Natural
Resource
Technology, Inc.
N R T

REMEDIAL INVESTIGATION / FEASIBILITY STUDY WORK PLAN

CAMPMARINA FORMER MANUFACTURED GAS PLANT SITE
SHEBOYGAN, WISCONSIN

Project No: 1665

Prepared For:

DRAFT

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TABLE OF CONTENTS

FIGURES

TABLES

APPENDICES

SHEETS

1.0 INTRODUCTION

This Remedial Investigation and Feasibility Study (RI/FS) Work Plan has been prepared for the Wisconsin Department of Natural Resources (WDNR) by Natural Resource Technology, Inc. (NRT) on behalf of Wisconsin Public Service Corporation (WPSC) for sediments in the Sheboygan River adjacent to the Campmarina Former Manufactured Gas Plant (MGP) (previously referred to as Sheboygan II, herein referred to as the site) in the City of Sheboygan, in Sheboygan County, Wisconsin (Figure 1). The WDNR, WPSC, and the City of Sheboygan (potentially responsible parties (PRPs)) have each entered into Contract Number SF-91-04 in accordance with Section 144.442 of the Wisconsin Statutes. The Contract requires the PRPs to prepare and submit an RI/FS that complies with the requirements of the Comprehensive Environmental Response Compensation, and Liability Act (CERCLA), 42 U.S.C. ss 9601 et seq., as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA).

The RI/FS Work Plan sets forth (i) the tasks to be undertaken in order to characterize the nature and extent of MGP contamination adjacent to the former MGP site (Sheet 1), (ii) the means by which data will be evaluated to assess ecological and human health risks, and (iii) the procedures for developing and evaluating remedial alternatives that address ecological and human health risks. In addition, the Work Plan identifies RI/FS deliverables and supporting documentation to be provided to WDNR and presents a preliminary schedule for completion of the RI/FS work.

1.1 SITE LOCATION AND DESCRIPTION

The former MGP site is located at 732 North Water Street, within the northwest 1/4 of the southwest 1/4 of Section 23, Township 15 North, Range 23 East, within Sheboygan County, Wisconsin (Figure 1). The site encompasses an area of approximately 1.5 acres adjacent to the Sheboygan River, approximately 1 mile west of Lake Michigan. The site is bounded by a private docking facility on the north, North Water Street on the east, an unused lot with condominiums on the south, and the Sheboygan River on the west (Sheet 1).

The former MGP is located on property owned by the City of Sheboygan, known as Campmarina. In the past Campmarina was equipped with parking areas, electrical power and potable water for recreational vehicle (RV) use. A docking area was also provided for recreational boat use on the Sheboygan River. The site was primarily covered with compacted gravel with an access road from the former North Water Street (north end of the site). After WPSC completed remediation work on the Campmarina property, the City of Sheboygan redeveloped both Campmarina and the property to the south into a neighborhood park (Riverside Park), a condominium complex, and a river walk.

1.1.1 Natural & Manmade Features

1.1.1.1 Natural Features

Natural features at the site have been modified by historic site use as a former MGP and RV park, followed by upland environmental remediation. The upland area is now a community park, named Riverside Park, with landscaped lawn, recreational areas, seating, and sidewalks. The western boundary of the site is formed by the Sheboygan River.

1.1.1.2 Manmade Features

Sanborn maps show the shorelines for the Sheboygan River at the MGP site. Between 1891 and 1903, the channel appears to have been straightened by fill that extended approximately 60 feet into the river. Later maps show that the shoreline has not changed substantially since 1903 (NRT 1998).

During the upland remediation that took place between 2000 and 2001, the river bank was partially excavated and restored with filter gravel, structural fill and riprap. Approximately 2 feet of structural fill was placed in the over-excavated area from 1 to 3 feet-below ground surface (bgs). A non-woven geofabric and 6 inches of filter gravel was placed along the base of the riverbank (1 feet bgs). A second layer of filter fabric was placed over the filter gravel followed by structural fill that was placed and compacted to restore the river bank at a slope of approximately 2 feet horizontal to 1 foot vertical (2H:1V). Riprap was then placed along the restored river bank. The upland area of the site is approximately 10 feet higher in elevation than the present shoreline, which is heavily rip-rapped.

A sheet pile barrier wall was installed along the Sheboygan River shoreline. The minimum design key depth was set approximately 3 feet below the interface between the clay and the upper intermittent sand, silt, gravel and clay zone. All of the sheet piles were installed to refusal, with the exception of two which were keyed a minimum of 1foot below the clay interface.

Boat Island is a man-made land mass located approximately 150 feet from the site shoreline. The island is approximately 375 feet long by 105 feet wide (at its widest point) and has several buildings which are used to store materials and supplies for the adjacent marina, the Outboard Motor Club, located to the north. The Outboard Motor Club purchased Boat Island from the City of Sheboygan in 1951. The island has seasonal docking for boats.

There is also a potential for active and inactive underground utilities in the river near the site. Any active utilities will be identified and flagged by the utility company locating service before conducting intrusive RI field activities. Subsurface utilities will be further investigated as potential preferential pathways for chemical constituent migration.

1.1.2 Topography

Based on (United States Geologic Survey) USGS Sheboygan North Quadrangle, photo revised 1973, relief within one mile of the site is approximately 95 feet, ranging from approximately 580 feet msl at Lake Michigan to approximately 675 feet msl northwest of the site in the City of Sheboygan. The ground surface elevation for the majority of the site groundwater monitoring wells ranges between 588 and 591 feet msl; the site slopes from Water Street to the Sheboygan River. The elevation of the Sheboygan River ranges from about 577 feet msl (April 2004) to 582 feet, dependent on the general elevation of Lake Michigan.

1.2 SITE HISTORY

MGP facilities used coal to manufacture gas for lighting and heating, and produced coal by-products which served as feedstocks for other chemical manufacturing operations. Nationwide, over 2,000 MGPs operated from 1816 to the early 1960s, until natural gas became readily available and replaced the production of manufactured gas. The history of operation of these facilities is not always well defined, since most MGPs were retired more than 35 years ago. However, sufficient records exist to ascertain the nature of gas production processes used and the probable volumes of gas and other related by-products manufactured. These records also provide information on other relevant factors in evaluating the likelihood for process residuals to remain on the respective properties as well as the probable characteristics and volumes of the residuals.

Two methods of coal gas production were used at the Campmarina MGP. The coal gas production method, used from 1872 to 1886, involved heating the coal in an airtight chamber (retort) which produced coke and gases containing a variety of volatilized organic constituents. The process also produced tar which was sold for beneficial use, including roofing, wood treatment, and paving roads. The gas was passed through purifiers to remove impurities such as sulfur, carbon dioxide, cyanide, and ammonia. Dry purifiers contained lime or hydrated iron oxide mixed with wood chips. The gas was then stored in large holders on-site prior to distribution for lighting and heating.

The carburetted water gas process, used from 1886 to 1929, involved passing air and steam over the incandescent coal in a brick-filled vessel to form a combustible gas which was then enriched by injecting a fine mist of oil over the bricks. The gas was then purified and stored in holders prior to distribution. The MGP ceased operation in 1929. Former aboveground MGP-related structures (Sheet 2) at the site included the following:

- Three gas holders ranging in diameter from approximately 35 feet to 70 feet, the larger two with capacities of 70,000 cubic feet and 200,000 cubic feet;
- One gas oil tank approximately 15 feet in diameter;
- Three tar tanks; two approximately 30 feet by 8 feet and one approximately 20 feet by 5 feet;
- One purifier approximately 25 feet in diameter; and,
- Gas manufacturing buildings including a garage, a gas meter shop, and a boiler room.

Based on review of Sanborn maps, the gas holders were removed from the site between 1950 and 1955. Review of the 1955 Sanborn map indicates that many of the MGP buildings were still present on the site. Sometime between 1955 and 1966, the remaining facility structures were razed and removed.

Numerous companies, which eventually became part of the Sheboygan Gas Light Company (SGLC), owned the former Sheboygan MGP. In 1922, SGLC merged with other utilities to form WPSC. In 1966, WPSC sold the property to Heileman Brewing Company (Heileman) for use as a parking lot. Heileman sold the property in 1977, and it was then under ownership of three other non-manufacturing companies until the City of Sheboygan purchased the property in 1985. The property was used as a boat dock and recreational vehicle camping area (Campmarina). The property was covered with gravel and provided seasonal access to slips for recreational watercraft. During 2001, the City of Sheboygan redeveloped Campmarina into Riverside Park.

Historical development activities adjacent to the site included a tannery, toy factory, and brewery. Tannery operations terminated sometime between 1903 and 1940 and the property was sold to Garton Toy Company (Garton). The 1950 Sanborn map indicates Garton used a portion of the site adjacent to the river, directly across New York Avenue, for paint and lacquer spraying.

1.3 CURRENT SITE USE

Following substantial completion of the upland remedial activities described in Section 1.1.1.2, construction activities were performed by the City of Sheboygan for a neighborhood park, Riverside Park that includes a river walk, removal of Water Street along Campmarina, landscaping, and recreational facilities.

Phase I upland remediation activities were performed from approximately October 2000 through January 2001. Phase II upland remediation activities were initiated in December 2000 and was substantially completed in July 2001. Construction of Riverside Park was initiated during the summer of 2001 and was substantially completed in June 2002. WPSC maintains the sheet piling containment system and operates a biosparge system in the upland area (Sheet 1). The system is designed to gently inject air into the subsurface within the containment area to promote natural biodegradation of MGP constituents in shallow groundwater. Routine groundwater monitoring is conducted to assess groundwater conditions.

1.4 SCOPE

This Work Plan contains 7 sections, as identified below. The Quality Assurance Project Plan (QAPP), Sampling and Analysis Plan (SAP), and site Health and Safety Plan (HSP), are included in Appendix A, B, and C, respectively. The QAPP describes the specific field and analytical procedures that will be employed while performing specific field investigation and sample collection tasks described in the SAP.

- Section 2.0 presents a discussion of available existing data for the site including description of Sheboygan River characteristics, climate, regional and site geology, hydrogeology, surrounding land use, ecological communities and habitats, and historic data collection activities.
- Section 3.0 presents the Data Quality Objectives (DQOs) and Work Plan rationale, including for RI sampling activities and the approach for preparing the Work Plan. The Work Plan approach also describes how RI activities will satisfy data needs.
- Section 4.0 presents the Data Management Plan (DMP).
- Section 5.0 describes the Feasibility Study (FS) scope of work.
- Section 6.0 presents the anticipated project schedule for the scope of work.
- Section 7.0 identifies reference documents used in the development of this work plan.

2.0 INITIAL EVALUATION

2.1 Sheboygan River Characteristics

The Sheboygan River has been designated a Class C surface water by the WDNR. Class C surface waters are not designated as suitable drinking water sources; however, they are suitable for fishing and fish propagation. Class C waters are also designated for primary (e.g., swimming) and secondary (e.g., boating) contact recreation. The reach of the Sheboygan River that is to be investigated during the RI/FS is classified as a warm water sport fish community (WWSF). A WWSF community includes surface waters capable of supporting a community of warm water sport fish or serving as a spawning area for warm water sport fish.

The U. S. Army Corps of Engineers (U.S. ACE) maintains a navigation channel and turning basin within the river at an approximate depth of 21 feet, more than one mile downstream of the MGP site. According to U.S. ACE records, dredging activities in the Sheboygan River have not been conducted upstream of the 8th Street bridge, approximately 2,200 feet downstream of the Pennsylvania Avenue bridge and more than 2,700 feet downstream of the MGP site. Maintenance dredging of the Sheboygan harbor last occurred in 1991 and was approved by WDNR (Sheboygan River RAP). Dredged materials were disposed of south of the harbor as part of a beach nourishment project.

No dredging activities have been documented in the study area. NRT was unable to locate documentation of boat landing construction activities adjacent to the site.

The USGS information indicates that the Sheboygan River has a drainage area of 427 square miles (mi^2), with the headwaters being located in Fond du Lac County. Near the site, the river varies from approximately 130 feet (on either the east or west side of Boat Island) to 300 feet wide (just upstream of Boat Island) along the site. Boat Island is in the approximate center of the river resulting in an east and a west channel adjacent to the site. The river has an average flow of 653 cubic feet per second and flows to the east-southeast approximately 1 mile before entering Lake Michigan via the City of Sheboygan.

During the 1995 and 1996 sediment investigations, an assumed river water elevation of 582 feet msl was used as a datum for sediment poling activities. This elevation was based on the USGS topographic quadrangle which indicates the water level in Lake Michigan outside of the Sheboygan Harbor is approximately 580 feet msl. The river bed elevation ranges from approximately 571.7 to 580.0 feet msl based on the poling data. Water depths at the site ranged from approximately 2 feet to greater than 10 feet at the time of measurement in 1995 and 1996.

Flow of the Sheboygan River is generally easterly, toward the lake, but southerly past the site and is controlled by dams located at Sheboygan Falls and Kohler. The dams are located approximately between 10 and 14 miles upstream of the site. The USGS operated two automated stream gauging stations; one near Interstate Highway I-43 (currently operational) and the other near the river mouth (no longer in operation). The stream flow data discussed below was collected from Hydrologic Station # 040860041, located at "Sheboygan River at Mouth at Sheboygan, WI". The station is located over one mile downstream of the WPSC site, with conditions similar to those of the river at the site. The station is no longer in use.

Daily mean discharge data (cubic feet/second [cfs]) between October 1993 and September 1995 are summarized below:

Summary of Flow Conditions	Flow (cfs)	Date
Daily Average for 2 year Record	177	---
Daily Maximum for 2 year Record	1,440	Mar. 23, 1994
Daily Minimum for 2 year Record	32	Sept. 15, 1995

In addition, the monthly average stream flow for this period is summarized below:

Month	Average Stream flow Discharge (in cfs)	Month	Average Stream flow Discharge (in cfs)
January	2,517	July	1,953
February	5,932	August	2,307
March	18,009	September	1,500
April	12,280	October	3,818
May	6,377	November	3,941
June	2,415	December	3,722

For this study period, the information indicates March had the highest average daily flow rate (18,009 cfs) and that September had the lowest average daily flow rate (1,500 cfs). Water levels and stream flow in the Sheboygan River are hydraulically controlled by two dams located upstream of the MGP site near Sheboygan Falls and Kohler, Wisconsin. The variability in water levels and stream flow in the Sheboygan River is the result of both snowfall accumulation (and the resulting spring run-off) and precipitation during late spring/early summer in any given year.

The site is not within the 100-year floodplain which is Elevation 584 msl (Phase II Remedial Work Plan, NRT, April 17, 2000).

2.2 Climate, Geology and Hydrogeology

Site-specific geologic and hydrogeologic information was obtained, in part, during the upland field investigations performed by NRT from 1996 through 1999.

2.2.1 Climate

The site is located in eastern Wisconsin, which has a continental climate characterized by moderate winters and warm summers. Climate conditions for the Sheboygan area were gathered by Weather Station 477725 of the Wisconsin State Climatology office (http://www.aos.wisc.edu/~sco/). The weather station is located at latitude 43°45'N, longitude 87°43'W at elevation 648 in Sheboygan, Sheboygan County. The monthly average temperatures for the period of record 1971 through 2000 in the Sheboygan area are summarized in the table below.

Temperature Summary

Station ID: 477725 SHEBOYGAN, WI

1971-2000 Averages

Element	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
Max °F	28.6	33.0	42.0	52.7	64.7	75.6	81.4	79.7	71.9	59.4	45.0	33.1	55.6
Min °F	13.2	18.1	26.6	35.8	45.2	54.5	61.4	61.3	53.6	42.7	31.3	19.3	38.6
Mean °F	20.9	25.6	34.3	44.3	55.0	65.1	71.4	70.5	62.8	51.1	38.2	26.2	47.1

Annual precipitation averages approximately 31.90 inches per year with the average snowfall being 48.3 inches per year. The monthly average precipitation and snowfall rates for the period of record 1971 through 2000 are summarized in the tables below.

Precipitation Summary

Station ID: 477725 SHEBOYGAN, WI

1971-2000 Averages

Element	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
Precip (in)	1.76	1.33	2.25	2.99	2.90	3.28	3.19	4.08	3.29	2.51	2.43	1.89	31.90

Snowfall Summary

Station: 477725 SHEBOYGAN, WI

1971-2000 Averages

Element	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
Snow(in)	14.8	10.1	7.8	2.1	0.0	0.0	0.0	0.0	0.0	0.1	3.0	10.4	48.3

2.2.2 Regional Geology and Hydrogeology

Near surface geology of Sheboygan County consists of unconsolidated glacial drift comprised of unsorted till as ground and end moraines, outwash as sorted and stratified sand and gravel, and glacial lake deposits as organic materials and stratified clays, silt and sand. Low permeable soils are indicative of the high clayey tills and lake bed deposits which blanket the majority of the county. Moderate and high permeable soils are typically associated with the less clayey till, outwash and end moraine. The glacial drift is Pleistocene to Recent in age and ranges in thickness from 50 to 200 feet (Skinner and Borman, 1973).

Regionally, unconsolidated deposits in the area are generally less than one hundred feet thick (Skinner, 1973). Based on available logs for wells within approximately one-half mile of the site, unconsolidated deposits in the area range in thickness from approximately 50 to 95 feet.

Bedrock geology beneath the glacial drift consists of Silurian and Ordovician-aged sedimentary dolomite, shale and sandstone, and Cambrian sandstones overlying Precambrian crystalline rock. The Silurian-aged dolomite is generally undifferentiated and comprised predominantly of the Niagara Dolomite. This dolomite is fine to medium-grained containing sandy chert nodules. These dolomites lie approximately 100 feet below ground surface (bgs) in the Sheboygan County area and are approximately 750 feet thick.

Three aquifer systems exist beneath the site area and are (from shallowest to deepest): the sand and gravel, the Niagara, and the sandstone. Skinner and Borman's (1973) description of these units is presented below.

The sand and gravel aquifer in the site area consists of buried highly permeable glacial sand and gravel and is most significant where thicknesses are greater than 50 feet. Local glacial sands and gravel may yield significant amounts of water for local use. Thicknesses range from 0 to 300 feet. The top of this aquifer ranges from 0 to 140 feet bgs.

The Niagara aquifer is the principal aquifer overlying the Maquoketa Shale and consists of Silurian-aged dolomites approximately 300 feet thick. The majority of the aquifer is under artesian conditions due to the overlying confining clayey till. In areas where the clayey till is not present, the aquifer is hydraulically connected with the overlying sand and gravel aquifer. The main source of recharge for the Niagara aquifer is from infiltration through the sand and gravel aquifer or through the overlying glacial outwash and till. Natural discharge occurs into Lake Michigan, nearby rivers and through wells. The Niagara aquifer is used for local domestic wells.

The sandstone aquifer is approximately 600 feet thick beneath Sheboygan County and includes Ordovician and Cambrian units beneath the confining Maquoketa Shale and above the Precambrian crystalline rock. This aquifer is approximately 600 feet bgs, beneath Sheboygan

County (Skinner and Borman, 1973). Local use of the sandstone aquifer for drinking water is low to moderate.

2.2.2.1 Local Geology-Upland

Geologic cross sections prepared during the upland remediation FS are provided in Appendix D. The surface soil (upper one foot of soil) in the upland portion of the site is dominated by silty, organic, gravel-soil and fill material. Heterogeneous fill material sampled in the upper 4 to 14 feet of the Campmarina and right-of-way property contained a discontinuous mixture of clay, silt, and sand with minor amounts of gravel. Miscellaneous fill material was also present consisting of ash/cinders, ceramic, glass, bricks, concrete, and wood.

Predominately fine-grained (silty to clayey sand) native alluvium soils were encountered beneath the fill material, with discontinuous units of silt and clay. Organic soils to silt with organics were encountered at, or just below, the water table interface, possibly representing former flood plane or river sediment deposits. The alluvium soil extends to approximately 18 to 23 feet bgs across the site.

Beneath the alluvium deposits, silty to sandy clays (glacial till) are present to the base of all soil borings which extended from 25 to 35 feet bgs. The till appears to be laterally continuous across Campmarina and the right-of-way property, and is a low permeability, low to medium plasticity, silty clay with few sandier unconnected facies.

2.2.2.2 Local Geology-River

Surficial soft sediments in the Sheboygan River are dominated by organic material intermixed with silt and/or sand. The soft sediments are non-native, organic silt/clay units to organic sands that overlie the native silty to sandy clays (till) deposits. The upper silty or organic sediments ranged in thickness from approximately 4 to 50 inches. The soft sediment layer was encountered the entire length of the site and continues downstream past the Pennsylvania Avenue Bridge, which is located approximately 400 feet downstream of the southern properly line of the former MGP site boundary. Sediment thicknesses were not evaluated on the west side of Boat Island or a significant distance upstream of the site.

Underlying the soft sediments is native till soils, generally comprised of clay and silt soils with varying amounts of sand and gravel.

2.2.2.3 Local Hydrogeology

Historic groundwater elevation measurements are provided in Table 1. Existing groundwater monitoring well and piezometer locations, with the corresponding groundwater surfaces from April 15, 2003, are shown on Figure 2 and 3, respectively. Depth to groundwater at Campmarina ranges from approximately 5 to 7 feet bgs in shallow groundwater wells and approximately 13 to 17 feet bgs in the deeper groundwater wells. The shallow groundwater wells and the deeper groundwater wells are both screened in the upper unlithified material. Shallow groundwater wells are screened in the alluvium and deeper groundwater wells are screened in the till. Flow in the shallow groundwater is generally to the west-southwest, mimicking ground surface contours with a general flow direction toward the Sheboygan River. The deeper groundwater flow in piezometers screened from approximately 30 to 35 feet bgs indicate flow direction is also generally west-southwest.

Hydraulic conductivity testing in site wells was conducted by NRT on August 15, 1995. Baildown recovery test results were analyzed using the Bouwer-Rice method. This method yields hydraulic conductivity (K) estimates under unconfined aquifer conditions. Estimated K values in the shallow monitoring wells ranged from 2.5x10-5 feet/minute to 2.5x10-4 feet/minute (1.2x10-5 cm/sec to 1.2x10-4 cm/sec). The monitoring well results are generally consistent with published estimates for silty sand, silt, and glacial till (Freeze and Cherry, 1979). Hydraulic conductivity testing was not performed in the deeper groundwater monitoring wells.

Grain-size analyses were conducted by NRT in 1995 on soil samples collected for each monitoring well boring location. Samples for grain size analysis were selected from soil units which typically have higher hydraulic conductivities. The results indicate soils within the upper aquifer beneath the site are dominated by sandy silt and silty sand, but the mixture of sand, silt and clay varies over the site. Grain-size of the deeper soils where piezometers are screened consist primarily of silt and clay.

The average linear groundwater flow velocity was estimated using the estimated horizontal hydraulic gradient (i), hydraulic conductivity (K), and assumed effective porosity (ne) for saturated materials at the site (Freeze and Cherry, 1979). The effective porosity values for silty sands, silts, and glacial till are generally on the order of 15 to 25 percent. Groundwater velocity (v) is estimated as follows:

$$v = Ki/ne$$

Based on the minimum and maximum values for K, i, and ne, the calculated minimum and maximum values for horizontal shallow groundwater flow velocities at the MGP site is approximately 3 to 63 feet per year.

Horizontal groundwater gradients were calculated for the site based on water table groundwater contour lines and direction of flow, and these area summarized below.

- In August and October 1995, prior to remediation, the estimated groundwater gradients in the shallow groundwater ranged between 0.048 feet/feet and 0.063 feet/feet, respectively.

- In December 1998, the calculated shallow groundwater gradient ranged from approximately 0.046 feet/feet to the west to 0.078 feet/feet to the southwest. The deeper groundwater gradient was calculated to be approximately 0.074 feet/feet to the west-southwest (toward the Sheboygan River).
- In April 2004, the calculated shallow groundwater gradient inside the containment area was 0.02 feet/feet while the deeper groundwater gradient was about 0.045 feet/feet.
- Outside the containment area, in the wells along Water Street, the shallow groundwater gradient is approximately 0.053 feet/feet.

Vertical hydraulic gradients were also calculated for the three well nests (MW-701/PZ-701, MW-706/PZ-702, and MW-707/PZ-703) and the results are summarized on Table 1. Generally, an upward vertical gradient has been present at well nest MW-706/PZ-702 while downward gradients have been present at well nests MW-701/PZ-701 and MW-707/PZ-703. The gradients in all three well nest have ranged from slight to moderate (Table 1).

2.3 Surrounding Land Use

The County of Sheboygan includes approximately 514 square miles of area, with agricultural land use being the dominant classification. The population of Sheboygan County is approximately 112,646 people (2000 Census), with the majority of people residing in incorporated areas. The greatest concentrations of people are located in the City of Sheboygan, Sheboygan Falls, Kiel and the Village of Kohler (WDNR 1993).

The City of Sheboygan encompasses 14.5 square miles. The population base in Sheboygan is 50,792 (2000 Census). The City of Sheboygan has a mixture of agricultural, residential, and industrial land use, with residential use being dominant.

Alternative Programs School, Jefferson School, Longfellow Elementary School, Sheboygan Area District School, Sheridan Elementary School, and Trinity Lutheran School are located within one-half mile of the former MGP site. There is a public park, Riverside Park, located at the site of the former MGP, condominiums to the south, and a boat house to the north as discussed in Section 1.1.

2.4 Ecological Communities and Habitats

As previously described, this section of the Sheboygan River is a warm water sport fish community. Findings from previous studies (Fago 1985, WDNR 1995) include the following:

- The fishery consists of smallmouth bass, walleye, northern pike, crappie, channel catfish, rock bass, and assorted panfish. Smallmouth bass dominate the sport fishery in this segment. Tolerant forage species include common carp, common shiner, sand shiner and bluntnose minnow. This segment also exhibits seasonal runs of salmon and trout.
- Macroinvertebrate collections made during pilot studies at the Tecumseh site (located approximately 10 miles upstream of the former MGP site) of the Sheboygan River and Harbor Superfund investigation in 1992 (BB&L), showed the Hilsenhoff biotic index (HBI) values of 5.155 for that segment of the Sheboygan River representing "fair" water quality with fairly substantial organic pollution. The river segment was dominated by the hydropyschid caddisfly Cheumatopsyche sp.

A fish and waterfowl consumption advisory was issued for Sheboygan River in the vicinity of the site in 1998 (WDOH &WDNR 1998).

2.5 Historic Data Collection Activities

To address concerns relating to sediments in the Great Lakes, Annex 14 of the 1978 Great Lakes Water Quality Agreement between the United States and Canada (amended in 1987) stipulates that cooperating parties identify the nature and extent of sediment impairment in the Great Lakes, and remediate those areas assessed as impairing beneficial/healthy utilization of the lakes and tributaries. Since that time, 43 Areas of Concern (AOCs) identified in the agreement, including the Sheboygan River, have undergone investigation toward a river-specific Remedial Action Plan (RAP). The Sheboygan River AOC includes the lower Sheboygan River downstream from the Sheboygan Falls Dam, including the entire harbor and near shore Lake Michigan. The MGP site is located within this area (Figure 1). In 1995, WDNR published the Sheboygan River Remedial Action Plan - A Plan to Clean Up Sheboygan Area Rivers and Harbor (Sheboygan River RAP).

The Sheboygan River RAP included problem identification, sources of pollution, goals and objectives, and recommendations to reach the goals. The Sheboygan River RAP identified point and non-point sources of several compounds of concern within the river. According to the Sheboygan River RAP, approximately 600 general and 150 specific WPDES permits have been issued to industries along the Sheboygan River. The City of Sheboygan has approximately 45 storm water runoff outfalls, which discharge directly into the Sheboygan River. Specific point sources of environmental concern included the following:

- Tecumseh Products Company;
- Kohler Company & Landfill Superfund Site;
- Thomas Industries;
- Diecast Corporation;

- C. Reiss Coal Company; and,
- WPSC Former MGP Site.

2.5.1 Blasland, Bouck & Lee, Inc. 1987

In May and September 1987, Blasland, Bouck & Lee, Inc. (BBL) conducted sediment sampling for PCBs and metals in relation to the Sheboygan River and Harbor Superfund Investigation. Fifteen (15) sediment samples were collected along the length of the river, with 10 samples being collected above the Pennsylvania Avenue bridge and 5 samples downstream of the bridge, during the Superfund investigation.

A number of sediment samples were collected near or just downstream of the MGP site (sample locations are provided in Appendix E). Three samples, R-98, R-100, and H-20, were observed to have oil or analyzed to have concentrations of polynuclear aromatic hydrocarbons (PAHs) in the sediments. Sample R-98 was collected near the downstream end of Boat Island and the sediment was described as "oil saturated" from 2 to 6 feet below the sediment surface. Sediment samples R-100 and H-20 were collected immediately downstream of the Pennsylvania Avenue bridge. Sample R-100 was described as "oil saturated" from 4 to 6 feet below the sediment surface; however, neither sample R-98 nor R-100 were analyzed for PAHs. Sample H-20 had a total PAHs concentration of 70 mg/kg. There was no mention of elevated PAHs downstream of sample location H-20 and no mention of oil saturated sediments was noted for samples R-99 and R-101, collected on the far side of Boat Island, opposite the MGP site. WDNR summarized the need for characterizing the extent of PAH sediment concentrations in a memorandum dated August 20, 1992. Excerpts from the memorandum are included in Appendix E.

2.5.2 WDNR 1995

In February 1995, WDNR collected one sediment sample adjacent to the MGP site, approximately 20 to 30 feet from the shoreline close to the downstream end of Boat Island. This sample, collected from 34 to 39 inches below the sediment surface, contained apparent coal tar and was analyzed for PAHs. The results indicated that total PAHs exceeded 3,000 mg/kg.

2.5.3 NRT 1995

During October 1995, NRT performed an initial sediment investigation to determine the absence/presence of MGP residuals in the surficial soft sediments (unconsolidated non-native material). The study indicated the presence of benzene, toluene, ethylbenzene, and xylenes (BTEX) and PAHs in sediments in the Sheboygan River adjacent to, and downstream of, the on-land portion of the site.

The sample collection and screening methods used were those described in the Sediment Sampling Work Plan, Former Sheboygan II Manufactured Gas Plant Site, Sheboygan, Wisconsin (NRT, August 1995). NRT conducted the initial sediment sampling with a manually driven Ogeechee™ corer and a Ponar™ grab dredge sampler. The longest sediment core collected using the Ogeechee™ corer was approximately 30 inches long, while the Ponar™ grab dredge sampler typically collects the top 6 inches of sediment. Six transects, consisting of 22 locations, were completed. These transects were identified as T701 through T706 and the sampling locations were labeled SD-701A through SD 706C (see Sheet 3).

The following is a summary of field observations from the initial investigation:

- All 6 sediment sample transects showed indications of either odor or tar. Sediment samples SD-702 A & B and SD-703A (Sheet 3) exhibited odors in sediments recovered in the hand-core samples. The samples were located within 25 feet of the shoreline.

- Sediment samples SD-701A, SD-703B, SD-704 A & B, SD-705 A, B, & C, and SD-706B (Sheet 3) all exhibited coal tar in sediments recovered in the hand-core samples, or on the sounding pole (used to evaluate the depth of sediments present at a given location). These samples were within 20 feet of the shore at SD-701 and within 60 feet of the shore at SD-704 and SD-706. In transects T703 and T705, tar was noted 70 feet and 100 feet, respectively, out from shore.

2.5.4 NRT 1995/1996

Following the October 1995 presence/absence study, NRT conducted more detailed field investigation in November 1995 and June 1996 to evaluate the distribution of MGP constituents and sediment characteristics. A summary of the field investigations, results, and recommendations is provided in the Sediment Investigation Report (NRT, November 1998). A vibrocore sediment collection technique was used to collect the sediment samples. Twelve transects were selected at locations starting approximately 375 feet upstream to approximately 900 feet downstream of the former MGP site (Sheet 2 and 3). The transects used in the 1995 investigation were overlapped and extended. These transects were identified as T701 through T712 and the sampling locations were labeled SD-701BV through SD-712BV. The transects did not extend past Boat Island to the river channel opposite the site.

The following is a summary of findings from the November 1995 and June 1996 field investigations:

- Numerous sediment cores exhibited tar, sheen, or odors within 125 feet of the shoreline, as shown on Sheet 3. Visual observations of tar, sheen, or odors extended approximately 1,300 to 1,600 feet along the shore beginning approximately 90 feet upstream of the former WPSC site boundary, along the site (approximately 580 feet) and extending approximately 900 feet downstream of the former WPSC site boundary.

- Field observations suggest that there has been little river scour through certain sections of this segment of the river. These field observations indicate that there is a thin layer where the tar is located within one-foot of the sediment surface. Further downstream, past Center Avenue extended (i.e., approximately the southern property line of the former Campmarina), the tar is deeper than 2 feet below the sediment surface.

- The sediment core logs indicate that there is an approximate 2 to 4 foot thick layer of non-native soft river bottom sediments, including silt, sand, and organic material. This layer did not exhibit aquatic plants at any of the sample locations. This soft upper layer is underlain by native glacial sediments, characterized by silty sands and the red brown clay till.

- Laboratory analytical results indicate the greatest concentrations of total PAHs occur in shallow sediments at locations SD-702BV, SD-702CV, SD-704BV, and SD-705BV, located within approximately 60 feet of the shoreline. Based on the depth to tar over much of the area, the constituents of concern do not appear to have migrated vertically; rather, the results suggest that the constituents of concern may have been buried by other non-native sediments deposited since MGP operations ceased.

- Elevated concentrations of BTEX co-occur with elevated concentrations of total PAHs. Concentrations of PCBs, metals, cyanide, and phenol in the sediments at the site are relatively low compared with the PAH levels. An analytical summary is provided in Table 2 (PAHs), Table 3 (BTEX) and Table 4 (metals, cyanide, PCBs, phenol, oil and grease, and TOC).

2.6 Current Status

2.6.1 River Characteristics

River characteristics (flow, depth, and topography) are anticipated to be similar to conditions in 1995/1996. Boat Island and the shoreline adjacent to the site maintain dock access for recreational boating. There is a potential for people to wade in the river during summer months. Fish advisories are posted for the lower portion of the Sheboygan River.

2.6.2 Chemical Constituents in Upland Area Soil

Chemical constituents in the upland area soils have been remediated and approved by the WDNR as part of an operable unit. Reports and correspondence summarizing these activities include:

- 1999, May 7, Natural Resource Technology, Inc., Feasibility Study Campmarina, Former Coal Gas Facility, Wisconsin Public Service Corporation, Sheboygan, WI, Project No. 1313;
- 2000, April 17, Natural Resource Technology, Inc., Phase II Remedial Work Plan, Campmarina and Center Avenue Right-Of-Way, Former Coal Gas Facility, Sheboygan, Wisconsin, Project No. 1313; and,
- 2000, November 2, Natural Resource Technology, Inc., Letter to Mr. John Feeney (Wisconsin Department of Natural Resources), Addendum to Remedial Work Plan, Phase I Excavation and Grading Former Coal Gas Facility, Wisconsin Public Service Corporation Campmarina and Center Avenue Right-of-Way, Sheboygan, Wisconsin, Project No. 1313.

2.6.3 Chemical Constituents in Groundwater

Results of the most recent rounds of groundwater monitoring are summarized in Table 5 (BTEX and cyanide) and Table 6 (PAHs). Sheet 1 provides the well locations. A complete summary of the current status of chemical constituents in the upland area groundwater and subsequent remediation is provided in the *2003 Annual Operation, Maintenance, and Monitoring Report*, Former Wisconsin Public Service Corporation Manufactured Gas Plant Site, Campmarina and Center Avenue Right-of-Way, Sheboygan, WI, prepared by NRT (December 2003).

Concentrations of BTEX, total PAHs, and dissociable cyanide in the shallow monitoring wells (MW-05, MW-708 and MW-709) located outside the containment barrier are below their respective NR 140 Preventive Action Limits (PALs). Concentrations of these constituents in deeper wells within the containment barrier (PZ-701 and PZ-702) remain stable, with only benzene and naphthalene above their respective NR 140 Enforcement Standards (ESs). BTEX and total PAH concentrations in PZ-703 (deeper well located within the containment barrier) exhibit an increasing trend since 1998, with benzene, ethylbenzene and naphthalene exceeding the enforcement standard.

2.6.4 Chemical Constituents in Sheboygan River Sediments

A summary of the analytical results from the 1995 and 1996 sediment sampling events are provided in Table 2 (PAHs), Table 3 (BTEX) and Table 4 (metals, cyanide, PCBs, phenol, oil and grease, and TOC). Sample locations are provided on Sheet 3 along with a distribution of BTEX and total PAHs.

The highest concentrations of BTEX co-occurred with the samples that also had the highest PAH concentrations. Laboratory results from the 1995 and 1996 site investigations indicate relatively low concentrations of PCBs, RCRA metals, cyanide, and phenol.

Based on the BTEX and total PAH analytical laboratory results, the highest concentrations of these parameters were present in the lower sediment of cores SD-702BV, SD-702CV, SD-704BV, and SD-705BV (Sheet 3 and Tables 2 and 3). These sediment cores are all located adjacent to, and just downstream of, the site. The depths at which these samples were collected ranged from 27 to 102 inches below the sediment surface. The deepest occurrences of tar are present in transects T704 and T705.

Visual observations indicate tar, sheen, and odors extend approximately 900 feet downstream of the former WPSC site; however, the analytical results from sediment sample SD-711AV indicate constituents of concern may have migrated approximately 580 feet downstream. BTEX and total PAH concentrations in samples downstream of transect T705 (approximately 450 feet upstream of transect T711) are significantly lower than the concentrations reported in samples from

transects T702, T704, and T705, immediately adjacent to the site. Additionally, the results indicate that sediments exposed to MGP residuals, especially downstream of transect T705, are buried below other non-native sediment. Sediment samples collected upstream of the MGP site (from SD-708AV & BV and SD-709AV), and approximately 900 feet downstream (SD-712AV and BV) of the MGP site, did not exhibit elevated BTEX or total PAH concentrations.
Three samples were submitted for laboratory analysis of PCBs and RCRA metals (Table 4). Neither PCBs nor metals are directly attributable to coal-gasification activities and neither is a coal gas by-product.

The PCB concentrations detected in three sediment samples from the site ranged from 0.42 mg/kg to 2.3 mg/kg. PCB concentrations detected upstream of the MGP site as part of the Sheboygan River and Harbor Superfund Project (Sheboygan River RAP, 1995) ranged between non-detect (ND) up to 4,500 parts per million (ppm) (WDNR 2000). The Record of Decision (ROD) issued in May 2000 by WDNR indicates a major component of the selected remedy is to achieve a soft sediment surface-weighted average concentration (SWAC) of 0.5 mg/kg for PCBs in the lower Sheboygan River.

Samples analyzed for RCRA metals indicate generally low levels of these constituents were present in sediment samples collected from locations where animal hair (suspected tannery waste) was present (Table 4). Concentrations of chromium and lead were detected ranging from 7.4 to 500 mg/kg and 28 to 140 mg/kg, respectively.

Thirteen sediment samples were analyzed for total cyanide, weak acid dissociable cyanide, and phenol in October and November 1995. There was no evidence of blue/black sheen and/or blue black wood chips observed in the sediments. The total and weak acid dissociable cyanides were detected in 5 of 13 sediment samples. Phenol was present in only 4 of 13 sediment samples. The low levels of cyanide and phenol detected during the investigation suggest that these compounds are not a concern in sediments at the site.

2.6.5 Chemical Constituents in Sheboygan River Surface Water

Surface water chemistry data for conventional pollutants (i.e. nutrients, solids, bacteria, etc.) have been collected on a nearly monthly basis in the Sheboygan River at the Esslingen Park sampling location by the WDNR since 1977. Esslingen Park is located approximately 1.5 miles upstream of the Former MGP site. Galarneau (1996) conducted a trend analysis for water quality parameters measured at Esslingen Park for the period from 1977 through 1994. Suspended solids, total phosphorus, dissolved phosphorus, ammonia, nitrate plus nitrite, chlorides, and fecal coliform bacteria, were collected fairly consistently over the study period. Water quality data collected from the Sheboygan River at Esslingen Park show downward trends in total phosphorus, dissolved phosphorus, nitrate plus nitrite, and fecal coliform bacteria. Chlorides display an upward trend over the same period.

3.0 DATA QUALITY OBJECTIVES AND WORK PLAN RATIONALE

3.1 Acceptance or Performance Criteria

Acceptance or performance criteria specify the quality of data required to support decisions regarding remedial response activities. Acceptance or performance criteria are based on the data quality objectives discussed in the following sections.

3.2 Overall Project Objectives and Decision Statements

The RI/FS will supplement existing data as necessary to assess risk to human health and ecological receptors and to define chemical constituent migration pathways. The objectives of the RI/FS are determined using the seven step process defined in *Guidance for the Data Quality Objectives Process* (EPA QA/G-4, August 2000). The Data Quality Objectives will, at a minimum, reflect the use of analytical methods for identifying and addressing contamination consistent with the *National Contingency Plan*, 40 CFR Part 300 (NCP), the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA), as amended by the *Superfund Amendment and Reauthorization Act of 1986* (SARA), and guidance as provided in Contract SF-91-04.

3.2.1 Step 1 Problem Statement

The planning team members and their respective roles in the project are identified in Section 2.0 and Figure 1 of the QAPP (Appendix A of this Work Plan).

As described in detail in Section 2.5.3 of this Work Plan, an initial sediment investigation (presence/absence study) conducted in October 1995 by NRT indicated the presence of BTEX and PAHs in Sheboygan River sediments adjacent to, and downstream of, the former MGP site. Additional sediment samples were collected in November 1995 and June 1996 as described in Section 2.5.4. These soil borings indicate there is an approximate 2 to 4 foot thick layer of non-native soft river sediments, including silt, sand, and organics. The soft upper layer is underlain by native glacial sediments, characterized by silty sands and red-brown clay. Degraded coal tar was identified in surficial sediments (0 to 2 feet below top of sediment) adjacent to the MGP site, and in an area approximately 900 feet downstream of the site, approximately 50 to 125 feet from the shore.

The Problem Statement for this remedial investigation (RI) and feasibility study (FS) is as follows:

To determine the current nature and concentrations of selected site-specific chemicals of potential concern (COPCs) in sediment and surface water media that may present risks to human health and the environment, which would therefore warrant further evaluation or action.

The Campmarina MGP site is within the Sheboygan River and Harbor Superfund Site (EPA ID# WID980996367). The Superfund Site is primarily concerned with polychlorinated biphenyls (PCBs) in sediments. In contrast, the Campmarina MGP site is primarily concerned with BTEX and PAHs within a limited area (Sheet 4). To the extent practical, the evaluation methods for the Campmarina MGP site will be consistent with those of the larger Superfund Site.

3.2.2 Step 2 Decision Identification

The RI/FS results will provide data to assess risk to human health and ecological receptors and to define potential chemical constituent migration pathways. The objectives of the RI/FS are to determine the nature and extent of chemical constituents in the sediments that pose a risk to ecological and human health adjacent to the former Campmarina MGP. Overall objectives to be achieved by the RI/FS are:

- Determine the nature and extent of chemical constituents in soft sediment and surface water adjacent to the site;
- Collect sufficient data to support an ecological risk and human health assessment;
- Identify and quantify potential ecological risks and human health posed by COPCs;
- Identify affected soft sediment that is available to the benthic community and a source to the water column;
- Estimate the volume of soft sediment which exceed chemical concentrations estimated to adversely affect ecological risk and human health;
- Collect sufficient data to develop and evaluate remedial action alternatives to address environmental affects to site soft sediment and surface water, if appropriate; and,
- Develop and analyze alternative remedial approaches, if appropriate, that comply with the National Contingency Plan (NCP).

The areas of concern may be altered depending on activities conducted as part of the PCB Superfund Site. Affected sediment from the MGP site that is overlain with sediment contaminated with PCBs may be considered stable at the present time.

3.2.3 Step 3 Decision Inputs

The RI/FS objectives will be met through characterizing (i.e., visual, field measurements, etc.) and collecting additional sediment and water column samples for analysis of BTEX, PAHs, metals, cyanide, PCBs, percent solids, total organic carbon (TOC), and carbon soot. Select samples will be used to correlate chemical concentrations with adverse affects on the benthic community. In addition, select samples will also be evaluated for geotechnical parameters including Atterberg limits, grain size, organic content, specific gravity, and moisture content. The Sampling and Analysis Plan (SAP), provided in Appendix B of this Work Plan, provides sample collection devices, types, frequencies, and analytical methods. An analytical summary is provided in Table 9 of this Work Plan. Analytical data will comply with the requirements of the QAPP. Existing data will be qualitatively used to identify areas which require additional sampling locations, as well as compare previous sample results with the current conditions.

3.2.3.1 Ecological Risk Assessment

Analytical results of non-native soft sediment samples from 0 to 6 inches below the top of sediment will be used in a screening level ecological risk assessment (SLERA). Recommendations for remedial action and remediation action levels will be determined based on results of ecological risk and human health assessment models. The SLERA will determine whether a full baseline ecological risk assessment is required. The SLERA will be performed as follows:

- *Ecological Risk Assessment Guidance for Superfund (ERAGS): Process for Designing and Conducting Ecological Risk Assessments, Interim Final*, EPA/540/R-97/006, USEPA, Environmental Response Team, Edison, NJ, 1997; and,
- *Wildlife Exposure Factors Handbook, Volume I,* EPA/600/R-93/187a, USEPA, Office of Research and Development, Washington, D.C., 1993.

For each complete exposure pathway, a screening ecotoxicity value will be selected or derived in accordance with the ERAGS (USEPA, 1997). The ecotoxicity value will represent a concentration of dose that is a conservative threshold for adverse ecological effects. Maximum site concentrations in sediment and surface water will be compared to the selected screening ecotoxicity values. If a constituent does not have an ecotoxicity value, one will be derived, using methods consistent with the following guidance:

- *RCRA Ecological Screening Levels*, USEPA Region 5; August 2003;
- *Equilibrium-Partitioning Sediment Benchmarks (ESBs) For The Protection of Benthic Organisms*, EPA/600/R-02-013, USEPA, 2003; and
- *National Water Quality Criteria*, EPA-822-R-02-047, USEPA, November 2002.

Most MGP related constituents are not substantially bioaccumulated up the food chain; therefore, threats will be greatest in areas where benthic (bottom-dwelling) and water column organisms are exposed to relatively high concentrations of contaminants in sediment or surface water. The site-specific ecological risk assessment of the Sheboygan MGP site will be designed to quantitatively characterize threats to the most sensitive receptors, receiving the highest exposures to MGP related contaminants.

The ecological risk assessment will focus on benthic invertebrates that inhabit the sediment as these relatively immobile organisms are sensitive receptors that are likely to be exposed to sediment associated with MGP residuals. Fish are also likely to be exposed to sediment associated with MGP residuals at the site; however fish are more mobile which reduces the exposure in comparison to benthic organisms. Site-Specific Equilibrium-Partitioning Sediment Benchmarks (ESBs, USEPA, 2000, 2002) and direct sediment toxicity testing will be developed to identify areas of the site in which MGP residuals are not expected to cause adverse effects to organisms.

To develop the draft ESBs for PAH mixtures, USEPA used an existing data set on the acute toxicity of PAHs in water-only exposures to estimate a final chronic value (FCV) that is expected to be protective of 95% of the species tested (USEPA, 2002, DiToro and McGrath, 2000). Under the assumptions of equilibrium partitioning and the target lipid model, the FCV is used to determine the corresponding critical concentrations of individual PAHs in other phases (i.e., sediment organic carbon). The ESB approach calculates an "equilibrium-partitioning sediment benchmark toxic unit (ESBTU) for each PAH as the concentration of the PAH in the site sediment sample divided by the critical concentration for the particular PAH. If the sum of the toxic units for total PAHs in the sediment of porewater (referred to as SUM-$ESBTU_{TOT}$) is less than or equal to 1.0, the concentration of the mixture of PAHs in the sediment is acceptable for the protection of benthic organisms from chronic effects.

USEPA recognizes that the national ESBs may be overprotective at some sites if the characteristics of the sediment inhibit the partitioning of PAHs from sediment to porewater and tissue. Adsorption of PAHs to soot or "black carbon" in sediment has been shown to reduce the partitioning of PAHs and is expected to reduce associated bioavailability and toxicity. The USEPA Bioavailablity Procedure, described in draft version of *Procedures for the Derivation of Site-Specific Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic Organisms: Nonionic Organics,* (USEPA, 2003), assumes that the bioavailable concentration of PAHs in sediment can be estimated from the "freely-dissolved" concentration in the interstitial water. The bioavailable fraction can be used to develop a site-specific ESB to replace the national ESB. Concentrations of black carbon (soot) will be measured in sediment for used in a partitioning model to estimate the fraction of PAHs in sediment that is bioavailable at the site.

The need for a full baseline ecological risk assessment will be determined based on the results of the SLERA. If parameters are detected for which comparative screening values are not available, the risk assessor shall use CBSQGs and best professional judgment in making recommendations for further evaluation. Factors to be considered will include frequency of detection, concentration, bioavailability or presence of chemical form that can affect organisms; potential for bioaccumulation or bioconcentration; toxicity characteristics and potency.

3.2.3.2 Human Health Risk Assessment

The human health risk assessment (HHRA) will be performed in accordance with EPA guidance using non-native soft sediment samples between 0 to 2 feet below the top of sediment to provide a quantitative assessment of the potential for adverse health effects that may result from exposure to COPCs at the site. The HHRA will comply with the following guidance documents:

- *Risk Assessment Guidance for Superfund (RAGS), Volume 1 - Human Health Evaluation Manual, Part A,* Interim Final, EPA 540/1-89/002, USEPA, December 1989;
- *Risk Assessment Guidance for Superfund (RAGS), Volume 1 - Human Health Evaluation Manual, Part D, (Standardized Planning, Reporting, and Review of Superfund Risk Assessments),* Final, USEPA, December 2001;
- *Risk Assessment Guidance for Superfund (RAGS), Volume 1 - Human Health Evaluation Manual, Part ED, (Supplemental Guidance for Dermal Risk Assessment),* Interim, EPA/540/R/99/005, USEPA Office of Emergency and Remedial Response, Washington, D.C., September 2001;
- *Memorandum from Administrator Carol M. Browner to Assistant Administrators, Associate Administrators, Regional Administrators, General Counsel and Inspector General on March 21, 1995,* EPA Risk Characterization Program, USEPA Office of the Administrator, Washington, D.C., March 21, 1995; and,
- *Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites, OSWER 9285.6-10,* USEPA, Office of Emergency and Remedial Response, Washington, D.C., December 2002.

Chemicals of potential concern (COPCs) will be retained for further evaluation in the risk assessment. COPCs will be selected by comparing maximum concentrations detected in exposure media to *Preliminary Remediation Goals (PRGs) Tables*, EPA Region IX, 2002 (www.epa.gov/Region9/waste/sfund/prg/index).

Maximum concentrations will be screened against the lower of either the cancer-based PRG or one-tenth of the non-cancer-based PRG. These maximum concentrations also will be compared to regulations that may be "applicable or relevant and appropriate requirements" (ARARs) to remediation of the site.

Chemicals with no PRGs or ARARs (i.e., no toxicological or regulatory basis for considering or not considering in an assessment) will not be retained as COPCs. However, these constituents will be qualitatively discussed in the HHRA. The discussion will acknowledge the presence, potential toxicity, and implications for not quantifying risk from these constituents. If these constituents are detected at very high concentrations, methods to evaluate the toxicity may be proposed (i.e., development of toxicity values).

In accordance with EPA RAGS Part A, selection criteria for COPCs at the site may include the following:

- Frequency of detection in medium and attainment of reporting limits (RLs); Chemicals not detected in any sample will not be included as a COPC in that medium;
- Historical site information/activities; Chemicals with detection frequencies less than 5% that are not expected to be present based on historical data or other site-specific information will not be included as COPCs;
- Sample chemical detections relative to blank chemical detections; and,
- Chemical concentration relative to upgradient and background concentrations and risk-based screening criteria.

Exposure scenarios will be developed for each identified exposure pathway. Exposure assumptions used in daily intake calculations will be based on information contained in EPA guidance, site-specific information, and professional judgment. Exposure factor assumptions will generally consist of upper-bound values which represent the reasonable maximum exposure (RME). A central tendency (CT) evaluation will be performed if the estimated cancer risks exceed the acceptable risk range of 1x10-6 to 1x10-4 and the hazard index is greater than 1.0

3.2.4 Step 4 Investigation Boundaries

The investigation will be limited to sediment samples and surface water samples adjacent to, and downstream of, the former MGP as shown on Sheet 4. Sample volumes necessary for analyses will be dictated by the analytical and toxicity testing laboratories and will be provided in the SAP. Sediment samples will be collected using piston-type coring devices, a Ponar dredge or similar methods. The samples for laboratory analyses will be selected from discrete depth intervals. Surface water will be sampled using a grab sampling device (e.g., Niskin bottle) or integrator (e.g., ISCO sampler) at established locations. Field operating procedures (FOPs) for sediment and surface water sampling collection are included as Attachment 1 in the SAP, Appendix B and summarized on Table 10 of this Work Plan.

3.2.5 Step 5 Decision Rules

Synoptically-collected sediment samples will be subject to toxicity testing and chemical analysis for COPCs to determine the concentrations that cause effect to benthic organisms. If the chemical concentrations of COPCs exceed calculated site-specific risk values, further evaluation or remedial action will likely be warranted. If the chemical concentrations of COPCs do not exceed the calculated site-specific risk values, there will be no need for remedial actions at the MGP site.

3.2.6 Step 6 Decision Error Limits

The sampling design errors will be minimized to the extent possible by collecting representative samples that reflect the variability in sample population for risk assessment. Sampling collection and measurement decision errors will be minimized by following the FOPs provided in Attachment 1 of the SAP, Appendix B of this Work Plan, and documenting field activities that deviated from the FOPs. Similarly, laboratory analyses will follow the standard laboratory procedures and quality control/quality assurance (QA/QC) samples will be collected to identify errors associated with sample collection and analyses. Finally, analytical data from Phase I and II will be validated by a third party data validator to ensure data usability and facilitate data reduction in accordance with the QAPP included in Appendix A of this Work Plan.

3.2.7 Step 7 Optimizing Design

The most cost-effective sampling approach to achieve the objectives of the RI/FS is to complete bathymetric surveys and collect soft sediment samples based on previous investigation results.

For ecological risk assessment, soft sediment samples from 0 to 6 inches below the top of sediment will be collected and analyzed using a mobile laboratory as a screening tool to verify a range of chemical concentrations. Select samples will be evaluated for toxicity analysis and chemical constituents in a fixed-base laboratory for use in calculating the ecological site-specific risk values for chemicals of concern (COCs). Porewater concentrations will be estimated in accordance with Derivation of Site-Specific Equilibrium Partitioning Sediment Guidelines (ESGs) for the Protection of Benthic Organisms: Nonionic Organics.

For human health risk assessment, soft sediment samples from 0 to 2 feet below the top of sediment will be collected and analyzed in a fixed-base laboratory for use in calculating the human health site-specific risk values for COCs. Sample results from the ecological risk assessment will also be included in the human health risk database.

Surface water samples will be collected and analyzed in a fixed-base laboratory during Phase I for use in the ecological and human health risk assessments.

After the site-specific risk values are calculated, additional cores will be advanced in a second sampling phase through unconsolidated material to refusal (the top of consolidated sediments) using vibrocore techniques to delineate the nature and extent (lateral and vertical) of affected sediments within the river. To minimize costs, each 1 foot interval of the cores will be analyzed in the mobile laboratory. A split sample from approximately 5% of the samples analyzed in the mobile laboratory will also be sent to a fixed-based laboratory. This process will eliminate the need for any post-remediation confirmation sampling as the mobile laboratory will be fully certified and able to provide defensible data packages. Analytical data packages will be validated by a third party data validator to ensure data usability and facilitate data reduction in accordance with the QAPP included in Appendix A of this Work Plan. Approximately 5 percent of the samples analyzed in the mobile laboratory during Phase II will be submitted to a fixed-base laboratory for QA/QC.

The SAP, provided in Appendix B of this Work Plan, has been developed to maximize the project objectives and usability of the data. Conditions in the field (e.g., inability to access a sampling location) or data validation may limit useable data. Corrective action to identify, recommend, approve, and implement measures to counter unacceptable procedures, or out of quality control performance than can affect data quality, are addressed in Section 13.0 of the QAPP, included as Appendix A of this Work Plan.

3.3 Project Approach

An integrated approach toward characterizing the nature and extent of potential affects to human health and the environment will be utilized during the RI/FS. Site characterization data obtained through previous investigative activities will be qualitatively utilized to assist with designing the

RI sampling activities, as appropriate. Analytical data derived from the investigation of the site will be incorporated into the development of a human health risk assessment and ecological risk assessment. Data from the RI/FS will be evaluated qualitatively and statistically. A technical memorandum presenting the exposure scenarios and assumptions and recommendations of the risk assessments will be prepared and submitted to the WDNR.

The RI/FS field activities will include the following:

River Characteristics

- Perform multi-beam sonar (bathymetry), sub-bottom profiling (sediment thicknesses), and side scan sonar (identify sediment transition zones, evaluate river bottom elevation and identify potential debris or other manmade materials) that may obstruct investigation activities and remediation, if necessary.

Sediment

- Collect and analyze sediment samples from the Sheboygan River. Sediment sampling will be conducted in two phases. The first phase is primarily to calculate a site-specific risk value. The second phase is to further characterize sediment concentrations and the nature of soft sediment.

- The first sampling phase will confirm the results of the sub-bottom profiling through poling along transect locations and will calculate a site-specific risk value protective of ecological and human health.

  The first sampling phase will collect soft sediment samples from 0 to 6 inches below the top of soft sediment to evaluate the chemical characteristics and the corresponding toxicity to assess the ecological risk. A mobile laboratory will be used to identify samples which represent total PAH concentrations spread over a range of approximately 10 ppm to 1,000 ppm. Samples within this range will be submitted to a fixed-base laboratory for analysis of BTEX, PAHs, metals, cyanide, PCBs, percent solids, TOC, black carbon (soot), and grain size. A portion of the sample will also be used in toxicity testing. The Hyallella (amphipod) 28-day test will be used to evaluate the toxicity of whole sediments in accordance with USEPA protocols. This species is a relatively immobile benthic organism inhabiting the sediment.

The first sampling phase will also collect additional soft sediment composite samples from 0 to 2 feet below the top of soft sediment to evaluate the chemical concentrations for the human health risk assessment. Samples will be submitted to a fixed-base laboratory for analysis of BTEX, PAHs, metals, cyanide, PCBs, percent solids, TOC, and grain size.

- The second sampling phase will further characterize sediment concentrations and the nature of sediment.

  The second phase of sampling will consist of sediment cores advanced using vibrocore techniques to refusal, generally the top of consolidated sediment. Sediment cores will be subdivided into 12-inch intervals, and each interval sample will be composited and analyzed by a mobile laboratory for the COCs identified in the risk assessments. Cores which exhibit evidence of tar or sheen in all intervals may not be analyzed as these cores are assumed to be included in a remedial option. Each interval in cores without visual evidence of tar or sheen will be analyzed for COCs to characterize concentrations in sediment.

  In addition, at approximately every fifth core location, a dedicated core will be collected and analyzed for geotechnical parameters including shear strength (field measured), Atterberg limits, grain size, organic content, specific gravity, and moisture content. Geotechnical samples may be discrete intervals, or composite samples, depending on the conditions observed.

Surface Water

- Determine the surface water elevation adjacent to the site in the Sheboygan River.
- Collect and analyze surface water grab samples from Sheboygan River during Phase I sediment sampling for PAHs, total and dissolved metals, and total and dissolved cyanide. Each surface water sample will also be measured in the field for temperature, pH, dissolved oxygen, specific conductivity, and turbidity.

Tables 7 and 8 provide the analytical methodology and project quantitation limits for the ecological and human health risk assessments, respectively. Laboratory method detection limits will be provided prior to field activities. A preliminary summary of the analytical program for the site is provided in Table 9 and discussed in the QAPP and SAP included in Appendices A and B, respectively, of this Work Plan.

4.0 DATA MANAGEMENT PLAN

The data management plan describes the process for management of data and information collected during the remedial investigation and feasibility study (RI/FS). The plan outlines the procedures that will ensure the quality and integrity of the data collected during the RI and includes the disposition of data and special data handling procedures. Specific data documentation protocols are detailed in the Quality Assurance Project Plan (QAPP), included in Appendix A of this report.

Two data types are associated with the investigation. The first is technical data that are required for, or generated by, specific investigative tasks. These data include field observations, laboratory analytical results, geotechnical testing results, and validation data. The second data type includes information associated with resulting work products which includes, but is not limited to, calculations, charts, tables, drawings, the written reports used to document evaluations, and project management activities.

4.1 Field Measurements and Observations

Field measurements and observations will be recorded in the field logbook as described in Section 5.1 of the QAPP, included in Appendix A of this Work Plan.

4.2 Sample Identification and Chain-of-Custody

Field samples will be identified by sample labels, handled and shipped under chain-of-custody procedures as described in Section 5.1 of the QAPP and Attachment 1 of the SAP included in Appendix A and B, respectively, of this Work Plan.

4.3 Laboratory Documentation

Laboratory records will document sample receipt dates, laboratory analysis dates, and report dates. After quality assurance review, the results will be electronically transmitted to NRT. Details of laboratory documentation are described in Section 5.2 and Attachment 3 of the QAPP, included in Appendix A of the Work Plan.

4.4 Data Reduction and Review

Procedures for ensuring the correctness of the data reduction, validation, and reporting are described in Section 9.0 of the QAPP, included in Appendix A of the Work Plan.

4.5 Project Tracking

Monthly progress reports will be submitted to the WDNR. The reports will include a discussion of the following:

- Progress made during the current reporting period;
- Problems encountered in the field;
- Anticipated problems and recommended solutions;
- Quality Assurance;
- Deliverables that were submitted during the reporting period;
- Planned activities during the next report period; and,
- Schedule.

4.6 Technical Memorandum

A technical memorandum will be prepared at the conclusion of Phase I to present the preliminary results of the SLERA and HHRA. The memorandum will identify COCs to be analyzed in Phase II and present a calculated risk value for the site.

4.7 RI Report

An RI Report will be prepared at the conclusion of the investigation. This report will include the following information and documentation:

- A description of the field procedures and methods used during the RI;
- A discussion of the nature and rationale for any significant variances for the scope of work described in the RI/FS work plan;
- The data obtained during the RI considered to be of useable quality;
- The methods and rationales used in the evaluation of RI data;
- The conclusions of the ecological and human health risk assessment, including any recommendations for more detailed assessments, if applicable;
- Conclusions regarding the nature and extent of affected sediment; and,
- Supporting materials for RI data including sediment core logs, laboratory analytical reports, field observations, and similar information.

5.0 FEASIBILTIY STUDY SCOPE OF WORK

A Feasibility Study (FS) will be performed to evaluate remedial actions which may be required at the site. The FS will be prepared based on the findings of the RI.

At a minimum, the FS will include the following:

- Development of Remedial Action Objectives;
- Identification of Applicable Technologies and Development of Remedial Alternatives; and,
- Remedial Alternatives Evaluation and Recommendation for Selected Remedial Alternative.

It is anticipated the FS Report will contain the following sections:

- Executive Summary;
- Introduction, Project Objectives and Site Background;
- Summary of Remedial Action Objectives and General Response Actions;
- Identification and Screening of Remedial Technologies;
- Development of Initial Screening of Remedial Alternatives;
- Analysis of Alternatives; and,
- Recommended Remedial Alternative.

The introduction will provide background information regarding site location, history, and operation. The nature of the problem, as identified through the various studies, will be presented.

A summary of hydrogeological conditions, the nature and extent of chemical presence, and ecological and human health risk assessment addressed in the RI Report will also be provided with a corresponding determination of the size and area of sediments requiring remediation.

The feasible technology options for site remediation will be identified for each general response action, and the results of the remedial technologies screening will be described. Remedial alternatives will be developed by combining the technologies identified in the previous screening process.

Remedial alternatives will be comparatively evaluated following the process specified in the "Interim Guidance for Conducting RI/FS under CERCLA" (USEPA, 1988). In the guidance, a set of nine evaluation criteria has been developed that is to be applied in the evaluation of each Remedial Alternative. These criteria will be used to select a final recommended remedial alternative.

6.0 SCHEDULE

The anticipated project schedule, through the initiation of the selected remedy, is provided below. This schedule is subject to change based on the RI findings, work progress, and other factors.

