Final Remedial Design Report
Former Monarch Chemicals, Inc. Site
37 Meadow Street, Utica, New York
NYSDEC Site Number 6-33-030

June 7, 2005
004-03445-04-005

Prepared for
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CERTIFICATION

All engineering information, conclusions, and recommendations in this document have been prepared under the supervision of and reviewed by a LFR Levine·Fricke New York Professional Engineer.

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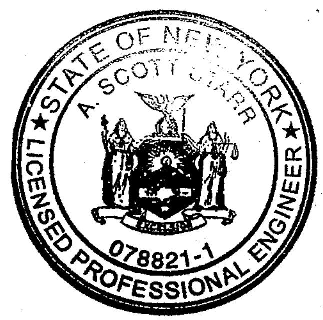
6/7/05

Date



1.0 INTRODUCTION

This document represents the Final Remedial Design Report for the former Monarch Chemicals, Inc. (MCI) site in Utica, New York ("the Site"; Figure 1) as required by the New York State Department of Environmental Conservation (NYSDEC) Order on Consent Index Number A6-0449-0107, Site Number 6-33-030 ("the Consent Order"). JCI Jones Chemical, Inc. (JCI; the Respondent) and the NYSDEC entered into the Consent Order on February 10, 2003, to initiate remedial actions at the Site.

On behalf of JCI, LFR Levine·Fricke (LFR) prepared this Final Remedial Design Report in accordance with:

- Remedial Design/Remedial Action (RD/RA) Work Plan (LFR 2003), which was approved by NYSDEC on December 11, 2003, and included the Field Sampling Plan (FSP), Quality Assurance Project Plan (QAPP), Health and Safety Plan (HSP) and Citizen Participation Plan (CPP)
- "Record of Decision" (ROD) for the Site (NYSDEC 2001)
- "Guidance on EPA Oversight of Remedial Designs and Remedial Actions Performed by Potentially Responsible Parties" (United States Environmental Protection Agency [U.S. EPA] 1990)
- "Remedial Design/Remedial Handbook" (U.S. EPA 1995)

The objective of this Final Remedial Design Report is to present the design approach and the results of engineering analyses to support the remediation plans and technical specifications. The report describes site background, remedial-action objectives, design criteria, and the various elements of the remedial action.

2.0 BACKGROUND

2.1 Site Description

The MCI site is located at 37 Meadow Street, Utica, New York. The Site occupies 7.56 acres in southeastern Oneida County in Central New York State and is located within the Harbor Point Area, a historical industrial zone, where approximately 90 percent of the industrial facilities have been demolished or razed. To the north, the MCI site is bordered by Lee Street and the Mohawk Valley Oil (MVO) site, and to the south by the CONRAIL right-of-way. To the east, the Site is bordered by Meadow Street and the Lee Street Terminal, and to the west by the former Utica Water Gas Plant (Figure 2). The MCI site is currently classified by NYSDEC as an inactive hazardous-waste site Class 2.

The Site is fenced with a 6-foot-high chain-link fence, topped with three strands of barbed wire; access is limited by a lockable gate located in the southeast corner along Meadow Street. The MCI site and its buildings are now vacant. The Site is relatively flat. Much of the open area is covered with gravel, and grassy areas exist in the southern and western portions of the MCI site. A lightly wooded area is present in the southeastern corner of the Site.

On the eastern portion of the MCI site, a large building, reportedly more than 100 years old, formerly housed the office and warehouses, including the chlorine-repackaging room, bleach-production room, and various storage areas. One storage barn and three pole barns are present south and west of the large building. A number of concrete bulk-storage tank pads, or concrete pads, are also scattered throughout the Site. The concrete pads reportedly served as foundations for aboveground storage tanks (ASTs), which were used to store bulk acids, bleach, liquid caustic soda, and other materials. A single railroad spur enters the property from the west and separates into two parallel spurs. Each spur runs to the east, one along the north side and the other along the south side of the large building.

2.2 Present Operations

The MCI site has been inactive since 1995; there are no ongoing industrial activities at the Site.

2.3 Historical Operations

The Site consists of two parcels totaling 7.56 acres. JCI purchased the 6-acre parcel from the Charles C. Kellogg and Sons Company ("Kellogg") in 1966. Kellogg managed a lumber milling, planing, storage, and distribution operation on the property. Prior to Kellogg's ownership, the property was reportedly owned by H.C. Ballou. Land use during H.C. Ballou's ownership is not known (Atlantic Environmental Services, Inc. [AES] 1993).

JCI purchased the 1.56-acre parcel to the south of the 6-acre parcel from the Owasco River Railway, Inc., a subsidiary of the Penn Central Corporation (URS Consultants, Inc. [URS] 1990).

Before MCI's shutdown in May 1995, operations at the Site included:

- repackaging of chlorine, ferric chloride, hydrochloric acid, hydrofluorosilicic acid, nitric acid, and sulfuric acid
- manufacture of sodium hypochlorite (bleach)
- dilution and repackaging of sodium hydroxide and muriatic acid
- distribution of various organic and inorganic (water treatment-related) chemicals

The ASTs that formerly existed on the Site were used to store a variety of inorganic chemicals. The ASTs were located inside the large building and outside on the concrete pads. A 2,000-gallon diesel underground storage tank (UST), removed in April 1986, had been located south of the storage barn, along the eastern fence line (Figure 2). The UST had been used to store fuel for MCI's vehicles.

Production of bleach occurred primarily in the western portion of the large building. During the production of bleach and the handling of other products, two waste streams were generated. One waste stream was aqueous wastewater, which was designated hazardous because of its corrosivity. The second waste stream consisted of a residue generated during the cleaning of brass valve components from chlorine containers. This residue was considered hazardous only because of its cadmium and lead components.

3.0 SELECTED REMEDY

Based on the Feasibility Study (FS; LFR 2000), NYSDEC issued the ROD (2001) that describes the selected remedy to be implemented at the Site to meet the Standards, Criteria and Guidance (SCGs).

3.1 Remedial Action Objectives

The Remedial Action Objectives (RAOs) include the following:

- eliminate, to the extent practicable, the potential future ingestion of affected groundwater that does not meet NYSDEC Class GA Ambient Water Quality Criteria
- eliminate, to the extent practicable, the potential off-site migration of contaminated groundwater that does not meet NYSDEC Class GA Ambient Water Quality Criteria due to elevated levels of chlorinated volatile organic compounds (VOCs), such as tetrachloroethene (PCE) and trichloroethene (TCE)
- eliminate, to the extent practicable, direct exposure to VOCs and semivolatile organic compounds (SVOCs)

The NYSDEC's Technical and Administrative Guidance Memorandum (TAGM) Number HWR-94-4046, which list the recommended soil cleanup objectives (RSCOs) for the chemicals of concern (COCs), is the chemical-specific SCG that would guide the remediation of affected soil.

