Bruce Urben-LMC
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ARCS V

Remedial Activities at Uncontrolled Hazardous Waste Sites in Region V

EPA United States Environmental Protection Agency

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Mr. Jon Peterson (5HSRW-6J)
Remedial Project Manager
U.S. EPA Region 5
77 W. Jackson Boulevard
Chicago, IL 60604

Subject: N.W. Mauthe, WI—Final Design Submittal
WA No. 88-5N6G; Contract No. 68-W8-0040

Dear Jon:

Please find enclosed a copy of the Final Design Submittal for the N.W. Mauthe Remedial Design. This submittal includes a description of the remedial design as well as final versions of the Health & Safety Plan, QAPP, Cleanup Verification Plan, Contingency Plan, Groundwater Monitoring Plan, and Construction Quality Assurance Plan. The documents were revised from the 75 percent design submittal based on comments received from U.S. EPA and from Gary Edelstein and Terry Koehn with WDNR. This submittal does not include a final copy of the Subcontract Documents, which were submitted previously under separate cover.

Please call me if you have any questions or comments.

Sincerely,

CH2M HILL

Cathy Barnett

Cathy Barnett
Site Manager

MKE10015DEF.DOC
Enclosure
cc: Stephen Nathan/PO/U.S. EPA Region 5 (w/o enclosure)
Brigitte Manzke/CO/U.S. EPA Region 5 (w/o enclosure)
Gary Edelstein/WNDR (3 copies)
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Final Design Submittal

N.W. Mauthe Site
Appleton, Wisconsin

WA No. 88-5N6G / Contract No. 68-W8-0040

Prepared by

CH2M HILL

May 1995

MKE100154CC.WP5

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MKE100154CD.WP5

N.W. Mauthe Site Remedial Action Final Design Submittal

This technical report summarizes the remedial design (RD) activities for the N.W. Mauthe (Mauthe) Superfund site in Appleton, Wisconsin.

Objective of Remedial Design Submittal

This design submittal includes the basis for the RD and the supporting plans required during remedial action (RA) activities. Final design plans (technical specifications and drawings) were submitted previously. The supporting plans consist of the following:

- A Health and Safety Plan (HASP) that describes the health and safety procedures to be followed by CH2M HILL during RA activities.
- A Quality Assurance Project Plan (QAPP) for analytical testing during RA. The QAPP was approved by the U.S. Environmental Protection Agency (U.S. EPA) Quality Assurance Section (QAS) on February 8, 1995.
- A Cleanup Verification Plan (CVP) that describes the procedures to be used during the excavation of hot spot soils to demonstrate that cleanup has been achieved.
- A Contingency Plan (CP) that discusses procedures to be used in the event of an accident or emergency at the site during RA activities.
- A Construction Quality Assurance Plan (CQAP) that describes the site-specific construction components of the quality assurance program that will ensure that the completed project meets or exceeds all design criteria.

Site Description and History

The Mauthe site is a former electroplating facility located at 725 South Outagamie Street in Appleton, Wisconsin. About 0.6 acre in size and triangular in shape, the site is located in an area of mixed commercial, light industrial, and residential properties. The facility consisted of two buildings (the Zinc and Chromium Buildings). The site is bordered by Melvin Street on the north, an asphalt parking lot owned by Miller Electric and Manufacturing Company on the west, and the Fox Valley & Western, Ltd., railroad on the southeast. Private residences are located immediately south of the railroad tracks and on the north side of Melvin Street (Figure 1).

Hard chromium plating was conducted in the Chromium Building from 1960 to 1976. Objects to be electroplated were rinsed with a chlorinated solvent to remove oils and then submerged in plating solution baths. Hydrogen gas and chromic acid vapors generated from the plating process were exhausted from the building by a ventilating fan, whereas splashes, drips, and spills from the plating and degreasing activities were directed to a shallow floor trench and channeled into the sanitary sewer system.

Zinc, cadmium, copper, and possibly silver were electroplated in the Zinc Building from 1978 to 1987. A *Pretreatment Baseline Report* submitted by the Mauthe Company to the City of Appleton on January 4, 1985, states that the company used 1,1,1-trichloroethane (27 gal/year) for parts degreasing and several plating bath solutions in the electroplating process. Liquid wastes were discharge, untreated, into the sanitary sewer system.

In 1982, the Wisconsin Department of Natural Resources (DNR) received a report of yellow-green water in puddles south of the Chromium Building. Over the years, plating solutions and waste solvents had leaked from holding vats, tanks, and channels into surrounding soils. Additionally, plating tank solutions were allegedly discharged onto the ground outside the building by sump pumps.

The DNR began an investigation of the site in April 1982. Surface water removal actions also began at that time. A total of 18 monitoring wells were installed. Soil boring samples and groundwater samples revealed contamination at the site. Under contract to the DNR, Commercial Pumping and Incineration installed a shallow groundwater collection system parallel to the railroad track in May 1982. For 2 years, shallow groundwater and surface water were collected and transferred to the De Pere publicly owned treatment works (POTW). The Mauthe site was added to the National Priorities List (NPL) in 1989 based on information gathered during several rounds of environmental sampling and health assessments.

A remedial investigation (RI) was performed for the DNR by CH2M HILL from November 1991 to May 1992. The RI included monitoring well installation; surface and subsurface soil sampling; test pit excavation; groundwater, residential, sump, and sewer water sampling; hydraulic conductivity testing; surface water sampling; and videotaping of the sanitary and storm sewer lines. The results of the RI are documented in the *Remedial Investigation Report, N.W. Mauthe Site, Appleton, Wisconsin* (CH2M HILL February 1993).

Soil and groundwater sampling results showed the greatest concentrations of hazardous substances in the area around the Zinc and Chromium Buildings. The chemicals most often detected above background levels or state groundwater standards include chromium (both hexavalent and total), zinc, cadmium, cyanide, trichloroethene, 1,1,1-trichloroethane, 1,1-dichloroethene, and toluene.

Subsurface soil contamination was detected to a maximum depth of 25 feet. Subsurface soil contamination extended horizontally over the entire Mauthe property and to the south side of the railroad tracks adjacent to the property. Outside the process buildings area,

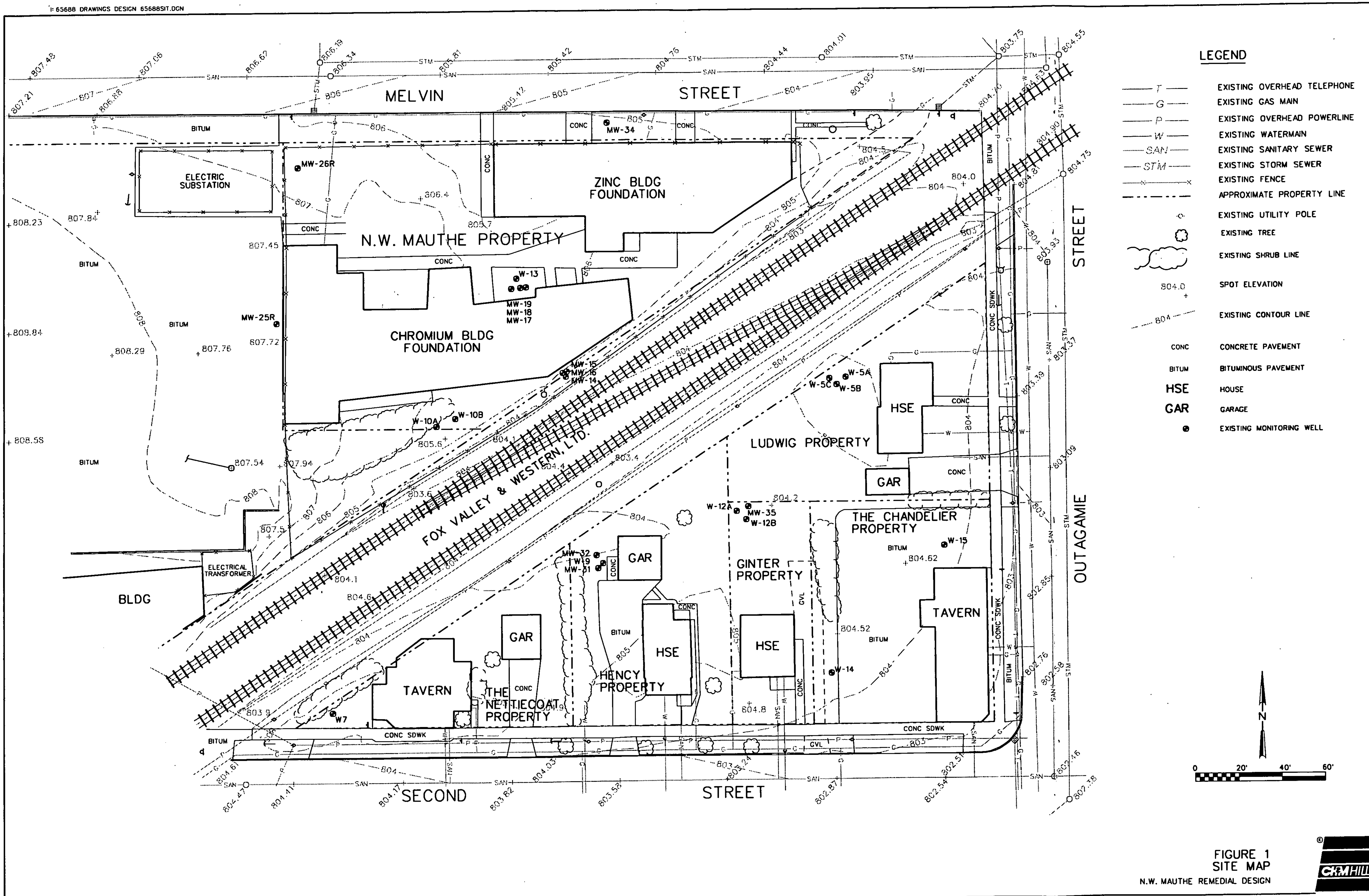

FIGURE 1
SITE MAP
N.W. MAUTHE REMEDIAL DESIGN

CH2M HILL

the vertical extent of contamination is more limited and does not extend to the 25-foot depth observed near the buildings. Chromium is the most widely distributed contaminant of the chemicals analyzed for in the RI. Selected volatile organic compounds (VOCs) were detected in subsurface soils but have a more limited distribution.

Hexavalent chromium-contaminated groundwater extends over most of the block bordered by Melvin, Outagamie, and Second Streets. Most or all of the chromium in groundwater exists in the hexavalent form.

Surface water samples collected from puddles along the southern edge of the Mauthe property contained chromium and some VOCs.

A feasibility study (FS) was conducted by CH2M HILL to develop and evaluate RA alternatives for the site *(Feasibility Study Report, N.W. Mauthe Site, Appleton, Wisconsin,* CH2M HILL, May 1993). The DNR, in consultation with the U.S. EPA, used the information presented in the FS Report to select a RA alternative in its Record of Decision (ROD) in accordance with the National Contingency Plan (NCP). The ROD was signed in March 1994. The remedial actions required at the site are as follows:

- Demolition and removal of the buildings of the Mauthe property
- Removal and disposal of containerized waste stored on the property
- Improvement or installation of foundation drain systems and cleaning, painting, or sealing of basement walls or floors, as needed, for homes or businesses in the area of the site affected by site contamination
- Excavation of soils with a total chromium concentration greater than 500 mg/kg
- Offsite treatment and disposal of the excavated soils
- Backfilling of the excavation
- Capping of the site with 2 feet of clay soil and topsoil, with the establishment of vegetative cover
- Installation of groundwater collection trenches and construction and operation of a groundwater treatment facility with discharge to the sanitary sewer
- Promulgation of institutional controls to prevent access, excavation, disturbance of the cap, future excavation in contaminated soils, and installation of drinking water wells
- Monitoring the effectiveness of the groundwater treatment system

- Operation and maintenance of all systems

The demolition of site buildings and the removal and disposal of the containerized waste was accomplished in the fall 1994 during remedial design.

The RD was split into two parts to allow a trench test to be completed on a portion of the groundwater collection system before design of the groundwater treatment facility. This submittal addresses those portions of the RD that relate to construction of the groundwater collection system, removal of hot spot soils, and miscellaneous work on neighboring properties. A separate submittal will be prepared to address the RD for the groundwater treatment facility.

Basis of Remedial Design

This section presents the design analyses used in the development of the technical plans and specifications presented in this submittal. The section is organized by the major design/construction tasks anticipated for the RA. A brief description of each task is presented along with applicable design criteria and considerations. Design information presented is based on data and information gathered during the RI and RD field investigations.

General Requirements

General Requirements are intended to provide information necessary for the subcontractor to address details not directly related to the specific construction tasks specified in the Technical Specifications. They include general site information such as site conditions, access, easements and permits, mobilization, and health and safety requirements.

Site Conditions, Access, Easements, and Permits

Documents containing information about site conditions will be made available to the subcontractor. The subcontractor will be responsible for permits related to construction activities. The U.S. EPA will obtain permits and access agreements that require long lead-time or affect the design. Specific responsibilities are discussed below. Permits related to the groundwater treatment system will be presented in the design submittal related to groundwater treatment.

Subcontractor Responsibilities. The subcontractor will be responsible for obtaining and complying with any required permits during the RA except for those specifically obtained by the U.S. EPA. Per the National Contingency Plan (NCP), permits are not required for work performed entirely onsite; however, substantive requirements of permits must be followed.

The subcontractor will be required to perform all work in accordance with applicable local, state, and federal regulations. Federal and State of Wisconsin applicable or relevant and appropriate requirements (ARARs) for the RA are listed in Table 1.

Permits and Agreements to be obtained by the U.S. EPA. The U.S. EPA is responsible for obtaining the following permits or access agreements:

- A permit for construction activities to be performed on Fox Valley & Western, Ltd., right-of-way. CH2M HILL submitted technical information to be used to obtain the railroad permit on October 17 and December 7, 1994. Negotiations with the railroad have not been finalized. The subcontract documents separated the work that would require removal of the railroad tracks from the other activities as alternate work. This provides the flexibility to continue construction during the negotiations.

- Access agreements from the residences and businesses affected by the work: the Ludwig residence, the Hency residence, the Ginter residence, the Chandelier, the Nettiecoat, and Miller Electric.

- A permit for construction activities to be performed on City of Appleton property. This applies to all work within the street right-of-way including the construction of the groundwater collection trench that runs through Second Street. CH2M HILL submitted a copy of the project plans and specifications to the city on January 31, 1995. The City had no comments or requests for changes. A final construction permit will be obtained by the subcontractor prior to construction.

Mobilization

The subcontractor is responsible for mobilization of subcontractor personnel and equipment and for the mobilization and maintenance of site office and equipment trailers and portable toilets. The subcontractor will also provide a site office for CH2M HILL. The subcontractor will provide utility hookups to site trailers and any additional utility hookups required for the RA.

The subcontractor will be responsible for the proper disposal of all hazardous and nonhazardous waste generated during the RA, including disposal of personnel protection gear, decontamination water, and general sanitary wastes.

Health and Safety Requirements

The health and safety of subcontractor personnel will be the subcontractor's responsibility. The subcontractor will be responsible for the health and safety training (if required) of personnel at the site and will supply health and safety equipment for subcontractor personnel. It is anticipated that all work will be performed in Level D

Table 1
ARARs for the N.W. Mauthe Site Remedial Action
Related to Construction Activities

Law, Regulation, or Policy	Applicability
Federal	
40 CFR 260 through 264 Resource Conservation and Recovery Act (RCRA)	Regulates the generation, transport, storage, treatment, and disposal of hazardous wastes in the course of remedial action. RCRA requirements may apply to the stockpiling, treatment, transport, and disposal of excavated soils and sludges.
40 CFR 51 Clean Air Act of 1963 (revised??)	Sets Ambient Air Quality Standards. The standards would be applied to discharges of toxic substances to the atmosphere during waste handling and treatment.
OSHA Standard, Part 1910 Occupational Safety and Health Act	Regulates working conditions to ensure safety and health of workers.
State of Wisconsin	
NR 140 Groundwater Quality	Specifies groundwater quality preventative action limits and enforcement standards.
NR 141 Monitoring Well Construction and Abandonment	Specifies construction and abandonment standards for monitoring wells.
NR 149 Groundwater Testing Procedures	Regulates laboratory procedures and requirements for groundwater monitoring analysis.
NR 158 Spills	Establishes actions and procedures for discharges of hazardous substances. This relates to unintentional spills and discharges of hazardous substances.
NR 200 Application for Discharge Permit	WPDES permits are not required for onsite discharges, however, all the substantive requirements must be met.
NR 610 through 615 Small and Large Generator Standards	Specifies transportation standards for hazardous waste based on RCRA standards.
NR 675 Land Disposal Restrictions	Identifies hazardous wastes that are restricted from land disposal and defines exceptions. Soil and debris exceeding TCLP levels or considered to contain listed waste-type contamination may not be disposed in a landfill without treatment.

personal protective equipment. The subcontractor will be required to submit a Site Health and Safety Plan to CH2M HILL for review before implementation of the RA. A copy of CH2M HILL's HASP will be provided to the subcontractor as a courtesy.

The subcontractor will be required to monitor the air for the protection of his workers. CH2M HILL will monitor the air at the site boundaries and for the protection of CH2M HILL workers and will initiate controls, if necessary, to reduce emissions.

Earthwork

Clearing, Grubbing, and Stripping

Clearing, grubbing, and stripping will be performed before hot spot soil excavation. Small trees and shrubs in the southwest area of the Mauthe property and trees and shrubs on the Hency property will be cleared and grubbed. Cleared materials and vegetative strippings are considered noncontaminated and will be disposed of offsite.

Stripped topsoil may be contaminated. Topsoil will be stockpiled on the Mauthe site for testing and handled in the same manner as the excavated soil. If the topsoil is determined to be nonhazardous (i.e., has a concentration of total chromium less than 50 mg/kg), it may be reused during surface restoration.

Groundwater Collection System

The groundwater collection system consists of three trenches as described below:

- The West Trench that crosses the Miller Electric Property to the west of the site.
- The Central Trench that runs south of the site parallel to the railroad tracks.
- The Southeast Trench that runs along Second Street and Outagamie Street.

The West Trench and the Southeast Trench are located beyond the estimated extent of groundwater contamination and are designed to prevent the further migration of contamination. The Central Trench is designed to prevent further migration of hazardous substances from the property and to reverse the groundwater hydraulic gradient between the site and the residences to the south.

The groundwater collection trenches will include a 6-inch perforated high density polyethylene (HDPE) collection pipe buried in filter material. The groundwater will be directed through the trenches to manholes where the water will be collected and pumped to the groundwater treatment facility. Pumps will be installed during the installation of the groundwater treatment facility.

The filter material was sized to satisfy gradation requirements between the native soil and the filter material without having to use a geotextile for separation. The use of a geotextile was avoided for the following reasons:

- Placement of the geotextile could cause smearing of the sidewalls.

- The geotextile could reduce water infiltration into the trench because of biological or chemical growth on the fabric or physical clogging.

Calculations on the selection of the gradation for the filter fabric are presented in Appendix A.

Hot Spot Soil Excavation

Soil excavation will be performed for the hot spot soil removal and for the construction of the groundwater collection trenches. All soil that is excavated will be tested to determine the proper method of disposal.

The area of hot spot removal was defined during the FS as the area where the concentration of total chromium exceeds 500 mg/kg. The limits of hot spot contamination were estimated during the FS and will be presented in the Drawings. The subcontractor will be informed that the limits may change in the field.

Excavation of the hot spot areas will be performed in the following manner:

- The subcontractor will remove a volume of soil from within the area designated as a hot spot in the drawings. The volume removed will be about one truck load or rolloff container (15 to 20 cubic yards).

- The subcontractor will stockpile the material onsite or in a truck or rolloff container.

- CH2M HILL will test the soil using an X-ray Fluorescence (XRF) Spectrometer to determine the level of contamination. Sampling methods are described in detail in the QAPP.

- If the concentration of chromium exceeds 500 mg/kg, the material will be removed to a hazardous waste facility for stabilization and disposal at a Subtitle D landfill.

- If the concentration of chromium is between 100 and 500 mg/kg, a sample will be collected for toxicity characteristic leaching procedure (TCLP) testing. If the material is TCLP characteristic, the soil will be disposed of as hazardous. If the material is not TCLP characteristic, the soil will be disposed of as special waste at a Subtitle D landfill. If a relationship between the concentration of chromium and the results of the TCLP testing can be developed, the disposition of the soil may be determined without additional TCLP tests.

- If the concentration of chromium is between 50 and 100 mg/kg, the soil will be disposed of as special waste at a Subtitle D landfill.

- If the concentration of chromium is less than 50 mg/kg, the soil will be used as onsite backfill.

The detection limits on the XRF spectrometer are dependent on the soil characteristics and the concentration of chromium and other metals within the soil. The detection limit with the XRF is typically around 50 mg/kg. However, interference from iron may increase the detection limit to 100 mg/kg. The XRF will be calibrated prior to use during construction to develop a relationship between the XRF readings and actual contaminant concentrations. A detailed description of the calibration process is presented in the QAPP.

Once the limits of expected hot spot contamination have been excavated, verification sampling will be performed in accordance with the CVP and the QAPP.

The volumes of soil to be excavated were estimated as described below:

- Hot spot soil (chromium concentration greater than 500 mg/kg): 7,100 cubic yards (cy)

- Additional soil excavated in order to perform the hot spot removal (estimated chromium concentration between 100 and 500 mg/kg): 1,800 cy

- Soil excavated for the construction of the groundwater collection trench system:

  - Total chromium concentration between 100 and 500 mg/kg: 70 cy
  - Total chromium concentration between 50 and 100 mg/kg: 300 cy
  - Total chromium concentration below 50 mg/kg: 3,000 cy

  Assumptions:

  - Soil excavated from the Central Trench was divided into each level based on the contours presented in the FS Report.

  - Soil excavated from the other trenches is assumed to be less than 50 mg/kg based on the RI results.

Waste haulers must be licensed by the Wisconsin Department of Transportation (DOT) as hazardous waste haulers and must comply with all federal, state, and local regulations regarding the handling and transport of such material. The RCRA facility accepting the waste must be in compliance with all applicable federal and states regulations and the U.S. EPA Offsite Policy.

Backfilling

The hot soil excavations will be backfilled with project soil determined to be nonhazardous or clean imported fill. The total volume of hot spot excavation to be backfilled is about 9,000 cy. Assuming that about 3,000 cy of backfill will come from the excavation of the groundwater collection trenches, an additional 6,000 cy of material will need to be imported.

A portion of the excavation may be backfilled with pea gravel to act as a supplemental groundwater collection sump. This collection area would be connected to the West Trench by an additional trench. Collected groundwater would gravity flow from the collection sump to the West Trench. A discussion of the collection sump is presented below.

A soil cover will be constructed over the backfilled hot-spot area on the Mauthe property. The soil cover will consist of 2 feet of compacted clay overlain by 6 inches of topsoil. A granular fill will be placed over the clay in the area that will serve as the foundation to the groundwater treatment facility.

Groundwater Collection and Disposal

The subcontractor will be responsible for dewatering the groundwater collection trenches and hot spot excavations as necessary to complete the construction activities. Groundwater must be collected and tested to determine proper disposal. The subcontractor is responsible for proper disposal of the groundwater.

Surface Water Collection

Surface water that collects on the soil cover over the Mauthe property will be directed through ditches to storm sewers on Melvin Street and Outagamie Street. The surface water ditches along the railroad tracks will be reconstructed following the hot spot removal to provide for adequate collection and conveyance of surface water. An existing culvert on the south side of the tracks will be replaced to provide an appropriate gradient for surface water flow. A new culvert will be installed north of the tracks. Surface water calculations are presented in Appendix A.

Additional Work on Adjacent Properties

Miscellaneous activities will be performed on the properties adjacent to the site in addition to the work related to the hot spot excavation and groundwater collection system as described below.

Foundation drain systems will be installed around the following structures:

- The Hency Residence
- The Ginter Residence

The drain system will consist of a 2-foot-thickness of filter material. A 4-inch perforated pipe will run along the base of the drain system. Groundwater collected within the system will be directed to the closest groundwater collection trench through a lateral drainage pipe.

The Ludwig residence already has a foundation drain. It will be connected to the Center Trench by a lateral drainage pipe. The sump from the Nettiecoat Junction will also be directed to the Southeast Trench by a lateral drainage pipe. The property owner will select the method of tie-in from the foundation drain or sump to the groundwater collection system. The following options are proposed:

- Allowing gravity flow from the basement system to the trench with a check valve to prevent back-up from the trench into the basement system. DNR would provide courtesy checks on the check valve during flood events.

- Using a sump pump to convey the groundwater from the basement to the trench via a force main.

- Using a sump pump to convey water out of the foundation system with gravity flow to the collection system.

Maintenance of the sump pump would be the responsibility of the property owner. In addition to the exterior work, the interior walls and floors of the Hency, Ginter, and Ludwig residences will be cleaned and sealed with an epoxy coating.

The Hency garage, which is located over the hot spot excavation area, will be demolished and replaced in kind following excavation and backfill.

Site Restoration

The subcontractor will be required to restore the surface of all disturbed areas. The parking areas disturbed (on the Miller Electric property and at the Chandelier) will be restored to existing condition. A temporary asphalt patch will be placed over the excavation along Second Street in accordance with City of Appleton requirements. The City of Appleton will provide the permanent patch on the street and will submit a bill to the U.S. EPA for the work.

The yards of the residents and businesses will be seeded, fertilized, and mulched. The subcontractor will execute necessary measures to minimize soil erosion until the seed develops an adequate root system. Trees and shrubs removed during construction will be replaced. A residential fence will be installed along the north property line of the Ludwig and Hency properties.

Final restoration will not be performed on the Mauthe site under this subcontract. Provisions for final restoration will be included in the subcontract for the construction of the groundwater treatment facility because that subcontract will involve additional work in the area that would disturb seeding. The subcontractor will be required to install silt fence around the site to reduce erosion.

Construction Documentation

A construction documentation report will be prepared at the completion of construction. This report will summarize the work performed and deviations from the subcontract documents. It will be prepared in general conformance with NR 516 and NR 724.13. The subcontractor will supply information that will be used in the report, such as record drawings and survey data, but the final report will be prepared by CH2M HILL.

Excavation Area Groundwater Collection Sump

The ROD for the site includes the possibility of converting the excavated hot spot area into a groundwater collection sump *if it is determined during RD that the addition of such a sump would significantly hasten achievement of remedial goals for soil and groundwater*. A qualitative evaluation was performed to evaluate this possibility. The sump would be constructed by backfilling the excavation with a permeable material and directing the groundwater collected to the West Trench through a trench. A quantitative evaluation was not attempted because of the variable nature of the subsurface conditions.

The inclusion of a groundwater sump in the hot spot excavation area would result in the initial removal of highly contaminated groundwater from the unexcavated soil within the radius of influence of the sump. A significant portion of this groundwater is expected to be collected during excavation activities as the groundwater seeps into the excavation. Once this initial quantity of contaminated groundwater has been removed from the sump, no additional benefit would be expected due to the very slow groundwater velocities observed at the site. There is limited additional benefit due primarily to the hydraulic conductivity (including fracturing) of the materials at the site and the proximity of the groundwater collection trenches. In addition, the installation of the sump may reduce the amounts of contamination flushed from the remaining site soils downgradient of a groundwater sump. Since capping of the site will minimize infiltration of surface water into the site soils and infiltration provides a significant amount of recharge to the materials, a sustainable yield of groundwater to the sump is unlikely. The collection sump may intercept a portion of the groundwater migrating through soil at the site, precluding it from flushing through the contaminated soil downgradient.

The proposed groundwater collection sump is shown in Figure 2. The sump is located in one of the areas with the greatest soil contamination—beneath the former location of the Chromium Building. The estimated cost for including the sump in the RA is $133,000. Details on the cost estimate are presented in Appendix A.

The groundwater collection sump will not be constructed. The U.S. EPA and the WDNR determined that the sump would not provide a substantial benefit to the project.

Air Monitoring

An evaluation of the concentrations of contaminants in the soil was performed to determine if fenceline monitoring would be necessary during construction to protect offsite residents.

The potential risks during remediation were calculated using the methodology in Risk Assessment Guidance for Superfund: Volume 1—Human Health Evaluation Manual (Part B, Development of Risk-based Preliminary Remediation Goals), U.S. EPA, December 1991 (RAGs Part B). The transport of volatiles to a residential receptor at the site fenceline was modeled in accordance with Section 3.3.1 of RAGS Part B, and the transport of particulates (PM10) was modeled in accordance with RAGS Part B Section 3.3.2. The onsite maximum observed soil contaminant concentrations for volatiles and an average of the observed contaminant concentrations for particulates were used in the model. The results of the evaluation are presented in Table 2.

The calculated risks are conservative in that all of the particulates and volatiles to be inhaled are assumed to come from the site. The duration of exposure is assumed to be 2 months.

No chemical-specific excess lifetime cancer risk exceeds 1×10^{-6}. The sum of the exposed-based cancer risk is 5×10^{-8}. The hazard quotient based on noncarcinogenic contaminants is less than 1 for each specific chemical; the hazard index is also less than 1 at 0.39.

This evaluation demonstrates that the potential risk to offsite residents during RA activities does not warrant fenceline monitoring. Onsite workers will perform monitoring in accordance with the HASP. In addition, the subcontractor will be required to minimize the creation of dust through dust control measures such as wetting down the site.

Cost Estimate for Remedial Action

The cost estimate prepared for the 75 percent design was revised to reflect changes resulting from comments on the 75 percent design including comments from the

U.S. EPA, the WDNR, and the Corps of Engineers; fine-tuning of information including the trenching methods specified; and comments from potential proposers. The contingency that had been applied at the 75 percent design stage was also eliminated.

The engineer's estimated cost for this portion of the RA is $ 5,788,221. Details on the cost estimate are presented in Appendix A.

Project Schedule

The current project schedule is presented on Figure 3. This schedule includes the remaining RD activities and RA for this portion of the work and for the groundwater treatment facility.

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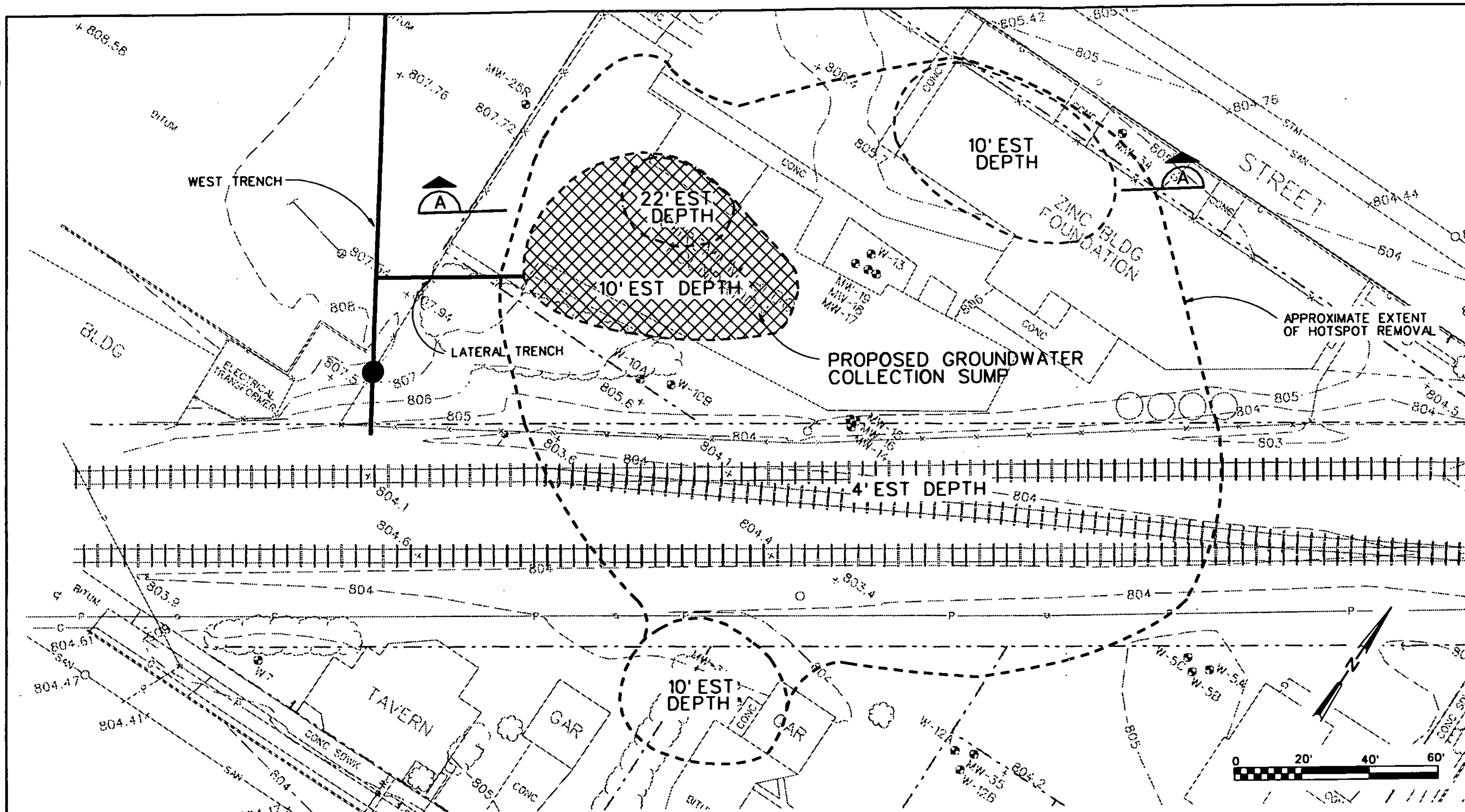
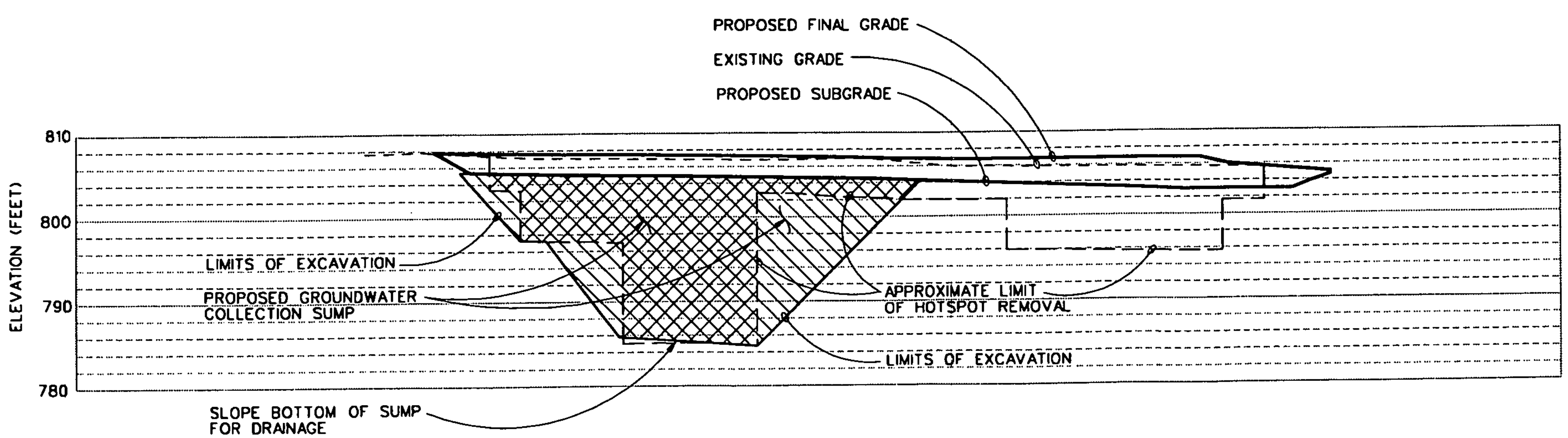


LEGEND

—— T ——	EXISTING OVERHEAD TELEPHONE
—— G ——	EXISTING GAS MAIN
—— P ——	EXISTING OVERHEAD POWERLINE
—— W ——	EXISTING WATERMAIN
—— SAN ——	EXISTING SANITARY SEWER
—— STM ——	EXISTING STORM SEWER
——x——	EXISTING FENCE
—·—·—	APPROXIMATE PROPERTY LINE
	EXISTING UTILITY POLE
	EXISTING TREE
	EXISTING SHRUB LINE
804.0 +	SPOT ELEVATION
804	EXISTING CONTOUR LINE
HSE	HOUSE
GAR	GARAGE
	EXISTING MONITORING WELL
- - - -	APPROXIMATE LIMITS OF HOTSPOT REMOVAL



SECTION A

0 20' 40' 60'

FIGURE 2
GROUNDWATER COLLECTION SUMP
N.W. MAUTHE REMEDIAL DESIGN

CH2M HILL

Table 2

N.W. Mauthe Risks due to Inhalation of Soil Particulates and Volatiles

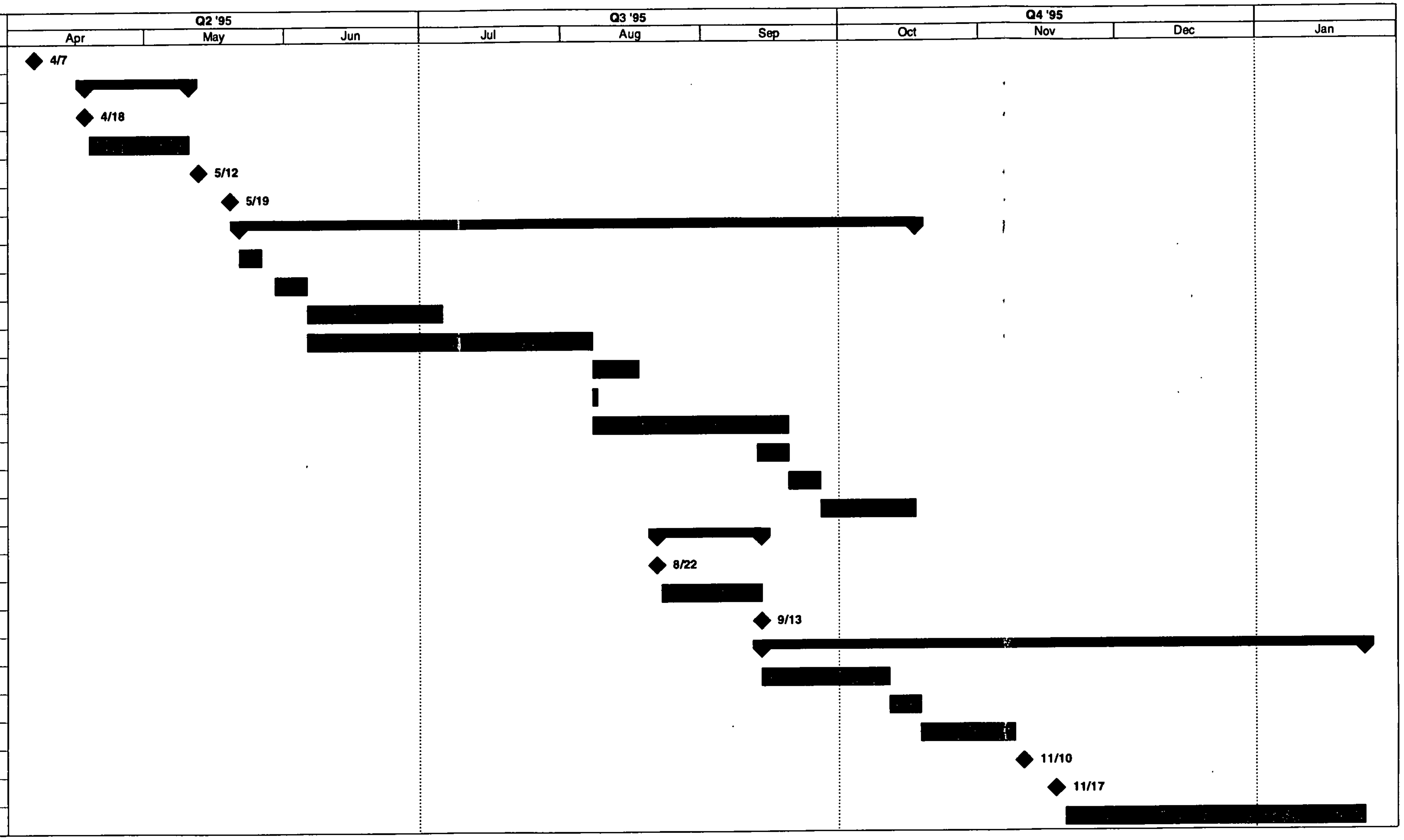
Chemical	Concentration in Soil µg/kg	Exposure Based Risk: Cancer Risk	Exposure Based Risk: Noncancer Hazard Index	Oral Slope Factor (mg/kg/day)	Inhalation Slope Factor (mg/kg/day)	Oral RfD (mg/kg/day)	Inhalation RfD (mg/kg/day)	Soil to Air Volatilization Factor [VF] (m3/kg)	Molecular Diffusivity [Di] (cm2/sec)	Henry's Law Constant [H] (atm-m3/mol)	Soil/water Partition Coefficient [Kd] (cm3/g)	Soil/air Partition Coefficient (g soil/cm3 air)	Effective Diffusivity (cm2/s)	Organic Carbon Partition Coefficient [Koc]
Volatile Organic														
Carbon tetrachloride	7	2.3E-11	–	0.13	0.0525	0.0007	–	11476	0.074996	2.00E-02	9E+00	0.0939	0.0530	436.516
Chloroform	4	2.8E-11	–	0.0061	0.0805	0.01	–	7880	0.08345	3.75E-03	9E-01	0.1761	0.0590	43.6516
1,1-dichloroethane	2	–	7.9E-07	–	–	0.1	0.14285	5145	0.0856	5.70E-03	6E-01	0.3869	0.0605	30.20
1,1-dichloroethene	32	3.6E-09		0.6	0.175	0.009	–	1063	0.08577	1.54E-01	1E+00	4.8896	0.0607	64.5654
Toluene	58	–	9.6E-06	–	–	0.2	0.11428	15519	0.0737	6.61E-03	5E+00	0.0527	0.0521	257
1,1,1-trichloroethane	1500	–	9.4E-05	–	–	0.09	0.2857	18298	0.0750	2.76E-03	3E+00	0.0374	0.0530	151
1,1,2-trichloroethane	13	2.8E-11	2.3E-06	0.057	0.056	0.004	–	18869	0.0750	9.61E-04	1E+00	0.0352	0.0530	56
Trichloroethylene (TCE)	3400	1.6E-09	–	0.011	0.00595	0.006	–	9098	0.0764	8.92E-03	3E+00	0.1453	0.0540	126
Metals														
Aluminum	17300000	–	–	–	–	–	–	–	–	–	–	–	–	–
Arsenic	9000	2.7E-08	2.1E-02	1.75	15.05	0.0003	–	–	–	–	–	–	–	–
Barium	154000	–	1.6E-03	–	–	0.07	0.00014285	–	–	–	–	–	–	–
Cadmium	3660000	3.4E-09	–	–	6.3	–	–	–	–	–	–	–	–	–
Chromium VI	2250000	1.4E-08	3.2E-01	–	42	0.005	–	–	–	–	–	–	–	–
Chromium III	15000000	–	1.1E-02	–	–	1	–	–	–	–	–	–	–	–
Copper	1310000	–	2.5E-02	–	–	0.037	–	–	–	–	–	–	–	–
Lead	1970000	–	–	–	–	–	–	–	–	–	–	–	–	–
Manganese (food)	972000	–	5.5E-03	–	–	0.14	0.00011428	–	–	–	–	–	–	–
Mercury	740	–	1.8E-03	–	–	0.0003	0.00008571	–	–	–	–	–	–	–
Nickel	36000	–	1.3E-03	–	–	0.02	–	–	–	–	–	–	–	–
Vanadium	48000	–	4.9E-03	–	–	0.007	–	–	–	–	–	–	–	–
Sum of Risks		5E-08	0.39											

Assumptions

Length - Side of Contaminated Area (m)	200
Wind Speed in Mixing Zone (m/sec)	2.25
Diffusion Height (m)	2
Area of Contamination (cm2)	35303155
Exposure Interval (s)	8E+08
True Soil Porosity (Unitless)	0.35
True soil/particulate density (g/cm3)	2.65
Organic carbon content of soil (fraction)	0.02
Body Weight (kg)	70
Averaging Time - Cancer risk (yr)	70
Averaging Time - Noncancer risk (yr)	0.167
Exposure Frequency (d/yr)	365
Exposure Duration (yr)	0.167
Soil Ingestion Rate (mg/day)	50
Inhalation Rate (m3/day)	20
Particulate Emission Factor (m3/kg)	5E+09

Figure 3
Schedule for RD and RA Activities
N.W. Mauthe Remedial Design

ID	Task Name	Dur	Start	Finish	Pred
1	Receive Work Assignment for RA	0d	4/7/95	4/7/95	
2	**Subcontractor Procurement for RA**	**17d**	**4/18/95**	**5/10/95**	1
3	Receive Proposals for Phase I	0d	4/18/95	4/18/95	
4	Review and Approval of Proposals	16d	4/19/95	5/10/95	3FS+1d
5	Notice of Award to Subcontractor for Phase I	0d	5/12/95	5/12/95	4FS+2d
6	Notice to Proceed to Subcontractor for Phase I	0d	5/19/95	5/19/95	5FS+5d
7	**Remedial Action**	**104d**	**5/22/95**	**10/17/95**	6
8	Subcontractor Mobilization	5d	5/22/95	5/26/95	6
9	Initial Site Work	5d	5/30/95	6/5/95	8
10	West Groundwater Collection Trench	21d	6/6/95	7/5/95	9
11	Hot Spot Excavation	44d	6/6/95	8/7/95	9
12	Central Groundwater Collection Trench	8d	8/8/95	8/17/95	11
13	Demo Hency Garage	1d	8/8/95	8/8/95	11
14	Southeast Groundwater Collection Trench	30d	8/8/95	9/19/95	11
15	Construct Hency Garage	5d	9/13/95	9/19/95	14FF
16	Site Restoration	5d	9/20/95	9/26/95	15
17	Demobilization	15d	9/27/95	10/17/95	16
18	**Design of Groundwater Treatment System**	**16d**	**8/22/95**	**9/13/95**	
19	Submit Final Design of GW Treatment Facility	0d	8/22/95	8/22/95	
20	Agency Review of GW Treatment Facility Desig	15d	8/23/95	9/13/95	19FS+1d
21	EPA Approval of GW Treatment Facility Design	0d	9/13/95	9/13/95	20
22	**Remedial Action GW Treatment System**	**92d**	**9/14/95**	**1/24/96**	21
23	Subcontract Documents to Bidders	20d	9/14/95	10/11/95	
24	Review Bids	5d	10/12/95	10/18/95	23
25	Subcontract Package to EPA for Review	15d	10/19/95	11/8/95	24
26	Notice of Award to Subcontractor	0d	11/10/95	11/10/95	25FS+2d
27	Notice to Proceed to Subcontractor	0d	11/17/95	11/17/95	26FS+5d
28	Construction of GW Treatment Facility	45d	11/20/95	1/24/96	27



C:\BARNETT\MAUTHE\SUPPLNS\MFINDES.MPP

SURFACE WATER CALCULATIONS

PREPARED FOR: Cathy Barnett

PREPARED BY: Eric Freiburger

DATE: December 9, 1994

SUBJECT: Mauthe Culvert Design

PROJECT: Mauthe

Surface water runoff was calculated using the methodology of the U.S. Soil Conservation Service Technical Release 55 (SCS-TR-55). Flows were calculated for both the 100 and 25-year, 24-hour storm event (4.5 inches and 5.5 inches of precipitation, respectively). Culverts were evaluated for combinations of nonsubmerged inlets and outlets and submerged inlets and outlets as well as full and partially full pipe conditions. Triangular channels are 3:1 sideslope riprap with a 0.5% bed slope. Channel designs were analyzed using the Pennsylvania Department of Environmental Resources method of riprap sizing. This method is based on the permissible velocity concept. Manning's equation is used and Manning's n is a function of the D50 and the depth of flow. The solution process is iterative. The depth of flow, channel velocity, and D50 are determined from a combination of Manning's n-depth of flow equation, the Manning's equation, and the continuity equation. This method is based on Soil Conservation Service techniques.

Calculations were computed with the computer software entitled SEDCAD$^+$ (ref.:Civil Software Design, P.O. Box 706, Ames, Iowa 50010). The following lists parameters and results of this analysis.

North Culvert Area

Drainage Area:	0.73 acres grass (CN=74) and 0.17 acres impervious (CN=98)
Peak Runoff:	25-year storm event: 2.12 cfs 100-year storm event: 2.82 cfs
Channel:	Triangular 3H:1V side slopes 0.5% bed slope 9-inch D50 3-inch D10 Depth of flow: 0.7 feet for 25-year storm 0.8 feet for 100-year storm
Culvert:	Sch 40 PVC with wingwalls Inlet invert elevation: 801

Discharge invert elevation: 798.3
Culvert length: 70 feet
Pipe slope: 3.9%
Allowable headwater: 2 feet
Design tailwater: 1 foot

Minimum Pipe Size: 25-year storm: 9-inch diameter (1.6-feet headwater, inlet control, partially full pipe flow)
100-year storm: 12-inch diameter (1.4-feet headwater, inlet control, partially full pipe flow)

East Culvert Area

Drainage Area: 0.72 acres grass (CN=74) and 0.08 acres impervious (CN=98)

Peak Runoff: 25-year storm event: 1.79 cfs
100-year storm event: 2.41 cfs

Channel: Triangular
3H:1V side slopes
0.5% bed slope
9-inch D50
3-inch D10
Depth of flow: 0.7 feet for 25-year storm
0.8 feet for 100-year storm

Culvert: Sch 40 PVC with concrete drop inlet
Culvert inlet elevation: 795.9
Discharge invert elevation: 795
Culvert length: 45 feet
Pipe slope: 2.0%
Allowable headwater with drop inlet: 4.0 feet
Design tailwater: 1 foot

Drop Inlet: 12-inch diameter pipe with a metal drainage grate (see attached catalog page)
Rim Elevation: 802

Minimum Pipe Size: 25-year storm: 8-inch diameter (2.4-feet headwater, outlet control, full pipe flow)
100-year storm: 8-inch diameter (4.0-feet headwater, outlet control, full pipe flow)

DRAINAGE GRATES

R-4030 Series Heavy Duty Grates

R-4040 Series Light Duty Grates

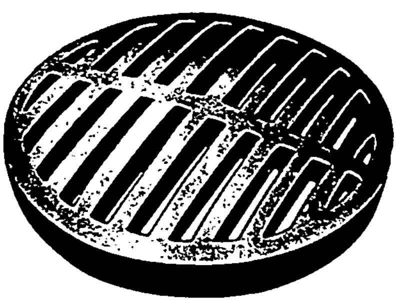
Designed to fit in bell end of standard sewer pipe.

Bell and spigot vitrified clay and concrete pipe are made under many specifications and dimensions vary. Check the grate sizes in the table to be sure they will fit the pipe you are using.

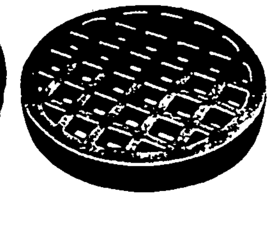
If specified, special lug arrangement is available on R-4040 series which modifies grate to fit corrugated metal pipe in sizes indicated.

Weight in Pounds: Heavy Duty R-4030	Weight in Pounds: Light Duty R-4040	Dimensions in inches: Pipe Size	Grate Dia.	Grate Thickness*
6‡	4	4	5¾	1½
13‡	8	6	8	2
25‡	11	8	10⅜	2¼
25‡	14	10	12⅝	2½
38‡	32	12	14¾	2½
70‡	55	15	18¼	2¾
115†**⊗	75	18	22	2¾
200†**⊗	100	21	25½	3
210†**	140	24	29	3¼
290**	155	27	32¾	3½
300**⊗	180⊗	30	36	3¾
525**	300⊗	36	42	4

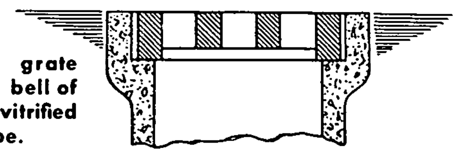
*For light duty series this figure includes legs. **Slotted openings.
†Slight Crown. ‡Square openings. ⊗Not recommended for bicycle traffic.
For safety standards see pages 88 to 93.



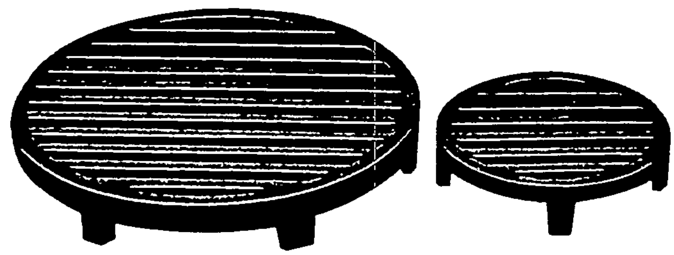
R-4030 Type Grate**



R-4030 Type Grate‡



Showing grate placed in bell of standard vitrified sewer pipe.



R-4040 Type Grate with Legs

Specify:

1. Catalog number.
2. Pipe size.
3. Lugs on R-4040 for corrugated pipe if required.

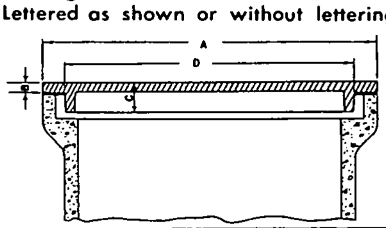
R-4044 Series Manhole Lids to Fit Over Pipe Bell

Medium Duty

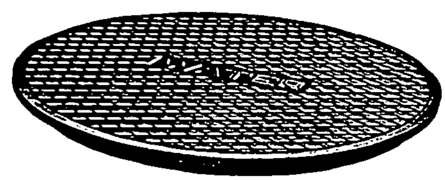
Bell and spigot vitrified clay and concrete pipe is made under many specifications and dimensions vary. Check the lid size in the table to be sure they will fit the pipe you are using.

Specify:

1. Catalog number.
2. Lettered as shown or without lettering.



Catalog No.	For Pipe Size	Dimensions in inches: A	B	C	D	Wt. Lbs.
R-4044-A	4	7⅛	½	1¼	5⅜	7
R-4044-B	6	9½	½	1½	7¾	13
R-4044-C	8	12¼	½	2	10¼	20
R-4044-D	10	14¾	½	2¼	12¾	30
R-4044-E	12	17¼	⅝	2¼	14½	50
R-4044-F	15	21¼	⅝	2¼	17	53
R-4044-G	18	25½	⅝	2½	21¾	111
R-4044-J	21	29½	¾	2½	24⅞	150
R-4044-K	24	33¼	¾	2½	29¼	170
R-4044-L	30	42	⅞	2¾	35¾	340
R-4044-M	36	49¼	⅞	2¾	42½	435



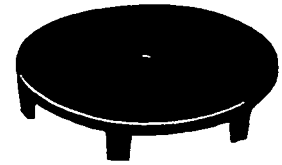
R-4055 Series Covers to Fit in Sewer Pipe Bell

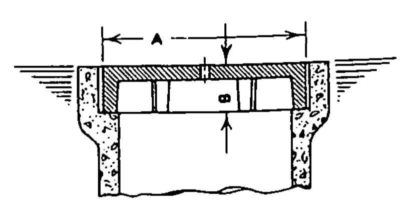
Medium Duty

Supplied with 1" lift hole as standard. Available without lift hole if so specified.

When ordering, advise pipe size. Remember, bell and spigot vitrified clay and concrete pipe is made under many specifications and dimensions vary. Check the cover size in the table to be sure they will fit the pipe you are using.

