	Soil
Volatile Organic Compounds						
1,2-Dichloroethane-d4					76-114	70-121
Toluene-d8					88-110	81-117
p-Bromofluorobenzene					86-115	74-121
1,1-Dichloroethene	61-145	59-172	14	22		
Trichloroethene	71-120	62-137	14	23		
Benzene	76-127	66-142	11	21		
Toluene	76-125	59-139	13	21		
Chlorobenzene	75-130	60-133	13	21		

TABLE 14
Quality Control Performance Criteria
for Matrix Spikes/Matrix Spike Duplicates and Surrogates

	Matrix Spike/Duplicate				Surrogate	
	% Recovery		% RPD		% Recovery	
	Water	Soil	Water	Soil	Water	Soil
Semivolatile Organic Compounds						
Nitrobenzene-d5					35-114	23-120
2-Fluorobiphenyl					43-116	30-115
Terphenyl-d14					33-141	18-137
Phenol-d5					10-94	24-113
2-Fluorophenol					21-100	25-121
2,4,6-Tribromophenol					10-123	19-122
Phenol	12-110	26-90	42	35		
2-Chlorophenol	27-123	25-102	40	50		
1,4-Dichlorobenzene	36-97	28-104	28	27		
N-Nitroso-di-N-propylamine	41-116	41-126	38	38		
1,2,4-Trichlorobenzene	39-98	38-107	28	23		
4-Chloro-3-Methylphenol	23-97	26-103	42	33		
Acenapthene	46-118	31-137	31	19		
4-Nitrophenol	10-80	11-114	50	50		
2,4-Dinitrotoluene	24-96	28-89	38	47		
Pentachlorophenol	9-103	17-109	50	47		
Pyrene	26-127	35-142	31	36		

APPENDIX H

APPENDIX H

LABORATORY QUALITY ASSURANCE FOR DIOXIN ANALYSIS

ENSECO-CALIFORNIA QUALITY ASSURANCE PROJECT PLAN

ANALYTICAL SERVICES
QUALITY ASSURANCE PROJECT PLAN

FOR

ANALYSIS OF POLYCHLORINATED DIOXINS/FURANS BY LOW RESOLUTION GC/MS

Prepared by:

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Enseco-California Analytical Laboratory
Analytical Quality Assurance Project Plan
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3.0 PROJECT DESCRIPTION

Enseco is committed to providing quality environmental analytical services to both the public and private sectors. To ensure the production of scientifically sound, legally defensible data of known, documentable and verifiable quality, an extensive Quality Assurance (QA) program has been implemented within Enseco. This program relies on clearly defined objectives, well-documented procedures, a comprehensive audit system, and management support, both Corporate and Regional, for its effectiveness.

This analytical quality assurance plan addresses analyzing project samples for tetra through octa dibenzo-p-dioxins and dibenzofurans. It describes the methods and procedures that are used by Enseco-California Analytical Laboratory (CAL) to ensure that definable quality, precision, accuracy, and completeness objectives are met. Procedures and policies outlined in this document serves to supplement the quality assurance objectives delineated in "Enseco Incorporated-Quality Assurance Program Plan for Environmental Chemical Monitoring", Revision 3.4, April 1991 and is based on the USEPA Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans, QAMS-005/80.

4.0 RESPONSIBILITIES AND AUTHORITIES

The advanced technologies services group hierarchy is shown in Figure 4-1 and a schematic of the project work flow is shown in Figure 4-2. Responsibilities are outlined as follows:

DIVISIONAL QUALITY ASSURANCE DEPARTMENTS

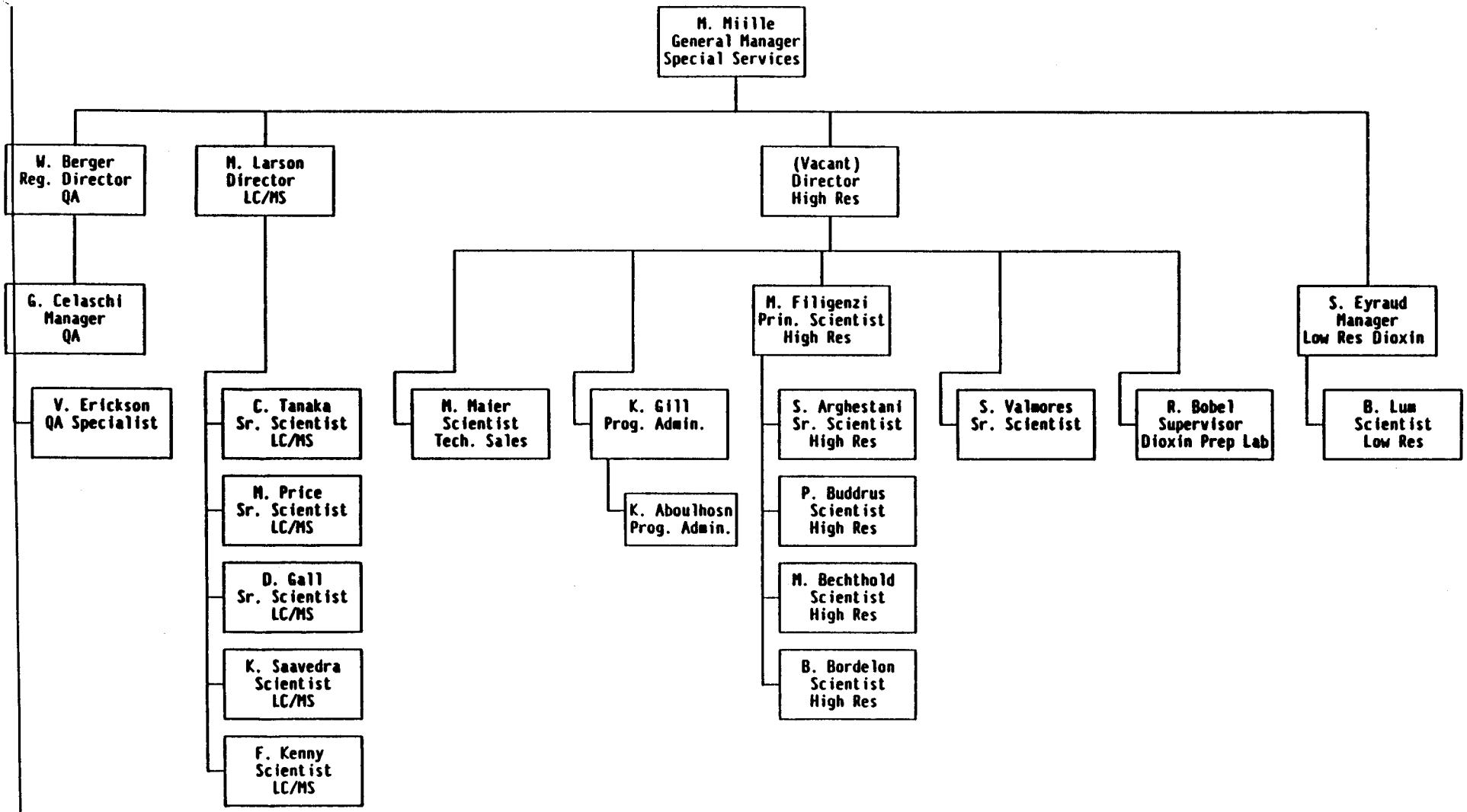
Members

Each Regional QA Department is managed by a QA Manager with oversite from a Regional Quality Assurance Director. The QA Manager reports directly to the Regional General Manager and the Regional QA Director. The QA Manager is supported by a QA staff within the laboratory. The QA Manager is the final authority within each laboratory on all issues dealing with data quality. He/she has the authority to require that procedures be amended to discontinued or analyses suspended or repeated. He/she can make recommendations to the Regional General Manager and the Corporate QA Director regarding suspension or termination of employees for incompetence or non-compliance with QA procedures. The authority of the Division QA Manager comes directly from the Corporate QA Director.

DIVISIONAL MANAGEMENT

Members

The managers, supervisors, department directors, and program administrators who direct the analytical work at each laboratory are directly responsible for ensuring that all employees reporting to them are complying with the Enseco QA Plan.



Enseco-California Analytical Laboratory
West Sacramento, California

Project Flow
Figure 4.2
Dioxin/Furans Workcell

FUNCTION	RESPONSIBILITIES	RESPONSIBLE INDIVIDUAL
Workcell Manager	Client contact, scheduling, problem resolution.	Shelly Eyraud
Sample Custodian	Receives samples, reviews COC transfer of custody.	Diana Brooks
Extraction Group	Requests sample, prepares samples for analysis.	Lenny Shorter
Analytical Group	Analyzes extracts, completes Level 1 & 2 review, implements corrective actions.	Bruce Lum
Data Control	Generates data packages. Project is readied for archive.	Marybeth Weeks
	5% random audit.	QA Dept.
Program Administrator	Completes Level 3 review, submits data to client.	Shelly Eyraud

The managers and supervisors of the laboratory have the authority to accept or reject data based on compliance with well-defined QC criteria. In addition, managers and supervisors, with the approval of the QA department, can accept or reject data that fall outside of established QC guidelines if, in their judgement, there are technical reasons which warrant the acceptance or rejection of the data. These circumstances must be well documented and any need for corrective action identified by the incident must be defined and initiated. The authority of the laboratory management comes directly from the President and the Regional General Manager.

DIVISIONAL PERSONNEL

Members

All laboratory personnel (including chemists, managers, etc.) involved in the generation and reporting of data have a responsibility to understand and follow the Enseco QA Plan.

Laboratory personnel have the authority to accept or reject data based on compliance with well-defined QC criteria. The acceptance or rejection of data that fall outside of established QC guidelines must be approved by laboratory management and the QA department. The authority of the laboratory personnel flows from the Regional General Manager.

5.0 QUALITY ASSURANCE OBJECTIVES

FOR MEASUREMENT DATA IN TERMS OF PRECISION, ACCURACY, COMPLETENESS, REPRESENTATIVENESS AND COMPARABILITY

The effectiveness of a QA program is measured by the quality of data generated by the laboratory. Data quality is judged in terms of its precision, accuracy, representativeness, completeness and comparability. These terms are described as follows:

DCS = Duplicate control samples, a pair of standard, control matrix that is spiked with a group of target compounds.

RPD = Relative percent difference.

RSD = Relative standard deviation.

CV = Coefficient of variation.

S = Standard deviation.

X = A measured value.

$\bar{X}$ = Average. Calculated as the sum of all measured values in a population divided by the number of values in the population.

n = Number of measurements or values in a population.

Precision is the degree to which the measurement is reproducible. Precision can be assessed by replicate measurements of DCS, reference materials, or environmental samples. Enseco routinely monitors precision by comparing the RPD between DCS measurements with control limits established at plus three standard deviations from the mean RPD of historical DCS data.

Precision is frequently determined by comparison of replicates. The standard deviation of "n" measurements of "x" is commonly used to estimate precision.

Standard deviation (S) is calculated as follows:

$$S = \sqrt{\frac{1}{n-1} \sum_{i=1}^{N} (Xi - \bar{X})^2}$$

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

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

$$RSD = 100\ (s/\bar{X})$$

or

$$CV = 100\ (s/\bar{X})$$

where: RSD = relative standard deviation

CV = coefficient of variation

s = Standard deviation

$\bar{X}$ = mean

In the case of duplicates, the RPD between the two samples may be used to estimate precision.

$$RPD = \frac{|D_1 - D_2|}{(D_1 + D_2)/2} \times 100$$

where: RPD = relative percent difference

D_1 = first sample value

D_2 = second sample value (duplicate)

Accuracy is a determination of how close the measurement is to the true value. Accuracy can be assessed using DCS, standard reference materials, or spiked environmental samples. Unless specified otherwise in special contracts, Enseco monitors accuracy by comparing DCS results with control limits established at plus or minus three standard deviation units from the mean of historical LCS results.

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

$$\text{Percent Recovery} - \frac{X}{T} \times 100$$

where: X = the observed value of measurement

T = "true" value

Representativeness is the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. Analytical data should represent the sample analyzed regardless of the heterogeneity of the original sample matrix. Enseco strives to accommodate all sample matrices. Some samples may require analysis of multiple phases to obtain representative results.

Completeness is a measure of the amount of valid data obtained from a measurement system compared with the amount that was expected to be obtained under normal conditions.

To be considered complete, the data set must contain all QC check analyses verifying precision and accuracy for the analytical protocol. In addition, all data are reviewed in terms of stated goals in order to determine if the data base is sufficient.

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

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

The completeness objective is 100%. Reanalysis will be performed in accordance with the procedures stated in Section 9.0, Analytical Procedures, and in Appendix I in order to meet this completeness goal.

Comparability expresses the confidence with which one data set can be compared to another data set measuring the same property. Comparability is ensured through the use of established and approved analytical methods, consistency in the basis of analysis (wet weight, volume, etc.), consistency in reporting units (ppm, ppb, etc.), and analysis of standard reference materials.

Modified Method 8280 (Test Methods for Evaluating Solid Waste, SW-846, 3rd Edition, November 1986) will be used for the analysis of polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans by low resolution GC/MS. See Appendix I for the list of enhancements to Method 8280 that are part of Enseco-CAL's procedure.

Method specific accuracy and precision objectives are listed in Table 5.1.

TABLE 5.1

ACCURACY AND PRECISION OBJECTIVES

COMPOUND	SPIKE CONCENTRATION (ng)	% RECOVERY	RPD
2,3,7,8-TCDF	10	60-140	50
1,2,3,7,8-PeCDF	10	60-140	50
1,2,3,4,7,8-HxCDF	10	60-140	50
1,2,3,4,6,7,8-HpCDF	10	60-140	50
OCDF	50	60-140	50
2,3,7,8-TCDD	10	60-140	50
1,2,3,7,8-PeCDD	10	60-140	50
1,2,3,4,7,8-HxCDD	10	60-140	50
1,2,3,4,6,7,8-HpCDD	10	60-140	50
OCDD	50	60-140	50

Units = ng/sample

6.0 SAMPLING PROCEDURES

The generation of quality data begins with the collection of the sample, and therefore the integrity of the sample collection process is of concern to the laboratory. Samples must be collected in such a way that no foreign material is introduced into the sample and no material of interest escapes from the sample prior to analysis. To ensure sample integrity, the following must be considered:

- Samples must be collected in appropriate containers. In general, glass containers are used for organic parameters;
- The sample containers must be properly cleaned to ensure that the sample is not contaminated during the collection process;
- Samples must be preserved appropriately to minimize the loss of materials of interest due to adsorption, chemical or biological degradation, or volatilization;
- Appropriate volumes of sample must be collected to ensure that the required detection limits can be met and quality control samples can be analyzed;
- Samples must be properly shipped to the laboratory, in the appropriate time frame, to ensure that holding times for the analyses can be met.