Deliverables/Reviews	Start	Finish	Duration
1. WDNR Review of RI/FS WP	Jul 04	Aug 04	60 Days
2. Finalize RI/FS WP	Sep 04	Sep 04	30 Days
3. Perform RI Field & Lab Work - Phase 1	Oct 04	Oct 04	30 Days
4. Toxicity Testing	Nov 04	Nov 04	30 Days
5. Perform Risk Assessment; Begin RI Report	Dec 04	Feb 05	90 Days
6. Prepare Risk Assessment Tech Memo	Mar 05	Mar 05	30 Days
7. WDNR Review of RA Tech Memo	Apr 05	Apr 05	30 Days
8. Perform RI Field & Lab Work - Phase 2	May 05	May 05	30 Days
9. Complete Draft RI Report	Jun 05	Jul 05	60 Days
10. WDNR Review of RI Report	Aug 05	Oct 05	90 Days
11. Finalize RI Report	Nov 05	Nov 05	30 Days
12. Prepare Draft FS Report	Dec 05	May 06	180 Days
13. WDNR Review of FS Report	Jun 06	Aug 06	90 Days
14. Finalize FS Report	Sep 06	Sep 06	30 Days
15. WDNR Issues Proposed Plan (PRAP)	Oct 06	Nov 06	60 Days
16. Public Comments on PRAP	Dec 06	Jan 07	60 Days
17. WDNR Decision on PRAP	Feb 07	Mar 07	60 Days
18. WDNR Issues ROD	Apr 07	May 07	60 Days
19. WPSC Notifies WDNR of Consultants	Jun 07	Jun 07	30 Days
20. Prepare Draft RD/RA Work Plan (90% Design)	Jun 07	Nov 07	180 Days
21. WDNR Review of RD/Work Plan	Dec 07	Feb 08	90 Days

Deliverables/Reviews	Start	Finish	Duration
22. Finalize RD/RA Work Plan (100% Design)	Mar 08	Apr 08	60 Days
23. Prepare RA Construction Plans/Specs	May 08	Jun 08	60 Days
24. Bidding and Procurement	July 08	Aug 08	90 Days
25. Initiate Remedial Construction	Sept 08	TBD	TBD

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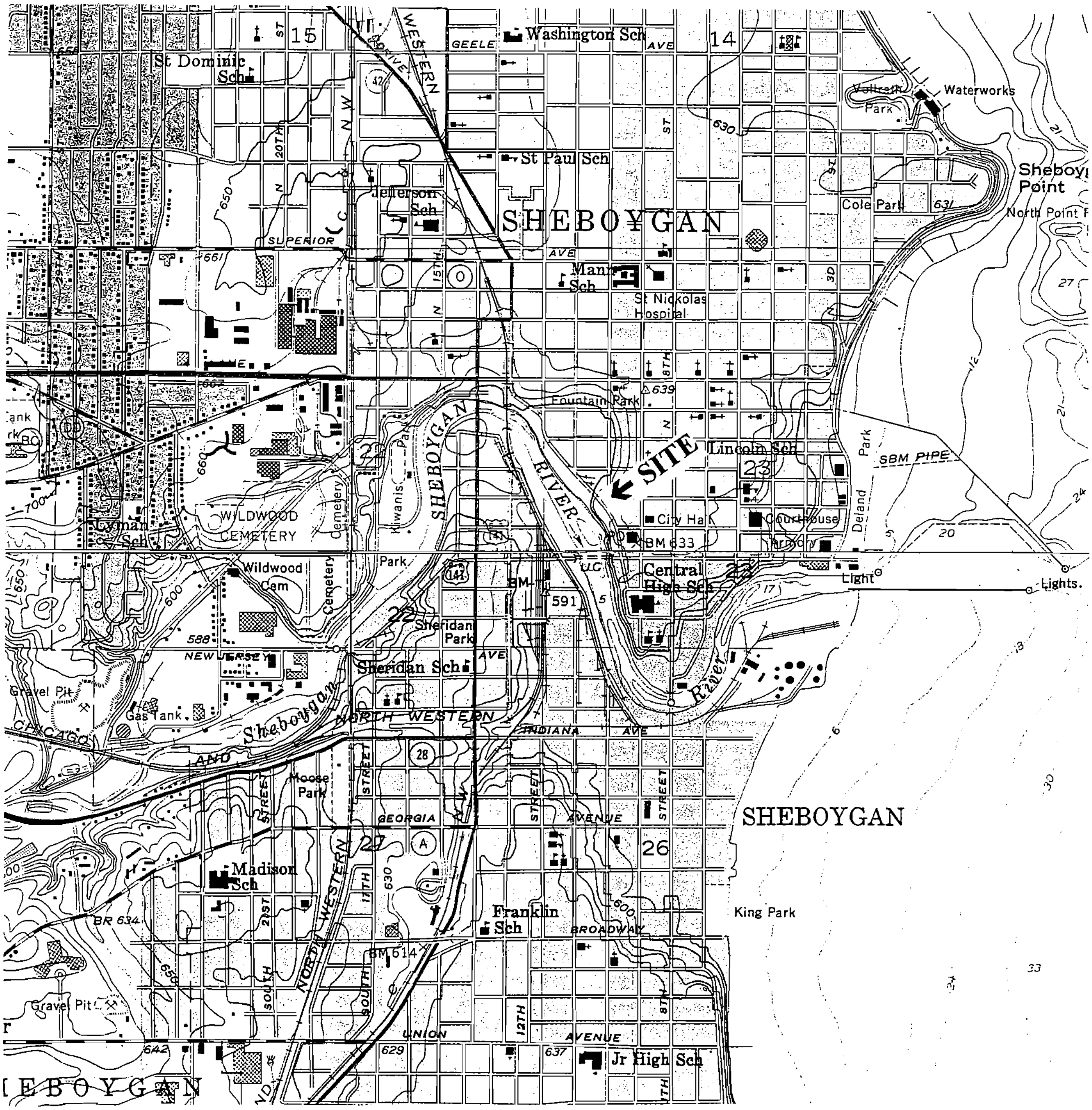
FIGURES



SOURCE: USGS 7.5 MINUTE QUADRANGLE,
SHEBOYGAN NORTH AND SOUTH.
DATED 1954. PHOTOREVISED 1973.

QUADRANGLE LOCATION

N

0 2000 4000

SCALE IN FEET

CONTOUR INTERVAL 10 FEET

Natural Resource Technology

N R T

SITE LOCATION MAP

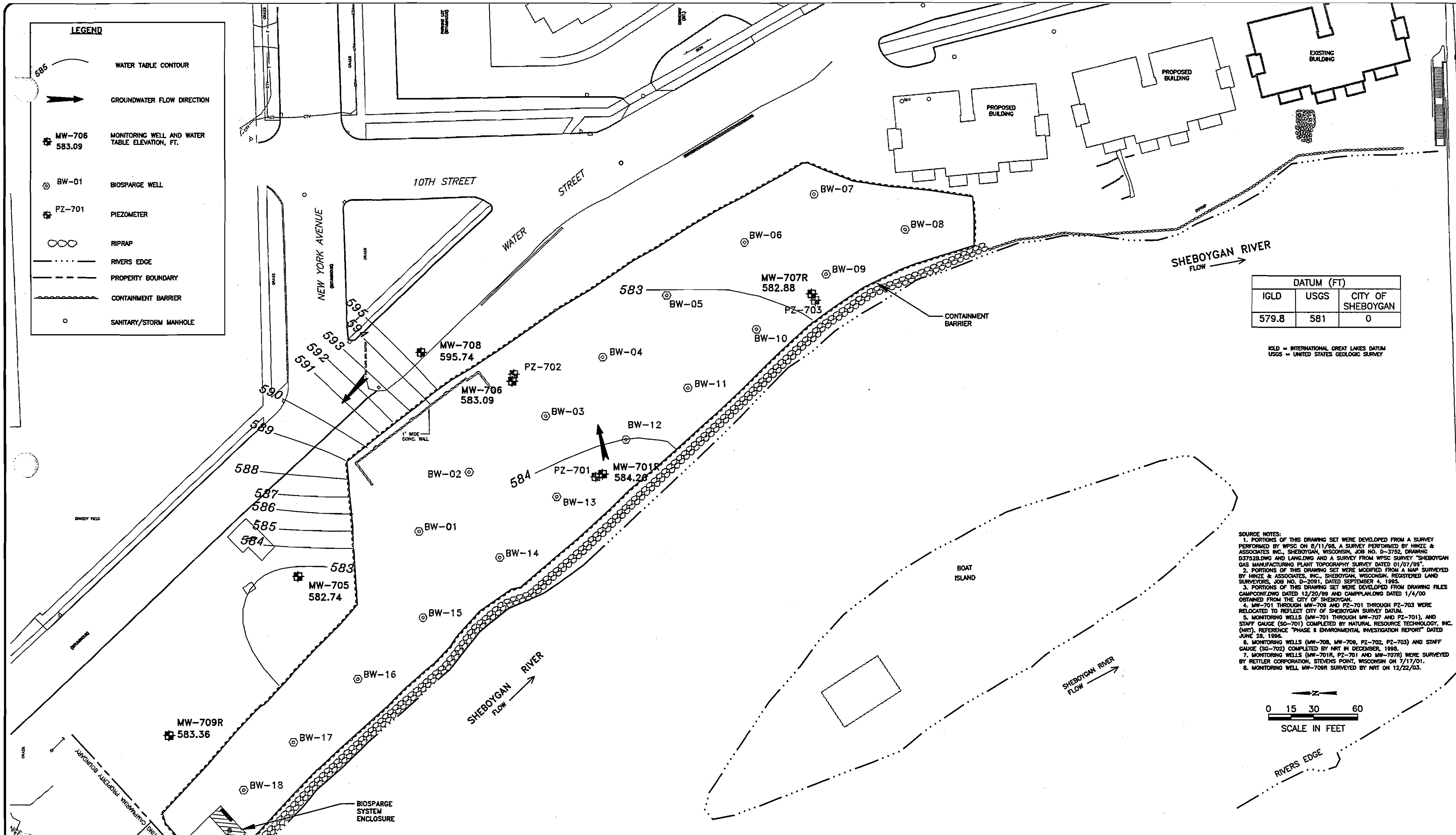
CAMPMARINA FORMER COAL GAS FACILITY
WISCONSIN PUBLIC SERVICE CORPORATION
SHEBOYGAN, WISCONSIN

DRAWN BY: TAS APPROVED BY: JMK DATE: 04/23/04

PROJECT NO. 1665

DRAWING NO. 1665-A01

FIGURE NO. 1



DATUM (FT)		
IGLD	USGS	CITY OF SHEBOYGAN
579.8	581	0

IGLD = INTERNATIONAL GREAT LAKES DATUM
USGS = UNITED STATES GEOLOGIC SURVEY

SOURCE NOTES:
1. PORTIONS OF THIS DRAWING SET WERE DEVELOPED FROM A SURVEY PERFORMED BY WPSC ON 8/11/98, A SURVEY PERFORMED BY HINZE & ASSOCIATES INC., SHEBOYGAN, WISCONSIN, JOB NO. D-3752, DRAWING D3752B.DWG AND LANG.DWG AND A SURVEY FROM WPSC SURVEY "SHEBOYGAN GAS MANUFACTURING PLANT TOPOGRAPHY SURVEY DATED 01/07/99".
2. PORTIONS OF THIS DRAWING SET WERE MODIFIED FROM A MAP SURVEYED BY HINZE & ASSOCIATES, INC., SHEBOYGAN, WISCONSIN. REGISTERED LAND SURVEYORS, JOB NO. D-2091, DATED SEPTEMBER 4, 1995.
3. PORTIONS OF THIS DRAWING SET WERE DEVELOPED FROM DRAWING FILES CAMPCONT.DWG DATED 12/20/99 AND CAMPPLAN.DWG DATED 1/4/00 OBTAINED FROM THE CITY OF SHEBOYGAN.
4. MW-701 THROUGH MW-709 AND PZ-701 THROUGH PZ-703 WERE RELOCATED TO REFLECT CITY OF SHEBOYGAN SURVEY DATUM.
5. MONITORING WELLS (MW-701 THROUGH MW-707 AND PZ-701), AND STAFF GAUGE (SG-701) COMPLETED BY NATURAL RESOURCE TECHNOLOGY, INC. (NRT). REFERENCE "PHASE II ENVIRONMENTAL INVESTIGATION REPORT" DATED JUNE 28, 1996.
6. MONITORING WELLS (MW-708, MW-709, PZ-702, PZ-703) AND STAFF GAUGE (SG-702) COMPLETED BY NRT IN DECEMBER, 1998.
7. MONITORING WELLS (MW-701R, PZ-701 AND MW-707R) WERE SURVEYED BY RETTLER CORPORATION, STEVENS POINT, WISCONSIN ON 7/17/01.
8. MONITORING WELL MW-709R SURVEYED BY NRT ON 12/22/03.

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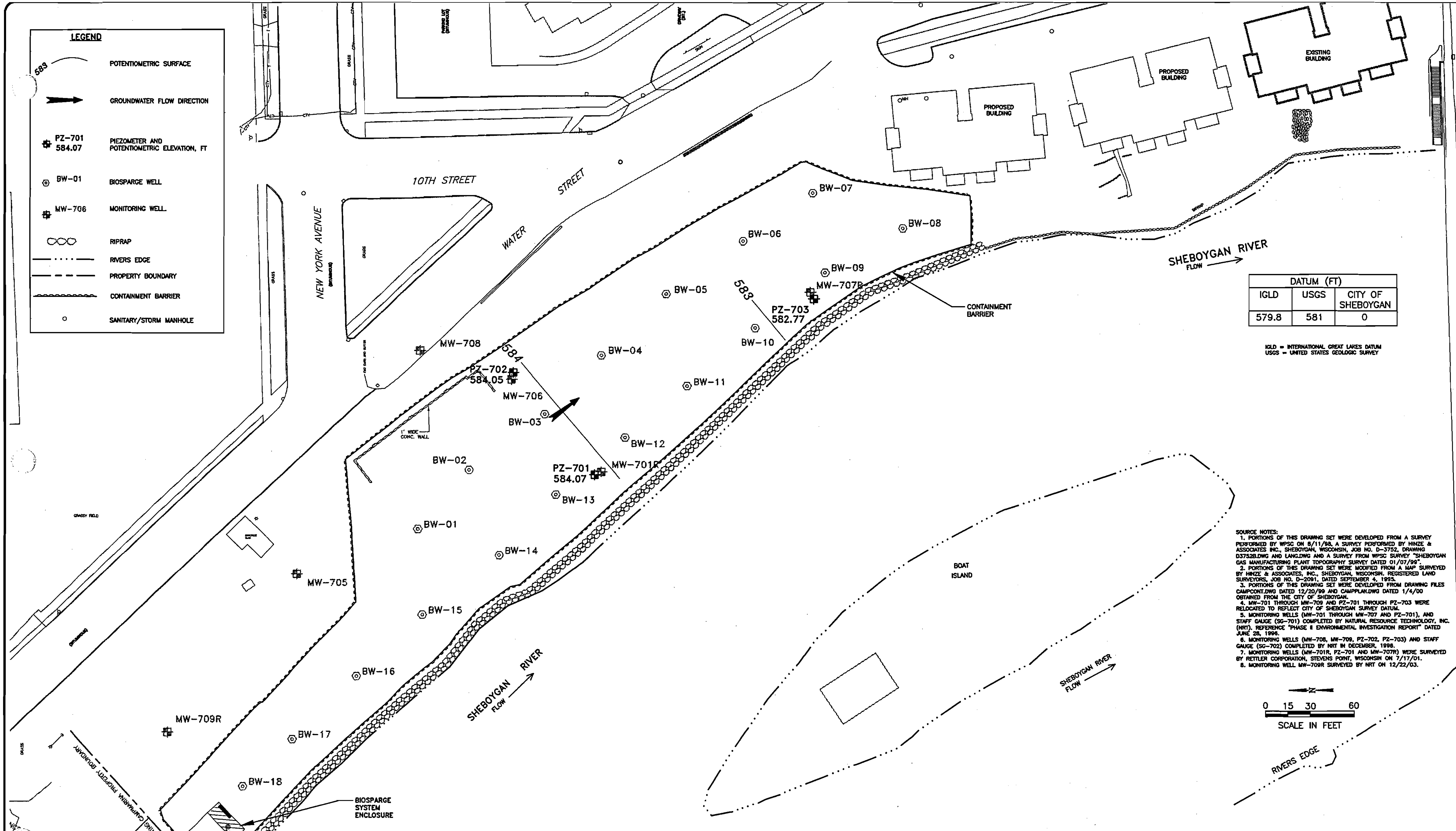
NRT

WATER TABLE ELEVATION CONTOUR DURING BIOSPARGE SYSTEM OPERATION 4/15/03

RI/FS WORK PLAN
CAMPMARINA AND CENTER AVENUE RIGHT-OF-WAY
WISCONSIN PUBLIC SERVICE CORPORATION
CITY OF SHEBOYGAN, WISCONSIN

CAD FILE: 1665\2-sed\1665-2-B02.DWG
REFERENCE FILES:

PROJECT NO. 1665/2.0
DRAWN BY: RLH 05/19/04
CHECKED BY: JMK
APPROVED BY:
FIGURE NO. 2



Natural Resource Technology
NRT

POTENTIOMETRIC SURFACE CONTOURS DURING BIOSPARGE SYSTEM OPERATION 4/15/03

RI/FS WORK PLAN
CAMPMARINA AND CENTER AVENUE RIGHT-OF-WAY
WISCONSIN PUBLIC SERVICE CORPORATION
CITY OF SHEBOYGAN, WISCONSIN

CAD FILE: 1665\2-sed\1665-2-B03.DWG
REFERENCE FILES:

PROJECT NO. 1665/2.0
DRAWN BY: RLH 05/19/04
CHECKED BY: JMK
APPROVED BY:
FIGURE NO. 3

TABLES

Table 1. Groundwater Elevations and Vertical Gradients
Wisconsin Public Service Corporation - Campmarina Former MGP Site
Sheboygan, WI

Monitoring Location	Ground Surface Elevation (feet, MSL)	Top of PVC Elevation (feet, MSL)	Total Well Depth (feet)	Screen Length (feet)	Top of Screen Elevation (feet, MSL)	Middle of Screen Elevation (feet, MSL)	Monitoring Date	Depth to Water (feet)	Groundwater Elevation (feet, MSL)	Change in head (feet)	Change in distance (feet)	Vertical Gradient	Direction
MW-701	588.97	588.51	13.4	10	585.11		8/14/1995	5.51	583.00	7.38	27.63	2.67E-01	downward
							8/20/1995	5.63	582.88	9.14	27.51	3.32E-01	downward
							9/25/1995	5.58	582.93	10.30	27.56	3.74E-01	downward
							12/21/1998	5.72	582.79	0.60	27.42	2.19E-02	downward
							4/18/2000	5.95	582.56	0.42	27.19	1.54E-02	downward
							6/19/2000	5.62	582.89	0.78	27.52	2.83E-02	downward
							Well Replaced	--	--				
MW-701R		590.47	10.80	10	589.67		6/25/2002	6.20	584.27	3.64	28.90	1.26E-01	downward
							11/7/2002	6.60	583.87	-0.08	28.50	-2.81E-03	upward
							1/24/2003	7.06	583.41	-0.06	28.04	-2.14E-03	upward
							4/15/2003	6.21	584.26	0.19	28.89	6.58E-03	downward
							7/1/2003	6.18	584.29	0.21	28.92	7.26E-03	downward
PZ-701	589.28	588.89	36.02	5	557.87	555.37	8/14/1995	13.27	575.62				
							8/20/1995	15.15	573.74				
							9/25/1995	16.26	572.63				
							12/21/1998	6.70	582.19				
							4/18/2000	6.75	582.14				
							6/19/2000	6.78	582.11				
		590.53	37.66	5	557.87	555.37	6/25/2002	9.90	580.63				
							11/7/2002	6.58	583.95				
							1/24/2003	7.06	583.47				
							4/15/2003	6.46	584.07				
							7/1/2003	6.45	584.08				
							9/30/2003	6.61	583.92				
MW-702	590.39	590.09	13.40	10	586.69		8/14/1995	4.86	585.23				
							8/20/1995	4.69	585.40				
							9/25/1995	4.88	585.21				
							12/21/1998	4.83	585.26				
							4/18/2000	4.52	585.57				
							6/19/2000	2.68	587.41				
MW-703	589.16	588.80	13.46	10	585.34		8/14/1995	5.63	583.17				
							8/20/1995	5.69	583.11				
							9/25/1995	5.74	583.06				
							12/21/1998	5.7	583.10				
							4/18/2000	5.99	582.81				
							6/19/2000	5.56	583.24				

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MW-704	589.43	589.05	13.20	10	585.85		8/14/1995	5.93	583.12				
							8/20/1995	5.96	583.09				
							9/25/1995	6.00	583.05				
							12/21/1998	5.63	583.42				
							4/18/2000	5.64	583.41				
							6/19/2000	5.62	583.43				
MW-705	590.22	589.91	16.66	10	583.25		8/14/1995	6.95	582.96				
							8/20/1995	6.07	583.84				
							9/25/1995	6.09	583.82				
							12/21/1998	6.14	583.77				
							4/25/2000	6.11	583.80				
							6/19/2000	5.74	584.17				
							6/25/2002	10.27	579.64				
							11/7/2002	7.05	582.86				
							4/15/2003	7.17	582.74				
							7/1/2003	6.80	583.11				
							9/30/2003	7.23	582.68				
MW-706	591.51	591.34	14.10	10	587.94		8/14/1995	3.5 *	587.8 *				
							8/20/1995	3.4 *	587.9 *				
							9/25/1995	3.5 *	587.8 *				
							12/21/1998	3.34	588.00	-1.15	29.34	-3.92E-02	upward
							4/18/2000	2.98	588.36	-0.20	29.70	-6.73E-03	upward
							6/19/2000	3.65	587.69	-0.15	29.03	-5.17E-03	upward
							6/25/2002	8.40	582.94	2.25	24.28	9.27E-02	downward
							11/7/2002	9.22	582.12	-1.92	23.46	-8.18E-02	upward
							1/24/2003	--	--				
							4/15/2003	8.25	583.09	-0.96	24.43	-3.93E-02	upward
							7/1/2003	8.77	582.57	-1.49	23.91	-6.23E-02	upward
PZ-702	591.62	591.16	38.62	5	561.2	558.7	12/21/1998	2.01	589.15				
							4/18/2000	2.60	588.56				
							6/19/2000	3.32	587.84				
							6/25/2002	10.47	580.69				
							11/7/2002	7.12	584.04				
							1/24/2003	7.58	583.58				
							4/15/2003	7.11	584.05				
							7/1/2003	7.10	584.06				
							9/30/2003	7.18	583.98				

Table 1. Groundwater Elevations and Vertical Gradients
Wisconsin Public Service Corporation - Campmarina Former MGP Site
Sheboygan, WI

Monitoring Location	Ground Surface Elevation (feet, MSL)	Top of PVC Elevation (feet, MSL)	Total Well Depth (feet)	Screen Length (feet)	Top of Screen Elevation (feet, MSL)	Middle of Screen Elevation (feet, MSL)	Monitoring Date	Depth to Water (feet)	Groundwater Elevation (feet, MSL)	Change in head (feet)	Change in distance (feet)	Vertical Gradient	Direction
MW-707	590.29	590.08	13.35	10	586.73		8/14/1995	7.48	582.60				
							8/20/1995	7.71	582.37				
							9/25/1995	7.67	582.41				
							12/21/1998	6.65	583.43	2.84	26.71	1.06E-01	downward
							4/18/2000	--	--				
							6/19/2000	6.05	584.03	3.94	27.31	1.44E-01	downward
							Well Replaced	--	--				
MW-707R		587.78	11.97	10	585.81		6/25/2002	4.57	583.21	3.79	26.49	1.43E-01	downward
							11/7/2002	5.04	582.74	-0.03	26.02	-1.15E-03	upward
							1/24/2003	--	--				
							4/15/2003	4.9	582.88	0.11	26.16	4.20E-03	downward
							7/1/2003	4.99	582.79	4.40	26.07	1.69E-01	downward
PZ-703	589.85	589.22	33.94	5	559.2	556.7	12/21/1998	8.63	580.59				
							1/19/1999	8.96	580.26				
							4/18/2000	9.49	579.73				
							6/19/2000	9.13	580.09				
							6/25/2002	9.80	579.42				
							11/7/2002	6.45	582.77				
							1/24/2003	--	--				
							4/15/2003	6.45	582.77				
							7/1/2003	10.83	578.39				
							9/30/2003	9.40	579.82				
MW-708	606.45	606.09	18.86	15	602.23		12/10/1998	16.39	589.70				
							12/21/1998	16.78	589.31				
							4/18/2000	15.21	590.88				
							6/19/2000	14.98	591.11				
							6/25/2002	14.22	591.87				
							11/7/2002	11.05	595.04				
							1/24/2003	11.58	594.51				
							4/15/2003	10.35	595.74				
							7/1/2003	10.66	595.43				
							9/30/2003	11.07	595.02				

Table 1. Groundwater Elevations and Vertical Gradients
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Sheboygan, WI

Monitoring Location	Ground Surface Elevation (feet, MSL)	Top of PVC Elevation (feet, MSL)	Total Well Depth (feet)	Screen Length (feet)	Top of Screen Elevation (feet, MSL)	Middle of Screen Elevation (feet, MSL)	Monitoring Date	Depth to Water (feet)	Groundwater Elevation (feet, MSL)	Change in head (feet)	Change in distance (feet)	Vertical Gradient	Direction
MW-709	588.51	587.95	12.50	10	585.45		12/21/1998	7.27	580.68				
							4/18/2000	7.62	580.33				
							6/19/2000	7.23	580.72				
							Well Replaced	--	--				
MW-709R	589.15	588.81	16.54	10	582.27		6/25/2002	9.23	579.58				
							11/7/2002	6.40	582.41				
							4/15/2003	5.45	583.36				
							7/1/2003	5.30	583.51				
							9/30/2003	6.33	582.48				
SG-701	na	582.02	na	na	na		8/14/1995	2.00	580.02				
							8/20/1995	2.33	579.69				
							9/25/1995	2.49	579.53				
SG-702	na	581.37	an	na	na		\`\`\`\`\`\`\`\`\`\`\`	2.33	579.04				

[U-PAR/JTB 11/03]

Notes:
1. PZ-701, MW-701R and MW-707R were surveyed on 7/17/01 by Rettler Corporation from Stevens Point, Wisconsin. PZ-101 was extended from pre-remedial ground surface elevation to existing ground surface elevation.
2. Elevations are referenced to United States Geologic Survey Geodetic Sea Level Datum.
3. * Estimated value.
4. MW-709 was surveyed on 12/22/03 by NRT using MW-701R TOC as a bench mark and a laser level.
5. '-- Not Measured

Horizontal Gradient Calculation:

Change in head between 584 ft contour and 583 ft contour = 1 ft
Change in distance between 584 ft contour and 583 ft contour = 145 ft
Horizontal Gradient = 1/145 = 7E-3 to the southeast

Table 2. Sediment Analytical Results - Polynuclear Aromatic Hydrocarbons (PAHs)
Wisconsin Public Service Corporation - Campmarina Former MGP Site
Sheboygan, WI

Sample Number	Sample Interval (inches)	Sample Date	PAHs (µg/kg)																		Total PAHs (mg/kg)
			Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(b)fluoranthene	Benzo(k)fluoranthene	Benzo(a)pyrene	Benzo(g,h,i)perylene	Chrysene	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	1-Methylnaphthalene	2-Methylnaphthalene	Naphthalene	Phenanthrene	Pyrene	
Method Detection Limit			40	80	8	2	2	2	8	4	4	4	8	16	4	25	25	40	16	8	
Hand Cored Samples																					
BKG-700	0-15	10/16/1995	nd	nd	35	380	130	69	260	160	180	nd	640	nd	94	nd	nd	nd	62	160	2.17
SD-701B	0-10	10/17/1995	nd	nd	nd	8	14	nd	nd	17	8	nd	18	nd	9	nd	nd	nd	nd	11	0.08
SD-702A	0-16.75	10/16/1995	nd	nd	nd	18	11	15	18	36	10	14	18	nd	23	nd	nd	nd	nd	nd	0.16
SD-702B	0-15.25	10/16/1995	nd	nd	nd	89	57	55	98	150	64	21	83	nd	94	nd	nd	nd	nd	120	0.83
SD-703C	0-23	10/17/1995	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
SD-704B	0-23	10/17/1995	26,000	12,000	15,000	11,000	2,400	3,100	7,700	5,300	70,000	1,300	56,000	31,000	3,200	nd	nd	124,000	66,000	9,600	443.60
SD-706C	0-11	10/18/1995	nd	nd	38	110	39	47	82	110	82	nd	300	nd	93	nd	nd	nd	160	180	1.24
Vibrocore Samples																					
SD-701BV	47-69	6/11/1996	nd	nd	3,900	3,500	610	1,200	2,200	1,100	1,400	nd	8,400	4,000	1,400	11,000	10,000	7,200	10,000	2,900	68.81
SD-702BV	75-86	11/5/1995	203,000	nd	106,000	67,000	22,000	17,000	50,000	37,000	42,000	nd	330,000	207,000	28,000	nd	nd	974,000	344,000	99,000	2,526.00
SD-702CV	0-27	6/11/1996	nd	nd	nd	6	nd	nd	5	nd	nd	nd	10	nd	nd	nd	nd	nd	nd	nd	0.02
SD-702CV	27-64	6/11/1996	33,000	nd	37,000	29,000	5,400	4,500	14,000	10,000	11,000	nd	141,000	66,000	7,500	157,000	145,000	297,000	134,000	23,000	1,114.40
SD-702CV	80-89	6/11/1996	114,000	nd	32,000	29,000	40,000	8,200	15,000	8,800	10,000	nd	102,000	71,000	5,700	206,000	188,000	358,000	119,000	20,000	1,326.70
SD-703BV	37-42	6/13/1996	nd	nd	nd	13	15	4	11	10	7	nd	20	nd	5	nd	nd	nd	nd	8	0.09
SD-704BV	28-102	6/13/1996	68,000	nd	22,000	24,000	4,800	8,200	17,000	12,000	9,700	nd	41,000	52,000	8,000	158,000	135,000	190,000	91,000	25,000	865.70
SD-704BV	112-116	6/13/1996	nd	nd	510	380	100	150	360	320	230	nd	1,300	370	210	470	700	3,000	1,800	570	10.47
SD-705BV	45-47	11/5/1995	1,030,000	nd	359,000	345,000	115,000	66,000	263,000	204,000	228,000	nd	1,580,000	490,000	156,000	nd	nd	2,520,000	1,370,000	568,000	9,294.00
SD-705BV	53-58	11/5/1995	nd	nd	75	50	16	11	38	26	2	nd	130	45	23	nd	nd	470	150	75	1.11
SD-705DV	36-54	6/13/1996	nd	nd	2,500	1,500	280	470	1,100	770	720	nd	5,100	1,300	530	2,700	2,300	3,900	7,800	1,800	32.77
SD-706CV	46-59	6/18/1996	nd	nd	30	60	14	14	51	58	38	nd	120	nd	23	nd	nd	nd	150	59	0.62
SD-707BV	35-43	11/4/1995	3,300	nd	1,800	3,300	840	120	1,400	1,400	2,900	120	11,000	650	1,000	nd	nd	nd	6,000	8,500	42.33
SD-707CV	60-79	6/11/1996	nd	nd	250	310	48	95	210	140	120	nd	730	97	110	75	92	nd	930	630	3.84
SD-708AV	53-66	11/4/1995	nd	nd	110	120	40	28	97	75	74	nd	220	97	53	nd	nd	nd	330	200	1.44
SD-709AV	11-24	11/4/1995	nd	nd	39	110	42	24	70	52	56	nd	170	51	33	nd	nd	nd	110	140	0.90
SD-711AV	36-48	6/18/1996	nd	nd	1,700	930	170	150	540	410	410	nd	1,700	1,300	nd	3,400	1,800	790	4,000	1,300	18.60
SD-712AV	38-48	6/18/1996	nd	nd	610	430	110	130	300	240	210	nd	2,200	340	180	nd	nd	nd	2,100	1,300	8.15
SD-712BV	48-77	6/18/1996	nd	nd	18	50	13	22	42	49	23	nd	120	nd	22	nd	nd	nd	56	26	0.44

NOTES:
1) nd = Parameter Not Detected
2) µg/Kg = micrograms perKilogram
3) mg/Kg = milligrams per Kilogram

Table 3. Sediment Analytical Results - BTEX
Wisconsin Public Service Corporation - Campmarina Former MGP Site
Sheboygan, WI

Sample Number	Interval (inches)	Sample Date	BTEX (µg/kg) Benzene	Toluene	Ethylbenzene	Xylenes, total	Total BTEX (mg/kg)
Method Detection Limit			5	5	5	15	
Hand Cored Samples							
BKG-700	0-15	10/16/1995	nd	nd	nd	nd	0
SD-701B	0-10	10/17/1995	nd	nd	nd	nd	0
SD-702A	0-16.75	10/16/1995	nd	nd	nd	nd	0
SD-702B	0-15.25	10/16/1995	nd	nd	nd	nd	0
SD-703C	0-23	10/17/1995	nd	nd	nd	nd	0
SD-704B	0-23	10/17/1995	6,300	9,500	24,000	31,000	70.8
SD-706C	0-11	10/18/1995	nd	nd	nd	nd	0
Vibrocore Samples							
SD-701BV	47-69	6/11/1996	nd	280	810	690	1.78
SD-702BV	75-86	11/5/1995	110,000	220,000	280,000	380,000	990
SD-702CV	0-27	6/11/1996	nd	nd	nd	nd	0
SD-702CV	27-64	6/11/1996	49,000	100,000	120,000	170,000	439
SD-702CV	80-89	6/11/1996	30,000	110,000	210,000	240,000	590
SD-703BV	37-42	6/13/1996	nd	nd	nd	nd	0
SD-704BV	28-102	6/13/1996	11,000	3,900	71,000	88,000	173.9
SD-704BV	112-116	6/13/1996	400	nd	1,700	1,600	3.7
SD-705BV	45-47	11/5/1995	1,400	1,200	7,200	7,700	17.5
SD-705BV	53-58	11/5/1995	nd	nd	49	50	0.099
SD-705DV	36-54	6/13/1996	270	62	940	450	1.722
SD-706CV	46-59	6/18/1996	nd	nd	nd	nd	0
SD-707BV	35-43	11/4/1995	nd	nd	nd	nd	0
SD-707CV	60-79	6/11/1996	nd	nd	nd	nd	0
SD-708AV	53-66	11/4/1995	nd	nd	nd	nd	0
SD-709AV	11-24	11/4/1995	nd	nd	nd	nd	0
SD-711AV	36-48	6/18/1996	18	25	36	71	0.15
SD-712AV	38-48	6/18/1996	nd	nd	nd	nd	0
SD-712BV	48-77	6/18/1996	nd	nd	nd	nd	0

NOTES:
1) BTEX = Benzene, Toluene, Ethylbenzene, Xylenes
2) nd = Parameter Not Detected
3) µg/Kg = micrograms perKilogram
4) mg/Kg = milligrams per Kilogram

Table 4. Sediment Analytical Results
Cyanide, Phenol, TOC, Oil & Grease, RCRA Metals & PCBs
Wisconsin Public Service Corporation - Campmarina Former MGP Site
Sheboygan, WI

Sample Number	Sample Interval (inches)	Sample Date	Total Cyanide (mg/kg)	Weak Acid Dissociable Cyanide (mg/kg)	Phenol (mg/kg)	Oil & Grease (mg/kg)	TOC (mg/kg)
Method Detection Limit			0.25	0.25	0.13	500	--
Hand Cored Samples							
BKG-700	0-15	10/16/1995	0.59	nd	nd	na	30,000
SD-701B	0-10	10/17/1995	nd	nd	nd	na	17,000
SD-702A	0-16.75	10/16/1995	0.3	nd	nd	na	20,000
SD-702B	0-15.25	10/16/1995	nd	nd	nd	na	20,000
SD-703C	0-23	10/17/1995	nd	nd	nd	na	17,000
SD-704B	0-23	10/17/1995	0.84	0.62	2	na	31,000
SD-706C	0-11	10/18/1995	nd	nd	0.19	na	7,600
Vibrocore Samples							
SD-701AV	47-69	6/11/1996	na	na	na	na	na
SD-702BV	75-86	11/5/1995	0.98	0.51	48	na	27,900
SD-702CV	27-64	6/11/1996	na	na	na	43,400	>100,000
SD-702DV	GB	6/13/1996	na	na	na	na	71,600
SD-705BV	45-47	11/5/1995	8.7	3	4.3	na	25,700
SD-705BV	53-58	11/5/1995	nd	nd	nd	na	1,600
SD-707BV	35-43	11/4/1995	nd	nd	nd	na	1,100
SD-708AV	53-66	11/4/1995	nd	nd	nd	na	1,100
SD-708BV	52-60	6/11/1996	na	na	na	na	na
SD-709AV	11-24	11/4/1995	nd	nd	nd	na	1,700
SD-711AV	24-28	6/18/1996	na	na	na	31,400	19,000
SD-711AV	36-48	6/18/1996	na	na	na	na	2,000
SD-711BV	50-58	6/18/1996	na	na	na	2,570	21,000
SD-711BV	78-87	6/18/1996	na	na	na	na	9,600

Sample Number	Sample Interval (inches)	Sample Date	RCRA Metals (mg/kg) Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver	Total PCBs (mg/Kg)
Method Detection Limit			0.12	0.5	1	1	4	0.02	0.12	1	0.12
SD-701BV	47-69	6/11/1996	na	na	na	na	na	na	na	na	0.42
SD-702CV	27-64	6/11/1996	1.8	26	1.6	43	140	0.2	<0.48	<1.0	1.8-2.3
SD-708BV	52-60	6/11/1996	2.1	47	1.4	500	71	0.47	<0.48	<1.0	na
SD-711BV	50-58	6/18/1996	1.0	12	1.1	7.4	28	0.18	<0.12	<1.0	0.97

NOTES:
1) nd = Parameter Not Detected
2) na = Parameter Not Analyzed for in this sample
3) mg/Kg = milligrams per Kilogram
4) TOC = Total Organic Carbon
5) PCBs = Polychlorinated Biphenyls

Table 5. Groundwater Analytical Results - Cyanide and BTEX
Wisconsin Public Service Corporation - Campmarina Former MGP Site
Sheboygan, WI

		Cyanide, dissolved (mg/L)			BTEX (µg/L)				
Sampling Location	**Sampling Date**	**Cyanide (amenable)**	**Cyanide (dissociable)**	**Cyanide (total)**	**Benzene**	**Toluene**	**Ethylbenzene**	**Xylene, total**	**Total BTEX**
Wisconsin Groundwater Quality Standards (NR140)									
Preventive Action Limit		ns	*0.04*	ns	*0.5*	*200*	*140*	*1,000*	ns
Enforcement Standard		ns	**0.2**	ns	**5**	**1,000**	**700**	**10,000**	ns
MW-701	8/15/1995	<0.0050	0.025	0.11	**10,000**	96	**880**	820	11,796
	9/25/1995	<0.0050	0.020	0.088	**12,000**	53	**780**	680	13,513
	12/21/1998	0.05	*0.11*	0.17	**10,200**	77 *	**818**	717	11,812
MW-701R	6/25/2002	0.15	0.012	0.16	**2,700**	28	*330*	330	3,388
	11/7/2002	--	--	--	--	--	--	--	--
	7/1/2003	--	--	0.13	**3,400**	21 *	*340*	260	4,021
PZ-701	8/17/1995	0.02	<0.0050	0.02	**5**	6.3	3.6	11	25.9
	9/25/1995	0.014	<0.0050	0.014	*2.2*	6.6	1.7	6.8	17.3
	12/21/1998	--	--	--	*0.96* *	1.8 *	1.1 *	4.2 *	8.1
	6/25/2002	0.74	*0.19*	0.83	<0.45	<0.68	<0.82	<1.7	nd
	11/7/2002	0.042	*0.049*	0.18	*0.90*	<0.84	<0.53	<1.1	0.9
	4/15/2003	0.47	0.028	0.47	<0.41	<0.67	<0.54	<1.8	nd
	7/1/2003	--	--	0.34	<0.30	<0.58	<0.60	<1.2	nd
	9/30/2003	--	--	0.26	0.35 *	<0.58	<0.60	<1.2	0.4
MW-702	8/15/1995	<0.0050	*0.043*	0.20	**5,900**	**2,300**	**1,500**	*1,600*	11,300
	9/25/1995	<0.0050	0.032	0.072	**6,100**	**2,100**	**1,400**	*1,400*	11,000
MW-703	8/15/1995	<0.0050	0.039	0.12	**1,300**	29	**980**	430	2,739
	9/25/1995	<0.0050	0.028	0.14	**1,300**	23	**1,100**	450	2,873
	12/21/1998	0.05	*0.074*	0.20	**1,190**	9.2 *	**973**	408	2,580
MW-704	8/15/1995	<0.0050	*0.056*	0.31	**340**	*200*	*280*	430	1,250
dup(MW-799)	8/15/1995	0.190	0.022	0.29	**310**	190	*280*	440	1,220
	9/25/1995	<0.0050	*0.062*	0.28	**1,100**	*380*	*670*	970	3,120
dup(MW-799)	9/25/1995	0.02	*0.041*	0.36	**1,100**	*360*	*610*	900	2,970
	12/21/1998	0.22	0.017	0.31	**29**	1.6 *	13	11.3	55
dup(MW-B)	12/21/1998	0.29	0.023	0.29	**22**	1.2 *	9.5	8.7 *	41
MW-705	8/15/1995	<0.0050	<0.0050	<0.0050	<1.0	<1.0	<1.0	<3.0	nd
	9/25/1995	<0.0050	<0.0050	<0.0050	<0.50	<1.0	<1.0	<3.0	nd
	12/21/1998	<0.001	<0.001	<0.001	<0.50	<0.60	<0.60	<2.2	nd
dup(MW-A)	12/21/1998	<0.001	0.004	<0.001	<0.50	<0.60	<0.60	<2.2	nd
	6/25/2002	0.076	0.013	0.080	<0.45	<0.68	<0.82	<1.7	nd
dup(QA/QC-1)	6/25/2002	0.088	0.008	0.10	<0.45	<0.68	<0.82	<1.7	nd
	11/7/2002	0.110	<0.0027	0.060	<0.25	<0.84	<0.53	<1.1	nd
	4/15/2003	0.10	0.0064	0.10	<0.41	<0.67	<0.54	<1.8	nd
	7/1/2003	--	--	0.14	<0.30	<0.58	<0.60	<1.2	nd
	9/30/2003	--	--	0.15	<0.30	<0.58	<0.60	<1.2	nd

Table 5. Groundwater Analytical Results - Cyanide and BTEX
Wisconsin Public Service Corporation - Campmarina Former MGP Site
Sheboygan, WI

		Cyanide, dissolved (mg/L)			BTEX (µg/L)				
Sampling Location	**Sampling Date**	**Cyanide (amenable)**	**Cyanide (dissociable)**	**Cyanide (total)**	**Benzene**	**Toluene**	**Ethylbenzene**	**Xylene, total**	**Total BTEX**
Wisconsin Groundwater Quality Standards (NR140)									
Preventive Action Limit		ns	*0.04*	ns	*0.5*	*200*	*140*	*1,000*	ns
Enforcement Standard		ns	**0.2**	ns	**5**	**1,000**	**700**	**10,000**	ns
MW-706	8/15/1995	<0.0050	<0.0050	<0.0050	**34,000**	**13,000**	*560*	*7,900*	55,460
	9/25/1995	<0.0050	<0.0050	<0.0050	**31,000**	**12,000**	<2,500	*7,700*	50,700
	6/25/2002	0.078	0.0099	0.081	**1,900**	**1,300**	*270*	*1,020*	4,490
	11/7/2002	--	--	--	--	--	--	--	--
	7/1/2003	--	--	0.099	**6,500**	**2,200**	*360*	*1,870*	10,930
PZ-702	12/21/1998	<0.002	<0.002	<0.002	<0.50	1.5 *	<0.60	<2.2	1.5
	6/25/2002	<0.0023	<0.00084	<0.0023	<0.45	<0.68	<0.82	<1.7	nd
	11/7/2002	<0.0027	<0.0027	<0.0027	<0.25	<0.84	<0.53	<1.1	nd
	4/15/2003	<0.0015	<0.0019	<0.0015	<0.41	<0.67	<0.54	<1.8	nd
dup(QA/QC-1)	4/15/2003	<0.0015	<0.0095 C	<0.0015	<0.41	<0.67	<0.54	<1.8	nd
	7/1/2003	--	--	<0.0015	<0.30	<0.58	<0.60	<1.2	nd
	9/30/2003	--	--	0.0033 *,B	<0.30	<0.58	<0.60	<1.2	nd
MW-707	8/15/1995	0.210	*0.042*	0.38	**1,500**	190	**3,600**	*1,400*	6,690
	9/25/1995	<0.0050	*0.058*	0.44	**1,200**	130	**3,500**	*1,200*	6,030
	12/21/1998	0.13	0.033	0.64	**830**	82 *	**3,110**	990 *	5,012
MW-707R	6/25/2002	0.76	0.010	0.78	**1,100**	51	**2,300**	760	4,211
	11/7/2002	--	--	--	--	--	--	--	--
	7/1/2003	--	--	0.26	**1,300**	73	**2,800**	950	5,123
PZ-703	12/21/98**	0.002 *	0.002 *	0.002 *	**960 ****	26 **	*429 ***	301 **	1,716
	12/21/98***	--	--	--	**1,170 *****	26 ***	*527 ****	299 ***	2,022
	1/19/1999	--	--	--	**71**	9.6	12	15.2	108
	6/25/2002	<0.0023	0.0009 *	<0.0023	**570**	14	*150*	86	820
	11/7/2002	0.0080 *	<0.0027	0.0070 *	**460**	16	130	101	707
	4/15/2003	0.0025 *	<0.0019	0.0025 *	**880**	22	*260*	146	1,308
	7/1/2003	--	--	0.0019 *	**1,800**	64	**760**	450	3,074
	9/30/2003	--	--	0.0039 *,B,A	**2,000**	65	**910**	520	3,495
MW-708	12/21/1998	<0.001	<0.001	<0.001	<0.50	<0.60	<0.60	<2.2	nd
	6/25/2002	0.003 *	<0.00084	0.0036 *	<0.45	<0.68	<0.82	<1.7	nd
	11/7/2002	<0.0027	<0.0027	0.0060 *	<0.25	<0.84	<0.53	<1.1	nd
dup(QA/QC-1)	11/7/2002	0.0040 *	<0.0027	0.0040 *	<0.25	<0.84	<0.53	<1.1	nd
	4/15/2003	<0.0015	0.0022 *	<0.0015	<0.41	<0.67	<0.54	<1.8	nd
	7/1/2003	--	--	0.0046 *	<0.30	<0.58	<0.60	<1.2	nd
	9/30/2003	--	--	0.0034 *,B	<0.30	<0.58	<0.60	<1.2	nd

Table 5. Groundwater Analytical Results - Cyanide and BTEX
Wisconsin Public Service Corporation - Campmarina Former MGP Site
Sheboygan, WI

Sampling Location	Sampling Date	Cyanide, dissolved (mg/L) Cyanide (amenable)	Cyanide (dissociable)	Cyanide (total)	BTEX (µg/L) Benzene	Toluene	Ethylbenzene	Xylene, total	Total BTEX
Wisconsin Groundwater Quality Standards (NR140)									
Preventive Action Limit		ns	*0.04*	ns	*0.5*	*200*	*140*	*1,000*	ns
Enforcement Standard		ns	**0.2**	ns	**5**	**1,000**	**700**	**10,000**	ns
MW-709	12/21/1998	0.03	0.014	0.030	<0.50	<0.60	<0.60	<2.2	nd
MW-709R	6/25/2002	0.45	0.027	0.480	<0.45	<0.68	<0.82	<1.7	nd
	11/7/2002	0.038	0.0070 *	0.16	<0.25	<0.84	<0.53	<1.1	nd
	4/15/2003	0.28	0.010	0.28	<0.41	<0.67	<0.54	<1.8	nd
	7/1/2003	--	--	0.25	<0.30	<0.58	<0.60	<1.2	nd
dup(M)	7/1/2003	--	--	0.24 N	<0.30	<0.58	<0.60	<1.2	nd
	9/30/2003	--	--	0.11	<0.30	<0.58	<0.60	<1.2	nd
dup(M)	9/30/2003	--	--	0.12	<0.30	<0.58	<0.60	<1.2	nd

[U-PAR/JTB 11/03]

Notes:

1) Concentrations that attain/exceed a preventive action limit (PAL) are shown in *italics and underlined*.
2) Concentrations that attain/exceed an enforcement standard (ES) are **underlined and bold**.
* : Laboratory note - Parameter detected above the limit of detection (LOD) but below the limit of Quantitation (LOQ).
** : Laboratory note - The original analysis contained concentrations above the calibration curve.
*** : Laboratory note - The sample was reanalyzed past hold time, concentrations were within the calibration curve.
A : Laboratory note-Laboratory Control Spike recovery not within control limits.
B : Laboratory note-Analyte present in method blank.
C : Laboratory note- Elevated detection limit.
N : Laboratory note-Spiked sample recovery not within control limits.
M : Field duplicate identity was erroneously identified (field duplicate or field blank)
<0.0050 : Parameter not detected above the Limit of Detection indicated.
-- : Analysis was not performed
nd : Analyte not detected
ns : NR 140 standard not established
dup(QA/QC-1): Field duplicate sample (field identity shown in parentheses).

Table 6. Groundwater Analytical Results - Polynuclear Aromatic Hydrocarbons
Wisconsin Public Service Corporation - Campmarina Former MGP Site
Sheboygan, WI

		POLYNUCLEAR AROMATIC HYDROCARBONS - PAHs (µg/L)																		
Sampling Location	Sampling Date	Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo (a) pyrene	Benzo (b) fluoranthene	Benzo (ghi) perylene	Benzo (k) fluoranthene	Chrysene	Dibenz (a,h) anthracene	Fluoranthene	Fluorene	Indeno (1,2,3-cd) pyrene	1-Methylnaphthalene	2-Methylnaphthalene	Naphthalene	Phenanthrene	Pyrene	Total PAHs
		Wisconsin Groundwater Quality Standards (NR 140)																		
Preventive Action Limit		ns	ns	*600*	ns	*0.02*	*0.02*	ns	ns	*0.02*	ns	*80*	*80*	ns	ns	ns	*8*	ns	*50*	ns
Enforcement Standard		ns	ns	**3,000**	ns	**0.2**	**0.2**	ns	ns	**0.2**	ns	**400**	**400**	ns	ns	ns	**40**	ns	**250**	ns
MW-701	8/15/1995	800	<2.0	23	3.4	**1.8**	**0.6**	1.2	0.54	**1.7**	0.25	49	*130*	0.76	--	--	**220**	100	20	1,352
	9/25/1995	680	1,100	17	2	**1**	**0.24**	0.67	0.3	**1.0**	0.4	29	*100*	0.36	--	--	**3,800**	81	11	5,824
	12/21/1998	420	<1.3	32	15	**7.7**	**5.4**	4.5	2.5	**7.6**	6.7	56	*92*	4.3	367	188	**3,740**	129	*98*	5,176
MW-701R	6/25/2002	2,500 D	<770 D	*1,300 D, **	<630	**420 D, ***	<470 D	<500 D	<430 D	**640 D, ***	63	**1,300 D, ***	**790 D, ***	<470 D	--	--	**9,400 D**	3,500 D	**1,800 D, ***	21,713
	11/7/2002	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	7/1/2003	310 D,*,&	17 &	<200 D	45	**35**	**16**	15	19	**42**	3.5 *	<130 D	<170 D	10	420 D,A,*,&	480 D,*,&	**2,200 D,&**	260 D, *	<170 D	3,873
PZ-701	8/17/1995	<1.0	<2.0	1.5	0.89	**0.43**	**0.21**	0.24	0.18	**0.61**	<0.10	3.3	1.0	<0.10	--	--	<1.0	6.6	2.1	17
	9/26/1995	<1.0	<2.0	0.25	0.13	<0.20	<0.050	<0.10	<0.050	*0.13*	<0.10	0.70	<0.40	<0.10	--	--	<1.0	0.8	0.77	2.8
	12/21/1998	<1.4	<1.3	0.23 *	0.25 *	<0.21	<0.12	<0.23	<0.23	<0.092	<0.25	0.60 *	0.42	<0.11	<0.94	<0.92	7.3	0.80	1.1 *	11
	6/25/2002	0.040 *	0.059 *	0.073	0.13	*0.100*	*0.084*	0.059	0.065	*0.092*	0.018 *	0.23	<0.021	0.058	--	--	0.18	0.10	0.19	1.5
	11/7/2002	0.11 *	0.087 *	0.15 *	0.19 *	*0.16*	*0.17*	0.16	0.14 *	*0.16*	<0.048	0.44 *	0.053	0.13 *	0.076 *	<0.051	0.34	0.38	0.38	3.1
	4/15/2003	<0.018	<0.019	0.023 *	0.019 *	0.017 *	0.017 *	0.017 *	<0.019	0.015 *	<0.016	0.029 *	<0.017	<0.021	0.045 *	0.045 *	0.067 *	0.032 *	0.034 *	0.4
	9/30/2003	0.043 *	0.13	0.23	0.42	**0.24**	*0.19*	0.15	0.17 &	**0.27**	0.067	0.82 D	0.056 *	0.14	0.046 *	0.042 *	0.22	0.89 D	0.82 D	4.9
MW-702	8/15/1995	390	<2.0	19	2.9	**1.4**	**0.32**	0.93	0.48	**1.5**	0.23	41	*150*	0.55	--	--	**7,300**	96	35	8,039
	9/25/1995	400	1,400	17	3.7	**1.8**	**0.66**	1.6	0.73	**1.9**	0.28	32	*140*	0.76	--	--	**6,400**	90	13	8,503
MW-703	8/15/1995	180	<2.0	17	1.4	**0.46**	*0.1*	0.24	0.16	**0.55**	0.17	28	70	0.16	--	--	**2,400**	74	9.2	2,781
	9/25/1995	220	430	14	1.2	**0.37**	*0.05*	0.34	0.12	**0.51**	0.23	19	54	0.19	--	--	**2,700**	58	5.9	3,504
	12/21/1998	262	<1.3	5.9	8.7	**2.4**	**1.7**	1.6	0.91	<0.092	<0.25	10	45	1.4	408	<0.92	**3,080**	24	16	3,868
MW-704	8/15/1995	770	<2.0	44	26	**22**	**8.9**	17	7.9	**19**	<0.10	*150*	*180*	10	--	--	**5,200**	220	*56*	6,731
dup(MW-799)	8/15/1995	660	<2.0	44	25	**21**	**8.7**	16	7.3	**19**	<0.10	*140*	*190*	9.2	--	--	**3,600**	220	*55*	5,015
	9/25/1995	440	1,400	20	5.0	**3.1**	**2.7**	<0.10	2.3	**3.5**	<0.10	36	*120*	<0.10	--	--	**4,200**	120	13	6,366
dup(MW-799)	9/25/1995	420	1,100	64	46	**38**	**14**	31	15	**31**	3.2	*210*	*170*	20	--	--	**3,100**	310	*83*	5,655
	12/21/1998	1.6 *	5.9	6.0	8.9	**9.5**	**8.1**	7.0	3.5	**4.4**	<0.25	21	10	7.7	14	3.6	*22*	19	26	178
dup(MW-B)	12/21/1998	1.6 *	<1.3	4.9	6.6	**7.6**	**6.0**	5.3	2.4	**3.0**	<0.25	16	6.8	5.8	9.5	<0.92	*17*	16	20	129
MW-705	8/15/1995	<1.0	<2.0	<0.20	<0.050	<0.20	<0.050	<0.10	<0.050	<0.10	<0.10	<0.20	<0.40	<0.10	--	--	<1.0	<0.40	<0.20	nd
	9/25/1995	<1.0	<2.0	<0.20	<0.050	<0.20	<0.050	<0.10	<0.050	<0.10	<0.10	<0.20	<0.40	<0.10	--	--	<1.0	<0.40	<0.20	nd
	12/21/1998	<1.4	<1.3	<0.10	<0.10	<0.21	<0.12	<0.23	<0.23	<0.092	<0.25	<0.23	<0.056	<0.11	<0.94	<0.92	<0.73	<0.11	<0.39	nd
dup(MW-A)	12/21/1998	<1.4	<1.3	<0.10	<0.10	<0.21	<0.12	<0.23	<0.23	<0.092	<0.25	<0.23	<0.056	<0.11	<0.94	<0.92	<0.73	<0.11	<0.39	nd
	6/25/2002	<0.018	<0.023	<0.020	<0.019	<0.012	<0.014	<0.015	<0.013	<0.018	<0.017	<0.028	<0.021	<0.014	--	--	<0.027	<0.019	<0.020	nd
dup(QA/QC-1)	6/25/2002	<0.018	<0.023	<0.020	<0.019	<0.012	<0.014	<0.015	<0.013	<0.018	<0.017	<0.028	<0.021	<0.014	--	--	<0.027	<0.019	<0.020	nd
	11/7/2002	<0.018	<0.019	<0.020	<0.012	0.017 *	0.013 *	<0.016	<0.019	<0.014	<0.016	0.016 *	<0.017	<0.021	<0.017	<0.017	<0.024	<0.016	<0.017	0.05
	4/15/2003	<0.018	<0.019	<0.020	<0.012	<0.014	<0.013	<0.016	<0.019	<0.014	<0.016	<0.013	<0.017	<0.021	<0.018	0.031 *	0.10	<0.016	<0.017	0.1
	7/1/2003	<0.018 &	<0.019 &	<0.020	<0.012	<0.014	<0.013	<0.016	<0.019	<0.014	<0.016	0.015 *	<0.017	<0.021	<0.018 A,&	<0.017 &	0.029 *,&,B	<0.016	0.018 *	0.1
	9/30/2003	<0.018	<0.019	<0.020	0.016 *	0.014 *	<0.013	<0.016	<0.019 &	0.014 *	<0.016	0.014 *	<0.017	<0.021	<0.018	<0.017	0.059 *	<0.016	0.020 *	0.1

Table 6. Groundwater Analytical Results - Polynuclear Aromatic Hydrocarbons
Wisconsin Public Service Corporation - Campmarina Former MGP Site
Sheboygan, WI

Sampling Location	Sampling Date	Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo (a) pyrene	Benzo (b) fluoranthene	Benzo (ghi) perylene	Benzo (k) fluoranthene	Chrysene	Dibenz (a,h) anthracene	Fluoranthene	Fluorene	Indeno (1,2,3-cd) pyrene	1-Methylnaphthalene	2-Methylnaphthalene	Naphthalene	Phenanthrene	Pyrene	Total PAHs
		POLYNUCLEAR AROMATIC HYDROCARBONS - PAHs (µg/L)																		
		Wisconsin Groundwater Quality Standards (NR 140)																		
Preventive Action Limit		ns	ns	*600*	ns	*0.02*	*0.02*	ns	ns	*0.02*	ns	*80*	*80*	ns	ns	ns	*8*	ns	*50*	ns
Enforcement Standard		ns	ns	**3,000**	ns	**0.2**	**0.2**	ns	ns	**0.2**	ns	**400**	**400**	ns	ns	ns	**40**	ns	**250**	ns
MW-706	8/15/1995	197,000	1,480,000	**177,000**	129,000	**83,000**	**31,000**	62,000	29,000	**82,000**	13,000	**266,000**	**640,000**	32,000	--	--	**1,900,000**	730,000	**142,000**	5,993,000
	9/25/1995	9,400	82,000	**15,000**	11,000	**6,700**	**2,400**	4,900	980	**5,400**	<10	**8,400**	**57,000**	2,700	--	--	**166,000**	56,000	**9,700**	437,580
	6/25/2002	<290 D	2,700 D	*1,400 D*	1,000 D	**830 D**	**270 D, ***	270 D, *	460 D, *	**920 D**	<270 D	**2,200 D**	**1,200**	320 D, *	--	--	**7,100 D**	3,200 D	**2,200**	24,070
	11/7/2002	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	7/1/2003	34 &	370 D,*,&	<200 D	<120 D	<140 D	**29**	21	31	<140 D	6.4	<130 D	<170 D	18	510 D,A,*,&	640 D,&	**2,200 D,&**	250 D, *	<170 D	4,109
PZ-702	12/21/1998	<1.4	<1.3	0.44	0.90	<0.21	**0.20 ***	<0.23	<0.23	**0.27 ***	<0.25	1.5	0.50	<0.11	<0.94	<0.92	1.2 *	1.5	2.3	8.8
	6/25/2002	<0.018	0.059*	<0.020	<0.019	<0.012	<0.014	<0.015	<0.013	<0.018	<0.017	<0.028	0.030*	<0.014	--	--	0.42	0.063	0.021 *	0.6
	11/7/2002	<0.018	0.023 *	<0.020	0.015 *	<0.014	<0.013	0.016 *	<0.019	*0.023 **	<0.016	0.039 *	0.020 *	<0.021	0.031 *	0.032 *	0.087	0.084	0.046 *	0.4
	4/15/2003	<0.018	<0.019	<0.020	0.013 *	<0.014	<0.013	<0.016	<0.019	<0.014	<0.016	0.013	0.017	<0.021	0.054 *	0.045 *	0.12	0.042 *	0.018 *	0.3
dup(QA/QC-1)	4/15/2003	<0.018	<0.019	<0.020	0.012 *	<0.014	<0.013	<0.016	<0.019	<0.014	<0.016	<0.013	<0.017	<0.021	0.042 *	0.072	0.20	0.026 *	<0.017	0.4
	7/1/2003	<0.018 &	0.037 *,&,B	<0.020	<0.012	<0.014	<0.013	<0.016	<0.019	0.014 *	<0.016	0.022 *	<0.017	<0.021	0.029 *,&,A,B	0.022 *,&,B	0.045 *,&,B	0.058 B	0.033 *	0.3
	9/30/2003	<0.018	<0.019	<0.020	<0.012	<0.014	<0.013	<0.016	<0.019 &	<0.014	<0.016	<0.013	<0.017	<0.021	<0.018	<0.017	0.049 *	0.019 *	<0.017	0.1
MW-707	8/15/1995	430	<2.0	12	2.2	**1.6**	**0.38**	1.3	0.52	**1.3**	0.25	27	*93*	0.74	--	--	**3,100**	60	12	3,742
	9/25/1995	240	1,400	10	0.4	**0.66**	**0.23**	0.83	0.19	**0.64**	0.40	21	*81*	0.35	--	--	**3,400**	60	5	5,221
	12/21/1998	221	<1.3	15	<0.10	**2.1**	<0.12	1.7	0.76	**2.2**	<0.25	28	64	1.3	454	<0.92	**3,470**	69	*58*	4,387
MW-707R	6/25/2002	< 120 D	6.4	6.2	1.8	**1.2**	**0.73 ***	0.61 *	0.51 *	**1.2**	<0.34	7.5	<130 D	0.48 *	--	--	**1,600 D**	<120 D	7.3	1,634
	11/7/2002	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	7/1/2003	<180 D,&	6.8 &	9	1.8 *	**1.5 ***	<1.3	<1.6	<1.9	**1.8 ***	<1.6	9.6	39	<2.1	270 D,A,*,&	18 &	**1,800 D,&**	<160 D	12	2,170
PZ-703	12/21/1998	<1.4	<1.3	0.20 *	0.22 *	<0.21	<0.12	<0.23	<0.23	<0.092	<0.25	0.25 *	0.44	<0.11	2.8 *	<0.92	**86**	0.53	0.64 *	91
	6/25/2002	1.2	<0.46	0.45 *	<0.38	<0.24	<0.28	<0.30	<0.26	<0.36	<0.34	<0.56	<0.42	<0.28	--	--	**190**	0.38 *	<0.40	192
	11/7/2002	<1.8	<1.9	<2.0	<1.2	<1.4	<1.3	<1.6	<1.9	<1.4	<1.6	<1.3	<1.7	<2.1	<1.7	<1.7	**41**	<1.6	<1.7	41
	4/15/2003	<1.4	<1.5	<1.6	<0.96	<1.1	<1.0	<1.3	<1.5	<1.1	<1.3	<1.0	<1.4	<1.7	<1.4	<1.4	*30*	1.4 *	<1.4	31
	7/1/2003	2.8 &,*	<1.9 &	<2.0	<1.2	<1.4	<1.3	<1.6	<1.9	<1.4	<1.6	<1.3	<1.7	<2.1	7.0 &,A	5.0 &,*	**410 D,&**	<1.6	<1.7	425
	9/30/2003	3.9	0.47 *	<0.40	<0.24	<0.28	<0.26	<0.32	<0.38 &	<0.28	<0.32	<0.26	0.41 *	<0.42	8.4	7.2	**350 D**	0.41 *	<0.34	371
MW-708	12/21/1998	<1.4	<1.3	<0.10	<0.10	<0.21	<0.12	<0.23	<0.23	<0.092	<0.25	<0.23	<0.056	<0.11	<0.94	<0.92	<0.73	<0.11	<0.39	nd
	6/25/2002	<0.018	<0.023	<0.020	<0.019	0.014 *	<0.014	<0.015	<0.013	<0.018	<0.017	<0.028	<0.021	<0.014	--	--	<0.027	<0.019	<0.020	0.01
	11/7/2002	<0.018	<0.019	<0.020	<0.012	<0.014	<0.013	<0.016	<0.019	<0.014	<0.016	<0.013	<0.017	<0.021	<0.017	<0.017	<0.024	<0.016	<0.017	nd
dup(QA/QC-1)	11/7/2002	<0.018	<0.019	<0.020	<0.012	<0.014	<0.013	<0.016	<0.019	<0.014	<0.016	<0.013	<0.017	<0.021	<0.017	<0.017	<0.024	<0.016	<0.017	nd
	4/15/2003	<0.018	<0.019	<0.020	<0.012	<0.014	<0.013	<0.016	<0.019	<0.014	<0.016	<0.013	<0.017	<0.021	0.019 *	0.026 *	0.088	<0.016	<0.017	0.1
	7/1/2003	0.056 *,&,B	0.032 *,&,B	<0.020	<0.012	<0.014	<0.013	<0.016	<0.019	<0.014	<0.016	<0.013	0.020 *,B	<0.021	0.20 A,&,B	0.20 B,&	1.5 B,D,&	0.024 *,B	<0.017	2.0
	9/30/2003	<0.018	<0.019	<0.020	<0.012	<0.014	<0.013	<0.016	<0.019 &	<0.014	<0.016	<0.013	<0.017	<0.021	<0.018	<0.017	0.23	<0.016	<0.017	0.2

Natural Resource Technology, Inc.

Table 6. Groundwater Analytical Results - Polynuclear Aromatic Hydrocarbons
Wisconsin Public Service Corporation - Campmarina Former MGP Site
Sheboygan, WI

Sampling Location	Sampling Date	Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo (a) pyrene	Benzo (b) fluoranthene	Benzo (ghi) perylene	Benzo (k) fluoranthene	Chrysene	Dibenz (a,h) anthracene	Fluoranthene	Fluorene	Indeno (1,2,3-cd) pyrene	1-Methylnaphthalene	2-Methylnaphthalene	Naphthalene	Phenanthrene	Pyrene	Total PAHs
		POLYNUCLEAR AROMATIC HYDROCARBONS - PAHs (µg/L)																		
		Wisconsin Groundwater Quality Standards (NR 140)																		
Preventive Action Limit		ns	ns	*600*	ns	*0.02*	*0.02*	ns	ns	*0.02*	ns	*80*	*80*	ns	ns	ns	*8*	ns	*50*	ns
Enforcement Standard		ns	ns	**3,000**	ns	**0.2**	**0.2**	ns	ns	**0.2**	ns	**400**	**400**	ns	ns	ns	**40**	ns	**250**	ns
MW-709	12/21/1998	3.4 *	<1.3	2.9	1.3	**0.30 ***	**0.51**	<0.23	<0.23	**0.66**	<0.25	6.6	3.3	<0.11	<0.94	<0.92	4.6	8.4	10	42
MW-709R	6/25/2002	0.13	<0.023	0.032*	<0.019	*0.10*	<0.014	<0.015	<0.013	<0.018	<0.017	<0.028	0.041 *	<0.014	--	--	1.8 D	0.084	0.027*	2.2
	11/7/2002	<0.018	<0.019	<0.020	<0.012	<0.014	<0.013	<0.016	<0.019	<0.014	<0.016	<0.013	<0.017	<0.021	<0.017	<0.017	<0.024	<0.016	<0.017	nd
	4/15/2003	<0.018	<0.019	<0.020	<0.012	<0.014	<0.013	<0.016	<0.019	<0.014	<0.016	<0.013	<0.017	<0.021	0.020 *	0.034 *	0.12	<0.016	<0.017	0.2
	7/1/2003	<0.018	<0.019	<0.020	<0.012	<0.014	<0.013	<0.016	<0.019	<0.014	<0.016	<0.013	<0.017	<0.021	0.020 *	0.019 *	0.040 *	<0.016	<0.017	0.1
dup(M)	7/1/2003	0.023 *,&,B	0.019 *	<0.020	<0.012	<0.014	<0.013	<0.016	<0.019	<0.014	<0.016	<0.013	<0.017	<0.021	0.084 A,&,B	0.044 *,&,B	0.74 B,D,&	<0.016	<0.017	0.9
	9/30/2003	<0.018	<0.019	<0.020	<0.012	<0.014	<0.013	<0.016	<0.019 &	<0.014	<0.016	<0.013	<0.017	<0.021	<0.018	<0.017	<0.024	<0.016	<0.017	nd
dup(M)	9/30/2003	<0.018	<0.019	<0.020	0.065	*0.059*	*0.066*	0.098	0.056 *,&	*0.057*	0.093	<0.013	<0.017	0.094	<0.018	<0.017	0.025*	<0.016	<0.017	0.6

[U-PAR/JTB 11/03]

Notes:

1) Concentrations that attain/exceed a preventive action limit (PAL) are shown in *italics and underlined*.
2) Concentrations that attain/exceed an enforcement standard (ES) are **underlined and bold**.
* : Laboratory note - Parameter detected above the limit of detection (LOD) but below the limit of Quantitation (LOQ).
A : Laboratory note-Laboratory Control Spike recovery not within control limits.
B : Laboratory note-Analyte present in method blank.
D : Laboratory note- Analyte value from diluted analysis.
& : Laboratory note-Precision not within control limits.
M : Field duplicate identity was erroneously identified (field duplicate or field blank)
<2.0 : Parameter not detected above the Limit of Detection indicated.
-- : Analysis was not performed
nd : Analyte not detected
ns : NR 140 standard not established
dup(QA/QC-1): Field duplicate sample (field identity shown in parentheses).

