DESIGN PACKAGE

ENVIRONMENTAL RESOURCES MANAGEMENT GROUP

Warner, Norcross & Judd

Design Package
Ground Water Remediation System
Wicks Creek Site
Douglas, Michigan

April 17, 1995

Project No. 94263

Environmental Resources Management-North Central, Inc.
540 Lake Cook Road, Suite 300
Deerfield, Illinois 60015

ERM®

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CONTENTS

APPENDICES:

LIST OF TABLES

LIST OF FIGURES

LIST OF DRAWINGS

1.0 *INTRODUCTION*

This report details the Design Package for the ground water extraction and treatment systems located at the Wicks Creek Site one-half mile northwest of the Haworth, Inc. (Haworth) Plant at 200 Washington Road in Douglas, Michigan (Figure 1-1). The Design Package is being submitted to the Michigan Department of Natural Resources (MDNR) by Haworth in accordance with the March 25, 1994 letter from MDNR (MDNR, 1994) in which MDNR requested design details of the remedial system. Response action alternatives were presented in the January 1994 "Wicks Creek and Off-Site Ground Water Investigation and Response Action Analysis" (Environmental Resources Management-North Central, Inc., 1994) and at a meeting with MDNR, Haworth, and Environmental Resources Management-North Central, Inc. (ERM-North Central) personnel on February 22, 1994.

A common element of each response action alternative presented was the installation and operation of a single extraction well within close proximity to the organic contaminant source area at the Haworth Plant. The remaining elements for each alternative dealt with different remediation configurations near the plume's termination point at Wicks Creek located approximately one-half mile northwest of the Haworth Plant (Figure 1-2). Because the two areas (the Haworth Plant Site and Wicks Creek Site) entail different designs, a Design Package was prepared for each area separately. This Design Package details the implementation of the remediation at the Wicks Creek Site. A Design Package for the response action for the Hawthorn Plant Site will be separately submitted.

The following sections provide a summary of the design basis of the ground water remediation system (Section 2.0), a description of the ground water remediation system (Section 3.0), ground water remediation system monitoring (Section 4.0), and a discussion of the ground water remediation system schedule (Section 5.0).

2.0 DESIGN BASIS OF THE GROUND WATER REMEDIATION SYSTEM

This section reviews the clean-up objectives (CUOs) and presents the design basis of the ground water remediation system. The system is divided into three parts: (1) the ground water extraction system, (2) the ground water treatment system, and (3) the ground water disposal system.

2.1 CLEAN-UP OBJECTIVES

2.1.1 *Background*

Previous investigations of the Haworth Plant property and the off-site area northwest and north of the plant, have delineated an organic contaminant plume as originating under what is now the Haworth Plant and extending northwest to Wicks Creek whereupon it discharges into the Creek's surface water. As described in the previous investigations, the plume has been detected in the regional sand/silty sand aquifer, which underlies the entire area. Forming the base of the aquifer and contamination is a very low hydraulic conductivity clay till layer. Ground water flow direction at the plant has been observed to extend to the northwest toward Wicks Creek.

The primary constituents of the ground water plume migrating northwestward from the Haworth Plant are the chlorinated solvent trichloroethene (TCE), and TCE degradation products. These organic constituents are consistent with the results of a soil and soil gas investigation, which identified potential source areas beneath the current Plant. In addition, these chlorinated organic solvents are consistent with historical manufacturing operation, prior to the occupancy of the plant by Haworth, in which parts degreasing utilizing TCE was a significant manufacturing component of the site operations.

The focus of the response actions for the site and site area is on the ground water contamination. Soil contamination present beneath the Plant, while representing a potential continuing source of ground water contamination, does not currently pose a risk to personnel at the Plant due to the presence of the building. Since a potential risk of exposure is present only when construction is conducted through the concrete slab, which serves as the building foundation, all such activities that Haworth has implemented since knowing of the subsurface contamination have included and allowed for worker health and safety protection.

The ground water contamination, identified immediately adjacent to and downgradient from the Haworth Plant, requires remediation at this time. The presence of the organic contaminants in the ground water plume has resulted in the discharge of these contaminants to Wicks Creek at concentrations above acceptable levels. Therefore, it is appropriate that the present response actions for the site concentrate only on the current risk posed by the contaminated ground water plume.

In addition to the chlorinated solvent constituents in the plume, there are two inorganic parameters in the ground water which may be attributable to the site: manganese and zinc. The detected concentrations of both of these parameters in the ground water samples collected from the monitoring wells in the Wicks Creek Area were all below the MERA Type B Drinking Water Values for the respective parameter (See Table 2-1).

2.1.2 *Clean-Up Criteria*

Part 201 of the Michigan Environmental Protection Code, 1994 PA 257, formerly known as the Michigan Environmental Response Act, 1982 PA 307 (MERA), contains three levels of clean-up criteria (Types A through C) for the response to hazardous waste sites. Type A criteria are set at the background concentrations or the method detection limits, whichever is higher. Type B criteria include risk-based concentrations and levels that: (1) meet aesthetic-based limits in ground water, (2) protect aquifers and surface waters from the migration of compounds in soils, and (3) protect direct uses of the soils. Finally, Type C criteria are based on a site-specific risk assessment.

In general, the clean-up criteria utilized for the design of the Wicks Creek Site ground water remediation system is the MERA Type B. However, if the target method detection limit or the background concentration of a particular compound or analyte is higher than its Type B level, the clean-up criteria are set at the higher level. The Type B clean-up levels are presented in Table 2-1. The metals concentrations are less than the MERA Type B health-based criteria. Therefore, metal removal from the effluent has not been considered in the design of the ground water remediation system.

2.1.3 *Selected Ground Water Remediation System*

The "Wicks Creek and Off-Site Ground Water Investigation Report and Response Action Analysis" (ERM-North Central, 1994) identified various technologies to remediate the Wicks Creek area's ground water. The selected ground water remediation system will utilize a collection system of three extraction wells for ground water withdrawal. Ground water treatment will utilize an air stripping with vapor-phase granulated activated carbon (GAC) treatment and ground water polishing with aqueous GAC treatment. The Wicks Creek Site treated effluent will be discharged directly to Wicks Creek according to the terms of the NPDES permit to be obtained as part of this project.

2.2 *GROUND WATER EXTRACTION SYSTEM*

The ground water flow system at both the Haworth Plant area and the Wick Creek area was modeled as part of the Remedial Design to: (1) generate quantitative predictions of the ground water flow systems resulting from the pumping of ground water extraction wells at both the Haworth Plant area and the Wicks Creek area, and (2) predict resultant contaminant transport at the site after the ground water extraction system is operating.

Specific requirements governing the ground water modeling efforts include the following:

- Minimize the number of extraction wells necessary for plume capture,
- Prevent the ground water plume from continuing to discharge to Wicks Creek, and
- Minimize drawdown while effectively capturing the contaminated ground water to minimize the ground water requiring treatment.

The required ground water capture zone consists of the area between the Haworth Plant and a direct line to Wicks Creek which contains the ground water organic plume.

The U.S. Geological Survey's Modular Three-Dimensional Finite Difference Ground Water Flow Model (MODFLOW) (McDonald and Harbaugh, 1988) was selected for this project because it is widely used and it is capable of representing a wide array of geological and boundary conditions. MODELCAD, a preprocessor distributed by Geraghty and Miller, Inc. (1993), was used for the construction of MODFLOW input files. In addition, MODELCAD was used to create input data sets for use with MODPATH (Pollock, 1989).

MODPATH is capable of tracking particles within the modeled domain using heads and cell-by-cell flow values generated by MODFLOW, thereby allowing for an assessment of the impact of active pumping on contaminant movement. Although MODFLOW and MODPATH are not capable of simulating contaminant transport, the conservative particle tracking movement and travel times based on the ground water model-generated velocity field allows for assessment of the capture zone of one or multiple pumping wells.

The model consisted of the area shaded in blue on Figure 2-1. Grid lines were placed parallel to the site grid. The model bottom was constituted from soil boring information, which identified the top of the aquifer's underlying the layer. The till elevation data was input into SURFER program and kriged to generate a regularly spaced grid. The kriged grid was then imported into MODELCAD to represent the bottom of the regional aquifer. Horizontal hydraulic conductivity for the regional aquifer was the mean of all the sand facies slug test results at the site; 3.48 feet/day. Vertical hydraulic conductivity was selected as being a magnitude lower than the horizonal; 0.348 feet/day. The saturated thickness of the regional aquifer was evaluated from the water level data collected during the Remedial Investigation.

Precipitation in the Douglas area averages approximately 38 inches per year. Because the sandy soil is very permeable, it was assumed for the purpose of this model that nearly all of the precipitation directly infiltrates the soil with the remainder lost to evaporation or runoff. A recharge value of 36 inches per year was assigned to the top layer of the model.

After initial construction of the model, simulations were performed to determine the consistency of model output to site collected ground water elevations. The initial conditions model runs were completed to provide a basis upon which the modeled remedy could be compared. Predicted hydraulic heads for the area for the initial conditions are shown on Figure 2-1. Starting positions for particle tracking analysis were made upgradient of Wicks Creek and at various locations with the Haworth Plant.

Simulations were made for the extraction well remedy which includes the placement of one extraction well located at the Haworth plant and three extraction wells located along an east-west section of Wicks Creek (Figure 2-2). The model was run several times with various pumping rates in the four wells. The maximum sustainable pumping rates for the given geologic conditions present at the site are 4 gallons per minute (gpm) for wells EW-2 through EW-4 and 5 gpm for EW-1. Figure 2-2 shows the predicted model generated heads, locations of pumping wells, and particle traces for the area when the extraction wells are pumping at the above-specified rates.

Figure 2-3 depicts the estimated drawdown for various pumping rates using the above specified geologic conditions with the Theis equation. The predicted maximum pumping rates calculated by the MODFLOW simulation of 5 gpm in EW-1 and 4 gpm in EW-2 through EW-4 closely match the results of the Theis calculation thereby confirming the model maximum discharge results. Table 2-2 summarizes the design parameters for each of the extraction wells.

2.3 *GROUND WATER TREATMENT SYSTEM*

Although extraction wells EW-2 through EW-4 at the Wicks Creek Site are each expected to discharge at 4 gpm, the ground water treatment system has been designed to treat up to 20 gallons per minute of volatile organic compounds (VOCs) contaminated ground water as shown in Table 2-1. The treatment system utilizes air stripping followed by carbon adsorption to meet the treatment levels shown on Table 2-1.

The air stripper will be a multi-stage diffuser that includes both an air supply blower and a booster blower for off gas vapor-phase treatment. Exhaust gases from the air stripper system will be transferred to a vapor-phase GAC system by a vapor booster blower. The vapor-phase GAC system will consist of two GAC units, operated in series.

Ground water leaving the air stripper will be pumped through an aqueous GAC system consisting of two low pressure carbon canisters, operated in series. Effluent from the aqueous GAC system will be directly discharged to Wicks Creek. The ground water treatment system will be controlled by a control panel with necessary switches and alarms. The panel will include starters and system control.

A disposal cartridge-type water filter will be installed between the air stripper and aqueous GAC system. The filter will act to remove suspended solids and to reduce blinding of the aqueous GAC system.

Details of the ground water treatment system are provided in Appendix B.

2.4 *TREATED GROUND WATER DISPOSAL SYSTEM*

After treatment, the effluent from the Wicks Creek Site ground water treatment system will be discharged directly to Wicks Creek according to the terms of the NPDES Permit. A pipeline will be installed from the treatment system building to the creek to facilitate this discharge.

3.0 DESCRIPTION OF THE GROUND WATER REMEDIATION SYSTEM

The various components of the Wicks Creek Site ground water remediation system are described in this section. An overall block flow diagram for the system is illustrated in Figure 3-1. The process flow diagram is presented on Drawing 94263-20-2, and the location of the system components are noted on Drawing 94263-20-3. The system is divided into three parts: (1) the ground water extraction system, (2) the ground water treatment system; and (3) the treated ground water disposal system.

3.1 GROUND WATER EXTRACTION SYSTEM

The ground water extraction system will be comprised of the ground water extraction wells (EW-2 through EW-4), ground water extraction pumps, and associated compressed air supply and discharge piping systems.

3.1.1 Ground Water Extraction Wells

The ground water extraction well construction is detailed in Drawing 94263-20-4. Key design components are discussed below.

- Each extraction well is constructed of 4-inch inside diameter, 304 stainless steel, riser, prepacked well screen and sump.
- The prepacked screens will be designed to minimize the inflow of total suspended solids and turbidity originating from the formation by retaining most of this material.
- The prepacked well screen has a 0.006 slot opening and the sand mesh size is 10-40.
- Extraction wells EW-2 through EW-4 will be installed to 10 feet below the base of the aquifer, approximately 40 feet below grade. The well screen will extend from the top of the water table to the base of the aquifer, a length of approximately 20 feet.
- The space between each borehole well and the prepacked screen and sump will be backfilled with additional amounts of sand to provide a thicker, more effective filter pack around the screen. The sand mesh size is 10-40.

A well vault will be constructed over each well head to allow access to install and maintain the ground water extraction well and pump. Key design components are discussed below:

- An access manway, designed to withstand truck traffic, to permit access for maintenance;
- A bottom drain, to facilitate the downward drainage of any moisture that may accumulate in the well vault;
- Air supply, vent, and discharge piping connections; and
- A carrier pipe to route the piping from the ground water extraction well to the ground water treatment system.

3.1.2 *Ground Water Extraction Pump*

Ground water is extracted by using a pneumatic, bottom inlet, submersible pump with an effective operating range of 1 to 10 gpm in each extraction well. Each ground water extraction pump operating discharge flow rate is 4 gpm (5,760 gpd). Appendix A contains the Technical Specifications for a pneumatic submersible pump.

The pump is suspended within the well sump from the in-well tubing. The in-well tubing is connected to the pump and attached to an adjustable well head seal. By loosening the seal, the pump can be raised or lowered to this selected depth.

The extraction pump is operated by transferring ground water to the ground water treatment system in alternating fill and empty cycles. A fill cycle during which no compressed air is provided to the pump, is followed by a discharge cycle during which compressed air expels the ground water. An internal mechanism activates the discharge cycle when the pump fluid chamber is full.

To control the pump's discharge flow rate, the fill and/or discharge cycle time is adjusted by throttling the vent discharge. Opening the vent valve reduces the fill cycle time, while closing the valve increases the time. The empty time can be adjusted by regulating the compressed air supply pressure. Increasing the pressure reduces the empty cycle time, while reducing the pressure increases the time. The empty time cycle can also be adjusted by throttling the discharge flow. The vent valve, compressed air regulator, and discharge valve are located in the treatment system building.

3.1.3 *Associated Piping Systems*

The ground water extraction pump utilizes compressed air for the discharge cycle. Compressed air at 70 psig minimum pressure is dried by an air dryer system to a (-) 40°F dew point. The dried compressed air pressure is indicated (PI-200). The compressed air flow to the pumps, controlled by an on-off flow control valve (FCV-200) and pressure by a regulator (see Item 3.1.2). The control panel has open-close-auto hand control (HC-200) that provides the current signal to open FCV-200 (see Item 3.2).

With the ground water treatment system operating, the flow control valve (FCV-200) is energized to the open position from the control panel. In the event of an alarm condition (see Item 3.2), which requires shutdown of the ground water extraction pump, the control panel de-energizes the flow control valve to the closed position. Clearing of the alarm condition will energize the flow control valve to the open position. For shutdown of the ground water remediation system for maintenance, the compressed air isolation valve is to be manually closed.

Each extraction pump discharge has a sample port, flow element with flow totalizer indicator (FE-200 A-C and FQI-200 A-C), and throttling valve (see Item 3.1.2).

Compressed air is also being used to operate a transfer pump, rated at 0 to 5 gpm. The transfer pump will be utilized to empty exhausted vapor-phase GAC system units of free liquid and for housekeeping activities. The pump can discharge to a drum for treatment at a later date or directly to the air stripper system. The operation of the pump will be manually controlled by opening the compressed air supply valve. The pump discharge capacity will also be manually controlled by adjusting the compressed air pressure regulator.

3.2 *GROUND WATER TREATMENT SYSTEM*

The ground water treatment system, comprised of an air stripper with vapor-phase GAC system and aqueous GAC system, will reduce VOCs from the extracted ground water. The treatment system also has a pump station with filter system to reduce the solids loading to the aqueous GAC system. The treatment system has instrumentation to monitor equipment operations and totalize the treated discharge flow.

3.2.1 *Air Stripper System*

The air stripper system will receive extracted ground water directly from the extraction well pumps. A transfer pump, collecting fluids from housekeeping activities, also discharges to the air stripper system. The air stripper system is designed to treat 20 gpm of extracted water flow at an air stripper air rate of 300 scfm. Appendix B contains the

Technical Specifications for the air stripper system. The air stripper system design features include:

- The air stripper system, including the vapor booster blower, will be designed for a NEMA rating of 3R.

- The air stripper system design utilizes a multi-stage diffuser air stripper. The stripper overflows directly into the pump station (see Item 3.2.2). The stripper has a level switch low (LSL-201). At low water level, the switch activates an alarm (LAL-201) at the control panel and shuts down the ground water remediation system. The design allows for the diffuser chamber to be drained for inspection, cleaning, or unit repair.

- A centrifugal blower, rated at 300 scfm with a 5 HP motor, provides the air stripper system with outside air, or a blend of inside and outside air. The blower discharge has a pressure indicator (PI-201), a temperature indicator (TI-201), and a flow switch low (FSL-201). At a low flow condition, the switch activates an alarm (FAL-201) at the control panel and shuts down the ground water remediation system. The vapor booster blower has to be operating prior to starting the centrifugal blower.

- A centrifugal vapor booster blower, rated at 300 scfm with a 5 HP motor, provides a vacuum on the air stripper that discharges the vapors via the vapor-phase GAC system to atmosphere. The blower discharge has a pressure indicator (PI-202), a temperature indicator (TI-202), and a flow switch low (FSL-202). At a low flow condition, the switch activates an alarm (FAL-202) at the control panel and shuts down the ground water remediation system.

The start-up sequence is critical. The compressed air flow control valve (FCV-200) will not open until: (1) all of the control panel alarms have been cleared, and (2) the vapor booster blower and air stripper system have been started (vapor booster blower first and then the air stripper system).

3.2.2 *Vapor-Phase Granular Activated Carbon System*

The vapor-phase GAC system is designed to adsorb organic contaminants from the extracted vapors on a flow-through basis by using two downflow GAC canister in series. The vapor booster blower, rated at 300 scfm, provides a vacuum on the air stripper that discharges the vapors via the vapor-phase GAC system to atmosphere. The system will be designed to accept canisters of varying sizes to optimize system operation. It is expected that larger canisters will be used initially, while the influent concentrations are high, and smaller canisters will be put into place later in the project after the influent concentrations have decreased. The first canister in the series will receive the highest contaminant loading and, therefore, will be the first canister to be exhausted. The second canister in the series will act as a polishing step and receive a very light loading. Appendix B contains the Technical Specifications for the vapor-phase GAC system. The vapor-phase GAC system design features include:

- Two 2,500-pound canister units, operated in series,
- Sample ports before, between, and after the series units,
- A differential pressure indicator (PDI-203) to monitor pressure loss, and
- Quick disconnects on the canisters to allow rapid canister switching and replacement.

Analytical sampling will be conducted, on a periodic basis, from a sample port between the two canisters to determine if contaminants are passing through the first canister. When contaminants are detected, the carbon in the first canister is assumed to have exhausted its adsorption capacity and breakthrough is said to have occurred. During the initial operations of the ground water remediation system, it is anticipated that a 2,500-pound canister would be exhausted in 60 days.

When breakthrough occurs, the first canister will be taken out of service and sent off site for disposal or regeneration. A fresh canister will then be put into service, as the second in the series, so that the cleanest water contacts the freshest adsorbent.

3.2.3 *Pump Station*

The air stripper system effluent overflows to a pump station, where the ground water is pumped through a filter system to an aqueous GAC system for discharge. The pump station will be designed to be capable of pumping 20 gpm at 150 feet of TDH with a 0.5 HP motor. Appendix B contains the Technical Specifications for the pump station. The pump station design features include:

- The pump station will be designed for a NEMA rating of 3R.
- A 150-gallon tank will be fully enclosed and vented to the atmosphere through a single 50-pound vapor-phase canister. The vapor-phase GAC canister will allow volume changes in the tank operating water level without discharging VOCs to the atmosphere. The canister will be replaced once a year.
- The tank will be equipped with three level switch devices. A level switch (LSH-204) will monitor the tank for excessive

volume. If the volume should exceed this switch setting, the switch will activate an alarm (LAH-204) at the control panel and shut down the ground water remediation system. The other set of level switches, a high and low switch, will start and stop the pump, respectively.

- The pump has a hand control off-auto switch (HC-204) in the control panel. In auto selection, the set of high and low level switches start and stop the pump.

- The pump will transfer the tank's contents to the filter system at a set flow rate of 20 gpm. The flow regulator (FO-204) will maintain constant flow through the system over the varying pressures on the pump.

- The pump discharge will have a pressure indicator (PI-204) and sample port.

The pump station will be designed to compensate for pressure losses through the filter and aqueous GAC systems. A spare, uninstalled pump will be provided.

3.2.4 *Filter System*

The filter system will be designed to remove suspended solids, including oxidized iron, on a flow-through basis by using a high-solids capacity, disposable, cartridge-type filter. The purpose of the filtration system is to reduce fouling of the aqueous GAC system. The filtration system will consist of two units: one operating and one standby. The initial system design calls for a multi-media cartridge filter to remove particulates larger than 50 microns, with a 99 percent removal efficiency. The filtration system will be designed to accept varying filter cartridge media to optimize solids removal and treatment system efficiency. The discharge from the filtration system will be piped under pressure to the aqueous GAC system. Appendix B contains the Technical Specifications for the filter system. The filter system design features include:

- Filter system vessels designed in accordance with ASME code;

- Filter system instrumentation designed for a NEMA rating of 3R;

- Two units operating in series, each with a design flow rate capacity of at least 30 gpm and solids holding capacity of at least 10 lbs;

- Quick opening to allow easy access to remove dirty filters;

- Flow diversion valves between the two filters to allow filter changeover without interrupting treatment system operation; and

- Filter system pressure loss monitoring with a pressure differential indicator (PDI-205). If the pressure loss across the filter exceeds 15 pounds per square inch, a pressure differential switch high (PDSH-205) will activate an alarm (PDAH-205) to indicate that the filter requires replacement. Upon annunciation of the PDAH, the stand-by filter will be manually put into operation to allow replacement of the used filter. The used filter will be disposed of off site.

If for some reason the used filter is not replaced before becoming clogged, the pressure will increase on the pump discharge until the flow regulator is overcome and flow is reduced. When the pump flow rate is reduced, the water volume will rise in the tank until the level switch (LSH-204) signal is activated, annunciating an alarm and shutting down the ground water remediation system.

3.2.5 *Aqueous Granular Activated Carbon System*

The aqueous GAC system is designed to adsorb organic contaminants from the extracted ground water on a flow-through basis by using two downflow GAC canisters in series. The system will be designed to accept canisters of varying sizes to optimize system operation. It is expected that larger canisters will be used initially, while the influent concentrations are high, and smaller canisters will be put into place later in the project after the influent concentrations have decreased. The first canister in the series will receive the highest contaminant loading and, therefore, will be the first canister to be exhausted. The second canister in the series will act as a polishing step and receive a very light loading. Appendix B contains the Technical Specifications for the aqueous GAC system. The aqueous GAC system design features include:

- Two 1,000-pound canister units, operated in series.

- Sample ports before, between, and after the series units.

- A pressure differential indicator (PDI-206) to monitor pressure loss.

- Quick disconnects on the canisters to allow rapid canister switching and replacement.

Analytical sampling will be conducted, on a periodic basis, from a sample port between the two canisters to determine if contaminants are passing through the first canister. When contaminants are detected, the carbon in the first canister is assumed to have exhausted its adsorption capacity, and breakthrough is said to have occurred. During the initial operations of the ground water remediation system, it is anticipated that a 1,000-pound canister would be exhausted in 400 days.

When breakthrough occurs, the first canister will be taken out of service and sent off site for disposal or regeneration. A fresh canister will then be put into service, as the second in the series, so that the cleanest water contacts the freshest adsorbent. Quick disconnects between the units will be manually switched to make this change.

The aqueous GAC system discharges to Wicks Creek and has a flow element with flow totalizer indicator (FE-207 and FQI-207) to monitor the treated water flow. A temporary 10,000-gallon effluent holding tank will be used initially to collect the treated effluent. Once analytical results confirm that the effluent is acceptable for discharge, this tank will be bypassed and the treated effluent will be discharged directly to Wicks Creek.

3.2.6 *Control Panel*

The operations of the ground water remediation system are monitored and controlled from a single control panel. Equipment-mounted switches and motors are wired to alarms or hand controls in the panel. The control panel design features include:

- Hand controls for the following valve or motor operation:
    - HC-200 for the open-close-auto operation of FCV-200,
    - HC-201 for the start-stop operation of the air stripper blower,
    - HC-202 for the start-stop operation of the vapor booster blower, and
    - HC-204 for the hand-off-auto operation of the pump station.
- Annunciation of the following alarms:
    - Level alarm low (LAL-201) for the air stripper system,
    - Flow alarm low (FAL-201) for the air stripper system,
    - Flow alarm low (FAL-202) for the vapor booster blower,
    - Level alarm high (LAH-204) for the pump station,
    - Pressure differential alarm high (PDAH-205) for the filter system.

- Operating status lights for the following valve or motor operation:

  - Valve FCV-200 open,
  - Air stripper blower operating,
  - Vapor booster blower operating, and
  - Pump station pump operating.

- Relays to shut down the ground water remediation system by de-energizing the valve FCV-200, for any of the following conditions:

  - Shutdown of either the vapor booster or air stripper blower, or

  - Except for alarm PDAH-205, annunciation of all other alarms.

Plant operating personnel will be notified of the annunciation of any alarms by the energizing of a remote alarm (MA-200) located at the Haworth Plant.

3.2.7 *System Layout*

The location of the system components are noted on Drawings 94263-20-3 and 94263-20-5.

All equipment components of the ground water treatment system will be located in the supplied prefabricated treatment system building. The equipment in this building will be designed for a NEMA rating of 3R.

3.2.8 *Temporary Effluent Holding Tank*

A temporary effluent holding tank will be needed during the demonstration of compliance operation to store 8 hours of treated ground water flow. The ground water remediation system demonstration of compliance is detailed in Appendix C. The volume of ground water to be produced is approximately 5,760 gallons.

Treated ground water will be piped directly from the aqueous GAC system into the effluent holding Baker tank with an available volume of 10,000 gallons. The tank will have a level indicator (LI-207) with locking valve on the tank drain. The tank's drain will be piped to the discharge to Wicks Creek. Samples of the treated ground water flow will be obtained and analyzed.

3.3 *TREATED GROUND WATER DISPOSAL SYSTEM*

The treated ground water will be discharged directly to Wicks Creek according to the provisions of the NPDES permit to be obtained. The effluent flow will be totalized (FQI-207).

3.4 *SEQUENCE OF OPERATIONS*

3.4.1 *Conditions*

The Wicks Creek Site ground water remediation system, startup and shutdown, sequence of operations are presented below. The sequence is based upon the following conditions:

1. All equipment is functional.

2. The hand controls have been placed in the following positions:

   - FCV-200, HC-200 in close;
   - Air stripper blower, HC-201, in stop;
   - Vapor booster blower, HC-202, in stop; and
   - Pump station, HC-204, in stop;

3. The vapor-phase and aqueous GAC system canisters are hooked up for series operation, and the canisters are not exhausted.

4. The filter system has a unit in operation and one in standby.

5. All valves are closed, except the following valves, which are open (see Drawing No. 94263-20-2):

   - Compressed air supply to the air dryer system,
   - Extracted ground water discharge and vent,
   - Treated effluent discharge to Wicks Creek,

6. The control panel is energized.

7. All alarm conditions have been cleared.

8. The air compressor system is operative.

3.4.2 *System Startup*

The Wicks Creek Site ground water remediation system start-up sequence is noted below:

1. Place the vapor booster blower hand control (HC-202) in the start position. Check PI-202 and TI-202 readings (should be

approximately ___ psi and ____°F, respectively, settings to be determined by equipment supplier).

2. Place the air stripper blower hand control (HC-201) in the start position. Check PI-201 and TI-201 readings (should be approximately ___ psi and ___°F, respectively, settings to be determined by equipment supplier).

3. Place the pump station hand control (HC-204) in the auto position.

4. Open the compressed air isolation valve to the extraction well pump regulators. Check PI-200 pressure reading (should read at least 70 psig).

5. Place the FCV-200 hand control, HC-200, to the auto position.

6. Adjust the extraction well pump air supply regulators to 50 psi.

7. Adjust the extraction well pump vent valves to obtain the desired pump discharge flow rate of 4 gpm from each well. Confirm flow rates by reading the totalizers FQI-200 A through C.

8. Observe the operation of the ground water treatment system (pressures, temperatures, differential pressure losses, and flow rates).

9. If required, adjust the extraction well pumps' discharge flow to obtain the desired treated water discharge flow of 4 gpm from each well. Confirm flow rate by reading the totalizer FQI-207.

3.4.3 *System Shutdown*

The Wicks Creek area ground water remediation system shutdown sequence is noted below:

1. Manually close the compressed air isolation valve to the extraction well supply pressure regulator.

2. Place FCV-200 hand control HC-200 to the closed position.

4.0 GROUND WATER REMEDIATION SYSTEM MONITORING

4.1. PERFORMANCE MONITORING

Performance monitoring will be conducted during the operation and startup of the ground water remediation system proposed for installation at the Wicks Creek Site. Performance monitoring will be conducted to evaluate: (1) the progress of the remediation, (2) compliance with the conditions on the discharge, and (3) the efficiency of the treatment system. The following activities will be conducted to achieve the indicated objectives:

- Effluent Monitoring - To evaluate compliance with discharge requirements.

- Treatment and Air Emissions Monitoring - To evaluate GAC usage in air emissions.

- Water Level Monitoring - To determine the extent of the ground water capture zone.

- Ground Water Quality Monitoring - To evaluate the progress of the interim response actions and the attainment of ground water clean-up criteria.

- Reporting - To document the results of the performance monitoring.

Performance monitoring requirements are described in detail in Appendix C, the Performance Monitoring Plan.