Sample Containers and Preservatives

Enseco can assist in the sample collection process by providing consultation and assistance to client designing sampling programs. Also, Enseco can make available to the client the Enseco "Sample Safe™", a set of sample containers that are properly cleaned and preserved for use in sample collection.

EPA has established holding time requirements for some analyses. However, holding times for dioxins/furans can vary depending upon the method requested. EPA Method 1613A states that up to one year before extraction of aqueous and solid samples is acceptable due to the stability of dioxins and furans in the environment. This is consistent with the scientific literature which contains several references to the half-life of dioxins in soil - all of which measure the time in years. Samples will be extracted and analyzed according to a client's contract specifications.

On occasion, a sample must be reanalyzed to comply with this QA Program Plan. If this reanalysis is conducted outside of the holding time, the laboratory will be considered to have fulfilled its obligation to meet holding times if the first preparation and/or analysis was initiated within the prescribed holding time.

7.0 SAMPLE CUSTODY

A sample is considered in custody if:

- It is in the sampler's or the transferee's actual possession;
- It is in the sampler's or the transferee's view, after being in his/her physical possession;
- It was in the sampler's or the transferee's physical possession and then he/she secured it to prevent tampering; and
- It is placed in a designated secure area.

Upon transfer of custody to Enseco, samples proceed through an orderly processing sequence specifically designed to ensure continuous integrity of both the sample and its documentation.

All samples are received by Enseco's Sample Control Group's designated sample custodian and are carefully checked for label identification, and completed, accurate chain-of-custody records. Photographs document the condition of samples and each sample is then assigned a unique laboratory identification number through a computerized Laboratory Information Management System (LIMS) that stores all identifications and essential information. The LIMS system tracks the sample from storage through the laboratory system until the analytical process is completed and the sample is returned to the custody of the Sample Control Group for disposal. This process is summarized in Figure 7-1. Access to all Enseco laboratories is restricted to prevent any unauthorized contact with samples, extracts, or documentation.

In the event that the laboratory sample custodian judges the sample custody to be invalid (e.g., samples arrive damaged or custody seals have been broken), the Program Administrator (PA) will be advised immediately and the samples will not be analyzed until the PA so authorizes. The PA or designated representative will immediately contact the client. The PA and the client will make a decision as to the fate of the sample(s) in question on a case-by-case basis. The sample(s) will either be processed "as is" with custody failure noted along with the analytical data, or rejected with sampling rescheduled if necessary. Any problem with a sample will be noted on the chain-of-custody form.

An example of the Enseco Chain-Of-Custody Record used to transmit samples from the client to the laboratory is given in Figure 7-2.

FIGURE 7-1

ENSECO SAMPLE PROCESSING FLOW CHART

Sample Control

* Check and document physical condition of sample
* Verify documentation and parameter assignment
* Log into LIMS
* Send acknowledgement letter to client

Proper Storage

* Store sample according to preservation guidelines
* Transfer sample to lab with proper documentation

Laboratories

* Document analytical work
* Return unused samples to Sample Control

Sample Control

* Return sample to client or arrange for sample disposal

Enseco
A Gaming Company

CHAIN-OF-CUSTODY RECORD

SAMPLER: (*Signature*) _____ Date Shipped _____ Carrier _____

Phone _____ Airbill No. _____ Cooler No. _____

SHIP TO:

Enseco-Cal Lab
2544 Industrial Blvd.
West Sacramento, CA 95691
(916) 372-1393

ATTENTION: _____

SEND RESULTS TO:

Client Name _____
Company _____
Address _____
_____
Phone _____

PROJECT NAME _____ **PROJECT NO.** _____ **P.O. NO.** _____

Relinquished by: (*Signature*)	Received by: (*Signature*)	Date	Time
Relinquished by: (*Signature*)	Received by: (*Signature*)	Date	Time
Relinquished by: (*Signature*)	Received at lab by: (*Signature*)	Date	Time
Relinquished from lab by: (*Signature*)	Received by: (*Signature*)	Date	Time

ANALYSIS REQUEST

Sample ID Number	Sample Description	Date Time Sampled	Analysis Requested	Sample Condition Upon Receipt

Special Instructions Comments:

NOTE: UNUSED PORTIONS OF NON-AQUEOUS SAMPLES WILL BE RETURNED TO CLIENT

Expected Analytical T.A.T's: _____ Immediate Attention (200% surcharge) _____ RUSH (50-100% surcharge) _____ Standard

Cal Lab ID Number: *(for lab use only)*

Client Retains White Copy Only

(Revised 1 87)

8.0 ANALYTICAL CALIBRATION PROCEDURES AND FREQUENCY

Standard/Reagent Preparation

To ensure the highest purity possible, all primary reference standards and standard solutions used by Enseco are obtained from the National Institute of Standards and Technology, the EPA Repository or other reliable commercial sources. Dioxins/furans standards will be purchased from Cambridge Isotope Laboratories, Woburn, Massachusetts or from the US EPA, EMSL-Las Vegas (when available). All standards and standard solutions are logged into a data base that identifies the supplier, lot number, purity/concentration, receipt/preparation date, preparer's name, method of preparation, expiration date, and all other pertinent information.

Reagents are examined for purity by subjecting an aliquot or subsample to the analytical method in which it will be used; for example, every lot of dichloromethane (for organic extractables) is analyzed for undesirable contaminants prior to use in the laboratory.

Instrument Calibration and Tuning

Calibration of instrumentation is required to ensure that the analytical system is operating correctly and functioning at the proper sensitivity to meet established reporting limits. Each instrument is calibrated with standard solutions appropriate to the type of instrument and the linear range established for the analytical method. Specific procedures are described as follows:

Tuning

Mass calibration of the mass spectrometer is tuned prior to the analysis of standards or samples each analysis day. The compound FC43 is used to tune the instrument for greater sensitivity in the high mass range to achieve better response in the later eluting compounds.

Window Defining Mix (WDM)

The window defining mix is analyzed to verify that the switching times between the descriptors have been appropriately set and is analyzed for the following conditions:

- Before initial calibration on each instrument and on each gas chromatography column used for analysis.
- Each time a new initial calibration is performed, regardless of reason.
- Each time that adjustments or instrument maintenance activities are performed that may affect retention times.

Initial Calibration

Five calibration solutions (CC1-CC5) containing 10 unlabelled and 6 carbon labeled PCDDs/PCDFs at known concentrations are used to calibrate the instrument before sample analysis can commence. Analytes and concentrations are listed on Table 8.1. The relative ion abundance ratios (using areas to calculate the ratios) must be within the limits outlined in Table 8.2 In addition, all analytes must fall within the retention time windows as determined by the WDM and meet the mass spectrometer sensitivity criteria, i.e., the signal-to-noise ratio must be greater than 2.5 for the unlabelled PCDDs/PCDFs ions and greater than 10 the the internal standard ions. The %RSD of the RRF's for the unlabelled PCDDs/PCDFs, the surrogate, and the internal standards must not exceed 15%. Formulas used to calculate %RSD and RRF are listed in Section 14.0.

Continuing Calibration Standard (Daily Standard)

The daily standard is analyzed every 12 hours to demonstrate continued acceptable GC/MS performance. The RRF of the compounds in the continuing calibration standard must be within 30% of the average RRF determined from the Initial Calibration. If this criteria cannot be met, analysis is suspended, the problem investigated, corrective actions implemented, and a new 5 point calibration is performed, if needed.

Optimum Range

The optimum concentration range of this method is 0.5 - 10 ppb.

TABLE 8.1

Concentration Calibration Solutions*
Used for Initial Calibration

	Low	Mid-Low	Med.	Mid-high	High
2,3,7,8-TCDF	0.2	0.5	1.0	2.0	5.0
1,2,3,7,8-PnCDF	0.2	0.5	1.0	2.0	5.0
1,2,3,6,7,8-HxCDF	0.2	0.5	1.0	2.0	5.0
1,2,3,4,6,7,8-HpCDF	0.2	0.5	1.0	2.0	5.0
OCDF	0.40	0.50	2.0	4.0	5.0
2,3,7,8-TCDD	0.2	0.5	1.0	2.0	5.0
1,2,3,7,8-PnCDD	0.2	0.5	1.0	2.0	5.0
1,2,3,6,7,8-HxCDD	0.2	0.5	1.0	2.0	5.0
1,2,3,4,6,7,8-HpCDD	0.2	0.5	1.0	2.0	5.0
OCDD	0.40	0.50	2.0	4.0	5.0
13C-2,3,7,8-TCDF	0.5	0.5	0.5	0.5	0.5
13C-2,3,7,8-TCDD	0.5	0.5	0.5	0.5	0.5
13C-1,2,3,7,8-PnCDD	1.0	1.0	1.0	1.0	1.0
13C-1,2,3,6,7,8-HxCDD	1.0	1.0	1.0	1.0	1.0
13C-1,2,3,4,6,7,8-HpCDD	1.0	1.0	1.0	1.0	1.0
13C-OCDD	5.0	5.0	5.0	5.0	5.0
37Cl-2,3,7,8-TCDD	0.2	0.2	0.2	0.2	0.2

* Concentrations are in ng/ul.

TABLE 8.2

Criteria for Isotopic Ratio Measurements
for PCDDs and PCDFs

	Analyte	Selected ions	Relative Intensity
PCDFs			
	Tetra	304/306	0.65-0.89
	Penta	340/342	1.31-1.77
	Hexa	374/376	1.05-1.41
	Hepta	408/410	0.88-1.18
	Octa	442/444	0.75-1.01
PCDDs			
	Tetra	320/322	0.65-0.89
	Penta	356/358	1.31-1.77
	Hexa	390/392	1.05-1.41
	Hepta	424/426	0.88-1.18
	Octa	458/460	0.75-1.01
Internal Standards			
	13C-TCDF	316/318	0.65-0.89
	13C-2,3,7,8-TCDD	332/334	0.65-0.89
	13C-PnCDD	368/370	1.31-1.77
	13C-HxCDD	402/404	1.05-1.41
	13C-HpCDD	436/438	0.88-1.18
	13C-OCDD	470/472	0.75-1.01
Recovery Standard			
	13C-1,2,3,4-TCDD	332/334	0.65-0.89

9.0 ANALYTICAL PROCEDURES

The methods used are those specified by the US EPA and other federal agencies, state agencies, and professional organizations, as provided in the following references:

- Current EPA (CLP) protocols for the analysis of organic and inorganic hazardous substances including chlorinated dioxins and furans.
- "Test Methods for Evaluating Solid Waste" (SW-846), 2nd Edition (revised), Update I (1984), Update II (1985), 3rd Edition (1986), Update I (1989), Office of Solid Waste and Emergency Response, US EPA.

The choice of method is dependent on the objectives of the study in terms of qualitative certainty, quantitative sensitivity, precision and accuracy, and the type of matrix to be analyzed. Each method used routinely is documented in the form of an SOP. The SOP contains detailed instructions concerning both the use and the expected performance of the method. The method selected will detect and quantify 2,3,7,8-tetrachlorinated dibenzo-p-dioxin (2,3,7,8-TCDD), 2,3,7,8-tetrachlorinated dibenzofuran (2,3,7,8-TCDF), and the 2,3,7,8-substituted penta-, hexa-, hepta-, and octachlorinated dibenzo-p-dioxins (PCDDs) and dibenzofurans (PCDFs). Any deviations from published methodology are documented and explained in Appendix I. Samples that initially do not meet quality assurance objectives will be reanalyzed once to verify observed anomalies. Additional reanalysis can be performed at the request of the client for a minimal fee. Specific analytical procedures are as follows:

Internal Standards

To quantitate and measure recovery of the analytes, labeled internal standards will be added to all pre-extraction samples, QC samples, blanks, extraction, and to calibration solutions. Calculated internal standard recoveries must be >=40% or the signal-to-noise ratio must be at least 10:1 before data is considered acceptable. Otherwise, samples will be reextracted and reanalyzed at a smaller sample volume. Associated analytes and internal standards are listed in Appendix I.

Surrogate

The surrogate 37Cl-2,3,7,8-TCDD will be added to all pre-cleanup blanks, samples, QC samples, and to calibration solutions. The calculated % recovery is used to verify the recovery of unlabelled PCDDs/PCDFs and to monitor the efficiency of the cleanup procedures.

Recovery Standard

To measure the % recovery of the labeled internal standards, the recovery standard 13C-1,2,3,4-TCDD will be added to all blank, sample, and quality control sample extracts just prior to GC/MS analysis.

Additional Quality Control

In addition, the following quality control samples will be analyzed:

- Method blanks
- Matrix spike/matrix spike duplicate sample
- Duplicate control sample (DCS)

Definitions, frequency, and corrective action are discussed in Section 11.0, Internal QC Checks and Frequency. Acceptability criteria are listed in Table 5.1, Accuracy and Precision Objectives.

Calculations

A summary of calculations used to determine PCDF/PCDD recoveries and concentrations are listed in Section 14.0, Specific Procedures Used to Assess Data Precision, Accuracy, and Completeness.

Identification

For a gas chromatographic peak to be unambiguously identified as a PCDD/PCDF, it must met the following criteria:

- The absolute retention times must be within method acceptance limits.
- All of the specified ions listed in Appendix I for each PCDD/PCDF must be present in the ion current profile. The ion current response for the two quantitation ions and the M-[COCl]+ ions for the analytes must maximize simultaneously.
- The integrated ion current for each analyte ion listed in Appendix I must be at least 2.5 times background noise with no detector saturation.
- Ion abundance ratios must meet the criteria listed in Table 8.2.

Confirmation

Because specificity for all of the isomers cannot be achieved on a 60 M DB-5 chromatographic column, a second column (SP-2331) will be used to confirm the presence of any 2,3,7,8-substituted PCDDs/PCDFs detected. Samples are first analyzed on a GC/MS fitted with a 60 M DB-5 chromatographic column. If any 2,3,7,8-substituted tetra-, penta-, or hexa- PCDDs/PCDFs are detected, the sample extracts will be reanalyzed using a 60 M SP-2331 chromatographic column. If data resulting from SP-2331 column does not confirm results from the DB-5 column, only data calculated from the SP-2331 column will be reported. All data will be corrected following proper error correction protocol.

10.0 DATA REDUCTION, VALIDATION, AND REPORTING

All analytical data generated within Enseco laboratories are extensively checked for accuracy and completeness. The data validation process consists of data generation, reduction, and three levels of review, as described below (also see Figure 10-1).

Level 1 Review

The analyst who generates the analytical data has the prime responsibility for the correctness and completeness of the data. All data are generated and reduced following protocols specified in laboratory SOPs.

Data will be reduced by an analyst in one of the following ways:

- Manually computing results directly on the data sheet, chromatogram, or on calculation pages attached to the raw data;
- Inputting raw data for computer processing.

If data are manually reduced by an analyst, all steps in the computation will be provided including equations used and the source of input parameters such as response factors (RFs), dilution factors, and calibration constants.