Catalog No.	Pipe Size	Dimensions in inches: A	B	Wt. Lbs.
R-4055-4	4	5¾	1½	5
R-4055-6	6	8	2	8
R-4055-8	8	10⅜	2¼	15
R-4055-10	10	12⅝	2½	22
R-4055-12	12	14¾	2½	30
R-4055-15	15	18¼	2¾	45
R-4055-18	18	22	2¾	50
R-4055-21	21	25½	3	110
R-4055-24	24	29	3¼	125
R-4055-27	27	32¾	3½	170
R-4055-30	30	36	3¾	240
R-4055-36	36	42	4	375





CIVIL SOFTWARE DESIGN

SEDCAD+ Version 3

STORM SEWER SIZING

by

Name: EJF

Company Name: CH2M HILL NORTHWEST, INC.
File Name: C:\SEDCAD3\MAUTHE

Date: 12-09-1994

Civil Software Design -- SEDCAD+ Version 3.1

Company Name: CH2M HILL NORTHWEST, INC.
Filename: C:\SEDCAD3\MAUTHE User: EJF
Date: 12-09-1994 Time: 07:06:00
STORM SEWER SIZING
Storm: 5.50 inches, 100 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

SUBWATERSHED/STRUCTURE INPUT/OUTPUT TABLE

-Hydrology-

JBS	SWS	Area (ac)	CN	UHS	Tc (hrs)	K (hrs)	X	Base-Flow (cfs)	Runoff Volume (ac-ft)	Peak Discharge (cfs)
111	1	0.73	74	M	0.112	0.000	0.000	0.0	0.17	2.10
111	2	0.17	98	F	0.009	0.000	0.000	0.0	0.07	0.71
		Type: Culvert			Label: NORTH STORM SEWER					
111 Structure		0.90							0.24	
111 Total IN/OUT		0.90							0.24	2.82
		Type: Null			Label: NORTH STORM SEWER					
112 Structure		0.90							0.24	
112 Total IN/OUT		0.90							0.24	2.82
111 to 112 Routing						0.000	0.000			
121	1	0.72	74	M	0.117	0.000	0.000	0.0	0.17	2.07
121	2	0.08	98	F	0.009	0.000	0.000	0.0	0.04	0.34
		Type: Null			Label: EAST STORM SEWER					
121 Structure		0.80							0.20	
121 Total IN/OUT		0.80							0.20	2.41
		Type: Culvert			Label: EAST STORM SEWER					
122 Structure		0.80							0.20	
122 Total IN/OUT		0.80							0.20	2.41
121 to 122 Routing						0.000	0.000			

Civil Software Design -- SEDCAD+ Version 3.1

Company Name: CH2M HILL NORTHWEST, INC.
Filename: C:\SEDCAD3\MAUTHE User: EJF
Date: 12-09-1994 Time: 07:06:00
STORM SEWER SIZING
Storm: 5.50 inches, 100 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

DETAILED SUBWATERSHED INPUT/OUTPUT TABLE

J	B	S	SWS	Seg. #	Land Flow Condition	Distance (ft)	Slope (%)	Velocity (fps)	Segment Time (hr)	Time Conc. (hr)	Muskingum K (hr)	Muskingum X
1	1	1	1	-a	3	400.00	2.00	0.99	0.11	0.112		
1	1	1	2	-a	7	100.00	2.00	2.85	0.01	0.009		
1	2	1	1	-a	3	420.00	2.00	0.99	0.12	0.117		
1	2	1	2	-a	7	100.00	2.00	2.85	0.01	0.009		

Civil Software Design -- SEDCAD+ Version 3.1

Company Name: CH2M HILL NORTHWEST, INC.
Filename: C:\SEDCAD3\MAUTHE User: EJF
Date: 12-09-1994 Time: 07:06:00
STORM SEWER SIZING
Storm: 5.50 inches, 100 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

NON-POND STRUCTURE INPUT/OUTPUT TABLE

J1, B1, S1
NORTH STORM SEWER

Drainage Area from J1, B1, S1, SWS(s)1-2: 0.9 acres
Total Contributing Drainage Area: 0.9 acres

Entrance Loss Coefficient	Maximum Headwater (ft)	Pipe Length (ft)	Pipe Slope (%)	Manning's n	Tailwater (ft)
0.50	2.0	70.0	3.9	0.014	1.0

Minimum Pipe Diameter Required: 12.0 inches
(See Culvert Utility Program for full performance curves)

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN/OUT	0.24	2.82

****

J1, B2, S2
EAST STORM SEWER

Drainage Area from J1, B2, S2 0.8 acres
Total Contributing Drainage Area: 0.8 acres

Entrance Loss Coefficient	Maximum Headwater (ft)	Pipe Length (ft)	Pipe Slope (%)	Manning's n	Tailwater (ft)
0.90	4.0	45.0	2.0	0.014	1.0

Minimum Pipe Diameter Required: 8.0 inches
(See Culvert Utility Program for full performance curves)

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN/OUT	0.20	2.41

****

Civil Software Design -- SEDCAD+ Version 3.1

Company Name: CH2M HILL NORTHWEST, INC.
Filename: C:\SEDCAD3\MAUTHE User: EJF
Date: 12-09-1994 Time: 07:06:10
STORM SEWER SIZING
Storm: 4.50 inches, 25 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

SUBWATERSHED/STRUCTURE INPUT/OUTPUT TABLE

-Hydrology-

JBS	SWS	Area (ac)	CN	UHS	Tc (hrs)	K (hrs)	X	Base-Flow (cfs)	Runoff Volume (ac-ft)	Peak Discharge (cfs)
111	1	0.73	74	M	0.112	0.000	0.000	0.0	0.12	1.53
111	2	0.17	98	F	0.009	0.000	0.000	0.0	0.06	0.58
	Type: Culvert Label: NORTH STORM SEWER									
111	Structure	0.90							0.18	
111	Total IN/OUT	0.90							0.18	2.12
	Type: Null Label: NORTH STORM SEWER									
112	Structure	0.90							0.18	
112	Total IN/OUT	0.90							0.18	2.[illegible]
111 to 112	Routing					0.000	0.000			
121	1	0.72	74	M	0.117	0.000	0.000	0.0	0.12	1.51
121	2	0.08	98	F	0.009	0.000	0.000	0.0	0.03	0.27
	Type: Null Label: EAST STORM SEWER									
121	Structure	0.80							0.15	
121	Total IN/OUT	0.80							0.15	1.79
	Type: Culvert Label: EAST STORM SEWER									
122	Structure	0.80							0.15	
122	Total IN/OUT	0.80							0.15	1.79
121 to 122	Routing					0.000	0.000			

Civil Software Design -- SEDCAD+ Version 3.1

Company Name: CH2M HILL NORTHWEST, INC.
Filename: C:\SEDCAD3\MAUTHE User: EJF
Date: 12-09-1994 Time: 07:06:10
STORM SEWER SIZING
Storm: 4.50 inches, 25 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

DETAILED SUBWATERSHED INPUT/OUTPUT TABLE

J	B	S	SWS	Seg. #	Land Flow Condition	Distance (ft)	Slope (%)	Velocity (fps)	Segment Time (hr)	Time Conc. (hr)	Muskingum K (hr)	Muskingum X
1	1	1	1	-a	3	400.00	2.00	0.99	0.11	0.112		
1	1	1	2	-a	7	100.00	2.00	2.85	0.01	0.009		
1	2	1	1	-a	3	420.00	2.00	0.99	0.12	0.117		
1	2	1	2	-a	7	100.00	2.00	2.85	0.01	0.009		

Civil Software Design -- SEDCAD+ Version 3.1

Company Name: CH2M HILL NORTHWEST, INC.
Filename: C:\SEDCAD3\MAUTHE User: EJF
Date: 12-09-1994 Time: 07:06:10
STORM SEWER SIZING
Storm: 4.50 inches, 25 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

==
NON-POND STRUCTURE INPUT/OUTPUT TABLE
==

J1, B1, S1
NORTH STORM SEWER

Drainage Area from J1, B1, S1, SWS(s)1-2: 0.9 acres
Total Contributing Drainage Area: 0.9 acres

Entrance Loss Coefficient	Maximum Headwater (ft)	Pipe Length (ft)	Pipe Slope (%)	Manning's n	Tailwater (ft)
0.50	2.0	70.0	3.9	0.014	1.0

Minimum Pipe Diameter Required: 8.0 inches
(See Culvert Utility Program for full performance curves)

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN/OUT	0.18	2.12

****

J1, B2, S2
EAST STORM SEWER

Drainage Area from J1, B2, S2 0.8 acres
Total Contributing Drainage Area: 0.8 acres

Entrance Loss Coefficient	Maximum Headwater (ft)	Pipe Length (ft)	Pipe Slope (%)	Manning's n	Tailwater (ft)
0.90	4.0	45.0	2.0	0.014	1.0

Minimum Pipe Diameter Required: 8.0 inches
(See Culvert Utility Program for full performance curves)

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN/OUT	0.15	1.79

****

SEDCAD+ CULVERT SIZING UTILITY

NORTH CULVERT, 25-YEAR STORM

Design Discharge	=	2.120 cfs
Entrance Loss Coefficient	=	0.5
Pipe Length	=	70.000 feet
Pipe Slope	=	3.900 %
Manning's n	=	0.014
Maximum Headwater	=	2.000 feet
Tailwater Depth	=	1.000 feet

Smallest Diameter Required to Pass Flow is 8 inches

PERFORMANCE CURVES:

Diameter: 4 inches

Headwater (ft)	Discharge (cfs)	Control	Flow Type
0.20	0.01		0
0.40	0.02		0
0.60	0.03		0
0.80	0.03		0
1.00	0.04		0
1.20	0.05		0
1.40	0.06		0
1.60	0.07		0
1.80	0.08	Outlet (Subcritical)	1
2.00	0.08	Outlet (Subcritical)	1
2.20	0.09	Outlet (Subcritical)	1
2.40	0.10	Outlet (Subcritical)	1
2.60	0.11	Outlet (Subcritical)	1
2.80	0.12	Outlet (Subcritical)	1
3.00	0.13	Outlet (Subcritical)	1

Diameter: 6 inches

Headwater (ft)	Discharge (cfs)	Control	Flow Type
0.20	0.14	Outlet (Subcritical)	1
0.40	0.28	Outlet (Subcritical)	2
0.60	0.41	Inlet (Supercritical)	3
0.80	0.55	Inlet (Supercritical)	4
1.00	0.69	Inlet	5
1.20	0.83	Outlet	6
1.40	0.96	Outlet	7
1.60	1.02	Outlet	7
1.80	1.04	Outlet	7
2.00	1.06	Outlet	7
2.20	1.08	Outlet	7
2.40	1.10	Outlet	7
2.60	1.12	Outlet	7
2.80	1.14	Outlet	7
3.00	1.16	Outlet	7

Diameter: 8 inches

Headwater (ft)	Discharge (cfs)	Control	Flow Type
0.20	0.25	Outlet (Subcritical)	2
0.40	0.49	Inlet (Supercritical)	4
0.60	0.74	Outlet	6
0.80	0.99	Inlet	8
1.00	1.19	Inlet	8
1.20	1.39	Inlet	8
1.40	1.59	Inlet	8
1.60	1.79	Inlet	8
1.80	1.99	Inlet	8
2.00	2.06	Inlet	8
2.20	2.12	Inlet	8
2.40	2.19	Inlet	8
2.60	2.25	Inlet	8
2.80	2.31	Inlet	8
3.00	2.37	Inlet	8

Diameter: 9 inches

Headwater (ft)	Discharge (cfs)	Control	Flow Type
0.20	0.27	Outlet (Subcritical)	1
0.40	0.54	Outlet (Subcritical)	2
0.60	0.81	Inlet (Supercritical)	3
0.80	1.10	Inlet (Supercritical)	4
1.00	1.41	Outlet	6
1.20	1.73	Outlet	7
1.40	2.03	Inlet	8
1.60	2.22	Inlet	8
1.80	2.42	Inlet	8
2.00	2.61	Inlet	8
2.20	2.80	Inlet	8
2.40	3.00	Inlet	8
2.60	3.08	Inlet	8
2.80	3.16	Inlet	8
3.00	3.24	Inlet	8

Diameter: 12 inches

Headwater (ft)	Discharge (cfs)	Control	Flow Type
0.20	0.33	Outlet (Subcritical)	1
0.40	0.65	Inlet (Supercritical)	3
0.60	0.98	Inlet (Supercritical)	4
0.80	1.53	Inlet (Supercritical)	4
1.00	2.09	Inlet (Supercritical)	4
1.20	2.68	Outlet	7
1.40	3.20	Inlet	8
1.60	3.63	Inlet	8
1.80	4.05	Inlet	8
2.00	4.39	Inlet	8

2.20	4.73	Inlet	8
2.40	5.06	Inlet	8
2.60	5.34	Inlet	8
2.80	5.61	Inlet	8
3.00	5.89	Inlet	8

Diameter: 15 inches

Headwater (ft)	Discharge (cfs)	Control	Flow Type
0.20	0.38	Outlet (Subcritical)	1
0.40	0.76	Outlet (Subcritical)	2
0.60	1.24	Inlet (Supercritical)	3
0.80	1.88	Inlet (Supercritical)	3
1.00	2.63	Inlet (Supercritical)	3
1.20	3.45	Inlet (Supercritical)	3
1.40	4.30	Inlet (Supercritical)	4
1.60	5.10	Inlet	5
1.80	5.78	Inlet	5
2.00	6.39	Inlet	5
2.20	6.96	Inlet	5
2.40	7.46	Inlet	5
2.60	7.96	Inlet	5
2.80	8.40	Inlet	5
3.00	8.84	Inlet	5

SEDCAD+ CULVERT SIZING UTILITY

NORTH CULVERT, 100-YEAR STORM

Design Discharge	=	2.820 cfs
Entrance Loss Coefficient	=	0.5
Pipe Length	=	70.000 feet
Pipe Slope	=	3.900 %
Manning's n	=	0.014
Maximum Headwater	=	2.000 feet
Tailwater Depth	=	1.000 feet

Smallest Diameter Required to Pass Flow is 12 inches

PERFORMANCE CURVES:

Diameter: 8 inches

Headwater (ft)	Discharge (cfs)	Control	Flow Type
0.20	0.25	Outlet (Subcritical)	2
0.40	0.49	Inlet (Supercritical)	4
0.60	0.74	Outlet	6
0.80	0.99	Inlet	8
1.00	1.19	Inlet	8
1.20	1.39	Inlet	8
1.40	1.59	Inlet	8
1.60	1.79	Inlet	8
1.80	1.99	Inlet	8
2.00	2.06	Inlet	8
2.20	2.12	Inlet	8
2.40	2.19	Inlet	8
2.60	2.25	Inlet	8
2.80	2.31	Inlet	8
3.00	2.37	Inlet	8

Diameter: 9 inches

Headwater (ft)	Discharge (cfs)	Control	Flow Type
0.20	0.27	Outlet (Subcritical)	1
0.40	0.54	Outlet (Subcritical)	2
0.60	0.81	Inlet (Supercritical)	3
0.80	1.10	Inlet (Supercritical)	4
1.00	1.41	Outlet	6
1.20	1.73	Outlet	7
1.40	2.03	Inlet	8
1.60	2.22	Inlet	8
1.80	2.42	Inlet	8
2.00	2.61	Inlet	8
2.20	2.80	Inlet	8
2.40	3.00	Inlet	8
2.60	3.08	Inlet	8
2.80	3.16	Inlet	8
3.00	3.24	Inlet	8

Diameter: 12 inches

Headwater (ft)	Discharge (cfs)	Control	Flow Type
0.20	0.33	Outlet (Subcritical)	1
0.40	0.65	Inlet (Supercritical)	3
0.60	0.98	Inlet (Supercritical)	4
0.80	1.53	Inlet (Supercritical)	4
1.00	2.09	Inlet (Supercritical)	4
1.20	2.68	Outlet	7
1.40	3.20	Inlet	8
1.60	3.63	Inlet	8
1.80	4.05	Inlet	8
2.00	4.39	Inlet	8
2.20	4.73	Inlet	8
2.40	5.06	Inlet	8
2.60	5.34	Inlet	8
2.80	5.61	Inlet	8
3.00	5.89	Inlet	8

Diameter: 15 inches

Headwater (ft)	Discharge (cfs)	Control	Flow Type
0.20	0.38	Outlet (Subcritical)	1
0.40	0.76	Outlet (Subcritical)	2
0.60	1.24	Inlet (Supercritical)	3
0.80	1.88	Inlet (Supercritical)	3
1.00	2.63	Inlet (Supercritical)	3
1.20	3.45	Inlet (Supercritical)	3
1.40	4.30	Inlet (Supercritical)	4
1.60	5.10	Inlet	5
1.80	5.78	Inlet	5
2.00	6.39	Inlet	5
2.20	6.96	Inlet	5
2.40	7.46	Inlet	5
2.60	7.96	Inlet	5
2.80	8.40	Inlet	5
3.00	8.84	Inlet	5

Diameter: 18 inches

Headwater (ft)	Discharge (cfs)	Control	Flow Type
0.20	0.43	Outlet (Subcritical)	1
0.40	0.86	Inlet (Supercritical)	3
0.60	1.49	Inlet (Supercritical)	3
0.80	2.26	Inlet (Supercritical)	3
1.00	3.15	Inlet (Supercritical)	3
1.20	4.13	Inlet (Supercritical)	3
1.40	5.21	Inlet (Supercritical)	3
1.60	6.36	Inlet (Supercritical)	3
1.80	7.46	Inlet (Supercritical)	4
2.00	8.42	Inlet	5

2.20	9.29	Inlet	5
2.40	10.10	Inlet	5
2.60	10.83	Inlet	5
2.80	11.52	Inlet	5
3.00	12.18	Inlet	5

Diameter: 21 inches

Headwater (ft)	Discharge (cfs)	Control	Flow Type
0.20	0.48	Outlet (Subcritical)	1
0.40	0.95	Inlet (Supercritical)	3
0.60	1.73	Inlet (Supercritical)	3
0.80	2.64	Inlet (Supercritical)	3
1.00	3.67	Inlet (Supercritical)	3
1.20	4.82	Inlet (Supercritical)	3
1.40	6.07	Inlet (Supercritical)	3
1.60	7.42	Inlet (Supercritical)	3
1.80	8.85	Inlet (Supercritical)	3
2.00	10.31	Inlet (Supercritical)	4
2.20	11.59	Inlet	5
2.40	12.77	Inlet	5
2.60	13.85	Inlet	5
2.80	14.85	Inlet	5
3.00	15.78	Inlet	5

SEDCAD+ CULVERT SIZING UTILITY

EAST CULVERT, 25-YEAR STORM

Design Discharge	=	1.790 cfs
Entrance Loss Coefficient	=	0.9
Pipe Length	=	45.000 feet
Pipe Slope	=	2.000 %
Manning's n	=	0.014
Maximum Headwater	=	4.000 feet
Tailwater Depth	=	1.000 feet

Smallest Diameter Required to Pass Flow is 8 inches

PERFORMANCE CURVES:

Diameter: 4 inches

Headwater (ft)	Discharge (cfs)	Control	Flow Type
0.40	0.02		0
0.80	0.04		0
1.20	0.07		0
1.60	0.09	Outlet (Subcritical)	1
2.00	0.11	Outlet (Subcritical)	1
2.40	0.13	Outlet (Subcritical)	1
2.80	0.15	Outlet (Subcritical)	1
3.20	0.17	Outlet (Subcritical)	1
3.60	0.20	Outlet (Subcritical)	1
4.00	0.22	Outlet (Subcritical)	2
4.40	0.24	Outlet (Subcritical)	2
4.80	0.26	Outlet (Subcritical)	2
5.20	0.28	Outlet (Subcritical)	2
5.60	0.30	Outlet (Subcritical)	2
6.00	0.33	Outlet (Subcritical)	2

Diameter: 6 inches

Headwater (ft)	Discharge (cfs)	Control	Flow Type
0.40	0.16	Outlet (Subcritical)	1
0.80	0.32	Outlet (Subcritical)	2
1.20	0.48	Inlet (Supercritical)	3
1.60	0.63	Inlet (Supercritical)	4
2.00	0.79	Outlet	6
2.40	0.95	Outlet	7
2.80	1.04	Outlet	7
3.20	1.09	Outlet	7
3.60	1.15	Outlet	7
4.00	1.20	Outlet	7
4.40	1.26	Outlet	7
4.80	1.31	Outlet	7
5.20	1.37	Outlet	7
5.60	1.42	Outlet	7
6.00	1.48	Outlet	7

Diameter: 8 inches

Headwater (ft)	Discharge (cfs)	Control	Flow Type
0.40	0.49	Inlet (Supercritical)	4
0.80	0.99	Inlet	8
1.20	1.23	Inlet	8
1.60	1.47	Inlet	8
2.00	1.70	Outlet	7 *
2.40	1.94	Outlet	7
2.80	2.10	Outlet	7
3.20	2.23	Outlet	7
3.60	2.37	Outlet	7
4.00	2.50	Outlet	7
4.40	2.63	Outlet	7
4.80	2.77	Outlet	7
5.20	2.90	Outlet	7
5.60	3.02	Outlet	7
6.00	3.12	Outlet	7

* (Transition Region - Data may need to be smoothed.)

Diameter: 9 inches

Headwater (ft)	Discharge (cfs)	Control	Flow Type
0.40	0.54	Outlet (Subcritical)	2
0.80	1.08	Inlet (Supercritical)	4
1.20	1.63	Outlet	6
1.60	2.08	Outlet	7
2.00	2.31	Outlet	7
2.40	2.54	Outlet	7
2.80	2.78	Outlet	7
3.20	3.01	Outlet	7
3.60	3.18	Outlet	7
4.00	3.34	Outlet	7
4.40	3.51	Outlet	7
4.80	3.68	Outlet	7
5.20	3.84	Outlet	7
5.60	4.01	Outlet	7
6.00	4.14	Outlet	7

Diameter: 12 inches

Headwater (ft)	Discharge (cfs)	Control	Flow Type
0.40	0.65	Inlet (Supercritical)	3
0.80	1.53	Inlet (Supercritical)	4
1.20	2.68	Outlet	7
1.60	3.63	Inlet	8
2.00	4.39	Inlet	8
2.40	5.05	Inlet	8
2.80	5.47	Inlet	8
3.20	5.89	Outlet	7 *
3.60	6.26	Outlet	7

4.00	6.60	Outlet	7
4.40	6.95	Outlet	7
4.80	7.25	Outlet	7
5.20	7.55	Outlet	7
5.60	7.85	Outlet	7
6.00	8.13	Outlet	7

* (Transition Region - Data may need to be smoothed.)

Diameter: 15 inches

Headwater (ft)	Discharge (cfs)	Control	Flow Type
0.40	0.76	Outlet (Subcritical)	2
0.80	1.88	Inlet (Supercritical)	3
1.20	3.45	Inlet (Supercritical)	3
1.60	5.10	Inlet	5
2.00	6.39	Inlet	5
2.40	7.46	Inlet	5
2.80	8.40	Inlet	5
3.20	9.25	Inlet	5
3.60	10.03	Inlet	5
4.00	10.74	Inlet	5
4.40	11.40	Inlet	5
4.80	12.01	Outlet	6
5.20	12.51	Outlet	6
5.60	13.01	Outlet	6
6.00	13.47	Outlet	6

SEDCAD+ CULVERT SIZING UTILITY

EAST CULVERT, 100-YEAR STORM

Design Discharge	=	2.410 cfs
Entrance Loss Coefficient	=	0.9
Pipe Length	=	45.000 feet
Pipe Slope	=	2.000 %
Manning's n	=	0.014
Maximum Headwater	=	4.000 feet
Tailwater Depth	=	1.000 feet

Smallest Diameter Required to Pass Flow is 8 inches

PERFORMANCE CURVES:

Diameter: 4 inches

Headwater (ft)	Discharge (cfs)	Control	Flow Type
0.40	0.02		0
0.80	0.04		0
1.20	0.07		0
1.60	0.09	Outlet (Subcritical)	1
2.00	0.11	Outlet (Subcritical)	1
2.40	0.13	Outlet (Subcritical)	1
2.80	0.15	Outlet (Subcritical)	1
3.20	0.17	Outlet (Subcritical)	1
3.60	0.20	Outlet (Subcritical)	1
4.00	0.22	Outlet (Subcritical)	2
4.40	0.24	Outlet (Subcritical)	2
4.80	0.26	Outlet (Subcritical)	2
5.20	0.28	Outlet (Subcritical)	2
5.60	0.30	Outlet (Subcritical)	2
6.00	0.33	Outlet (Subcritical)	2

Diameter: 6 inches

Headwater (ft)	Discharge (cfs)	Control	Flow Type
0.40	0.16	Outlet (Subcritical)	1
0.80	0.32	Outlet (Subcritical)	2
1.20	0.48	Inlet (Supercritical)	3
1.60	0.63	Inlet (Supercritical)	4
2.00	0.79	Outlet	6
2.40	0.95	Outlet	7
2.80	1.04	Outlet	7
3.20	1.09	Outlet	7
3.60	1.15	Outlet	7
4.00	1.20	Outlet	7
4.40	1.26	Outlet	7
4.80	1.31	Outlet	7
5.20	1.37	Outlet	7
5.60	1.42	Outlet	7
6.00	1.48	Outlet	7

Diameter: 8 inches

Headwater (ft)	Discharge (cfs)	Control	Flow Type
0.40	0.49	Inlet (Supercritical)	4
0.80	0.99	Inlet	8
1.20	1.23	Inlet	8
1.60	1.47	Inlet	8
2.00	1.70	Outlet	7 *
2.40	1.94	Outlet	7
2.80	2.10	Outlet	7
3.20	2.23	Outlet	7
3.60	2.37	Outlet	7
4.00	2.50	Outlet	7
4.40	2.63	Outlet	7
4.80	2.77	Outlet	7
5.20	2.90	Outlet	7
5.60	3.02	Outlet	7
6.00	3.12	Outlet	7

* (Transition Region - Data may need to be smoothed.)

Diameter: 9 inches

Headwater (ft)	Discharge (cfs)	Control	Flow Type
0.40	0.54	Outlet (Subcritical)	2
0.80	1.08	Inlet (Supercritical)	4
1.20	1.63	Outlet	6
1.60	2.08	Outlet	7
2.00	2.31	Outlet	7
2.40	2.54	Outlet	7
2.80	2.78	Outlet	7
3.20	3.01	Outlet	7
3.60	3.18	Outlet	7
4.00	3.34	Outlet	7
4.40	3.51	Outlet	7
4.80	3.68	Outlet	7
5.20	3.84	Outlet	7
5.60	4.01	Outlet	7
6.00	4.14	Outlet	7

Diameter: 12 inches

Headwater (ft)	Discharge (cfs)	Control	Flow Type
0.40	0.65	Inlet (Supercritical)	3
0.80	1.53	Inlet (Supercritical)	4
1.20	2.68	Outlet	7
1.60	3.63	Inlet	8
2.00	4.39	Inlet	8
2.40	5.05	Inlet	8
2.80	5.47	Inlet	8
3.20	5.89	Outlet	7 *
3.60	6.26	Outlet	7

4.00	6.60	Outlet	7
4.40	6.95	Outlet	7
4.80	7.25	Outlet	7
5.20	7.55	Outlet	7
5.60	7.85	Outlet	7
6.00	8.13	Outlet	7

* (Transition Region - Data may need to be smoothed.)

Diameter: 15 inches

Headwater (ft)	Discharge (cfs)	Control	Flow Type
0.40	0.76	Outlet (Subcritical)	2
0.80	1.88	Inlet (Supercritical)	3
1.20	3.45	Inlet (Supercritical)	3
1.60	5.10	Inlet	5
2.00	6.39	Inlet	5
2.40	7.46	Inlet	5
2.80	8.40	Inlet	5
3.20	9.25	Inlet	5
3.60	10.03	Inlet	5
4.00	10.74	Inlet	5
4.40	11.40	Inlet	5
4.80	12.01	Outlet	6
5.20	12.51	Outlet	6
5.60	13.01	Outlet	6
6.00	13.47	Outlet	6

SEDCAD+ RIPRAP CHANNEL DESIGN

NORTH CULVERT CHANNEL, 25-YEAR STORM

INPUT VALUES:

Shape	TRIANGULAR	
Discharge	2.12 cfs	
Slope	0.50 %	
Sideslopes (L and R)	3.00:1	3.00:1
Freeboard	1 ft	

RESULTS:

Mild Slope Design

Depth	0.72 ft
with Freeboard	1.72 ft
Top Width	4.32 ft
with Freeboard	10.32 ft
Velocity	1.37 fps
Cross Sectional Area	1.55 sq ft
Hydraulic Radius	0.34 ft
Manning's n	0.038
Froude Number	0.40
Dmax	1.500 ft (18.00 in)
D50	0.750 ft (9.00 in)
D10	0.250 ft (3.00 in)

SEDCAD+ RIPRAP CHANNEL DESIGN

NORTH CULVERT CHANNEL, 100-YEAR STORM

INPUT VALUES:

Shape	TRIANGULAR	
Discharge	2.82 cfs	
Slope	0.50 %	
Sideslopes (L and R)	3.00:1	3.00:1
Freeboard	1 ft	

RESULTS:

Mild Slope Design

Depth	0.80 ft
with Freeboard	1.80 ft
Top Width	4.80 ft
with Freeboard	10.80 ft
Velocity	1.47 fps
Cross Sectional Area	1.92 sq ft
Hydraulic Radius	0.38 ft
Manning's n	0.038
Froude Number	0.41
Dmax	1.500 ft (18.00 in)
D50	0.750 ft (9.00 in)
D10	0.250 ft (3.00 in)

SEDCAD+ RIPRAP CHANNEL DESIGN

EAST CULVERT CHANNEL, 25-YEAR STROM

INPUT VALUES:

Shape	TRIANGULAR	
Discharge	1.79 cfs	
Slope	0.50 %	
Sideslopes (L and R)	3.00:1	3.00:1
Freeboard	1 ft	

RESULTS:

Mild Slope Design

Depth	0.67 ft
with Freeboard	1.67 ft
Top Width	4.05 ft
with Freeboard	10.05 ft
Velocity	1.31 fps
Cross Sectional Area	1.37 sq ft
Hydraulic Radius	0.32 ft
Manning's n	0.038
Froude Number	0.40
Dmax	1.500 ft (18.00 in)
D50	0.750 ft (9.00 in)
D10	0.250 ft (3.00 in)

SEDCAD+ RIPRAP CHANNEL DESIGN

EAST CULVERT CHANNEL, 100-YEAR STROM

INPUT VALUES:

Shape	TRIANGULAR	
Discharge	2.41 cfs	
Slope	0.50 %	
Sideslopes (L and R)	3.00:1	3.00:1
Freeboard	1 ft	

RESULTS:

Mild Slope Design

Depth	0.75 ft
with Freeboard	1.75 ft
Top Width	4.53 ft
with Freeboard	10.53 ft
Velocity	1.41 fps
Cross Sectional Area	1.71 sq ft
Hydraulic Radius	0.36 ft
Manning's n	0.038
Froude Number	0.41
Dmax	1.500 ft (18.00 in)
D50	0.750 ft (9.00 in)
D10	0.250 ft (3.00 in)

FILTRATION CALCULATIONS

CH2M HILL

SUBJECT N. W. Mauthe
GW Collection Trench

BY CGB
SHEET NO. 1 of ____ DATE ____
PROJECT NO. GLE 65688

Objective: Determine the gradation of the filter material backfill to be used in the groundwater collection trenches

Elimate geotextile between filter material and native soil if possible

Particle Size Gradations for native soil

Sieve Size	SB1	W4	W7	W9	W10B	AVG
	Percent Passing By Weight *					
No. 4	100	100	97	99	94	98
No. 10	98	97	95	98	93	96
No. 20	97	95	92	97	92	95
No. 40	96	87	88	95	91	91
No. 50	95	78	81	94	89	87
No. 80	90	53	67	90	85	77
No. 100	89	48	63	88	84	74
No. 200	81	35	51	81	77	65
0.015mm	55	20	27	57	52	42
0.0015mm	21	8	9	25	23	17

* Samples within top 10' of subsurface

Gradations are plotted on the attached graph

Proposed Filter Material: WisDOT Fine Aggregate No. 1, Section 501.3.6.3 of WisDOT Standard Specs

Sieve Size	Percent Passing
3/8-in	100
No. 4	90-100
No. 16	45-80
No. 50	10-30
No. 100	2-10

Gradation is plotted on the attached graph

SHEET___OF___

CH2M HILL

PROJECT NUMBER: GLE65688

PARTICLE-SIZE ANALYSIS

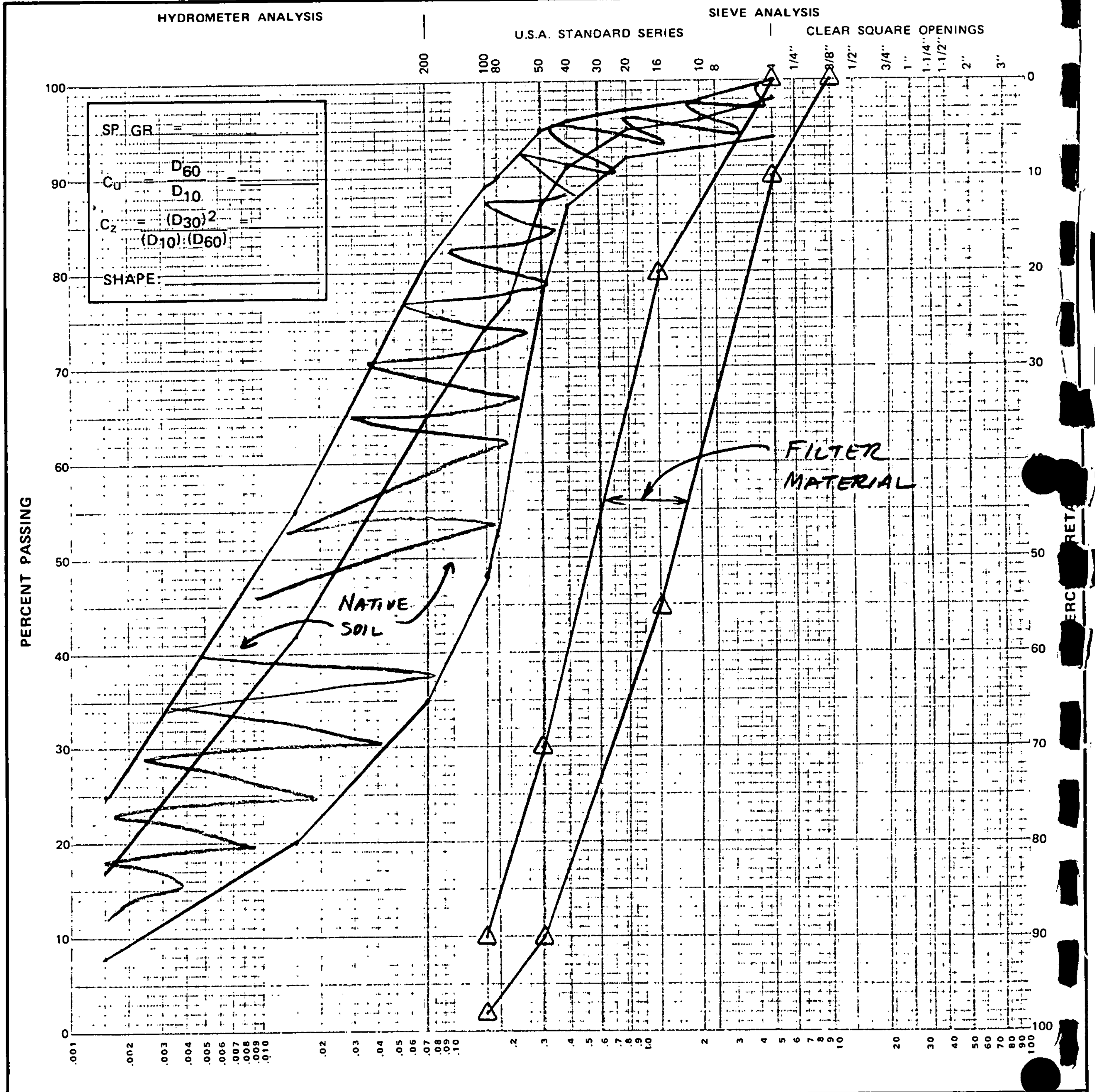
ASTM D42

PROJECT DESCRIPTION: N. W. Mauthe Remedial Design

MATERIALS LABORATORY: ______

SAMPLE LOCATION: ______ SAMPLE NO. ______

TYPE OF SAMPLE: ______



COL-LOIDS	CLAY SIZE	SILT SIZE	SAND					COBBLES
			FINE	MEDIUM	COARSE			

SAMPLE CLASSIFICATION ______

TESTED BY:	DATE:	COMPUTED BY:	DATE:	CHECKED BY:	DATE:

SUBJECT N.W. Mauthe GW Collection Trench Filter Design	BY CBB
	SHEET NO. 2 of ___ DATE ___
	PROJECT NO. GLE65688

For Native Soil:

d_{50}: 0.010 — 0.16
d_{15}: 0.002 — 0.006
d_{85}: 0.10 - 0.28

For Filter Material:

d_{15}: 0.2 – 0.35
d_{50}: 0.5 – 1.2

Filter Design Criteria:

Ref. Braja M. Das, Principles of Foundation Engineering, Brooks/Cole, 1984

Check to see that:

(a) Soil to be protected is not washed into filter material:

$$\frac{D_{15(F)}}{D_{85(B)}} < 5$$

(F) = FILTER MATL
(B) = NATIVE SOIL

$$\frac{0.2 \text{ to } 0.35}{0.10 \text{ to } 0.28} = 0.71 \text{ to } 3.5 < 5$$

Okay

(b) Excessive hydrostatic pressure is not created in the soil that has the lower coefficient of permeability

$$\frac{D_{15(F)}}{D_{15(B)}} > 4$$

$$\frac{0.2 \text{ to } 0.35}{0.002 - 0.006} = 33 \text{ to } 175 > 4$$

Okay

Additional Reference Check:

Winterkorn and Fang, Foundation Engineering Handbook, Van Nostrand Reinhold, 1975

$$\frac{D_{15}(F)}{D_{85}(B)} < 4 \text{ to } 5 < \frac{D_{15}(F)}{D_{15}(B)}$$ ~ same as Das

Winterkorn and Fang also notes that an additional criterion is sometimes applied by the Corps of Engineers

$$\frac{d_{50}(F)}{d_{50}(B)} \leqq 25$$

for our materials $\frac{d_{50}(F)}{d_{50}(B)} = \frac{0.5 \text{ to } 1.2}{0.010 \text{ to } 0.16}$

$= 0.05$ to 120

The upper bound exceeds 25 — however, the Corps allows a higher ratio for plastic clay which is the case @ Mauthe:

For these clay soils, the D_{15} size of the filter may be as great as 0.4 mm and the above D_{50} criteria will be disregarded. This relaxation in criteria for protecting medium to highly plastic clays will allow the use of a one-stage filter material; however, the filter must be well graded, and to insure nonsegregation of the filter material, a coefficient of uniformity (D_{60} to D_{10}) of not greater than 20 will be required."

$d_{15}(F) < 0.4$

$$Cu(F) = \frac{D_{60}(F)}{D_{10}(F)} = \frac{0.7 \text{ to } 1.9}{0.15 \text{ to } 0.3} = 2.3 \text{ to } 13$$

< 20

Okay

GROUNDWATER COLLECTION SUMP COST ESTIMATE

CH2M HILL	SUBJECT N.W. Mauthe Groundwater Collection Sump	BY CLB	
		SHEET NO. 1 of 3	DATE 12/16/94
		PROJECT NO. GLE65688.FDDS	

Objective : Prepare a rough cost estimate for converting a portion of the hot spot excavation into a groundwater collection sump

Cost presented will be that in excess of the cost of the rest of the remedial action

Items Included:

- regrade the bottom of the sump area for drainage purposes
- install a lateral trench to direct the groundwater from the sump to the groundwater collection system (West Trench)
- replace the Earth fill with Filter Material for drainage purposes

This cost estimate does not include the cost for treating additional groundwater that would be collected in the sump.

Volume of Groundwater Sump Area $\cong$ 2,500 cy
- includes 1.5:1 sideslopes for excavation

Add 20% to imported material quantity:

V = 3,000 cy

A. Regrade bottom of sump: ~100 cy of material

100 cy @ \$2.50 cy = \$250.00

B. Lateral Connection Trench:

Volume = 70 x 4 X 23 = 6,440 cf = 240 cy
with 25% swell = 300 cy

1. Excavation: 240 cy @ \$2/cy = \$480
2. Disposal: Assume 1/2 is TCLP characteristic and the rest is special waste

   150 cy @ \$400 = \$60,000
   150 cy @ \$150 = \$22,500

3. Backfill w/ Pea Gravel: 300 cy @ \$19.20 = \$5,760
4. Filter Fabric: 350 sf @ \$1.50 = \$525
5. Drainage Pipe: 70 lf @ \$10 = \$700
6. Pavement Resurfacing: 100 sf @ \$3.00 = \$300

TOTAL 1 – 6 = \$90,265

C. Replace Earthfill with Filter Material (Pea Gravel)

V = 3,000 cy

Cost = Filter Material – Pea Gravel = \$19.20 - \$5.00

3,000 cy @ 14.20 = \$42,600

SUBJECT N. W. Mautne Groundwater Collection Sump	BY CbB
	SHEET NO. 3 of 3 DATE 12/16/94
	PROJECT NO. GLE65688.FD.DS

TOTAL COST For converting a portion of the hot spot area to a sump:

A + B + C = $ 133,115

Largest portion of cost is disposal of TCLP characteristic material from the lateral trench — this may be reduced if material is not TCLP characteristic

NOTE: Doesn't include any additional mob, demob, or insurance costs for the subcontractor

REMEDIAL ACTION COST ESTIMATE

N.W. MAUTE COST ESTIMATE

FACILITY NAME:	N.W. Mauthe Remedial Action	ESTIMATE TYPE:	Engineer's Estimate
FILE NAME:	MautheRA.xls	ESTIMATOR:	Doug Lisak
PROJECT NAME:	N. W. Mauthe Site	DATE:	25-Apr-95
PROJECT NUMBER:	GLE65688.FD.DS	FACILITY TOTAL:	$5,788,221

DESCRIPTION	QTY	UNITS	MATERIAL COST	EXTENDED COST	RESOURCE
BONDS					
Performance and Payment Bonds	1	%	$5,788,221	$57,882	
SUBTOTAL				$57,882	
CONSTRUCTION FACILITIES/TEMP CONTROLS					
Mobilization (Including Insurances)	4	%	$5,788,221	$231,529	
Pre-Installation Ground Settlement Survey	1	LS	$6,000.00	$6,000	See Unit Cost Development
Post-Installation Ground Settlement Survey	1	LS	$6,000.00	$6,000	See Unit Cost Development
Demobilization	1	LS	$27,000.00	$27,000	See Unit Cost Development
SUBTOTAL				$270,529	
DEMOLITION/REMOVAL/DISPOSAL					
Clearing, Grubbing & Stripping	1	LS	$4,825.00	$4,825	Means 021-104-0350
Remove Manholes	2	EA	$3,700.00	$7,400	See Unit Cost Development
Remove Building Foundation	267	CY	$127.00	$33,867	Means 020-554-5200
Remove Building Slab	504	CY	$127.00	$63,970	Means 020-554-5200
Remove Concrete Sidewalks	326	SY	$6.55	$2,132	Means 020-554-4200
Offsite Disposal of TCLP Hazardous Concrete	2,500	TN	$200.00	$500,000	See Unit Cost Development
Remove/Replace Concrete Culvert/New Catch Basin	1	EA	$8,300.00	$8,300	See Unit Cost Development
Abandon Existing Monitoring Wells	26	EA	$563.00	$14,638	Weyerhaeuser Estimate
Offsite Disposal of TCLP Hazardous Soil	12,500	TN	$200.00	$2,500,000	See Unit Cost Development
Offsite Disposal of Nonhazardous Soil	5,500	TN	$85.00	$467,500	See Unit Cost Development
Offsite Disposal of Listed Soil	45	TN	$311.00	$13,995	See Unit Cost Development
Excavation of Hot Spot Areas - Level D	11,500	TN	$10.15	$116,725	See Unit Cost Development
Excavation of Hot Spot Areas - Level C	5,500	TN	$11.67	$64,185	See Unit Cost Development
Backfill with Nonhazardous Material from Onsite	5,600	CY	$8.30	$46,480	See Unit Cost Development
Backfill with Imported Earthfill Material	12,000	TN	$11.70	$140,400	See Unit Cost Development
Backfill with Imported Granular Material	100	TN	$18.30	$1,830	See Unit Cost Development
SUBTOTAL				$3,986,247	
TRENCH EXCAVATION/BACKFILL					
West Groundwater Collection Trench	1	LS	$100,600.00	$100,600	See Unit Cost Development
Central Groundwater Collection Trench	1	LS	$79,400.00	$79,400	See Unit Cost Development
Southeast Groundwater Collection Trench	1	LS	$206,600.00	$206,600	See Unit Cost Development
Influent Piping	350	LF	$31.00	$10,850	See Unit Cost Development
Influent Piping Rail Road Undercrossing	80	LF	$360.00	$28,800	See Unit Cost Development
Trench Test	1	LS	$3,750.00	$3,750	Mauthe Phase 1 Unit Price
Disposal of Groundwater	60,000	GAL	$1.25	$75,000	Mauthe Phase 1 Unit Price
Surface Restoration	1	LS	$25,000.00	$25,000	Estimator Judgement
Residential Foundation Drains	590	LF	$28.00	$16,520	See Unit Cost Development
Trench Stabilization	20	CY	$50.00	$1,000	Mauthe Phase 1 Unit Price
SUBTOTAL				$547,520	

FACILITY NAME:	N.W. Mauthe Remedial Action	ESTIMATE TYPE:	Engineer's Estimate
FILE NAME:	MautheRA.xls	ESTIMATOR:	Doug Lisak
PROJECT NAME:	N. W. Mauthe Site	DATE:	25-Apr-95
PROJECT NUMBER:	GLE65688.FD.DS	FACILITY TOTAL:	$5,788,221

DESCRIPTION	QTY	UNITS	MATERIAL COST	EXTENDED COST	RESOURCE
MISCELLANEOUS ITEMS					
Drill Monitoring Wells	200	LF	$22.84	$4,568	ECHOS Cost Assemblies
Install Well Screens for Monitoring Wells	140	LF	$9.87	$1,382	ECHOS Cost Assemblies
Install Filter Packs for Monitoring Wells	172	LF	$9.56	$1,644	ECHOS Cost Assemblies
Install Well Casings for Monitoring Wells	80	LF	$5.05	$404	ECHOS Cost Assemblies
Install Fine Sand Seals for Monitoring Wells	16	LF	$57.94	$927	ECHOS Cost Assemblies
Install Bentonite Annular Space for Monitoring Wells	30	LF	$28.97	$869	ECHOS Cost Assemblies
Install Surface Protection for Monitoring Wells	1	LS	$1,271.20	$1,271	ECHOS Cost Assemblies
Develop Monitoring Wells	32	HR	$100.00	$3,200	ECHOS Cost Assemblies
Residential Garage	1	LS	$8,400.00	$8,400	Means 131-204-0450
Offsite Fencing	250	LF	$30.15	$7,538	Mauthe Phase 1 Unit Price
SUBTOTAL				$30,203	
ALTERNATE A BID ITEMS					
Offsite Disposal of TCLP Hazardous Soil from Tracks	4,000	TN	$200.00	$800,000	See Unit Cost Development
Offsite Disposal of Special Waste from Tracks	50	TN	$85.00	$4,250	See Unit Cost Development
Excavation of Hot Spot Areas - Level D	3,500	TN	$10.15	$35,525	See Unit Cost Development
Excavation of Hot Spot Areas - Level C	500	TN	$11.67	$5,835	See Unit Cost Development
Backfill with Imported Granular Material at Tracks	2,500	TN	$18.30	$45,750	See Unit Cost Development
Influent Piping under Railroad Tracks	70	LF	$64.00	$4,480	See Unit Cost Development
SUBTOTAL				$895,840	
			FACILITY TOTAL:	$5,788,221	

PERFORMANCE & PAYMENT BONDS – ALLOW 1% OF TOTAL

MOBILIZATION (INCLUDE INSURANCES, PERMITS & GENERAL CONDITION ITEMS LIKE DECON. SETUP & OFFICE/UTILITY SETUP)

ALLOW 4% OF TOTAL

DEMOBILIZATION

REMOVE DECON SETUP	– ALLOW	5,000
" OFFICE/UTILITIES	– "	15,000
" EQUIPMENT	– "	10,000
		$30,000

PRE-INSTALLATION SURVEY

SAME AS PRELIMINARY ESTIMATE $6,000

SAME FOR POST-INSTALLATION SURVEY $6,000

CLEAR & GRUB

SAME AS PRELIMINARY ESTIMATE 4,825

DEMOLITION

REMOVE CULVERT	– SAME AS PRELIM EST	8,300
REMOVE MANHOLES	– " " " "	7,400
REMOVE BLDG FOUNDATION	" " " "	33,867
" " SLAB	" " " "	63,970
" SIDEWALKS	" " " "	2,132
		$115,669

DISPOSE OF TCLP HAZARDOUS CONCRETE

2500 TONS BID ITEM AT $200/TON (SAME AS SOIL)
= $500,000

ABANDON MONITORING WELLS

SAME AS PRELIMINARY ESTIMATE = $14,638

SUBJECT NW [illegible] BY [illegible]
ENGINEER'S ESTIMATE SHEET NO. 2 of 5 DATE 25 APR 95
PROJECT NO. GLE 65757.EP.BA

WEST TRENCH

MANHOLE (PRICE FROM PRELIM COST EST) = $16,800
SHEET PILING FOR MANHOLE (16' DEEP)
ALLOW 10' x 10' OPENING
= 40' x 45' DEEP (30' DEPTH + 15' TOE) = 1800 SF
@ 13.50
$24,300

WALERS = 1800 SF * 38 PSF/2000 @ 25% BRACING = 9 TONS
@ $160.00/TN
$1,440

EXC, BACKFILL, CLEANOUTS, PIPE (FROM PRELIM COST = $130/LF)
MODIFIED UNIT PRICE WITHOUT SHEETING
SAY DOUBLE PRICE DUE TO REDUCED
PRODUCTIVITY = $260/LF @ 203 LF = 52,780

TEMP UTILITIES (FROM PRELIM EST)
= 26400
x 20% OF TOTAL TRENCH = 5280
TOTAL WEST TRENCH = $100,600

SOUTHEAST TRENCH
MANHOLE (PRICE FROM PRELIM COST EST) = 16,800
SHEET PILING FOR MANHOLE — SAME AS ABOVE = 24,300
WALERS = 1,440

EXC, BACKFILL, CLEANOUTS, PIPE (FROM PRELIM COST) =
$260/LF x 570 LF = $148,200

TEMP UTILITIES
26,400
@ 60%
15,840

$206,580

CENTRAL TRENCH (SEE PAGE 2)
285 LF @ 260/LF = $74,100

TEMP UTILITIES
$26,400
@ .20
= 5,280

$79,380

OFFSITE DISPOSAL OF TCLP SOIL
SAME AS PRELIM COST EST = $200/TON

OFFSITE DISPOSAL OF NONHAZARDOUS SOIL
SAME AS PRELIM COST EST = $85/TON

OFFSITE DISPOSAL OF LISTED SOIL
ECOLOGY SERVICE QUOTE - PHASE I = $311/TON

EXCAVATION - HOT SPOTS - LEVEL D
SAME AS PRELIMINARY COST EST

EXCAVATION - HOT SPOTS - LEVEL C
PRELIM COST + 15%

BACKFILL WITH NON HAZARDOUS MAT'L FROM ONSITE
$8.30 (SEE PRELIMINARY EST)

BACKFILL WITH IMPORTED COMMON
$11.70 (SEE PRELIM EST)

GRANULAR BACKFILL
(MEANS 022-308-2021) 18.30/TN

INFLUENT PIPE (OPEN CUT)
(SEE PRELIM EST) = 31.00/LF

INFLUENT PIPE (JACKED)
PRELIMINARY PRICING WAS BASED
UPON RR TRACKS BEING REMOVED WITHOUT JACKING

INFLUENT PIPE (JACKED)

ASSUME JACKING PIT = 10 VLF
HISTORICAL COST = $ 1,000/VLF = $ 10,000
(2 PITS REQUIRED - JACKING/RECEIVING) x 2
$ 20,000

80 LF @ 46.80 (PRE EST MAT'L PRICE) = 3,744
LABOR/EQUIP - JACK 50'/DAY = 2 DAYS
(PRELIM EST) x 2375 = 4,750

28,494
= $360/LF

TRENCH TEST / DISPOSAL OF GROUNDWATER

TRENCH TEST - PHASE I BID PRICE
DISPOSAL OF GROUNDWATER - DITTO

SURFACE RESTORATION

SEE PRELIMINARY EST = $ 25,000

RESIDENTIAL FOUNDATION DRAINS

SEE PRELIMINARY EST $ 16,520

GARAGE / FENCING / TRENCH STAB

GARAGE	$ 8,400	(PRELIM COST EST)
FENCING	7,538	(" " ")
STABILIZATION	1,000	(" " ")

WELLS

SEE PRELIMINARY EST = $ 9,000

RR UNDERCROSSING (OPEN CUT)

(SEE PRELIMINARY ESTIMATE) $ 64/LF

SUBJECT NW INTAKE

ENGINEER'S ESTIMATE

BY LISAK

SHEET NO. 5 of 5 DATE 25 APR 95

PROJECT NO. GLE65757.EP.BA

MONITORING WELLS (FROM ECHOS COST ASSEMBLIES)

DRILL WELLS @	22^{84}/LF	REF = 33-23-1101 Pg 145
WELL SCREENS @	9^{87}/LF	33-23-0201 Pg 144
FILTER PACKS @	9^{56}/LF	33-23-1401 Pg 146
WELL CASINGS @	5^{05}/LF	33-23-0101 Pg 144
SAND SEALS @	57^{94}/LF (2'/EA)	33-23-2101 Pg 146
BENTONITE	28^{97}/LF	33-23-2101 Pg 146
SURFACE PROTECTION @	158^{90}/EA x 8	33-23-2214 Pg 146
DEVELOP WELLS	$100^{\$}$/HR	EST JUDGEMENT

ENGINEER'S ESTIMATE

BID SCHEDULE

LUMP SUM AND UNIT PRICES FOR BASE BID

Item	Est. Quan.	Unit of Payment	UP (Fig)	Unit Price or Lump Sum Amount (Written out in Words)	Ext. Total Amt.
(1)	Performance and Payment Bonds (Reimbursement based on documentation, not to exceed amount of this bid item)				
	1	LUMP SUM	$		$ 57,882
(2)	Mobilization (May not exceed 5 percent of total amount of bid items)				
	1	LUMP SUM	$		$ 231,529
(3)	Pre-installation Ground Settlement Survey				
	1	LUMP SUM	$		$ 6000
(4)	Demobilization				
	1	LUMP SUM	$		$ 27000
(5)	Clearing, Grubbing, and Stripping				
	1	LUMP SUM	$		$ 4825
(6)	Demolition, Removal, and Disposal				
(6A)	Demolition				
	1	LUMP SUM	$		$ 115669
(6B)	Offsite Disposal of TCLP Characteristic Hazardous Soil				
	12,500	T	$ 200		$ 2,500,000
(6C)	Offsite Disposal of Special Waste				
	5,500	T	$ 85		$ 467,500
(6D)	Offsite Disposal of Listed Soil				
	45	T	$ 311		$ 13,995

(6E) Offsite Disposal of TCLP Characteristic Hazardous Foundation Slabs and Footings

2,500 T $ 200 ______ $ 500,000

(7) Excavation of Hot Spot Areas

(7A) Excavation of Hot Spot Areas in Level D

11,500 T $ 10.15 ______ $ 116,725

(7B) Excavation of Hot Spot Areas in Level C

5,500 T $ 11.67 ______ $ 64,185

(8) Backfill of Hot Spot Areas

(8A) Backfill with nonhazardous material from excavation activities.

5,600 CY-VM $ 8.30 ______ $ 46,480

(8B) Backfill with imported material—Earthfill

12,000 T $ 11.70 ______ $ 140,400

(8C) Backfill with imported material—Granular Fill

100 T $ 18.30 ______ $ 1,830

(9) Groundwater Collection System

(9A) West Groundwater Collection Trench

1 LUMP SUM $____ ______ $ 100,600

(9B) Central Groundwater Collection Trench

1 LUMP SUM $____ ______ $ 79,400

(9C) Southeast Groundwater Collection Trench

1 LUMP SUM $____ ______ $ 206,600

(9D) Influent Piping by Open Cut Method

350 LF $ 31 ______ $ 10,850

(9E) Influent Piping by Boring and Jacking under Railroad Tracks

1 LUMP SUM $____ ______ $ 28,800

Item	Description	Quantity	Unit	Unit Price		Total
(10)	Trench Test	1	LUMP SUM	$		$ 3750
(11)	Disposal of Groundwater	60,000	GAL	$ 1.25		$ 75000
(12)	Surface Restoration	1	LUMP SUM	$		$ 25000
(13)	Residential Foundation Drains	1	LUMP SUM	$		$ 16520
(14)	Residential Garage	1	LUMP SUM	$		$ 8400
(15)	Residential Fencing	1	LUMP SUM	$		$ 7538
(16)	Abandon Existing Monitoring Wells	1	LUMP SUM	$		$ 14638
(17)	Trench Stabilization	20	CY	$ 50		$ 1000
(18)	Post-installation Ground Settlement Survey	1	LUMP SUM	$		$ 6000
(19)	Drill Monitoring Wells	200	VLF	$ 22.84		$ 4568
(20)	Install Well Screen for Monitoring Wells	140	VLF	$ 9.87		$ 1382

(21) Install Filter Pack for Monitoring Wells

172	VLF	$ 9.56	$ 1644

(22) Install Well Casing for Monitoring Wells

80	VLF	$ 5.05	$ 404

(23) Install Fine Sand Seal for Monitoring Wells

16	VLF	$ 57.94	$ 927

(24) Install Bentonite Annular Space Seal for Monitoring Wells

30	VLF	$ 28.97	$ 869

(25) Install Surface Protection for Monitoring Wells

1	LUMP SUM	$,	$ 1271

(26) Develop Monitoring Wells

32	HR	$ 100	$ 3200

TOTAL BASE BID AMOUNT:

____________________ Dollars and $______ Cents
(Amount Written Out in Words)

$ 4,892,381
(Amount in Figures)

LUMP SUM AND UNIT PRICES FOR ALTERNATE A

The Bidder further agrees, that, in the event that excavation and disposal of contaminated soil from within the Fox Valley & Western, Ltd., right-of-way is added to the subcontract scope of work, by the CONTRACTOR, the following Alternate A Bid Items shall be added to the scope of work. The scope of work for the Alternate A Bid items is included in the appropriate specification sections and drawings of the Subcontract Documents. Determination of low bid will be based on the sum of the Base Bid and the Alternate A Bid items.

Bidders must complete both the Base Bid Schedule and the Alternate A Bid Items or their bid will be considered nonresponsive. Inclusion of Alternate A work in the sum of the Base Bid and the Alternate A Bid items will not obligate the CONTRACTOR to exercise the Alternate A work.

ALTERNATE A BID ITEMS

Item	Est. Quan.	Unit of Payment	UP (Fig)	Unit Price or Lump Sum Amount (Written out in Words)	Ext. Total Amt.
(A1)	Offsite Disposal of TCLP Characteristic Hazardous Soil excavated from the railroad property				
	4,000	T	$ 200		$ 800,000
(A2)	Offsite Disposal of Special Waste excavated from the railroad property				
	50	T	$ 85		$ 4,250
(A3)	Excavation of Hot Spot Areas in Level D within the railroad property				
	3,500	T	$ 10.15		$ 35,525
(A4)	Excavation of Hot Spot Areas in Level C within the railroad property				
	500	T	$ 11.67		$ 5835
(A5)	Backfill with imported material within the railroad property--Granular Fill				
	2,500	T	$ 18.30		$ 45,750
(A6)	Influent Piping under Railroad Tracks by Open Cut Method				
	70	LF	$ 64		$ 4480

TOTAL SUM OF ALTERNATE A BID ITEMS

______________________________ Dollars and $________

(Amount Written Out in Words)

$ 895,840
(Amount in Figures)

TOTAL AMOUNT OF BASE BID AMOUNT PLUS SUM OF ALTERNATE A BID ITEMS FOR DETERMINATION OF LOWEST BID:

______________________________ Dollars and $________

(Amount Written Out in Words)

$ 5,788,221
(Amount in Figures)

END OF SECTION

APPENDIX B
HEALTH AND SAFETY PLAN

CH2M HILL HEALTH AND SAFETY PLAN

This plan will be kept onsite during field activities and will be reviewed and updated as necessary. This plan adopts, by reference, the standards of practice (SOP) contained in the CH2M HILL *Waste Management and Industrial Processes Discipline Health and Safety Manual, Volumes 1 and 2*, and other applicable CH2M HILL SOPs as appropriate. The Site Safety Coordinator (SSC) is to be familiar with these SOPs. In addition, this plan adopts procedures contained in the work plan for the project.

1.0 PROJECT INFORMATION AND DESCRIPTION

CLIENT OR OWNER: U.S. EPA Region 5

PROJECT NO: GLE65688.FD.DS

PROJECT MANAGER: Cathy Barnett/MKE **OFFICE:** GLR/MKE

SITE NAME: N.W. Mauthe Company

SITE ADDRESS: 725 South Outagamie Street, Appleton, WI

DATE HEALTH AND SAFETY PLAN PREPARED: December 1994

DATE(S) OF INITIAL VISIT: November 1991 through April 1992

DATE(S) OF SITE WORK: April 1995 through February 1996

SITE ACCESS: The site is accessible from Second and Outagamie Streets.

SITE SIZE: The N.W. Mauthe Company is about 25,000 sq ft. The Chromium Building and the Zinc Building occupy 7,500 sq ft and 5,000 sq ft, respectively.

SITE TOPOGRAPHY: The site topography is fairly flat, but drops off to a shallow ditch which runs between the Site and railroad tracks.

HISTORY: The N.W. Mauthe site is a former electroplating facility located at 725 South Outagamie Street in Appleton, Wisconsin. Approximately 0.6 acres in size and triangular in shape, the site is located in an area of mixed commercial, light industrial, and residential properties. The facility consisted of two building (the Zinc and Chromium Buildings). The site is bordered by Melvin Street on the north, an asphalt parking lot owned by Miller Electric an Manufacturing Company on the west, and the Fox Valley & Western, Ltd., railroad on the southeast. Private residences are located immediately south of the railroad tracks and on the north side of Melvin Street.

Hard chromium plating was conducted in the Chromium Building from 1960 to 1976. Objects to be electroplated were rinsed with a chlorinated solvent to remove oils, then submerged in plating solution baths. Hydrogen gas and chromic acid vapors generated from the plating process were exhausted form the building by a ventilating fan, while splashes, drips, and spills from the plating and degreasing activities were directed to a shallow floor trench and channeled into the sanitary sewer system.

Zinc, cadmium, copper, and possibly silver were electroplated in the Zinc Building from 1978 to 1987. A *Pretreatment Baseline Report* submitted by the N.W. Mauthe Company to the City of Appleton on January 4, 1985, states that the company used 1,1,1-trichloroethane (27 gal/year) for parts degreasing and several plating bath solutions in the electroplating process. Liquid wastes were discharge, untreated, into the sanitary sewer system.

In 1982, the DNR received a report of yellow-green water in puddles south of the Chromium Building. Over the years, plating solutions and waste solvents had leaked from holding vats, tanks, and channels into surrounding soils. Additionally, plating tank solutions were allegedly discharged onto the ground outside the building by sump pumps.

The DNR began an investigation of the site in April 1982. Surface water removal actions also began at that time. A total of 18 monitoring wells were installed. Soil boring samples and groundwater samples revealed contamination at the site. Under contract to the DNR, Commercial Pumping and Incineration installed a shallow groundwater collection system parallel to the railroad track in May 1982. For 2 years, shallow groundwater and surface water were collected and transferred to the De Pere publicly owned treatment works (POTW). The N.W. Mauthe site was added to the NPL in 1989 as the result of several rounds of environmental sampling and health assessments.

A remedial investigation (RI) was performed by CH2M HILL from November 1991 to May 1992. The RI included monitoring well installation; surface and subsurface soil sampling; test pit excavation; groundwater, residential, sump, and sewer water sampling; hydraulic conductivity testing; surface water sampling; and videotaping of the sanitary and storm sewer lines. The results of the RI are documented in the *Remedial Investigation Report, N.W. Mauthe Site, Appleton, Wisconsin* (CH2M HILL February 1993).

Soil and groundwater sampling results showed the greatest concentrations of hazardous substances in the area around the Zinc an Chromium Building. The chemicals most often detected above background levels or state groundwater standards include chromium (both hexavalent and total), zinc, cadmium, cyanide, trichloroethene, 1,1,1-trichloroethane, 1,1-dichloroethene, and toluene.

Subsurface soil contamination was detected to a maximum depth of 25 feet. It extended horizontally over the entire Mauthe property and to the south side of the railroad tracks adjacent to the property. Outside the process buildings area, the vertical extent of contamination is more limited and does not extend to the 25-foot depth observed near the buildings. Chromium is the most widely distributed contaminant of the chemicals analyzed for in the RI. Selected volatile organic compounds (VOCs) were detected in subsurface soils but have a more limited distribution.

Hexavalent chromium-contaminated groundwater extends over most of the block bordered by Melvin, Outagamie, and Second Streets. Most or all of the chromium in groundwater exists in the hexavalent form.

Surface water samples collected from puddles along the southern edge of the Mauthe property contained chromium and some VOCs.

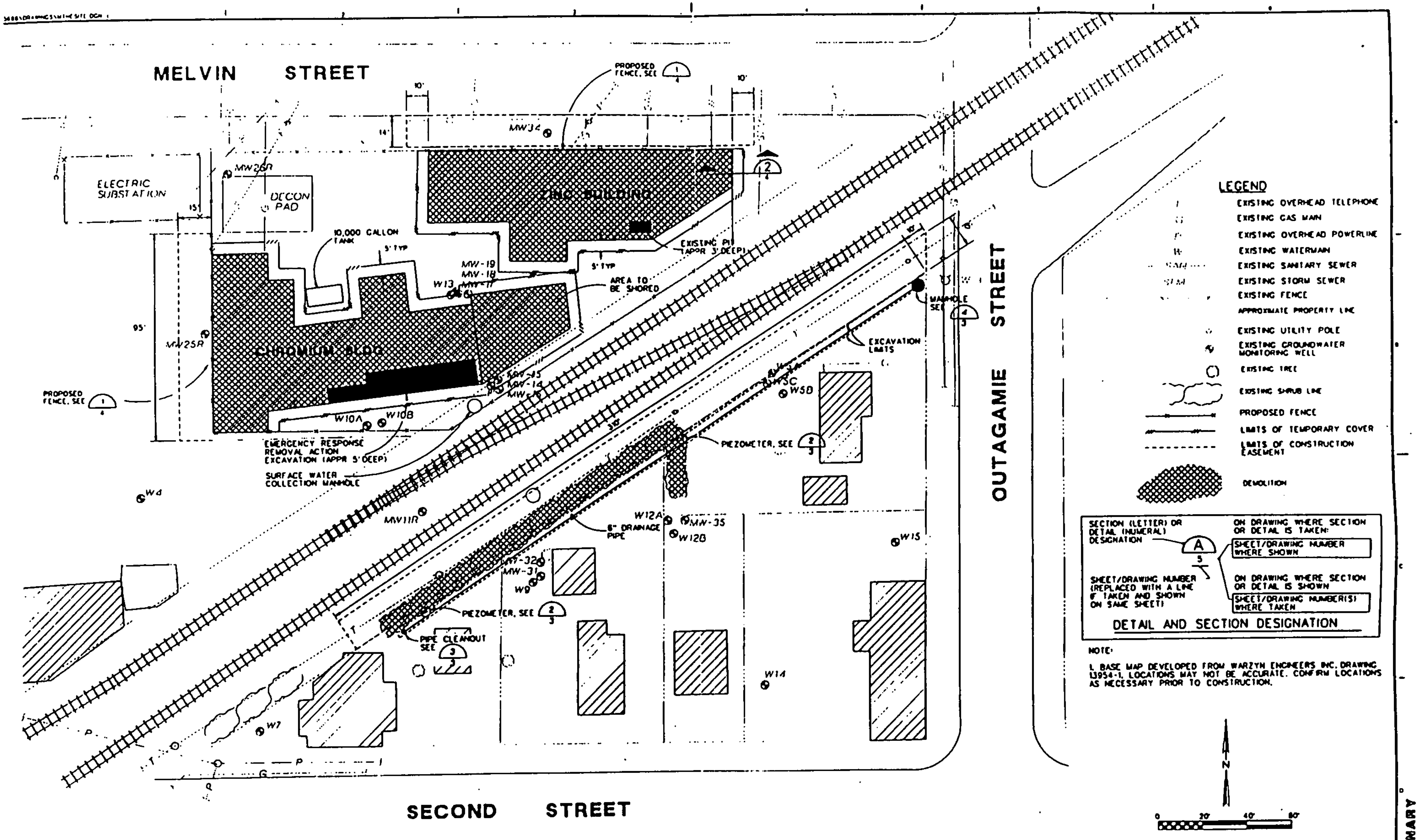
A feasibility study (FS) was conducted by CH2M HILL to develop and evaluate remedial action alternatives for the site (*Feasibility Study Report, N.W. Mauthe Site, Appleton, Wisconsin, CH2M HILL, May 1993*). The DNR, in consultation with the United States Environmental Protection Agency (U.S. EPA), used the information presented in the FS to select a remedial action alternative in its Record of Decision (ROD) in accordance with the National Contingency Plan (NCP). The ROD was signed in March 1994. The remedial actions required at the site are as follows:

- Demolition and removal of the buildings of the N.W. Mauthe property

- Removal and disposal of containerized waste stored on the property

- Improvement or installation of foundation drain systems and cleaning, painting, or sealing of basement walls or floors, as needed, for homes or businesses in the area of the site affected by site contamination

- Excavation of soils with a total chromium concentration greater than 500 mg/kg



CH2M HILL

DSGN C.C. BARNETT
DR P.Z. ALLEN
CHK
APVD

NO. DATE REVISION BY APVD

REUSE OF DOCUMENTS

PREDESIGN ACTIVITIES
N.W. MAUTHE SITE
APPLETON, WISCONSIN

SITE PLAN

SHEET 1
DATE JUNE 1994
PROJ NO. GLE65688

PRELIMINARY

- Offsite treatment and disposal of the excavated soils
- Backfilling the excavation
- Capping the site with two feet of clay soil and topsoil, with the establishment of vegetative cover
- Installation of groundwater collection trenches and construction and operation of a groundwater treatment facility with discharge to the sanitary sewer
- Institutional controls to prevent access, excavation, disturbance of the cap, future excavation in contaminated soils, and installation of drinking water wells
- Monitoring the effectiveness of the groundwater treatment system
- Operation and maintenance of all systems

The demolition of site buildings and the removal and disposal of the containerized waste was accomplished in the fall of 1994 during remedial design.