4.2 SAMPLING AND ANALYSIS

The Performance Monitoring Plan requires extensive sampling and analysis to document the condition of the ground water extraction treatment and disposal system. Appendix D, the Sampling and Analysis Plan, describes the performance monitoring data collection strategy, as well as the specific protocols to be followed for sample collection, identification, labeling, handling, custody, laboratory and field analysis of samples, and documentation and reporting. The quality assurance/quality control activity associated with the sampling and analysis activities are also included throughout the Sampling and Analysis Plan.

5.0 GROUND WATER REMEDIATION SYSTEM SCHEDULE

5.1 CONSTRUCTION

The ground water remediation system construction schedule, for the Wicks Creek Site, is presented in Figure 5-1. The construction duration from submittal of the Design Report to completion of checkout is 26 weeks. An 8-week period has been allocated for MDNR Design Report and NPDES Permit Application review.

5.2 OPERATIONS

The ground water remediation system for the Wicks Creek Site will operate until the CUOs outlined in Item 2 have been achieved. The system could operate for up to 30 years.

TABLES

TABLE 2-1

GROUND WATER REMEDIATION SYSTEM
GROUND WATER CRITERIA
WICKS CREEK SITE
HAWORTH PLANT
DOUGLAS, MICHIGAN

Compound	Wicks Creek Site Ground Water Quality (1)		MERA Type B Health Based Drinking Water Value (3) (ug/l)	Treated Ground Water Quality Value (ug/l)
	Average (ug/l)	Maximum (ug/l)		
Organic Compounds:				
Chlorobenzene	(2)	(2)	130	130
Chloroform	(2)	(2)	5.6	5
1,2-Dichlorobenzene	(2)	(2)	600	600
1,1-Dichloroethane	(2)	(2)	840	840
total-1,2-Dichloroethene	270	1,600	(4)	77
cis-1,2-Dichloroethene	Not Analyzed	Not Analyzed	77	- -
trans-1,2-Dichloroethene	Not Analyzed	Not Analyzed	120	- -
2,4-Dimethylphenol	1	2	350	350
Tetrachlorethene	(2)	(2)	0.7	1 (5)
1,1,1-Trichloroethane	25	150	200	200
Trichloroethene	5,700	34,000	2.2	2
Toluene	(2)	(2)	1,500	1,500
Vinyl Chloride	(2)	(2)	0.016	1 (5)
Metals:				
Lead	(2)	(2)	4	4
Manganese	34	81	170	170
Nickel	(2)	(2)	530	530
Zinc	18	55	2,300	2,300

Notes:

(1) Listed compounds are those contaminants detected in ground water samples collected from the Haworth Plant Site, Wick Creek and Off-Site Ground Water Investigation Report and Response Action Analysis (see in report issued January 1994; Table 4-2, nomitoring wells MW321I, MW321D, MW323I, MW323D, MW324I and MW324D).
(2) Compound was analyzed for, but not detected.
(3) MERA Operational Memorandum #8 (Revision 3), dated February 4, 1994: Type B Criteria Rules 299.5709, 299.5711(2), 299.5711(5) and 299.5713.
(4) Criteria not specified.
(5) Detection Limit, see note 3.

TABLE 2-2

EXTRACTION WELLS
DESIGN SUMMARY
WICKS CREEK SITE
HAWORTH PLANT
DOUGLAS, MICHIGAN

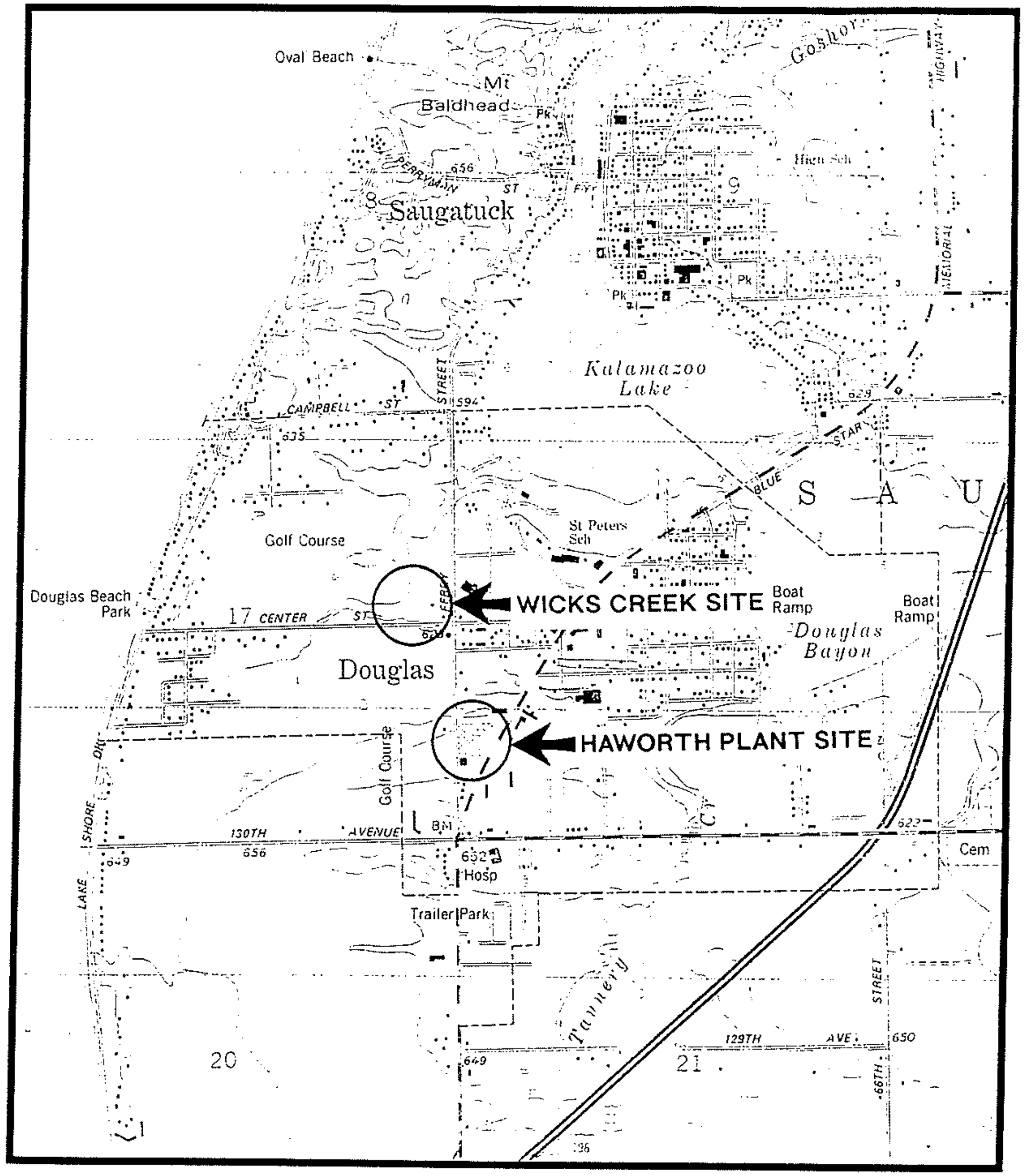
Item	Haworth Plant Site	Wicks Creek Site		
	EW-1	EW-2	EW-3	EW-4
Design Ground Water Extraction Flow (gpm)	5	4	4	4
Distance Below Grade (ft)				
Top of Screen	30	10	6	6
Existing Water Level	32	19	7	15
Drawdown Water Level (at design flow)	45	30	18	26
Bottom of Screen (top of till)	50	30	26	26

Key:

gpm = Gallons per minute
ft = Feet

FIGURES

SAUGATUCK
MICHIGAN
7.5 MINUTE SERIES (TOPOGRAPHIC)
1981



SCALE 1:24000

1 .5 0 1 MILE

CONTOUR INTERVAL 10 FEET

FIGURE 1-1

SITE LOCATION MAP
GROUND WATER REMEDIATION SYSTEM
HAWORTH PLANT
DOUGLAS, MICHIGAN

ERM

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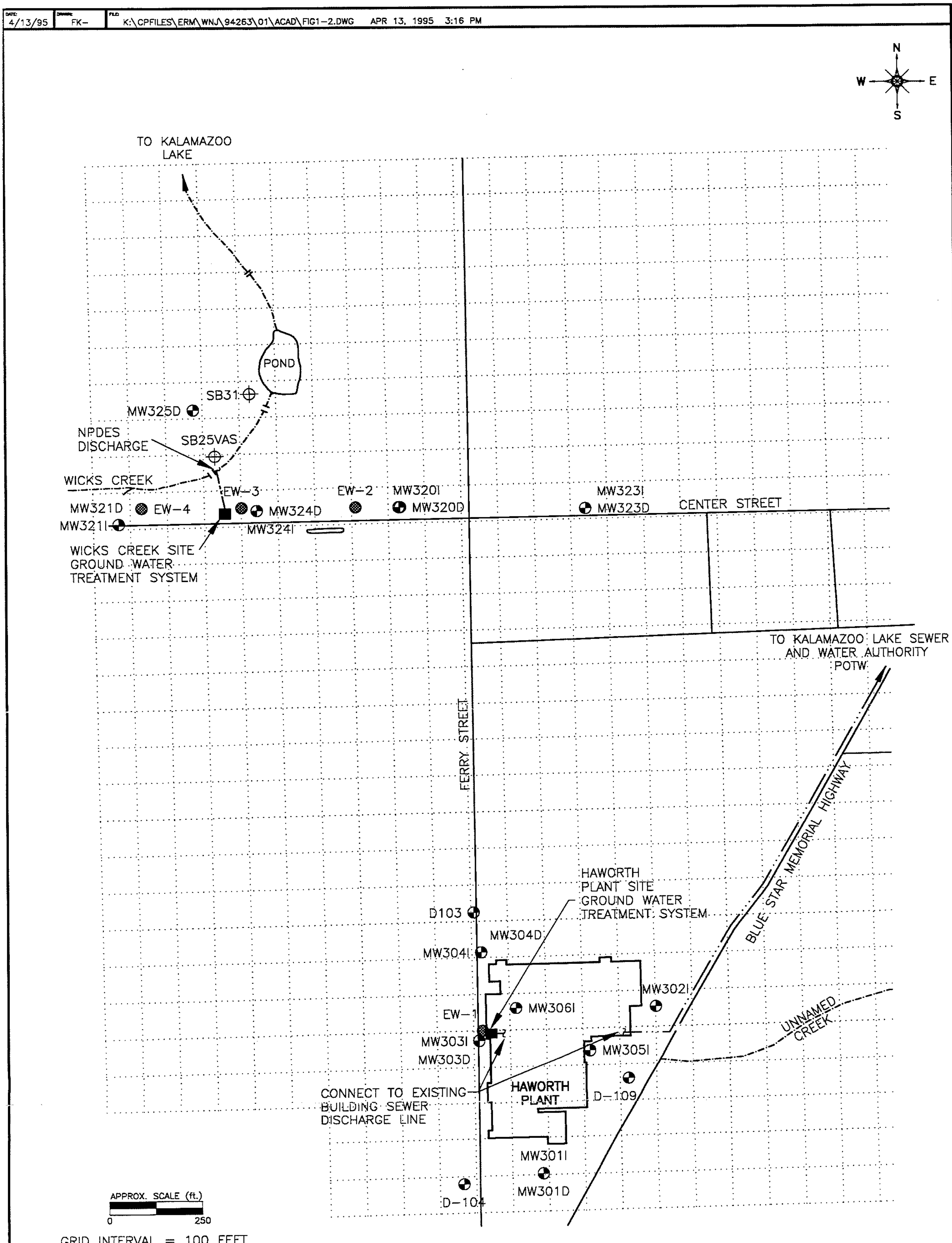


NOTE:
NO DRINKING WATER WELLS ARE LOCATED ON ADJACENT PROPERTIES.

FIGURE 1-2

SITE LAYOUT PLAN
GROUND WATER REMEDIATION SYSTEM
HAWORTH PLANT
DOUGLAS, MICHIGAN

ERM

FIGURE 2-1

PRE EXTRACTION WELL FLOW CONDITIONS
IN MODELED DOMAIN
HAWORTH PLANT
DOUGLAS, MICHIGAN

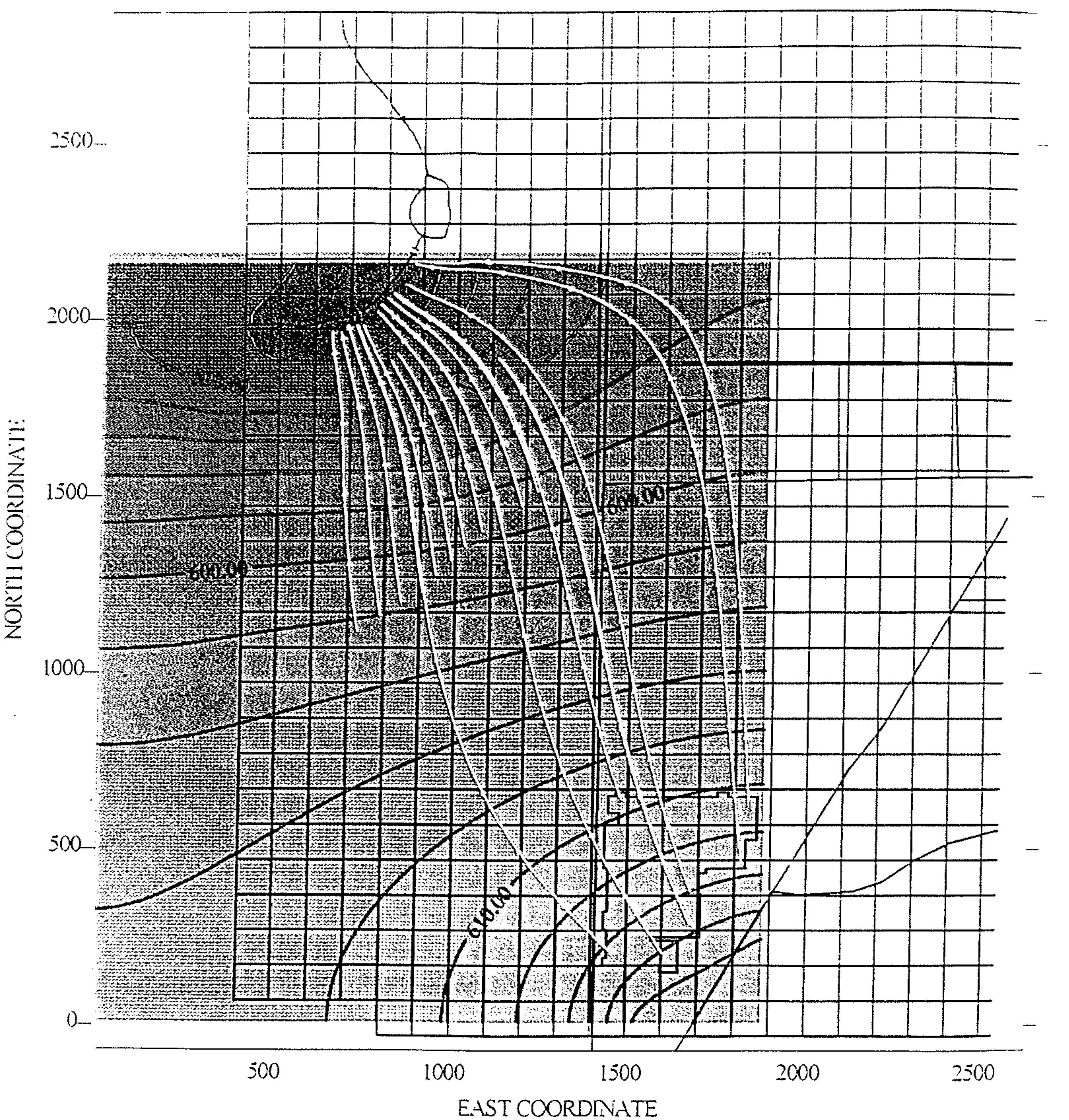


FIGURE 2-2

EXTRACTION WELLS PUMPING-GROUND WATER CONTOURS
HAWORTH PLANT
DOUGLAS, MICHIGAN

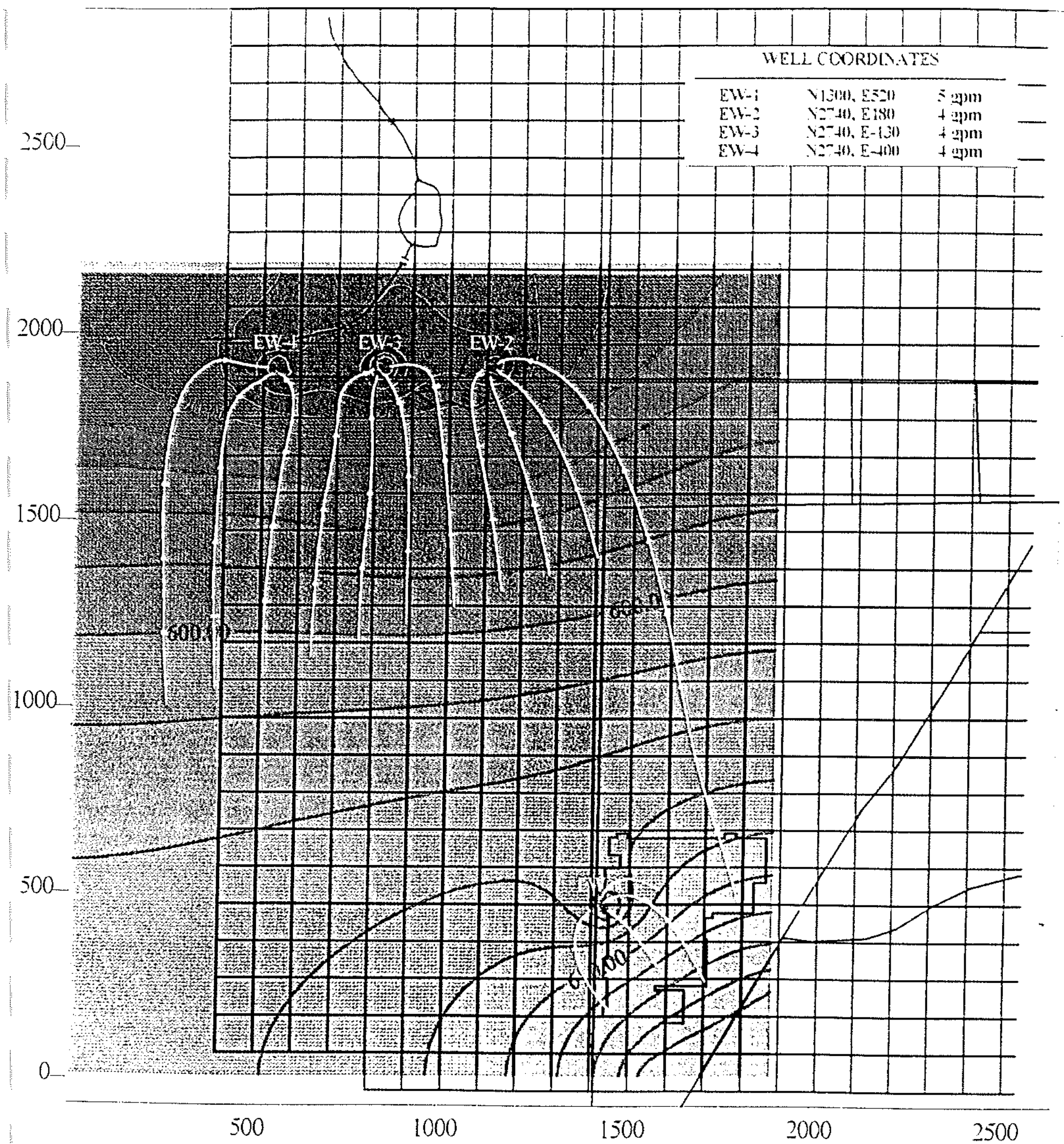
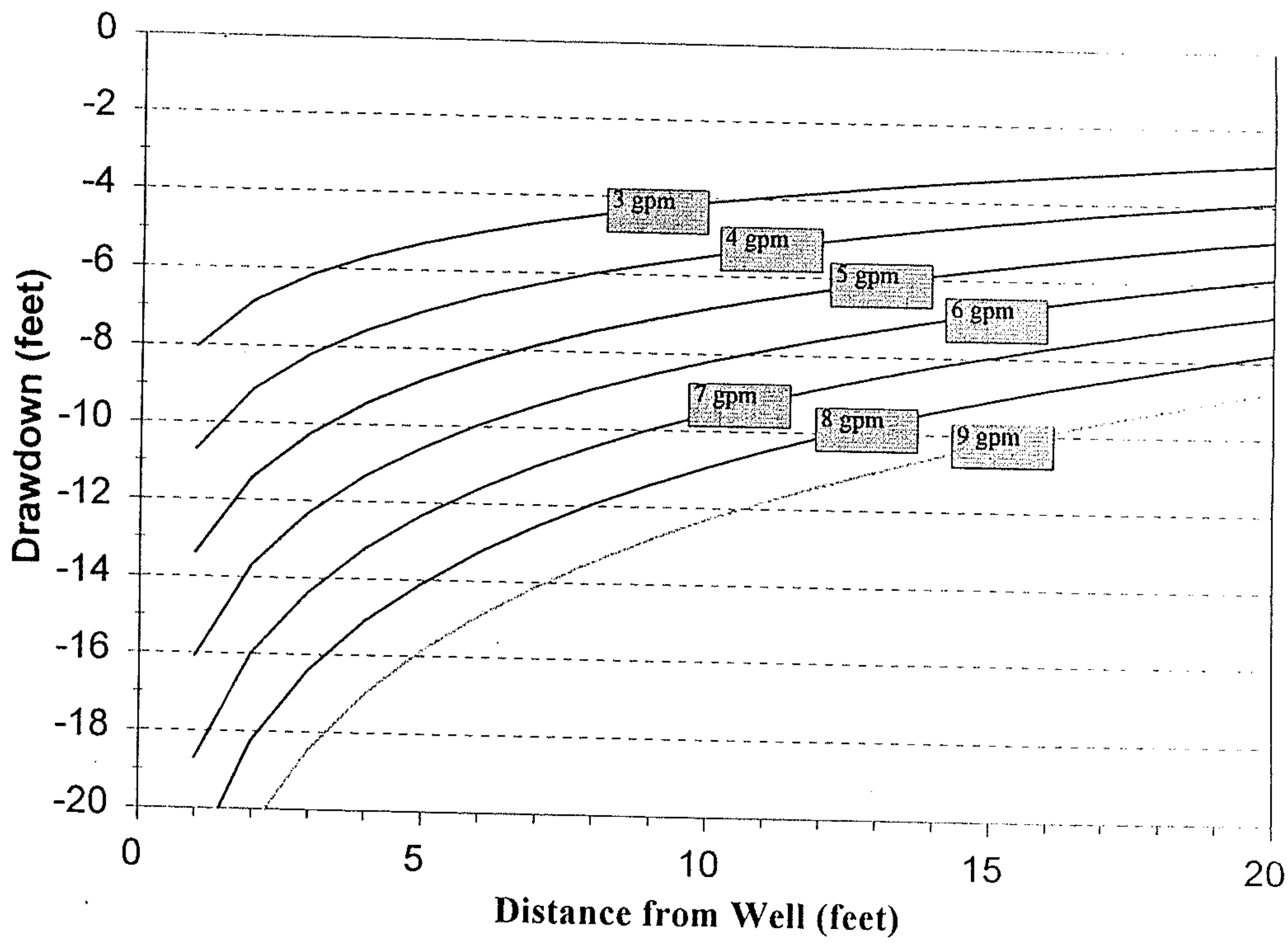


Figure 2-3
Theis Equation Drawdown vs Distance



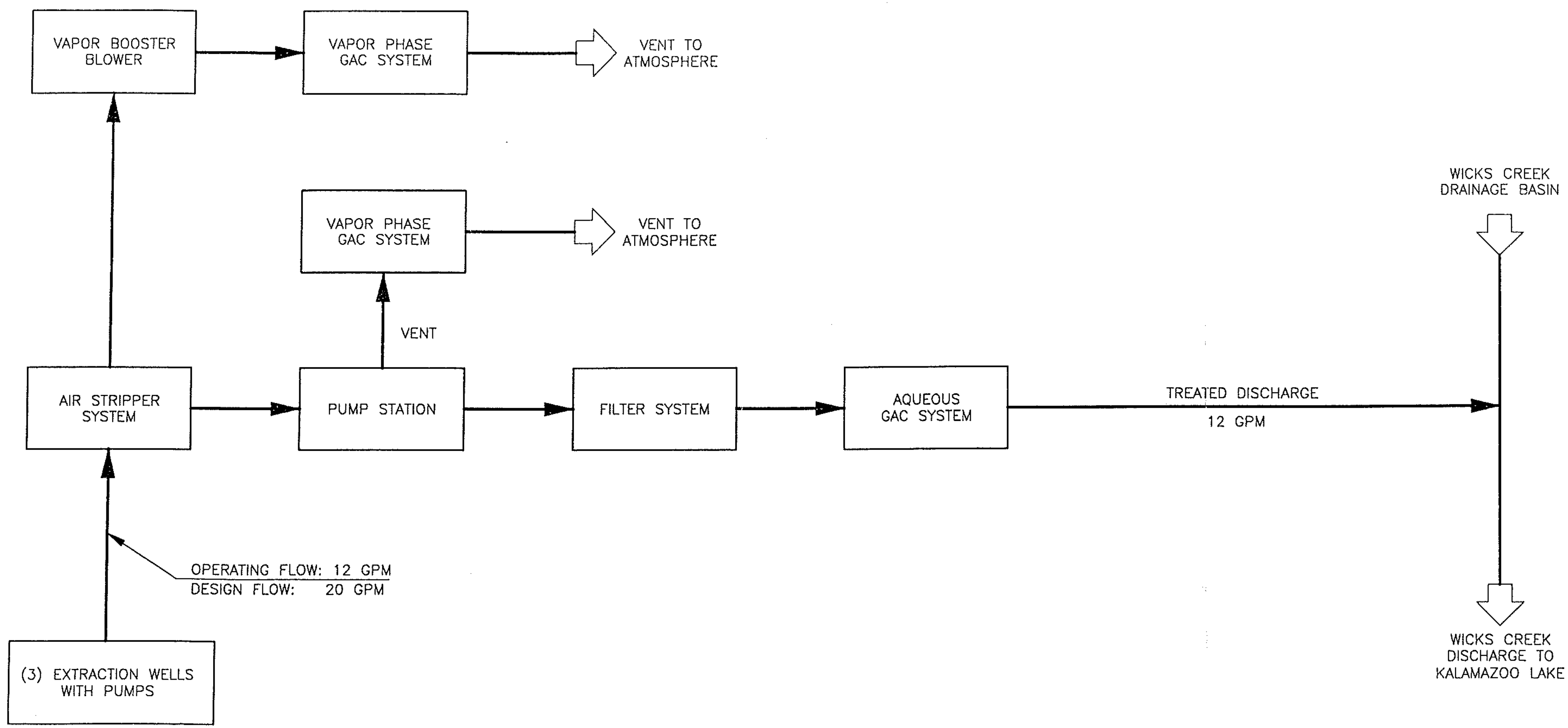


FIGURE 3-1

BLOCK FLOW DIAGRAM
WICKS CREEK SITE
GROUND WATER REMEDIATION SYSTEM
HAWORTH PLANT
DOUGLAS, MICHIGAN

ERM

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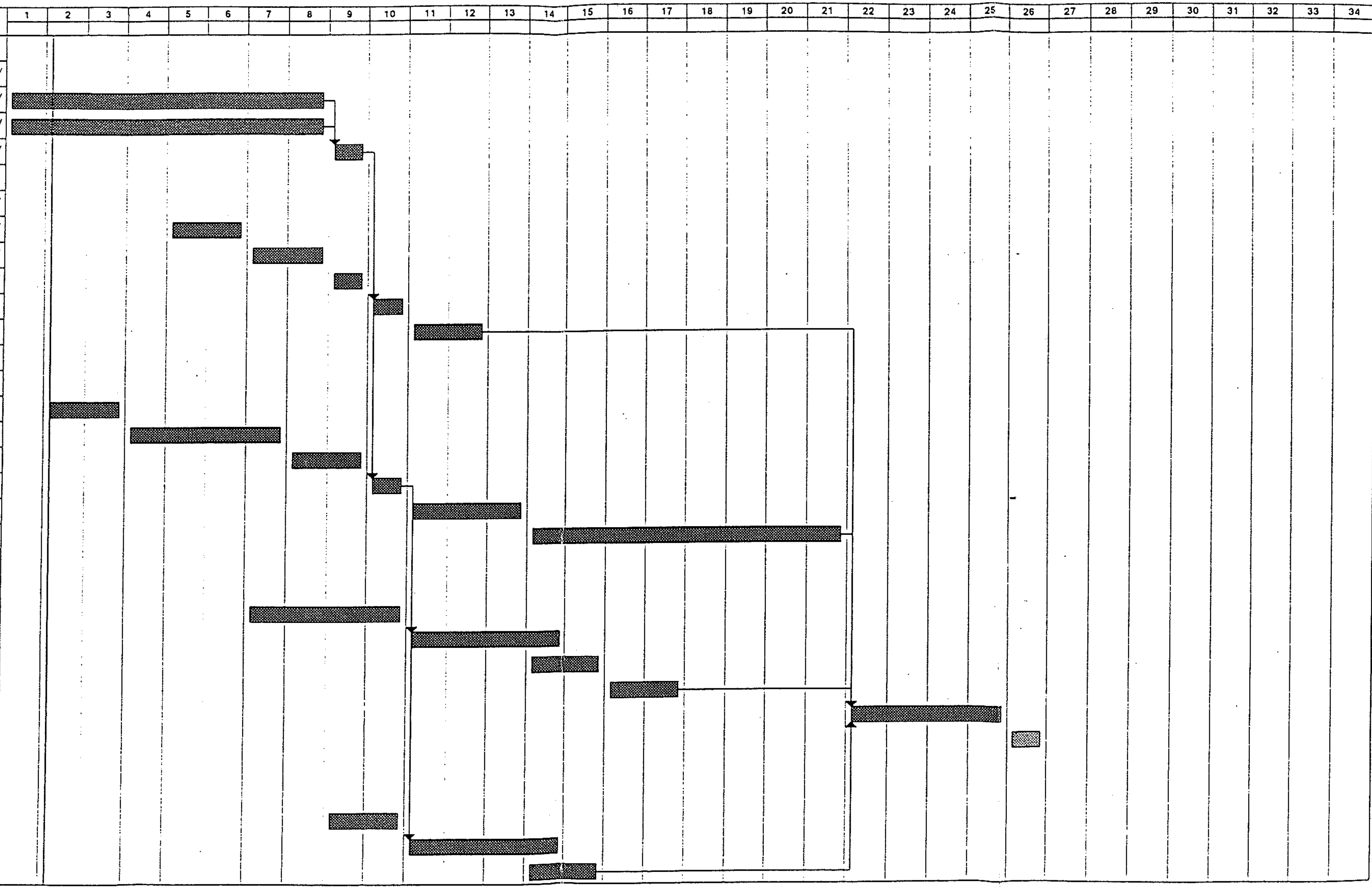
DATE: 1/19/95