If data are directly acquired from instrumentation and processed, the analyst shall verify that the following are correct: project and sample numbers, calibration constants and RFs, output parameters such as units, and numerical values used for detection limits (if a value is reported as less than).

Finally, each analyst reviews the quality of his or her work based on an established set of guidelines. The analyst reviews the data package to ensure that:

- Sample identification is correct;
- Sample preparation information is correct and complete;
- Analysis information is correct and complete;
- The appropriate SOPs have been followed;
- Analytical results are correct and complete;
- QC samples are within established control limits;
- Blanks are within appropriate QC limits;
- Special sample preparation and analytical requirements have been met;
- Congener identification is correct; and
- Documentation is complete (e.g., all anomalies in the preparation and analysis have been documented, Out-of-Control forms [if required] are complete; holding times are documented, etc.).

The data reduction and validation steps are documented, signed and dated by the analyst. This initial review step, performed by the analyst, is designated Level 1 review. The analyst then passes the data package to an independent reviewer, who performs a Level 2 review.

Level 2 Review

Level 2 review is performed by a supervisor or data review specialist whose function is to provide an independent review of the data package. This review is also conducted according to an established set of guidelines and is structured to ensure that:

- Calibration data are scientifically sound, appropriate to the method, and completely documented;
- QC samples are within established guidelines;
- Qualitative identification of sample components is correct;
- Quantitative results are correct;
- Documentation is complete and correct (e.g., anomalies in the preparation and analysis have been documented; Out-of-Control forms [if required] are complete; holding times are documented, etc.).
- The data are ready for incorporation into the final report; and
- The data package is complete and ready for data archive.

Level 2 review is structured so that all calibration data and QC sample results are reviewed and all of the analytical results from 10% of the samples are checked back to the bench sheet. If no problems are found with the data package, the review is complete. If any problems are found with the data package, an additional 10% of the samples are checked to the bench sheet. The process continues until no errors are found or until the data package has been reviewed in its entirety. Errors that are found are documented and transmitted to the appropriate supervisor. The cause of the errors is then addressed with additional training or clarification of procedures to ensure that quality data will be generated at the bench.

Level 2 review is also documented and the signature of the reviewer and the date of review recorded. The reviewed data are then approved for release and a final report is prepared.

Level 3 Review

Before the report is released to the client, the Program Administrator who is responsible for interfacing directly with the client reviews the report to ensure that the date meet the overall objectives of the client, as understood by the Program Administrator. This review is labeled Level 3 review.

Each step of this review process involves evaluation of data quality based on both the results of the QC data and the professional judgement of those conducting the review. This application of technical knowledge and experience to the evaluation of the data is essential in ensuring that data of high quality are generated consistently.

In addition to the three levels of review discussed above, the Divisional QA department randomly audits 5% of all projects reported. The QA audit includes verifying that holding times have been met, calibration checks are adequate, qualitative and quantitative results are correct, documentation is complete, and QC results are complete and accurate. During the review, the QA department checks the data from 20% of the samples back to the bench sheet. If no problems are found with the data package, the review is complete. If any problems are found with the data package, an additional 10% of the samples are checked to the bench sheet. Errors that are found are documented and transmitted to the appropriate supervisors and managers. The cause of the errors is then addressed with additional training or clarification of procedures to that quality data is generated from the lab. The process continues until no errors are found or until the data package has been reviewed in its entirety.

Detection Limits

The detection limit will be calculated for the 10 congeners when no unlabelled PCDFs/PCDDs are detected in the samples. The process is discussed in Appendix I. Calculations are listed in Section 14.0.

Reporting

Results will be reported to the second decimal place in units of ng/l (ppt) for aqueous samples, and ng/g (ppb) for solid samples on a wet weight basis.

An example of a dioxin/furan data validation scheme is shown as Figure 10-1.

Data Reporting

A variety of reporting formats, from computerized data tables, to complex reports discussing regulatory issues, to a CLP-deliverables package, are available. In general, Enseco reports contain:

- General Discussion: Description of samples types, tests performed, any problems encountered and general comments are given.
- Analytical Data: Data are reported by sample or by test. Pertinent information including dates sampled, received, prepared, and extracted are included on each results page. The Enseco reporting limit for each analyte is also given.
- QC Information: The results (Percent Recovery and Relative Percent Difference) of the Laboratory Control Samples analyzed with the project are listed, together with the control limits. Also, the analytical results for method blanks generated during analysis of organic and metals parameters are given.

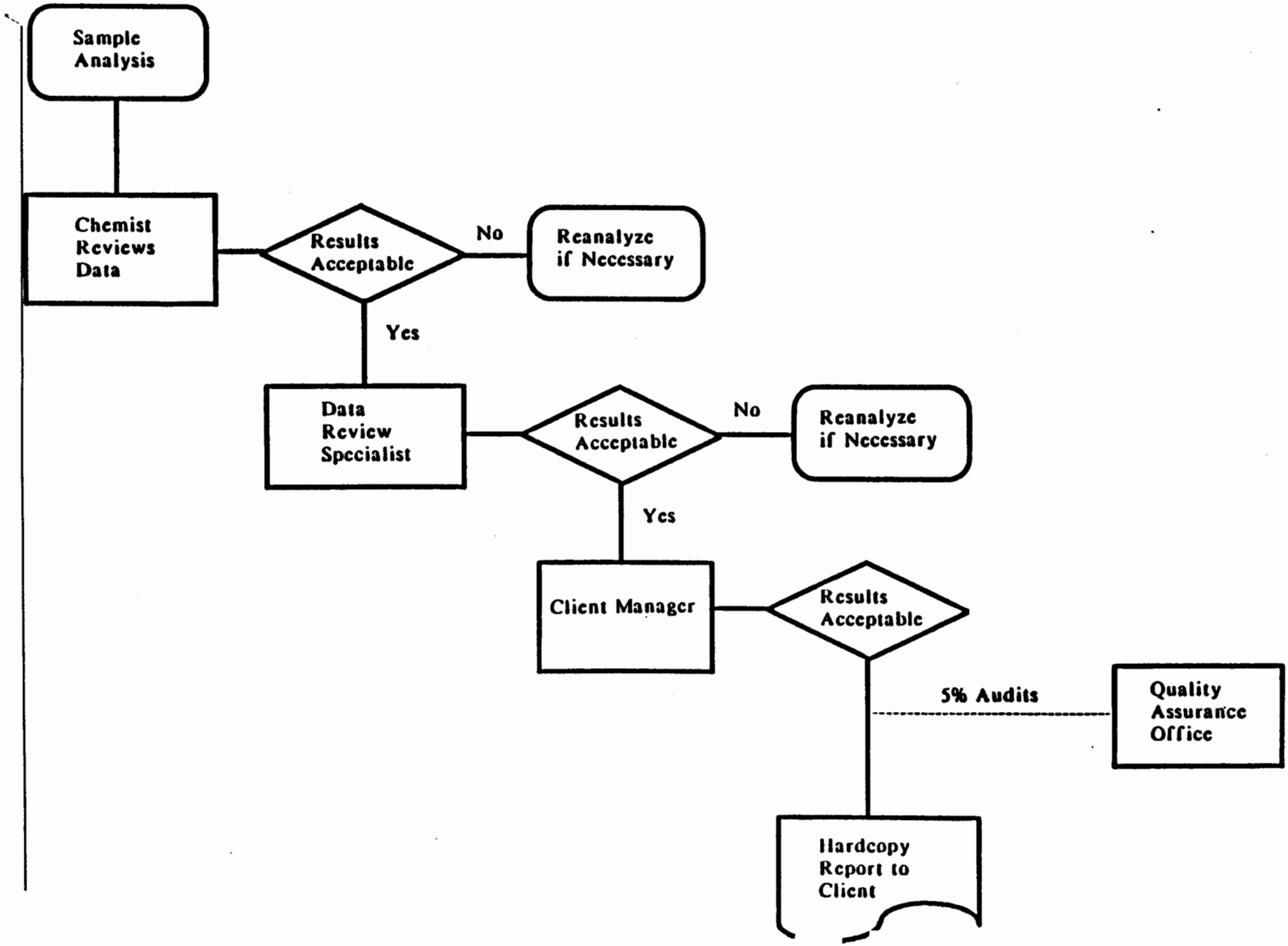
  Results of any matrix spikes, duplicates, matrix spike duplicates or other project-specific QC are also reported.
- Methodology: Reference for analytical methodology used is cited.
- Raw Data: Including calibration data, window defining mix data are included in CLP-type deliverables.

Data Validation

Data validation involves reviewing sample results, quality control, and procedures for compliance with the data quality objectives outlined in this document or with client specified objectives. The scheme used for validation of data is shown in Figure 10.1.

Figure 10-1

Data Validation Scheme



11.0 INTERNAL QC CHECKS

Laboratory Performance QC samples will be added to the normal laboratory sample stream to demonstrate that the laboratory is operating within prescribed requirements for accuracy and precision. Quality control samples are of known content and concentration so that accuracy and precision can be determined and control charts can be prepared. Measures taken to control analytical data quality include use of specific acceptance criteria for instrument calibration, laboratory control samples, duplicate analyses, blank samples, and spiked samples.

Laboratory Performance QC is provided as a standard part of every routine Enseco analysis. The main elements of Laboratory Performance QC are:

- The analysis of Laboratory Control Samples, which include Duplicate Control Samples (DCS), Single Control Samples (SCS), and method blanks; and
- The generation of daily calibration data.

Duplicate Control Samples (DCS) are used to monitor the precision and accuracy of the analytical system on an on-going basis. Each DCS consists of a standard, control matrix that is spiked with the internal standards and the surrogate representative of the method analytes. A DCS pair is analyzed for every 20 samples processed by the method. DCS are analyzed with environmental samples to provide evidence that the laboratory is performing the method within accepted QC guidelines for accuracy and precision.

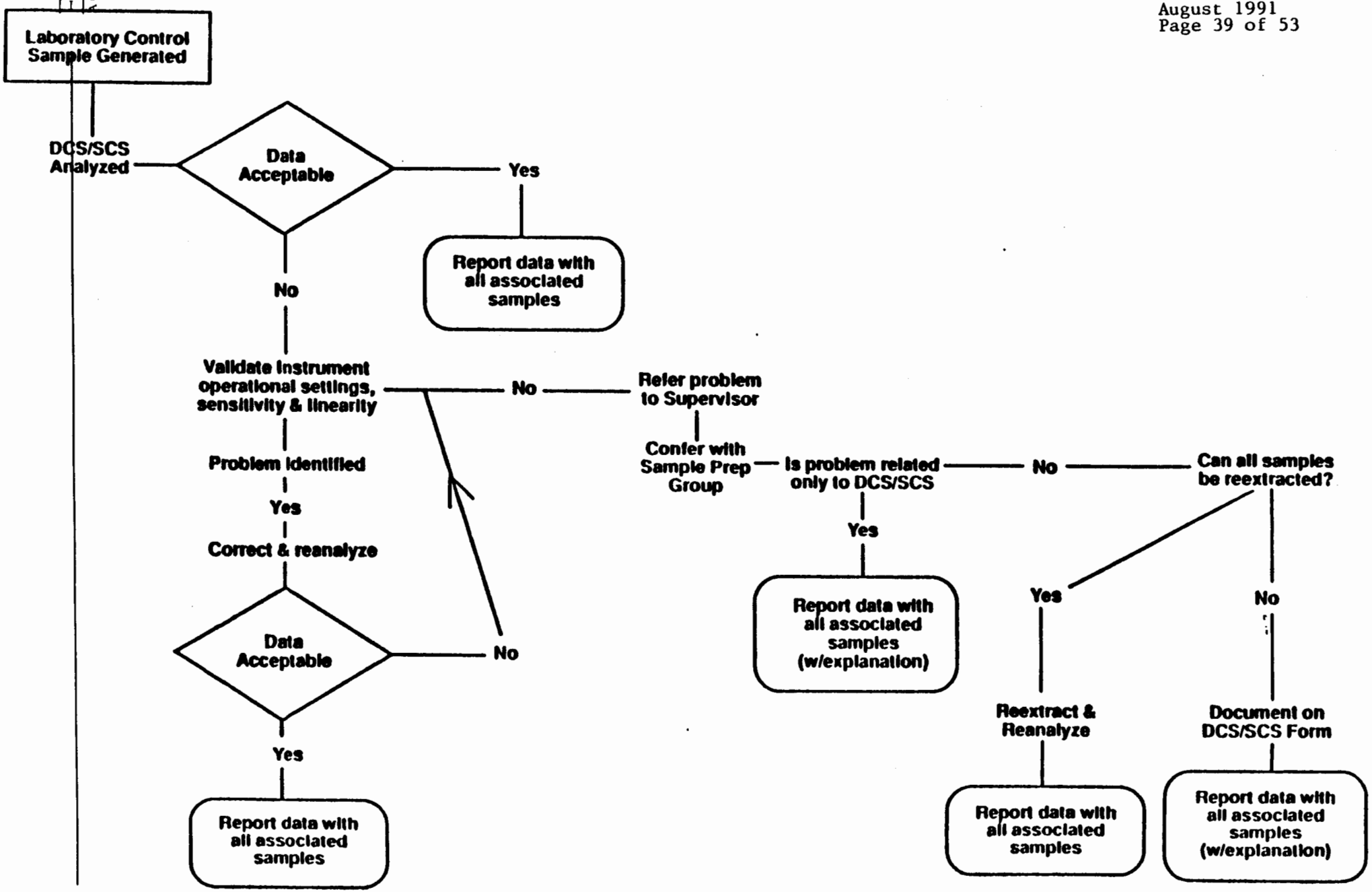
Accuracy (average recovery of each analyte in the DCS pair) and precision (Relative Percent Difference [RPD] between each analyte in the DCS pair) data are compared to control limits that have been established for each of the analytes contained in the DCS. Initially, control limits for analytes spiked into the DCS are taken directly from the CLP program. If CLP limits are not available, Enseco historical data are used to set the control limits. As sufficient laboratory data become available, the control limits are redefined based upon the most recent nine months of DCS data. Control limits for accuracy for each analyte are based on the historical average recovery (mean of the average recoveries of the DCS pairs) plus or minus three standard deviation units. Control limits for precision for each analyte are based on the historical RPD and range from zero (no difference between DCS results) to the average RPD plus three standard deviation units.

Analytical data that are generated with a DCS pair which falls within the established control limits are judged to be in control. The procedure used to evaluate data from control samples is given in Figure 11-1. The protocols include examination of instrument performance and preparation and analysis information, consultation with the supervisor, and finally a decision path for determining whether reanalysis is warranted.

Method Blank

Method blanks, also known as reagent, analytical, or preparation blanks, are analyzed to assess the level of background interference or contamination which exists in the analytical system and which might lead to the reporting of elevated concentration levels or false positive data.