2.0 PROJECT ORGANIZATION AND TASKS TO BE PERFORMED UNDER THIS PLAN

2.1 PROJECT ORGANIZATION

CH2M HILL:

Project Manager:	Cathy Barnett	(414) 272-2426
Site Safety Coordinator:	Alan Parker	(414) 272-2426
Health and Safety Manager:	Christine Culligan	(414) 272-2426

2.2 DESCRIPTION OF TASKS

- Installation of groundwater collection system consisting of three trenches and two collection manholes. A portion of the excavated soil is considered hazardous.
- Performance of a trench test on one of the groundwater collection trenches.
- Demolition of building foundations and the disposal of the demolition debris offsite.
- Excavation and disposal of about 7,000 cy of TCLP characteristic soil.
- Site grading including construction of surface water collection.

2.3 DESCRIPTION OF SUBCONTRACTORS

REFERENCE SECTION 3, *CORPORATE HEALTH AND SAFETY PROGRAM MANUAL*

When specified in the project documents (e.g., contract), this plan may cover those subcontractors contracted with CH2M HILL. However, this plan does not address hazards specific to specialty contractor's work (e.g., drill rig safety as it applies to the operation of the rig, or construction safety). The specialty subcontractor is responsible for safety procedures and plans specific to their work. Subcontractors must comply with an established health and safety plan: CH2M HILL will monitor and enforce general compliance with the established plan.

3.0 HAZARD EVALUATION AND CONTROL

3.1 HEAT AND COLD STRESS (REFERENCE CH2M HILL SOP HS-09)

3.1.1 GUIDELINES FOR WORKING IN TEMPERATURE EXTREMES WHILE WEARING PERSONAL PROTECTIVE EQUIPMENT (PPE)

Temperature	Work Cycle	Rest Cycle	Control Measures
<32° F or <55° F and raining	2 hrs	15 min	Review cold stress in safety meeting. Rest in a warm area. Drink at least 8 ounces of warm non-caffeinated, non-alcoholic beverage at each rest break. Schedule a mid-day lunch break of at least 30 minutes in a warm area to begin not later than 5 hours after startup.
72° to 77° F	2 hrs	5 min	Review heat stress in safety meeting. Take resting pulse rate before beginning work. Drink 8 ounces of cool water before beginning work, and 4 ounces at rest break. Have ice available.
77° to 82° F	2 hrs	5 min	As above, but seated rest break. Monitor pulse rate. (See below.)
82° to 87° F	60 min	15 min	As above, but rest area to be shaded.
87° to 90° F	30 min	15 min	As above. Try to provide a shaded work area.
> 90° F	15 min	15 min	As above. Provide a shaded area with seats in the work area for team members to use as needed. Try to reschedule work to avoid mid-day heat.

PULSE CRITERIA. Take resting radial (wrist) pulse at start of work day; record it. Measure radial pulse for 30 seconds as rest period begins. Pulse not to exceed 110 beats per minute (bpm), or 20 bpm above resting pulse. If pulse exceeds this criteria, reduce work load and/or shorten the work cycle by one third, and observe for signs of heat stress. No team member is to return to work until his/her pulse has returned to < 110 bpm, or resting pulse + 20 bpm.

3.1.2 SYMPTOMS AND TREATMENT OF HEAT AND COLD STRESS

Heat Stroke	Heat Exhaustion	Frostbite	Hypothermia
Red, hot, dry skin; dizziness; confusion; rapid breathing and pulse; high body temperature.	Pale, clammy, moist skin; profuse sweating; weakness; normal temperature; headache; dizzy; vomiting.	Blanched, white, waxy skin, but tissue resilient; tissue cold and pale.	Shivering, apathy, sleepiness; rapid drop in body temperature; glassy stare; slow pulse; slow respiration.
Cool victim rapidly by soaking in cool (not cold) water. Get medical attention immediately!!	Remove victim to a cool, air conditioned place. Loosen clothing, place head in low position. Have victim drink cool (not cold) water.	Remove victim to a warm place. Rewarm area quickly in warm (not hot) water. Have victim drink warm fluids--not coffee or alcohol. Do not break any blisters. Elevate the injured area and get medical attention.	Remove victim to a warm place. Have victim drink warm fluids--not coffee or alcohol. Get medical attention.

3.2 PHYSICAL (SAFETY) HAZARDS AND CONTROLS (REFERENCE APPROPRIATE CH2M HILL SOP HS-03)

Hazard	Engineering or Administrative Controls
Flying debris/objects	Provide shielding and PPE.
Noise > 85 dBA	Noise protection and monitoring required.
Steep terrain/unstable surface	Brace and shore equipment.
Build-up of explosive gases	Provide 20 lb A,B,C fire extinguisher and ventilation.
Build-up of static electricity	No spark sources within 50 feet of an excavation, heavy equipment, or UST removal. Ground as appropriate.
Gas cylinders	Make certain gas cylinders are properly anchored and chained. Keep cylinders away from ignition sources.
High pressure hose rupture	Check to see that fitting and pressurized lines are in good repair before using.
Electrical shock	Make certain third wire is properly grounded. Do not tamper with electrical wiring unless qualified to do so.
Suspended loads	Work not permitted under suspended loads.
Moving vehicles	Back-up alarm required for heavy equipment. Observer remains in contact with operator and signals safe back-up. Personnel to remain outside of turning radius.
Overhead electrical wires	Heavy equipment (e.g., drill rig) to remain at least 15 feet from overhead powerline for powerlines of 50 kV or less. For each kV > 50 increase distance 1/2 foot.
Buried utilities, drums, tanks, and so forth.	Locate buried utilities, drums, tanks, etc., before digging or drilling and mark location.
Slip, trip, fall hazards due to muddy work areas	Use wood pallets or similar devices in muddy work areas.
Back injury	Use proper lifting techniques, or provide mechanical lifting aids.
Confined space entry	Permit and safety plan required (reference CH2M HILL SOP HS-17).
Trenches/excavations	Make certain trench meets OSHA standard before entering. All excavations > 5 feet deep must be sloped or shored. Excavations > 4 feet deep must have a ladder every 25 feet. If not entering trench, remain 2 feet from edge of trench at all times.
Protruding objects	Flag visible objects.

3.3 PROCEDURES TO LOCATE BURIED UTILITIES

Known utilities in the work area include electric (buried and overhead), telephone, gas cable, sanitary sever, storm sewer, and water. A utility survey (e.g., Digger's Hotline) must be performed by the Subcontractor before installation of the groundwater collection system and any other activity requiring soil excavation.

3.4 BIOLOGICAL HAZARDS AND CONTROLS

Hazards	Location and Control Measures

None known.

3.5 TICK BITES, LYME DISEASE, AND ROCKY MOUNTAIN SPOTTED FEVER (RMSF)

Check often for tick bites. If bitten, carefully remove tick with tweezers, making certain to remove pincers, being careful not to crush the tick. After removing the tick, wash your hands. Disinfect area, and dress. If the tick resists or cannot be completely removed, seek medical attention.

Look for symptoms of lyme disease or RMSF. Lyme: rash that looks like a "bulls-eye," with small welt in center, several days to weeks after tick bite. RMSF: Rash comprising red spots under skin, 3 to 10 days after tick bite. For both, chills, fever, headache, fatigue, stiff neck, bone pain. If symptoms appear, seek medical attention.

3.6 RADIOLOGICAL HAZARDS AND CONTROLS

Refer to the CH2M HILL *Waste Management and Industrial Processes Discipline Health and Safety Manual, Volume 2* for standards of practice for operating in contaminated areas.

Hazards	Controls

None known.

3.7 HAZARDS POSED BY CHEMICALS BROUGHT ONSITE

Refer to CH2M HILL Hazard *Communication Program Manual* which is available from the Corporate Human Resources Department in Denver. The Project Manager is to request Material Safety Data Sheets (MSDSs) from the client, or contractors and subcontractors for chemicals that CH2M HILL employees are potentially exposed to. The following must be conducted:

- Employees must receive HAZCOM training
- Inventory of chemicals brought onsite by subcontractors must be on file
- Obtain an MSDS for each hazardous chemical present onsite
- All chemical containers must be labeled with the identity of the chemical and any hazard warning

	Chemical		Location
1.	Methane [Organic Vapor Analyser (OVA) Cal Gas]	1.	Site Trailer
2.	Isobutylene [HNu Cal Gas]	2.	Site Trailer
3.	Pentane [CGI Cal Gas]	3.	Site Trailer
4.	Hydrogen [PID]0	4.	Site Trailer

3.8 KNOWN CONTAMINANTS OF CONCERN

Contaminant	PEL, REL, or TLV (ppm)	IDLH (ppm)	Symptoms and Effects of Exposure	PIP
Acetone	750 ppm	20,000 ppm	Inhalation irritates the eyes, nose and throat. Ingestion can cause headaches, dizziness and dermatitis.	9.69
Aluminum metal/powder	15 mg/m^3	NA	Dust is a respiratory and eye irritant. Dyspnea, cough, lethargy, anorexia and an increased respiratory rate. Lung bibrosis can occur after long term exposure.	NA
Cadmium	0.2 mg/m^3	NA	Cadmium is moderately toxic when ingested causing severe irritation to the digestive system. Inhalation exposures primarily affect the lungs and kidneys causing pulmonary edema and anemia. Symptoms of over-exposure include dryness of the throat, cough, headache, shortness of breath and vomiting.	NA
Chromium	0.5 mg/m^3	500 mg/m^3	Hexavalent chromium is a carcinogen. Inhalation of chromium fumes causes histologic fibrosis of the lungs.	NA
Cyanide STEL	5 mg/m^3 4.7 ppm	50 mg/m^3	Asphyxia and death can occur by inhalation. When absorbed through the skin confusion, nausea, headaches and weakness occur. Ingesting causes an increased respiratory rate and vomiting.	NA
Lead	0.050 mg/m^3	NA	Lead is more toxic by inhalation than by ingestion since much of ingested lead passes through the body unabsorbed. Lead is a cumulative poison that builds up in the body. Symptoms of chronic over-exposure include: weakness, metallic taste, nausea, vomiting, and muscle pains.	NA
Methyl chloride	50 ppm	10,000 ppm	Inhalation can result in dizziness, nausea, vomiting and visual distortion. Eye or skin contact can cause staggering, slurred speech, convulsions, coma, kidney and liver damage and frostbite. Carcinogen.	
1,1,1-Trichloroethane	350 ppm	1,000 ppm	Headaches, lassitude, CNS depression. Ingestion can be followed by irritated eyes and poor equilibrium. Contact can cause dermatitis and cardiac arrhythmia.	11.00
Trichloroethane	50 ppm	1,000 ppm	Headaches, visual distortion and vertigo occurs when inhaled. Ingestion causes tremors, somnolence and nausea. Skin and eye exposure can be followed by irritated eyes, dermatitis, vomiting, cardiac arrhythmia and paresthesia. Carcinogen.	9.45
Zinc	NA	NA	Zinc is relatively nontoxic but when combined with oxygen or mineral acids the resulting compound can have a toxic effect.	

3.9 POTENTIAL ROUTES OF EXPOSURE		
DERMAL: Minimize exposures through the use of skin and hand protection.	**INHALATION:** Minimize organic vapor and dust exposure through the use of appropriate respiratory protection inside exclusion zones or at designated hot spots.	**INGESTION:** Avoid ingestion through the use of appropriate hand and face protection, and conformance with SOPs concerning food and drink, and personal hygiene.

4.0 PERSONNEL

4.1 EMPLOYEES (REFERENCE CH2M HILL SOP HS-01 and HS-02)

Employees listed below are enrolled in the CH2M HILL chemical protection program (CPP) and have taken initial and annual medical surveillance examinations. Employees designated "SSC" have received 8 hours of supervisor and 8 hours of instrument training and can serve as site safety coordinator (SSC) for the level of protection indicated. There must be one SSC present during any task performed in a work area with the potential for exposure to safety and health hazards. Employees designated "FA-CPR" are currently certified by the American Red Cross, or equivalent, in first aid and CPR. There must be one FA-CPR designated employee present during any task performed in an area the potential for exposure to safety and health hazards.

Employee Name	Office	Responsibility	SSC/FA-CPR
TO BE NAMED BEFORE WORK BEGINS	MKE	Field Team Leader	Level
Alan Parker	MKE	Site Safety Coordinator	Level D SSC; FA-CPR
Cathy Barnett	MKE		FA-CPR
Gina Bayer	MKE		Level D SSC; FA-CPR
Tim Harrison	MKE		Level D SSC; FA-CPR
Patrick Allen	MKE		
Jeff Keiser	MKE		Level C SSC; FA-CPR
Jeff Lamont	MKE		Level B SSC; FA-CPR

4.2 HEALTH AND SAFETY AND FIELD TEAM CHAIN OF COMMAND AND PROCEDURES

4.2.1 OWNER/CLIENT

U.S. EPA Contact: Jon Peterson/U.S. EPA (312) 353-1264

4.2.2 CONTRACTOR

Project Manager:	Cathy Barnett	(414) 272-2426
SSC:	Alan Parker	(414) 272-2426

4.2.3 SUBCONTRACTOR

General health and safety communications with subcontractors contracted with CH2M HILL, and covered by this plan are as follows:

- Request that subcontractor (if specialty subcontractor) submit safety or health plan applicable to their expertise (e.g., drill rig safety plan), and attach to this plan.
- Brief subcontractor employees on this plan.
- Health and safety communications are to be directed to the subcontractor-designated safety representative.

- Notify the subcontractor-designated representative if an apparent hazard (e.g., violation of established plan) is observed. Specialty subcontractors are responsible for mitigating hazards (e.g., a drill rig safety hazard).

- If a hazard persists, warn subcontractor. Stop work affected by hazard, as a last resort, if hazard is not eliminated.

- When an apparent imminent danger exists, promptly remove all affected personnel. Notify the project manager.

Subcontractor:
Contact Name: **TO BE ADDED BEFORE WORK BEGINS**
Phone Number:

5.0 PERSONAL PROTECTIVE EQUIPMENT (PPE) SPECIFICATION[1] (REFERENCE CH2M HILL SOP HS-07 and HS-08)

Task	Level	Body	Foot	Head[2]	Eye	Hand	Respirator
Observation of demolition, excavation, or construction of groundwater collection system. If contact with contaminated soil, water, or dust is necessary to perform work.	D	Poly-coated Tyvek	Steel-toe boots with Rubber boot covers	Hardhat; Splash shield	Safety glasses	Neoprene gloves	None required.
Observation of above if contact is not necessary.	D	Work clothes or coveralls	Steel-toe boots	Hardhat	None required		None required.
All tasks requiring upgrade per Section 5.1 or 6.0.	C	Poly-coated Tyvek	Steel-toe boots with Rubber boot covers	Hardhat	Not Applicable	Neoprene gloves	APR, full face, MSA Ultratwin or equivalent, cartridges.
Not approved by this plan.	B			Hardhat			Positive pressure demand SCBA; MSA Ultralite or equivalent PRE pressure [res pressure]

Note 1: Modifications:
Note 2: The SSC shall specify hardhat areas.

5.1 REASONS TO UPGRADE OR DOWNGRADE LEVEL OF PROTECTION

Upgrade	Downgrade
• Request of individual performing task. • Change in work task that will increase contact or potential contact with hazardous materials. • Occurrence or likely occurrence of gas or vapor emission. • Known or suspected presence of dermal hazards. • Instrument action levels (Section 6.0) exceeded.	• New information indicating that situation is less hazardous than originally thought. • Change in site conditions that decreases the hazard. • Change in work task that will reduce contact with hazardous materials.

6.0 AIR MONITORING EQUIPMENT SPECIFICATION (REFERENCE CH2M HILL SOP HS-06)

Instrument	Tasks	Action Levels		Frequency	Calibration
Explosimeter-CGI (with an inhibitor filter for leaded gasoline).	Intrusive Operations. When entering the zinc or chromium buildings.	0-10% LEL 10-25% LEL >25% LEL	No expl.[1] hazard Work may continue with extreme caution and continuous monitoring. Expl. hazard; evacuate or vent	Initially and periodically throughout the task.	Daily, with pentane, per manufacturer directions.
HNu, OVM or OVA with 11.7 eV lamp	Demolition and excavation.	0-1 ppm > 1-5 ppm[ab] > 5 ppm[ab]	Level D Level C Stop work; re-evaluate	Initially and periodically throughout task.	Daily, with 100 ppm isobutylene, per manufacturers directions.
Miniram Dust Monitor or equivalent.	While operations that generate dust are conducted.	0.1 mg/m^3 0.1-3.53 mg/m^3 > 3.53 mg/m^3	Level D Level D Practice dust suppression. Level C	Continuously when operations are in the buildings or whenever dust is likely.	Daily, with an approved calibrator, before and after measurement.

Note 1: expl = explosion Note 2: pot = potential Note 3: def = deficient Note 4: ab = above background
Note 5: N/A = not applicable

6.1 CALIBRATION SPECIFICATION

Instrument	Gas	Span	Reading	Method
PID: HNU, 11.7 eV probe	100 ppm isobutylene	5.0 ± 2.0	68 ppm	1.5 l/m reg T-tubing 0.25 l/m reg direct tubing
FID: OVA-128	100 ppm methane	3.0 ± 1.5	100 ppm	1.5 l/m reg T-tubing
CGI: MSA 260, 261, 360, or 361	0.75% pentane	N/A	50% LEL ± 5 % LEL	1.5 l/m reg direct tubing

6.2 AIR SAMPLING

See Air Monitoring Plan.

7.0 DECONTAMINATION SPECIFICATION (REFERENCE SOP)

Personnel	Sample Equipment	Heavy Equipment
Boot wash/rinse	Wash/rinse equipment	Power wash
Glove wash/rinse	Solvent rinse equipment	Steam clean
Outer glove removal	Solvent disposal method:	Water disposal method:
Body suit removal		
Inner glove removal		
Respirator removal		
Hand wash/rinse		
Face wash/rinse		
Shower ASAP		
PPE disposal method:	To be handled by subcontractor.	
Water disposal method:	To be handled by subcontractor.	

7.1 DIAGRAM OF PERSONNEL DECONTAMINATION LINE

WILL USE DEMOLITION CONTRACTOR DECONTAMINATION LINE.

8.0 SPILL CONTAINMENT PROCEDURES

Containers protected in metal containers. Dust suppression will take place when required.

9.0 CONFINED SPACE ENTRY

Confined space entry requires an additional health and safety plan and a permit. Refer to CH2M HILL SOP HS-17, contained in the *Waste Management and Industrial Processes Discipline Health and Safety Manual, Volume 1.*

10.0 WORK PROCEDURES

10.1 WORK PRACTICES

- Follow facility health and safety policies. No spark sources within the work area.
- Avoid visibly contaminated areas.
- No eating, drinking, or smoking in contaminated areas, or work areas.
- SSC to establish areas for eating, drinking, smoking.
- No contact lenses where hazardous materials are present.
- No facial hair that would interfere with respirator fit if Level C or B is anticipated.
- Site work will be performed during daylight hours whenever possible. Any work conducted during hours of darkness will require enough illumination intensity "to read a newspaper without difficulty."

10.2 WORK AREA CONTROL MEASURES

- Site safety coordinator (SSC) to conduct site safety briefing (see below) before starting field activities, or as tasks and site conditions change.
- SSC records safety briefing attendance in logbook, and documents topics discussed.
- Post OSHA job site poster in a central and conspicuous location at the site office area.
- Determine wind direction.
- Establish work areas.
- Establish decontamination procedures, including respirator decontamination procedures, and test.
- Utilize access control at the entry and exit from each work zone.
- Chemicals to be stored in proper containers.
- MSDSs are available for onsite chemicals employees exposed to.
- Establish onsite communications. These should consist of:
  - Line of sight/hand signals
  - Air horn
  - Two-way radio or cellular phone if available
- Establish emergency signals. For example:
  - Grasping throat with hand--EMERGENCY--HELP ME
  - Grasping buddy wrist--LEAVE AREA NOW
  - Thumbs up--OK, UNDERSTOOD
  - Two short blasts on air horn--ALL CLEAR
  - Continuous air horn--EMERGENCY--EVACUATE
- Establish "buddy" system.
- Establish procedures for disposal of material generated onsite.
- Initial air monitoring conducted by SSC in appropriate level of protection.
- SSC to conduct periodic inspections of work practices to determine effectiveness of this plan. Deficiencies to be noted, reported to DHSM or RHSM, and corrected.
- Site safety briefing topics: general discussion of health and safety plan; site specific hazards; location of work zones; PPE requirements; equipment; special procedures; emergencies.

11.0 EMERGENCY RESPONSE PLAN (REFERENCE CH2M HILL SOP HS-12)

11.1 PRE-EMERGENCY PLANNING

The SSC performs the applicable pre-emergency planning tasks before starting field activities and coordinates emergency response with the facility and local emergency service providers as appropriate.

- Locate nearest telephone to the site and inspect onsite communications.
- Locate chemical, safety, radiological, biological hazards.
- Confirm and post emergency telephone numbers and route to hospital or facility clinic.
- Post site map marked with location of emergency equipment and supplies.
- Review emergency response plan for applicability to any changed site conditions, alterations in onsite operations, or personnel availability.
- Where appropriate and acceptable to the client, inform emergency room/ambulance service and emergency response teams of anticipated types of site emergencies.
- Designate one vehicle as the emergency vehicle; place hospital or clinic directions and map inside; keep keys in ignition during field activities.
- Inventory and check site emergency equipment and supplies.
- Review emergency procedures for personnel injury, exposures, fires, explosions, chemical and vapor releases with field personnel.
- Locate onsite emergency equipment and supplies of clean water.
- Verify local emergency contacts, hospital routes, evacuation routes, and assembly points.
- Drive route to hospital or clinic.
- Review names of onsite personnel trained in first aid and CPR.
- Review notification procedures for contacting CH2M HILL's medical consultant and team member's occupational physician.
- Brief new workers on the emergency response plan.

11.2 EMERGENCY EQUIPMENT AND SUPPLIES

The SSC marks the locations of emergency equipment on the site map and posts the map in the support zone.

- 20 lb ABC fire extinguisher
- Industrial first aid kit
- Facility emergency equipment:
- Additional emergency equipment:
- Nearest phone

11.3 EMERGENCY MEDICAL TREATMENT

- The SSC will assume charge during a medical emergency until the ambulance arrives, or the injured person is admitted to the emergency room.
- Prevent further injury.
- Initiate first aid and CPR.
- Call the ambulance and hospital or clinic.
- Determine if decontamination will make injury worse. Yes--seek medical treatment immediately.
- Make certain that injured person is accompanied to emergency room.
- Notify the Project Manager of the injury.
- Notify the District or Regional Health and Safety Manager.
- Notify the injured person's human resources department.
- Prepare an incident report. Submit this to the Corporate Director Health and Safety (WDC) and Corporate Human Resources Department (DEN) within 48 hours.

11.4 EVACUATION

- Evacuation routes will be designated by SSC before beginning of work.
- Onsite and offsite assembly points will be designated before beginning of work.
- Personnel will exit the work area and assemble at the onsite assembly point upon hearing the emergency signal for evacuation.
- Personnel will assemble at the offsite point upon hearing the emergency signal for a facility evacuation.
- The SSC and a "buddy" will remain onsite after the site has been evacuated (if possible) to assist local responders and advise them of the nature and location of the incident.
- SSC accounts for all personnel in the onsite assembly zone.
- A person designated by the SSC (before work) will account for personnel at the offsite assembly area.
- The SSC is to write up the incident as soon as possible after it occurs, and submit a report to the Corporate Director Health and Safety.

11.5 EVACUATION ROUTES AND ASSEMBLY POINTS

11.6 EVACUATION SIGNALS

Exclusion Zone **Site**

12.0 EMERGENCY RESPONSE TELEPHONE NUMBERS

SITE ADDRESS:	725 South Outagamie Street; Appleton, WI	**Phone:**	TO BE ADDED BEFORE WORK BEGINS
Police:	(414) 832-5500	**Phone:**	911 (verify)
Address:	2222 South Walnut Street		(414) 832-5500
Fire:	(414) 832-5810	**Phone:**	911 (verify)
Address:	700 North Drew Street		(414) 832-5810
Ambulance:	Appleton Fire Department	**Phone:**	911 (verify)
Address:	700 North Drew Street		(414) 832-5810
Explosive Unit:		**Phone:**	911 (verify)
Poison Control Center:	St. Elizabeth Hospital	**Phone:**	1 (800) 942-5969
Diggers Hotline:		**Phone:**	(800) 242-8511
Water:	City of Appleton Utilities	**Phone:**	(414) 832-5599
Gas:	Wisconsin Gas Company	**Phone:**	(414) 735-1246
Electric:	Wisconsin Electric Power Company	**Phone:**	(414) 735-0705
AT&T:		**Phone:**	(414) 521-7730
U.S. Sprint:		**Phone:**	(800) 521-0579
CSC Communications:		**Phone:**	(414) 496-8872
Cablevision:		**Phone:**	(414) 749-1309
Norlight:		**Phone:**	(414) 725-5538
Hospital:	St. Elizabeth	**Phone:**	(414) 738-2000
Address:	1506 South Oneida Street		

Route To Hospital: (Refer to map Page 17.)

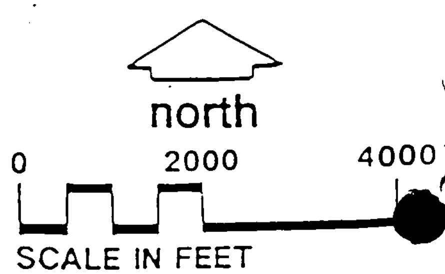
12.1 GOVERNMENT AGENCIES INVOLVED IN PROJECT

Federal: Jon Peterson/U.S. EPA	**Phone:**	(312) 353-1264
State: Gary Edelstein/WDNR	**Phone:**	(608) 267-7563

Drafting Standards ___ INITIALS ___ DATE ___
Lead Professional ___
Section ___
PM ___ INITIALS ___ DATE ___
Division ___
Other ___

NOTE

1. BASE MAP DEVELOPED FROM THE APPLETON AND NEENAH, WISCONSIN 7½ MINUTE U.S.G.S. TOPOGRAPHIC QUADRANGLE MAPS, DATED 1955, PHOTOREVISED 1975.



ROUTE TO HOSPITAL

13.0 EMERGENCY CONTACTS

Contractor Medical Consultant

Dr. Kenneth Chase
Washington Occupational Health Associates
(202) 463-6698 (8 a.m. to 5 p.m. EST)
(202) 463-6440 (after hours answering service; physical will return call within 30 minutes)

Contractor Health and Safety Director

Name: David A. Waite/SEA
Phone: (206) 453-5000

District Health and Safety Manager (DHSM)

Name:
Phone:

Regional Health and Safety Manager (RHSM)

Name: Christine Culligan
Phone: (414) 272-2426

Radiation Health Manager (RHM)

Name:
Phone:

Client

U.S. EPA contact:

Jon Peterson/U.S. EPA
Phone: (312) 353-1264

Occupational Physician (Regional or Local)

Park Crest Medical Clinic
2665 South Moorland Road
New Berlin, WI
(414) 786-1199

Site Safety Coordinator (SSC)

Name: Alan Parker
Phone: (414) 272-2426

Regional Manager

Name: Gary Beech
Phone: (414) 272-2426

Project Manager

Name: Cathy Barnett
Phone: (414) 272-2426

Regional Human Resources Department

Name: Marty Oldham/MKE
Phone: (414) 272-2426

Corporate Human Resources Department

Name: Beth Brown/DEN
Phone: (303) 771-0952

If an injury occurs, notify the injured person's personnel office as soon as possible after obtaining medical attention for the injured. Notification MUST be made within 24 hours of the injury.

14.0 PLAN APPROVAL

This site safety plan has been written for use by CH2M HILL. CH2M HILL claims no responsibility for its use by others, unless specified and defined in project or contract documents. The plan is written for the specific site conditions, purposes, dates, and personnel specified and must be amended if these conditions change.

PLAN WRITTEN BY: Christine Culligan **DATE:**

PLAN APPROVED BY: **DATE:** 2-23-94

14.1 PLAN AMENDMENTS

DATE: **CHANGES MADE BY:**

CHANGES TO PLAN:

APPROVED: **DATE:**

14.2 PLAN AMENDMENTS

DATE: **CHANGES MADE BY:**

CHANGES TO PLAN:

APPROVED: **DATE:**

15.0 ATTACHMENTS TO PLAN

Attachment 1: Employee signoff

Attachment 2: Applicable MSDS

Attachment 3: Confined Space SOP-17

Note: Once approved, a copy of this plan should be forwarded to Cindy Carr/WDC.

ATTACHMENT 1

EMPLOYEE SIGNOFF

The employees listed below have been provided a copy of this health and safety plan, have read and understood it, and agree to abide by its provisions.

EMPLOYEE NAME	EMPLOYEE SIGNATURE / DATE

MKE10015336.WP5

CONFINED SPACE ENTRY

Standard of Practice HS-17

1.0 THE BASICS

What is a confined space?

A confined space may be any vessel, structure or excavation that is not designed for continuous human occupancy, but has enough room for you to perform a task. Access into or out of the space is limited.

Examples: Storage tanks, vessels, pipelines, sewers, tanks, silos, bins, boilers, bunkers, ducts, sewers, tunnels, ship holds, and open top spaces over four feet deep such as pits, trenches, and vaults.

Why can confined spaces be dangerous?

Injuries and deaths can occur in confined spaces because of:

- oxygen deficiency
- the presence of materials that may be flammable, explosive, toxic, radioactive, or corrosive
- physical contact with live electrical sources, moving equipment, or hot surfaces
- hot air or steam
- engulfment by liquids, powders, or grains

What are "permitted" confined spaces?

OSHA requires a permit to enter some confined spaces. Common traits of a permit-required confined space include: a hazardous atmosphere; presence of a potentially engulfing material; an internal design that may trap or asphyxiate an entrant; or some other recognized serious safety or health hazard.

Non-permitted confined spaces do not contain atmospheric hazards or have the potential to contain any hazard capable of causing death or serious physical harm.

Who determines if a confined space requires a permit?

CH2M HILL or a "host employer" (client/owner).

Who's affected by this Standard of Practice (SOP)?

Project managers and any employee or subcontractor who may enter a confined space.

What do you need to know?

Before entering a confined space, you must be acquainted with the Occupational Safety and Health Administration's (OSHA) regulations about confined space entry. This standard of practice details what you must know and how you must proceed when working in a confined space.

A glossary of applicable terms is provided in Attachment 1.

1.1 THE LAW

Two OSHA standards drive CH2M HILL's SOP for confined space entry. State standards may also apply and some owners and clients may have their own standards of practice.

Attachment 2 will help you determine which confined space standard applies. Clarifying which law applies to the confined space entry may require help from the health and safety staff.

This SOP describes the requirements for permit-required confined spaces. Health and safety staff can help you determine the requirements for non-permit-required confined space entry.

1.2 ORGANIZATIONAL RESPONSIBILITIES

OSHA's standard includes specific responsibilities for the client/owner (called the "host employer" by OSHA), and CH2M HILL.

Host Employer

The host employer must:

- Identify permit-required spaces and advise CH2M HILL of the applicability of the OSHA standard;
- Inform CH2M HILL of the hazards within the space and any procedures that apply;
- Coordinate entry operations when host employees work near the space;
- Debrief CH2M HILL at the end of the entry as to any hazards confronted or created in the space.

CH2M HILL

CH2M HILL also has responsibilities when performing a permit-required entry for a host employer. The CH2M HILL project manager must:

- Obtain information about the hazards associated with the space and any procedures that apply;
- Inform the host employer of the permit space program CH2M HILL will follow;
- Coordinate entry operations with the host employer when host employees will be working near the space;
- Inform the host employer of any hazards confronted or created in the space.

CH2M HILL Subcontractors

CH2M HILL has the same responsibilities as a host employer when a subcontractor performs a permit-required entry that we control. The subcontractor has the following responsibilities:

- Obtain from CH2M HILL information about the hazards associated with the space and any procedures that apply;
- Inform CH2M HILL of the permit space program they will follow;
- Coordinate entry operations with CH2M HILL when we will be working near the space;
- Inform CH2M HILL of any hazards confronted or created in the space.

2.0 CH2M HILL'S PROGRAM

Every confined space must be evaluated prior to entry to determine if it is a permit space. If a permit is required, then you must follow the provisions of the CH2M HILL Permit-Required Confined Space Program.

This program was developed to maximize efficiency in the field and to help you effectively coordinate with host employers and subcontractors. The program meets applicable OSHA requirements.

Here are the program's basic provisions.

Before Entry

Each permit-required confined space:

- must have a trained entry supervisor who authorizes entry by signing the permit;
- will have an assigned attendant who has the fundamental responsibility to monitor authorized entrants;
- must be posted so that only authorized employees enter the space;
- will have a permit that identifies procedures for the specific entry.

2.0 CH2M HILL'S PROGRAM, CONT.

Employees who will perform permit-space entry:

- must be able to recognize the hazards associated with permit space entry;
- must have completed required training;
- must not enter a permit space unless authorized on the permit by an entry supervisor;
- will not be permitted to enter a permit space until all sections of the CH2M HILL Confined Space Entry Permit and Pre-Entry Checklist are completed and the permit is signed by the entry supervisor
- will be supplied equipment needed to perform the permit space entry as specified on the entry permit;
- will have medical approval before supplied air respirators can be used, and each respirator must be tested for proper fit;
- will have completed basic pre-entry testing;
- will have received a pre-entry briefing.

During Entry

Entry supervisors, authorized entrants, and attendants as identified on the entry permit shall perform the duties assigned to their roles as described below:

- Confined space work will be undertaken under controlled traffic and pedestrian conditions.
- Vehicles will not be left running near a confined space or near air-moving equipment being used for ventilation.
- Smoking, eating, or drinking in confined spaces is prohibited.

After Entry

Illnesses and injuries incurred during confined space work (or as a result of confined space work) must be reported to the project manager, the corporate director of health and safety, and the regional human resources administrator.

3.0 ENGINEERING CONTROLS

Engineering controls (ventilation, purging, and flushing) are the primary means for achieving acceptable entry conditions in a confined space. If controls fail to achieve such conditions, personal protective equipment (PPE) is used to control exposure.

Ventilation may be used for hazard control if hazardous atmospheres are the sole hazard in the confined space. Ventilation must be adequate to maintain acceptable conditions.

Tests must be conducted prior to entry to demonstrate these conditions.

If ventilation is used, some elements of the confined space program may not be required. For example:

- A permit may not be required;
- Entry supervisors, attendants, and authorization of entrants may not be required;
- Rescue services may not be required.

The necessity of including these elements should be evaluated on a case-by-case basis. Testing is required prior to entry and as appropriate during entry.

Table 1
Acceptable and Non-Acceptable Entry Conditions
(Hazardous Atmospheres)

Hazardous Atmosphere	Limit	Action
Oxygen Deficiency	19.5% - 23.5% O_2	Acceptable entry condition.
	< 19.5% O_2	Non-acceptable entry condition. Ventilate or provide supplied air respirator (SAR).
	> 23.5% O_2	Non-acceptable entry condition. Ventilate.
Gases or Vapors (Explosive)	< 10% LEL	Acceptable entry condition.
	$\geq$ 10% LEL	Non-acceptable entry condition. Ventilate.
Dust (Explosive)	<LEL or vision obscured at >5 feet	Acceptable entry condition.
	≥LEL or vision obscured at ≤5 feet	Non-acceptable entry condition. Ventilate.
Gases or Vapors (Toxic)	$\leq$ Published exposure limit (see note)	Acceptable entry condition.
	> Published exposure limit (see note) but $\leq$ IDLH	Non-acceptable entry condition. Ventilate or provide respiratory protection. -- air purifying respirator (APR) or supplied air respirator (SAR).
	> IDLH	Non-acceptable entry condition. Ventilate, or provide supplied air respirator (SAR).
Dust (Toxic)	$\leq$ 5 mg/m3; or $\leq$ published exposure limit (see note)	Acceptable entry condition.
	> 5 mg/m3; or > published exposure limit (see note)	Non-acceptable entry condition. Ventilate or provide respiratory protection -- air purifying respirator (APR) or supplied air respirator (SAR).

Note: A published exposure limit includes: (1) the OSHA permissible exposure limit (PEL); (2) the NIOSH recommended exposure limit (REL); (3) the ACGIH threshold limit value (TLV); (4) a limit established by CH2M HILL or host employer.

4.0 TESTING SEQUENCE

When hazardous atmosphere testing is required, the sequence is:

- Oxygen deficiency ($\%O_2$)
- Flammability (% lower explosive limit)
- Toxic air contaminants
- Toxic dusts

Figures 1 and 2 are a flowchart that describes testing sequence, respirator selection, and acceptable entry conditions.

5.0 EQUIPMENT

Requirements for personal protection, testing and other equipment vary from project to project and are specified in Sections 5.0, 6.0, and 7.0 of the confined space entry permit (CSEP). Equipment is generally available through the regional equipment coordinator.

Required PPE may include (CSEP Section 5.0):

- Body protection: clothing such as Tyvek, Saranex, or cotton coveralls;
- Head and eye protection: hard hat with chin strap; safety glasses with side shields or goggles;
- Hand and foot protection: outer gloves, chemical resistant or leather; inner gloves, PVC surgical gloves; boots, steel toe-shank leather with chemical resistant overboots, or steel toe-shank rubber boots;
- Respiratory protection: supplied-air respirators such as self-contained breathing apparatus; air purifying respirators with absorbent cartridges; five-minute emergency escape breathing packs;
- Other: hearing protection.

Required air testing equipment (CSEP Section 6.0) may include:

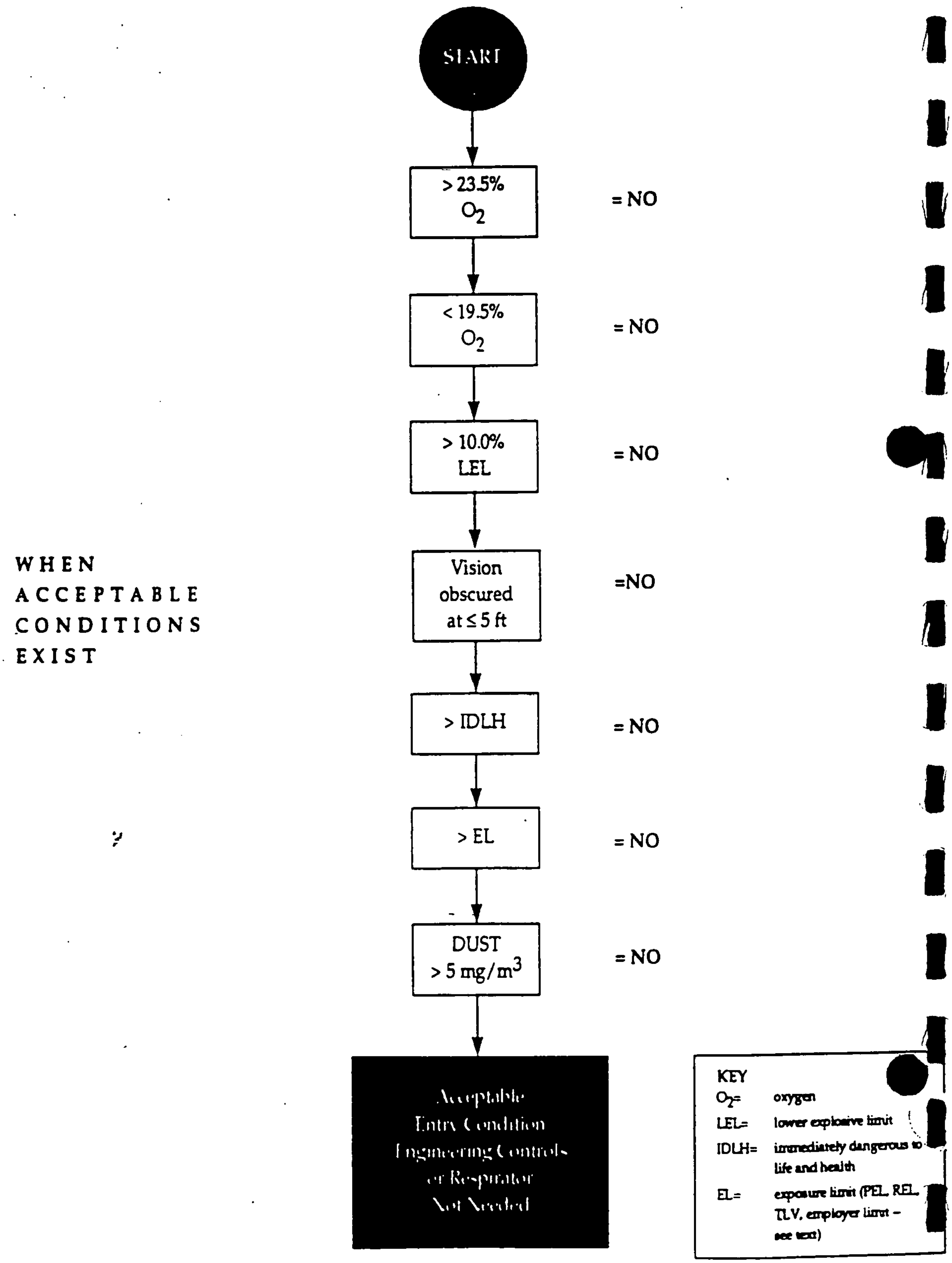
- **Combustible gas indicator which measures the levels of explosive gases and vapors and the level of oxygen;**
- **Monitox monitor, or Drager colorimetic detector tube which measures the level of hydrogen sulfide or other toxic gases;**
- Other monitors for toxic gases, which may include: the organic vapor analyzer, organic vapor meter, or the photoionization detector;
- **Miniram dust monitor which measures the level of dust. (Note: obscured vision may be sufficient to determine the dust level.)**

Other required equipment (CSEP Section 7.0) may include:

- **Communications equipment, such as walkie-talkies or cellular telephones;**
- **Alarms;**
- **Fire extinguisher;**
- **Explosion-proof lighting;**
- **Rescue and retrieval equipment such as a tripod with block and chest or full body harness, wristlets, and retrieval lines;**
- **Ventilation equipment such as a blower with enough flexible duct to adequately ventilate the confined space (if possible, use an electric blower rather than a gasoline-powered blower);**
- Other equipment such as barriers, shields, and ladders.

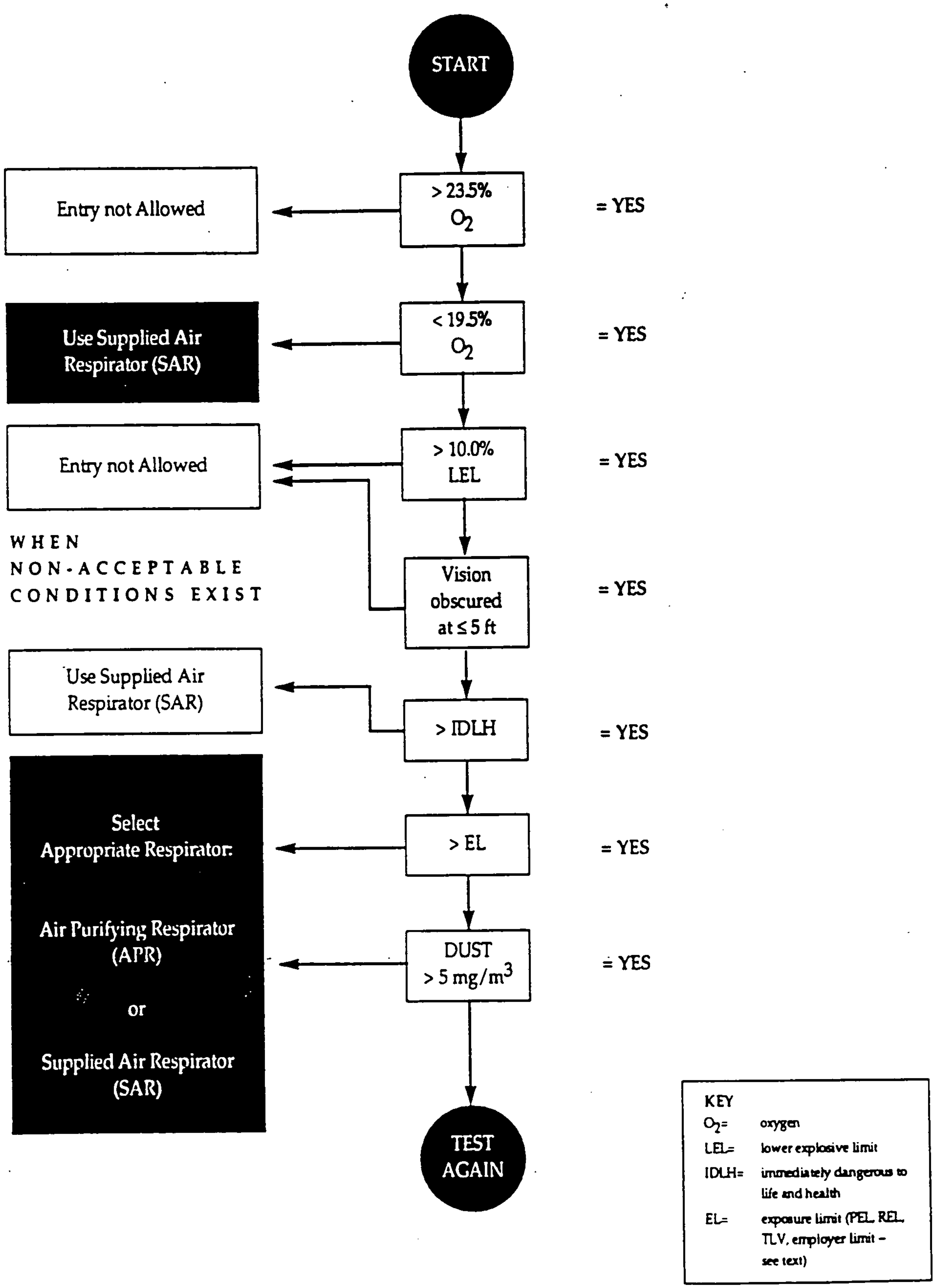
FIGURE 1

TESTING SEQUENCE, RESPIRATOR SELECTION, AND ACCEPTABLE ENTRY CONDITION FLOWCHART



F I G U R E 2

WHEN ENGINEERING CONTROLS FAIL TO ACHIEVE ACCEPTABLE ENTRY CONDITIONS



6.0 ENTRY SUPERVISOR AND ATTENDANTS

The project manager is responsible for identifying an entry supervisor and attendant(s) who are qualified to perform the duties outlined below. The entry supervisor and attendant may be the same person if he or she can meet all required qualifications.

Generally, the site safety coordinator or resident project representative serves as entry supervisor and attendant.

Note that the attendant must remain outside the permit space at all times while entry is occurring.

The entry supervisor does not have to be present during entry unless he or she serves as the attendant.

If questions arise about a candidate's qualifications, contact a member of the health and safety staff.

7.0 EMPLOYEE RESPONSIBILTIES

The project manager is responsible for:

- Identifying the need for confined space entry in the project planning documents; obtaining and providing the required host employer information; and obtaining and supplying the required subcontractor information;
- Providing sufficient resources and personnel to implement this confined space entry SOP;
- Working with the health and safety manager and entry supervisor as necessary to develop site specific procedures and training protocols.

The entry supervisor is responsible for:

- Coordinating work planning;
- Recognizing and evaluating the hazards that may be present during entry, including the possible behavioral effects and the modes, signs, symptoms, and consequences of exposure;
- Developing the appropriate control measures;
- Completing the necessary checklists and permits;
- Verifying that testing has been conducted and that all procedures and equipment are in place before allowing the entry to begin;
- Preparing rescue plans and procedures;
- Verifying that rescue services are available;
- Positioning rescue equipment at or near the confined space;
- Authorizing entry by signing the permit;
- Posting the permit and appropriate warning signs;
- Positioning the attendants;
- Providing continuous or periodic testing of the confined space as specified in the permit, or assigning responsibility for testing to an attendant or authorized entrant;

7.0 EMPLOYEE RESPONSIBILTIES, CONT.

- Suspending the entry and evacuating the space if conditions change and present an actual or potentially dangerous situation;
- Removing unauthorized entrants from the space, or suspending entry if unauthorized entrants enter the space;
- Terminating the entry and canceling the permit when the work is completed.

The attendant is responsible for:

- Knowing the hazards that may be present during entry, including the possible behavioral effects and the modes, signs, symptoms, and consequences of exposure;
- Monitoring entrants for any indication of adverse exposure to a dangerous situation;
- Continuously maintaining an accurate count of authorized entrants;
- Remaining outside the permit space until relieved, and performing no duties that might interfere with the attendant's primary duty to monitor the entrants;
- Monitoring activities inside and outside the space to determine if it is safe for entrants to remain in the space;
- Maintaining communications with entrants, and suspending the entry and evacuating the space if conditions change and present an actual or potentially dangerous situation;
- Performing non-entry rescues, unless authorized on the permit to enter the space for rescue;
- Maintaining rescue equipment at or near the confined space;
- Summoning rescue and emergency services;
- Warning unauthorized persons to stay away from the space, and notifying the entry supervisor and entrants if unauthorized persons enter the space.

The authorized entrants are responsible for:

- Knowing the hazards that may be present during entry, including the possible behavioral effects and the modes, signs, symptoms, and consequences of exposure;
- Communicating with the attendant as appropriate to enable the attendant to monitor entrant status;
- Alerting the attendant whenever any entrant exhibits any warning signs of adverse exposure to a dangerous situation;
- Evacuating the space upon orders of the attendant when an alarm is sounded, or upon recognizing a dangerous situation.

8.0 TRAINING

Entry supervisors, attendants, and authorized entrants are required to complete a video-based basic training module available from the corporate director of health and safety.

Employees must complete the examination portion of the module and score 80% or greater before performing a permit entry.)

8.0 TRAINING, CONT.

Basic training may also be provided by the host employer. This training must meet OSHA requirements.

In addition, the following training is required:

- Training for the specific respirator used for the permit space entry. This training can be conducted by the health and safety manager, or by completing a training module available from the respirator manufacturer.
- Other training required by federal, state, or local regulation or by CH2M HILL policy. This training may include topics such as hazard communication, hazardous waste site operations, or bloodborne pathogens.

Document the training by having trainees sign the training roster (Attachment 5). Send the completed roster to the corporate director of health and safety. If the training is provided by an outside source, a certificate should be requested, and forwarded to the corporate director of health and safety.

8.1 PRE-ENTRY BRIEFING

A pre-entry briefing specific to the space being entered is mandatory before employees enter a permit space. The entry supervisor conducts the briefing for the attendants and authorized entrants. The briefing must include at least the following elements:

- An explanation of the real and potential hazards of the confined space and the work to be performed, including the possible behavioral effects, and the modes, signs, symptoms and consequences of exposure;
- A review of the controls that will be in effect, including traffic controls; equipment, including PPE; the permit and individual assignments; the rescue procedures; special procedures; communication procedures, including signals between the entrants and attendants; available testing data.

9.0 PERMIT REVIEW

A qualified person (such as a health and safety manager) should review the confined space entry permit. Once the review is completed, the reviewer signs in the block provided in CSEP Section 13.0.

10.0 ATTACHMENTS

Attachment 1: Glossary

Attachment 2: Legal Considerations

Attachment 3: CH2M HILL Confined Space Entry Permit and Pre-Entry Checklist

Attachment 4: Postings

Attachment 5: Training Roster

ATTACHMENT 1 - GLOSSARY

Acceptable Entry Conditions Conditions in a permit space that allow employees to safely enter and work within the space. See Table 1 and Figure 1.

Attendant An individual stationed outside the permit space who monitors the authorized entrants and who fulfills the attendant's responsibilities specified in this SOP.

Authorized Entrant An individual who is authorized by the entry attendant to enter a permit space and who fulfills the responsibilities specified in this SOP.

Blanking or Blinding The absolute closure of a pipe, line, or duct by fastening a solid plate that completely covers the bore and that is capable of withstanding the maximum upstream pressure.

Confined Space A space that: (1) is large enough and so configured that an employee can bodily enter and perform a task; (2) has limited or restricted means of entry or exit; and (3) is not designed for continuous employee occupancy. Confined spaces include, but are not limited to, the following: storage tanks, process vessels, reaction vessels, bins, boilers, ventilation and exhaust ducts, sewers, underground utility vaults, tunnels, pipelines, compartments of ships, and open top spaces more than 4 feet deep such as pits, trenches, tubs, vaults, and vessels.

Control Each permit space entry will be controlled by using a permit system. Employees shall not enter a permit space unless authorized on the permit by an entry supervisor.

Coordination Each permit entry is coordinated with host employers and subcontractors by the project manager, with exchange of information as appropriate.

Double Block and Bleed Isolating a confined space from a line, duct, or pipe by locking or tagging two closed in-line valves and locking or tagging open to the outside atmosphere a drain or bleed in the line between the two closed valves.

Emergency Any occurrence or event internal or external to the permit space (including any failure of hazard control or monitoring equipment) that could endanger entrants.

Engineering Controls The primary means to achieve acceptable entry conditions, such as ventilation, purging, and flushing. If engineering controls fail to achieve acceptable conditions, personal protective equipment is used to control exposure.

Engulfment The surrounding and effective capture of a person by a liquid or finely divided solid that can be aspirated to cause death by filling or plugging the respiratory system, or that can exert enough force on the body to cause death by strangulation, constriction, or crushing.

Entry The action by which a person passes through an opening into a permit-required confined space. Entry includes ensuing work activities in that space and is considered to have occurred as soon as any part of the entrant's body breaks the plane of an opening into the space.

Entry Permit (CSEP) The document provided by CH2M HILL or a host employer to allow or control entry into a permit space. Employees will not be permitted to enter a permit space until all sections of the CH2M HILL Confined Space Entry Permit and Pre-Entry Checklist (or the host employer's permit) are completed and the permit is signed by the entry supervisor.

ATTACHMENT 1 - GLOSSARY

Entry Supervisor The person responsible for determining if acceptable entry conditions are present at a permit space, for authorizing entry and overseeing entry operations, and for terminating entry.

Evaluation Each confined space will be evaluated prior to entry to determine if it is a permit space.

Hazardous Atmosphere An atmosphere that may expose employees to the risk of death, incapacitation, impairment or inability to self-rescue, injury or acute illness from one or more of the following: (1) flammable gas, vapor, or mist > 10% of its lower explosive limit (LEL); (2) airborne combustible dust at a concentration that meets or exceeds its LEL; (3) atmospheric oxygen concentration <19.5% or >23.5%; (4) exposure to atmospheric concentration of any substance in excess of its published exposure limit; (5) any other atmospheric condition that is immediately dangerous to life or health (IDLH). Refer to Table 1.

Hot Work Permit The written authorization to perform operations (for example, riveting, welding, cutting, and heating) capable of providing a source of ignition.

Immediately Dangerous to Life or Health (IDLH) Any condition that poses an immediate or delayed threat to life or that would cause irreversible adverse health effects or that would interfere with an individual's ability to escape unaided from a permit space.

Incident Reporting Illnesses and injuries incurred during confined space work or as a result of confined space work shall be reported to the project manager, the corporate director of safety and health, and the regional human resources administrator.

Inerting The displacement of the atmosphere in a permit space by a noncombustible gas (such as nitrogen) to such an extent that the resulting atmosphere is noncombustible.

Isolation The process by which a permit space is removed from service and completely protected against the release of energy and material into the space by such means as: blanking or blinding; misaligning or removing sections of lines, pipes, or ducts; a double block and bleed system; lockout or tagout of all sources of energy; or blocking or disconnecting all mechanical linkages.

Line Break The intentional opening of a pipe, line, or duct that is or has been carrying flammable, corrosive, or toxic material, an inert gas, or any fluid at a volume, pressure, or temperature capable of causing injury.

Lockout or Tagout The act of using a lock, tag, or other device to physically remove sources of energy from a confined space. An example would be the use of a lock to prevent an electrical switch from being activated.

Medical Approval Entry supervisors, attendants, and authorized entrants who use air supplied respirators shall be medically approved for use of these devices. Health and safety staff must be consulted to determine if entry supervisors, attendants, or authorized entrants who use air purifying respirators require medical approval.

Non-Permit Confined Space A confined space that does not contain or have the potential to contain any hazard capable of causing death or serious physical harm.

Oxygen Deficient Atmosphere An atmosphere containing <19.5% oxygen by volume.

ATTACHMENT 1 - GLOSSARY

Oxygen Enriched Atmosphere An atmosphere containing >23.5% oxygen by volume.

Permit-Required Confined Space (permit space) A confined space that has one or more of the following characteristics: (1) contains or has a potential to contain a hazardous atmosphere; (2) contains a material that has the potential to engulf an entrant; (3) has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section; or (4) contains any other recognized serious safety or health hazard.

Permit-Required Confined Space Program (permit space program) The employer's overall program for controlling and protecting employees from permit space hazards and for regulating employee entry into permit spaces.

Permit System The employer's written procedure for preparing and issuing permits for entry and for returning the permit space to service following termination of entry.

Posting Permit spaces are posted as described in Attachment 5 so that only authorized employees enter the space. The permit is also to be posted near the entrance of the permit space.

Pre-Entry Briefing Prior to entry, authorized entrants and attendants shall receive a pre-entry briefing as described in Section 9.1.

Recognition Employees who perform permit space entry must be able to recognize the hazards associated with permit space entry.

Rescue Procedures Each permit will identify rescue procedures for the specific permit entry.

Rescue Service The personnel designated to rescue employees from permit spaces.

Respirator Fit Tests Employees who use a respirator must be tested for respirator fit; quantitative fit testing is encouraged.

Retrieval System The equipment (including retrieval lines, chest or full-body harnesses, wristlets, and lifting devices or anchors) used for non-entry rescue of persons from permit spaces.

Testing The process by which hazards that may confront entrants of a permit space are identified and evaluated.

Training Entry supervisors, attendants and authorized entrants shall successfully complete basic training as described in Section 9.0.

ATTACHMENT 2 - LEGAL CONSIDERATIONS

The Occupational Safety and Health Administration (OSHA) regulates confined space entry through 29 CFR1910.146 Permit-Required Confined Spaces (which is contained in the General Industry Standards) and through the less stringent 29 CFR 1926.21 Safety Training and Education (which is contained in the Construction Industry Standards). Confined space entry is also regulated through various state standards. Some owners and clients may have their own standards of practice.

The 29 CFR 1910.146 technically applies only to general industry and not to the construction industry, except when construction is performed at industrial processes, including existing industrial facilities. OSHA is expected to enforce 1910.146 as the standard of practice for the construction industry by using the "general duty" clause of the Occupational Safety and Health Act (OSH Act). (Note: California's proposed confined space standard contains the provisions of 1910.146 and regulates construction.) Under 1910.146 OSHA holds employers responsible for safety standards or industry practices that they could or should have known about that protect employees from similar, known hazards.

Differences Between 29 CFR 1926.21 and 29 CFR 1910.146

The 1926.21 construction standard requires that employees be instructed in:

- the nature of confined space hazards involved;
- the necessary precautions to be taken;
- the use of protective and emergency equipment required.

The 1910.146 general industry standard goes further by mandating permits for confined spaces that pose health and safety risks. These types of confined spaces (which are termed "permit-required spaces") require identification, and hazard recognition, evaluation, and control; training; atmosphere testing; engineering controls; personal protective equipment; isolation; rescues and communication systems; entry with signed authorization by a qualified entry supervisor; and attendants to monitor authorized entrants. This CH2M HILL SOP is based on 1910.146.

The definition of a confined space in 1926.21 is different and broader than the definition of a permit-required confined space contained in 1910.146. In 1926.21, a confined space is any space large enough for an employee to enter, has limited means of entry and exit, and is not designed for continuous occupancy. In 1910.146, a permit-required confined space means a confined space which is subject to the accumulation of toxic or flammable contaminants, has an oxygen deficient or enriched atmosphere. A permit space is a confined space that contains recognized health and safety hazards, could trap an entrant, or contains material that can engulf an entrant.