FIGURE 5-1
CONSTRUCTION SCEDULE
WICKS CREEK SITE

ID	Task Name	Duration
1		
2	Agency Submittal	34w
3	MDNR Design Report Review	8w
4	NPDES Permit Review	8w
5	Approval	1w
6		
7	Extraction Wells	13w
8	Specification	2w
9	Bid	2w
10	Bid Review	1w
11	Bid Placement	1w
12	Installation	2w
13		
14	Equipment	25w
15	Specification	2w
16	Bid	4w
17	Bid Review	2w
18	Bid Placement	1w
19	Drawings and Approval	3w
20	Fabrication & Delivery	8w
21		
22	Construction	17w
23	Specification	4w
24	Bid	4w
25	Bid Review	2w
26	Bid Placement	2w
27	Construction	4w
28	Checkout	1w
29		
30	Power And Phone	13w
31	Specification	2w
32	Utility Contact	4w
33	Install	2w



Project:
Date: 1/30/95

Task		Milestone	◆	Rolled Up Task		Rolled Up Progress	
Progress		Summary		Rolled Up Milestone ◇			

DRAWINGS

94263-20-1

VALVES

NORMALLY OPEN / NORMALLY CLOSED

- GATE VALVE
- GLOBE VALVE
- 3-WAY VALVE
- BALL VALVE
- BUTTERFLY VALVE
- NEEDLE VALVE
- CHECK VALVE
- CHECK VALVE (PISTON OPERATED)
- CHECK VALVE (BALL TYPE)
- EXCESS FLOW VALVE
- DIAPHRAGM VALVE
- ANGLE GATE VALVE
- 4-WAY ANGLE VALVE
- PLUG
- VACUUM RELIEF
- PRESSURE RELIEF
- "Y" TYPE VALVE

VALVE OPERATORS

- HANDWHEEL
- HANDLE OR WRENCH
- PRESSURE REDUCING
- BACK PRESSURE
- DIFFERENTIAL PRESSURE REGULATOR
- DIAPHRAGM
- SOLENOID
- ELECTRIC MOTOR
- GEAR
- HYDRAULIC
- PISTON

SYMBOLS

- PRIMARY FLOW
- SECONDARY FLOW
- AIR FILTER
- AIR LUBRICATOR
- FILTER-REGULATOR-LUBRICATOR UNIT
- CONCENTRIC REDUCER
- ECCENTRIC REDUCER
- STRAINER "Y" TYPE
- STEAM TRAP
- AIR RELEASE
- STRAINER SINGLE BASKET
- STRAINER DUAL BASKET
- FLANGED ORIFICE ASSEMBLY
- METERED TUBE ORIFICE ASSEMBLY
- EJECTOR
- INSULATED
- INSULATED & ELECTRIC HEAT TRACED
- INSULATED & STEAM HEAT TRACED
- PROTECTIVE DIAPHRAGM
- RUPTURE DISK
- OPEN DRAIN OR OPEN SIGHT FUNNEL
- EXPANSION JOINT

EQUIPMENT

- CENTRIFUGAL PUMP
- POSITIVE DISPLACEMENT AIR COMPRESSOR
- POSITIVE DISPLACEMENT PUMP
- VERTICAL SLURRY PUMP
- VERTICAL TURBINE PUMP
- SUBMERSIBLE PUMP
- AIR OPERATED DIAPHRAGM

INSTRUMENTATION

- MOUNTED LOCALLY AT EQUIPMENT OR LINE
- MOUNTED ON PRIMARY CONTROL PANEL FRONT
- MOUNTED ON AUXILIARY CONTROL PANEL FRONT
- MOUNTED INSIDE PRIMARY CONTROL PANEL
- MOUNTED INSIDE AUXILIARY CONTROL PANEL
- INDICATOR LAMP
- INSTRUMENT INCLUDED IN COMPUTER, MICRO PROCESSOR, OR PROGRAMMABLE CONTROLLER SYSTEM
- ALARM INDICATION AT REMOTE SUPERVISORY STATION
- INSTRUMENT CONNECTION OR UNSPECIFIED LINE
- INSTRUMENT AIR LINE
- CAPILLARY LINE
- ELECTRIC LINE
- HYDRAULIC TUBING

ELECTRICAL

CS XX — CONTROL STATION

- M – MANUAL
- HOA – HAND/OFF/AUTO
- MA – MANUAL/AUTO
- SS – START/STOP
- OCA – OPEN/CLOSE/AUTO

INTERLOCK

- AND — EFFECTIVE IF ALL INPUTS EXIST
- I — INTERLOCK LOGIC AS DEFINED
- OR — EFFECTIVE IF ONE OR MORE INPUTS EXIST

MEANINGS OF INSTRUMENT IDENTIFICATION LETTER

	FIRST LETTER		SUCCEEDING LETTERS		
	INITIATING VARIABLE MEASURED OR	MODIFIER	READOUT OR PASSIVE FUNCTION	OUTPUT FUNCTION	MODIFIER
A	ANALYSIS (pH, ETC.)		ALARM		
B	BURNER FLAME				
C	CONDUCTIVITY (ELECTRICAL)			CONTROL	
D	DENSITY OR SPECIFIC GRAVITY	DIFFERENTIAL			
E	VOLTAGE (EFM)		PRIMARY ELEMENT		
F	FLOW RATE	RATIO (FRACTION)			
G	GAGING (DIMENSIONAL)		GLASS		
H	HAND (MANUALLY INITIATED)				HIGH
I	CURRENT (ELECTRICAL)		INDICATE		
J	POWER	SCAN			
K	TIME OR TIME SCHEDULE			CONTROL STATION	
L	LEVEL		LIGHT (PILOT)		LOW
M	MOISTURE OR HUMIDITY				
N	NOISE				
O	MALFUNCTION		ORIFICE (RESTRICTION)		MIDDLE OR INTERMEDIATE
P	PRESSURE OR VACUUM		POINT (TEST CONNECTION)		
Q	QUANTITY OR EVENT	INTEGRATE OR TOTALIZE			
R	RADIOACTIVITY		RECORD OR PRINT		
S	SPEED OR FREQUENCY	SAFETY		SWITCH	
T	TEMPERATURE			TRANSMIT	
U	MULTIVARIABLE		MULTIFUNCTION	MULTIFUNCTION	MULTIFUNCTION
V	VISCOSITY			VALVE, DAMPER OR LOUVER	
W	WEIGHT OR FORCE		WELL		
X	TORQUE				
Y	USER'S CHOICE			RELAY OR COMPUTE	
Z	POSITION			DRIVE, ACTUATE OR UNCLASSIFIED FINAL CONTROL ELEMENT	

NOTE:

1. FOR PIPING AND INSTRUMENTATION DIAGRAM SEE DRAWING 94263-10-2.

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REVISIONS

ERM Environmental Resources Management

PIPING AND INSTRUMENTATION DIAGRAM
SYMBOL LIST
WICKS CREEK SITE
GROUND WATER REMEDIATION SYSTEM
HAWORTH PLANT
DOUGLAS, MICHIGAN

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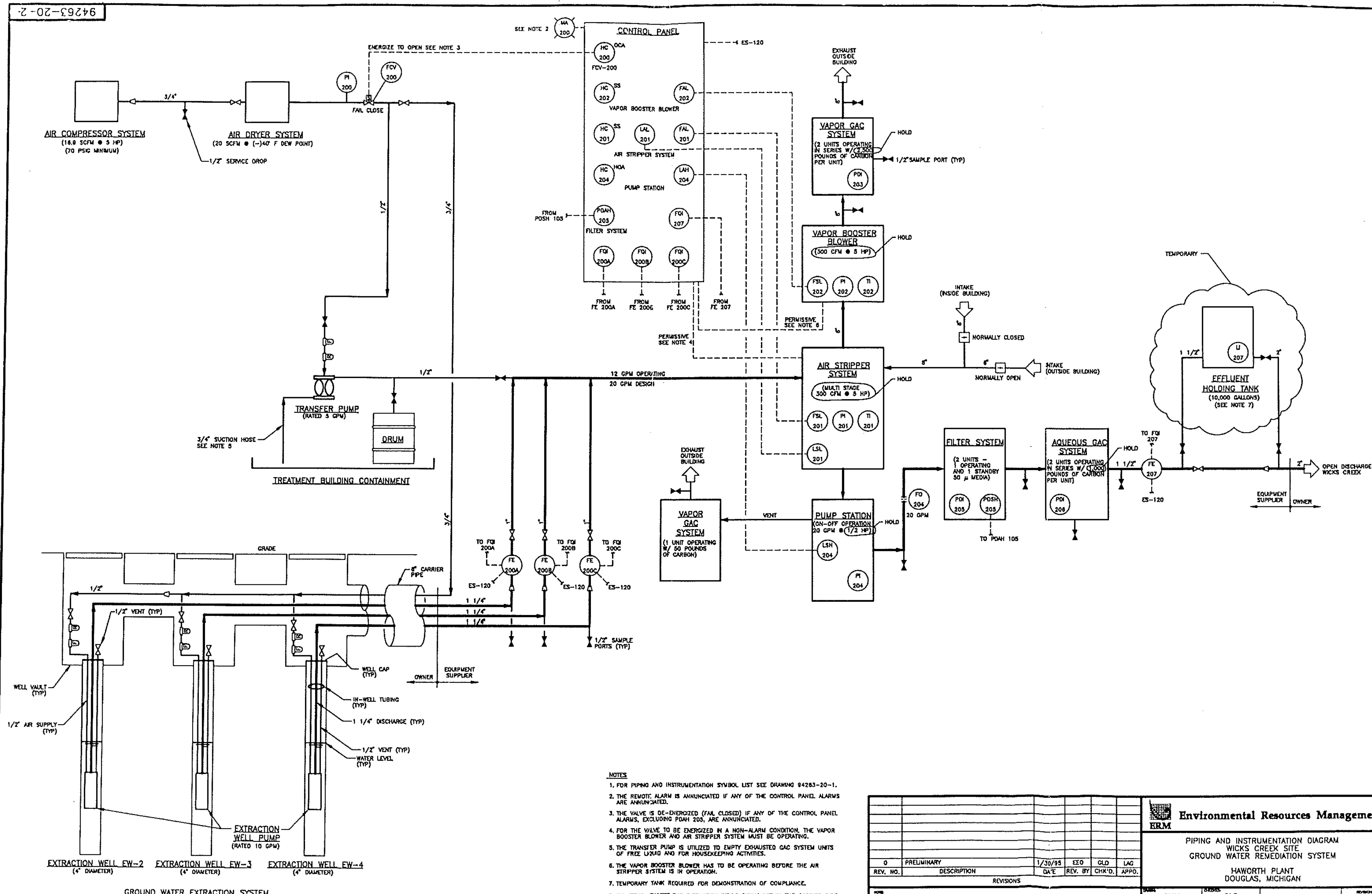

NOTES

1. FOR PIPING AND INSTRUMENTATION SYMBOL LIST SEE DRAWING 94263-20-1.
2. THE REMOTE ALARM IS ANNUNCIATED IF ANY OF THE CONTROL PANEL ALARMS ARE ANNUNCIATED.
3. THE VALVE IS DE-ENERGIZED (FAIL CLOSED) IF ANY OF THE CONTROL PANEL ALARMS, EXCLUDING PDAH 205, ARE ANNUNCIATED.
4. FOR THE VALVE TO BE ENERGIZED IN A NON-ALARM CONDITION, THE VAPOR BOOSTER BLOWER AND AIR STRIPPER SYSTEM MUST BE OPERATING.
5. THE TRANSFER PUMP IS UTILIZED TO EMPTY EXHAUSTED GAC SYSTEM UNITS OF FREE LIQUID AND FOR HOUSEKEEPING ACTIVITIES.
6. THE VAPOR BOOSTER BLOWER HAS TO BE OPERATING BEFORE THE AIR STRIPPER SYSTEM IS IN OPERATION.
7. TEMPORARY TANK REQUIRED FOR DEMONSTRATION OF COMPLIANCE.
8. ALL ITEMS, EXCEPT THE EXTRACTION WELLS PIPING WITHIN THE CARRIER PIPE, MA-200, EFFLUENT HOLDING TANK AND DISCHARGE PIPE TO WICKS CREEK IS PROVIDED BY THE EQUIPMENT SUPPLIER.

REV. NO.	DESCRIPTION	DATE	REV. BY	CHK'D.	APPO.
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REVISIONS

ERM Environmental Resources Management

PIPING AND INSTRUMENTATION DIAGRAM
WICKS CREEK SITE
GROUND WATER REMEDIATION SYSTEM

HAWORTH PLANT
DOUGLAS, MICHIGAN

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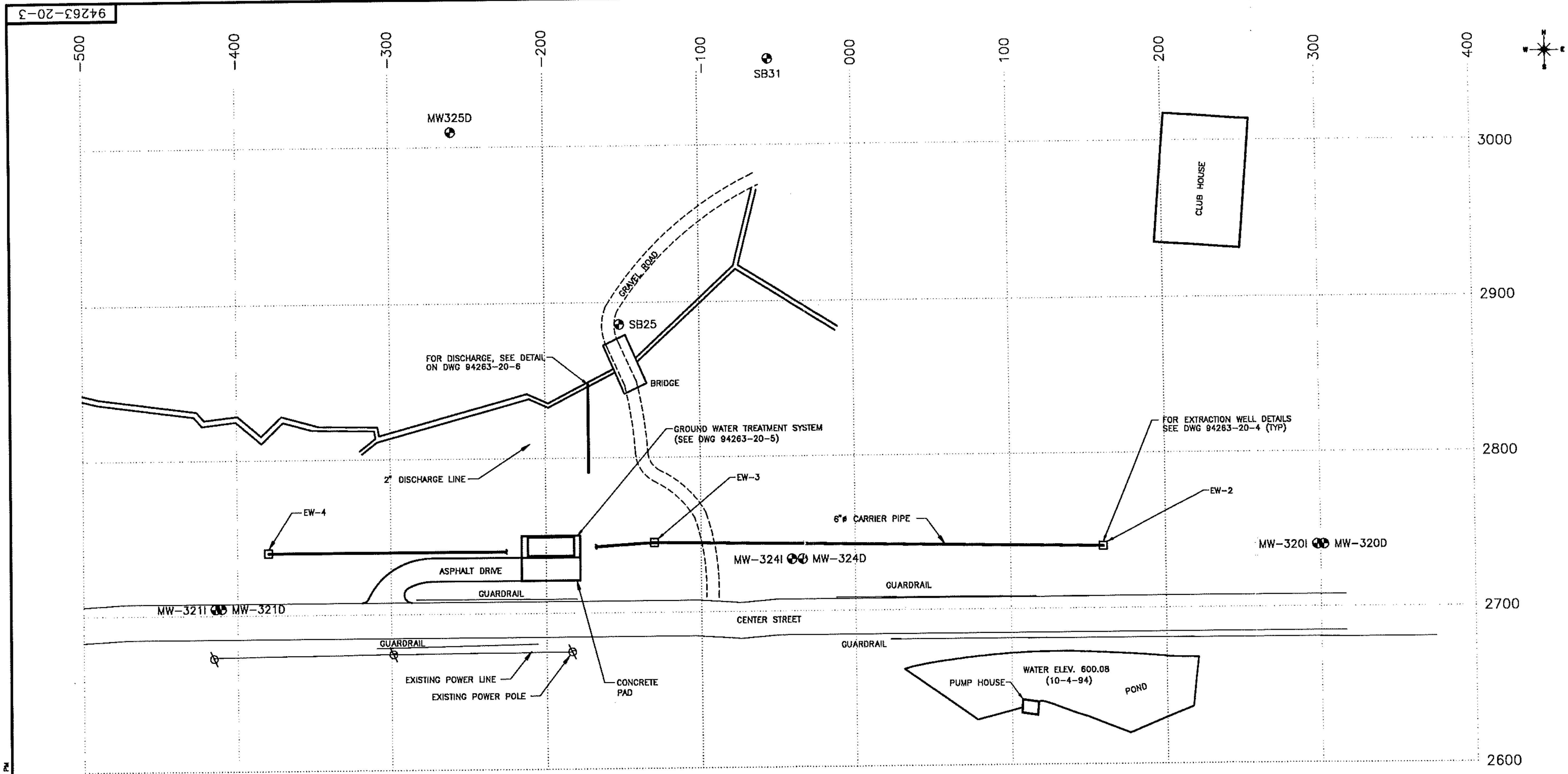

SYMBOL LEGEND	
⊕	MONITORING WELL LOCATION
▽	STRAT TEST LOCATION
⌀	UTILITY POLE LOCATION
—600—	CONTOUR LINE

WELL COORDINATE & ELEVATION TABLE

WELL NO.	NORTHING	EASTING	CASING EL.	GROUND EL.	REMARKS
EW-2	2,740	160			NEW
EW-3	2,745	-130			NEW
EW-4	2,740	-380			NEW
MW-320 I	2,740	298			NEW
MW-320 D	2,740	302			NEW
MW-324	2,720	-48			REPLACE
MW-324 D	2,720	-52			REPLACE

HOLD

BENCHMARK ELEVATION: 652.392 USGS DATUM

SE COR., 130th AVENUE & BLUE STAR HIGHWAY
STD. TABLET P.T. STA. No. 76 Y 1926
REF. USGS BOOK #67

BENCHMARK ELEVATION: 598.20 USGS DATUM

R.R. SPIKE IN ROOT OF 48" OAK TREE AT STA.
2960 N./ -270 E.

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ERM Environmental Resources Management

LOCATION PLAN
WICKS CREEK SITE
GROUND WATER REMEDIATION SYSTEM

HAWORTH PLANT
DOUGLAS, MICHIGAN

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SCALE: 1" =30'-0" | APPROVED:

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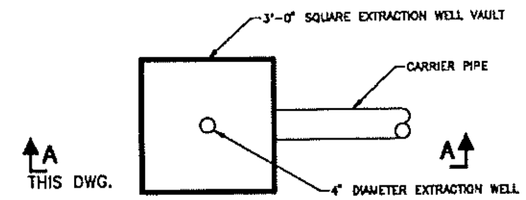
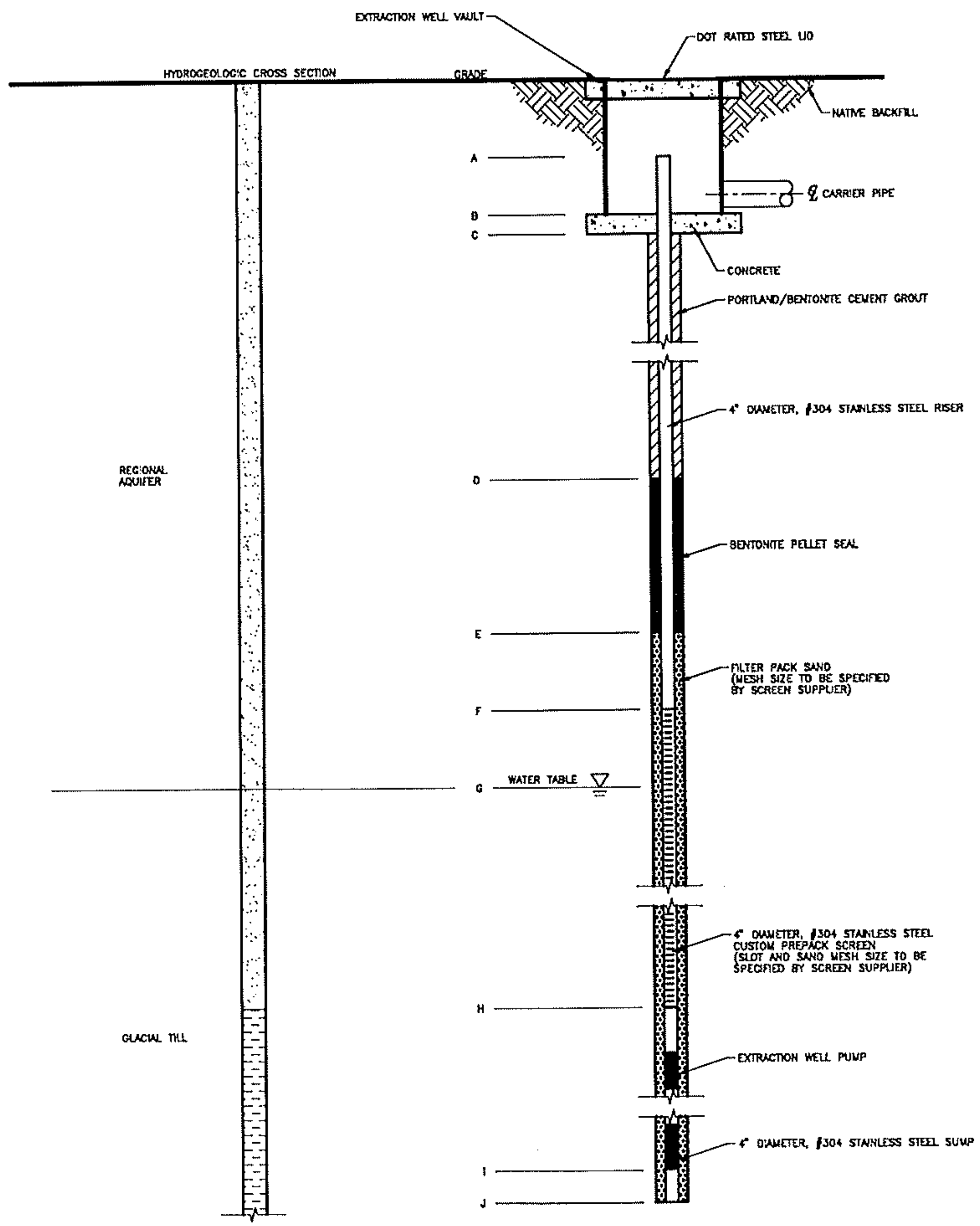


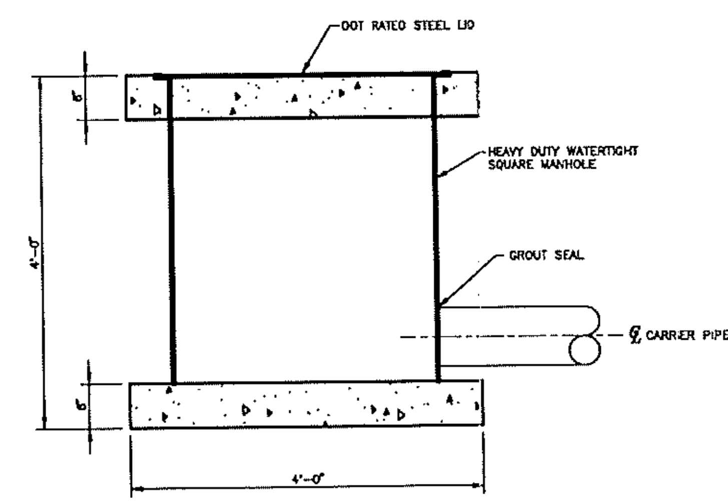
EXTRACTION WELL VAULT PLAN
(FOR LOCATIONS, SEE DWG 94263-20-3)



SECTION A-A
(FOR DISTANCE BELOW GRADE, SEE TABLE THIS DRAWING)

EXTRACTION WELL DISTANCE TABLE

LETTER	ITEM	DISTANCE BELOW GRADE - FEET		
		EW2	EW3	EW4
A	TOP OF RISER	2'-0"	2'-0"	2'-0"
B	BOTTOM OF WELL (VAULT FLOOR)	3'-10"	3'-10"	3'-10"
C	BOTTOM OF CONCRETE	4'-4"	4'-4"	4'-4"
D	BOTTOM OF PORTLAND/BENTONITE CEMENT GROUT	NA	NA	NA
E	BOTTOM OF BENTONITE PELLET SEAL	8'-0"	5'-6"	5'-6"
F	TOP OF SCREEN	10'-0"	6'-0"	6'-0"
G	WATER TABLE (INITIAL)	19'-0"	7'-0"	15'-0"
H	BOTTOM OF SCREEN	30'-0"	26'-0"	26'-0"
I	BOTTOM OF EXTRACTION PUMP	38'-0"	34'-0"	36'-0"
J	BOTTOM OF SUMP	40'-0"	36'-0"	34'-0"



EXTRACTION WELL VAULT DETAIL
SCALE: 1"=0'-6"

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ERM Environmental Resources Management

EXTRACTION WELL PLAN & DETAIL
WICKS CREEK SITE
GROUND WATER REMEDIATION SYSTEM

HAWORTH PLANT
DOUGLAS, MICHIGAN

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SCALE: 1"=2'-0" | APPROVED:

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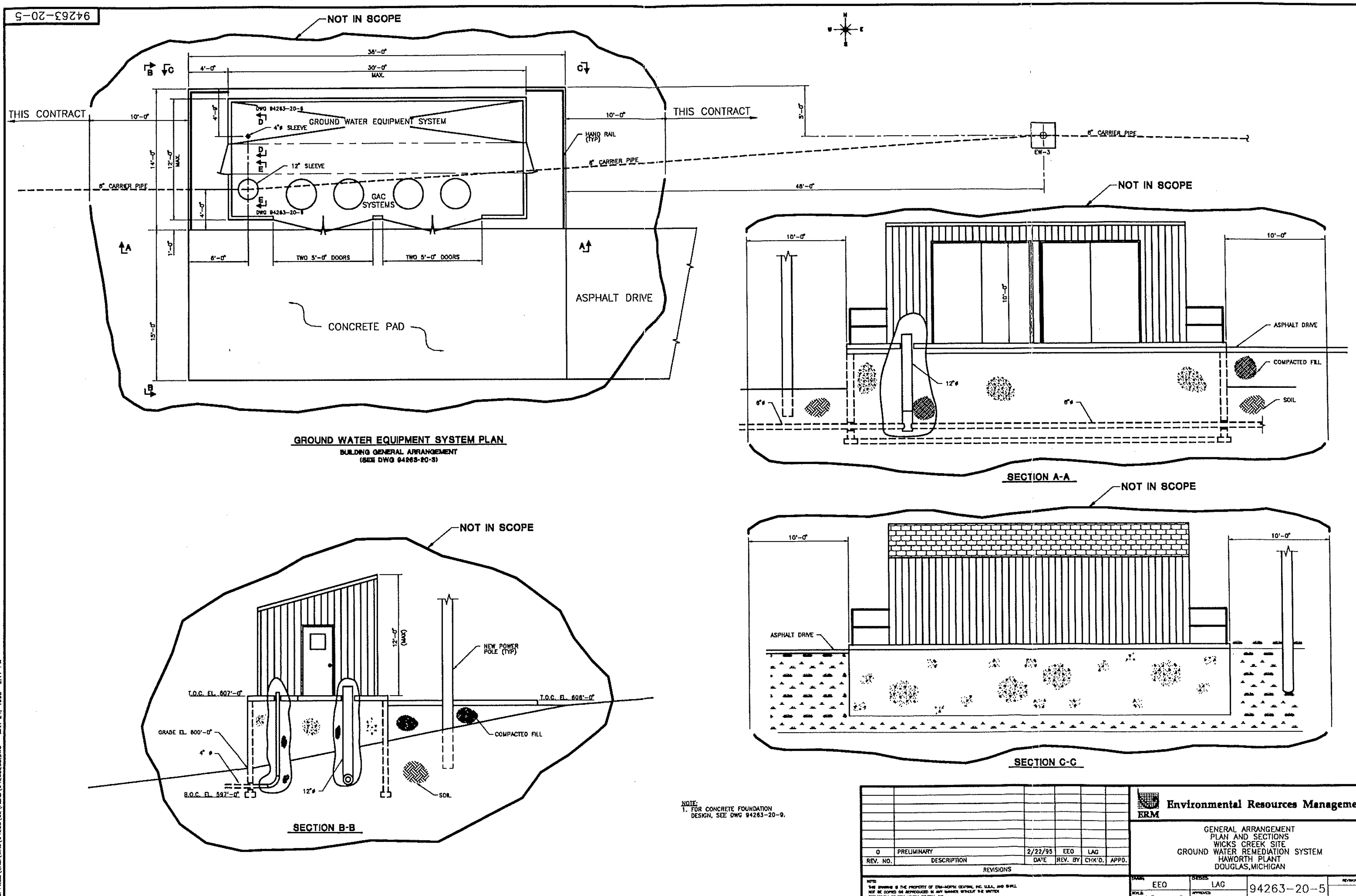
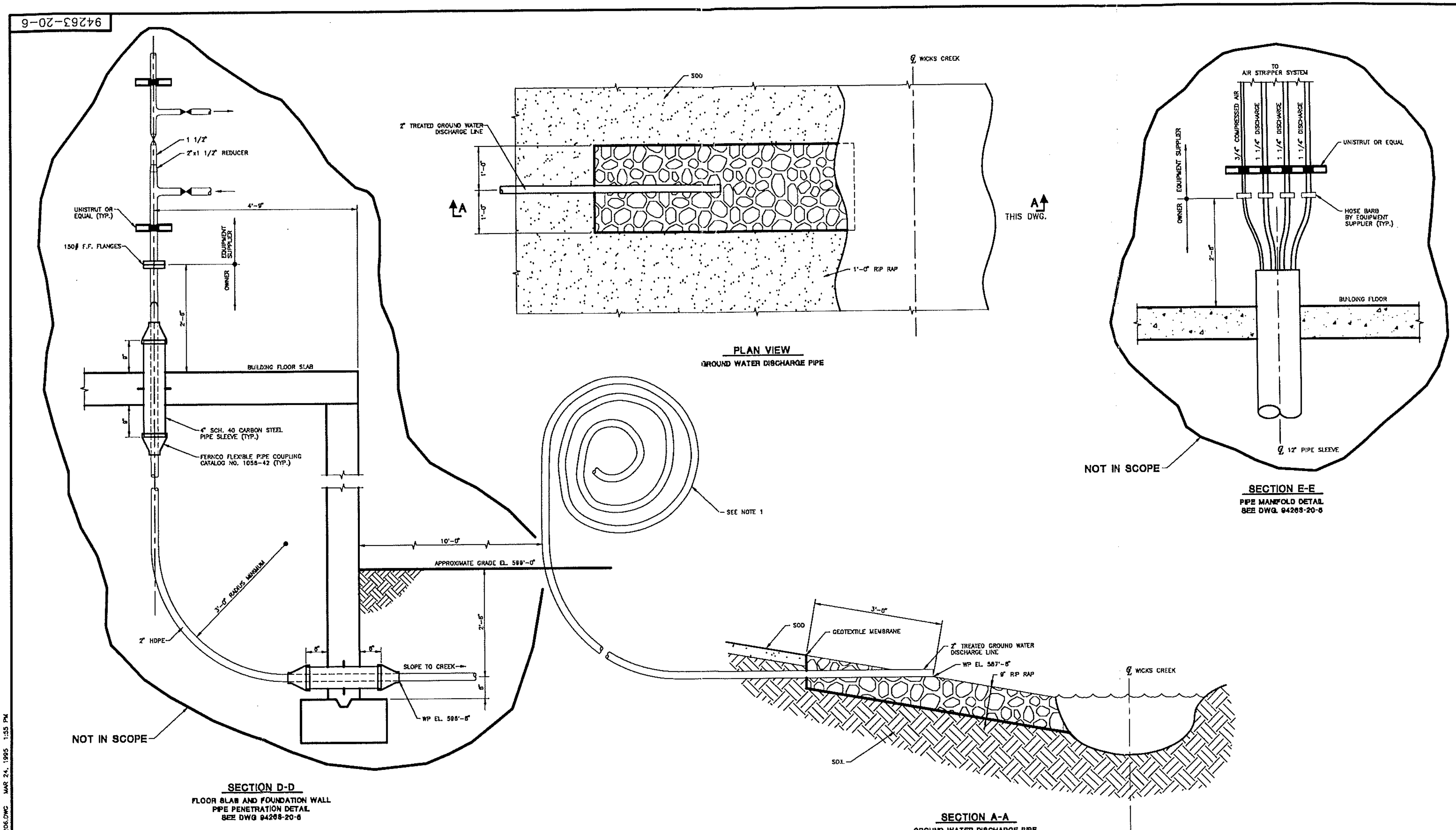


94263-20-5
NOT IN SCOPE
THIS CONTRACT
GROUND WATER EQUIPMENT SYSTEM
4"ø SLEEVE
12" SLEEVE
8" CARRIER PIPE
GAC SYSTEMS
HAND RAIL (TYP)
EW-3
TWO 5'-0" DOORS
CONCRETE PAD
ASPHALT DRIVE
GROUND WATER EQUIPMENT SYSTEM PLAN
BUILDING GENERAL ARRANGEMENT
(SEE DWG 94263-20-3)
SECTION A-A
COMPACTED FILL
SOIL
SECTION C-C
NEW POWER POLE (TYP)
T.O.C. EL. 607'-0"
T.O.C. EL. 606'-0"
GRADE EL. 600'-0"
B.O.C. EL. 597'-0"
SECTION B-B
NOTE:
1. FOR CONCRETE FOUNDATION DESIGN, SEE DWG 94263-20-9.
0 PRELIMINARY 2/22/95 EEO LAG
REV. NO. DESCRIPTION DATE REV. BY CHK'D. APPD.
REVISIONS
Environmental Resources Management
GENERAL ARRANGEMENT
PLAN AND SECTIONS
WICKS CREEK SITE
GROUND WATER REMEDIATION SYSTEM
HAWORTH PLANT
DOUGLAS, MICHIGAN
EEO
LAG
1/4"=1'-0"
94263-20-5



NOTE:

1. THE 2" GROUND WATER DISCHARGE LINE SHALL BE ROUTED TO WITHIN 10'-0" OF THE FUTURE GROUND WATER TREATMENT BUILDING. AT THAT POINT THE LINE SHALL TERMINATE ABOVE GROUND WITH AN ADDITIONAL LENGTH OF 70'-0" MINIMUM.