The chemical-specific SCG for the groundwater medium are the New York State Groundwater Standards (6 NYCRR Part 703.5) for Class GA (i.e., for any groundwater; "Groundwater Standards"):

Chemical of Concern	**Soil Medium (mg/kg)**	**Groundwater Medium (μg/l)**
Tetrachloroethene (PCE)	1.4	5
Trichloroethene (TCE)	0.7	5
Cis-1,2-Dichloroethene (cis-1,2-DCE)	0.3	5
Trans-1,2-Dichloroethene (trans-1,2-DCE)	0.3	5
1,1-Dichloroethene (1,1-DCE)	0.4	5
Vinyl chloride	0.2	2
1,1,1-Trichloroethane	0.8	5
1,1-Dichloroethane	0.2	5
Total cPAHs	10	-

Notes:
cPAH = carcinogenic polynuclear aromatic hydrocarbons
mg/kg = milligram per kilogram
μg/l = microgram per liter

3.2 Remedial Design Measures

Based on the analysis presented in the FS (LFR 2000), NYSDEC (2001) issued the ROD which listed Alternative #8 as the selected remedial alternative. Alternative #8 included:

- soil-vapor extraction (SVE) of PCE-affected subsurface soil
- capping or removal of carcinogenic polynuclear aromatic hydrocarbon (cPAH)-affected surface soil with concentrations exceeding 10 milligrams per kilogram (mg/kg)
- institutional controls of SVOCs remaining in subsurface soil below the 500 mg/kg SCG
- pump-and-treat/hydraulic control/institutional controls/ethanol injection for chlorinated VOCs in groundwater to augment reductive dechlorination
- institutional controls/monitored natural attenuation (MNA) of PCE and related breakdown products downgradient of the Site

3.3 Niagara Mohawk Power Corporation's Proposed Remedial Actions

The coal tar and PAHs detected in the subsurface in the western portions of Site are related to past manufactured-gas plant (MGP) operations that occurred at the adjacent Water Gas Plant. Niagara Mohawk's (NiMo's) proposed remedial actions for the Water Gas Plant also addresses the cleanup of the affected soil and groundwater in the western and southern portions of the MCI site. The proposed remedial actions include:

- installation of barrier (slurry) wall around the former Water Gas Plant and western portions of the Site (Figure 2)
- surface capping within the barrier wall
- hydraulic control
- removal of surficial non-aqueous phase liquid (NAPL) and purifier debris

At the present time, NYSDEC is reviewing NiMo's RD/RA work plans. This Pre-RD Report details the cleanup approach by JCI to address affected soil and groundwater outside (east) of NiMo's barrier wall.

4.0 SITE CONDITIONS

This section summarizes the site conditions from data gathered during the Remedial Investigation (RI; LFR 1999) and the recent Pre-RD field activities (LFR 2004) conducted at the Site. A brief discussion on subsurface-soil conditions, groundwater flow, and distribution of chlorinated-solvent contamination is included.

4.1 Physical Setting

The entire Harbor Point area is within the 100-year floodplain (FEMA 1984). The northern portion of the Harbor Point peninsula falls within the regulated floodway of the Mohawk River, and the remaining portion of the Harbor Point area is contained within the 100-year floodway fringe.

The Harbor Point Area has been subjected to intense industrial activity since 1845, and the Site has remained industrial at least since the 1950s (Figure 3). The future land use for the property is expected to remain industrial (JCI 1999). According to the City of Utica's Renewal Plan for Harbor Point, future land use includes primarily commercial and recreational development. The City of Utica's plan does not include residential development for the MCI site vicinity (Figure 3).

There is no present or future groundwater use at the Harbor Point Area. Currently, potable water to the Harbor Point Area and vicinity is supplied by the Utica Water Board. The Utica Water Board supply originates from the Hinckley Reservoir, located approximately 15 miles north of the Site.

The City of Utica has an ordinance that requires commercial or industrial water users located within 500 feet of a City water line to connect to that line (PES 1997). An active water line exists along Washington and Lee Streets. With the City ordinance and the active water lines, all future users at the Site and its vicinity would be required to connect to the City's water system.

4.2 Hydrogeology

The subsurface at the Site is underlain by four distinct stratigraphic units consisting of fluvial and glaciolacustrine sediments (Figures 4 and 5). In descending order, these units are the upper sand/fill unit and the silty clay unit ("the shallow zone"), the clayey sand/silty sand unit ("the intermediate zone"), and the glacial till unit ("the deep zone"). The summary of monitoring well construction details used to define the stratigraphic units is presented as Table 1.

4.2.1 Shallow Zone (Less Than 15 to 20 Feet Below Ground Surface)

The upper sand/fill unit is composed primarily of sand and fill material. The thickness of this unit ranges from 3 to 10 feet below ground surface (bgs). The sand is dark gray, predominantly well-graded (poorly sorted), fine- to coarse-grained, and subangular to subrounded. Fill material consists of a variety of waste materials, including gravels, coal cinders, coal ash, glass bottles, brick fragments, wood chips, ceramics, boots, garments, scrap metals, and MGP combustion waste. Similar types of fill materials were found on the neighboring NiMo and MVO sites.

The silty clay unit underlies the upper sand/fill unit; contact between these units is gradational. The silty clay unit occurs at depths ranging from 8 to 12 feet bgs. The thickness of the silty clay ranges from 10 to 20 feet. Although the silty clay unit was found in a majority of the soil borings, it was absent in the southwest corner of the Site, where a peat layer approximately 4 feet thick was found below the upper sand/fill unit. The silty clay unit is predominantly a clay unit with varying amounts of silt. Although the silty clay unit acts as a confining layer to the underlying sediments, it has not been effective in preventing downward migration of chemicals into underlying sediments. Along the western border of the Site (adjacent to the NiMo former Water Gas Plant property), NAPLs (coal tar and light fuel oil) were found throughout this unit.

4.2.2 Intermediate Zone (Approximately 15 to 35 Feet Below Ground Surface)

The clayey sand/silty sand unit underlies the silty clay confining unit. The clayey sand/silty sand unit occurs at depths from 15 to 20 feet bgs and ranges from 10 to 25 feet in thickness. The clayey sand unit is primarily a sand unit with varying amounts of clay and silt. The sand is heterogeneous, ranging from very fine- to coarse-grained, and its grain texture ranges from poorly graded to well graded. Soil borings bordering the NiMo site's former Water Gas Plant property contained NAPLs (coal tar and light fuel oil) in this unit.

4.2.3 Deep Zone (Greater Than 35 Feet Below Ground Surface)

The glacial till unit underlies the clayey sand/silty sand unit with a sharp contact. The glacial till unit occurs at depths from 34 to 36 feet bgs and is composed of clay and silt with minor amounts of gravel. NAPLs (coal tar and light fuel oil) were not found in the glacial till unit, indicating that the glacial till unit may be an effective barrier to downward migration of chemicals.

4.2.4 Groundwater Occurrences and Flow

On June 14, 2004, LFR collected water-level measurements from on-site and selected off-site monitoring wells to evaluate groundwater flow and gradients. The water levels and groundwater elevations (along with the historical water-level measurements) were presented in the Pre-RD Report (LFR 2004). Groundwater elevation contour maps for the shallow and intermediate zones are shown on Figures 6 and 7, respectively.

- Depths to groundwater typically range from 4 to 7 feet bgs. The upper sand/fill unit (shallow) is not a significant water-bearing zone; however, the clayey sand/silty sand unit (intermediate) constitutes a relatively significant water-bearing zone at the Site.
- Groundwater flow in the shallow zone is primarily toward the east-northeast; in the intermediate zone, groundwater flow is generally toward the north.
- The horizontal hydraulic gradient in the shallow zone ranges from 0.002 to 0.005 foot per foot (ft/ft). The horizontal gradient in the intermediate zone ranges from 0.008 to 0.010 ft/ft. Estimated vertical hydraulic gradients were 0.086 and 0.139 ft/ft. The vertical hydraulic gradient is downward, indicating there is a downward component of groundwater flow from shallower to deeper sediments.

4.3 Summary of Affected Media

The COCs for the Site primarily include chlorinated solvents and cPAHs. RI and Pre-RD sampling data show that higher concentrations of VOCs and SVOCs are present in the shallow water-bearing zone rather than in the intermediate zone (LFR 1999 and 2004).

The shallow-depth (less than 3.5 feet bgs) soil sample concentrations shown on Figure 8 indicate the sources of chlorinated solvents outside NiMo's barrier wall that will be addressed by JCI. Figure 2 shows the monitoring well locations. Source areas include:

- in the northeast and northwest corners of the storage barn, near SB-38, SB-40, SB-34, and MWS-15
- between railroad spurs, north of the loading dock near SB-42, SB-43, and MWS-10

- in the north-central portion of the Site in the vicinity of the concrete pad near SB-57 and MWS-8)

The chlorinated-solvent groundwater plume extends from the Site to the southeastern portion of the MVO site and the access road, east of the MVO site.