Laboratory Performance QC Control Sample Evaluation



As part of the standard Enseco QC program, a method blank is analyzed with every batch of samples processed. A method blank consists of reagents specific to the method which are carried through every aspect of the procedure, including preparation, cleanup, and analysis. The results of the method blank analysis are evaluated, in conjunction with other QC information, to determine the acceptability of the data generated for that batch of samples.

A method blank is prepared and analyzed with every analytical lot or for every 20 samples, whichever is more frequent. Any analyte detected in the blank must be below the reporting limit, otherwise samples are reextracted and reanalyze.

Matrix-Specific QC

Matrix-Specific QC is used to assess the effects of a sample matrix or field conditions on the analytical data.

Different regulatory programs have different requirements in terms of Matrix-Specific QC. In order to ensure that the data generated meet all Data Quality Objectives, Enseco encourages its clients to include Matrix-Specific QC that fulfills the Data Quality Objectives and regulatory requirements of the project. A discussion of the different elements of Matrix-Specific QC follows.

Matrix Spikes and Matrix Spike Duplicates

A Matrix Spike (MS) is an environmental sample to which known concentrations of analytes have been added. The MS is taken through the entire analytical procedure and the recovery of the analytes is calculated. Results are expressed as percent recovery. The MS is used to evaluate the effect of the sample matrix on the accuracy of the analysis.

A Matrix Spike Duplicate (MSD) is an environmental sample that is divided into two separate aliquots, each of which is spiked with known concentrations of the analytes. The two spiked aliquots are processed separately and the results compared to determine the effects of the matrix on the precision and accuracy of the analysis. Results are expressed as RPD and percent recovery.

Surrogate Compounds

Surrogates are organic compounds which are similar to the analytes of interest in chemical behavior, but which are not normally found in environmental samples. A labeled surrogate will be added to all extracted, pre-cleanup blanks, samples, QC samples, and to calibration solutions to monitor the efficiency of the cleanup procedure.

Field Blank

Field blanks are check samples that monitor contamination originating from the collection, transport or storage of environmental samples. Solvents such as trichloroethylene are the medium of choice for field blanks when sampling for dioxins and furans; however, if solvents are also parameters of interest, no field blank will be collected. One example of a field blank is an equipment blank. Another type of field blank is a trip blank. A trip blank is a laboratory control matrix (typically water) which is sent to the field in an appropriate sample container, remains unopened in the field, and then is sent back to the laboratory. The purpose of the trip blank is to assess the impact of field and shipping conditions on the samples. The results from field blanks are reported to the client as samples in the same concentration units as the samples. No correction of the analytical data is done in the laboratory based on the analysis of field blanks. The purpose of the trip blank is to assess the impact of field and shipping condition on the samples.

12.0 PERFORMANCE AND SYSTEMS AUDIT

Enseco laboratories participate in a variety of federal and state certification programs, (including the US EPA CLP), that subject each of the laboratories to stringent systems and performance audits on a regular basis. A system audit is a review of laboratory operations conducted to verify that the laboratory has the necessary facilities, equipment, staff and procedures in place to generate acceptable data. A performance audit verifies the ability of the laboratory to correctly identify and quantitate compounds in blind check samples submitted by the auditing agency. The purpose of these audits is to identify those laboratories that are capable of generating scientifically sound data. Enseco is certified to perform environmental analyses under programs administered by the US EPA, US Army, US Navy, and over 4 states. The most current list of Enseco certification is available upon request.

The results of these check samples are used to identify areas where additional training is needed or clarification of procedures is required.

Ciba-Geigy, Inc. performed both a system and a performance audit for this project. Two 2,3,7,8-TCDD performance evaluation samples were supplied by EPA Region I and submitted to the laboratory for concurrent analysis with samples. Diana Baldi and Frank Saksa of Ciba-Geigy conducted a systems audit while samples were being processed by the laboratory.

A summary of the types and frequency of systems and performance audits is summarized in Table 12.1.

TABLE 12.1

SUMMARY OF PERFORMANCE AND SYSTEM AUDITS

PROGRAM	NAME	TYPE (P OR S)	FREQUENCY
Drinking water	WS	Performance	Semi-Annual
Waste water	WP	Performance	Semi-Annual
EPA-CLP	QB	Performance	Quarterly*
U.S. Navy	PE	Performance	Every 18 mos.*
U.S. Army	PE	Performance	Every 18 mos.*
Calif. Dept. Food and Agriculture	PE	Performance	Quarterly
NPDES	DMR-QA	Performance	Annually
EPA-CLP		System	Annually*
Calif. ELAP		System	Biannually
U.S. Navy		System	Annually
Utah		System	Annually
U.S. Army		System	Every 18 mos.*
Divisional QA		System	Quarterly (approx.)
ENSECO Corporate		System	Annually
Ciba-Geigy, Inc.		System	Random

Clients may request performance of specific performance and systems audits as a requirement of contract award.

* Contract award required.

13.0 PREVENTIVE MAINTENANCE

To minimize downtime and interruption of analytical work, preventive maintenance is routinely performed on each analytical instrument.

Designated laboratory personnel are trained in routine maintenance procedures for all major instrumentation. When repairs are necessary, they are performed by either trained staff or trained service engineers employed by the instrument manufacturer.

Each laboratory has detailed SOPs on file that describe preventive maintenance procedures and schedules.

All aspects of routine and non-routine instrument maintenance are recorded in logbooks, and a log book is dedicated to each instrument.

Balances are calibrated daily or as used with Class S or Class S traceable weights at specific weights of use with the results entered in a logbook kept near the balance.

Ovens and refrigerators are fitted with uniquely marked thermometers and monitored daily. Limits for refrigerators are 2°C to 6°C. If a temperature falls outside these limits, the appropriate laboratory manager is alerted and corrective action is taken. The readings are entered in a logbook kept near the thermometer. Annually the thermometer is calibrated vs. an NIST traceable thermometer.

14.0 SPECIFIC PROCEDURES USED TO ASSESS DATA PRECISION ACCURACY, AND COMPLETENESS

Calculations for accuracy (% R) and precision (RPD, RSD) were discussed and defined in Section 5.0 Data Quality Objectives. Formulas used to calculate relative response factors (RRF), concentration, and detection limits are as follows:

Definitions

Cn = concentration of native PCDD/PCDF found in the sample

Cis = concentration of internal standards

W = weight (g) of sample extracted

V = volume (mL) of sample extracted

Qis = quantity (ng) of internal standard added to sample before extraction

Qrs = quantity (ng) of recovery standard added to sample extract

Qs = quantity (ng) of surrogate added to sample before extraction

An = integrated ion abundance of the quantitation ion of the isomer of interest (Table 1).

Ais = integrated ion abundance of the quantitation ion of the appropriate internal standard (Table 1 and 2).

RRFn is the response factor of the quantitation ion of the isomer of interest relative to that of the appropriate internal standard.

RRFs is the response factor of the quantitation ion of the surrogate relative to that of the appropriate internal standard.

RRFis is the response factor of the internal standard relative to that of the appropriate recovery standard.

Relative Response Factors

$$RRFn = \frac{An \times Cis}{Ais \times Cn}$$

$$RRFis = \frac{Ais \times Crs}{Ars \times Cis}$$

$$RRFs = \frac{As \times Cis}{Ais \times Cs}$$

Concentration

The concentrations of the various isomers of each congener shall be calculated using the RRF determined for that particular isomer from the initial calibration.

= SOIL =

$$Cn\ (ng/g) = \frac{Qis \times An}{W \times Ais \times RRFn}$$

= WATER =

$$Cn\ (ng/L) = \frac{Qis \times An}{V \times Ais \times RRFn}$$

Detection Limits

For samples in which no unlabelled PCDFs/PCDDs are detected, calculate the detection limit for each of the 10 congeners. The DL is the concentration of a given PCDF/PCDD congener that would produce a signal with peak height of 2.5 times the background signal level, or when no interference is present, the equivalent concentration that the peak would represent if it were a PCDF/PCDD congener. The data must be carefully examined to determine which DL calculation will be used. Follow the rules below.

When only electronic noise is present, or if only one chemical peak is present at either the primary or secondary ion, use the following calculation:

$$DL = \frac{\text{ht of the line (i.e., 2.5 x noise)} \times Qis}{His \times RRFn \times W\ (\text{or } V)}$$

When chemical peaks are present at both the primary and secondary ions that do not meet ratio criteria use formula 2 below:

$$MPC = \frac{Hx \times Qis}{His \times RRFn \times (W \text{ or } V)}$$

15.0 CORRECTIVE ACTION

When errors, deficiencies, or out-of-control situations exist, the QA program provides systematic procedures, called "corrective actions," to resolve problems and restore proper functioning to the analytical system.

Laboratory personnel are alerted that corrective actions may be necessary if:

- QC data are outside the acceptable windows for precision and accuracy;
- Blanks, DCS or SCS contain contaminants above acceptable levels;
- Undesirable trends are detected in spike recoveries or RPD between duplicates;
- There are unusual changes in detection limits;
- Deficiencies are detected by the QA department during internal or external audits or from the results of performance evaluation samples; or
- Inquiries concerning data quality are received from clients.

Corrective action procedures are often handled at the bench level by the analyst, who reviews the preparation or extraction procedure for possible errors, checks the instrument calibration, spike and calibration mixes, instrument sensitivity, and so on. If the problem persists or cannot be identified, the matter is referred to the laboratory supervisor, manager and/or QA department for further investigation. Once resolved, full documentation of the corrective action procedure is filed with the QA department. Corrective action documentation is routinely reviewed by the of QA.

16.0 QA REPORTS TO MANAGEMENT

The reporting system is a valuable tool for measuring the overall effectiveness of the QA program. It serves as an instrument for evaluating the program design, identifying problems and trends, and planning for future needs. Regional QA Directors submit extensive monthly reports to the Corporate QA Director and the Regional General Manager. These reports include:

- The results of internal systems audits including any corrective actions taken;
- Performance evaluation scores and commentaries;
- Results of site visits and audits by regulatory agencies and clients;
- Performance on major contracts, (including CLP);
- Problems encountered and corrective actions taken;
- Holding time violations;
- Comments and recommendations; and
- A summary of the 5% QA data audits conducted.

The Corporate Director of QA submits regularly reports on the status of the QA program to the President and Regional General Manager. These reports summarize the information gathered through the laboratory reporting system and contain a thorough review and evaluation of laboratory operations throughout Enseco.

APPENDIX I PCDDS/PCDFS

Enseco-Cal Lab performs United States Environmental Protection Agency (US EPA) Method 8280 for polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) with some minor modifications to the published method. Since the method was first published in the Federal Register in September 1986, this method has undergone several updates and changes by EPA to keep pace with technology and method improvements during that time period.

Isomer specificity for all 2,3,7,8-substituted PCDDs/PCDFs cannot be achieved on the 60 M DB-5 column. In order to determine the concentrations of the individual 2,3,7,8-substituted isomers, the sample extract shall be reanalyzed on a 60 M SP-2331 GC column. The chromatographic resolution is evaluated using a commercially available column performance mixture containing the TCDD isomers that elute most closely with 2,3,7,8-TCDD.

GENERAL DIFFERENCES

- Calculation of Detection Limits

  The sensitivity of this method is dependent upon the level of interferences within the sample matrix. All PCDD and PCDF analyses performed for EPA since 1982 has used a technique for calculating the detection limit for each of the chlorination levels and each congener by using the noise level present in the elution window and the height of the chromatographic peak of the internal standard. Both the signal to noise and peak height are determined by the data system of the GC/MS. The result of the calculation is a detection limit that is specific to the homologous series and sample. We are not aware of any laboratories in the dioxin field that use or have used the MDL study referenced in the original 8280 method.

- Internal Standards

Due to the increased availability of the ^{13}C-labeled PCDD and PCDF internal standards, Enseco-Cal Lab currently uses six instead of only the two internal standards specified and one recommended in the method. This clearly improves the quality of the data.

Internal Standards and Corresponding Analytes

^{13}C-TCDD	^{13}C-TCDF	^{13}C-PnCDD	^{13}C-HxCDD	^{13}C-HpCDD	^{13}C-OCDD
TCDD	TCDF	PnCDF	HxCDF	HpCDF	OCDF
37Cl-TCDD	----	PnCDD	HxCDD	HpCDD	OCDD

- Reporting Format

The reporting forms at the end of Method 8280 have been revised a number of times to improve the initial version. Enseco-Cal Lab results, while not reported on the forms in Method 8280, are in a "CLP-like" format.

- Initial Calibration

The initial calibration is performed with single injections of a five point curve.

- Acceptance of Internal Standard Recoveries

Method 8280 specifies internal standard recoveries must be 40% or greater. If recoveries do fall below 40%, then the signal-to-noise ratio is calculated. The recoveries of the internal standards are judged acceptable if the signal-to-noise ratio is greater than 10:1.

- Key Ions Used in the Analysis

Below are the ions used in the determination of PCDDs and PCDFs, they will differ from those listed in Method 8280. The quality of data will not be effected as the ions are consistently used in both the analytical standards and samples.

Ions Specified for Selected Ion Monitoring for PCDDs and PCDFs

Analyte	Quantitation ion	Confirmation ion	M-[COCl] +
PCDFs			
Tetra	306	304	243
Penta	340	342	277
Hexa	376	374	311
Hepta	410	408	345
Octa	444	442	379
PCDDs			
Tetra	322	320	259/257
Penta	358	356	293
Hexa	392	390	327
Hepta	426	424	361
Octa	460	458	395
Internal Standards			
13C-TCDF	318	316	
13C-2378-TCDD	334	332	
13C-PnCDD	370	368	
13C-HxCDD	404	402	
13C-HpCDD	438	436	
13C-OCDD	472	470	

- PCDD/PCDF isomers in the window defining mix for a 60 M DB-5 (or equivalent) column.

Homologue	First Eluted	Last Eluted
TCDD	1368-	1238-
TCDF	1368-	1289-
PeCDD	12478	12389-
PeCDF	13468-	12389-
HxCDD	124679-	123467-
HxCDF	123468-	123489-
HpCDD	1234679-	1234678-
HPCDF	1234678-	1234789-

SPECIFIC DIFFERENCES

- Analytical

Section 4.3.2 -	8280:	30 M DB-5
	Cal:	60 M DB-5
Section 10.3 -	8280:	Recommended that the GC/MS run be divided into five selected ion monitoring sections.
	Cal:	GC/MS run is divided into three selected ion monitoring sections.
Section 11.1 -	8280:	Response factor of the quantitation ion (m/z 334) of the internal standard, ^{13}C-2,3,7,8-TCDD.
	Cal:	Response factor of the quantitation ion of the compound of interest relative to the appropriate $^{13}C_{12}$-labelled internal standard.