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REV. NO.	DESCRIPTION	DATE	REV. BY	CHK'D.	APPD.
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ERM Environmental Resources Management

PIPING SECTIONS AND DETAILS
WICKS CREEK SITE
GROUND WATER REMEDIATION SYSTEM
HAWORTH PLANT
DOUGLAS, MICHIGAN

DRAWN	CHECKED	DWG. NO.	REVISION
FK	GLD	94263-20-6	0
SCALE: 1" = 1'-0"	APPROVED: LAG		

APPENDIX A

GROUND WATER EXTRACTION PUMP TECHNICAL SPECIFICATIONS

WATER TEK SERVICES, INC. 39 CLAYTON AVENUE LAKE VILLA, ILLINOIS 60046 (708) 356-1414
FAX (708) 356-6967

January 13, 1995

Fax: 708-940-9280

Larry Ganzel
ERM North Central
540 Lake Cook Road, Suite 300
Deerfield, IL 60015

Subject: Haworth Plant Site
Douglas, MI
Wicks Creek - Case No. 2

Dear Larry:

Water Tek Services is pleased to submit for your review our revised recommendations and specifications for the subject remediation system. Our design is based on three 4" extraction wells and a total flow rate of 20 gpm. Since the building is not existing we are specifying a QED integrated treatment system pre-piped and wired in a pre-fabricated building. The complete treatment system would be manufactured at QED in Ann Arbor, Michigan and hydraulically tested prior to shipment.

We specify a Model 20 Integrated Treatment System as follows:

<u>Pre-Fabricated Building</u>

One (1) Pre-fabricated Building 10' wide X 30' long with heater, lights, mechanical vent. The building shall be R-11 insulated. Steel frame construction, steel wall skin and roof. Floor shall be steel grading, non-explosion proof, non-fire rated construction. Building shall include 2" HT steel pre-fabricated containment wall and sump. We include two sets of double doors with two manway doors.

<u>Pneumatic Pumps</u>

Three (3) QED 4" Pneumatic Hammerhead Pumps, Model H-4 each rated for up to 12 gpm at 25 feet. Included are well caps, filter regulators and 50' downwell tubing.

<u>Compressor</u>

One (1) Compressor Package, 5 hp, 16.9 Scfm with desiccant dryer, TEFC motor.

Air Stripper

One (1) QED Model 2341 White Water™ Air Stripper System with 5.0 hp blower rated at 300 cfm. Included is pump out package with one (1) transfer pump, Model T25100 rated for 20 gpm at 100' TDH, 1.5 hp TEFC motor.

One (1) Booster blower, 5 hp TEFC motor.

Bag Filters

Two (2) Model PF-40 Bag Filters with Pressure Switch.

Sump Pump

One (1) Air Diaphragm sump pump for integral floor sump.

Liquid Phase Carbon

Two (2) QED Model L1000HP high pressure carbon adsorption units rated for up to 50 gpm each. Each unit contains 1,000 pounds of carbon.

Vapor Phase Carbon

Two (2) 2,500 pound vapor phase carbon unit rated at 100 to 1,000 cfm, series operation.

Control Panel (NEMA 4)

One (1) QED Model Data 30, PLC based control system with telemetry and data acquisition. We include step down transformer and all control functions as specified. We also include one auto dialer system.

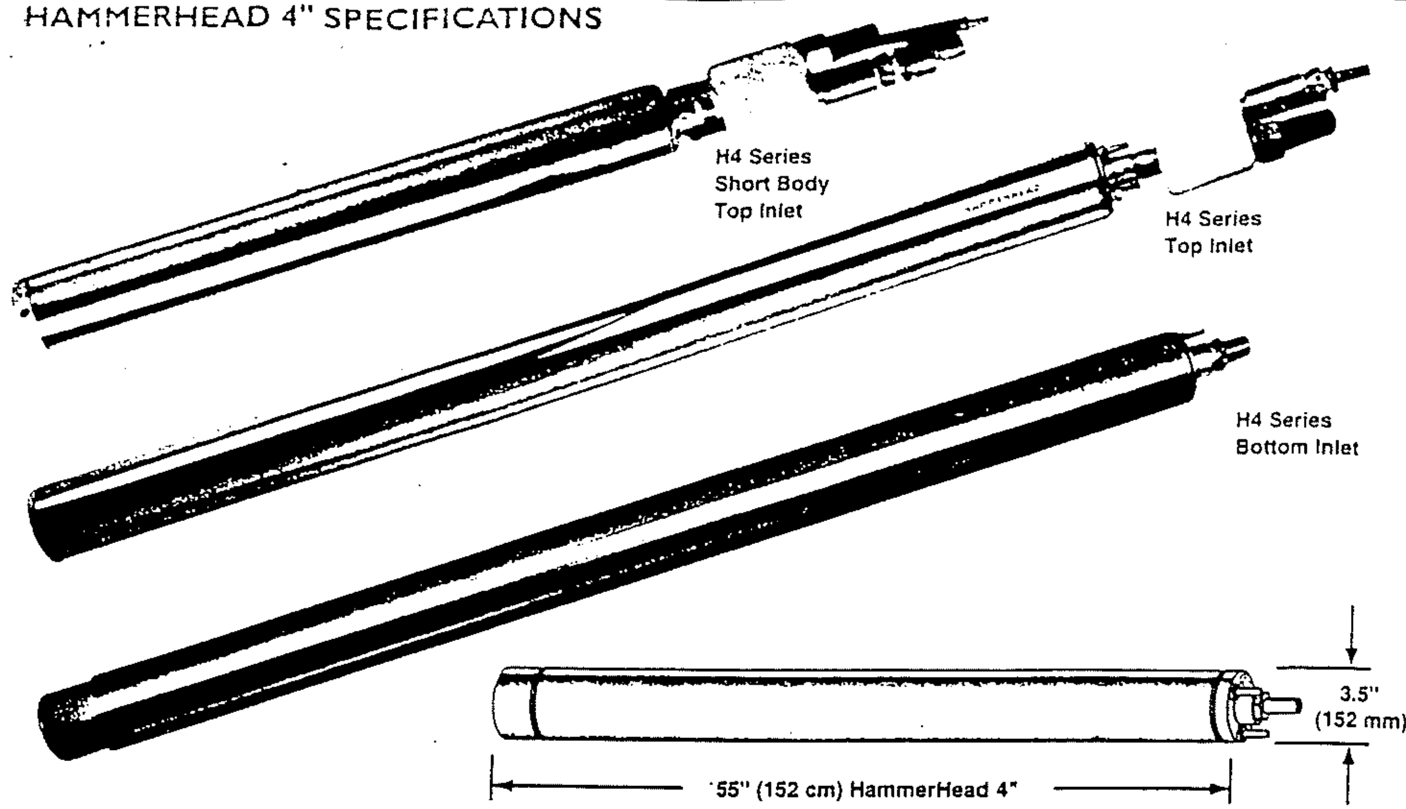
The complete system will be pre-piped, pre-wired, and tested in our shop prior to shipment.

The total budget cost for the treatment package as described above is $106,000.00 We do not include installation of building. Specifications were submitted previously.

Tom Lawn

TL:ss

HAMMERHEAD 4" SPECIFICATIONS



	H4 Series Bottom Inlet	H4 Series Top Inlet	Short H4, Top Inlet
Model No.	H45SSB, H45SEB, HF45SSB, HF45SEB	H45SET, HF45SET	HF43SET
Pump Type	Positive Air Displacement	Positive Air Displacement	Positive Air Displacement
Inlet	Bottom	Top	Top
O.D.	3.5" (89 mm)	3.5" (89 mm)	3.5" (89 mm)
Length	55" (140 cm)	60" (152 cm)	42" (105 cm)
Weight	23.5 lbs. (10.7 kg)	24.0 lbs. (10.9 kg)	16.0 lbs. (7.3 kg)
Materials	Stainless steel construction, with Teflon® inlet and discharge check balls, stainless steel or epoxy float, Viton O-rings	Stainless steel, Q-Tal & brass construction, with Teflon® inlet and discharge check balls, epoxy float, Viton O-rings	Stainless steel, Q-Tal & brass construction, with Teflon® inlet and discharge check balls, epoxy float, Viton O-rings,
Fittings: Type	Standard—Barb Optional—Quick Connects	Standard—Barb Optional—Quick Connects	Standard—Barb Optional—Quick Connects
Sizes: Liquid Discharge	3/4" (19 mm) O.D. (H45SSB, H45SEB) or 1-1/4" (32 mm) O.D. (HF45SSB, HF45SEB) tubing standard*	3/4" (19 mm) O.D. (H45SET) or 1-1/4" (32 mm) O.D. (HF45SET) tubing standard*	1-1/4" (32 mm) O.D. tubing standard*
Air Supply Exhaust	3/8" (9 mm) O.D. Tubing 1/2" (13 mm) O.D. Tubing	3/8" (9 mm) O.D. Tubing 1/2" (13 mm) O.D. Tubing	3/8" (9 mm) O.D. Tubing 1/2" (13 mm) O.D. Tubing
Pump Stroke	0.8 gal. (2850 ml.)	0.8 gal. (2850 ml.)	0.32 gal. (1200 ml.)
Operating pressure range	10-160 psi (70-1,100 kPa)	10-160 psi (70-1,100 kPa)	10-160 psi (70-1,100 kPa)
Maximum lift	300 ft. (90 m)	300 ft. (90 m)	300 ft. (90 m)
Maximum flow rate	14+ GPM (54+ LPM) HF45SSB, HF45SEB	11+ GPM (41+ LPM) HF45SET	10 GPM (38 LPM)
Minimum submergence	42" (107 cm) above pump bottom	Top Inlet Port— 58" (147 cm) above bottom of pump	Top Inlet Port— 38" (97 cm) above bottom of pump
Density of pumped liquid	1.0 g/cc (stainless float); 0.7 g/cc up (epoxy float)	0.7 g/cc up	0.7 g/cc up
Cap sizes**	4", 6", and 8" (100, 150, & 200 mm) diameter (standard and vacuum seal)	4", 6", and 8" (100, 150, & 200 mm) diameter (standard and vacuum seal)	4", 6", and 8" (100, 150, & 200 mm) diameter (standard and vacuum seal)

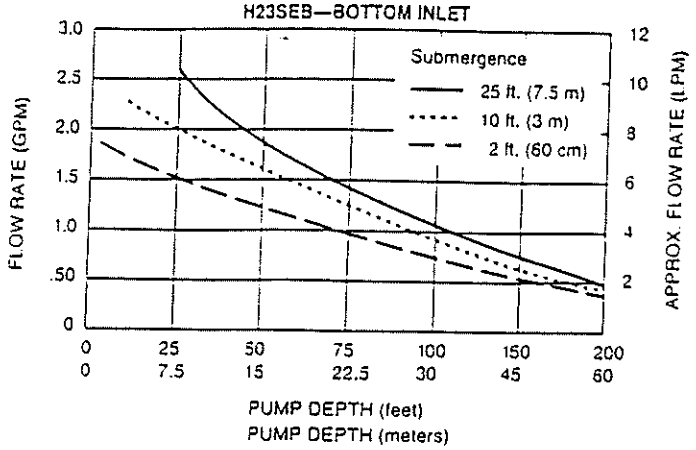
* Note: Pumps are available with tubing or hose; quick disconnect fittings are available on request. Hose sizes are: 1" (25 mm) I.D. discharge, 3/8" (9 mm) I.D. air supply, 3/8" (9 mm) I.D. exhaust.

** Special caps available.

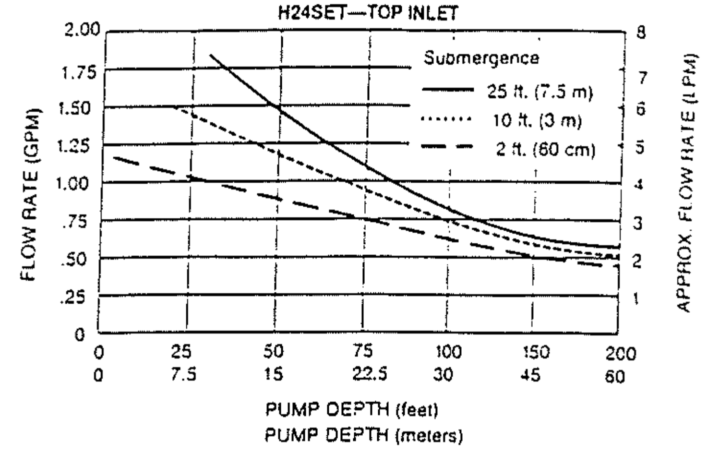
H2 SERIES

100 psi (700 kPa) drive air pressure was supplied for all pump depths.

H23SEB—BOTTOM INLET



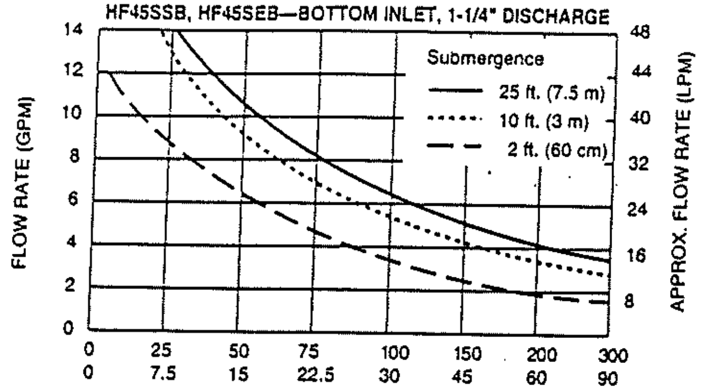
H24SET—TOP INLET



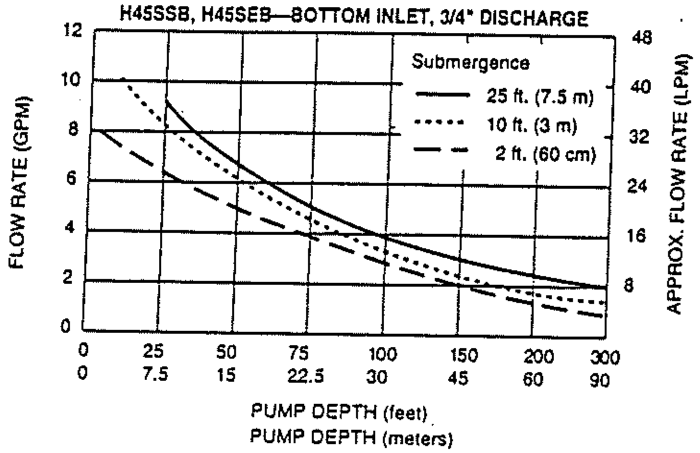
H4 SERIES

100 psi (700 kPa) drive air pressure was supplied for all pump depths less than 150 feet (45 meters); 160 psi (1,100 kPa) drive air pressure was supplied for all greater pump depths.

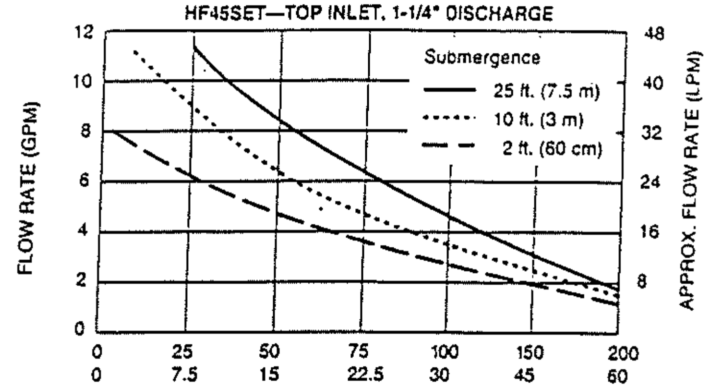
HF45SSB, HF45SEB—BOTTOM INLET, 1-1/4" DISCHARGE



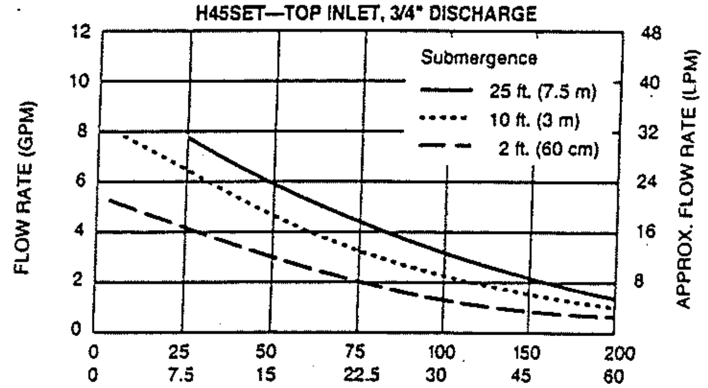
H45SSB, H45SEB—BOTTOM INLET, 3/4" DISCHARGE



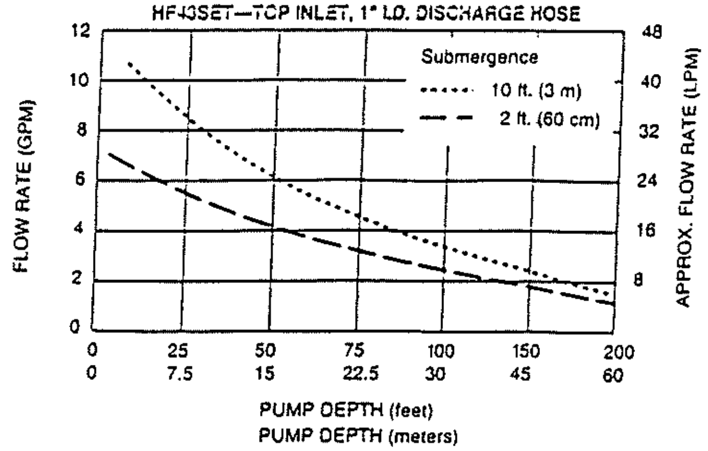
HF45SET—TOP INLET, 1-1/4" DISCHARGE



H45SET—TOP INLET, 3/4" DISCHARGE



HF43SET—TOP INLET, 1" I.D. DISCHARGE HOSE



NOTE: Pump depth is measured down from the top of the well casing to the top of the pump fittings. Submergence is measured up from the lowest inlet point on the pump inlet to the top of the static water or product in the well.

APPENDIX B

GROUND WATER EXTRACTION TREATMENT TECHNICAL SPECIFICATIONS

WATER TEK SERVICES, INC. 39 CLAYTON AVENUE LAKE VILLA, ILLINOIS 60046 (708) 356-1414
FAX (708) 356-6967

January 13, 1995

Fax: 708-940-9280

Larry Ganzel
ERM North Central
540 Lake Cook Road, Suite 300
Deerfield, IL 60015

Subject: Haworth Plant Site
Douglas, MI
Wicks Creek - Case No. 2

Dear Larry:

Water Tek Services is pleased to submit for your review our revised recommendations and specifications for the subject remediation system. Our design is based on three 4" extraction wells and a total flow rate of 20 gpm. Since the building is not existing we are specifying a QED integrated treatment system pre-piped and wired in a pre-fabricated building. The complete treatment system would be manufactured at QED in Ann Arbor, Michigan and hydraulically tested prior to shipment.

We specify a Model 20 Integrated Treatment System as follows:

<u>Pre-Fabricated Building</u>

One (1) Pre-fabricated Building 10' wide X 30' long with heater, lights, mechanical vent. The building shall be R-11 insulated. Steel frame construction, steel wall skin and roof. Floor shall be steel grading, non-explosion proof, non-fire rated construction. Building shall include 2" HT steel pre-fabricated containment wall and sump. We include two sets of double doors with two manway doors.

<u>Pneumatic Pumps</u>

Three (3) QED 4" Pneumatic Hammerhead Pumps, Model H-4 each rated for up to 12 gpm at 25 feet. Included are well caps, filter regulators and 50' downwell tubing.

<u>Compressor</u>

One (1) Compressor Package, 5 hp, 16.9 Scfm with desiccant dryer, TEFC motor.

Air Stripper

One (1) QED Model 2341 White Water™ Air Stripper System with 5.0 hp blower rated at 300 cfm. Included is pump out package with one (1) transfer pump, Model T25100 rated for 20 gpm at 100' TDH, 1.5 hp TEFC motor.

One (1) Booster blower, 5 hp TEFC motor.

Bag Filters

Two (2) Model PF-40 Bag Filters with Pressure Switch.

Sump Pump

One (1) Air Diaphragm sump pump for integral floor sump.

Liquid Phase Carbon

Two (2) QED Model L1000HP high pressure carbon adsorption units rated for up to 50 gpm each. Each unit contains 1,000 pounds of carbon.

Vapor Phase Carbon

Two (2) 2,500 pound vapor phase carbon unit rated at 100 to 1,000 cfm, series operation.

Control Panel (NEMA 4)

One (1) QED Model Data 30, PLC based control system with telemetry and data acquisition. We include step down transformer and all control functions as specified. We also include one auto dialer system.

The complete system will be pre-piped, pre-wired, and tested in our shop prior to shipment.

The total budget cost for the treatment package as described above is $106,000.00 We do not include installation of building. Specifications were submitted previously.

Tom Lawn

TL:ss

2/15/95 CARBTROL® CORPORATION MULTI-STAGE DIFFUSER REMOVAL ESTIMATE 3:31 PM

PROJECT: 0 Wicks Creek Site – Air Strip
FLOW IN GPM: 20
TEMP IN °F: 55

OF STAGES REQUESTED: 4
DESIGN CFM PER CELL: 100

PERFORMANCE:

CONTAMINANT	INFLUENT(ppb)	ACTUAL EFFLUENT(ppb)	K FACTOR	AIR DISCHARGE #/DAY	AIR DISCHARGE ppmv
cis-1,2-Dichloroethylene	1600	3.55	2.886	0.38	2.68
1,1,1-Trichloroethane	150	0.22	3.309	0.04	0.18
Trichloroethylene	34000	14.28	4.788	8.16	42.21
TOTALS	35750	18.05		8.58	45.07

Strip with MSD-4-100

Assume dimethyl phenol will not strip and is contained in effluent at 2 ppm

PROJECT: Widas Creek Site - Polish

FLOW IN GPM: 20.00
FLOW IN GPD: 28800.00

PERFORMANCE:

CONTAMINANT	CONC(ppb)	#CONT /DAY	# CARBON /DAY	# CONT /1000 gal	# CARBON /1000 gal
cis-1,2-Dichloroethylene	3.55215317	0.00	1.29	0.00	0.04
1,1,1-Trichloroethane	0.21561824	0.00	0.28	0.00	0.01
Trichloroethylene	14.2820427	0.00	0.63	0.00	0.02
Dimethylphenol	2	0.00	0.16	0.00	0.01
TOTALS	20.0498141	0.00	2.36	0.00	0.08

Polish MSO-4-100 Effluent with carbon

Carbon usage rate - 2.4 #/operating day

CARBTROL® Corporation Carbon Usage Calculation —treat off-gas 9:22 AM

PROJECT: Wicks Creek Site

FLOW IN CFM: 400.00
FLOW IN CFD: 576000.00

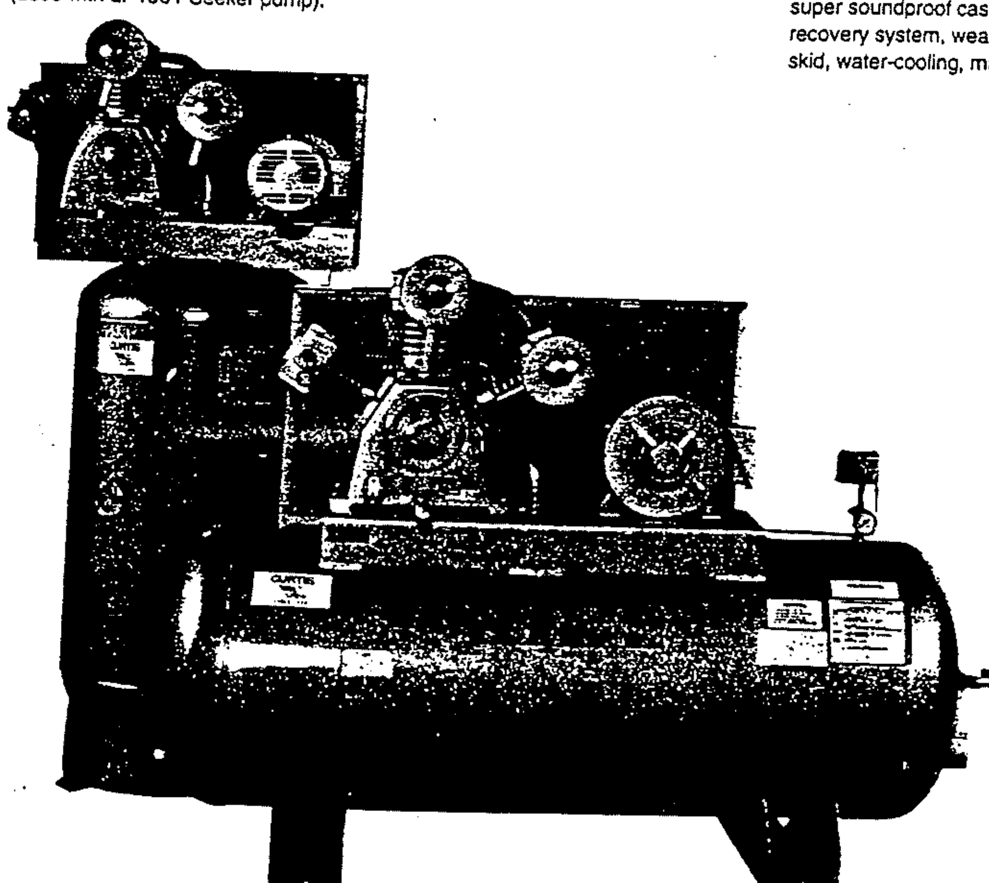
PERFORMANCE:

CONTAMINANT	CONC(ppmv)	#CONT /DAY	#CARBON /DAY	#CONT /100,000cf	#CARBON /100,000cf
cis-1,2-Dichloroethylene	2.68	0.38	8.25	0.07	1.43
1,1,1-Trichloroethane	0.18	0.04	0.25	0.01	0.04
Trichloroethylene	42.21	8.16	33.02	1.42	5.73
TOTALS	45.07	8.58	41.51	1.49	7.21