Table 7. Ecological-Risk Based Assessment Practical Quantitation Levels (PQLs)
Wisconsin Public Service Corporation - Campmarina Former MGP Site
Sheboygan, WI

Project Compound List	CAS Number	Aanalytical Method Number[cd]	Surface Water Eco-Risk Based		Sediment Eco-Risk Based	
			MDL* ug/L	PQL ug/L	MDL* ug/kg (dry wt.)	PQL ug/kg (dry wt.)
Volatile Organic Compounds						
Benzene	71-43-2	SW846-8260B		114		142
Ethylbenzene	100-41-4	SW846-8260B		14		175
Toluene	108-88-3	SW846-8260B		253		1220
Xylenes (Total)	1330-20-7	SW846-8260B		27		433
Semi volatile Organic Compounds						
Naphthalene	91-20-3	SW846-8270C		5.53		110
C1-naphthalenes	-	SW846-8270C		2.33		127
C2-napthalenes	-	SW846-8270C		0.86		146
C3-napthalenes	-	SW846-8270C		0.32		166
C4-napthalenes	-	SW846-8270C		0.12		188
Acenaphthylene	208-96-8	SW846-8270C		8.77		129
Acenaphthene	83-32-9	SW846-8270C		1.6		140
Fluorene	86-73-7	SW846-8270C		1.12		154
C1-fluorenes	-	SW846-8270C		0.4		174
C2-fluorenes	-	SW846-8270C		0.15		196
C3-fluorenes	-	SW846-8270C		0.055		220
Phenanthrene	85-01-8	SW846-8270C		0.55		170
Anthracene	120-12-7	SW846-8270C		0.59		170
C1-phenanthrene/anthracenes	-	SW846-8270C		0.21		191
C2-phenanthrene/anthracenes	-	SW846-8270C		0.091		213
C3-phenanthrene/anthracenes	-	SW846-8270C		0.04		237
C4-phenanthrene/anthracenes	-	SW846-8270C		0.016		261
Fluoranthene	206-44-0	SW846-8270C		0.2		202
Pyrene	129-00-0	SW846-8270C		0.29		199
C1-pyrene/fluoranthenes	-	SW846-8270C		0.14		220
Benzo(a)anthracene	56-55-3	SW846-8270C		0.064		240
Chrysene	218-01-9	SW846-8270C		0.058		241
C1-benzo(a)anthracene/chrysenes	-	SW846-8270C		0.024		266
C2-benzo(a)anthracene/chrysenes	-	SW846-8270C		0.014		288
C3-benzo(a)anthracene/chrysenes	-	SW846-8270C		0.0048		318
C4-benzo(a)anthracene/chrysenes	-	SW846-8270C		0.002		347
Benzo(b)fluoranthene	205-99-2	SW846-8270C		0.019		280
Benzo(k)fluoranthene	207-08-9	SW846-8270C		0.018		280
Benzo(a)pyrene	50-32-8	SW846-8270C		0.027		276
Perylene	198-55-0	SW846-8270C		0.026		276
Benzo(e)pyrene	192-97-2	SW846-8270C		0.026		276
Indeno(1,2,3-cd)pyrene	193-39-5	SW846-8270C		0.008		319
Dibenzo(a,h)anthracene	53-70-3	SW846-8270C		0.008		321
Benzo(g,h,i)perylene	191-24-2	SW846-8270C		0.013		313
Polychlorinated Biphenyls (PCBs)						
Total PCBs	1336-36-3	SW846-8082		0.00012		59.8
Inorganics						**mg/kg**
Aluminum	7429-90-5	SW846-6010B		87		-
Antimony	7440-36-0	SW846-7061A		80		2
Arsenic	7440-38-2	SW846-7061A		148		9.8
Barium	7440-39-3	SW846-6010B		220		-
Cadmium	7440-43-9	SW846-7131A		0.15		0.99
Chromium	7440-47-3	SW846-6010B		42		43
Copper	7440-50-8	SW846-6010B		1.58		32
Cyanide	57-12-5	SW846-9010B		5.2		0.0001
Iron	7439-89-6	SW846-6010B		-		20
Lead	7439-92-1	SW846-6010B		1.17		36
Manganese	7439-96-5	SW846-6010B		1000		460
Mercury	7439-97-6	SW846-7470A aq 7471A soil		0.0013		0.18
Nickel	7440-2-0	SW846-6010B		28.9		23
Selenium	7782-49-2	**SW846-7741A**		5		-
Silver	7440-22-4	SW846-6010B		0.12		1.6
Vanadium	7440-62-2	SW846-6010B		12		-
Zinc	7440-66-6	SW846-6010B		65.7		120

Table 7. Ecological-Risk Based Assessment Practical Quantitation Levels (PQLs)
Wisconsin Public Service Corporation - Campmarina Former MGP Site
Sheboygan, WI

* TBD - to be determined upon selection of laboratory.
Notes:
1. Surface water and sediment PQLs for BTEX are based on U.S. EPA, Region 5, RCRA Ecological Screening Levels (August 2003).

2. Sediment PQLs for PAHs are based on ESB (USEPA, 2003), normalized to 1% TOC. Surface water and sediment PQLs for PCBs are based on U.S. EPA, Region 5, RCRA Ecological Screening Levels (August 2003). Sediments must be reported on a dry wt basis. The reporting limits (RLs) must be based on the lowest-level standard in the calibration curve. Sample-specific RLs will vary based on the % solids of the sediment sample.

3. For hardness-dependent metals (beryllium, cadmium, chromium^{+3}, copper, lead, nickel and zinc), freshwater chronic criteria are based on soft water with a total hardness of 50 mg/L as $CaCO_3$. Soft water is common within Region 5 and this risk-based PQL may be recalculated when site-specific water hardness data is less than 50 mg/L. PQLs for metals in sediment represent Threshold Effect Concentrations as compiled in Wisconsin Department of Natural Resources. December 2003. Consensus-Based Sediment Quality Guidelines. Recommendations for Use & Application. Interim Guidance. WT-732 2003. PQL for cyanide is based on U.S. EPA, Region 5, RCRA Ecological Screening Levels (August, 2003). Surface water PQLs are based on U.S. EPA, Region 5, RCRA Ecological Screening Levels (August, 2003) and represent concentrations of dissolved metals. Surface water PQL for aluminum and iron represent National Ambient Water Quality Criteria.

Table 8. Human-Risk Based Assessment Practical Quantitation Levels (PQLs)
Wisconsin Public Service Corporation - Campmarina Former MGP Site
Sheboygan, WI

Project Compound List	CAS Number	Aanalytical Method Number[d]	Sediment Human Health Risk Based PQL	Surface Water Human Health Risk Based PQL		
			EPA Reg IX PRGs[a] (mg/kg, dry)	EPA Reg IX PRGs[b] (ug/L)	NRWQC[c] Organism Only (ug/L)	NRWQC[c] Water and Organism (ug/L)
Volatile Organic Compounds						
Benzene	71-43-2	SW846-8260B	0.6	0.34	51	2.2
Ethylbenzene	100-41-4	SW846-8260B	9	3	2100	520
Toluene	108-88-3	SW846-8260B	66	72	15000	1300
Xylenes	1330--20-7	SW846-8260B	27	21	-	-
Semivolatile Organic Compounds						
Non-Carcinogenic PAHs						
Acenaphthene	83-32-9	SW846-8270C	130	37	990	670
Acenaphthylene	208-96-8	SW846-8270C	-	-	-	-
Anthracene	120-12-7	SW846-8270C	6.1	180	40000	8300
Benzo(g,h,i)perylene	191-24-2	SW846-8270C	-	-	-	-
Fluoranthene	206-44-0	SW846-8270C	230	150	140	130
Fluorene	86-73-7	SW846-8270C	160	24	5300	1100
1-Methylnaphthalene	90-12-0	SW846-8270C	-	-	-	-
2-Methylnaphthalene	91-57-6	SW846-8270C	-	-	-	-
Naphthalene	91-20-3	SW846-8270C	6	0.6	-	-
Perylene	198-55-0	SW846-8270C	-	-	-	-
Phenanthrene	85-01-8	SW846-8270C	-	-	-	-
Pyrene	119-00-0	SW846-8270C	85	18	4000	830
Benzo(e)pyrene	192-97-2	SW846-8270C	-	-	-	-
Carcinogenic PAHs						
Benzo(a)anthracene	56-55-3	SW846-8270C	0.62	0.092	0.018	0.0038
Benzo(a)pyrene	50-32-8	SW846-8270C	0.062	0.009	0.018	0.0038
Benzo(b)fluoranthene	205-99-2	SW846-8270C	0.62	0.092	0.018	0.0038
Benzo(k)fluoranthene	207-08-9	SW846-8270C	6.2	0.92	0.018	0.0038
Chrysene	218-01-9	SW846-8270C	3.8	9.2	0.018	0.0038
Dibenzo(a,h)anthracene	53-70-3	SW846-8270C	0.062	0.009	0.018	0.0038
Indeno(1,2,3-cd)pyrene	193-39-5	SW846-8270C	0.62	0.092	0.018	0.0038
Polychlorinated Biphenyls (PCBs)						
Total PCBs	1336-36-3	TBD[e]	0.11	0.034	0.000064	0.000064
Inorganics						
Aluminum	7429-90-5	SW846-6010B	7600	3600	-	-
Antimony	7440-36-0	SW846-6010B	3.1	1.5	640	5.6
Arsenic	7440-38-2	SW846-7061A	0.39	0.045	0.14	0.018
Barium	7440-39-3	SW846-6010B	540	260	-	-
Cadmium	7440-43-9	SW846-7131A	4	2	-	-
Chromium (total)	16065-83-1	SW846-6010B	210	11	-	-
Copper	7440-50-8	SW846-6010B	310	150	-	1300
Cyanide (hydrogen)	57-12-5	SW846-9010B	1.1	0.62	140	140
Iron	7439-89-6	SW846-6010B	2300	1100	-	300
Lead	7439-92-1	SW846-6010B	400	-	-	-
Manganese	7439-96-5	SW846-6010B	180	88	100	50
Mercury	7439-97-6	SW846-7470A aq 7471A soil	2.3	1	-	-
Nickel	7440-02-0	SW846-6010B	160	73	4600	610
Selenium	7782-49-2	SW846-7741A	39	18	4200	170
Silver	7440-22-4	SW846-6010B	39	18	-	-
Vanadium	7440-62-2	SW846-6010B	55	26	-	-
Zinc	7440-66-6	SW846-6010B	2300	1100	26000	7400

[a]United States Environmental Protection Agency Region 9 Preliminary Remediation Goals (PRGs). October 2002. Revised February 2003. [URL: http://www.epa.gov/region09/waste/sfund/prg/].

[b]United States Environmental Protection Agency Region 9 Preliminary Remediation Goals (PRGs). October 2002. Revised February 2003. [URL: **http://www.epa.gov/region09/waste/sfund/prg/]**

[c]NRWQC: National Recommended Water Quality Criteria - Correction." USEPA Office of Water. For human health consumption of water and organism and organism only. EPA 822-Z-99-001. April 1999. Updated January 2004.

[d] "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods". Third Edition of SW-846, as updated by Updates I, II, IIA, IIB, III and IIIA. U.S.EPA

[e] TBD - To Be Determined, SW846-8082 MDL Range 0.054-0.90 ug/L and 57-70 ug/Kg

Table 9. Analytical Summary
Campmarina Former MGP Site , Sheboygan Wisconsin
Wisconsin Public Service Corporation

Sample *Type/Location*	Matrix	Parameter[1]	Method	Quantity[2]	Container Type	Minimum Volume	Preservation	Holding Time from Sampling Date[3]
Phase I Sampling Event								
Initial Screening Sheboygan River Sediment 0 to 6 inches below top of sediment to identify SLERA samples	Sediment (Mobile Laboratory)	Total PAHs	8270C	varies	Amber Glass	4 oz	not required for mobile laboratory unless samples are held more than 2 hours: cool to 4° C, dark	upon receipt
		Description	Field/ ASTM D2488	varies	NA	NA	NA	NA
SLERA Sheboygan River Sediment 0 to 6 inches below top of sediment	Sediment (Fixed Based Laboratory)	BTEX	8260B	23	Glass	2oz	methanol, cool to 4°C	7/28 days
		PAHs[4]	8270C	23	Amber Glass	4 oz	cool to 4° C, dark	14/40 days
		MGP Metals[5]	6010 (7471 for Hg)	23	Plastic	600 ml	HNO to pH<2	6 months
		PCBs	8082	23	Amber Glass	4 oz	cool to 4° C, dark	14/40 days
		"Soot" Carbon[6]	Gustaffson *et al.*	23	Plastic	500 g	cool to 4° C, dark	28 days
		Percent Solids	160.0	23	Glass	4 oz	cool to 4° C, dark	28 days
		Grain Size	ASTM D422	23	Glass or Plastic	8 oz[7]	NA	NA
		TOC	9060Dup/ASTM	23	Plastic	100 g	cool to 4° C, dark	28 days
		Description	Field/ ASTM D2488	23	NA	NA	NA	NA
		Biological Testing[8]	28-d *Hyallella*	23	Plastic	2 L		
HHRA Sheboygan River Sediment 0 to 2 feet below top of sediment	Sediment (Fixed Based Laboratory)	BTEX	8260B	20	Glass	2oz	methanol, cool to 4°C	7/28 days
		PAHs	8270C	20	Amber Glass	4 oz	cool to 4° C, dark	14/40 days
		MGP Metals[5]	6010/7471	20	Plastic	600 ml	HNO to pH<2	6 months
		PCBs	8082	20	Amber Glass	4 oz	cool to 4° C, dark	14/40 days
		TOC	9060Dup/ASTM	20	Plastic	100 g	cool to 4° C, dark	28 days
		Percent Solids	160.0	20	Glass	4 oz	cool to 4° C, dark	28 days
		Description	Field/ ASTM D2488	20	NA	NA	NA	NA
SLERA and ***HHRA*** Sheboygan River Surface Water (0.5 of water depth)	Water (Fixed Based Laboratory)	PAHs[4]	8270C	6	Amber Glass	1 liter	cool to 4° C, dark	14 days
		MGP Metals[5]	6010/7471	6	Plastic	600 ml	HNO to pH<2	6 months
		PCBs	8082	6	Amber Glass	1 liter	cool to 4° C, dark	14/40 days
		Temperature	field	6	NA	NA	NA	NA
		pH	field	6	NA	NA	NA	NA
		Specific Conductivity	field	6	NA	NA	NA	NA
		Dissolved Oxygen	field	6	NA	NA	NA	NA
		Turbidity	field	6	NA	NA	NA	NA
Phase II Sampling Event								
Define Extent Sheboygan River Sediment 1-ft intervals of Vibro-Cores	Sediment (Mobile Laboratory for COCs; 5% to Fixed Laboratory)	COCs[9]	varies	TBD				
		PCBs	8082	TBD	Amber Glass	1 liter	cool to 4° C, dark	14/40 days
		Atterberg Limits	ASTM D4318	1 per 5[10]	Glass or Plastic	8 oz	NA	NA
		Grain Size	ASTM D422	1 per 5[10]	Glass or Plastic	8 oz[7]	NA	NA
		Specific Gravity	ASTM D854	1 per 5[10]	Glass or Plastic	8 oz	NA	NA
	(Fixed Based Lab for Geotech)	Moisture Content	ASTM D2216	1 per 5[10]	Glass or Plastic	8 oz	NA	NA
		Organic Content	ASTM D2974	1 per 5[10]	Glass or Plastic	8 oz	NA	NA
		Classification	ASTM D2487	1 per 5[10]	NA	NA	NA	NA
		Shear Strength	Field; Pocket Penetrometer	1 per 5[10]	Core	NA	NA	NA
		Shear Strength	Field; Torvane	1 per 5[10]	Core	NA	NA	NA
Waste Characterization	Sediment (Fixed Based Laboratory)	Protocol B	varies	1[11]	Glass	26 oz	VOCs, methanol, cool to 4°C, dark; Others cool to 4° C, dark	varies

Table 9. Analytical Summary
Campmarina Former MGP Site , Sheboygan Wisconsin
Wisconsin Public Service Corporation

References:

A. Test Methods for Evaluating Solid Wastes, USEPA SW-846, revised 1991.
B. Code of Federal Regulations Chapter 40 Part 136.
C. American Society for Testing and Materials.

Notes:

1. The list of analytes and project quantitation limits for each parameter are included in Tables 7 and 8.
2. Sample quantity does not include QA/QC samples. Sample e frequency of QA/QC samples is detailed in Section 3 and Section 8 of the QAPP.
3. Extraction holding time/Analysis holding time. If sediment samples are frozen, holding time increases to one year.
4. A list of 34 PAHs, including chain parameters as provided in USEPA Guidance Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic Organisms: PAH Mixtures, 2002 by SW-846 Method 8270C with gas chromatograph/mass spectrometry in the selected ion mode of operation.
5. MGP Metals as provided in WDNR guidance, Assessing Sediment Quality at Manufactured Gas Plant Sites, March 1996. Includes aluminum, antimony, arsenic, barium, cadmium, chromium, copper, cyanide, iron, lead, manganese, mercury, nickel, selenium, silver, vanadium, and zinc.
6. "Soot" Carbon is the remaining carbon after muffle furnace drying and acid treatment of sediments to remove other forms of carbon. Used to estimate the bioavailable concentration of PAHs in sediment from the "freely-dissolved" chemical in the interstitial water based on USEPA Bioavailability Procedure, 2000, Gustafsson, et al. 1997, and Accardi-Day and Gschwend, 2003.
7. Assumes no gravel present. If significant gravel is present, collect 1 gallon.
8. The *Hyallella* (amphipod) 28-day test will be used to evaluate the toxicity of whole sediments. This test will be performed in accordance with USEPA.
9. COCs as defined in the SLERA and HHRA.
10. A minimum of one core will be collected for geotechnical parameters per every five cores collected for analytical analysis, subject to change based on field conditions. Geotechnical samples may be discrete intervals, or composite samples, depending on the conditions observed.
11. Composite sample for analysis of Protocol B to evaluate potential landfill disposal in the FS.

SLERA = Screening Level Ecological Risk Assessment
HHRA = Human Health Risk Assessment
BTEX = Benzene, Toluene, Ethylbenzene, and Xylenes.
PAHs = Polynuclear Aromatic Hydrocarbons

MGP = Manufactured Gas Plant
PCBs = Poly-Chlorinated Biphenyls
TOC = Total Organic Carbon
COCs = Chemicals of Concern
TBD = To Be Determined

Table 10. Analytical Quality Control Summary
Campmarina Former MGP Site , Sheboygan Wisconsin
Wisconsin Public Service Corporation

Sample *Type/Location*	Matrix	Parameter[1]	Method	Sample Quantity	MS/MSD	Blind Duplicate	Equipment Blank[2]	Trip Blank
Phase I Sampling Event								
Initial Screening Sheboygan River Sediment 0 to 6 inches below top of sediment to identify SLERA samples	Sediment (Mobile Laboratory)	Total PAHs	8270C	varies	varies	varies		
		Description	Field/ ASTM D2488					
SLERA Sheboygan River Sediment 0 to 6 inches below top of sediment	Sediment (Fixed Based Laboratory)	BTEX	8260B	23	2	2		27
		PAHs[4]	8270C	23	2	2		27
		MGP Metals[5]	6010 (7471 for Hg)	23	2	2		27
		PCBs	8082	23	2	2		27
		"Soot" Carbon[6]	Gustaffson *et al.*	23				23
		Percent Solids	160.0	23				23
		Grain Size	ASTM D422	23				23
		TOC	9060Dup/ASTM	23				23
		Description	Field/ ASTM D2488	23				23
		Biological Testing[8]	28-d *Hyallella*	23				23
HHRA Sheboygan River Sediment 0 to 2 feet below top of sediment	Sediment (Fixed Based Laboratory)	BTEX	8260B	20	1	1		22
		PAHs	8270C	20	1	1		22
		MGP Metals[5]	6010/7471	20	1	1		22
		PCBs	8082	20	1	1		22
		TOC	9060Dup/ASTM	20				20
		Percent Solids	160.0	20				20
		Description	Field/ ASTM D2488	20				20
SLERA and ***HHRA*** Sheboygan River Surface Water (0.5 of water depth)	Water (Fixed Based Laboratory)	PAHs[4]	8270C	6	1	1		8
		MGP Metals[5]	6010/7471	6	1	1		8
		PCBs	8082	6	1	1		8
		Temperature	field	6				6
		pH	field	6				6
		Specific Conductivity	field	6				6
		Dissolved Oxygen	field	6				6
		Turbidity	field	6				6
Phase II Sampling Event								
Define Extent Sheboygan River Sediment 1-ft intervals of Vibro-Cores	Sediment (Mobile Laboratory for COCs 5% to Fixed Laboratory)	COCs[9]	varies	**TBD**	TBD	TBD		**TBD**
		PCBs	8082	TBD	TBD	TBD		**TBD**
		Atterberg Limits	ASTM D4318	1 per 5 [10]				1 per 5 [10]
		Grain Size	ASTM D422	1 per 5 [10]				1 per 5 [10]
		Specific Gravity	ASTM D854	1 per 5 [10]				1 per 5 [10]
	(Fixed Based Lab for Geotech)	Moisture Content	ASTM D2216	1 per 5 [10]				1 per 5 [10]
		Organic Content	ASTM D2974	1 per 5 [10]				1 per 5 [10]
		Classification	ASTM D2487	1 per 5 [10]				1 per 5 [10]
		Shear Strength	Field; Pocket Penetrometer	1 per 5 [10]				1 per 5 [10]
		Shear Strength	Field; Torvane	1 per 5 [10]				1 per 5 [10]
Waste Characterization	Sediment (Fixed Based Laboratory)	Protocol B	varies	1[11]				1

Table 10. Analytical Quality Control Summary
Campmarina Former MGP Site , Sheboygan Wisconsin
Wisconsin Public Service Corporation

References:

A. Test Methods for Evaluating Solid Wastes, USEPA SW-846, revised 1991.
B. Code of Federal Regulations Chapter 40 Part 136.
C. American Society for Testing and Materials.

Notes:

1. The list of analytes and project quantitation limits for each parameter are included in Tables 7 and 8.
2. Dedicated or disposbale equipment will be used whenever possible to limit the number of equipment blanks required.
3. Extraction holding time/Analysis holding time. If sediment samples are frozen, holding time increases to one year.
4. A list of 34 PAHs, including chain parameters as provided in USEPA Guidance Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic Organisms: PAH Mixtures, 2002 by SW-846 Method 8270C with gas chromatograph/mass spectrometry in the selected ion mode of operation.
5. MGP Metals as provided in WDNR guidance, Assessing Sediment Quality at Manufactured Gas Plant Sites, March 1996. Includes aluminum, antimony, arsenic, barium, cadmium, chromium, copper, cyanide, iron, lead, manganese, mercury, nickel, selenium, silver, vanadium, and zinc.
6. "Soot" Carbon is the remaining carbon after muffle furnace drying and acid treatment of sediments to remove other forms of carbon. Used to estimate the bioavailable concentration of PAHs in sediment from the "freely-dissolved" chemical in the interstitial water based on USEPA Bioavailability Procedure, 2000, Gustafsson, et al. 1997, and Accardi-Day and Gschwend, 2003.
7. Assumes no gravel present. If significant gravel is present, collect 1 gallon.
8. The *Hyallella* (amphipod) 28-day test will be used to evaluate the toxicity of whole sediments. This test will be performed in accordance with USEPA.
9. COCs as defined in the SLERA and HHRA.
10. A minimum of one core will be collected for geotechnical parameters per every five cores collected for analytical analysis, subject to change based on field conditions. Geotechnical samples may be discrete intervals, or composite samples, depending on the conditions observed.
11. Composite sample for analysis of Protocol B to evaluate potential landfill disposal in the FS.

SLERA = Screening Level Ecological Risk Assessment
HHRA = Human Health Risk Assessment
BTEX = Benzene, Toluene, Ethylbenzene, and Xylenes.
PAHs = Polynuclear Aromatic Hydrocarbons
MS/MSD = Matrix Spike/Matrix Spike Duplicate

MGP = Manufactured Gas Plant
PCBs = Poly-Chlorinated Biphenyls
TOC = Total Organic Carbon
COCs = Chemicals of Concern
TBD = To Be Determined

APPENDIX A

QUALITY ASSURANCE PROJECT PLAN (QAPP)

QUALITY ASSURANCE PROJECT PLAN
For
Remedial Investigation/Feasibility Study
Former Campmarina Manufactured Gas Plant
Sheboygan, Wisconsin

Contract Number: SF-91-04

Prepared by:

Natural Resource Technology, Inc.
23713 West Paul Road, Suite D
Pewaukee, WI 53072

Approvals

[John Feeney– WDNR, Site Project Coordinator]	Date
[John O'Grady–USEPA, Site Project Coordinator]	Date
[Charlene Kahzae –WDNR QA Coordinator]	Date
[Richard H. Weber – Natural Resource Technology Inc., Project Manager]	Date
[Jennifer M. Kahler – Natural Resource Technology Inc., RI/FS Leader]	Date
[Clark J. Crosby – Natural Resource Technology Inc., Project Quality Assurance Officer]	Date
[TBD, FIXED-BASE LABORATORY, Laboratory Project Manager]	Date
[TBD, FIXED-BASE LABORATORY, Quality Assurance Director]	Date

QUALITY ASSURANCE PROJECT PLAN
(continued)

[TBD, MOBILE LABORATORY, Laboratory Project Manager] Date

[TBD, MOBILE LABORATORY, Quality Assurance Director] Date

[TBD, TOXICITY LABORATORY, Laboratory Project Manager] Date

[TBD, TOXICITY LABORATORY, Quality Assurance Director] Date

QUALITY ASSURANCE PROJECT PLAN DISTRIBUTION LIST

Name	Project Responsibility	Affiliation
John Feeney	Project Coordinator	WDNR
Charlene Kahzae	QA Coordinator	WDNR
Richard H. Weber	Project Manager	NRT
Jennifer M. Kahler	RI/FS Leader	NRT
Clark J. Crosby	Project QA Officer	NRT
TBD	Fixed-Base Laboratory Project Manager	TBD
TBD	Fixed-Base Laboratory QA Director	TBD
TBD	Mobile Laboratory Project Manager	TBD
TBD	Mobile Laboratory QA Director	TBD
TBD	Toxicity Laboratory Project Manager	TBD
TBD	Toxicity Laboratory QA Director	TBD

TABLE OF CONTENTS

FIGURES

TABLES

ATTACHMENTS

1.0 PROJECT DESCRIPTION

This Quality Assurance Project Plan (QAPP), presents the organization, objectives, planned activities, and specific Quality Assurance/Quality Control (QA/QC) procedures associated with the Remedial Investigation and Feasibility Study (RI/FS) for sediments in the Sheboygan River adjacent to the Campmarina former manufactured gas plant (MGP) (herein referred to as the site) in the City of Sheboygan, in Sheboygan County, Wisconsin.

Specific protocols for sampling, sample handling and storage, chain-of-custody, and laboratory and field analyses to be performed as part of the RI are described in this QAPP. All QA/QC procedures are structured in accordance with applicable technical standards, U.S. EPA's requirements, regulations, guidance, and technical standards.

This QAPP has been prepared in accordance with the USEPA Region 5 QAPP policy as presented in USEPA RCRA QAPP Instructions, (Revision April 1998), which includes the elements of Guidance for Quality Assurance Project Plans, (EPA QA/G-5, December 2002), Requirements for Quality Assurance Project Plans (EPA QA/R-5, March 2001), Guidance for the Data Quality Objectives Process (EPA QA/G-4, August 2000), and guidance as included in Contract SF-91-04.

Details of the project description are provided in the RI/FS Work Plan, dated July 9, 2004.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITY

At the direction of Contract SF-91-04 by the WDNR, WPSC and the City of Sheboygan have been identified as settling potential responsible parties (Settling PRPs). WPSC has taken the responsibility for all phases of the investigation. Natural Resource Technology, Inc. (NRT) is the principal consultant to WPSC and is responsible for the performance of all services required to implement each phase, including project management, field investigation, sub-consultants (drilling, surveying, laboratory, data validator), data management, data analysis, reporting, and any subsequent studies. The various quality assurances, field, laboratory and management responsibilities of key project personnel are defined below.

2.1 Project Organization Chart

The lines of authority specific to this investigation are presented in Figure 1 of this QAPP. Resumes for key QA personnel are included in Attachment 1 of this QAPP.

2.2 Management Responsibilities

John Feeney, WDNR, Former Campmarina MGP Site Project Coordinator

The WDNR has the overall responsibility for all phases of the investigation.

John O'Grady, USEPA, Former Campmarina MGP Site USEPA Coordinator

The USEPA will be responsible for oversight of all activities led by WDNR.

The Settling PRPs for the Former Campmarina MGP Site

The Settling PRPs, led by WPSC, are responsible for implementing the project, and have the authority to commit the resources necessary to meet project objectives and requirements. WPSC will report directly to the WDNR Project Coordinator and will provide the major point of contact and control for matters concerning the project. Connie Lawniczak is WPSC's primary point-of-contact. Ms. Lawniczak occasionally consults with Mark Thimke of Foley and Lardner for advice on legal, policy, and strategy matters.

Richard W. Weber, P.E., Natural Resource Technology, Inc., Project Manager (PM)

The PM has the responsibility for ensuring that the project meets WDNR's objectives. The PM will report directly to the Settling PRPs and the WDNR Project Coordinator and is responsible for technical and project oversight. The PM will:

- Define project objectives and develop a detailed work plan schedule;
- Establish project policy and procedures to address the specific needs of the project as a whole, as well as the objectives of each task;
- Acquire and apply technical and corporate resources as needed to assure performance within budget and schedule constraints;
- Develop and meet ongoing project and/or task staffing requirements, including mechanisms to review and evaluate each task product;
- Review the work performed on each task, with the technical assistance of NRT Senior Advisors, to ensure its quality, responsiveness, and timeliness;
- Review and analyze overall task performance with respect to planned requirements and authorizations;
- Review and approve all deliverables, with the technical assistance of NRT Senior Advisors, before their submission to WDNR; and,
- Represent the project team at meetings and public hearings.

Richard G. Fox, Laurie L. Parsons, P.E., Spiros L. Fafalios, P.E., Natural Resource Technology, Inc., Senior Technical Advisors

The PM will draw upon the talents and experience of the Senior Technical Advisors, as needed, for various project activities that may include, among other things:

- Agency interface and negotiations;
- Interpretation of investigation results;
- Development and assessment of appropriate remedial technologies;
- Input on feasibility cost estimates; and,
- Technical review of project deliverables.

<u>Jennifer M. Kahler, E.I.T., NRT, Remedial Investigation/Feasibility Study Leader (RI/FS Leader)</u>

The RI/FS Leader has the responsibility for implementation of specific project tasks identified at the Site, and is responsible for the supervision of NRT project personnel, subconsultants, and subcontractors. The RI/FS Leader reports directly to the Project Manager. The RI/FS Leader will:

- Define project objectives and develop work schedules;
- Orient all field leaders and support staff concerning the project's special considerations;
- Monitor and direct the field leaders;
- Develop and meet ongoing project and/or task staffing requirements, including mechanisms to review and evaluate each task product;
- Review the work performed on each task to ensure its quality, responsiveness, and timeliness;
- Review and analyze overall task performance with respect to planned requirements and authorizations;
- Ultimately be responsible for the preparation and quality of interim and final reports; and,
- Represent the RI project team at meetings.

2.3 Quality Assurance (QA) Responsibilities

Clark J. Crosby, NRT, Project QA Officer

The QA Officer will remain independent of direct job involvement and day-to-day operations, and have direct access to corporate executive staff as necessary, to resolve any QA dispute. He is responsible for auditing the implementation of the QA program in conformance with the demands of specific investigations, NRT's policies, and WDNR requirements. The QA Officer has sufficient authority to stop work on the investigation as deemed necessary in the event of serious QA issues. Specific function and duties include:

- Performing QA audits on various phases of the field operations;
- Reviewing and approving QA plans and procedures;
- Providing QA technical assistance to project staff;
- Reporting on the adequacy, status, and effectiveness of the QA program on a regular basis to the RI/FS Leader for technical operations; and,
- Responsible for the data validation of all sample results from the analytical laboratory.

Charlene Kahzae, WDNR Quality Assurance Coordinator (QAC)

The WDNR QAC has the responsibility to review and approve all QAPPs.

2.4 Other Key Project Responsibilities

Jody T. Barbeau, NRT, Field Leader

The NRT project manager will be supported by the NRT field team leader. He is responsible for leading and coordinating the day-to-day activities of the various resource specialists under his supervision. The NRT field team leader is an experienced environmental professional and will report directly to the NRT project manager. Specific field team leader responsibilities include:

- Provision of day-to-day coordination with the NRT RI/FS Leader on technical issues;
- Implementing of field-related work plans;
- Coordinating and managing field staff including sampling and drilling, and supervising mobile laboratory staff:
- Implementing QC for technical data provided by the field staff including field measurement data;
- Adhering to work schedules provided by the RI/FS Leader and/or advising of schedule delays;
- Authoring, writing, and approving of text and graphics required for field team efforts;
- Coordinating and overseeing technical efforts of subcontractors assisting the field team;
- Identifying problems at the field team level, resolving difficulties in consultation with the RI/FS Leader, implementing and documenting corrective action procedures, and provision of communication between team and upper management; and,
- Participating in preparation of final report.

Eric P. Kovatch, P.G., NRT, Senior Hydrogeologist

Eric Kovatch is very familiar with the site, having been involved in the RI/FS and subsequent remedial action for the upland MGP impacts, and for the initial sediment investigations performed y NRT. Mr. Kovatch will be a resource to the RI/FS Leader and Field Leader for hydrogeologic aspects of the RI.

Other NRT technical and support staff, including geologists, scientists, and CAD operators, will be added to the project team on an as-needed basis throughout the RI and FS activities.

2.5 Laboratory Responsibilities

The laboratories assigned with responsibility for chemical analyses (fixed-base and mobile) of environmental media and for toxicity testing are yet to be determined. NRT is in the process of pre-qualifying labs and soliciting proposals. The analytical laboratory procedures will follow the USEPA Contract Laboratory Program (CLP) and maintain NELAC national certification. The toxicity testing laboratory will maintain NELAC national certification for environmental toxicology and microbiology. The laboratory Quality Assurance Plans (QAP) and State/Federal certifications will be provided prior to field activities. The following personnel responsibilities are generally applicable to all analytical and toxicity testing laboratories.

Laboratory Client Services Manager

The laboratory client services manager is responsible for the management of the analytical requirements for sample analysis and will interface directly with the RI/FS Leader. The client services manager provides a complete interface with clients from initial project specification to final deliverables.

Laboratory Project Manager

The Laboratory Project Manager is a technical advisor and is responsible for summarizing and reporting overall unit performance. Responsibilities include:

- Provide technical, operational, and administrative leadership;
- Allocation and management of personnel and equipment resources;
- Quality performance of the facility;
- Certification and accreditation activities; and,
- Compliance with audits and corrective actions.

Quality Assurance Director (QA Director)

The QA Director has the overall responsibility for data after it leaves the laboratory. The QA Director will be independent of the laboratory but will communicate data issues through the Laboratory Director. In addition, the QA Director will:

- Oversee laboratory QA;
- Oversee QA/QC documentation;
- Conduct detailed data review;
- Determine whether to implement laboratory corrective actions, if required;
- Define appropriate laboratory QA procedures; and,
- Prepare laboratory SOPs.

QA review will be provided by the Laboratory Director and QA Director prior to release of all data to NRT.

Laboratory Sample Management Office

The Sample Management Office will report to the Laboratory Director. Responsibilities of the Sample Management Office will include:

- Receiving and inspecting the incoming sample containers;
- Recording the condition of the incoming sample containers;
- Verify sample pH;
- Verifying chain-of-custody;
- Notifying laboratory manager and laboratory supervisor of sample receipt and inspection;
- Assigning a unique identification number and customer number, and entering each into the sample receiving log;
- Initiate transfer of the samples to appropriate lab sections; and,
- Controlling and monitoring access/storage of samples and extracts.

Laboratory Technical Staff (TS)

The TS will be responsible for sample analyses and identification of corrective actions. The staff will report directly to the Laboratory Director.

2.6 Special Training Requirements and Certifications

The purpose of this section is to address any specialized or non-routine training requirements necessary for completion of the subject investigation. Sufficient information shall be provided to ensure that special training skills can be verified, documented and updated as necessary.

2.6.1 Training

Requirements for specialized training for non-routine field sampling techniques, field analyses, laboratory analyses, and data validation are specified below.

Non-routine field sampling techniques: Currently there are no non-routine field sampling techniques that require specialized training.

Non-routine field analyses: Currently there are no non-routine analyses that require specialized training.

Non-routine laboratory analyses: Currently there are no non-routine laboratory analyses techniques that require specialized training.

Data validation: Selected samples will be validated by MAKuehl Company. Data validation will be performed using the most current methods and quality control criteria from SW-846 and the USEPA's Contract Laboratory Program (CLP) National Functional Guidelines for Organic and Inorganic Data Review. Data validation will also be performed in accordance with the appropriate USEPA Region 5 standards. The CLP Data review guidance will be used only to the extent that it is applicable to the SW-846 methods; SW-846 methodologies will be followed primarily and given preference over CLP when differences occur.

2.6.2 Certification

The data validator, Marcia Kuehl, has attained certifications required for implementing this plan for MAKuehl Company. The data validator's resume is presented in Attachment 2 of this QAPP.

The names, addresses, and telephone numbers of key personnel are as follows:

Richard H. Weber: Project Manager	Natural Resource Technology, Inc. 23713 West Paul Road, Suite D Pewaukee, Wisconsin 53072 262.522.1237 (direct) 262.719.3868 (mobile) 262.523.9000 (office main line)
Jennifer M. Kahler: RI/FS Leader	Natural Resource Technology, Inc. 23713 West Paul Road, Suite D Pewaukee, Wisconsin 53072 262.522.1227 (direct) 262.719.4525 (mobile) 262.523.9000 (office main line)
Clark J. Crosby: Project Quality Assurance Officer	Natural Resource Technology, Inc. 23713 West Paul Road, Suite D Pewaukee, Wisconsin 53072 262.522.1197 (direct) 262.719.4510 (mobile) 262.523.9000 (office main line)
Jody T. Barbeau: Field Leader	Natural Resource Technology, Inc. 23713 West Paul Road, Suite D Pewaukee, Wisconsin 53072 262.522.0393 (direct) 262.719.4515 (mobile) 262.523.9000 (office main line)

TBD: Fixed-Base Laboratory Client Services Manager	TBD
TBD: Mobile Laboratory Client Services Manager	TBD
TBD: Toxicity Laboratory Client Services Manager	TBD

3.0 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA

The overall QA objective is to implement procedures to assure data of sufficient quality to meet or exceed the objectives of this project. The objective of this QAPP is to address the processes required to provide data that meet the project objectives through the following procedures/specifications:

- Collection, preservation, packaging, and transporting surface water and sediment samples;
- Field data collection activities;
- Record keeping;
- Data management;
- Chain-of-custody procedures;
- Analytical methods; and
- Precision, accuracy, completeness, representativeness, decision rules, comparability and level of quality control effort conformance for sample analysis.

Analytical methods and detection/reporting limits for chemical parameters to be analyzed in water and sediment during this RI/FS for ecological and human health risk assessments are listed in Table 7 and 8, respectively, of the Work Plan. A summary of analytical parameters to be analyzed for each matrix and sampling activity is provided in Table 9 of the Work Plan. Select water quality parameters (i.e., pH, turbidity, specific conductance, Eh, temperature and dissolved oxygen) will be measured in the field as described in the FOPs located in Attachment 1 of the Sampling and Analysis Plan (SAP) included as Appendix B of the Work Plan.

The goals for precision, accuracy, and completeness intended for use on this project are discussed in Sections 3.1 through 3.3. Laboratory quality assurance objectives are presented in the analytical laboratory's QA/QC Plan, which will be provided prior to field activities.
All data will be reported completely. No data will be omitted unless an error occurred in the analyses or the run was invalidated because of QC sample recovery or poor precision.

3.1 Precision

Precision is a measurement of the degree to which two or more measurements are in agreement, which is quantitatively assessed based on standard deviation. Precision in the laboratory is assessed through the calculation of relative percent difference (RPD) and calculation of relative standard deviations (RSD) for three or more replicate samples. The equations to be used to verify precision in this RI/FS are found in Section 12.1 of this QAPP. General precision goals are provided in Table 1 of this QAPP.

For inorganic parameters, precision will be assessed through the analysis of sample/sample duplicate pair and field duplicate pairs. Laboratory precision will be assessed through the analysis of matrix spike/matrix spike duplicate (MS/MSD) and field duplicate samples for organic parameters.

Precision for field parameters, including pH, turbidity, specific conductance, Eh, temperature, and dissolved oxygen, will be determined through duplicate analysis of 1 in every 20 samples. Precision control limits for field measured parameters are provided in Table 2 of this QAPP.

3.2 Accuracy

Accuracy is the degree of agreement between an observed value and an accepted reference of true value. Accuracy in the field is assessed through the use of field blanks and trip blanks and through the adherence to all sample handling, preservation and holding times. One trip blank will accompany each batch of aqueous sample containers shipped to the laboratory. Laboratory accuracy is assessed through the analysis of a matrix spike/matrix spike duplicate (MS/MSD) (1 per 20 samples), standard reference materials (SRM), laboratory control samples (LCS), and surrogate compounds. The equation to be used for accuracy for this RI is found in Section 12.1 of this QAPP. Accuracy control limits for the laboratory are given in Table 1 of this QAPP.

Accuracy for field measured parameters including pH, turbidity, specific conductance, Eh, temperature, and dissolved oxygen will be assessed through instrument calibration standards discussed in instrument calibration and maintenance FOPs (see Section 4.0). Accuracy control limits are provided in Table 2 of this QAPP.

3.3 Completeness

Data completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions. Analytical and field completeness will be addressed by applying data quality checks and assessments described in Section 3.1 and 3.2 and Section 9.0 to ensure that the data collected are valid and significant.

As shown on Table 1 of this QAPP, the laboratory completeness objectives for the RI will be 90 percent or greater. A third party data validator will follow procedures described in Section 9.2 to assess the completeness and validity of laboratory data deliverables. For the RI, 100 percent of all laboratory analytical results will be validated. The completeness of an analysis will be documented by including in the report sufficient information to allow the data validator to assess the quality of the results. The information delivered may include such items as chromatograms, spectra, QC data, and summaries of results. Additional information, such as the laboratory worksheets and notes, will be stored with the sample results in the laboratory. The raw data will be archived for at least five years by the laboratory. All analytical information will be retained by the laboratory regardless of whether NRT requests the substantiation of results.

3.4 Data Representativeness

Data representativeness expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition within a defined spatial and/or temporal boundary. All proposed field testing and measurement procedures will follow the Work Plan and QAPP using proper sampling techniques.

As described in Section 10.0, Performance System Audits and the proper execution of field activities are the main mechanism for ensuring data representativeness. Representativeness in the laboratory is ensured through the use of the proper analytical procedures, appropriate methods, meeting sample holding times, and analyzing field duplicate samples.

3.5 Comparability

Data comparability expresses the confidence with which one data set can be compared to another data set. Procedures for field measurements, contained in Attachment 1 of the SAP included in Appendix B of the Work Plan, will ensure that tests performed at various locations across the Site are conducted using accepted procedures, in a consistent manner between locations and over time, and including appropriate QA/QC procedures to ensure the validity of the data. Sampling procedures for environmental matrices are provided in Section 4.0 to ensure that samples are collected using accepted field techniques.

Environmental samples will be analyzed by a laboratory to be determined using protocols for sample preservation, holding times, sample preparation, analytical methodology, and QC as described in USEPA SW-846.

Planned analytical data will be comparable when similar sampling and analytical methods are used as documented in the QAPP. Comparability is also dependent on similar QA objectives. The parameter units to be used for this RI are listed in Table 3 of this QAPP.

3.6 Level of QC Effort for Sample Parameters

Field blank, method blank, trip blank, field duplicate, laboratory duplicate, laboratory control, standard reference materials (SRM) and matrix spike samples will be analyzed to assess the quality of the data resulting from the field sampling and analytical programs. QC samples are discussed below and summarized in Table 10 of the Work Plan.

- Trip blanks consisting of ASTM Type II water prepared by the laboratory will be submitted to the analytical laboratories with aqueous volatile organic compound (VOC) samples to provide the means to assess the quality of the data resulting from the field-sampling program.
- Field (equipment) blank samples are analyzed to check for procedural chemical constituents at the facility that may cause sample contamination.
- Trip blanks are used with aqueous VOC samples to assess the potential for contamination of samples due to contaminant migration during sample shipment and storage.
- Method blank samples are generated within the laboratory and used to assess contamination resulting from laboratory procedures.
- Duplicate samples are analyzed to check for sampling and analytical reproducibility.
- MS/MSD samples provide information about the effect of the sample matrix on the digestion and measurement methodology. Depending on site-specific circumstances, one MS/MSD should be collected for every 20 or fewer investigative organic compound samples of a given matrix.

The general level of QC effort will be one field duplicate and one field blank for every 20 or fewer investigative samples. One trip blank consisting of ASTM Type II ultra pure water will be included along with each sample delivery group of aqueous VOC samples. Sampling procedures are specified in Attachment 1 of the SAP included in Appendix A of this Work Plan.

4.0 SAMPLING PROCEDURES/FIELD SAMPLING PLAN

(REFER TO APPENDIX B OF THE WORK PLAN)

5.0 CUSTODY PROCEDURES

Sample custody is controlled and maintained through the chain-of-custody procedures. Chain of custody is the means by which the possession and handling of samples will be tracked from the source (field) to their final disposition, the laboratory. A sample is considered to be in a person's custody if it is in the person's possession or it is in the person's view after being in his or her possession or it was in that person's possession and that person has locked it in a vehicle or room. Sample containers will be cleaned and preserved at the laboratory before shipment to the site.

The following section and FOP Sampling, Labeling, Storage, and Shipment, located in Attachment 1 of the SAP included in Appendix B of the Work Plan, describe procedures for maintaining sample custody from the time samples are collected to the time they are received by the analytical laboratory. The laboratory's chain-of-custody procedures will be provided prior to field activities.

5.1 Field Custody Procedures

Field logbooks will provide the means of recording data collecting activities performed during the investigation. As such, entries will be described in as much detail as possible so that persons going to the facility could reconstruct a particular situation without reliance on memory.

Field logbooks will be bound page numbered field survey books or notebooks. Logbooks will be assigned to field personnel, but will be stored in the document control center 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:

- Person to whom the logbook is assigned;
- Logbook number;
- Project name;
- Project start date; and,
- End date.

Entries into the logbook will contain a variety of information. At the beginning of each day, the date, start time, weather, names of all sampling team members present, level of personal protection equipment being used, and the signature of the person making the entry will be entered. 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 logbook.

Measurements made and samples collected will be recorded. All entries will be made in permanent ink, signed, and dated and no erasures will be made. If an incorrect entry is made, the information will be crossed out with a single strike mark that is initialed and dated by the sampler. Whenever a sample location is surveyed, which includes compass and distance measurements or, latitude and longitude information (e.g., obtained by using a global positioning system) shall be recorded. In the event that photographs are taken to document field activities, the number and brief description of the photographs taken will also be recorded. All equipment used to make measurements will be identified, along with the date of calibration.

Samples will be collected following the sampling procedures documented in Section 4.0 of this QAPP. The equipment used to collect samples will be noted, along with the time of sampling, sample description, depth at which the sample was collected, 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.

The sample packaging and shipment procedures summarized below will ensure that the samples will arrive at the laboratory with the chain-of-custody intact. The protocol for specific sample numbering and other sample designations are included in an FOP provided in Attachment 1 of the SAP included in Appendix B of this Work Plan of this QAPP. Examples of field custody documents and instructions for completion are also presented in Attachment 1 of the SAP included in Appendix B of the Work Plan of this QAPP.

- The field sampler is personally responsible for the care and custody of the samples until they are transferred or properly dispatched. Field procedures have been designed such that as few people as possible will handle the samples.
- All bottles will be identified by the use of sample tags with sample numbers, sampling locations, date/time of collection, and type of analysis. The sample numbering system is presented in the FOP.
- Sample labels will be completed for each sample using waterproof ink.

- Samples will be accompanied by a properly completed chain-of-custody form (see FOP). 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.

- Samples will be properly packaged on ice at 4oC for shipment and dispatched to the appropriate laboratory for analysis, with a separate signed custody record enclosed in and secured to the inside top of each sample box or cooler. Shipping containers will be locked and secured with strapping tape and custody seals for shipment to the laboratory. The custody seals will be attached to the front right and back left of the cooler and covered with clear plastic tape after being signed by the field team leader. The cooler will be strapped shut with strapping tape in at least two locations.

5.2 Laboratory Custody Procedures

Laboratory custody procedures for sample receiving and log-in; sample storage and numbering; tracking during sample preparation and analysis; and storage of data will be provided prior to field activities.

5.2.1 Sample Receipt

A sample custodian is responsible for receiving samples, completing chain-of-custody records, determining and documenting the condition of samples received through the Cooler Receipt form, logging samples into the LIMS system, and storing samples in appropriate limited-access storage areas. Chain-of-custody documentation is also maintained for the transfer of samples between the laboratory, and for shipment of samples to subcontracted laboratories.

Upon sample receipt, an inventory of shipment contents is compared with the chain-of-custody record, and any discrepancies, including broken containers, inappropriate container materials or preservatives, headspace in volatile organics samples, and incorrect or unclear sample identification, are documented and communicated immediately to the appropriate project manager.

Each sample is given a unique laboratory code and an analytical request form is generated.

5.2.2 Sample Storage

Samples are stored in secure limited-access areas. Walk-in coolers or refrigerators are maintained at 4 ± 2° C or as required by the applicable regulatory program. The temperatures of all refrigerated storage areas are monitored and recorded a minimum of once per day. Deviations of temperature from the applicable range require corrective action, including moving samples to another storage location if necessary.

5.2.3 Sample Custody

Sample custody is defined by this document as when:

- It is in someone's actual possession;
- It is in someone's view after being in their physical possession;
- It was in someone's possession and then locked, sealed, or secured in a manner which prevents unsuspected tampering; or,
- It is placed in a designated and secured area.

Samples are removed from storage areas by the sample custodian or analysts and transported to secure laboratory areas for analysis. Access to the laboratory and sample storage areas is restricted to laboratory personnel and escorted visitors only; all areas of the laboratory are therefore considered secure. If required by the applicable regulatory program, internal chain-of-custody is documented in a log by the person moving the samples between laboratory and storage areas.

Laboratory documentation used to establish COC and sample identification may include the following:

- Field COC forms or other paperwork that arrives with the sample;
- The laboratory COC;
- Sample labels or tags attached to each sample container;
- Sample custody seals;
- Sample preparation logs (i.e., extraction and digestion information) recorded in hardbound laboratory books that are filled out in legible handwriting, and signed and dated by the chemist;
- Sample analysis logs (e.g., metals, GC/MS, etc.) information recorded in hardbound laboratory books that are filled out in legible handwriting, and signed and dated by the chemist;
- Sample storage log (same as the laboratory COC); and,
- Sample disposition log, which documents sample disposal by a contracted waste disposal company.

5.2.4 Sample Tracking

All samples are maintained in the appropriate coolers prior to and after analysis. The analysts remove and return their samples as needed. Samples that require internal COC are relinquished to the analysts by the sample custodians. The analyst and sample custodian must sign the original COC relinquishing custody of the samples from the sample custodian to the analyst.

When the samples are returned, the analyst will sign the original COC returning sample custody to the sample custodian. Sample extracts are relinquished to the instrumentation analysts by the preparatory analysts. Each preparation department tracks internal COC through their logbooks/spreadsheets.

Any change in the sample during the time of custody will be noted on the COC (i.e., sample breakage or depletion).

5.2.5 Sample Disposal

A minimum of thirty days following completion of the project, or after a period of time specified by any applicable project requirements, sample disposal is performed in compliance with federal, state, and local regulations. Alternatively, samples may be returned to the client by mutual agreement. All available data for each sample, including laboratory analysis results and any information provided by the client, are reviewed before sample disposal.

All samples are characterized according to hazardous/non-hazardous waste criteria and are segregated accordingly. All hazardous waste samples are disposed of according to formal procedures outlined in the laboratory's Standard Operating Procedure (SOP). It should be noted that all waste produced at the laboratory, including the laboratory's own various hazardous waste streams, is treated in accordance with all applicable state and Federal laws.

Complete Internal Chain of Custody documentation is maintained for some samples from initial receipt through final disposal. This ensures that an accurate history of the sample from "cradle to grave" is generated. Internal Chain Documentation through disposal shall be in place by the start date of field activities.

5.3 Project File

The project file will be the central repository for all documents, which constitute evidence relevant to sampling and analysis activities as described in this QAPP. NRT is the custodian of the evidence file and maintains the contents of evidence files for the investigation, including all relevant records, reports, logs, field notebooks, pictures, subcontractor reports and data reviews in a secured, limited access area and under custody of the NRT project manager. NRT will be maintaining a project file. The project file will include at a minimum:

- Field logbooks;
- Field data and data deliverables;
- Photographs;
- Drawings;
- Soil boring logs;
- Laboratory data deliverables;
- Data validation reports;
- Data Assessment reports;
- Progress reports, QA reports, interim project reports, etc.; and,
- All custody documentation (tags, forms, air bills, etc.).

6.0 CALIBRATION PROCEDURES AND FREQUENCY

This section describes the calibration procedures and the frequency at which these procedures will be performed for both field and laboratory instruments.

6.1 Field Instrument Calibration

Quantitative field data to be obtained during surface water sampling include pH, Eh, turbidity, specific conductance, and temperature. Qualitative field data to be obtained during soil sampling include screening soil samples for the presence of volatile organic constituents. This screening will include headspace evaluations using either a photoionization (PID) or a flame ionization detector (FID).

FOPs located in Attachment 1 of the SAP included in Appendix B of the Work Plan describe the instruments typically used to measure water quality (pH, Eh, turbidity, specific conductance, and temperature) and the calibration methods, standards, and frequency requirements for each instrument. At a minimum, calibration of field instruments will be conducted once per day, prior to beginning field activities. Calibration results will be recorded in the Project Field Book.

6.2 Laboratory Instrument Calibration

All equipment and instruments used at the laboratory will be operated, maintained and calibrated according to the manufacturer's guidelines and recommendations, as well as to criteria set forth in the applicable analytical methodology. Operation and calibration are performed by personnel who have been properly trained in these procedures. Documentation of calibration information is maintained in appropriate reference files. The frequency of calibration and concentration of calibration standards are determined by the manufacturer's guidelines and the analytical method. Generally, purchased standards have a shelf life of 12-36 months and prepared standards have a shelf life of 1-12 months. Recalibration is required at anytime the instrument is not operating correctly or functioning at the proper sensitivity.

7.0 ANALYTICAL PROCEDURES

Surface water and sediment samples collected during field sampling activities for the Campmarina Former MGP sediment investigation will be analyzed by a laboratory to be determined.

7.1 Field Analytical Procedures

Field procedures for collecting and preserving sediment samples are described in FOPs located in Attachment 1 of the SAP included in Appendix B of the Work Plan.

Samples may also be evaluated for shear strength using a pocket penetrometer and torvne.

7.2 Laboratory Analytical Procedures

This section describes the analytical procedures to be followed in the laboratory. Laboratory analytical procedures will follow USEPA methods contained in SW-846. Analytical methods, method detection limits, and reporting limits selected for use in this RI/FS are listed in Tables 7 and 8 of the Work Plan for surface water and sediment matrices, respectively. Table 9 of the Work Plan (Analytical Summary) lists the number of samples and analytical methods anticipated for use in this RI/FS. Table 10 of the Work Plan provides a summary of the quality control samples which will be submitted to the laboratory. A laboratory to be determined will provide analytical services. The selected laboratory's QA manual and copies of the State or Federal Certifications will be submitted in Attachment 3 of this QAPP to the WDNR prior to sample analysis for this project. General laboratory analytical procedures and sample handling procedures will be included in the laboratory's QA manual, to be submitted prior to field activities in Attachment 3 of this QAPP.

Samples may also be tested by a geotechnical laboratory for soil properties such as Atterberg Limits, grain size distribution (sieve and hydrometer), moisture content, specific gravity, and total organic content using testing procedures standardized by the American Society of Testing Materials (ASTM).

7.2.1 Sample Preparation and Analytical Methods

The laboratory will implement the project required SOPs. The laboratory SOPs for sample preparation, cleanup and analysis are based on SW-846 Update III, ASTM and USEPA procedures. The SOPs provide sufficient details specific to the methods identified for this project.

7.2.2 Confirmation Analysis Methods

The laboratory SOPs will identify the confirmatory analysis appropriate for this project. The basis for these SOPs are SW-846 Update III, ASTM and USEPA procedures. These protocols include second column confirmation for the gas chromatography methods.

In addition confirmatory analysis may be performed by the evaluation of field duplicates. Although analyte concentrations between duplicates analyses may vary, the target analytes present should be the same. This can be considered confirmation analysis.

7.2.3 Method Validation

In order to demonstrate that the laboratory is capable of detecting and quantitating analytes at specific levels required by regulatory agencies or clients, each laboratory establishes method detection limits (MDLs), instrument detection limits (IDLs), and practical quantitation limits (PQLs), as required by the specific method protocols. These limits, along with other related detection or quantitation limits, are defined as follows:

- Method Detection Limit (MDL) - the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero. The MDL is a theoretical, statistically-derived value determined by preparing at least seven replicates of a low-level spiked matrix, which are taken through the entire sample preparation and analysis procedure; the standard deviation of the results is multiplied by the appropriate student's t value at the 99% confidence level to obtain the MDL. The laboratory will perform MDL studies using the procedure defined in 40 CFR Part 136, Appendix B, Definition and Procedure for the Determination of the Method Detection Limit - Revision 1.11. MDLs are determined for each method and instrument annually, at a minimum, or when significant modifications to the procedure or instrumentation have been made, as determined by laboratory manager.

- *Practical or Estimated Quantitation Limit* (PQL or EQL) - an estimate of the lowest concentration of a substance that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operations. Typically, the PQL (EQL) is a nominal value selected at a level between 3 and 10 times the MDL.

8.0 INTERNAL QUALITY CONTROL CHECKS

8.1 Field Quality Control Checks

The QC criteria for each field measurement are provided in Table 1 and 2 of this QAPP. Assessment of field sampling precision and bias will be made by collecting field duplicates and field blanks for laboratory analysis. Collection of the samples will be in accordance with the applicable FOPs described in Section 4.0 of this QAPP at the frequency indicated in Section 3.0 of this QAPP.

Blind duplicate surface water and sediment samples will be collected to allow determination of analytical precision. One duplicate sample of each matrix will be collected for every 20 samples or per sampling event if less than 20 samples are collected. Duplicate sample aliquots for surface water will be collected sequentially as grab samples after collection of the initial sample aliquot. Duplicate sediment sampling is best accomplished by splitting the sample from a composite sample. Duplicate sediment samples for VOC analysis will be a discrete sample collected from the same interval, if possible, or location. The sample location will not be disclosed to the analytical laboratory.

One (1) equipment blank will be collected for each day of sampling activity when non-dedicated sampling equipment is used. The equipment blank samples will be used as a QC check of the decontamination procedures for sampling equipment. A VOC trip blank will be included in each cooler containing surface water matrix samples and sent to the laboratory for VOC analysis.

8.2 Laboratory Quality Control Checks

The internal QC checks and SOPs for laboratory analyses of sediment and surface water samples that will be collected during the RI/FS will be included in the laboratory's QA Manual to be submitted prior to field investigations. In general, laboratory analytical internal QA/QC will be conducted in accordance with USEPA SW 846 to ensure the reliability and validity of the analysis performed at the laboratory. The checks include internal QC methods covering the following:

- surrogate spikes;
- duplicates;
- preparation blanks;
- calibration;
- lab quality control samples; and,
- reagent checks.

A site-specific MS/MSD sample will be analyzed as a further QC check. The matrix spike samples will be analyzed at the same frequency as the duplicate samples (1 per every 20 samples collected or 1 per sample set if less than 20). The matrix spike samples will allow accuracy to be determined by using the percent recovery of the spiked compounds. The purpose of the MS/MSD samples is to monitor any possible matrix effects specific to samples collected from the Site. Acceptable QC limits for the MS/MSD samples are found in USEPA SW 846. The specific sample location that will be used for matrix spikes may be chosen by the Project RI/FS Leader, or Project QA Officer.

All data obtained will be properly recorded. The data package will include a full deliverable package capable of allowing the recipient to reconstruct QC information and compare it to QC criteria. Any samples analyzed in nonconformance with the QC criteria will be reanalyzed by the laboratory, if sufficient volume is available.

9.0 DATA REDUCTION, VALIDATION, AND REPORTING

All data generated through field activities, or by the laboratory operation shall be reduced and validated prior to reporting. The laboratory shall not disseminate data until it has been subjected to the procedures summarized in the subsections below.

9.1 Data Reduction

9.1.1 Field Data Reduction Procedures

Field measurements of pH, Eh, turbidity, temperature, and specific conductance are read directly in the units of final use, as discussed in Section 3.0 of this QAPP and listed in Table 3 of this QAPP. Field personnel are responsible for monitoring the collection and reporting of field data. Field personnel will review field measurements at the time of measurement and will re-measure a parameter as necessary to assure quality and accuracy are maintained.

All field data will be recorded on appropriate field data record forms or into field log books immediately after measurements are taken and maintained in NRT's office project file. If errors are made, results will be legibly crossed out, initialed and dated by the field member, and corrected in a space adjacent to the original (erroneous) entry. The Project QA Officer will review field procedures and compare field data to previous measurements to assess comparability and accuracy of the field data measurements.

9.1.2 Laboratory Reduction Procedures

Results of laboratory analyses will be reported in units of final use, as discussed in Section 3.0 and listed in Table 3 of this QAPP. Laboratory calculations will be performed as prescribed for a given analytical method or in conformance with acceptable laboratory standards at the time the calculation is performed.

The laboratory will retain quality assurance/quality control records for at least five years. Original laboratory reports will be stored in the NRT project files. Copies of raw data will be available for review at the laboratory. Copies of raw data may be requested as part of the QA/QC review. For this project, NRT has requested a fully validatable data package. The data package request will include the following information:

1. Transmittal letter with appropriate signatures
2. Sample identification numbers; and sample tag numbers
3. Analytical method used
4. Name of analyst
5. Date of analysis
6. Matrix sampled
7. Reagent concentrations
8. Instrument settings
9. Sample analytical results (including copies of Form I and strip chart printouts)
10. Method blank results
11. Surrogate recovery results for appropriate organic methods, including associated EPA or laboratory acceptance criteria
12. Chain of Custody documents
13. Case narrative
14. Calibration summaries and results of initial and continuing calibration verification standards, with calculated recoveries
15. Method blank summaries
16. Sample quantitation report
17. Standards preparation information

Prior to issuing the laboratory reports, the laboratory QA Manager will review the final data report. The Project RI/FS Leader, Project QA Officer, or appropriate personnel assigned by the

Project Manager will review the laboratory data. Section 12.0 outlines the procedures for evaluating the accuracy and precision of data. If comparison of data to previous measurements or known conditions at the Site indicates anomalies, the laboratory will be instructed to review the submitted data while NRT reviews the methods used to obtain the data. If anomalies remain, the laboratory may be asked to re-analyze selected samples.

9.2 Data Validation

Data validation procedures shall be performed for both field and laboratory operations as described below.

9.2.1 Procedures Used to Validate Field Data

Procedures to validate field data for this project will be facilitated by adherence to FOPs identified in Attachment 1 of the SAP included in Appendix B of the Work Plan. The performance of all field activities, calibration checks on all field instruments at the beginning and end of each day of use, manual checks of field calculations, checking for transcription errors and review of field log books is the responsibility of the Field Team Leader.

9.2.2 Procedures Used to Validate Laboratory Data

Procedures to validate laboratory data will be in accordance with the most current methods and quality control criteria from the USEPA'S Contract Laboratory Program, (CLP) National Functional Guidelines for Organic Data Review (EPA 540/R-99/008, 1999) and Contract Laboratory Program, National Functional Guidelines for Inorganic Data Review (EPA 540/R-94/012, 1994) and as appropriate to the methods in this QAPP. Data validation will also be performed in accordance with the appropriate Region 5 procedures, USEPA Region 5, Standard Operating Procedure for Validation of CLP Organic Data, April 1991, revised February 1997, last revised November 2002. The CLP data review guidance will be used only to the extent that it is applicable to the SW-846 methods; SW-846 methodologies will be followed primarily and given preference over CLP when differences occur. Essentially, all technical holding times shall be reviewed, instrument performance check sample results shall be evaluated, results of initial and continuing calibration will be reviewed and evaluated by trained reviewers independent of the laboratory. The role of the data validator is indicated in Section 2.0 of this QAPP. Also, results of blanks, surrogate spikes, MS/MSDs, laboratory control samples, and target compound identification and quantitation will be reviewed/evaluated by the data validator. All sample analytical data for each sample matrix shall be validated.

The data validator will also evaluate the overall completeness of the data package. Completeness checks will be administered on all data to determine whether deliverables specified in the QAPP are present. At a minimum, deliverables will include sample chain-of-custody forms, analytical results, QC summaries, and supporting raw data from instrument printouts. The reviewer will determine whether all required items are present and request copies of missing deliverables.

9.3 DATA REPORTING

Data reporting procedures shall be carried out for field and laboratory operations as indicated below.

9.3.1 Field Data Reporting

All RI field documents will be accounted for when they are completed. Accountable documents include items such as field notebooks including tabulated results of all measurements made in the field and documentation of all field calibration activities, sample logs, field data records, photographs, data packages, computer disks, and reports.

9.3.2 Laboratory Data Reporting

Laboratory data will be submitted to the WDNR after the independent validation activity has been concluded. The NRT QA Officer and RI/FS Leader will perform a final review of the report summaries and case narratives to determine whether the report meets project requirements. In addition to the record of chain-of-custody, the report format will include a case narrative, analytical data summarized in tabular format with such information as sample identification, sample matrix description, parameters analyzed and their corresponding detected concentrations, and the detection limit. Analytical results will be incorporated into reports as data tables, maps showing sampling locations and analytical results, and supporting text, as appropriate.

10.0 PERFORMANCE SYSTEM AUDITS AND FREQUENCY

Performance and system audits of both field and laboratory activities will be conducted to verify that sampling and analysis are performed in accordance with the procedures established in the sampling plan and QAPP. The audits of field and laboratory activities include two independent parts; internal and external.