Elevated PCE and TCE concentrations were limited to the MCI site. The off-site groundwater, hydraulically downgradient on the MVO site, is characterized by elevated concentrations of degradation products, indicating the leading edge of the affected groundwater plume.

Elevated benzene, toluene, ethylbenzene, and total xylene (BTEX) concentrations in soil or groundwater at the Site are limited primarily to the western perimeter. The source of BTEX on the MCI site is attributed to the MGP operations on the former Water Gas Plant property and is not addressed in this remedial design.

Elevated PAH and BTEX concentrations and/or NAPLs are present in both soil and groundwater along the western border of the Site. The source of PAHs and BTEX is related to the MGP operations that occurred on the adjacent former Water Gas Plant property. NiMo's proposed barrier wall, surface cap, and hydraulic-control actions at the former Water Gas Plant will be extended onto the MCI site to address the PAHs and BTEX detected on site.

4.3.1 Surface-Soil Sampling for Polynuclear Aromatic Hydrocarbons

In November 2003, LFR collected 11 surface-soil samples from 0 to 2 feet bgs from each of the PAH-affected areas identified in the ROD (NYSDEC 2001). The surface-soil sampling locations and cPAH concentrations are shown on Figure 9. Based on the soil remedial goal of 10 mg/kg for surface soils affected with cPAHs, three of the four PAH-affected areas will require remediation. The area southeast of the warehouse building is covered with asphalt and, therefore, may require minimal soil removal in the exposed unpaved areas. Removal of the PAH-affected surface soils is discussed further in Section 6.4.

4.3.2 Subsurface-Soil Sampling

In May 2004, numerous direct-push soil samples were collected from various sampling locations (SB-25 to SB-67) as shown on Figure 8. Forty-three soil samples were collected from an average depth of 3 feet bgs and analyzed by an on-site mobile laboratory for targeted chlorinated solvents (LFR 2004). The soil-sampling intervals were selected by screening the soil cores with an organic vapor analyzer (OVA) equipped with a photoionization detector. The total chlorinated-ethene concentrations (i.e., sum of PCE and its breakdown products TCE, cis-1,2-dichloroethene [cis-1,2-DCE], trans-1,2-DCE, 1,1-DCE, and vinyl chloride concentrations) are shown on Figure 8. PCE concentrations ranged from below detection limits to 6,309,400 micrograms per kilogram (μg/kg; or parts per billion [ppb]).

Elevated PCE concentrations were detected in the sources areas previously identified during the RI (LFR 1999) as shown on Figure 8:

- between the railroad tracks adjacent to the AST storage pad (SB-34 through SB-37 and SB-42 through SB-47)
- northeast corner of the storage barn (SB-38 through SB-41 and SB-63)
- in the south-central portion of the Site (SB-25 through 28)

4.3.3 Groundwater Sampling

In June 2004, LFR personnel sampled selected on-site monitoring wells for VOCs and MNA indicator parameters. The samples were collected using low-flow sampling techniques described in the RD/RA Work Plan (LFR 2003). Isoconcentration plots of total chlorinated-ethene concentrations for the shallow and intermediate zones are shown on Figures 10 and 11, respectively.

PCE concentrations ranged up to 50,000 micrograms per liter (μg/l); shallow well MWS-10, located adjacent to the AST pad between rail spurs, exhibited the highest PCE concentration. Several breakdown products of PCE—such as TCE, cis-1,2-DCE, and vinyl chloride—were detected in elevated concentrations in many wells sampled. Significant sources of chlorinated solvents are apparent between railroad spurs adjacent to AST pad, and in the northeastern corner of the storage barn, as shown on Figure 10.

The decrease in PCE concentrations and detection of cis-1,2-DCE and vinyl chloride in elevated levels (Table 2) indicates that PCE is undergoing significant degradation. In the source area well MWS-10, PCE has decreased from 150,000 μg/l (1997) to 84,000 μg/l (1998) and 50,000 μg/l (2004). In another source-area well (MWS-15), northeast of the storage barn, PCE concentrations decreased from 12,000 μg/l (1997) to 230 μg/l (2004), while cis-1,2-DCE concentrations increased from 3,800 μg/l (1998) to 8,600 μg/l (2004) and vinyl chloride levels increased from 730 μg/l (1998) to 1,200 μg/l (2004).

In the intermediate zone, chlorinated-solvent concentrations are generally lower than the shallow zone (Table 2; Figure 11). The intermediate-zone chlorinated solvent plume is characterized largely by degradation products (cis-1,2-DCE and vinyl chloride). In OW-1I in the source area, PCE was below detection limits, and cis-1,2-DCE and vinyl chloride concentrations were detected at 3,700 and 270 μg/l, respectively. In the hydraulically downgradient well MW-416I, PCE was not detected, but the cis-1,2-DCE concentration was elevated at 19,000 μg/l. The cis-1,2-DCE level increased from 4,000 μg/l in 1996 to 19,000 μg/l in 2004, a strong indication that degradation is occurring. In another hydraulically downgradient well (MW-13I), PCE was not detected, and cis-1,2-DCE and vinyl chloride levels were detected at 6,000 and 1,500 μg/l, respectively.

The chlorinated-solvent groundwater plume extends from the Site to the southeastern portion of the MVO site and the access road east of the MVO site. The off-site groundwater, hydraulically downgradient on the MVO site, is characterized by elevated concentrations of degradation products indicating the leading edge of the affected groundwater plume.

4.4 Mass Estimate

Based on the data presented in the RI and the Pre-RD Summary Report (LFR 1999 and 2004), the mass of total chlorinated ethenes (PCE, TCE, cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride) in soil and groundwater on the Site was estimated. These calculations are an order of magnitude approximation and do not account for dense NAPL (DNAPL) PCE or contamination that has migrated beyond the Site boundaries.

4.4.1 Mass in Vadose Zone

To estimate the mass of total chlorinated ethenes in the vadose zone, the following assumptions were made:

- The density of the soil is 115 pounds per cubic foot.
- The average vadose-zone thickness across the affected area is approximately 6 feet.
- The total area of affected soil as presented on Figure 8 is approximately 53,000 square feet. The area is subdivided based upon total chlorinated ethene concentrations.

The mass of total chlorinated ethenes in the vadose-zone soil within each contour was calculated as follows to be 1,598 pounds:

$$\left(\frac{115\ \text{lb soil}}{\text{ft}^3}\right)(\text{Volume of soil})\left(\frac{\text{Average Concentration }\mu\text{g}}{\text{kg of soil}}\right)\left(\frac{\text{kg}}{2.2\ \text{lb}}\right)\left(\frac{\text{g}}{10^6\ \mu\text{g}}\right)\left(\frac{\text{lb}}{453.6\ \text{g}}\right) = \text{lbs}$$

A summary of the mass estimates for total chlorinated ethenes in soil is presented in the following table:

Total Chlorinated-Ethene Contour from Figure 8	Average Concentration Within Contour (μg/kg)	Area Within Contour (square feet)	Affected Volume (cubic feet)	Mass (pounds)
1,000,000 μg/kg	3,000	344	2,064	713
100,000 μg/kg	500	1,790	10,740	618
10,000 μg/kg	50	2,900	17,400	100
1,000 μg/kg	5	48,000	288,000	166

Notes: μg/kg = micrograms per kilogram

4.4.2 Dissolved-Phase Mass in Groundwater

In the shallow saturated zone, the mass of total chlorinated ethenes as presented in Figure 10 was calculated with the following assumptions:

- The porosity of the shallow zone is 10%.
- The areas of the chlorinated ethene-affected groundwater on the Site in the shallow zone within the specified contours are as follows:
  - 50,000-μg/l contour line = 1,100 square feet
  - 40,000-μg/l contour line = 2,800 square feet
  - 30,000-μg/l contour line = 4,900 square feet
  - 20,000-μg/l contour line = 7,100 square feet
  - 10,000-μg/l contour line = 17,300 square feet
  - 1,000-μg/l contour line = 26,600 square feet, plus 2,910 square feet in isolated southern portion of Site
- The average saturated thickness of the shallow aquifer is approximately 10 feet.