Carbon usage rate to treat off-gas from MSD-4-100
~42#/operating day

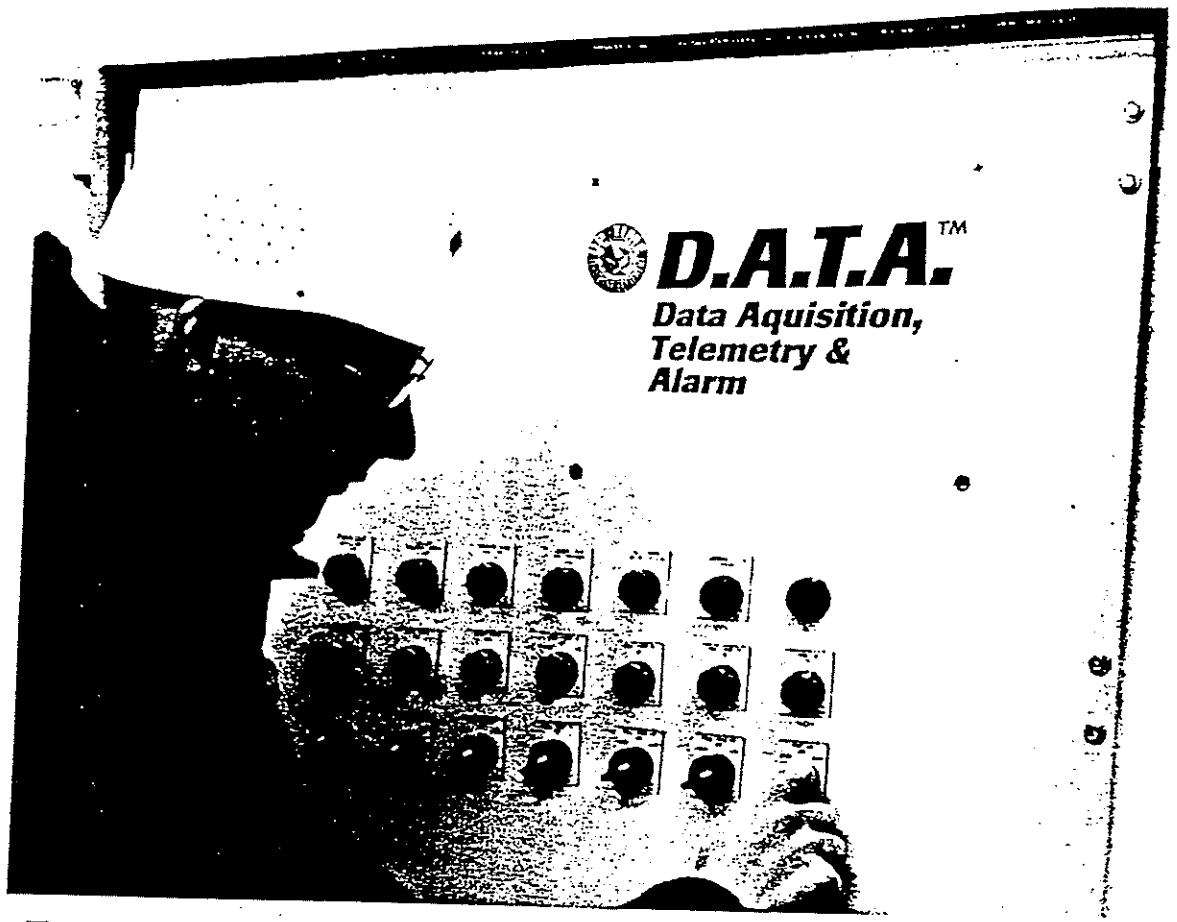
COMPRESSOR SPECIFICATIONS

Compressor Model(s)	Pulse Driver™ Model LD16	Various	Various
Type	Piston	Reciprocating	Screw
Output	1.6 SCFM@0 psi/0.3 SCFM@55 psi (2.7 m³/h@0 kPa/0.5 m³/h@380 kPa)	Range: 6.8-45.5 SCFM @100 psi (11.5-77 m³/h@700 kPa) Model "5": 16.9 SCFM (29 m³/h) Model "7": 24.0 SCFM (41 m³/h)	Range: 11.5-2,090 SCFM@110 psi (19.5-3,550 m³/h@760 kPa) Model "6": 21 SCFM (36 m³/h)
Duty Cycle	100% on	50% on/50% off	100% on
Maximum Pressure	55 psi (380 kPa)	150 psi (1,030 kPa)	190 psi (1,310 kPa)
Maximum lift/TDH	50' (15 m)	300' (90 m)	400' (120 m)
Motor	1/3 HP (0.25 kw)	Range: 2-15 HP (1.5-11.2 kw) Model "5": 5 HP (3.7 kw) Model "7": 7.5 HP (5.6 kw)	Range: 3-475 HP (2.2-355 kw) Model "6": 5 HP (3.7 kw)
Power	110 VAC, 60 Hz, 1 phase 230/460 VAC, 60 Hz, 3 phase	Range: 115/230 VAC, 60 Hz, 1 phase (other voltages available) Model "5": 115/230 VAC (230/460 VAC optional) Model "7": 230/460 VAC	Range: 230/460 VAC, 60 Hz, 3 phase Model "6": Same as above
Dimensions (LxWxH)	16x12x12" (40x30x30 cm)	Range: 66.5x18.5x45"—73x28x60" (169x47x114 cm—185x71x152 cm) Model "5": 68x24.5x50" (173x62x127 cm) Model "7": 68x24.5x50" (173x62x127 cm)	Range: 21x22x25"—144x77x80" (53x57x64 cm—366x196x204 cm) Model "6": 21x22x25" (53x57x64 cm)
Weight	40 lbs. (18 kg)	Range: 449-1,379 lbs. (204-626 kg) Model "5": 616 lbs. (280 kg) Model "7": 616 lbs. (280 kg)	Range: 243-12,560 lbs. (110-5,700 kg) Model "6": 243 lbs. (110 kg)
Tank Size	None	Range: 80-120 gal. (300-450 l) included Model "5": 120 gal. (450 l) Model "7": 120 gal. (450 l)	Range: 5-2,200 gal. (19-8,300 l) recommended Model "6": 30 gal. (113 l)@110 psi 20 gal. (76 l)@145-190 psi
Options, Extras	Includes tank-full shutoff (available without) and pump cycle controller, adaptor for Seeker Mate modular controller (used with LP1501 Seeker pump).	Motor starter, belt guard-mounted air-cooled aftercooler (required w/air dryer options), Hankison refrigerated or desiccant air dryer.	205 psi (1,410 kPa) pressure, Quadro control (reduces energy cost), remote air intake filter (for excessive dust). Larger model options: super soundproof casing, heat recovery system, weatherproof casing, skid, water-cooling, magnetic starter.



Reciprocating compressors are available with horizontal or vertical tanks.

Models 10-20-30



Integrated Treatment Buildings

(708) 356-1414
FAX (708) 356-6967

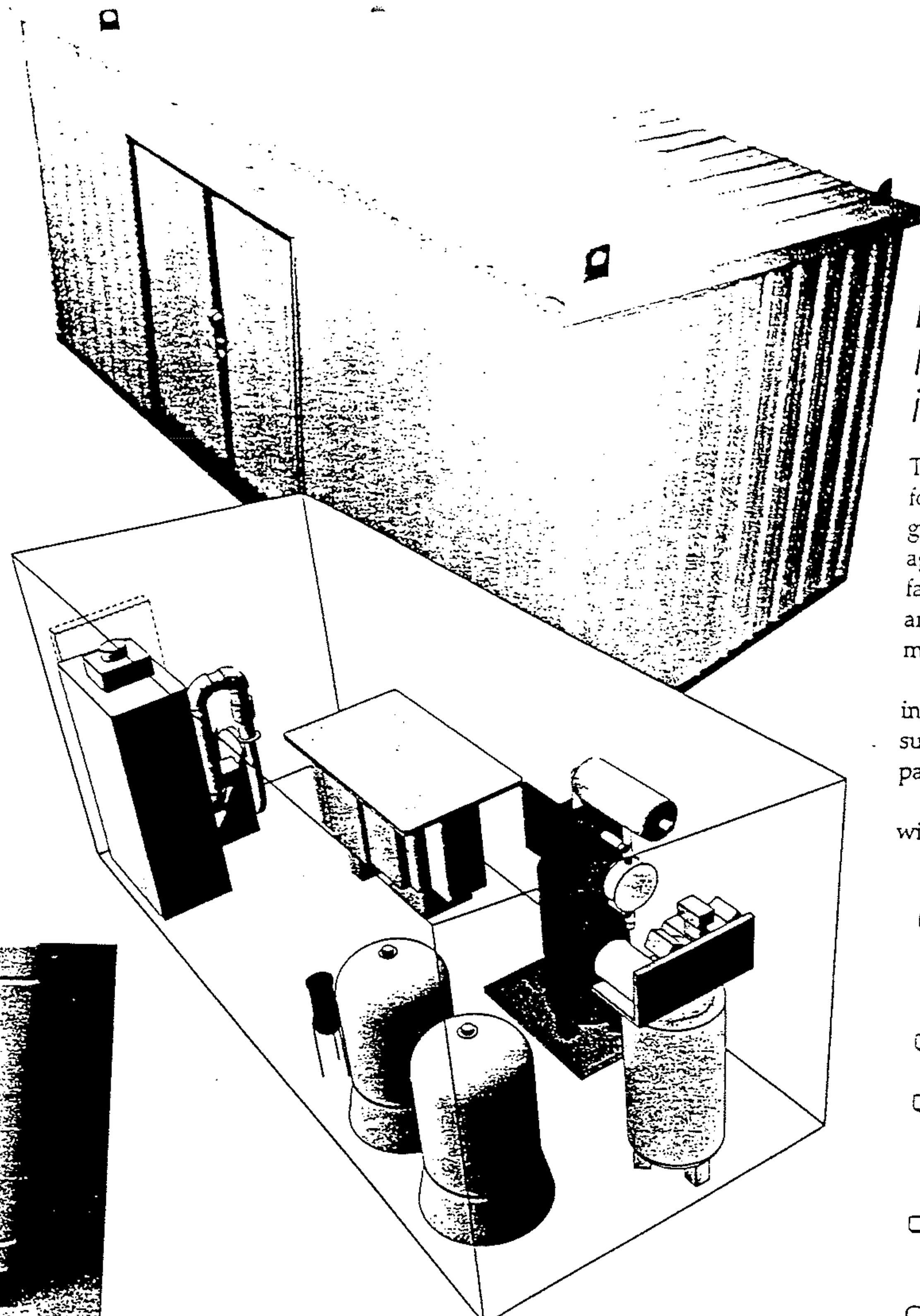
WATER TEK SERVICES, INC.
Manufacturer's Representative

Tom W. Lawn

39 Clayton Avenue
Lake Villa, IL 60046

UP TIME TREATMENT EQUIPMENT

"Working Night & Day"



The D.A.T.A. system combines a powerful, industrial-grade PLC (programmable logic controller) with built-in alarm, remote control, and data acquisition. D.A.T.A. sharply reduces site O&M costs by allowing troubleshooting and system parameter charges over phone lines. Alarm output options include pagers, host computer, and (in the near future) fax. Other capabilities are an optional lightning protection package and UpTime–exclusive MMI (Man-Machine Interface) software to ease system use.

Delivering the New Standard in Treatment

The UpTime™ symbol stands for... products designed to give remediation project managers what they need most—fast startup, low O&M cost, and sharply reduced equipment downtime.

...systems organized into integrated buildings—far superior to one-of-a-kind, patchwork approaches.

...comprehensive support with

- ❑ complete, easy-to-use manuals
- ❑ 800-line help from a work-group enabled customer service staff that's the largest in the industry
- ❑ a nationwide technical sales force
- ❑ controls engineered for simple startup, smooth operation, and remote dial-up trouble-shooting
- ❑ certified 100% pre-shipment performance testing.

Call today for application help, specifications, or a quote on any treatment building, trailer, or equipment.

1-800-624-2026

Treatment Equipment from QED
P.O. Box 3726, Ann Arbor, MI 48106 USA
1-313-995-2547 FAX 1-313-995-1170

Economical Modular Buildings

QED Models [illegible] and [illegible] integrated treatment buildings cover an extremely broad spectrum of applications. Approximate maximum liquid flow ratings are 10, 20, and 30 GPM respectively. Sizes range from 8x8x12' to 8x8x16' and 8x8x20', with a variety of floor plans to meet different needs.

Nearly 950 different combinations can be configured from the menu of process elements:

- White Water™ E-Z Tray™ air stripper*
- Pneumatic or electric cleanup pumps
- Oil/water separator—with integral transfer tank*
- Booster blower
- Soil vapor extraction system
- Air sparge or bio-vent system
- Liquid and/or vapor phase carbon
- Reciprocating or screw-type compressor for pneumatic pump systems

Buildings are delivered complete, pre-tested, and ready to run, with steel frame construction, corrosion-resistant painted steel skin and roof (with four corner lifting hooks), EXP lights, fan, and heater, and remote mount external NEMA 4 control panel, easily upgradable to provide D.A.T.A.* (Data Acquisition, Telemetry and Alarms) capability.

QED goes to extra lengths to provide extreme flexibility in system design. Most process units can be by-passed and all buildings are liquid phase carbon ready, with piping to run series or parallel. All available choices can be made from a surprisingly small number of subassemblies. This powerful manufacturing process means QED can specify, quote, produce, and deliver faster and more efficiently than other vendors.

Building interiors are spacious, well-lit, fully insulated and finished, with plenty of room for equipment, connections, and personnel.

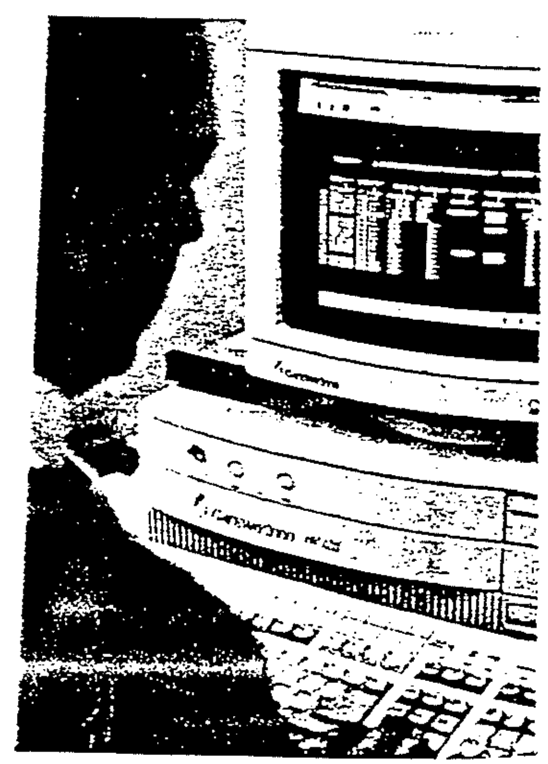
Custom Power and Performance

For applications requiring higher liquid flow rates (>30 GPM) or other capacities outside modular system range, QED can custom-engineer buildings and systems with many of the same benefits. Cost and delivery are quoted on a job-by-job basis.

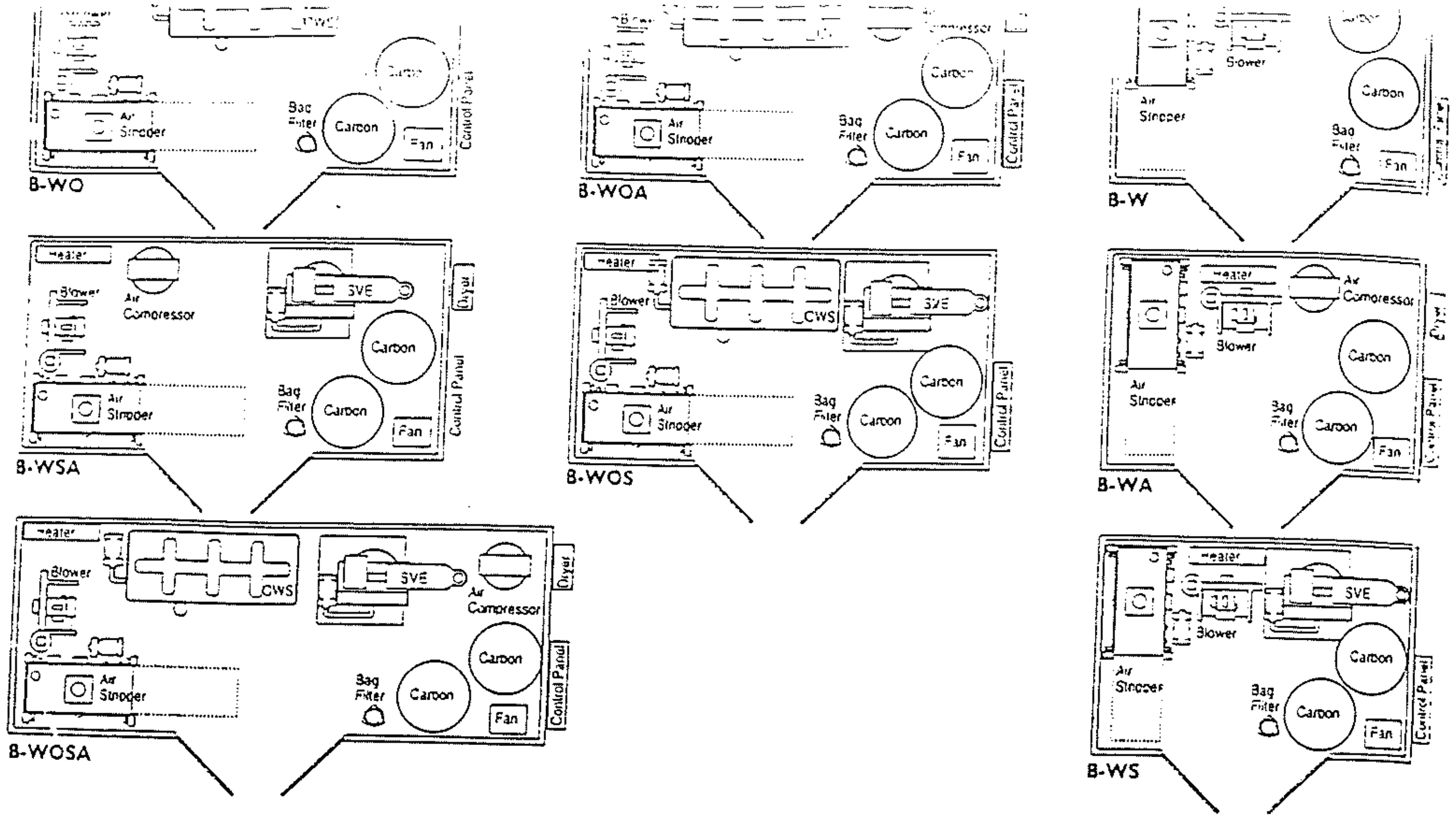
Modifications can include trailer mounting, larger buildings, and/or location of process elements (i.e. carbon absorbers, catalytic or thermal oxidizers) outside of the treatment building.

Quick, Easy Specification

Most of the information required to choose the appropriate model can be obtained through a series of simple questions. Our technical sales staff or your local QED representative will be glad to help.



* Exclusive QED UpTime Feature



QED INTEGRATED BUILDINGS

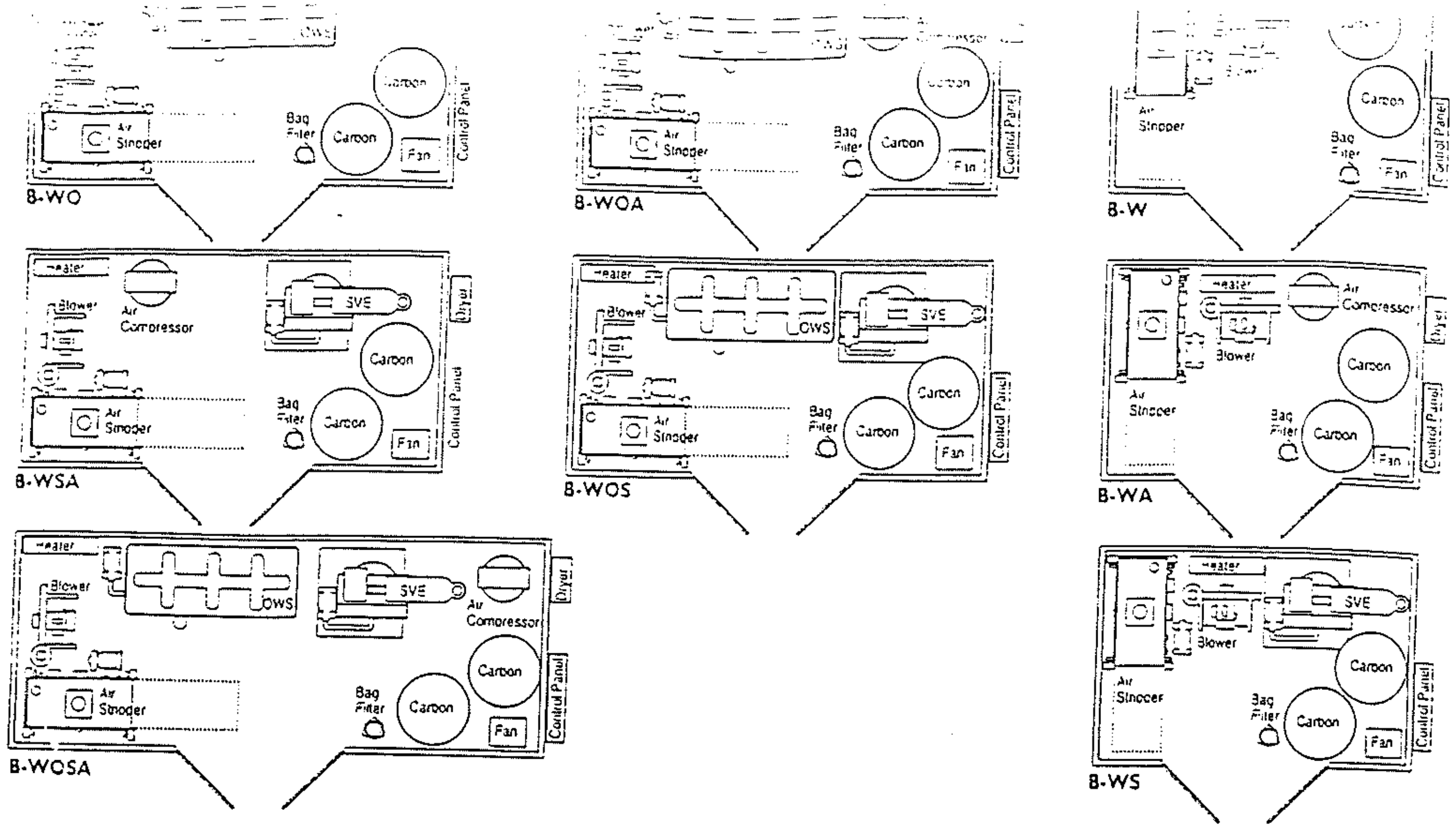
Process Element	MODEL 10 10 GPM	MODEL 20 20 GPM	MODEL 30 30 GPM*
Oil Water Separation	76"Lx31"Wx37"H	76"Lx31"Wx49"H	76"Lx43"Wx49"H
Integral transfer tank	30 gal.	60 gal.	90 gal.
Integral product tank	30 gal.	30 gal.	45 gal.
Transfer pump	10 gpm; 50'TDH; 0.75HP	20 gpm; 50'TDH; 1.5HP	30 gpm; 50'TDH; 1.5HP
WhiteWater Stripper	Model 4.4 200 cfm; 3HP; 230V; 1PH	Model 8.4 300 cfm; 5HP; 230V; 1PH	Model 12.4 450 cfm; 7.5HP; 230V; 3PH
Pneumatic pumps			
HammerHead 4"	1-2 pumps	3-4 pumps	5-6 pumps
Solo II	1-3 pumps	4-6 pumps	7-10 pumps
HammerHead 2"	1-4 pumps	5-8 pumps	9-12 pumps
Electric pumps	1-2 pumps	3-4 pumps	5-6 pumps
Compressor	16.9 cfm; 5HP; 230V; 1PH	31.2 cfm; 10HP; 230V; 3PH	42 cfm; 10HP; 230V; 3PH
Air Sparge	**0-50 cfm** 7psi; 5HP; 230V; 1PH	**50-130 cfm** 7psi; 5HP; 230V; 1PH	**130-260 cfm** 7psi; 7.5HP; 230V; 3PH
Soil Vapor Extraction	**0-150 cfm**	**150-275 cfm**	**275-450 cfm**
Low-Vac	50"H2O; 2HP;230V; 1PH	87"H2O; 5HP;230V; 1PH	N/A
High-Vac	14"Hg; 3HP; 230V; 1PH	14"Hg; 5HP; 230V; 1PH	14"Hg; 7.5HP; 230V; 3PH

Building Part No.	Process Elements	Size	Key:
B-WS	WW; SVE/AS	8'X12'	WW-Stripper
B-W	WW	8'X12'	OWS-Oil Water Separator
B-WA	WW; AC	8'X12'	SVE/AS-Soil vac/Air Sparge
B-WOS	OWS; WW; SVE/AS	8'X16'	AC-Air compressor
B-WOA	OWS; WW; AC	8'X16'	
B-WO	OWS; WW	8'X16'	
B-WSA	WW; SVE/AS; AC	8'X16	
B-WOSA	OWS; WW; SVE/AS; AC	8'X20'	

All buildings include: steel frame construction, steel wall skin and roof, NEMA 4 electrical panel, remote mount external panel, liquid carbon ready, EXP exhaust fan, EXP lighting, EXP 3600 watt heater, R-11 insulation, external mount desiccant air drier for air compressor systems, double swing long wall doors, four corner lifting hooks, Class-1, Div.-2 standard.

Options: D.A.T.A.™ controller, booster blower, SVE/AS manifold, diamond-plate floor, bag filter, external compressor, Class-1, Div.-1, 460/230/208 voltages; 1 and 3 phase available on most systems.

* Please contact factory to verify configuration, price and availability on Model 30 systems.



QED INTEGRATED BUILDINGS

Process Element	MODEL 10 10 GPM	MODEL 20 20 GPM	MODEL 30 30 GPM*
Oil Water Separation	76"Lx31"Wx37"H	76"Lx31"Wx49"H	76"Lx43"Wx49"H
Integral transfer tank	30 gal.	60 gal.	90 gal.
Integral product tank	30 gal.	30 gal.	45 gal.
Transfer pump	10 gpm; 50'TDH; 0.75HP	20 gpm; 50'TDH; 1.5HP	30 gpm; 50'TDH; 1.5HP
WhiteWater Stripper	Model 4.4 200 cfm; 3HP; 230V; 1PH	Model 8.4 300 cfm; 5HP; 230V; 1PH	Model 12.4 450 cfm; 7.5HP; 230V; 3PH
Pneumatic pumps			
HammerHead 4"	1-2 pumps	3-4 pumps	5-6 pumps
Solo II	1-3 pumps	4-6 pumps	7-10 pumps
HammerHead 2"	1-4 pumps	5-8 pumps	9-12 pumps
Electric pumps	1-2 pumps	3-4 pumps	5-6 pumps
Compressor	16.9 cfm; 5HP; 230V; 1PH	31.2 cfm; 10HP; 230V; 3PH	42 cfm; 10HP; 230V; 3PH
Air Sparge	**0-50 cfm** 7psi; 5HP; 230V; 1PH	**50-130 cfm** 7psi; 5HP; 230V; 1PH	**130-260 cfm** 7psi; 7.5HP; 230V; 3PH
Soil Vapor Extraction	**0-150 cfm**	**150-275 cfm**	**275-450 cfm**
Low-Vac	50"H2O; 2HP;230V; 1PH	87"H2O; 5HP;230V; 1PH	N/A
High-Vac	14"Hg; 3HP; 230V; 1PH	14"Hg; 5HP; 230V; 1PH	14"Hg; 7.5HP; 230V; 3PH

Building Part No.	Process Elements	Size	Key:
B-WS	WW; SVE/AS	8'X12'	WW-Stripper
B-W	WW	8'X12'	OWS-Oil Water Separator
B-WA	WW; AC	8'X12'	SVE/AS-Soil vac/Air Sparge
B-WOS	OWS; WW; SVE/AS	8'X16'	AC-Air compressor
B-WOA	OWS; WW; AC	8'X16'	
B-WO	OWS; WW	8'X16'	
B-WSA	WW; SVE/AS; AC	8'X16	
B-WOSA	OWS; WW; SVE/AS; AC	8'X20'	

All buildings include: steel frame construction, steel wall skin and roof, NEMA 4 electrical panel, remote mount external panel, liquid carbon ready, EXP exhaust fan, EXP lighting, EXP 3600 watt heater, R-11 insulation, external mount desiccant air drier for air compressor systems, double swing long wall doors, four corner lifting hooks, Class-1, Div.-2 standard.

Options: D.A.T.A.™ controller, booster blower, SVE/AS manifold, diamond-plate floor, bag filter, external compressor, Class-1, Div.-1. 460/230/208 voltages: 1 and 3 phase available on most systems.

* Please contact factory to verify configuration, price and availability on Model 30 systems.

SPECIFICATIONS FOR LCD COUNTER P/N 37247
SENSORS P/N 37249 & 37250

1. **Counter shall be electronic.** Two alkaline batteries will serve as an integrated voltage supply.