10.1 FIELD PERFORMANCE AND SYSTEM AUDITS

10.1.1 Internal Field Audits

The NRT QA Officer will conduct internal audits of field activities including sampling and field measurements. These audits will verify that all established procedures are being followed. Internal field audits will be conducted at least once at the beginning of the field sampling/collection activities. Project staging may warrant subsequent audits if re-mobilization is necessary.

The audit program consists of the following:

- Examine daily field records, field sampling records, field screening analytical results, field instrument operating records, and any other data collection sheets during and after field measurements; and,

- Observe field activities to confirm that sample collection, handling and packaging, including chain-of-custody procedures, are in compliance with the established procedures, project protocols, and standard accepted methods, as detailed in the FOPs located in Attachment 1 of the SAP included in Appendix B of the Work Plan.

10.1.2 External Field Audits

The WDNR Site Project Coordinator may conduct external field audits at any time during the field operations. These audits may or may not be announced and are at the discretion of the WDNR. External field audits will be conducted according to the field activity information presented in the QAPP. The external field audit process may include (but not limited to):

- Sampling equipment decontamination procedures;
- Sample bottle preparation procedures;
- Sampling procedures;
- Examination of field sampling and safety plans;
- Sample QA procedures
- Procedures for verification of field duplicates;
- Sample preservation and preparation for shipment; and
- Field screening practices.

10.2 LABORATORY PERFORMANCE AND SYSTEMS AUDITS

The adequacy and implementation of the laboratory's quality assurance plan are assessed on an ongoing basis through systems and performance audits. Systems audits evaluate practices against established quality system objectives and requirements. Performance audits measure the comparability and accuracy of laboratory data through the analysis of reference materials for which the true value is unknown to the analyst. Audits may be performed by the laboratory (internal), or by clients, regulatory agencies, or accreditation bodies (external).

10.2.1 Internal Laboratory Audits

The internal laboratory audit will be conducted by the laboratory Quality Assurance (QA) Coordinator. The internal system audits will be done on an annual basis while the internal performance audits will be conducted on a quarterly basis to evaluate the laboratory's quality system and range of test capabilities. The audits are conducted to determine the following:

- Whether the procedures defined in the quality system are being followed;
- Whether the objectives defined in the quality system are being achieved; and,
- Identify opportunities for improvement.

The QA Coordinator prepares an audit plan for each audit, which defines the scope of the audit, requirements that the audit will be conducted against, and the audit technique(s) to be used (observation, record review, interview). The internal system audits may include, but not limited to, an examination of laboratory documentation on sample receiving, sample log-in, sample storage, chain-of-custody procedures, sample preparation and analysis, and instrument operating records. The performance audits will involve preparing blind QC samples and submitting them along with project samples to the laboratory for analysis throughout the project. The laboratory Quality Assurance (QA) Manager will evaluate the analytical results of these blind performance samples to ensure the laboratory maintains acceptable QC performance.

The results of each audit are reported to the Laboratory Director and Supervisors for review and comment. Any deficiencies noted by the auditor are summarized in an audit report and corrective action is taken within a specified length of time to correct each deficiency. Should problems impacting data quality be found during an internal audit, any client whose data is adversely impacted will be given written notification if not already provided.

10.2.2 External Laboratory Audits

Upon client, regulatory agency, or accreditation body notification of intent to audit, the quality assurance officer notifies laboratory personnel and corporate quality assurance. During the audit, the Lab Project Manager and Lab QA Director, or a designee, provides escort for the auditors, and participates in the pre-audit and post-audit conferences. Additional laboratory personnel are called upon as necessary during the course of the audit. An external audit may be conducted, as appropriate, by WDNR. These audits may or may not be announced and are at the discretion of the WDNR.

External audits may include any or all of the following:

- Review of laboratory analytical procedures;
- Laboratory on-site visits, and/or;
- Submission of performance evaluation samples to the laboratory for analysis;
- Failure of any or all audit procedures chosen can lead to laboratory disqualification, and the requirement that another suitable laboratory be chosen;

An external on-site review may consist of:

- Sample receipt procedures;
- Custody and sample security and log in and sample tracking procedures;
- Calibration records;
- Instrument logs and statistics (number and type);
- Review of QA procedures;
- Review of logbooks;
- Review of sample preparation procedures;
- Sample analytical SOP review;
- Instrument (normal or extends quantitation report) reviews;
- Personnel interviews;
- Review of deadlines and glassware prep; and,
- A close out to offer potential corrective action.

It is common practice when conducting an external laboratory audit to review one or more data packages from sample lots recently analyzed by the laboratory. This review will most likely include but not be limited to:

- Comparison of resulting data to the laboratory SOP or method, including coding for deviations;
- Verification of initial and continuing calibrations within control limits;
- Verification of surrogate recoveries and instrument tuning results where applicable;
- Review of extended quantitation reports for comparisons of library spectra to instrument spectra, where applicable;
- Recoveries on control standard runs;
- Review of run logs with run times, ensuring proper order of runs;
- Review of spike recoveries/QC sample data;
- Review of suspected manually integrated GC data and its cause (where applicable);
- Review of GC peak resolution for isolated compounds as compared to reference spectra (where available); and,
- Assurance that samples are run within holding times.

All data will be reviewed while on the premises, so that any questionable data can be discussed with the staff.

Following the audit, the QA Officer provides a written summary of the audit to the laboratory director, department supervisors, and QA Director. The summary includes the areas reviewed, and strengths and deficiencies identified during the audit.

The Lab QA Director initiates the corrective action process for each finding and is responsible for ensuring timely corrective action. The Lab QA Director prepares the audit report response, and prepares any follow-up responses as corrective actions are completed.

11.0 PREVENTATIVE MAINTENANCE

11.1 FIELD INSTRUMENT PREVENTATIVE MAINTENANCE

Each piece of field equipment is checked according to its routine maintenance schedule and before field activities begin. Field instruments will be checked and calibrated daily before use. Calibration checks will be documented on the daily field logs. Critical spare parts such as tape and batteries will be kept on-sit to reduce potential downtime. Backup instruments and equipment will be available on-site or within 1-day shipment to avoid delays in the filed schedule.

Equipment that may be used in the field for this RI/FS includes the following:

- Water quality meter (includes pH, Eh, turbidity, temperature and specific conductance, and dissolved oxygen); and,
- Photoionization Detector or Flame Ionization detector.

Field personnel will report all equipment maintenance and/or replacement needs to the Project QA Officer and will record the information on the daily field record. Calibration and Maintenance FOPs are provided in Attachment 1 of the SAP included in Appendix B of the Work Plan.

11.2 LABORATORY INSTRUMENT PREVENTATIVE MAINTENANCE

As part of the QA Plan, a routine preventative maintenance program will be conducted by the laboratory to minimize the occurrence of instrument failure and other system malfunctions. Designated laboratory employees regularly perform routine instrument maintenance tasks (or coordinate with the vendor). All maintenance that is performed is documented in the laboratory's operating record. All maintenance that is performed is in accordance with the manufacturer's specifications and is documented in the laboratory's maintenance logbooks.

Preventative maintenance procedures, frequency with which components of key analytical instruments or equipment are serviced, and other pertinent information are available for each instrument identified in the laboratory's QAM.

11.3 INSPECTION/ACCEPTANCE REQUIREMENTS FOR SUPPLIES AND CONSUMABLES

11.3.1 Field Supplies and Consumables

For this RI/FS, critical supplies will be tracked in the following manner.

Item	Date Received	Condition	Responsible Individual
Tyvek suits			
Latex gloves			
Respirator Cartridges			
Sample Containers			
Decon Materials			
Alconox detergent			
pH buffer solutions			
Calibration solutions			

Labels indicating the following information on receipt and testing are to be used for critical supplies and consumables:

- Unique identification number (if not clearly shown);
- Date received;
- Date opened;

- Date tested (if performed);
- Date to be retested (if applicable); and,
- Expiration date (if applicable).

11.3.2 Laboratory Supplies and Consumables

Items have traceable documentation (e.g., labels or logbooks) for date received, date opened, and date expired.

Critical Supplies & Consumables	Inspection/ Acceptance Testing Requirements	Acceptance Criteria	Testing Method	Frequency	Responsible Individual	Handling/ Storage Conditions
Standards	Refer to the Manufacturer's Certificate of Analysis.					
Acids	< RL's for common lab contaminants	< RL's all elements	SW-846	Each Lot	Receiving / Laboratory Personnel	Vented Acid Cabinets
Solvents	< RL's for common lab contaminants	< RL's for common lab contaminants	SW-846	Each Lot	Receiving / Laboratory Personnel	Vented Solvent Cabinets

12.0 SPECIFIC ROUTINE PROCEDURES USED TO EVALUATE DATA PRECISION, ACCURACY, AND COMPLETENESS

The purpose of this section is to indicate the methods by which it will be ensured that the data collected for this investigation is in accordance with the data quality objectives (DQOs) for the Site. Factors considered in this RI/FS include:

- The risk assessment parameters chosen based on conditions and possible receptors associated with the project (i.e. ecological data quality levels, human health data quality levels, soil screening guidance, etc.);
- The chemical constituents known and/or suspected to be of concern, as they relate to the data quality level parameters chosen; and,
- The choice of analytical and sample preparation methods for chemical constituents of concern, whose method detection limits will meet or exceed the data quality level concentrations for the chemical constituents of concern.

Once these goals and objectives are evaluated and chosen, analytical data quality will be assessed to determine if the objectives have been met. In addition, the data will be reviewed for indications of interferences to results caused by sample matrices, cross contamination during sampling, cross contamination in the laboratory, and sample preservation and storage anomalies (i.e. samples holding time or analytical instrument problems).

As discussed in Section 3, the validity of data will be evaluated in terms of precision, accuracy, and completeness. Described below are ways in which these three parameters will be evaluated. Evaluations will be performed upon completion of RI field activities.

12.1 ACCURACY ASSESSMENT

Accuracy - Data accuracy, which is assessed for laboratory data only, is based on recoveries. In order to assure the accuracy of the analytical procedures, an environmental sample shall be spiked with a known amount of the analytes. The increase in concentration of the analyte observed in the spiked sample, due to the addition of known quantity of the analyte, compared to the reported value of the same analyte in the un-spiked sample determines the percent recovery.

Percent recovery (%R) for MS/MSD results is determined according to the following equation:

$$R\% = \frac{(A - B)}{T} \times 100$$

Where A = Amount in spiked sample
B = Amount in sample
T = Known amount added (true value of spike)

Percent recovery (%R) for LCS and surrogate compound results is determined according to the following equation:

$$R\% = \frac{\text{Experimental concentration} \times 100}{\text{Known amount added}}$$

This information is reviewed periodically by the Project RI/FS Leader or Project QA Officer. The goals for the recovery of any constituent in a spiked or QA/QC sample are presented in Table 1 of this QAPP.

12.2 PRECISION ASSESSMENT

Precision - For data generated by the laboratory, data precision is estimated by comparing analytical results from duplicate samples. The comparison is made by calculating the relative percent difference (RPD) given by:

$$RPD\% = \frac{2(S_1 - S_2)}{S_1 + S_2} \times 100$$

Where S_1 = sample result
S_2 = duplicate result

This information is calculated and reviewed periodically by the Project RI/FS Leader and/or Project QA Officer. The goals for data precision for duplicate samples are presented in Table 1 of this QAPP. For data generated in the field, the precision goals are summarized in Table 2 of this QAPP.

12.3 COMPLETENESS ASSESSMENT

Completeness - Data completeness will be evaluated by comparing the objectives of the RI/FS efforts with the data obtained and determining whether there are any shortcomings in required information. A series of protocols, described below, will be used to evaluate data completeness. The purpose is to accomplish the following:

- Rigorously assess the quality and adequacy of data collected during the RI/FS;
- Review data collected during the RI/FS to evaluate if the study's objectives are being addressed and met; and,
- Ensure that the data collected are valid by applying the quality checks described in this and other sections of the QAPP.

Completeness is the ratio of the number of valid sample results to the total number of samples analyzed with a specific matrix and/or analysis. Following completion of the analytical testing, the percent completeness will be calculated by the following equation:

$$\% \text{ completeness} = \frac{A}{B} \times 100$$

Where: A = number of valid measurements;
B = number of measurements planned

The goals for data completeness for laboratory measurements were presented previously in Table 1 of this QAPP.

12.4 ASSESSMENT OF DATA

Laboratory analytical data and field data will be reviewed by the Project Manager, RI/FS Leader and QA Officer in accordance with procedures and protocols outlined in this QAPP to assess the integrity of the data generated during this RI. An assessment will be made to determine if the project objectives described in Section 1.0 have been achieved. Corrective Action described in Section 13.0 will be implemented, if necessary, to meet objectives for data integrity.

Only data generated in association with QC results meeting the objectives presented in Section 3 will be considered useable for decision making purposes. In addition, the data obtained will be both qualitatively and quantitatively assessed. The assessment will be performed the by the QA Officer and the results presented and discussed in the final investigation report. Factors to be considered in this assessment of field and laboratory data will include, but not necessarily be limited to, the following:

- Were all samples obtained using the methodologies and SOPs proposed in the QAPP?

- Were all proposed analyses performed according to the SOPs provided in the QAPP?
- Were samples obtained from proposed sampling locations and depths?
- Do any analytical results exhibit elevated detection limits due to matrix interferences or contaminants present at high concentrations?
- Were any analytes not expected to be present at the facility, identified as either target parameters or Tentatively Identified Compounds (TICs)?
- Were all field and laboratory data validated according to the validation protocols, including project-specific QC objectives, proposed in the QAPP?
- Which data sets were found to be unusable (qualified as "R") based on data validation results?
- Which data sets were found to be usable for limited purposes (qualified as "J") based on data validation results?
- What affect do qualifiers applied as a result of data validation have on the ability to implement the project decision rules?
- Has sufficient data of appropriate quality been generated to support a human health and/or ecological screening risk assessment?
- Can valid conclusions be drawn for all matrices at each unit and/or area under investigation?
- Were all issues requiring corrective action, as presented in the monthly progress reports fully resolved?
- Have any remaining data gaps been identified and summarized in the final investigation report?
- Based on the overall findings of the investigation and this assessment, were the original project objectives appropriately defined? If not, have revised project objectives been developed?

13.0 CORRECTIVE ACTION

Corrective action is the process of identifying, recommending, approving, and implementing measures to counter unacceptable procedures or out of quality control performance that can affect data quality. Corrective action can occur during field activities, laboratory analyses, data validation, and data assessment. All corrective action proposed and implemented should be documented in the regular quality assurance reports to management. Corrective action should be implemented only after approval by the Project Manager or his or her designee (e.g., the RI/FS Leader). If immediate corrective action is required, approvals secured by telephone from the Project Manager should be documented in an additional memorandum.

For noncompliance problems, a formal corrective action program will be determined and implemented at the time the problem is identified. In the field, the person who identifies the problem is responsible for notifying the RI/FS Leader, who will notify the Project Manager, who in turn will notify WPSC and the WDNR Project Coordinator. If the problem is analytical in nature, information will be promptly communicated to the WDNR Project Coordinator via fax or telephone during that same day or the next business day. Implementation of corrective action will be confirmed in writing through the same channels.

Any nonconformance with the established QC procedures in the QAPP or sampling plan will be identified and corrected in accordance with the QAPP. The Project Manager or RI/FS Leader, or his or her designee, will issue a nonconformance report for each nonconformance condition. If noncompliance is observed in the laboratory or during data validation, the analyst or data validator will notify the Project Manager or RI/FS Leader and communication will continue in the same manner as described above.

13.1 FIELD CORRECTIVE ACTION

If errors in field procedures are found during the observation or review of field activities by the NRT QA Officer or his designee, corrective action will be initiated. Nonconformance to the QA/QC requirements of the field operating procedures (FOPs) will be identified by field audits or immediately by project staff who know or suspect that a procedure is not being performed in accordance with the requirements. The NRT QA Officer or his designee will be informed immediately upon discovery of all deficiencies. Timely action will be taken if corrective action is necessary.

Corrective action in the field may be needed when the sample network is changed (i.e., more/less samples, sampling locations other than those specified in the QAPP, etc.) or when sampling procedures and/or field analytical procedures require modification due to unexpected conditions. In general, the RI/FS Leader, Project Manager, and QA Officer may identify the need for corrective action. The field staff will recommend a corrective action. The Project Manager or RI/FS Leader will approve the corrective measure that will be implemented by the field team. It will be the responsibility of the Project Manager or RI/FS Leader to ensure that corrective action has been implemented.

If the corrective action will supplement the existing sampling plan (i.e., additional soil borings) using existing and approved procedures in the QAPP, corrective action approved by the Project Manager or RI/FS Leader will be documented. If the corrective actions result in less samples (or analytical fractions), alternate locations, etc., which may result in non-achievement project QA objectives, it will be necessary that all levels of project management, including the WDNR Project Coordinator, concur with the proposed action.

Corrective action resulting from internal field audits will be implemented immediately if data may be adversely affected due to unapproved or improper use of approved methods. The NRT QA Officer will identify deficiencies and recommend corrective action to the Project Manager or

RI/FS Leader. The RI/FS Leader and field team will implement corrective actions. Corrective action will be documented in QA reports to the entire project management team.

Corrective actions will be implemented and documented in the project field record book. No staff member will initiate corrective action without prior communication of findings through the proper channels. If corrective actions are insufficient, work may be stopped by the WNDR Project Coordinator.

If at any time a corrective action issue is identified which directly impacts project DQOs, the WDNR Project Coordinator will be notified immediately.

13.2 LABORATORY CORRECTIVE ACTION

Corrective action in the laboratory may occur prior to, during and after initial analyses. A number of conditions such as broken sample containers, multiple phases, low/high pH readings, potentially high concentration samples may be identified during sample log-in or just prior to analysis. It may be necessary for the laboratory QA Director to approve the implementation of corrective action. The laboratory QAP specifies some conditions during or after analysis that may automatically trigger corrective action or optional procedures. These conditions may include dilution of samples, additional sample extract cleanup, automatic reinjection/reanalysis when certain QC criteria are not met.

The bench chemist will identify the need for corrective action. The laboratory manager/director will approve the required corrective action to be implemented by the laboratory staff. The laboratory QA Director will ensure implementation and documentation of the corrective action. If the nonconformance causes project objectives not to be achieved, it will be necessary to inform all levels of project management, including the WDNR, to concur with the corrective action.

These corrective actions are performed prior to release of the data from the laboratory. The corrective action will be documented in both the laboratory's corrective action log (signed by

14.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

The deliverables associated with the tasks identified in the Work Plan and quarterly progress reports will contain separate QA sections in which data quality information collected during the task is summarized. Those reports will be the responsibility of the NRT Project Manager and will include the NRT QA Officer report on the accuracy, precision, and completeness of the data, as well as the results of the performance and system audits, and any corrective action needed or taken during the project.

14.1 CONTENTS OF PROJECT QA REPORTS

The QA reports will contain on a routine basis, all results of field and laboratory audits, all information generated during the past quarter reflecting on the achievement of specific DQOs, and a summary of corrective action that was implemented, and its immediate results on the project. The status of the project with respect to the Project Schedule included in this QAPP will be determined. Whenever necessary, updates on training provided, changes in key personnel, anticipated problems in the field or laboratory for the coming month that could bear on data quality along with proposed solutions, will be reported. Detailed references to QAPP modifications will also be highlighted. All QA reports will be prepared in written, final format by the Project Manager or his or her designee. To the extent possible, assessment of the project should also be performed on the basis of available QC data and overall results in relation to originally targeted objectives.

In the event of an emergency, or in case it is essential to implement corrective action immediately, QA reports can be made by telephone to the appropriate individuals, as identified in the Project Organization and Corrective Action sections of this QAPP. However, these events, and their resolution will be addressed thoroughly in the next QA report.

14.2 FREQUENCY OF QA REPORTS

The QA Reports will be prepared on a quarterly basis and will be delivered to all recipients by the end of the first full week of the quarter. The reports will continue without interruption, until the project has been completed.

14.3 INDIVIDUALS RECEIVING/REVIEWING QA REPORTS

All individuals identified in the Project Organization chart will receive copies of the monthly QA Report.

15.0 REFERENCES

American Society for Testing and Materials (ASTM), Annual, Book of ASTM Standards: Construction, Vol. 4.08 and 4.09: Soil and Rock (I and II). ASTM, Philadelphia, PA.

Unified Soil Classification System (USCS), January 1986.

U.S. Environmental Protection Agency (USEPA), 1988, Guidance for Conducting RI/FS under CERCLA, IPA/540/G-89/004, 1988.

U.S. Environmental Protection Agency (USEPA), Test Methods for Evaluating Solid Wastes, Third Edition, Revised 1991.

U.S. Environmental Protection Agency (USEPA), Contract Laboratory Program National Functional Guidelines for Superfund, Inorganic Methods Data Review, (EPA-540/R-94/012), 1994).

U.S. Environmental Protection Agency (USEPA), Region V, Resource Conservation and Recovery Act, Quality Assurance Project Plan, Revision 1998.

U.S. Environmental Protection Agency (USEPA), Contract Laboratory Program National Functional Guidelines for Superfund, Organic Methods Data Review, OSWER 9240.1-44, (EPA-540-R-99-008), 1999.

U.S. Environmental Protection Agency (USEPA), Guidance for the Data Quality Objectives Process (EPA QA/G-4) (EPA 600/R-96/055), August 2000.

U.S. EPS, August 2000, QA/G-4, Guidance for the Data Quality Objectives Process.

U.S. Environmental Protection Agency (USEPA), Requirements for Quality Assurance Project Plans for Environmental Data Operations (EPA QA/R-5). March 2001.

U.S. Environmental Protection Agency (USEPA), Requirements for Quality Assurance Project Plans for Environmental Data Operations (EPA QA/G-5) (EPA/240/R-02/009), December 2002.

U.S. Environmental Protection Agency (USEPA), 40CFR (Code of Federal Regulations), Part 136, Appendix B. Definition and Procedures for the Determination of the Method Detection Limit, Revision 1.11.265-267.

U.S. EPA Region V's, Standard Operating Procedures for Validation of CLP Organic Data, April 1991, revised February 1997, last revised November 2002.

Wisconsin Department of Natural Resources, April 6, 1992. *Campmarina, The Former Coal Gas Facility Operated by Wisconsin Public Service Corporation and Owned By the City of Sheboygan located in Sheboygan, WI".* Section 144.442, Wis. Stats. CONTRACT. Contract Number SF-91-04.

FIGURE

PROJECT TEAM

REMEDIAL INVESTIGATION/ FEASIBILITY STUDY

CAMPMARINA FORMER MGP SITE, SHEBOYGAN, WISCONSIN

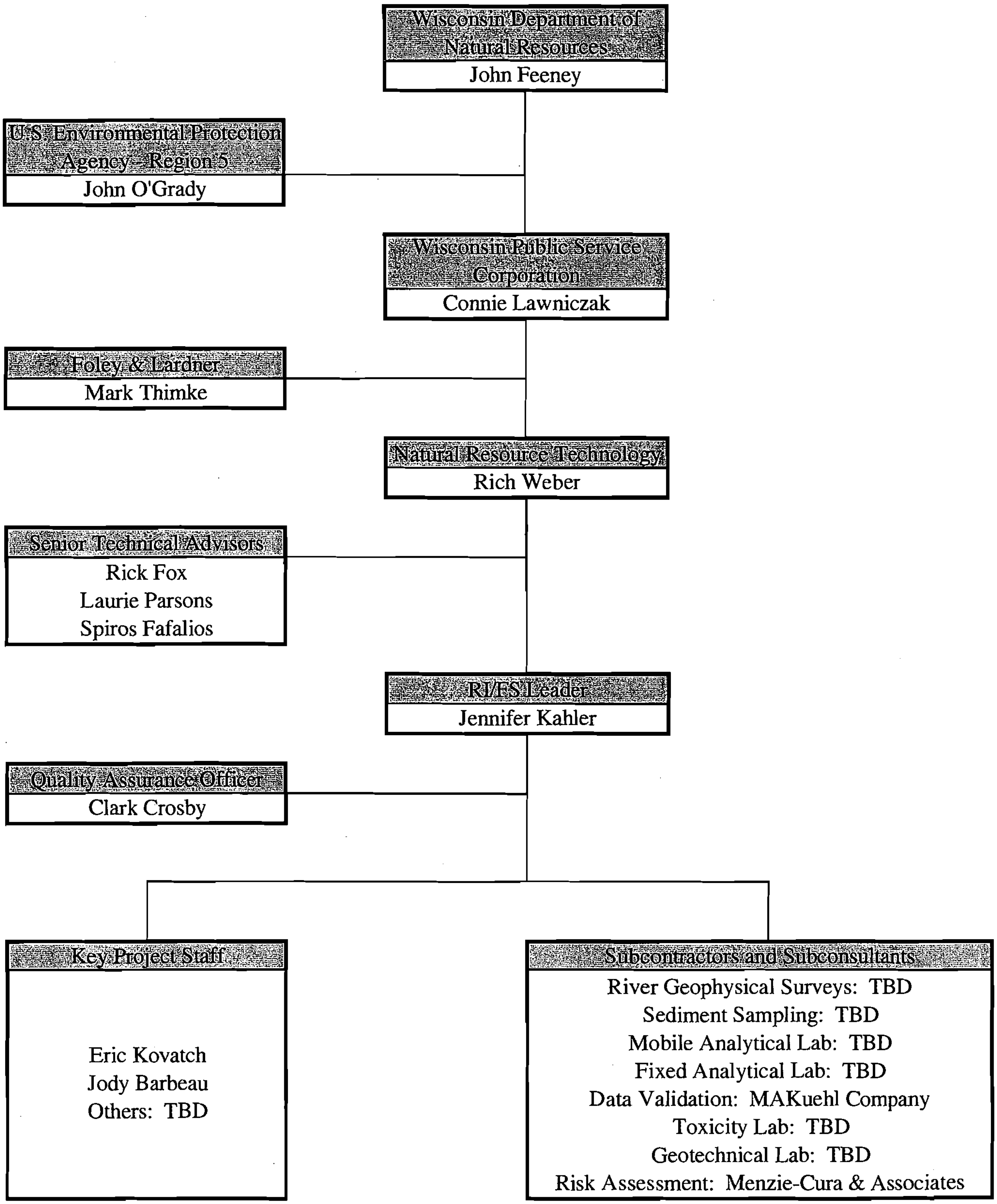

FIGURE 1

TABLES

Table 1. Project Goals for Precision, Accuracy, and Completeness for Laboratory Measurements
Wisconsin Public Service Corporation – Campmarina Former MGP Site
Sheboygan, Wisconsin

Analytical Method	Precision Goal[1] (%RPD)	Accuracy Goal (%R)		Completeness Goal (%)
	Sediment & Water	Sediment	Water	Sediment & Water
EPA 8260B	30	+/-50	+/-30	90
EPA 8270C	30	+/-50	+/-30	90
EPA 6010B/7471	30	+/-50	+/-30	90
EPA 8082	30	+/-50	+/-30	90

Table 2. Project Goals for Precision, Accuracy, and Completion of Field Measurements
Wisconsin Public Service Corporation – Campmarina Former MGP Site
Sheboygan, Wisconsin

	Precision Goal	Accuracy Goal	Completion Goal
Temperature (EC)[1]	0.1 deg. C	NA	90%
pH (units)	0.1 unit	NA	90%
Specific Conductance (umhos/cm)[2]	100 umhos/cm	NA	90%
Turbidity (NTU)[3]	0.05 NTU	NA	90%
Dissolved Oxygen (ppm)[4]	0.3 ppm	NA	90%

Notes:
1. EC = degrees Centigrade
2. umhos/com = micromhos per centimeter
3. NTU = Nephelometric Turbidity Unit
4. ppm = parts per million

Table 3. Data Measurement Units for Field and Laboratory Measurements
Wisconsin Public Services Corporation - Campmarina Former MGP Site
Sheboygan, Wisconsin

Parameter	Units
pH	pH units
Temperature	degrees Celsius (°C)
Turbidity	Nephelometric Turbidity Unit (NTU)
Dissolved Oxygen	parts per million (ppm)
Specific Conductance	microsiemens per centimeter at 25°C (uS/cm)
Concentration of chemical in surface water	micrograms per liter (ug/l) organic milligrams per liter (mg/l) inorganic
Concentration of chemical in sediment	milligrams per kilogram (mg/kg)
Organic Content by Loss-on-Ignition	percent (%)
Total Organic Carbon (TOC)	milligrams per kilogram (mg/kg)
Atterberg Limits	percent (%)
Grain Size Distribution	percent (%)
Specific Gravity	(dimensionless)
Moisture Content	percent (%)
Strength	pounds per foot inch (psf)

ATTACHMENT 1

KEY STAFF RESUMES

JODY T. BARBEAU
ENVIRONMENTAL SCIENTIST I

Summary of Qualifications

Five years of experience in environmental consulting including hazardous and solid waste management, ecological studies and environmental permitting. Additional experience includes toxicity testing and analytical testing of water and wastewater in a laboratory setting as well as conducting lake and stream ecological surveys. Project experience includes rapid biological assessments of streams for municipalities and industries, stream surveys for utilities, Phase I site assessments, groundwater monitoring and soil and sediment sampling at industrial and utility facilities, including manufactured gas plants and ash landfills.

Professional Experience

NATURAL RESOURCE TECHNOLOGY, INC., Pewaukee, Wisconsin (2000 to Present), Environmental Scientist I

SWEARINGEN ECOLOGY ASSOCIATES - UNITED STATES, Columbia, South Carolina (1997 to 1999), Aquatic Biologist

CENTER FOR GREAT LAKES STUDY, Milwaukee, Wisconsin (1996 to 1997) Field Technician/ Aquatic Biologist

Project Experience

Site Investigations

- Site investigation data acquisition for several sites including active and inactive ash landfills, petroleum bulk terminals, manufacturing facilities and industrial facilities, including former manufactured gas plants. Experience in monitoring well installations, hydraulic conductivity testing, pump testing, groundwater and soil sampling, contractor management, groundwater contour mapping, data analysis, and report preparation.

Stream Investigations

- Lead project coordinator and investigator for biological assessments which included the preliminary site visit, collection and identification of benthic macroinvertebrates and interpretation of data to determine extent of impact. Performed for municipalities, industries and landfills as specified by their National Pollution Discharge Elimination System (NPDES) permit. Responsible for biomonitoring reporting to state agencies.

Project Experience (cont'd)

Solid Waste Management

- Responsible for annual bioassesment of stream adjacent to landfill.

- Responsible for field coordination of contractors, general construction observations, and documentation.

Environmental Compliance

- Investigator or lead project coordinator for projects with South Carolina Department of Health and Environmental Control and Wisconsin Department of Natural Resources. Compliance and toxicity testing for several municipalities and industries to meet discharge permit requirements.

Remediation System Operations and Maintenance

- Provide routine maintenance on groundwater extraction system including sampling of influents, effluents and monitoring wells. Monitored and maintained system for optimal operation.

Education

B.S., Biology, University of Wisconsin- Milwaukee, 1996

Other Training

Aquatic Ecology Field Course, UW – River Falls
40-Hour OSHA Health & Safety Training for Hazardous Waste Operations - (29CFR1910.120)

Professional Affiliations

North American Benthological Association
Wisconsin Ground Water Association
National Ground Water Association
Federation of Environmental Technologists
Coleopterist's Society

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CLARK J. CROSBY
PROJECT CHEMIST/MIS MANAGER

Summary of Qualifications

Twenty years of experience in an analytical chemistry environment. Related experience includes proficiency in analytical techniques, raw data analysis, applied quality assurance management, data verification and validation, and laboratory management. Also experienced in analytical data management as related to the collection, qualification, and reporting of analytical data. Extensive experience in computer network installation and administration, web server design, data management techniques, and database programming.

Professional Experience

NATURAL RESOURCE TECHNOLOGY, INC., Pewaukee, Wisconsin (1999 to Present),
MIS Manager, Project Chemist
KATALYST ANALYTICAL TECHNOLOGIES, Peoria, Illinois (1998-1999),
Technical Services Director
SPECIALIZED ASSAYS, INC., Nashville, Tennessee (1997 to 1998),
Regional Marketing Manager - Upper Midwest Region
MARQUETTE UNIVERITY, Milwaukee, Wisconsin (1996 to 1997), Business Manager - Chemistry Department, Laboratory Instructor
MIDWEST ANAYLTICAL, Milwaukee, Wisconsin (1996 to 1996), Chemist - Marketing
SWANSON ENVIRONMENTAL, Brookfield, Wisconsin (1994 to 1996), Manager
REXNORD, INC./RADIAN CORPORATION, Milwaukee, Wisconsin (1978 to 1994),
Regional Quality Assurance Manager – Engineering, R&D Technologist
ALDRICH CHEMICAL COMPANY, Milwaukee, Wisconsin (1975 to 1978), Quality Assurance Technologist

Professional Experience

MIS Manager

- Windows NT Network Management and Administration. - Establish and monitor data management protocols that maintain data integrity and validity through hardware redundancy and scheduled backups.

- Design and setup of Material Safety Data Sheet (MSDS) web based library system on a Linux platform. Includes web server design and relational database (SQL) programming.

- Microsoft Certified Professional (MCP)- #1966070.

- Computer hardware/software resources manager.

Professional Experience (cont'd)

Technical Services Director

- Analytical data verification and validation.
- Program MS-Access to analyze downloaded data and produce reports that meet U.S. EPA and U.S. Air Force standards for data deliverables.
- Specify analytical methods that meet all regulatory agency protocols, develop cost proposals, develop and format electronic data deliverable requirements using government specifications, and monitor project performance during contract execution.
- Novell network/computer systems director for laboratory protocol and performance issues.

Project Development and Management

- Assist clients in developing project specific needs including meeting regulatory data quality objectives, electronic data deliverable requirements, and developing spreadsheet (MS-Excel) and database (MS-Access) solutions to regulatory requirements.
- Manage complex analytical projects.

Business Manager – Chemistry Department

- Develop electronic systems (FoxPro, MS-Excel) to manage the purchasing system within the department.
- Monthly budget analysis and reports to the Chemistry Department Chairman detailing current budget status.
- Teach undergraduate chemistry lab – Instrumental Analysis Laboratory.

Chemist – Marketing

- Market and service regional accounts.
- Setup an environmental laboratory.

Manager of Laboratory Operations

- Technical management of an environmental laboratory.

Professional Experience (cont'd)

- Statistical data analysis using MS-Excel and FoxPro.
- Develop yearly budget and laboratory performance goals.

Quality Assurance Manager-Environmental Engineering

- Regional Laboratory Auditor - Onsite audit of environmental laboratories following RCRA guidelines and protocols.
- Regional Quality Assurance Officer – establish and enforce standard engineering QA protocol for regional engineering offices.
- Data Validation - U.S. EPA Contract Laboratory Program guidelines in Organic and inorganic Statement of Work (SOW).
- Network Manager–install, maintain and administer a Novell 3.12 network.
- Computer System Analyst – Laboratory Information Management System.
- Database design and programming using dBase III and Clipper. Joint publication of "U.S. Treatability Database V5.0".
- Project Director - Author Health & Safety manual for assigned projects, monitor and control budgets and staffing, OSHA Compliance including management of MSDS's.
- Bench Chemist - develop acrylic latex caulks, sealants and adhesives for industrial and commercial use.

Quality Assurance Technologist

- Customer Service – detailed product analysis to resolve customer issues.
- Analyst – Quality Control – Spectroscopy.

Education

Milwaukee Area Technical College, AAS-Chemistry, Milwaukee, Wisconsin, 1978-1982
Cardinal Stritch College, Business Management, Milwaukee, Wisconsin, 1990

Patents and Publications

Dostal, Hansen, Crosby, "U.S. EPA Treatability Database V5.0", U.S. Environmental Protection Agency, Cincinnati, Ohio, 1992

Additional Professional Activities

Microsoft Certified Professional (MCP)- #1966070
Short Course – Novell 4.11 Administration, Marquette University
OSHA 40Hr Certified, CFR1910.120

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SPIROS L. FAFALIOS, P.E.
ENVIRONMENTAL ENGINEER

Summary of Qualifications

Ten years of experience in environmental engineering and consulting involving subsurface investigation and remediation activities at petroleum, hazardous waste/Toxic Substances Control Act (TSCA), former manufactured gas plant (MGP) and electric plant sites. Conducted site investigations including soil, groundwater, soil vapor and wetland media. Experienced in preparation of remedial alternatives analysis, remedial action plans, plans and specifications, bidding/contract documents, and air monitoring plans. Knowledgeable in the design, construction, operation and monitoring of soil and groundwater remediation systems. Construction oversight experience includes various forms of in-situ and ex-situ remedial actions. Project management experience includes work plan and proposal preparation, budget setup and compliance, data analysis and report preparation.

Professional Experience

NATURAL RESOURCE TECHNOLOGY, INC., Pewaukee, Wisconsin (1996 to Present),
Senior Environmental Engineer
DAMES & MOORE, Brookfield, Wisconsin (1993 to 1996), Environmental Scientist
U.S. AIR FORCE, Stationed Worldwide (1989 to 1993), Intelligence Officer

Project Experience

Manufactured Gas Plant (MGP) Remediation

- Project Engineer for the design and installation of a multi-layer earthen cap and downgradient sheet pile dock wall and groundwater pumping and treatment system at a former MGP located along the Fox River in eastern Wisconsin. Responsibilities include management of all aspects of the project. Ongoing project included thermal treatment and reuse of 23,000 tons of treated soil as backfill beneath the cap. Remedial design plans were tailored to facilitate future development of the site, while minimizing impact to neighboring residents.

- Owner's Representative for implementation of a multi-site MGP remediation project in southeastern Wisconsin including excavation and thermal treatment of approximately 30,000 tons of contaminated soil. Duties included day-to-day onsite decision-making and interface with client, regulators, contractors and consultants.

- Project Engineer for the design and installation of a multi-layer geosynthetic cap and sealed sheet pile wall at a former MGP located along a major river in eastern Wisconsin. Responsibilities included management of all aspects of the project. Ongoing project included thermal treatment and reuse of 11,000 tons of treated soil as backfill above and

Project Experience (cont'd)

beneath the cap. Remedial design plans were tailored to meet city redevelopment design needs, while minimizing impact to neighboring residents.

- Project Manager for evaluation of remedial action options and remedial design at a former manufactured gas plant (MGP) site in northeast Wisconsin. Areas of concern included limited surface soil impacts and shallow groundwater. Remedial actions proposed included source removal, monitored natural attenuation, and institutional controls. Remedial design included remediation by natural attenuation to meet a performance based cleanup standard and institutional controls to limit direct contact concerns.

- Project Manager for evaluation of remedial action options at a former manufactured gas plant (MGP) site in eastern Wisconsin. Areas of concern included unsaturated soil impacted with MGP debris (ash and blue wood chips), saturated soil impacted with emulsified coal tar, and shallow groundwater. Remedial actions evaluated ranged from excavation with off-site disposal and thermal treatment, in-situ stabilization (shallow soil mixing), in-situ chemical oxidation, permeable reactive barriers, and containment. Assembled alternatives were presented in a remedial action options report.

- As Project Engineer, planned and implemented remedial actions at a former MGP site in northern Wisconsin, including managing excavation and thermal treatment or disposal of 14,000 tons of MGP-impacted soils and debris. Responsibilities included oversight of excavation activities, operation/maintenance of dewatering system, ambient air monitoring, regulatory agency coordination, assisting in public relations, and report preparation.

<u>Electric and Gas Utilities</u>

- Project Engineer preparing feasibility studies for the remediation of an ash landfill in Michigan. Key remedial considerations included elevated groundwater levels that allowed leaching of ash constituents that could eventually impact city potable water supplies. Remedial alternatives under consideration include groundwater extraction and treatment, excavation of saturated ash and a low permeability cap.

- Project Engineer for the design of a reverse osmosis point-of-use water treatment system to address groundwater impacted with boron from a closed ash landfill in southeastern Wisconsin.

- Project Engineer for evaluation of groundwater data in support of site closure at an active ash management site in Illinois. Included evaluation of groundwater data within Electric Power Research Institute database program, and preparation of hydrogeologic assessment report.

Project Experience (cont'd)

- As Project Engineer, planned or implemented subsurface investigation activities at two MGP sites to evaluate pre- and post-remedial conditions, including post-soil remediation groundwater monitoring and pre-remedial geotechnical evaluation for design of a groundwater containment system.

- As Project Engineer, prepared three remedial action options reports, three remedial work plans, and two design reports for MGP sites to include soil, shallow groundwater, bedrock aquifer, ambient air and river sediment media considerations.

- Conducted an air sparge pilot test and a groundwater pump test for design of full-scale groundwater remediation systems.

Petroleum

- Planned or implemented remedial investigations for approximately 30 petroleum release sites in Wisconsin to evaluate the extent of impact to soil and groundwater. Field supervisory activities included soil test pit and soil boring advancement; groundwater monitoring well installation; soil and groundwater sampling; and aquifer testing.

- Designed and installed three groundwater extraction and treatment systems to address petroleum impacts. Designs included development of remedial alternatives, remedial action plans, plans and specifications, and bidding/contract documents. Installation included startup, operation and monitoring, and reporting activities.

- Management of four soil and groundwater remediation systems including operation, maintenance, monitoring and reporting. Three of the systems included groundwater extraction and treatment for remediation of petroleum impacted groundwater. Two of the systems included soil vacuum extraction and air sparge operations. One system included remote monitoring capabilities.

- Supervised on-site thermal treatment of nearly 7,000 tons of petroleum-impacted soil in a publicly sensitive area. Conducted portable gas chromatograph (GC) analyses to evaluate soil quality.

- Conducted two soil vacuum extraction pilot tests, one air sparge test and two groundwater pump tests for design of full scale soil and groundwater remediation systems.

- Conducted a municipal pumping test to evaluate drinking water contamination related to petroleum releases.

Project Experience (cont'd)

Property Transaction Assessments

- Executed three site assessments for industrial property transfers. Supervised Phase II investigations to determine the nature and extent of soil and groundwater impacts. Site assessments have revealed polychlorinated biphenyl (PCB), hydrocarbon and metals impacts.

Hazardous Waste/Toxic Substances Control Act

- Implemented wetlands sediment sampling and characterization for a PCB and metals hazardous waste site registered in the Wisconsin Resource Conservation & Recovery Act (RCRA) program. Established wetlands sampling grid, data collection parameters, collected sediment samples, and logged wetlands sediment characteristics for use in remedial action plan development.

- Conducted grid delineation and sampling of PCB-containing transformer residuals in surface soils.

- Assisted in the design, installation and monitoring of a soil vacuum extraction, ozone sparge and groundwater extraction and treatment system to address pentachlorophenol releases in soil and groundwater. Installation included a combined total of over 50 vertical soil vapor extraction, groundwater extraction, ozone sparge and vapor monitoring wells. Developed and executed soil vapor, soil and groundwater sampling protocols during monitoring activities. Evaluated and reported system performance.

- Assisted in the design of two groundwater extraction and treatment systems and one soil vacuum extraction system to address petroleum hydrocarbon impacts to soil and groundwater. Installed horizontal vapor extraction and groundwater extraction wells.

- Conducted a municipal pumping test to evaluate drinking water contamination related to chlorinated solvent release.

- Conducted one soil vacuum extraction pilot test, one air sparge pilot test and one groundwater pump test for design of a full-scale soil and groundwater remediation system.

Ambient Air Monitoring

- Prepared perimeter ambient air monitoring plans for five MGP site remediation activities, including real time and synoptic sample collection and fugitive emission control measures, such as vapor suppressants, foaming agents, perimeter misters, and conventional techniques.

Project Experience (cont'd)

- Implemented perimeter ambient air monitoring plans at eight former MGP remediation sites in Wisconsin. Perimeter monitoring resulted in minimal disturbance to neighboring residents and businesses, due to immediate fugitive emission mitigation actions taken at all sites, where fugitive odors or dust were noted.

Publications/Presentations

Fafalios, Spiros L. and Wittenberg, Roy E., "A Decision-Making Model for Managing MGP Waste Materials", IGT, 12th International Symposium on Environmental Biotechnologies and Site Remediation Technologies, December 1999, Orlando, Florida.

Covi, Arthur and Fafalios, Spiros L., "Materials Management Strategy for MGP residuals in the Public Right of Way", GTI, 1st International Symposium on Natural Gas Technologies: What's New & What's Next, September 2002, Orlando, Florida.

Education

M.S., Environmental Engineering, Milwaukee School of Engineering, 1998
B.S., Biology, U.S. Air Force Academy - Colorado Springs, Colorado, 1989

Professional Registration

Professional Engineer #E33328 - Wisconsin
Professional Engineer #45838 – Michigan

Other Training and Certification

40-Hour OSHA Health and Safety Training for Hazardous Waste Site Operations
8-Hour Annual OSHA HAZWOPER Refresher Training
American Red Cross First Aid and CPR
Underground Storage Tank Assessor

RICHARD G. FOX
SENIOR SCIENTIST

Summary of Qualifications

Seventeen years of professional consulting experience throughout the United States. Currently leads Natural Resource Technology's sediment practice where he has focused his efforts on sediment issues associated with large polychlorinated biphenyl (PCB) sediment sites, including the Fox and Hudson Rivers, and former manufactured gas plant (MGP) sites. Widely recognized for his expertise in metals and organic geochemistry in aquatic systems, determining sediment cleanup values, and negotiating with state and federal agencies regarding sediment projects.

While the Chicago-area office manager for Hart Crowser, Inc., served as project manager and technical expert for negotiating and executing a dredging project on the Fox River in Green Bay, Wisconsin for the Fort James Corporation (now part of Georgia-Pacific Corporation). Also worked for a potentially responsible party (PRP) group on a natural resources damage assessment (NRDA) project focusing on the east branch of the Grand Calumet River where he conducted a large sediment sampling program and performed analyses of remediation and restoration alternatives. Other projects included work on numerous former MGP sites in Wisconsin, Indiana, Massachusetts, and Rhode Island.

As Environmental Scientist with U.S.EPA's Great Lakes National Program Office (GLNPO), served as the chair of the Toxicity/Chemistry Workgroup for the Assessment and Remediation of Contaminated Sediments (ARCS) Program. The ARCS Program was responsible for advancing the state of science and technology for work on contaminated sediment sites. The ARCS Program published over 50 documents related to contaminated sediment work. Responsible for the *Assessment Guidance Document.* Considered a regional expert in analyses of PCBs, polynuclear aromatic hydrocarbons (PAHs) and other organic compounds in Region 5. Served as chief scientist on various research cruises onboard U.S.EPA's *R/V Lake Guardian* and *R/V Mudpuppy*.

As an environmental organic geochemist, co-authored a step-by-step data validation guidance document and determined statewide background concentrations for metals and organic chemicals in various media (including sediments, soils, fish tissues, groundwater, and surface water) for the Washington Department of Ecology.

Professional Experience

NATURAL RESOURCE TECHNOLOGY, INC., Pewaukee, Wisconsin (2001 to Present),
Senior Scientist
KESTREL MANAGEMENT SERVICES, LLC, Kenosha, Wisconsin (2001), Senior Consultant
HART CROWSER, INC., Lake Forest, Illinois (1996 to 2001), Senior Associate and Chicago
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (U.S.EPA), Chicago, Illinois, (1991 to 1996), GREAT LAKES NATIONAL PROGRAM OFFICE (GLNPO), Environmental Scientist and Regional Expert
PTI ENVIRONMENTAL SERVICES (now Exponent), Bellevue, Washington, (1990 to 1991)
Environmental Geochemist

Project Experience

Manufactured Gas Plant (MGP) Sediment Work

- Sediment Coordinator for MGP management program including eight sites in Wisconsin and Michigan. Sediment management for MGP sites include performing sediment assessments, feasibility studies, and negotiating with state agencies on sediment matters.

- Project Manager for a feasibility study to perform a sediment remediation at a northern Wisconsin MGP site. Remediation will include dredging to accommodate a boat launch facility in fall 2004.

- Project Manager for MGP sediment removal project in Wisconsin. Dry-excavated MGP residuals from a site concurrent with a pre-planned river draw down. Performed design, acquired permits, and finished sediment removal in less than two months.

- Wrote sediment investigation report for three eastern Wisconsin MGP sites. Sediment work included chemical testing and biological evaluation of core and grab samples.

- Project Manager for a comprehensive nature and extent study of MGP-impacted sediment for site in Bristol, Rhode Island. Wrote sampling and analysis plan (SAP) and quality assurance project plan (QAPP). Chief scientist for field investigations that required in-field decision making based on observational results of samples collected.

- Wrote SAP and QAPP for Phase II sediment investigation for site in Beverly, Massachusetts. Results were used to present an array of remedial alternatives. Chief scientist for sediment sampling event. Assisted with remedial alternatives analysis. Remedial alternatives were compared to published sediment quality values.

- Performed technical reviews of bench-scale and pilot-scale applications of chemical amendments to PAH-contaminated sediments as a means of remediating inter-tidal sediments contaminated with MGP waste for site in Salem, Massachusetts.

- Wrote SAP and QAPP for nature and extent characterization of sediments impacted by MGP waste for site in Westerly, Rhode Island. Provided technical basis for determining sediment cleanup objectives to state agency.

Project Experience (Cont'd)

- Lead author for sampling and analysis plan (SAP) for pre-design sediment characterization of the lower Fox River in Wisconsin for the Wisconsin Department of Natural Resources (WDNR). The sediment characterization will involve delineation of the prism of sediments that exceed the 1 ppm cleanup standard set forth in the Record of Decisions (RODs) in Operable Units (OUs) 1, 2, and 4. The characterization will also consist of collecting engineering data to prepare the dredge design for those OUs.

- Project Manager for the dredging 50,000 cubic yards (cy) of sediment from the lower Fox River, Wisconsin off Fort James Corporation's (now part of Georgia-Pacific Corp.) Green Bay west plant at the site known as SMU 56/57. Cleanup terms were agreed to and the administrative order of consent (AOC) was signed in May 2000. Helped prepare the draft AOC, evaluated disposal options for sediments, provided dredge prism and a visual graphic of the surficial sediment concentrations after sediments were dredged, developed an approach to confirm cleanup objectives were met, developed a design memorandum for dredging, wrote a SAP and quality assurance project plan (QAPP) for monitoring dredging effectiveness (i.e., discharge water quality and attainment of cleanup objectives). Played a key role in negotiating the terms of the settlement with U.S.EPA and the WDNR. The design memorandum, SAP, and QAPP were all approved on schedule and dredging was performed in 2000. All deadlines for this project were met because of a positive working relationship with the agencies.

- Reviewed data collected from a stream in Wisconsin that was contaminated with wood-treating residuals (including pentachlorophenol). Analytical chemistry and toxicological studies were performed to determine the effect of contaminants on local biota. Provided technical direction for negotiation with WDNR.

- Wrote environmental monitoring plan (EMP) for restoration of a 105-acre impoundment of the Rouge River in Livonia, Michigan. Restoration activities included rehabilitation of the dam that forms the impoundment, dewatering of the lake, and the subsequent removal of 600,000 cy of sediments contaminated with up to 50 parts per million of PCBs. The EMP described the sampling and analyses required ensuring that sediment removal actions met restoration goals. Negotiated real-time immunoassay techniques with MDNR (now MDEQ).

<u>Geochemistry Work</u>

- Assisted with preparation of expert report on fate and transport of pesticides at a pesticide reformulation site. Used extensive knowledge of organic geochemistry and pesticides to determine responsibility of parties at contaminated site.

Project Experience (Cont'd)

- Performed an assessment of background concentrations of metal, PAHs, semi-volatiles, and volatile organic compounds in the State of Washington.

Natural Resources Damage Assessment (NRDA) Work

- Assisted with assessment of remedial options for sediments in the Grand Calumet River/Indiana Harbor Ship Canal in northwestern Indiana. Work was performed for a PRP group under the NRDA action brought by the Natural Resource Trustees, which include the U.S.EPA, the U.S. Fish and Wildlife Service, and the Indiana Department of Natural Resources. Performed a current conditions survey and a PRP search for the region. Technical liaison between the PRP Group and Indiana Department of Environmental Management. Contaminants of concern at this site include pesticides, PCBs, PAHs, and heavy metals.

- Performed analysis of restoration options for NRDA in a large Great Lakes watershed. PCBs were the contaminants of concern.

- Performed analysis of soil and sediment samples for impacts due to mining on Clark Fork River, Montana NRDA site.

Contaminated Sediment Policy Development

- Member of an advisory group that develops and evaluates sediment quality guidelines (SQGs). The SQGs are empirically derived from databases that contain synoptically collected chemical and biological data. These databases have been used to develop SQGs, which predict expected biological effects based on chemical results.

- Served as a Lead Assessment Coordinator for the ARCS program, with responsibilities that included managing analytical services, reviewing quality assurance project plans, conducting field and laboratory audits, and validating data. Chair of the ARCS toxicity/chemistry work group and author and primary editor of the "ARCS Assessment Guidance Document." This comprehensive work recommends procedures for collecting sediment samples, performing chemical (including screening-level) analyses, testing for toxicity, analyzing benthic communities, and evaluating data quality. Performed sediment assessments at Sheboygan River (WI), Duluth-Superior Harbor (MN/WI), Waukegan Harbor (IL), Lake St. Clair (MI), Maumee River (OH), and Presque Isle Bay (PA).

Publications

Garbaciak, S., Spadaro, P.A., Thornburg, T.M., and Fox, R.G. 1997. "Sequential Risk Mitigation and the Role of Natural Recovery in Contaminated Sediment Projects." *Preprints of the International Conference on Contaminated Sediments*. Rotterdam, Netherlands.

Editor for an ARCS-dedicated issue of the *Journal of Great Lakes Research*, 1996.

Fox, R.G., Dennis-Flagler, D., Cowgill, D.C., Garbaciak, S., Tuchman, M.L., Crecelius, E.A., Ingersoll, C.G., and Burton, G.A. 1995. "Integrated Sediment Assessment Approach of the U.S. Assessment and Remediation of Contaminated Sediments (ARCS) Program." *Proceedings for Sediment Remediation '95*. Windsor, Ontario.

Fox, R.G., Cowgill, D., Garbaciak, S., Crecelius, E.A., Ingersoll, C.G., and Burton, G.A. 1993. "Integrated Sediment Assessment Approach of the United States Environmental Protection Agency's Assessment and Remediation of Contaminated Sediments (ARCS) Program." *Proceedings of the Characterization and Treatment of Sludge (CATS II) Congress.* Antwerp, Belgium.

Wade, T.L., Atlas, E.L., Brooks, J.M. Kennicutt II, M.C., Fox, R.G., Sericano, J., Garcia, B., and DeFreitas, D. 1988. "NOAA Gulf of Mexico Status and Trends Program: Trace Organic Contaminant Distribution in Sediments and Oysters." *Estuaries*, 11:171-179.

Presentations

Fox, R.G. "Practical Considerations for Negotiating Achievable Sediment Cleanups." Presented at Environment 2003 Meeting of Federation of Environmental Technologists, Milwaukee, Wisconsin. March 2003.

Fox, R.G. "Negotiating and Implementing Attainable Cleanup Levels: Case Study Dredging SMU 56/57, Fox River," Sediment Management Seminar, Fort Lauderdale, Florida, February 2003.

Fox, R.G. Practical Considerations for Performance-Based Sediment Cleanup Decisions." 5th International Symposium on Sediment Quality Assessment. Aquatic Ecosystem and Health Management Society, Chicago, Illinois. October 2002.

Fox, R.G., Henningson, J., Daniels, J.R., Herzog, J. "Sediment Clean-up Levels: State vs. Federal Standards." Presented at Environment 2000 Meeting of Federation of Environmental Technologists, Milwaukee, Wisconsin. March 2000.

Instructor, 18th Annual Meeting of the Society for Environmental Toxicology and Chemistry, San Francisco, California ("Use of Sediment Quality Guidelines in the Assessment and Management of Contaminated Sediments."). November 1997.

Presentations (Cont'd)

Fox, R.G., Crecelius, E.A., Ingersoll, C.G., and Burton, G.A. "Integrated Sediment Assessment of Saginaw Bay, Michigan, for the ARCS Program." Presented at the 1st Specialized Conference on Contaminated Aquatic Sediments, International Association on Water Quality, Milwaukee, Wisconsin. Conference Organizer. 1993.

Instructor, 14th Annual Meeting of the Society for Environmental Toxicology and Chemistry, Houston, Texas ("Assessment of Contaminated Sediments.") November 14, 1993.

Invited Convener and Session Chair, 36th Conference on Great Lakes Research, Green Bay, Wisconsin ("Progress in the Assessment and Remediation of Contaminated Sediments (ARCS) Program.") June 6-10, 1993.

Instructor, University of Wisconsin-Madison, College of Engineering, Engineering Professional Development Course ("Managing Contaminated Sediment.") April 13-15, 1993.

Professional Affiliations

Federation of Environmental Technologists (FET); Co-Chair of Sediment Subcommittee
Western Dredging Association
Society of Environmental Toxicology and Chemistry

Education

M.S., Oceanography, Texas A&M University, 1988
B.S., Chemistry, University of Wisconsin-Madison, 1984
B.S., Geology & Geophysics, University of Wisconsin-Madison, 1984

Other Achievements

U.S.EPA's Bronze Medal for Commendable Service (1992)

JENNIFER M. KAHLER, E.I.T.
ENVIRONMENTAL ENGINEER

Summary of Qualifications

Nine years of experience in water resources and environmental engineering. She has been involved in several remedial investigations from the development of work plans, quality assurance project plans, health and safety plans, performing the field investigation activities, and preparing remedial reports and feasibility studies. In addition, she has experience writing environmental compliance documents and implementing compliance programs. She has designed several water resource projects, including wetlands for detention and sedimentation; provided stormwater analysis on numerous properties, including hydrologic and hydraulic analyses; inventoried and assisted in delineating wetlands; and designed erosion control construction techniques.

Professional Experience

NATURAL RESOURCE TECHNOLOGY, INC., Pewaukee, Wisconsin (2003 to Present), Environmental Engineer
GEOMATRIX CONSULTANTS, INC., Staff to Project Engineer (1997 to 2003)
RUST ENVIRONMENT AND INFRASTRUCTURE, Water Resources Engineer (1995 to 1997)
DUPAGE COUNTY DEPARTMENT OF ENVIRONMENTAL CONCERNS, Civil Engineer Intern (May to August 1994)

Project Experience

Environmental Investigation

- Project Engineer for preparation of the work plan, health and safety plan, and quality assurance project plan for the preliminary site assessment of multiple electrically charged substations in western New York. The work plans considered the historical management of PCB-contaminated oil, recorded spills, existing and historical oil-filled equipment locations/staging areas, and oil/fuel tanks. Conducted field activities including surface soil and subsurface soil sampling through test pits and soil borings, subsurface structure (vaults and underground conduit banks) investigations including debris and water sampling, and installation of groundwater monitoring wells for the characterization of VOCs, SVOCs, metals, and PCBs.

- Project Engineer for preparation of a self-implementing cleanup plan for a western New York substation to address PCBs and PAHs in soil. Analytical results from a preliminary site assessment indicated areas of elevated PCBs and PAHs which were further delineated on a grid pattern at several depths in preparation of the cleanup plan. The plan was submitted and approved by the U.S.EPA.

Professional Experience (cont'd)

- Prepared a sampling and analysis plan (SAP) for the pre-design sediment characterization study along the Lower Fox River in northeastern Wisconsin. Sediment samples attained using vibracore technology will be analyzed for PCBs using a hybrizyme PCB immunoassay kit and a modified U.S.EPA method 8082 known as the Fox River Method to refine the extent of impact. Sample locations with elevated PCB concentrations will be further investigated. In addition, select samples will be analyzed for engineering, geotechnical, and physical parameters.

- Staff Engineer for preparation of a quality assurance project plan (QAPP) for remedial investigations of a former animal glue manufacturing facility on the National Priorities List and associated inactive landfill area in western New York. The QAPP was submitted to and approved by the U.S.EPA. Conducted field activities including: drilling overburden and bedrock wells; Geoprobe™ subsurface soil sampling; test pit subsurface sampling; and collection of surface soil/sediment samples, surface water samples, landfill leachate, landfill gas, and groundwater. Laboratory analytical results were used to characterize the nature and extent of contamination and procedures for developing and evaluating remedial alternatives for the site.

- Staff Engineer for installation, development, and hydraulic conductivity testing of groundwater monitoring wells (which included subsurface soil and groundwater sampling) to characterize the former incinerator ash landfill in western New York. Additional site characterization was performed through soil vapor analysis, storm sewer water analysis, surface soil sampling, and continued water level measurements. The remedial investigation supported a petition to delist certain parcels from the New York State Department of Environmental Conservation (NYSDEC) Registry of Inactive Hazardous Waste Disposal Sites.

- Staff Engineer for collection of groundwater samples and water level measurements for site characterization as part of the underground storage tank (UST) investigation in upstate New York. Responsible for preparing the investigation report. Recommendations of the report identified monitored natural attenuation as an appropriate remedial plan. Developed the Environmental Monitoring Plan which outlined a specific schedule and sampling analysis plan to monitor natural attenuation of petroleum related constituents.

- Staff Engineer for preparation of a remedial investigation/feasibility study (RI/FS) and quality assurance project plan (QAPP) for remedial investigations of landfilled waste debris originating from off-site of a western New York National Priorities List site. The RI/FS and QAPP were submitted to the U.S.EPA. Field activities conducted include: drilling several overburden wells; Geoprobe™ subsurface soil sampling; and collection of surface soil/sediment samples; surface water samples; and groundwater samples.

Professional Experience (cont'd)

Laboratory analytical results were used to characterize the nature and extent of contamination and to identify procedures for developing and evaluating remedial alternatives for the site.

- Staff Engineer for collection of leachate and waste samples using Geoprobe™ equipment to characterize a landfill site in western New York. Analytical results were used to determine whether phytoremediation is a suitable approach to reduce/eliminate the need to collect, haul, and treat leachate. Analysis of these samples indicated occurrence of natural attenuation and results were used to design the phytoremediation system.

Remediation

- Project Engineer for evaluation of remedial action options at a former manufactured gas plant (MGP) site in eastern Wisconsin. Areas of concern included unsaturated soil impacted with MGP debris (ash and blue wood chips), saturated soil impacted with emulsified coal tar, and shallow groundwater. Remedial actions evaluated ranged from excavation with off-site disposal and thermal treatment, in-situ stabilization (shallow soil mixing), in-situ chemical oxidation, permeable reactive barriers, and containment. Assembled alternatives were presented in a remedial action options report.

- Project Engineer for evaluation of remedial action options and remedial design at a former manufactured gas plant (MGP) site in northeast Wisconsin. Areas of concern included limited surface soil impacts and shallow groundwater. Remedial actions proposed included source removal, monitored natural attenuation, and institutional controls. Remedial design included remediation by natural attenuation to meet a performance based cleanup standard and institutional controls to limit direct contact concerns.

- Project Engineer for preparation of a remedial investigation/feasibility study (RI/FS) Work Plan and quality assurance project plan (QAPP) for remedial investigations of sediment in a river adjacent to a former manufactured gas plant (MGP) in northeast Wisconsin. The RI/FS and QAPP were prepared in accordance with a contract between the utility, city, and WDNR. Field activities conducted include: collection of sediment samples and surface water samples to evaluate the vertical and lateral extent of impact. In accordance with the Work Plan, a human health risk assessment will be performed and toxicity testing is planned to evaluate the ecological risk. Results of the risk assessments will be used to develop a site specific cleanup standard as the site moves towards a feasibility study.

Professional Experience (cont'd)

- Project Engineer for preparation of a remedial investigation report of sediment in a river adjacent to a former manufactured gas plant (MGP) in northeast Wisconsin. The investigation included river bathymetry, sediment poling, sediment coring, surface water sampling, and a preliminary benthic community survey. The RI report presented the methodologies, analytical results, and presented a site conceptual model for the distribution of MGP residuals and dissolved phase constituents.

- Project Engineer for development of an environmental management plan (EMP) for construction activities at an active power plant. The EMP provided special handling requirements for lead-based paints, asbestos, and other hazardous materials related to buildings that were removed/relocated. In addition, a circulating water line was relocated through a historical diesel fuel spill, which impacted groundwater and saturated soil. The EMP provided handling requirements for diesel fuel impacted soil and construction water generated during trenching activities.

- Staff Engineer for development of engineering drawings for the removal of approximately 10,000 cubic yards of soil impacted with TCE and arsenic at a former pole treating facility in Madera County, California. Performed field construction management and contractor oversight to examine depths of excavations, collect confirmation soil samples and conduct compaction tests using a nuclear density gauge. Functioned as public contact during construction activities to address issues of concern.

- Staff Engineer for delineation of the boundary of pesticide and nitrogen-species impacted soils of a former agricultural chemical distribution facility in California. Prepared the feasibility study, which assessed remedial alternatives including asphalt capping, excavation and off-site disposal, excavation and low temperature thermal desorption, phytoremediation, and natural attenuation. Low temperature thermal desorption was selected to treat approximately 1,000 cubic yards of soil. Developed engineering drawings and conducted field construction management and contractor oversight.

- Staff Engineer for groundwater monitoring at a western New York lumber yard before and after removal of two underground storage tanks (USTs). Conducted contractor oversight during the UST removal and prepared the Investigation/Remediation Report for submittal to the NYSDEC.

Environmental Compliance

- Staff Engineer for inspections of approximately 150 bulk agricultural chemical distribution facilities in Oklahoma and Kansas for compliance with internal company policies. Inspections included verifying adequacy of the secondary containment structures in regards to volume, integrity, and tank configuration.

Professional Experience (cont'd)

- Staff Engineer for preparation of federal U.S.EPA risk management plan (RMPs) and California accidental release prevention programs (CalARP) documents for various agricultural distribution facilities throughout California. Plans included a radius of impact and estimate of impacted population for a worst-case release scenario and most-likely release scenario for the accidental release of chemicals listed in the program. Plans were submitted to local, state, and federal administrating agencies.

- Staff Engineer for preparation of a spill prevention containment and countermeasure (SPCC) plan for an oil dehydration facility located on a former oil refinement site in Bakersfield, California. The facility was approximately 10 acres with over 20 oil and water filled tanks of various sizes within five tank farms and included an asphalt emulsion operation.

- Staff Engineer for preparation of a stormwater pollution prevention plan for two active municipal solid waste landfills in California. The plan addressed secondary containment of waste oils used in maintenance of landfill equipment, fueling islands, erosion control, general housekeeping, and waste management practices to limit the contact of waste with rainfall and runoff.

<u>Stabilization/Streambank Restoration</u>

- Water Resources Engineer for design of over 1,000 feet of channel which ran partially through a mature maple forest in southeastern Wisconsin. The lower portion of the channel included reno mattresses and gabion baskets for stabilizing the channel banks. The upper portion of the channel was designed with a low-flow meandering channel in a high flow channel. Both were seeded with native wetland vegetation and protected by a coconut fiber mat. An energy dissipater was designed at the confluence of the channel and a creek to minimize potential damage to the creek caused by excessive velocities. Native shade-tolerant shrubs were planted along portions of the lower bank.

- Water Resources Engineer for hydrologic and hydraulic analysis, using HEC-1/HEC-2, of a ravine in suburban Milwaukee that was severely eroded and steep. Final design recommendations included gabion basket "check dams" to reduce velocities in the ravine.

- Water Resources Engineer for field survey of 3,400 feet of streambank to classify the severity of streambank erosion in suburban Milwaukee. Sections of the creek were evaluated based on soil types, vegetative cover, typical vegetation and severity of erosion. Recommended stabilization methods for each level of erosion including bioengineering and traditional structural techniques. The project was conducted as part of the Wisconsin Department of Natural Resources' Urban Nonpoint Source Water Pollution Abatement Program.