Determining Which Confined Space Standard Applies

If entry for any reason (including construction or contract work) is to occur at existing industrial processes including facilities owned by the private sector, municipalities, or at a hazardous waste operation, the more stringent 1910.146 standard applies. Project managers should follow the CH2M HILL SOP, but should first verify that more stringent state

ATTACHMENT 2 - LEGAL CONSIDERATIONS

standards, or a client-specific standard of practice does not supersede the federal standard. Health and safety staff can help with this determination.

If the entry is to occur at a construction site (for example, a site regulated by 29 CFR 1926), the project manager should first determine if the space meets the definition of a permit-required confined space contained in 1910.146. Health and safety staff can help with this determination. CH2M HILL recommends applying 1910.146 on a case-by-case basis in instances where the permit-required confirmed space definition is met, but only after discussing the application with the client or owner.

If the project manager determines that 1910.146 does not apply to the particular construction site entry, the provisions of the less stringent 1926.21 may be applied. In practice, it is recommended that this CH2M HILL SOP be modified to include specific provisions relevant to the construction and entry site in question, leaving out provisions that do not apply. Health and safety staff should be consulted.

Project managers should note that although the client owner (host employer) has defined responsibilities which include notifying CH2M HILL of the applicability of 1910.146, OSHA standards specifically apply to employers who expose their employees to hazards. CH2M HILL would be liable under the OSH Act for exposing our employees to permit space hazards even if the host employer believes that 1910.146 does not apply.

(Note: For example, a municipality may not be regulated by 1910.146. However, CH2M HILL is regulated by 1910.146. Permit space entries performed by CH2M HILL for the municipality would be under the scope of this SOP.) For this reason, the CH2M HILL project manager should always determine the applicability of 1910.146 after discussions with the client. The project manager may have to inform the client or owner that CH2M HILL cannot execute the confined space entry unless we receive the scope and budget to comply with 1910.146.

ATTACHMENT 3 -- CH2M HILL CONFINED SPACE ENTRY PERMIT (CSEP) AND PRE-ENTRY CHECKLIST

1.0 GENERAL INFORMATION		
PROJECT:	PROJECT #:	PROJECT MANAGER:
DATE PERMIT PREPARED:	DATE OF ENTRY:	DATE PERMIT CANCELED:
SITE NAME:		
LOCATION:		
DESCRIPTION OF PERMIT SPACE:		

2.0 PURPOSE OF PERMIT SPACE ENTRY

3.0 AUTHORIZED PERSONNEL	
NAME	RESPONSIBILITY
	Entry Supervisor
	Attendant
	Entrant
	Entrant
	(specify)

4.0 HAZARDS EXPECTED			
	Flammable or Explosive		Toxic (specify)
	Oxygen Deficient		Hydrogen Sulfide
	Physical Hazards:		
	Other Conditions and Considerations:		

5.0 REQUIRED PERSONAL PROTECTIVE EQUIPMENT (PPE)					
BODY	HEAD	GLOVES	BOOTS	RESPIRATORY	OTHER

6.0 REQUIRED AIR TESTING EQUIPMENT					
Y	N	EQUIPMENT	Y	N	EQUIPMENT
		Combustible Gas/O_2 Indicator			Organic Vapor Analyzer
		Hydrogen Sulfide Monitor			Organic Vapor Meter______ ev
		Colorimetric Tube (specify):			HNU Photoionizer______ ev
		Other (specify):			

7.0 OTHER REQUIRED EQUIPMENT		
Y	N	EQUIPMENT
		Ventilation (specify):
		Communication (specify):
		Alarm (specify):
		Fire Extinguisher (specify):
		Lighting (specify):
		Rescue/Retrieval (specify):
		Other (specify):

8.0 PERMIT SPACE ENGINEERING CONTROLS					
Y	N	CONTROL	Y	N	CONTROL
		Ventilation			Lockout-Tagout
		Purging-Inerting			Blinding-Blanking
		Flushing			Double Block-Bleed
		Line Breaking			Other (specify)

9.0 COMMUNICATION PROCEDURES

10.0 RESCUE PROCEDURES

Sections 1.0 - 10.0 Reviewed By (Signature)	Date	Time

11.0 PRE-ENTRY CHECKLIST					
Y	N		Y	N	
		Medical Approval			Communications Verified
		Respirator Fit Test			Rescue Procedures Verified
		General Training Completed			Traffic Control Established
		Testing Equipment Onsite			Isolation Verified
		Testing Equipment Operational			First Aid Kit Onsite
		Testing Equipment Calibrated			Hot Work Permit Posted
		PPE Onsite			CS Entry Permit Posted
		Other Equipment Onsite			Pre-Entry Briefing Complete
		Initial Testing Complete			Lighting Adequate

12.0 AIR TESTING					
TEST	ACCEPTABLE CONDITION	INITIAL TEST	PERIODIC TEST	PERIODIC TEST	PERIODIC TEST
TIME	N/A				
% O_2	19.5% - 23.5%				
% LEL	≤ 10% LEL				
DUST	Vision obscured > 5 ft				
TOXIC					
H_2S	≤ 10 ppm				
DUST	Miniram ≤ 5 mg/m^3				
BY					

13.0 ENTRY AUTHORIZATION		
Authorized By (Entry Supervisor Signature)	Date	Time

14.0 PROBLEMS ENCOUNTERED DURING ENTRY

15.0 PERMIT CANCELATION		
Canceled By (Entry Supervisor Signature)	Date	Time

INSTRUCTIONS FOR COMPLETING CH2M HILL CONFINED SPACE ENTRY PERMIT AND PRE-ENTRY CHECKLIST

NOTE:	This is a generic permit designed for many applications. However, to comply with OSHA standard, all information in each block must be completed !! If the information is not needed: place an "X" in the "N" block or use the abbreviation "N/A" as appropriate.
Section 1.0.	Self-explanatory.
Section 2.0.	Self-explanatory. Example: "To obtain sample of effluent for chemical analysis."
Section 3.0.	Self-explanatory. Attach additional sheets if necessary. Entry supervisor must be qualified and trained to authorize entry.
Section 4.0.	Place an "X" in the block to denote if hazard is present. Briefly describe any known physical hazards or other special conditions or considerations.
Section 5.0.	Specify necessary PPE. If not needed, enter "N/A" into appropriate space.
Section 6.0.	If needed, place an "X" in the "Y" block. If not needed, place an "X" in the "N" block. Specify the type of colorimetric tube needed. Specify the lamp energy of the OVM and HNU.
Section 7.0.	If needed, place an "X" in the "Y" block. If not needed, place an "X" in the "N" block. Specify the type of equipment needed.
Section 8.0.	If needed, place an "X" in the "Y" block. If not needed, place an "X" in the "N" block. Specify the type of equipment needed.
Section 9.0.	Self-explanatory.
Section 10.0.	Self-explanatory.
NOTE:	It is recommended that a qualified person (such as a health and safety manager) review Sections 1.0 through 10.0 of the CSEP, and sign the signature block.
Section 11.0.	When complete, place an "X" in the "Y" block. If not applicable, place an "X" in the "N" block.
Section 12.0.	Record testing equipment readings, including the time the reading were taken. The person who takes the readings initials the "BY" block. This page may be photocopied and attached to the permit if additional room is needed to record instrument readings.
Section 13.0.	Entry is authorized by the entry supervisor by signing the entry authorization block.
Section 14.0.	Describe any problems encountered during entry.
Section 15.0.	The permit is canceled by the entry supervisor by signing the permit cancellation block.

A COPY OF THE CANCELED CSEP IS FORWARDED TO THE CORPORATE DIRECTOR OF HEALTH AND SAFETY (CDHS).

ATTACHMENT 4

POSTINGS

Entrances to the confined space must be posted. Signs should contain, but are not limited to, the following information:

DANGER
PERMIT-REQUIRED CONFINED SPACE
DO NOT ENTER

When a specific work practice is performed or specific protective equipment is necessary, additional postings may be required, such as:

RESPIRATOR REQUIRED
FOR ENTRY

LIFELINE REQUIRED
FOR ENTRY

HOT WORK PERMITTED

NO HOT WORK PERMITTED

A copy of the current, completed, confined space entry permit must be conspicuously posted at the entry point to the confined space.

ATTACHMENT 5-
CH2M HILL CONFINED SPACE TRAINING ATTENDANCE ROSTER

Training Topics: CH2M HILL's video-based confined space training module; or:

Location:_______________________________ **Date :**_______________________________

Trainer(s):____

I have understood the materials presented and have had my questions answered satisfactorily. In the event of any further questions, I know the individuals to contact.

Employee Name (Please Print)	Employee Number	Region	Employee Signature

PLEASE FORWARD A COPY OF THIS ROSTER TO THE CORPORATE DIRECTOR OF HEALTH AND SAFETY

AIR PRODUCTS

BYRNE SPECIALTY GASES

Byrne Specialty Gases, Inc.
514 S. River Street
Seattle, Washington 98108 (206) 764-4633

Specialty Gas Material Safety Data Sheet

EMERGENCY PHONE (800) 523-9374 IN PENNSYLVANIA (800) 322-9092	PRODUCT NAME ISOBUTYLENE	CAS #115-11-7
AIR PRODUCTS AND CHEMICALS, INC. BOX 538 ALLENTOWN, PA 18105 (215) 481-8257	TRADE NAME AND SYNONYMS Isobutylene CHEMICAL NAME AND SYNONYMS Isobutylene, Isobutene, 2-Methylpropene	
ISSUE DATE AND REVISIONS 04/78, 06/85	FORMULA (iso) C_4H_8	CHEMICAL FAMILY Alkene

HEALTH HAZARD DATA

TIME WEIGHTED AVERAGE EXPOSURE LIMIT

See last page.

SYMPTOMS OF EXPOSURE

Inhalation: Moderate concentrations which exclude an adequate supply of oxygen to the lungs cause dizziness, drowsiness and eventual unconsciousness. It also has a very mild anesthetic effect which might cause lack of coordination or lessened mental alertness.

Skin and Eye Contact: It is mildly irritating to mucous membranes. Due to its rapid rate of evaporation, isobutylene can cause tissue freezing or frostbite on contact.

TOXICOLOGICAL PROPERTIES

Isobutylene has a very mild anesthetic effect, however, the major health hazard is the exclusion of an adequate supply of oxygen to the lungs.

Frostbite effects are a change in color of the skin to gray or white possibly followed by blistering.

RECOMMENDED FIRST AID TREATMENT

PROMPT MEDICAL ATTENTION IS REQUIRED IN ALL CASES OF OVEREXPOSURE TO ISOBUTYLENE. RESCUE PERSONNEL SHOULD BE EQUIPPED WITH SELF-CONTAINED BREATHING APPARATUS AND MUST BE AWARE OF EXTREME FIRE AND EXPLOSION HAZARD.

Inhalation: Move exposed personnel to an uncontaminated area. If not breathing, give artificial respiration, preferably mouth-to-mouth. If breathing is difficult, give oxygen. Medical assistance should be sought immediately.

Skin Contact or Frostbite: Remove contaminated clothing and flush affected areas with lukewarm water. DO NOT USE HOT WATER. A physician should see the patient promptly if the cryogenic "burn" has caused blistering of the skin or deep tissue freezing.

HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES
Isobutylene is flammable over a wide range in air.

PHYSICAL DATA

BOILING POINT	LIQUID DENSITY AT BOILING POINT
19.6°F (−6.9°C)	39.1 lb/ft^3 (626 kg/m^3)
VAPOR PRESSURE @ 70°F (21.1°C) = 39 psia (269 kPa)	GAS DENSITY AT 70°F, 1 atm 0.148 lb/ft^3 (2.37 kg/m^3)
SOLUBILITY IN WATER Insoluble	FREEZING POINT −220.6°F (−140.3°C)
APPEARANCE AND ODOR Colorless gas with an unpleasant odor similar to that which is emitted when burning anthracite coal.	

FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (Method used)	AUTO IGNITION TEMPERATURE	FLAMMABLE LIMITS % BY VOLUME
See last page.	869°F (465°C)	LEL 1.8 UEL 9.6

EXTINGUISHING MEDIA	ELECTRICAL CLASSIFICATION
Water, carbon dioxide, dry chemical	Class 1, Group not specified

SPECIAL FIRE FIGHTING PROCEDURES

Keep cylinder(s) cool with water spray from a distance. If possible without risk, move cylinder(s) away from fire area. If possible without risk, stop the flow of gas to a fire. Allow gas fire to burn itself out. (Continued on last page.)

UNUSUAL FIRE AND EXPLOSION HAZARDS

Isobutylene is denser than air and can travel considerable distances to an ignition source and flash back. Cylinder(s) may explode or vent when exposed to fire.

REACTIVITY DATA

STABILITY		CONDITIONS TO AVOID
Unstable		
Stable	X	

INCOMPATIBILITY (Materials to avoid)

Oxidizers

HAZARDOUS DECOMPOSITION PRODUCTS

None

HAZARDOUS POLYMERIZATION		CONDITIONS TO AVOID
May Occur		
Will Not Occur	X	

SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

Evacuate all personnel from affected area. Use appropriate protective equipment. If leak is in user's equipment, be certain to purge piping with an inert gas prior to attempting repairs. If leak is in container or container valve, call the "800" emergency phone number listed herein.

WASTE DISPOSAL METHOD

All Federal, State and Local regulations regarding health and pollution should be followed in waste disposal. Contact Air Products for specific recommendations. Do not dispose of unused quantities.

(Continued on last page.)

SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (Specify type) Positive pressure air line with mask or self-contained breathing apparatus should be available for emergency use.

VENTILATION	LOCAL EXHAUST	SPECIAL
Hood with forced ventilation	To prevent accumulation above the LEL	
	MECHANICAL (Gen.)	**OTHER**
	In accordance with electrical codes	

PROTECTIVE GLOVES
Plastic or rubber

EYE PROTECTION
Safety goggles or glasses

OTHER PROTECTIVE EQUIPMENT
Safety shoes, safety shower, eyewash "fountain."

SPECIAL PRECAUTIONS*

SPECIAL LABELING INFORMATION
DOT Shipping Name: Liquified petroleum gas DOT Hazard Class: Flammable gas
DOT Shipping Label: Flammable gas ID No.: UN 1075

SPECIAL HANDLING RECOMMENDATIONS
Use only in well-ventilated areas. Valve protection caps must remain in place unless container is secured with valve outlet piped to use point. Do not drag, slide or roll cylinders. Use a suitable hand truck for cylinder movement. Use a pressure reducing regulator when connecting cylinder to lower pressure (< 250 psig) piping or systems. Do not heat cylinder by any means to increase the discharge rate of product from the cylinder. Use a check valve or trap in the discharge line to prevent hazardous back flow into the cylinder.

For additional recommendations consult the Air Products Specialty Gas Catalog Safety and Technical Information Section or Compressed Gas Association Pamphlet P-1.

SPECIAL STORAGE RECOMMENDATIONS
Protect cylinders from physical damage. Store in cool, dry, well-ventilated area of non-combustible construction away from heavily trafficked areas and emergency exits. Do not allow the temperature where cylinders are stored to exceed 130°F (54°C). Cylinders should be stored upright and firmly secured to prevent falling or being knocked over. Full and empty cylinders should be segregated. Use a "first in-first out" inventory system to prevent full cylinders being stored for excessive periods of time. Post "No Smoking or Open Flames" signs in the storage or use area. There should be no sources of ignition in the storage or use area.

For additional recommendations consult the Air Products Specialty Gas Catalog Safety and Technical Information Section or Compressed Gas Association Pamphlet P-1.

SPECIAL PACKAGING RECOMMENDATIONS
Isobutylene is noncorrosive and may be used with any common structural material.

OTHER RECOMMENDATIONS OR PRECAUTIONS
Earth-ground and bond all lines and equipment associated with the isobutylene system. Electrical equipment should be non-sparking or explosion proof. Compressed gas cylinders should not be refilled except by qualified producers of compressed gases. Shipment of a compressed gas cylinder which has not been filled by the owner or with his (written) consent is a violation of Federal Law (49CFR).

*Various Government agencies (i.e., Department of Transportation, Occupational Safety and Health Administration, Food and Drug Administration and others) may have specific regulations concerning the transportation, handling, storage or use of this product which will not be reflected in this data sheet. The customer should review these regulations to ensure that he is in full compliance.

Specialty Gas Department
Air Products and Chemicals, Inc.
Box 538, Allentown, PA 18105
(215) 481-8257

AIR PRODUCTS

TIME WEIGHTED AVERAGE EXPOSURE LIMIT (Continued)

Isobutylene is defined as a simple asphyxiant. Oxygen levels should be maintained at greater than 18 molar percent at normal atmospheric pressure which is equivalent to a partial pressure of 135 mm Hg. (ACGIH 1984–85)

FLASH POINT (Method Used) (Continued)

−105°F (−76°C) Closed Cup

SPECIAL FIRE FIGHTING PROCEDURES (Continued)

Ventilate low areas where flammable or explosive mixtures may form.

WASTE DISPOSAL METHOD (Continued)

Return the properly labeled shipping container to Air Products for disposal with valve(s) tightly closed, outlet seal(s) secured and valve protection cap in place. For emergency disposal assistance, call the "800" emergency phone number listed herein.

American Burdick & Jackson
Material Safety Data Sheet

MATERIAL SAFETY DATA SHEET

PENTANE

emergency telephone no. 312/973-3600 (American Scientific Products)
chemtrec telephone no. 800/424-9300
information telephone no. 616/726-3171 (American Burdick & Jackson)

I. Identification

chemical name: Pentane — molecular weight: 72.15
chemical family: Aliphatic Hydrocarbon — formula: C_5H_{12}
synonyms: n-Pentane
DOT proper shipping name: Pentane
DOT hazard class: Flammable Liquid
DOT identification no.: UN1265 — CAS no.: 109-66-0

II. Physical and Chemical Data

boiling point, 760mm Hg: 36.07°C — freezing point: -129.7°C — evaporation rate: (BuAc=1) ca 29
vapor pressure at 20°C: 420 mm Hg — vapor density (air = 1): 2.5 — solubility in water: @ 20°C 0.04%
% volatiles by volume: ca 100 — specific gravity (H_2O = 1): @ 20°C 0.626 — stability: Stable
hazardous polymerization: Not expected to occur.
appearance and odor: Clear, colorless liquid with a mild hydrocarbon odor.
conditions to avoid: Heat, sparks, open flame, open containers, and poor ventilation.

materials to avoid: Strong oxidizing agents.

hazardous decomposition products: Incomplete combustion can generate carbon monoxide and other toxic vapors.

III. Fire and Explosion Hazard Data

flash point, (test method): -40°C (Tag closed cup) — auto ignition temperature: 296°C
flammable limits in air % by volume: lower limit: 1.5 — upper limit: 7.8
unusual fire and explosion hazards: Very volatile and extremely flammable.

extinguishing media: Carbon dioxide, dry chemical or foam.

special fire fighting procedures: Water will not be effective in extinguishing a fire and may spread it, but a water spray can be used to cool exposed containers. Wear full protective clothing and self-contained breathing apparatus. Heat will build pressure and may rupture closed storage containers.

IV. Hazardous Components

	%	TLV	CAS no.
Pentane	ca 100	600 ppm	109-66-0

American Burdick & Jackson's Disclaimer: "The information and recommendations presented herein are based on sources believed to be reliable as of the date hereof. American Burdick & Jackson makes no representation as to the completeness or accuracy thereof. It is the user's responsibility to determine the product's suitability for its intended use, the product's safe use, and the product's proper disposal. No representations or warranties not expressly set forth herein are made hereunder, whether express or implied by operation of law or otherwise, including, but not limited to any implied warranties of MERCHANTABILITY OR FITNESS. American Burdick & Jackson neither assumes nor authorizes any other person to assume for it, any other or ADDITIONAL LIABILITY OR RESPONSIBILITY resulting from the use of, or reliance upon, this information."

V. Health Hazards

Occupational Exposure Limits

OSHA	8-hour PEL	-	1000 ppm
	Ceiling	-	not listed
	Peak	-	not listed
ACGIH	TLV-TWA	-	600 ppm
	TLV-STEL (15-min)	-	750 ppm
NIOSH	TLV-TWA	-	120 ppm
	TLV-C	-	610 ppm

Concentration Immediately Dangerous to Health

OSHA/NIOSH	5,000 ppm

Odor Threshold

NIOSH	2.2 ppm
OHS	10 ppm
NSC	not listed

Primary Routes of Entry

Pentane may exert its effects through inhalation, skin absorption, and ingestion.

Industrial Exposure: Route of Exposure/Signs and Symptoms

Inhalation: Exposure can cause dizziness, headache, nausea, and narcosis.

Eye Contact: Liquid and high vapor concentration can be irritating.

Skin Contact: Prolonged or repeated skin contact can cause irritation and dermatitis through defatting of skin.

Ingestion: Can cause gastrointestinal tract discomfort.

Effects of Overexposure

Pentane is a mild eye and mucous membrane irritant, primary skin irritant, and central nervous system depressant. Acute exposure irritates the eyes and respiratory tract. Extreme concentrations can produce drowsiness and other signs of narcosis. Chronic exposure can cause dermatitis.

Medical Condition Aggravated by Exposure

Preclude from exposure those individuals susceptible to dermatitis.

Emergency First Aid

Inhalation: Immediately remove to fresh air. If not breathing, administer mouth-to-mouth rescue breathing. If there is no pulse administer cardiopulmonary resuscitation (CPR). Contact physician immediately.

Eye Contact: Rinse with copious amounts of water for at least 15 minutes. Get emergency medical assistance.

Skin Contact: Flush thoroughly for at least 15 minutes. Wash affected skin with soap and water. Remove contaminated clothing and shoes. Wash clothing before re-use, and discard contaminated shoes. Get emergency medical assistance.

Ingestion: Call local Poison Control Center for assistance. Contact physician immediately. Aspiration Hazard - Do not induce vomiting.

VI. Safety Measures and Equipment

Ventilation: Adequate ventilation is required to protect personnel from exposure to chemical vapors exceeding the PEL and to minimize fire hazards. The choice of ventilation equipment, either local or general, will depend on the conditions of use, quantity of material, and other operating parameters.

Respiratory: Use approved respirator equipment. Follow NIOSH and equipment manufacturer's recommendations to determine appropriate equipment (air-purifying, air-supplied, or self-contained breathing apparatus).

Eyes: Safety glasses are considered minimum protection. Goggles or face shield may be necessary depending on quantity of material and conditions of use.

Skin: Protective gloves and clothing are recommended. The choice of material must be based on chemical resistance and other user requirements. Generally, neoprene or Buna-N offers acceptable chemical resistance. Individuals who are acutely and specifically sensitive to pentane may require additional protective equipment.

Storage: Pentane should be protected from temperature extremes and direct sunlight. Proper storage of pentane must be determined based on other materials stored and their hazards and potential chemical incompatibility. In general, pentane should be stored in an acceptably protected and secure flammable liquid storage room.

Other: Emergency eye wash fountains and safety showers should be available in the vicinity of any potential exposure. Ground and bond metal containers to minimize static sparks.

VII. Spill and Disposal Data

Spill Control: Protect from ignition. Wear protective clothing and use approved respirator equipment. Absorb spilled material in an absorbent recommended for solvent spills and remove to a safe location for disposal by approved methods. If released to the environment, comply with all regulatory notification requirements.

Waste Disposal: Dispose of pentane as an EPA hazardous waste. Hazardous waste number: D001(Ignitable).

Revision Date: 6/85

KEY

ca	Approximately	STEL	Short Term Exposure Level
na	Not applicable	TLV	Threshold Limit Value
C	Ceiling	TWA	Time Weighted Average
PEL	Permissable Exposure Level	BuAc	Butyl Acetate

NSC National Safety Council ("Fundamentals of Industrial Hygiene", 1983)
OHS Occupational Health Services ("Hazardline")

MATERIAL SAFETY DATA SHEET
(Essentially Similar to Form OSHA-20)

MSA P/N 34337

SECTION I

PRODUCT NAME	MSA CLEANER-SANITIZER II		
MANUFACTURER	Mine Safety Appliances Company 600 Penn Center Boulevard Pittsburgh, PA 15235	FORMULA CODE	8599-03
		COMPLETED BY	L. P. Dewosky
		TITLE	Mgr.Product Safe
EMERGENCY PHONE NO.	412-273-5500	DATE	6/9/83

SECTION II - INGREDIENTS

	CAS NUMBER	WEIGHT,
ACTIVE INGREDIENTS:		54.7
SODIUM CARBONATE	497-19-8	42.2
TRISODIUM PHOSPHATE	7601-54-9	10.0
ALKYL (C14, 50%; C12, 40%; C16, 10%) DIMETHYL BENZYL AMMONIUM CHLORIDES	139-08-2	2.[illegible]
INERT INGREDIENTS:		45.3
SODIUM TRIPOLYPHOSPHATE	7758-29-4	
SODIUM BICARBONATE	144-55-8	
WATER	7732-18-5	
ISOMERIC LINEAR ALCOHOLS (C11-C15) POLYETHOXY ETHANOLS	68131-40-8*	
ETHANOL	64-17-5	
ISOBORNYL ACETATE	125-12-2	

SECTION III - PHYSICAL DATA

BOILING POINT (° F.)	NA	SPECIFIC GRAVITY (H_2O = 1)	0.8
VAPOR PRESSURE (mm Hg.)	NA	% VOLATILE BY VOLUME	NA
VAPOR DENSITY (AIR = 1)	NA	EVAPORATION RATE (______ = 1)	NA
SOLUBILITY IN WATER	20%	pH 1% AQUEOUS SOLUTION	9.5 - 10.
APPEARANCE AND ODOR	FRAGRANT BLEND OF WHITE POWDERS		

SECTION IV - FIRE AND EXPLOSION DATA

FLASH POINT (Method used)	NO FLASH TO 240 F	FLAMMABLE LIMITS	Lel NA	Uel NA	
EXTINGUISHING MEDIA	WATER SPRAY (FOG), FOAM, DRY CHEMICAL, CARBON DIOXIDE				
SPECIAL FIRE FIGHTING PROCEDURES	BLANKET FIRE WITH EXTINGUISHING MEDIUM				

SKIN CONTACT WITH POWDER MAY CAUSE BURNS. FLUSH AFFECTED AREA WITH CLEAN WATER.

EYE CONTACT WITH POWDER MAY CAUSE CORNEAL BURNS. AVOID RUBBING EYES BECAUSE WATER INSOLUBLE PARTICLES MAY SCRATCH CORNEA. IMMEDIATELY FLUSH EYES WITH CLEAN WATER WHILE HOLDING EYELIDS APART. CONTINUE FLUSHING FOR AT LEAST 15 MINUTES OR UNTIL IRRITATION SUBSIDES. CONSULT PHYSICIAN AS SOON AS POSSIBLE.

INHALATION OF A LARGE ENOUGH QUANTITY TO POSE A SIGNIFICANT HEALTH HAZARD IS IMPROBABLE.

INGESTION OF POWDER IS HARMFUL OR FATAL. SHOULD INGESTION OCCUR, DRINK MILK, RAW EGG WHITE, OR GELATIN SOLUTION, OR LARGE QUANTITIES OF WATER. AVOID ALCOHOL. CONSULT PHYSICIAN AS SOON AS POSSIBLE.

SECTION VI - REACTIVITY DATA

STABILITY	UNSTABLE		CONDITIONS TO AVOID	NONE
	STABLE	X		
HAZARDOUS POLYMERIZATION	MAY OCCUR		CONDITIONS TO AVOID	NONE
	WILL NOT OCCUR	X		
HAZARDOUS DECOMPOSITION PRODUCTS	UNDETERMINED			
INCOMPATIBILITY (MATERIALS TO AVOID)	OXIDIZING AGENTS SOAP AND ANIONIC SURFACTANTS DEACTIVATE GERMICIDE			

SECTION VII - SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED	SWEEP UP
WASTE DISPOSAL METHOD	REMOVE TO SANITARY LANDFILL AWAY FROM WATER SUPPLIES DESTROY EMPTY CONTAINERS

SECTION VIII - SPECIAL PROTECTION INFORMATION

SPECIAL RESPIRATORY PROTECTION	NOT REQUIRED
SPECIAL SKIN PROTECTION	NOT REQUIRED
SPECIAL EYE PROTECTION	NOT REQUIRED

SECTION IX - SPECIAL PRECAUTIONS

SPECIAL HANDLING PRECAUTIONS	NOT REQUIRED
SPECIAL STORAGE PRECAUTIONS	NOT REQUIRED.
OTHER SPECIAL PRECAUTIONS	NOT REQUIRED

chemists helping chemists in research & industry

aldrich chemical co.

P.O. Box 355, Milwaukee, Wisconsin 53201 USA

Telephone: (414) 273-3850
TWX: (910) 262-3052 Aldrichem MI
Telex: 26 843 Aldrich MI
FAX: (414) 273-4979

ATTN: SAFETY DIRECTOR
CH2M HILL INC
PO BOX 4400
RESTON VA 22090
KIRK THOMSPON

DATE: 11/06/87
CUST # 924476 P.O. # W6530

MATERIAL SAFETY DATA SHEET

IDENTIFICATION

PRODUCT # 15490-3 NAME: METHYL ALCOHOL, 99.9%, SPECTROPHOTOMETRIC GRADE

CAS # 67-56-1

TOXICITY HAZARDS

RTECS # PC1400000
METHANOL

IRRITATION DATA	
SKN-RBT 500 MG/24H MOD	28ZPAK -,33,72
EYE-RBT 40 MG MOD	UCDS** 3/24/70
TOXICITY DATA	
ORL-HMN LDLO:428 MG/KG	NPIRI* 1,74,74
ORL-HMN LDLO:143 MG/KG	34ZIAG -,382,69
UNR-MAN LDLO:868 MG/KG	85DCAI 2,73,70
ORL-RAT LD50:5628 MG/KG	GTPZAB 19(11),27,75
IHL-RAT LC50:64000 PPM/4H	NPIRI* 1,74,74
IPR-RAT LD50:7529 MG/KG	EVHPAZ 61,321,85
IVN-RAT LD50:2131 MG/KG	EVHPAZ 61,321,85
ORL-MUS LD50:7300 MG/KG	TXCYAC 25,271,82
IPR-MUS LD50:10765 MG/KG	EVHPAZ 61,321,85
SCU-MUS LD50:9800 MG/KG	TXAPA9 18,185,71
IVN-MUS LD50:4710 MG/KG	EVHPAZ 61,321,85
SKN-RBT LD50:15800 MG/KG	NPIRI* 1,74,74
IPR-RBT LD50:1826 MG/KG	EVHPAZ 61,321,85
IVN-RBT LD50:8907 MG/KG	EVHPAZ 61,321,85
IPR-GPG LD50:3556 MG/KG	EVHPAZ 61,321,85
IPR-HAM LD50:8555 MG/KG	EVHPAZ 61,321,85

REVIEWS, STANDARDS, AND REGULATIONS
ACGIH TLV-TWA 200 PPM; STEL 250 PPM (SKIN) 85INA8 5,372,86
MSHA STANDARD-AIR:TWA 200 PPM (260 MG/M3) (SKIN) DTLVS* 3,155,71
OSHA STANDARD-AIR:TWA 200 PPM FEREAC 39,23540,74
NIOSH REL TO METHYL ALCOHOL-AIR:TWA 200 PPM;CL 800 PPM/15M MMWR** 34(1S),21S,85
EPA GENETOX PROGRAM 1986, NEGATIVE: SHE-CLONAL ASSAY; CELL TRANSFORM.-SA7/SHE
EPA GENETOX PROGRAM 1986, NEGATIVE: N CRASSA-ANEUPLOIDY; IN VITRO SCE-NONHUMAN
EPA TSCA CHEMICAL INVENTORY, 1986
EPA TSCA SECTION 8(E) STATUS REPORT 8EHQ-0378-0108
EPA TSCA TEST SUBMISSION (TSCATS) DATA BASE, DECEMBER 1986
NIOSH ANALYTICAL METHODS: SEE METHANOL, 2000
MEETS CRITERIA FOR PROPOSED OSHA MEDICAL RECORDS RULE FEREAC 47,30420,82

ONLY SELECTED REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES (RTECS) DATA IS PRESENTED HERE. SEE ACTUAL ENTRY IN RTECS FOR COMPLETE INFORMA

chemists helping chemists in research & industry

aldrich chemical co.

ALDRICH

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MATERIAL SAFETY DATA SHEET

CATALOG # 15490-3 NAME: METHYL ALCOHOL, 99.9%, SPECTROPHOTOMETRIC GRADE

------------------ HEALTH HAZARD DATA ------------------

ACUTE EFFECTS
MAY BE FATAL IF SWALLOWED.
HARMFUL IF INHALED OR ABSORBED THROUGH SKIN.
SYMPTOMS OF EXPOSURE MAY INCLUDE BURNING SENSATION, COUGHING, WHEEZING, LARYNGITIS, SHORTNESS OF BREATH, HEADACHE, NAUSEA AND VOMITING.
EXPOSURE CAN CAUSE:
DAMAGE TO THE EYES
DAMAGE TO THE LIVER
DAMAGE TO THE HEART
DAMAGE TO THE KIDNEYS
GASTROINTESTINAL DISTURBANCES
MAY CAUSE CONVULSIONS.

FIRST AID
IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH COPIOUS AMOUNTS OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED CLOTHING AND SHOES.
ASSURE ADEQUATE FLUSHING OF THE EYES BY SEPARATING THE EYELIDS WITH FINGERS.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
CALL A PHYSICIAN.
DISCARD CONTAMINATED CLOTHING AND SHOES.

ADDITIONAL INFORMATION
METHYL ALCOHOL MAY BE FATAL OR CAUSE BLINDNESS IF SWALLOWED. CANNOT BE MADE NON-POISONOUS.

--------------------PHYSICAL DATA --------------------

MELTING POINT: -98 C
BOILING POINT: 64.6 C
SPECIFIC GRAVITY: 0.791
VAPOR DENSITY: 1.1
VAPOR PRESSURE: 97.68 MM @ 20 C

------------ FIRE AND EXPLOSION HAZARD DATA ------------

AUTO IGNITION TEMP.: 725 F
LOWER EXPLOSION LEVEL: 6.0%
UPPER EXPLOSION LEVEL: 36.0%
FLASH POINT: 52 F

EXTINGUISHING MEDIA
CARBON DIOXIDE, DRY CHEMICAL POWDER, ALCOHOL OR POLYMER FOAM.

SPECIAL FIRE FIGHTING PROCEDURES
WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO PREVENT CONTACT WITH SKIN AND EYES.

UNUSUAL FIRE AND EXPLOSION HAZARDS
EXTREMELY FLAMMABLE.
VAPOR MAY TRAVEL CONSIDERABLE DISTANCE TO SOURCE OF IGNITION AND FLASH BACK.

------------------ REACTIVITY DATA ------------------

INCOMPATIBILITIES
ACIDS
ACID CHLORIDES
ACID ANHYDRIDES
OXIDIZING AGENTS
REDUCING AGENTS
ALKALI METALS

Belgium: Aldrich Chemie N.V./S.A. Bd. Lambermontlaan 140, b. 6 ...
France: Aldrich-Chimie S.a.r.l. 27, Fosse des Treize ...
Japan: Aldrich Japan, Kyodo Bldg. Shinkanda ...
United Kingdom: Aldrich Chemical Co. Ltd. The Old Brickyard, New Road, Gillingham, Dorset SP8 4JL
West Germany: Aldrich-Chemie GmbH & Co. KG, D-7924 Steinheim, Telephone (07329) 87-0

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MATERIAL SAFETY DATA SHEET

CATALOG # 15490-3 NAME: METHYL ALCOHOL, 99.9%, SPECTROPHOTOMETRIC GRADE

HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS
TOXIC FUMES OF:
CARBON MONOXIDE, CARBON DIOXIDE

SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED
EVACUATE AREA.
SHUT OFF ALL SOURCES OF IGNITION.
WEAR SELF-CONTAINED BREATHING APPARATUS, RUBBER BOOTS AND HEAVY RUBBER GLOVES.
COVER WITH DRY-LIME, SAND, OR SODA ASH. PLACE IN COVERED CONTAINERS USING NON-SPARKING TOOLS AND TRANSPORT OUTDOORS.
VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.

WASTE DISPOSAL METHOD
BURN IN A CHEMICAL INCINERATOR EQUIPPED WITH AN AFTERBURNER AND SCRUBBER BUT EXERT EXTRA CARE IN IGNITING AS THIS MATERIAL IS HIGHLY FLAMMABLE.

OBSERVE ALL FEDERAL, STATE & LOCAL LAWS.

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE

WEAR APPROPRIATE NIOSH/MSHA-APPROVED RESPIRATOR, CHEMICAL-RESISTANT GLOVES, SAFETY GOGGLES, OTHER PROTECTIVE CLOTHING.
MECHANICAL EXHAUST REQUIRED.
SAFETY SHOWER AND EYE BATH.
DO NOT BREATHE VAPOR.
AVOID CONTACT WITH EYES, SKIN AND CLOTHING.
AVOID PROLONGED OR REPEATED EXPOSURE.
DO NOT USE IF SKIN IS CUT OR SCRATCHED. WASH THOROUGHLY AFTER HANDLING.
POISON.
KEEP TIGHTLY CLOSED.
KEEP AWAY FROM HEAT, SPARKS, AND OPEN FLAME.
HYGROSCOPIC.
STORE IN A COOL DRY PLACE.

ADDITIONAL PRECAUTIONS AND COMMENTS

NOT APPLICABLE

```
FFFFFFFFFF   III    SSSSSS    HHHH   HHHH   EEEEEEE   RRRRR
FFFFFFFFFF   III  SS      SS  HHHH   HHHH   EEEEEEE   RR   RR
FFF          III   SS         HHHH   HHHH   EE        RR    RR
FFFFFFFF     III        SS    HHHHHHHHHHH   EEEEEEE   RRRRR
FFFFFFFF     III          SS  HHHHHHHHHHH   EEEEEEE   RRRR
FFF          III          SS  HHHH   HHHH   EE        RR RR
FFF          III  SS     SS   HHHH   HHHH   EEEEEEE   RR  RR
FFF          III    SSSSS     HHHH   HHHH   EEEEEEE   RR    RR

      MM   MM    SSSSS   DDDDDD      SSSSS
      MMM MMM   SS       DD    DD   SS
      MM M MM    SSS     DD    DD     SSS
      MM   MM       SS   DD    DD        SS
      MM   MM   SSSSS    DDDDDD      SSSSS
```

IMPORTANT SAFETY INFORMATION -- DO NOT DISCARD.

PLEASE ROUTE TO COMPANY SAFETY OFFICER.

FISHER SCIENTIFIC HAS A COMPLETE LINE OF SAFETY PRODUCTS AND INFORMATION FOR THE LABORATORY. CONTACT YOUR LOCAL FISHER BRANCH FOR FILMS, BROCHURES, CATALOGS AND PRODUCTS.

CH2M HILL
1941 ROLAND CLARKE PL
RESTON VA 22091

IF NAME AND/OR ADDRESS HAVE CHANGED, CONTACT YOUR FISHER SALES REPRESENTATIVE OR YOUR LOCAL FISHER BRANCH.

REQUIRED MATERIAL SAFETY DATA SHEETS (MSDS) NOT INCLUDED IN THIS MAILING WILL FOLLOW UNDER SEPARATE COVER.
THIS PACKET MAY CONTAIN MSDS FOR PRODUCTS MANUFACTURED BY OTHERS AND DISTRIBUTED BY FISHER SCIENTIFIC COMPANY. THESE MSDS WERE PREPARED BY THE MANUFACTURER AND FISHER DISCLAIMS ALL LIABILITY FOR THE CONTENT.

METHANOL
METHANOL
METHANOL

MATERIAL SAFETY DATA SHEET

FISHER SCIENTIFIC
CHEMICAL DIVISION
1 REAGENT LANE
FAIR LAWN NJ 07410
(201) 796-7100

EMERGENCY CONTACTS
GASTON L. PILLORI
(201) 796-7100

DATE: 03/01/86
PO NBR: N/A
ACCT: 111597-01
INDEX: 03-8605-80215
CAT NO: A41220

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SUBSTANCE IDENTIFICATION

CAS-NUMBER 67-56-1

SUBSTANCE: **METHANOL**

TRADE NAMES/SYNONYMS: METHYL ALCOHOL; WOOD ALCOHOL; METHYL HYDROXIDE; CARBINOL; MONOHYDROXYMETHANE; WOOD SPIRIT; WOOD NAPHTHA; U154; UN 1230;

CHEMICAL FAMILY:
HYDROXYL, ALIPHATIC

MOLECULAR FORMULA: C-H4-O ; MOL WT: 32.04

CERCLA RATINGS (SCALE 0-3): HEALTH=1 FIRE=3 REACTIVITY=0 PERSISTENCE=0
NFPA RATINGS (SCALE 0-4): HEALTH=1 FIRE=3 REACTIVITY=0

COMPONENTS AND CONTAMINANTS

PERCENT: 100 COMPONENT: METHYL ALCOHOL

OTHER CONTAMINANTS: NONE

EXPOSURE LIMITS:
200 PPM OSHA TWA
200 PPM NIOSH RECOMMENDED TWA
200 PPM ACGIH TWA (SKIN); 250 PPM ACGIH STEL

PHYSICAL DATA

DESCRIPTION: CLEAR, COLORLESS LIQUID; CHARACTERISTIC ALCOHOL ODOR.

BOILING POINT: 147 F (64 C) MELTING POINT: -144 F (-98 C)

SPECIFIC GRAVITY: 0.8 VAPOR PRESSURE: 97 MMHG @ 20 C

EVAPORATION RATE: (ETHER=1) 5.9 (TTE) SOLUBILITY IN WATER: SOLUBLE

SO[illegible] ETHER, BENZENE, ALCOHOL, KETONES, ORG[illegible] .LVE[illegible]

ODOR THRESHOL[illegible] 100 PPM   VAPOR DENSITY: 1.1

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:
DANGEROUS FIRE/NEGLIGIBLE EXPLOSION HAZARD WHEN EXPOSED TO HEAT OR FLAME.
FIRE AND EXPLOSION HAZARD BY REACTION WITH STRONG OXIDIZERS.
VAPORS ARE HEAVIER THAN AIR AND MAY TRAVEL A CONSIDERABLE DISTANCE TO A SOURCE OF IGNITION AND FLASH BACK.
VAPOR-AIR MIXTURES ARE EXPLOSIVE.

FLASH POINT: 52 F (11 C) (CC)   UPPER EXPLOSION LIMIT: 36.5%

LOWER EXPLOSION LIMIT: 6.0%   AUTOIGNITION TEMP.: 725 F (385 C)

FLAMMABILITY CLASS(OSHA): IB

FIREFIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE, WATER SPRAY OR FOAM
(1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FOR LARGER FIRES, USE WATER SPRAY OR FOAM: FOAM IS PREFERRABLE.

FIREFIGHTING:
FLAMMABLE LIQUID (POISONOUS)- WEAR RESPIRATORY EQUIPMENT. DO NOT ATTEMPT TO EXTINGUISH FIRE UNLESS SPILL FLOW CAN BE STOPPED. USE FLOODING QUANTITIES OF WATER AS A FOG AND TO COOL ALL CONTAINERS INVOLVED IN FIRE. APPLY WATER FROM AS FAR A DISTANCE AS POSSIBLE. APPLICATION OF SOLID STREAMS OF WATER MAY SPREAD FIRE.

TOXICITY

. PPM EYE-HUMAN IRRITATION; 500 MG/24 HOURS SKIN-RABBIT MODERATE IRRITATION; 0 MG EYE-RABBIT MODERATE IRRITATION; 340 MG/KG ORAL-HUMAN LDLO; 868 MG/KG UNKNOWN-HUMAN LDLO; 5628 MG/KG ORAL-RAT LD50; 64,000 PPM/4 HOURS INHALATION-RAT LC50; 1000 PPM INHALATION-MONKEY LCLO; 500 MG/KG SKIN-MONKEY LDLO; 20 GM/KG SKIN-RABBIT LD50; 8600 MG/M3 INHALATION-HUMAN TCLO; MUTAGENIC DATA (RTECS); REPRODUCTIVE EFFECTS DATA (RTECS); CARCINOGEN STATUS: ONE.
METHYL ALCOHOL IS A EYE, SKIN, AND MUCOUS MEMBRANE IRRITANT AND A CENTRAL ERVOUS SYSTEM DEPRESSANT.

HEALTH EFFECTS AND FIRST AID

INHALATION:
ARCOTIC. 25,000 PPM IMMEDIATELY DANGEROUS TO LIFE OR HEALTH.
ACUTE EXPOSURE- INTOXICATION BEGINS WITH A STATE OF INEBRIATION. WITHIN 12-18 HOURS, HEADACHE, ANOREXIA, WEAKNESS, FATIGUE, LEG CRAMPS, VERTIGO AND RESTLESSNESS OCCUR, FOLLOWED BY NAUSEA, VOMITING, DIARRHEA, DIZZINESS, AND OTHER SIGNS OF NARCOSIS, THEN SEVERE ABDOMINAL, BACK AND LEG PAIN, MUSCULAR INCOORDINATION, SWEATING, TRACHEITIS AND BRONCHITIS. APATHY OR DELIRIUM MAY PROGRESS TO COMA. EXCITEMENT, MANIA AND CONVULSIONS OCCUR

RARE. BLURRED OR DIMMED VISION HAS OCCURRED WITH OPTIC NEURITIS, EYE PAIN AND ATROPHY, CONCENTRIC VISUAL FIELDS AND PHOTOPHOBIA, FOLLOWED BY TRANSIENT OR PERMANENT BLINDNESS. ACIDOSIS MAY RESULT IN RAPID, SHALLOW RESPIRATION, CYANOSIS, COMA AND HYPOTENSION. MILD TACHYCARDIA, CARDIAC DEPRESSION AND PERIPHERAL NEURITIS ARE POSSIBLE AS WELL AS LIVER AND KIDNEY DAMAGE AND CEREBRAL FAILURE OR CIRCULATORY COLLAPSE. PROLONGED ASTHENIA AND PARTIAL OR COMPLETE LOSS OF VISION IN 2-6 DAYS, AND PERMANENT RENAL DYSFUNCTION MAY FOLLOW NON-FATAL INTOXICATION. BLINDNESS IS CAUSED AT 800 TO 1000 PPM. 50,000 PPM WILL PROBABLY CAUSE DEATH IN 1 TO 2 HOURS.

CHRONIC EXPOSURE- PROLONGED OR REPEATED EXPOSURE MAY CAUSE SYMPTOMS SUCH AS BLURRED VISION, CONTRACTION OF VISUAL FIELDS AND SOMETIMES, COMPLETE BLINDNESS. SEE MUTAGENIC DATA AND ANIMAL REPRODUCTIVE EFFECTS DATA REFERENCES IN TOXICITY SECTION.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, PERFORM ARTIFICIAL RESPIRATION. KEEP AFFECTED PERSON WARM AND AT REST. GET MEDICAL ATTENTION.

IN CONTACT:
RITANT/NARCOTIC.
ACUTE EXPOSURE- CONTACT WITH LIQUID CAN PRODUCE DEFATTING AND A MILD DERMATITIS. READILY ABSORBED THROUGH INTACT SKIN TO CAUSE NARCOSIS, OPTIC NEURITIS AND ACIDOSIS.

CHRONIC EXPOSURE- PROLONGED OR REPEATED SKIN CONTACT PRODUCES ECZEMA, REDNESS AND SCALING. CHRONIC ABSORPTION MAY RESULT IN VISUAL IMPAIRMENT AND OPTIC NEURITIS. SEE MUTAGENIC DATA AND ANIMAL REPRODUCTIVE EFFECTS DATA REFERENCES IN TOXICITY SECTION.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

E CONTACT:
RITANT.
ACUTE EXPOSURE- EYE CONTACT WITH METHANOL HAS CAUSED SUPERFICIAL CORNEAL LESIONS. INGESTION, INHALATION OR SKIN ABSORPTION MAY RESULT IN BLURRED OR DIMMED VISION FOLLOWED BY TRANSIENT OR PERMANENT BLINDNESS, WITH OPTIC NEURITIS, EYE PAIN, ATROPHY, CONCENTRIC VISUAL FIELDS AND PHOTOPHOBIA. 5 PPM AND 40 MG CAUSE MODERATE IRRITATION IN EYES OF HUMANS AND RABBITS RESPECTIVELY.

CHRONIC EXPOSURE- REPEATED OR PROLONGED CONTACT MAY CAUSE CONJUNCTIVITIS. VISUAL IMPAIRMENT AS DESCRIBED ABOVE MAY INDICATE CHRONIC EXPOSURE BY INGESTION, INHALATION OR SKIN ABSORPTION.

IRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

.ESTION:
COTIC.
ACUTE EXPOSURE- MAY CAUSE DELAYED SYMPTOMS OF HEADACHE, ANOREXIA, WEAKNESS, FATIGUE, LEG CRAMPS, VERTIGO AND RESTLESSNESS, FOLLOWED BY NAUSEA, VOMITING, DIARRHEA, DIZZINESS, AND OTHER SIGNS OF NARCOSIS. SEVERE ABDOMINAL,

BACK AND LEG PAIN, MUSCULAR INCOORDINATION, SWEATING, TRACHEITIS AND BRONCHITIS MAY OCCUR. APATHY OR DELIRIUM MAY PROGRESS TO COMA. EXCITEMENT, MANIA AND CONVULSIONS HAVE OCCURRED RARELY. BLURRED OR DIMMED VISION FOLLOWED BY TRANSIENT OR PERMANENT BLINDNESS WITH OPTIC NEURITIS, EYE PAIN, ATROPHY, CONCENTRIC VISUAL FIELDS AND PHOTOPHOBIA MAY OCCUR. ACIDOSIS MAY RESULT IN RAPID, SHALLOW RESPIRATION, CYANOSIS, COMA AND HYPOTENSION. MILD TACHYCARDIA, CARDIAC DEPRESSION AND PERIPHERAL NEURITIS ARE POSSIBLE, AS WELL AS LIVER AND KIDNEY DAMAGE AND CEREBRAL AND PULMONARY EDEMA. DEATH IS POSSIBLE FROM RESPIRATORY FAILURE OR CIRCULATORY COLLAPSE. PROLONGED ASTHENIA AND PARTIAL OR COMPLETE LOSS OF VISION IN 2-6 DAYS, AND PERMANENT RENAL DYSFUNCTION MAY FOLLOW NON-FATAL INTOXICATION.

FIRST AID- GET MEDICAL ATTENTION IMMEDIATELY. IF MEDICAL ATTENTION IS NOT IMMEDIATELY AVAILABLE, AND IF VICTIM IS CONSCIOUS, ATTEMPT TO INDUCE VOMITING BY TOUCHING FINGER TO BACK OF THROAT. ALSO GIVE SODIUM BICARBONATE (BAKING SODA), 2 TEASPOONFULS IN WATER.

REACTIVITY

EACTIVITY:
TABLE AT ORDINARY PRESSURES UP THE BOILING POINT, 64 C.

NCOMPATIBILITIES:
XIDIZERS AND OTHER MATERIALS. EXAMPLES FOLLOW:

ETHANOL:
CHLOROFORM AND SODIUM HYDROXIDE: EXPLOSIVE REACTION.
CALCIUM CARBIDE: VIOLENT REACTION.
MAGNESIUM: VIOLENT REACTION.
CYANURIC CHLORIDE: VIOLENT REACTION.
BERYLLIUM HYDRIDE: INTENSE REACTION AT 200 C.
BROMINE: INTENSE EXOTHERMIC REACTION.
CHROMIC ANHYDRIDE: POSSIBLE EXPLOSIVE REACTION.
NICKEL: POSSIBLE IGNITION IN THE PRESENCE OF CATALYTIC AMOUNTS.

ECOMPOSITION:
OMBUSTION PRODUCTS INCLUDE TOXIC/HAZARDOUS GASES OF FORMALDEHYDE, CARBON ONOXIDE AND CARBON DIOXIDE.

OLYMERIZATION:
ILL NOT OCCUR.

****
CONDITIONS TO AVOID

Y BE IGNITED BY HEAT, SPARKS OR FLAMES. CONTAINER MAY EXPLODE IN HEAT OF IRE. VAPOR EXPLOSION AND POISON HAZARD INDOORS, OUTDOORS OR IN SEWERS. RUN-F TO SEWER MAY CREATE FIRE OR EXPLOSION HAZARD.

OID CONTACT WITH OR STORAGE WITH INCOMPATIBLE MATERIALS, INCLUDING THOSE ISTED IN THE REACTIVITY SECTION.

SPILL AND LEAK PROCEDURES

OCCUPATIONAL SPILL:
SHUT OFF IGNITION SOURCES. PROVIDE VENTILATION. WEAR RESPIRATORY PROTECTION. DO NOT TOUCH SPILLED MATERIAL. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS. FOR SMALL SPILLS, TAKE UP WITH SAND OR OTHER NON COMBUSTIBLE, ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL. CLOSE TIGHTLY AND LABEL 'FLAMMABLE'. FOR LARGER SPILLS, DIKE AS CLOSE TO SPILL AS PRACTICAL TO MINIMIZE ENVIRONMENTAL CONTAMINATION. NO SMOKING, FLAMES OR FLARES IN HAZARD ARES. KEEP OUT OF SEWERS AND WATER SOURCES.

WHEN MATERIAL IS INVOLVED IN FIRE:
DO NOT ATTEMPT TO EXTINGUISH FIRE UNLESS SPILL OR LEAK FLOW CAN BE STOPPED.
USE FLOODING QUANTITIES OF WATER AS A FOG.
APPLICATION OF SOLID STREAMS OF WATER MAY SPREAD FIRE.
USE FLOODING QUANTITIES OF WATER TO COOL ALL CONTAINERS INVOLVED IN FIRE.
APPLY WATER TO MATERIAL FROM AS FAR A DISTANCE AS POSSIBLE.
EXTINGUISH WITH DRY CHEMICAL, ALCOHOL FOAM OR CARBON DIOXIDE.
DO NOT ALLOW RUN-OFF WATER TO CONTAMINATE SEWERS OR WATER SOURCES.

WHEN MATERIAL NOT INVOLVED IN FIRE:
KEEP OPEN FLAMES, SPARKS OR OTHR IGNITION SOURCES AWAY.
DO NOT ALLOW MATERIAL TO CONTAMINATE SEWERS OR WATER SOURCES.
BUILD DIKES FOR CONTAINMENT OF SPILL FLOW.
STOP LEAK IF YOU CAN DO IT WITHOUT RISK.
KNOCK DOWN VAPORS WITH WATER SPRAY.

PROTECTIVE EQUIPMENT

VENTILATION:
PROVIDE LOCAL EXHAUST VENTILATION OR GENERAL DILUTION VENTILATION TO MEET PERMISSIBLE EXPOSURE LIMITS. VENTILATION EQUIPMENT MUST BE EXPLOSION-PROOF.

RESPIRATOR:
2000 PPM- SUPPLIED-AIR RESPIRATOR.
SELF-CONTAINED BREATHING APPARATUS.

10,000 PPM- SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE, HELMET, OR HOOD.
SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE.

> 10,000 PPM, INCLUDING THE IDLH LEVEL, 25,000 PPM (2.5%)-
TYPE C SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE, HELMET, OR HOOD OPERATED IN POSITIVE PRESSURE MODE OR IN CONTINUOUS-FLOW MODE.

FIREFIGHTING- SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

CLOTHING:
EMPLOYEE MUST WEAR IMPERVIOUS CLOTHING AS NECESSARY TO AVOID ANY POSSIBILITY OF CONTACT WITH SOLUTIONS OR MISTS.

GLOVES:
WEAR PROTECTIVE GLOVES AS NECESSARY TO AVOID REPEATED OR PROLONGED CONTACT

WITH SOLUTION OR MIST. PREFERRED MATERIALS: BUTYL, NEOPRENE AND NITRILE RUBBER GLOVES.

EYE PROTECTION:
WEAR FACESHIELD (8 INCH MINIMUM) OR SPLASH-PROOF SAFETY GOGGLES WHERE THERE IS REASONABLE PROBABILITY OF CONTACT WITH LIQUID OR MIST. DO NOT WEAR CONTACT LENSES WHEN WORKING WITH CHEMICALS.

AUTHORIZED - ALLIED FISHER SCIENTIFIC
CREATION DATE: 10/25/85   REVISION DATE: 11/14/85

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ATTACHMENT 1

EMPLOYEE SIGNOFF

The employees listed below have been provided a copy of this health and safety plan, have read and understood it, and agree to abide by its provisions.

EMPLOYEE NAME	EMPLOYEE SIGNATURE / DATE

MKE10015336.WP5

CONFINED SPACE

(Reference CH2M HILL SOP-17, *Confined Space Entry*)

This section covers the general safety requirements of confined space entry. Before entering CH2M HILL entrants will be required to attend a confined space training program that includes videos, discussions, demonstrations and a written exam.

The following general work practices will be followed prior to entry into the confined space.

* Evaluate space and hazards (hazardous atmosphere, engulfement, physical dangers, an internal configuration that could entrap an entrant spaces require a permit).
* Test the atmosphere from outside the space. Test for O_2, LEL, and other anticipated atmospheric contaminants. The initial atmosphere test will determine if ventilation is required prior to and during entry. If ventilation is required because of contaminants within the space, a permit is required.
* If a permit is required the permit must include the following;
  - signature of an entry supervisor,
  - a list of authorized entrants,
  - name(s) of designated attendant,
  - procedures for the specific entry,
  - be completely filled out and
  - must be posted at entry site.
* Conduct pre-entry briefing that will include the following;
  - discuss and demonstrate required safety equipment and air monitors,
  - explanation of hazards and signs, symptoms of exposure,
  - review of permit and emergency procedures and
  - discuss communication procedures and use of radio.
* If determined to be a permit space lock/tag out valves on input lines and other hazardous energy sources.

Confined Space Entry

ENTRY SUPERVISOR

Makes sure conditions are safe.

* Before entry, verifies that the permit is filled out and complete. Signs the form and ensures all safety steps listed on the permit are taken.
* During entry;
  - checks conditions to make sure they stay safe,
  - if conditions become unsafe cancels permit and orders everyone out of the space,
  - and when the work is finished cancels the permit and concludes the operation.

ATTENDANT

The attendant stays at post to observe conditions and support the entrants.

* Must know the hazards of the permit space and signs of exposure.
* Keep a current count and be able to identify all entrants.
* Stay in continuous contact with the entrants.
* Be sure only authorize people enter the space.
* Order all workers out of the space when the attendant;
  - sees a condition not allowed by the entry permit,
  - notices signs of exposure in any entrant,
  - sees something outside the permit space that could cause danger inside.
* An attendant must never leave the observation post for any reason.
* If the entrants have a problem and can't escape, call the rescue team at once.
* In case of emergency DO NOT ENTER THE PERMIT SPACE.

ENTRANT
* Must know the hazard of the space and signs of exposure. For example, lack of oxygen can cause;
  - loss of muscle control,
  - mental confusion,
  - breathing difficulty
  - misguided feeling of well-being
  - ringing in the ear
  - death
* Discuss, know and use your personal protective equipment.
* Keep in contact with the attendant and leave the space at once if you are ordered to evacuate.
* If you see that you are in danger leave the space and tell the attendant.

Air Monitoring
Contaminant gases and vapors can be found in confined spaces. Your physical senses are not a reliable means of detecting the presence of dangerous concentrations. A gas meter must be used for detection purposes. The gas monitoring equipment used on the project will be discussed and demonstrated during the pre-entry briefing.

APPENDIX C
QAPP

Quality Assurance Project Plan (QAPjP)
Remedial Design/Remedial Action
N.W. Mauthe Company, Appleton, Wisconsin
Prepared by: CH2M HILL
EPA No: 88-5N6G

Region 5
Office of Superfund
December 1994

MKE10014BBF.WP5

TITLE PAGE

QUALITY ASSURANCE PROJECT PLAN (QAPjP)
Remedial Design/Remedial Action
N.W. Mauthe Company, Appleton, Wisconsin
Prepared by: CH2M HILL
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Region 5
Office of Superfund
December 1994

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MKE10014AEC.WP5

Section 1
Introduction

The United States Environmental Protection Agency (EPA) requires that all environmental monitoring and measurement efforts mandated or supported by the U.S. EPA participate in a centrally managed quality assurance (QA) program.

Any party generating data under this program has the responsibility to implement minimum procedures to assure that the precision, accuracy, completeness, and representativeness of its data are known and documented. So that the responsibility is met uniformly, each party must prepare a written QA Project Plan (QAPjP) covering each project it is to perform.

This QAPjP presents the organization, objectives, functional activities, and specific QA and quality control (QC) activities associated with the remedial design (RD) study and remedial action (RA) for the N.W. Mauthe Company located in the City of Appleton, Wisconsin.

This QAPjP also describes the specific protocols that will be followed for sampling, sample handling and storage, chain of custody, and laboratory and field analyses.

All QA/QC procedures will be in accordance with applicable professional technical standards, U.S. EPA requirements, government regulations and guidelines, and specific project goals and requirements. This QAPjP is prepared for U.S. EPA Region 5 under Work Assignment No. 88-5N6G, by CH2M HILL in accordance with all U.S. EPA QAPjP guidance documents, in particular, the Contract Laboratory Program (CLP) guidelines, *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans (QAMS-005/80),* and the *Region 5 Model QAPjP (1991).*

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Section 3
Project Description

3.1 Site Description

The N.W. Mauthe Company (Site) is a former electroplating facility located at 725 South Outagamie Street in the City of Appleton, in east-central Wisconsin (Figure 3-1). The Site lies in a mixed industrial and residential area within the city limits in west-central Appleton.

The Site is roughly triangular in shape and occupies about one-quarter of a city block (Figure 3-2). West Melvin Street forms the northern boundary, and an asphalt parking lot owned by the Miller Electric and Manufacturing Company (Miller Electric) forms the western property boundary of the Site. A railroad right-of-way owned by the Wisconsin Central Ltd. forms the southeast boundary of the Site. Private residences are located immediately southeast of the railroad tracks and on the north side of Melvin Street.