- Sample Preparation

Section 9.2.5 -	8280:	Soil extraction with 20 mL methanol in and 80 mL petroleum ether.
	Cal:	20 mL methanol and 150 mL hexane. Acceptable internal standard recoveries have been demonstrated using hexane as an extraction solvent.
Section 9.2.5.1 -	8280:	Kuderna-Danish concentration.
	Cal:	Concentration performed by rotary evaporation.

Section 9.3 - 9.6 8280: Regents used 20% KOH, 5% NaCl

Cal: Regents used 10N NaOH, DI H_2O

The acid/base wash is performed on an optional basis. A silica/alumina column cleanup is the first column cleanup performed and follows (Section 11.3) from SOW 9/86, Rev. 8/87, Form IFB Series WA 86-K357. The second column is the carbon column cleanup. This cleanup is also from SOW 9/86, Rev. 8/87, Section 11.4.3 - 11.4.5 with omitting 5% benzene as the only modification.

Section 9.7 8280: Gravity column with 4 g of Woelm super 1 neutral alumina.

Cal: Two columns in series. The first consisting of 1 cm Na_2SO_4, silica gel, 4 g 44% H_2SO_4 (silica gel, 1 g silica gel, 2 g 33% 1M NaOH/silica gel, 1 g silica gel and glasswool. The second consisting of 1 cm Na_2SO_4, 6g acid alumina and glasswool. The above column packing materials can be found in Section 11.3, SOW 9/86, Rev. 8/87, Form IFB Series WA 86-K357. This cleanup is mandatory.

APPENDIX I

APPENDIX I

MONSANTO PLANT RULES FOR CONTRACTORS

Monsanto

Monsanto Chemical Group
Nitro, West Virginia

Plant Rules For Contractors

Revised June 1993

EMERGENCIES

- Call Extension 2222
- Give Your Name
- Give Your Location (Building Number)
- Give Nature of Emergency (Fire, Spill, Accident, etc.)
- Do Not Hang Up Until All Information is Confirmed

MONSANTO CHEMICAL GROUP

Nitro, West Virginia Plant

GENERAL PLANT RULES FOR CONTRACTORS

INTRODUCTION

We welcome you into our plant and want to help you in every way possible. It is our company's policy to make safety a vital, necessary part of our work. We make every effort to see that all work in our plant is performed the right way—the safe way.

This guide has been prepared to assist you in performing your work in our plant the safe way. The rules and regulations which you are expected to follow have been prepared for your protection, as well as ours. These may be supplemented by special departmental rules in the area in which you work. You and your supervisory personnel should become thoroughly familiar with and conform to these rules and regulations. Failure to do so could result in removal from the premises. A Monsanto representative will answer any questions you may have regarding this guide or other plant practices.

A Monsanto representative will be in charge of every job in the plant on which an outside contractor will work. The contractor will deal only with this representative in all cases where the job is involved. This individual is

responsible for safety, industrial hygiene, housekeeping, quality of work, costs and time schedules. Except where safety is involved or in cases of emergency, any directions or orders received from persons other than the representative will be discussed with the representative before any action is taken.

Any occurrence of chemical exposure by contractor employees must be reported to the representative.

Inside the rear cover of this guide is a questionnaire for comprehension and a form to be signed by the contractor employee stating that he/she received, read and understood the contents of the guide.

This guide is to be kept on your person at all times when in the plant as it contains information you need for your health and safety.

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XV. JOB SPECIFIC COMMUNICATION INFORMATION

I. SAFETY ORIENTATION

A. All contractor personnel will have the Monsanto plant safety orientation before performing any work in the plant. Contractor personnel will affix the safety orientation sticker to their hard hats to identify that they have had the safety orientation. Safety orientations are job specific because of the requirement for reviewing chemicals that may be possibly contacted. The safety orientation will be conducted by the Monsanto representative for the job.

B. The contractor will be responsible for conducting safety meetings to inform his/her employees about Monsanto's rules and procedures. Records of all contractor safety meetings will be submitted to the Monsanto representative.

C. Contractor operations will be periodically reviewed by the Monsanto representative in consultation with health and safety professionals as a further check that the contractor is complying with applicable health and safety laws, rules and regulations and with contractual requirements and is not endangering personnel and property.

D. The Monsanto representative is to be immediately notified by the contractor of any OSHA recordable injury/illness or near miss incident by contractor employees. The incident is to be investigated by the contractor and Monsanto.

E. Contractor supervision is required to provide the Monsanto representative a safety summary at the completion of the job or monthly, whichever is less. The summary is to include the following:
   (1) OSHA injuries/manhours worked
   (2) Safety/Health Audits, if performed.

   The Monsanto representative will in turn forward this documentation to the plant safety office.

II. EMERGENCY PROCEDURE

A. Reporting Emergencies (fire, serious injury, etc.)
   (1) Call Extension 2222.
   (2) Give your name.
   (3) Give your location (building number). See the plant map on page 39.

   (4) Give description of emergency (fire, spill, accident, etc.)
   (5) Do not hang up until all information is confirmed.

B. Responding to emergencies (if siren is sounded due to fire or other emergency).
   (1) Contractor's personnel will stop all work.
   (2) All personnel will assemble at the designated headcount location for the job unless travel presents an exposure to the emergency incident. If unable to report in person, call in headcount (Ext. 4389 or 759-4389).
   (3) Contractor job superintendent will take headcount. Results of this headcount will be reported to Extension 4389 (Monday-Friday 7:00 A.M.-4:00 P.M.) or to Extension 4220 (off-shifts, holidays, and weekends).

   (4) The contractor's employees will stand by until the "all clear" siren is given, or until the representative gives them permission to return to work or instructs them to leave the plant.

(5) Should evacuation be necessary, the contractor's employees should be cognizant of wind direction and, if not directed to a specific evacuation point by the Monsanto representative, select an assembly point which best suits the immediate conditions (location of chemical release and wind direction). See plant map for evacuation points.

(6) If one of the contractor's vehicles is traveling on a plant road at the time the siren is sounded, he/she is to immediately pull off the road and turn off the engine and report to assembly point. (Leave key in vehicle). The employee may call in if travel to the assembly point presents an exposure.

C. Type of Emergency

Emergency incidents will be classified as either:

*TYPE 1: All plant emergencies other than chemical release.

*TYPE 2: Plant emergency involving a chemical release.

The emergency siren will sound the number of times to correspond to the type of emergency. The series (either one or two blasts)

will be repeated three times. Location and other information about the emergency will be announced over the Public Address (P.A.) and squawk box systems.

When the emergency is over, the siren will sound one blast to indicate "all clear."

D. Emergency Siren Test

(1) A test will be conducted each Monday at 1:00 P.M. At that time, the siren will blow one series.

III. SECURITY

A. Work Areas

1. Contractors and their employees normally will be governed by the terms of their particular contract.
2. In all cases, contractor's personnel are confined to the particular area in which they are working.

B. Plant Entry

1. All contract employees are required to identify themselves on entering and leaving the plant so that an overall headcount is maintained by plant Security.

2. The Monsanto representative will designate what plant gate all the contractor's employees will enter and leave the plant.
3. In the event that the contractor's work requires his/her employees to enter the plant during hours other than the regular daily working hours, the contractor will notify the representative in charge of the job.
4. All persons visiting the contractor's job site may do so only with the approval of the representative in charge. These individuals will be registered in and out of the gate which is designated by the representative. Visitors must also receive the required Safety Orientation before entering the plant.

C. Cameras
1. Cameras, portable radios, tape decks, television sets and like equipment may not be brought into the plant. Photographs of Monsanto property and equipment must be authorized by the plant manager.

D. Material Passes
1. Contractor's employees may not remove

any Monsanto material or property from the plant without a written material pass approved by the Monsanto representative.
2. Vehicles entering and leaving the plant are subject to inspection.

IV. VEHICLES AND TRAFFIC

A. Plant Access
1. Only vehicles required for the work will be premitted in the plant.
2. Private conveyances will not be allowed in the plant except by written permission (plant manager approval) obtained by the Monsanto representative in charge of the job. All traffic and stop signs will be obeyed.
3. Routes for the contractor's employees through the plant to the job site will be designated by the representative.
4. Do not block any emergency equipment (fire hydrants, hose houses, extinguishers, buildings, roadways, walkways or railroads) without approval of the Monsanto representative.

B. Speed Limits
1. The contractor's employees shall adhere

to plant speed limits (15 mph) while driving a vehicle in the plant. Drivers must slow down and sound horn at all blind corners and building entrances. Drivers must honor all stop signs.

C. Vehicle/Construction Equipment Safety

1. When it is necessary to transport workers by truck, people being transported will sit entirely inside the body of the truck, will not stand and will not ride with their legs or arms dangling over the side.
2. No one will be allowed to ride heavy equipment except those operators authorized to do so.
3. Contractor furnished construction equipment must be inspected and approved by the Monsanto representative or his designate prior to any use of that equipment on Monsanto property.
4. All contractor furnished construction equipment/vehicles are required to have "roll over protection." Heavy construction equipment must have seatbelts and overhead protection, such as a roll bar.
5. When heavy construction equipment (cranes, pickers, manlifts, etc.) is moved

from one location in the plant to another, a "spotter" is required to walk in front of the equipment and assist in directing the equipment to its new location.

Moving heavy equipment, in an area where roads, planted areas, walkways, asphalt covered areas might be damaged, will be cleared with the representative before proceeding.

V. FACILITIES

A. Sanitary Facilities

1. The representative will designate areas in which the contractor may set up lunch and toilet facilities. It is expected that the contractor will enforce provisions against loitering or throwing trash on the premises by any of his/her employees.
2. The toilet facilities designated by the representative will be used only as toilet facilities. No smoking, loafing or loitering in these areas will be permitted.
3. The contractor is responsible for providing adequate wash-up facilities for his employees. The Monsanto representative will identify a water supply and location for the facilities. If a convenient water

supply cannot be provided by Monsanto, it will be the contractor's responsibility to provide the service.

4. The contractor's employees will not be permitted to use the lunchroom facilities and vending machines in Building 57 without written permission of the Monsanto representative. The contractor's employees will not be permitted to use Monsanto toilet and/or shower facilities in Building 66.
5. Monsanto retains the right to enter the lunch and toilet facilities established by the contractor for the purpose of inspection. Notice will be given to the contractor's supervisor and that individual is expected to accompany the Monsanto representative on the inspection.
6. The use of Monsanto safety showers and eyebaths may be used by the contractor's employees on an emergency basis only.

B. Parking
   1. The representative will designate where contractor's employees will be permitted to park. Parking in the visitor's parking

area or in driveways or on the shoulders of the plant entrance road and passageways is prohibited.

C. Temporary Structures
   1. Before any temporary structure is located in the plant, a Temporary Structure Authorization must be obtained from the Monsanto representative.

VI. GENERAL SAFETY RULES

A. The following safety rules have been prepared for the contractors in order to protect contractor's personnel, Monsanto's personnel and plant equipment. These rules may be supplemented by special departmental rules when an area where work is being done presents special or additional hazards.
   1. Smoking by contractor's employees will not be permitted in the plant except in areas specifically designated in writing and signed by the representative in charge of the job and approved by the plant safety department. Approved smoking areas will be provided by the contractor. Violation of this rule

will result in the immediate and permanent removal of the employee from the plant property. A valid fire and welding permit does not constitute permission for smoking in an area.

2. Working while under the influence of alcohol or carrying intoxicating beverages into or within the plant is prohibited. Violation of this rule will result in immediate and permanent removal of the employee from plant property.
4. "Horseplay" is prohibited.
5. The carrying of open flames in the plant is prohibited.
6. Due to the possibility of contamination of food, eating in areas other than those areas designated for eating is prohibited. Also, food and beverages must be carried and stored in closed or covered containers except inside the designated eating areas.
7. Access to safety equipment and fire fighting equipment must be kept clear at all times.
8. Materials and tools shall not be dropped or thrown from platforms, structures or scaffolds.
9. Ground areas where overhead work is

being performed must be surrounded by barricade tape.

10. All openings, including excavations, will be adequately barricaded and/or shored to comply with OSHA requirements and Monsanto requirements. Where Monsanto requirements are more stringent than OSHA's, Monsanto policy shall rule.
11. Do not store material closer than 10 feet from railroad tracks and 10 feet from power poles.
12. Compressed gas cylinders must have a protective cap on them when not in service. All cylinders (full or empty) must be kept in an upright position. Cylinders must be properly secured to prevent tipping. Cylinder valves must be closed when the cylinder is not being used.
13. Proper authorization must be secured from the representative before any work is performed on or near power lines.
14. Gasoline and other flammables will be transported in safety cans or other approved containers. Flammables will not be allowed on the job in open or faulty

containers or in glass jugs. Use only metal safety cans with flame arrestors for small quantities of gasoline.

15. The contractor shall keep the premises clean, safe and orderly at all times and shall eliminate unsafe conditions when directed by the representative. If, for any reason, work is stopped by plant personnel, the contractor or his/her supervisor will notify the Monsanto representative for instructions before proceeding.
16. All work shall be performed in a safe, professional manner and contractor personnel are expected to abide by all safety rules at all times.
17. The contractor and his/her employees are expected to follow and enforce all current rules and regulations as provided by OSHA, the West Virginia Department of Health and Labor, and the Monsanto Environmental, Safety and Health Guidelines. The most stringent will govern.

VII. PERMITS

A. General

Contractor employees shall follow all rules relating to plant safety permits. The Monsanto representative will review and explain permits and permit procedures as they apply.

Plant operations/owning department personnel are responsible for preparing the work site, initiating the permit, and approving the permit. Contract employees doing the work will sign the permit indicating their compliance to exposure elimination actions required on the permit.

Violation of these permit procedures can result in eviction of the contractor and/or his/her employees from the plant.

B. Types of Permits

1. Hot Work Permit

   This permit covers any construction, maintenance or operations work related activity which could produce a source of ignition. Such activities would include, but are not limited to welding, cutting and heating with an open flame, soldering, grinding, chipping, drilling,

using an impact wrench or air hammer, and using non-explosion-proof electrical equipment or other items which may cause a spark.

2. Confined Space Entry
   This permit covers any construction, maintenance, or operations work related activity in a confined space, which is any area with limited entry and exit and/or limited or no ventilation, which contains known and/or potential hazards and which is not designated for continuous human occupancy. Examples include, but are not limited to, vessels/tanks, tank cars, bins, boilers, column skirts, pits and trenches more than 4′ deep, sewers and underground tunnels.
3. Breaking Into Pipelines/Equipment/Containers
   This permit covers any construction, maintenance, or operations work related activity of breaking into all piping systems, process vessels and equipment, storage vessels and equipment, or ductwork.
4. Hazardous Energy Control Lockout/Tagout
   This permit covers any construction,

maintenance, or operations work related activity where exposure to hazardous energy such as work in or on power driven equipment and associated systems and/or power distribution systems. Examples include, but are not limited to, electric motors and electrical distribution systems, air driven equipment and compressed air systems, steam driven equipment, fans and blowers where wind/air currents could cause motion, hydraulic systems, and natural gas lines.