Professional Experience (cont'd)

- Staff Engineer for preparation of plans for the stabilization of approximately 5,000 feet of creek channel within mountainous terrain in California. The channel was to convey a 100-year storm event plus large spill flows from an existing canal. Existing creek slopes ranged from 3 to 40 percent, with velocities approaching 45 feet per second at peak flow. A trapezoidal gabion-lined channel was employed along a "stair-step" creek profile to reduce velocities and contain flows. The design also included stabilization of several land slide areas and provisions for conveying tributary surface drainage flows.

- Staff Engineer for design and development of engineering drawings for the repair of landfill drainage paths in California. Design consisted of reno mattress-lined down chutes, sub-surface drainage piping, and sedimentation basin inlet repairs.

- Staff Engineer for development of engineering drawings for the repair of a section of a California landfill side slope which had failed in heavy rain. Design incorporated a geocomposite liner to channel sub-surface drainage to a rock lined ditch.

- Staff Engineer for preparation and implementation of temporary erosion control measures on a California Indian tribe property to prevent further erosion from land development activities in which portions of a tributary and wetland area were filled without proper permits. The tribe wanted to proceed with development under the Nationwide Permit Number 26 (NWP 26). To comply with NWP 26, the tribe had to minimize and rectify adverse impacts including indirect impacts due to siltation to downstream waters. Erosion control measures included: severely rutted side slopes were dressed and hydro-seeded with selected erosion control grass species; open areas received broadcast fertilizing and seeding with a similar mixture of grasses. Hay bales were also placed within the drainage paths to decrease velocities and remove sediment loads.

<u>Wetland and Riparian Environments</u>

- Student design project of a stormwater wetland along the Embrass River in Champaign County, Illinois. Secondary design goal was to provide wildlife habitat. Analysis included hydrology of plant communities, specification of plant species, and design of inlet and outlet structures to meet specified release rates and storage capacities.

- Civil Engineer for field verification of 149 wetlands for modification of the DuPage County, Illinois GIS system. Wetlands verified through using national wetland inventory maps, vegetation identification, quality of vegetation and quality of wildlife habitat.

- Civil Engineer who assisted in wetland delineations and monitoring of mitigation sites in Illinois. Monitoring consisted of rating the vegetative quality based on accepted Illinois practices and techniques. Assisted in the enforcement of sedimentation/erosion control practices for the protection of wetlands.

Professional Experience (cont'd)

- Water Resources Engineer/Project Manager for development of work plan for vegetating and maintaining a 85-acre constructed wetland consisting of native shallow marshes, sedge meadows, and wet prairies. The wetland was designed to remove sediments in the runoff entering Lake Delavan, Wisconsin. The work plan included weed control methods, identified appropriate species, and plans and specifications for planting areas. Prepared permitting for maintenance dredging of three on-site ponds. Managed three contractors to repair and revegetation the site.

Stormwater Management

- Civil Engineer for DEC-1 economic flood analysis model for eight clusters to the East Branch DuPage River in Illinois. The model highlighted clusters with the most economic damage based on low entry elevations, house types, and station crest elevations of historical storm events. Analysis led to prioritizing flood-proofing projects.

- Civil Engineer for investigation of several drainage complaints in Illinois. Conducted on-site overviews of the attributing causes and provided preliminary recommendations and follow-up investigations.

Water Resources

- Civil Engineer for modification of cross sections of FEQ unsteady flow hydraulic model for the placing of a berm along the East Branch DuPage River in Illinois. Project included excavation to extend a possible wetland mitigation bank. Analysis included evaluation of increased stage elevations, possible design alternatives, and costs.

- Civil Engineer for review of permit applications for meeting requirements as set forth in the DuPage County (Illinois) Stormwater Management Plan. Included analysis of cut and fill in the floodplain, compensatory storage, release rates, and stage elevations.

- Water Resources Engineer for design of a 20 acre-foot detention pond with maintenance road for dredging vehicles in eastern Wisconsin. Design included use of non-woven fabric filters and a clay lining. Developed an operation and maintenance plan for the detention pond.

- Water Resources Engineer for investigation of the feasibility of damming water to re-open an historical sawmill in Greenbush, Wisconsin. Involved correlating flows from surrounding gauging stations to attain historical flow information, HEC-1, HEC-2 analysis, and environmental investigation. Completed the preliminary hydrologic/ hydraulic and U.S. Army Corps of Engineers Section 404 Wetland Permit. As part of the permit package, conceptual wetland mitigation plans were prepared to create several wetland communities focused on diversity of flora and wildlife habitat.

Professional Experience (cont'd)

- Civil Engineer who compared traditional HEC-1/HEC-2 hydrologic/hydraulic analysis methods with FEQ unsteady state flow model for state and Federal Emergency Management Agency (FEMA) approval of FEQ methods. The watershed, in DuPage County, Illinois, was divided into over 120 sub-basins and compared using 18 historical storm events, as well as the 2-, 10-, 25-, 50-, and 100-year storm events. As a result, the state and FEMA approved the use of FEQ in DuPage County for floodplain remapping and analysis.

Education

B.S., Civil Engineering, University of Illinois, Champaign-Urbana, 1994

Other Training and Certification

State of Wisconsin Engineer-In-Training (EIT) Certification - #14962
40-Hour OSHA Health & Safety Training for Hazardous Waste Operations
8-Hour Annual OSHA HAZWOPER Refresher Training

ERIC P. KOVATCH, P.G., P.H.
SENIOR HYDROGEOLOGIST

Summary of Qualifications

Thirteen years of environmental and hazardous waste management and consulting experience as a hydrogeologist and project manager of soil and groundwater site investigations and remediation of contamination by petroleum products, chlorinated organics, coal gasification by-products, metals, dioxin, PCP, and PCBs. Consulting experience includes proposal preparation and review, project budgeting, scheduling, data analysis, report preparation, and remedial alternatives analysis as well as aquifer testing.

Professional Experience

NATURAL RESOURCE TECHNOLOGY, INC., Pewaukee, Wisconsin (1993 to Present), Hydrogeologist
RADIAN CORPORATION, Milwaukee, Wisconsin (1991 to 1993), Hydrogeologist
UNIVERSITY OF IDAHO, Moscow, Idaho (1990 to 1991), Research Assistant

Project Experience

Remedial Investigations

- Project Manager for remedial investigations in cooperation with the Electric Power Research Institute (EPRI) for utility clients. Sites included investigation of soil and groundwater contaminated with PCP and dioxins at a power pole treatment site in western Wisconsin and leachate and groundwater impacts near ash landfills in southern Wisconsin and central Illinois. The site investigations and reporting were completed with partial EPRI research funding. All work was completed in accordance with EPRI guidelines and budgeting criteria. In addition, the PCP/dioxin pole treatment site was remediated and successfully closed by WDNR, while remediation is currently underway at one of the ash landfill sites.

- Project Manager for several remedial projects involving former dumps historically operated by government and industrial clients. Investigation and remediation of these former dumps was undertaken under Wis. Adm. Code NR 700 rather than NR 500 so that long-term liability and monitoring issues could be avoided. Following completion of the remedial activities, the WDNR granted site closure for all these sites.

- Conducted remedial investigation of diesel contaminated soils at an Illinois land farm. Installed lysimeters and wells to monitor the impact of land farming activities on the vadose zone and shallow unconfined aquifer. Supervised quarterly sampling activities.

Project Experience (Cont'd)

- Utilized SESOIL to establish site-specific soil standards for petroleum hydrocarbons, chlorinated VOCs, and PAHs and to evaluate possible groundwater impacts resulting from known soil impacts at a number of different sites. SESOIL results were used to support case closure requests submitted to WDNR. NRT has received closure for a number of sites and other requests are currently being reviewed and evaluated by WDNR.

- Project Manager for several remedial investigations involving soil and groundwater contamination for industrial, utility, and government clients. Industrial and utility clients were found to be a source of industrial solvents, including trichloroethene (TCE), 1,1,1-trichloroethane (TCA), and 1,1-dichloroethene (DCE), or wood preservatives (dioxin and PCP, in particular), in soil and groundwater. Government clients were responsible for protecting drinking water aquifer(s) and municipal water-supply wells from possible closure due to groundwater contamination by industrial solvents and petroleum hydrocarbons. Supervised and executed the remedial investigations, which included: 1) delineation of near-surface source areas using soil vapor technologies; 2) delineation of soil impacts; and 3) delineation of groundwater impacts by installing and sampling groundwater monitoring wells; 4) computer modeling; 5) aquifer testing, including analysis of 72 hour pumping tests with recharge; and 6) data analysis and reporting. For one site, NRT and the client negotiated with WDNR to allow continued groundwater monitoring rather than pursue more aggressive remedial approaches.

- Conducted remedial investigations for several large railroad facilities in the Midwest to define the extent of petroleum hydrocarbon contamination. Responsible for supervising all field data collection activities. Aquifer characteristics were evaluated to assess product migration and interconnection between areas of known contamination. Data collected from the investigations were used to design and install product recovery systems at different areas across the facilities.

- Performed remedial investigations for groundwater contamination at manufacturing and U.S. military facilities in Michigan, Wisconsin, and Illinois. Responsible for planning and supervising field data collection activities to determine source areas and define the nature and extent of chlorinated VOC contamination in the vadose zone and confined and unconfined drinking water aquifers.

- Conducted a remedial investigation for soil contamination at a demolition landfill located on a US Air Force Base in New Mexico. Responsible for supervising field activities including soil boring installation and trenching activities for the soil sampling program implemented to define the nature and extent of contamination in the vadose zone.

Project Experience (Cont'd)

Manufactured Gas Plants (MGPs)

- Project Manager for Phase I and II investigations of five former MGPs in northeastern Wisconsin and upper Michigan. Projects involved historical site research, development and implementation of soil, groundwater, and river sediment sampling programs, and delineation of impacted soils/groundwater/sediments. Detected compounds include coal tar, cyanides, phenols, VOCs, and PAHs generated as by-products of coal gasification.

- Remedial investigations for several former MGPs in Wisconsin, Illinois, and Michigan to define the extent of MGP wastes and by-products impacting soil, groundwater, and river sediments. Responsible for supervising field activities, including: 1) site reconnaissance; 2) soil vapor probe, test pit, soil boring, and monitoring well installation; 3) soil, groundwater, and sediment sampling; and 4) aquifer testing. Data used to identify parameters present, trace historical sources, and evaluate source control measures.

River Sediment Investigations

- Lead project coordinator and investigator for a Remedial Investigation of the Lower Fox River and Green Bay sediments contaminated with PCBs and other chemical parameters. The area investigated included the 39-mile stretch of river from Little Lake Butte des Morts to Green Bay, as well as all of Green Bay itself. An 11-mile stretch of the Lower Fox River and Green Bay was proposed for inclusion on the National Priority List in the summer of 1998; therefore, all project activities were completed in accordance with CERCLA guidance. Facilitated completion of the necessary work plans and QAPP, along with implementation and completion of the RI. The RI included evaluating data from previous sediment investigations, as well as the current data, which were incorporated to describe site conditions and characteristics. The RI was completed to support both a risk assessment and feasibility study of PCB contaminated sediments. As the WDNR was the contracting agency, project activities also involved communicating and working directly with WDNR staff on all aspects of the project, as well as other federal and inter-governmental agency representatives when appropriate.

- Lead investigator for multi-year sediment investigations at five manufactured gas plant sites located in Green Bay, Marinette, Oshkosh, Sheboygan and Two Rivers. These projects involved the investigation of sediments on the Fox, East, Menominee, Sheboygan, and West Twin Rivers. Sediment sampling was conducted to identify contamination "hot spots" and define the extent and magnitude of contaminants for remedial purposes. Sampled along transects selected by reviewing historical shoreline and industrial information and any previously existing sediment data from other nearby sites. Different sampling techniques were used under adverse conditions on heavy wood

Project Experience (Cont'd)

sediments, heavy gravel, clay, silt, sand, fill and tar. The sediment sampling techniques employed included use of a Ponar™ dredge sampler, Ogeechee™ sand corer, Vibracore™, and drill rig. Additionally, hydrodynamic surveys were completed for some of these areas and the data was reviewed to assess areas where coal tar impacted sediments may accumulate and evaluate sediment types and thickness.

RCRA Investigations

- Supervised field activities at RCRA sites in Wisconsin and Georgia to determine the nature and extent of soil and groundwater contamination. Contaminants included VOCs and metals. Following completion of the field investigation activities, prepared report for internal review and comment. Both projects were completed successfully and the site in Wisconsin received WDNR closure.

Site Assessments

- Performed numerous site assessments for industrial property transfers in Illinois, Iowa, Wisconsin, and Georgia. Supervised Phased II and III investigations to determine the nature and extent of soil and groundwater contamination. Contaminants included metals, VOCs, and petroleum hydrocarbons. Successful completion of these assessments allowed clients to move forward in negotiations and/or modify transfer agreements, as necessary.

- Conducted hydrogeologic assessment at an industrial site in Illinois. Assessment performed to determine the sources of VOCs. Responsible for supervising the soil and groundwater sampling program to determine sources and extent of groundwater contamination. Incorporated data, results, and conclusions into a report generated for client use when entering into the state agency voluntary clean-up program.

Municipal Wastewater Re-Use

- Monitored hydrogeologic impacts associated with land application of treated municipal wastewater. Evaluated groundwater recharge and possible groundwater use for aquaculture purposes. Research included monitoring the vadose zone using lysimeters, tensiometers, and a neutron probe to evaluate soil water content.

Publications

Kovatch, E.P., D.R. Ralston, J.E. Hammel, "Hydrogeologic Impacts of Lawn Irrigation with Secondary Treated Municipal Sewage Effluent on the University of Idaho Campus", Idaho Water Resources Research Institute, June 1991.

Professional Affiliations

Association of Ground Water Scientists and Engineers
National Ground Water Association

Education

M.S., Hydrology, University of Idaho, 1991
B.S., Geology, University of Wisconsin-River Falls, 1988

Professional Registrations

Wisconsin Professional Geologist #279
Wisconsin Professional Hydrologist #32-111
Minnesota Professional Geologist #30333
Illinois Licensed Professional Geologist #196-000736

Other Training

40-Hour OSHA Health & Safety Training for Hazardous Waste Operations (29 CFR 1910.120)
Radiation Safety Course, NRC 10 CFR & Idaho Department of Health and Welfare
American Red Cross Emergency First Aid and Cardiopulmonary Resuscitation

Other Achievements

NRT's Health & Safety Coordinator.
Radian Corporation Individual Achievement Award - February 1993.
Proficient with numerous computer models and programs including: SESOIL, Quickflow, WHPA, MOC, Modflow, ACAD, GTGS, Aqtesolv, and Microsoft Office.
Skilled using surveying equipment for recording and accurately producing site maps.

LAURIE L. PARSONS, P.E., P.H.
VICE PRESIDENT, PRINCIPAL ENGINEER

Summary of Qualifications

Nineteen years of experience in environmental and consulting engineering, project and technical management, soil/groundwater/sediment contamination assessments, remedial design engineering/analysis, construction management, and regulatory interface. Environmental experience includes landfill liner and containment analysis, brownfield redevelopment, Environmental Response, Compensation, and Liability Act (CERCLA) feasibility studies, Resource Conservation and Recovery Act (RCRA) corrective actions, remediation of underground storage tank releases, and groundwater resource management. Computer modeling experience includes development of site-specific soil quality standards, capture zone analysis, and contaminant transport analysis.

Professional Experience

NATURAL RESOURCE TECHNOLOGY, INC., Pewaukee, Wisconsin (1994 to Present), Vice President, Principal Engineer

WARZYN INC., Madison and Milwaukee, Wisconsin (1986 to 1994), Water Resources and Environmental Engineer

UNIVERSITY OF WISCONSIN-MADISON, (1984 to 1986), Civil and Environmental Engineering, Hydraulics Division, Research Assistant

WISCONSIN DEPARTMENT OF NATURAL RESOURCES, Bureaus of Water Resources and Wastewater Management, Madison, Wisconsin (1980 to 1984), Planning Analyst and Environmental Specialist

Project Experience

Manufactured Gas Plant (MGP) Remediation

- Team Leader for manufactured gas plant (MGP) management program including eight sites in Wisconsin and Michigan. The MGP management program includes site assessments, investigations, development of management strategies, coordinating with local municipalities on property redevelopment plans, implementation of remedies, agency negotiations, and general support to utility client for all aspects of the MGP site management program.

- Senior Project Engineer for development of initial soil, groundwater and sediment investigation and remedial cost estimates at seven MGP sites in Wisconsin for use in commission filings and insurance coverage negotiations.

- Project Manager for remedial excavation and thermal treatment of source impacted soils at a former MGP site in Stevens Point, Wisconsin. Responsibilities included oversight of the remedial alternatives analysis and remedy selection process, directing the project execution and field supervisors for excavation activities, subcontractor negotiations, design oversight

Project Experience (Cont'd)

for dewatering and groundwater treatment system, agency and public relations, and review of the final documentation report.

- Technical review for remedial programs in progress at a former MGP sites located in Wisconsin on the Upper Fox River in Oshkosh, Sheboygan River in Sheboygan, and East River in Green Bay. Key responsibilities within these programs include developing design plans for limited excavations coupled with, and/or capping and hydraulic containment, assisting with consideration of site-redevelopment goals, and continued review of coal tar impacted sediments with respect to evaluating impact to ecological endpoints of concern.

Remedial Design and Site Closures

- Senior Engineer/Project Manager directing the remediation of contaminated soil at multiple former wood treating sites. Responsibilities included oversight for the design of a biological treatment cell and regulatory issues such as hazardous waste classifications, obtaining hazardous waste treatment variances, sampling strategies and parameter requirements, and groundwater monitoring requirements.

- Project Engineer for developing a remedial alternatives and cost analysis for waste materials and contaminated groundwater associated with manufactured gas plant waste at an industrial facility in southeastern Wisconsin. Treatment schemes evaluated included neutralization, hydroxide precipitation, filtration, aeration and anion exchange to address the groundwater contaminants identified at the site which included PAHs, VOCs, low pH and cyanide.

- Senior Engineer directing remediation activities at several sites from remediation oversight through closure phases. Example projects include a 25,000 ton soil excavation and thermal treatment project, removal and closure of a 30,000 gallon leaking fuel oil UST below a manufacturing building, and closure of chlorinated hydrocarbon spill site.

- Designed a recovery well and pretreatment system for capture of groundwater impacted by anti-freeze at a construction equipment manufacturing facility located in central Wisconsin. Prepared permit applications for discharge of recovered water to storm and sanitary sewers. Worked closely with plant staff through construction, start-up and performance monitoring.

- Technical Manager and Lead Engineer for analysis and design of groundwater and soil remediation systems for more than 20 petroleum underground storage tank sites in Wisconsin. Clients included several major petroleum and manufacturing companies.

Project Experience (Cont'd)

Prepared investigation work plans, corrective action reports, and permitting documents.

Performed management of construction oversight, start-up testing, and performance monitoring. Design experience includes: dual-phase soil vapor and groundwater extraction systems, thermal treatment, in-situ oxidation, and air sparging.

Brownfield Redevelopment

- Project Manager for planning and design of the redevelopment of a former industrial cooling water reservoir and utility corridor property in southeastern Wisconsin. Project included obtaining a State of Wisconsin storm water nonpoint source grant for converting the reservoir into a wet detention basin to serve the community for water quality improvements and integrating environmental remediation into the site-wide redevelopment plan.

- Project Manager for implementing environmental management controls at the Milwaukee Art Museum Expansion project in Milwaukee, Wisconsin. Responsibilities included negotiating with local wastewater utility representatives and Wisconsin Department of Natural Resources for acceptance of discharges from the dewatering system, soil management and re-disposition on-site, locating and permitting an alternative fill disposal location, and the concurrent investigation, remediation and closure of underground storage tanks formerly located within the building footprint.

- Project Engineer for assisting the City of West Bend and the local Redevelopment Corporation in resolving redevelopment issues at the former West Bend Plating site for future use as part of the city's riverwalk park. Activities included planning meetings with state agencies, the city, legislative representatives and other stakeholders on the project, and evaluating probable remedial response actions such as capping and monitoring. Related services included assisting the city with developing budgetary costs for environmental restoration of more than 20 properties located within a planned Tax Incremental Financing (TIF) District designed to redevelop the downtown area.

Landfill and Solid Waste Services

- Senior Engineer and Manager for implementation of remediation measures at a closed ash disposal facility located in southeastern Wisconsin. Major components of the project included coordinating an ash stabilization/treatability study, feasibility study, assisting client with remedy selection, engineered cover design, construction oversight and documentation of ash removal and cover placement. Other aspects of the project included assisting the utility client with negotiating connection of residences and businesses to the local municipal water supply and design review of a reverse osmosis system for point of use water treatment.

Project Experience (Cont'd)

- Project Manager for preparing feasibility studies and reviewing corrective measures for mitigating groundwater impacts at several closed ash landfills in Wisconsin and Michigan.

- Project Engineer/Manager for implementation of source control measures including groundwater extraction network design, bidding and construction, treatment system evaluation, and NPDES permitting for a closed municipal landfill.

- Project Engineer/Manager for a detailed in-field hydrologic study of landfill covers including field instrumentation, data analysis, and numerical modeling at the Omega Hills Landfill Final Cover Test Plot Study, Germantown, Wisconsin. Performed related evaluations of leachate collection system performance and leachate management strategies.

- Project Engineer for hydraulic performance analyses of a multiple liner system at Parkview Landfill, Menomonee Falls, Wisconsin.

- Project Engineer responsible for performing or reviewing hydraulic evaluations and water budget analyses for more than ten sites including new, operating, and closed landfills located throughout the Midwest. Facility types included municipal solid waste, industrial, CERCLA, and RCRA sites. Design work included dual leachate/gas extraction systems.

<u>RCRA Compliance/CERCLA Sites</u>

- Project Manager responsible for remedial alternatives evaluation for chlorinated hydrocarbon contaminated soil and groundwater at a manufacturing plant in Milwaukee, Wisconsin. Project included preparation of a RCRA closure investigation and pre-design testing reports, present worth analysis, treatability study, and conceptual design for construction of remedial system. Project also included a separate investigation and successful closure of a former drum storage pad.

- Lead Project Engineer responsible for design of RCRA facility investigation associated with former hazardous waste handling activities at a manufacturing plant in southeastern Wisconsin. The project was subject to RCRA permit and Corrective Action requirements. Project also included development and preliminary design of interim remedial actions to begin source control and treatment of soil and groundwater impacted by chlorinated hydrocarbons.

- Performed groundwater flow analysis, evaluation of alternative remediation strategies, and development of remedy selection documents for Ninth Avenue Dump Superfund Site, Gary, Indiana.

Project Experience (Cont'd)

- Developed RI/FS work plan documents for investigation of surface water, sediment, and groundwater contamination in an industrial area, North Bronson Superfund Site, Bronson, Michigan.

- Performed groundwater flow analyses, contaminant transport assessment, and remedial performance evaluations for multiple CERCLA sites located in Michigan.

Groundwater Resources and Wastewater Management

- Project Engineer for a multi-year program to develop a wellhead protection plan for a large municipality. Components of the project include developing short-term well rehabilitation plans and long-term strategies for minimizing susceptibility of the water supply aquifer to surface contamination.

- Project Manager for a study designed to evaluate the potential source of VOC contamination in a high capacity municipal well. Aspects of the project included performing a capture zone analysis, review of historical records of nearby industries, and a groundwater investigation.

- Project Engineer for evaluation of the effects of high volume (1 mgd), oil, and grease type discharges on a local municipal wastewater utility for a major manufacturer of home care and cosmetic products. Characterized wastewater sources and type, conducted sampling program and assisted in developing recommended actions for the facility.

- Designed and conducted field investigations including wastewater characterization, unsaturated soil zone monitoring, and groundwater impact assessment for evaluating performance of municipal and industrial wastewater land disposal systems. Investigation included installation of multi-depth suction lysimeters and groundwater monitoring wells, and modifications to the land disposal system operational parameters.

Publications/Presentations

Robb, Christopher A., Parsons, L.J. and Wittenberg, Roy E., "Integrating MGP Site Development with Engineered Cover Systems." Gas Technology Institute, 13th International Symposium, Site Remediation Technologies & Environmental Management Practices in the Utility Industry, Orlando, Florida, December 2000.

Parsons, L.J. "The Milwaukee Art Museum Expansion: Environmental Challenges & Solutions in Urban Shoreline Redevelopment," Federation of Environmental Technologists Annual Meeting, Milwaukee, Wisconsin, March 2000.

Publications/Presentations

Robb, Christopher A., Parsons, Laurie J. and Wittenberg, Roy E., "Cost Effective and Flexible Remediation and Containment Strategies for MGP Sites," IGT, 12th International Symposium on Environmental Biotechnologies and Site Remediation Technologies,

Orlando, Florida, December 1999.

Parsons, L.J. and Karnauskas, R.J. "Update on Contaminated Site Closure Under Chapter NR700, Wis. Admin. Code." Federation of Environmental Technologists, Environment '99 Conference, Milwaukee, Wisconsin, March 1999.

Parsons, L.J. "Management of Contaminated Sediments - Technical Overview of Assessment Approaches." Milwaukee Bar Association, Environmental Law Section, December 1997.

Montgomery, R.J., Parsons, L.J. and Otzelberger, Daniel G. "Final Cover Test Plot Study at the Omega Hills Landfill - Two Year Summary Report," 11th Annual Madison Waste Conference, Madison, Wisconsin, 1989.

Montgomery, R.J. Parsons, L.J., and Phillippi, Thomas E. "The Omega Hills Landfill Final Cover Test Plot Study: Project Update and Data Summary," 10th Annual Madison Waste Conference, Madison, Wisconsin, 1988.

Parsons, Laurie J. "Field Investigation of Groundwater Impacts of Absorption Pond Systems Used for Wastewater Disposal," Wisconsin Department of Natural Resources Groundwater Management Practice Monitoring Project Summaries, PUBL-WR205-90, November 1990. Full paper prepared for Master of Science Degree, Civil and Environmental Engineering, University of Wisconsin, Madison, 1987.

Professional Affiliations

American Society of Civil Engineers (ASCE)
National and Wisconsin Groundwater Association (NGWA/WGWA)
Federation of Environmental Technologists (FET)
Engineers and Scientists of Milwaukee (ESM)

Education

M.S., Civil and Environmental Engineering, University of Wisconsin-Madison, 1987
B.S., Environmental Science/Water Chemistry, University of Wisconsin-Green Bay, 1980

Professional Registration

Professional Engineer #E27812 - Wisconsin
Professional Hydrologist #34 - Wisconsin

RICHARD H. WEBER, P.E.
SENIOR ENGINEER

Summary of Qualifications

Twenty two years of experience in environmental consulting and geotechnical engineering in the United States and abroad, specializing in client service and management of large projects. Rich joined Natural Resource Technology from MWH, where he was most recently a Principal Engineer in their Industrial and Federal Operations. His technical expertise includes solid waste, contaminated sediments, construction management, and geotechnical analysis.

Professional Experience

NATURAL RESOURCE TECHNOLOGY, Pewaukee, Wisconsin (2003 to Present),
Senior Engineer

MWH (Predecessor companies of Montgomery Watson Harza, Montgomery Watson, and Warzyn Engineering), Milwaukee, Wisconsin, (1989 – 2003),
Principal Engineer/ Vice President

MWH (Warzyn Engineering), Madison, Wisconsin (1983 – 1989),
Geotechnical Section Manager

DAMES & MOORE, Chicago, IL, (1981 – 1983), Geotechnical Engineer

Project Experience

Remedial Design and Site Closure/ Construction Management

- Project Manager with complete technical and construction responsibility for the $23 million closure of three un-engineered landfills at the former Chanute Air Force Base in Rantoul, Illinois. Work was performed under the auspices of both the U.S. EPA Region 5 CERCLA Program and Illinois EPA regulations. Closure work at the three landfills, varying in size from 12 to 22 acres, included waste consolidation followed by confirmation sampling and analyses, installation of passive gas vent systems and perimeter leachate collection systems, and construction of 5-ft thick composite geosynthetic and soil covers. Attended regular meetings with Air Force and agency personnel to report on engineering and construction work progress, budget, and schedule issues. Also supported Air Force efforts in community education and involvement.

- Project Manager responsible for planning, development of work plans, procurement of subcontractors, and start-up of construction operations for a $1.5 million soil remediation delivery order at an active U.S. Air Force Base in Ramstein, Germany. Facilities included in the scope of this delivery order were an existing engine test cell, motor pool, construction services camp, former liquid oxygen plant, and former skeet range. Soil

Project Experience (cont'd)

contamination was derived from historic fuel spills, leaking tanks, maintenance activities, and lead shot.

- Project Geotechnical Engineer that assisted in development of a remedial design for containment of PCB-contaminated sediments in Waukegan Harbor, Illinois. The conceptual design included soil-bentonite slurry walls and sheet pile walls.

RCRA/TSCA

- Project Manager for the design and permitting of an impoundment for disposal of approximately 700,000 cy of contaminated sediments to be hydraulically dredged from the Grand Calumet River in Gary, Indiana. The five-mile stretch of river is contaminated with PCBs, PAHs, and heavy metals; some sediments exceed TSCA and RCRA hazardous waste limits. An approximately 33-acre impoundment was designed to contain the dredged sediments using RCRA Subtitle C liner technology. Liner design consisted of both a primary and secondary HDPE geomembrane with granular and geonet drainage layers, overlying a geosynthetic clay liner. A gradient control system was designed below the liner for site dewatering during construction. Design included a soil-bentonite slurry wall around the impoundment to minimize construction dewatering, and to provide tertiary containment of the dredged materials.

Contaminated Sediments/ Construction Management

- Project Manager of a multi-disciplined team to work with the Wisconsin Department of Natural Resources (DNR) and Fox River Group in site characterization, design, permitting, and implementation of the SMU 56/57 Demonstration Project in Green Bay, Wisconsin. The project was unique in that the Group, comprising seven paper mills along the Fox River, and the DNR worked together under a Memorandum of Agreement to implement a pilot sediment removal project intended to remove contaminated sediment from SMU 56/57, and thereby to generate as much information as reasonably possible relevant to an assessment of implementability, effectiveness, and expense of large-scale sediment dredging and disposal from the Lower Fox River. Investigation, design, and permitting were performed, including preparation of an environmental assessment, followed by dredging. About 31,000 cubic yards of soft sediment, contaminated with upwards of 700 mg/kg of PCBs, were hydraulically dredged and disposed for the $12.4 million project budget. Sediments were dewatered on shore and then disposed in a Wisconsin solid waste landfill having the necessary approvals under a TSCA waiver from the Department and U.S. EPA. Dredge carriage water was treated on site and discharged back to the river under a project WPDES permit.

Project Experience (cont'd)

Landfill and Solid Waste Services

- Project Manager of a design-build project to implement closure of a former industrial waste landfill in Rosemount, Minnesota. Additional investigations were performed using geophysical and backhoe test pit methods to better characterize the site. An interim response action was completed consisting of localized "hot spot" removal. An x-ray florescence meter was used to field screen waste materials and determine disposal requirements, backed up by random laboratory confirmatory testing. Managed the preparation of construction plans and technical specifications. Successfully assisted the owner negotiate modifications to the approved Closure Plan with the state and county that cut approximately $135,000 from the budgeted landfill cover construction costs.

- Project Manager for a series of projects resulting from ongoing environmental monitoring and regulatory compliance at a closed hazardous waste unit in Germantown, Wisconsin. Projects included groundwater monitoring well installation and analytical testing, leachate head well installation in municipal solid waste and subsequent downhole geophysical logging, final cover construction documentation and preparation of a closure certification report under state hazardous waste regulations, and design and construction documentation of groundwater extraction systems for impacted overburden and bedrock aquifers. Monitoring wells were installed both in soil and bedrock, and in vertical and angle borings. Waterloo multi-port wells were installed in the angle borings. Borehole packers were used during drilling for pressure testing of the bedrock, and to isolate zones for sampling for water quality to determine contamination profiles. Performed a pumping test in the bedrock aquifer to design the groundwater control system. Also was the Field Geotechnical Engineer for construction documentation of a soil-bentonite slurry wall construction as part of overall environmental improvements.

- Assisted the City of Hartford in negotiations with the Wisconsin DNR in response to allegations that a former uncontrolled landfill caused VOC contamination in a municipal water supply well approximately one-half mile away. Managed the preparation of a groundwater monitoring plan and subsequent investigation to prepare an in-field condition report of the former dump. The investigation included a file search for historical and technical information, the installation of groundwater monitoring wells and landfill gas probes, and a soil gas survey. A field GC was used to screen water samples and expedite evaluation of the degree and extent of groundwater contamination. The investigation minimized impacts to use of the site, which currently is a park containing athletic fields and recreational areas. A private well in the vicinity was also sampled and adjacent residences were tested for the presence of landfill gas. A passive gas migration control trench was designed and installed as an interim remedial action to protect neighboring homes and apartments. Additional off-site groundwater investigation was completed, followed by development of a remedial actions options plan. Proposed groundwater remediation includes in-situ enhanced biodegradation. A prescriptive

Project Experience (cont'd)

remedy of capping the landfill was determined to be unwarranted, which will allow continued uninterrupted use of the park during groundwater remediation.

- Managed numerous construction quality assurance projects for phased development and closure at the Kestrel Hawk Landfill (formerly Land Reclamation Company) in Racine, Wisconsin. Construction projects included clay liners and leachate collection systems, manholes interior to the landfill, compacted clay barrier walls separating the hazardous waste unit from the non-hazardous portion, both clay and RCRA composite (40-mil VLDPE) final covers, dual vertical extraction systems for landfill gas and leachate, and storm water control systems. Also managed the preparation of contract documents, specifications, and construction drawings. Fast turnaround on construction observation reports allowed the owner to get timely WDNR approval for refuse filling in critically need airspace.

Geotechnical Analysis

- Performed geotechnical analysis to evaluate the potential for slope instability associated with proposed development of the new Elm Road Generating Station in Oak Creek, Wisconsin. Site development plans include the excavation of approximately 5 million cubic yards of earth for the new electrical power plant area. As much as 75 feet of soil fill will be placed over an existing closed ash landfill to get rid of the excess soils. Pre- and post-fill slopes were evaluated for stability and determined to be satisfactory. Stability analysis included an evaluation of interface sliding along a geosynthetic leachate seep collection system to be placed at the west toe of the landfill prior to soil filling.

- Project Manager for forensic geotechnical analysis following a sudden mass waste movement event at an active solid waste landfill in southeast Wisconsin. Worked with the facility owner, the DNR, and subconsultant university professors to investigate probable cause(s), and to develop a plan for repair and restoration. Investigation included photo-documentation; surveying; field sampling and laboratory physical testing of the compacted clay liner, 60-mil HDPE geomembrane liner, geotextile cushion, and granular drainage layer; laboratory interface shear strength testing; and installation of instrumentation to measure pore water pressures beneath the liner. Extensive analyses were performed to evaluate global and veneer stability of the waste mass and liner components. The assessment determined primary factors for the waste movement were insufficient interface strength and waste mass geometry (height/width ratio). Subsequent restoration included the relocation of about 400,000 cubic yards of municipal waste and replacement of the geosynthetic liner.

- Geotechnical Engineer for design of a municipal waste landfill in Menomonee Falls, Wisconsin. Performed hydraulic uplift analysis of landfill subbase and slope stability analysis of excavation sideslopes. During construction of Phase I, provided engineering support to owner and contractor, and prepared final construction documentation report for

Project Experience (cont'd)

the unique multi-layered liner system. The liner system consisted of the 5-foot thick primary clay liner, the 3-foot thick secondary clay liner, and the 2-foot thick gradient control clay liner. Each liner was overlain with a 1-foot thick granular drainage layer. Was also the Project Manager for construction quality assurance services during final cover construction as portions of the landfill reached final grade.

- Staff Geotechnical Engineer during a major subsurface investigation and test fill to assess feasibility of constructing a new international airport facility in the soft marine clays off of Lantau Island in Hong Kong. Field investigation included use of insitu testing with field vane shear and electronic cone penetrometer (piezocone) devices. Drilling was done both on-shore, and off-shore from floating barges and jack-up platforms.

Publications/Presentations

Weber, R.H., Otzelberger, D.G. "Field Methods Used to Drill and Instrument Angle Borings in Niagara Dolomite." Presented at 14th Annual Madison Waste Conference, Madison, Wisconsin. September 1991.

Weber, R.H., Thompson, S. "Landfill Gas Migration Evaluation and Remedial System Design: A Case Study." Presented at the 32nd Annual International Solid Waste Exposition of the Solid Waste Association of North America, San Antonio, Texas. August 1994.

Weber, R.H. "SMU 56/57 Sediment Removal Demonstration Project." Poster Session at Federation of Environmental Technologists Conference, Regulations and Remedial Technologies Pertaining to Contaminated Sediments, Milwaukee, Wisconsin. January 1999.

Professional Affiliations

American Society of Civil Engineers (ASCE), Member
American Council of Engineering Companies of Wisconsin (ACEC WI; formerly the Wisconsin Association of Consulting Engineers, WACE)
- Department of Natural Resources Liaison Committee – Solid Waste Subcommittee Chair, 1987-2002

Federation of Environmental Technologists (FET), Sediment Committee
Western Dredging Association (WEDA)

Education

M.S., Civil/ Geotechnical Engineering, Northwestern University, Evanston, IL, 1981
B.S., Civil Engineering, University of Wisconsin, Platteville, WI, 1979

Professional Registration

Professional Engineer, #E22938 – Wisconsin
Professional Engineer, #062-047154 – Illinois
Professional Engineer, #E19700348 – Indiana

Regulatory Committees

Wisconsin Department of Natural Resources
External Technical Advisory Committee, Member, Chapter NR 500 Wis. Adm. Code, Revision of the Solid Waste Regulations per Federal Subtitle D (1990-1994)

Wisconsin Department of Natural Resources
Contaminated Sediment Advisory Committee, Member (2000-2001)

ATTACHMENT 2

THIRD PARTY DATA VALIDATOR QUALIFICATIONS

Marcia A. Kuehl

Marcia Kuehl is an environmental chemist and manager with over 20 years of experience in laboratory analysis, environmental data collection, quality assurance and data assessment. She was involved in the early development of the EPA Contract Laboratory Program and subsequent data validation protocols. Currently, Ms. Kuehl is the President/Owner of an environmental consulting firm, the MAKuehl Company. Ms. Kuehl performs and manages the multiple tasks of data validation, laboratory and field audits and assists engineering firms in Quality Assurance Project Plans (QAPP) and Data Quality Objectives (DQO) development.

Ms. Kuehl's educational background is in chemistry, with environmentally focused graduate research in the maternal transfer of PCBs conducted while pursuing her Master's of Environmental Arts and Sciences (M.E.A.S.) degree. In order to conduct this research, she was responsible for developing the analysis method, statistical design and quality assurance program to provide defensible data. This experience was invaluable in her QA role at U.S. EPA. She recently completed her M.S. in Environmental Science and Policy thesis titled "Polychlorinated Biphenyl Congener Patterns in Lake Michigan Mass Balance Study Biota".

Ms. Kuehl has written and reviewed **technical guidance** documents during and after her tenure at EPA. Ms. Kuehl was involved in establishing the DQOs for the Region V Dioxin study with Dow Chemical, and was subsequently asked to join the National Dioxin QA Task Force. The first protocols for EPA regional data validation of Contract Laboratory Program (CLP) were written by Ms. Kuehl, and her involvement in the CLP technical caucuses dates from their inception. Ms. Kuehl developed the DQO process that Donohue and Associates followed for its assigned EPA Region V ARCS contract RI/FS investigations.

Ms. Kuehl has provided for **implementation of QA programs** through her creation of laboratory QA programs for the EPA Central Regional Laboratory and two commercial laboratories. Ms. Kuehl led all scoping meetings involving environmental measurements to guide staff in appropriate DQO selection. Field Sampling Plans as well as Quality Assurance Project Plans were either written or reviewed by her for all federal lead projects.

Ms. Kuehl has proven **skills in communicating** technical information to professionals and the public. She has conducted training for attorneys, geologists, and engineers in the principles of environmental QA from the DQO process through sample collection, analysis and evaluation. Ms. Kuehl has trained EPA subcontractors and state environmental personnel in data validation, statistics, and writing QAPPs. Integrating these subcontractors into project teams and monitoring the quality of their work was her responsibility. Ms. Kuehl has presented technical issues and findings at national and regional meetings of the American Chemical Society, American Society for Quality Control, Water Environment Federation, American Institute of Chemical Engineers and the EPA.

Ms. Kuehl has had over 24 years experience in **conducting on-site audits** of environmental laboratories. She has audited over 15 laboratories providing analytical data under contract to the EPA Contract Laboratory Program, and an additional 14 laboratories that provided analytical data in support of remedial activities and RCRA monitoring programs. She has audited EPA ORD and industrial laboratories conducting ultra-trace level analyses for polychlorinated dibenzofurans and polychlorinated dibenzodioxins for the EPA National Dioxin Study. Most recently she has audited eight federal, state, university and commercial laboratories providing ultra-trace level analyses of congener specific PCBs for the EPA Lake Michigan Mass Balance Study and the seven contract laboratories for the Hudson River Contaminant Assessment Reduction Program. She has been retained by several laboratories to conduct "pre-audits" of them prior to their EPA and/or State audits, and she provides several engineering firms with "capacity and capability" audits of laboratories they are considering for large monitoring projects. She has also worked with a laboratory decertified by the State of Wisconsin in correcting deficiencies and successfully re-applying for certification.

Ms. Kuehl has **implemented automated data verification processes**. As QC Coordinator for the Lake Michigan Mass Balance study, she is responsible for review of all of the organic contaminant data in air, water, sediment and biota. As data was submitted to the EPA, she reviewed each spreadsheet for compliance with the electronic data standard reporting format and the researchers Measurement Quality Objectives. Data was then converted for loading into the data verification program, Research Data Management Quality Control System (RDMQ) developed by Environment Canada. She conducted data verification through RDMQ by the QC Coordinator, and resolved data quality and reporting issues with the laboratory. She worked with Booz Allen & Hamilton to create an automated data verification program for the PCB, pesticide, PNA, dioxin/furan and metals data collected for the Hudson River Contaminant Assessment Reduction Program.

Ms. Kuehl has **validated analytical data** for over 24 years, beginning in the infancy of the EPA Contract Laboratory Program in 1980. She was one of the EPA representatives that met quarterly with the CLP laboratory community and EPA research chemists to refine both the reporting and technical requirements of the CLP from 1980-1984. During her career she has validated data from Superfund sites, RCRA RFI sites and DOD sites for over 10,000 samples. Since 1995, she has validated PCB data for over 2,500 samples collected from the Fox River for the DNR, engineering firms and the paper industry.

Ms. Kuehl's involvement and input into the field of environmental quality assurance are documented and known to her peers. The experience and knowledge Ms. Kuehl holds will enable her to provide data validation support to NRT.

MARCIA A. KUEHL

3470 CHARLEVOIX CT. GREEN BAY, WISCONSIN 54311
OFFICE PHONE/FAX: (920) 469-9113 HOME PHONE: (920) 469-2437
E-mail: makuehl@aol.com

EXPERIENCE

1/93- present **MAKUEHL CO.**, Green Bay, Wisconsin.
PRESIDENT/OWNER
Provide technical consultation to environmental laboratories and engineering firms by conducting pre-audits, preparing QA Program and Project Plans, and writing SOPs. Assist engineering firms by providing field and lab audits and data validation services. Serve as analytical coordinator for selection and tracking of labs data quality and analytical turnaround time. Prepare and review QA Project Plans, and facilitate QAPjP approval process with EPA.

8/92-1/93 **ORTEK Environmental Laboratory**, Green Bay, Wisconsin.
LABORATORY DIRECTOR
Supervised staff of 20 chemists and technicians. Prepared and implemented productivity controls including staff "right-sizing", equipment utilization goals, and cross training. Developed Health and Safety Program and budget to maintain compliance with tribal and federal environmental regulations.

6/91-8/92 **ORTEK Environmental Laboratory**, Green Bay, Wisconsin.
QUALITY ASSURANCE DIRECTOR
Wrote Quality Assurance Manual that was approved by the U.S. Navy, HAZWRAP, U.S. EPA CLP and U.S. Army Corps of Engineers. Managed federal analytical projects for DOE and NEESA ($90,000 to $450,000) for compliance with established protocols. Provided clients with technical assistance on appropriate analytical methodology and QA requirements to
meet project needs.

1/87-6/91 **Donohue and Associates**, Sheboygan, Wisconsin.
SENIOR ENVIRONMENTAL CHEMIST
Served as Senior Technical Lead on projects requiring quality assurance and field sampling plans that complied with U.S. EPA guidelines and protocols. Reviewed and validated environmental chemistry data and determined DQOs during project scoping. Prepared Work Plans, Quality Assurance Project Plans, and Field Sampling Plans. Served as Field Team Leader, Project Manager, Site Safety Officer, data validator or on-site senior chemist for Superfund remedial projects for Region V ARCS contract. Project sites included: Crab Orchard National Wildlife Refuge, Carterville, IL; Forest Waste Disposal Site, Otisville, MI; Bofors Site, Muskegon, MI; Himco Dump, Elkhart, IN.

Prepared QC Plans, Sampling and Monitoring Well Installation Plans, Final Reports, and QC Summary Reports for 12 U.S Army Corps of Engineers Confirmation/Quantitation studies. Validated lab data and provided field support at nine abandoned NIKE missile bases and two former ordnance plants. Conducted investigation of mercury spill in sewer line, selected remedial alternative, and supervised clean-up.

1/85-1/87 **Donohue Analytical**, Sheboygan, Wisconsin.
QUALITY CONTROL COORDINATOR
Developed a quality assurance program that resulted in certifications by the State of Wisconsin, Chemical Waste Management, U.S. Army Corps of Engineers, and U.S. EPA Region V. Managed analytical contract ($200,000) with ETC Corporation to meet Waste Management Northern Region analytical requirements for landfill monitoring.

9/80-1/85 **U.S. EPA Central Regional Laboratory, Region V**, Chicago, Illinois.
QUALITY CONTROL COORDINATOR
Created training program for federal, state, and contractor personnel in data validation from the Superfund Contract Laboratory Program. Conducted on-site audits of CLP laboratories. Authored and managed the Central Regional Laboratory Quality Assurance Operation Plan which was cited by EPA auditors as a model plan.

EDUCATION

2002 **University of Wisconsin-Green Bay**, Green Bay, Wisconsin.
M.S. Environmental Science and Policy

1983-present **Health and Safety** 8 hour HAZWOPER refresher, first aid and CPR certification current

1982 **OSHA Training Institute**, Des Plaines, Illinois.
40-hour Hazardous Site Health and Safety Course, certified through Level A

1979-1980 **University of Wisconsin-Green Bay**, Green Bay, Wisconsin.
M.E.A.S. Environmental Stressors program courses

1977-1978 **University of Minnesota**, Minneapolis, Minnesota.
Medicinal Chemistry and Toxicology program courses

1977 **University of Wisconsin-Eau Claire**, Eau Claire, Wisconsin.
B.S. Chemistry, A.C.S. Accredited Degree

PRESENTATIONS, PUBLICATIONS, AND AWARDS

6/03 "Polychlorinated Biphenyl (PCB) Congener Patterns in Lake Michigan Mass Balance Study Biota", IAGLR annual meeting

6/01 "When 1 + 1 ≠ 2: Total PCBs for the Lake Michigan Mass Balance Study", IAGLR annual meeting.

7/00 Appointed to the Laboratory Certification Standards Review Council by the Governor of the State of Wisconsin.

6/97 "Quality Assurance Challenges Faced During the EPA Lake Michigan Mass Balance Study", IAGLR annual meeting.

5/97 "Data Quality Objectives: Boilerplate, Statistics and Reality", 20th Annual EPA/WEF Analysis of Pollutants in the Environment Conference.

5/96 "Lake Michigan Mass Balance Study: Amalgam, Resin and Dramamine", 19th Annual EPA/WEF Analysis of Pollutants in the Environment Conference.

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8/90 "Mercury Removal from a Sanitary Sewer System at Hanscom AFB, Massachusetts", AIChE annual meeting.

6/89 "Field Precision at Hazardous Waste Sites", American Chemical Society, 22nd Annual Great Lakes Regional meeting.

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7/88 "Field Duplicates and Splits: Agree to Disagree", EPA Waste Testing and Quality Assurance Symposium, Washington, DC.

1989 <u>Use of a Batch Asphalt Plant for Remediation of Soils Contaminated by Volatile Organic Compounds</u>, 43rd Purdue Industrial Waste Conference Proceedings.

1985 EPA Bronze Medal for Commendable Government Service for technical contributions to the National Dioxin Study.

1982 EPA Bronze Medal for Commendable Government Service for the development of an innovative training program for state and federal personnel in Superfund analytical data validation and quality control.

ATTACHMENT 3

LAB QAPPs AND CERTIFICATIONS

To be submitted with Final

APPENDIX B

SAMPLING AND ANALYSIS PLAN (SAP)

TABLE OF CONTENTS

ATTACHMENTS

1 INTRODUCTION

1.1 Objectives

This Sampling and Analysis Plan (SAP) describes environmental sample collection and other field activities to be conducted in support of the remedial investigation and feasibility study. Field activities will include: hydrographic surveys, non-native soft sediment sampling for characterization of ecological and human health risk assessments, non-native soft sediment sampling for geotechnical characterization and extent of sediment exceeding the calculated site-specific risk value, and surface water sampling.

The selection and rationale for analytical sampling are discussed in Section 3.0 of the Work Plan. The frequency and analytical methods for sediment and surface water samples collected during this investigation are summarized on Table 9 of the Work Plan and discussed in the following sections. Sample collection methods, as well as other field activities, are also described in the following sections with details presented in Field Operating Procedures (FOPs) included as Attachment 1 to this SAP. All field sampling activities will be conducted in accordance with the QAPP and Health and Safety Plan (HSP), included in Appendices A and C of the Work Plan, respectively.

2 SCOPE OF WORK

2.1 Site Mobilization

Each person entering the site will review the HSP. The site will be cleared through Diggers Hotline and the shoreline will be marked to indicate where underground utilities cross the river prior to Phase I sampling. If utilities are identified, an on-site meeting will be arranged with utility representatives.

2.2 Geophysical Surveys

Prior to collecting sediment samples, river bathymetry and the location of soft sediment deposits will be evaluated through hydrographic surveys, including multi-beam sonar (bathymetry), sub-bottom profiling (sediment thickness), and side scan sonar. The bathymetric survey will map the sediment bed elevation, while the sidescan sonar survey will identify sediment transition zones and the location of submerged potential obstructions. In addition, the sub-bottom profiling survey will identify areas with accumulation of soft sediment. Sediment stratigraphy and thickness will be confirmed through sediment poling during sediment sampling. The bathymetric survey will be performed prior to the sidescan and sub-bottom surveys as the bathymetry data will be used to select the orientation of sidescan sonar transects. The surveys will be performed in accordance with the subcontractor's technical FOPs, included as Attachment 2 to this SAP.

The results from the hydrographic surveys will provide a comprehensive assessment of the extent and thickness of non-native soft sediment that will be used in evaluating remedial options. Data collected during these activities will be used to identify appropriate locations for collecting sediment samples. The bathymetry information will be utilized with United States Geological Survey (USGS) stream flow measurements to calculate flow velocities and discharge for this segment of the river. Flood information available from the Federal Emergency Management Administration (FEMA) will be used to assess flood flow frequency, volume, and discharge velocities for evaluation of potential scour in the river channel.

2.2.1 Base Mapping and Survey Control

Accurate topographic and bathymetric surveys are required to develop a base map in support of final engineering design and to provide an accurate representation of all project data. All survey data and locations will be in latitude/longitude (degrees, minutes, and seconds) for horizontal control and later converted to the Sheboygan County coordinate system. Vertical control will be referenced to the North American Vertical Datum of 1988 (NAVD88). The base map will be used for the following:

- Plotting RI sample locations on a uniform x-y-z coordinate system;
- Depicting the sediment elevations;
- Generating current distribution and volume estimates of non-native soft sediment which exceeds a calculated site-specific risk value;
- Identifying public and private shoreline features that may be affected by remedial work (docks, bulkheads, etc.);
- Providing a large-scale base map upon which utility data, derived from outside sources, can be accurately shown;
- Providing a construction base map for project infrastructure and facilities (docks, slurry piping, dewatering plant, wastewater treatment plant, etc.) that may be part of the remedial action; and,
- Establishing a construction grid system upon which engineering calculations will be based.

Minimum requirements for the topographic survey and mapping effort, along with the corresponding survey control, are described in the following subsections.

2.2.2 Bathymetric Survey

A bathymetric survey will be conducted in order to provide a baseline sediment bed elevation. The elevations will be entered into the project database and utilized during remedial design. The survey will be performed in general accordance with the USACE online document (http://www.usace.army.mil/publications/eng-manuals/em1110-2-1003/toc.htm).

These specifications are to be regarded as a general guideline that may be modified upon selection of a geophysical surveying contractor.

Multi-beam sonar will be used to perform the bathymetry survey. The bathymetry will be determined over the entire length of the former MGP site, plus a distance of approximately 200 feet upstream of the site and continuing approximately 600 feet downstream of the Pennsylvania Avenue Bridge (total length of approximately 1,800 feet). The bathymetry survey will include the entire width of the river over this distance (approximately 10-12 acres).

Horizontal positioning for the survey vessel and bathymetric sensors will be maintained by an onboard differential global positioning system (DGPS) that will receive signal corrections from a shore-based unit. The average accuracy for such systems is ±0.03 feet for horizontal positioning (although ±3 feet is acceptable) and ±0.10 feet for vertical positioning. The horizontal positioning data will be transmitted in real-time to an onboard vessel tracking system. Horizontal control will be referenced to latitude/longitude in degrees, minutes, and seconds and later converted to Sheboygan County coordinate system. Vertical control will be referred to NAVD88. During the bathymetric survey work, an on-site staff gage will be used to correlate river level to the vertical datum.

The collected bathymetric values will be used to estimate sediment elevations. All bathymetric datasets will be gridded and incorporated into a series of digital terrain models (DTM) and elevation contour basemaps (probable 1-foot contour intervals).

2.2.3 Side-Scan Sonar Survey

A side-scan sonar survey will be completed to provide information on the bottom conditions of the river. The goals of the side-scan survey are to map sediment transition boundaries and determine the presence or absence of submerged potential obstructions. The survey will start approximately 200 feet upstream of the site and continue approximately 600 feet downstream of the Pennsylvania Bridge. The survey will encompass the same area described in Section 2.2.2 for the bathymetric survey.

Acoustic imagery will be obtained along longitudinal survey lines parallel to the shore. Bank-to-bank sidescan coverage will be achieved by acquiring multiple survey lines with overlapping coverage. A typical sidescan swath can be calculated at approximately 20 times the distance between the transducer and the riverbed.

Horizontal and vertical positioning of the survey vessel and sidescan transducers will be maintained in the same manner as discussed in Section 2.2.2 for the bathymetric survey. The acoustic imagery will be processed and interpreted to graphically represent the physical characteristics of the riverbed (i.e., sediment type and transition boundaries) and location of obstructions to be avoided. Digital mosaics will be generated and incorporated in the project database with the baseline bathymetric data. These data will be used to assist in identifying the lateral extents of sediment sampling requirements and to aid in the remedial design.

2.2.4 Sub-Bottom Profiling

Sub-bottom profiling will be used to further identify the lateral extent of sediment types identified by the sidescan sonar survey and provide a high-resolution image of the subsurface stratigraphy. The data will provide information regarding the vertical extent of the soft sediment transition to hard sediment horizon in the subsurface. The sub-bottom profiles will be completed moving parallel to the shoreline. The survey will start approximately 200 feet upstream of the site and continue approximately 600 feet downstream of the Pennsylvania Avenue Bridge, the same area as the bathymetric survey and side-scan sonar.

The sub-bottom profile survey will be conducted concurrently with the sidescan sonar survey. Therefore, the same survey line spacing will be implemented for sub-bottom profiling as described in Section 2.2.3 for sidescan sonar. Likewise, horizontal and vertical positioning of the survey vessel and sub-bottom profiler will be maintained in the same manner as discussed in Section 2.2.2 for the bathymetric survey.

The sub-bottom profile data will be processed and interpreted to graphically represent the sediment horizon. Longitudinal profiles will be generated and incorporated in the project database with the bathymetric and sidescan sonar datasets. These data will be used to assist in identifying the lateral and vertical requirements for sediment sampling and assist in remedial design.

2.3 Sediment Poling

Sediment poling will be conducted prior to sediment sample collection in Phase I for comparison to sediment thicknesses generated during sub-bottom profiling. A minimum of 12 transects will be established across the river, with poling locations spaced approximately 50-feet along each transect to the west side of the river. One background transect will be placed approximately 200 feet upgradient of the site and one transect will be placed approximately 600 feet downgradient of the Pennsylvania Street (Work Plan Sheet 4).

At each location, an aluminum rod will be advanced through the water to the top of soft sediment and manually pushed to refusal to estimate the thickness of soft sediment. The depth to the top of soft sediment and the thickness of soft sediment will be recorded on field logs included in the FOP.

Horizontal control will utilize GPS and the boat will be properly anchored to maintain position. Poling locations will be recorded as latitude/longitude and later converted to the Sheboygan County coordinate system. Vertical control will be established relative to the staff gage (referenced in Section 2.2.2) installed at the site (NAVD88) on the northern end of the former WPSC property boundary. A FOP for sediment poling is included in Attachment 1 of this SAP.

2.4 Sediment Sampling

Two sediment sampling phases will be conducted. Phase I sampling is primarily to calculate a site-specific risk value based on ecological risk and human health risk assessments. Phase II sampling is to further characterize sediment concentrations and the nature of non-native soft sediment that exceed the calculated site-specific risk value and to collect representative sediment samples for geotechnical and waste disposal characterization. The sampling events will employ different sampling techniques and will have separate analytical parameters. To address QA/QC, blind duplicate and matrix spike/matrix spike duplicate (MS/MSD) samples will be collected as described in Section 3.0 of the QAPP.

The investigation will be limited to non-native soft sediment samples and surface water samples upstream, adjacent to, and downstream of the former MGP site as shown on Sheet 4 of the Work

Plan. Table 9 of the Work Plan provides the analytical summary with analytical methods, quantity of samples, container type, sample volume, preservation, and holding times from sample date.

Horizontal control will utilize a GPS and the boat will be properly anchored to maintain position. Locations will be recorded as latitude/longitude and later converted to the Sheboygan County coordinated system. Vertical control will be established relative to the staff gage (referenced in Section 2.2.2) installed at the site (NAVD88).

2.4.1 Phase I Sediment Sampling

2.4.1.1 Ecological Risk Assessment

A minimum of 23 samples will be collected for evaluation of the screening level ecological risk assessment (SLERA). Non-native soft sediment samples will be collected adjacent to the site, generally within the areas previously characterized, with a goal of obtaining several samples in each of three total PAH concentration ranges as described below. Samples will be initially analyzed using an on-site mobile laboratory. Based on the total PAH concentrations reported by the mobile laboratory, select samples will be analyzed by a fixed-base laboratory and evaluated for toxicity testing, as further described below.

A Ponar™ grab sampler will be used to collect non-native soft sediment samples from the top 6 inches of sediment at select locations within the areas previously characterized. The depth to the top of soft sediment and the thickness of soft sediment measured by poling techniques will be recorded prior to using the Ponar™ grab sampler. FOPs for sediment sampling collection are included in Attachment 1 of this SAP. The grab sampler will be manually lowered into the water to the top of sediment at which time the sample device will shut and the sampler will be manually raised to the boat deck. The sample will be screened for the presence of volatile organic vapors with a photoionization detector (PID), inspected for acceptance criteria, standing water will be removed, and the sediment will be described according to ASTM D-2488. The sediment will be removed from the grab sampler and homogenized in a stainless steel bowl using a stainless steel spoon. Unrepresentative material (i.e., stones, wood chips) will be removed from the sample at the discretion of the field sampler and will be documented in the field log. Sufficient sediment volume will be collected (estimated to require three to five grabs) and mixed in the bowl to allow for chemical analysis (mobile laboratory and fixed-base laboratory, in select samples), physical analysis, and sediment toxicity testing. Each of these sub-samples will be collected using a stainless steel spoon.

The mobile laboratory will be used to identify samples with concentrations representing a range of total PAH concentrations. Optimally, the distribution will be:

Sample Quantity	Total PAHs (ppm)
3	Background/Upstream Reference Locations
5	10-90
10	100-900
5	1,000 +

Reference locations will be selected in an area without any input from the MGP site. Sediment samples with total PAH concentrations that are not within these ranges listed above, or samples with total PAH concentrations in a range that has already met the optimum sample quantity, will be handled as investigative waste material and a new sample location will be evaluated. All sediment samples will be stored on ice during the mobile laboratory analysis. Total PAH concentrations within these ranges will be distributed to the extent possible in order to evaluate a broad range of sediment toxicity. Sediment samples within these ranges will be sent to a fixed-base laboratory under chain-of-custody procedures, as described in the FOP included in Attachment 1 of this SAP, for analysis of the following constituents:

- Benzene, toluene, ethylbenzene, and xylenes (BTEX);
- 34 PAHs, including chain parameters;
- Metals (aluminum, antimony, arsenic, barium, cadmium, chromium, copper, cyanide, iron, lead, manganese, mercury, nickel, selenium, silver, vanadium, and zinc);
- Polychlorinated biphenyls (PCBs);
- "Soot" carbon and total organic carbon (TOC);
- Percent solids; and,
- Grain size.

The full analytical lists with project quantitation limits (PQLs) are provided on Table 7 of the Work Plan. PAHs will be analyzed using USEPA SW846 Method 8270C with GC/MS in the Selected Ion Monitoring (SIM) mode of operation. Sediment samples will also be analyzed for "soot" carbon, based on the procedural definition of soot as the remaining carbon after muffle furnace drying and acid treatment of sediments to remove other forms of carbon (Gustaffson *et al.* 1997, Accardi-Dey and Gschwend, 2003). The analytical data package will be fully data validatable.

A portion of each of the 23 samples sent for fixed-base laboratory analysis will also be sent to a toxicity laboratory for testing using a modified version of the procedures described by EPA/600/R-99/064 Methods for Measuring the Toxicity and Bioaccumulation of Sediment-Associated Contaminants with Freshwater Invertebrates, Second Edition; Method 100.4. The test endpoints will be a 28-day survival and growth (weight and length) test using *Hyallella* *azteca* (amphipod) to evaluate the toxicity of whole sediments. Each set of whole sediment toxicity tests will be conducted with an uncontaminated control sediment and a minimum of 8 replications of each sediment sample.

2.4.1.2 Human Health Risk Assessment

A minimum of 20 samples will be collected for the human health risk assessment. Non-native soft sediment samples will be collected adjacent to and slightly downstream of the site, generally within the areas previously investigated, based upon areas where there is a high probability of direct contact to MGP residuals in the sediments due to recreational activities (i.e., wading or swimming in river, fishing, etc). The depth to the top of soft sediment and the thickness of soft sediment will be recorded on field logs prior to using the push sampler. Samples will be collected from 0 to 2 feet below the top of sediment (the assumed depth to which a person would sink to, wading across the river) in locations that meet the following criteria:

- Areas in which MGP residuals (tar and sheen) have been observed;
- Areas with shallow water depths;
- Areas of the river accessible from land (i.e., boat dock areas); and,
- Areas of the river in which site conditions indicate people may access the river.

An Ogeechee™ open barrel corer or other drive-push sampler will be manually pushed or driven to 2 feet below the non-native soft sediment surface (see the FOP Appendix A of the Work Plan). Following retrieval of the corer, the sample will be extruded from the core sleeve, screened for the presence of volatile organic vapors with a PID, and the sediment will be described in accordance with ASTM D-2488. The sediment will be homogenized over the entire core length in a stainless steel bowl using a stainless steel spoon. Unrepresentative material (i.e., stones, wood chips) will be removed from the sample at the discretion of the field sampler and will be documented in the field log. The sediment will be sent to a fixed-base laboratory under chain-of-custody procedures analyzed for the following parameters:

- BTEX;
- 20 PAHs;
- Metals (aluminum, antimony, arsenic, barium, cadmium, chromium, copper, cyanide, iron, lead, manganese, mercury, nickel, selenium, silver, vanadium, and zinc);
- PCBs;
- Percent solids; and,
- TOC.

The full analytical lists with PQLs are provided on Table 8 in the Work Plan. PAHs will be analyzed using USEPA SW846 Method 8270C with GC/MS in the Selected Ion Monitoring (SIM) mode of operation. The analytical data package will be fully data validatable.

2.4.2 Phase II Sediment Sampling

After a site-specific risk value has been calculated, sediment coring will be conducted to further characterize sediment concentrations and the nature of non-native soft sediment exceeding the calculated site-specific risk value. All sampling activities will be cleared with Digger's Hotline to mark utility structures, cables, and pipelines.

The soft sediment samples will be collected using a vibrocore sampler or equivalent to refusal (i.e., top of native consolidated sediment). The vibrocore sampler is electrically powered to advance a core tube with a dedicated liner up to 20 feet into soft sediment.

A FOP for sample collection is included in Attachment 1 of this SAP. The FOP covers sample location, securing of the sampling vessel at a station position, and includes the stepwise procedure for the deployment and retrieval of the vibrocore, and subsequent sediment collection. After selecting the subcontractor, the FOP may be modified. Historical data has shown that core recoveries are as low as 60 percent; however, technology for collecting core samples has advanced to the point where 90 percent recovery should be expected for most sample types. To prevent precluding any emergent technologies, a performance-based specification will be written in the request for proposal to potential sampling subcontractors. The specifications that will be required include:

- Ability to attain and maintain station position: use of spuds is preferred over anchoring;
- Station location: less than 3 feet (approximately 1 meter) (x, y) using DGPS in latitude/longitude degrees, minutes, and seconds and later converted to Sheboygan County coordinate system;
- Depth measurement with water level correction: less than 0.1 feet (approximately 3 centimeters (cm)) (z) referenced to NAVD88; water elevation to be surveyed at least once per day (i.e., mid-day) for determining core sample elevation;
- Coring equipment: vibrocore or equivalent;
- Recovery/penetration: greater than 90 percent (this is a goal, not a minimum requirement);
- Ability to document rate of penetration; and,
- Ability to collect core samples down to the native clay layer (potentially 5 to 20 feet).

This SAP and the QAPP (included in Appendix A of the Work Plan) are subject to change to include additional FOPs after subcontractors are selected.

The majority of transects used in the 1995/1996 sediment investigation will be initially used to compare current conditions and assess the effect of upland remediation on sediment quality (Sheet 3 of the Work Plan). Up to 12 transects will be established. A background transect will be established approximately 200 feet upstream of the former MGP site boundary, and a transect will be established approximately 600 feet downstream of the Pennsylvania Avenue bridge to define the extent of MGP residuals exceeding the calculated site-specific risk value (Sheet 4 of the Work Plan).

Cores will be advanced from the west side of the river moving easterly toward the site along transects as shown on Sheet 4. Core locations will be spaced approximately 100 feet apart. As core locations approach the shoreline, the distance may increase or decrease to fit a core location adjacent to the shoreline (Sheet 4 of the Work Plan).