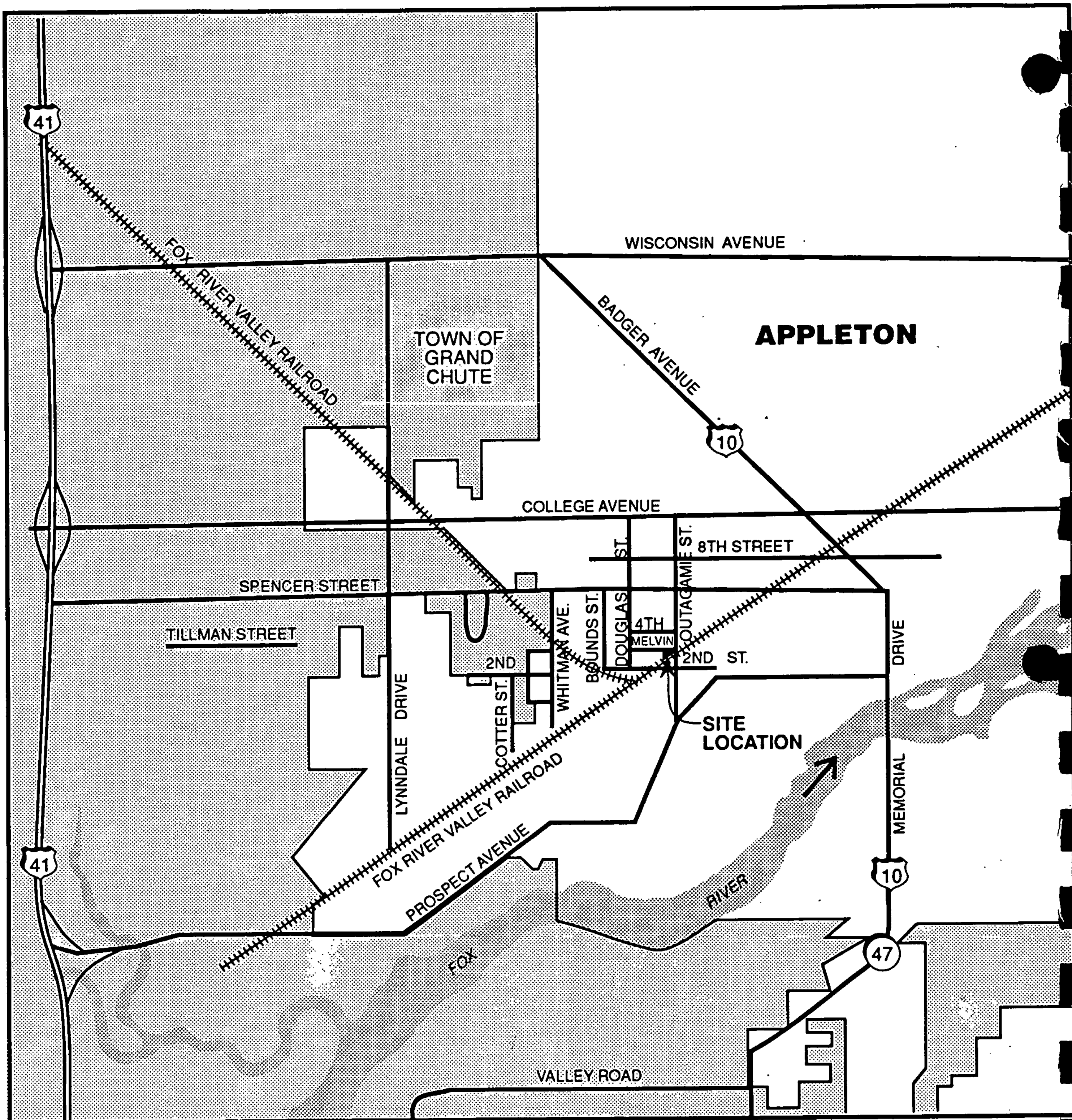
Two buildings are located on the Site. Of the approximately 25,000-square-foot site, the Chromium Building occupies about 7,500 square feet and the Zinc Building occupies about 5,000 square feet. The ground surface north of the Chromium Building is mostly gravel parking lot. Tall weeds cover the ground south of this building. The Site topography is fairly flat, but drops off to a shallow ditch that runs between the Site and the railroad tracks. The adjacent streets serve as corridors for both overhead and underground utilities.

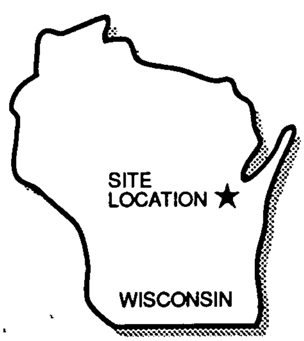
3.2 Site History

Hard chromium plating was conducted in the Chromium Building from 1960 to 1976. Objects to be electroplated were rinsed with a chlorinated solvent to remove oils and submerged in plating solution baths. Hydrogen gas and chromic acid vapors generated from the plating process were exhausted from the building by a ventilating fan, whereas splashes, drips, and spills from the plating and degreasing activities were directed to a shallow floor trench and channeled into the sanitary sewer system.

Zinc, cadmium, copper, and possibly silver were electroplated in the Zinc Building from 1978 to 1987. A *Pretreatment Baseline Report* submitted by the N.W. Mauthe Company to the City of Appleton on January 4, 1985, states that the company used 1,1,1-trichloroethane (27 gallons a year) for parts degreasing and several plating bath solutions

GLE5688.PD.OS Site Location Map 8-25-94 mjl





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Map Source: R.R. Donnelley & Sons Co. Cartographic Services

FIGURE 3-1
Site Location Map
N.W. Mauthe Site

CH2M HILL

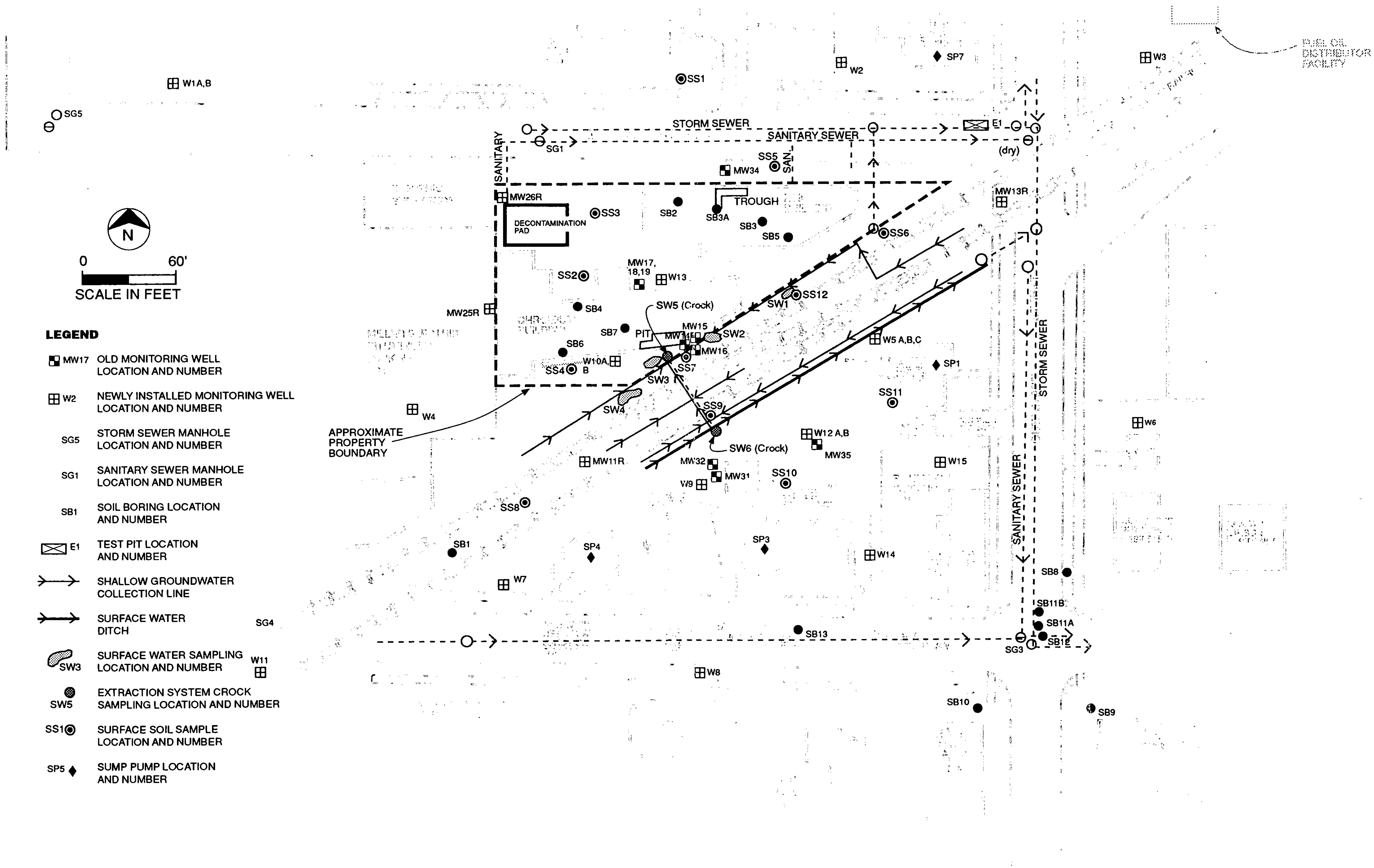

FIGURE 3-2
RI/FS Sampling Locations and Site Features Map
N.W. Mauthe Site

in the electroplating process. Untreated liquid wastes were discharged into the sanitary sewer system.

In 1982, the Wisconsin Department of Natural Resources (DNR) received a report of yellow-green water in puddles south of the Chromium Building. Over the years, plating solutions and waste solvents had leaked from holding vats, tanks, and channels into surrounding soils. Additionally, plating tank solutions were allegedly discharged to ground soils outside the buildings by sump pumps. Samples of water from puddles contained 7.6 to 62 mg/L total chromium, and groundwater samples collected in 1982 contained a maximum of 840 mg/L total chromium.

3.3 Past Data Collection Activity/Current Status

3.3.1 Site Investigations

The DNR began an investigation of the site in April 1982. Surface water removal actions also began at that time. A total of 18 monitoring wells were installed. Soil boring samples and groundwater samples revealed contamination at the site. Under contract to the DNR, Commercial Pumping and Incineration (CPI) installed a shallow groundwater collection system parallel to the railroad track in May 1982. For approximately 2 years, shallow groundwater and surface water were collected and transferred to the De Pere publicly owned treatment works (POTW). After several rounds of environmental sampling and health assessments, the N.W. Mauthe site was added to the NPL in 1989.

In 1990 a Superfund Remedial Investigation/Feasibility Study (RI/FS) Work Plan was prepared by Warzyn Engineering, Inc. (Warzyn March 1990). The work plan was modified by CH2M HILL in consultation with the DNR and the U.S. EPA. The RI was conducted by CH2M HILL at the Mauthe site from November 1991 to May 1992 using the modified version of the work plan. The RI included monitoring well installation; surface and subsurface soil sampling; test pit excavation; groundwater, residential sump, and sewer water sampling; hydraulic conductivity testing; surface water sampling; and videotaping of the sanitary and storm sewer lines. The results of the RI are documented in the *Remedial Investigation Report, N.W. Mauthe Site, Appleton, Wisconsin* (CH2M HILL February 1993).

3.3.2 Nature and Extent of Contamination

Soil and groundwater sampling results show the greatest concentrations of hazardous substances in the area around the Zinc and Chromium Buildings. The chemicals most often detected above background levels or state groundwater standards include chromium (both hexavalent and total), zinc, cadmium, cyanide, trichloroethene, 1,1,1-trichloroethane, 1,1-dichloroethene, and toluene. Benzene and xylenes were detected in samples collected near a neighboring fuel oil distributor and do not appear to be attributable to industrial activities at the Mauthe site.

Subsurface soil contamination was detected to a maximum depth of 25 feet. Contamination extends horizontally over the entire Mauthe property and to the south side of the railroad tracks adjacent to the property. Outside the process buildings area, the vertical extent of contamination is more limited and does not extend to the 25-foot depth observed near the buildings. Chromium is the most widely distributed contaminant of the chemicals analyzed for in the RI. Selected volatile organic compounds (VOCs) were detected in subsurface soils but have a more limited distribution.

Hexavalent chromium-contaminated groundwater extends over much of the block bordered by Melvin, Outagamie, and Second Streets. Most or all of the chromium in groundwater exists in the hexavalent form.

Surface water samples collected from puddles along the southern edge of the Mauthe property contained chromium and some VOCs. A video survey of the sanitary and storm sewers along Melvin Street revealed a previously unmapped sanitary sewer lateral, the origin of which is unknown. A dye study indicated that the sewer laterals from the Mauthe site are clogged or collapsed.

3.4 Project Objectives

Based on the RI findings, a FS was prepared (CH2M HILL May 1993) and a Record of Decision (ROD) for remediation of the Site was signed in March 1994 by the DNR and the U.S. EPA. The U.S. EPA assumed the lead role in the remedial design/remedial action (RD/RA) and issued a work assignment to CH2M HILL in May 1994 to perform RD. The basic components of the remediation include demolition of the onsite buildings, excavation of soil containing total chromium in concentrations greater than 500 ppm, installation of groundwater extraction trenches, and onsite groundwater treatment before discharge to the Appleton POTW.

Additional information on the groundwater flow and quality is required for the design of the groundwater treatment facility. This information will be obtained at the beginning of the Remedial Action by prioritizing the construction of a portion of the groundwater collection trench system. A subcontractor will set up and run a trench test on this portion of the trench under the supervision of CH2M HILL. The subcontractor will collect and dispose of groundwater during the test. CH2M HILL will collect groundwater samples for performance of a bench-scale treatability test.

Compounds to be analyzed during the bench-scale treatability test are listed in Table 3-2. The treatability test will use water collected from the later stages of the trench test, after the water quality stabilizes. Chemical analysis of the influent and treated water will be part of the treatability testing. About 5 samples of influent water and 25 samples of effluent water will be tested.

The remaining RA activities will be performed at the same time as the treatability study and subsequent remedial design of the groundwater treatment system. These activities include the removal of hot spot soils—soils containing chromium at a concentration greater than 500 ppm.

CH2M HILL will sample the excavated soil to determine appropriate disposal. Each load of excavated material (approximately 20 cubic yards) will be field tested using an X-ray Fluorescence (XRF) Spectrometer to determine the concentration of total chromium. If the chromium concentration is between 100 and 500 mg/kg, a sample will be taken and tested for TCLP metals. Soil that is TCLP characteristic will be treated at a hazardous waste facility.

Following excavation of the hot spot area, CH2M HILL will perform verification sampling to determine if cleanup has been achieved. Details on the verification sampling including sampling locations are presented in the Cleanup Verification Plan. An estimated 25 verification samples will be tested.

Tasks, subtasks, and activities described in the RD Work Plan, are directed toward the accomplishment of these primary objectives.

3.5 Sample Network Design and Rationale

The activities and subtasks related to the field work are summarized in Table 3-1. The Field Sampling Plan (FSP), which describes sampling and field procedures associated with the RD/RA activities, is included as Appendix A.

3.6 Parameters to be Tested and Frequency

Table 3-2 is a list of sample matrixes, analytical parameters, and estimated number of samples. Table 3-3 provides a summary of sample quantity, container, preservative, and packaging requirements.

3.7 Data Quality Objectives

Data Quality Objectives (DQOs) are qualitative and quantitative statements that specify the quality of the data required to support decisions made during the RD and RA activities and are based on the end uses of the data to be collected. As such, different data uses may require different levels of data quality. There are five analytical levels that address various data uses and the QA/QC effort and methods required to achieve the desired level of data quality. These levels are:

- **Screening (DQO Level 1):** This level provides the lowest data quality but the most rapid results. It is often used for health and safety monitoring at the site and for engineering screening of alternatives (bench-scale tests). DQO Level 1 data include those generated onsite through the use of DO, redox, pH, conductivity, and other real-time monitoring equipment at the site.

- **Field Analyses (DQO Level 2):** This level provides rapid results and better quality than Level 1. Depending on the level of quality control exercised, this level may include mobile lab generated data. DQO Level 2 data include those generated onsite through the use of the XRF Spectrometer.

- **Engineering (DQO Level 3):** This level provides an intermediate level of data quality and can be used for assessing remedial alternatives. (Engineering analyses may include laboratory data analyses with quick turnaround used for screening but without full QC documentation.) Samples collected to be analyzed for Level 3 data as part of this RD include treatability test groundwater samples that will be analyzed for one or more of the following parameters: hexavalent chromium, cyanide, cyanide amenable to chlorine, total metals, volatile organic compounds (VOCs), alkalinity, TOC, TDS, and hardness.

- **Confirmation (DQO Level 4):** This level provides the highest level of data quality and is used for assessing if final remedial design alternatives have effectively cleaned up the site. These analyses require full laboratory program analytical and data validation procedures in accordance with U.S. EPA recognized protocols. The Level 4 data to be collected for the RD will include the treatability test sludge to be tested for TCLP VOCs, TCLP metals, free liquids, corrosivity, and percent solids. The Level 4 data to be collected as part of the RA will include the confirmatory clean soil samples to be analyzed for total chromium.

- **Non-Standard (DQO Level 5):** This level refers to analyses by non-standard protocols, for example, when exacting detection limits or analysis of an unusual chemical compound is required. These analyses often require method development or adaptation. The level of QC is similar to that of DQO Level 4 data. Level 5 data will not be collected as part of this RD.

3.8 Project Schedule

A schedule of RA and RD activities for the N.W. Mauthe Company is provided in Figure 3-3.

Figure 3-3
N.W. Mauthe Tentative Project Schedule

ID	Task Name	Dur	Start	Finish	Pred
1	75% Plans, Specs, and Support Plans	31d	11/7/94	12/20/94	
2	Agency Review of 75% Design	15d	12/21/94	1/12/95	1
3	100% Plans and Specifications	15d	1/13/95	2/2/95	2
4	Agency Review of Final Design	25d	2/3/95	3/10/95	3
5	EPA Approval of Final Design	0d	3/10/95	3/10/95	4
6	Distribute Subcontract Documents to Bidders	20d	3/13/95	4/7/95	5
7	Review Bids	5d	4/10/95	4/14/95	6
8	Submit Subcontract Package to EPA for Review	15d	4/17/95	5/5/95	7
9	Notice of Award to Subcontractor	0d	5/9/95	5/9/95	8FS+2d
10	Notice to Proceed to Subcontractor	0d	5/16/95	5/16/95	9FS+5d
11	**Remedial Action**	**112d**	**5/17/95**	**10/24/95**	**10**
12	Subcontractor Mobilization	10d	5/17/95	5/31/95	10
13	Groundwater Collection Trenches/Manholes	45d	6/1/95	8/3/95	12
14	Restoration of Trench Areas	5d	8/4/95	8/10/95	13
15	Removal of Temporary Cover	5d	6/1/95	6/7/95	12
16	Demolition of Building Slabs	10d	6/8/95	6/21/95	15
17	Construction of Temporary Berms	5d	6/8/95	6/14/95	15
18	Excavation/Backfill of Hot Spot Soils	30d	6/22/95	8/3/95	16
19	Boring/Jacking under Railroad	30d	7/21/95	8/31/95	18SS+20d
20	Backfill of Boring/Jacking Pits	5d	9/1/95	9/8/95	19
21	Installation of Influent Pipe	15d	9/11/95	9/29/95	20
22	Site Restoration	15d	10/2/95	10/20/95	21
23	Sucontractor Demobilization	2d	10/23/95	10/24/95	22
24	**Design of Groundwater Treatment System**	**94d**	**6/22/95**	**11/2/95**	
25	Perform Pump Test	13d	6/22/95	7/11/95	13SS+15d
26	GW Quality Preliminary Analytical	2d	6/26/95	6/27/95	25SS+2d
27	Prepare Treatability Test Plan	5d	6/28/95	7/5/95	26
28	Agency Review of Treatability Test Plan	10d	7/6/95	7/19/95	27
29	Perform GW Treatability Testing	15d	7/20/95	8/9/95	28
30	GW System 100% Design	40d	8/10/95	10/5/95	29
31	Progress Meeting with Agencies	0d	8/23/95	8/23/95	30SS+10d
32	Agency Review of GW System Design	20d	10/6/95	11/2/95	30
33	**Remedial Action GW Treatment System**	**92d**	**11/3/95**	**3/15/96**	
34	Solicit Subcontractor/Award	47d	11/3/95	1/11/96	32
35	Construction of Groundwater Treatment Facility	45d	1/12/96	3/15/96	34

Table 3-1
RD/RA Activities and Subtasks
N.W. Mauthe Company Appleton, Wisconsin

Activity	Subtask	Field Work Activity
Remedial design	A. Construction of the groundwater extraction trench.	A. Oversight of disposal of contaminated soil.
	B. Perform trench test to determine groundwater flow and quality.	B.1. Oversight of subcontractor performing trench test. B.2. Collect groundwater from trench test.
	C. Treatability testing.	C. Perform bench-scale treatability test.
Remedial Action	A. Soil excavation. B. Site cleanup.	A. Collection of samples and determination of appropriate disposal methods. B. Collection and analysis of confirmatory clean soil samples.

Table 3-2
Sampling and Analysis Summary for RD and RA Activities
N.W. Mauthe Company
Appleton, Wisconsin
(Page 1 of 2)

Sample Matrices	Analytical Parameter	Analytical Method	Estimated Number of Samples[a]				
			Field and Treatability Test Samples[b]	Field and Treatability Test Blanks	Trip blanks	Field and Treatability Dups	MS or MS/MSD
Remedial Design—Groundwater	hexavalent chromium	SW-846 7195	30	3	NA	3	2
	chromium (total)	SW-846 3020A/7191	30	3	NA	3	2
	cyanide (total)	SW-846 9010A	30	3	NA	3	2
	cyanide—amenable to cl⁻	SW-846 9010A	30	3	NA	3	2
	iron	SW-846 3010A/6010A	30	3	NA	3	2
	aluminum (total)	SW-846 3020A/6010A	30	3	NA	3	2
	arsenic (total)	SW-846 3020A/6010A	30	3	NA	3	2
	cadmium (total)	SW-846 3020A/6010A	30	3	NA	3	2
	copper (total)	SW-846 3020A/6010A	30	3	NA	3	2
	lead (total)	SW-846 3020A/6010A	30	3	NA	3	2
	nickel (total)	SW-846 3020A/6010A	30	3	NA	3	2
	zinc (total)	SW-846 3020A/6010A	30	3	NA	3	2
	manganese	SW-846 3010A/6010A	30	3	NA	3	2
	mercury	SW-846 7470A	30	3	NA	3	2
	VOCs	SW-846 8260A	30	3	6	3	2
	alkalinity	EPA 310.1	30	3	NA	3	NA
	hardness	EPA 130.2	30	3	NA	3	NA
	TOC	EPA 415.1	30	3	NA	3	2
	TDS	EPA 160.1	30	3	NA	3	NA
	field pH	internal SOP	30	NA	NA	3	NA
	field conductivity	internal SOP	30	NA	NA	3	NA
	field redox potential (Eh)	internal SOP	30	NA	NA	3	NA
	field temperature	internal SOP	30	NA	NA	3	NA
	field dissolved oxygen (DO)	internal SOP	30	NA	NA	3	NA
Treatability Test sludge	TCLP extraction	SW-846 1311	30	NA	NA	3	NA
	TC rule metals	SW-846 6010/7000[c]	30	3	NA	3	NA
	TC rule VOCs	SW-846 8260	30	3	NA	3	NA
	free liquids	SW-846 9095	30	3	NA	3	NA
	corrosivity	SW-846 9040A/9041A	30	3	NA	3	NA
	total residue solids	EPA 160.3	30	3	NA	3	NA

Table 3-2
Sampling and Analysis Summary for RD and RA Activities
N.W. Mauthe Company
Appleton, Wisconsin
(Page 2 of 2)

Sample Matrices	Analytical Parameter	Analytical Method	Estimated Number of Samples[a]				
			Field and Treatability Test Samples[b]	Field and Treatability Test Blanks	Trip blanks	Field and Treatability Dups	MS or MS/MSD
Remedial Action	soil chromium (cleanup verification)	SW-846 3050/7191[d]	25	NA	NA	3	2
	soil chromium (field screening)	XRF Field Screening	20	NA	NA	2	NA
	TCLP extraction	SW-846 1311	20	2	NA	2	NA
	TC rule metals	SW-846 6010/7000[c]	275	NA	NA	28	NA

[a] QC samples will be collected at the following frequency:
1. field blanks = collected at a frequency of 1/10 field samples/matrix
2. trip blank sample (provided with each shipment of VOC samples)
3. field Duplicates = collected at a frequency of 1/10 field samples/matrix
4. matrix spike or matrix spike/matrix spike duplicate samples = collected at a frequency of 1/20 field samples/matrix

[b] RD sample numbers are estimates. Actual number of analyses performed will be dependent on the extent of contamination in the treatability test influent water and on the procedures tried with the treatability test.

[c] See Table 3-4 digestion and analytical procedures.

[d] SAS is attached.

Table 3-3
Sample Containers, Preservatives, and Holding Times
N.W. Mauthe Company Appleton, Wisconsin

Analysis	Container Type	Preservation and Storage Requirements	Maximum Holding Times
Target Compound List—VOCs	Three 40-mL vials[a] for the aqueous samples	HCL to a pH ≤ 2, 4°C, and protect from light	7 days unpreserved and 14 days preserved
Target Analyte List—metals	1-L plastic bottle[a] for the aqueous samples and 125 mL widemouth jar[a] for soils	Aqueous = HNO_3 to a pH ≤ 2, all = 4°C and protect from light	Hg = 28 days others = 180 days
Hexavalent chromium	1-L plastic bottle[a]	4°C; protect from light	24 hours
Cyanide—total and amenable to chlorine	2-L plastic bottle[a]	5–7 mL $NaAsO_2$, NaOH to a pH ≥ 12, 4°C, and protect from light	14 days
TOC	250-mL plastic bottle[a]	H_2SO_4 to a pH ≤ 2, 4°C; protect from light	28 days
TDS	250-mL plastic bottle[a]	4°C; protect from light	7 days
Alkalinity	250-mL plastic bottle[a]	4°C; protect from light	14 days
Hardness	250-mL plastic bottle[a]	HNO_3 to a pH ≤ 2, all = 4°C and protect from light	180 days
TCLP/waste characterization parameters	16-oz. widemouth glass jar	4°C; protect from light	See SW-846 method 1311 for holding times
Treatability testing	Six 5-gallon plastic containers	4°C; protect from light	Not applicable

[a]Teflon-lined cap or septum.

Table 3-4 TC Rule Metals, Digestion and Analytical Procedures			
Metal	**Regulatory Limit (mg/L)**	**Digestion Method**	**Analytical Method**
Arsenic	5.0	SW-846 3050A	SW-846 7060A
Barium	100.0	SW-846 3050A	SW-846 6010A
Cadmium	1.0	SW-846 3050A	SW-846 6010A
Chromium	5.0	SW-846 3050A	SW-846 6010A
Lead	5.0	SW-846 3050A	SW-846 7421
Mercury	0.2	NA	SW-846 7471A
Selenium	1.0	SW-846 3050A	SW-846 7740
Silver	5.0	SW-846 3050A	SW-846 6010A

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Section 4
Project Organization and Responsibility

At the direction of the EPA Region 5, CH2M HILL has responsibility for conducting the RD at the Mauthe Site in Appleton, Wisconsin. CH2M HILL will perform the RD and prepare the RD report. Project management will also be provided by CH2M HILL. The various QA and management responsibilities of key project personnel are defined below and shown in Figure 4-1.

4.1 U.S. EPA Region 5 Remedial Project Manager (RPM)

The RPM has the responsibility for the implementation of the RD.

4.2 EPA Region 5 QA Officer

The EPA Region 5 QA Officer is responsible for review and approval of all QAPjPs and field and laboratory procedures.

4.3 CH2M HILL Program Manager

The CH2M HILL Program Manager is Alpheus Sloan III. He has overall responsibility for meeting EPA objectives and CH2M HILL quality standards. In addition, the Program Manager is responsible for technical QC and project oversight.

4.4 QA Manager

CH2M HILL's Acting QA Manager is John Fleissner. The QA Manager will remain independent of direct job involvement and day-to-day operations and has direct access to management staff, as necessary, to resolve any QA dispute. Specific functions and duties include the following:

- Provide QA review of various phases of the project, as necessary
- Review QA plans and procedures
- Provide QA technical assistance to project staff, as necessary

4.5 CH2M HILL Site Manager

The CH2M HILL Site Manager (SM) is Cathy Barnett. The SM is responsible for implementing the project and is authorized to commit resources to meet project objectives and requirements. The SM's primary function is to achieve technical, financial, and scheduling objectives. The SM will report directly to the EPA Region 5 RPM and will be the major point of contact and control for matters concerning the project. More specifically, the SM will:

- Define project objectives and develop a detailed work plan and 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 to meet budget and schedule constraints
- Orient field leaders and support staff with regard to the project's special considerations
- Monitor and direct the field team leaders
- Develop and meet ongoing project or task staffing requirements, including mechanisms to review and evaluate each task product
- Review the work performed on each task to ensure quality, responsiveness, and timeliness
- Review and analyze overall task performance with regard to planned schedule and budget
- Preparation of the RD
- Review external reports (deliverables) before submission to EPA Region 5
- Accept responsibility for the preparation and quality of interim and final reports
- Represent the project team at meetings and public hearings

4.6 CH2M HILL Review Team Leader

The Review Team Leader is Jeff Keiser. The role of the Review Team Leader is to support the SM in site management activities and to act as the coordinator of CH2M HILL internal reviews. The Review Team Leader will also be involved in the planning activities conducted at the beginning and during the project.

4.7 CH2M HILL Field Team Leader

The Site Manager will be supported by the Field Team Leader. The Field Team Leader is Alan Parker. The Field Team Leader is responsible for leading and coordinating day-to-day activities of the various field staff and will report directly to the SM. Specific responsibilities of the Field Team Leader include the following:

- Provide day-to-day coordination with the SM
- Implement field-related work plans
- Coordinate and manage field staff, including sampling staff
- Implement QC for technical data provided by the field staff, including field measurement data
- Adhere to work schedules provided by the SM
- Coordinate and provide oversight for technical efforts of subcontractors assisting the field team
- Identify problems in the field and communicate between field staff and the SM to resolve those problems
- Prepare the field technical memorandums
- Prepare QA audits on various phases of the field operations

4.8 CH2M HILL Sample Tracking/Sample Management Manager

Chris Ohland is the Sample Tracking/Sample Management Manager. He will be responsible for tracking the data, and overseeing the data evaluation. Specific responsibilities include the following:

- Schedule the analytical laboratories
- Oversee the tracking of samples and data from the time of field collection until results are entered into the database
- Schedule sample analysis with RSCC to track laboratory accountability and to schedule RA data review by Contracting Analytical Services Section (CASS)
- Oversee RD data validation and production of result tables
- Evaluate RA and RD data usability

CH2M HILL will provide Region 5 with advance notice of planned sampling and analysis activities through the monthly and weekly sampling projections. The projections will include samples planed for treatability and will serve as the initial advance notice that samples are being taken that will require CASS validation.

CH2M HILL will procure the laboratory(s) to perform the non-CLP analyses. The laboratory procurement process shall be performed in a fashion that meets all federal guidelines. CH2M HILL will solicit laboratory information to include the laboratory Quality Assurance Plan, a capabilities statement, and their government price list. CH2M HILL will review the laboratory qualifications and request formal bids. CH2M HILL will then contract with a laboratory. U.S. EPA Region 5 shall retain the right to reject any laboratory at any point of the procurement process.

Additionally, CH2M HILL will provide copies of the chain of custody forms to the Region 5 RSCC as each group of samples is shipped to the non-CLP laboratory. The chain of custody form will serve as specific notice of the data that will require validation.

At least biweekly after samples are shipped to the laboratory, CH2M HILL will provide updates to the RSCC regarding the status of the samples and of any changes in the date when sample results are expected to arrive at CASS for validation.

Copies of the final approved non-CLP analytical service requests and any modifications that were made during the laboratory analysis and information on any discussions with the laboratory during the analysis period that may affect the data validation will be provided to the U.S. EPA RSCC along with the raw data packages from the laboratory. CH2M HILL will be responsible for entering non-CLP data into the ANSETS non-CLP data tracking computer program.

4.9 CH2M HILL Technical Resources

The technical resources for this project will be drawn from CH2M HILL's corporate resources. The technical resources will be used to gather and analyze data and to prepare various task reports and support materials.

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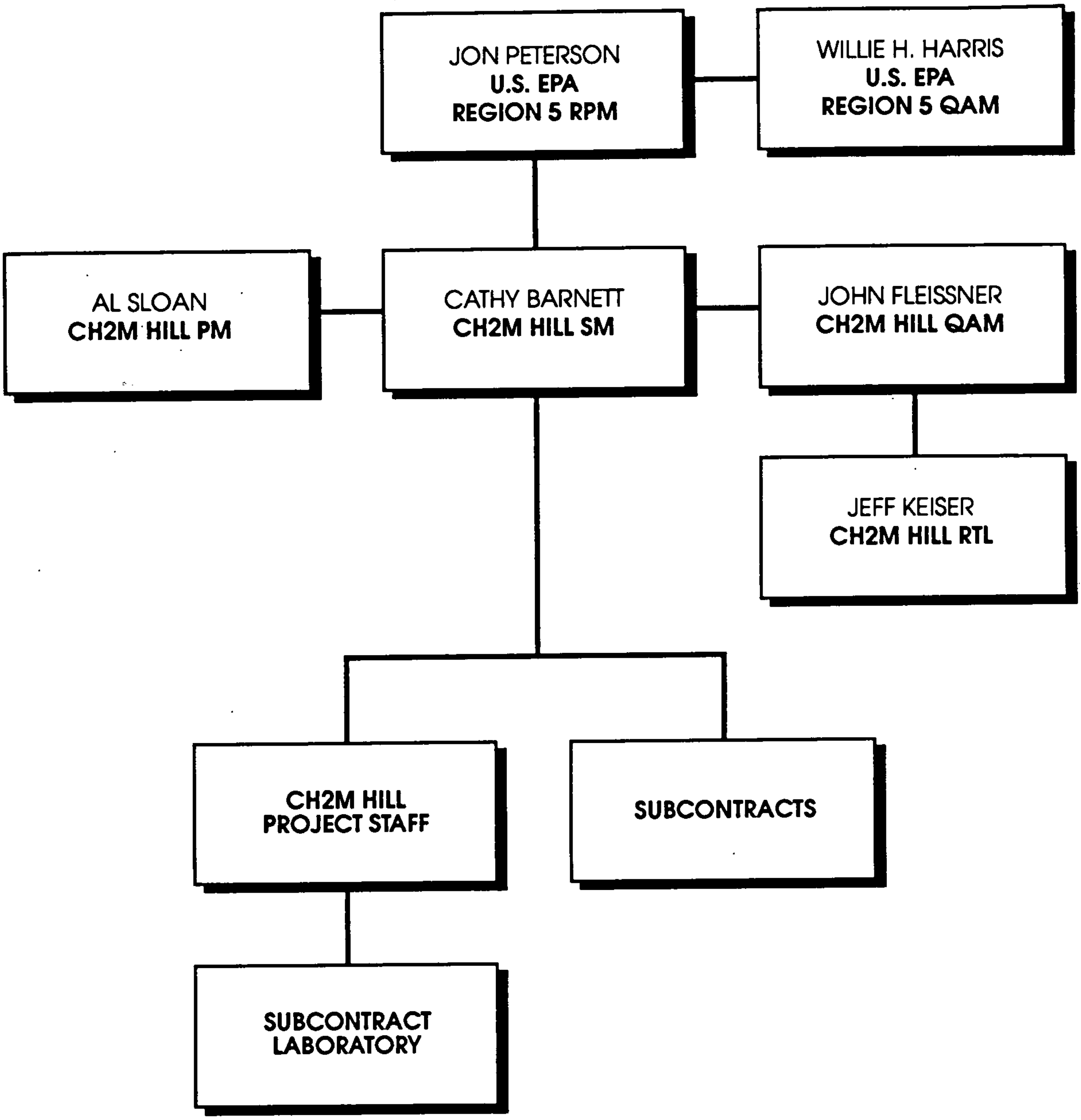

FIGURE 4-1
Project Organization
N.W. Mauthe Site

CH2M HILL

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Section 5
Quality Assurance Objectives for Measurement Data

The overall QA objective is to develop and implement procedures for field sampling, chain of custody, laboratory analysis, and reporting that will provide results that are legally defensible in a court of law. Specific procedures for sampling, chain of custody, laboratory instrument calibration, laboratory analysis, reporting of data, internal QC, audits, preventive maintenance of field equipment, and corrective action are described in other sections of this QAPjP. The purpose of this section is to address the specific objectives for accuracy, precision, completeness, representativeness, and comparability.

5.1 Level of Quality Control Effort

Field blank, trip blank, duplicate, and matrix spike samples will be analyzed to assess the quality of the data resulting from the field sampling program.

Field and trip blanks consisting of distilled water will be submitted to the analytical laboratories to provide the means to assess the quality of the data resulting from the field sampling program. Field blank samples are analyzed to check for procedural contamination at the site that may cause sample contamination. One field blank will be collected and analyzed for every 10 or fewer investigative samples. Trip blanks are used to assess the potential for contamination of samples due to contaminant migration during sample shipment and storage. One volatile organic analysis (VOC) trip blank will be included along with each shipment of aqueous VOC samples.

Duplicate samples are analyzed to check for sampling and analytical reproducibility. One field duplicate will be collected and analyzed for every 10 or fewer investigative samples, per matrix.

Matrix spikes provide information about the effect of the sample matrix on the preparation and measurement methodology. Inorganic parameter matrix spike (MS) samples are performed singularly. Organic matrix spikes are performed in duplicate and are hereinafter referred to as MS/MSD samples. One MS or MS/MSD will be collected for every 20 or fewer investigative samples, per matrix. MS/MSD samples are investigative samples. Soil MS/MSD samples require no extra volume for VOCs or extractable organic compounds, but aqueous MS/MSD samples must be collected at double the volume for VOCs and extractable organics.

The number of blank, duplicate, and MS or MS/MSD samples to be collected are listed in Table 3-2. Sampling procedures are specified in the FSP.

The RA confirmatory soil samples will be sent to a Wisconsin certified laboratory for analysis. The treatability study samples will be sent to the CH2M HILL treatability laboratory in West Allis, Wisconsin, for analysis. Table 3-2 contains the analytical parameters to analyzed for in the groundwater and soil samples. Tables 5-1, 5-2, and 5-3 contain the detection and reporting limits for the organic and inorganic compounds.

The level of QC effort provided by the laboratory will be, depending on the analysis preferred, equivalent to the confirmatory level (Level 4) or equivalent to the engineering level (Level 3) as specified in Section 3.7.

The QC level of effort for the field measurement of pH, conductivity, temperature, redox potential, and dissolved oxygen will be equivalent to the Screening Level (Level 1) as specified in Section 3.7 of this QAPjP. See standard operating procedures (SOPs) for measurements in the Field Sampling Plan (Appendix A) for specific QA/QC procedures.

5.2 Accuracy, Precision, and Sensitivity of Analysis

The fundamental QA objective with respect to accuracy, precision, and sensitivity of laboratory analytical data is to achieve the QC acceptance criteria of the analytical procedures as specified in the non-CLP analytical request forms or as specified in the laboratory's Quality Assurance Plan (QAP). The method detection limits required for these analyses are listed in Tables 5-1, 5-2, and 5-3 of this QAPjP.

The SOPs for the field equipment to measure pH, conductivity, Eh, dissolved oxygen (DO), temperature, and total chromium are outlined in Appendix A. These SOPs contain accuracy, precision and sensitivity requirements.

5.3 Completeness, Representativeness and Comparability

5.3.1 Completeness

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. It is expected that the selected analytical laboratory will provide data meeting QC acceptance criteria for 95 percent or more for all samples analyzed.

Following completion of the analytical testing, the percent completeness will be calculated by the following equation:

$$\text{completeness (\%)}: = \frac{\text{(number of valid data)}}{\text{(number of samples collected for each parameter analyzed)}} \times 100$$

The data generated that is of acceptable quality will be used regardless of whether the 95 percent QC acceptance goal is achieved.

5.3.1 Representativeness

Representativeness expresses the degree to which data precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. Representativeness is a qualitative parameter that is dependent upon the proper design of the sampling program and proper laboratory protocol. The rationale of the sampling network is discussed in detail in the FSP. Representativeness will be satisfied by following the FSP, such that proper sampling technique(s) are used, proper analytical procedures are followed, and holding times for the samples are not exceeded in the laboratory. Representativeness will be assessed by the analysis of field duplicated samples.

5.3.3 Comparability

Comparability expresses the confidence with which one data set can be compared with another. The extent to which existing and planned analytical data will be comparable depends on the similarity of sampling and analytical methods. The procedures used to obtain the planned analytical data, as documented in the QAPjP, are expected to provide comparable data. These new analytical data, however, may not be directly comparable to existing data because of differences in procedures and QA objectives.

Table 5-1

Volatile Organics Parameter List and Required Detection and Reporting Limits. SW-846 Method 8260A

Volatiles	CAS Number	Water Detection µg/L	Water Reporting µg/L	Soil Detection µg/Kg	Soil Reporting µg/Kg
Chloromethane	74-87-3	1.0	5.0	1.0	10.0
Bromomethane	74-83-9	1.0	5.0	1.0	10.0
Vinyl Chloride	75-01-4	0.1	5.0	1.0	10.0
Chloroethane	75-00-3	1.0	5.0	1.0	10.0
Methylene Chloride	75-09-2	1.0	5.0	1.0	10.0
Acetone	67-64-1	2.0	10.0	2.0	10.0
Carbon Disulfide	75-15-0	1.0	5.0	1.0	10.0
1,1-Dichloroethene	75-35-4	0.7	5.0	1.0	10.0
1,1-Dichloroethane	75-34-3	1.0	5.0	1.0	10.0
1,2-Dichloroethene (total)	540-59-0	1.0	5.0	1.0	10.0
Chloroform	67-66-3	0.6	5.0	1.0	10.0
1,2-Dichloroethane	107-06-2	0.5	5.0	1.0	10.0
2-Butanone	78-93-3	1.0	5.0	1.0	10.0
1,1,1-Trichloroethane	71-55-6	1.0	5.0	1.0	10.0
Carbon Tetrachloride	56-23-5	0.5	5.0	1.0	10.0
Bromodichloromethane	75-27-4	1.0	5.0	1.0	10.0
1,2-Dichloropropane	78-87-5	0.5	5.0	1.0	10.0
c-1,3-Dichloropropene	10061-01-5	1.0	5.0	1.0	10.0
Trichloroethene	79-01-6	0.5	5.0	1.0	10.0
Dibromochloromethane	124-48-1	1.0	5.0	1.0	10.0
1,1,2-Trichloroethane	79-00-5	0.1	5.0	1.0	10.0
Benzene	71-43-2	0.5	5.0	1.0	10.0
t-1,3-Dichloropropene	70061-02-6	1.0	5.0	1.0	10.0
Bromoform	75-25-2	1.0	5.0	1.0	10.0
4-Methyl-2-pentanone	108-10-1	1.0	5.0	1.0	10.0
2-Hexanone	591-78-6	2.0	10.0	1.0	10.0
Tetrachloroethene	127-18-4	1.0	5.0	1.0	10.0
Toluene	108-88-3	0.3	5.0	1.0	10.0
1,1,2,2-Tetrachloroethane	79-34-5	1.0	5.0	1.0	10.0
Chlorobenzene	108-90-7	1.0	5.0	1.0	10.0
Ethyl benzene	1000-41-4	1.0	5.0	1.0	10.0
Styrene	100-42-5	0.5	5.0	1.0	10.0
Xylenes (total)	1330-20-7	1.0	5.0	1.0	10.0

* Detection limits are based on 25 gram samples. Soil reporting limits, as calculated on a dry weight basis, will vary with the percent moisture.

Table 5-2

Inorganic Parameter List and Required Detection Limits

Analyte	Water Detection Limit (μg/L)	Soil Detection Limit (mg/kg)
Chromium (+6)	5	NA
Chromium (+3-total)	2	1.0
Cyanide	20	NA
Cyanide (amenable to chlorine)	20	NA
Iron	7	NA
Aluminum	35,000	NA
Arsenic	500	NA
Cadmium	150	NA
Copper	1,000	NA
Lead	1,000	NA
Nickel	1,000	NA
Zinc	5,000	NA
Manganese	2	NA
Mercury	0.2	NA
Alkalinity	10,000	NA
Hardness	10,000	NA
TOC	1,000	NA
TDS	4,000	NA

1. The instrument detection limits are obtained in pure water. The detection limits for samples may be considerably higher depending on the sample matrix.

Table 5-3
Final TC Rule Parameters and Required Reporting Limits

List of Constituents	Regulatory Level (mg/L)
Volatile Organics	
Benzene	0.5
Carbon Tetrachloride	0.5
Chlorobenzene	100.0
Chloroform	6.0
1,2-Dichloroethane	0.5
1,1-Dichloroethylene	0.7
Methyl Ethyl Ketone	200.0
Tetrachloroethylene	0.7
Trichloroethylene	0.5
Vinyl Chloride	0.2
Metals	
Arsenic	5.0
Barium	100.0
Cadmium	1.0
Chromium	5.0
Lead	5.0
Mercury	0.2
Selenium	1.0
Silver	5.0

Section 6
Sampling Procedures

A FSP has been prepared and is attached as Appendix A. The FSP contains sampling procedures and includes the following:

- Detailed procedures for the collection of samples for the required parameters
- Detailed procedures for sample packaging, handling, and shipment
- Summary of sample container, reagent, preservative, and hold time requirements
- Chain-of-custody procedures
- Detailed procedures for preparation/collection of trip blanks and field blanks
- Documentation requirements of sampling activities (use of field log books, field measurement forms, etc.)
- Summary of the sampling and analysis program

Refer to Table 3-2 for a summary of the sampling and analysis program and Table 3-3 for summaries of sample quantity, container, preservative, and packaging requirements.

Section 7
Sample Custody

It is U.S. EPA and Region 5 Policy to follow the U.S. EPA Region 5 sample custody, or chain-of-custody protocols as described in ''NEIC Policies and Procedures,'' EPA-330/9-78DDI-R, revised June 1985. Chain-of-custody involves three parts: sample collection, laboratory analysis, and final evidence files. Final evidence files, including all originals of laboratory reports and purge files, are maintained under document control in a secure area.

A sample or evidence file is under your custody if it

- is in your possession,
- is in your view, after being in your possession,
- is in your possession and you place them in a secured location, or is in a designated secure area.

7.1 Field Chain-of-Custody Procedures

The sample packaging and shipment procedures summarized below will be followed so 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 the FSP (Appendix A).

7.1.1 Field Procedures

- 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.

- All bottles are to be labeled with sample numbers and locations.

- Sample labels are to be completed for each sample using waterproof ink unless prohibited by weather conditions. For example, a logbook notation would explain that a pencil was used to fill out the sample tag because the ballpoint pen would not function in freezing weather.

- The Field Team Leader is to review all field activities to determine whether proper custody procedures were followed during the field work and decide if additional samples are required. The SM will notify the U.S. EPA RPM if a breach or irregularity in chain-of-custody procedures occurs.

7.1.2 Field Logbooks/Documentation

Data collection activities performed are to be recorded in a field logbook. Activities will be described in as much detail as possible so that persons going to the site could re-construct a particular situation without reliance on memory.

Field logbooks will be bound 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
- End date

Entries into the logbook will contain a variety of information. At the beginning of each entry, the date, start time, weather, names of all sampling team members present, level of personal protection being used, and the signature of the person making the entry will be entered. 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. Entries will be made in ink and no erasures will be allowed. If an incorrect entry is made, the information will be crossed out with a single strike mark, initialed, and dated. Whenever a sample is collected or a measurement is made, a detailed description of the location of the station, including compass and distance measurements, shall be recorded. The number of the photographs taken of the station, if any, will also be noted. 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 the FSP (Appendix A). The equipment used to collect samples will be noted, along with the time of sampling, sample description, depth at which the sample was collected, and volume and number of containers. A sample identification number will be assigned before sample collection. Field duplicate samples, which will receive an entirely separate sample identification number, will be noted under the sample description.

7.1.3 Transfer of Custody and Shipment Procedures

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

- 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 closed and secured with strapping tape and EPA custody seals for shipment to the laboratory. The preferred procedure includes use of a custody seal attached to the front right and back left of the cooler. The custody seals are to be covered with clear plastic tape. The cooler is to be strapped shut with strapping tape in at least two locations.

- Whenever samples are co-located 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 co-located. 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 of the custody form.

- 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 sampling office.

- 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 and the custody seals remain intact.

7.2 Laboratory Chain-of-Custody Procedures

The chain-of-custody procedures for the analytical laboratory(s) are discussed in the laboratory's QAP or the Treatability Test Plan.

7.3 Final Data Files Custody Procedures

CH2M HILL is the custodian of the data files and will maintain the RD data files. Included in the data files are all relevant records, reports, logs, field notebooks, pictures, subcontractor reports, correspondence, laboratory logbooks, chain-of-custody forms, analytical data, and any other pertinent records stored in a secured, limited access area and under custody of the SM.

Section 8
Calibration Procedures and Frequency

This section describes procedures for maintaining the accuracy of all the instruments and measuring equipment that are used for conducting field tests and laboratory analyses. These instruments and equipment should be calibrated prior to each use or on a scheduled, periodic basis.

8.1 Field Instruments/Equipment

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

Equipment to be used during the field sampling will be examined to check that it is operating properly. This includes checking the manufacturer's operating manual and the instructions for each instrument to check that the maintenance requirements are being observed. Field notes from previous sampling trips will be reviewed so that notations on prior equipment problems are not overlooked and to check that all necessary repairs to equipment have been carried out. A spare electrode will be sent with each pH meter to be used for field measurements. Two thermometers will be sent to sampling locations where measurement of temperature is required, including those locations where a specific conductance probe/thermometer is required.

Calibration of field instruments, as specified by the SOPs, will be performed at the intervals specified by the manufacturer or more frequently as conditions dictate. Field instruments will include a pH meter, thermometer, DO meter, specific conductivity meter, a reduction/oxidation probe, and an XRF Spectrometer.

In the event that an internally calibrated field instrument fails to meet calibration/checkout procedures, it will be returned to the manufacturer for service.

Field equipment calibration procedures can be found in the FSP with general procedures described below:

8.1.1 pH Meter Calibration

The pH meter will be calibrated with standard buffer solutions before each field trip. In the field, the meter will be calibrated daily, as described below, with two buffers before use. The calibrations performed, standard used, and sample pH values are to be recorded in the field notebook. Appropriate new batteries will be purchased and kept with the meters to facilitate immediate replacement in the field as necessary.

pH meter calibration:

- Temperature of sample and buffer should be the same.
- Connect pH electrode into pH meter and turn on pH meter.
- Set temperature based on the temperature of buffer; place electrode in first buffer solution.
- After reading has stabilized, adjust ''CALIB'' knob to display correct value.
- Repeat procedure for second buffer solution.
- Place pH electrode in the sample and record the pH as displayed.
- Remove pH electrode from sample and rinse off with distilled water.
- The pH meter must be recalibrated every time it is turned off and turned back on, or if it starts giving erratic results.

8.1.2 Thermometer Calibration

The thermometers must be inspected before use to ensure there is no mercury separation. The thermometers should be rechecked in the field before and after use to see if the readings are logical and the mercury is still intact. The thermometers should be checked biannually for calibration by immersing them in a bath of known temperature until equilibrium is reached. They should be discarded if found to have more than 10 percent error. The reference thermometer used for the bath calibration should be National Bureau of Standards (NBS) traceable.

8.1.3 Conductivity Meter Calibration

The conductivity cells of the specific conductivity meter will be cleaned and checked against known conductivity standards before each field trip. In the field, the instrument will be checked daily with NBS traceable standards. The calibration procedure is described below.

- Place the probe in conductivity calibration standard solution.
- Set temperature knob for temperature of standard solution.
- Turn to appropriate scale and set the instrument for the value of calibration standard.
- Rinse off the electrode with distilled water.
- Measure the conductivity for distilled water to be used for a field blank, making sure temperature is set correctly to the temperature of solution to be tested.
- If the conductivity of the blank (distilled water) is high, it must be discarded and a new blank sample procured.

8.1.4 Dissolved Oxygen Meter Calibration

The DO meter will be cleaned and calibrated before each field trip. In the field, the DO meter will be calibrated as described below.

Calibration:

- Switch to Calib O2 position.
- Place the probe in moist air. This can be accomplished in two ways: (1) place the probe in the calibration bottle along with a few drops of water, or (2) the probe can also be wrapped loosely in a damp cloth taking care not to touch the membrane. Wait about 10 minutes for temperature stabilization. This may be done simultaneously while the probe is stabilizing.
- With the Calib knob, set the meter pointer to the mark for the local altitude. Be sure the reading is steady. Recalibration is recommended

when altitude is changed. A 1,000-foot altitude change can result in a 3 percent error (0.3 @ 10 mg/L).

The probe is now calibrated and should hold this calibration value for many measurements. Calibration can be disturbed by physical shock, touching the membrane, or drying out of the electrolyte.

8.1.5 Reduction/Oxidation Probe Calibration

The reduction/oxidation (redox) probe will be clean and checked for general operating conditions prior to each field trip. In the field the redox probe will be calibrated as described below.

Calibration:

- Rinse electrodes and glass sample container thoroughly with DI water.
- Fill glass container with fresh standard redox solution, either ferrous-ferric or quinhydrone.
- Turn range switch to proper range and engage operating button.
- Adjust the asymmetry control to the millivolt potential of the standard redox solution.
- Without changing the asymmetry control, repeat the calibration procedure until two successive readings are within 10 mV of the standard redox solution.

All readings and calibrations should be recorded in the field notebook.

8.1.6 XRF Spectrometer Calibration

The XRF Spectrometer will cleaned and checked for general operating conditions prior to delivery to the site. A representative from the manufacturer of the equipment, the ATX-100, will be onsite at the start of the activities involving the meter to assist in calibration and training.

The ATX-100 provides data on all of the elements that will fluoresce with the selected radioactive source. This data is reported in the form of a count value and index value for each element. The element index value is the element count value divided by the backscatter count value. These values will be obtained for individual elements directly from a digital LCD readout on the instrument. The full spectrum of data can be observed on the instrument at the time of the analysis via a CRT. Element peaks in the spectrum are identified by moving a cursor to the peak and reading the element symbol, count value, and index value on a LCD display.

Calibration of the instrument will be accomplished by comparing the results from the XRF spectrometer to total metal analyses of the samples. The same sample that is used to obtain the XRF results will be analyzed. The results will be plotted and a regression analysis conducted. From this technique an equation relating count or index values to concentration values will be developed. A minimum of three samples will be evaluated to develop the correlation.

8.2 Laboratory Instruments

Calibration procedures for the laboratory equipment will be provided in the laboratory's QAP or Treatability Test Plan. Records of calibration, repairs, or replacement will be filed and maintained by the designated laboratory personnel performing QC activities. These records will be filed at the location where the work is performed and will be subject to QA audit. For all instruments, the laboratory will maintain a factory-trained repair staff with in-house spare parts or will maintain service contracts with vendors.

8.2.1 Organic Analyses QC

Prior to calibration, the instrument(s) used for gas chromatograph/mass spectrometer (GC/MS) analyses are tuned by analysis of p-bromofluorobenzene (BFB) for volatile analyses. The instrument tune will be verified each 12 hours of operation.

After the tuning criteria are met, the instrument is initially calibrated using a five-point calibration curve. Continuing calibration is verified as specified in the method, or at least each working day, using criteria specified by the method. The calibration standards will be U.S. EPA-or NBS-traceable and will be spiked with internal standards and surrogate compounds. Calibration and continuing calibration verification of instruments will be performed at approved intervals as specified by the manufacturer or the analytical method (whichever is more frequent). Calibration standards used as reference standards will be traceable to the NBS or the U.S. EPA.

8.2.2 Metals Analysis QC

The atomic absorption spectrophotometer (AAS) and inductively coupled plasma emission spectrophotometer (ICP) instruments will be calibrated by use of a minimum of three calibration standards prepared by dilution of certified stock solutions. An analysis blank is to be prepared with one calibration standard at the quantitation limit for the metal. The other standards bracket the concentration range of the samples. Calibration standards will contain acids at the same concentration as the digestates.

A continuing calibration standard, prepared from a different stock solution than that used for preparation of the calibration standards, is prepared and analyzed after each 10 samples or each 2 hours of continuous operation. The value of the continuing calibration standard concentration must agree with $\pm$ 10 percent of the initial value or the appropriate corrective action is taken, which may include recalibrating the instrument and reanalyzing the previous 10 samples.

For the ICP, linearity near the quantitation limit will be verified with a standard prepared at a concentration of two times the quantitation limit. This standard must be run at the beginning and end of each sample analysis run or at least twice per 8-hour period.

Section 9
Analytical Procedures

The analysis of RD and RA groundwater and soil samples collected during field sampling activities for the N.W. Mauthe Company RA will be subcontracted to a Wisconsin certified laboratory. The treatability study samples will be analyzed at CH2M HILL's treatability laboratory.

9.1 Laboratory Analysis

Published U.S. EPA analytical methods have been selected for use on this study. The selected methods provide detection limits in water that are equal to or lower than Wisconsin's drinking water limits for the compounds of interest, as appropriate, or less than municipal discharge limits, as appropriate. The laboratory selected to perform the confirmatory analysis portion of this project shall provide a QAP that will contain SOPs that supplement the analytical methodologies. The non-CLP analytical request forms for the RA analyses can be found in Appendix D.

9.2 Field Screening Analytical Protocols

The procedures for field measurement of pH, Eh, DO, specific conductivity, temperature, and total chromium are described in the SOPs in FSP.

Section 10
Internal QC Checks

10.1 Field Measurement

See the FSP for initial field parameter QC check requirements and procedures. The assessment of field measurement precision and accuracy will be made through the collection and analysis of field duplicates, by taking multiple readings on a single sample or standard, and by calibrating the instruments. QC checks will be performed in accordance with each field parameter's SOP, see the FSP.

10.2 Laboratory Analysis

QC checks for the treatability lab will consist of reviewing the Treatability Test Plan and maintaining complete and accurate records. A QA program and QC checks will be employed by the analytical laboratory selected to perform the confirmatory analyses to ensure the production of analytical data of known and documented usable quality.

10.2.1 QA Program

The laboratory selected to perform the confirmatory sampling will be a Wisconsin certified laboratory that will have a written QAP. The QAP provides guidelines to ensure the reliability and validity of work conducted at the laboratory. Compliance with the QAP is coordinated and monitored by the laboratories' QA unit (QAU). The QAU acts independently of the operating departments and reports directly to the lab manager.

The objectives of the laboratory QAP are to:

- Ensure that all procedures are documented, including any changes in administrative and/or technical procedures.

- Ensure that all analytical procedures are conducted according to sound scientific principles and have been validated.

- Monitor the performance of the laboratory by a systematic inspection program and provide for a corrective action as necessary.

- Ensure that all data are properly recorded and archived.

10.2.2 QC Checks

The laboratory QAP or Treatability Test Plan will contain a SOP for each analytical method. These SOPs will specify the types of audits required (sample spikes, surrogate spikes, reference samples, controls, and blanks), the frequency of each audit, the compounds to be used for sample spikes and surrogate spikes, and the QC acceptance criteria for these audits.

The laboratory will document, in each data package provided, that both initial and ongoing instrument and analytical QC functions have been met. Any samples analyzed in nonconformance with the QC criteria will either be reanalyzed by the laboratory or duly noted as to the quality of the analytical result.

Section 11
Data Reduction, Validation, and Reporting

11.1 Data Reduction

11.1.1 Field Measurements and Sample Collection

Raw data from field measurements and sample collection activities will be appropriately recorded in the field log book. If the data are to be used in the project reports, they will be reduced and summarized, and the method of reduction will be documented in the report.

11.1.2 Laboratory Services

The samples collected at the N.W. Mauthe Company site will be sent either to the CH2M HILL treatability laboratory or to a Wisconsin certified laboratory, depending on the required analyses. Data reduction and result reporting will be performed by each laboratory in accordance with the requirements of their QAP or treatability test plan. The RD data will then be sent to the CH2M HILL for data validation and the RA data will be sent to the CASS for data validation.

11.2 Data Validation

11.2.1 Field Measurement Data Validation

Field result data validation will simply consist of the field team leader double checking at least 10 percent of the field calculations and ensuring that instrument calibration occurred at the frequency described in the SOPs.

11.2.2 Laboratory Data Validation

The treatability test data will be reviewed by the SM. This review will consist of double checking at least 10 percent of the sample calculations, checking to determine if the analyses scheduled to be performed were actually performed, and to review the raw data to determine if any procedural errors may have occurred. The RA analytical laboratory data validation will be performed by the CASS.

The RA data and results will be reviewed against the analytical requirements specified in the non-CLP analytical request forms and/or against the analytical requirements of referenced U.S. EPA methodologies.

11.3 Data Reporting

11.3.1 Field Measurement Data Reporting

Raw data from field measurements and sample collection activities will be appropriately recorded in the field log book. If the data are to be used in the project reports, they will be reduced or summarized and the method of reduction will be documented in the report.

11.3.2 Laboratory Data Reporting

The treatability study report will conform with the reporting requirements specified in the Treatability Test Plan. The analytical laboratory will prepare and submit full analytical reports to CH2M HILL in compliance with requirements of the laboratory subcontract. The laboratory will report the data in the same chronological order in which it was analyzed. The laboratory will provide, at a minimum, the following information:

- Cover sheets listing the samples included in the report and comments describing problems encountered in analysis
- Tabulated results of inorganic and organic compounds identified and quantified
- Analytical results for QC sample spikes, sample duplicates, initial and continuous calibration verifications, blank results, laboratory control sample results, MS or MS/MSD sample results, and any interference check sample results
- Tabulation of instrument detection limits determined in pure water
- Raw data system printouts (or legible photocopies) identifying date of analyses, analyst, parameters determined, calibration curve used, associated method blanks, and any dilutions

Section 12
Performance and System Audits

12.1 Field Audits

An internal audit of field activities will be conducted by CH2M HILL's SM. The audit will include an examination of field sampling records, field instrument operating records, sample collection, handling, and packaging in compliance with the established procedures, maintenance of QA procedures, chain of custody, etc. The audit will occur at the onset of the project to verify that all established procedures are followed. If necessary, a follow-up audit will be conducted to correct deficiencies and to verify that QA procedures are maintained throughout the remediation.