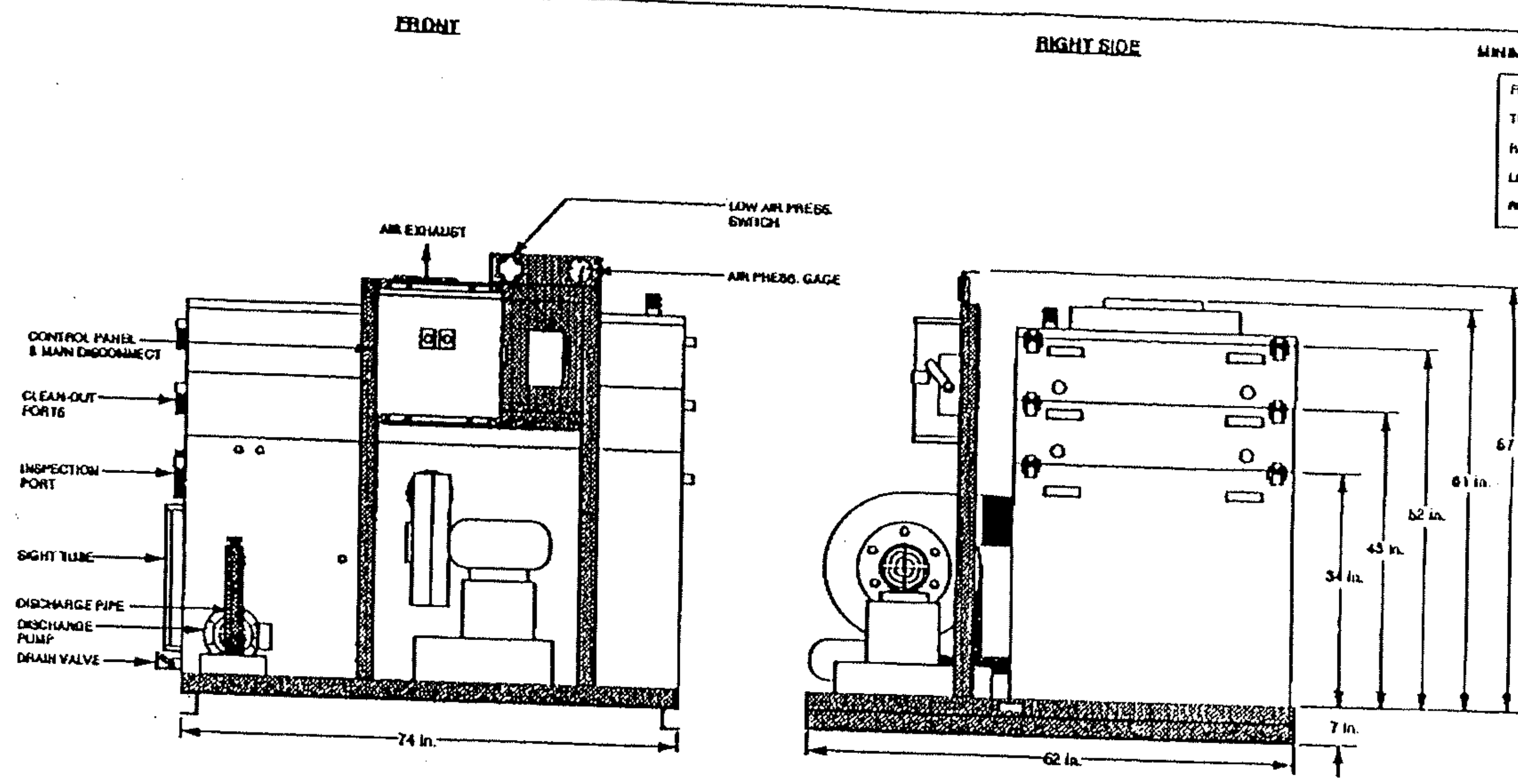
2. **Counter shall have an 8-digit LCD display, 8 mm high.**

3. **Counter shall be able to be reset.** The counter can be operated with or without reset by appropriate wiring of the "Reset enable" input. Zero resetting of the counter is possible in two ways:
   - manually with the rest button on the front panel,
   - electrically by wiring the Reset input.

4. **Down well cable shall be constructed with a Kynar resin jacket.** Cable shall include (2) #18 gage tinned copper conductors with pvc insulation encapsulated within a 3/16 diameter Kynar resin jacket.

5. **Sensor shall be constructed of stainless steel** with a liquid tight compression fitting.

6. **Sensor shall be attached directly to head of pump.** Sensor shall be threaded directly in the head of the pump without disassembly of the pump.



MINIMUM CLEARANCE

FRONT	1.5 ft.
TOP	24 in.
REAR	NA
LEFT	3.5 ft.
RIGHT	1 ft.

BASIC SYSTEM

- ✓ SUMP TANK
- ✓ AERATION TRAYS
- ✓ BLOWER
- ✓ AIR PRESSURE GAGE
- ✓ DEMISTER PAD
- ✓ PIPING
- ✓ SPRAY NOZZLE
- ✓ WATER LEVEL SIGHT TUBE
- ✓ GASKETS
- ✓ LATCHES
- ✓ FRAME

OPTIONAL ITEMS

- __ DISCHARGE PUMP
- __ FEED PUMP
- __ ADDITIONAL BLOWER
- __ EXP MOTORS
- __ BLOWER START/STOP PANEL
- ✓ CONTROL PANEL
- ✓ MAIN DISCONNECT SWITCH -
- __ IS COMPONENTS/REMOTE MOUNT
- __ INTERMITTENT OPERATION
- __ STROBE LIGHT
- __ ALARM HORN
- __ POWER LOSS INDICATOR
- ✓ LOW AIR PRESSURE ALARM SWITCH
- ✓ HIGH WATER LEVEL ALARM SWITCH
- ✓ DISCHARGE PUMP LEVEL SWITCH
- __ WATER PRESSURE GAGES
- __ DIGITAL WATER FLOW INDICATOR
- __ AIR FLOW METER
- __ TEMPERATURE GAGES
- __ LINE SAMPLING PORTS
- __ AIR BLOWER SILENCER
- __ WASHER WAND
- __ AUTO DIALER

NOTE:

1. DRAWING REPRESENTS A UNIT TYPICAL TO THE SPECIFICATION YOU REQUESTED. MINOR CHANGES MAY RESULT IN THE MANUFACTURING PROCESS

CONNECTION INFORMATION

ITEM	SIZE
GRAVITY DISCHARGE	3 in. Ø FEMALE SLIP JOINT, PVC80
DISCHARGE PUMP	2 in. Ø FEMALE SLIP JOINT, PVC80
WATER INLET	2 in. Ø FEMALE SLIP JOINT, PVC80
AIR EXHAUST NOZZLE	10 in. Ø RING

POWER: 3Ø, 230volt, 4 WIRE and GROUND

*CONSULT N.E.E.P. FOR AMPACITIES AND OTHER VOLTAGE OPTIONS

	QED ENVIRONMENTAL SYSTEMS P.O. BOX 3726 ANN ARBOR, MI 48106			
TOLERANCES UNLESS OTHERWISE SPECIFIED ± 1 in.	DRAWING NAME: 3621			
	DRAWING #: Q1294-021171			
DRAWN: SCR	CUSTOMER: EHM			
DATE: 12-16-94	SCALE:	SIZE: A	SHEET:	OF:

White Water
SHALLOW TRAY TECHNOLOGY AIR STRIPPERS

System Performance Estimate

Client and Proposal Information:

ERM Northeast
Site: Haworth Plant, Douglas, MI
Q1294-021171

Model Chosen:	3600
Water Flow Rate:	30.0 gpm
Air Flow Rate:	900 cfm
Water Temp:	50.0 F
Air Temp:	50.0 F
A/W Ratio:	224.4 cu. ft/ cu. ft
Safety Factor:	None

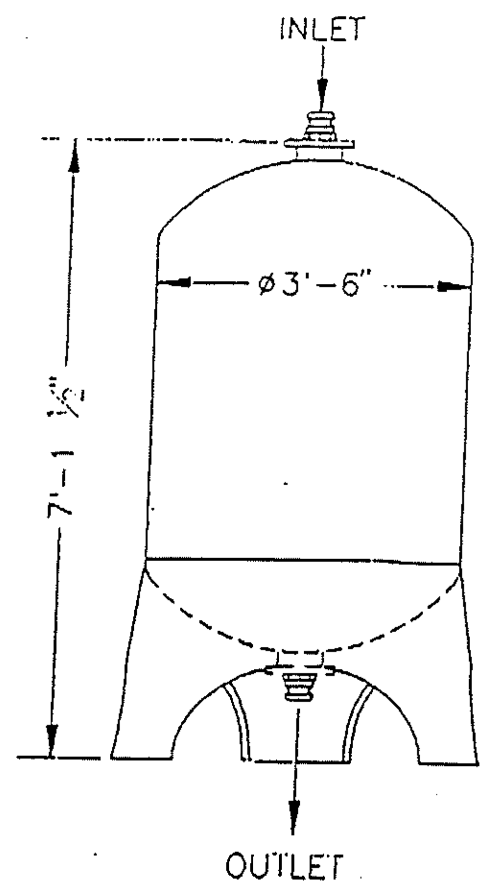
Contaminant	Untreated Influent	Model 3611 Effluent Water Air(lbs/hr) % removal	Model 3621 Effluent Water Air(lbs/hr) % removal	Model 3631 Effluent Water Air(lbs/hr) % removal	Model 3641 Effluent Water Air(lbs/hr) % removal
1,1,1-Trichloroethane	25 ppb	1.000 ppb 0.000360 97.4388%	0.016 ppb 0.000375 99.9344%	0.000 ppb 0.000375 99.9983%	0.000 ppb 0.000375 100.0000%
1,2-Dichloroethane	270 ppb	33 ppb 0.003557 88.0967%	4 ppb 0.003992 98.5831%	1.000 ppb 0.004037 99.8313%	0.054 ppb 0.004051 99.9799%
Trichloroethylene	5700 ppb	44 ppb 0.084877 99.2377%	1.000 ppb 0.085523 99.9942%	0.003 ppb 0.085538 100.0000%	0.000 ppb 0.085538 100.0000%

This report has been generated by ShallowTray Modeler software version 1.4.1. This software is designed to assist a skilled operator in predicting the performance of a ShallowTray air stripping system. The software will accurately predict the system performance when both the equipment and the software are operated according to the written documentation and standard operation. North East Environmental Products, Inc. cannot be responsible for incidental or consequential damages resulting from the improper operation of either the software or the air stripping equipment. Report generated: 12/16/1994

Carbon Service Company

AQUA 1000 HP

TYPICAL FLOWS	10-30 gpm
MAXIMUM SUGGESTED FLOW#	50 gpm
MAXIMUM PRESSURE	150 psig
MAXIMUM TEMPERATURE	150°F



STANDARD FEATURES

* 1,000 lbs. of domestic virgin carbon, coal base, 8 x 30 mesh, 900 min. I_2#.
* 2" FNPT inlet and outlet connections.
* Heavy duty, corrosion resistant *Polyglass®* composite poly vessel.
* An advanced internal distribution and collection system designed to maximize flow and carbon utilization.
* High Pressure vessel rated to 150 psig operation @ 150° F.

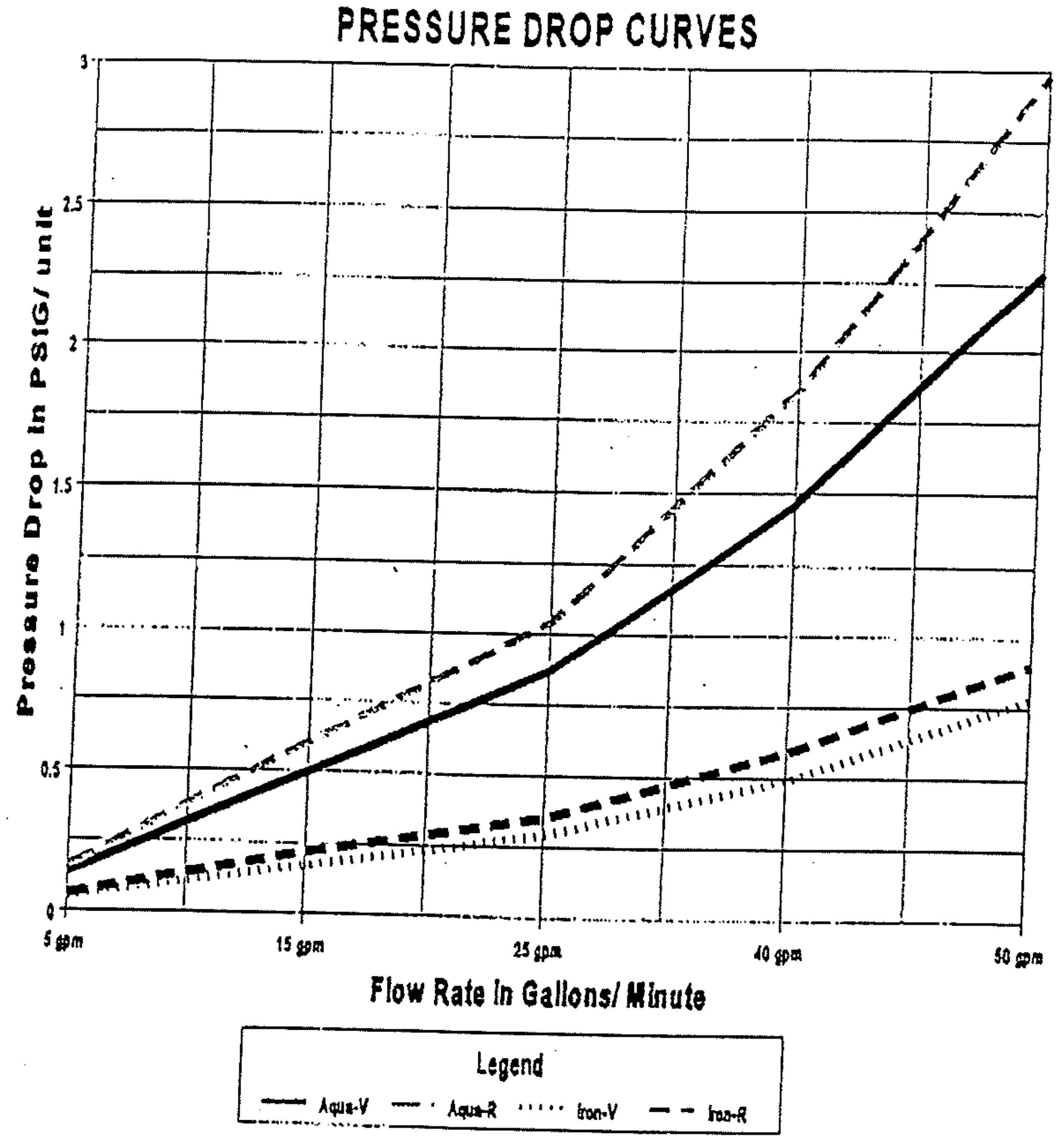
OPTIONAL FEATURES

* Top quality reactivated coal base carbon, 8 x 30 mesh, 850 min. I_2#.
* 1½" Cam-Lok® fittings w/ caps.
* Pressure gauge assembly.
* Sample port assembly.
* Flexible hose assemblies w/ Cam-lok fittings.
  1½" x 6'
  1½" x 12
  1½" x 20'
* Duplex solids prefilter systems.

(#) Based on (2) two units operating in-series and may not be effective in all applications.

P.O. Box 838 • Donora, Pennsylvania 15033 • Phone 412-379-8032 • Fax 412-379-7780

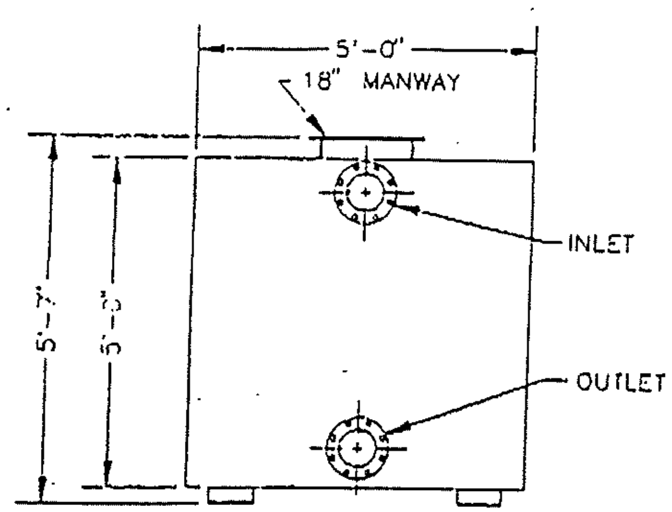
Aqua 1000 HP & Ironmaster 900 HP



Carbon Service Company

AIR 2500

TYPICAL FLOWS	100-1,000 cfm
MAXIMUM SUGGESTED FLOW#	1,250 cfm
MAXIMUM PRESSURE	14 psi
MAXIMUM TEMPERATURE	150°F



STANDARD FEATURES

* 2,500 lbs. domestic source virgin 4 x 10 mesh carbon, coal or coconut base, 60 min. CCl_4 activity.
* Heavy duty ¼" steel vessel w/ corrosion resistant 16 mil applied interior high solids epoxy lining.
* Over 2,825 in² of surface area for superior air distribution and the lowest pressure drops.
* 4" FNPT inlet and outlet connections. 6" flange or FNPT connections are available. (+$100.00)
* 100% carbon utilization for increased service life and lower maintenance costs.

OPTIONAL FEATURES

* Cam-lok fittings for connections.
  4" (w/caps +
  6" (w/caps +
* Top quality reactivated 4 x 10 mesh coal or coconut base carbon.
* High temperature model available for applications to 250 F°.
* Condensate drain line.
* Hard pipe manifold systems. Call for pricing.
* Flexible hose assemblies w/ Cam-lok fittings.
  4" x 10' or 20'
  6" x 10' or 20'

(#) Based on minimum accepted contact times and single stage operation. May not be effective in all applications.

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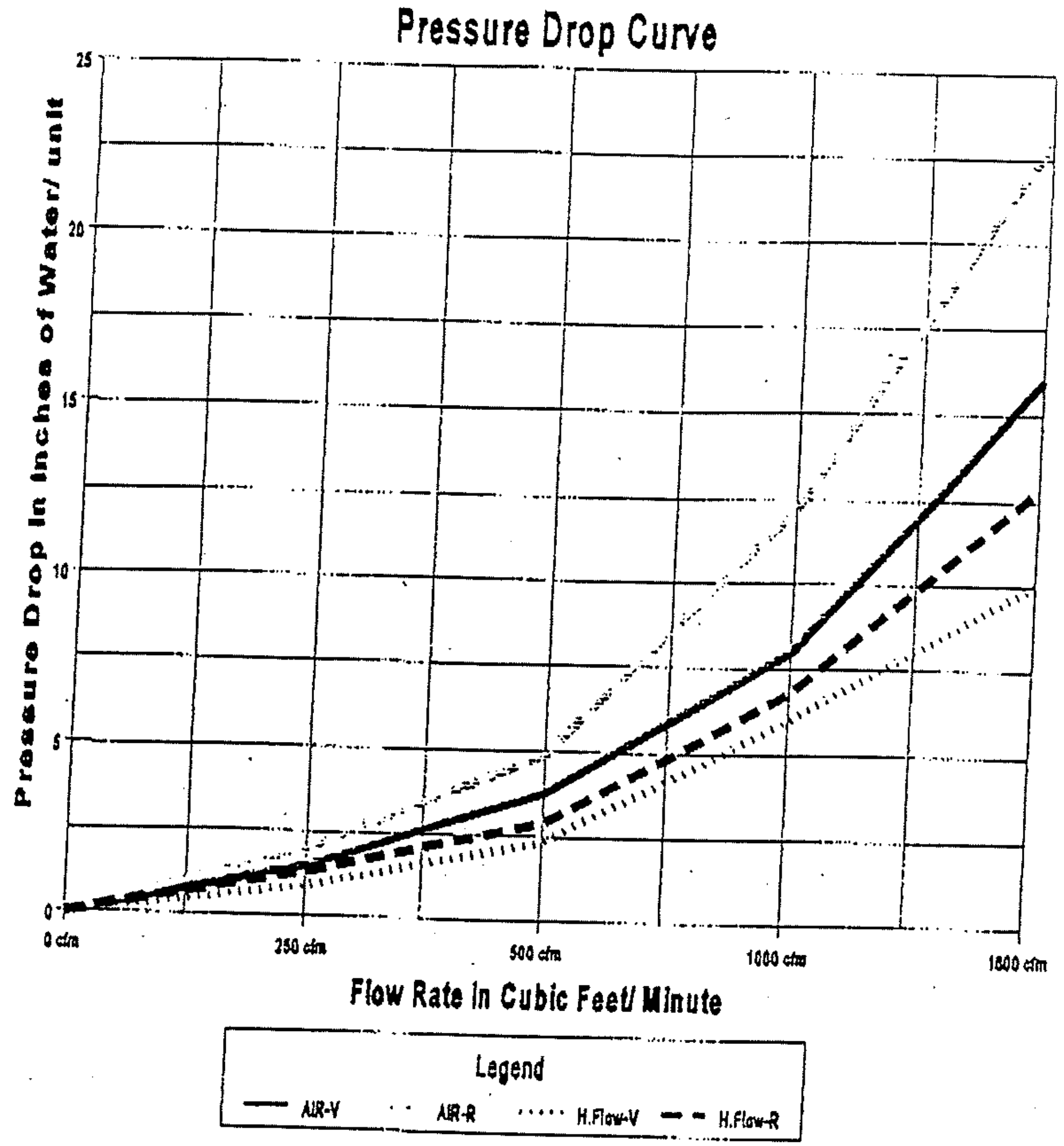
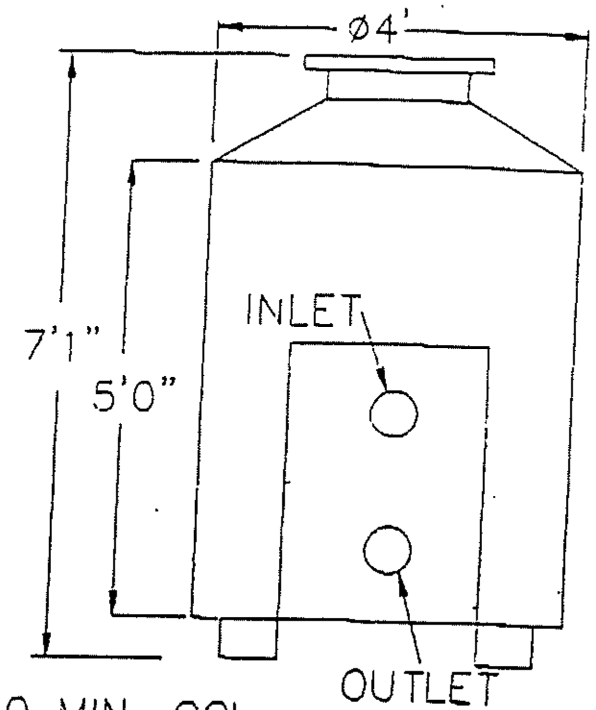
AIR 2500 and Custom HF



AIR 2500
ACTIVATED CARBON ADSORBER



MAX. FLOW	1000 CFM
MAX. PRESSURE	7 PSI
MAX. TEMP.	125 F

STANDARD FEATURES:

* 2500 lbs. OF TOP QUALITY VIRGIN VAPOR PHASE CARBON, 60 MIN. CCl_4
* HEAVY DUTY CUSTOM FABRICATED STEEL VESSEL W/ CORROSION RESISTANT INTERIOR LINING
* 4" MALE QUICK CONNECT IN/OUT FITTINGS
* AN SUPERIOR INTERNAL AIR DISTRIBUTION SYSTEM PROVIDING LOW PRESSURE DROPS AND EFFICIENT CARBON UTILIZATION.

OPTIONAL FEATURES:

* COCONUT OR COAL BASE VIRGIN CARBONS.
* ALTERNATE FITTINGS.
* HOSES AND PIPING.
* 2500 lbs. REACTIVATED CARBON FILL

QED ENVIRONMENTAL SYSTEMS, INC.

APPENDIX C

PERFORMANCE MONITORING PLAN

CONTENTS - APPENDIX C

LIST OF TABLES

LIST OF FIGURES

1.0 INTRODUCTION

This attachment describes the performance monitoring to be conducted during the operation of the Wicks Creek Site, ground water remediation (GWR) system at the Haworth Plant in Douglas, Michigan. This Performance Monitoring Plan (the "Plan") describes the activities to be conducted at the Wicks Creek Site to evaluate: (1) the progress of the remediation, (2) compliance with the discharge requirements, and (3) the efficiency of the extraction and treatment systems. Environmental Resources Management-North Central, Inc. (ERM-North Central) was retained by Haworth to prepare this Plan. More specifically, this Plan describes the following activities that are being conducted to achieve the indicated objectives:

- **Effluent Monitoring:** To evaluate compliance with the effluent criteria,
- **Intrastate Treatment and Air Emissions Monitoring:** To evaluate granular activated carbon (GAC) usage and air emissions,
- **Water Level Monitoring:** To determine the extent of the ground water capture zone,
- **Ground Water Quality Monitoring:** To evaluate the progress of the interim response actions and the attainment of the ground water clean-up criteria, and
- **Reporting:** To document the results of the performance monitoring.

The results of the performance monitoring will be used to assess the need for corrective action or system modifications and to document the achievement of the remediation goals. The following section provides a description of each of the foregoing activities. The GWR system process and instrumentation diagram is presented on Figures C-1 and C-2.

2.0 EFFLUENT MONITORING

2.1 OBJECTIVES

Treated ground water will be analyzed for the constituents of concern to assure that it meets the effluent criteria prior to discharge to Wicks Creek. The constituents of concern and their associated effluent criteria are shown on Table C-1. Haworth personnel will monitor the effluent from the ground water treatment system to verify compliance with the effluent criteria.

2.2 START-UP EFFLUENT MONITORING

Before treated ground water is discharged to Wicks Creek and during the first three months of the GWR operation, effluent monitoring will be conducted more frequently than during the later stages of the system operation. The start-up effluent monitoring phase will ensure that the GWR system operates properly and that the treated ground water achieves the effluent criteria. The start-up phase will consist of sampling and analyzing the treatment system effluent at an initial frequency of one sample every four hours and gradually decreasing the frequency to one sample every month. The frequency and durations of the various performance monitoring activities are summarized on Table C-2.

The effluent samples will be analyzed for the parameters listed on Table C-1. These parameters include metals, volatile organic compounds (VOCs), and semivolatile organic compounds (SVOCs) previously detected in the ground water samples from the Wicks Creek Site. Based on equilibrium diagrams (i.e., adsorption isotherms) for the parameters of concern, the VOC will break through the treatment system components before the SVOCs; therefore, the VOC analyses can be used as indicator parameters for SVOC effluent monitoring.

During the start-up effluent monitoring phase, the GWR system will be operated continuously at the anticipated operating flow rate (estimated at 12 gallons per minute) for 8 hours, and the treatment system effluent will be discharged to an off-line 10,000-gallon holding tank located downstream of the effluent sampling valve. The holding tank will consist of a Baker tank that will be delivered during the construction of the GWR system and will be used as necessary during the initial operation of the GWR system. Treated ground water samples will be collected at startup, and every four hours for the first 8 hours of operation. After 8 hours, the ground water extraction and treatment systems will be shut down and the effluent will be held in the holding tank until the analytical results from the collected samples can be evaluated to confirm compliance with the effluent criteria.

If the effluent sampling results reveal that the effluent criteria have been exceeded, the treated ground water will remain in the holding tank until it can be transported for off-site disposal. Prior to off-site disposal, the Michigan Department of Natural Resources (MDNR) will be consulted to ensure that the selected commercial hazardous waste treatment and disposal facility is acceptable. Depending upon the selected facility's requirements, an additional sample may be collected from the tank for analysis of confirmatory disposal parameters. Concurrent with disposal of the treated ground water, the treatment system will be evaluated to determine the cause of the exceedance of the target effluent criteria. In accordance with Section 6.1 of this Plan, a noncompliance report will be submitted to the MDNR within the following 10 working days and will describe the reason that the effluent criteria were exceeded and the measures taken to bring the tested ground water into compliance with the target effluent criteria. After the problem with the GWR system has been corrected, the GWR system will be restarted and the start-up effluent monitoring phase will be repeated.

In the event that the analytical results from the 8-hour start-up monitoring indicate that all of the effluent criteria have been met, the ground water in the holding tank will be discharged to Wicks Creek and the GWR system will be restarted. After restarting the GWR system, effluent sampling will continue on a more frequent schedule for the first three months of operation (see Table C-2). During this time, the effluent will be continuously discharged to Wicks Creek. If the effluent sampling results indicate that the effluent criteria have been exceeded, the GWR system will be shut down immediately, the MDNR will be notified of the noncompliance within 24 hours, and modifications to the GWR system will be made. A noncompliance report describing the treatment problem and the measures taken to correct it will be submitted to the MDNR in accordance with Section 6.1 of this Plan. After the system is restarted, the start-up effluent monitoring will be repeated beginning with the eight-hour testing. When all of the effluent samples from the start-up monitoring phase (i.e., the entire three month period) meet the target effluent criteria, the start-up effluent monitoring phase will be complete and the quarterly effluent monitoring phase will begin.

If the GWR system is shut down for reasons other than noncompliance with the target effluent criteria (e.g., maintenance, operational problems, or insufficient capture zone) during the start-up effluent monitoring phase, an effluent sample will be collected immediately before system shutdown to confirm compliance with the effluent criteria. If the results of the effluent sample analysis indicate compliance with the effluent criteria, the system will be restarted without conducting the start-up effluent monitoring phase and the effluent monitoring will continue at the same frequency as before the shutdown. If the sample results indicate noncompliance with the target effluent criteria, the start-up monitoring phase must be repeated, beginning with the 8-hour testing, when the system is restarted.

2.3 QUARTERLY EFFLUENT MONITORING

To verify continued compliance with the effluent criteria after the start-up effluent monitoring phase has been completed, samples of the treatment system effluent will be collected and analyzed for the effluent monitoring parameters (Table C-1) on a quarterly basis. During this phase, the GWR system will be shutdown if:

1. Laboratory results indicate exceedance of the target effluent criteria, or

2. Maintenance, service, or modification of the system is required.

If situation (1) applies, the procedures used for the start-up effluent monitoring will be followed, i.e., the MDNR will be verbally notified within 24 hours of the noncompliance, the GWR system will be modified to correct the problem, the system will be restarted, the start-up effluent monitoring phase will be repeated beginning with the daily testing, and a noncompliance report will be submitted to the MDNR in accordance with Section 6.1 of this Plan. If situation 2 applies, an effluent sample will be collected immediately before system shutdown for analysis of the effluent monitoring parameters to confirm compliance with the target effluent criteria. If the laboratory analytical results show exceedance of the target effluent criteria, situation (1) will apply and the appropriate procedures will be followed. If the laboratory analytical results do not indicate exceedance of the target effluent criteria, the GWR system will be restarted after the necessary maintenance, service, or modifications have been made; effluent samples will be collected one week after restarting the system; and the quarterly sampling program will continue thereafter as scheduled.

An effluent monitoring flow chart describing the decision process from the start-up effluent monitoring through the completion of the remediation is presented on Figure C-3. The procedures for collecting and analyzing the effluent monitoring samples are described in the Sampling and Analysis Plan (Appendix D).

2.4 DATA ANALYSIS AND INTERPRETATION

The analytical results of the effluent monitoring samples will be compared to the effluent criteria and used to evaluate whether the effluent standards established in the ground water discharge permit exemption are being achieved. If the target effluent criteria are being achieved, the GWR system will continue to be operated. If the effluent monitoring data show that the target effluent criteria are not being met, the GWR system will be shut down until the cause of the exceedance is corrected and a noncompliance report will be submitted to the MDNR in accordance with Section 6.1 of this Plan. The effluent monitoring data will be used in conjunction with the ground water quality monitoring data (see Section 5.0) to determine whether any analysis can be removed from the list of parameters that must be monitored. If an analyte is not detected in the influent, effluent, and monitoring well samples for three consecutive quarters, then that specific analyte will be removed from the list of effluent monitoring parameters (Table C-1).