5. Fire Protection Impairments
   This permit covers any construction, maintenance, or operations work related activity on a fire protection system —sprinkler, deluge systems or firewater pumping systems. Fire protection systems are to be operable at all times unless an impairment is unavoidable and approved. This permit is issued/approved by the Safety department or shift supervisor only.
6. Excavation and Digging
   This permit covers any construction, maintenance, or operations work related activity when excavating and/or digging to any depth greater than 1 foot.

Unless the work is continuous, a permit is required for backfilling operations. Excavation in contaminated areas, regardless of the depth, require a permit.

7. Asbestos
   Only trained/certified personnel are to remove asbestos. Proper authorization must be secured from the Monsanto representative prior to the handling of materials containing asbestos. If insulation is to be removed and the asbestos content is uncertain, the insulation must be handled as asbestos.

VIII. PERSONAL PROTECTIVE EQUIPMENT

A. Approved hard hats, safety glasses, safety shoes, and long sleeve shirts must be worn while in the plant. All of this equipment will be worn when performing work in or traveling through operating units, tank farms, or open air areas. Safety glasses are the minimum protective equipment that is to be worn when performing work in office buildings. Depending upon the location of the office and the nature of the work, additional protective equipment may be required. It is the responsibility of the con-

tractor to enforce the use of this equipment; Monsanto will not be expected to provide this equipment to the contractor and/or his/her employees.

B. Contact Lenses
   1. Contact lenses cannot be worn in the plant.

C. Industrial Hygiene
   1. If it is determined that special industrial hygiene or safety equipment, in addition to that mentioned above, is necessary, the contractor will be notified and will be required to supply this equipment. This may include, but is not limited to, respirators where gas, vapor or dust exposure is likely to exceed recommended levels, body covering where there is a need to avoid skin contact, or hearing protection where noise exposures may exceed 85 dBA.
   2. If the work is to be performed requires the use of respiratory equipment, all personnel (including supervision) on that job must meet all elements of the OSHA respiratory program including:
      a. Individuals must be clean shaven. No

visible stubble in the respirator sealing area.

b. Individuals must be medically evaluated by the contractor to determine physical ability to work while using a respirator. Documentation to Monsanto representative.

c. Individuals must be fit tested, by the contractor. Documentation to Monsanto representative.

IX. MEDICAL TREATMENT

A. The contractor is responsible for providing first aid treatment for his/her employees.

B. Monsanto will assist in providing care for seriously injured personnel so that they can be prepared for transportation to a hospital. Utilize the plant emergency system for quick response.

C. All injuries to contractor personnel are to be reported to the Monsanto representative immediately with follow-up on Monsanto Form G-4001 within 24 hours.

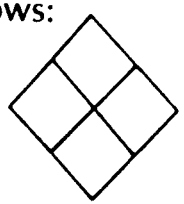
X. HAZARD COMMUNICATION

A. Material Safety Data Sheets (MSDS)

1. The contractor must receive data sheets for any Monsanto substances with which his employees may come into contact. All contract employees must understand the hazards of these materials and any precautions needed.
2. The contractor must provide a MSDS to the Monsanto representative for any substance brought by contract employees onto the Monsanto site. A copy must also be forwarded immediately to the safety office.

B. In-Plant Hazard Labeling System

In-plant vessels are labeled with signs which appear as follows:

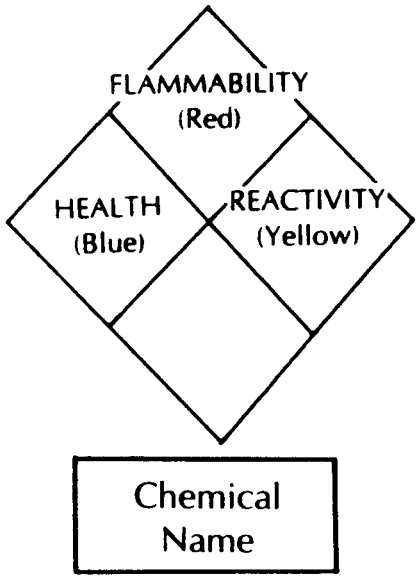


Chemical Name

On the bottom is the chemical name of the contents. It may, if the contents are a complex mixture, refer to the operating procedures. The diamond-shaped diagram shown on the top gives, at a glance, a general idea of the

inherent hazards of the chemical and the order of severity of these hazards under emergency conditions, such as spills, leaks and fires. This provides emergency responders and other effected personnel with basic information needed for safe tactical procedures in emergency operations, gives on-the-spot information to safeguard the lives of fire-fighting personnel and the others who may be exposed, and provides plant design engineers and plant protection and safety personnel with a means of identifying hazardous materials and areas in which they are stored.

The diagram identifies the "health", "flammability" and "reactivity" (instability and water reactivity) of a chemical and indicates the order of severity of each hazard by use of one of five numeral gradings, from four (4) indicating a severe hazard or extreme danger, to zero (0) indicating no special hazard. In the diamond-shaped diagram, the "health" hazard is identified at the left, "flammability" at the top, and "reactivity" at the right.



The bottom space is primarily used to identify unusual reactivity with water. A "W" with a line through its center alerts fire-fighting personnel to the possible hazard in using water. Oxidizing chemicals are identified in the bottom space by "OXY." To supplement the arrangement, colored backgrounds are used to identify the hazard categories—blue for "health," red for "flammability", and yellow for "reactivity."

The following paragraphs summarize the meanings of the numbers in each hazard category:

HEALTH

4 A few whiffs of the gas or vapor could cause death, or the gas, vapor, or liquid could be fatal on penetrating normal protective clothing. The normal, full-protective clothing available to the average fire department will not provide adequate protection against skin contact with these materials. Only special protective clothing designed to protect against the specific hazard should be worn.

3 Materials extremely hazardous to health, but areas may be entered with extreme care. Full protective clothing, including self-contained breathing apparatus, rubber gloves, boots and bands around legs, arms and waist should be provided. No skin surface should be exposed.

2 Materials hazardous to health, but areas may be entered freely with self-contained breathing apparatus.

1 Materials only slightly hazardous to health. It may be desirable to wear self-contained breathing apparatus.

0 Materials that, on exposure under fire conditions, would offer no health hazard beyond that of ordinary combustible materials.

FLAMMABILITY

4 Very flammable gases, very volatile flammable liquids, and materials that in the form of dusts or mists readily form explosive mixtures when dispersed in air. Flash point generally <73°F.

3 Liquids that can be ignited under almost all normal temperature conditions. Water may be ineffective on these liquids because of their low flashpoints. Solids that form coarse dusts, solids in shredded or fibrous form that create flash fires, solids that burn rapidly, usually because they contain their own oxygen, and any material that ignites spontaneously at normal temperatures in air. Flashpoints <100°F.

2 Liquids that must be moderately heated before ignition will occur and solids that readily give off flammable vapors. Water spray may be used to extinguish the fire because the material can be cooled to below its flashpoint, which is <200°F.

1 Materials that must be preheated before ignition can occur. Most combustible solids have a flammability rating of 1. Flash generally above 200°F.

0 Materials that will not burn.

REACTIVITY

4 Materials that, in themselves, are readily capable of detonation or of explosive decomposition or explosive reaction at normal temperatures and pressures. If a chemical with this hazard rating is in an advanced or massive fire, the area should be evacuated.

3 Materials that, in themselves, are capable of detonation or of explosive decomposition or of explosive reaction, but which require a strong initiating source or which must be heated under confinement before initiation. Fire fighting should be done from an explosion-resistant location.

2 Materials that, in themselves, are normally unstable and readily undergo violent chemical change, but do not detonate. In advanced or massive fires, fire fighting should be done from a protected location.

1 Materials that, in themselves, are normally stable, but which may become unstable at elevated temperatures and pressures or which may react with water with some release of energy, but not violently. Caution must be used in approaching the fire and applying water.

0 Materials that are normally stable, even under fire exposure conditions and that are not reactive with water. Normal fire fighting procedures may be used.

XI. WASTE DISPOSAL

Because of concern for the environment and regulations, all waste/debris from contract jobs will be disposed of in an environmentally acceptable manner. The Monsanto representative (in conjunction with the Environmental Group) and contractor will document disposal method/location prior to job beginning. Load tickets from disposal location will be submitted to the representative. Of particular concern are asbestos, asbestos containing materials, chemically contaminated equipment, pipe, etc. and dirt, concrete, etc.

XII. TOOLS AND EQUIPMENT

The contractor is expected to provide all necessary tools and equipment to perform the job. All tools used (including but not limited to, hoists, cranes, scaffolds, and lifts) are subject to inspection and approval/rejection by Monsanto.

Monsanto's tools and equipment shall not be used by Contractors' employees without prior written approval of the representative. In the event Contractor is permitted to use Monsanto's

tools/equipment, first aid/medical facilities, personal protective equipment, or other services, Contractor (through an officer or other authorized representative) shall be required to agree in writing to the following:

In consideration of Monsanto Company ("Monsanto") providing for use by Contractor, its employees, representatives or agents, (fill in appropriate items, service tools, equipment or facilities to be provided by Monsanto) (Name of Contractor) ("Contractor") agrees that (1) Monsanto, its subsidiaries, and their respective employees, representatives and agents, shall not be liable for and Contractor released and discharges Monsanto, its subsidiaries, and their respective employees representatives and agents, from any and all claims, liabilities, actions, suits, judgments, losses, illnesses, injuries, deaths, damages, costs and expenses arising out of, related to or connected with Monsanto's providing to, or use by, Contractor, its employees, representatives or agents, of the above described items services, tools, equipment or facilities, (2) Contractor assumes all risk and responsibility therefor, (3) Contractor shall indemnify and save harmless Monsanto, its subsidiaries, and their respective employees, representatives and agents, from

and against any and all such claims, liabilities, actions, suits, judgments, losses, illnesses, injuries, deaths, damages, costs and expenses and (4) the foregoing shall apply irrespective of any negligence or fault ot Monsanto, its subsidiaries, or their respective employees, representatives or agents, whether such negligence or fault is joint, several, sole of otherwise.

The items, services, tools, equipment or facilities are provided by Monsanto on an AS IS, WHERE-IS BASIS, MONSANTO MAKES NO WARRANTY OR REPRESENTATION OF ANY KIND, EXPRESS OR IMPLIED, WITH RESPECT TO THE ITEMS, SERVICES, TOOLS, EQUIPMENT OR FACILITIES AND MAKES NO WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PURPOSE.

Contractor agrees to return any items, tools, equipment or facilities in the same, good-working condition as received from Monsanto. See following tear-out page for agreement form.

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TOOL AND EQUIPMENT USE AGREEMENT

(To be Signed by Contractor Representative and Retained by Monsanto Representative)

In consideration of Monsanto Company ("Monsanto") providing for use by Contractor, its employees, representatives or agents the following tools, equipment or facilities (list items being used here)

_____

_____

_____

_____

the contractor _____
(fill in name of contractor) agrees that (1) Monsanto, its subsidiaries, and their respective employees, representatives and agents, shall not be liable for and contractor releases and discharges Monsanto, its subsidiaries, and their respecrive employees, representatives and agents, from any and all claims, liabilities, actions, suits, judgment, losses, illnesses, injuries, deaths, damages, costs and expenses arising out of, related to or connected with Monsanto's providing to, or use by, Contractor, its employees, representatives or agents, of

the above described items services, tools, equipment or facilities, (2) Contractor assumes all risk and responsibility therefor, (3) Contractor shall indemnify and save harmless Monsanto, its subsidiaries, and their respective employees, representatives and agents, from and against any and all such claims, liabilities, actions, suits, judgments, losses, illnesses, injuries, deaths, damages, costs and expenses and (4) the foregoing shall apply irrespective of any negligence or fault of Monsanto, its subsidiaries, or their respective employees, representatives or agents, whether such negligence or fault is joint, several, sole or otherwise.

The items, services, tools, equipment or facilities are provided by Monsanto on an AS IS, WHERE-IS BASIS. MONSANTO MAKES NO WARRANTY OR REPRESENTATION OF ANY KIND, EXPRESS OR IMPLIED, WITH RESPECT TO THE ITEMS, SERVICES, TOOLS, EQUIPMENT OR FACILITIES AND MAKES NO WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PURPOSE.

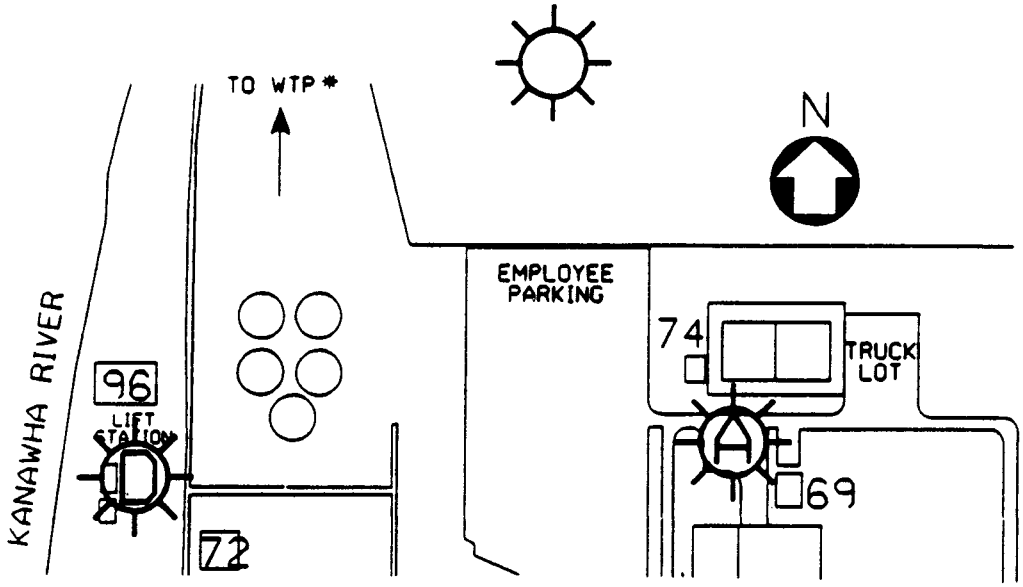
Contractor agrees to return any items, tools, equipment or facilities in the same, good working condition as received from Monsanto.