Based on these assumptions, the volume of affected groundwater within each shallow-zone contour was estimated and the mass of total chlorinated ethenes in groundwater is calculated to be 58 pounds as follows:

$$(\text{Volume of Water gal})\left(\frac{\text{Average Concentration } \mu g}{l}\right)\left(\frac{3.78\,l}{gal}\right)\left(\frac{g}{10^6\ \mu g}\right)\left(\frac{lb}{453.6\ g}\right) = lbs$$

A summary of the mass estimates for total chlorinated ethenes in the shallow saturated zone is presented in the following table:

Total Chlorinated Ethenes Within Contour from Figure 10	Average Concentration within Contour (μg/l)	Area within Contour (square feet)	Affected Volume (gallons)	Total Mass (pounds)
50,000 μg/l	55,000	1,100	8,200	3.8
40,000 μg/l	45,000	2,800	20,900	7.8
30,000 μg/l	35,000	4,900	36,650	11
20,000 μg/l	25,000	7,100	53,100	10.6
10,000 μg/l	15,000	17,300	129,400	16
1,000 μg/l	5,000	29,510	220,700	9.2

Note: μg/l = micrograms per liter

Similarly, the mass of total chlorinated ethenes on-site in the intermediate groundwater (Figure 11) is estimated to be 7 pounds based upon the following assumptions:

- The porosity in the intermediate zone is 20 percent.
- The average concentration of total chlorinated ethenes in the intermediate zone within the Site is 5,000 μg/l over an area of 42,000 square feet.
- The saturated thickness of the intermediate aquifer is 20 feet.

4.4.3 Saturated Soil-Sorbed Mass

For a typical chlorinated-ethene site, LFR estimates that the mass of PCE adsorbed to soil is up to 10 times the mass contained in the dissolved phase. Similar estimates of sorbed mass can be made for the PCE degradation by-products based on estimated sorption characteristics (three times the mass for TCE, two times for the DCE isomers, and the amount of VC sorbed mass is assumed zero based on very low values for its sorption coefficient).

Given that there is significant degradation, PCE and TCE are not readily present in the intermediate zone at appreciable concentrations and only DCE and vinyl chloride remain in this zone. Therefore, based upon the volume of water affected on-site within the intermediate zone and assumption that 80 percent of the 5,000-μg/l total of chlorinated ethenes is the DCE isomers and the remaining 20 percent is vinyl chloride, then the mass of chlorinated ethene is 12 pounds.

In the shallow zone, similar conditions are present except within the area of MWS-10 where 80 percent of the chlorinated ethene is PCE. A review of the above table indicates that 33.2 pounds of total chlorinated ethenes are within the 20,000-μg/l contour. Assuming that 80 percent of the chlorinated ethene within this area is dissolved PCE, then 266 pounds of PCE is sorbed to the soil. Similarly, assuming 5 percent is TCE and the remaining 15 percent is DCE, then there is approximately 5 pounds of TCE and 10 pounds of DCE sorbed to the soil.

Beyond the 20,000-μg/l contour to the 1,000-μg/l contour, it is estimated that 80 percent of the total chlorinated ethenes is DCE, and the remaining 20 percent is vinyl chloride. A review of the above table indicates that 25.2 pounds of total chlorinated ethenes are dissolved in groundwater within the 1,000-μg/l to the 20,000-μg/l contours. Therefore, the mass of DCE sorbed to the soil is 40 pounds, and the mass of vinyl chloride is assumed to be zero because of its low affinity for sorbing to soil.

This yields approximately 333 pounds of chlorinated ethenes adsorbed to soil.

4.4.4 Total Mass

Total mass estimates for chlorinated ethenes are summarized in the following table. The estimate does not consider free liquid-phase PCE, nor chlorinated ethenes in the vapor and soil-moisture phases in the void space of the vadose zone.

Zone	Total Chlorinated Ethenes (pounds)
Vadose Zone	1,597
Dissolved Phase (Groundwater)	65
Saturated Soil	333
Total	**1,995**

5.0 SITE PREPARATION

Site-preparation activities will be implemented prior to construction of the remedial systems. The site-preparation activities will consist generally of initial tasks that must be completed by the remedial-action contractor and owner's engineer before on-site construction can begin.

5.1 Regulations and Permits

The selected remedial-action contractor will be required to obtain all building and electrical permits prior to construction. In addition, the remedial-action contractor will be required to coordinate all building and electrical inspections and provide the inspectors access to the project, as necessary.

LFR may be required to obtain the required environmental permits. These permits may include acquisition of an Underground Injection Control permit.

5.2 Environmental Controls

The remedial-action contractor will be required to provide barricades and fencing to prevent unauthorized personnel from entering the construction areas and prevent potential exposure pathways. Minimal inhalation and direct-contact exposure to VOCs are expected by the construction workers during trenching in the source area. This exposure will be monitored using an OVA and regulated in accordance with the HSP.

5.3 Traffic Controls

Because the locations of the proposed construction activities are located on the MCI property, only limited on-site traffic control will be required as the Site is vacant. Barricades and temporary fencing will be used to control access to the construction areas.

5.4 Site Access

Access to the construction areas will be limited to authorized personnel during construction activities.

5.5 Staging Areas and Decontamination Areas

The remedial-action contractor will establish material and equipment staging areas and decontamination areas. These areas will be used to prevent the spread of affected media.

6.0 DESIGN OF REMEDIAL COMPONENTS

Based upon the conclusions of the FS (LFR 2000) and the ROD (NYSDEC 2001), soil and groundwater remedial components are required to be implemented.

Remediation of the soil medium involves the following components:

- Treat unsaturated soils affected with chlorinated solvents exceeding the SCGs by in situ SVE. The off-gas will be treated using granular-activated carbon (GAC).
- Cap or remove surface soils affected with cPAHs.
- Implement institutional controls to restrict residential use of the Site and control on-site excavation that could potentially disturb the affected soil.

Given the high water table and need for hydraulic control of the shallow zone, a dual-phase extraction (DPE) system will be implemented in lieu of the SVE system. The DPE system is similar to an SVE system, with the exception that it will extract both water and soil vapor from extraction wells. By lowering the water table and exposing the soil, remediation of chlorinated ethenes will proceed more rapidly, as the mass-transfer coefficient for PCE and its breakdown products is more efficient in the vapor phase than the dissolved phase.

Remediation of the groundwater medium involves the following components:

- Extract and treat affected groundwater using a network of multiple-depth recovery wells and prevent further migration of the groundwater plumes

- Treat extracted groundwater with an air-stripping unit, and discharge the treated water into the publicly owned treatment works (POTW) until groundwater remediation goals have been achieved.
- Upon establishment of hydraulic control and remediation of the soil, treat shallow aquifer areas with the highest chlorinated VOCs through injection of ethanol to promote anaerobic degradation, unless determined unnecessary based upon monitoring data. After implementation of remedial systems, three years of monitoring data will be collected and evaluated to evaluate whether ethanol injection is necessary. If the monitoring data indicates that ethanol injection may be necessary to aggressively treat the "hot spots," a remedial design (including an operation, maintenance, and monitoring [OM&M] plan for ethanol injection) will be prepared and submitted to NYSDEC for review and approval.
- Conduct MNA of the leading edge of the PCE and related breakdown-product plume. A groundwater-monitoring program will be implemented to monitor the effectiveness of the MNA. This remedy will include a contingency plan that will require the leading edge of the plume to be treated if data from the OM&M plan indicates that natural attenuation will not meet the remedial goals in 23 to 29 years.
- Implement institutional controls (i.e., deed restrictions) to limit future on-site groundwater use to non-potable purposes until groundwater remediation goals are achieved.