3.0 INTRASTATE TREATMENT AND AIR EMISSIONS MONITORING

3.1 OBJECTIVES

Because the aqueous and vapor-phase GAC materials used in the ground water treatment system are expendable, the system must be monitored to determine when the canisters of GAC are spent and must be replaced. This portion of the performance monitoring is designed to provide the system operator with the necessary data to determine when a GAC canister must be replaced to ensure that the canister is replaced before any emissions or discharge criteria are exceeded. In addition, influent monitoring will be performed and the results will be compared to the effluent monitoring results to determine the contaminant removal rate and the total mass of contaminants removed.

3.2 INTRASTATE TREATMENT MONITORING

Most of the reduction in contaminant concentrations achieved by the ground water treatment system will be accomplished by the air stripping and vapor-phase GAC components. The air stripping system is designed to remove organic contaminants from the extracted ground water on a flow-through basis using fresh air. Air stripping is followed by an aqueous GAC system for polishing. Residual organic contaminants are adsorbed onto carbon on a flow-through basis using two parallel trains of two GAC canisters in series. The first canister in the series will receive the highest contaminant loading and, therefore, will be the first canister to be exhausted. When breakthrough occurs (i.e., the capacity of the first canister is exhausted and contaminants pass through it to the second canister), the first canister will be taken out of service, the second canister will be used as the first canister, and a fresh canister will then be put into service as the second canister in the series.

To determine when breakthrough occurs, intrastate treatment monitoring will be performed. For this monitoring, treated ground water samples will be collected from the sampling port on the downstream side of the first canister and analyzed for those parameters identified in Table C-1. These intrastate samples will be collected at a frequency of twice every week for the first 4 weeks of the system operation (i.e., coincident with the start-up phase of the effluent monitoring) and once every week for the next five months. Thereafter, the frequency of this monitoring will be one-third of the time to breakthrough of the most recent GAC canister in the first position. For example, if the GAC canister experiences breakthrough after 6 weeks of usage in the first canister position, then the intrastate monitoring frequency would be 2 weeks.

In addition, effluent from the air stripper will be analyzed for Table C-1 parameters. Monitoring will be to confirm operation of the air stripper consistent with the design. Air stripper effluent monitoring will be as described on Table C-2 for effluent monitoring.

3.3 *INTRASTATE VAPOR-PHASE GAC AND GAC EXHAUST AIR EMISSIONS MONITORING*

During the startup of the GWR system, the VOC concentrations from exhaust on the first vapor-phase GAC canister will be monitored by using a photoionization detector (PID) equipped with an 11.7 eV lamp. The PID is capable of semiquantitative detection of total VOC concentrations ranging from 0.1 to 2,000 parts per million by volume (Vppm) of isobutylene equivalents. This monitoring will be performed at a frequency of once every day for the first three days of the system operation once per week thereafter for the next 2 months and until breakthrough occurs. Thereafter, the frequency of this monitoring will be one third at the time to breakthrough of the most recent GAC canister in the first position.

In addition, during startup and operation of the GWR system, the exhaust from the GAC canister will be analyzed with the PID to confirm that the exhaust concentration is less than 5 Vppm. Vapor-phase GAC exhaust monitoring is described in Table C-2. The procedures for performing the emissions monitoring are described in the Sampling and Analysis Plan (Attachment D).

The purpose of performing the air emissions monitoring is to: (1) verify that the vapor-phase GAC canisters remove VOC emissions from the air stripper, and (2) determine the bedlife of the vapor-phase GAC canister. In the event that readings from the vapor-phase GAC canister vent exceed 5 Vppm, the MDNR will be notified and, if necessary, measures will be taken to control the vent emission.

3.4 *INFLUENT MONITORING*

As indicated previously, periodic influent monitoring will be performed throughout the operation of GWR system to: (1) track the progress of remediation, and (2) calculate the rate of contaminant removal and the total mass of contaminants removed. Influent sampling will be conducted more frequently during the first 3 months of the system operation because the influent concentrations are expected to peak and then decline steadily during that time. As shown on Table C-2, influent samples will be collected every day for the first 4 days, every week for the next 3 weeks, and once a month for the next 2 months. After that, the influent will be sampled every 3 months, at the same time that the ground water quality samples are collected. The influent samples will be analyzed for the parameters listed on Table C-1.

3.5 *DATA ANALYSIS AND INTERPRETATION*

The analytical results from the intrastate and air emissions monitoring will be compared to the analytical results from the previous sampling events to determine whether the GAC canisters are spent and breakthrough has occurred.

PID readings from the first vapor-phase GAC canister vent will be compared to analytical results from the previous sampling event to determine whether the GAC canister is spent and breakthrough has occurred. Any detectable contaminant concentrations in the intrastate monitoring samples will be considered indicative of breakthrough of the first GAC canister in the series. Accordingly, the spent canister will be replaced with the second canister in the series, and a new canister will be installed as the second canister in the series.

The influent sample results will be plotted against time of operation to evaluate the progress of the remediation. In addition, the influent sample data will be compared to the effluent sample data to determine the efficiency of contaminant removal and the total mass of contaminant removed.

4.0 WATER LEVEL MONITORING

4.1 OBJECTIVES

One of the goals for this remediation is to capture the ground water that contains contaminant concentrations above the MDNR's Type B criteria. The water level monitoring activities are designed to develop the data necessary to determine whether the extent of the capture zone complies with the remediation goals.

4.2 WATER LEVEL MONITORING PROCEDURES

To ensure that the extraction system generates a capture zone of sufficient extent, the ground water levels will be monitored more frequently during the startup of the GWR system than during the later stages of the system operation. The start-up water level monitoring phase will last for the first three months of the GWR system operation and will consist of measuring the water levels at the site once every week for the first month and then once every month for the next 2 months (Table C-2). After this initial demonstration, ground water elevations will be measured and reported quarterly to confirm the attainment of the capture zone goals and requirements. Static water levels will be measured in all of the monitoring wells, piezometers, and extraction wells located on the site. The procedures for measuring the static water levels are described in the Sampling and Analysis Plan (Appendix D).

4.3 DATA ANALYSIS AND INTERPRETATION

For each set of static water level measurements, a geostatistical analysis of the piezometric surface elevation data will be conducted, and the resulting ground water contours will be plotted on a site map. A flow net analysis of the resulting ground water contours will be performed to determine whether the extent of the capture zone achieves the requirements of the discharge permit exemption and the goals of the Response Plan.

If the capture zone is determined to be sufficient during the first 3-month operating period, no adjustment to the GWR system will be required, and water level monitoring may be performed on a quarterly basis thereafter. However, if capture zone requirements are not achieved within the first three-month operating period, the ground water elevation data will be evaluated with respect to time in order to project the steady-state capture zone.

If the final steady-state capture zone does not meet the requirements, the monitoring well and piezometer network, as well as the method of evaluation of the capture zone will be re-examined to determine whether the distribution of the data is causing an artificial problem. In this case, additional piezometers will be installed and/or a new method of capture zone evaluation will be used. If the foregoing activities do not result in attainment of the required capture zone, the ground water flow model will be recalibrated by using new water levels, extraction well pumping rates, and existing rainfall data. The results of the recalibrated model will be used to determine modifications to the extraction system that would allow the capture zone requirements to be attained.

The GWR system will continue to be operated without fully achieving the capture zone goals and requirements as long as the ground water quality monitoring data show that the plume is not spreading beyond its original limits. This will allow the pumping rate to be adjusted until a satisfactory capture zone is achieved.

5.0 GROUND WATER QUALITY MONITORING

5.1 OBJECTIVES

The GWR system at the Wicks Creek Site will be operated until the contaminant concentrations in the ground water beneath the site have met the MDNR's Type B criteria for three consecutive quarters.

The achievement of the ground water quality criteria will be determined based on the results of ground water samples collected from selected monitoring and extraction wells at the site.

5.2 MONITORING PROCEDURES

During the operation of the GWR system, selected extraction and monitoring wells will be sampled once every three months to determine the ground water quality at the site. The locations of the extraction and monitoring wells included in the ground water quality monitoring network are shown on Figure C-4. The data collected from the three monitoring wells situated within the extraction area (i.e., EW2, EW3, and EW4) will be used to track the reduction in contaminant concentrations. The results of samples taken from the 5 monitoring wells (i.e., MW320D, MW321D, MW322D, MW323D, and MW325D) will be used to track: (1) the reduction in contaminant concentrations in the extraction area, and (2) the extent of the contaminants. The other monitoring wells at the site are not included in the ground water quality monitoring network because they have either consistently shown no detectable contamination or they are situated very close to another well that is included in the monitoring network.

The ground water quality samples will initially be analyzed for Table C-1 parameters of concern. These analyses cover all of the compounds previously detected in the ground water samples.

The following situations may alter the analytical parameters or the wells to be included in the quarterly ground water quality sampling:

1. If an analyte is not detected (i.e., all concentrations are below the detection limits) in any of the wells in the ground water quality monitoring network for three consecutive quarters, then that specific analyte will be removed from the monitoring requirement list, except as specified in situation (3) in this series.

2. If samples from any individual well in the ground water monitoring network have analytical results that meet the clean-up criteria for three consecutive quarters, then that specific well will

be removed from the monitoring requirement list, except as specified in situation (3) in this series.

3. After ground water samples from all of the monitoring network wells at the site have met the clean-up criteria for two consecutive quarters, any monitoring wells that were previously removed from the monitoring requirement list will be sampled one additional time for all of the parameters previously detected at the site.

The procedures to be used to collect the ground water samples from the extraction and monitoring wells, and the analytical methods to be used to analyze the samples are described in the Sampling and Analysis Plan (Attachment D).

5.3 *DATA ANALYSIS AND INTERPRETATION*

The analytical results from the extraction and monitoring well samples will be used to: (1) demonstrate achievement of the ground water criteria, and (2) determine whether any analytical fractions or specific wells can be removed from the monitoring requirement list. The ground water quality data will be evaluated with respect to the MDNR's Type B criteria as indicated in Section 5.1. In addition, the data will be analyzed and interpreted with regard to vertical, horizontal, and temporal trends.

TABLES

TABLE C-1

EFFLUENT LIMITS
WICKS CREEK SITE
HAWORTH PLANT
DOUGLAS, MICHIGAN

Compound	Target Method Detection Limit[1] (µg/l)	Effluent Criteria (µg/l)
Parameters Being Analyzed[2]		
Chloroform	1	5
Chlorobenzene	1	130
1,1-Dichloroethane	1	840
Total-1,2-Dichloroethene	1	77
Tetrachloroethene	1	1
Toluene	1	1500
1,1,1-Trichloroethane	1	200
Trichloroethene	1	2
Vinyl Chloride	1	1

[1] The Target method detection limits were obtained from the Michigan Environmental Response Act Operational Memorandum No. 8, Revision 3, dated February 4, 1994.

[2] Analyses for additional parameters may be required by the NPDES Permit.

TABLE C-2

FREQUENCY AND DURATION OF PERFORMANCE
MONITORING ACTIVITIES
WICKS CREEK SITE
HAWORTH PLANT
DOUGLAS, MICHIGAN

Monitoring Activity	Frequency	Duration
Effluent Monitoring		
Start-up test	1 every 4 hours	8 hours
First 3 days	1 every day	3 days
Next 3 weeks	1 every week	3 weeks
Next 2 months	1 every month	2 months
Until Completion	1 every 3 months	(1)
Intrastage Aqueous-Phase GAC Monitoring		
First Month	2 every week	4 weeks
Next 5 months	1 every week	5 months
Until completion	(2)	(1)
Intrastage Vapor-Phase GAC		
First 3 days	1 every day	3 days
Next 2 months	1 every week	2 months
Until completion	(2)	(1)
GAC Exhaust Monitoring		
Start-up test	1 every 4 hours	8 hours
First 3 days	1 every day	3 days
Next 3 weeks	1 every week	3 weeks
Next 2 months	1 every month	2 months
Until completion	1 every 3 months	(1)
Influent Monitoring		
Start-up test	1 every 8 hours	8 hours
First 3 days	1 every day	4 days
Next 3 weeks	1 every week	3 weeks
Next 2 months	1 every month	2 months
Until completion	1 every 3 months	(1)
Water Level Monitoring		
First month	1 every week	4 weeks
Next 2 months	1 every month	2 months
Until Completion	1 every 3 months	(1)
Ground Water Quality Monitoring		
Until completion	1 every 3 months	(1)

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1 The monitoring will be continued at the frequency indicated until remediation has been completed.

2 The monitoring frequency will be one-third the expected bedlife of the granular activated carbon (GAC) canister in the first position.

FIGURES

94263-20-1

VALVES

NORMALLY OPEN / NORMALLY CLOSED

- GATE VALVE
- GLOBE VALVE
- 3-WAY VALVE
- BALL VALVE
- BUTTERFLY VALVE
- NEEDLE VALVE
- CHECK VALVE
- CHECK VALVE (PISTON OPERATED)
- CHECK VALVE (BALL TYPE)
- EXCESS FLOW VALVE
- DIAPHRAGM VALVE
- ANGLE GATE VALVE
- 4-WAY ANGLE VALVE
- PLUG
- VACUUM RELIEF
- PRESSURE RELIEF
- "Y" TYPE VALVE

VALVE OPERATORS

- HANDWHEEL
- HANDLE OR WRENCH
- PRESSURE REDUCING
- BACK PRESSURE
- DIFFERENTIAL PRESSURE REGULATOR
- DIAPHRAGM
- SOLENOID
- ELECTRIC MOTOR
- GEAR
- HYDRAULIC
- PISTON

SYMBOLS

- PRIMARY FLOW
- SECONDARY FLOW
- AIR FILTER
- AIR LUBRICATOR
- FILTER-REGULATOR-LUBRICATOR UNIT
- CONCENTRIC REDUCER
- ECCENTRIC REDUCER
- STRAINER "Y" TYPE
- STEAM TRAP
- AIR RELEASE
- STRAINER SINGLE BASKET
- STRAINER DUAL BASKET
- FLANGED ORIFICE ASSEMBLY
- METERED TUBE ORIFICE ASSEMBLY
- EJECTOR
- INSULATED
- INSULATED & ELECTRIC HEAT TRACED
- INSULATED & STEAM HEAT TRACED
- PROTECTIVE DIAPHRAGM
- RUPTURE DISK
- OPEN DRAIN OR OPEN SIGHT FUNNEL
- EXPANSION JOINT

EQUIPMENT

- CENTRIFUGAL PUMP
- POSITIVE DISPLACEMENT AIR COMPRESSOR
- POSITIVE DISPLACEMENT PUMP
- VERTICAL SLURRY PUMP
- VERTICAL TURBINE PUMP
- SUBMERSIBLE PUMP
- AIR OPERATED DIAPHRAGM

INSTRUMENTATION

- MOUNTED LOCALLY AT EQUIPMENT OR LINE
- MOUNTED ON PRIMARY CONTROL PANEL FRONT
- MOUNTED ON AUXILIARY CONTROL PANEL FRONT
- MOUNTED INSIDE PRIMARY CONTROL PANEL
- MOUNTED INSIDE AUXILIARY CONTROL PANEL
- INDICATOR LAMP
- INSTRUMENT INCLUDED IN COMPUTER, MICRO PROCESSOR, OR PROGRAMMABLE CONTROLLER SYSTEM
- ALARM INDICATION AT REMOTE SUPERVISORY STATION
- INSTRUMENT CONNECTION OR UNSPECIFIED LINE
- INSTRUMENT AIR LINE
- CAPILLARY LINE
- ELECTRIC LINE
- HYDRAULIC TUBING

ELECTRICAL

CS XX CONTROL STATION

- M – MANUAL
- HOA – HAND/OFF/AUTO
- MA – MANUAL/AUTO
- SS – START/STOP
- OCA – OPEN/CLOSE/AUTO

INTERLOCK

- AND EFFECTIVE IF ALL INPUTS EXIST
- I INTERLOCK LOGIC AS DEFINED
- OR EFFECTIVE IF ONE OR MORE INPUTS EXIST

MEANINGS OF INSTRUMENT IDENTIFICATION LETTER

	FIRST LETTER		SUCCEEDING LETTERS		
	INITIATING VARIABLE MEASURED OR	MODIFIER	READOUT OR PASSIVE FUNCTION	OUTPUT FUNCTION	MODIFIER
A	ANALYSIS (pH, ETC.)		ALARM		
B	BURNER FLAME				
C	CONDUCTIVITY (ELECTRICAL)			CONTROL	
D	DENSITY OR SPECIFIC GRAVITY	DIFFERENTIAL			
E	VOLTAGE (EFM)		PRIMARY ELEMENT		
F	FLOW RATE	RATIO (FRACTION)			
G	GAGING (DIMENSIONAL)		GLASS		
H	HAND (MANUALLY INITIATED)				HIGH
I	CURRENT (ELECTRICAL)		INDICATE		
J	POWER	SCAN			
K	TIME OR TIME SCHEDULE			CONTROL STATION	
L	LEVEL		LIGHT (PILOT)		LOW
M	MOISTURE OR HUMIDITY				
N	NOISE				
O	MALFUNCTION		ORIFICE (RESTRICTION)		MIDDLE OR INTERMEDIATE
P	PRESSURE OR VACUUM		POINT (TEST CONNECTION)		
Q	QUANTITY OR EVENT	INTEGRATE OR TOTALIZE			
R	RADIOACTIVITY		RECORD OR PRINT		
S	SPEED OR FREQUENCY	SAFETY		SWITCH	
T	TEMPERATURE			TRANSMIT	
U	MULTIVARIABLE		MULTIFUNCTION	MULTIFUNCTION	MULTIFUNCTION
V	VISCOSITY			VALVE, DAMPER OR LOUVER	
W	WEIGHT OR FORCE		WELL		
X	TORQUE				
Y	USER'S CHOICE			RELAY OR COMPUTE	
Z	POSITION			DRIVE, ACTUATE OR UNCLASSIFIED FINAL CONTROL ELEMENT	

NOTE:

1. FOR PIPING AND INSTRUMENTATION DIAGRAM SEE DRAWING 94263-10-2.

REV. NO.	DESCRIPTION	DATE	REV. BY	CHK'D.	APPD.
0	PRELIMINARY	1/33/95	FX	LAG	

REVISIONS

ERM Environmental Resources Management

PIPING AND INSTRUMENTATION DIAGRAM
SYMBOL LIST
WICKS CREEK SITE
GROUND WATER REMEDIATION SYSTEM
HAWORTH PLANT
DOUGLAS, MICHIGAN

FK | LAG | NO SCALE | Figure C-1 | 0

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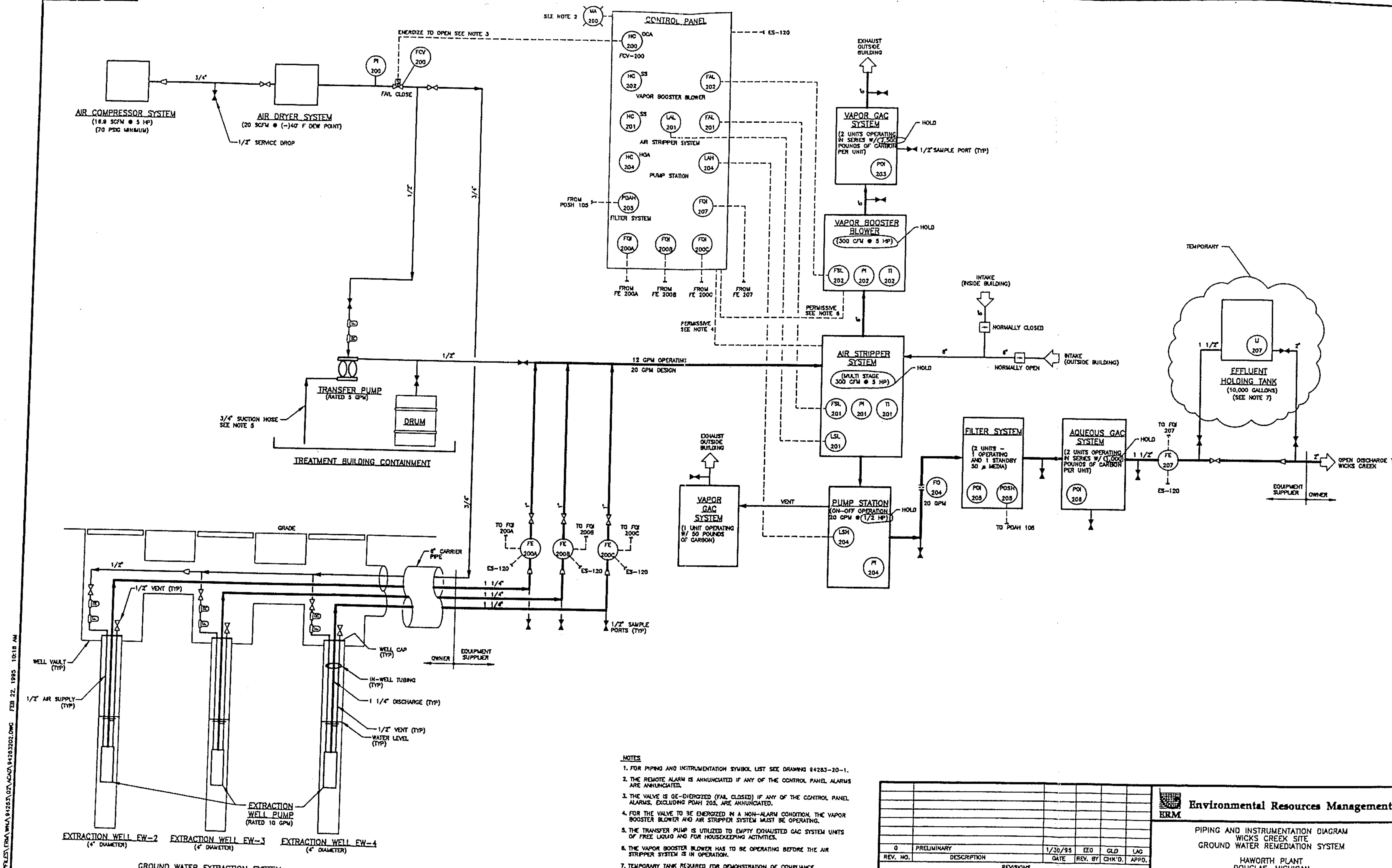
94263-20-2



NOTES

1. FOR PIPING AND INSTRUMENTATION SYMBOL LIST SEE DRAWING 94263-20-1.
2. THE REMOTE ALARM IS ANNUNCIATED IF ANY OF THE CONTROL PANEL ALARMS ARE ANNUNCIATED.
3. THE VALVE IS DE-ENERGIZED (FAIL CLOSED) IF ANY OF THE CONTROL PANEL ALARMS, EXCLUDING POAH 205, ARE ANNUNCIATED.
4. FOR THE VALVE TO BE ENERGIZED IN A NON-ALARM CONDITION, THE VAPOR BOOSTER BLOWER AND AIR STRIPPER SYSTEM MUST BE OPERATING.
5. THE TRANSFER PUMP IS UTILIZED TO EMPTY EXHAUSTED GAC SYSTEM UNITS OF FREE LIQUID AND FOR HOUSEKEEPING ACTIVITIES.
6. THE VAPOR BOOSTER BLOWER HAS TO BE OPERATING BEFORE THE AIR STRIPPER SYSTEM IS IN OPERATION.
7. TEMPORARY TANK REQUIRED FOR DEMONSTRATION OF COMPLIANCE.
8. ALL ITEMS, EXCEPT THE EXTRACTION WELLS PIPING WITHIN THE CARRIER PIPE, MA-200, EFFLUENT HOLDING TANK AND DISCHARGE PIPE TO WICKS CREEK IS PROVIDED BY THE EQUIPMENT SUPPLIER.

REV. NO.	DESCRIPTION	DATE	REV. BY	CHK'D.	APPD.
0	PRELIMINARY	1/30/95	EEO	GLD	LAG

REVISIONS

ERM Environmental Resources Management

PIPING AND INSTRUMENTATION DIAGRAM
WICKS CREEK SITE
GROUND WATER REMEDIATION SYSTEM

HAWORTH PLANT
DOUGLAS, MICHIGAN

CMM	GLD	Figure C-2	0
NONE	LAG		

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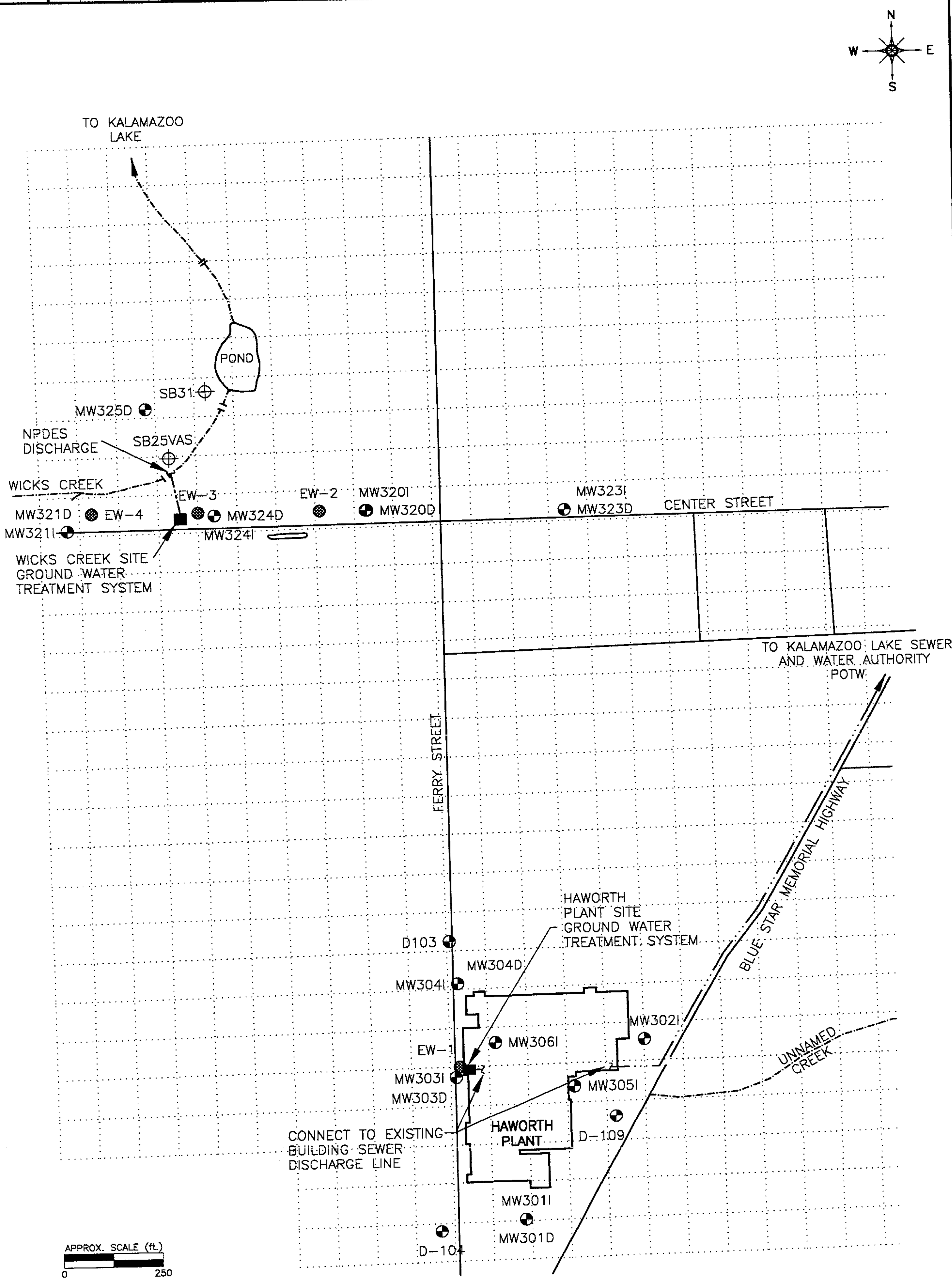
3/95 | DRAWN: FK- | FILE: K:\CPFILES\ERM\WNJ\94263\01\ACAD\FIG1-2.DWG APR 13, 1995 3:16 PM



GRID INTERVAL = 100 FEET

SYMBOL LEGEND	
(filled circle with quarters)	MONITORING WELL LOCATION
(circle with cross)	SOIL BORING LOCATION
(shaded circle)	EXTRACTION WELL
– – –	NPDES DISCHARGE PIPING
—— · · ·	SANITARY SEWER DISCHARGE (POTW)

NOTE: NO DRINKING WATER WELLS ARE LOCATED ON ADJACENT PROPERTIES.

FIGURE C-4

SITE LAYOUT PLAN
GROUND WATER REMEDIATION SYSTEM
HAWORTH PLANT
DOUGLAS, MICHIGAN

ERM

APPENDIX D

SAMPLING AND ANALYSIS PLAN

CONTENTS - APPENDIX D

LIST OF TABLES

LIST OF FIGURES

1.0 INTRODUCTION

1.1 DOCUMENT SCOPE AND OBJECTIVES

This Sampling and Analysis Plan presents the sampling procedures and analytical methods to be implemented as part of the performance monitoring of the ground water remediation (GWR) system proposed for installation at the Wicks Creek Site at Haworth, Inc. (Haworth) in Douglas, Michigan. This Plan describes the performance monitoring data collection strategy, as well as the specific protocols to be followed for sample collection, identification, labeling, handling, custody, laboratory and field analysis of samples, and documentation and reporting. The quality assurance/quality control (QA/QC) activities associated with the sampling and analysis activities are also included throughout this document.

Haworth retained Environmental Resources Management-North Central, Inc. (ERM-North Central) to prepare this Plan to define the procedures that will ensure the precision, accuracy, completeness, and representativeness of the collected data. All QA/QC procedures described in this Plan are in accordance with all applicable professional technical standards, the Michigan Department of Natural Resources's (MDNR's) and U.S. Environmental Protection Agency's (USEPA's) requirements, and project-specific goals and requirements.

1.2 PROJECT ORGANIZATION AND PERSONNEL RESPONSIBILITIES

The MDNR is responsible for the government reviews associated with this remediation and Haworth has the overall responsibility for implementing this action. ERM-North Central has been contracted by Haworth to prepare plans and specifications and to implement the remedial action at the site. The ERM-North Central project manager is responsible for scheduling, inspecting, and directing the sampling tasks related to the performance monitoring; selecting a laboratory to perform the required sample analyses; and ensuring that the project meets the MDNR's objectives and the QA/QC standards specified in this Plan.