As cores are brought to the surface, the sediment will be screened for the presence of volatile organic vapors with a PID and described in accordance with the ASTM D-2488 and the FOPs included in Attachment 1 of this SAP. Each core will be subdivided into 1 foot intervals. The bottom interval will be combined with the interval above it if it is less than 6 inches long. If greater than 6 inches, the bottom interval will be its own sample. Each 1 foot interval will be homogenized in a stainless steel bowl using a stainless steel spoon. Unrepresentative material (i.e., stones, wood chips) will be removed from the sample at the discretion of the field sampler and will be documented in the field log.

Each composited non-native soft sediment sample will be analyzed in a mobile laboratory to further characterize sediment concentrations of the chemicals of concern (COCs) identified in the risk assessments. A split sample from approximately 5% of the samples analyzed in the mobile laboratory will also be sent to a fixed-based laboratory. Cores which exhibit visible or olfactory evidence of tar or significant sheen in all intervals may not be analyzed, as these cores will be considered affected by MGP residuals, and thus require evaluation during the FS. Each interval in cores without visual or olfactory evidence of tar or significant sheen will be analyzed for COCs to characterize concentrations in sediment. The analytical data packages will be fully validated by a third party data validator. If a core does not exceed the calculated site-specific risk value in any interval, the core location will not be considered in the FS. Additional cores may be advanced between sampling locations and transects to refine the area considered in the FS.

Based on visible and olfactory observations during previous NRT sediment investigations at the site, non-MGP affected sediment overlies MGP affected sediment in certain locations. These locations may be considered "naturally capped" during remedial option evaluations in the FS. However, there is a potential this overlying non-MGP affected material is PCB-impacted and will be removed during PCB remediation associated with the Sheboygan River and Harbor Superfund Site (EPA ID# WID980996367). This may expose the MGP affected material and remove or limit the integrity of the natural capping effect. Therefore, intervals of non-MGP affected sediment greater than 2 feet thick, overlaying isolated intervals with MGP affected sediment (i.e., visual, olfactory, or COC concentrations greater than the calculated site-specific risk value), will be analyzed for PCBs to provide data for evaluation during the FS. A composite sample for PCB analysis will be collected from each 1-foot interval, overlaying MGP affected sediment, to the top of sediment core.

In addition to the cores for analytical testing, approximately one core per every five cores will be collected for analysis of geotechnical parameters for use in the FS. These parameters include: Atterberg limits, grain size, specific gravity, organic content by loss-on-ignition, and moisture content. Field measurements to estimate shear strength will be collected using a pocket penetrometer and a torvane (using a large vane for soft soils). Geotechnical samples may be discrete intervals, or composite samples, depending on the conditions observed.

A composite sample will also be prepared for waste characterization by collecting and combining the entire core from 3 different locations in the project area. The composite sample will be sent to a fixed-base laboratory under chain-of-custody procedures. The sample will be analyzed for Protocol B parameters to identify potential disposal options.

2.5 Surface Water Sampling

A total of six surface water grab samples and one duplicate sample will be collected from the Sheboygan River during Phase I of the sediment sampling. Three samples will be collected from locations adjacent to the site and three samples will be collected from upstream of the site (Sheet 4 of the Work Plan) in accordance with the FOP in Attachment 1 of this SAP, Samples will be collected with a grab sample device (i.e., Horizontal Beta Plus methods or Niskin bottle) at approximately half the water depth at the site. The bottle shall be lowered slowly to the depth of collection, allowed to equilibrate for one minute, and then tripped to capture the sample. For the duplicate sample, the water will be immediately subsampled.

Temperature, pH, dissolved oxygen, specific conductivity, and turbidity will be measured using hand-held field instruments prior to sample collection at each location.

Samples collected from the surface water will be sent to a fixed-base laboratory under chain-of-custody procedures and analyzed for the following parameters:

- 34 PAHs; and,
- Total and dissolved metals (aluminum, antimony, arsenic, barium, cadmium, chromium, copper, cyanide, iron, lead, manganese, mercury, nickel, selenium, silver, vanadium, and zinc).

Dissolved metal samples will be field filtered using dedicated and disposable filters. The analytical package will be fully data validatable.

2.6 Investigative Waste Management

Investigative wastes will be managed in accordance with the current WDNR General Interim Guidelines for the Management of Investigative Wastes (Publication RR-556, April 2002). Investigative waste will be containerized in DOT approved drums until disposal arrangements are made. Solid wastes will be disposed at an off-site facility based on the constituents and concentrations present in the soils. Liquid wastes will be disposed of via the City of Sheboygan sanitary sewer system, following City approval.

3.0 REFERENCES

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ATTACHMENT 1
NRT FIELD OPERATING PROCEDURES (FOPS)

Table 1 - Summary of Field Operating Procedures
Campmarina Former Manufactured Gas Plant, Sheboygan WI
Wisconsin Public Service Corporation

FOP Number	Description
07-03-03	Chain-Of-Custody Procedures
07-09-03	Vibro-Core Sampling
07-09-04	Granular Sediment Classification
07-09-05	Sediment Grab Samples
07-09-06	Open Barrel Punch Corer
07-09-07	Surface Water Samples Using Horizontal Beta Plus Bottles
07-09-09	Sediment Thickness Using Poling Techniques
07-09-10	Sample, Labeling, Storage, and Shipment
07-09-11	Non-Disposable and Non-Dedicated Sampling Equipment Decontamination

CHAIN-OF-CUSTODY PROCEDURES

1.0 PURPOSE

Chain-of-custody procedures are established to provide sample integrity. Sample custody protocols will be based on procedures as described in "NEIC Policies and Procedures", EPA-330/9-78-DD1-R, Revised June, 1985. This custody is in two parts: sample collection and laboratory analysis. A sample is under a person's custody if it meets the following requirements:

- It is in the person's possession;
- It is in the person's view, after being in the person's possession;
- It was in the person's possession and it was placed in a secured location; or
- It is in a designated secure area.

All samples submitted to a laboratory shall be accompanied by a properly completed Chain of Custody form.

2.0 FIELD SPECIFIC CUSTODY PROCEDURES

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

Field procedures are as follows:

(a) The field sampler is personally responsible for the care and custody of the samples until they are transferred or properly dispatched. As few people as possible should handle the samples.

(b) All bottles should be tagged with sample numbers and locations.

(c) Sample tags should be filled out using waterproof ink for each sample.

(d) The Project Manager should review all field activities to determine whether proper custody procedures were followed during the field work and decide if additional samples are required.

Transfer of Custody and Shipment Procedures are as follows:

(a) Samples should be accompanied by a properly completed chain-of-custody form. The sample numbers, locations, media, time of collection, preservative and required analyses 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.

(b) 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 locked and/or secured with strapping tape in at least two locations for shipment to the laboratory.

(c) Whenever samples are split with a source or government agency, a separate Sample Receipt is prepared for those samples and marked to indicate with whom the samples are being split. The person relinquishing the samples to the facility or agency should request the representative's signature acknowledging sample receipt. If the representative is unavailable or refuses, this is noted in the "Received By" space.

(d) All shipments will be accompanied by the Chain-of-Custody record identifying the contents. The original record will accompany the shipment, and the pink and yellow copies will be retained by the sampler for returning to the sample office.

(e) If the samples are sent by common carrier, a bill of lading should be used. Receipts of bills of lading will be retained as part of the permanent documentation. If sent by mail, the package will be registered with return receipt requested. Commercial carriers are not required to sign off on the custody form as long as the custody forms are sealed inside the sample cooler.

The Chain of Custody records will be kept with the analytical laboratory reports in the project master file.

CHAIN OF CUSTODY RECORD

Natural Resource Technology
N R T

Sample Collectors(s)/Signature(s)	NATURAL RESOURCE TECHNOLOGY, INC. PEWAUKEE, WISCONSIN	Laboratory Samples are Being Submitted To: ____________ Quote Number/Addendum Number ____________ Attached: YES __ NO __

Site Name: ______________________

Site Address: ______________________

____

Send Report To:
Project Manager: ______________ Project Number: __________
Natural Resource Technology, Inc.
23713 W. Paul Road Task Number: __________
Pewaukee, WI 53072
Telephone (262) 523-9000 Fax (262) 523-9001

Temperature of temperature blank __________
If sample(s) were received on ice and there was ice remaining, you may report the temperature as "received on ice". If all of the ice was melted, the temperature of the melt may be substituted for a temperature blank.

I hereby certify that I received, properly handled, and maintained custody of these samples as noted below:

Relinquished By (Signature)	Date/Time	Received By (Signature)	Date/Time
Relinquished By (Signature)	Date/Time	Received By (Signature)	Date/Time
Relinquished By (Signature)	Date/Time	Received By (Signature)	Date/Time

Analytical Method / Numbers

Lab Use Only

Field ID Number	Date Collected	Time Collected	Sample: Media	Sample: Device	Location / Description	PID Reading	Field Comments	Preserv. Type	# of Cont.								Lab ID Number	Sample Conditions @ Laboratory

SPECIAL INSTRUCTIONS

Laboratory shall retain samples for 30 days after issuing Analytical report unless indicated otherwise below:
___ Return ___ Other ______________

VIBRO-CORE SAMPLING

1.0 GENERAL

The vibro-corer is an electrical powered sediment sampling system featuring a vibrator head that drives a core tube (often containing a cellulose acetate butyrate (CAB) liner) into the sediment. Liners can be up to 20 ft (6 m) long and 4 inch inside diameter; lengths are selected based on sediment measured. The following SOP explains the technique for collecting sediment core samples using a vibro-corer. The procedures cover the following activities:

- Site position.
- Securing the barge for sampling.
- Sampling procedure.

2.0 EQUIPMENT and SUPPLIES

The following equipment and supplies would be needed for a typical sampling at one station:

- Vibro-corer (including core tube)
- Winch
- CAB core tubes
- Core catcher
- Stainless steel bowls and spatulas
- HDPE sediment sample bottles
- Glass bottles for organic contaminant samples
- Ice chests
- Labels
- Markers/pencils
- GPS or other locational equipment
- Generator
- Heavy duty riveter and aluminum rivets
- Battery powered cordless drill
- Battery powered cordless saw
- Personal protection equipment (i.e., hard hats with face shields, gloves, Tyvec ™suits, steel toed boots, safety glasses)
- Core caps
- Duct tape

3.0 COLLECTION PROCEDURES

A sampling activity may include collecting more than one type of sample at a site. This procedure will detail the collection of sediment core samples from a site location. When benthic organism samples are being collected at the same site, it is important to collect benthic organism samples prior to the collection of sediment samples to minimize disturbances of the benthic organisms.

3.1 Sample Location

The sample location may be either defined prior to sampling, or the site can be selected during the sampling procedure. Sites should be located with a Differential Global Positioning System (DGPS) with has an accuracy of less than a meter. Actual locational readings should not be recorded until the barge is anchored at the sampling site. The location should be verified after coring to confirm position. Data should be recorded in latitude and longitude in North America Datum (NAD).

3.2 Securing the vessel

The sampling vessel should be triple anchored, moored to a secure fixture or spudded prior to collecting cores.

3.3 Sample Procedure

The following procedure is a suggested method to collect sediment core samples:

1. Measure the water depth and soft sediment thickness.

2. Insert core catcher into CAB tube.

3. Position core catcher, drill holes, and rivet into place with aluminum rivets.

4. Lift the vibrating head with the winch to a vertical position so that it is suspended just off the bow of the sampling vessel.

5. Insert the core tube into the vibrating head, making sure that the tube slides in all the way.

6. Tighten the collar to the vibro-corer (two bolts on each side).

7. Lower the entire assembly until the core nose is just above the sediment surface. Care should be taken to ensure that the cutter head or end of the core tube does not come into contact with the vessel during deployment. Verify that the generator is on. Turn on the vibrating head.

8. Slowly lower the vibro-corer by running out 6-10 inches of cable at a time. Monitor core tube penetration by feeling for slack in the cable. Note appropriate rate of penetration in field log.

9. When the vibro-corer ceases to penetrate the sediment (stops lowering or is "refused"), or the vibrating head is near the sediment surface, reverse the winch and pull the unit from the sediment. Do not allow the vibrating head to become imbedded into the sediment.

10. Turn off the power to the vibrating head when the core breaks free of the sediment.

11. During retrieval, the coring device and core tube need to be maintained in a vertical position to minimize disturbance of the collected sediments. Lift the assembly so that the sediment/water interface is visible. Wash the excess sediment from the outside of the tube. Once out of the water, the cutter head should be inspected and a physical description of the material at the mouth of the core entered into the core log. Drill holes through tube at the sediment/water interface and decant water from tube.

12. Tie line around tube in a single or double clove hitch.

13. Disengage tube lay sediment core on the deck, saw off excess core tube at the sediment surface and cap the top of the tube with a red cap plug. Both ends should then be secured tightly with duct tape to prevent leakage. The amount of sediment in the tube should be measured and recorded in the sample log, along with the overall condition of the core. The core tube then should be marked to denote the following:

- Station identification;
- Sediment recovery;
- Bottom and top; and,
- Date and time sampled.

14. Handle and sub-sample core as desired, either on board or at a shore based location.

4.0 REFERENCES

1. Sediment Sampling guide and Methodologies (2nd Edition), United States Environmental Protection Agency, Division of Surface Water, Cincinnati, Ohio, 2001.

GRANULAR SEDIMENT CLASSIFICATION

1.0 GENERAL

Granular sediment is material for which percentages of individual components that make up the sediment can be determined. The sediment description and identification scheme presented herein is based upon visual inspection and manual testing. Sediment description and identification can be broken down into two main categories; class of material, and physical parameters. This sediment classification guideline is based upon ASTM D 2488-00, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).

2.0 SEDIMENT CLASSESS

Granular sediment is comprised of three classes of material, biogenic, mineral/lithic, and glass. Glass is likely to be only a minimal component so it does not warrant further discussion. The descriptive classification for both mineral and biogenic types is based upon grain-size and sediment constituents.

2.1 Biogenic (Organic) Sediments

Biogenic sediments (organic origin) are those that contain remains or traces of once-living organisms in a concentration of greater than 50%. This class of sediment is often flocculent at the sediment/water interface and has a "pudding-like" texture due to its high content of organic material. Biogenic sediments are often dark brown to black in color, and have an organic odor. Basic components of those sediments include; shell fragments, fish parts, plant material, and fecal pellets.

2.2 Mineral Sediments

Mineral sediments consist of mineral grains derived from physically weathered rocks, precipitates and authigenic sources in a concentration of greater than 50%. For the definitions of clay, sand, and silt, section 3 of ASTM Standard D2488 should be consulted. If there are enough biogenic/organic constituents present to influence the soil properties, ASTM D2488 section 14.8 should be consulted. Common components of mineral sediments include; quartz, feldspars, clay minerals, micas, and rock fragments.

3.0 PHYSICAL PARAMETERS

Physical descriptions derived from visual observation and manual testing can be used to classify sediment origin (biogenic or mineral) as well as physical properties of the material. The physical sediment description includes the following parameters:

- Color;
- Odor;
- Obvious materials;
- Structure;
- Consistency (including particle size, shape and angularity for course grained-sediments);
- Gradation;
- Dry Strength (manual test);
- Dilatancy (manual test);
- Toughness (physical description); and,
- Plasticity (physical description).

The sediment color should be identified using a Munsell® soil color chart. Often organic sediments (biogenic) turn color after exposure to air, any such color change should be noted as well.

The odor of a sample should be described if it is organic or is petroleum or chemical. If the odor does not fall into those categories, describe as best as possible.

Any obvious material in samples, such as coal fines, metallic chips, wood, etc. should be noted, and depth of material recorded. Further, any sheen on the water surface due to sediment disturbance should also be recorded.

The structure of the sediment should be described utilizing the following table taken from ASTM D-2488.

TABLE 7 Criteria for Describing Structure

Description	Criteria
Stratified	Alternating layers of varying material or color with layers at least 6 mm thick
Laminated	Alternating layers of varying material or color with layers less than 6 mm thick
Fissured	Breaks along definite planes of fracture with little resistance to fracturing
Slickensided	Fracture planes appear polished or glossy, sometimes striated
Blocky	Cohesive soil that can be broken down into small angular lumps which resist further breakdown
Lensed	Inclusion of small pockets of different soils, note thickness
Homogeneous	Same color and appearance throughout sample

Consistency for fine-grained sediments (50% or more fines) of biogenic or mineral sources should be described as very soft to very hard utilizing the following table taken from ASTM D-2488.

TABLE 5 Criteria for Describing Consistency

Description	Criteria
Very soft	Thumb will penetrate sediment more than 1 in. (25 mm)
Soft	Thumb will penetrate sediment about 1 in. (25 mm)
Firm	Thumb will indent sediment about ¼ in. (6mm)
Hard	Thumb will not indent sediment but readily indented with thumbnail
Very hard	Thumbnail will not indent soil

Consistency for course-grained sediments (less than 50% fines) should include several descriptive observations; particle size, particle shape, and angularity. Particle size differentiates between sand, silt and clay. The definitions of sand, silt and clay can be found in ASTM D2488 Section 3.1. Particle shape refers to the length, width, and thickness of the individual particles. The description of particle shape should only be used in cases where the particle shape is flat, elongated, or flat and elongated as define by Table 2 from ASTM D 2488.

Table 2 Criteria for Describing Particle Shape

Flat	Particles with width/thickness >3
Elongated	Particles with width/length >
Flat and elongated	Particles meet criteria for both flat and elongated

The angularity refers to the overall shape or outline of a particle. The description should either be angular, sub-angular, sub-rounded or rounded as defined in Table 1 taken from ASTM D2488.

TABLE 1 Criteria for Describing Angularity of Coarse-Grained Particles

Description	Criteria
Angular	Particles have sharp edges and relatively plane sides with unpolished surfaces
Sub-angular	Particles are similar to angular description but have rounded edges
Sub-rounded	Particles have nearly plane sides but have well-rounded corners and edges
Rounded	Particles have smoothly curved sides and no edges

Gradation refers to the distribution of grain sizes present in a sample and should be used where course-grained sediments are encountered. The description should be either well-graded or poorly-graded as defined in sections 15.31 and 15.32 of ASTM D 2488.

For fine-grained mineral sediments, dry strength, dilatancy, toughness and plasticity should be used to classify the material as lean clay, fat clay, silt or elastic silt. For further information on individual

manual tests, tables 8 through 12 in section 14 of ASTM D 2488 should be consulted and/or the NRT Fine-grained Soils Field Identification sheet which is based on the ASTM standards.

4.0 CHECKLIST for SEDIMENT DESCRIPTION

The following is a checklist for describing and classifying sediments. Appropriate visual inspection and manual testing should be recorded on the field log.

1. Class type (Biogenic or Mineral,)
2. Color using a Munsell® soil color chart (in moist condition, note color change when exposed to air for biogenic sediments)
3. Odor (organic, chemical, etc.)
4. Any obvious materials (coal fines, metallic chips, wood, sheen, etc.)
5. Note any structures (fissured, lens, etc.)
6. Consistency, including particle-size range, shape, and angularity for coarse-grained sediments
7. If mineral sediment decide whether sediment is fine grained (<50% fines)or course grained (>50% fines)
8. If fine grained do the following manual tests to determine whether the sediment is a lean clay, fat clay, silt or elastic silt as defined by ASTM 2488 section 14.7:
   - Dry strength;
   - Dilatancy;
   - Toughness, and,
   - Plasticity.
9. If course grained, describe the sediment as sand or gravel per guidelines presented in ASTM D 2488 section 15. The following visual observations should also be noted:
   - Particle size
   - Particle shape
   - Angularity
   - Gradation

7.0 REFERENCES

1. ASTM, 2000. Standard Practice for Description and Identification of Soils (Visual-Manual Procedure). ASTM D-2488-00.

2. Sediment Sampling guide and Methodologies (2nd Edition), United States Environmental Protection Agency, Division of Surface Water, Cincinnati, Ohio, 2001.

SEDIMENT GRAB SAMPLES

1.0 GENERAL

The collection of surface sediment samples will be based on the EPA-approved Puget Sound Estuary Protocols for sediment sample collection (Tetra Tech, 1986) and ASTM method D-4823. Undisturbed sediment samples will be collected from the upper 5 to 10 cm using a petite Ponar™ grab sampler methodology. The grab sampler will be deployed from the sampling vessel by hand. The grab sampler will be manned by a minimum of two crew: one field technician will handle the deployment and retrieval of the sampler while the vessel operator controls the boat and records the sampling location.

2.0 CHECKLIST FOR TAKING GRAB SAMPLES

1. Make field notes and logbook entries as necessary throughout the sampling process to ensure thorough and accurate record keeping.
2. Maneuver the sampling boat to the sampling location as identified in the SAP.
3. Measure and record the depth to sediment and sediment thickness using the poling methods discussed below. This information will be used for comparison with any hydrographic survey results.
4. Open the sampler and slide the locking pin into place.
5. Guide the sampler overboard.
6. Lower the sampler to the sediment surface at approximately 1.0 ft/sec.
7. Record the location of the boat when sampler reaches bottom.
8. Begin retrieving the sampler and raise it at approximately 1.0 ft/sec.
9. Guide the sampler on board the vessel and place it on the work table on the deck; use care to avoid jostling that might disturb the integrity of the sample.
10. Examine the sample for the following sediment acceptance criteria:

- Sampler jaw is closed and the sample does not contain foreign objects;
- A penetration depth of at least 5 cm has been achieved.
- The sampler is not overfilled so that the sediment surface presses against the top of the sampler;
- No leakage has occurred, as indicated by overlying water on the sediment surface;
- No sample disturbance has occurred, as indicated by limited turbidity in the overlying water;

- No winnowing has occurred, as indicated by a relatively flat undisturbed surface; and,

If sample acceptance criteria are not achieved, the sample will be rejected and the location re-sampled. If unable to obtain a sample that meets the appropriate acceptance criteria within 50 feet of the proposed location, the sample will be relocated as determined by the Project Manager or Task Manager, as appropriate.

11. Decant or siphon off any standing water from the surface of the sediment using a hose. Care should be taken to not disturb the integrity of the sediment surface.
12. Visually classify sediment in accordance with the Natural Resource Technology, Inc. SOP for sediment classification and record the descriptions on the sediment sampling form and photograph sample.
13. Collect the sediment from the sampler using a stainless steel implement and care not to include any material that has been in contact with any interior sampler surface. Place this sediment into an appropriate-sized stainless steel homogenization bowl.
14. Thoroughly rinse the interior of the sampler until all loose sediment has been washed off.
15. Repeat the sampling process (if necessary) until sufficient volume is obtained to satisfy the sampling requirements for each location. Collect successive grab samples within a radius of 10 feet of the initial sampling location.
16. Homogenize the bulk sediment until it has uniform color and texture.
17. Clean the exterior of all sample containers and store them in a cooler with ice.
18. The procedure for the Non-Disposable and Non-Dedicated Sampling Equipment Decontamination guidelines (NRT 07-09-11) should be followed.
19. Ensure that sediment descriptions and supporting logbook entries are complete.
20. Proceed to the next proposed sampling location.

3.0 REFERENCES

1. ASTM, 1999. Standard Guide for Core Sampling Submerged, Unconsolidated Sediments. ASTM method D-4823.

2. Sediment Sampling guide and Methodologies (2nd Edition), United States Environmental Protection Agency, Division of Surface Water, Cincinnati, Ohio, 2001.

OPEN BARREL PUNCH-CORER

1.0 GENERAL

The collection of short cores in water depths ranging from 0.5 meter (m) to 10 m using an open barrel punch –corer sampler is based in part on the ASTM method D-4823. The corer will be deployed from the sampling vessel by hand to collect an undisturbed sediment sample to a depth of approximately. 4 feet below the sediment/surface water interface. The open barrel punch –corer will be manned by a minimum of two crew: one field technician will handle the deployment and retrieval of the corer while the vessel operator controls the boat and records the sampling location.

2.0 CHECKLIST FOR USING THE OPEN BARREL PUNCH-CORER

1. Make field notes and logbook entries as necessary throughout the sampling process to ensure thorough and accurate record keeping.
2. Maneuver the sampling boat to the sampling location as identified in the SAP.
3. Measure and record the depth to sediment and sediment thickness using the poling methods. This information will be used for comparison with any hydrographic survey results.
4. Place the core-barrel liner (thin-walled tube) inside barrel of core sampler followed by the core catcher. Open the check valve located atop the corer. Attach lengths of rod to the corer to enable the operator to push the corer down to the appropriate depth. The rods also allow for the use of weights to help drive the core if needed.
5. Guide the corer overboard.
6. Lower the corer to the sediment surface at approximately 1.0 ft/sec so as to minimize sediment surface disturbances.
7. Record the location of the boat when sampler reaches bottom.
8. Push or use the weights to drive the sampler to the depth specified in the SAP.
9. Close the check valve on the barrel core sampler and begin retrieving the sampler, raising it at approximately 1.0 ft/sec.
10. Guide the corer on board the vessel and place it on the work table on the deck; use care to avoid jostling that might disturb the integrity of the sample. Remove the core liner from the barrel.
11. Examine the sample for the following sediment acceptance criteria:

- The sampler is not overfilled so that the sediment surface presses against the top of the sampler;
- No leakage has occurred, as indicated by overlying water on the sediment surface;
- No sample disturbance has occurred, as indicated by limited turbidity in the overlying

water;

If sample acceptance criteria are not achieved, the sample will be rejected and the location re-sampled. If unable to obtain a sample that meets the appropriate acceptance criteria within 50 feet of the proposed location, the sample will be relocated as determined by the Project Manager or Task Manager, as appropriate.

12. Decant or siphon off any standing water from the surface of the sediment. Care should be taken to not disturb the integrity of the sediment surface. Extrude the sediment from the core liner.
13 Visually classify sediment in accordance with the Natural Resource Technology, Inc. SOP for sediment classification and record the descriptions on the sediment sampling form and photograph sample.
14 Repeat the sampling process (if necessary) until sufficient volume is obtained to satisfy the sampling requirements for each location. Collect successive core samples within a radius of 10 feet of the initial sampling location.
15 f sediment collected from cores is to be homogenized, then mix the sediment using stainless steel homogenization bowls and spoons until it has uniform color and texture.
16 Clean the exterior of all sample containers and store them in a cooler with ice.
17 The procedure for the Non-Disposable and Non-Dedicated Sampling Equipment Decontamination guidelines (NRT 07-09-11) should be followed.
18 Ensure that sediment descriptions and supporting logbook entries are complete.
19 Proceed to the next proposed sampling location.

3.0 REFERENCES

1. ASTM, 1999. Standard Guide for Core Sampling Submerged, Unconsolidated Sediments. ASTM method D-4823.

2. Sediment Sampling guide and Methodologies (2nd Edition), United States Environmental Protection Agency, Division of Surface Water, Cincinnati, Ohio, 2001.

SURFACE WATER SAMPLES USING HORIZONTAL BETA PLUS™ BOTTLES

1.0 GENERAL

Surface water samples will be collected using a Horizontal Beta Plus™ water sampler methodology and following guidelines published by House (1993). The Horizontal Beta Plus™ is a bottle type sampler (similar to a Kemmerer Sampler) that takes a discreet grab sample of surface water. The sampler will be deployed from the sampling vessel by hand. The grab sampler will be manned by a minimum of two crew members: one field technician will handle the deployment and retrieval of the sampler while the vessel operator controls the boat and records the sampling location.

2.0 CHECKLIST FOR TAKING SURFACE WATER GRAB SAMPLES

1. Make field notes and logbook entries as necessary throughout the sampling process to ensure thorough and accurate record keeping.
2. Maneuver the sampling boat to the sampling location as identified in the SAP.
3. Measure and record the depth to sediment and sediment thickness using the poling methods discussed below. This information will be used for comparison with any hydrographic survey results.
4. Make a preliminary inspection of the Horizontal Beta Plus™ bottle prior to use. Close air vent and drain valve
5. Place bottle so that the bushing on the trip mechanism is on the top of the handle.
6. Set the bottle sampler for collecting a sample:

- Locate the stainless steel pins in the trip assembly (by the plastic trip assembly);
- Grasp the round white balls on the cable assembly, pull stopper out of end of the main tube so that loop in cable can be placed over closest pin of the trip assembly;
- Repeat instructions with other stopper and hook the cable loop on the pin which projects above the plastic trip assembly. The bottle sampler is now "set" to collect a sample.

7. Lower the bottle to the desired depth (approximately0.8 times the total water depth) at each location in the water, keeping the line taught. Drop the messenger down the line. The messenger will strike the trip assembly causing the cables to release and the stoppers to close, trapping the sample inside the bottle.
8. Begin retrieving the sampler and raise it at approximately 1.0 ft/sec.
9. Guide the sampler on board the vessel and place it on the work table on the deck; use care to avoid jostling that might disturb the integrity of the sample.
11. Caution should be used when opening the bottle sampler in case contents are under

pressure. Decant sample into appropriate pre-labeled sample bottles. For samples that need to be field filtered, water will be collected directly from the grab sampler using a sterile Kendall Monojet™ 60cc syringe and passing the water through a disposable 0.45 μm filter into the appropriate sample container. Place samples in cooler and keep temperature at 4° C.

12. Thoroughly rinse the interior of the sampler.
13. Repeat the sampling process (if necessary) until sufficient volume is obtained to satisfy the sampling requirements for each location. Collect successive grab samples within a radius of 10 feet of the initial sampling location.
14. Clean the exterior of all sample containers and store them in a cooler with ice.
15. The procedure for the Non-Disposable and Non-Dedicated Sampling Equipment Decontamination guidelines (NRT 07-09-11) should be followed.
16. Proceed to the next proposed sampling location.

3.0 REFERENCES

1. House, L.B., P.E. Hughhs, and R.J. Waschbusch. 1993. Concentrations and Loads of Polychlorinated Biphenyls in Major Tributaries Entering Green Bay, Lake Michigan, 1989-1990. U.S. Geological Survey Open-File Report 93-132. Prepared by USGS in cooperation with USEPA and the WDNR.

2. Widco®, 2000. Operating instructions for Horizontal Beta Plus™ Sample bottle.

SEDIMENT THICKNESS USING POLING TECHNIQUES

1.0 GENERAL

Soft sediment thickness will be determined by poling techniques. The measurements will be used to collect additional data from each specific sampling location and to field check any hydrographic survey results. The pole consists of several six-foot long aluminum sections that can be placed together to the appropriate length. The pole is marked in one-foot increments that are subdivided into one-inch increments. The pole will be deployed from the sampling vessel by hand. The pole will be manned by two crew: one field technician will handle the deployment and retrieval of the sampler while the vessel operator controls the boat and records the sampling information and location.

2.0 CHECKLIST FOR TAKING SEDIMENT THICKNESS MEASUREMENTS USING A POLE

1. Make field notes and logbook entries as necessary throughout the sampling process to ensure thorough and accurate record keeping.
2. Maneuver the sampling boat to the sampling location as identified in the SAP. Record location of boat on the NRT Field Observation Form.
3. Lower the pole to the sediment surface slowly to avoid displacing any flocculent sediment. When there is slight resistance, read the pole to the nearest inch mark and record on the NRT Field Report form. This is the depth to sediment from the water surface.
4. Continue to push the pole into the sediment until refusal occurs. Read the pole to the nearest inch mark and record measurement on the NRT Field Report form. This is the depth to refusal measurement.
5. Slowly pull the pole out of the sediment.
6. Record any observations on the field form such as potential sediment types (as evidenced by material adhering to bottom of pole), and any visible signs of contamination.
7. The procedure for the Non-Disposable and Non-Dedicated Sampling Equipment Decontamination guidelines (NRT 07-09-11) should be followed.
8. Ensure that sediment depths, descriptions and supporting logbook entries are complete.
9. Proceed to the next proposed sampling location.

SAMPLE LABELING, STORAGE, AND SHIPMENT

1.0 GENERAL

The collection and analysis of samples of environmental media, including soils, groundwater, surface water, and sediment, are the central activities of the field investigation. These samples must be properly labeled to preserve its identity, and properly stored and shipped in a manner that preserves its integrity and chain of custody. This procedure presents methods for these activities.

2.0 CHECKLIST FOR SAMPLE LABELING

1. Make field notes and logbook entries as necessary throughout the sampling process to ensure thorough and accurate record keeping.
2. Assign each sample retained for analysis a unique 9-digit identification code. This code will be formatted as follows:

SD **051804001**
Sample Matrix Month/Date/Year Consecutive Sample Number

3. Consecutive sample numbers will indicate the individual sample's sequence in the total set of samples collected during the investigation. The sample number above would indicate the 1st sample retained for analysis during the field investigation, collected May 18, 2004.
4. Affix a non-removable (when wet) label to each container. The following information will be written on the label in ink that will not smudge when wet:

- Project Number;
- Sample ID (Step 2 above);
- Date of sample collection;
- Time of sample collection (military time);
- Specify how sample collected (Ponar™ grab, push core, etc.);
- Sampler initials;
- Preservative (if applicable); and,
- Analytes for analysis.

3.0 PROCEDURE FOR SAMPLE STORAGE

1. Immediately after collection, placement in the proper container, and labeling, place samples to be retained for chemical analysis into re-sealable plastic bags.
2. Place bagged samples into ice chest filled approximately half-full of bagged ice.
3. Maintain samples in an ice chest. Periodically drain off melt water and replenish ice.
4. Ship samples on a daily basis if possible.
5. Maintain appropriate custody procedures on coolers and other sample storage containers at all times.

4.0 PROCEDURE FOR SAMPLE SHIPPING

1. Fill out the chain-of-custody form completely (See attached example) with all relevant information. The white copy goes to the analytical lab and should be placed in a re-sealable plastic bag inside the sample cooler; the sampler should retain the copy.
2. Place a layer of inert cushioning material such as bubble pack in the bottom of the cooler.
3. Place each bottle in a bubble wrap sleeve or other protective wrap, followed by bagging each sample in a re-sealable plastic bag.
4. Place bottles in cooler with the volatile organic analysis towards the center of the cooler.
5. Pack bottles with ice in plastic bags. At packing completion, cooler should be approximately 50% ice, by volume. Coolers should be completely filled, so that samples do not move excessively during shipping.
6. Tape cooler drain close and wrap cooler completely with strapping tape in two or more locations to secure lid.
7. Place laboratory label address and overnight delivery waybill in sleeve attached to cooler handle.
8. Place custody seal across the front or seam side between lid and cooler body.
9. Sign the custody seal with an indelible soft-tip marker, and then cover with an additional wrap of transparent tape.
10. Place "Fragile" and "This Side Up" labels on all four sides of cooler.
11. For coolers shipped overnight delivery, retain a copy of the shipping waybill, and attach to the chain-of-custody documentation.

Eff. Date	Initiator	Apprv'd

NON-DISPOSABLE AND NON-DEDICATED SAMPLING EQUIPMENT DECONTAMINATION

1.0 GENERAL

This procedure is to be used for the decontamination of non-disposable and non-dedicated equipment used in the collection of environmental samples. The purpose of this procedure is to remove chemical constituents from previous samples from the sampling equipment. This prevents these constituents from being transferred to later samples, or being transported out of controlled areas.

2.0 Procedure for Decontamination

1. If necessary, use a brush or scraper to remove visible soil/sediments adhering to the equipment, and a non-phosphate detergent (e.g., Alconox) to remove any oils, grease, and/or hydraulic fluids adhering to the equipment. Continue washing until all visible contaminates (i.e., particulate matter or surface film) are removed.
2. Rinse with pressurized low-volume tap water or steam.
3. Rinse with a 10% nitric acid rinse.
4. Rinse with pressurized low-volume tap water or steam.
5. Rinse with deionozed water (demonstrated-analyte free). The criteria for analyte-free water are the Method Detection Limits (MDLs) for the analytes. Specifically for common laboratory contaminants listed below, the allowable limits are set at three times the respective MDLs determined by the most sensitive analytical method:

- Methylene Chloride;
- Acetone;
- Toluene;
- 2-Butanone (a.k.a., Methyl Ethyl Keytone); and,
- Phthalates

6. Rinse with a methanol/hexane rinse.
7. Rinse with deionized water (demonstrated-analyte free).
8. Unless the equipment is going to be used immediately, it will be wrapped in new aluminum foil (shiny side out) to keep it clean until needed. New visqueen can be substituted for the aluminum foil.

ATTACHMENT 2
SUBCONTRACTOR STANDARD OPERATING PROCEDURES

Onyx Special Services, Inc.
Hydrographic Standard Operations & Procedures

MULTIPLE TRANSDUCER (ARRAY) BATHYMETRY

Equipment Overview:
Multiple transducer sonar systems (termed "Array" systems) are designed to collect multiple depth measurements along a line running perpendicular to the travel path of the survey vessel (called the vessel 'swath'). This enables array systems to collect thousands of data points per hour, covering a survey area in a fraction of the time it would take a single transducer system to do the same. The result is a reasonably detailed bathymetric survey, supported by data point coverage on a fixed interval. The primary advantage of an array system is the limited amount of draft needed to operate the transducers, as well as to provide data spacing at a regular interval between receptors. These systems are best suited to large expanses of extremely shallow water (between 2' and 20' of water depth) where a high level of contour detail is required.

In addition to positioning and heading, array systems must compensate for the heave, pitch and roll motions of the vessel they are attached to. A GPS unit, a gyro, and a motion reference unit (MRU) must be incorporated into the system to tie positioning to the depth points and to correct for vessel motion. The final component of an array system is software to integrate and control the individual pieces of hardware. In most cases the software links the hardware outputs together, calculates and applies corrections to the data in real-time, and provides a navigation module. Like commercial single-beam and multi-beam systems, array systems can be adjusted to reflect changing sound velocities and are fully automated in their collection of data.

The array system used for this project is manufactured by Ross Laboratories, and is called the **Ross Mini/Smart Sweep** system. The system designed with 8 single-beam transducers set 5 feet apart from each other for a total swath width of 40 feet. To accomplish this, two booms are outfitted to the survey vessel with 3 transducers mounted onto each. When the booms are extended outward from the vessel, each of the 6 transducers are spaced 5' apart from each other creating the total swath width perpendicular to the travel of the vessel. Two additional transducers are mounted through the hull of the survey vessel to complete the total swath width of 40', with soundings collected every 5' along the swath.

The transducers used in the Ross Mini/Smart Sweep system operate at a **frequency of 200kHz**, and have switchable **beam widths between 11° and 22°**. Ross transducer units are capable of receiving sounding measurements in water depths of 1.5 feet to over 200 feet below the face of the unit. In our configuration, the draft (distance between the face of the transducer and the top of the water) of each transducer can be adjusted from 6 inches to 18 inches; thus giving the system the ability to survey area as shallow as 2 feet of water depth.

Our Mini/Smart Sweep system is mounted to a pontoon-style vessel. This configuration is ideal for inland shallow water operations in that it provides a very stable platform with a minimal amount of vessel draft (estimated between 14 & 18 inches including the outboard drive). The vessel is outfitted with a **TSS Standard** gyro and **"DMS 2"** motion reference unit (MRU) for heading determination and heave/pitch/roll compensation. We will use an **Applied Microsystems** sound velocity **"Smart Sensor"** to provide values for the speed of sound in water (more accurate than the standard "bar check" method). In an effort to obtain added accuracy, a **Trimble MS750/4800** RTK system **with horizontal and vertical centimeter level positioning accuracy** will be used to provide vessel positioning.

Calibration:
Two types of calibration checks will be conducted: a transducer accuracy test and a sediment penetration test. The transducer accuracy test will verify that each transducer in the array is recording water depths correctly on a daily basis. This is accomplished by extending a plate below each transducer to a known fixed depth. The known plate

Onyx Special Services, Inc.
2135 W. Nordale Drive
Appleton, WI 54914
Tel: 920.749.8100 Fax: 920.749.8110

VEOLIA Environment

depth is then compared to the depth reported by each transducer to verify their individual accuracy. Any deviations will be corrected prior to collecting the data.

The second calibration check is the sediment penetration test, which attempts to determine how deep the array system transducers are penetrating into the soft sediments of the bottom. Onyx will perform a sediment penetration test once per survey matrix (roughly 50 to 60 acres in area). A steel plate (10 inches square by 0.5 inches thick, weighting roughly 14 lbs.) attached to a graduated rule will be lowered into the water adjacent to one of the inboard transducers. Once on bottom, the depth from the surface of the water to the steel plate will be recorded along with the depth reported by the adjacent transducer. No adjustments will be made in the field to the transducers to correct for differences observed between the two measurements.

In addition, a sound velocity profile will be conducted once per matrix surveyed. The average will be computed from the profile and used as the speed of sound input for the collection software on that day. Onyx-SS will use a Smart SV sound velocity profiler manufactured by Applied Geomechanics for creating the velocity profile. The sensor will be lowered into the water column and stopped at 2-foot increments to obtain the profile. The actual profile data will be applied to the data collected that day during post processing.

Survey Setup:

Water depth, current, and site configuration will be reviewed prior to deployment of the array system. Upon review, a pre-designed survey track-line plan (running with the river flow where possible) and survey matrix will be entered into the HyPack navigation software. The trackline plan will position parallel tracklines (set 40 feet apart from each other) within the matrix to be surveyed. Tracklines will extend the full width of the river and will be used as reference/guidelines for completing each matrix. Matrices are pre-defined survey blocks which are "filled" with data as the array vessel passes through them (refer to the e-document "HyPack Max Operation Manual" for details on program operation).

The array transducers will be deployed to a draft between 6 and 18 inches, depending on the depths anticipated in that day's survey matrix and weather conditions. Survey speed will be held between 3 and 5 knots in areas with greater than 5 feet of water depth, and 2 to 3 knots in all other areas. The gyro, MRU, and RTK systems will all be mounted in the same horizontal centerline position ("stacked" on top of another) on the vessel; thus eliminating all but vertical offsets for each piece of equipment. The position of the MRU will be considered the origin for offsets on the vessel (x=0, y=0, z=0). Each array transducer will have a unique horizontal offset; however they will all have the same vertical offset (or draft).

Survey geodesy for the HyPack navigation software will be set in State Plane (NAD83) Wisconsin Central (4802) with the vertical datum of NAVD 88. Navigation input for the Marine Sonic sonar will come directly from the RTK system (GLL & GGA @ 9600 baud).

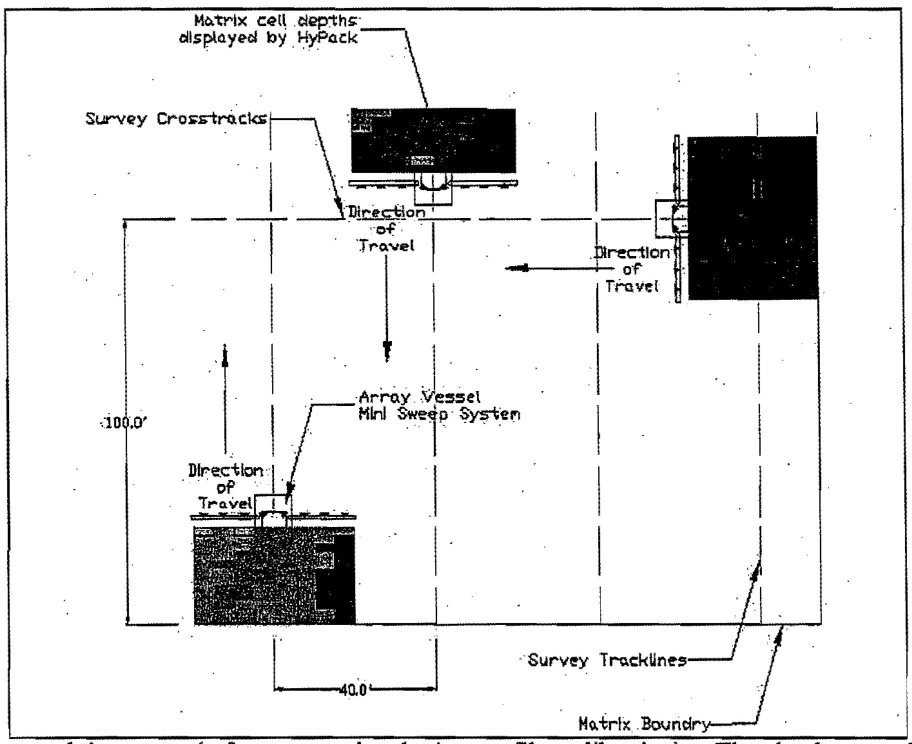
Daily Survey Procedure

The array survey crew will consist of two crewmembers (1 vessel operator and 1 sonar technician). Prior to launching the vessel, the survey crew will setup the RTK positioning system over one of the pre-surveyed benchmarks within the area to be surveyed that day (refer to the RTK Positioning SOP document for details on this procedure). A technician will also adjust the draft of the individual transducers for the weather and anticipated survey conditions within that day's survey matrix.

Next the tech will power-up the topside sonar PC, which activates the Ross Labs SmartSweep collection software. The hardware will be setup to transmit on a short pulse (SH), narrow beam width (11° angle) configuration. Once the operation of the SmartSweep system is confirmed, the array vessel will be launched and the sonar technician will power-up the HyPack Max 2.11c navigation software (refer to the e-document "HyPack Max Operation Manual" for details on program operation). The survey trackline plan and matrix for the days survey activities will be loaded and displayed for the vessel operator to follow.

The vessel operator will navigate to the anticipated deepest area within the matrix to collect a sound velocity profile and to conduct the first calibration test (transducer Accuracy test). When completed, the vessel will navigate to the center of the matrix to conduct the second calibration test (sediment penetration test). Finally, the crew will navigate the vessel to the nearest datum gage and record the measurement and time. Periodic manual datum measurements (1 to 4 hour time intervals, depending on the amount of change observed) from datum gages in the survey area will be collected as a backup to the RTK system output.

Once the system is setup, calibrated, and operating satisfactory to the client representative, the survey will begin. The matrix surveyed will be completely filled with data, using the track-line plan as a guide. The array vessel will collect data at a 5-foot interval (40-foot swath track) within the matrix, as well as running perpendicular crosstracks at 100-foot intervals. Each matrix will be broken up into cells measuring 5-foot wide (swath) by 2-foot long (along vessel track). Once data is collected in a cell, HyPack will be configured to "fill" the cell (the color the cell is filled with will correspond with a depth scale) with the average corrected depth obtained from all of the soundings recorded within it. This allows the operator to have a real-time view of bottom depths as well as identify where the vessel has collected data.



Both SmartSweep and HyPack save data collected to their respective harddrives within a folder labeled with the day's date. The depths saved by SmartSweep are referred to as "uncorrected" depths in that they are the actual depths recorded by each transducer based on the average speed of sound in water (refer to sound velocity profile calibration). The depths saved by HyPack are referred to as "corrected" depths in that these depths have been corrected for transducer draft, heave/pitch/roll movements of the vessel, and horizontal position/elevation changes obtained by the RTK positioning system.

All frequencies, configuration settings, and survey progress with the area track-line plan will be recorded on the daily survey log. A copy of this log showing the information recorded each day is included with this SOP.

Project Safety

Onyx's basic marine safety policy includes steel toes safety shoes, life vests, and hard hats when working with overhead equipment. For this project, we will be conducting all survey operations from the survey vessel *Array Surveyor,* a Coast Guard compliant pontoon vessel with marine radio and onboard cellular phone. Prior to launching at any site, Onyx will obtain phone numbers and radio channels for hailing facility staff and key project personnel. Once contacts are identified, everyone will be notified of the day's events and schedule that pertain to them. In addition, Onyx will broadcast notices on the marine emergency channel 16 at regular intervals throughout the day as to our whereabouts and progress.

Onyx Special Services, Inc.
Hydrographic Standard Operations & Procedures

SUB-BOTTOM PROFILING SONAR SYSTEM

Equipment Overview:
Sub-bottom profiling is used to create an image of both the river/lake bottom and the various sediment/soil layers beneath it. The sub-bottom profiler produces an image by keying off of the different densities of objects and/or geologic features of the river bottom. In some cases, these images can be used to identify vegetation, wood, steel, light sediments, clay, sand, and bedrock in a particular area.

Onyx-SS will use an Edgetech 216S with the X-Star processor, which is capable of penetrating the subsurface to a depth of 50m. The unit will be towed along side the survey vessel and utilize a **fluctuating frequency range between 2 and 16 kHz**. The range will be limited to **50 meters, which corresponds to a survey track-line spacing of 150 feet at 10% overlap.** We will use a **Trimble MS750/4800** RTK system **with horizontal and vertical centimeter level positioning accuracy**. Overall accuracy of the sub-bottom profiling images is dependent on accurate estimations of sonar unit layback (the horizontal distances between the towed sonar unit and the DGPS beacon); **we anticipate the overall accuracy of sub-bottom profiling images to be within 1 foot due to the shallow water towing arrangement**. All raw data will be saved to digital tape, then converted to CD for presentation to the client.

Calibration:
Calibration checks are typically conducted on an available control structure below the water surface (i.e. a known/charted rock outcrop). These checks are performed by saving a line of data, which crosses over the control structure, and comparing its position to the charted position at a later date. Unfortunately in this area there are no known or charted rock outcrops with which to do this with. In addition, these check are generally performed during the post processing of the data, which does not allow for adjustment in the field. However, we will be collecting side scan data simultaneously with the sub-bottom survey and both systems will use the same positioning input directly from the RTK system (GLL & GGA @ 4800 baud). The positioning system is calibrated daily utilizing the side scan sonar (refer to the Calibration section of the Side Scan Sonar SOP for details), thus it is reasonable to assume that the field calibration is valid for both sonar collection systems.

In addition, a sound velocity profile will be conducted once a week. The average will be computed from the profile and used as the speed of sound input for the collection software. Onyx-SS will use a Smart SV sound velocity profiler manufactured by Applied Geomechanics for creating the velocity profile.

Survey Setup:
Water depth, current, and site configuration will be reviewed prior to deployment of the sonar. Upon review, a pre-designed survey track-line plan (running with the river flow) will be entered into the HyPack navigation software. The trackline plan (identical for both side scan and sub-bottom work) will position parallel tracklines 120 feet apart from each other within the area to be surveyed. The tracklines will extend the full width of the river for complete coverage of the survey area.

The sub-bottom profiling sonar is typically deployed to a depth that minimizes turbulence around the fish and maintains it at a near constant height/direction through the water. When survey speeds are held between 3 and 5 knots (in areas with greater than 5 feet of water depth), the sonar will be deployed to a depth of 3 feet. In extremely shallow areas, the vessel speed will be reduced (2 to 3 knots) as well as the fish height (2 feet of water depth). We anticipate the fish layback to vary no more than 1 to 2 feet, which will be updated within the software to reflect our survey speed.

Survey geodesy for the HyPack navigation software will be set in State Plane (NAD83) Wisconsin Central (4802) with the vertical datum of NAVD 88. However, the Edgetech X-Star sub-bottom profiling sonar software only collects data in geographic coordinates, so all sonar images will the geo-referenced in latitude and longitude (DDM).

Daily Survey Procedure

The sub-bottom profiling survey crew will consist of two crewmembers (1 vessel operator and 1 sonar technician), with one of the crewmembers being a lead surveyor within the Onyx-SS hydrographic survey group. Prior to launching the vessel, the survey crew will setup the RTK positioning system over one of the pre-surveyed benchmarks within the area to be surveyed that day (refer to the RTK Positioning SOP document for details on this procedure). The sonar technician will then connected the umbilical to the sub-bottom tow fish, power-up the topside sonar PC, and activate the Edgetech X-Star profiling software. During the start-up process, the operator will hear an audible test "chirp" from the fish indicating that the system is communicating properly (refer to the Edgetech X-Star Manual for details on program operation).

Once the operation of the sub-bottom profiling system is confirmed, the survey vessel will be launched and the sonar technician will power-up the HyPack Max 2.11c navigation software (refer to the e-document "HyPack Max Operation Manual" for details on program operation). The survey trackline plan for the days survey activities will be loaded and displayed for the vessel operator to follow. The vessel operator will navigate the vessel to the control structure to confirm the side scan sonar accuracy (refer to the Side Scan Sonar SOP). Along the way, the sonar technician will deploy the sub-bottom tow fish and set the sonar gains to provide satisfactory image quality. Unlike other sonar systems, the image displayed by the sub-bottom profiling software is independent from the image recorded. Thus, images can be improved during data processing to provide the best possible resolution for making thickness determinations.

Once the review is complete and satisfactory, the survey will be conducted according to the track-line plan. Each trackline that is run will be given a unique number and saved to data tape as they are collected. The software saves individual survey image files and navigation files to data tape for conversion to CD at a later date.

All frequencies, configuration settings, and survey progress with the area track-line plan will be recorded on the daily survey log. A copy of this log showing the information recorded each day is included with this SOP.

Onyx Special Services, Inc.
Hydrographic Standard Operations & Procedures

SIDE SCAN SONAR SYSTEM

Equipment Overview:
Commercial side scan sonar has many applications. Its primary application in survey work is target/debris identification and location. DGPS is employed to give targets/bottom outcrops a location; as the data is converted to a real-time visual image. These images are saved and cataloged for re-interpretation at a later date. The side scan sonar unit produces an image off one or both sides of the unit (each side identified as a left or right channel). The range of the sonar is determined by the transmitted frequency of the unit; and is usually operator defined. The higher the sonar frequency, the better the resolution of the image collected and the smaller the range in which the sonar can survey.

For the purpose of this survey, a dual frequency (**600 kHz x 150 kHz**) sonar will be used to obtain images of the river bottom. The unit will be hard mounted to the survey vessel, utilizing **only one channel** at a time for increased image detail. The range will be limited to **50 meters, which corresponds to a survey track-line spacing of 150 feet at 10% overlap.** We will use a **Trimble MS750/4800** RTK system **with horizontal and vertical centimeter level positioning accuracy**. Overall accuracy of the side scan images is dependent on accurate estimations of sonar unit layback (the horizontal distances between the towed sonar unit and the DGPS beacon); **we anticipate the overall accuracy of side scan images to be centimeter level due to the hard mount design.** All raw images will be saved to CD and provided to the client along with a viewing program. A high frequency (**1200 kHz**) **Side Scan Sonar made by Marine Sonics** will be available for detailed images of crucial areas.

Calibration:
Calibration checks will be conducted once daily on any available control structure extending below the water surface (i.e. bridge piers, pilings, boat docks, etc...). These checks will be performed by saving an image of the control structure on both the left and right channels. The two images will be recorded to disk and re-opened in the Marine Sonic viewing program "SeaScan Review" (refer to the SeaScan and SeaScan Review Manuals for details on program operation). The position of the control structure will be recorded on each image and compared for accuracy.

In addition, a sound velocity profile will be conducted once a week. The average will be computed from the profile and used as the speed of sound input for the collection software. Onyx-SS will use a Smart SV sound velocity profiler manufactured by Applied Geomechanics for creating the velocity profile.

Survey Setup:
Water depth, current, and site configuration will be reviewed prior to deployment of the sonar. Upon review, a pre-designed survey track-line plan (running with the river flow) will be entered into the HyPack navigation software. The trackline plan will position parallel tracklines (set 120 feet apart from each other) within the area to be surveyed. The line spacing will allow for sonar image overlap greater than 10% at a range of 50 meters. The tracklines will extend the full width of the river for complete coverage of the survey area.

The side scan sonar is typically deployed to a depth equal to between 8% and 20% of the range (approximately 12 to 30 feet at a 50-meter range). However, due to the shallow depths associated with the OU's, the depth will be held between 2' and 7' on a fixed mount. Survey speed will be held between 3 and 5 knots in areas with greater than 5 feet of water depth, and 2 to 3 knots in all other areas. Positioning accuracy will be greatly enhanced with the use of the hard mount for the tow fish in that the sonar layback will be fixed with no need for computation.

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Survey geodesy for the HyPack navigation software will be set in State Plane (NAD83) Wisconsin Central (4802) with the vertical datum of NAVD 88. However, the Marine Sonic side scan sonar software only collects data in geographic coordinates, so all sonar images will the geo-referenced in latitude and longitude (DDM). The navigation input for the Marine Sonic sonar will come directly from the RTK system (GLL & GGA @ 4800 baud).

Daily Survey Procedure

The side scan survey crew will consist of two crew members (1 vessel operator and 1 sonar technician), with one of the crew members being a lead surveyor within the Onyx-SS hydrographic survey group. Prior to launching the vessel, the survey crew will setup the RTK positioning system over one of the pre-surveyed benchmarks within the area to be surveyed that day (refer to the RTK Positioning SOP document for details on this procedure). The sonar technician will then attach the tow fish to the fixed mount and connect the umbilical. Next the tech will power-up the top-side sonar PC, activate the SeaScan image collection software, and have the vessel operator assist in performing a "rub test" on the tow fish to confirm the system is operational. The rub test is accomplished by activating the tow fish, setting the sonar gains at their highest levels, and then physically rubbing the left and right transducers of the tow fish by hand. The sonar technician will observe signal spikes on the sonar image, indicating that the fish and the topside PC are communicating.

Once the operation of the side scan system is confirmed, the survey vessel will be launched and the sonar technician will power-up the HyPack Max 2.11c navigation software (refer to the e-document "HyPack Max Operation Manual" for details on program operation). The survey trackline plan for the days survey activities will be loaded and displayed for the vessel operator to follow. The vessel operator will navigate the vessel to the control structure to confirm sonar accuracy. Along the way, the sonar technician will deploy the tow fish and set the sonar gains. Once the gains are set and satisfactory to the client representative, the control structure will be imaged and recorded for review.

Once the review is complete and satisfactory, the survey will be conducted according to the track-line plan. Sonar images will attain 95% bottom coverage of the survey area for that day. The SeaScan software will be set to automatically record images along the survey tracklines with a 10% along-track overlap. The software saves individual image (*.mst) files and navigation files within a folder labeled with the day's date.

When changes in water depth dictate, the image gains and sonar depth (deployed deeper as water depth increases) will be fine adjusted on the fly in order to obtain the best image resolution possible. In an effort to limit the amount of adjustment needed, the survey track-line plan will be set up to maintain similar depths along each survey track. All test and final images will be copied onto CD(s) at the end of each day.

All frequencies, configuration settings, and survey progress with the area track-line plan will be recorded on the daily survey log. A copy of this log showing the information recorded each day is included with this SOP.

APPENDIX C

HEALTH AND SAFETY PLAN (HSP)

SITE HEALTH AND SAFETY PLAN

WISCONSIN PUBLIC SERVICE CORPORATION
FORMER MGP PLANT
SHEBOYGAN (CAMPMARINA), WISCONSIN

PROJECT #1665

NATURAL RESOURCE TECHNOLOGY, INC.
PEWAUKEE, WISCONSIN

JULY 9, 2004

Natural
Resource
Technology

N R T

Natural Resource Technology, Inc.

N R T

SITE HEALTH AND SAFETY PLAN
WISCONSIN PUBLIC SERVICE CORPORATION
FORMER MGP PLANT SITE
SHEBOYGAN (CAMPMARINA), WISCONSIN

Prepared for:

Wisconsin Public Service Corporation.
Green Bay, Wisconsin

Prepared by:

Natural Resource Technology, Inc.
23713 W. Paul Road, Suite D
Pewaukee, WI 53072

July 9, 2004

Project No: 1665

Jody T. Barbeau
Environmental Scientist

Kenneth G. Fries, P.E., CHMM
Environmental Health & Safety Engineer

NATURAL RESOURCE TECHNOLOGY
SMALL SITE
HEALTH AND SAFETY PLAN

1.0 GENERAL INFORMATION

Site/Location:	Former MGP Site/Sheboygan	Proj. #:	1665
Plan Prepared by:	Jody T. Barbeau	Date:	July 9, 2004
Plan Reviewed by:	Kenneth G. Fries, P.E., CHMM	Date:	July 9, 2004

Activity(s): Planned Activities include: Sediment Investigation – grab and surface sediment Sampling, sediment coring

Dates of work: Starting Fall 2004

Natural Resource Technology personnel: **Signature**

Description of Site (include map if possible): Former Manufactured Gas Plant Located in Sheboygan, WI

Types of Hazardous Material: see attachment B
Special Notes: None

Major Health/Safety Hazards (contamination, equipment, fire etc.): Physical and Chemical hazards --- see Attachments A and B.

The Safety coordinator/emergency coordinator and Designated First-Aid provider will be the NRT staff personnel supervising the field investigation/work.

2.0 SAFETY PLAN

Protective Equipment/Instruments

Hard hat:	X	Boots:	X	Glasses (type):	X
Suits:		Respirator:		Gloves	X
PID:	IF NEEDED	CGI:		Other:	

Safety Equipment/Instructions: See Attachment A. The above equipment shall be on-site and it shall be available for use.

HARD HAT MUST BE WORN AT ALL TIMES DURING DRILLING

Decontamination Methods: See Attachment A.

3.0 EMERGENCY PLANNING

Phone #'s

Client Contact:	Shirley Scharff	920-433-1396
Fire Dept:	Sheboygan Fire Department	911/ 920-459-3320
Police:	Sheboygan Police Dept.	911/ 920-459-3333
Sheriff:	Sheboygan Co. Sheriff	911/ 920-459-3111
NRT:	Richard Weber	262/522-1237/523-9000
Ambulance or Emerg. Med.	Orange Cross Ambulance Service Inc. 2629 N 7th Sheboygan, WI.	920-457-4233
Contractors:	None indicated at this time	
Hospital:	St. Nicholas Hospital	920-459-4760
	1601 North Taylor Drive, Sheboygan, WI 53081-2496	

Hospital Directions: MAP OF ROUTE TO HOSPITAL IS ATTACHED.

RESOURCES

Telephone:	Mobile phone - bring	Electric:	Bring
Water:	Bring	Other:	

MAPQUEST

Send To Printer Back To Directions

Start: 732 N Water St
Sheboygan, WI
53081-3935 US

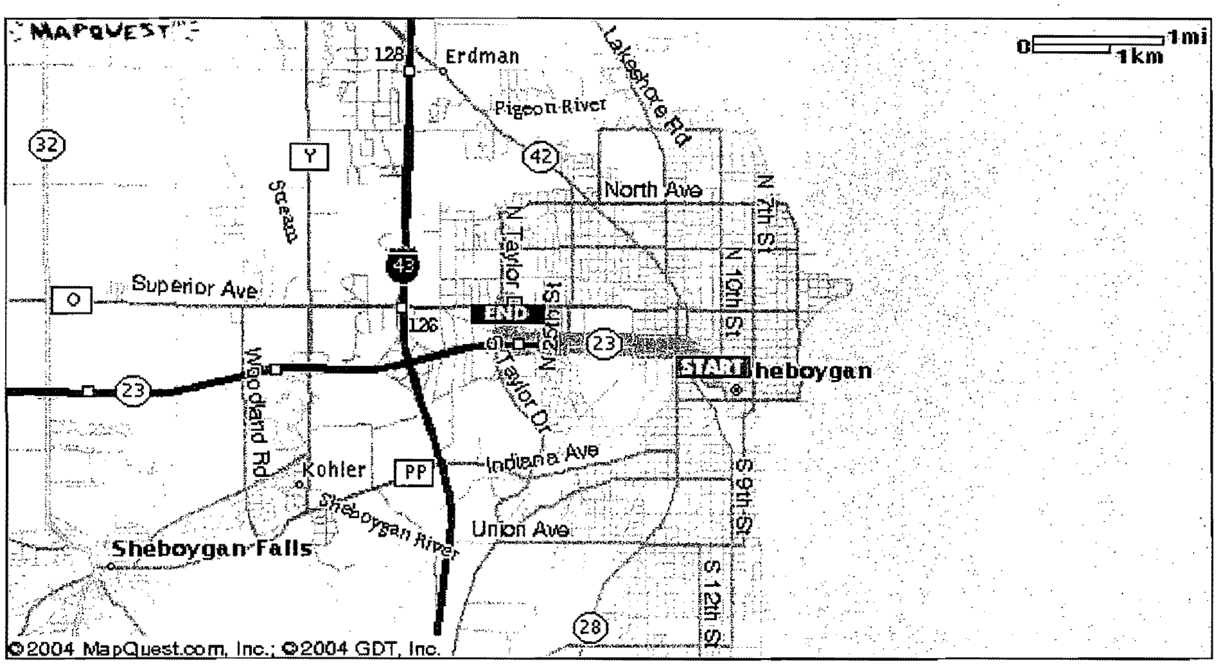
End: 1601 N Taylor Dr
Sheboygan, WI
53801 US

Distance: 2.11 miles

Total Estimated Time: 5 minutes

Directions	Distance
START **1.** Start out going Northwest on N WATER ST toward WISCONSIN AVE.	0.1 miles
2. Turn SLIGHT LEFT to stay on N WATER ST.	0.1 miles
3. N WATER ST becomes N 13TH ST.	<0.1 miles
4. Turn LEFT onto ERIE AVE.	0.4 miles
WEST 23 **5.** ERIE AVE becomes KOHLER MEMORIAL DR/WI-23 W.	0.8 miles
RAMP **6.** Take the TAYLOR DR ramp.	0.1 miles
7. Turn RIGHT onto N TAYLOR DR.	0.3 miles

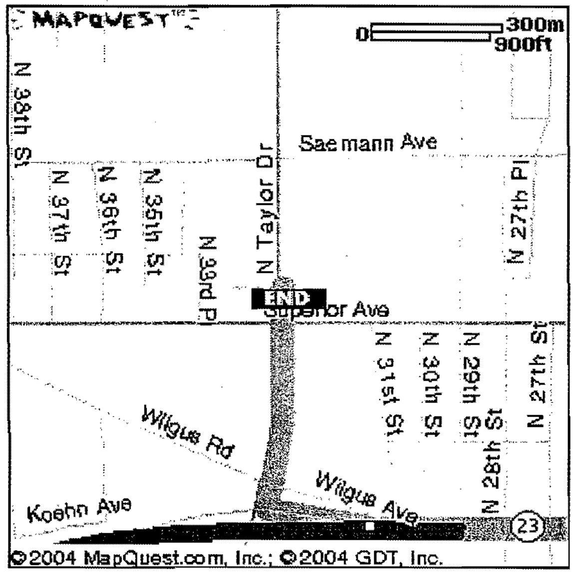
END **End at 1601 N Taylor Dr, Sheboygan, WI 53801 US**



Start: **End:**

732 N Water St
Sheboygan, WI
53081-3935 US

1601 N Taylor Dr
Sheboygan, WI
53801 US



NAVTEQ ON BOARD

Notes:

FIELD HEALTH & SAFETY BRIEFING

NRT Project # 1665 ______________ NRT Task # ______________

I HEREBY CERTIFY THAT I HAVE READ AND UNDERSTOOD ALL HEALTH AND SAFETY PROCEDURES AS STATED HEREIN:

Name (printed)	Signature	Date

This page should be removed or copied after it has been signed and put into the project file.

ATTACHMENT A

HEALTH AND SAFETY PLAN
FOR
SITE INVESTIGATIONS

WISCONSIN PUBLIC SERVICE CORPORATION.
FORMER MGP PLANT
SHEBOYGAN (CAMPMARINA), WI

NRT PROJECT NO. 1665

JULY 9, 2004

TABLE OF CONTENTS

TABLE OF CONTENTS
(Continued)

Page

LIST OF TABLES

Table **Page**

1.0 INTRODUCTION

1.1 Purpose and Scope

This document describes the general health and safety procedures and requirements for the installation of borings/wells, test pit excavations and groundwater sampling for site investigations. This document applies to field work performed by Natural Resource Technology, Inc. (NRT) at sites requiring no special analysis of physical and/or chemical hazards as identified in the site specific health and safety plan for the individual facility. This document is also intended to serve as a standard attachment to the site specific health and safety plan involving the above investigative tasks to streamline the health and safety plan preparation process to ensure that the work performed by NRT is done in compliance with applicable federal occupational safety and health regulations.