The following sections describe the proposed design of the remedial components to remediate soil and groundwater affected with PCE and its degradation products. Construction drawings for the proposed remedial systems are included in Appendix A, and written specifications are included in Appendix B.

6.1 Soil-Vapor Extraction Pilot and Aquifer Pump Tests

A SVE pilot test and aquifer pump test were performed in accordance with the RD/RA Work Plan (LFR 2003) to evaluate design parameters for the proposed remediation systems. The tests were performed in June 2004 and data and analyses were presented in the Pre-RD Summary Report (LFR 2004).

6.1.1 Soil-Vapor Extraction Pilot Test

The SVE pilot test analysis indicated a soil intrinsic permeability of 3.17×10^{-7} square centimeters at 25 inches of water vacuum and 80 standard cubic feet per minute (scfm), which is conducive to SVE. The radius of influence (ROI) observed during the pilot test was approximately 30 feet; however, the ROI may be underestimated given the lack of an impermeable surface and likelihood of short circuiting. In addition, the flow rate may also have been overestimated due to the potential short-circuiting without a surface seal. Based upon the operation of the SVE pilot test, it was concluded that DPE would be more efficient than SVE because of the high water table, distribution of contamination below the water table, and need to capture groundwater in the shallow zone.

Effluent sampling of the SVE pilot-test system indicated a potential concentration of PCE of 220 parts per million by volume (ppm_v; 1,626 milligrams per cubic meter [mg/m^3]) at startup. The actual influent vapor concentration may be less, as the pilot study was performed in the area with the highest detected concentrations of chlorinated hydrocarbons.

6.1.2 Pump Test

The data analysis and results of the pump tests performed in June 2004 on the shallow and intermediate water-bearing zones were presented in the Pre-RD Summary Report (LFR 2004). A summary of the results is presented in the following table:

Parameter	Units	Shallow	Intermediate
Hydraulic Conductivity	ft/d	0.3	6.42
Transmissivity	ft^2/d	3	128
Saturated Thickness	ft	10	20
Storativity	-	0.1	0.0023
Specific Capacity	gpm/ft	0.066	0.16
Hydraulic Gradient	ft/ft	0.001-0.009	0.004-0.01
Effective Porosity	percent	10	20
Velocity	ft/yr	1.6-9.4	50-120
Radius of Influence	feet	<20	80/500 [1]

Notes:
[1] downgradient stagnation point/crossgradient capture width
d = day; ft = feet; gpm = gallon per minute; yr = year

Although the ROI in the shallow zone was measured to be less than 20 feet, it is expected to be much greater than this observed value. The likely reason for the observed small ROI was due to the inability to remove the water in storage within the short duration of the pump test.

6.2 Dual-Phase Extraction

Soil sample collection using a core sampler during the RI phase (LFR 1999) and Pre-RD sampling in May 2004 (LFR 2004) indicated that sorbed PCE and TCE is present in the vadose zone across the Site. It appears that the most affected soil is present between the rail spurs in the area of the former tank pads. Two other separate "hot spots" appear present outside the NiMo's proposed barrier wall location: along the northern fence line and south of the warehouse building.

Although a SVE system was identified in the ROD, a DPE system is proposed to treat the affected soil that is above the PCE and its byproducts' SCGs in the vadose zone. The DPE is very similar to a SVE system; in addition to extracting and treating soil vapors, affected groundwater will also be extracted using the DPE system. Pre-RD data collected in May and June 2004 indicated that the DPE system would be more effective at the Site due to the shallow water table, porous vadose zone, and low transmissivity of the shallow aquifer. DPE is a proven technology for remediation of soil and dissolved-phase chlorinated ethenes.

The proposed DPE system will extract groundwater and soil vapor from multiple groundwater/vapor-recovery wells. A vacuum (up to 14 inches of mercury) will be applied to a draw-tube placed at a specified height in each recovery well. Groundwater will be extracted through the draw-tube until the groundwater surface is depressed below the set height of the draw-tube. The proposed DPE system will be configured to lower the groundwater surface in the adjacent soil to variable depths, which can be adjusted after startup. At this time, the system will begin to extract air from the recovery well through the draw-tube. The extracted soil vapor and groundwater will be routed to an air/water-separator tank. Extracted groundwater will be pumped from the separator tank to a low-profile air-stripping unit for treatment. After treatment, the extracted groundwater will be pumped to the municipal sewer. The extracted air will be treated with vapor-phase GAC and discharged to the atmosphere.

The operation of the groundwater-extraction portion of the DPE system will be affected by the proposed NiMo slurry wall. This cut-off wall will act to limit the recharge of groundwater onto the MCI property in the shallow and intermediate saturated zones. Therefore, dewatering of the shallow zone with the DPE system will not require management of a large volume of water, as there will not be a continuing source of groundwater.

6.2.1 Groundwater Extraction

The proposed locations of the 16 DPE recovery wells are shown on Figure 12. The recovery wells will be installed to 15 feet bgs and will primarily recover vapors from the vadose zone and will serve to lower the adjacent water table to allow vapors to be recovered from below the natural water table.

The draw-tube in each well (level of drawdown) will be configured to allow maximum groundwater capture of dissolved-phase plume and exposure of the sorbed contaminants below the natural water table. Based on the pump-test results, the specific capacity of the shallow zone is 0.066 gallon per minute (gpm) per foot of drawdown without vacuum enhancement. With vacuum enhancement, the flow rate will likely be slightly greater, as the radius of influence would be increased. Assuming an average draw down of 7 feet per well, then a conservative design flow rate is 0.5 gpm per well.

Calculations estimating the steady-state groundwater capture zone of the DPE system are presented in Appendix C. The equations used in the calculations assume homogeneous and isotropic aquifer of uniform thickness and constant flow (Fetter 1999). Figure 13 presents the estimated groundwater capture zone in comparison to the horizontal extent of chlorinated ethene-affected groundwater. A pumping rate of 0.5 gpm from a single extraction well will provide a stagnation point approximately 1,000 feet downgradient. However, a more conservative estimate of 45 feet was used for the design. The crossgradient extent of the capture zone is calculated to be over 3,000 feet. However, considering the effects of recharge and the results of the pump test, the likely stagnation point and crossgradient capture zone are significantly less. It is estimated that the steady state radius of influence of each extraction well is approximately 45 feet after 30-days of pumping (Appendix C).

The total volume of groundwater to be extracted by the system is estimated to be 8 gpm from the 16 wells. Using a safety factor of 1.25, the design groundwater flow rate from the shallow zone is approximated as 10 gpm.

6.2.2 Vapor Recovery

Figure 8 shows the estimated horizontal extent of chlorinated ethene-affected soil above the SCGs. Based on the pilot test, the projected radius of influence was estimated to be approximately 30 feet; however, given site conditions and the large vacuum generated by the DPE system, a more appropriate radius of influence for design is approximately 40 feet. The projected capture zone for soil vapor is shown on Figure 12 and overlaps the majority of the area with chlorinated-ethene concentrations above SCGs. Vacuum levels will be measured in various monitoring wells as needed to obtain additional vacuum level data.

The DPE wells will cycle between extracting groundwater and soil vapor; therefore, average parameters will be used to estimate the air-flow rate. An estimate of the air-flow rate from each well was made using an average operating pressure at the wellhead of 14 inches of mercury column vacuum, an anticipated radius of influence of 40 feet, a well diameter of 4 inches, and an average exposed well screen length of 10 feet. Using the rate equation presented in Johnson et al. 1990, the air-flow rate was projected to be 72 scfm per well, or 135 actual cubic feet per minute (acfm; Appendix D). Using a safety factor of 1.1, the design air-flow rate is approximated as 80 scfm, or 150 acfm per well. This produces a total system flow rate of approximately 1,280 scfm, or 2,400 acfm. To accommodate the high air-flow requirements at 14 inches of mercury (1,280 scfm), the system will be designed to rotate the operation of recovery wells to reduce the flow demand. This will in turn reduce the size of the required DPE pump.