Signed _____
Contractor Representative

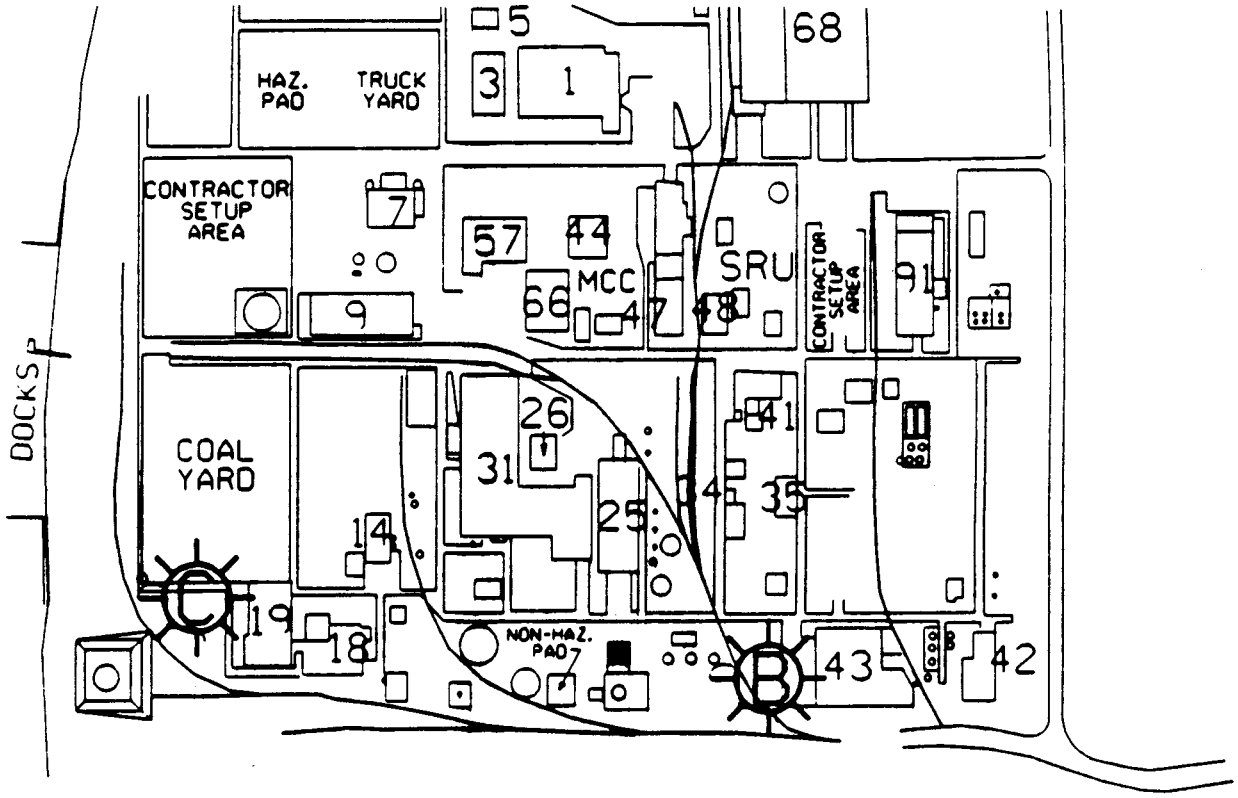
Date _____

TEAR OUT THIS PAGE AND GIVE TO MONSANTO REPRESENTATIVE

PLANT EMERGENCY EVACUATION AREAS



38



39

XV. COMMUNICATION INFORMATION

Monsanto Representative _____

Ext. _____

Building/Area Identification _____

Emergency Notification: **2222**

Headcount Reporting

	Assembly Area
Monday-Friday, 7:00-3:30	or 759-4389 or 4389
Other Hours	or 758-4220 or 4220

Location of phone for emergencies:

_____

_____

_____

Emergency Assembly Area _____

YOUR NOTES

YOUR NOTES

EMERGENCIES

- Call Extension 2222
- Give Your Name
- Give Your Location (Building Number)
- Give Nature of Emergency (Fire, Spill, Accident, etc.)
- Do Not Hang Up Until All Information is Confirmed

PLATES

LEGEND

RB1 ●	PROPOSED SOIL, SEDIMENT, OR SURFACE WATER SAMPLING LOCATION AND IDENTIFICATION
WT-12A ⊕	PROPOSED MONITORING WELL LOCATION AND IDENTIFICATION
MW-1A ◕	MONITORING WELL LOCATION AND IDENTIFICATION
— — —	APPROXIMATE PROPERTY LINE
— · — · —	EDGE OF WATER
-·-·-·-·-	DRAINAGE SWALE
—×—×—	FENCE

NOTES:

1. EXACT LOCATION OF TEEPEE INCINERATOR UNKNOWN.

200' 0 200'

Title:

PROCESS AREA SITE PLAN

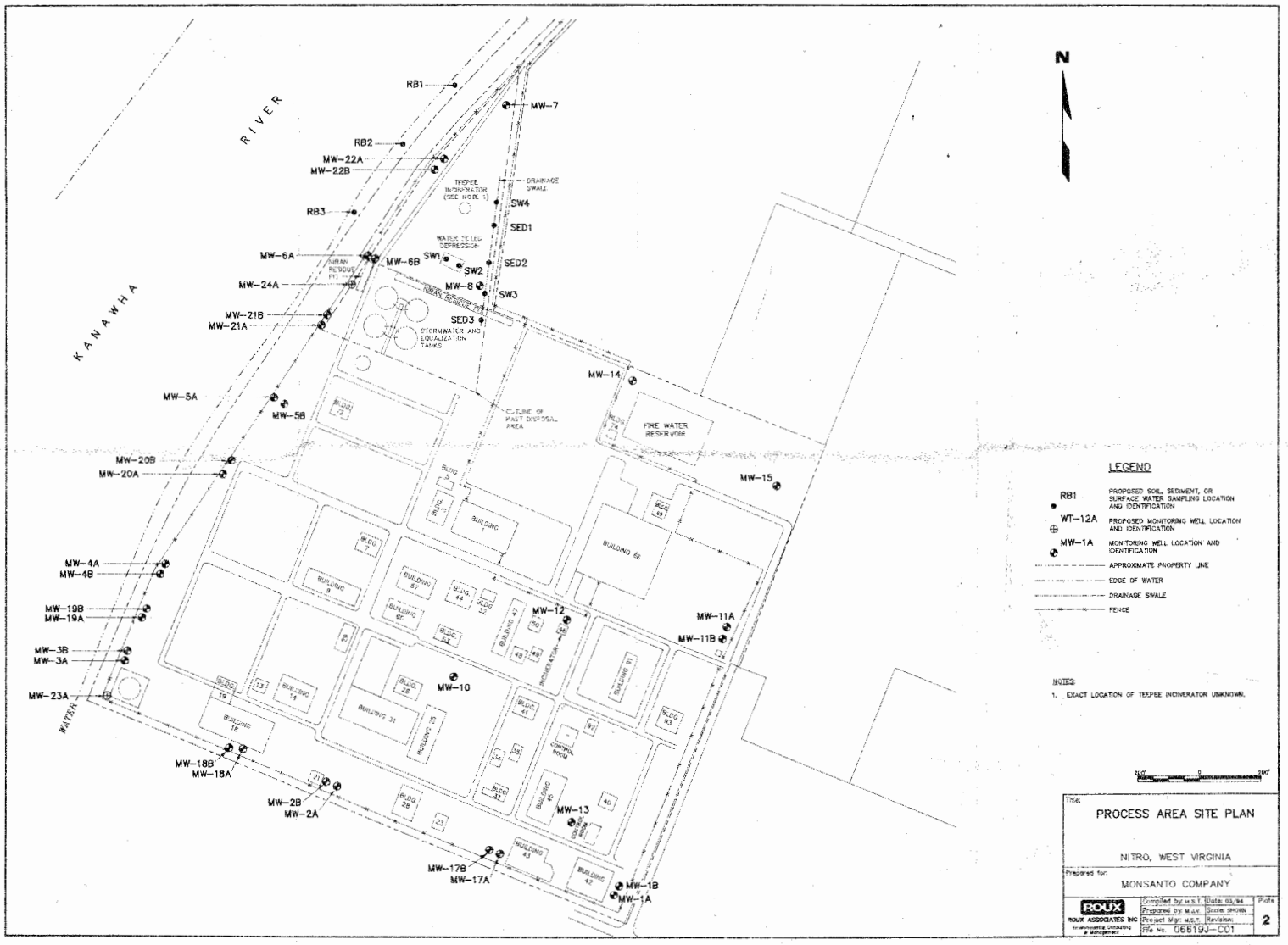
NITRO, WEST VIRGINIA

Prepared for:

MONSANTO COMPANY

ROUX ASSOCIATES INC
Environmental Consulting & Management

Compiled by: M.S.T.	Date: 03/94	Plate
Prepared by: M.J.V.	Scale: SHOWN	
Project Mgr: M.S.T.	Revision:	2
File No. 06619J-C01		


N
KANAWHA RIVER
RB1
MW-7
RB2
MW-22A
MW-22B
TEPEE INCINERATOR (SEE NOTE 1)
DRAINAGE SWALE
SW4
SED1
RB3
WATER TABLE DEPRESSION
MW-6A
MW-6B
SW1
SW2
SED2
MW-24A
MW-8
SW3
MW-21B
MW-21A
SED3
STORMWATER AND EQUALIZATION TANKS
MW-14
MW-5A
MW-5B
C/LINE OF WASTE DISPOSAL AREA
FIRE WATER RESERVOIR
MW-20B
MW-20A
MW-15
BUILDING
BUILDING 66
MW-4A
MW-4B
MW-19B
MW-19A
MW-12
MW-11A
MW-11B
MW-3B
MW-3A
MW-10
MW-23A
WATER
MW-18B
MW-18A
MW-2B
MW-2A
MW-13
MW-17B
MW-17A
MW-1B
MW-1A
LEGEND
RB1 PROPOSED SOIL, SEDIMENT, OR SURFACE WATER SAMPLING LOCATION AND IDENTIFICATION
WT-12A PROPOSED MONITORING WELL LOCATION AND IDENTIFICATION
MW-1A MONITORING WELL LOCATION AND IDENTIFICATION
APPROXIMATE PROPERTY LINE
EDGE OF WATER
DRAINAGE SWALE
FENCE
NOTES:
1. EXACT LOCATION OF TEPEE INCINERATOR UNKNOWN.
200' 0 200'
Title: PROCESS AREA SITE PLAN
NITRO, WEST VIRGINIA
Prepared for: MONSANTO COMPANY
ROUX
ROUX ASSOCIATES INC
Environmental Consulting & Management
Compiled by: M.S.T.
Date: 03/94
Prepared by: M.J.V.
Scale: SHOWN
Project Mgr: M.S.T.
Revision:
File No. 06619J-C01
Plate 2

LEGEND

WT-12A ⊕	PROPOSED MONITORING WELL LOCATION AND IDENTIFICATION
WT-1A ◕	MONITORING WELL LOCATION AND IDENTIFICATION
586	TOPOGRAPHIC CONTOUR LINE (FEET) CONTOUR INTERVAL= 2 FT. RIVER BANK CONTOUR INTERVAL= 5 FT.
	APPROXIMATE PROPERTY LINE
	EDGE OF WATER
	DRAINAGE SWALE
	FENCE

200' 0 200'

INCINERATOR UNKNOWN.

Title:

SITE MAP

NITRO, WEST VIRGINIA

Prepared for:

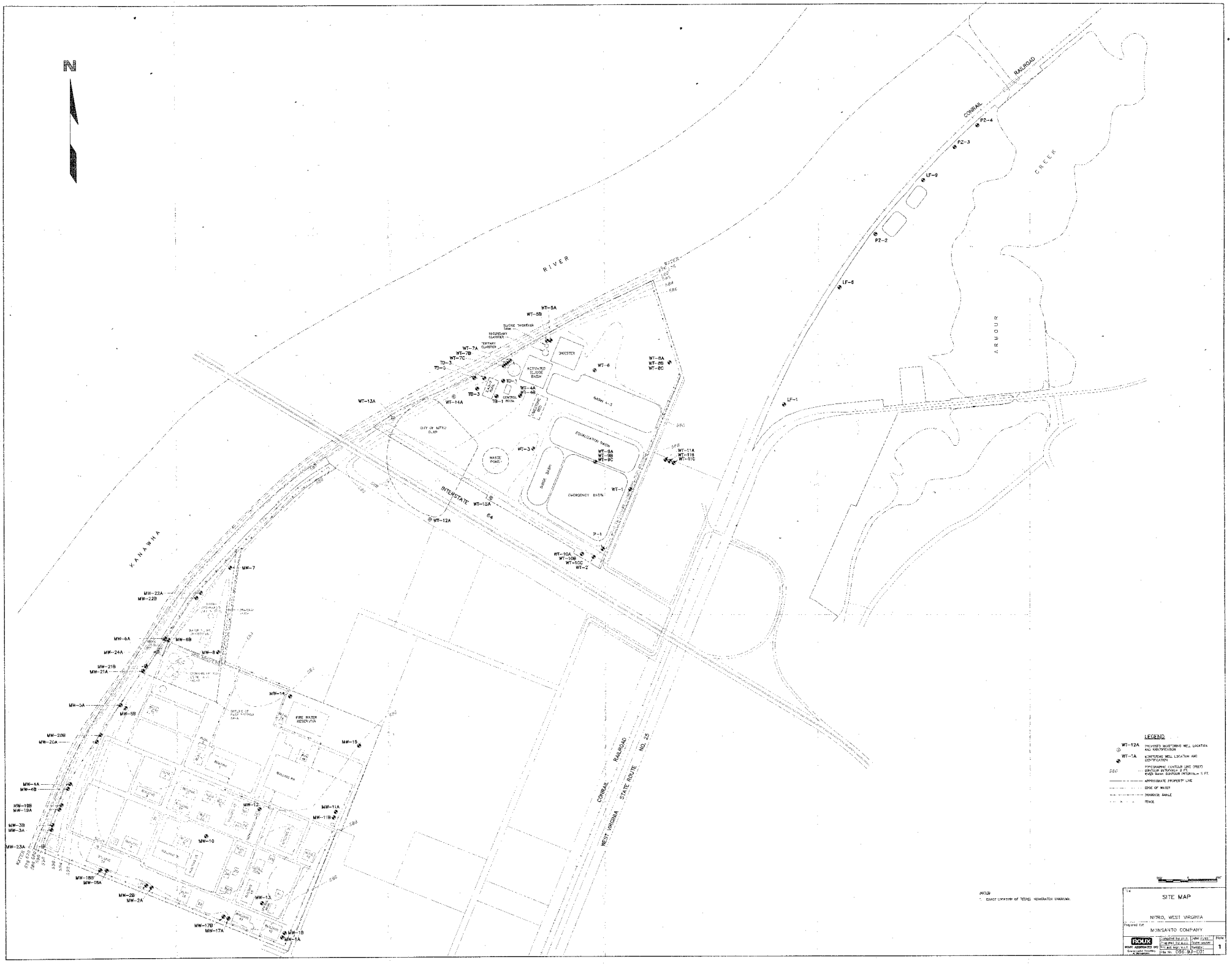
MONSANTO COMPANY

ROUX

ROUX ASSOCIATES INC

Environmental Consulting & Management

Compiled by: J.L.S.	Date: 11/93	Plate
Prepared by: M.J.V.	Scale: SHOWN	1
Project Mgr: M.S.T.	Revision:	
File No. 06619J-E01		