1.2 Responsibilities

Responsibilities for health and safety compliance issues associated with hazardous waste operations are primarily vested in the project organization, with support from appropriate health and safety professionals on NRT's technical and administrative staffs.

1.2.1 Corporate Director of Health and Safety (CDHS)

The CDHS acts as a technical resource to all NRT offices on health and safety matters. This person is responsible for ensuring that all NRT health and safety programs comply with applicable federal, state, and local statutes for safety and health protection; executive orders; operating orders; permits and regulations; and company policies and procedures. The CDHS is also responsible for review and approval of all site-specific Health and Safety Plans, serves in a consultation capacity to the technical staff on health and safety-related issues, and has the authority to conduct health and safety audits.

1.2.2 Project Manager (PM)

The PM is accountable for health and safety compliance on his or her projects. The PM is responsible for the technical and financial execution of the project, and has the authority to commit resources, adopt program policies and procedures, and approve expenditures and subcontracts. The PM will ensure that adequate resources are budgeted and available to implement a sound health and safety program and that appropriate technical resources are brought in to support the health and safety needs of the project. The PM will ensure that health and safety is a high priority in planning fieldwork and or lab studies, and that adequate resources are available to develop and implement an appropriate project-specific health and safety plan.

1.2.3 Project Health and Safety Officer (PHSO)

The PHSO is responsible for developing and implementing the project- or site-specific Health and Safety Plan. In the event a PHSO has not been identified for a specific project, the PM will assume those responsibilities. The PM is ultimately responsible for health and safety for the project. It is the responsibility of the PM to report any unsafe conditions reported by the project staff to the CDHS and to work cooperatively to mitigate unsafe conditions. The PHSO will also ensure compliance with health and safety requirements presented in this Manual and in project- or site-specific Health and Safety Plans. The PM will serve as the PHSO unless site-specific hazards are identified warranting assignment of the PHSO to the project. To meet these responsibilities, the PM/PHSO may:

- Act as a health and safety consultant to the project field staff;
- Provide site-specific training to all staff assigned to work at the site;
- Review and confirm any changes in personal protective clothing or respiratory protection requirements;
- Require the specific health and safety precautions be taken before personnel enter a site;
- Restrict access to the site or a portion thereof;
- Perform necessary personnel monitoring;
- Stop work when the health or safety of project personnel are jeopardized and order the immediate evacuation of personnel from any area of the site;
- Require personnel to obtain immediate medical attention if warranted;
- Provide health and safety briefings to all site visitors; and
- Enforce the requirements stated in the Corporate Health and Safety Manual and the project- or site-specific Health and Safety Plan.

1.2.4 Field Team Members

All NRT personnel must know, understand and comply with the requirements of this Manual and any project- or site-specific Health and Safety Plans developed for their projects. Field personnel will:

- Read and understand all applicable health and safety plans;
- Perform their work safely;

- Be aware of and alert for signs and symptoms of work-related injuries and illnesses; and,

- Promptly report any unsafe conditions that may occur on site to the PHSO, PM, and/or CDHS.

1.2.5 Subcontractors

Subcontractors have primary responsibility for the health and safety of their own employees. However, NRT is required by OSHA standards (e.g., 29 CFR 1910.120 and 1910.1200) to provide information to its subcontractors on known or potential workplace hazards, as well as the methods proposed to manage the identified hazards.

It is currently OSHA policy to issue citations to prime contractors in the event that their subcontractor is found to be out of compliance with regulatory requirements. NRT may incur civil penalties as a result of non-compliance with regulatory requirements by its subcontractors and/or injuries or illnesses incurred by the subcontractor's staff. Personal injury suits have been successfully brought against prime contractors in instances where a subcontractor's employee has demonstrated that the lack of health and safety oversight on the part of a prime contractor played a role in his or her sustaining an injury or illness.

NRT intends to manage its subcontractors to protect the health and well being of NRT staff. NRT's objective is to manage subcontractors in a way that limits NRT's and our client's liabilities related to subcontractor performance, including management of health and safety issues. To achieve this objective, a minimum level of subcontractor surveillance, with respect to health and safety issues is required.

When required by NRT, the subcontractor must review project-specific health and safety information and hazards, and develop and implement a health and safety plan. This plan must comply with all applicable health and safety regulations and any project-specific requirements that NRT has specified. The subcontractor must provide NRT with a copy of this plan before the start of work. NRT acceptance of the subcontractor's plan does not mean that NRT concurs with the adequacy of the plan for protection of the health and safety of the subcontractor's employees. That responsibility rests solely with the subcontractor. NRT review of subcontractor health and safety plans will be for the purposes of: 1) assessing potential health and safety impacts to NRT personnel and 2) meeting NRT legal responsibilities as a prime contractor. Any deficiencies in the subcontractor's plan or inconsistencies in proposed work practices between NRT and its subcontractor should be identified at this point. If appropriate, these deficiencies or differences should be resolved before the work begins.

1.3 Health and Safety Plan Modification Procedures

Due to varying site conditions or the finding of unanticipated hazards, it may be necessary to revise the health and safety plan. Necessary plan changes that call for more stringent procedures or a higher level of personal protective equipment may be made at any time by the PM or Task Leader in cooperation with the PHSO. The PM should be notified at the soonest available opportunity.

Plan changes that would make safety procedures or personal protective equipment requirements less stringent may be made only upon approval of the PM after consultation with the CDHS. Plan changes must always be put in writing and communicated to all field personnel.

2.0 TRAINING

2.1 General

All NRT and subcontractor employees performing field work on this project are required to have appropriate safety training as specified in the OSHA Standards, particularly the HAZWOPER Standard 29CFR1910.120. NRT personnel performing fieldwork on this project meet the necessary general training requirements. Subcontractors are responsible for supplying NRT's PM with written statements certifying that all of their project personnel meet the necessary general training requirements.

2.2 Site-Specific

Site-specific hazard and hazard control information is contained in this health and safety plan. All NRT personnel will be provided with a copy of this plan prior to the beginning of fieldwork. Each person will be required to "sign off" that they have read, understood, and will follow the procedures set forth in the plan.

2.3 Informational Briefings

It is the responsibility of each NRT staff member directing field operations to keep their crew members appraised of site conditions relative to health and safety, and of any approved modifications to the plan. This will be accomplished through ongoing "tailgate" meetings. All personnel are required to report injuries, illnesses and unsafe conditions to their immediate supervisor. The supervisor is required to report in writing any such accidents to the PM and PHSO within 24 hours of occurrence.

3.0 MEDICAL SURVEILLANCE

The hazardous substances known or suspected to be present at the site are not known to produce injury or illness that would not be detected by the medical examination specified in the NRT Standard Practices Manual, Section 6, Health and Safety, Number 06-10. The medical monitoring program established in this section of the Standard Practices Manual complies with all OSHA guidelines regarding and necessitating medical monitoring in the work place.

4.0 CONTAMINATION CONTROL

The potential for equipment and personal contamination exists at this site. To prevent the spread of contamination, the following procedures must be adhered to.

4.1 Work Zones

All work crews, whether drilling, excavating or performing other activities, must prevent the uncontrolled movement of contaminated or potentially contaminated soil and water. All soil and water removed from its natural setting should be considered contaminated unless proven otherwise by chemical analysis or specifically known to be clean material in which verification sampling is occurring. Work crews will prevent migration of removed materials by establishing work zones and decontamination procedures. Work zones will be delineated. Only persons certified as having the necessary training and medical qualifications will be allowed in the Exclusion (EZ) or Contamination Reduction (CRZ) zones. A field log will be maintained identifying all people on site entering the EZ. The following describes the zones to be established during drilling:

- ■ Exclusion Zone - An Exclusion Zone (EZ) will be established surrounding the drilling or excavation site, if necessary. The EZ will comprise an area of at least as large as a circle having a diameter equaling one half the mast height of the drilling equipment or arm of excavating equipment. The size and shape of the EZ will be determined by the PHSO. No personnel will be permitted in the EZ unless they are in full compliance with the site health and safety plan.

- ♦ Contamination Reduction Zone - A Contamination Reduction Zone (CRZ) is to provide a controlled area for performing decontamination. If a CRZ is necessary for the job, the size and the shape of the CRZ will be determined by the PHSO.

4.2 Decontamination Procedures

Personal decontamination will be accomplished by using good personal hygiene. Personal contamination should not occur if the protection methods specified in this plan are used. However, the following procedures must be complied with to ensure that contamination does not remain on equipment, sample containers, or in contact with personnel.

- ■ While in the EZ clean gross contamination off equipment by scraping or brushing. Collect all contaminated soil with the drill cuttings and transport the cuttings in an appropriate manner to the staging area on site (i.e. placed in DOT approved 55-gallon drums which become the site owner's responsibility).

- If steam cleaning of equipment is required it will occur at the designated area on site. If capture of decontamination water is required, it will be placed in DOT approved 55-gallon drums and become the site owner's responsibility.

After equipment and sample container decontamination is accomplished, drilling crewmembers must remove personal protective equipment (PPE) before leaving the CRZ. PPE must be removed in a step-wise fashion to prevent contamination of work clothing, as follows:

- Remove all contaminated soil from work boots and remove protective clothing for decontamination or disposal. If disposable personal protective equipment is required, it should be placed in an open top drum designated for that purpose. A lid should be placed on the drum after usage. All drummed material will be labeled identifying contents and the date filled.

- Remove and wash outer gloves and hard hat. Place disposable gloves in a collection bag.

- The use of respiratory protection is not anticipated. If a respirator must be used or otherwise removed from its containers, wash it down and take it with you as you exit the CRZ.

- Final daily decontamination will be reviewed by the PHSO to ensure that no contaminated articles are left which may be accessible to the public. Therefore, all disposable personal protective equipment and other miscellaneous garbage will be stored in a drum with a secured lid.

After leaving the CRZ, and before eating, drinking, smoking, or using the restroom, all personnel must wash their hands, arms, face, and neck. In addition, all personnel should take a full-body shower at the end of the workday. A full-body shower includes the use of a wash cloth to scrub the skin.

4.3 Waste Storage and Disposal

Since all soil and water removed from its natural setting is considered potentially contaminated, these materials will be stored and disposed of according to the guidelines established in the Work Plan for the site. If no guidelines have been established in the work plan for storage and disposal of these investigative wastes, the procedures outlined in NRT Standard Practices Manual, Section 6, Health and Safety, Number 06-07 with the WDNR Investigative Waste Policy attachments will be followed in storing and disposing of the wastes.

Disposal of the wastes will be at the expense of the site owner. Waste container contents and identification will be made in the field log for future reference. All containers will be distinctly labeled using a paint pen or marker.

5.0 JOB SAFETY ANALYSES

5.1 General

All personnel in the vicinity of the drilling operations are not only subject to the hazards of direct exposure, but also to dangers posed by the machinery operation. In addition, stresses due to working in protective clothing will be encountered. Physical, chemical, and biological hazards are present at most job sites.

5.1.1 Heat/Cold Stress

Temperature extremes, wet working conditions, and personal protective equipment can all combine to cause injury and illness to field workers. In general, high temperatures and/or impermeable personal protective equipment can induce heat stress. Cold stress can be induced by low temperatures and/or wet skin or clothing.

The signs and symptoms of temperature extreme stress follow.

- Heat Stress: Profuse sweating, weakness, rapid pulse, dizziness, nausea, and headache. If heat stroke occurs, the skin will be hot, dry and flushed.

- Cold Stress: Involuntary shivering, speech difficulty, loss of manual dexterity, and memory lapse. The most severe localized form of cold stress, frostbite, causes the skin to become numb, pale, hard, and cold.

First aid measures to be taken for each type of stress follows.

- Heat Stress: Move the person to a shaded, cool area. Have them drink large quantities of fluids. In the case of heat stroke, seek medical attention immediately.

- Cold Stress: Move the person to a heated, sheltered area. Immerse exposed body parts in warm (104-113^0 F) water. If exposed skin is numb, do not rub it. If frostbite is suspected, seek medical attention as soon as possible.

5.1.2 Slips, Trips, and Falls

The most common hazards that will be encountered will be slips, trips, and falls. Common sense will be used to avoid these hazards. When working on slippery surfaces, tasks will be planned to decrease the risk of slipping. Slippery surfaces will be avoided, work and travel will not be hurried, and good housekeeping will be maintained. All personnel must vigilantly observe where they are working and walking to avoid slips, trips, and falls.

5.1.3 Vehicular Traffic

Another common hazard that will be encountered at many sites will be vehicle traffic, including cars, trucks, drilling rigs and heavy machinery. Common sense will be used to avoid these hazards. When it is necessary to move a vehicle, all drivers must be mindful that pedestrians are present on site. Pedestrians must use common sense to avoid standing in blind spots or in high traffic areas. All personnel must vigilantly observe where they are working and walking to avoid being struck by vehicles which, for one reason or another, are moving. Finally, when working in high traffic areas (i.e., on the edge or in the middle of city streets or heavily used parking areas) personnel are required to either set up traffic cones or wear orange traffic safety vests to alert drivers to their presence.

Work performed in rail yards or along railroad tracks poses an additional hazard. Numerous incidents have occurred when working between or alongside rail lines and has resulted in serious injury or death. Therefore the following rules must be followed when working near rail lines:

1) Never walk or step on a railroad track. The tracks can be slick and injury due to slipping off a track is possible.

2) Never run over tracks - Always Walk. Tripping injuries can occur when running over the tracks which can result in serious head injuries.

3) Never stand between the tracks. When necessary, walk across the railroad tracks and stand to one side or the other of a rail line.

4) Always wear a hard hat, eye protection, steel-toed boots and an orange reflective vest for personal protection.

In addition to these rules, whenever work is done near railroad tracks or in a railroad right-of-way, the railroad company must be contacted and a flagman requested to monitor work activities. No work will be done without a railroad flagman being present unless the railroad company expressly permits it.

5.1.4 Exposure to Excessive Noise

Overexposure to noise can result in hearing loss. If it is difficult to hear normal speech when the speaker is 3 to 4 feet from the listener, and that condition is present for more than four hours a day, it will be assumed that the noise level exceeds 85 dBA and appropriate hearing protection will be used. The disposable "ear plug" type hearing protectors are recommended.

5.1.5 Chemical Hazards

Personal protective equipment requirements are stated in the NRT Safe Work Practices and Methods of Personnel Protection Section 6.0. Material Safety Data Sheets for suspected contaminants are contained in Attachment A.

5.1.6 Biological Hazards

During warm weather months, potential biological hazards include venomous insects, snakebites, and poisonous plants. Appropriate safety measures, such as the use of insect repellent and probing of possible nesting areas, will be taken to prevent exposure to biological hazards. Long sleeves and pants will provide protection from contact with poisonous plants.

5.2 Task Specific

5.2.1 Well and Bore Hole Drilling

In addition to the possibility of contact with the above listed chemicals, physical hazards associated with well and bore hole drilling include:

- Snapping cables;
- Brush and equipment fires;
- Being hit by equipment;
- Being caught in rotating tools;
- Falling objects;
- Exposure to excessive noise; and
- Contact with energized electrical lines.

5.2.2 Air Rotary Drilling

This type of drilling, in addition to the above listed hazards, may also expose field personnel to blowing dust and high-pressure airlines.

5.2.3 Well, Seep, and Pipe Sampling

Collection of these samples presents the hazard of inhalation exposure to and skin contact with the substances listed in Attachment A.

5.2.4 Drilling/Excavation Near Overhead Electrical Lines

Drilling or excavation activities near overhead electrical lines present a serious electrocution hazard. Safe work distance must be maintained. This distance is a function of the humidity and the voltage present. Should work in the proximity of overhead lines be required, the minimum clearance will be determined based on OSHA standards.

5.2.5 Drilling/Excavation Near Underground Electrical/Utility Lines

Buried electrical/utility lines present a hidden danger while drilling/excavating. The NRT PM or PHSO will be responsible for contacting the local underground utility locator service (i.e. Diggers Hotline in Wisconsin). The locator service will mark all underground lines to ensure safe working conditions. Drilling/excavation will not occur within three feet of any marked underground line.

5.2.6 Thunderstorms and Rain

Drilling/excavation activities during electrical storms poses a hazard of electrocution by lightning strike, and adverse working conditions, as well as high winds tipping the drill rig. All drilling/excavation activities will stop and the drilling rig mast will be lowered at the approach of a thunderstorm. Drilling activities during rainstorms can cause not only slippery conditions but also excess friction on cathead pulleys. This can cause dangerous conditions during drive sampling operations. Therefore all drive sampling operations will cease and, depending on the PHSO's assessment, drilling may be halted.

5.2.7 Test Pits and Excavation

Test pits and excavations pose a serious threat of injury resulting from falls or excavation wall collapses. During excavation or digging activities an exclusion work zone will be established around excavating machinery. All bystanders and on-lookers will be prohibited from entering this work zone while the excavating machinery is in operation. The work zone will be large enough so that the excavating machinery (i.e. trackhoe, etc.) can rotate 360° without extending out of the work zone. After the excavation is completed it should either be backfilled immediately or the entire excavation will be encircled with a physical barrier (i.e. barricades, orange excavation fencing, etc.) which will limit access to the excavation and decrease the likelihood of injury resulting from falls. Any excavation greater than four feet deep will NOT be entered unless the walls of the excavation have been reinforced to prevent wall collapse. Entry into any excavation greater than four feet deep will constitute a confined space entry procedure. Therefore, no excavation entrance is allowed.

A PID will be used to monitor air quality in the breathing zone of the work area for VOC vapor levels and in an excavation (See Table 1). Prior to Contractor Personnel entering any excavations to install piping or any other equipment, the PID will be lowered into the excavation to determine air quality in the excavation as well. Additionally, if an excavation is deeper than 4 feet, it is considered a confined space in accordance with OSHA definitions. Therefore, the walls of any excavation deeper than 4 feet that require entry by site personnel will be reinforced and shored. Additionally, any personnel entering confined space will wear a body harness attached to a safety line. Besides using the PID to monitor VOC vapors in the breathing zone and in confined spaces, an oxygen meter will also be used. The oxygen meter will be used to measure percent oxygen in any excavation considered to be a confined space. Calibration of the combustible gas meter is required based on use to insure accuracy

5.2.8 Operations On Surface Waters

The procedures specified in this subsection are designed to protect NRT staff when conducting work activities involving water craft vessels on surface waters. Governmental laws and regulations regarding onshore waters are under the jurisdiction of the Unites States Coast Guard (USCG-Great Lakes) and the Wisconsin Department of Natural Resources (WDNR-Wisconsin inland waters). When conducting any surface water work activities out of state (i.e. other than Wisconsin), that state regulatory agency and its regulations will be adhered to.

5.2.8.1 Scope and Applicability

The procedures specified in this subsection apply to all work activities involving surface waters. The highest ranking NRT staff member (i.e. Project Manager, Field Task Leader) at the work site is responsible for implementing this plan. The work activities will not be initiated prior to receiving approval from the Environmental Health & Safety Manager (EHSM).

- Work activities can be conducted in "open water" or "ice" conditions; and,
- Each NRT staff person at the site is responsible for following these procedures.

5.2.8.2 Small Water Craft

The following procedures will be observed when NRT staff conducts work activities in "open water" conditions in a small water craft:

- Work will not be initiated prior to meeting approval from the EHSM;
- All work activities conducted on surface waters will be conducted in accordance with the requirements of the USCG and WDNR (or other appropriate state agency);
- Personal Flotation Devices (PFD) that are USCG approved must be worn at all times when on surface waters. One adult size PFD (wearable style) for every person on the water craft is required;
- A minimum of two (2) PFDs must be on board on the water craft at all times on Wisconsin waters;
- Have on board a "throwable" flotation device w/attached line;
- Distribute weight evenly across the beam of the watercraft;
- Only allow one person to stand at a time in a small watercraft vessel;
- Do not exceed manufacture's capacity plate load limits;
- Attach a lanyard or safety line which can be tied to the sampling personnel when water surface conditions are rough. This will enable easier retrieval of the person should he/she fall over the side of the water craft;

- Check running condition of the outboard motor prior to launching (i.e. ample supply of fuel/oil mix, fuel line in good condition, integrity of the propeller, **EXTRA SHEER PINS);**
- Equipment to have on board include oars, anchor w/line (100 foot minimum line on inland waters) and mooring lines of adequate length;
- Wear work gloves when using equipment that could injure hands;
- Wear hard hat if overhead hazards exist (e.g. A-Frame, use of long coring devices);
- Secure overboard equipment to vessel; and,
- Use proper lifting techniques when retrieving heavy equipment.

5.2.8.3 Shallow Water

Work activities in shallow water along the shore line shall consider the following hazards:

- Use waders to minimize exposure to water, sediment contaminant exposure and heat loss;
- Proceed carefully – water currents and falling can cause the waders to fill creating a very serious condition. In addition to wearing a PFD, a safety line should be tethered to the person walking in water currents.
- Fatigue can occur more rapidly from walking through the water.

5.2.9 Heat Stress

- Wear thin cotton clothing under Tyvek™ suits;
- Have thirst liquids available; and,
- Stop work if heat exhaustion occurs (i.e. light headedness, profuse sweating).

5.2.10 Ice

Collection of samples through frozen rivers/lakes presents the difficulties of working on ice. All precautions for slips, trips and falls will be observed. Ice thickness will be at a minimum of 9 inches thick before work activities will commence.

The following procedures will be observed when NRT staff conducts work activities on "ice" conditions:

- Work activities will not be initiated prior to meeting approval from the Environmental Health & Safety Manager (EHSM);

- Know the ice (i.e. thickness) and proceed with extreme caution. Ice thickness at a minimum should be 18 to 24 inches (when conducting drilling operations) and inspected for integrity. Check ice thickness regularly when traversing across ice to assure adequate support exists. Be especially cautious when approaching pressure cracks, areas of open water or areas of rivers where water velocity may be higher.

- Wear PFDs at all times if ice thickness is less than 4 inches.

- Warm weather causes ice thinning and potential for slipping (drilling holes on thinning ice can cause flooding of ice surface and can accelerate ice thinning and breakage);

- Equipment may be required to be hauled between work stations (use sleds); and,

- Fatigue can occur from walking and drilling holes.

5.2.11 Cold Stress

- Dress in layers and regulate clothing to activity levels;

- Wear plenty of layer clothing (so layers can be added or removed);

- Cover exposed skin when windy;

- Glove liners can keep hands warm but reduce dexterity;

- Use face masks and helmet liners to keep head warm and,

- Stop work if conditions get too cold.

5.2.12 Always Work In Pairs – Never Conduct Work Activities Alone.

Due to the location and manner in which work activities are conducted, the threat of falling into the water is very high.

Carry retrieval equipment including:

- 50 foot of line at least 3/8 inch diameter.

- Two - six (6) foot 2" x 4"s.

Based on water currents, water temperature and the amount of clothing worn by NRT staff, the threat of being swept downstream or drowning is possible. Extreme caution must be used when conducting these type of work activities. If a NRT staff employee should fall into the water, the employee will be retrieved and all warranted precautions shall be taken to ensure the safety and well being of that individual. All work activities will be immediately suspended and the person brought to shore. All wet clothing shall be removed and the person shall be dried and dressed in a set of dry clothes. **If the possibility of hypothermia exists, seek medical attention immediately.**

Persons sampling contaminated or potentially contaminated materials should wear the same personal protective equipment (PPE) as listed for monitoring well sampling. The required PPE will be carried along on the sediment sampling water craft. PPE can add to heat stress during warm conditions and can cause decreased mobility dexterity.

5.2.13 Weather Conditions

No work activities will be conducted when there is thunder and lightning in the area. All NRT staff will come to shore during these weather conditions and will remain on shore until all lightning has ceased Other weather conditions (i.e. wave heights, strong winds, snowfall, light rain, etc.) will need to be monitored by NRT staff, and if conditions warrant, work activities will be suspended.

5.2.14 Subcontractors

It is the responsibility of the PM with the assistance of the EHSM to require any and all subcontractors assisting in the work activities, to adhere to this Water Course-SOP. Any refusal on behalf of the subcontractor regarding this Water Course SOP will mandate shutdown of the project.

6.0 SAFE WORK PRACTICES/METHODS OF PERSONNEL PROTECTION

6.1 General

To prevent accidental ingestion of chemical contaminants, the following rules must be compiled with when working within the exclusion/contamination reduction zones, and when taking or handling samples:

- No eating, drinking, or smoking is allowed at work locations.
- No fires are allowed at work locations.
- All personnel must wash their hands, arms, face, and neck immediately after leaving the exclusion/contamination reduction zones. This must also be done after taking samples and prior to eating, drinking, smoking, or using the restroom.
- All personal protective equipment must be removed prior to eating, drinking, smoking, or using the restroom.

6.2 Drilling/Excavation

6.2.1 Equipment

Drilling rigs and heavy equipment should be inspected at the start of each day to detect equipment problems. Particular attention should be paid to cables and hydraulic lines. Examine them for evidence of stretching, fraying and cracking. The fuel system should be in good repair (free from leaks) to avoid the potential for fire or explosion. The drill rig and heavy equipment should be equipped with or have stationed in the area two 20-lb. type BC fire extinguishers. Staff should be trained in the proper use of the extinguishers.

6.2.2 Drilling/Excavation Site

The drilling/excavation area should be located away from overhead electrical lines. The location of buried water, electrical, telephone, and gas utility lines must be determined and staked. Slope of terrain, stability of embankments, soil load bearing ability, etc. should be evaluated in selection of the drilling/excavation locations.

6.2.3 Personal Protective Equipment

Persons handling contaminated or potentially contaminated equipment or soils must wear the following protective gear:

- Long sleeve coveralls (light or heavy weights subject to ambient temperature);
- Bib style rain pants where wet operations exist;

- Nitrile gloves;
- Vinyl gloves for sample handling;
- Safety glasses with side-shields; (REQUIRED AT ALL TIMES)
- Hard hat; (REQUIRED AT ALL TIMES)
- Steel-toed boots; (REQUIRED AT ALL TIMES)
- Reflective orange vest; (worn as the situation warrants) and
- Hearing protection (as required).

Persons whose skin or inner clothing comes in contact with contaminated soils or liquids should remove such clothing, shower or clean as appropriate, then re-suit for continued work activity.

6.2.4 Monitoring

A photoionization detector (PID) and possibly a combustible gas indicator (CGI) will be used to measure air contaminant concentrations in the breathing and work zones. Readings are to be recorded on the logs and in the project logbook. The PID will be calibrated per the air monitoring action plan contained in Table 1. If a CGI is also used to detect combustible conditions at the work site, the monitoring will also follow the plan listed in Table 1.

6.2.5 Hearing Protection

If you must raise your voice to converse with person's three feet away from you, you are probably being overexposed to noise. In these instances, the wearing of hearing protection is required. The muff or "EAR" type disposable earplugs will suffice.

6.3 Sampling of Wells

6.3.1 Personal Protective Equipment

Persons sampling contaminated or potentially contaminated materials must wear the following protective gear:

- Long sleeve coveralls (light or heavy weights subject to ambient temperature);
- Bib style rain pants where wet operations exist;
- Nitrile gloves;
- Vinyl gloves for sample handling;

- Safety glasses with side-shields;
- Steel-toed boots; and
- Hearing protection (as required).

Persons whose skin or inner clothing comes in contact with contaminated soils or liquids should remove such clothing, shower or clean as appropriate, then re-suit for continued work activities.

NOTE: Outer gloves should be changed between samples if contact to the sample occurs. This will preserve sample integrity.

6.3.2 Air Monitoring

A PID may be used to measure air contaminant concentrations at the well head during water sampling. If measurements are collected, they should be recorded in the project logbook. The PID will be calibrated at the start of each day. Air monitoring should follow the action plan contained in Table 1.

6.4 Buddy System

Each worker will maintain visual contact with another worker at all times. The buddy system will ensure against an employee becoming stressed with a co-worker being aware of his or her condition. Workers should *watch out* for each other while working close to potential chemical and physical hazards. For example, all work in the exclusion zone should be scheduled so that no employee works alone in this zone at any time.

6.5 Daily Start-up and Shutdown Procedures

The following protocols will be followed daily prior to the start of work activities:

- The PHSO will review site conditions to determine if modifications of the work and safety plans are needed;
- Personnel will be briefed and updated on any new safety procedures based on the previous day's findings and the planned work activity for that day;
- All safety equipment will be checked for proper function;
- The PHSO will ensure that the first aid equipment is readily available; and
- The PHSO will initiate appropriate monitoring.
- The following protocol will be followed at the end of daily operations and before breaks:

- All personnel will proceed through appropriate decontamination procedures and facilities; and,
- The work site will be left clean. Drums will be properly labeled and staged.

7.0 DOCUMENTATION

7.1 Accident Reports

All accidents, including those that do not result in injury or illness, are to be reported to the PHSO or the PM within 24 hours of their occurrence. The report form to be used can be seen in Table 2. The policy specified in the NRT Standard Practices Manual, Section 6, Health and Safety, Number 06-12 regarding notification of the PHSO or PM will be followed.

TABLE 1
AIR MONITORING RESPONSE PLAN

Note 1:	A PhotoVac MicroTip 3000 PID (or equivalent) will be calibrated and checked on a minimum basis at least three times per day: 1) before work activities begin; 2) during lunch break or approximately half way through the working day; and 3) following work activities at the end of the day. These calibration checks will be used to ensure accuracy of VOC readings. Calibration procedures will follow those outlined in the PID manual.
Note 2:	The PID will be used to monitor air quality in the breathing zone of the work area for VOC vapor levels. Prior to Contractor Personnel entering any excavations to install piping or any other equipment, the PID will be lowered into the excavation to determine air quality in the excavation as well. Additionally, if an excavation is deeper than 4 feet deep, it is considered a confined space in accordance with OSHA definitions. Therefore, the walls of any excavation deeper than 4 feet that require entry by site personnel will be reinforced and shored. Additionally, any personnel entering confined space will wear a body harness attached to a safety line. Besides using the PID to monitor VOC vapors in the breathing zone and in confined spaces, an oxygen meter will also be used. The oxygen meter will be used to measure percent oxygen in any excavation considered to be a confined space. Calibration of the combustible gas meter is required based on use to insure accuracy.
Note 3:	The VOCs "action level" is considered when a reading of 50 ppm is sustained on the PID when the PID is held at a constant height, whether in the excavation or the breathing zone. Reaching the VOC action level will require use of either full-face or half-face respirators utilizing Organic Vapor cartridge filters. Additionally, further air quality monitoring will be required to ensure that the PID readings do not exceed a sustained reading of 500 ppm. This will be done under the direction of the NRT PHSO who will determine specific modifications to work practices and personal protective equipment requirements. If the 500-ppm action level is achieved, all activities on the site will immediately stop. The NRT PM will be contacted prior to taking any further action on the site, unless a situation exists which requires immediate action. Options such as nitrogen purging will be considered based on the most current information available.

TABLE 2.
NRT's Accident/Injury Report Form   Project No. 1665

Date: ____________________ Time: ____________________

Location of Incident: ____

Was Anyone Injured ____________________ Name of Injured: ____________________

Describe Company First Aid (If Applicable): ____________________

____

____

Physician's Treatment (If Applicable): ____________________

____

____

Description of Incident: ____

____

____

____

____

____

Corrective Action: ____

____

____

____

Additional Comments: ____

____

Reported By: ____

Distribution:
Corp. H & S Dir. ____________________
Project Manager: Richard H. Weber ____________________ Other: ____________________

ATTACHMENT B

HEALTH AND SAFETY PLAN
FOR
GENERAL SITE INVESTIGATIONS

WISCONSIN PUBLIC SERVICE CORPORATION
FORMER MGP PLANT
SHEBOYGAN (CAMPMARINA), WISCONSIN

(NRT PROJECT NO. 1665)
JULY 9, 2004

MATERIAL SPECIFICATION DATA SHEETS (MSDS)

♦ BENZENE	♦ NAPHTHA (COAL TAR)
♦ ETHYLBENZENE	♦ PCBs
♦ TOLUENE	♦ CYANIDE
♦ XYLENES	
♦ PAHs (TECHNICAL SHEET)	

BENZENE

BNZ

CAUTIONARY RESPONSE INFORMATION

Common Synonyms	Watery liquid	Colorless	Gasoline-like odor
Benzol Benzole	Floats on water. Flammable, irritating vapor is produced. Freezing point is 42°F.		

Restrict access.
Avoid contact with liquid and vapor.
Wear goggles and self-contained breathing apparatus.
Shut off ignition sources and call fire department.
Stay upwind and use water spray to " knock down" vapor.
Notify local health and pollution control agencies.
Protect water intakes.

Fire

FLAMMABLE.
Flashback along vapor trail may occur.
Vapor may explode if ignited in an enclosed area.
Wear goggles and self-contained breathing apparatus.
Extinguish with dry chemical, foam, or carbon dioxide.
Water may be ineffective on fire.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

VAPOR
Irritating to eyes, nose and throat.
If inhaled, will cause headache, difficult breathing, or loss of consciousness.
Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

LIQUID
Irritating to skin and eyes.
Harmful if swallowed.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.

Water Pollution

HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. CORRECTIVE RESPONSE ACTIONS

Stop discharge
Contain
Collection Systems: Skim
Chemical and Physical Treatment: Burn
Salvage waterfowl

2. CHEMICAL DESIGNATIONS

2.1 CG Compatibility Group: 32; Aromatic Hydrocarbon
2.2 Formula: C_6H_6
2.3 IMO/UN Designation: 3.2/1114
2.4 DOT ID No.: 1114
2.5 CAS Registry No.: 71-43-2
2.6 NAERG Guide No.: 130
2.7 Standard Industrial Trade Classification: 51122

3. HEALTH HAZARDS

3.1 Personal Protective Equipment: Self contained positive pressure breathing apparatus; protective gloves and clothing.
3.2 Symptoms Following Exposure: Dizziness, excitation, pallor, followed by flushing, weakness, headache, breathlessness, chest constriction, nausea, and vomiting. Coma and possible death.
3.3 Treatment of Exposure: SKIN: flush with water followed by soap and water; remove contaminated clothing and wash skin. EYES: flush with plenty of water until irritation subsides. INHALATION: remove from exposure immediately. Call a physician. IF breathing is irregular or stopped, start resuscitation, administer oxygen.
3.4 TLV-TWA: 0.5 ppm
3.5 TLV-STEL: 2.5 ppm
3.6 TLV-Ceiling: Not listed
3.7 Toxicity by Ingestion: Grade 3; LD_{50} = 50 to 500 mg/kg
3.8 Toxicity by Inhalation: Currently not available.
3.9 Chronic Toxicity: Leukemia.
3.10 Vapor (Gas) Irritant Characteristics: If present in high concentrations, vapors may cause irritation of eyes or respiratory system. The effect is temporary.
3.11 Liquid or Solid Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
3.12 Odor Threshold: 4.68 ppm
3.13 IDLH Value: 500 ppm
3.14 OSHA PEL-TWA: 1 ppm.
3.15 OSHA PEL-STEL: 5 ppm
3.16 OSHA PEL-Ceiling: Not listed
3.17 EPA AEGL: Not listed

4. FIRE HAZARDS

4.1 Flash Point: 12°F C.C.
4.2 Flammable Limits in Air: 1.3%-7.9%
4.3 Fire Extinguishing Agents: Dry chemical, foam, or carbon dioxide.
4.4 Fire Extinguishing Agents Not to Be Used: Water may be ineffective.
4.5 Special Hazards of Combustion Products: Not pertinent.
4.6 Behavior in Fire: Vapor is heavier than air and may travel considerable distance to a source of ignition and flash back.
4.7 Auto Ignition Temperature: 1097°F
4.8 Electrical Hazards: Class I, Group D
4.9 Burning Rate: 6.0 mm/min.
4.10 Adiabatic Flame Temperature: Currently not available
4.11 Stoichometric Air to Fuel Ratio: 35.7 (calc.)
4.12 Flame Temperature: Currently not available
4.13 Combustion Molar Ratio (Reactant to Product): 9.0 (calc.)
4.14 Minimum Oxygen Concentration for Combustion (MOCC): Not listed

5. CHEMICAL REACTIVITY

5.1 Reactivity with Water: No reaction.
5.2 Reactivity with Common Materials: No reaction.
5.3 Stability During Transport: Stable.
5.4 Neutralizing Agents for Acids and Caustics: Not pertinent.
5.5 Polymerization: Not pertinent.
5.6 Inhibitor of Polymerization: Not pertinent.

6. WATER POLLUTION

6.1 Aquatic Toxicity:
5 ppm/6 hr/minnow/lethal/distilled water
20 ppm/24 hr/sunfish/TL_m/tap water
6.2 Waterfowl Toxicity: Currently not available
6.3 Biological Oxygen Demand (BOD): 1.2 lb/lb, 10 days
6.4 Food Chain Concentration Potential: None.
6.5 GESAMP Hazard Profile:
Bioaccumulation: 0
Damage to living resources: 2
Human Oral hazard: 1
Human Contact hazard: II
Reduction of amenities: XXX

7. SHIPPING INFORMATION

7.1 Grades of Purity: Industrial pure – 99+%; Thiophene-free – 99+%; Nitration – 99+%; Industrial – 90% - 85+%; Reagent – 99+%
7.2 Storage Temperature: Ambient.
7.3 Inert Atmosphere: No requirement.
7.4 Venting: Pressure-vacuum.
7.5 IMO Pollution Category: C
7.6 Ship Type: 3
7.7 Barge Hull Type: 3

8. HAZARD CLASSIFICATIONS

8.1 49 CFR Category: Flammable liquid
8.2 49 CFR Class: 3
8.3 49 CFR Package Group: II
8.4 Marine Pollutant: No
8.5 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue)..........	2
Flammability (Red)............	3
Instability (Yellow)............	0

8.6 EPA Reportable Quantity: 10 pounds
8.7 EPA Pollution Category: A
8.8 RCRA Waste Number: U019
8.9 EPA FWPCA List: Yes

9. PHYSICAL & CHEMICAL PROPERTIES

9.1 Physical State at 15° C and 1 atm: Liquid
9.2 Molecular Weight: 78.11
9.3 Boiling Point at 1 atm: 176°F = 80.1°C = 353.3°K
9.4 Freezing Point: 42.0°F = 5.5°C = 278.7°K
9.5 Critical Temperature: 552.0°F = 288.9°C = 562.1°K
9.6 Critical Pressure: 710 psia = 48.3 atm = 4.89 MN/m^2
9.7 Specific Gravity: 0.879 at 20°C (liquid)
9.8 Liquid Surface Tension: 28.9 dynes/cm = 0.0289 N/m at 20°C
9.9 Liquid Water Interfacial Tension: 35.0 dynes/cm = 0.035 N/m at 20°C
9.10 Vapor (Gas) Specific Gravity: 2.8
9.11 Ratio of Specific Heats of Vapor (Gas): 1.061
9.12 Latent Heat of Vaporization: 169 Btu/lb = 94.1 cal/g = 3.94×10^5 J/kg
9.13 Heat of Combustion: –17,460 Btu/lb = –9698 cal/g = -406.0×10^5 J/kg
9.14 Heat of Decomposition: Not pertinent.
9.15 Heat of Solution: Not pertinent.
9.16 Heat of Polymerization: Not pertinent.
9.17 Heat of Fusion: 30.45 cal/g
9.18 Limiting Value: Currently not available
9.19 Reid Vapor Pressure: 3.22 psia

NOTES

BENZENE

BNZ

9.20 SATURATED LIQUID DENSITY

Temperature (degrees F)	Pounds per cubic foot
55	55.330
60	55.140
65	54.960
70	54.770
75	54.580
80	54.400
85	54.210
90	54.030
95	53.840
100	53.660
105	53.470
110	53.290
115	53.100
120	52.920
125	52.730
130	52.540
135	52.360
140	52.170
145	51.990
150	51.800
155	51.620
160	51.430
165	51.250
170	51.060
175	50.870

9.21 LIQUID HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
45	0.394
50	0.396
55	0.398
60	0.400
65	0.403
70	0.405
75	0.407
80	0.409
85	0.411
90	0.414
95	0.416
100	0.418

9.22 LIQUID THERMAL CONDUCTIVITY

Temperature (degrees F)	British thermal unit inch per hour-square foot-F
75	0.988
80	0.981
85	0.975
90	0.969
95	0.962
100	0.956
105	0.950
110	0.944
115	0.937
120	0.931
125	0.925
130	0.919
135	0.912
140	0.906
145	0.900
150	0.893
155	0.887
160	0.881
165	0.875
170	0.868

9.23 LIQUID VISCOSITY

Temperature (degrees F)	Centipoise
55	0.724
60	0.693
65	0.665
70	0.638
75	0.612
80	0.588
85	0.566
90	0.544
95	0.524
100	0.505
105	0.487
110	0.470
115	0.453
120	0.438

9.24 SOLUBILITY IN WATER

Temperature (degrees F)	Pounds per 100 pounds of water
77	0.180

9.25 SATURATED VAPOR PRESSURE

Temperature (degrees F)	Pounds per square inch
50	0.881
60	1.171
70	1.535
80	1.989
90	2.547
100	3.227
110	4.049
120	5.033
130	6.201
140	7.577
150	9.187
160	11.060
170	13.220
180	15.700
190	18.520
200	21.740
210	25.360

9.26 SATURATED VAPOR DENSITY

Temperature (degrees F)	Pounds per cubic foot
50	0.01258
60	0.01639
70	0.02109
80	0.02681
90	0.03371
100	0.04196
110	0.05172
120	0.06317
130	0.07652
140	0.09194
150	0.10960
160	0.12980
170	0.15270
180	0.17850
190	0.20750
200	0.23970
210	0.27560

9.27 IDEAL GAS HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
0	0.204
25	0.219
50	0.234
75	0.248
100	0.261
125	0.275
150	0.288
175	0.301
200	0.313
225	0.325
250	0.337
275	0.349
300	0.360
325	0.371
350	0.381
375	0.392
400	0.402
425	0.412
450	0.421
475	0.431
500	0.440
525	0.449
550	0.457
575	0.465
600	0.474

ETHYLBENZENE

ETB

CAUTIONARY RESPONSE INFORMATION

Common Synonyms	Liquid	Colorless	Sweet, gasoline-like odor
EB Phenylethane	Floats on water. Flammable, irritating vapor is produced.		

Keep people away. Avoid contact with liquid and vapor.
Avoid inhalation.
Wear goggles, self-contained breathing apparatus, and rubber overclothing (including gloves).
Shut off ignition sources and call fire department.
Stay upwind and use water spray to "knock down" vapor.
Notify local health and pollution control agencies.
Protect water intakes.

Fire

FLAMMABLE.
Flashback along vapor trail may occur.
Vapor may explode if ignited in an enclosed area.
Wear goggles, self-contained breathing apparatus, and rubber overclothing (including gloves).
Extinguish with dry chemical, foam, or carbon dioxide.
Water may be ineffective on fire.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

VAPOR
Irritating to eyes, nose and throat.
If inhaled, will cause dizziness or difficult breathing.
Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

LIQUID
Will burn skin and eyes.
Harmful if swallowed.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.
DO NOT INDUCE VOMITING.

Water Pollution

HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.
Fouling to shoreline.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. CORRECTIVE RESPONSE ACTIONS

Stop discharge
Contain
Collection Systems: Skim
Clean shore line
Salvage waterfowl

2. CHEMICAL DESIGNATIONS

2.1 CG Compatibility Group: 32; Aromatic Hydrocarbon
2.2 Formula: $C_6H_5CH_2CH_3$
2.3 IMO/UN Designation: 3.3/1175
2.4 DOT ID No.: 1175
2.5 CAS Registry No.: 100-41-4
2.6 NAERG Guide No.: 129
2.7 Standard Industrial Trade Classification: 51126

3. HEALTH HAZARDS

3.1 Personal Protective Equipment: Self-contained breathing apparatus; safety goggles.
3.2 Symptoms Following Exposure: Inhalation may cause irritation of nose, dizziness, depression. Moderate irritation of eye with corneal injury possible. Irritates skin and may cause blisters.
3.3 Treatment of Exposure: INHALATION: if ill effects occur, remove victim to fresh air, keep him warm and quiet, and get medical help promptly; if breathing stops, give artificial respiration. INGESTION: induce vomiting only upon physician's approval; material in lung may cause chemical pneumonitis. SKIN AND EYES: promptly flush with plenty of water (15 min. for eyes) and get medical attention; remove and wash contaminated clothing before reuse.
3.4 TLV-TWA: 100 ppm
3.5 TLV-STEL: Not listed.
3.6 TLV-Ceiling: 125 ppm
3.7 Toxicity by Ingestion: Grade 2; LD_{50} = 0.5 to 5 g/kg (rat)
3.8 Toxicity by Inhalation: Currently not available.
3.9 Chronic Toxicity: Currently not available
3.10 Vapor (Gas) Irritant Characteristics: Vapors cause moderate irritation such that personnel will find high concentrations unpleasant. The effect is temporary.
3.11 Liquid or Solid Characteristics: Causes smarting of the skin and first-degree burns on short exposure; may cause secondary burns on long exposure.
3.12 Odor Threshold: 140 ppm
3.13 IDLH Value: 800 ppm
3.14 OSHA PEL-TWA: 100 ppm
3.15 OSHA PEL-STEL: Not listed.
3.16 OSHA PEL-Ceiling: Not listed.
3.17 EPA AEGL: Not listed

4. FIRE HAZARDS

4.1 Flash Point: 80°F O.C. 59°F C.C.
4.2 Flammable Limits in Air: 1.0%-6.7%
4.3 Fire Extinguishing Agents: Foam (most effective), water fog, carbon dioxide or dry chemical.
4.4 Fire Extinguishing Agents Not to Be Used: Not pertinent
4.5 Special Hazards of Combustion Products: Irritating vapors are generated when heated.
4.6 Behavior in Fire: Vapor is heavier than air and may travel considerable distance to the source of ignition and flash back.
4.7 Auto Ignition Temperature: 860°F
4.8 Electrical Hazards: Not pertinent
4.9 Burning Rate: 5.8 mm/min.
4.10 Adiabatic Flame Temperature: Currently not available
4.11 Stoichometric Air to Fuel Ratio: 50.0 (calc.)
4.12 Flame Temperature: Currently not available
4.13 Combustion Molar Ratio (Reactant to Product): 13.0 (calc.)
4.14 Minimum Oxygen Concentration for Combustion (MOCC): N_2 diluent: 9.0%

5. CHEMICAL REACTIVITY

5.1 Reactivity with Water: No reaction
5.2 Reactivity with Common Materials: No reaction
5.3 Stability During Transport: Stable
5.4 Neutralizing Agents for Acids and Caustics: Not pertinent
5.5 Polymerization: Not pertinent
5.6 Inhibitor of Polymerization: Not pertinent

6. WATER POLLUTION

6.1 Aquatic Toxicity:
29 ppm/96 hr/bluegill/TL_m/fresh water
6.2 Waterfowl Toxicity: Currently not available
6.3 Biological Oxygen Demand (BOD): 2.8% (theor.), 5 days
6.4 Food Chain Concentration Potential: None
6.5 GESAMP Hazard Profile:
Bioaccumulation: 0
Damage to living resources: 3
Human Oral hazard: 1
Human Contact hazard: I
Reduction of amenities: XX

7. SHIPPING INFORMATION

7.1 Grades of Purity: Research grade: 99.98%; pure grade: 99.5%; technical grade: 99.0%
7.2 Storage Temperature: Ambient
7.3 Inert Atmosphere: No requirement
7.4 Venting: Open (flame arrester) or pressure-vacuum
7.5 IMO Pollution Category: B
7.6 Ship Type: 3
7.7 Barge Hull Type: Currently not available

8. HAZARD CLASSIFICATIONS

8.1 49 CFR Category: Flammable liquid
8.2 49 CFR Class: 3
8.3 49 CFR Package Group: II
8.4 Marine Pollutant: No
8.5 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue)..........	2
Flammability (Red)............	3
Instability (Yellow)............	0

8.6 EPA Reportable Quantity: 1000 pounds
8.7 EPA Pollution Category: C
8.8 RCRA Waste Number: Not listed
8.9 EPA FWPCA List: Yes

9. PHYSICAL & CHEMICAL PROPERTIES

9.1 Physical State at 15° C and 1 atm: Liquid
9.2 Molecular Weight: 106.17
9.3 Boiling Point at 1 atm: 277.2°F = 136.2°C = 409.4°K
9.4 Freezing Point: –139°F = –95°C = 178°K
9.5 Critical Temperature: 651.0°F = 343.9°C = 617.1°K
9.6 Critical Pressure: 523 psia = 35.6 atm = 3.61 MN/m^2
9.7 Specific Gravity: 0.867 at 20°C (liquid)
9.8 Liquid Surface Tension: 29.2 dynes/cm = 0.0292 N/m at 20°C
9.9 Liquid Water Interfacial Tension: 35.48 dynes/cm = 0.03548 N/m at 20°C
9.10 Vapor (Gas) Specific Gravity: Not pertinent
9.11 Ratio of Specific Heats of Vapor (Gas): 1.071
9.12 Latent Heat of Vaporization: 144 Btu/lb = 80.1 cal/g = 3.35×10^5 J/kg
9.13 Heat of Combustion: –17,780 Btu/lb = –9877 cal/g = -413.5×10^5 J/kg
9.14 Heat of Decomposition: Not pertinent
9.15 Heat of Solution: Not pertinent
9.16 Heat of Polymerization: Not pertinent
9.17 Heat of Fusion: Currently not available
9.18 Limiting Value: Currently not available
9.19 Reid Vapor Pressure: 0.4 psia

NOTES

ETHYLBENZENE

ETB

9.20 SATURATED LIQUID DENSITY		9.21 LIQUID HEAT CAPACITY		9.22 LIQUID THERMAL CONDUCTIVITY		9.23 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit inch per hour-square foot-F	Temperature (degrees F)	Centipoise
40	54.990	40	0.402	-90	1.065	40	0.835
50	54.680	50	0.404	-80	1.056	50	0.774
60	54.370	60	0.407	-70	1.047	60	0.719
70	54.060	70	0.409	-60	1.037	70	0.670
80	53.750	80	0.412	-50	1.028	80	0.626
90	53.430	90	0.414	-40	1.018	90	0.586
100	53.120	100	0.417	-30	1.009	100	0.550
110	52.810	110	0.419	-20	1.000	110	0.518
120	52.500	120	0.421	-10	0.990	120	0.488
130	52.190	130	0.424	0	0.981	130	0.461
140	51.870	140	0.426	10	0.971	140	0.436
150	51.560	150	0.429	20	0.962	150	0.414
160	51.250	160	0.431	30	0.953	160	0.393
170	50.940	170	0.434	40	0.943	170	0.374
180	50.620	180	0.436	50	0.934	180	0.356
190	50.310	190	0.439	60	0.924	190	0.340
200	50.000	200	0.441	70	0.915	200	0.325
210	49.690	210	0.443	80	0.906	210	0.311
				90	0.896		
				100	0.887		
				110	0.877		
				120	0.868		
				130	0.859		
				140	0.849		
				150	0.840		
				160	0.830		

9.24 SOLUBILITY IN WATER		9.25 SATURATED VAPOR PRESSURE		9.26 SATURATED VAPOR DENSITY		9.27 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
68	0.020	80	0.202	80	0.00370	-400	-0.007
		100	0.370	100	0.00654	-350	0.026
		120	0.644	120	0.01099	-300	0.060
		140	1.071	140	0.01767	-250	0.093
		160	1.713	160	0.02734	-200	0.125
		180	2.643	180	0.04087	-150	0.157
		200	3.953	200	0.05926	-100	0.187
		220	5.747	220	0.08363	-50	0.217
		240	8.147	240	0.11520	0	0.246
		260	11.290	260	0.15510	50	0.274
		280	15.320	280	0.20490	100	0.301
		300	20.410	300	0.26570	150	0.327
		320	26.730	320	0.33910	200	0.353
		340	34.460	340	0.42620	250	0.377
		360	43.800	360	0.52850	300	0.401
		380	54.950	380	0.64720	350	0.424
						400	0.446
						450	0.467
						500	0.487
						550	0.507
						600	0.525

TOLUENE

TOL

CAUTIONARY RESPONSE INFORMATION

Common Synonyms	Watery liquid	Colorless	Pleasant odor
Methylbenzene Methylbenzol Toluol	Floats on water. Flammable, irritating vapor is produced.		

Keep people away.
Shut off ignition sources and call fire department.
Stay upwind and use water spray to "knock down" vapor.
Avoid contact with liquid and vapor.
Notify local health and pollution control agencies.
Protect water intakes.

Fire	FLAMMABLE. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area. Wear goggles and self-contained breathing apparatus. Extinguish with dry chemical, foam, or carbon dioxide. Water may be ineffective on fire. Cool exposed containers with water.
Exposure	CALL FOR MEDICAL AID. VAPOR Irritating to eyes, nose and throat. If inhaled, will cause nausea, vomiting, headache, dizziness, difficult breathing, or loss of consciousness. Move to fresh air. If breathing has stopped, give artificial respiration. If breathing difficult, give oxygen. LIQUID Irritating to skin and eyes. If swallowed, will cause nausea, vomiting or loss of consciousness. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk. DO NOT INDUCE VOMITING.
Water Pollution	Dangerous to aquatic life in high concentrations. Fouling to shoreline. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.

1. CORRECTIVE RESPONSE ACTIONS

Stop discharge
Contain
Collection Systems: Skim
Chemical and Physical Treatment: Burn
Clean shore line
Salvage waterfowl

2. CHEMICAL DESIGNATIONS

2.1 CG Compatibility Group: 32; Aromatic Hydrocarbon
2.2 Formula: $C_6H_5CH_3$
2.3 IMO/UN Designation: 3.2/1294
2.4 DOT ID No.: 1294
2.5 CAS Registry No.: 108-88-3
2.6 NAERG Guide No.: 130
2.7 Standard Industrial Trade Classification: 51123

3. HEALTH HAZARDS

3.1 Personal Protective Equipment: Air-supplied mask; goggles or face shield; plastic gloves.
3.2 Symptoms Following Exposure: Vapors irritate eyes and upper respiratory tract; cause dizziness, headache, anesthesia, respiratory arrest. Liquid irritates eyes and causes drying of skin. If aspirated, causes coughing, gagging, distress, and rapidly developing pulmonary edema. If ingested causes vomiting, griping, diarrhea, depressed respiration.
3.3 Treatment of Exposure: INHALATION: remove to fresh air, give artificial respiration and oxygen if needed; call a doctor. INGESTION: do NOT induce vomiting; call a doctor. EYES: flush with water for at least 15 min. SKIN: wipe off, wash with soap and water.
3.4 TLV-TWA: 50 ppm
3.5 TLV-STEL: Not listed.
3.6 TLV-Ceiling: Not listed.
3.7 Toxicity by Ingestion: Grade 2; LD_{50} = 0.5 to 5 g/kg
3.8 Toxicity by Inhalation: Currently not available.
3.9 Chronic Toxicity: Kidney and liver damage may follow ingestion.
3.10 Vapor (Gas) Irritant Characteristics: Vapors cause a slight smarting of the eyes or respiratory system if present in high concentrations. The effect is temporary.
3.11 Liquid or Solid Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
3.12 Odor Threshold: 0.17 ppm
3.13 IDLH Value: 500 ppm
3.14 OSHA PEL-TWA: 200 ppm
3.15 OSHA PEL-STEL: 500 ppm, 10 minute peak once in 8 hour shift
3.16 OSHA PEL-Ceiling: 300 ppm
3.17 EPA AEGL: Not listed

4. FIRE HAZARDS

4.1 Flash Point: 55°F O.C. 40°F C.C.
4.2 Flammable Limits in Air: 1.27%-7%
4.3 Fire Extinguishing Agents: Carbon dioxide or dry chemical for small fires, ordinary foam for large fires.
4.4 Fire Extinguishing Agents Not to Be Used: Water may be ineffective
4.5 Special Hazards of Combustion Products: Not pertinent
4.6 Behavior in Fire: Vapor is heavier than air and may travel a considerable distance to a source of ignition and flash back.
4.7 Auto Ignition Temperature: 896°F
4.8 Electrical Hazards: Class I, Group D
4.9 Burning Rate: 5.7 mm/min.
4.10 Adiabatic Flame Temperature: Currently not available
4.11 Stoichometric Air to Fuel Ratio: 42.8 (calc.)
4.12 Flame Temperature: Currently not available
4.13 Combustion Molar Ratio (Reactant to Product): 11.0 (calc.)
4.14 Minimum Oxygen Concentration for Combustion (MOCC): N_2 diluant: 9.5%

5. CHEMICAL REACTIVITY

5.1 Reactivity with Water: No reaction
5.2 Reactivity with Common Materials: No reaction
5.3 Stability During Transport: Stable
5.4 Neutralizing Agents for Acids and Caustics: Not pertinent
5.5 Polymerization: Not pertinent
5.6 Inhibitor of Polymerization: Not pertinent

6. WATER POLLUTION

6.1 Aquatic Toxicity:
1180 mg/l/96 hr/sunfish/TL_m/fresh water
6.2 Waterfowl Toxicity: Currently not available
6.3 Biological Oxygen Demand (BOD): 0%, 5 days; 38% (theor), 8 days
6.4 Food Chain Concentration Potential: None
6.5 GESAMP Hazard Profile:
Bioaccumulation: 0
Damage to living resources: 2
Human Oral hazard: 1
Human Contact hazard: II
Reduction of amenities: XXX

7. SHIPPING INFORMATION

7.1 Grades of Purity: Research, reagent, nitration-all 99.8 + %; industrial: contains 94 + %, with 5% xylene and small amounts of benzene and nonaromatic hydrocarbons; 90/120: less pure than industrial.
7.2 Storage Temperature: Ambient
7.3 Inert Atmosphere: No requirement
7.4 Venting: Open (flame arrester) or pressure-vacuum
7.5 IMO Pollution Category: C
7.6 Ship Type: 3
7.7 Barge Hull Type: Currently not available

8. HAZARD CLASSIFICATIONS

8.1 49 CFR Category: Flammable liquid
8.2 49 CFR Class: 3
8.3 49 CFR Package Group: II
8.4 Marine Pollutant: No
8.5 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue)..........	2
Flammability (Red).............	3
Instability (Yellow).............	0

8.6 EPA Reportable Quantity: 1000 pounds
8.7 EPA Pollution Category: C
8.8 RCRA Waste Number: U220
8.9 EPA FWPCA List: Yes

9. PHYSICAL & CHEMICAL PROPERTIES

9.1 Physical State at 15° C and 1 atm: Liquid
9.2 Molecular Weight: 92.14
9.3 Boiling Point at 1 atm: 231.1°F = 110.6°C = 383.8°K
9.4 Freezing Point: –139°F = –95.0°C = 178.2°K
9.5 Critical Temperature: 605.5°F = 318.6°C = 591.8°K
9.6 Critical Pressure: 596.1 psia = 40.55 atm = 4.108 MN/m²
9.7 Specific Gravity: 0.867 at 20°C (liquid)
9.8 Liquid Surface Tension: 29.0 dynes/cm = 0.0290 N/m at 20°C
9.9 Liquid Water Interfacial Tension: 36.1 dynes/cm = 0.0361 N/m at 25°C
9.10 Vapor (Gas) Specific Gravity: Not pertinent
9.11 Ratio of Specific Heats of Vapor (Gas): 1.089
9.12 Latent Heat of Vaporization: 155 Btu/lb = 86.1 cal/g = 3.61 X 10^5 J/kg
9.13 Heat of Combustion: –17,430 Btu/lb = –9686 cal/g = –405.5 X 10^5 J/kg
9.14 Heat of Decomposition: Not pertinent
9.15 Heat of Solution: Not pertinent
9.16 Heat of Polymerization: Not pertinent
9.17 Heat of Fusion: 17.17 cal/g
9.18 Limiting Value: Currently not available
9.19 Reid Vapor Pressure: 1.1 psia

NOTES

TOLUENE

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9.20 SATURATED LIQUID DENSITY		9.21 LIQUID HEAT CAPACITY		9.22 LIQUID THERMAL CONDUCTIVITY		9.23 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit inch per hour-square foot-F	Temperature (degrees F)	Centipoise
-30	57.180	0	0.396	0	1.026	0	1.024
-20	56.870	5	0.397	10	1.015	5	0.978
-10	56.550	10	0.399	20	1.005	10	0.935
0	56.240	15	0.400	30	0.994	15	0.894
10	55.930	20	0.402	40	0.983	20	0.857
20	55.620	25	0.403	50	0.972	25	0.821
30	55.310	30	0.404	60	0.962	30	0.788
40	54.990	35	0.406	70	0.951	35	0.757
50	54.680	40	0.407	80	0.940	40	0.727
60	54.370	45	0.409	90	0.929	45	0.700
70	54.060	50	0.410	100	0.919	50	0.673
80	53.750	55	0.411	110	0.908	55	0.649
90	53.430	60	0.413	120	0.897	60	0.625
100	53.120	65	0.414	130	0.886	65	0.603
110	52.810	70	0.415	140	0.876	70	0.582
120	52.500	75	0.417	150	0.865	75	0.562
		80	0.418	160	0.854	80	0.544
		85	0.420	170	0.843	85	0.526
		90	0.421	180	0.833	90	0.509
		95	0.422	190	0.822	95	0.493
		100	0.424	200	0.811	100	0.477
		105	0.425	210	0.800		
		110	0.427				
		115	0.428				
		120	0.429				
		125	0.431				

9.24 SOLUBILITY IN WATER		9.25 SATURATED VAPOR PRESSURE		9.26 SATURATED VAPOR DENSITY		9.27 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
68	0.050	0	0.038	0	0.00070	0	0.228
		10	0.057	10	0.00103	25	0.241
		20	0.084	20	0.00150	50	0.255
		30	0.121	30	0.00212	75	0.268
		40	0.172	40	0.00296	100	0.281
		50	0.241	50	0.00405	125	0.294
		60	0.331	60	0.00547	150	0.306
		70	0.449	70	0.00727	175	0.319
		80	0.600	80	0.00954	200	0.331
		90	0.792	90	0.01237	225	0.343
		100	1.033	100	0.01584	250	0.355
		110	1.332	110	0.02007	275	0.367
		120	1.700	120	0.02518	300	0.378
		130	2.148	130	0.03127	325	0.389
		140	2.690	140	0.03850	350	0.400
		150	3.338	150	0.04700	375	0.411
		160	4.109	160	0.05691	400	0.422
		170	5.018	170	0.06840	425	0.432
		180	6.083	180	0.08162	450	0.443
		190	7.323	190	0.09675	475	0.453
		200	8.758	200	0.11400	500	0.462
		210	10.410	210	0.13340	525	0.472
						550	0.482
						575	0.491
						600	0.500

M-XYLENE

XLM

CAUTIONARY RESPONSE INFORMATION

Common Synonyms			
1,3-Dimethylbenzene Xylol	Watery liquid	Colorless	Sweet odor
	Floats on water. Flammable, irritating vapor is produced.		

Keep people away.
Shut off ignition sources and call fire department.
Avoid contact with liquid and vapor.
Notify local health and pollution control agencies.
Protect water intakes.

Fire	FLAMMABLE Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area. Wear self-contained breathing apparatus. Extinguish with foam, dry chemical, or carbon dioxide. Water may be ineffective on fire. Cool exposed containers with water.
Exposure	CALL FOR MEDICAL AID. VAPOR Irritating to eyes, nose, and throat. If inhaled, will cause headache, difficult breathing, or loss of consciousness. Move to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen. LIQUID Irritating to skin and eyes. If swallowed, will cause nausea, vomiting, or loss of consciousness. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk. DO NOT INDUCE VOMITING.
Water Pollution	HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS. Fouling to shoreline. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.