External audits of the field activities may also be conducted by the U.S. EPA Region 5 Monitoring and Quality Assurance Branch (MQAB) as well as the Central District Office.

12.2 Laboratory Audits

The analytical laboratory selected to perform the confirmatory sample analyses will be a Wisconsin certified laboratory; the certification program signifies that the laboratory has successfully meet the QA/QC requirements set forth by the State of Wisconsin.

The confirmatory sample laboratory will also be audited by reviewing its QAP and/or SOPs. SOPs that will be reviewed include, but will not be limited to: documentation on sample receiving and sample log-in, sample storage procedures, chain-of-custody procedures, sample preparation and analysis, instrument operating records, data reduction, and data reporting procedures.

CH2M HILL's treatability laboratory will be audited by reviewing the Treatability Test Plan. This plan will include, but will not be limited to: documentation on sample storage procedures, sample preparation and analysis, instrument operating records, data reduction, and data reporting procedures.

External audits of the laboratories may be conducted by the U.S. EPA Region 5 MQAB/CASS.

Section 13
Preventive Maintenance Procedures

13.1 Field Equipment/Instruments

The field equipment for this project includes thermometers, pH meter, Eh probe, and conductivity meter. Specific preventative maintenance procedures to be followed for field equipment are those recommended by the manufacturer.

Field instruments will be checked and calibrated in the warehouse before they are shipped or carried to the field. These instruments will be checked and calibrated daily before use. Calibration checks will be documented with the sample results in a field log book.

Critical spare parts such as tape, papers, pH probes, electrodes, and batteries will be kept onsite to minimize instrument downtime. Backup instruments and equipment should be available onsite or within a 1-day shipment to avoid delays in the field schedule.

13.2 Laboratory Instruments

As part of their QA/QC program, a routine preventative maintenance program will be required by the selected analytical laboratory. The objective of the preventative maintenance program is to minimize the occurrence of instrument failure and other system malfunctions. The laboratory will have an internal group to perform routine scheduled maintenance and to repair or to coordinate with the vendor for the repair of all instruments. All laboratory instruments will be maintained in accordance with manufacturer's specifications and within the requirements of the specific method.

Section 14
Specific Routine Procedures to Assess Data Precision, Accuracy, and Completeness

14.1 Field Measurements

Field data will be assessed by the site Field Team Leader. The Field Team Leader will review the field results for compliance with the established QC criteria that are specified in the QAPjP and FSP. Accuracy of the field measurements will be assessed using daily instrument calibration and the analysis of blanks. Precision will be assessed on the basis of reproducibility by analyzing duplicate samples or by taking multiple readings of a single sample. Data completeness will be calculated using Equation 14-1.

$$\%\ \text{Completeness} = \frac{\text{Valid Data Obtained}}{\text{Total Data Planned}} \times 100 \qquad \text{Equation 14-1}$$

14.2 Laboratory Data

Laboratory results will be assessed for compliance with required precision, accuracy, completeness, and sensitivity as follows:

14.2.1 Precision

For organic analyses, precision of laboratory analysis will be assessed by comparing matrix spike and matrix spike duplicate analytical results. Laboratory duplicate analyses for both organic and inorganic analyses. The relative percent difference (%RPD) will be calculated for each pair of duplicate analysis using Equation 14-2.

$$\%\text{RPD} = \frac{S - D}{(S + D)/2} \times 100 \qquad \text{Equation 14-2}$$

Where: S = First sample value (original or MS value)
D = Second sample value (duplicate or MSD value)

14.2.2 Accuracy

Accuracy of laboratory results will be assessed for compliance with the established QC criteria described in Section III of the QAPjP using the analytical results of method, field and trip blanks, and MS/MSD samples. The percent recovery (%R) of matrix spike samples will be calculated using Equation 14-3.

$$\%R = \frac{A - B}{C} \times 100 \qquad \text{Equation 14-3}$$

Where:

A = The analyte concentration determined experimentally from the spiked sample

B = The background level determined by a separate analysis of the unspiked sample

C = The amount of the spike added

14.2.3 Completeness

The data completeness of laboratory analyses results will be assessed for compliance with the amount of data required for decisionmaking. The completeness is calculated using Equation 14-1.

Section 15
Corrective Actions

Corrective actions may be required for two classes of problems: analytical and/or equipment problems and noncompliance problems. Analytical and equipment problems may occur during sampling, sample handling, sample preparation, laboratory instrumental analysis, and data review. If the problem is analytical in nature, information on these problems will be promptly communicated to CH2M HILL's SM and Data/Sample Management Manager. Implementation of corrective action will be confirmed in writing through the same channels.

For noncompliance problems, a formal corrective action program will be determined and implemented at the time the problem is identified. The person who identifies the problem is responsible for notifying the SM, who in turn shall notify the RPM. Any nonconformance with the established quality control procedures in the QAPjP or FSP will be identified and corrected in accordance with the QAPjP. The U.S. EPA, RPM or their designee will issue a nonconformance report for each nonconformance condition.

15.1 Sample Collection/Field Measurements

Technical staff and project personnel will be responsible for reporting all suspected technical or QA nonconformances or suspected deficiencies of any activity or issued document by reporting the situation to the Field Team Leader. The Field Team Leader will be responsible for assessing the suspected problems in consultation with the SM and for making a decision based on the potential for the situation to affect the quality of the data. If it is determined that the situation warrants a reportable nonconformance requiring corrective action, then a nonconformance report will be initiated by the SM.

Field corrective actions will be implemented and documented in the field log book. No staff member will initiate a corrective action without prior communication of findings through the proper channels. If corrective actions are insufficient, work may be stopped by stop-work order by the RPM.

The SM will be responsible for ensuring that corrective action for nonconformances is initiated by:

- Evaluating all reported nonconformances
- Controlling additional work on nonconforming items
- Determining disposition or action to be taken

- Maintaining a log of nonconformances
- Reviewing nonconformance reports and corrective actions taken
- Ensuring nonconformance reports are included in the project files

Corrective action for field measurements may include:

- Repeating the measurement to check the error
- Checking for all proper adjustments for ambient conditions such as temperature
- Checking the batteries
- Recalibrating
- Checking the calibration
- Replacing the instrument or measurement devices
- Stopping work (if necessary)

The Field Team Leader is responsible for site activities. In this role, the Field Team Leader may be required to adjust the site programs to accommodate site-specific needs. When it becomes necessary to modify a program, the responsible person notifies the SM who in turn notifies the RPM of the anticipated change and implements the necessary changes after obtaining the approval of the RPM Coordinator. The Field Team Leader is responsible for controlling, tracking, and implementing the identified changes. Reports on all changes will be distributed to all affected parties, including the U.S. EPA RPM.

15.2 Laboratory Analyses

Corrective actions are required whenever an out-of-control event or potential out-of-control event is noted. The investigative action taken is somewhat dependent on the analysis and the event.

Laboratory personnel are alerted that corrective actions may be necessary if:

- QC data are outside the warning or acceptable windows for precision and accuracy

- Blanks contain target analytes above acceptable levels

- Undesirable trends are detected in spike recoveries or RPD between duplicates

- There are unusual changes in detection limits

- Deficiencies are detected by the QA department during internal or external audits or from the results of performance evaluation samples

- Inquiries concerning data quality are received

Corrective action procedures are often handled at the bench level by the analyst who reviews the preparation or extraction procedure for possible errors and checks the instrument calibration, spike and calibration mixes, instrument sensitivity, and so on. If the problem persists or cannot be identified, the matter is referred to the laboratory supervisor, manager and/or QA department for further investigation. Once resolved, full documentation of the corrective action procedure is filed with the QA department, and included in the case narrative portion of the analytical report.

Section 16
Quality Assurance Reports to Management

In addition to the audit reports submitted to the SM in accordance with QAPjP Section 12, a monthly progress report that addresses all QA issues and corrective actions proposed or already taken is submitted to the EPA RPM. The final RD report will contain a QA section that summarizes data quality information collected during the project.

APPENDIX A
FIELD SAMPLING PLAN

Appendix A
Field Sampling Plan
N.W. Mauthe RD/RA

1. Summary of Sampling Activity

1.1 Remedial Design Activities

A trench test will be performed to determine groundwater flow quantities and groundwater quality prior to the design of the groundwater collection trenches and onsite groundwater pretreatment system. A 290-foot-long section of the proposed groundwater collection system will be installed, along with two piezometers and a manhole for groundwater collection. A 72-hour pump test will be set up by a subcontractor and run by CH2M HILL. Figure A-1 presents a plan and profile view of the test trench.

CH2M HILL will collect groundwater samples from the test trench before, during, and after the test to characterize the water before performing bench-scale treatability testing. A sufficient volume of groundwater will also be collected during each sampling event to perform the treatability testing. Ideally, the groundwater used as the treatability testing influent water will represent stable groundwater extraction conditions in the groundwater collection system, and thus would be collected from the later stages of the test. However, because it is possible that groundwater movement into the collection system will be slow after the initial capture of perched water, groundwater for the treatability testing will be collected at each characterization sampling event in case little or no groundwater is collected subsequent to the event.

1.2 Remedial Action Activities

Soil testing will be performed during remedial action for two purposes—to determine the appropriate disposal of excavated soil and to verify that cleanup has been achieved. CH2M HILL will collect samples from the material excavated during the hot spot removal and during construction of the groundwater collection trenches. Each load of excavated material (approximately 20 cubic yards) will be field tested using an XRF to determine the concentration of total chromium. The soil will be disposed of in the following manner:

- If the total chromium concentration exceeds 500 mg/kg, the soil will be taken to a hazardous waste facility for treatment and disposal.

- If the total chromium concentration is between 100 and 500 mg/kg, the soil will be tested to determine if it is TCLP characteristic. If it is TCLP characteristic, the soil will be treated as hazardous waste. If it is not TCLP characteristic, it will be disposed of at a Subtitle D landfill as special waste.

- If the total chromium concentration is between 50 and 100 mg/kg, the soil will be considered special waste and will be disposed of at a Subtitle D landfill.

- If the total chromium concentration is less than 50 mg/kg, it will be used as backfill in the hot spot areas.

Verification sampling will be performed following excavation of the hot spot areas. The rationale for the sampling plan is presented in the Cleanup Verification Plan. Verification samples will be tested in the laboratory for total chromium.

2. Sample Network and Rationale

2.1 Project Approach

Groundwater collected in the test trench section will be sampled and analyzed for chemical and physical parameters to determine representative influent characteristics of the extracted groundwater before it is pretreated. The influent characteristics will be compared to the Appleton POTW pretreatment criteria or requirements, and the treatability test will be used to determine chemical dosages, metal hydroxide precipitate settling behavior, and UV exposure time (if needed), to treat the groundwater to meet the POTW's criteria.

The treatability test effluent (treated) water will be analyzed to determine the effectiveness of the bench-scale treatment tests. Soil samples from the hot spot removal will be tested to determine the appropriate disposal methods. Verification testing will be performed following the removal of hot spot soils to determine if cleanup goals have been met.

2.2 Parameters Analyzed

Three groups of analyses will be performed on the groundwater samples: field parameters, organic and inorganic contaminants, and conventional parameters.

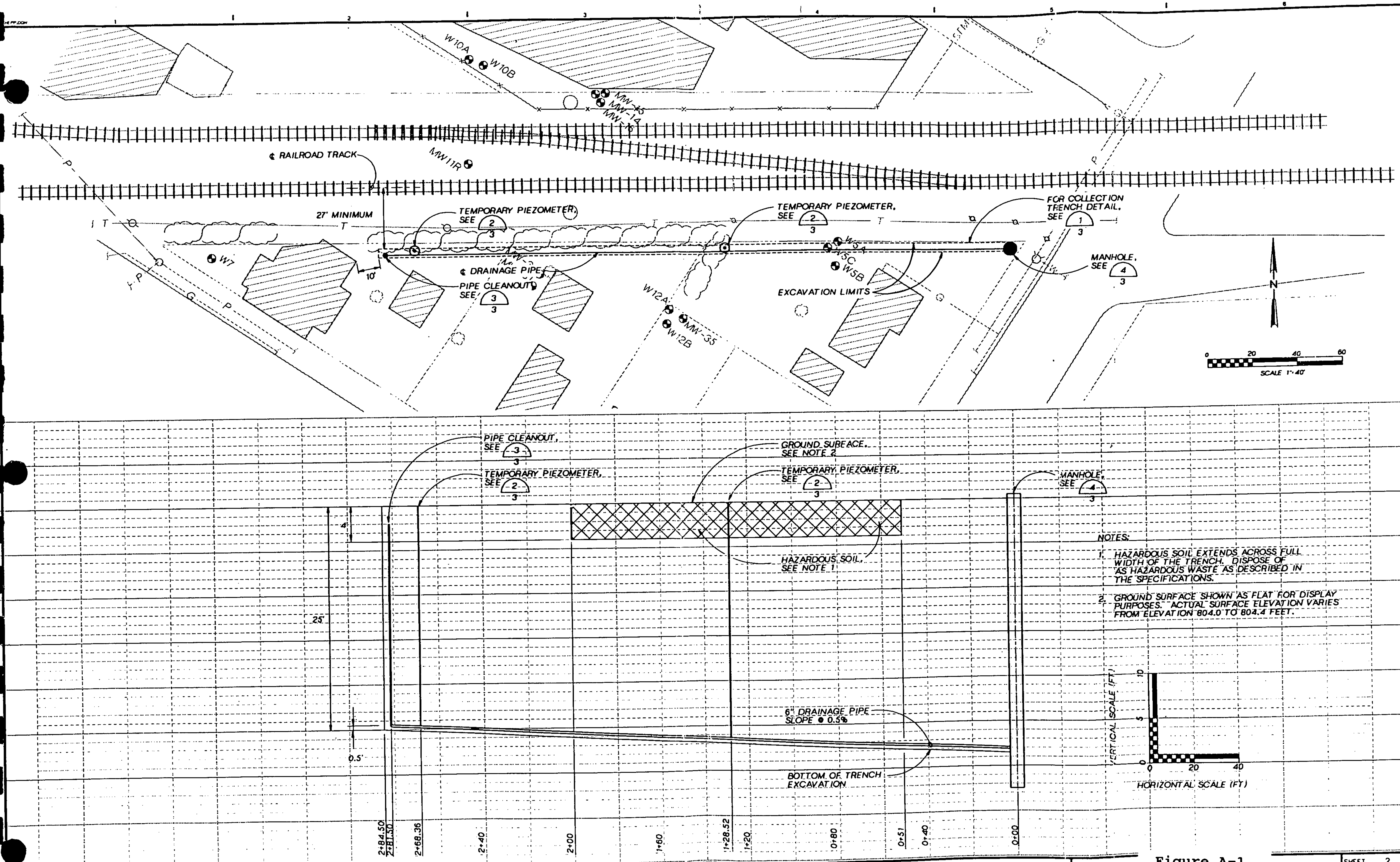


Figure A-1
PLAN AND PROFILE

CH2M HILL	DSGN C.G. BARNETT	DR P.E. ALLEN	CHK X
	APVD X		

NO.	DATE	REVISION	BY	APVD

BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

PREDESIGN ACTIVITIES
N.W. MAUTHE SITE
APPLETON, WISCONSIN

SHEET 2
DWG NO.
DATE JUNE 1994
PROJ NO. GLE65688

The filter cake used during the treatability tests will be analyzed for the parameters required for landfill disposal. The hot spot soils and verification samples will be tested for total chromium. The parameters that make up each group are listed below. The quality assurance project plan (QAPjP) describes the analytical methods, detection limits, quality control/quality assurance sampling, and data quality objective (DQO) levels. Table 3-2 of the QAPP contains the laboratory analytical methods and QA/QC sampling requirements.

2.2.1 Water Sample Parameters

Field Analyses. The following field parameters will be analyzed onsite shortly after the groundwater is extracted:

- pH and temperature
- Specific conductance
- Redox potential
- Dissolved oxygen

Organic and Inorganic Analyses. Table A-1 lists the inorganic parameters to be analyzed before and after the treatability tests, and the applicable Appleton POTW current sewer code limits and proposed new limits. Appleton does not have an established limit for volatile organic compounds (VOCs); limits for VOCs will be negotiated with the POTW. If the analysis of the untreated groundwater results in nondetects for some parameters, these parameters will not be analyzed for in the treated water.

Conventional Analyses. The following conventional analyses will be performed for design needs:

- Total dissolved solids (TDS)
- Total organic carbon (TOC)
- Alkalinity
- Hardness

2.2.2 Filter Cake Sample Parameters

TCLP testing for metals will be conducted on the filter cake solids generated during the treatability testing.

2.2.3 *Hot Spot Soil Parameters*

Soil excavated from the hot spot areas will be tested for total chromium in the field using an XRF. Samples with a total chromium concentration between 100 and 500 mg/kg will also be tested for TCLP metals. Verification samples will be tested for total chromium in the laboratory.

2.3 Sampling Locations and Frequency

2.3.1 *Trench Test*

Two piezometers will be installed as part of the test trench. A manhole with a pump to extract collected groundwater (see Figure A-1) will also be installed. Groundwater will be collected for characterization analysis at five separate times:

- Once after the trench is installed, before startup of the pump test
- Once each day during the 3-day pump test
- Once after the pump test is completed

The groundwater will either be collected from a sampling port or discharge line at the manhole as the collected groundwater is being pumped out, or it will be obtained with a stainless steel bailer from the northern most piezometer. Groundwater sampled from the manhole will most closely represent the composition of the pretreatment system's influent groundwater.

The groundwater collected for characterization will be sent offsite to a local laboratory that day for analysis. Hexavalent chromium has a 24-hour holding time. Subsequently, the laboratory will be verbally notified whenever a sample is being sent or couriered to them for hexavalent chromium analysis so they can prepare and analyze the sample within holding times. A sufficient volume of groundwater will also be collected during each of the five sampling events to conduct the treatability tests. If groundwater flow rates into the trench indicate a steady supply of groundwater, then groundwater for the treatability tests needs to be collected only after the system has stabilized. The extra volume of groundwater should be collected before the pump test begins, however, in case recharge to the trench is slow.

2.3.2 *Hot Spot Areas*

Each load of excavated soil (approximately 20 cubic yards) will be field tested using an XRF to determine the appropriate disposal methods.

If the XRF analysis of the soil sample for a load of excavated material indicates that the material may be suitable for backfill, collect three additional samples for confirmation using the XRF. These samples will be collected randomly form the load unless a portion of the load appears to be contaminated, in which case, at least one sample will be collected from a visually contaminated area.

Cleanup verification testing will be performed on 25 samples in a systematic grid pattern. Details on the development of the grid and the number of confirmatory samples is presented in the Cleanup Verification Plan. Soil collected for confirmatory analysis will be sent offsite to a laboratory for analysis.

3. Sampling Equipment and Procedures

General procedures for performing field tests and collecting groundwater samples are described below. Additional details related to specific sampling procedures are discussed in Appendix B.

3.1 Sampling Equipment

3.1.1 Groundwater Sampling

The following items are required to sample the extracted groundwater:

- Sample collection and field testing equipment
  - Stainless steel bailer
  - Nylon rope
  - Sample containers with preservatives and labels provided by the analytical laboratory
  - Five 10-gallon plastic carboys
  - Clean glass or stainless steel beaker for temperature, conductance, dissolved oxygen, pH, and redox potential measurements
  - Cooler, ice
  - Thermometer (0° to 50°C range)

- Conductance and pH meter
- Dissolved oxygen meter
- Redox potential meter
- Decontamination solutions, containers, brushes, etc.

• Sample records

- Field notebooks
- Laboratory log sheets
- EPA chain-of-custody forms
- EPA Region 5 sample tags

3.1.2 Filtercake Sampling

The following items are required to sample the treatability testing filtercake and treated water:

• Equipment needed to collect samples

- Uncoated scoop for filtercake sample collection
- Stainless steel bowl
- Stainless steel spoon for solids media transfer to sample container
- Sample containers

• Sample records

- Daily activity logs
- Laboratory log sheets
- EPA chain-of-custody forms
- EPA Region 5 sample tags

3.1.3 Hot Spot Soil Sampling

The following items are required to sample the excavated soil and to collected verification samples from the excavations:

• Equipment needed to collect samples

  - Uncoated scoop or spoon for soil sample collection
  - Stainless steel bowl
  - Stainless steel spoon for solids media transfer to sample container
  - Sample containers

- Sample records

  - Daily activity logs
  - Laboratory log sheets (for verification samples)
  - EPA chain-of-custody forms (for verification samples)
  - EPA region 5 sample tags (for verification samples)

3.1.4 Sampling Equipment Calibration

The calibration procedures and frequency of calibration for sampling equipment are provided in Appendix B.

3.1.5 Sampling Equipment Preventive Maintenance

Each piece of sampling equipment will be tested to verify that it is in proper working order before it is sent to the site. Equipment will also be tested before each use. The instrument operator's manual will dictate the frequency of calibration and maintenance.

3.2 Sampling and Measurement Procedures

The general sampling procedures and sequence described below are recommended as a guide to sampling. Sampling will proceed in the following sequence:

1. Organize and decontaminate sampling equipment and calibrate instruments.

2. Purge sampling port by opening the valve and briefly releasing water from the sample port. If using a bailer, remove three well volumes of water before sampling. Collect purge water for proper disposal.

3. Collect water samples per procedures outlined below (see Water Sample Collection Procedures).

4. Preserve samples for storage and laboratory analyses (aqueous VOC samples shall be collected first, in a nonturbulent manner, into vials that have preservative already added to them).

5. Perform field analyses (record pH, temperature, conductance, redox, and dissolved oxygen readings).

6. Complete sample records and chain-of-custody forms and seals.

7. Ship samples by overnight courier to analytical laboratory, or arrange pick-up on delivery to local laboratory.

3.2.1 Water Sample Collection Methods

Samples will be collected after purging the port, or piezometer. Volatile organic analysis (VOA) vials will be filled first. To collect the VOA samples:

- Reduce volume of discharge from the sampling sort until a trickle flow is achieved.

- Add preservative (HCl) to the vials, if not already added by laboratory.

- Place the mouth of the VOA vial at the end of the port and allow bottle to fill slowly.

- Fill vial in a steady, gentle stream with a minimum of agitation.

- Fill until a meniscus forms on the mouth of the VOA vial.

- Cap the vial, and check for air bubbles by inverting the vial and tapping on the palm of the hand. If bubbles are present, repeat procedure until a bubble-free sample is obtained.

To collect nonfiltered samples:

- Increase discharge rate and fill the sample containers to the shoulder.
- Add preservative as required.

3.2.2 Filtercake Solids Sample Collection Methods

Filtercake samples will be collected by dipping an uncoated scoop into the jar holding the solids. The solids will be transferred from the scoop to a stainless steel bowl and then transferred from the bowl to the sample jars using stainless steel spoons.

3.2.3 Hot Spot Soil Sample Collection Methods

Soil samples to be used for determining disposal methods will be collected by dipping an uncoated scoop into the load of soil to be disposed of. The soil will be transferred from the scoop to a stainless steel bowl and then transferred from the bowl to the sample jars using stainless steel spoons.

If the XRF analysis for a load of excavated material indicates the material may be suitable for backfill, collect three additional samples according to the following:

- Inspect the surface of the soil for visible contamination.
- Collect three additional samples for verifying the disposal method using the sample collection methods described above. Collect additional samples from areas of visual contamination, if any. If more than three areas of contamination are observed, collect samples form the three most visibly contaminated areas. If less than three areas of contamination are observed, collect the remaining samples randomly from the load. Composite sampling will not be allowed.

Verification samples will be taken using an uncoated scoop or spoon from the top six inches of soil at the sample location. The soil will be transferred from the scoop or spoon to a stainless steel bowl.

3.3 Sample Shipping

Coolers will be used to transport samples from the field to the analytical laboratory. Samples requiring preservation by cooling will be kept cold at a constant temperature (4°C).

All shipments will be accompanied by a chain-of-custody record identifying the contents. The original record will accompany the shipment, and a copy will be retained by the sampler.

All shipping coolers must have two custody seals placed over the lid opening, one on each side.

The copy of the airbill accompanying each shipping container will be retained as part of the permanent documentation. Commercial carriers are not required to sign the custody form as long as the custody forms are sealed inside the sample cooler and the custody seals remain intact. If a local laboratory is analyzing the samples, same-day pickup or delivery of the samples may be arranged.

4. Sample Container Preparation, Sample Preservation, and Maximum Holding Time

4.1 Bottle Requirements

Table 3-3 of the QAPP lists the sample containers used for each of the analyses. The sample containers (bottles) used for this sampling effort will be prepared according to the procedures specified in the U.S. EPA's *Specifications and Guidance for Obtaining Contaminant-Free Sample Containers, April 1990.*

4.2 Sample Preservation and Holding Time

Table 3-3 of the QAPP summarizes the requirements for sample containers, preservatives, and sample holding times. Sample containers that are certified by the laboratories as precleaned will be used. Preservatives will be prepared using reagent grade chemicals. Samples will be kept iced to maintain a temperature of 4°C for preservation.

5. Sample Documentation and Custody Procedures

5.1 Sample Identification System

A sample numbering system devised by CH2M HILL will be used to identify each sample, including duplicates and blanks. A list of sample identification numbers will be maintained in the field logbook by the field activity manager. Each CH2M HILL sample number will consist of three components, as described below.

Each sample will have up to a four-digit code corresponding to the media, (and identifying the N.W. Mauthe site), followed by a three-digit code identifying the sample location. The last three digits are the sequential sample number. Sample numbers will not be repeated within a sample station, medium, or among differing media. Duplicate samples will not be distinguished within the sample numbers, but will be distinguished through the subsample identification within the sample tracking and data management systems. This is done so that no bias is given to these samples during analyses. The media letter codes and reserved sample numbers are as follows:

- GW—Groundwater Sample
- PS—Process Solids Sample
- TW—Treated Water Sample
- TS—Treated Solids Sample
- EX—Excavated Soil Sample
- CV—Cleanup Verification Soil Sample

The following designations are used in the sample location code to indicate the type of feature sampled or test number:

- PZ—Piezometer
- MH—Manhole
- T—Test

For QA/QC samples the following designations are added to the end of the sample number:

- Blanks—B
- Duplicates—D
- MS/MSD—MS

Examples of sample numbers are as follows:

- WM-GWPZ2-01—Groundwater sample collected from the N.W. Mauthe site, Piezometer No. 2, Sample Event 1

- WM-GWMH1-03—Groundwater sample collected from the N.W. Mauthe site, Manhole No. 1, Sample Event 3

- WM-TWT01-02-MS—Treated water sample collected after treatability test, Test No. 1, Sample No. 2, matrix spike/matrix spike duplicate

5.2 Initiation of Field Custody Procedures

EPA Region 5 chain-of-custody protocols, as described in the National Enforcement Investigations Center (NEIC) Policies and Procedures, EPA-330/9-78-DDI-R, revised June 1985, will be followed for all samples collected for chemical analysis. The custody procedures are described in Section 7 of the QAPP.

5.3 Field Activity Documentation and Logbook

The field logbook, as described in the QAPP, will be initiated at the start of the first startup sampling activity and should be used to record onsite activities during process startup. The field logbook is a controlled document that becomes part of the permanent site file.

Instructions for recording information into the field logbook are provided in Section 7.1.2 of the QAPP, ''Field Logbooks/Documentation.'' The following additional information should also be recorded:

- Arrival and departure times of site visitors
- Arrival and departure times of equipment
- Project number
- Equipment calibration information (equipment type and I.D. number, calibration standards used, instrument response, problems and repairs, etc.)
- Method of shipment
- Health and safety issues (level of protection, ambient screening results, etc.)
- Any unusual conditions or observations

The following entries will be made each day of sampling. Entries will be in ink, and no erasures will be permitted. Each page will be initialed. Incorrect entries will be crossed out with a single strike mark and initialed. At the beginning of each entry, the date, start time, and the names of site personnel and visitors present will be recorded. The following will be included in each entry:

- A summary of daily site activities and level of personal protection
- References to other project notebooks kept onsite (e.g., health and safety officer's notebook)
- Record of photographs taken with a description of each and its key points of interest and the photographer's name, date, time, site location, and site

description. Videotape, slides, or photographs taken onsite or at sampling locations should be numbered to correspond to logbook entries.

5.4 Sample Shipment and Chain-of-Custody

EPA chain-of-custody forms, sample bottle tags, and custody seals will be used for samples shipped to laboratories contacted by CH2M HILL for SAS work. CH2M HILL chain-of-custody forms, sample bottle labels, and custody seals will be used for the shipment of water samples collected for the treatability test to be conducted by CH2M HILL.

Sample documentation, packing and shipping instructions are provided in Appendix C in the QAPP.

6. Decontamination Procedures

This section provides the general guidelines for the decontamination of personnel, sampling and monitoring equipment, and sample bottles.

The following will be onsite:

- Distilled water
- 2.5 percent (by weight) trisodium phosphate (TSP) and water solution for decontamination
- Large plastic pails or tubs for TSP and water; scrub brushes; squirt bottles for TSP, methanol, and water; plastic bags and sheeting (visqueen)

6.1 Personnel Decontamination

The following personnel decontamination procedures will be performed after tasks are completed that may have contaminated the worker and when the worker leaves the contaminated area:

1. Remove outer gloves and discard
2. Remove respirator (if worn)
3. Remove disposable coveralls (e.g., Tyveks®) and discard
4. Remove latex boot covers (if worn) and discard
5. Remove inner gloves (if worn) and discard

6. Sanitize respirator (if worn)

6.2 Sampling and Monitoring Equipment Decontamination

Where groundwater has been in contact with field equipment used during sampling (i.e., bailer), the equipment will be decontaminated after sampling with a TSP and distilled water solution, followed by a distilled water rinse.

APPENDIX B
FIELD MEASUREMENTS AND MONITORING SOPs

Appendix B

Field Measurements and Monitoring SOPs
N.W. Mauthe RD/RA

B1. pH

Method

Electrometric

References

Methods for Chemical Analysis of Water and Wastes, U.S. EPA, Method 150.1, 1983.

Orion SA250 pH Meter Instruction Manual, 1987, Part No. 205376-001, Orion Research Incorporated, Boston, MA.

Orion Ross pH Electrode Instruction Manual, 1988, Part No. 502700-098, Orion Research Incorporated, Boston, MA.

Sensitivity

0.01 pH unit

Range

1 to 12 pH units

Sample Holding Time

Less than 6 hours

Reagents

- pH buffer solutions for pH 4, 7, and 10
- Deionized water in squirt bottle
- 3 M KCL internal filling solution
- Storage solutions

Apparatus

- pH meter
- Combination pH and reference electrode
- Beakers, plastic or glass
- Spare battery

Calibration (most pH Meters)

1. Select either pH 4 and 7, or pH 7 and 10 buffers, whichever will bracket the expected sample concentration. Note: Mix all buffer solutions before use.

2. Place electrode in pH 7 buffer solution. Wait for the pH to stabilize and adjust CAL until pH display reads 7.0.

3. Rinse electrodes and replace pH 7 buffer with either pH 4 or 10 buffer.

4. Wait for the pH value to stabilize. Adjust SLOPE until pH display reads 4.0 for the pH 4 buffer or 10.0 for the pH 10 buffer. Note: Slope values in the 92 to 102 percent range are acceptable.

5. Rinse electrodes and replace pH 4/10 buffer with pH 7 buffer.

6. If display reading is not 7.0, repeat steps 2 through 4.

Autocalibration (Orion SA 250)

1. Select either pH 4 and 7, or pH 7 and 10 buffers, whichever will bracket the expected sample concentration. Note: Shake all buffer solutions before use.

2. Select pH mode and resolution (pH 0.1).

3. Press ISO and verify that the isopotential point is 7.0.

4. Place electrode and Automatic Temperature Compensation (ATC) probe in pH 7 buffer.

5. Press CAL. The display will alternate between 0.1 and the pH value of the buffer. Wait for the pH value to stabilize. Press ENTER. After a short pause the display will advance to 0.2.

6. Rinse electrodes and ATC probe and replace pH 7 buffer with either pH 4 or 10 buffer.

7. Wait for pH value to stabilize. Press ENTER. The letters pH will be displayed. The pH meter is calibrated and ready for use. Note: Slope values in the 92 to 102 percent range are acceptable.

8. Rinse electrode and ATC probe and place into sample. Read the pH directly.

Calibration Frequency

Daily, at the beginning and end of the day, recheck calibration with pH 7 buffer once every 10 samples and after maintenance.

Operating Procedure

1. Check all connections for tight fit.

2. Inspect electrodes (and ATC probe).

3. Check battery charge.

4. Perform calibration, at the beginning and end of the day.

5. Rinse the electrode with distilled water and then with the sample to be measured.

6. Place electrode (and ATC probe) in previously mixed sample. Immerse electrode such that junction is covered by sample.

7. When the display is stable, record sample pH.

8. Recheck calibration with pH 7 buffer solution once every ten samples.

9. After use store electrode. For short-term storage (up to 1 week) soak electrode in manufacturer's recommended storage solution. For long-term storage, the reference chamber should be filled and the filling hole securely covered.

10. Cover the sensing element and/or reference junction with its protective cap and a few drops of the manufacturer's recommended storage solution.

When calibrating the meter, use pH 4 and 7 buffers for sample with pH <7, and pH 7 and 10 buffers for samples with pH >7. Measurement of pH is temperature dependent. Therefore, temperatures of buffers and samples should be within 2°C. This is not applicable for meters equipped with an automatic temperature compensation probe.

Weak organic salts, inorganic salts, and oil and grease interfere with pH measurements. If oil and grease are visible, note on data sheet. Clean electrode as described in manufacturer's instrument manual.

Avoid rubbing or wiping electrode bulb to reduce chance of error from polarization. To ensure a quick response and free-flowing liquid junction, the sensing element and reference junction must not be allowed to dry out.

Quality Control Requirements

Accuracy will be assessed by performing two measurements on two standard buffer solutions that bracket the pH range of the samples. Recheck calibration with ph 7 buffer solution once every ten samples. Each measurement will be within ± 0.05 standard unit of pH selection. Precision will be assessed by duplicate measurements and must be less than or equal to 0.1 standard unit. Duplicates will be run at the rate of one every ten samples.

Preventive Maintenance (Frequency)

1. Check batteries (daily).

2. Perform a two-point calibration (daily and after maintenance).

3. Inspect the electrode for scratches, cracks, salt crystal buildup, or membrane/junction deposits. Rinse off any salt buildup with deionized water and remove membrane/junction deposits as described in the manufacturer's operators manual (as needed).

4. Clean electrode by soaking in 0.1M HCL or $HN0_3$ for 30 minutes, followed by soaking in storage solution for at least 1 hour (as needed or when slow response is observed).

5. Drain the reference chamber and flush it with the manufacturer's filling solution (weekly).

B2. Specific Conductivity and Temperature

References

Methods for Chemical Analysis of Water and Wastes, U.S. EPA Method 120.1, 1983.

YSI Models 33 and 33M S-C-T Meters, Instructions, November 1987, Item 021470, Yellow Springs Instrument Co., Yellow Springs, Ohio.

Sensitivity

1 μmho/cm @ 25°C.

Range

0.1 to 100,000 μmho/cm.

Sample Holding Time

Determine onsite or within 24 hours.

Reagents

Distilled water in squirt bottle and standard potassium chloride solution.

Reagent Preparation

1. Stock Potassium Chloride (KC1) Solution (1.00 N): Dissolve 74.555 g KCl in distilled water and dilute to 1,000 mL in a volumetric flask.

2. Standard Potassium Chloride Solution (0.01 N): Dilute 10.0 mL of stock 1.00 N KCl solution to 1,000 mL with distilled water using a volumetric pipet and flask.

Apparatus

Conductivity meter and electrodes. Beakers or jars, plastic, or glass; spare batteries, size D alkaline.

Calibration Procedure

1. Switch mode to OFF and unplug the probe, correct meter zero (if necessary) by turning the adjustment screw so that the meter needle coincides with the zero on the conductivity scale.

2. Switch mode to REDLINE, correct meter redline (if necessary) by turning the adjustment screw so that the meter needle coincides with the redline on the meter face. If this cannot be accomplished, replace the batteries.

3. Plug the probe into the probe jack.

4. Place the probe in the 0.01 N standard potassium chloride solution. Record temperature (°C) and conductance (micromho/cm).

5. Correct conductivity reading for temperature. This value must correspond ($\pm$10 percent) to the expected value in Table 1. If the calibration fails, then appropriate corrective action must be performed and the instrument recalibrated.

Note: The temperature probe should be calibrated against a NBS, an ATSM standard or equivalent thermometer before each sampling event.

Operation Procedure

1. Perform calibration at end and beginning of the day.

2. Switch mode to TEMPERATURE. Allow time for the probe temperature to come to equilibrium with that of the water before reading. Read the temperature on the bottom scale of the meter in degrees Celsius.

3. Switch mode to X100. If the reading is below 50 on the 0 to 500 range (5.0 on the 0 to 50 mS/m range), switch to X10. If the reading is still below 50 (5.0 mS/m), switch to the X1 scale. Read the meter scale and multiply the reading by the mode factor. The answer is expressed in microohms/cm. Measurements are not temperature compensated.

4. When measuring on the X100 and X10 scales, depress the CELL TEST button. The meter reading should fall less than 2 percent; if greater, the probe is fouled and the measurement is in error. Clean the probe and remeasure.

Operating Suggestions

- Obstructions near the probe can disturb readings.
- When the calibration test indicates low readings the probable cause is dirty electrodes. Hard water deposits, oil, and organic matter are the most likely contaminants.
- Caution: Do not touch the electrodes inside the probe. The plating material is soft and can be scraped off.
- If cleaning does not restore the probe performance, replatinizing may be required. Always rinse the probe thoroughly in tap water, then in distilled or deionized water after cleaning and before storage. It is best (not required) to store conductivity cells in deionized water.
- Most problems in obtaining good records with monitoring equipment are related to electrode fouling and to inadequate sample circulation.

Calibration Frequency

At the beginning and end of the day or after maintenance, recharge battery after each use. Factory checkout and calibration shall be yearly or when malfunctioning.

Calculations

Calculate conductivity using the formula:

$$G_{25} = \frac{G_T}{[1 + 0.02\,(T-25)]}$$

where:

G_{25} = conductivity at 25°C, μmho/cm
T = temperature of sample, °C
G_T = conductivity of sample at temperature T, μmho/cm

Table 1
Conductivity Meter Calibration Table

Temperature (°C)	Conductivity (μmho/cm)
15	1,141.5
16	1,167.5
17	1,193.6
18	1,219.9
19	1,246.4
20	1,273.0
21	1,299.7
22	1,326.6
23	1,353.6
24	1,380.8
25	1,408.1
26	1,436.5
27	1,463.2
28	1,490.9
29	1,518.7
30	1,546.7

Quality Control Requirements

The accuracy of conductivity measurements will be assessed by measurement with a 0.01 N standard KCl solution before sample analysis and at the end of the day. Accuracy of measurements will be ±5 percent of the standard. Precision will be assessed by analysis of duplicate measurements which will have a relative percent difference of ≤15 percent. Duplicates will be run at the rate of one every ten samples. The thermometer on the conductivity meter will be checked before each sampling event for accuracy against an ASTM, NBS standard or equivalent thermometer. Accuracy of the measurement shall be ±1°C.

Preventive Maintenance

- The only maintenance required in battery replacement (every 200 hours or as needed).
- Recalibration (if necessary) should be done at the factory.

B3. Dissolved Oxygen

References

Methods for Chemical Analysis of Water and Wastes, EPA Method 360.1, 1983

YSI Model 51B Dissolved Oxygen Meter, Instruction Manual, November 1989, Yellow Springs Instrument Company, Yellow Springs, Ohio

Range

0 to 15 mg/L

Apparatus

- DO meter and membrane probe
- YSI submersible stirrer, if available
- Spare size C, carbon zinc batteries
- Spare membranes and KCl

Meter Setup

1. With switch in the Off position, adjust the meter pointer to zero with the screw in the center of the meter panel. Readjustment may be necessary if the instrument position is changed.

2. Switch to Zero and adjust to zero with the Zero control knob.

3. Switch to Full Scale and adjust the Full Scale knob until the meter needle aligns with the ''15'' mark on the mg/L scale.

4. Attach the prepared probe to the Probe connector of the instrument and adjust the retaining ring finger tight.

5. Before calibrating allow 15 minutes for optimum probe stabilization. Repolarize whenever the instrument has been Off or the probe has been disconnected.

Calibration

1. Switch to Calib O2 position.

2. Place the probe in moist air. This can be accomplished in two ways: (a) place the probe in the calibration bottle along with a few drops of water, or (b) the probe can also be wrapped loosely in a damp cloth taking care not to touch the membrane. Wait about 10 minutes for temperature stabilization. This may be done simultaneously while the probe is stabilizing.

3. With the Calib knob, set the meter pointer to the mark for the local altitude. The site is at about 800 feet National Geodetic Vertical Datum of 1929. Be sure the reading is steady. Recalibration is recommended when altitude is changed. A 1,000-foot altitude change can result in a 3 percent error (0.3 @ 10 mg/L).

4. If a steady reading cannot be obtained at the appropriate level, the meter should be returned to the manufacturer and another meter should be used.

The probe is now calibrated and should hold this calibration value for many measurements. Calibration can be disturbed by physical shock, touching the membrane, or drying out of the electrolyte.

Quality Control

Duplicate DO measurements shall be taken at a frequency equal to 10 percent of the daily sample population. The sample will be retested after rinsing the probe in DI water. If the DO results differ by more than 0.2 mg/L,the meter shall be recalibrated, and the sample retested.

Operation Procedure

With the meter prepared for use and the probe calibrated, place the probe in the sample to be measured and provide stirring.

1. Stirring for the 5739 probe can best be accomplished with a YSI submersible stirrer. If the stirrer is not used, provide manual stirring by raising and lowering the probe about 1 ft/sec.

2. Allow sufficient time for probe to stabilize to sample temperature and DO.

3. Turn the switch to Temp and read temperature from the lower meter scale. Set the O2 Solubility Factor dial to the observed temperature.

4. Turn the switch to Read O2 and read the DO value in mg/L directly from the meter.

Operating Suggestions

- Membranes will last indefinitely, depending on usage. Average replacement is 2 to 4 weeks. However, should the electrolyte be allowed to evaporate and an excessive amount of bubbles form under the membrane, or the membrane becomes damaged, thoroughly flush the reservoir with KCl and install a new membrane.

- Replace the membrane if erratic readings are observed or calibration is not stable.

- Detailed instructions regarding care and preparation of the probe are listed in the YSI instruction manual.

Calibration Frequency

At the beginning and end of the day or after maintenance, recharge battery after each use. Factory checkout and calibration shall be yearly or when malfunctioning.

B4. Field Measurement of Eh

Method

Electrometric

References

A Compendium of Superfund Field Operations, U.S. EPA, 1987

Water and Environmental Technology, American Standards for Testing and Materials Standards, Volume 11.01, Method D1498, 1987

Sensitivity

10 millivolts (mV)

Range

-1,500 to 1,500 mV

Sample Holding Time

None; measure as quickly as possible after sample collection.

Reagents

- ZoBell solution
- DI water in squirt bottle

Apparatus

- pH meter
- ORP electrodes (reference electrode of calomel, silver-silver chloride, or equivalent and a oxidation-reduction electrode of platinum, gold, silver, or other nobel metal)
- Glassware that has been rinsed with DI water

Calibration

1. Rinse electrodes and glass sample container thoroughly with DI water.

2. Fill glass container with fresh standard Redox solution, either ferrous-ferric or quinhydrone.

3. Turn range switch to proper range and engage operating button.

4. Adjust the asymmetry control to the millivolt potential of the standard Redox solution.

5. Without changing the asymmetry control, repeat the calibration procedure until two successive readings are within 10 mV of the standard redox solution.

The instrument shall be calibrated at the beginning and end of the day and after maintenance. Duplicate measurements shall be taken at a frequency equal to 10 percent of the daily sample population. The sample will be retested after rinsing the electrodes in DI water. If the Eh results differ by more than 10 mV, the meter shall be recalibrated and the sample retested.

Procedure

1. Check batteries before going into the field.

2. Calibrate meter according to manufacturer's instructions.

3. Bring the reference ZoBell solution to sample temperature and record temperature

4. Measure potential of the ZoBell solution in millivolts at sample temperature ($Eh_{ZoBell(obs)}$) and check against theoretical value of measured temperature ($Eh_{ZoBell + Reference}$). This should be +/-10 millivolts.

5. Rinse electrodes thoroughly with DI water.

6. Place sample in clean glass container and insert electrodes. Agitate and allow sample to stabilize (about 20 minutes). Take reading.

7. Record data (Eh_{obs}) and calculate Eh relative to standard hydrogen electrode.

8. Calculate sample Eh to the nearest 10 millivolts as follows:

$$Eh_{sample} = Eh_{obs} + Eh_{ZoBell\ +\ Reference} - Eh_{ZoBell(obs)}$$

9. Rinse electrodes thoroughly and store in DI water.

Accuracy and Precision

Accuracy and precision are dependent on the instrument used; refer to manufacturer's manual.

Expected accuracy and precision are ±2 percent of reading.

Preventive Maintenance

Refer to manufacturer's manual.

B5. XRF Spectrometer

Method

X-Ray Fluorescence (XRF)

References

Standard Operating Procedures for the ATX-100 Portable XRF, Enviro Recovery Consultants.

Method Detection Limit

The method detection limit is estimated to be 50 mg/kg. The analytical range for chromium is 50 mg/kg to 50,000 mg/kg.

Apparatus

- ATX-100 Portable X-Ray Fluorescence Spectrometer utilizing a Cadmium -109 radiation source. The K-lines will be used as the chromium emission lines. Chromium identification is based on pre-established wavelength criteria.

- 10 cc XRF cups

Instrument Initial Calibration

Ten field samples of known (or approximate) concentrations of chromium shall be collected. These samples should have a concentration range of what is expected to be encountered at the site (from clean to highly contaminated samples). Multiple (up to 10) XRF measurements shall be recorded and an average calculated for these samples. These samples shall also be sent to a pre-approved offsite laboratory for analysis of chromium by SW 846 3050/7191.

The offsite laboratory results shall be correlated with their corresponding average XRF signal values. This will serve as the site-specific calibration curve. The acceptance criteria for the initial calibration shall be a correlation coefficient $\geq$ 0.900. Field sample concentrations will be calculated using a regression analysis based on the calibration curve. No field testing will be conducted until a calibration curve has been developed.

Daily Continuing Calibration

A field sample with a concentration at the midpoint of the initial calibration range, verified by an offsite laboratory, shall be analyzed daily before field samples are analyzed and at the end of each work day to verify the validity of the initial calibration. The acceptance criteria for the continuing calibration is ±40 percent.

Sample Collection and Preparation

Sample analysis of chromium shall be performed in-situ. However, 10 percent of the samples will be verified by analyzing a prepared sample in a field laboratory (using the XRF) and by offsite laboratory analysis using approved methods.

The following sample collection and preparation procedures shall be used for field laboratory testing for calibration and field laboratory quality control samples:

- Collect the soil sample using a stainless steel hand trowel and place it in a 4-ounce glass jar.

- Dry sample in convection or microwave oven.

- Break-up large clods of soil using a stainless steel hand trowel.

- Dry-sieve soil through No. 10 (2.00 mm) stainless steel sieve onto a square piece of plastic. Conduct the sieving operation by means of lateral and vertical motion of the sieve, accompanied by a jarring action in order to keep the sample moving continuously over the surface of the sieve. Discard portion of sample retained on the sieve.

- Grind a known amount of the soil using a mortar and pestle and dry-sieve through a No. 200 (75 μm) using the sieving operation discussed above.

Place the prepared sample in a 10 cc XRF cup for analysis of chromium by the ATX-100 XRF. The same sample XRF cup will be capped, placed in a "zip-lock" bag and sent to an offsite laboratory for verification.

Operating Procedure

To measure chromium concentrations, place the sensor window of portable XRF unit over the desired location. Open the window and expose the sample for approximately 100 seconds. The exposure times must be consistent. Record the signal value in the logbook along with a unique sample name, date, time and location and close the window. The concentration is then determined by a regression fit into the initial calibration curve.

Quality Control Procedures

Measures must be taken to ensure the reliability and representativeness of the sample results. This shall be accomplished by verifying 10 percent of the field in-situ results comparing the results of a prepared sample using the XRF and offsite laboratory analysis.

Field duplicate analyses shall be conducted for 5 percent of the samples analyzed to show the variability of the results due to instrument fluctuations. Take multiple readings without moving the sensor head. The QC acceptance criteria for field duplicates will be -100 to +50 percent difference.

Field replicate analyses shall be conducted for 5 percent of the sample locations to measure the variability of the samples due to homogeneity or non-homogeneity. Take two measurements from within close proximity to each other (same sample location). The QC acceptance criteria for field replicates will be -100 to +50 percent difference.

Sample reliability and representativeness is ensured by proper instrument maintenance, consistent sampling and analysis procedures, and proper decontamination procedures to prevent cross-contamination problems.

Preventive Maintenance

The XRF sensor (detector) shall be covered by clear plastic wrap to prevent contamination. The plastic sheet should be replaced periodically to prevent cross-contamination. The plastic sheet shall also be used in the field laboratory analysis for consistency. <u>NOTE:</u> The same type of plastic (i.e. thickness) should always be used for reproducible results.

Interferences

Care should be taken to prevent cross contamination during the analysis process. Efforts should be taken to keep the detector sensor window clean. This includes covering the window with plastic during sample analysis.

High iron levels in the soil may cause a positive sample bias. The bias is reduced by determining a site-specific initial calibration curve described above.

High water content in the soil may interfere with sample analysis. Extremely moist samples should be allowed to dry by placing the sample on a paper towel before analysis.

ATX-100 Portable XRF
Analytical Results
Chromium

Sample ID	XRF Count	Cr (ppm)

APPENDIX C

SAMPLE DOCUMENTATION AND PACKING AND SHIPPING INSTRUCTIONS

Appendix C
Sample Shipment Documentation

Sample Documentation and Packing and Shipping

Sample Tag (Figure 1)

1. Enter date of sampling.

2. Enter time of sampling (military time only).

3. Specify ''grab'' or ''composite'' sample with an ''X.''

4. Enter CH2M HILL sample identification code.

5. Obtain signature of sample team leader.

6. Indicate preservative used (if any) with an ''X.''

7. Specify all parameters for analysis by placing an ''X'' to the right of each one.

8. Indicate the sample number. For analysis through the CLP, record the number from the stick-on labels. For SAS analyses through a contractor-procured laboratory, record the unique CH2M HILL sample number.

9. Indicate case number (e.g., Case No. 1234).

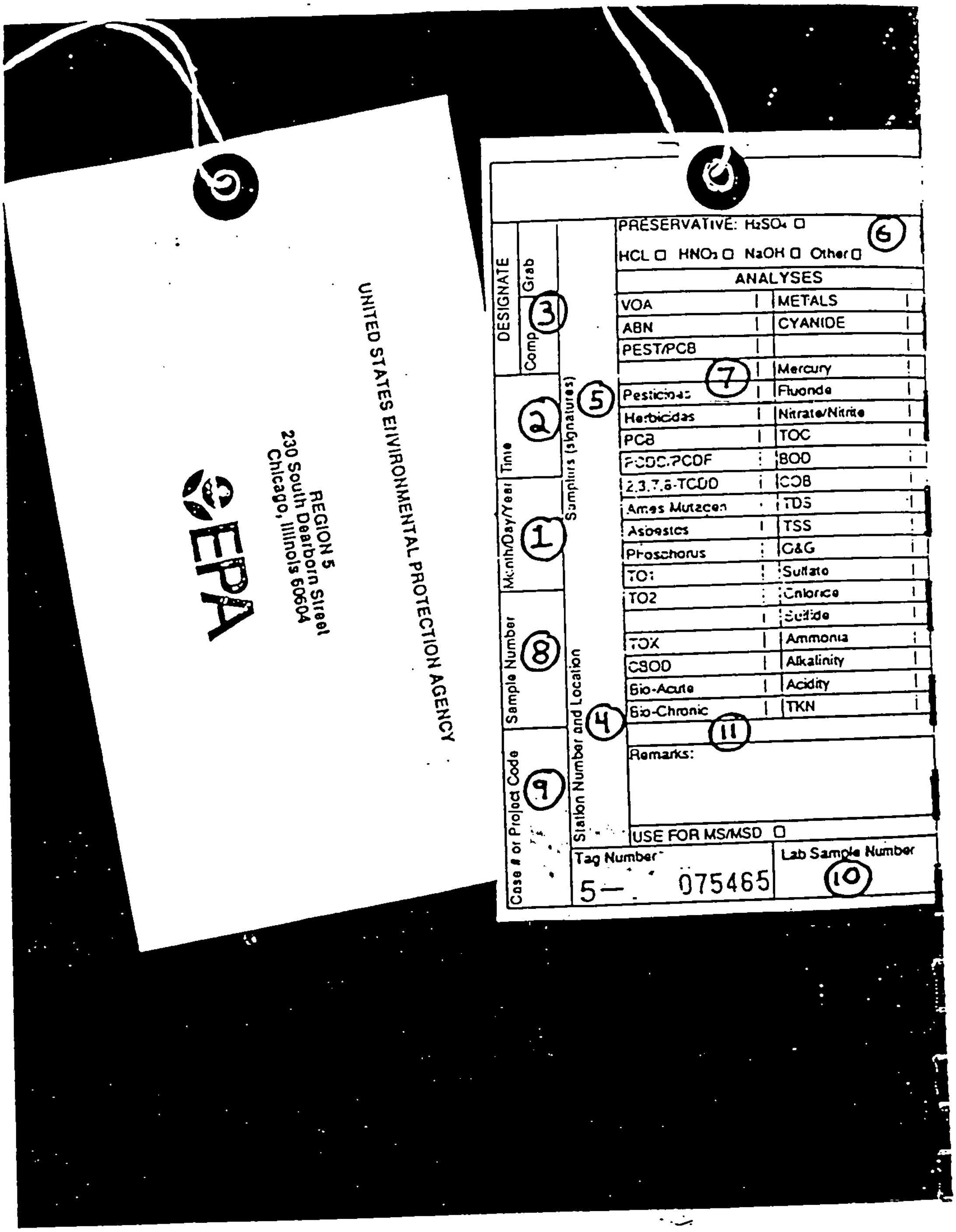
10. Leave BLANK (for laboratory use only).

11. Enter any desired analyses not listed on menu (e.g., PCBs, ammonia, sulfide, etc.) and mark box with an ''X.''

Combined Chain of Custody and Traffic Report Forms; for RAS (Figure 2) or SAS (Figure 3)

A. Project Code: Leave blank.

B. Account Code: Leave blank.



NOTE: For purposes of illustration forms are reproduced at 70% of original size.

Figure 1

RAS Combined Chain-of-Custody and Traffic Report Forms

EPA — United States Environmental Protection Agency, Contract Laboratory Program, Sample Management Office, PO Box 818 Alexandria, VA 22313, 703-557-2490 FTS 557-2490

Organic Traffic Report & Chain of Custody Record (For Organic CLP Analysis)

SAS No. (M) — Case No. (M)

1. Project Code (A) — Account Code (B) — 2. Region No. (G) — Sampling Co. (H) — 4. Date Shipped (K) — Carrier (K)

Regional Information (C) — Sampler (Name) (I) — Airbill Number (K)

Non-Superfund Program (D) — Sampler Signature (I) — 5. Ship To (L)

Site Name (E) — 3. Type of Activity (J): SF, PRP, ST, FED, PA, SS, LSI, SI, NPLD, CLEM, REM A, REM, O&L, UST

City, State (F) — Site Spill ID (F)

6. Preservative (Enter in Column D): 1. HCl; 2. HNO_3; 3. $NaHSO_4$; 4. H_2SO_4; 5. Other (SAS) (Specify); 6. Ice only; N. Not preserved

7. Sample Description (Enter in Column A): 1. Surface Water; 2. Ground Water; 3. Leachate; 4. Rinsate; 5. Soil/Sediment; 6. Oil (SAS); 7. Waste (SAS); 8. Other (SAS) (Specify)

CLP Sample Numbers (from labels)	A Enter # from Box 7	B Conc. Low Med High	C Sample Type: Comp./Grab	D Preservative from Box 6	E RAS Analysis: VOA	BNA	Pest/PCB	High: ARO/TOX	F Regional Specific Tracking Number or Tag Numbers	G Station Location Number	H Mo/Day/Year/Time Sample Collection	I Sampler Initials	J Corresp. CLP Inorg. Samp. No.	K Designated Field QC
(N)	(O)								(P)	(Q)	(R)	(S)	(T)	(U)

Shipment for Case complete? (Y/N) (V) — Page 1 of ___ (W) — Sample used for a spike and/or duplicate (X) — Additional Sampler Signatures (Y) — Chain of Custody Seal Number (Z)

CHAIN OF CUSTODY RECORD

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
(AA)					
Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Received by: (Signature)	Date / Time	Received for Laboratory by: (Signature)	Date / Time	Remarks Is custody seal intact? Y/N/none	

Split Samples ☐ Accepted ☐ Declined (Signature) (BB)

EPA Form 9110-2 (Rev. 5-91) Replaces EPA Form (2075-7), previous edition which may be used

DISTRIBUTION: Blue - Region Copy Pink - SMO Copy White - Lab Copy Yellow - Lab Copy for Return to SMO

Figure 2

SAS Combined Chain-of-Custody and Traffic Report Forms

EPA United States Enviromental Protection Agency
Contract Laboratory Program

Special Analytical Services
Packing List/Chain of Custody

1. Project Code	Account Code	2. Region No.	Sampling Co.	4. Date Shipped	Carrier
Regional Information		Sampler *(Name)*		Airbill Number	
Non-Superfund Program		Sampler Signature		5. Ship To	
Site Name		3. Purpose* Lead: SF, PRP, ST, FED; Early Action: CLEM, PA, REM; SI, ESI, RI, OIL, UST; Long-Term Action: FS, RD, RA, O&M, NPLD			
City, State	Site Spill ID			ATTN:	

SAS No.

Case No.

6. Matrix *(Enter in Column A)*
1. Surface Water
2. Ground Water
3. Leachate
4. Field QC
5. Soil/Sediment
6. Oil
7. Waste
8. Other *(Specify in Column A)*

7. Preservative *(Enter in Column D)*
1. HCl
2. HNO3
3. NAHSO4
4. H2SO4
5. NAOH
6. Ice Only
7. Other *(Specify in Column D)*
N. Not Preserved

Sample Numbers (From Labels)	A Matrix (from Box 6) Other:	B Conc.: Low Med High	C Sample Type Comp./Grab	D Preservative (from Box 7) Other:	E Analysis	F Regional Specific Tracking Number or Tag Numbers	G Station Location Identifier	H Mo/Day/Year/Time Sample Collection	I Sampler Initials	J Field QC Qualifier B=Blank S=Spike D=Duplicate R=Rinsate PE=Perform. eval -=Not a QC Sample

Shipment for SAS Complete? (Y / N)	Page __ of __	Sample(s) to be Used for Laboratory QC	Additional Sampler Signatures	Chain of Custody Seal Number(s)

CHAIN OF CUSTODY RECORD

Relinquished by: *(Signature)*	Date/Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date/Time	Received by: *(Signature)*
Relinquished by: *(Signature)*	Date/Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date/Time	Received by: *(Signature)*
Relinquished by: *(Signature)*	Date/Time	Received for Laboratory by: *(Signature)*	Date/Time	Remarks Is custody seal intact? Y / N / none	

DISTRIBUTION: White – Region Copy; Gold – Lab Copy for Return to Region; Yellow – Data User**; Pink [redacted] Copy for Return to Data User**

EPA Form 9110-3

SEE REVERSE FOR ADDITIONAL STANDARD INSTRUCTIONS
*SEE REVERSE FOR PURPOSE CODE DEFIN[redacted]S

A21-012-7 REV. 3/94

[redacted]er me[redacted]rganiz[redacted]ich co[redacted]he la[redacted]ervice[redacted]50202[redacted]

Figure 3

C. Regional Information: If sampling is in support of oversight activities, indicate here. If this is an enforcement site, record "TGB102." If not, record "TFA102."

D. NonSuperfund Program: If sampling is not done under the Superfund program, enter the name of the program (e.g., RCRA).

E. Site Name, City, State: Complete as instructed.

F. Site Spill ID: Enter ID code provided by the office.

G. Region No.: Enter "Region 5."

H. Sampling Company: Enter "CH2M HILL."

I. Sampler Information: Complete as instructed.

J. Type of Activity:

SF—Superfund lead
PRP—PRP lead
ST—State lead
FED—Federal lead
PA—Preliminary assessment
SSI—Screening site investigation
LSI—Listing site investigation
RIFS—Remedial Investigation/Feasibility Study
RD—Remedial design
O&M—Operation & Maintenance
NPLD—National Priorities List delete
CLEM—Classic emergency
REMA—Removal assessment
REM—Removal
OIL—Oil response
UST—Underground storage tank response

K. Shipping Information: Complete as instructed.

L. Ship To: Enter laboratory name, address and sample recipient/custodian.

M. Case No.: Complete as instructed.

N. Sample Numbers: For routine organic/inorganic samples, enter the CLP numbers from the "stick-on" labels. For SAS samples shipped to a CH2M HILL-procured laboratory, enter the unique CH2M HILL-generated sample number.

O. Sample Information: Complete as instructed.

P. Regional Specific Tracking Number or Tag Number: Enter sample tag number(s).

Q. Station Location Number: Enter sample identifier (as defined in the QAPP).

R. Time/Date: Complete as instructed. Use military time.

S. Sampler Initials: OPTIONAL.

T. Corresponding CLP Organic/Inorganic Sample Number: Enter CLP sample number (from "stick-on" labels) of corresponding sample from same location. Not applicable to SAS forms.

U. Designated Field QC: Indicate QC status when applicable (field blanks, trip blanks, duplicates, MS/MSD, etc.).

V. Sampling Status: Is the sampling for this Case/SAS complete? Circle one.

W. Page 1 of : Record number of documents enclosed in cooler.

X. MS/MSD and/or Duplicate: List samples.

Y. Additional Samplers Signatures: OPTIONAL.

Z. Chain of Custody Seal No.: Enter the numbers that appear on the custody seals to be used to seal the cooler (there should be two).

AA. "Relinquished by" and "Time/Date": Complete as instructed. Use military time.