Although most of the area where vapor recovery will occur does not have a surface seal, the pilot test demonstrated that an effective radius of influence can be achieved without a surface seal. Therefore, it is assumed that a surface seal to confine the flow in the vadose zone will not be required. This assumption will be confirmed at startup and continuously assessed during the operation of the DPE system. If at anytime it is determined that the lack of a surface seal is causing unacceptable short-circuiting, then a surface seal will be constructed.

6.2.3 Dual-Phase Extraction Well Construction

Sixteen vertical, 4-inch-diameter recovery wells (designated RW-1 through RW-16) are proposed for the DPE system. The recovery wells will be installed to depths of approximately 15 feet bgs with a screen interval of 13 feet. A detail of a typical recovery well is presented in Appendix A. The wells will be installed with a conventional drill rig using a hollow-stem auger with an outside diameter of at least 8 inches. Each recovery well will be constructed of 4-inch-diameter Schedule 40 flush-joint polyvinyl chloride (PVC) casing and well screen. The well screen will be 0.010-inch slotted PVC. The screened interval of the well will be 2 to 15 feet bgs. The annular space of the borehole from 2 feet bgs to the bottom of the well will be filled with a 20/30 sand pack. A bentonite seal will be installed in the remaining annular space up to the bottom of the vault. Each well will be completed in a locking 12-inch-diameter traffic-rated steel vault, and will be individually manifolded and piped to the treatment building to reduce time associated with opening and finding vaults during OM&M activities, especially in the winter. Each manifold will be equipped with a vacuum gauge, a ball valve, and a port to measure flow as shown in the construction drawings in Appendix A. A 2-inch adjustable draw-tube will be installed in each recovery well; the draw-tubes will provide flexibility in the operational profile of the system and allow appropriate drawdown in the recovery wells.

6.2.4 Dual-Phase Extraction Piping

Each of the recovery wells will be connected to an individual vacuum-supply line routed underground. Each vacuum line will be constructed of 2-inch-diameter Schedule 40 PVC pipe and will be buried approximately 48 inches bgs. The vacuum lines will be sloped toward the recovery wells. Each supply line will have a ball valve, vacuum gauge, and sample port located in the treatment building for ease of access and operation. The recovery wells will be connected to five manifolds that are 4-inch Schedule 80 PVC. Each of the five manifolds will operate a zone and will be equipped with a motor-operated valve to turn on and off the vacuum supply, a vacuum gauge, and a sampling port. The zone manifolds will be connected to the DPE pump with 8-inch-diameter Schedule 80 PVC pipe. The vapor-extraction piping network will be pressure-tested for one hour at a pressure of 30 pounds per square inch (psi).

6.2.5 Dual-Phase Extraction Pump Design

The total estimated groundwater flow rate is approximately 8 gpm. Because of uncertainty in the actual hydraulic conductivity of the formation, the design DPE pump will be capable of extracting and discharging at least 10 gpm at a vacuum of at least 14 inches of mercury. The DPE pump must also be capable of extracting at least 1,280 scfm, or 2,400 acfm, of soil vapor if all wells are operated simultaneously. Given this high volume demand when all recovery wells operate simultaneously, the operation of the recovery wells will be rotated to reduce the size of the required pump. However, certain recovery wells in the source areas and at the leading edge of the shallow groundwater plume will be operated continuously while others will be operated on a timer. Five wells will be operated continuously for a demand of 750 acfm. An additional three wells will be operated on a rotational basis for a demand of 1,200 acfm per cycle.

Based on the design requirements, the recommended DPE pump is a Dekker Model VMX1203KA1, or equivalent pump. This is an oil-filled, liquid-ring vacuum pump with an internal cooling system. The liquid-ring pump can generate a vacuum of up to 29 inches of mercury on a pressure vessel (the air/water-separator tank). The supplied vacuum will extract groundwater and soil vapor from the recovery wells through a piping manifold and into the air/water-separator tank. Controls in the tank allow vapor removal with the liquid-ring vacuum pump and groundwater removal using a centrifugal pump.

Performance information for this pump is included in Appendix E. The proposed pump motor provides 100 horsepower and operates on 460-VAC, three-phase, electrical power. The DPE pump system will be skid-mounted and equipped with a heat exchanger, particulate filter, a timer, air and water flow meters, and pressure and vacuum gauges. The DPE pump system includes a 200-gallon air/water-separator tank and a centrifugal pump for automatically transferring water to the tray air-stripping unit. The air/water-separator tank will be equipped with level sensors and control valves to route the air to the vacuum pump and the water to the tray stripper. The manufacturer specifies that the system has an operating noise level of approximately 80 decibels at 3.5 feet. To reduce the potential noise levels, the DPE motor and pump will be housed in an insulated building for additional sound-suppression.

The liquid-ring pump will operate using a variable frequency drive, which reduces the speed of the vacuum pump when demand for vacuum decreases, resulting in less energy consumption. The vacuum pump will also contain internal controls to shut down the system if the motor's temperature reaches a factory-set high temperature limit. After the motor cools, the pump will restart automatically.

6.2.6 Treatment System Design

Extracted groundwater will be treated with a tray air-stripping unit prior to being discharged into the municipal sewer. Extracted soil vapor will be treated with vapor-phase GAC prior to discharge to the atmosphere.

6.2.6.1 Soil-Vapor Extraction Emission Control

Air emissions must comply with the requirements of 6 NYCRR Part 212 for General Process Emission Sources and the New York State Division of Air Resources Guidelines for the Control of Toxic Ambient Air Contaminants (Guidelines; November 12, 1997). Therefore, based upon this requirement, an analysis was performed in accordance with Appendix B of the Guidelines to evaluate the allowable emission rate. This analysis is included as Appendix F.

The allowable emission rate was determined for the three compounds expected to be present in the vapor stream at appreciable concentrations. These compounds are PCE, TCE, and cis-1,2-DCE. As PCE is the most sensitive compound of the three—based upon its much higher detected concentration in the vapor-phase as demonstrated by the pilot test sampling and lower Annual Guideline Concentration (AGC; 1.0 microgram per cubic meter [$\mu g/m^3$])—it was selected for the emission-rate analysis. Vinyl chloride was not considered because it is not expected to be detected in shallow soil vapor at appreciable concentrations.

Using the Standard Point Source Method (Guidelines 1997; Appendix B), the maximum allowable annual emission rate for PCE is 354 pounds per year, or 0.04 pound per hour assuming 8,760 operating hours per year. Based upon the pilot-test data, the PCE removal rate is expected to be less than 2 pounds per hour at startup, but is expected to quickly decrease after the first week of operation. The emission rate is anticipated to be greater than the maximum allowable rate for the first month; therefore, emission-control technology will be used to reduce the PCE-emission rate to well below the allowable limit.

It is estimated that 1,995 pounds of total chlorinated ethenes are present in the vadose zone and sorbed to soil beneath the groundwater. Carbtrol® Corporation's recommended adsorption capacity for its GAC for PCE removal is 0.35 pound of PCE per pound of GAC. Considering the TCE and DCE, which have lower adsorption capacities, the design average adsorption capacity was assumed to be 0.2 pound of chlorinated ethenes per pound of GAC. Therefore, approximately 10,000 pounds of GAC will be consumed over the project life.

At startup, it is estimated that 2 pounds per hour of chlorinated ethenes will be removed, but that the removal rate will quickly decrease to less than 0.5 pound per day. If two 3,000-pound vapor-phase GAC units are installed in series (Carbtrol® Model G-9) to treat the system emissions, then each unit will have the carbon changed out once. The first change out will likely occur after two weeks of operation. The calculations for the design of the emission-control system are included as Appendix D. Specifications for the proposed GAC units are included in Appendix B, and manufacturer cut-sheets are included in Appendix G.