1. CORRECTIVE RESPONSE ACTIONS

Stop discharge
Contain
Collection Systems: Skim
Chemical and Physical Treatment: Burn
Clean shore line
Salvage waterfowl

2. CHEMICAL DESIGNATIONS

2.1 CG Compatibility Group: 32; Aromatic Hydrocarbon
2.2 Formula: m-$C_6H_4(CH_3)_2$
2.3 IMO/UN Designation: 3.2/1307
2.4 DOT ID No.: 1307
2.5 CAS Registry No.: 108-38-3
2.6 NAERG Guide No.: 130
2.7 Standard Industrial Trade Classification: 51124

3. HEALTH HAZARDS

3.1 Personal Protective Equipment: Approved canister or air-supplied mask; goggles or face shield; plastic gloves and boots.
3.2 Symptoms Following Exposure: Vapors cause headache and dizziness. Liquid irritates eyes and skin. If taken into lungs, causes severe coughing, distress, and rapidly developing pulmonary edema. If ingested, causes nausea, vomiting, cramps, headache, and coma; can be fatal. Kidney and liver damage can occur.
3.3 Treatment of Exposure: INHALATION: remove to fresh air; administer artificial respiration and oxygen if required; call a doctor. INGESTION: do NOT induce vomiting; call a doctor. EYES: flush with water for at least 15 min. SKIN: wipe off, wash with soap and water.
3.4 TLV-TWA: 100 ppm
3.5 TLV-STEL: 150 ppm
3.6 TLV-Ceiling: Not listed.
3.7 Toxicity by Ingestion: Grade 3; LD_{50} = 50 to 500 g/kg
3.8 Toxicity by Inhalation: Currently not available.
3.9 Chronic Toxicity: Kidney and liver damage.
3.10 Vapor (Gas) Irritant Characteristics: Vapors cause a slight smarting of the eyes or respiratory system if present in high concentrations. The effect is temporary.
3.11 Liquid or Solid Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
3.12 Odor Threshold: 0.05 ppm
3.13 IDLH Value: 900 ppm
3.14 OSHA PEL-TWA: 100 ppm
3.15 OSHA PEL-STEL: Not listed.
3.16 OSHA PEL-Ceiling: Not listed.
3.17 EPA AEGL: Not listed

4. FIRE HAZARDS

4.1 Flash Point: 81°F C.C.
4.2 Flammable Limits in Air: 1.1%-7.0%
4.3 Fire Extinguishing Agents: Foam, dry chemical, or carbon dioxide
4.4 Fire Extinguishing Agents Not to Be Used: Water may be ineffective.
4.5 Special Hazards of Combustion Products: Not pertinent
4.6 Behavior in Fire: Vapor is heavier than air and may travel considerable distance to a source of ignition and flash back.
4.7 Auto Ignition Temperature: 982°F
4.8 Electrical Hazards: Class I, Group D
4.9 Burning Rate: 5.8 mm/min.
4.10 Adiabatic Flame Temperature: Currently not available
4.11 Stoichometric Air to Fuel Ratio: 50.0 (calc.)
4.12 Flame Temperature: Currently not available
4.13 Combustion Molar Ratio (Reactant to Product): 13.0 (calc.)
4.14 Minimum Oxygen Concentration for Combustion (MOCC): Not listed

5. CHEMICAL REACTIVITY

5.1 Reactivity with Water: No reaction
5.2 Reactivity with Common Materials: No reaction
5.3 Stability During Transport: Stable
5.4 Neutralizing Agents for Acids and Caustics: Not pertinent
5.5 Polymerization: Not pertinent
5.6 Inhibitor of Polymerization: Not pertinent

6. WATER POLLUTION

6.1 Aquatic Toxicity:
22 ppm/96 hr/bluegill/TL_m/fresh water
6.2 Waterfowl Toxicity: Currently not available
6.3 Biological Oxygen Demand (BOD): 0 lb/lb, 5 days; 0% (theor.), 8 days
6.4 Food Chain Concentration Potential: Currently not available
6.5 GESAMP Hazard Profile:
Bioaccumulation: 0
Damage to living resources: 3
Human Oral hazard: 1
Human Contact hazard: II
Reduction of amenities: XX

7. SHIPPING INFORMATION

7.1 Grades of Purity: Research: 99.99%; Pure: 99.9%; Technical: 99.2%
7.2 Storage Temperature: Ambient
7.3 Inert Atmosphere: No requirement
7.4 Venting: Open (flame arrester) or pressure-vacuum
7.5 IMO Pollution Category: C
7.6 Ship Type: 3
7.7 Barge Hull Type: Currently not available

8. HAZARD CLASSIFICATIONS

8.1 49 CFR Category: Flammable liquid
8.2 49 CFR Class: 3
8.3 49 CFR Package Group: III
8.4 Marine Pollutant: No
8.5 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue)..........	2
Flammability (Red)............	3
Instability (Yellow)............	0

8.6 EPA Reportable Quantity: 1000 pounds
8.7 EPA Pollution Category: C
8.8 RCRA Waste Number: U239
8.9 EPA FWPCA List: Yes

9. PHYSICAL & CHEMICAL PROPERTIES

9.1 Physical State at 15° C and 1 atm: Liquid
9.2 Molecular Weight: 106.16
9.3 Boiling Point at 1 atm: 282°F = 138.9°C = 412.1°K
9.4 Freezing Point: –54.2°F = –47.9°C = 225.3°K
9.5 Critical Temperature: 650.8°F = 343.8°C = 617°K
9.6 Critical Pressure: 513.8 atm = 34.95 psia = 3.540 MN/m^2
9.7 Specific Gravity: 0.864 at 20°C (liquid)
9.8 Liquid Surface Tension: 28.6 dynes/cm = 0.0286 N/m at 20°C
9.9 Liquid Water Interfacial Tension: 36.4 dynes/cm = 0.0364 N/m at 30°C
9.10 Vapor (Gas) Specific Gravity: Not pertinent
9.11 Ratio of Specific Heats of Vapor (Gas): 1.071
9.12 Latent Heat of Vaporization: 147 Btu/lb = 81.9 cal/g = 3.43 X 10^5 J/kg
9.13 Heat of Combustion: –17,554 Btu/lb = –9752.4 cal/g = –408.31 X 10^5 J/kg
9.14 Heat of Decomposition: Not pertinent
9.15 Heat of Solution: Not pertinent
9.16 Heat of Polymerization: Not pertinent
9.17 Heat of Fusion: 26.01 cal/g
9.18 Limiting Value: Currently not available
9.19 Reid Vapor Pressure: 0.34 psia

NOTES

M-XYLENE

XLM

9.20 SATURATED LIQUID DENSITY		9.21 LIQUID HEAT CAPACITY		9.22 LIQUID THERMAL CONDUCTIVITY		9.23 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit inch per hour-square foot-F	Temperature (degrees F)	Centipoise
15	55.400	40	0.387	35	0.962	15	0.938
20	55.260	50	0.393	40	0.953	20	0.898
25	55.130	60	0.398	45	0.944	25	0.862
30	54.990	70	0.404	50	0.935	30	0.827
35	54.850	80	0.410	55	0.926	35	0.794
40	54.710	90	0.415	60	0.917	40	0.764
45	54.570	100	0.421	65	0.908	45	0.735
50	54.430	110	0.426	70	0.899	50	0.708
55	54.290	120	0.432	75	0.890	55	0.682
60	54.160	130	0.437	80	0.881	60	0.658
65	54.020	140	0.443	85	0.873	65	0.635
70	53.880	150	0.448	90	0.864	70	0.613
75	53.740	160	0.454	95	0.855	75	0.592
80	53.600	170	0.460	100	0.846	80	0.572
85	53.460	180	0.465			85	0.554
90	53.320	190	0.471				
95	53.180	200	0.476				
100	53.050	210	0.482				

9.24 SOLUBILITY IN WATER		9.25 SATURATED VAPOR PRESSURE		9.26 SATURATED VAPOR DENSITY		9.27 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
	I	60	0.090	60	0.00172	0	0.247
	N	70	0.127	70	0.00238	25	0.260
	S	80	0.177	80	0.00324	50	0.273
	O	90	0.242	90	0.00435	75	0.286
	L	100	0.326	100	0.00577	100	0.299
	U	110	0.434	110	0.00754	125	0.311
	B	120	0.571	120	0.00975	150	0.324
	L	130	0.743	130	0.01247	175	0.336
	E	140	0.956	140	0.01577	200	0.348
		150	1.219	150	0.01977	225	0.360
		160	1.538	160	0.02455	250	0.371
		170	1.924	170	0.03023	275	0.383
		180	2.388	180	0.03691	300	0.394
		190	2.939	190	0.04473	325	0.406
		200	3.590	200	0.05382	350	0.417
		210	4.355	210	0.06431	375	0.427
		220	5.247	220	0.07635	400	0.438
		230	6.282	230	0.09009	425	0.449
		240	7.476	240	0.10570	450	0.459
		250	8.846	250	0.12330	475	0.469
		260	10.410	260	0.14310	500	0.479
						525	0.489
						550	0.499
						575	0.508
						600	0.517

O-XYLENE

XLO

CAUTIONARY RESPONSE INFORMATION

Common Synonyms	Watery liquid	Colorless	Sweet odor
1,2-Dimethylbenzene Xylol	Floats on water. Flammable, irritating vapor is produced.		

Keep people away.
Shut off ignition sources and call fire department.
Avoid contact with liquid and vapor.
Notify local health and pollution control agencies.
Protect water intakes.

Fire

FLAMMABLE
Flashback along vapor trail may occur.
Vapor may explode if ignited in an enclosed area.
Wear self-contained breathing apparatus.
Extinguish with foam, dry chemical, or carbon dioxide.
Water may be ineffective on fire.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

VAPOR
Irritating to eyes, nose and throat.
If inhaled, will cause headache, difficult breathing, or loss of consciousness.
Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

LIQUID
Irritating to skin and eyes.
If swallowed, will cause nausea, vomiting, or loss of consciousness.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.
DO NOT INDUCE VOMITING.

Water Pollution

Dangerous to aquatic life in high concentrations.
Fouling to shoreline.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. CORRECTIVE RESPONSE ACTIONS

Stop discharge
Contain
Collection Systems: Skim
Chemical and Physical Treatment: Burn
Clean shore line
Salvage waterfowl

2. CHEMICAL DESIGNATIONS

2.1 **CG Compatibility Group:** 32; Aromatic Hydrocarbon
2.2 **Formula:** o-$C_6H_4(CH_3)_2$
2.3 **IMO/UN Designation:** 3.2/1307
2.4 **DOT ID No.:** 1307
2.5 **CAS Registry No.:** 95-47-6
2.6 **NAERG Guide No.:** 130
2.7 **Standard Industrial Trade Classification:** 51124

3. HEALTH HAZARDS

3.1 **Personal Protective Equipment:** Approved canister or air-supplied mask; goggles or face shield; plastic gloves and boots.
3.2 **Symptoms Following Exposure:** Vapors cause headache and dizziness. Liquid irritates eyes and skin. If taken into lungs, causes severe coughing, distress, and rapidly developing pulmonary edema. If ingested, causes nausea, vomiting, cramps, headache, and coma. Can be fatal. Kidney and liver damage can occur.
3.3 **Treatment of Exposure:** INHALATION: remove to fresh air; administer artificial respiration and oxygen if required; call a doctor. INGESTION: do NOT induce vomiting; call a doctor. EYES: flush with water for at least 15 min. SKIN: wipe off, wash with soap and water.
3.4 **TLV-TWA:** 100 ppm
3.5 **TLV-STEL:** 150 ppm
3.6 **TLV-Ceiling:** Not listed.
3.7 **Toxicity by Ingestion:** Grade 3; LD_{50} = 50 to 500 mg/kg
3.8 **Toxicity by Inhalation:** Currently not available.
3.9 **Chronic Toxicity:** Kidney and liver damage.
3.10 **Vapor (Gas) Irritant Characteristics:** Vapors cause a slight smarting of the eyes or respiratory system if present in high concentrations. The effect is temporary.
3.11 **Liquid or Solid Characteristics:** Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
3.12 **Odor Threshold:** 0.05 ppm
3.13 **IDLH Value:** 900 ppm
3.14 **OSHA PEL-TWA:** 100 ppm
3.15 **OSHA PEL-STEL:** Not listed.
3.16 **OSHA PEL-Ceiling:** Not listed.
3.17 **EPA AEGL:** Not listed

4. FIRE HAZARDS

4.1 **Flash Point:** 90°F C.C.
4.2 **Flammable Limits in Air:** 0.9 - 6.7%
4.3 **Fire Extinguishing Agents:** Foam, dry chemical, or carbon dioxide
4.4 **Fire Extinguishing Agents Not to Be Used:** Water may be ineffective.
4.5 **Special Hazards of Combustion Products:** Not pertinent
4.6 **Behavior in Fire:** Vapor is heavier than air and may travel considerable distance to a source of ignition and flash back.
4.7 **Auto Ignition Temperature:** 869°F
4.8 **Electrical Hazards:** Class I, Group D
4.9 **Burning Rate:** 5.8 mm/min.
4.10 **Adiabatic Flame Temperature:** Currently not available
4.11 **Stoichometric Air to Fuel Ratio:** 50.0 (calc.)
4.12 **Flame Temperature:** Currently not available
4.13 **Combustion Molar Ratio (Reactant to Product):** 13.0 (calc.)
4.14 **Minimum Oxygen Concentration for Combustion (MOCC):** Not listed

5. CHEMICAL REACTIVITY

5.1 **Reactivity with Water:** No reaction
5.2 **Reactivity with Common Materials:** No reaction
5.3 **Stability During Transport:** Stable
5.4 **Neutralizing Agents for Acids and Caustics:** Not pertinent
5.5 **Polymerization:** Not pertinent
5.6 **Inhibitor of Polymerization:** Not pertinent

6. WATER POLLUTION

6.1 **Aquatic Toxicity:**
>100 mg/l/96 hr/D. magna/TL_m/fresh water
6.2 **Waterfowl Toxicity:** Currently not available
6.3 **Biological Oxygen Demand (BOD):** 0 lb/lb. 5 days; 2.5% (theor.), 8 days
6.4 **Food Chain Concentration Potential:** Currently not available
6.5 **GESAMP Hazard Profile:**
Bioaccumulation: 0
Damage to living resources: 3
Human Oral hazard: 1
Human Contact hazard: I
Reduction of amenities: X

7. SHIPPING INFORMATION

7.1 **Grades of Purity:** Research: 99.99%; Pure: 99.7%; Commercial: 95+%
7.2 **Storage Temperature:** Ambient
7.3 **Inert Atmosphere:** No reaction
7.4 **Venting:** Open (flame arrester) or pressure-vacuum
7.5 **IMO Pollution Category:** C
7.6 **Ship Type:** 3
7.7 **Barge Hull Type:** Currently not available

8. HAZARD CLASSIFICATIONS

8.1 **49 CFR Category:** Flammable liquid
8.2 **49 CFR Class:** 3
8.3 **49 CFR Package Group:** II
8.4 **Marine Pollutant:** No
8.5 **NFPA Hazard Classification:**

Category	Classification
Health Hazard (Blue)..........	2
Flammability (Red)............	3
Instability (Yellow)............	0

8.6 **EPA Reportable Quantity:** 1000 pounds
8.7 **EPA Pollution Category:** C
8.8 **RCRA Waste Number:** U239
8.9 **EPA FWPCA List:** Yes

9. PHYSICAL & CHEMICAL PROPERTIES

9.1 **Physical State at 15° C and 1 atm:** Liquid
9.2 **Molecular Weight:** 106.16
9.3 **Boiling Point at 1 atm:** 291.9°F = 144.4°C = 417.6°K
9.4 **Freezing Point:** –13.3°F = –25.2°C = 248.0°K
9.5 **Critical Temperature:** 674.8°F = 357.1°C = 630.3°K
9.6 **Critical Pressure:** 541.5 atm = 36.84 psia = 3.732 MN/m^2
9.7 **Specific Gravity:** 0.880 at 20°C (liquid)
9.8 **Liquid Surface Tension:** 30.53 dynes/cm = 0.03053 N/m at 15.5°C
9.9 **Liquid Water Interfacial Tension:** 36.06 dynes/cm = 0.03606 N/m at 20°C
9.10 **Vapor (Gas) Specific Gravity:** Not pertinent
9.11 **Ratio of Specific Heats of Vapor (Gas):** 1.068
9.12 **Latent Heat of Vaporization:** 149 Btu/lb = 82.9 cal/g = 3.47 X 10^5 J/kg
9.13 **Heat of Combustion:** –17,558 Btu/lb = –9754.7 cal/g = –408.41 X 10^5 J/kg
9.14 **Heat of Decomposition:** Not pertinent
9.15 **Heat of Solution:** Not pertinent
9.16 **Heat of Polymerization:** Not pertinent
9.17 **Heat of Fusion:** 30.64 cal/g
9.18 **Limiting Value:** Currently not available
9.19 **Reid Vapor Pressure:** 0.28 psia

NOTES

O-XYLENE

XLO

9.20 SATURATED LIQUID DENSITY

Temperature (degrees F)	Pounds per cubic foot
15	56.460
20	56.330
25	56.190
30	56.050
35	55.910
40	55.770
45	55.630
50	55.490
55	55.360
60	55.220
65	55.080
70	54.940
75	54.800
80	54.660
85	54.520
90	54.380
95	54.250
100	54.110

9.21 LIQUID HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
35	0.389
40	0.391
45	0.394
50	0.396
55	0.398
60	0.400
65	0.402
70	0.404
75	0.406
80	0.408
85	0.411
90	0.413
95	0.415
100	0.417

9.22 LIQUID THERMAL CONDUCTIVITY

Temperature (degrees F)	British thermal unit inch per hour-square foot-F
35	1.043
40	1.035
45	1.027
50	1.018
55	1.010
60	1.002
65	0.993
70	0.985
75	0.977
80	0.969
85	0.960
90	0.952
95	0.944
100	0.935

9.23 LIQUID VISCOSITY

Temperature (degrees F)	Centipoise
15	1.328
20	1.263
25	1.202
30	1.145
35	1.092
40	1.042
45	0.995
50	0.952
55	0.911
60	0.873
65	0.836
70	0.802
75	0.770
80	0.740
85	0.712

9.24 SOLUBILITY IN WATER

Temperature (degrees F)	Pounds per 100 pounds of water
	INSOLUBLE

9.25 SATURATED VAPOR PRESSURE

Temperature (degrees F)	Pounds per square inch
60	0.071
70	0.101
80	0.141
90	0.194
100	0.263
110	0.352
120	0.465
130	0.609
140	0.787
150	1.007
160	1.277
170	1.605
180	1.999
190	2.469
200	3.028
210	3.686
220	4.456
230	5.352
240	6.389
250	7.581
260	8.947

9.26 SATURATED VAPOR DENSITY

Temperature (degrees F)	Pounds per cubic foot
60	0.00135
70	0.00188
80	0.00258
90	0.00349
100	0.00464
110	0.00611
120	0.00794
130	0.01021
140	0.01298
150	0.01634
160	0.02038
170	0.02520
180	0.03090
190	0.03759
200	0.04539
210	0.05443
220	0.06484
230	0.07674
240	0.09030
250	0.10560
260	0.12290

9.27 IDEAL GAS HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
0	0.261
25	0.274
50	0.287
75	0.299
100	0.311
125	0.323
150	0.335
175	0.347
200	0.358
225	0.370
250	0.381
275	0.392
300	0.403
325	0.414
350	0.424
375	0.435
400	0.445
425	0.455
450	0.465
475	0.475
500	0.485
525	0.494
550	0.504
575	0.513
600	0.522

P-XYLENE

XLP

CAUTIONARY RESPONSE INFORMATION

Common Synonyms			
1,4-Dimethylbenzene Xylol	Watery liquid	Colorless	Sweet odor
	Floats on water. Flammable, irritating vapor is produced. Freezing point is 56°F.		

Keep people away.
Shut off ignition sources and call fire department.
Avoid contact with liquid and vapor.
Notify local health and pollution control agencies.
Protect water intakes.

Fire

FLAMMABLE
Flashback along vapor trail may occur.
Vapor may explode if ignited in an enclosed area.
Wear self-contained breathing apparatus.
Extinguish with foam, dry chemical, or carbon dioxide.
Water may be ineffective on fire.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

VAPOR
Irritating to eyes, nose and throat.
If inhaled, will cause dizziness, difficult breathing, or loss of consciousness.
Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

LIQUID
Irritating to skin and eyes.
If swallowed, will cause nausea, vomiting, loss of consciousness.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.
DO NOT INDUCE VOMITING.

Water Pollution

HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.
Fouling to shoreline.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. CORRECTIVE RESPONSE ACTIONS

Stop discharge
Contain
Collection Systems: Skim
Chemical and Physical Treatment: Burn
Clean shore line
Salvage waterfowl

2. CHEMICAL DESIGNATIONS

2.1 CG Compatibility Group: 32; Aromatic Hydrocarbon
2.2 Formula: $p\text{-}C_6H_4(CH_3)_2$
2.3 IMO/UN Designation: 3.2/1307
2.4 DOT ID No.: 1307
2.5 CAS Registry No.: 106-42-3
2.6 NAERG Guide No.: 130
2.7 Standard Industrial Trade Classification: 51124

3. HEALTH HAZARDS

3.1 Personal Protective Equipment: Approved canister or air-supplied mask; goggles or face shield; plastic gloves and boots.
3.2 Symptoms Following Exposure: Vapors cause headache and dizziness. Liquid irritates eyes and skin. If taken into lungs, causes severe coughing, distress, and rapidly developing pulmonary edema. If ingested, causes nausea, vomiting, cramps, headache, and coma. Can be fatal. Kidney and liver damage can occur.
3.3 Treatment of Exposure: INHALATION: remove to fresh air; administer artificial respiration and oxygen if required; call a doctor. INGESTION: do NOT induce vomiting; call a doctor. EYES: flush with water for at least 15 min. SKIN: wipe off, wash with soap and water.
3.4 TLV-TWA: 100 ppm
3.5 TLV-STEL: 150 ppm
3.6 TLV-Ceiling: Not listed.
3.7 Toxicity by Ingestion: Grade 3; LD_{50} = 50 to 500 mg/kg
3.8 Toxicity by Inhalation: Currently not available.
3.9 Chronic Toxicity: Kidney and liver damage.
3.10 Vapor (Gas) Irritant Characteristics: Vapors cause a slight smarting of the eyes or respiratory system if present in high concentrations. The effect is temporary.
3.11 Liquid or Solid Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
3.12 Odor Threshold: 0.05 ppm
3.13 IDLH Value: 900 ppm
3.14 OSHA PEL-TWA: 100 ppm
3.15 OSHA PEL-STEL: Not listed.
3.16 OSHA PEL-Ceiling: Not listed.
3.17 EPA AEGL: Not listed

4. FIRE HAZARDS

4.1 Flash Point: 81°F C.C.
4.2 Flammable Limits in Air: 1.1%-7.0%
4.3 Fire Extinguishing Agents: Foam, dry chemical, or carbon dioxide
4.4 Fire Extinguishing Agents Not to Be Used: Water may be ineffective.
4.5 Special Hazards of Combustion Products: Not pertinent
4.6 Behavior in Fire: Vapor is heavier than air and may travel considerable distance to a source of ignition and flash back.
4.7 Auto Ignition Temperature: 984°F
4.8 Electrical Hazards: Class I, Group D
4.9 Burning Rate: 5.8 mm/min.
4.10 Adiabatic Flame Temperature: Currently not available
4.11 Stoichometric Air to Fuel Ratio: 50.0 (calc.)
4.12 Flame Temperature: Currently not available
4.13 Combustion Molar Ratio (Reactant to Product): 13.0 (calc.)
4.14 Minimum Oxygen Concentration for Combustion (MOCC): Not listed

5. CHEMICAL REACTIVITY

5.1 Reactivity with Water: No reaction
5.2 Reactivity with Common Materials: No reaction
5.3 Stability During Transport: Stable
5.4 Neutralizing Agents for Acids and Caustics: Not pertinent
5.5 Polymerization: Not pertinent
5.6 Inhibitor of Polymerization: Not pertinent

6. WATER POLLUTION

6.1 Aquatic Toxicity:
22 ppm/96 hr/bluegill/TL_m/fresh water
6.2 Waterfowl Toxicity: Currently not available
6.3 Biological Oxygen Demand (BOD): 0 lb/lb in 5 days
6.4 Food Chain Concentration Potential: Currently not available
6.5 GESAMP Hazard Profile:
Bioaccumulation: 0
Damage to living resources: 3
Human Oral hazard: 1
Human Contact hazard: I
Reduction of amenities: X

7. SHIPPING INFORMATION

7.1 Grades of Purity: Research: 99.99%; Pure: 99.8%; Technical: 99.0%
7.2 Storage Temperature: Ambient
7.3 Inert Atmosphere: No requirement
7.4 Venting: Open (flame arrester) or pressure-vacuum
7.5 IMO Pollution Category: C
7.6 Ship Type: 3
7.7 Barge Hull Type: Currently not available

8. HAZARD CLASSIFICATIONS

8.1 49 CFR Category: Flammable liquid
8.2 49 CFR Class: 3
8.3 49 CFR Package Group: III
8.4 Marine Pollutant: No
8.5 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue)..........	2
Flammability (Red)............	3
Instability (Yellow)............	0

8.6 EPA Reportable Quantity: 100 pounds
8.7 EPA Pollution Category: B
8.8 RCRA Waste Number: U239
8.9 EPA FWPCA List: Yes

9. PHYSICAL & CHEMICAL PROPERTIES

9.1 Physical State at 15° C and 1 atm: Liquid
9.2 Molecular Weight: 106.16
9.3 Boiling Point at 1 atm: 280.9°F = 138.3°C = 411.5°K
9.4 Freezing Point: 55.9°F = 13.3°C = 286.5°K
9.5 Critical Temperature: 649.4°F = 343.0°C = 616.2°K
9.6 Critical Pressure: 509.4 atm = 34.65 psia = 3.510 MN/m²
9.7 Specific Gravity: 0.861 at 20°C (liquid)
9.8 Liquid Surface Tension: 28.3 dynes/cm = 0.0283 N/m at 20°C
9.9 Liquid Water Interfacial Tension: 37.8 dynes/cm = 0.0378 N/m at 20°C
9.10 Vapor (Gas) Specific Gravity: Not pertinent
9.11 Ratio of Specific Heats of Vapor (Gas): 1.071
9.12 Latent Heat of Vaporization: 150 Btu/lb = 81 cal/g = 3.4 X 10^5 J/kg
9.13 Heat of Combustion: –17,559 Btu/lb = –9754.7 cal/g = –408.41 X 10^5 J/kg
9.14 Heat of Decomposition: Not pertinent
9.15 Heat of Solution: Not pertinent
9.16 Heat of Polymerization: Not pertinent
9.17 Heat of Fusion: 37.83 cal/g
9.18 Limiting Value: Currently not available
9.19 Reid Vapor Pressure: 0.34 psia

NOTES

P-XYLENE

XLP

9.20 SATURATED LIQUID DENSITY		9.21 LIQUID HEAT CAPACITY		9.22 LIQUID THERMAL CONDUCTIVITY		9.23 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit inch per hour-square foot-F	Temperature (degrees F)	Centipoise
60	53.970	60	0.412	60	0.935	60	0.678
65	53.830	70	0.418	65	0.928	65	0.654
70	53.690	80	0.424	70	0.921	70	0.631
75	53.550	90	0.429	75	0.914	75	0.610
80	53.410	100	0.435	80	0.907	80	0.590
85	53.270	110	0.440	85	0.900	85	0.571
90	53.140	120	0.446	90	0.892	90	0.552
95	53.000	130	0.451	95	0.885	95	0.535
100	52.860	140	0.457	100	0.878	100	0.519
105	52.720	150	0.462			105	0.503
110	52.580	160	0.468			110	0.488
115	52.440	170	0.474			115	0.474
120	52.300	180	0.479			120	0.460
		190	0.485				
		200	0.490				
		210	0.496				
		220	0.501				
		230	0.507				
		240	0.512				
		250	0.518				
		260	0.524				
		270	0.529				
		280	0.535				

9.24 SOLUBILITY IN WATER		9.25 SATURATED VAPOR PRESSURE		9.26 SATURATED VAPOR DENSITY		9.27 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
	I	60	0.096	60	0.00183	0	0.246
	N	70	0.135	70	0.00252	25	0.259
	S	80	0.187	80	0.00343	50	0.272
	O	90	0.255	90	0.00459	75	0.285
	L	100	0.343	100	0.00607	100	0.297
	U	110	0.456	110	0.00792	125	0.309
	B	120	0.599	120	0.01022	150	0.321
	L	130	0.777	130	0.01303	175	0.333
	E	140	0.998	140	0.01646	200	0.345
		150	1.270	150	0.02059	225	0.357
		160	1.600	160	0.02553	250	0.368
		170	1.998	170	0.03138	275	0.380
		180	2.475	180	0.03826	300	0.391
		190	3.041	190	0.04629	325	0.402
		200	3.710	200	0.05561	350	0.413
		210	4.493	210	0.06836	375	0.424
		220	5.407	220	0.07667	400	0.435
		230	6.465	230	0.09270	425	0.445
		240	7.683	240	0.10860	450	0.456
		250	9.080	250	0.12650	475	0.466
		260	10.670	260	0.14670	500	0.476
						525	0.486
						550	0.496
						575	0.505
						600	0.515

POLYCYCLIC AROMATIC HYDROCARBONS (PAHs)

Also known as: Polynuclear Aromatic Hydrocarbons, PNA, Polyaromatic Hydrocarbons
Examples: Benzo(a)pyrene, Benzanthracene, Benzo(b)fluoranthene, Fluoranthene, Naphthalene

WHAT ARE PAHs?

PAHs are a group of approximately 10,000 compounds, a few of which are listed above. Most PAHs in the environment are from incomplete burning of carbon-containing materials like oil, wood, garbage or coal. Many useful products such as mothballs, blacktop, and creosote wood preservatives contain PAHs. They are also found at low concentrations in some special-purpose skin creams and anti-dandruff shampoos that contain coal tars.

Automobile exhaust, industrial emissions and smoke from burning wood, charcoal and tobacco contain high levels of PAHs. In general, more PAHs form when materials burn at low temperatures, such as in wood fires or cigarettes. High-temperature furnaces produce fewer PAHs.

Fires can form fine PAH particles. They bind to ash particles and can move long distances through the air. Some PAHs can dissolve in water. PAHs can enter groundwater from ash, tar, or creosote that is improperly disposed in landfills.

HOW ARE PEOPLE EXPOSED TO PAHs?

Breathing: Most people are exposed to PAHs when they breathe smoke, auto emissions or industrial exhausts. Most exhausts contain many different PAH compounds. People with the highest exposures are smokers, people who live or work with smokers, roofers, road builders and people who live near major highways or industrial sources.

Drinking/Eating: Charcoal-broiled foods, especially meats, are a source of some PAH exposure. Shellfish living in contaminated water may be another major source of exposure. PAHs may be in groundwater near disposal sites where construction wastes or ash are buried; people may be exposed by drinking this water. Vegetables do not take up significant amounts of PAHs that are in soil.

Touching: PAH can be absorbed through skin. Exposure can come from handling contaminated soil or bathing in contaminated water. Low levels of these chemicals may be absorbed when a person uses medicated skin cream or shampoo containing PAHs.

DO STANDARDS EXIST FOR REGULATING PAHs?

Water: Wisconsin has established drinking water standards for five PAHs: Anthracene - 3,000 parts per billion (ppb), Benzo(a)pyrene - 0.2 ppb, Benzo(b)fluoranthene - 0.2 ppb, Fluoranthene - 400 ppb and Fluorene - 400 ppb. We suggest you stop drinking water containing more than these amounts. If other PAHs are found in your drinking water, contact your local public health agency for advice.

Air: No standards exist for the amount of PAHs allowed in the air of homes. We use a formula to convert workplace limits to suggested home limits. Based on the formula, we recommend levels of PAHs in air be no higher than 0.004 parts per million (ppm).

The Wisconsin Department of Natural Resources regulates the amount of several PAHs that can be released by industries.

WILL EXPOSURE TO PAHs RESULT IN HARMFUL HEALTH EFFECTS?

The effects of breathing high concentrations of PAHs have not been studied. However, PAHs may be attached to dust or ash causing lung irritation. Skin contact with PAHs may cause redness, blistering, and peeling.

The following health effects can occur after several years of exposure to PAHs:

Cancer: Benzo(a)pyrene, a common PAH, is shown to cause lung and skin cancer in laboratory animals. Other PAHs are not known to have this effect. Extracts of various types of smoke containing PAHs caused lung tumors in laboratory animals. Cigarette smoke will cause lung cancer.

Reproductive Effects: Reproductive problems and problems in unborn babies' development have occurred in laboratory animals that were exposed to benzo(a)pyrene. Other PAHs have not been studied enough to determine whether they cause reproductive problems.

Organ Systems: A person's lungs, liver, skin, and kidneys can be damaged by exposure.

In general, chemicals affect the same organ systems in all people who are exposed. However, the seriousness of the effects may vary from person to person.

A person's reaction depends on several things, including individual health, heredity, previous exposure to chemicals including medicines, and personal habits such as smoking or drinking.

It's also important to consider the length of exposure to the chemical; the amount of chemical exposure; and whether the chemical was inhaled, touched, or eaten.

CAN A MEDICAL TEST DETERMINE EXPOSURE TO PAHs?

Many PAHs can be detected in blood or urine soon after exposure. Tests for these compounds are not routine and can only be performed using special equipment not usually found in doctor's offices. People who think they may have been exposed to PAHs for a long time should contact their physician. Blood tests of liver and kidney function are available. People exposed to PAHs in air may want to ask their doctor to consider having lung function tests done.

Seek medical advice if you have any symptoms that you think may be related to chemical exposure.

This fact sheet summarizes information about this chemical and is not a complete listing of all possible effects. It does not refer to work exposure or emergency situations.

FOR MORE INFORMATION

- Poison Control Center, 800-815-8855
- Your local public health agency
- Division of Public Health, BEH, 1 West Wilson Street, Rm. 150, Madison, WI 53701-2659, (608) 266-1120 or Internet: www.dhfs.state.wi.us/eh/index.htm

DHFS

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(POH 4606 *Revised* 12/2000)

NAPHTHA: COAL TAR

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CAUTIONARY RESPONSE INFORMATION

Common Synonyms		
Mixture of benzene, toluene, xylenes	Watery liquid / Colorless to pale yellow / Gasoline-like odor Floats on water. Irritating vapor is produced.	

Keep people away.
Avoid inhalation.
Shut off ignition sources and call fire department
Avoid contact with liquid and vapor.
Stay upwind and use water spray to "knock down" vapor.
Notify local health and pollution control agencies.
Protect water intakes.

Fire	Combustible. Extinguish with foam, dry chemical or carbon dioxide. Cool exposed containers with water.
Exposure	CALL FOR MEDICAL AID. VAPOR Irritating to eyes, nose and throat. If inhaled, will cause dizziness, headache, difficult breathing or loss of consciousness. Move to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen. LIQUID Irritating to skin and eyes. If swallowed, will cause nausea or vomiting. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk. DO NOT INDUCE VOMITING.
Water Pollution	Effect of low concentrations on aquatic life is unknown. Fouling to shoreline. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.

1. CORRECTIVE RESPONSE ACTIONS

Stop discharge
Contain
Collection Systems: Skim
Chemical and Physical Treatment: Burn
Clean shore line
Salvage waterfowl

2. CHEMICAL DESIGNATIONS

2.1 **CG Compatibility Group:** 33; Miscellaneous Hydrocarbon Mixtures
2.2 **Formula:** Currently not available
2.3 **IMO/UN Designation:** 3.2/2553
2.4 **DOT ID No.:** 1268
2.5 **CAS Registry No.:** MX8030-31-7
2.6 **NAERG Guide No.:** 128
2.7 **Standard Industrial Trade Classification:** 33429

3. HEALTH HAZARDS

3.1 **Personal Protective Equipment:** Hydrocarbon vapor canister or air pack; plastic gloves; goggles or face shield.
3.2 **Symptoms Following Exposure:** Primarily a narcotic, causing unconsciousness in high concentrations. The symptoms of acute benzene poisoning are not likely, since the compound has components other than benzene.
3.3 **Treatment of Exposure:** Remove from exposure. Support respiration. Call physician.
3.4 **TLV-TWA:** 400 ppm
3.5 **TLV-STEL:** Not listed.
3.6 **TLV-Ceiling:** Not listed.
3.7 **Toxicity by Ingestion:** Grade 3; LD_{50} = 50 to 500 mg/kg
3.8 **Toxicity by Inhalation:** Currently not available.
3.9 **Chronic Toxicity:** Leukemia
3.10 **Vapor (Gas) Irritant Characteristics:** Vapors cause a slight smarting of the eyes or respiratory system if present in high concentrations. The effect is temporary.
3.11 **Liquid or Solid Characteristics:** Minimum hazard. If spilled on clothing and allowed to remain, may cause a smarting and reddening of the skin.
3.12 **Odor Threshold:** 4.68 ppm
3.13 **IDLH Value:** 1,000 ppm
3.14 **OSHA PEL-TWA:** 100 ppm
3.15 **OSHA PEL-STEL:** Not listed.
3.16 **OSHA PEL-Ceiling:** Not listed.
3.17 **EPA AEGL:** Not listed

4. FIRE HAZARDS

4.1 **Flash Point:** 107°F C.C.
4.2 **Flammable Limits in Air:** Currently not available
4.3 **Fire Extinguishing Agents:** Foam, carbon dioxide, or dry chemical
4.4 **Fire Extinguishing Agents Not to Be Used:** Not pertinent
4.5 **Special Hazards of Combustion Products:** Not pertinent
4.6 **Behavior in Fire:** Not pertinent
4.7 **Auto Ignition Temperature:** 900–950°F
4.8 **Electrical Hazards:** Class I, Group D
4.9 **Burning Rate:** 4 mm/min.
4.10 **Adiabatic Flame Temperature:** Currently not available
4.11 **Stoichometric Air to Fuel Ratio:** Not pertinent.
4.12 **Flame Temperature:** Currently not available
4.13 **Combustion Molar Ratio (Reactant to Product):** Not pertinent.
4.14 **Minimum Oxygen Concentration for Combustion (MOCC):** Not listed

5. CHEMICAL REACTIVITY

5.1 **Reactivity with Water:** No reaction
5.2 **Reactivity with Common Materials:** No reaction
5.3 **Stability During Transport:** Stable
5.4 **Neutralizing Agents for Acids and Caustics:** Not pertinent
5.5 **Polymerization:** Not pertinent
5.6 **Inhibitor of Polymerization:** Not pertinent

6. WATER POLLUTION

6.1 **Aquatic Toxicity:** Currently not available
6.2 **Waterfowl Toxicity:** Currently not available
6.3 **Biological Oxygen Demand (BOD):** Currently not available
6.4 **Food Chain Concentration Potential:** None
6.5 **GESAMP Hazard Profile:** Not listed

7. SHIPPING INFORMATION

7.1 **Grades of Purity:** Purity varies with coal used and distillation range taken.
7.2 **Storage Temperature:** Ambient
7.3 **Inert Atmosphere:** No requirement
7.4 **Venting:** Open (flame arrester)
7.5 **IMO Pollution Category:** B
7.6 **Ship Type:** 3
7.7 **Barge Hull Type:** 3

8. HAZARD CLASSIFICATIONS

8.1 **49 CFR Category:** Flammable liquid
8.2 **49 CFR Class:** 3
8.3 **49 CFR Package Group:** I
8.4 **Marine Pollutant:** Yes
8.5 **NFPA Hazard Classification:** Not listed
8.6 **EPA Reportable Quantity:** Not listed.
8.7 **EPA Pollution Category:** Not listed.
8.8 **RCRA Waste Number:** Not listed
8.9 **EPA FWPCA List:** Not listed

9. PHYSICAL & CHEMICAL PROPERTIES

9.1 **Physical State at 15° C and 1 atm:** Liquid
9.2 **Molecular Weight:** Not pertinent
9.3 **Boiling Point at 1 atm:** 200–500°F = 93–260°C = 366-533°K
9.4 **Freezing Point:** Not pertinent
9.5 **Critical Temperature:** Not pertinent
9.6 **Critical Pressure:** Not pertinent
9.7 **Specific Gravity:** 0.86–0.88 at 20°C (liquid)
9.8 **Liquid Surface Tension:** (est.) 20 dynes/cm = 0.020 N/m at 20°C
9.9 **Liquid Water Interfacial Tension:** (est.) 45 dynes/cm = 0.045 N/m at 20°C
9.10 **Vapor (Gas) Specific Gravity:** Currently not available
9.11 **Ratio of Specific Heats of Vapor (Gas):** (est.) 1.030
9.12 **Latent Heat of Vaporization:** (est.) 101 Btu/lb = 56.2 cal/g = 2.35×10^5 J/kg
9.13 **Heat of Combustion:** (est.) –18,200 Btu/lb = –10,100 cal/g = -424×10^5 J/kg
9.14 **Heat of Decomposition:** Not pertinent
9.15 **Heat of Solution:** Not pertinent
9.16 **Heat of Polymerization:** Not pertinent
9.17 **Heat of Fusion:** Currently not available
9.18 **Limiting Value:** Currently not available
9.19 **Reid Vapor Pressure:** 0.13 psia

NOTES

NAPHTHA: COAL TAR

9.20 SATURATED LIQUID DENSITY		9.21 LIQUID HEAT CAPACITY		9.22 LIQUID THERMAL CONDUCTIVITY		9.23 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit inch per hour-square foot-F	Temperature (degrees F)	Centipoise
50	53.680	50	0.478	50	1.040	50	9.343
52	53.680	52	0.478	52	1.040	52	8.841
54	53.680	54	0.478	54	1.040	54	8.370
56	53.680	56	0.478	56	1.040	56	7.927
58	53.680	58	0.478	58	1.040	58	7.511
60	53.680	60	0.478	60	1.040	60	7.119
62	53.680	62	0.478	62	1.040	62	6.751
64	53.680	64	0.478	64	1.040	64	6.404
66	53.680	66	0.478	66	1.040	66	6.078
68	53.680	68	0.478	68	1.040	68	5.770
70	53.680	70	0.478	70	1.040	70	5.481
72	53.680	72	0.478	72	1.040	72	5.207
74	53.680	74	0.478	74	1.040	74	4.950
76	53.680	76	0.478	76	1.040	76	4.707
78	53.680	78	0.478	78	1.040	78	4.477
80	53.680	80	0.478	80	1.040	80	4.260
82	53.680	82	0.478	82	1.040	82	4.056
84	53.680	84	0.478	84	1.040	84	3.862
86	53.680	86	0.478	86	1.040	86	3.679
88	53.680	88	0.478	88	1.040	88	3.506
90	53.680	90	0.478	90	1.040	90	3.342
92	53.680	92	0.478	92	1.040	92	3.187
94	53.680	94	0.478	94	1.040	94	3.040
96	53.680	96	0.478	96	1.040	96	2.901
98	53.680	98	0.478	98	1.040	98	2.770
100	53.680	100	0.478	100	1.040	100	2.645

9.24 SOLUBILITY IN WATER		9.25 SATURATED VAPOR PRESSURE		9.26 SATURATED VAPOR DENSITY		9.27 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
	INSOLUBLE	90	0.094		NOT PERTINENT		CURRENTLY NOT AVAILABLE
		100	0.124				
		110	0.163				
		120	0.211				
		130	0.272				
		140	0.347				
		150	0.440				
		160	0.553				
		170	0.691				
		180	0.856				
		190	1.054				
		200	1.290				
		210	1.569				
		220	1.897				
		230	2.281				
		240	2.728				
		250	3.247				
		260	3.846				
		270	4.535				
		280	5.323				
		290	6.221				
		300	7.241				
		310	8.394				
		320	9.695				
		330	11.160				
		340	12.790				

POLYCHLORINATED BIPHENYL

PCB

CAUTIONARY RESPONSE INFORMATION

Common Synonyms			
Arochlor Chlorinated biphenyl Halogenated waxes PCB Polychloropolyphenyls	Oily liquid to solid powder Sinks in water.	Light yellow liquid, or white powder	Weak odor

Notify local health and pollution control agencies.
Protect water intakes.
Keep people away.
Avoid contact with liquid and solid.
Call fire department.

Fire	Combustible. Extinguish with water, foam, dry chemical, or carbon dioxide.
Exposure	CALL FOR MEDICAL AID. LIQUID OR SOLID Irritating to skin and eyes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water.
Water Pollution	HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.

1. CORRECTIVE RESPONSE ACTIONS
Stop discharge
Contain
Collection Systems: Pump; Dredge
Clean shore line

2. CHEMICAL DESIGNATIONS
2.1 **CG Compatibility Group:** Not listed.
2.2 **Formula:** $(C_{12}H_{10-x})Cl_x$
2.3 **IMO/UN Designation:** Not listed
2.4 **DOT ID No.:** 2315
2.5 **CAS Registry No.:** 1336-36-3
2.6 **NAERG Guide No.:** 171
2.7 **Standard Industrial Trade Classification:** 51139

3. HEALTH HAZARDS
3.1 **Personal Protective Equipment:** Gloves and protective garments.
3.2 **Symptoms Following Exposure:** Acne from skin contact.
3.3 **Treatment of Exposure:** SKIN: wash with soap and water.
3.4 **TLV-TWA:** Not listed.
3.5 **TLV-STEL:** Not listed.
3.6 **TLV-Ceiling:** Not listed.
3.7 **Toxicity by Ingestion:** Grade 2; oral rat LD_{50} = 3980 mg/kg
3.8 **Toxicity by Inhalation:** Currently not available.
3.9 **Chronic Toxicity:** Causes chromosomal abnormalities in rats, birth defects in birds
3.10 **Vapor (Gas) Irritant Characteristics:** Vapors cause severe irritation of eyes and throat and cause eye and lung injury. They cannot be tolerated even at low concentrations.
3.11 **Liquid or Solid Characteristics:** Contact with skin may cause irritation.
3.12 **Odor Threshold:** Currently not available
3.13 **IDLH Value:** Not listed.
3.14 **OSHA PEL-TWA:** Not listed.
3.15 **OSHA PEL-STEL:** Not listed.
3.16 **OSHA PEL-Ceiling:** Not listed.
3.17 **EPA AEGL:** Not listed

4. FIRE HAZARDS
4.1 **Flash Point:** >288°F
4.2 **Flammable Limits in Air:** Currently not available
4.3 **Fire Extinguishing Agents:** Water, foam, dry chemical, or carbon dioxide
4.4 **Fire Extinguishing Agents Not to Be Used:** Not pertinent
4.5 **Special Hazards of Combustion Products:** Irritating gases are generated in fires.
4.6 **Behavior in Fire:** Not pertinent
4.7 **Auto Ignition Temperature:** Currently not available
4.8 **Electrical Hazards:** Not pertinent
4.9 **Burning Rate:** Currently not available
4.10 **Adiabatic Flame Temperature:** Currently not available
4.11 **Stoichometric Air to Fuel Ratio:** Not pertinent.
4.12 **Flame Temperature:** Currently not available
4.13 **Combustion Molar Ratio (Reactant to Product):** Not pertinent.
4.14 **Minimum Oxygen Concentration for Combustion (MOCC):** Not listed

5. CHEMICAL REACTIVITY
5.1 **Reactivity with Water:** No reaction
5.2 **Reactivity with Common Materials:** No reaction
5.3 **Stability During Transport:** Stable
5.4 **Neutralizing Agents for Acids and Caustics:** Not pertinent
5.5 **Polymerization:** Not pertinent
5.6 **Inhibitor of Polymerization:** Not pertinent

6. WATER POLLUTION
6.1 **Aquatic Toxicity:**
0.278 ppm/96 hr/bluegill/TL_m/fresh water
0.005 ppm/336-1080 hr/pinfish/TL_m/salt water
6.2 **Waterfowl Toxicity:** LD_{50} 2000 ppm (mallard duck)
6.3 **Biological Oxygen Demand (BOD):** Very low
6.4 **Food Chain Concentration Potential:** High
6.5 **GESAMP Hazard Profile:**
Bioaccumulation: +
Damage to living resources: 4
Human Oral hazard: 1
Human Contact hazard: II
Reduction of amenities: XX

7. SHIPPING INFORMATION
7.1 **Grades of Purity:** 11 grades (some liquid, some solids) which differ primarily in their chlorine content (20%-68% by weight)
7.2 **Storage Temperature:** Ambient
7.3 **Inert Atmosphere:** No requirement
7.4 **Venting:** Open
7.5 **IMO Pollution Category:** Currently not available
7.6 **Ship Type:** Currently not available
7.7 **Barge Hull Type:** Currently not available

8. HAZARD CLASSIFICATIONS
8.1 **49 CFR Category:** Class 9
8.2 **49 CFR Class:** 9
8.3 **49 CFR Package Group:** II
8.4 **Marine Pollutant:** Yes
8.5 **NFPA Hazard Classification:** Not listed
8.6 **EPA Reportable Quantity:** 1 pound
8.7 **EPA Pollution Category:** X
8.8 **RCRA Waste Number:** Not listed
8.9 **EPA FWPCA List:** Yes

9. PHYSICAL & CHEMICAL PROPERTIES
9.1 **Physical State at 15° C and 1 atm:** Solid
9.2 **Molecular Weight:** Not pertinent
9.3 **Boiling Point at 1 atm:** Very high
9.4 **Freezing Point:** Not pertinent
9.5 **Critical Temperature:** Not pertinent
9.6 **Critical Pressure:** Not pertinent
9.7 **Specific Gravity:** 1.3–1.8 at 20°C (liquid)
9.8 **Liquid Surface Tension:** Not pertinent
9.9 **Liquid Water Interfacial Tension:** Not pertinent
9.10 **Vapor (Gas) Specific Gravity:** Not pertinent
9.11 **Ratio of Specific Heats of Vapor (Gas):** Not pertinent
9.12 **Latent Heat of Vaporization:** Not pertinent
9.13 **Heat of Combustion:** Not pertinent
9.14 **Heat of Decomposition:** Not pertinent
9.15 **Heat of Solution:** Not pertinent
9.16 **Heat of Polymerization:** Not pertinent
9.17 **Heat of Fusion:** Currently not available
9.18 **Limiting Value:** Currently not available
9.19 **Reid Vapor Pressure:** Currently not available

NOTES

POLYCHLORINATED BIPHENYL

PCB

9.20 SATURATED LIQUID DENSITY		9.21 LIQUID HEAT CAPACITY		9.22 LIQUID THERMAL CONDUCTIVITY		9.23 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit inch per hour-square foot-F	Temperature (degrees F)	Centipoise
68	81.150		NOT PERTINENT		NOT PERTINENT		NOT PERTINENT
69	81.150						
70	81.150						
71	81.150						
72	81.150						
73	81.150						
74	81.150						
75	81.150						
76	81.150						
77	81.150						
78	81.150						
79	81.150						
80	81.150						
81	81.150						
82	81.150						
83	81.150						
84	81.150						
85	81.150						

9.24 SOLUBILITY IN WATER		9.25 SATURATED VAPOR PRESSURE		9.26 SATURATED VAPOR DENSITY		9.27 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
	INSOLUBLE		NOT PERTINENT		NOT PERTINENT		NOT PERTINENT

CYANIDE

Chemical reference numbers (CAS) of common forms: Cyanide 57-12-5, Zinc Cyanide 557-21-1, Sodium Cyanide 143-33-9, Potassium Cyanide 151-50-8, Hydrogen Cyanide 74-90-8

WHAT IS CYANIDE?

Cyanide is very poisonous. Cyanide can exist as a gas, liquid or white crystal powder. Cyanide is used in the electroplating industry, in metal cleaning operations, and as an industrial bug killer. Breathing the gas, eating the liquid or solid forms can make people suddenly lose consciousness or cause death.

There are no common uses of cyanide in the home. Most cyanide in the environment results from industrial processes and from improper waste disposal.

HOW ARE PEOPLE EXPOSED TO CYANIDE?

Breathing: Cyanide gas can be found in industrial emissions and car exhaust, cigarette smoke and certain papers and plastics as they burn. It is also possible to breathe or eat cyanide dust when working with cyanide powder. If people use a contaminated water supply, they can breathe cyanide when they cook or shower with the water.

Drinking/Eating: Cyanide is sometimes found in contaminated drinking water. People can be exposed when they drink contaminated water. People who handle contaminated soil may be exposed when they eat or touch their mouths with dirty hands.

Touching: Cyanide can enter the body through skin when people handle the chemical, contaminated soil or contaminated water. People can be exposed to cyanide if they wash or bathe with contaminated water.

DO STANDARDS EXIST FOR REGULATING CYANIDE?

Water: The federal drinking water standard for cyanide is set at 200 parts per billion (ppb). We suggest you stop drinking water containing more than 200 ppb of cyanide.

Air: No standards exist for the amount of cyanide allowed in the air of homes. We use a formula to convert workplace limits to suggested home limits. Based on the formula, we recommend cyanide levels be no higher than 90 ppb. Most people can't smell cyanide until levels reach 600 ppb. Cyanide compounds smell like bitter almonds to some people, while others cannot smell them at all. If you can smell the chemical, the level is too high to be safe.

The Wisconsin Department of Natural Resources regulates the amount of cyanide that can be released by industries.

WILL EXPOSURE TO CYANIDE RESULT IN HARMFUL HEALTH EFFECTS?

The following health effects are described in cases of suicide or accidental exposure to high levels of cyanide compounds. These effects are not expected following low-dose exposures:

- Irritation of skin and mucous membranes (causing redness or flushing of skin)
- Headaches, dizziness and loss of coordination
- Nausea and vomiting
- Rapid, deep breathing or gasping
- Rapid pulse rate and increased blood pressure
- Muscle spasms and convulsions
- Loss of consciousness and death.

The following health effects can occur after several years of exposure to low levels of cyanide:

Cancer: No studies show a relationship between exposure to cyanide and the development of cancer.

Reproductive Effects: Studies of laboratory animals show exposure to cyanide resulted in birth defects.

Organ Systems: Cyanide can cause nerve damage affecting hearing, vision, and muscle coordination. Damage to the thyroid gland is also possible, resulting in changes of metabolism in adults and slowing growth or development in children.

In general, chemicals affect the same organ systems in all people who are exposed. A person's reaction depends on several things, including individual health, heredity, previous exposure to chemicals including medicines, and personal habits such as smoking or drinking.

It's also important to consider the length of exposure to the chemical; the amount of chemical exposure; and whether the chemical was inhaled, touched, or eaten.

CAN A MEDICAL TEST DETERMINE EXPOSURE TO CYANIDE?

Doctors can test urine for "thiocyanate" shortly after exposure to cyanide. Blood levels of cyanide can indicate recent exposure. Cigarette smokers generally have higher levels of cyanide-related compounds in their bodies than non-smokers.

Seek medical advice if you have any symptoms that you think may be related to chemical exposure.

This fact sheet summarizes information about this chemical and is not a complete listing of all possible effects. It does not refer to work exposure or emergency situations.

FOR MORE INFORMATION

- Poison Control Center, 800-815-8855
- Your local public health agency
- Division of Public Health, BEH, 1 West Wilson Street, Rm. 150, Madison, WI 53701-2659, (608) 266-1120 or Internet: www.dhfs.state.wi.us/eh/index.htm

DHFS

Prepared by the
Wisconsin Department of Health and Family Services
Division of Public Health, with funds from the
Agency for Toxic Substances and Disease Registry,
Public Health Service,
U.S. Department of Health and Human Services.

(POH 4594 *Revised* 12/2000)

APPENDIX D

GEOLOGIC CROSS SECTIONS

APPENDIX E

EXCERPTS FROM WDNR MEMORANDUM
AUGUST 20, 1992

sediment is important at the Moss-American site because of the role these values play in consideration of level of cleanup. Since the establishment of these values is equally as important at the Sheboygan site, a Predesign Work Task for the site must also require the development of analytical low detection methods for PAH compounds in sediment and establishment of representative reference sediment concentrations.

NEED FOR CHARACTERIZATION OF THE AREAL AND VERTICAL EXTENT OF PAH SEDIMENT CONCENTRATIONS

H-20

The analytical data for PAHs in the RI/ESR is based on analysis of composited cores. Information is needed on PAH concentrations in core segments or identifiable core strata. Specific data is needed as it relates to surficial concentrations associated with the biologically active zone of sediments or strata that would become potentially exposed to channel dredging projects. The 2.0 to 4.0 ft. core depth at the harbor HSL sites was apparently chosen for analysis because it relates to being in an area above and below the channel dredging depth that would be necessary to maintain the navigational channel. One sediment area that especially needs further characterization is that associated with harbor sampling site H-20 which had a total PAH concentration of 70,000 $\mu g/kg$ (total of quantified and estimated concentrations) in the composited 2-foot long core. Information is needed on the maximum concentration of PAHs that can be found within the segments or strata of this core and the concentrations of PAHs in the sediments above (surface to 2.0 ft. depth) and below (greater than 4.0 ft. depth) this core.

H20
R-98
R-100

A review of the field notes taken during sampling indicates that the sediment materials in the core at H-20 were "oil saturated" from the 4.0 to 16.0 ft. depth. H-20 is immediately downstream of the Pennsylvania Avenue bridge. The description for the sediment material in sample cores taken at two sites immediately above Pennsylvania Avenue bridge also contains "oil saturated" core segments. In sample R-98 the oil saturated descriptor is associated with 2.0 to 6.0 ft. core depth and in sample R-100, oil saturated is associated with the 4.0 to 6.0 ft. depth. Neither R-98 nor R-100 were sites chosen for an HSL PAH analysis in the 2.0 to 4.0 ft. core lengths, so no PAH analysis is available for these cores. The next most upstream sampling site analyzed for PAHs was R-96 (HSL-10). This was a river sampling site and the total PAH concentration in the composited core (0 to 4.3 ft.) was 4,230 $\mu g/kg$. The sediment materials in the core were not described as oil saturated in the sampling notes. Downstream from H-20, the next sampling site which had sediment materials described as oil saturated was H-14 at the 4.0 to 8.0 ft. core depth. H-14 is located approximately one-half mile below H-20 in the inner harbor channel. It appears that initial characterization work for PAHs in sediment needs to focus on the area extending from river sampling site R-98 and extending down river to harbor site H-14 and beyond.

The RI/ESR reviews potential contribution sources of contaminants to the Sheboygan River. Many of these are potential sources of PAH discharges. One potential source not included in the Preliminary Site Assessment of the RI/ESR was a coal gasification plant that operated on the east bank of the Sheboygan River immediately upstream of the Pennsylvania Avenue bridge. The City of Sheboygan and the Wisconsin Public Service Corporation will be sharing the cost of an investigation of the site during the summer of 1992. The Wisconsin Public Service Corporation is a successor to the Sheboygan Coal Gas Company, the original operator of the gasification plant.

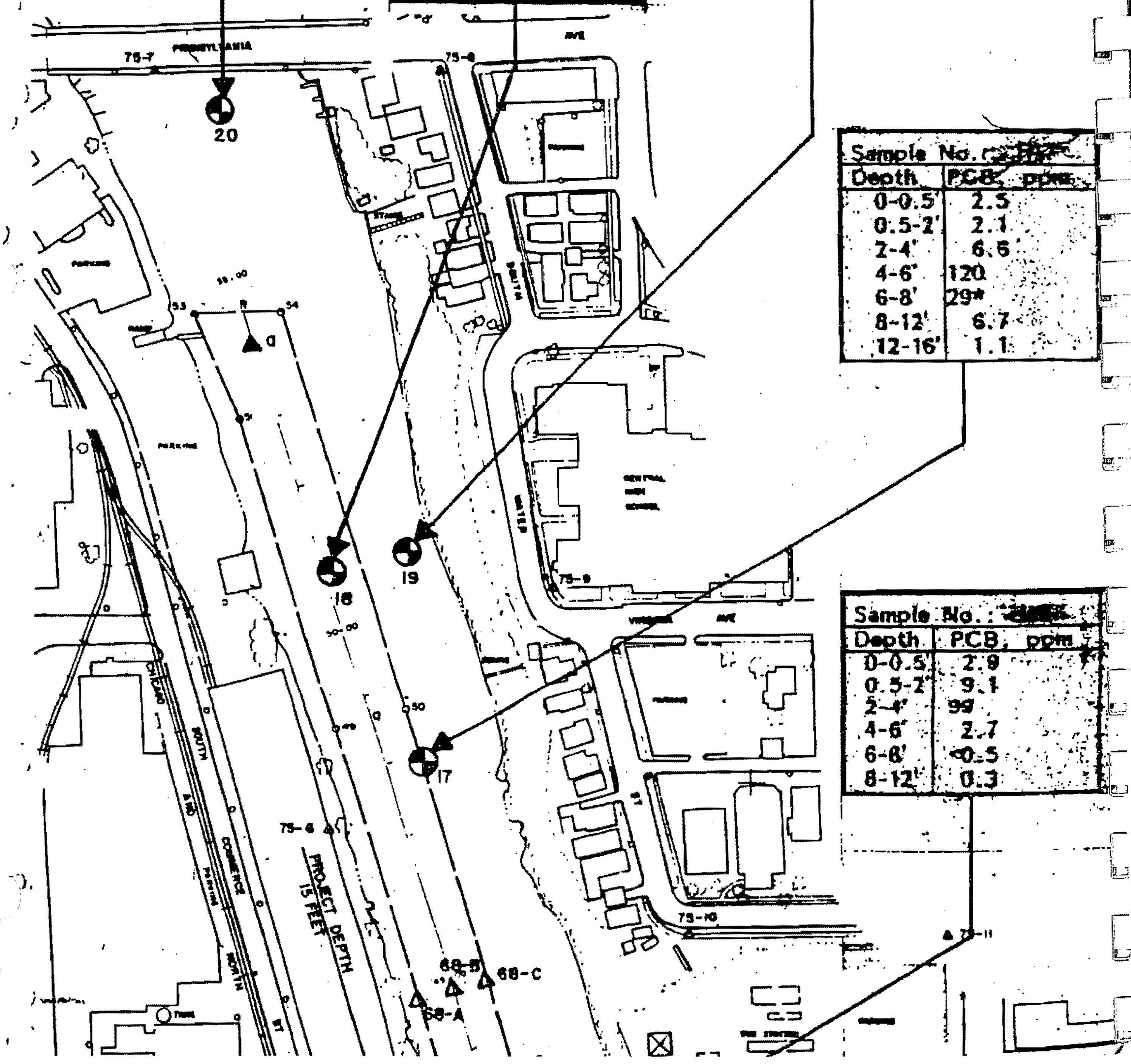
Sample No.: H20	
Depth	PCB, ppm
0-0.5'	1.7
0.5-2'	10.3
2-4'	1.0*
4-6'	0.2
6-8'	<.05
8-12'	0.13

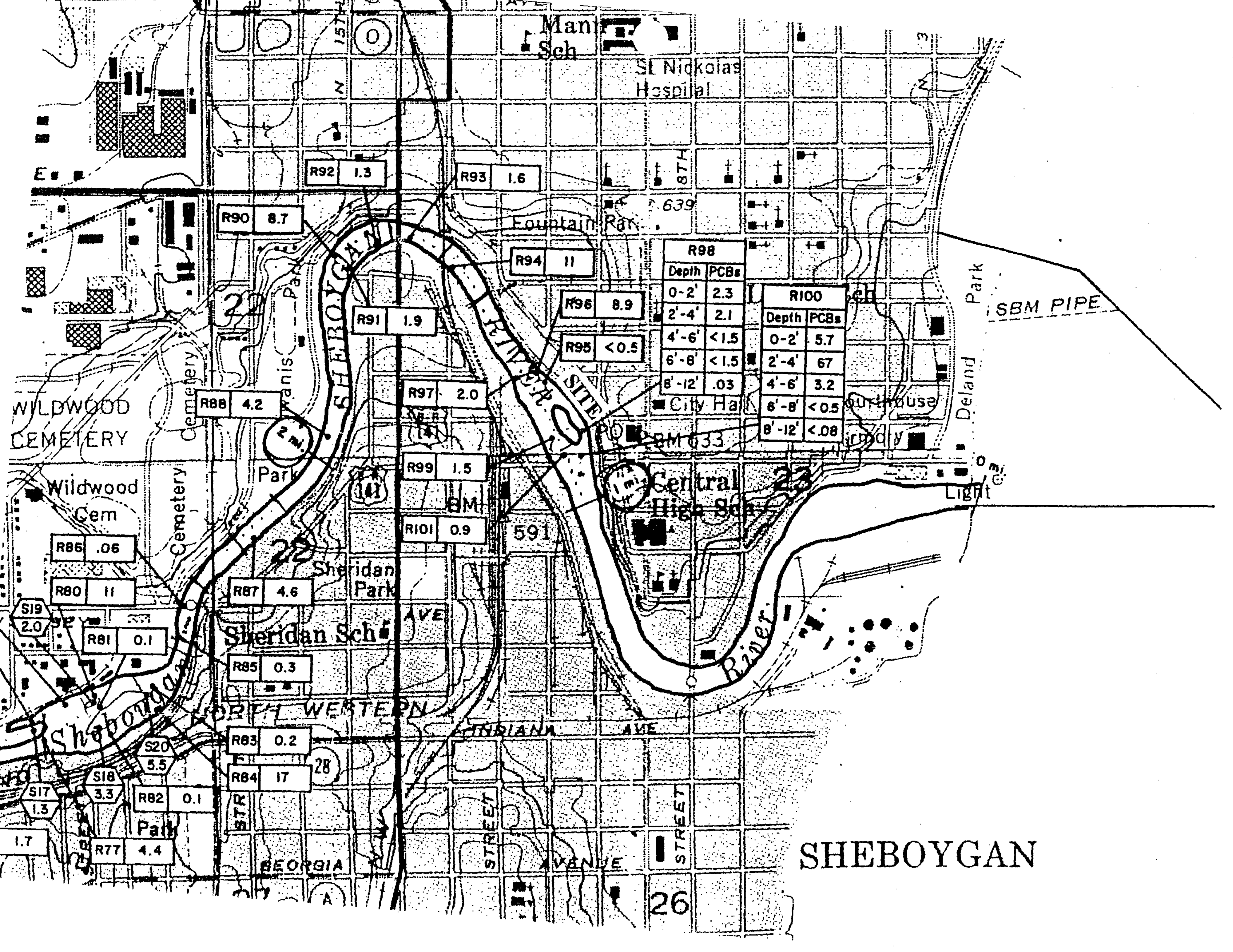
Sample No.: H18	
Depth	PCB, ppm
0-0.5'	2.5
0.5-2'	12
2-4'	108
4-6'	20
6-8'	13
8-12'	17
12-16'	2.2
16-20'	0.42*

Sample No.: H19	
Depth	PCB, ppm
0-0.5'	3.3
0.5-2'	7.3
2-4'	0.18
4-6'	1.3
6-8'	
8-12'	0.13

Sample No.: [redacted]	
Depth	PCB, ppm
0-0.5'	2.5
0.5-2'	2.1
2-4'	6.6
4-6'	120
6-8'	29*
8-12'	6.7
12-16'	1.1

Sample No.: [redacted]	
Depth	PCB, ppm
0-0.5'	2.9
0.5-2'	9.1
2-4'	99
4-6'	2.7
6-8'	<0.5
8-12'	0.3




Mann Sch
St Nickolas Hospital
R92 1.3
R93 1.6
R90 8.7
639
Fountain Park
R94 11
R98
Depth PCBs
0-2' 2.3
2'-4' 2.1
4'-6' <1.5
6'-8' <1.5
8'-12' .03
R100
Depth PCBs
0-2' 5.7
2'-4' 67
4'-6' 3.2
6'-8' <0.5
8'-12' <.08
R96 8.9
R91 1.9
R95 <0.5
SBM PIPE
Park
Deland
SHEBOYGAN RIVER
SITE
WILDWOOD CEMETERY
Cemetery
R88 4.2
2 mi.
R97 2.0
City Hall
Courthouse
BM 633
Park
R99 1.5
1 mi.
Central High Sch
23
0 mi.
Light
Wildwood Cem
BM
591
R101 0.9
R86 .06
22
Sheridan Park
R80 11
R87 4.6
S19 2.0
R81 0.1
Sheridan Sch
AVE
R85 0.3
River
Sheboygan
NORTH WESTERN
INDIANA AVE
R83 0.2
S20 5.5
R84 17
28
S18 3.3
S17 1.3
R82 0.1
Park
1.7
R77 4.4
GEORGIA AVENUE
STREET
26
SHEBOYGAN

Natural
Resource
Technology, Inc.
N R T

July 9, 2004
(1665)

Mr. John Feeney
Wisconsin Department of Natural Resources
W5750 Woodchuck Lane
P.O. Box 408
Plymouth, Wisconsin 53073

RE: Draft Remedial Investigation/Feasibility Study Work Plan
Former Wisconsin Public Service Corporation Manufactured Gas Plant Site
732 North Water Street, Sheboygan, Wisconsin

Dear Mr. Feeney,

On behalf of Wisconsin Public Service Corporation (WPSC), please find enclosed two copies of the above mentioned report for Sheboygan River sediments adjacent to the Former Campmarina Manufactured Gas Plant. The work plan includes the Data Management Plan, Feasibility Study Scope of Work, Quality Assurance Project Plan (QAPP), Sampling and Analysis Plan (SAP), and proposed schedule.

Please note that the analytical and toxicity testing laboratories and subconsultants have not been identified at this time. Natural Resource Technology, Inc. (NRT) is currently evaluating proposals to conduct these tasks. Once the analytical and toxicity testing laboratories are contracted, NRT will provide their respective Quality Assurance Manuals for inclusion in the final QAPP.

A review fee in the amount of $500 is enclosed. The proposed schedule (Section 6.0 of the Work Plan) allows 60 days for Wisconsin Department of Natural Resources (WDNR) to review the document and provide comments. During this time, NRT will be assembling the project team to conduct Phase I field activities beginning in October 2004.

NRT will be calling you in approximately one week to schedule a meeting in approximately 2 weeks for review of the work plan and discuss any initial questions you may have. We look forward to receiving review comments from you. If you have any questions, please call the undersigned.

23713 W. Paul Road, Unit D • Pewaukee, WI 53072 • (262) 523-9000 • Fax (262) 523-9001
www.naturalrt.com

Sincerely,

NATURAL RESOURCE TECHNOLOGY, INC.

Richard H. Weber/jmk

Richard H. Weber, P.E.
Project Manager

Jennifer M. Kahler

Jennifer M. Kahler, E.I.T.
Project Engineer

Encl.: Draft Remedial Investigation/Feasibility Study Work Plan (2 copies)
$500 Review Fee, Check Number 14278

Cc: Mr. Pablo Valentine, USEPA (2 copies)
Ms. Shirley Scharff, Wisconsin Public Service Corporation (1 copy)
Mr. Mark Thimke, Foley and Lardner (w/o enclosures)

[1665/corres/1665 WDNR EPA trans RI FS 07090408]