Distribution: For RAS the **Laboratory Copy** and **Laboratory Copy for Return to SMO** are included with the shipment. The **Region Copy** and **SMO Copy** are returned to the office. For SAS the **Laboratory Copy for Return to Region** and **Laboratory Copy**

for Return to Data User are included with the shipment. The **Region Copy** and **Data User Copy** are returned to the office.

Notice of Transmittal (Figure 4)

1. Enter name of team leader.

2. Enter team leader's firm name.

3. Enter CH2M HILL project number.

4. Enter case number.

5. Enter date.

6. Enter number of samples shipped.

7. Enter matrix of samples.

8. Enter the site name in words.

9. Enter the location of the site (city, state).

CH2M HILL Chain-of-Custody Form, Sample Labels, and Custody Seal Forms (Figures 5 and 6)

Samples collected for the treatability test to be conducted by CH2M HILL will be documented with CH2M HILL paperwork. Figure 5 shows the CH2M HILL chain-of-custody form, and Figure 5a shows the instructions for the form that are printed on the reverse side of the form. Figure 6 shows the CH2M HILL sample label and custody seal.

Figure 4
Notice of Transmittal

Date:

To: CH2M HILL
411 E. Wisconsin Avenue, Suite 1600
P.O. Box 2090
Milwaukee, WI 53201

Attn: Cherie Wilson

From: ____________________ / ____________________
(name) (firm)

CH2M HILL Project No.: ____

Enclosed are appropriate copies of the sample documentation forms completed under

Case No. ______ for the ___________, 19__ shipment of ____ ________ samples
(qty) (matrix)

from the _________________________ site located in _______________, _______.

MKE10013499.WP5

CH2M HILL
QUALITY ANALYTICAL LABORATORIES

CHAIN OF CUSTODY RECORD AND AGREEMENT TO PERFORM SERVICES

CH2M HILL Project # ☐☐☐☐☐☐☐☐.☐☐.☐☐

Purchase Order #

Project Name

Company Name/CH2M HILL Office

Project Manager & Phone #
Mr. [ ]
Ms. [ ]
Dr. [ ]

Report Copy to:

Requested Completion Date:

Sampling Requirements: SDWA ☐ NPDES ☐ RCRA ☐ OTHER ____

Sample Disposal: Dispose ☐ Return ☐

OF CONTAINERS

LAB TEST CODES

ANALYSES REQUESTED

SHADED AREA - FOR LAB USE ONLY

Lab 1 # | Lab 2 #

Quote # | Kit Request #

Project #

No. of Samples | Page | of

COC Rev | Login | LIMS Ver | Ack Gen

Sampling Date	Sampling Time	Type COMP	Type GRAB	Matrix WATER	Matrix SOIL	CLIENT SAMPLE ID (9 CHARACTERS)	# OF CONTAINERS	ANALYSES REQUESTED										REMARKS	LAB 1 ID	LAB 2 ID

Sampled By & Title (Please sign and print name) | Date/Time | Relinquished By (Please sign and print name) | Date/Time

Received By (Please sign and print name) | Date/Time | Relinquished By (Please sign and print name) | Date/Time

Received By (Please sign and print name) | Date/Time | Relinquished By (Please sign and print name) | Date/Time

Received By (Please sign and print name) | Date/Time | Shipped Via: UPS BUS Fed-Ex Hand Other____ | Shipping #

Work Authorized By (Please sign and print name) | Remarks

HAZWRAP/NESSA: Y N
QC Level: 1 2 3 Other:
COC Rec | ICE
Ana Req | TEMP
Cust Seal | Ph

Instructions and Agreement Provisions on Reverse Side

Figure 5

DISTRIBUTION: ORIGINAL - LAB, Yellow - LAB, Pink - Client
REV 11/92 FORM 340

CHAIN OF CUSTODY INSTRUCTIONS

CH2M HILL Project #:	CH2M HILL project number to be charged for work.
Purchase Order #:	Purchase order to be charged for work (OTC clients).
Project Name:	Name of project which the samples support.
Company Name/CH2M HILL Office:	Name of the company or CH2M HILL office requesting the work. Correspondence will be sent to the company address or CH2M HILL office.
Project Manager & Phone #:	Name and phone number of person who receives the laboratory report and can be contacted if questions arise.
Report Copy To:	Name and location of person to receive copy of laboratory report.
Requested Completion Date:	When the report is required. Normal Turnaround Time (TAT) = 23 days (30 days for Hazwrap C/D or CLP). Faster TAT must be prearranged through Client Services.
Sampling Requirements:	Program under which sampling and analysis are to be performed.
Sample Disposal:	Indicate whether the samples are to be returned to the project manager or disposed by the laboratory.
Sampling:	The date and time at which the sample was collected.
Type:	Indicate the type of sample (composite or grab) collected.
Matrix:	Indicate the sample matrix (water or soil).
Client Sample ID:	Identifier assigned by the project to uniquely identify the samples (must not exceed nine (9) characters).
Number of Containers:	The number of different containers for this line item or sample.
Analyses Requested:	Use one column for each parameter or group of parameters. Specific method numbers, parameter list, and TIC's should be indicated.
For Lab Use Only:	Do not mark in the shaded area.
Remarks:	Record any comments about each sample on the same line as the sample description, e.g., "Wastewater contains VOC's." Known high concentrations should be noted.
Sampled by and Title:	The person who took the sample signs this box and prints his/her name, title, date, and time when sampling was completed.
Relinquished By:	The sampler signs this box and prints his/her name, date, and time when the samples are given to someone else.
Received By:	The person who receives the samples signs here and prints his/her name, date, and time when the samples were accepted into his/her custody.
Sample Shipped Via:	How the samples are being shipped to the laboratory, e.g., "Fed Ex."
Air Bus Bill Number:	The number on the shipping papers by which the package can be traced.
Work Authorized By:	Printed name and signature of person authorizing the initiation of laboratory work.
Remarks:	Record any comments regarding the samples as a whole. Additional parameters or special requirements should be indicated.

Figure 5a

CH2M HILL

CUSTODY SEAL

Date ______________________ ______________________

Signature

CH2M HILL

PH. (205) 271-1444
Montgomery Office
2567 Fairlane Drive
Montgomery, Alabama 36116

CLIENT ______________________

SAMPLE NO. ______________________

LOCATION ______________________

____

ANALYSIS ______________________

____

PRESERVATIVE ______________________

DATE ____________ BY ______________

Figure 6

Packaging and Shipping Procedures

Low-Concentration Samples

1. Prepare coolers for shipment.

   - Tape drains shut.
   - Affix ''This Side Up'' labels on all four sides and ''Fragile'' labels on at least two sides of each cooler.
   - Place mailing label with laboratory address on top of coolers.
   - Fill bottom of coolers with about 3 inches of vermiculite or use performed poly-foam liner.
   - Place appropriate traffic reports, SAS packing lists, or regional field sheets and chain-of-custody records with corresponding custody seals on top of each cooler.

2. Arrange decontaminated sample containers in groups by sample number.

3. Mark volume levels on bottles with a grease pencil.

4. Secure appropriate sample tags around lids of containers with string or wire.

5. Secure container lids with strapping tape.

6. Arrange containers in front of assigned coolers.

7. Affix appropriate adhesive labels from assigned traffic report to each container. Protect with clear label protection tape.

8. Seal each container within a separate plastic bag.

9. Arrange containers in coolers so that they do not touch.

10. If ice is required to preserve the samples, cubes should be repackaged in double zip-loc bags and placed on and around the containers (especially on VOA vials).

11. Fill remaining spaces with vermiculite (or place poly-foam liner cover on top of samples).

12. Sign chain-of-custody form (or obtain signature) and indicate the time and date it was relinquished to Federal Express.

13. Separate copies of forms. Seal proper copies within a large zip-loc bag and tape to inside lid of cooler. Distribute remaining copies as indicated in the following sections.

14. Close lid and latch.

15. Carefully peel custody seals from backings and place intact over lid openings (right front and left back). Cover seals with clear protection tape (Figure 10).

16. Tape cooler shut on both ends, making several complete revolutions with strapping tape. **Do not** cover custody seals (see Figure 10).

17. Relinquish to Federal Express. Place airbill receipt inside the mailing envelope and send to the sample documentation coordinator along with the other documentation.

APPENDIX D
NON-CLP ANALYTICAL REQUEST FORMS

U.S. Environmental Protection Agency
Central Regional Laboratory
536 S. Clark Street, Chicago, Illinois 60605
PHONE: (312) 353-2720   FAX: (312) 886-2591

NON-CLP ANALYTICAL SERVICES
Client Request

A. EPA Region and Site Name: Region V, N.W. Mauthe Company

B. RSCC Representative: Brian Freeman

C. Telephone Number: (312) 353-2720

D. Date of Request: January 20, 1995

Please provide below a description of your request for Non-CLP Analytical Services. In order to most efficiently obtain laboratory capability for your request, please address the following considerations, if applicable. Incomplete or erroneous information may result in delay in the processing of your request. Please continue response on additional sheets, or attach supplementary information as needed.

1. General description of analytical service requested:

Analysis of subsurface soil samples for total chromium.

2. Definition and number of work units involved (specify whether whole samples or fractions; whether organics or inorganics; whether aqueous or Soil and sediments; and whether low, medium, or high concentrations):

25 subsurface soil samples will be collected and analyzed for low concentration total chromium.

These numbers, inclusive of QC samples, are only estimates.

3. Purpose of analysis (specify whether Superfund (Remedial or Enforcement), RCRA, NPDES, ETC.):

Superfund remedial.

4. Estimated date(s) of collection: June 1995

5. Estimated date(s) and method of shipment:

Method of shipment will be daily shipment by overnight carrier, or same day delivery by courier.

6. Approximate number of days results required after lab receipt of samples:

Sample results will be required no later than 7 days after sample receipt.

7. Analytical protocol required (attach copy if other than a protocol currently used in this program):

The soils shall be prepared according to EPA SW-846 Method 3050A.

Inorganic analysis will be performed as per EPA SW-846 Method 7191.

The required method detection limit for this procedure shall be ≤ 10 µg/L. The instrument detection limit shall be ≤ 2.5 µg/L.

8. Special technical instructions (if outside protocol requirements, specify compound names, CAS numbers, detection limits, etc.):

100 grams of soil sample will be collected and stored at 4°C until the time of analysis.

Any sample remaining after digestion should be stored at 4°C until the validation and the acceptance of the sample result.

The IDL must be shown to have been met prior to the analysis of any samples.

Each calibration blank and QC audit solution must contain the same nitric acid concentration as the samples, or diluted samples.

The sample solutions analyzed must have their matrix concentration fully documented in the raw data.

Each analytical determination must have the resulting absorbance clearly recorded and documented in their order of determination.

The calibration range of the GFAA analyses can not be exceeded. Dilute any sample that does exceed the calibration range.

The soil results shall be reported on a dry weight basis.

9. Analytical results required (if known, specify format for data sheets, QA/QC reports, Chain-of Custody documentation, etc.). If not completed, format of results will be left to program discretion.

The deliverables to be included shall at a minimum consist of the following.

1. A hard copy data package to include:
   a. all sample results and QA/QC results, cross referenced with field and laboratory sample ID numbers.

   b. all raw data, including but not limited to:
      1. copies of the chain-of-custodies;
      2. bench records for the following,
         a. sample weight,
         b. final and dilution volumes,
         c. sample printouts (for all field samples, blanks, and QA/QC samples performed on a project related sample),
         d. computer or hand generated data,
         e. and calculations;
      3. instrument calibration records (readings and linear regression data);
      4. chemist observations or notes;
      5. and soil results reported on a dry weight basis.

o Provide a written case narrative of the results, which shall include any unusual occurrences associated with the project analyses.

o All data and records provided by the laboratory must be legible and the data must be properly labelled.

10. Other (use additional sheets or attach supplementary information, as needed):

---

11. Name of sampling/shipping contact: Dave Shekoski

Phone: (414) 272-2426

I. QUALITY CONTROL REQUIREMENTS

Audits Required	Frequency of Audits	Limits* (±% or conc)
Preparation Blank	At least 1 per group of 10 or fewer samples	≤ IDL
Lab Duplicate	At least 1 per group of 10 or fewer samples	± 20% for aqueous and ± 35% or RPD is ≤ MDL.
Calibration Blank	At least 1 per group of 10 or fewer samples	≤ IDL
ICVs and CCVs	At least 1 per group of 10 or fewer samples	ICV = r ≥ 0.995 CCV = ± 10%
Matrix Spike	At least 1 per group of 20 or fewer samples	75-125%
Lab Control Spikes	1 per group of 20 or fewer samples	80-120%

III. Action Required if Limits are Exceeded:

Take corrective action and contact CH2M HILL.

APPENDIX D
CLEANUP VERIFICATION PLAN

Cleanup Verification Plan

Introduction

The goal of the RA is remove hot spot soil—soil that contains chromium at levels that exceed 500 mg/kg. The extent of this level of contamination was estimated during the preparation of the feasibility study (FS) based on the results of the remedial Investigation (RI). However, the estimated area is simply an approximation. In order to determine if the hot spot has been removed, verification samples will be collected from the base of the excavation and from the excavation sidewalls for comparison to the cleanup goal. This cleanup verification plan (CVP) was developed to provide a statistical basis for the selection of the sample locations.

The subcontractor will be directed to remove soil within the area designated as a hot spot. Once the hot spot area has been excavated, verification sampling will be performed to determine if remediation is complete. If the results of the cleanup verification sampling show that the chromium concentration exceeds 500 mg/kg, the subcontractor will be directed to remove more soil. This validation sampling, analysis, and soil excavation sequence will be continued until the hot spot removal is fully validated.

The subcontractor will not be able to excavate the entire hot spot area at one time because of the limited working space at the site. CH2M HILL will be taking samples for field analysis during the removal activities to evaluate the appropriate disposal methods for each load of soil. Additional field samples will be taken from the sidewalls and base of areas excavated. If the results of the field testing indicate that removal of the hot spot has been achieved before the estimated limits are reached, the excavation will be considered complete pending the results of the verification samples.

Sampling will be done in a grid pattern based on the sample size calculated in accordance with U.S. EPA guidance. Details of the sampling plan are discussed below. If the results of the field or laboratory testing indicate that the hot spot area will change dramatically (by 50 percent in either direction), this plan will be re-evaluated.

Objective

The selected remedy for the site includes the excavation of soils with a total chromium concentration greater than 500 mg/kg. Removal of these hot spots is estimated to result in the removal of about 80 percent of the chromium contaminant mass.

The objective of this CVP is to define the procedures and criteria to be used during hot spot excavation to achieve the predetermined cleanup goal. The site will not be considered remediated until the results of the sampling program indicate that the cleanup goal has been achieved.

Sample Size Calculation

To determine when the cleanup goal has been reached, the mean soil concentration was used in the statistical assessment decision for sample size calculation.[1] The sample size was calculated using the following equation:

$$n_f = \sigma^2 \frac{(Z_{1-\beta} + Z_{1-\alpha})^2}{(Cs - \mu_1)^2}$$

where:

n_f	=	sample size
σ^2	=	estimated variance based on historical data
$Z_{1-\beta}$	=	critical table value for the normal distribution for $1-\beta$ power
$Z_{1-\alpha}$	=	critical table value for the normal distribution for $1-\alpha$ confidence
Cs	=	cleanup goal
μ_1	=	the mean concentration where the site should be declared clean with a high probability

The sample size for the site was calculated using the soil data presented in Tables D-1 and D-2 in the RI. A worst case scenario was assumed where the mean concentration is not reduced from the original data—that is, it was not assumed that every sample would be ''cleaned down'' to 500 mg/kg of total chromium. The mean was calculated to be about 300 mg/kg. The standard deviation is assumed to be one-third of the original standard deviation calculated from the RI data and is estimated to be 400 mg/kg.

---

[1] *Methods for Evaluating the Attainment of Cleanup Standards, Volume 1: Soils and Solid Media*, U.S. EPA, 1989.

The sample size was calculated using a 95 percent confidence ($\alpha=0.05$) and 80 percent power ($\beta=0.20$). Appropriate Z-values were used. The calculation resulted in a sample size, n_f, of 25.

Sampling Plan

A systematic sampling plan will be used to determine the location of the cleanup verification samples. Soil sample locations will be identified by X and Y coordinates within a grid system.

The distance, L, between sampling locations was determined using the following equation:

$$L=\sqrt{\left(\frac{A}{n_f}\right)}$$

where:

A	=	sample area
n_f	=	sample size

The sample area was divided into two parts—the base of the excavation and the excavation sidewalls. The distance between sampling locations was determined separately for each part. The sample size was proportionally divided between the base and sidewall excavation. The base covers 83 percent of the sample area, and the sidewalls cover 17 percent of the sample area. This translates into a sample size of 20 for the base and 5 for the sidewalls.

Base Excavation Sampling Plan

The sample area for the base excavation is 35,000 square feet. For a sample size of 20, the spacing between adjacent points is determined to be 42 feet.

A random coordinate was determined to locate one point in the grid using the following equations:

$$X = X_{min} + (X_{max} - X_{min}) * RND$$
$$Y = Y_{min} + (Y_{max} - Y_{min}) * RND$$

Where RND is the next unused random number between 0 and 1 in a sequence of random numbers taken from a table of random units (Samuel M. Selby, *Standard Mathematical Tables*, 21st edition, the Chemical Rubber Co., 1973). Using X_{min} and Y_{min} = 125, X_{max} = 450 feet, and Y_{max} = 375 feet; and random numbers of .105 and .223; the random start was determined to be (X, Y) = (34, 56).

The sample grid is shown in Figure D-1. The sampling locations are the points at the intersections of the gridlines that are within the sample area boundaries. The grid intersections that lie outside the sample area will be ignored.

The location of a sample point in the field will be approximate because the measurement has some inaccuracies and there is judgment on the part of the field staff in locating the sample point.

The soil sample will be collected at the sample location from an area about 1 foot square. Soil will be collected from each corner of the square and from the center of the square and composited.

Sidewall Excavation Sampling Plan

The sample area for the base excavation is 7,200 square feet. For a sample size of 5, the spacing between adjacent points is determined to be 38 feet.

The location of the start of the sampling grid will be determined in the field based on the subcontractor's sequencing of construction. Using a random factor of .241 selected from a table of random units, the starting point will be located (0.241)(38)=9 feet from the northeast edge of the excavation and will continue along the sidewalls at a spacing of 35 feet.

The depth of the sample will be determined using the following equation:

$$Y = Y_{max} \times RND$$

Where Y_{max} = the depth of the excavation and RND is the next unused random number between 0 and 1 in a sequence of random numbers taken from a table of random units.

The soil sample will be collected at the sample location from the surface of the sidewall to a depth of 6-inches beyond the sidewall.

Implementation of Sampling Plan

The sampling grid will be used in the following manner:

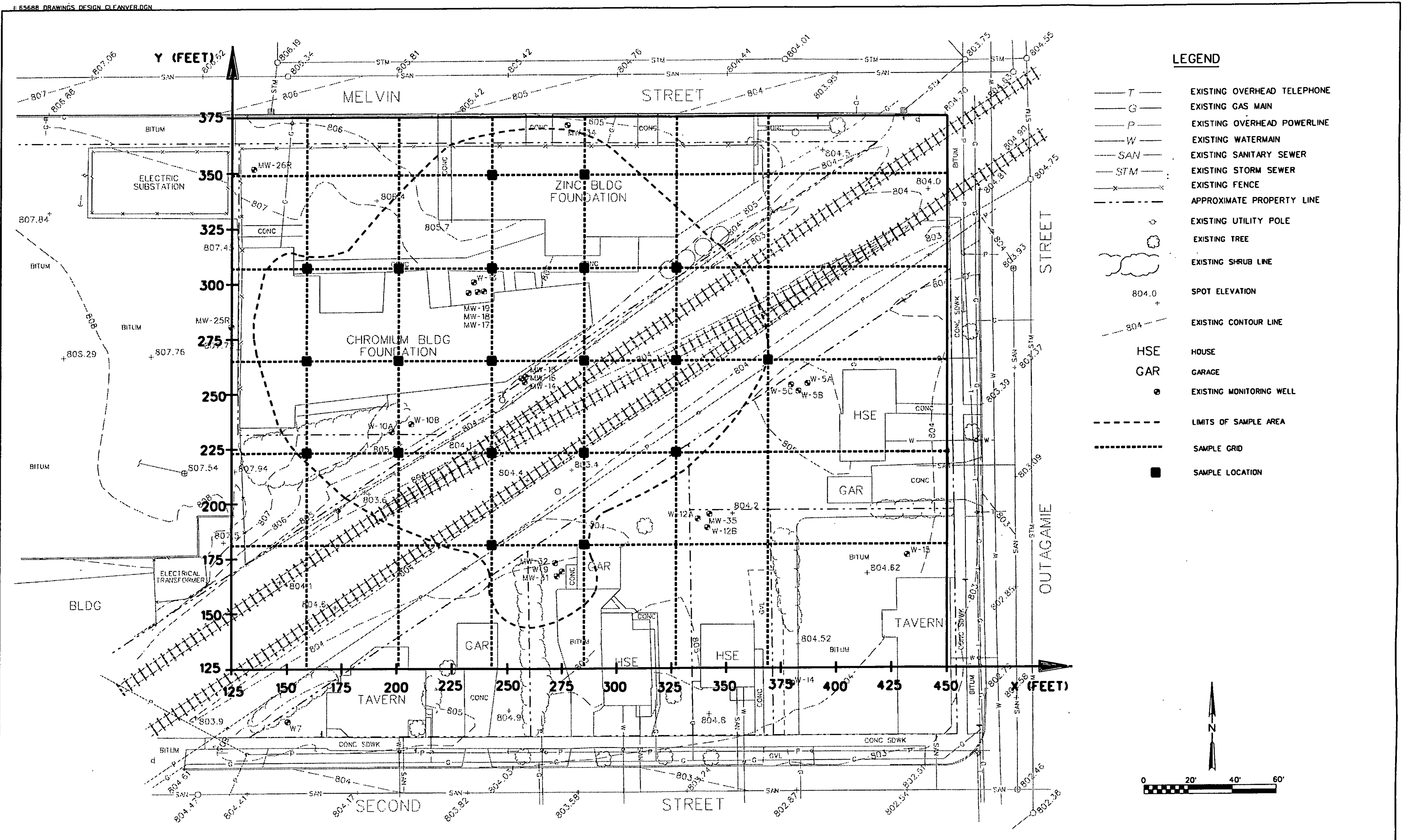


FIGURE D-1
CLEANUP VERIFICATION GRID
N.W. MAUTHE CLEANUP VERIFICATION PLAN

CH2M HILL

- Locate the sample coordinates.

- Follow the procedures described in the Quality Assurance Project Plan for sample collection and analysis.

- If the mean total chromium concentration is less than or equal to 500 mg/kg, the cleanup is validated and the excavation may be backfilled.

- If the mean total chromium concentration is greater than 500 mg/kg, additional excavation is required.

Because the subcontractor will not have the entire excavation area open at any one time, the full sample size will not be available for evaluation when the first excavations are completed. The evaluation of these first excavations will be made based on a smaller sample size. A mean will be calculated for each area as it is completed and will be revised as additional cleanup samples are analyzed.

Once the entire sample has been evaluated, the upper 95 percent confidence limit around the population mean will be calculated using the following equation:

$$\mu_{95} = \bar{x} + t_{1-\alpha,df} \frac{s}{\sqrt{n_f}}$$

where:

μ_{95}	=	upper 95 percent confidence limit
$t_{1-\alpha,df}$	=	statistical factor based on α and df (degree of freedom)
$\bar{x}$	=	mean
s	=	standard deviation
n_f	=	sample size

If μ_{95} is less than the cleanup goal, then the hot spot removal will be considered complete.

Additional excavation will be performed in the following manner:

- The subcontractor will be directed to excavate an additional foot of material within the area of the sampling location with the highest exceedance of the cleanup goal. This area is defined as a square area with a length (l) equal to the distance between sampling locations centered on the sampling location.

- A random sampling point will be selected within the excavated square using the following equation:

  X = (l) * RND
  Y = (l) * RND

  Where RND is the next unused random number between 0 and 1 in a sequence of random numbers taken from the table of random units.

- The resulting concentration from the sample will be evaluated in the same manner as the first sample and substituted into the sample population for reevaluation of the mean concentration.

Excavation will continue until cleanup has been verified.

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APPENDIX E
CONTINGENCY PLAN

Contingency Plan

Emergency Response Plan

Pre-Emergency Planning

The Site Safety Coordinator (SSC) should perform the applicable pre-emergency planning tasks before starting field activities;

- Locate nearest telephone to the site and inspect onsite communications.
- Locate chemical, safety, radiological, and biological hazards.
- Confirm and post emergency telephone numbers and map of route to hospital.
- Post site map marked with location of emergency equipment and supplies.
- Review emergency response plan for applicability to any changes in site conditions, alterations to onsite operations, or personnel availability.
- Designate one vehicle as the emergency vehicle. Place hospital directions and map inside. Keep keys accessible during field activities.
- Inventory and check site emergency equipment and supplies.
- Review emergency procedures for personnel injury, exposures, fires, explosions, chemical and vapor releases with field personnel.
- Locate onsite emergency equipment and supplies of clean water.
- Verify local emergency contacts, hospital routes, evacuation routes, and assembly points.
- Drive route to hospital.
- Review names of onsite personnel trained in first aid and CPR.
- Review notification procedures for contacting CH2M HILL's medical consultant and team members' occupational physicians.
- Brief new workers on the emergency response plan.

Emergency Equipment and Supplies

The SSC should mark the locations of the following emergency equipment on the site map and post the site map in the support zone:

- 20-lb ABC fire extinguisher
- Industrial first aid kit
- Facility emergency equipment
- Additional emergency equipment
- Nearest phone

Emergency Medical Treatment

The SSC will assume charge during a medical emergency until the ambulance arrives or the injured person is admitted to the emergency room. The following procedure will be implemented:

- Prevent further injury.
- Initiate first aid and CPR.
- Call the ambulance and hospital.
- Determine if decontamination will make injury worse.
- Make certain that injured person is accompanied to emergency room.
- Notify the Site Manager of the injury.
- Notify the District or Regional Health and Safety Manager.
- Notify the injured person's human resources department.
- Prepare an incident report to be submitted to the Corporate Director of Health and Safety and the Corporate Human Resources Department within 48 hours.

Evacuation

- Evacuation routes will be designated by the SSC before beginning work.

- Onsite and offsite assembly points will be designated before beginning work.

- An air horn will be used for the emergency signal.

- Personnel will exit the work area and ensemble at the onsite assembly point upon hearing the emergency signal for evacuation.

- Personnel will assemble at the offsite point upon hearing the emergency signal for a facility evacuation.

- The SSC and a "buddy" will remain onsite after the site has been evacuated (if possible) to assist local responders and advise them of the nature and location of the incident.

- The SSC will account for all personnel in the onsite assembly zone.

- A person designated by the SSC (before work) will account for personnel at the offsite assembly area.

- The SSC is to write up the incident as soon as possible after it occurs, and submit a report to the Corporate Director Health and Safety.

Emergency contacts and emergency notification procedures are presented on the attached forms. These forms should be posted in the field trailer for quick and easy access in the event of an emergency.

Local Notification and Involvement

An Emergency Response Meeting will be held at the site before the initiation of remedial action activities. The meeting attendees should include:

- Construction Manager
- CH2M HILL Site Safety Officer
- CH2M HILL Site Safety Coordinator
- Subcontractor Site Superintendent
- Subcontractor Safety Officer
- Fire Department Representative
- Police Department Representative
- Hospital Representative
- Emergency Response Representative

The meeting agenda will include the following:

- Description of work
- Description of site contamination
- Restriction to site access
- Forced evacuation assembly points
- Contact persons

First Aid Medical Information

At a minimum, one person onsite at all times will be trained in first aid and CPR. The SSC will review the names of trained personnel on a regular basis and will note trained personnel during health and safety briefings. The SSC is trained in first aid and CPR and will be responsible for first aid during emergencies. The SSC will designate a trained individual for those occasions when he or she is not onsite.

In the event of an emergency, the information noted on the Emergency Response Numbers form will be provided to the emergency response provider.

Spill Prevention, Control, and Countermeasures Plan

A spill prevention, control, and countermeasures plan will be developed for the operation of the groundwater treatment facility to address spills that may occur during operation of the facility.

Emergency Numbers

Service	Name/Location	Phone Number
Ambulance	Appleton Fire Department 700 North Drew Street	911 (414) 832-5810
Hospital	St. Elizabeth Hospital 1506 South Oneida Street	(414) 738-2100
Police	Appleton Police Department 2222 South Walnut Street	911 (414) 832-5500
Fire Department	Appleton Fire Department 700 North Drew Street	911 (414) 832-5810
Poison Control	St. Elizabeth Hospital 1506 South Oneida Street	1 (800) 942-5969
Gas Company	Wisconsin Gas Company	(414) 735-1246
Electric Company	Wisconsin Electric Power Company	(414) 735-0705
Water Department	City of Appleton	(414) 832-5599
State Emergency	IEMA	1 (800) 782-7860

Service	Name/Location	Phone Number
Federal Emergency	NRC	1 (800) 424-8802

WHEN CALLING 911 BE PREPARED TO ANSWER THE FOLLOWING QUESTIONS

WHO: N.W. Mauthe Superfund Site

WHERE: 725 South Outagamie Street (the corner of Outagamie Street and Melvin Street)

HOW MANY ARE INJURED?

DESCRIBE TYPE OF INJURIES/ILLNESS AND FIRST AID BEING ADMINISTERED

AN INDIVIDUAL MUST MEET THE EMERGENCY VEHICLE AT THE SITE ENTRANCE AND DIRECT THEM

In case of evacuation all site personnel will meet at the northwest corner of the intersection of Melvin Street and Outagamie Street for a head count.

Emergency Notification Procedure

If an emergency or unusual situation should come to your attention, it is your responsibility to notify others of the situation. An emergency can be an injury to a worker, an evacuation, fire, etc. An unusual situation could involve equipment failures, work that is not being performed appropriately, or anything involving risk or exposure to the public.

Failure to provide notification of any incident places everyone at a disadvantage. This must be avoided. Therefore, if you become aware of any emergency or unusual situation during your work period, provide notification as follows as soon as the conditions permit.

Following notification of emergency services, primary notification is to the CH2M HILL Site Manager or Construction Manager.

Name	Work Telephone	Home Telephone
Cathy Barnett, Site Manager	(414) 272-2426	(414) 352-8589
Alan Parker, Construction Man.	(414) 272-2426	(414) 354-1538

If the CH2M HILL Site Manager or Construction Manager cannot be reached, notify one of the following:

Name	Work Telephone	Home Telephone
Jeff Keiser	(414) 272-2426	(414) 422-0618
Bill Hubbard	(414) 272-2426	(414) 355-8025

If they cannot be reached, try to contact one of the following:

Name	Work Telephone	Home Telephone
Christine Culligan	(414) 272-2426	(414) 769-1377
Al Sloan	(414) 272-2426	(414) 549-5664

Do not stop calling until at least one of the above persons has been notified of the situation. Be prepared to identify the facts of the matter, status of emergency services, effect on the public, and any other pertinent information.

Do not talk to any members of the press, even if you are aware of all the facts. Refer the press to Jon Peterson/U.S. EPA (work telephone—(312) 353-1264). Do not interfere with any rescue or corrective operations. Cooperate and truthfully answer questions put to you by the police or other such official investigators.

Your cooperation in complying with the above emergency notification procedure is required.

PLEASE POST IN A LOCATION FOR READY REFERENCE

APPENDIX F
GROUNDWATER MONITORING PLAN

MKE100154D9.WP5/6

Groundwater Monitoring Plan

Introduction

Long-term monitoring will be conducted at the N.W. Mauthe site to evaluate the performance of the selected remedial action. Monitoring will consist of groundwater sampling to evaluate changes in groundwater quality and water table elevations to evaluate groundwater flow at the site. The groundwater collection system will remediate onsite groundwater contamination by extraction and will prevent the offsite migration of contaminated groundwater through hydraulic gradient control. Long-term operation of the collection system should also lead to the achievement of the Preventive Active Limits (PALs).

Objectives of Groundwater Monitoring Plan

The objectives of the groundwater monitoring program are to:

- Provide groundwater quality data to determine if groundwater contaminant concentrations are reducing

- Provide data to evaluate the hydraulic gradient control provided by the groundwater collection system

- Provide data to evaluate the containment of contaminated groundwater onsite

- Provide a trigger for the implementation of additional or corrective measures if it is determined that the system is not performing

The overall objective is to evaluate the effectiveness of the remedial action.

Background Information

The groundwater collection system consists of three trenches referred to as the West, Southeast, and Central Trenches (see Figure F-1). The three groundwater collection trenches range from 16 to 25 feet deep. The West and Southeast Trenches are located beyond the point at which PALs are exceeded, i.e., beyond the extent of the groundwater plume. The Center Trench is designed to prevent further migration of hazardous substances from the property and to reverse the groundwater hydraulic gradient between the site and the residences to the south.

Sample Network and Rationale

The groundwater monitoring well network was designed to provide information on water quality at the site and adjacent residential properties and on containment of the groundwater. A groundwater model was developed as part of the feasibility study (FS). Based on this model, the capture zone for the groundwater collection trenches was estimated to range from 2 to 40 feet with a log average of 8 feet. Monitoring wells will be positioned within 10 feet of the centerline of the groundwater collection trenches to monitor containment. Additional monitoring wells will be placed onsite (behind the Central Trench) and between the Central Trench and the Southeast Trench to determine if groundwater mounding is occurring and to provide information on hydraulic gradient control. Groundwater wells are also positioned both upgradient and downgradient of the site to monitor groundwater quality. In addition, a Stevens continuous water level recorder will be placed in the Central Trench manhole to monitor water levels in the trench. This data will allow for the evaluation of trench performance and any potential plugging or fouling issues.

The groundwater monitoring network comprises three existing monitoring wells and seven new monitoring wells. Details on the three existing monitoring wells are provided in Table F-1.

Table F-1
Existing Monitoring Wells

Monitoring Well Number	Approximate Total Depth (ft)
W-2	15
W-8	15
W-15	15

The newly proposed monitoring wells will be located as described below (see Figure F-1):

- Monitoring wells W-2 and MW-108 will be located upgradient of the site to monitor background conditions. W-2 will also monitor any petroleum contamination that may be migrating onsite from an upgradient source.

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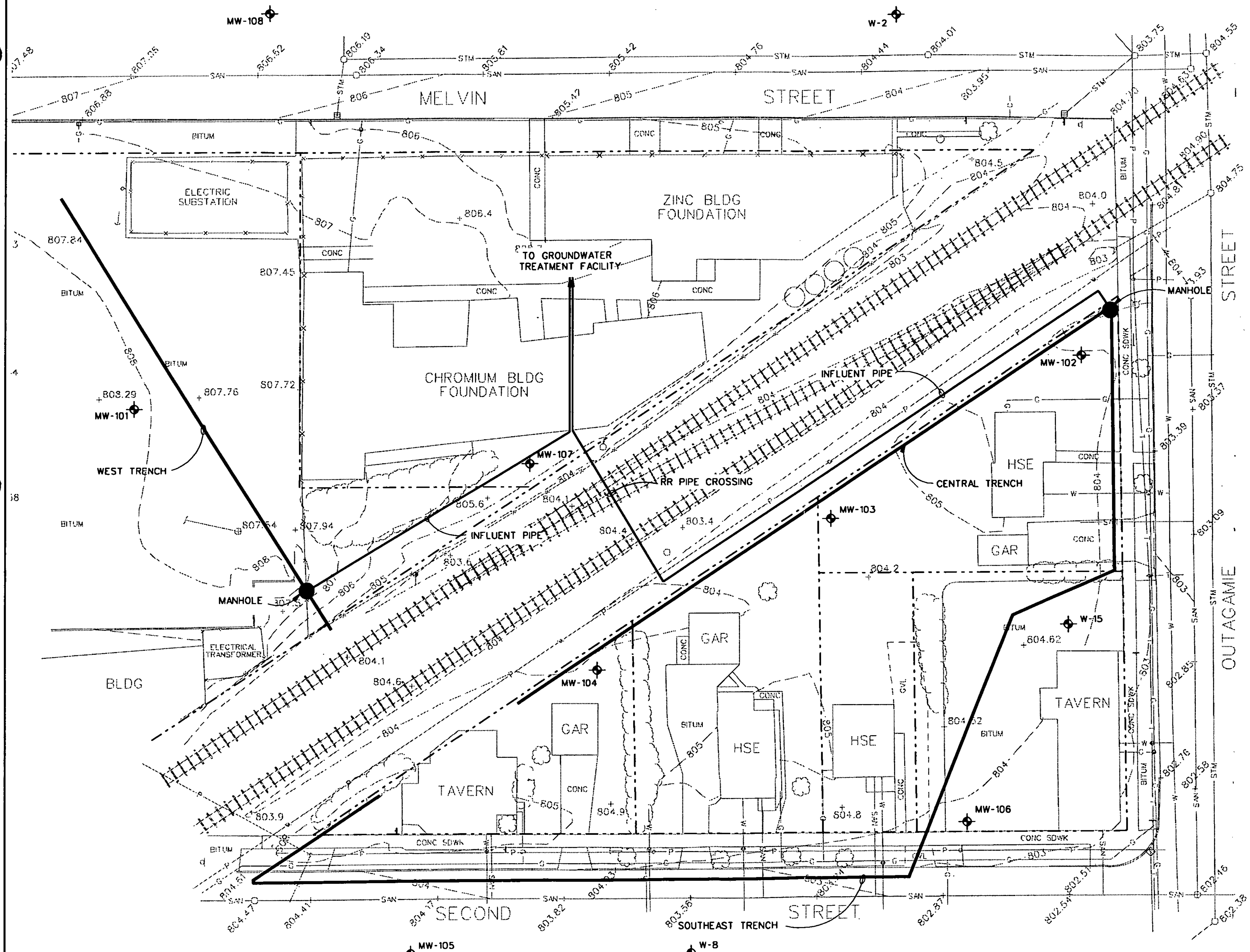

NOTES:

1. MONITORING WELLS W-2, W-8, AND W-15 ARE EXISTING. ADDITIONAL EXISTING MONITORING WELLS WILL BE ABANDONED DURING REMEDIAL ACTION.

2. MONITORING WELLS MW-101 THROUGH MW-108 WILL BE INSTALLED DURING REMEDIAL ACTION.

FIGURE F-1
GROUNDWATER COLLECTION SYSTEM AND MONITORING PLAN
GROUNDWATER MONITORING PLAN

CH2M HILL

- Monitoring well MW-101, which is located west of the site, will be used to monitor the effectiveness of the West Trench in preventing the migration of groundwater contamination.

- Three downgradient wells—MW-102, MW-103, and MW-104— will be used to monitor changes in groundwater quality downgradient of the Central Trench and to monitor hydraulic gradient control.

- Four wells—W-8, MW-15, MW-105, and MW-106—will be used to monitor changes in groundwater quality outside of the Southeast Trench. Monitoring wells MW-106 and W-15 will also be used to monitor hydraulic gradient control of the Southeast Trench.

- Monitoring well MW-107 will be positioned onsite to provide source area groundwater quality data and hydraulic gradient information upgradient of the Central Trench.

The seven new monitoring wells will be screened from the top of the water table to the base of the trenches to allow the capture of any groundwater passing though the groundwater collection trenches. Well depths are shown in Table F-2.

Table F-2
New Monitoring Wells

Monitoring Well Number	Approximate Total Depth (ft)
MW-101	28
MW-102	28
MW-103	27
MW-104	26
MW-105	16
MW-106	16

Table F-2 New Monitoring Wells	
Monitoring Well Number	**Approximate Total Depth (ft)**
MW-107	28
MW-108	28

Groundwater Sample Analysis

Parameters of Interest/Concern

Groundwater will be analyzed in the field and the laboratory for contaminants of concern (COCs). The parameters that make up each group are listed below. Field sampling and analyses will be performed in accordance with the *RI QAPP*.

Field Analyses

Groundwater elevations will be measured to the nearest 0.01 foot before purging and sampling the monitoring wells. The following field parameters will be analyzed shortly after collecting the groundwater samples:

- Temperature
- pH
- Specific conductance

Organic and Inorganic Analyses

Table F-3 lists the organic and inorganic parameters to be analyzed.

Table F-3 Contaminants of Concern	
Organic Parameters	**Inorganic Parameters**
Chloroform	Cadmium
1,1-dichloroethane	Chromium
1,1-dichloroethene	Cyanide
1,2-dichloroethene	Copper

Table F-3
Contaminants of Concern

Organic Parameters	Inorganic Parameters
Toluene	Mercury
1,1,1-trichloroethane	Manganese
1,1,2-trichloroethane	Zinc
Trichloroethene	
Benzene	
Xylene (total)	

Monitoring Frequency

Groundwater monitoring will be performed quarterly. The frequency of sampling and measurements will be re-evaluated after 1 year of data have been collected and evaluated.

Groundwater potentiometric surface elevations will be measured to monitor the capture of contaminated groundwater by the collection system. Groundwater elevations will also be used to adjust pumping rates needed to maintain the necessary zone of capture.

Data Evaluation

At the end of the first year of monitoring, quarterly data will be compiled to evaluate the performance of the groundwater collection system. These data will be used to identify and implement any corrective action required to maintain reliable operation.

After 2 years of quarterly monitoring, analytical results of the sampling program will be compiled. The analytical results will be averaged (where applicable) and the data evaluated to examine spatial and temporal trends. Data analyses will include:

- Plots of mean concentration versus time for each parameter analyzed
- Regression analyses on plots of moving average concentration versus time to determine direction of trends

Program Assessment

The monitoring program will be reassessed biennially. Specific adjustments to the program that may be necessary include:

- Analyte list—do analytes need to be added or deleted?

- Sampling frequencies—is quarterly sampling adequate or excessive?

- Monitoring well network—is the monitoring well network adequate? Do any wells need to be replaced or modified? Should additional wells be installed? Can some of the monitoring wells be deleted from the monitoring program?

- Monitoring Program—do the analytical data indicate that the overall concentrations are decreasing? Should the monitoring program continue?

At the end of the fifth year, all sampling results will be compiled. These analytical results will be averaged and evaluated for temporal trend. Compound concentrations will be compared with groundwater standards (PALs).

Appendix G
Construction Quality Assurance Plan

Section 1
Introduction

Purpose

This Construction Quality Assurance Plan (CQAP) for the ~~landfill~~ construction at the N.W. Mauthe site (Mauthe) provides for quality assurance (QA) activities during remedial action (RA). The CQAP, developed for the use of the Contractor, includes:

- Observation of construction activities
- Documenting that construction has been completed in general accordance with the plans and specifications and with QA procedures outlined in this plan

Scope and Limitations

Scope

The scope of this CQAP includes:

- Identifying the project participants and organizational structure
- Defining participants' responsibilities and authorities
- Outlining project communication
- Establishing quality levels and requirements
- Establishing project closeout guidelines

This CQAP identifies the project participants and their responsibilities and authorities, the documentation format, and general QA requirements for various project elements. The appendixes present QA requirements that relate to specific elements of construction and forms that will be used during construction to document QA activities.

Limitations

This CQAP has been prepared for the exclusive use of or for specific application to the remedial action at Mauthe. This CQAP does not apply to other components of construction.

Project Description

The Mauthe site is a former electroplating facility located at 725 South Outagamie Street in Appleton, Wisconsin. About 0.6 acre in size and triangular in shape, the site is located in an area of mixed commercial, light industrial, and residential properties. The facility consisted of two building (the Zinc and Chromium Buildings). The site is bordered by Melvin Street on the north, an asphalt parking lot owned by Miller Electric an Manufacturing Company on the west, and the Fox Valley & Western, Ltd., railroad on the southeast. Private residences are located immediately south of the railroad tracks and on the north side of Melvin Street (Figure 1-1).

Hard chromium plating was conducted in the Chromium Building from 1960 to 1976. Objects to be electroplated were rinsed with a chlorinated solvent to remove oils, then submerged in plating solution baths. Hydrogen gas and chromic acid vapors generated from the plating process were exhausted form the building by a ventilating fan, while splashes, drips, and spills from the plating and degreasing activities were directed to a shallow floor trench and channeled into the sanitary sewer system.

Zinc, cadmium, copper, and possibly silver were electroplated in the Zinc Building from 1978 to 1987. A *Pretreatment Baseline Report* submitted by the Mauthe Company to the City of Appleton on January 4, 1985, states that the company used 1,1,1-trichloroethane (27 gal/year) for parts degreasing and several plating bath solutions in the electroplating process. Liquid wastes were discharge, untreated, into the sanitary sewer system.

In 1982, the DNR received a report of yellow-green water in puddles south of the Chromium Building. Over the years, plating solutions and waste solvents had leaked from holding vats, tanks, and channels into surrounding soils. Additionally, plating tank solutions were allegedly discharged onto the ground outside the building by sump pumps.

The DNR began an investigation of the site in April 1982. Surface water removal actions also began at that time. A total of 18 monitoring wells were installed. Soil boring samples and groundwater samples revealed contamination at the site. Under contract to the DNR, Commercial Pumping and Incineration installed a shallow groundwater collection system parallel to the railroad track in May 1982. For 2 years, shallow groundwater and surface water were collected and transferred to the De Pere publicly owned treatment works (POTW). The Mauthe site was added to the NPL in 1989 as the result of several rounds of environmental sampling and health assessments.

A remedial investigation (RI) was performed by CH2M HILL from November 1991 to May 1992. The RI included monitoring well installation; surface and subsurface soil sampling; test pit excavation; groundwater, residential, sump, and sewer water sampling; hydraulic conductivity testing; surface water sampling; and videotaping of the sanitary and storm sewer lines. The results of the RI are documented in the *Remedial*

Investigation Report, N.W. Mauthe Site, Appleton, Wisconsin (CH2M HILL February 1993).

Soil and groundwater sampling results showed the greatest concentrations of hazardous substances in the area around the Zinc and Chromium Buildings. The chemicals most often detected above background levels or state groundwater standards include chromium (both hexavalent and total), zinc, cadmium, cyanide, trichloroethene, 1,1,1-trichloroethane, 1,1-dichloroethene, and toluene.

Subsurface soil contamination was detected to a maximum depth of 25 feet. It extended horizontally over the entire Mauthe property and to the south side of the railroad tracks adjacent to the property. Outside the process buildings area, the vertical extent of contamination is more limited and does not extend to the 25-foot depth observed near the buildings. Chromium is the most widely distributed contaminant of the chemicals analyzed for in the RI. Selected volatile organic compounds (VOCs) were detected in subsurface soils but have a more limited distribution.

Hexavalent chromium-contaminated groundwater extends over most of the block bordered by Melvin, Outagamie, and Second Streets. Most or all of the chromium in groundwater exists in the hexavalent form.

Surface water samples collected from puddles along the southern edge of the Mauthe property contained chromium and some VOCs.

A feasibility study (FS) was conducted by CH2M HILL to develop and evaluate remedial action alternatives for the site (*Feasibility Study Report, N.W. Mauthe Site, Appleton, Wisconsin, CH2M HILL, May 1993*). The DNR, in consultation with the United States Environmental Protection Agency (U.S. EPA), used the information presented in the FS to select a remedial action alternative in its Record of Decision (ROD) in accordance with the National Contingency Plan (NCP). The ROD was signed in March 1994. The remedial actions required at the site are as follows:

- Demolition and removal of the buildings on the Mauthe property
- Removal and disposal of containerized waste stored on the property
- Improvement or installation of foundation drain systems and cleaning, painting, or sealing of basement walls or floors, as needed, for homes or businesses in the area of the site affected by site contamination
- Excavation of soils with a total chromium concentration greater than 500 mg/kg

- Offsite treatment and disposal of the excavated soils
- Backfilling the excavation
- Capping the site with two feet of clay soil and topsoil, with the establishment of vegetative cover
- Installation of groundwater collection trenches and construction and operation of a groundwater treatment facility with discharge to the sanitary sewer
- Institutional controls to prevent access, excavation, disturbance of the cap, future excavation in contaminated soils, and installation of drinking water wells
- Monitoring the effectiveness of the groundwater treatment system
- Operation and maintenance of all systems

The demolition of site buildings and the removal and disposal of the containerized waste was accomplished in the fall of 1994 during remedial design.

Applicable Regulations and Guidance

This CQAP has been prepared to meet construction and QA requirements of the following:

- Hazardous and Solid Waste Amendments of 1984 to the Resource Conservation and Recovery Act (RCRA)
- CH2M HILL, *Construction Inspection Manual (CIM)*, revised January 1991

Key Concepts

Quality Assurance

QA refers to all activities designed to provide adequate documentation and confidence that materials and workmanship substantially meet the requirements of the project objectives.

Quality Control

QC refers to those actions taken by the manufacturer, fabricator, or contractor to confirm that materials and workmanship meet the requirements of the contract or purchase order and the applicable drawings and specifications. QC requirements are not specifically addressed in this document.

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Section 2
Responsibilities and Authority

Organizational Structure

The organizational structure of the construction team is shown in Figure 2-1. Key parties of the organization include the U.S. Environmental Protection Agency (U.S. EPA) and Wisconsin Department of Natural Resources (DNR), the Prime Contractor (CH2M HILL), and the Construction Subcontractor.

Responsibilities

U.S. EPA

The U.S. EPA is responsible for the overall construction of the facility. The U.S. EPA must demonstrate that the facility was constructed as specified in the design. The U.S. EPA will retain independent design, QA, and construction organizations to accomplish the work and will have the authority to hire and fire these organizations. The U.S. EPA also has the authority to accept or reject QA plans, reports, and recommendations of the contractor, and the materials and workmanship of the construction subcontractor.

DNR

The DNR has the responsibility and authority to review and accept, or reject, any design revisions or requests for variance to the remedial design. The DNR also has the authority to review all construction QA documentation during or after facility construction to confirm that procedures outlined in the approved CQAP were followed, and that the facility was constructed as specified in the design.

Contractor Site Manager

The site manager is responsible for contractor activities as stated in the ARCS V contract between the contractor and the U.S. EPA. The site manager provides and maintains qualified project staff, monitors and controls the budget, and is the primary contact with U.S. EPA on contractual matters. The site manager supervises the CH2M HILL design staff and assists them in resolving project related issues which cannot be adequately resolved at a lower level. The site manager will perform the majority of his or her duties from the CH2M HILL office in Milwaukee but will visit the site on an as-needed basis.

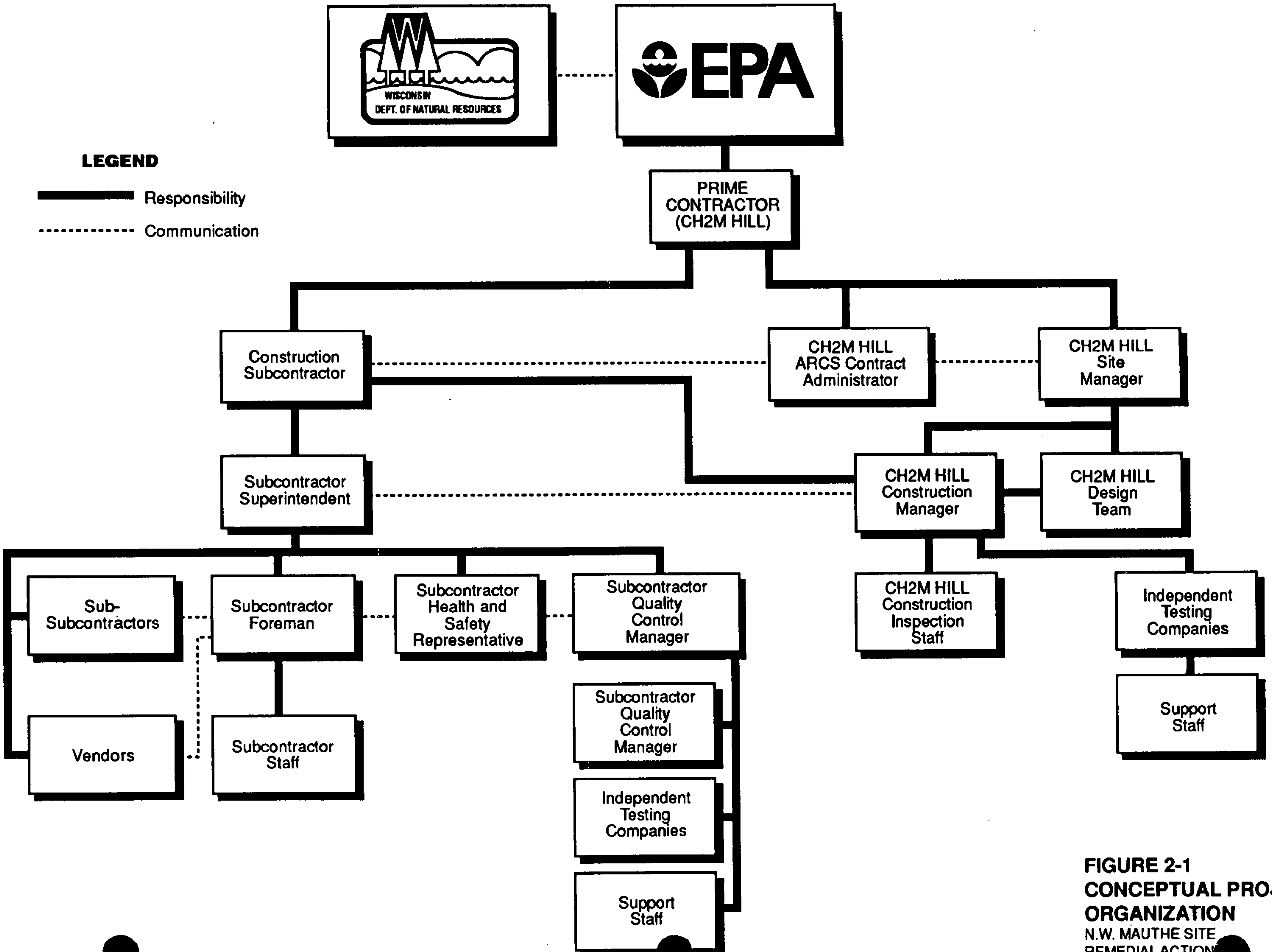


FIGURE 2-1
CONCEPTUAL PROJECT ORGANIZATION
N.W. MAUTHE SITE
REMEDIAL ACTION

Contractor Design Staff

The Design Staff's primary responsibility is to design the facility so that it will fulfill the operational requirements of the U.S. EPA and the performance requirements of the DNR. Design activities may not end until construction is completed. The design staff will:

- Clarify or interpret requirements of the plans and specifications
- Review submittals for conformance to the construction documents
- Review requests for design changes during construction
- Prepare design changes to account for unexpected site conditions or changes in construction or operation methodology

Resident Staff

The construction manager and field staff observe the construction subcontractors' materials and workmanship for compliance with the plans and specifications and can issue and enforce nonconformance report for subcontractor workmanship and materials that do not meet the requirements of the contract documents. The field staff has the authority to direct the subcontractor.

Construction Manager

The construction manager is directly responsible to the site manager for the field administration of the construction contract requirements during construction. He or she may have specific design review assignments during construction. In addition, the construction manager performs field observation duties and directs a field technical staff. The construction manager acts as a liaison, and is in direct communication with, the construction subcontractor and the CH2M HILL design team. The construction manager will be available onsite on a full-time basis during construction and will be present to observe construction of critical design features.

The construction manager is also responsible for implementing the CQAP and advising the CH2M HILL Site Manager on QA and construction-related issues. The construction manager coordinates and supervises the activities of quality assurance personnel and other personnel and organizations, as required; and provides QA, review, and advisory services during construction. The construction manager is also responsible for monitoring the QA and construction management activities and for seeing that they are on coordinated, yet independent, paths. He or she advises the site manager of conditions that may affect the proper execution or quality of the work.

The construction manager performs the following specific duties:

- Establishes site field office including communication and filing systems and other necessary office equipment
- Supervises and directs the field staff and independent testing companies' daily activities to coordinate with the subcontractors' daily activities
- Submits nonconformance reports and other QA documents to the U.S. EPA
- Reviews subcontractor change order cost estimates, time extension requests, and claims
- Reviews subcontractor schedules
- Reviews subcontractor bid breakdown and schedule of payment
- Documents the resolution of inadequacies noted in nonconformance reports
- Establishes location, time, and frequency sampling criteria for verification testing to be performed by the field staff or independent testing companies
- Reviews results of contractor-submitted QC tests for compliance with contract requirements
- Reviews daily inspection reports and test data for completeness
- Conducts progress meetings, and prepares and distributes meeting notes discussing progress, problem areas, and status of long-lead items
- Updates own record drawings to compare against subcontractors' record drawings
- Advises the site manager of conditions that may affect satisfactory completion and quality of work
- Provides adequate training of QA and support personnel
- Manages the QA budget

The construction manager must have experience working with construction contractors and have familiarity with the types of construction involved with this work. He or she must be certified for work at a hazardous waste site and should be qualified as a site safety coordinator. The construction manager should have experience on construction jobs that involve hazardous waste and should be familiar with monitoring equipment and field sampling techniques.

Field Staff

The field staff observe the contractors' materials and workmanship for compliance with the plans and specifications and can issue nonconformance reports for contractor workmanship and materials that do not meet the requirements of the contract documents.

Field staff perform the following duties:

- Observing the fabrication, manufacture, and testing of materials in the contractors' or vendors' offsite or onsite work areas, as required
- Observing and sampling purchased materials upon delivery to verify that correct type, quantity, and size of material has been furnished
- Observing performance of subcontractors' work and identifying areas of noncompliance with contract standards
- Performing field QA verification testing according to the program outlined by the CQAP
- Preparing daily diaries of construction activities, observations, and verification tests performed
- Advising the construction manager of site conditions or construction conditions that may affect the accomplishment or quality of work
- Maintaining a visual account of construction progress by taking photographs on a regular basis

Independent Testing Companies

Independent testing companies will be retained to perform analytical laboratory testing during construction. Responsibilities of the testing companies include:

- Controlling and supervising independent testing company personnel assigned to the project
- Ensuring that all personnel assigned to the project are properly qualified and trained for the assigned tasks

- Maintaining the proper equipment and supplies for performing the assigned tasks in accordance with specified test procedures
- Preparing test specimens and performing QA tests as requested
- Documenting and submitting test results
- Advising the site manager and staff concerning the interpretation of observations and test results
- Reporting noncompliance (e.g., failed tests) to the site manager immediately
- Maintaining project files for review, upon request, by the site manager and staff

Additional QC requirements of the laboratory are presented in the Quality Assurance Project Plan.

Construction Subcontractor

The construction subcontractor, by way of a specific contract with the contractor, is charged with performing the work in accordance with the subcontract documents.

Vendors, Independent Test Companies, and Sub-subcontractors to the Subcontractor

These organizations are agents of the construction subcontractor by way of contracts, sub-subcontracts, or similar arrangements. As such, they are responsible, through the subcontractor, for maintaining QC procedures in accordance with their contractual arrangements and the subcontractors' QC plans. Agents should also provide the subcontractor with QC data and reports necessary for the agents' submittals to the site manager.

Section 3
Project Communications

Lines of Communication

Accurate and timely communication is required to avoid construction-related conflicts and potential errors and omissions. The U.S. EPA, CH2M HILL, the construction subcontractor, and their respective employees and staff must have an established communication network as shown in Figure 2-1. Establishing open lines of communication is essential for maintaining strong working relationships and producing quality work.

The primary lines of communication between key project parties are shown in the General Organization Chart (Figure 2-1). Project-specific personnel and lines of communication will be discussed and established by all parties at the preconstruction meeting. The discussion will include:

- Communication procedures between supervisory and field staff
- Direct communication procedures between key parties for specific issues and situations
- Procedures and restrictions for secondary lines of communication within the project organization
- Procedures for information transfer and confirmation between the various parties
- Procedures for documentation of all communications
- Format for meetings, reports, submittals, etc.

Strict document control procedures will be established at the meeting for items such as subcontractor submittals, test results, and plan or specification revisions. These controls will include distribution and confirmation procedures to verify that documents are appropriately dispatched and incorporated into the project. Whenever possible, documents indicating revisions in plans, specifications, or procedures will be distributed immediately and explained to all parties at routine or special project meetings.

Project Meetings

Project meetings will be scheduled to promote communication between various personnel responsible for designing, constructing, managing, and observing the construction. Conduct of these meetings is the primary responsibility of the construction manager or an authorized representative. The purpose of the routine project meetings is to keep all parties informed and provide a forum for solving design, construction, and QA problems. Meeting minutes will be taken and distributed by the construction manager.

Preconstruction Meeting

A meeting will be held to identify project personnel, review the project, and schedule and clarify/resolve outstanding issues before construction startup. At a minimum, the site manager, construction manager, construction subcontractor, U.S. EPA and DNR representatives and selected sub-subcontractors should be present. During this meeting the site manager will:

- Provide each party with relevant construction and QA documents and supporting information. Supporting information may include construction drawings, specifications, and other applicable documents. This information transfer is not limited to documents distributed by the site manager. All parties should use the opportunity to distribute relevant documents.
- Review the General Conditions. Identify project site limits emphasizing coordination with adjacent property owners.
- Familiarize each party with their specific responsibilities relative to the design criteria, construction drawings, schedules, and specifications. Discuss specific milestone dates, liquidated damages, etc.
- Discuss the purpose of the CQAP and the documentation structure provided by the CQAP to verify that the facility will be constructed efficiently and within the specified design criteria and schedule.
- Review the responsibilities of each party.
- Review lines of authority and communication for each party.
- Discuss the established procedures and protocol for observations and tests, including sampling strategies.
- Discuss the established procedures and protocol for handling construction deficiencies, repairs, and retesting.

- Discuss the established procedures and protocol for handling construction deficiencies, repairs, and retesting.
- Review methods for documenting and reporting inspections and testing data.
- Review work area security and safety protocols.
- Discuss procedures for locating and protecting construction materials and preventing damage to the materials from inclement weather or other events.
- Conduct a site walk to review construction material and equipment storage locations.
- Discuss payment for work in-place, including method of payment and unit cost work.

The preconstruction meeting will be documented by the construction manager and minutes will be provided to all parties.