If, during operation of the vapor-extraction system (i.e., monthly sampling event), the mass flow rate of chlorinated hydrocarbons is less than AGC, the vapor-phase GAC will be left in the process; however, the vapor-phase GAC units will not be replaced.

6.2.6.2 Water-Extraction Emissions Control

The extracted water will be routed to an air-stripping unit for treatment prior to discharge to the municipal sewer. Discussion of the air-stripping unit design and air emissions are presented in Section 6.3.4.

6.2.7 Control System

The control system proposed for this application consists of a programmable logic controller (PLC) panel and motor control center panel that are Underwriters Laboratory listed. The proposed application for the PLC panel consists of simple input/output components intended to perform the following functions:

- Shut down the DPE transfer pump if the water level in the tray air-stripper sump reaches a preset level. The DPE transfer pump will restart when the water level in the tray air-stripper unit reaches a low-level set point.
- Shut down the entire DPE system if the high water switch in the water-knockout tank is tripped.
- Shut down the entire DPE system if the tray air-stripping unit's blower fails.
- Shut down the DPE system if the oil reservoir high- or low-level switches are tripped.
- Allow cyclic operation of the motor-operated valves of the DPE system manifold using an interval timer.

The control panels will also be protected from power surges with surge protectors. Because the Site will be remote with no on-site personnel, a telemetry system with modem will be included in the system design. The telemetry system will be accessible through dial-up connection and a Microsoft Windows-based interface screen. Under certain alarm condition, the telemetry system will fax an alarm notification to a pre-set telephone number.

6.2.8 Cleanup Time

Using the pilot-study data and assuming the change in concentration of extracted vapors would follow a first-order exponential decay, then a simple mathematical model was developed to estimate the effluent-VOC concentration at a given time. By knowing the effluent concentration at a given time, the mass-removal rate over that time period could be estimated.

As shown in Appendix D, assuming a 10-percent efficiency of the system, 640-scfm flow rate, and 1,995 pounds of chlorinated ethenes to be extracted, the estimated cleanup time is one year. However, based upon field experience and including a safety factor of 2, the likely time to achieve the cleanup goals in the vadose zone is over two years. The time estimated to clean up the shallow-zone saturated soils using groundwater extraction alone was estimated to be more than ten years (Appendix C). However, dewatering this thin zone and exposing the soil to vapor extraction will expedite remediation. These two estimates of time do not include the effects of potential NAPL PCE that would tend to extend the required time to achieve the SCGs. Therefore, it is estimated that the cleanup time of the shallow zone will be closer to ten years considering the effects of NAPL.

A determination of when to shut down the system will be made in the future based upon effluent monitoring results. Once the effluent concentrations reach asymptotic levels (vapor concentrations below laboratory detection levels), operation of the system will be varied to monitor rebound. Confirmation soil sampling will be performed to confirm that the cleanup objectives have been met.

6.3 Intermediate-Zone Extraction-and-Treatment

Based on the FS (LFR 2000), groundwater extraction-and-treatment was the selected alternative for controlling the off-site migration and reducing the mass of the dissolved-phase plume in the intermediate zone by achieving hydraulic control. In the absence of continued advective mass transport of PCE and its degradation products to a downgradient dissolved-phase plume, it is anticipated that the VOC concentrations in the downgradient portions of the plume beyond the property lines and hydraulic-control capture zone would be naturally attenuated (e.g., dilution, dispersion, irreversible adsorption, and/or chemical reaction). The extracted groundwater will be treated using an air-stripping unit and will be discharged to the municipal sewer or an on-site infiltration gallery.

To achieve hydraulic control of the dissolved-phase plume, a “barrier line” of extraction wells, as necessary, can be installed perpendicular to the longitudinal axis of the dissolved chemical plume. The objective of this hydraulic-control configuration is to prevent the migration of the plume by modifying the groundwater-flow field so that the dissolved-phase VOCs (above natural-attenuation levels) are captured by the extraction system. LFR calculates that three recovery wells (designated RW-2I through RW-4I) along the north property line fence will be sufficient for hydraulic containment and extraction of the dissolved-phase plume present in the intermediate zone at the Site. Additionally, one previously existing extraction well (RW-1I; installed as part of Pre-RD activities) within the source area between the rail spurs will be included with the groundwater extraction and treatment through wells RW-2I, RW-3I, and RW-4I. This well (RW-1I) will serve to improve capture and expedite cleanup.

The long-term operation of a pump-and-treat remediation system is typically not effective in cleaning up contaminated aquifers to health-based concentration goals because of the presence of chemicals sorbed to soil that act as a continuing source. However, pump-and-treat technology implemented as part of a treatment train can be very effective, as long as the limitations are understood, which may include long-term operation and potential groundwater concentration rebound during source-area remediation.

The operation of the groundwater-extraction system will be affected by the proposed NiMo’s slurry wall. This cut-off wall will act to limit the recharge of groundwater onto the MCI property in the shallow and intermediate saturated zones. Therefore, the potential pumping rates in the intermediate zone will likely be reduced, as there will not be a continuing source of groundwater. An added benefit of the lack of recharge will be an increase in the efficiency of the DPE system, as the contaminants of concern will tend to be removed more rapidly through the vapor phase than the aqueous phase.

6.3.1 Capture Zone

The main component in designing an effective pump-and-treat remediation system is accurately determining the capture zone of the groundwater-extraction wells. Most failures of conventional pump-and-treat systems are due to inadequate characterization of aquifer properties, thereby miscalculating the capture zone and flow rates of the groundwater-extraction wells. To minimize the uncertainty associated with the intermediate-zone characterization, a pump test was performed to establish aquifer parameters as summarized in the Pre-RD Summary Report (LFR 2004).

Based upon the pump-test results and simple mathematical models, the capture zone was estimated at an assumed pumping rate of 1.5 gpm. Appendix H shows the calculations for the capture zone of a three-recovery-well barrier line system influenced by natural hydraulic gradient at the Site. The Javendel and Tsang equation (Fetter 1999) indicated that pumping 1.5 gpm will produce a crossgradient capture zone of 480 feet. The groundwater capture zone of the remedial system will be confirmed at startup. The proposed pumping rates are feasible based upon the specific capacity determined in the pump test. The maximum predicted drawdown within the intermediate zone at this pump rate is approximately 10 feet. The downgradient stagnation point calculations are also included in Appendix H and indicate a stagnation point of approximately 50 feet.

The proposed locations of the three barrier line intermediate-zone groundwater-extraction wells and source-area extraction well, along with dissolved chlorinated-ethene concentrations in groundwater, are shown on Figure 14. Also shown on Figure 14 is the estimated groundwater capture zone of the barrier line in comparison to the horizontal extent of chlorinated ethene-affected groundwater. The groundwater capture zone of the remedial system will be confirmed at startup.

6.3.2 Extraction Well Design

Three vertical, 5-inch-diameter extraction wells are proposed for this groundwater-extraction system in conjunction with the existing 5-inch extraction well (RW-1I). Recovery wells RW-2I through RW-4I will be installed to a depth of approximately 35 feet bgs (Figure 14). The recovery wells will be installed with a conventional drill rig using a hollow-stem auger with an outside diameter of at least 8 inches. The recovery wells will be constructed of 5-inch-diameter Schedule 40 flush-joint PVC casing and well screen. The well screen will be 0.020-inch slotted PVC. The screened interval of each well will be the bottom 15 feet of the well. The annular space of the borehole will be filled with a 20/30 sand pack to at least 1 foot above the screened interval. At least a 1-foot-thick bentonite seal will be installed, and the remaining annular space up to the bottom of the vault will be filled with Type I Portland cement. Each well will be completed in a locking 12-inch-diameter steel vault rated for heavy traffic. A detail of a typical intermediate-zone extraction well is presented in the construction drawings (Appendix A).