N
RIVER
KANAWHA
ARMOUR
CREEK
CONRAIL
RAILROAD
INTERSTATE
WEST VIRGINIA
STATE ROUTE
NO. 25
SLUDGE THICKENER TANK
SECONDARY CLARIFIER
TERTIARY CLARIFIER
DIGESTER
ACTIVATED SLUDGE BASIN
CONTROL ROOM
BASIN 4-3
EQUALIZATION BASIN
EMERGENCY BASIN
WASTE POND
CITY OF NITRO DUMP
FIRE WATER RESERVOIR
WT-5A
WT-5B
WT-7A
WT-7B
WT-7C
TD-3
TD-2
TD-1
TB-3
TB-1
WT-4A
WT-4B
WT-13A
WT-14A
WT-6
WT-8A
WT-8B
WT-8C
WT-3
WT-9A
WT-9B
WT-9C
WT-11A
WT-11B
WT-11C
WT-1
P-1
WT-10A
WT-10B
WT-10C
WT-2
WT-12A
WT-15A
LF-1
LF-5
LF-6
PZ-2
PZ-3
PZ-4
MW-7
MW-22A
MW-22B
MW-6A
MW-6B
MW-24A
MW-8
MW-21B
MW-21A
MW-14
MW-5A
MW-5B
MW-20B
MW-20A
MW-15
MW-4A
MW-4B
MW-19B
MW-19A
MW-12
MW-11A
MW-11B
MW-3B
MW-3A
MW-10
MW-23A
MW-23B
MW-18B
MW-18A
MW-2B
MW-2A
MW-13
MW-17B
MW-17A
MW-1B
MW-1A
LEGEND
WT-12A PROPOSED MONITORING WELL LOCATION AND IDENTIFICATION
WT-1A MONITORING WELL LOCATION AND IDENTIFICATION
580 TOPOGRAPHIC CONTOUR LINE (REF) CONTOUR INTERVAL 2 FT. RIVER BANK CONTOUR INTERVAL 5 FT.
APPROXIMATE PROPERTY LINE
EDGE OF WATER
DRAINAGE SWALE
FENCE
NOTE:
* EXACT LOCATION OF TERRA VERMEATION UNKNOWN.
SITE MAP
NITRO, WEST VIRGINIA
Prepared for
MONSANTO COMPANY
ROUX ASSOCIATES INC
Environmental Consultants & Contractors
Compiled by: J.S. CHEM EJ
Checked by: M.B.
Drawn by: M.A.T.
Checked by:
File No. 056-93-C01
Date
Note 1

LEGEND

WT-12A — PROPOSED MONITORING WELL LOCATION AND IDENTIFICATION

WT-1 — MONITORING WELL LOCATION AND IDENTIFICATION

APPROXIMATE PROPERTY LINE

EDGE OF WATER

DRAINAGE SWALE

FENCE

200' 0 200'

Title:

WASTE TREATMENT AREA SITE MAP

NITRO, WEST VIRGINIA

Prepared for:

MONSANTO COMPANY

ROUX ASSOCIATES INC
Environmental Consulting & Management

Compiled by: M.S.T.	Date: 03/94	Plate
Prepared by: M.J.V.	Scale: SHOWN	3
Project Mgr: M.S.T.	Revision:	
File No. 06619J-C02		

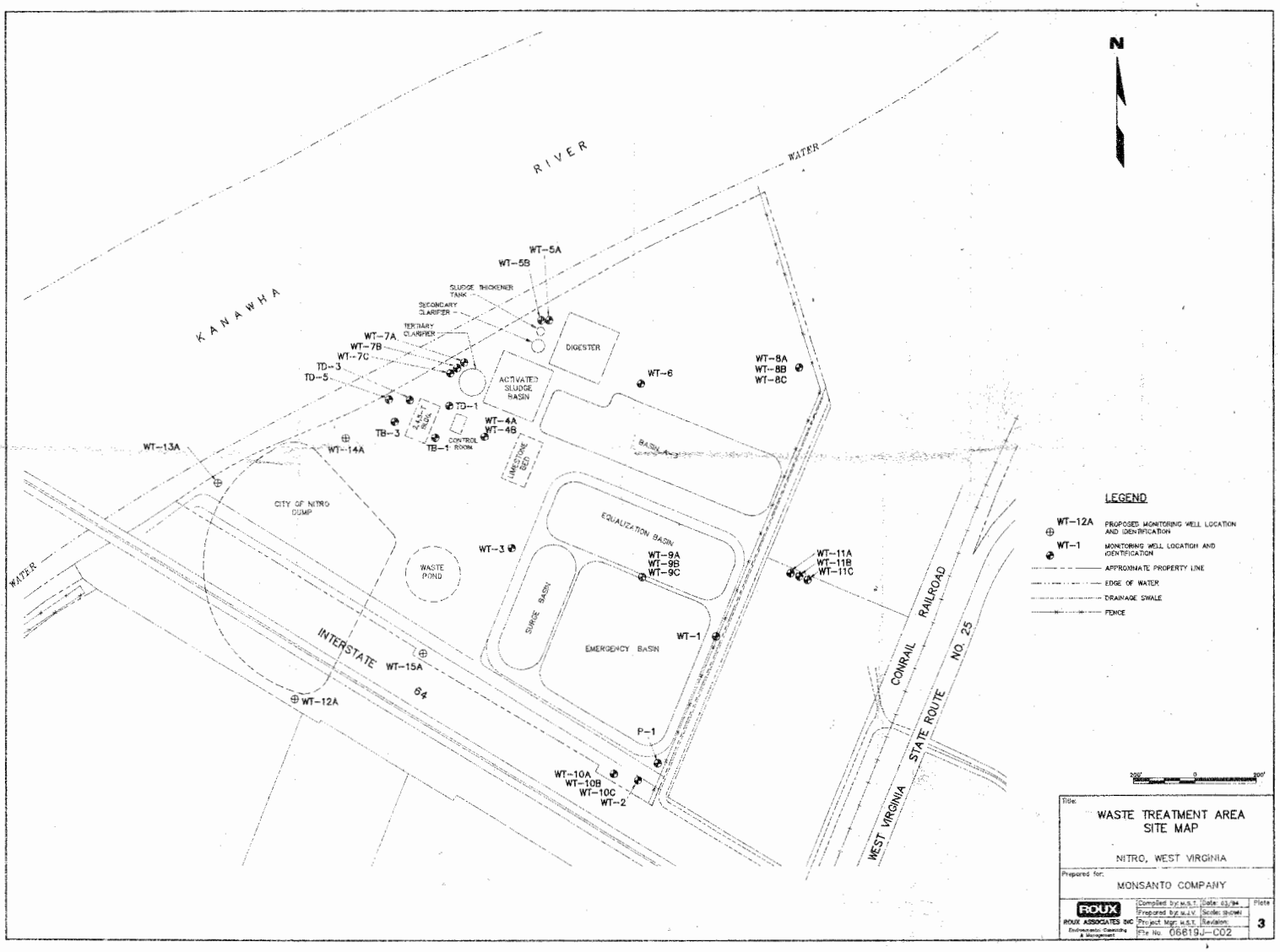

N
KANAWHA
RIVER
WATER
WT-5A
WT-5B
SLUDGE THICKENER TANK
SECONDARY CLARIFIER
TERTIARY CLARIFIER
WT-7A
WT-7B
WT-7C
TD-3
TD-5
DIGESTER
ACTIVATED SLUDGE BASIN
WT-6
WT-8A
WT-8B
WT-8C
TD-1
TB-3
TB-1
CONTROL ROOM
WT-4A
WT-4B
LIMESTONE BED
BASIN
WT-13A
WT-14A
CITY OF NITRO DUMP
EQUALIZATION BASIN
WT-3
WT-9A
WT-9B
WT-9C
WT-11A
WT-11B
WT-11C
WASTE POND
SURGE BASIN
EMERGENCY BASIN
WT-1
INTERSTATE 64
WT-15A
WT-12A
P-1
WT-10A
WT-10B
WT-10C
WT-2
CONRAIL RAILROAD
WEST VIRGINIA STATE ROUTE NO. 25
LEGEND
WT-12A PROPOSED MONITORING WELL LOCATION AND IDENTIFICATION
WT-1 MONITORING WELL LOCATION AND IDENTIFICATION
APPROXIMATE PROPERTY LINE
EDGE OF WATER
DRAINAGE SWALE
FENCE
200' 0 200'
Title:
WASTE TREATMENT AREA SITE MAP
NITRO, WEST VIRGINIA
Prepared for:
MONSANTO COMPANY
ROUX
ROUX ASSOCIATES INC
Environmental Consulting & Management
Compiled by: M.S.T.
Prepared by: M.J.V.
Project Mgr: M.S.T.
File No. 06619J-C02
Date: 03/94
Scale: SHOWN
Revision:
Plate
3

PLATE 4

85

REV.	DESCRIPTION	BY	APP'D	DATE

MONSANTO COMPANY
NITRO. W. VA.

LOCATION PLANTWIDE	T.S.D. JOB NO.
DEPT BLDG.	W.O. NO.

PLANT SEWERS
KEY MAP

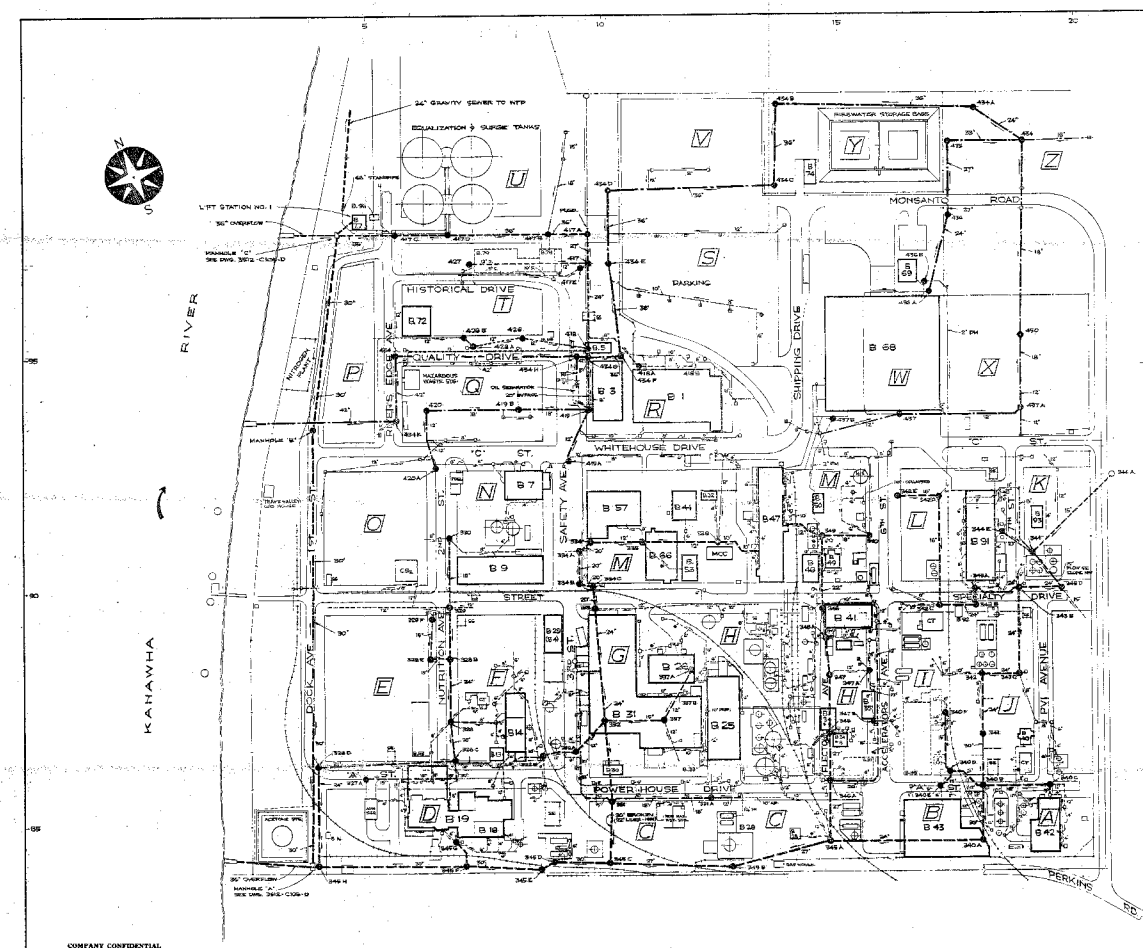
	BY	DATE	APP'D	DATE	APP'D	DATE
DRAWN	T.B. UNDERWOOD	3-18-92				
CHK'D	MYERS	3-30-92				
PROJ. ENGR.						

SCALE: 1" = 100'	DWG. NO. 5200-C01-0

REFERENCE DRAWINGS

AUTHORITY NO.

GAS HOUSE



AREA DRAWINGS REFERENCE LIST

DRAWING NUMBER	AREAS COVERED
5200-C02-D	A
" C03 "	B
" C04 "	C (EAST), G (SOUTHEAST), & H (SOUTH)
" C05 "	C (WEST)
" C06 "	D
" C07 "	E
" C08 "	F & G
" C09 "	H (NORTH)
" C10 "	I (SOUTH) & J (SOUTH)
" C11 "	I (NORTH) & J (NORTH)
" C12 "	K & L
" C13 "	M (EAST)
" C14 "	M (WEST)
" C15 "	N
" C16 "	O
" C17 "	P (SOUTH), T (SOUTH), & Q
" C18 "	R
" C19 "	S, V, W, X, Y, & Z
" C20 "	P (NORTH), T (NORTH) & U

LEGEND

H — AREA IDENTIFICATION

434 — STORM SEWER & MANHOLE

J — STORM SEWER & CATCH BASIN

— COMBINED SEWER & MANHOLE

— COMBINED SEWER & CATCH BASIN

— FORCE MAIN

ABANDONED SEWERS ARE NOT SHOWN

PLATE 4

REV.	DESCRIPTION	BY	APP'D	DATE

MONSANTO COMPANY
NITRO, W. VA.

LOCATION PLANTWIDE — C.A.D. JOB NO.
SCALE — FILE — W.O. NO.

PLANT SEWERS
KEY MAP

	BY	DATE	APP'D	DATE	APP'D	DATE
DRAWN	[illegible]	3-18-92				
CHK'D	MYERS	3-30-92				
ENG. CHIEF						

SCALE 1" = 100'

DWG. 5200-C01-J

AUTHORITY NO.

REFERENCE DRAWINGS

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ALWAYS WORK SAFELY AND LEAVE A CLEAN WORK AREA