Progress Meetings

Progress meetings will be held according to a schedule agreed to by the construction manager and the subcontractors. At a minimum, the meetings shall be attended by the construction subcontractor and the construction manager. The purpose of the progress meeting is to:

- Review the current activities and accomplishments
- Review the subcontractors' work plans for construction for the upcoming work
- Determine whether offsite personnel should be onsite to witness specified testing
- Discuss existing or potential construction or schedule problems including delivery of any long-lead items
- Discuss status of contract modifications

These progress meetings will be documented by the construction manager or a designated representative. Copies of the meeting minutes will be sent to all personnel attending the meeting and the site manager, if not present.

Problem or Work Deficiency Meetings

A special meeting may be held if a problem or deficiency is present or likely to occur. At a minimum, the meeting should be attended by the construction manager, the subcontractor, and the site manager. The purpose of the meeting is to define and resolve a problem or recurring work deficiency in the following manner:

- Define and discuss the problem or deficiency
- Review alternative solutions
- Implement a plan to resolve the problem or deficiency

These meetings will be documented by the construction manager or a designated representative. Copies of the meeting minutes will be sent to all personnel attending the meeting and the U.S. EPA, if not present.

Document Transmittals

Document transmittals between the project parties provide a record of communications and are necessary for keeping appropriate construction and QA personnel informed of project requirements, progress, changes, and quality of the work. To prevent misunderstandings and omissions, transmittals will be formally communicated with proper documentation and confirmation of submittal and receipt.

Contract Clarification/Interpretation Requests

Contract Clarification/Interpretation Requests (Form 270) are submitted when an explanation of the intent of specific construction requirements, as presented in the Subcontract Documents, is required. These are generally submitted by the construction subcontractor to the construction manager.

Contract Clarification/Interpretation Requests shall be submitted to the design team through the construction manager who will coordinate the request with the site manager. All interpretations of design or specifications by the design team will be issued in writing. In special cases, a design engineer may communicate a design interpretation or clarification verbally, followed by written confirmation. Responses to Contract Clarification/Interpretation Requests will be obtained in a timely manner to limit the impact on the construction schedule. The construction manager is responsible for informing all parties of the Design Team's interpretations and will control the distribution of documents to construction, QA, and regulatory personnel.

Contract Modification Requests

A Contract Modification Request is made if a change in plans and specifications is deemed necessary for the following reasons:

- Changed site conditions
- Changed materials conditions
- Alternative design procedures proposed
- Alternative materials proposed
- Unit cost item adjustment

Contract Modification Requests are generally written by a design engineer, possibly in response to a Contract Clarification/Interpretation Request submitted by the construction subcontractor or the construction manager, and implemented through the construction management chain. However, Contract Modification Requests involve other groups such as regulators, and estimators. As a result, all Contract Modification Requests should be submitted to the construction manager for coordination with the design engineer and other appropriate groups. The construction manager will review, negotiate, and finalize all Contract Modification Requests and issue Contract Modifications (Change Orders) as necessary. Responses to Contract Modification Requests will be obtained in a timely manner to limit the impact on the construction schedule. The construction manager is responsible for transmitting all Contract Modifications to the appropriate organizations, including the QA team, before the change becomes part of the project record.

Likewise, the construction manager may issue a Field Order (Form 275) for clarification and interpretation of drawings in cases where a contract modification is not suitable. For example, a Field Order may be issued in response to a Subcontractor-initiated Contract Clarification/Interpretation Request when the clarification does not affect the schedule or cost of the work.

Construction Subcontractor Submittals

The Subcontract Documents require that the Subcontractor submit a Quality Control Plan, materials certifications, inspection and test data, etc., for review by the site manager, the construction manager, and staff. Documents shall be submitted to the Contractor according to the frequency and number specified in the Subcontract Documents and the CQAP. Sub-subcontractor and vendor submittals shall be made through the Subcontractor. All test data and similar submittals shall be submitted with a transmittal form outlining the contents of the submittal and the date submitted.

The Subcontractor shall make submittals to the site manager, who will forward copies to the project assistant. A flow chart of the submittal process is shown in Figure 3-1.

As submittals are received, the receipt will be documented on a submittal log form by the project assistant. The project assistant will assign the submittal to appropriate project team member(s) for detailed review. The reviewer(s) will check the submittal for general compliance with the contract documents and will note missing information or deviations. The construction manager will oversee the review process and help resolve questions regarding compliance with Subcontract Documents.

Review comments on submittals will clearly state what (if any) information the reviewer considers to be missing. Notes will be written legibly with red ink on the front sheet of a submittal so that deficiencies can be clearly identified by the Subcontractor. Notes will not be in the form of questions, rather, they will state what has been omitted or what is not acceptable.

Following the detailed review, the project assistant will send a marked-up copy of the submittal and a submittal reply form to the Subcontractor. The project assistant will indicate on the submittal reply form whether deviations from the Subcontract Documents were noted, and whether additional submittals or resubmittals by the Subcontractor are required. The project assistant will keep the site manager and the construction manager informed of the submittal process. Copies of the original submittal, review copies, and submittal log and reply forms will be kept in a project submittal file.

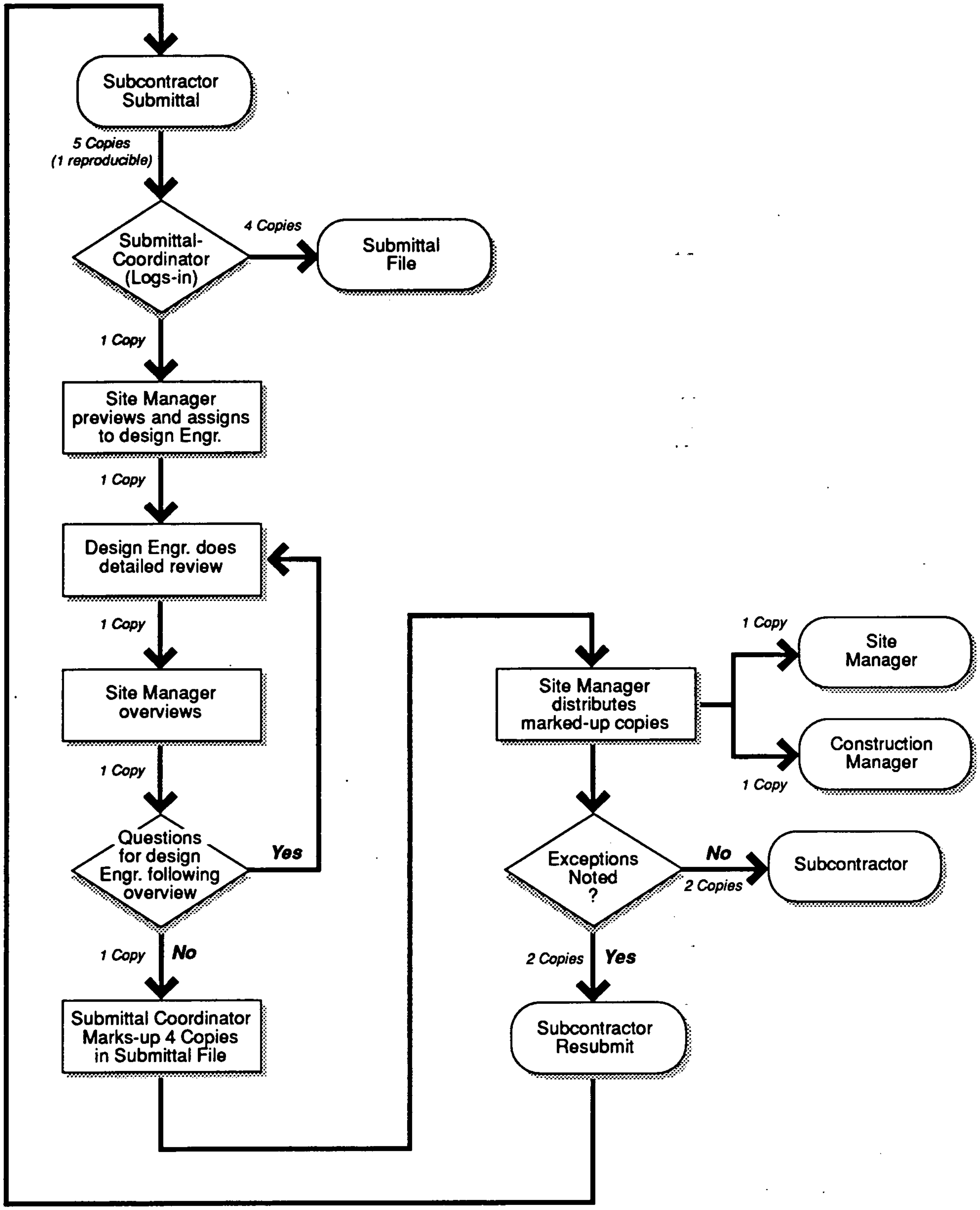
Before construction, the subcontractor should submit requests for approval of substitutions, clarifications of design, and other review items to the construction manager.

QC documentation generated by sub-subcontractors or suppliers will be submitted through the Subcontractor to the construction manager, who will forward copies to the site manager for conformance evaluation and incorporation into the records. The appendixes refer to specific forms that are to be used for QC data submittals. Sample copies of forms are supplied in Appendix E.

Nonconformance Reports

Initiation of Reports

When materials, methods, or work elements are not in accordance with contract documents and immediate resolution cannot be achieved, a nonconformance report will be prepared. Nonconformance reports initiated by the field staff will be submitted to the construction manager. He or she will issue the nonconformance report to the site



GLE65688.FD.D3 FIG 3-1 Sub Proc Flow 12-19-94 TLL

FIGURE 3-1
SUBMITTAL PROCESS FLOW CHART
N.W. MAUTHE SITE
REMEDIAL ACTION

manager and subcontractor and see that a corrective action plan is developed by the subcontractor.

The written nonconformance report should be issued as soon as possible after the nonconformance is detected. Each nonconformance report will be assigned a unique file number and recorded on a nonconformance report log. This log will allow its status to be easily tracked.

Sole exceptions to this policy will be verbal notices made by the construction manager or QA field staff to the subcontractor for procedures that can be, and are, corrected immediately upon notice. All verbal notices will be recorded in the daily reports with an explanation of corrective measures taken and the time required to bring the work into conformance.

Resolution of Nonconformances

No payment will be issued for nonconforming work until associated nonconformances are resolved. Each nonconformance report will remain in effect until corrective actions have been taken that meet the intent of the Subcontract Documents and the satisfaction of the onsite QA representatives. When corrective actions are acceptable, the construction manager will document the corrective actions taken and results of any retests, and will complete the acceptance portion of the nonconformance report. Likewise, the QA field staff will observe and document the corrective actions and acceptability of the results on field observation forms. Whenever possible, retests should be performed by the same QA field staff that initially detected the nonconformance.

Full documentation is required for resolution of each nonconformance report. When a nonconformance is resolved, the following documentation procedures will be followed:

- A copy of the observer's explanation of corrective action and acceptance will be attached to the nonconformance report for review and filing.

- Daily reports, data summaries, etc., will be updated to reflect the resolved status of the original deficiency (e.g., notes of corrective action in observation reports, resubmittals, retest results). At a minimum, the nonconformance report file number, date, test number, etc., that identify the initial deficiency will be included.

- The corrected nonconformances will be checked off the record book, initialed, and dated by the construction manager, site manager, or designated representative.

Section 4
Quality Level and Requirements

General

The quality of materials and workmanship will be controlled by the sub-subcontractor or supplier who furnishes the work or material involved. However, the subcontractors have the ultimate responsibility for QC of their sub-subcontractors and vendors.

QA personnel (i.e., field staff and outside laboratories or consultants designated by the construction manager) will observe QC testing of the construction materials, workmanship, and the subcontractors' QC activities. Specific QA requirements for observation and verification testing are detailed in the appendixes. Appendix E contains copies of forms to be used to document QA activities.

All QC testing, sampling, and inspection will be conducted by the subcontractor, the subcontractor's supplier, or subcontracted independent testing companies. The subcontractor will provide to the construction manager, in a timely fashion or as specified, copies of QC inspection and testing reports if specified in the contract. These reports will include documentation of failed tests and corrective actions taken.

Observation and Verification Testing

The appendixes outline the required QA observations. The field personnel should obtain, review, and familiarize themselves with the applicable procedures, codes, standards, specifications, drawings, observation requirements, and accept/reject criteria.

The construction manager oversees the proper performance of the required QA observation. To accomplish this, random observation and verification testing may be conducted.

Field QA personnel will document observations in the Daily Diary Inspection Report (Daily Report) and will document verification tests in the appropriate testing forms. All documentation must be recorded in ink. To correct an error on an inspection report, a single line will be drawn through the error with the correct information entered next to the error. All corrections should be initialed and dated.

Daily observation records and verification testing forms must, as a minimum, contain the following information:

- Item, condition, or activity observed or testing performed

- Location of observation or test
- Date of the observation or verification test
- Inspector's name and signature
- Type of verification test or observation
- Observation or verification test source criteria (drawing, specification, etc.)
- Results or acceptability
- Reference to corrective action taken in connection with nonconformance. Record the relevant nonconformance report number

Quality Assurance Subcontracts

The QA activities may include a contract for random independent laboratory testing.

Items or services procured for QA purposes that may affect the measurement of quality of the construction project should meet the requirements of the contract specifications and this CQAP, as applicable.

Section 5
Documentation

General

All project QA activities and QC submittals pertaining to the contract specifications and the CQAP are to be documented.

Test Results

Results from all field tests, laboratory tests, and material design evaluations should be submitted to the construction manager, who will forward copies to the site manager.

Photographic Record

A project photographic record will be made and kept as part of the QA record. In addition to recording construction progress and ''as-constructed'' installation details, the photographic record will be used to document deviations from design and nonconformance items or work. Each photograph will be marked with a sequence number, date, location, photographer, and description. Thirty-five millimeter color film will be used. Any of the observers may photograph work for record purposes. The construction manager will maintain the photographic record file.

Daily Inspection Reports

Daily inspection reports will be maintained by the QA field staff. At the end of each shift, copies of the daily report will be submitted to the construction manager. Each daily report will be completed in ink with each work day consecutively numbered in a bound document.

The content of the report will include, as a minimum (where applicable):

- Weather conditions
- Subcontractor(s) personnel onsite
- List of major equipment onsite (idle versus operating)
- Substantive conversations held with the subcontractor(s)
- Identification of separate attachments
- A log of work in progress and new work started
- Location and description of work

- Summary of verification testing performed for QA
- Signature of the inspector with full name, title, and date

Recordkeeping

Maintaining complete, accurate records of all work is crucial to verifying conformance to the specifications and drawings. Verbal communication during meetings, discussions with the QA team, and telephone conversations must be summarized in writing. Copies will be sent to the construction manager for further distribution.

Final Storage

A compilation of all construction records will kept in storage boxes following completion of construction. The records will be transmitted to U.S. EPA for final storage when the work assignment is completed.

ATTACHMENT A
QUALITY ASSURANCE REQUIREMENTS
GENERAL PRECONSTRUCTION ACTIVITIES

Attachment A

Quality Assurance Requirements
General Preconstruction Activities

A. General Preconstruction Activities

1. The construction manager and field staff should review for clarity the design drawings, the specifications, and the approved shop drawings for the facility to be constructed. The design criteria, plans, and specifications need to be understandable to both the field personnel and the construction subcontractor. If the design is deemed unclear by the construction manager, clarification requests should be forwarded to the design team for clarification or modification.

2. It shall be the responsibility of the construction manager to provide instructions and training to field personnel to acquaint them with design concepts and to provide them with a clear understanding of expected conditions, methods of construction, and the scope of plans and specifications.

3. Field personnel shall review site investigation information to familiarize themselves with the expected site conditions upon which the design was based. This will enable field personnel to identify any unexpected site conditions that may be encountered during construction. Unexpected site conditions may necessitate modifications of the design by the design engineer to facilitate component performance.

Attachment B
Quality Assurance Requirements Earthwork

Attachment B
Quality Assurance Requirements
Earthwork

A. Clearing, Grubbing and Stripping

1. Observations: Refer to CIM II-02110, Clearing, Grubbing and Stripping

2. Tests: None required

3. Sampling: None required

B. Excavation of Groundwater Collection Trench

1. Observations: Refer to:

   a. CIM II-02221, Trench Excavation and Backfill
   b. CIM II-02368, Steel Piling
   c. Street Excavation Standards—City of Appleton, DPW
   d. Technical submittals

2. Tests: None required

3. Sampling:

   a. Procedure

      (1) Composite grab samples
      (2) Analyze with XRF

   b. Sample size: Refer to QAPP

   c. Method of Determining Sample Location: Refer to Cleanup Verification Plan

   d. Frequency: Refer to Cleanup Verification Plan

   e. Acceptance and Rejection Criteria

      (1) 500+ ppm Chromium (total): Stabilize, dispose of at Subtitle D landfill

(2) 100–500 ppm Chromium (total):

(a) TCLP characteristic: Stabilize, dispose of at Subtitle D Landfill

(b) Non-TCLP Characteristic: Dispose of at Subtitle D Landfill

(3) 0–99 ppm Chromium (total): Use as onsite backfill material

(4) Refer to Clean Up Verification Plan

C. Installation of Groundwater Collection Trench

1. Observations: Refer To:

a. CIM II—02221, Trench Excavation and Backfill
b. CIM II—02601, Manholes and Cleanout Construction
c. Street Excavation Standards—City of Appleton, DPW
d. Technical submittals

2. Tests:

a. Relative Compaction: ASTM D698, 95 percent
b. Relative Density: ASTM D4254, 75 percent
c. In-Place Density: ASTM D2922
d. Moisture Content: ASTM D3017
e. 72-Hour trench test

3. Sampling:

a. Procedure: Groundwater Grab Sample
b. Sample Size: Refer to QAPP
c. Method For Determining Sample Location: Point of discharge
d. Frequency: Refer to QAPP
e. Acceptance and Rejection Criteria: None

D. Excavation of Contaminated Soil Onsite and Backfill

1. Observations: Refer To:

a. CIM II—02200, Earthwork
b. Technical submittals

2. Tests:

   a. Relative Compaction: ASTM D698, 95 percent
   b. Relative Density: ASTM D4254, 75 percent
   c. In-Place Density: ASTM D2922
   d. Moisture Content: ASTM D3017

3. Sampling:

   a. Procedure:
      (1) Composite Grab Sample
      (2) Analyze with XRF

   b. Sample Size: Refer to QAPP

   c. Method of Determining Sample Location: Refer to Cleanup Verification Plan

   d. Frequency: Refer to Cleanup Verification Plan

   e. Acceptance and Rejection Criteria:

      (1) 500+ ppm Chromium (total): Stabilize, dispose of at Subtitle D Landfill

      (2) 100-500 ppm Chromium (total):

         (a) TCLP Characteristic: Stabilize, dispose of at Subtitle D Landfill

         (b) Non-TCLP Characteristic: Dispose of at Subtitle D Landfill

      (3) 0-99 ppm Chromium (total): Use As Onsite Backfill Material

      (4) Refer to Clean Up Verification Plan

E. Surface Restoration

1. Observations: Refer To:

   a. CIM II—02485, Finish Grading and Lawns

b. CIM II—02575, Surface Restoration

2. Tests: None Required

3. Sampling: None Required

F. Foundation Drain Excavation and Installation

1. Observations:

a. Review Specifications and Approved Shop Drawings
b. Technical Submittals
c. CIM II-02221, Trench Excavation and Backfill

2. Tests:

a. Relative Compaction: ASTM D698, 95 percent
b. Relative Density: ASTM D4254, 75 percent
c. In-Place Density: ASTM 02922
d. Moisture Content: ASTM D3017

3. Sampling: None Required

ATTACHMENT C
QUALITY ASSURANCE REQUIREMENTS
GROUNDWATER MONITORING WELLS

Attachment C

Quality Assurance Requirements
Groundwater Monitoring Wells

1. Observations

   a. Review specification, applicable reference standards, and approved shop drawing submittals.

   b. Check that applicable products to be incorporated, such as well casings, screens, fittings, plugs, caps, guardposts, and concrete, are furnished and installed as specified.

   c. Check that materials to be used for gravel pack, and sand and bentonite seals are furnished and installed as specified.

   d. Observe that wells are drilled using specified methods, in the location and to the diameter and depth as shown.

   e. Observe that the well development is complete as specified and that clean, sediment-free water is produced.

2. Tests: None required

3. Sampling

   a. Sampling Procedure: Groundwater grab sample
   b. Sample Size: Refer to QAPP
   c. Method For Determining Sample Locations: Refer to QAPP
   d. Frequency of Sampling: Refer to QAPP
   e. Acceptance And Rejection Criteria: None

Attachment D
Quality Assurance Requirements—Polyethylene Piping

Attachment D

Quality Assurance Requirements—Polyethylene Piping

Delivery, Handling, and Storage

- Verify that the pipe is delivered to the site undamaged.
- Verify that the pipe is stored on level ground and that pipe is not stacked to the extent that excessive deformation could occur.
- Observe that the pipe is carefully handled so it will not be damaged by contact with sharp objects.

Material

- Verify that the pipe delivered is manufactured specifically for this project and conforms to the specifications.
- Verify that the pipe is of the sizes and types specified. Observe that the perforations are of the size and pattern specified.
- Verify that the polyethylene pipe lengths and fittings are of the same type, grade, and class of polyethylene compound, and supplied from the same raw material supplier.

Joints

- Observe that mechanical connections conform to the specifications.

Placement

- Observe that the pipe is handled with care to prevent damage or twisting when being lowered into the trench.
- Observe that the trench excavation and backfill conforms to the requirements of the Earthwork section.

ATTACHMENT E
QUALITY ASSURANCE DATA SUBMITTAL FORMS

CONSTRUCTION CONTRACT MODIFICATION FORMS

GLT301/009.51-5

SUBCONTRACT MODIFICATION INITIATION REQUEST NO.______

TO ____ **PROJECT MANAGER**

PROJECT ______________________________ **REF NO.** ________ **DATE** __________

SUBCONTRACT NO. ____

SUBCONTRACTOR ____

KEYWORD DESCRIPTION ____

It is requested by __________________ of __________________ that a subcontract modification be initiated to the above referenced contract.

1. Scope of work (use additional pages if required) ________________________________

2. Reason for modification ________________________________

3. Approximate cost change to subcontract price ________________________________

4. Will the subcontractor need additional contract time to complete the change in work scope?
   ________ yes ________ no ________ calendar days

5. Will the subcontractor need additional personnel to complete the change in work scope?
   ________ yes ________ no If so, trade(s) ____________________
   No. of personnel ____________________
   Duration ____________________ (calendar days)

6. Attachment identification:

REVIEWED BY ____________________________________ **DATE** ______________
PROJECT MANAGER

REV 4/93 Subcontract Use

COPY ALL SIGNERS

GLO65614.CM.PP Sub. Modif. Init. 4-16-93lml

SUBCONTRACT CHANGE ORDER

Date: ______________

Subcontract Change Order No.: ______________

Issue Identification: ______________________________

Project Name: ______________________________

Subcontractor: ______________________________

CH2M HILL
Subcontract No.: ______________

The following modifications to the subcontract are hereby ordered: (use additional pages if required)

Subcontract Amount		Subcontract Time (Calendar Days)	
Original	$ ______	Original Duration	______ Days
Previous Change Orders (Add/Deduct)	$ ______	Previous Change Orders (Add/Deduct)	______ Days
This Change Order (Add/Deduct)	$ ______	This Change Order (Add/Deduct)	______ Days
Revised Subcontract Amount	$ ______	Revised Subcontract Time	______ Days

The Revised Subcontract Completion Date is:

______________, 19 ______

CH2M HILL	Subcontractor
By: ______________	By: ______________
Date: ______________	Date: ______________

REV 12/90 FORM 273
REV 4/93 Subcontract Use
GLO65614.CM.PP Form 273 4-16-93lml

SUBSTITUTION REQUEST FORM
(ATTACHMENT TO SUBCONTRACTOR'S SUBMITTAL)

PROJECT ______________________________

SUBCONTRACTOR ______________________________

SUBCONTRACT NO. ______________ **TRANSMITTAL NO.** ______________

SPEC. SECTION ______________ **SUBMITTAL NO.** ______________

ESTIMATED VALUE ______________________________

SUBSTITUTION DESCRIPTION:

______________________________ ______________

SUBCONTRACTOR'S SIGNATURE DATE

CH2M HILL SIGNATURES

MODIFICATION ESTIMATOR	DATE	RECOMMENDED ☐ YES ☐ NO
CONSTRUCTION MANAGER	DATE	RECOMMENDED ☐ YES ☐ NO
DESIGNER	DATE	RECOMMENDED ☐ YES ☐ NO
PROJECT MANAGER	DATE	RECOMMENDED ☐ YES ☐ NO
PROGRAM MANAGER	DATE	ACCEPTED ☐ YES ☐ NO

1. ORIGINAL STAYS WITH SUBMITTAL
2. COPY TO PROJECT FILE
3. COPY ALL SIGNERS

REV 4/93 Subcontract Use

GLO65614.CM.PP Substit. Request 4-16-93lml

CH2M HILL

FIELD ORDER

Field Order No. ____________________

To: ____ Date: ____________________

Contractor

Project: ____ Project No. ____________________

Engineer: ____

Description of Alteration: ____

____

____

____

____

____

____

____

____

Reason for Alteration: ____

____

____

____

____

____

____

____

Refer to Drawing Sheets ______________________________ Section or Detail ____________________

____

Refer to Specification Paragraphs ____

____

Will Additional Drawings be Necessary ☐ Yes ☐ No Assigned No. of Drawings ____________________

It is understood and mutually agreed that this form is to be used only to record minor alterations which do not increase or decrease the Contract price; Contract times, or change the intent of a specific provision of the Contract. Any alterations involving change to the Contract price, Contract times, or Contract requirements must be covered by a formal Contract modification executed by the Owner and the Contractor. A summation of these field orders will be incorporated into a modification(s) prior to Contract completion.

ENGINEER

By: ______________________________

Date: ______________________________

Copy: Owner

CONTRACTOR: (RECEIPT ACKNOWLEDGEMENT)

By: ______________________________

Title: ______________________________

Date: ______________________________

REV 12/90 FORM 275

SUBMITTAL FORMS

THIS ORIGINAL IS AN 11 × 17

CH2M HILL LOG OF CONTRACTOR'S SUBMITTALS

DISPOSITION LEGEND
1. NO EXCEPTION NOTED
2. MAKE CORRECTIONS NOTED
3. REJECTED
4. REVISE AND RESUBMIT
5. SUBMIT SPECIFIED ITEM

TIME ALLOTTED FOR REVIEW IN GENERAL CONDITIONS ______ WORKING DAYS.

PROJECT: ______ PROJECT NO. ______ SHEET ______ OF ______

CONTRACTOR: ______

PROJECT MANAGER (PM): ______

SUBMITTAL NO.	SPEC. SEC. NO.	DESCRIPTION	DATE RECEIVED AND BY	REVIEWER AND LOCATION	DATE SENT TO REVIEWER	DATE SENT TO PM/RE	DATE EXPECTED BACK FROM REVIEWER	DATE RECEIVED FROM REVIEWER	DISPO-SITION (ABOVE)	DATE SENT TO CONTRACTOR	COMMENTS

(5.4)

FORM 298

CH2M HILL **REVIEW COMMENTS**

DATE: ____________________

SHEET ________ OF ________

PROJECT: ____________________ PROJECT NO.: ____________________

REVIEWER: ____________________ PHASE: ____________________

REFERENCE PAGE/SHEET No.	REVIEW COMMENTS	* TYPE	DESIGNER RESPONSE

TYPE: * 'F' - FATAL FLAW MUST BE REVISED
'S' - SERIOUS PROBLEM. NEEDS TO BE ADDRESSED. COULD ESCALATE TO 'F' IF LEFT UNATTENDED.
'C' - COORDINATION PROBLEM. DISCIPLINE NEEDS TO TALK
'N' - NOTE TO DESIGNER. ITEM. NOT SERIOUS. NO NEED TO INCORPORATE. BUT COULD RESULT IN A BETTER PRODUCT IN FUTURE

PHASE: 1 - PREDESIGN. 2 - DESIGN 3 - BID TO AWARD 4 - CONSTRUCTION

REV 12/90 FORM 29[illegible]

SAMPLE-ENGINEER'S SUBMITTAL REVIEW STAMP

☐ NO EXCEPTION TAKEN ☐ MAKE CORRECTIONS NOTED

☐ REJECTED ☐ REVISE AND RESUBMIT

☐ SUBMIT SPECIFIED ITEM

Checking is only for general conformance with the design concept of the project and general compliance with the information given in the contract documents. Any action shown is subject to the requirements of the plans and specifications. Contractor is responsible for: dimensions which shall be confirmed and correlated at the job site; fabrication processes and techniques of construction; co-ordination of his work with that of all other trades; and the satisfactory performance of his work.

CH2M HILL

Date ______________________ By______________________

EACH OFFICES' ADDRESS WILL BE AFFIXED

DATE: ____________________

SUBMITTAL REPLY FORM

TO: ____________________

____

____

____

ATTENTION: ____________________

RE: PROJECT: ____________________ PROJECT NO. ____________________

GENTLEMEN:

WITH REFERENCE TO YOUR TRANSMITTAL NO. ______ DATED ________ 19, ____
WE ARE TAKING THE FOLLOWING ACTION.

SPECIFICATION SECTION ____________________

DESCRIPTION	MFG/DWG OR BROCHURE NO.	NO EXCEPTION NOTED	MAKE CORRECTIONS NOTED	REJECTED	REVISE AND RESUBMIT	SUBMIT SPECIFIED ITEM	NO. OF COPIES TO					
1.												
2.												
3.												
4.												
5.												
6.												
7.												
8.												
9.												
10.												

REMARKS: ____________________

____

____

____

☐ SEE ATTACHED SHEET(S) FOR ADDITIONAL COMMENTS

CC: ☐ ____________________

☐ ____________________

☐ ____________________

☐ ____________________

☐ ____________________

BY: ____________________

DATE: ____________________

FORM 297

TRANSMITTAL OF SUBCONTRACTOR'S SUBMITTAL (ATTACH TO EACH SUBMITTAL)

TO: ______________________________
CH2M HILL, Inc.
____
____
____

Date: ______________________________
Transmittal No.: ______________________________
Submittal No.: ______________________________
☐ New Submittal ☐ Resubmittal
Previous Submittal No.: ______________________________

FROM: ______________________________
Subcontractor
____
____
____

Project: ______________________________
Project No.: ______________________________
Specification Section No.: ______________________________
(Cover only one section with each transmittal)

Submittal For: ☐ Shop Drawings ☐ Material Data ☐ Samples ☐ O & M Manual Information ☐ Proposed Substitution ☐ Other ______________________________

The following items are hereby submitted for review and action:

	DESCRIPTION OF ITEM SUBMITTED *(TYPE, SIZE, MODEL NUMBER, ETC.)*	MFG. OR CONTR. CAT., DRAWING OR BROCHURE NO.	NO. OF COPIES	SPEC. SEC. NO.

I certify, that the above submitted items have been reviewed in detail and are correct and in strict conformance with the subcontract drawings and specifications except as otherwise stated, are stamped accordingly.

____
Name of Subcontractor

____
Signature of Subcontractor

FORM 295
REV 5/93 SUBCONTRACT USE
GLO65624.CM.PP Form 295 5/93 5-7-93lml

CH2M HILL

Date: ______________

ROUTING OF SUBCONTRACTOR'S SUBMITTALS

Project: ______________________________ Project No. ______________

Subcontractor: ______________________________

Submittal No.: ______________

Date of Subcontractors Transmittal ______________

IS HEREBY TRANSMITTED FOR ACTION:

Item: ______________________________

Spec. Section: ______________

TO	INITIALS AND DATE	TARGET DATE
1.		
2.		
3.		
4.		
5.		
6.		

COMMENTS: (use additional pages if necessary) ______________________________

FORM 296
REV 4/93 Subcontract Use

GLO65614.CM.PP Form 296 4-16-93lm

THIS ORIGINAL IS A 2-PART FORM

NONCONFORMANCE REPORT FORM

GLT301/009.51-7

CH2M HILL

NONCONFORMANCE REPORT LOG

PAGE: ________ OF: ________

PROJECT: ______________________________ PROJECT NO. ____________

CONTRACTOR: ______________________________

DATE	SPEC SECTION	NONCONFORMANCE	ACCEPTED	
			BY	DATE

REV. 8/87 FORM 31

CH2M HILL

NONCONFORMANCE REPORT

Date	
Time	A.M./P.M.
Inspector	

To ______________________________

____

____

____

Project Title: ______________________________ Project No. __________

Contractor: ______________________________ Contract No. __________

You are hereby notified that ☐ tests ☐ inspection indicates that the ______________________________

____

does not conform to the specifications requirements. The specification violated is

Section ______________ Article/Paragraph ______________ Under the provisions

of the contract specifications, the requirements are ______________________________

____

____

Nonconforming work, materials, or equipment shall be required, under the Articles of the General Conditions of the Contract, to be removed and replaced at the Contractor's own expense.

Nonconformance report was received by Contractor

By ______________________________

Title ______________________________

Date ______________________________

CORRECTIVE MEASURES ARE ACCEPTABLE

BY: ______________________________ DATE: ______________

DISTRIBUTION:
1. FIELD OFFICE
2. CONTRACTOR
3. ENGINEER
4. OWNER

General Office Forms

GLT301/009.51-8

CH2M HILL TELEPHONE CONVERSATION RECORD

CALL TO ______________________________ PHONE NO. ______________

DATE ______________

CALL FROM ______________________________ TIME ____________ ☐ AM ☐ PM

MESSAGE TAKEN BY ______________________________ PROJECT NO. ______________

SUBJECT ______________________________

CH2M HILL

PHOTO RECORD FILE INDEX

ROLL NO. ______

PERIOD FROM ______ TO ______ 19 ___

PROJECT: ______ PROJECT NO. ______

PREPARED BY: ______

PICTURE NUMBER	PHOTO DESCRIPTION/LOCATION	DATE	DAILY LOG NUMBER

REV 1/87 FORM 3

CH2M HILL

PHOTO NEGATIVE FILE INDEX

NEGATIVE FILE NO.	SIZE	COLOR B-W	DATE	PROJECT NAME	PROJECT NO.

CH2M HILL

CONSTRUCTION SITE VISITORS LOG[1]

PROJECT: ______________________ PROJECT NO. ______________

CONTRACTOR: ______________________

RESIDENT ENGINEER ______________________

NAME	REPRESENTING	DATE	TIME IN	TIME OUT	REASON FOR VISIT

(6.15)

(1) NOTE: *VISI[illegible]S AT THE CONSTRUCTION SITE ARE THE RESPONSIBILITY OF THE C[illegible]RACTOR. THEREFORE, EACH* [redacted]

CH2M HILL

DAILY ACTION NOTES

DATE: ____________________

SHEET ______ OF ______

PHONE CALL LIST			THINGS TO DO			
TIME	TO/FROM	TOPIC	NO.	ITEM	ASSIGNED TO	COM-PLETED

FORM 302

CH2M HILL **MEETING NOTES**

PROJECT NUMBER ____________ SHEET ___ OF ___

NOTES ISSUED BY ____________ REGION

DATE ____________

SUBJECT: ____________

MEETING DATE: ____________ LOCATION ____________

ATTENDEES:

NOTES BY: ____________ REGION

TOPICS DISCUSSED	ACTION/NOTES

REV 1/83 FOR[illegible]22

CH2M HILL TRANSMITTAL

TO ______________________ FROM ______________________

ATTN ______________________ DATE ______________________

RE ______________________ PROJECT NUMBER ______________________

WE ARE SENDING YOU

☐ ATTACHED ☐ UNDER SEPARATE COVER VIA ______________________

☐ SHOP DRAWINGS ☐ DOCUMENTS ☐ TRACINGS

☐ PRINTS ☐ SPECIFICATIONS ☐ CATALOGS

☐ COPY OF LETTER ☐ ______________________

QUANTITY	DESCRIPTION

IF MATERIAL RECEIVED IS NOT AS LISTED, PLEASE NOTIFY US AT ONCE

REMARKS ______________________

COPY TO ______________________

REV 1/87 FORM 6

THIS ORIGINAL IS A 2-PART FORM

CH2M HILL

MEMORANDUM

To: ______ (OFFICE)

______ (OFFICE)

______ (OFFICE)

______ (OFFICE)

______ (OFFICE)

______ (OFFICE)

From: ______ (OFFICE)

Date: ______ Project No. ______

Re: ______

MEMO

REV 7/84 FORM

SAFETY FORMS

CH2M HILL

ACCIDENT REPORT

DATE: ______________________

NOTE: *TO BE COMPLETED ONLY FOR REPRESENTATIVES OF CH2M HILL, INC.*

PROJECT: ______________________ PROJECT NO. ______________________

INJURED EMPLOYEE: ______________________ EMPLOYEE NO. ______________________

DATE INJURED: ______________________ TIME ________ A.M. P.M.

DATE REPORTED: ______________________ LAST DAY WORKED: ______________________

DID EMPLOYEE RETURN TO WORK: ________ DATE RETURNED: ______________________

WHERE ACCIDENT OCCURRED: ______________________

WITNESSES: ______________________

WORK PERFORMING WHEN INJURED: ______________________

KIND AND EXTENT OF INJURY: ______________________

NAME - ADDRESS OF DOCTOR - HOSPITAL: ______________________

DESCRIPTION OF ACCIDENT: ______________________

WAS THERE EQUIPMENT MALFUNCTION? ☐ YES ☐ NO

DESCRIBE DAMAGE TO EQUIPMENT OR PROPERTY: ______________________

UNSAFE CONDITION OR ACT CAUSING ACCIDENT: ______________________

ACTION TAKEN TO PREVENT SIMILAR ACCIDENT: ______________________

ADDITIONAL RECOMMENDATIONS OR ACTION: ______________________

SUPERVISOR: ______________________

☐ PHOTO(S) TAKEN

NOTICE OF UNSAFE CONDITIONS

CH2M HILL

Date: ____________________

Project: ______________________________ Project No.: ____________________

Contractor: ______________________________

Owner: ______________________________

This notice is to advise you, the prime Contractor on the above Contract, that a potentially unsafe condition(s) have been observed on your Project by this representative of the Owner of the above mentioned project. These conditions are listed as follows:

ITEM	CONDITION

By this Notice, the Owner or its Representatives shall not assume any responsibility under the GENERAL CONDITIONS or assume any liability for the existence or correction thereof, for the noted potentially unsafe conditions, or any others that may have been unnoticed.

These conditions shall be remedied as soon as possible within a safe working period. If these corrections are not made, the Owner will be forced to remove all field staff from the job. No payment will be made for any work installed after this date until the noted potentially unsafe conditions are deemed by the Owner to have been made safe by the Contractor.

cc: Project Owner

Representative of the Owner: ____________________

Title: ____________________ Date: ____________________

Received By: ____________________
Contractor

Title: ____________________ Date: ____________________

REV 12/90 FORM 309

CH2M HILL

RECORD OF SAFETY MEETING FOR ENGINEERING/INSPECTION STAFF

DATE: ____________________

SHEET _____ OF _____

PROJECT: ______________________________ PROJECT NO. ____________

LOCATION: ______________________________

PURPOSE: ______________________________

ATTENDANCE:

TOPICS DISCUSSED	ACTION

PREPARED BY: ______________________

(7.3a)

(CONTINUED REVERSE SIDE)

FORM 31

CH2M HILL **EMERENGENCY PHONE NUMBERS**

	PHONE	ADDRESS	CONTACT	FIRST AID TRAINED
POLICE DEPARTMENT			ATTN:	
FIRE DEPARTMENT			ATTN:	
PARAMEDIC			ATTN:	
FIRE REPORT			ATTN:	
AMBULANCE SERVICE			ATTN:	
WATER DEPARTMENT			ATTN:	
GAS UTILITY			ATTN:	
ELECTRIC UTILITY			ATTN:	
TELEPHONE UTILITY			ATTN:	
LOCAL SANITARIAN			ATTN:	
HOSPITAL			ATTN:	
OWNER			ATTN:	
			ATTN:	
			ATTN:	
			ATTN:	
			ATTN:	
			ATTN:	

THIS NOTICE IS LOCATED AT: ______________________

FORM 311 REV 12/89

DATE: ____________________

ACCIDENT REPORT

NOTE: *TO BE COMPLETED ONLY FOR REPRESENTATIVES OF CH2M HILL, INC.*

PROJECT: ____________________ PROJECT NO. ____________________

INJURED EMPLOYEE: ____________________ EMPLOYEE NO. ____________________

DATE INJURED: ____________________ TIME ________ A.M. P.M.

DATE REPORTED: ____________________ LAST DAY WORKED: ____________________

DID EMPLOYEE RETURN TO WORK: ________ DATE RETURNED: ____________________

WHERE ACCIDENT OCCURRED: ____________________

WITNESSES: ____________________

WORK PERFORMING WHEN INJURED: ____________________

KIND AND EXTENT OF INJURY: ____________________

NAME - ADDRESS OF DOCTOR - HOSPITAL: ____________________

DESCRIPTION OF ACCIDENT: ____________________

WAS THERE EQUIPMENT MALFUNCTION? ☐ YES ☐ NO

DESCRIBE DAMAGE TO EQUIPMENT OR PROPERTY: ____________________

UNSAFE CONDITION OR ACT CAUSING ACCIDENT: ____________________

ACTION TAKEN TO PREVENT SIMILAR ACCIDENT: ____________________

ADDITIONAL RECOMMENDATIONS OR ACTION: ____________________

SUPERVISOR: ____________________

☐ PHOTO(S) TAKEN

FORM 308

NOTICE OF UNSAFE CONDITIONS

CH2M HILL

Date: ______________________

Project: ______________________ Project No.: ______________________

Contractor: ______________________

Owner: ______________________

This notice is to advise you, the prime Contractor on the above Contract, that a potentially unsafe condition(s) have been observed on your Project by this representative of the Owner of the above mentioned project. These conditions are listed as follows:

ITEM	CONDITION

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These conditions shall be remedied as soon as possible within a safe working period. If these corrections are not made, the Owner will be forced to remove all field staff from the job. No payment will be made for any work installed after this date until the noted potentially unsafe conditions are deemed by the Owner to have been made safe by the Contractor.

cc: Project Owner

Representative of the Owner: ______________________

Title: ______________________ Date: ______________________

Received By: ______________________
Contractor

Title: ______________________ Date: ______________________

REV 12/90 FORM 309

CH2M HILL

RECORD OF SAFETY MEETING FOR ENGINEERING/INSPECTION STAFF

DATE: ______________________

SHEET ______ OF ______

PROJECT: ______________________ PROJECT NO. ______________________

LOCATION: ______________________

PURPOSE: ______________________

ATTENDANCE:

TOPICS DISCUSSED	ACTION

PREPARED BY: ______________________

(7.3a)

(CONTINUED REVERSE SIDE)

FORM 31(

CONSTRUCTION REPORTING FORMS

CH2M HILL

DAILY INSPECTION DIARY

PROJECT NO. ______________________

(1) DAY: ______________ DATE: ___/___/___ WORK PERIOD ____ A.M./P.M. TO ____ A.M./P.M. REPORT NO. __________

WEATHER ____________ TEMP. MAX ______ °F: MIN ______ °F: PRECIPITATION ______________

(2) NUMBER AND CLASS OF PERSONNEL EMPLOYED:

(3)

MAJOR EQUIPMENT ON PROJECT AND AMOUNT OF USE			
NO.	DESCRIPTION	SIZE/CAPACITY	HRS. OPER.

(4) WORK ACCOMPLISHED TODAY:

(5) ______________________ RESIDENT ENGINEER'S SIGNATURE ______ DATE

REV 9/83 FORM 21A

CH2M HILL DAILY INSPECTOR'S REPORT

SCHEDULE: ____________ DATE: ____________

LINE: ____________ INSP.: ____________

PROJECT NO. ____________

ITEMS OF WORK COMPLETED	LOCATION OR STA. TO STA.	AMOUNT	REMARKS

REMARKS: ____________

FORM 272

CH2M HILL

PROJECT WEEKLY PROGRESS REPORT

TITLE

PROJECT NO.

REPORT DATE

1. WORK ACCOMPLISHED THIS WEEK

2. WORK SCHEDULED NEXT WEEK

3. PROJECT SCHEDULE

START DATE

COMPLETION DATE

TOTAL WORK DAYS SCHEDULED

TOTAL WORK DAYS TO DATE

GAINED OR (LOST) DAYS TO DATE

TOTAL DAYS REMAINING TO COMPLETION

COMMENTS

4. CONSTRUCTION BUDGET VS. ACTUAL

(Dollar Amount in Thousands)

		BUDGET	ACTUAL COMMITTED TO DATE
A. COMMITTED TO DATE:	1. BASIC CONTRACT		
	2. APPROVED CHANGE ORDERS		
	3. OWNER FURNISHED EQUIPMENT		
B. CONTINGENCY (3% OF BASIC CONTRACT)			
C. CONSTRUCTION BUDGET			

D. ESTIMATED INCREASE OR (DECREASE) FROM BUDGET

5. PERCENT OF WORK COMPLETED

Prepared by *Title*

FORM 106

CH2M HILL

PUNCH LIST

DATE: ____________

PAGE: ______ OF: ______

PROJECT: ______________________ PROJECT NO. ______________

CONTRACTOR: ______________________

INSPECTED BY: ______________________

ITEM	LOCATION	ACTION REQUIRED	ACCEPTED BY	ACCEPTED DATE

VERIFICATION TESTING FORMS

CH2M HILL

LOG OF INDEPENDENT TEST RESULTS

DATE: ____________________

PROJECT: ______________________________ PROJECT NO. ____________

CONTRACTOR: ______________________________

TESTING FACILITIES: ______________________________

ADDRESS: ______________________________

______________ ______________ ______________

CITY STATE ZIP CODE

DATE OF REPORT	MATERIAL	QTY REPRESENTED BY SAMPLE	TEST OR INSPECTION NUMBER	SPEC. SECTION	P - PROJECT S - SOURCES L - LAB		P - PASS F - FAIL	REMARKS
					SAMPLED	TESTED		

PREPARED BY: ______________________________

CH2M HILL NUCLEAR DENSITY TESTING

JOB NO. ____________ DATE ______

PROJECT ____________

REPORT NO. ____________

MATERIAL TESTED ____________ TEST GAUGE SERIALNO. ____________

TEST REFERENCE ☐ AASHTO T-99 METHOD ______ ☐ AASHTO T-180 METHOD ______ OTHER ______

☐ ASTM D-698 METHOD ______ ☐ ASTM D-1557 METHOD ______

STANDARD COUNT: MOISTURE ______ DENSITY ______

LOCATION					
TEST ELEVATION					
MATERIAL TYPE					

MOISTURE CONTENT ASTM D3017

TEST NUMBER						
MOISTURE COUNTS	TRENCH STD.					
	TEST					
COUNT TOTAL						
COUNT AVERAGE						
COUNT RATIO						
WATER LBS/FT.^{3}						

DENSITY ASTM D2922

TEST MODE — DEPTH						
REFERENCE UNIT WEIGHT	MAXIMUM					
	MINIMUM					
DENSITY COUNTS	TRENCH STD.					
	TEST					
COUNT TOTAL						
COUNT AVERAGE						
COUNT RATIO						
WET DENSITY LBS/FT.^{3}						
WATER LBS/FT.^{3}						
DRY DENSITY LBS/FT.^{3}						
% COMPACTION						
MOISTURE CONT. — % DRY DENSITY						
TESTED BY						
CHECKED BY						

REMARKS: ____________

FORM 178

CH2M HILL

PROJECT NUMBER

MOISTURE – DENSITY RELATIONS OF SOILS

ASTM D698/ASTM D1557

PROJECT DESCRIPTION: ____________________

MATERIALS LABORATORY: ____________________

SAMPLE LOCATION: ____________________ SAMPLE NO. ________

TYPE OF SAMPLE: ____________________

☐ ASTM D698	☐ ASTM D1557	☐ METHOD A MINUS NO. 4 (4.75-mm) SIEVE	☐ METHOD C MINUS 3/4-IN. (19.0-mm) SIEVE	COMMENTS:
5.5 LB (2.5-kg) RAMMER	10-LB (4.54-kg) RAMMER	25 BLOWS/LAYER USING 4-IN MOLD		
12-IN. (305-mm) DROP	18-IN. (457-mm) DROP	☐ METHOD B MINUS NO. 4 (4.75-mm) SIEVE	☐ METHOD D MINUS 3/4-IN. (19.0-mm) SIEVE	
3 LAYERS	5 LAYERS	56 BLOWS/LAYER USING 6-IN. MOLD		

COMPACTION DATA

RUN NO.	UNITS	1	2	3	4	5	6	7
SAMPLE AND CYLINDER MASS								
CYLINDER MASS								
WET SAMPLE MASS								
WET DENSITY								
MOISTURE CONTENT	%							
DRY DENSITY	LB/FT^3							

MOISTURE CONTENT DATA

CAN NO.								
GROSS WET MASS								
GROSS DRY MASS								
MOISTURE MASS								
TARE MASS								
DRY SOIL MASS								
MOISTURE CONTENT	%							

SUMMARY

OPTIMUM MOISTURE CONTENT	%							
MAXIMUM DRY DENSITY	LB/FT^3							
NATURAL MOISTURE CONTENT	%							

CALCULATIONS AND REMARKS: ____________________

TESTED BY:	DATE:	COMPUTED BY:	DATE:	CHECKED BY:	DATE:

CH2M HILL

	PROJECT NUMBER

MOISTURE - DENSITY TEST RESULTS

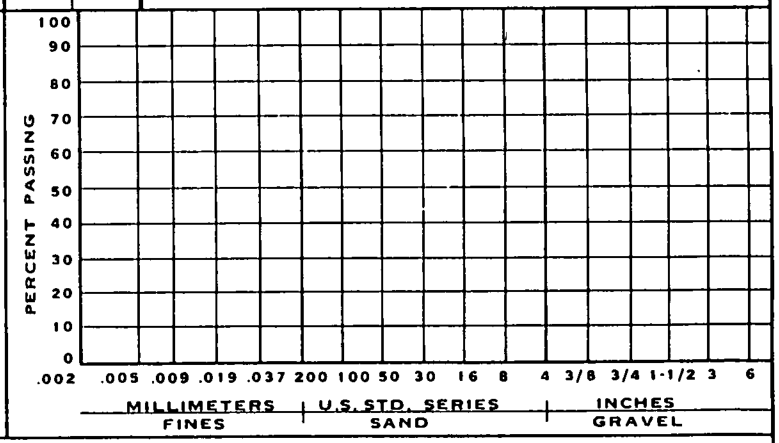
PROJECT DESCRIPTION: ______

MATERIALS LABORATORY: ______ TYPE OF SAMPLE: ______

SAMPLE LOCATION: ______ SAMPLE NO: ______

TEST SPECIFICATIONS	SYM		ASTM SOIL CLASSIFICATION:
☐ ASTM D698	LL		GEOLOGICAL CLASSIFICATION:
☐ ASTM D1557	PL		
METHOD	G_S		
☐ A ☐ C			
☐ B ☐ D			

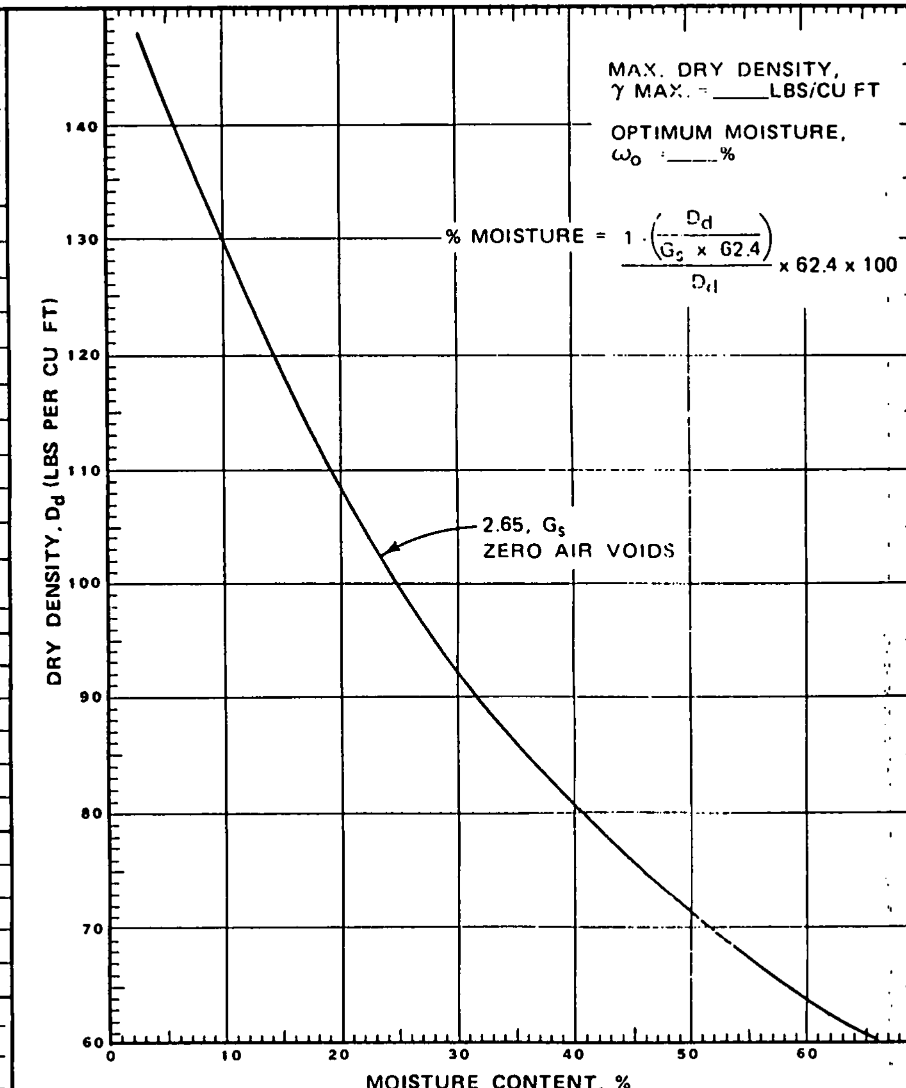
COMMENTS: ______



FIELD TEST RESULTS

TEST NO.	(UNITS)					
FIELD DRY DENSITY	LB/FT^3					
FIELD MOISTURE CONTENT	%					
PERCENT COMPACTION	%					
TEST NO.	(UNITS)					
FIELD DRY DENSITY	LB/FT^3					
FIELD MOISTURE CONTENT	%					
PERCENT COMPACTION	%					

REMARKS: ______



TESTED BY:	DATE:	COMPUTED BY:	DATE:	CHECKED BY:	DATE:

SHEET ________ OF ____

CH2M HILL

PROJECT NUMBER

MOISTURE CONTENT

ASTM D2216

PROJECT DESCRIPTION: ____________________

MATERIALS LABORATORY: ____________________

SAMPLE LOCATION: ____________________ SAMPLE NO. ________

TYPE OF SAMPLE: ____________________

SAMPLE LOCATION							
SAMPLE NO.							
CAN NO.							
GROSS WET MASS							
GROSS DRY MASS							
MOISTURE MASS							
TARE MASS							
DRY SOIL MASS							
MOISTURE CONTENT, %							
SAMPLE LOCATION							
SAMPLE NO.							
CAN NO.							
GROSS WET MASS							
GROSS DRY MASS							
MOISTURE MASS							
TARE MASS							
DRY SOIL MASS							
MOISTURE CONTENT, %							
SAMPLE LOCATION							
SAMPLE NO.							
CAN NO.							
GROSS WET MASS							
GROSS DRY MASS							
MOISTURE MASS							
TARE MASS							
DRY SOIL MASS							
MOISTURE CONTENT, %							

TESTED BY:	DATE:	COMPUTED BY:	DATE:	CHECKED BY:	DATE:

SHEET ______ OF ______

CH2M HILL

PROJECT NUMBER

SAND CONE FIELD DENSITY

ASTM D

PROJECT DESCRIPTION: ______

MATERIALS LABORATORY: ______

SAND CONE SERIAL NO. ______ BASE PLATE SERIAL NO. ______

ITEM	UNITS	TEST DATA				
TEST NUMBER						
TEST LOCATION						
TEST ELEVATION						
MATERIAL TYPE						
WET DENSITY						
BULK DENSITY OF SAND						
ORIGINAL SAND						
REMAINING SAND						
SAND USED						
GROSS VOLUME						
TARE VOLUME						
NET VOLUME OF TEST HOLE						
GROSS WET MASS						
TARE NUMBER						
TARE MASS						
WET SOIL MASS						
WET DENSITY						
MOISTURE CONTENT						
TARE NUMBER						
GROSS WET MASS						
GROSS DRY MASS						
MOISTURE MASS						
TARE MASS						
DRY SOIL MASS						
MOISTURE CONTENT	%					
TEST RESULTS						
IN-PLACE DRY DENSITY						
COMPACTION						
RELATIVE DENSITY						

SPECIFICATION

______ % ASTM D698 METHOD ______ = ______ LB/FT^3

______ % ASTM D1557 METHOD ______ = ______ LB/FT^3

______ % ASTM D2049 = ______ LB/FT^3

RELATIVE DENSITY (%)

$$= \frac{D_{FLD} - D_{MIN}}{D_{MAX} - D_{MIN}} \times \frac{D_{MAX}}{D_{FLD}} \times 100$$

REMARKS ______

TESTED BY:	DATE:	COMPUTED BY:	DATE:	CHECKED BY:	DATE:

CH2M HILL

PROJECT NUMBER

PARTICLE-SIZE ANALYSIS

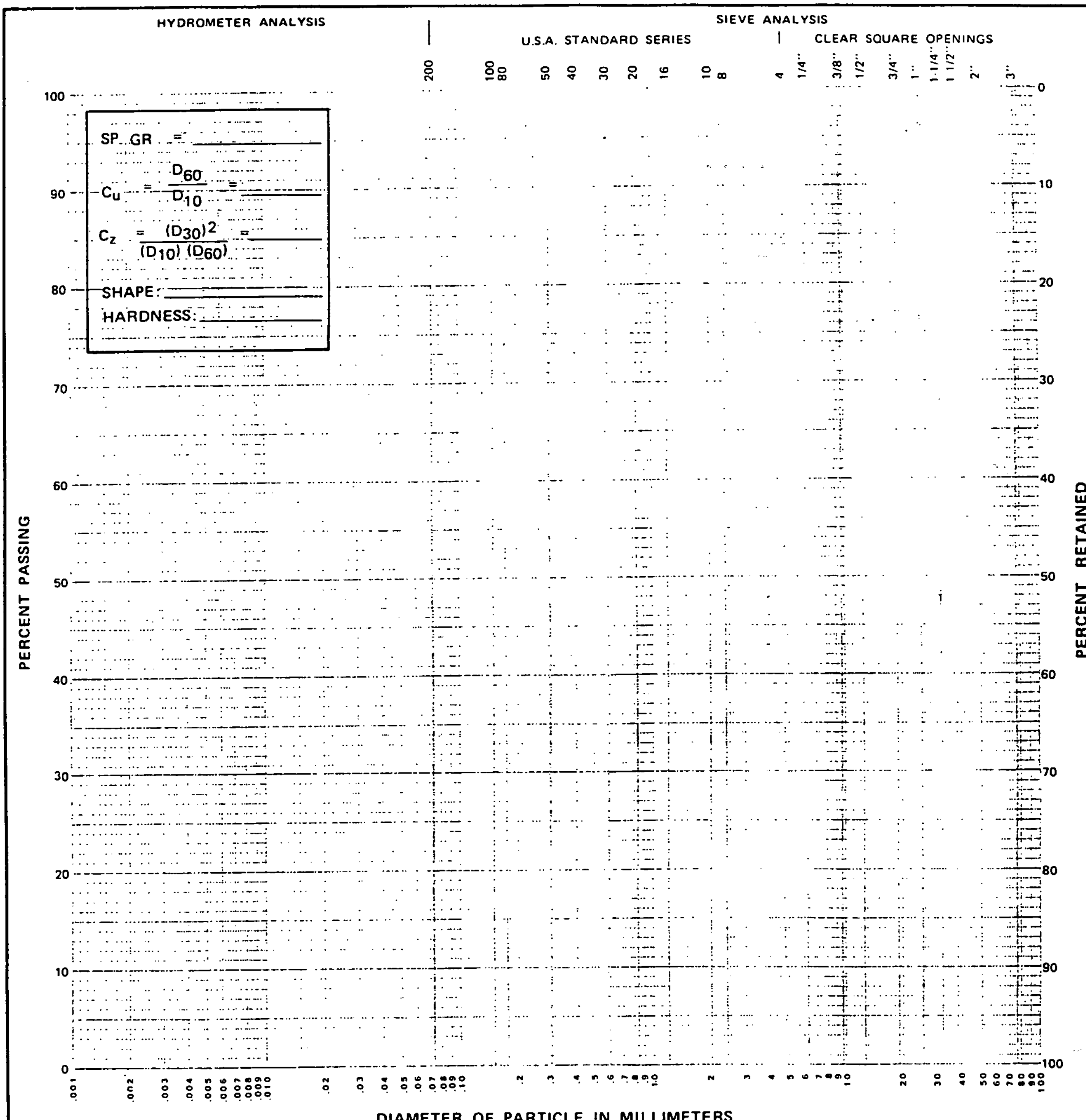
ASTM D422

PROJECT DESCRIPTION: ____________________

MATERIALS LABORATORY: ____________________

SAMPLE LOCATION: ____________________ SAMPLE NO. ____________

TYPE OF SAMPLE: ____________________



COL-LOIDS	CLAY SIZE	SILT SIZE	SAND			GRAVEL	COBBLES
			FINE	MEDIUM	COARSE		

SAMPLE CLASSIFICATION ____________________

TESTED BY:	DATE:	COMPUTED BY:	DATE:	CHECKED BY:	DATE:

CH2M HILL

PROJECT NUMBER

SOILS CLASSIFICATION AND TEST SUMMARY

ASTM D2487

PROJECT DESCRIPTION:

MATERIALS LABORATORY: TYPE OF SAMPLE:

SAMPLE LOCATION: SAMPLE NO:

SAMPLE LOCATION	SAMPLE NUMBER	DEPTH INTERVAL ( )	DESCRIPTION OF MATERIAL	ASTM CLASSIFICATION	MOISTURE			GRADATION, % PASSING						
					P.L. (%)	ω (%)	L.L. (%)	3"	1½"	# 4	#200			

(10.16)

REMARKS:

TESTED BY: DATE: COMPUTED BY: DATE: CHECKED BY: DA