After selecting a laboratory, the ERM-North Central project manager will provide the name of the laboratory to the MDNR project manager. The selected laboratory will designate an individual to be the primary contact for this project. This contact will be responsible for coordinating and scheduling the laboratory analysis, supervising in-house chain of custody, and overseeing the data review process and the preparation of the analytical reports. In addition, the laboratory QA officer will regularly review the laboratory protocols and the laboratory QA/QC documentation to ensure that the level of accuracy, precision, and completeness identified in the selected analytical methods are obtained.

The sampling and monitoring may be performed by ERM-North Central, the selected laboratory, trained Haworth personnel, or an approved subcontractor. Individuals responsible for the sampling and monitoring will be familiar with this Plan, the QA/QC objectives for this project, and standard sampling and monitoring protocols.

2.0 DATA COLLECTION STRATEGY

2.1 SAMPLE NETWORK DESIGN AND RATIONALE

The sample network design and rationale are presented in the Performance Monitoring Plan (Appendix C). A summary of the monitoring program is included as Tables D-1 and D-2. The sample matrices, field parameters to be measured, and laboratory parameters to be analyzed for each of the monitoring activities are presented on Table D-1, along with the QA/QC samples to be collected during each field sampling event. The frequency and duration of the sampling activities are shown on Table D-2.

2.2 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 site remediation 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.

For this project, the DQOs can be divided into three levels: screening, engineering, and conformational. The screening level provides the lowest data quality with the most rapid results. At this level, the DQOs are achieved through proper calibration and maintenance of field sampling equipment and comparison to standard references. For this project, the air emissions photoionization analysis and the depth, pH, specific conductance, and temperature water parameters will be monitored at the screening level DQO.

The engineering DQO level provides an intermediate level of data quality. Samples subject to this DQO are analyzed by following the MDNR laboratory methods and method detection limits, but are used for engineering purposes or require rapid turnaround. For this project, the influent, intrastage, and effluent ground water treatment system samples will be collected at this DQO.

The conformational level indicates samples for which blank, duplicate, and matrix spike samples will be collected. These investigative and quality control (QC) samples will be submitted to an approved laboratory for analysis by MDNR-approved methods that achieve the method detection limits specified by the MDNR. The results of the blank, duplicate, and matrix spike samples will be compared to the acceptable limits identified in the USEPA methods and evaluated to ensure a high degree of data quality. This level of DQO will be used for the quarterly ground water quality monitoring samples collected for analysis of volatile organic compounds (VOCs).

2.3 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 quarterly ground water quality monitoring program. Field blanks are analyzed to check for any on-site procedural contamination that may affect samples. Trip blanks, consisting of laboratory-supplied deionized, ultrapure water, will be submitted to the analytical laboratory to provide the means to assess the potential for contamination of samples through contaminant migration during sample shipment and storage. Duplicate samples are analyzed to check for sampling and analytical reproducibility. Matrix spike samples provide information about the effect of the sample matrix on the extraction and measurement methodology. The matrix spikes for organic analyses are performed in duplicate and are hereafter referred to as MS/MSD samples.

The level of QC effort for the quarterly ground water quality monitoring will be one field duplicate and one field blank for every 10 or fewer investigative samples. One VOC trip blank consisting of deionized, ultra-pure water will be included along with each shipment of VOC samples. Ground water samples for VOC analyses will be designated for MS/MSD analysis at a rate of one per group of 20 or fewer investigative samples per sample matrix. Aqueous samples designated for MS/MSD analysis must be collected at triple the volume for VOCs. The QC samples to be collected are summarized on Table D-1.

The level of QC effort provided by the laboratory will meet the requirements of the selected analytical methods. The level of QC effort for all field measurements will include initial and continuing calibrations for those instruments requiring calibrations. The specific calibration procedures detailed in the instrument manufacturers' operating manuals will be followed for each instrument at the site. The pH meter will be calibrated by using two buffer solutions at the beginning of each work day, with calibration verification once every 10 samples. The QC effort for field specific conductivity measurements and photoionization organic vapor screening will consist of an initial calibration at the beginning of the day. A standard solution with a known specific conductance will be used to calibrate the conductivity meter, and a standard reference gas will be used to calibrate the photoionization detector. Calibration of the water level probe and the temperature probe is unnecessary.

2.4 ACCURACY, PRECISION, AND SENSITIVITY OF ANALYSES

The QA objectives of the field analyses with respect to accuracy, precision, and sensitivity are to obtain acceptable data based on specified performance criteria. The project-required accuracy, precision, and sensitivity of the field measurements are specified in Table D-3.

The accuracy of the field instrumentation will be assessed by analyzing the standard samples as a means of post-calibration verification. The measured value of the standard samples must each be within the project-required accuracy range (see Table D-3) of the true standard value, or the equipment will require calibration. Precision will be assessed through duplicate measurements. The duplicate measurements must be within the project-required precision range shown on Table D-3, or the instrument will require recalibration. Information regarding the actual sensitivity of the selected equipment will be obtained from the manufacturers' manuals and recorded in the field notebook. The instrumentation selected for this project will have an actual sensitivity equal to or less than the project-required sensitivity shown on Table D-3.

The fundamental QA objective with respect to accuracy, precision, and sensitivity of laboratory analytical data is to achieve the QC acceptance criteria of the analytical protocols. To this end, the laboratory will meet the QC acceptance criteria of the selected USEPA methods. The project-required detection limits for the analytical samples are presented on Table D-4.

2.5 COMPLETENESS, REPRESENTATIVENESS, AND COMPARABILITY

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 laboratory will provide data meeting QC acceptance criteria for 90 percent or more of the investigative samples submitted for analysis.

Representativeness, which will be assessed by the analysis of field duplicate samples, expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. Representativeness is a qualitative parameter that is dependent upon the proper design of the sampling program and the proper selection of laboratory protocols. The sampling network at the site was designed to provide data representative of site conditions for evaluation of the effectiveness of remediation activities. During the development of the sampling network, consideration was given to past site activities, existing analytical data, the site physical setting, project sampling objectives, and the remedial action to be implemented. The rationale of the sampling network is discussed in the Performance Monitoring Plan (Appendix C). Representativeness will be satisfied by ensuring that this Sampling and Analysis Plan and the proper analytical procedures are followed, and that the holding times of the samples are not exceeded in the laboratory. The sample containers, preservation requirements, and holding times to be met to ensure representativeness are presented in Table D-5.

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 the sampling and analytical methods. The procedures used to obtain the planned analytical data, as documented in this Plan, are expected to provide comparable data.

3.0 SAMPLING PROCEDURES

The performance monitoring activities described in this Plan can be separated into the following four activities:

- Treatment system monitoring (including influent, effluent, and intrastage sampling);
- Air emissions monitoring;
- Water level monitoring; and
- Quarterly ground water quality monitoring.

The following subsections describe the sample collection, identification, labeling, handling, and analysis procedures for each of the performance monitoring activities, as appropriate. The types of samples to be collected and the sampling frequencies are summarized in Tables D-1 and D-2.

3.1 TREATMENT SYSTEM MONITORING

The influent, intrastage, and effluent treatment system water will be sampled regularly during the startup and operation of the ground water treatment system according to the schedule shown on Table C-2. Sampling valves are located: (1) immediately upstream of the air stripper, (2) immediately downstream of the air stripper, (3) immediately downstream of the first granular activated carbon (GAC) canister, and (4) immediately downstream of the second GAC canister. The samples for influent, intrastage, and effluent samples will be collected from these valves, respectively.

3.1.1 Sampling Equipment

The following equipment will be used for the collection of the influent, intrastage, and effluent water samples:

- Disposable sampling cup;
- 40-ml vials for VOC analysis;
- Cooler;
- Frozen blue ice packs;
- pH meter;
- Temperature probe or thermometer; and
- Personal protective equipment (e. g., safety glasses and latex gloves).

3.1.2 *Sampling Procedures*

Because the treatment system will be operated continuously, nonstagnant water will be flowing through the system. All treatment system influent, intrastage, and effluent samples obtained for analysis will be grab samples collected from the appropriate sampling valves (see Section 3.1). The samples will be collected as follows:

- Open the valve and pour 8 ounces of fluid into a disposable sampling cup.
- Return the 8 ounces to the collection system via air stripper.
- Refill the sampling cup with the next 8 ounces of water.
- Measure the pH and temperature by using a pH meter and temperature probe or thermometer.
- Fill the required number of 40-ml vials with water from the appropriate valve in a manner such that no air is trapped in the vials. For the influent, intrastage, and effluent sampling, a total of three 40-ml vials must be collected.

All of the treatment system monitoring samples require preservatives. The VOC samples should be preserved with hydrochloric acid added to the vial prior to the collection of the sample. The hydrochloric acid can be added to the vials in the field prior to sampling, or by the laboratory prior to the initial shipment of the vials to the field.

3.1.3 *Sample Identification*

Each influent, intrastage, and effluent sample taken during the execution of this Plan will be given an eight-digit sample designation as follows:

- Characters 1 and 2 - IN, IS, or EF to indicate that the sample is an influent, intrastage, or effluent sample, respectively; and
- Characters 3 through 8 - Six digits to represent the month, day, and year of sampling (e.g., 010695 to indicate January 6, 1995).

This sample designation system will permit accurate identification of the sample location and date. For example, an influent sample collected on March 10, 1995 would be designated IN031095 and an effluent sample collected October 1, 1994 would be designated EF100194.

3.1.4 *Sample Labeling, Handling, and Analysis*

All field samples will be identified with field sample identification labels placed on the sample containers. The labels will be securely affixed to each container by using clear packing tape. Sample identification labels will include the following information:

- Sample designation,
- Name and affiliation of collector,
- Date and time of collection, and
- Requested analysis.

All of the treatment system samples will be hand delivered or shipped via overnight courier to the selected laboratory for analysis. Sample chain-of-custody procedures, described in Section 4.0, will be adhered to both in the field and in the laboratory. All of the samples will be stored on ice in a cooler prior to and during the transportation of these samples to the laboratory. All of the influent, intrastage, and effluent water treatment samples will be analyzed for the parameters are listed on Table D-4, and the analytical methods and holding times are shown on Table D-5.

Many of the influent, intrastage, and effluent monitoring activities require that the analytical sample results be obtained within a specified time period (see Table D-6). The expected normal turnaround time is 14 days. Turnaround times as short as 48 hours from the time of receipt of the samples by the laboratory will be required for many of the influent, intrastage, and effluent monitoring samples. The required turnaround times for each of the influent, intrastage, and effluent monitoring activities is shown on Table D-6.

3.2 *AIR EMISSIONS MONITORING*

Air monitoring of the exhaust from the vapor-phase GAC canisters will be conducted to verify the control of VOC emissions. The monitoring will be conducted at the frequency described in Table D-2.

3.2.1 *Sampling Equipment*

A photoionization detector (PID) that is equipped with an 11.7 eV lamp and has an effective operating range of 0.1 to 2,000 parts per million by volume (Vppm) will be used to conduct the air-monitoring sampling.

3.2.2 *Sampling Procedures*

The PID will be operated in accordance with the manufacturer's instructions. An air sample will be measured at each GAC canister exhaust by inserting the detector probe tip into the exhaust vent. The detector will be held over the exhaust vent for a minimum period of at least 30 seconds. During this time, the sampler will observe the detector readings and record the peak value in the field notebook.

Each air monitoring sample from the exhaust will be identified in the field notebook by noting the date, time, and location of sample collection, and the results of the aforementioned air monitoring.

3.3 *GROUND WATER LEVEL MONITORING*

Static water levels will be measured in all of the monitoring wells, piezometers, and extraction wells at the site (see Figure D-1) at the frequency described in Table D-2. The measurements will be referenced to a known point on the well pipe that will be surveyed to a vertical accuracy of 0.01 foot and referenced to the nearest benchmark of the U.S. Geological Survey datum.

3.3.1 *Sampling Equipment*

An electronic water level meter capable of measuring the air-water interface to an accuracy of 0.01 foot will be used to measure the ground water levels. The meter will be capable of producing both an audible and visible notification of contact with the air/water interface. Prior to and immediately following a water level measurement, the electronic water level indicator will be decontaminated according to the procedures outlined in Section 3.5.

3.3.2 *Monitoring Procedure*

Prior to each ground water sampling event, depth-to-water measurements will be taken from all of the wells located on the site over a time span not to exceed six hours. The measurement of all wells within six hours will ensure a single point-in-time measurement of the water elevations at the site for use in preparing piezometric surface maps. The following steps will be used to measure the depth to water in each well:

- Turn on the water level meter,
- Push the test button to ensure the water level meter is working,
- Lower the probe until the light first flashes on and/or the buzzer begins to sound indicating the meter is at the air/water interface,
- Read the depth to water to the nearest 0.01 foot from the marked point on the well,
- Repeat the procedure until a consistent measurement is obtained, and
- Record the measurement in the field notebook.

During the first round of water level measurements, the total depth of each well or piezometer will be determined by using the following procedure:

- Lower the probe until it touches the bottom of the well;

- Read the depth to the bottom of the well to the nearest 0.01 foot;

- Calculate the total depth of the well by adding the depth to the bottom of the well as measured by the probe to the distance between the calibrated referenced point (i.e., the point at which the water level is detected) and the tip of the probe; and

- Record the measurement in a field notebook.

All ground water level measurements will be documented in the field notebook and on a field data form (see Section 5.1) along with the designation of the well or piezometer measured, the date and time of the measurement, and the name and affiliation of the individual performing the measurement.

3.4 *GROUND WATER MONITORING*

This section describes the procedures to be used during quarterly ground water quality sampling. The monitoring wells to be sampled include wells EW2, EW3 and EW4 situated within the extraction area, and wells MW320D, MW321D, MW323D and MW325D situated outside the extraction area. The locations of the monitoring wells are shown on Figure D-1.

3.4.1 *Sampling Equipment*

The following equipment will be used to sample the ground water monitoring wells:

- Disposable sampling cup,
- Dedicated Teflon bailers,
- Disposable rope,
- pH meter,
- Conductivity meter,
- Temperature probe or thermometer,
- Static water level meter, and
- A measuring bucket.

All of the equipment will be decontaminated using the procedures outlined in Section 3.5.

3.4.2 *Sampling Procedures*

The static water levels in all of the monitoring wells will be measured prior to the collection of ground water samples by using an electronic water level meter, as described in Section 3.3.2. Ground water samples will be collected from each of the designated monitoring wells by using the following procedure:

- Bailers, ropes, and all other field sampling and measuring equipment will be decontaminated prior to inserting them into a well, as discussed in Section 3.5.

- A dedicated bottom-filling, Teflon bailer will be used to purge the well and to withdraw samples from each well while taking special care to avoid physically altering or chemically contaminating the samples.

- Each well will be purged by bailing. After each well volume is removed, a representative sample will be collected in a disposable sampling cup, and the sample's pH, conductivity, and temperature will be measured.

- Each well will continue to be purged until at least three well volumes have been removed; the well yields low turbidity water; and consistent values of pH, conductivity, and temperature have been obtained for two successive samples (i.e., pH values within 0.10 pH units, conductivity values within 10 percent, and temperature values within 1.0°C of each other).

- After each monitoring well has been adequately purged, a ground water sample will be collected for laboratory analysis. If a well is bailed dry, the ground water will be permitted to recover, and a sample will be collected immediately after sufficient water has entered into the well.

- A new pair of sampling gloves will be donned prior to collecting each ground water sample. The ground water samples will be collected by directly filling the sample bottles from the bailer. Sample bottles will be filled in the order that best preserves the integrity of the sample (i.e., the bottles for the most sensitive analyses will be filled first).

Each VOC sample vial will be completely filled so that no air is entrapped in the vial. The VOC samples will be preserved with hydrochloric acid added to the vial prior to the collection of the sample.

Trip blanks, field blanks, duplicates, and MS/MSD samples will be collected during each round of quarterly ground water sampling. Trip blanks will consist of laboratory-grade deionized, ultrapure water prepared by the laboratory and shipped with the water sample containers. They will be kept with the investigative samples throughout the sampling event, and will be returned to the laboratory with the investigative samples. Trip blanks will be shipped and analyzed at a frequency of one per shipment of VOC samples.

Field blanks and duplicates will be collected at a frequency of one per 10 investigative samples. The field blank will be collected by passing laboratory-grade deionized, ultrapure water through the decontaminated sampling equipment immediately prior to sampling the well. The field blank sample designation will include an identification of which monitoring well's sampling equipment was used to collect the field blank. The field duplicate sample will be collected at the same time and in the same location as one of the investigative samples. The duplicate and investigative sample containers will be alternately filled. The MS/MSD samples will be collected at a frequency of one per 20 investigative samples. Each MS/MSD sample will be collected at the same time and location as one of the investigative samples, and the MS/MSD and investigative sample containers will be alternately filled.

3.4.3 *Sample Identification*

Each ground water sample collected from the monitoring wells during the execution of this Plan will be given a nine-character sample designation as follows:

- Characters 1 to 3 - Three digits to represent the quarter (1, 2, 3, or 4) and year of collection;
- Character 4 - A single letter to indicate the sample type (G - ground water investigative sample, D - duplicate, B - blank, and M - MS/MSD).
- Characters 5 to 9 - The monitoring well identification. (Note: The monitoring well identification may be as short as 3 and as long as 5 characters.)

This sample designation system will permit accurate identification of the sample, origin, and date. For example, an investigative ground water sample collected in the first quarter of 1995 from monitoring well MW01 would be designated 195GMW01. A duplicate of the same sample would be designated 195DMW01.

3.4.4 *Sample Labeling, Handling, and Analysis*

The same sample labeling and handling procedures specified in Section 3.1.4 for the treatment system monitoring samples will be used for the ground water monitoring samples.

The samples will be analyzed for the parameters are listed on Table D-4, and the analytical methods and holding times are shown on Table D-5.

3.5 *DECONTAMINATION PROCEDURES*

The following decontamination procedures will be employed to prevent cross contamination during the collection of water samples and the measurement of ground water levels. All equipment that will be used to develop, purge, and sample wells (i.e., bailers, water level meters, and rope) will be decontaminated prior to insertion into each well by using the following procedures:

- Scrub the equipment by using a brush and Alconox wash,
- Rinse the equipment with distilled water,
- Air dry the equipment, and
- Wrap the equipment in plastic while it is not being used.

New disposable sampling gloves will be donned each time a new well is sampled or a water treatment sample is collected. All decontamination, development, and purged water generated during the ground water monitoring activities will be placed in the air stripper.

4.0 SAMPLE CUSTODY

All samples will be accompanied by a properly completed chain-of-custody form. A chain-of-custody form provides the documentation necessary to trace sample possession from the time of collection to the time of receipt by the analytical laboratory. The sample numbers, locations, and requested analyses will be listed on the chain-of-custody form. When transferring the possession of samples, the individuals relinquishing and receiving the samples will sign, date, and note the time on the chain-of-custody form. The original chain-of-custody form and one carbonless copy will accompany the shipment. Two copies will be retained by the sampler and returned to the field office.

5.0 DOCUMENTATION AND REPORTING

5.1 FIELD MEASUREMENTS AND OBSERVATIONS

All field measurements and observations will be recorded in dedicated field notebooks. The bound field notebooks will be permanently labeled with the site name, site location, internal project number, and notebook number. Phone numbers of key project personnel and safety agencies such as the fire department, hospital, and police will be indicated in each field notebook. Each page in the field notebook will be numbered and dated at the time of use, and initialed at the bottom. Daily entries will begin with a synopsis of weather conditions, field conditions, personnel present, and projected work tasks for that day. All field tasks completed and the status of tasks in progress will be recorded in the field notebook. Entries will include all field measurements, calibration and preventive maintenance of field instruments, sampling locations, types of samples collected, sample numbers, physical appearance of samples, and the names of sampling personnel. No erasing of entries in the field notebook will be allowed, and corrections will be made by drawing a single line through the incorrect entry. All corrections of recorded data will be initialed and dated, and explanations for the changes will be provided. Copies of the field notebook will be made on a regular basis and stored in the project files.

In addition, for the treatment system monitoring, the ground water level monitoring, and the quarterly ground water quality monitoring, field data forms will also be completed. These data forms are shown as Figures D-2, D-3, and D-4, respectively. These duplicate entries (in the field notebook and on the data forms) will enable verification and proper tracking of all field sampling events.

5.2 REPORTING

Data collected during the field sampling and laboratory analysis will be maintained in the project files. Data to be incorporated into reports to the MDNR will be summarized and presented in tabular or graphical form where possible. All project reports and updates will be submitted as outlined in the Performance Monitoring Plan (Appendix C).

TABLES

TABLE D-1

PERFORMANCE MONITORING SAMPLING PARAMETERS
WICKS CREEK SITE
HAWORTH PLANT
DOUGLAS, MICHIGAN

Monitoring Activity	Sample Matrix	Field Parameter	Laboratory Parameter[1]	Field QA/QC Sample
Effluent Monitoring	Water	pH Temperature	Chlorobenzene Chloroform 1,1-Dichloroethane Total-1,2-Dichloroethene Tetrachloroethene Toluene 1,1,1-Trichloroethane Trichloroethene Vinyl Chloride Calcium Iron Suspended Solid	None
Intrastage GAC Monitoring	Water	pH Temperature	Chlorobenzene Chloroform 1,1-Dichloroethane Total-1,2-Dichloroethene Tetrachloroethene Toluene 1,1,1-Trichloroethane Trichloroethene Vinyl Chloride	None
Air Emissions Monitoring	Air	Total VOCs	—	None
Influent Monitoring	Water	pH Temperature	Chlorobenzene Chloroform 1,1-Dichloroethane Total-1,2-Dichloroethene Tetrachloroethene Toluene 1,1,1-Trichloroethane Trichloroethene Vinyl Chloride Calcium Iron Suspended Solid	None
Water Level Monitoring	Water	Depth	—	None
Ground Water Quality Monitoring	Water	Depth pH Conductivity Temperature	Chlorobenzene Chloroform 1,1-Dichloroethane Total-1,2-Dichloroethene Tetrachloroethene Toluene 1,1,1-Trichloroethane Trichloroethene Vinyl Chloride	[2]

Key:

GAC = Granular activated carbon
QA/QC = Quality assurance/quality control
VOCs = Volatile organic compounds

[1] Analyses for additional parameters may be required by the NPDES Permit.

[2] One field blank and one duplicate sample will be collected for VOCs for every 10 or fewer investigative samples collected. One matrix spike/matrix spike duplicate will be collected for VOCs for every 20 or fewer investigative samples collected. One trip blank will be included with each shipment of VOC samples.

TABLE D-3

PROJECT-REQUIRED ACCURACY, PRECISION, AND SENSITIVITY OF FIELD INSTRUMENTS
WICKS CREEK SITE
HAWORTH PLANT
DOUGLAS, MICHIGAN

Field Parameter	Project -Required Accuracy	Project-Required Precision	Project-Required Sensitivity
pH	±0.10 pH	±0.10 pH	0.1 pH
Specific Conductance	±5.0%	±5.0%	5 ms/cm
Temperature	±1.0°C	±1.0°C	0.3°C
Water Depth	±0.02 ft	±0.02 ft	0.01 ft
Photoionization Detector	±0.2 Vppm	±0.2 Vppm	0.1 Vppm

Key:

ms/cm = Micromhos/centimeter
Vppm = Parts per million by volume

TABLE D-5

SAMPLE CONTAINERS, PRESERVATIVES,
ANALYTICAL METHODS, AND HOLDING TIMES
WICKS CREEK SITE
HAWORTH PLANT
DOUGLAS, MICHIGAN

Parameter	Sample Container	Preservative	Analytical Method	Holding Time
MDNR VOC Scan 1[1]	3 x 40 ml glass vial	HCl to pH <2[2]	SW-846 8010	14 days[2]
MDNR VOC Scan 2[1]	3 x 40 ml glass vial	HCl to pH <2[2]	SW-846 8020	14 days[2]
Suspended Solids	500 ml plastic/glass jar	Cool, 4°C	EPA 160.2	7 days
Calcium	500 ml plastic/glass jar	HNO_3 to pH <2	SW-846 7140	6 months
Iron	500 ml plastic/glass jar	HNO_3 to pH <2	SW-846 7380	6 months

Key:

MDNR = Michigan Department of Natural Resources
SW-846 = Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 3rd Edition, Revision 1, July 1992.
VOC = Volatile organic compound

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1 The individual compounds to be analyzed are listed on Table D-4.

2 For the VOC samples, if hydrochloric acid (HCl) is not added to the vial prior to sample collection, do not add HCl and indicate this on the chain-of-custody form. The holding time for non-preserved VOC samples is 7 days.

TABLE D-6

PROJECT-REQUIRED LABORATORY TURN-AROUND TIME
FOR TREATMENT SYSTEM MONITORING ACTIVITIES
WICKS CREEK SITE
HAWORTH PLANT
DOUGLAS, MICHIGAN

Monitoring Activity	Project-Required Laboratory Turn-Around[1]
Effluent Monitoring	
Start-up test	48 hours
First 3 days	48 hours
Next 3 weeks	7 days
Next 2 months	(2)
Until completion	(2)
Intrastage GAC Monitoring	
First Month	48 hours
Next 5 months	7 days
Until Completion	(2)
Influent Monitoring	
Start-up test	48 hours
First 3 days	48 hours
Next 3 weeks	7 days
Next 2 months	(2)
Until completion	(2)

Key:

GAC = Granular Activated Carbon

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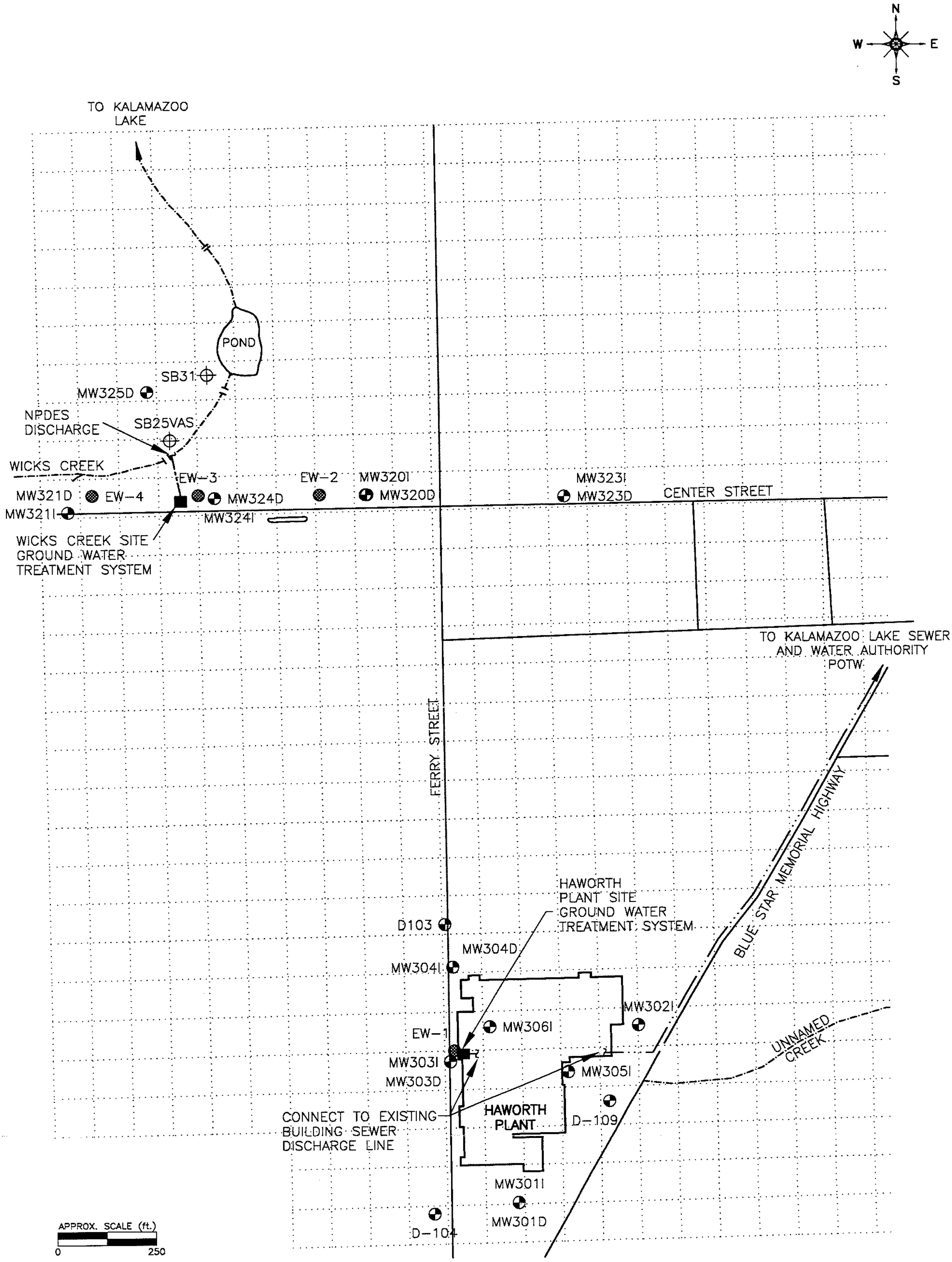
1 The laboratory turn-around time shown is from the time the sample is received by the laboratory.

2 These samples will not be rush samples and will be analyzed under normal laboratory turn-around time.

FIGURES

DATE:	DRAWN:	FILE:
4/13/95	FK-	K:\CPFILES\ERM\WNJ\94263\01\ACAD\FIG1-2.DWG APR 13, 1995 3:16 PM



APPROX. SCALE (ft.) 0 250

GRID INTERVAL = 100 FEET

SYMBOL LEGEND	
⊕ (monitoring well symbol)	MONITORING WELL LOCATION
⊕ (soil boring symbol)	SOIL BORING LOCATION
● (extraction well symbol)	EXTRACTION WELL
– – – –	NPDES DISCHARGE PIPING
—— · ·	SANITARY SEWER DISCHARGE (POTW)

NOTE: NO DRINKING WATER WELLS ARE LOCATED ON ADJACENT PROPERTIES.

FIGURE D-1

SITE LAYOUT PLAN
GROUND WATER REMEDIATION SYSTEM
HAWORTH PLANT
DOUGLAS, MICHIGAN

ERM

FIGURE D-3

GROUND WATER LEVEL MONITORING
FIELD DATA FORM
WICKS CREEK SITE
HAWORTH PLANT
DOUGLAS, MICHIGAN

Well Location	Elevation of Reference Point (feet amsl)	Sample Time	Depth to Water (feet below reference point)	Total Well Depth (feet below reference point)

Note:

[1] The elevation of the reference point on each well is surveyed to an accuracy of ±0.01 feet above mean seal level (amsl) relative to the U.S. Geological Survey datum 1929.