Each well will be equipped with a 1-inch pitless adapter, ball valve, check valve, flow meter, and sampling port as shown in the construction drawings (Appendix A). The appurtenant valves and meter will be located in the treatment building for ease of maintenance and regulation.

6.3.3 Groundwater-Extraction Pump Design

The proposed groundwater flow rates from RW-1I through RW-4I are 1.5 gpm per well, with an operational range of approximately 1 to 8 gpm. A design flow rate of 2 gpm per well will be used to provide a safety factor of 1.33. Based on the design requirements, the recommended groundwater-extraction pumps for the intermediate-zone wells are Grundfos 5SQE03A-90 series, or equivalent pump. Performance information for this pump is included in Appendix I. The proposed pump motors operate on 115-VAC, single-phase, electrical power.

The power supply to the recovery-well pumps will be equipped with an amperage sensor. If a pump draws the groundwater surface to the level of the intake, the pump will begin to cavitate and the amperage will change significantly. This amperage increase will be detected by the sensor and the sensor will signal the control panel to shut down the recovery well pump. After a five-minute time delay, the control panel will restart the recovery-well pumps. Upon startup of the groundwater-recovery system, several days will be spent adjusting the flow rates of the groundwater pumps to achieve optimal performance.

6.3.4 Treatment System Design

The extracted groundwater will be treated with a low-profile air-stripping unit and discharged to the municipal sewer.

6.3.4.1 Air-Stripping Unit

To treat the extracted groundwater at the proposed design flow rate of 6 gpm from the intermediate-zone extraction wells and 10 gpm from the DPE system, the average expected concentrations of chlorinated ethene in the influent was estimated as shown in Appendix J. Given the design flow rate of 16 gpm and influent concentration as shown in the following table, the proposed air-stripping unit was sized using the QED Air Stripper Model version C1.10 (Appendix J).

Compound	Tray Air-Stripping Unit Estimated Influent Concentrations (μg/l)	Tray Air-Stripping Unit Estimated Effluent Concentrations (μg/l)
Tetrachloroethene	5,643	<1
Trichloroethene	558	<1
Cis-1,2-Dichloroethene	4,081	1.6
trans-1,2-Dichloroethene	249	<1
Vinyl Chloride	324	<1

Based upon the model, a QED EZ-Tray 4.4 was selected as the proposed air-stripping unit. Information on this air-stripping unit is provided in Appendix K. The air-stripping unit is constructed of stainless steel, equipped with four trays, and capable of reducing the concentrations of the target compounds to less than 1 μg/l. The blower for the air-stripping unit should be capable of producing an air flow of approximately 210 acfm against a back pressure of 20 inches of water. Although the blower is equipped with inlet and outlet internal muffling, the treatment system will be installed inside a building to provide additional sound-suppression.

The blower motor will provide 5 horsepower and operate on 230-VAC, three-phase electrical power. The motor will be totally enclosed and fan-cooled. The air-stripping unit will be equipped with influent and effluent sampling ports, a mist eliminator, and a pressure gauge. The discharge stack will be 18 feet above ground surface.

6.3.4.2 Air-Stripping Unit Emission

Air emissions must comply with the requirements of 6 NYCRR Part 212 Guidelines. Therefore, based upon this requirement, an analysis was performed in accordance with Appendix B of the Guidelines to determine the allowable emission rate from the air-stripping unit. This analysis is included in Appendix F.

The allowable emission rate was determined for the five compounds expected to be present in the vapor stream. These compounds are PCE, TCE, cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride.

The estimated actual emissions rates for the air-stripping unit during startup and the initial weeks of operation are listed below based upon the QED model:

Compound	Tray Air-Stripping Unit Maximum Emission Rates (pound/hour)
Tetrachloroethene	0.051
Trichloroethene	0.005
cis-1,2-Dichloroethene	0.037
trans-1,2-Dichloroethene	0.0022
Vinyl Chloride	0.0029
Total	**0.098**

As PCE is the most sensitive compound of the four, it was selected for the emission-rate analysis. This determination was based upon an evaluation of the ratio of detected concentrations in the aqueous phase as demonstrated by the groundwater-sampling data to the corresponding AGC (1.0 $\mu g/m^3$). Using the Standard Point Source Method (Guidelines, Appendix B), the actual annual impact rate for PCE is 2.7 $\mu g/m^3$ assuming 8,760 operating hours per year and a PCE-emission rate of 0.051 pound per hour. This annual impact rate is greater than the AGC; therefore, emission-control technology will be required to reduce the PCE-emission rate to below the allowable limit. The estimated hourly PCE-emission rate (0.051 pound per hour) is based upon the groundwater-sampling data and the removal efficiency of the air-stripping unit.

It is estimated that when the PCE concentration reaches 83 milligrams per liter (mg/l) in the air-stripping unit influent, air emissions treatment will no longer be required as shown in Appendix F. The total chlorinated ethenes to be removed from groundwater is estimated to be 0.098 pound per hour. Carbtrol® Corporation's recommended adsorption capacity for its GAC for PCE removal is 0.35 pound of PCE per pound of GAC. Considering the TCE and DCE which have lower adsorption capacities, the design average adsorption capacity was assumed to be 0.2 pound of chlorinated ethene per pound of GAC. It is assumed that vinyl chloride has zero adsorption capacity; however, its emission is not expected to exceed the AGC of 0.11 $\mu g/m^3$.

At startup, it is estimated that 0.098 pound per hour of chlorinated ethenes will be removed, but that the removal rate will decrease over time. If two 170-pound vapor-phase GAC units are installed in series (Carbtrol® Model G-2; Appendix L) to treat the system emissions, then each unit will last approximately 350 days. The calculations for the design of the emission-control system are included as Appendix D. Specifications for the proposed GAC units are included in Appendix B, and manufacturer cut-sheets are included in Appendix L.

If, during operation of the air-stripping unit emissions-control system (i.e., monthly sampling event), the mass-flow rate of chlorinated ethene is less than AGC, the vapor-phase GAC will be left in the process; however, the vapor-phase GAC units will not be replaced.

6.3.5 Inorganic Fouling

There is the potential for scaling and fouling of the air-stripping unit from inorganic precipitation. The potential for scaling and fouling can be observed by monitoring the back pressure and visually inspecting the trays through the glass or by removing the trays. If operational data and observations warrant it in the future, a chemical-feed system using a concentrated blend of sequestering agents and polymers specifically designed to prevent the precipitation of hardness salts (calcium and manganese) and metal oxides (ferrous iron) will be added to the system.

6.3.6 Groundwater Effluent Discharge

At the present time, treated groundwater is proposed to be discharged into the sanitary-sewer system. However, JCI will evaluate the feasibility of returning the treated groundwater to the subsurface through an infiltration gallery. The air-stripping unit should readily reduce the chlorinated-ethene concentrations to below the Oneida County Department of Water Quality and Water Pollution Control discharge limit for Total Toxic Organics of 2 mg/l. A transfer pump will be used to pump the treated groundwater from the tray air-stripping unit into the sanitary sewer. A Goulds centrifugal-discharge pump (1-horsepower) will be capable of pumping a minimum of 18 gpm at a total discharge head of 40 feet.

An application with analytical data, discharge quantity, pretreatment-equipment specification, and a site plan will be required for approval of the discharge permit. A flow meter will provided by the city for a fixed cost and will be used to monitor the amount of groundwater entering the sewer. The discharge fee for disposing of water in the sanitary sewer is approximately $0.00171 per gallon. At the estimated groundwater flow rate of 18 gpm, the monthly disposal cost would be approximately $1,330; the annual disposal cost would be approximately $15,960. However, as discussed earlier, the flow rate will likely be much less once the shallow zone is dewatered and the slurry wall is installed, cutting off recharge.

If the discharge to sanitary sewer system is cost-prohibitive, JCI will evaluate alternate methods for the disposal of treated groundwater, such as an infiltration gallery system. The design and specifications of infiltration gallery will be provided to NYSDEC for review and approval should JCI choose to implement.

6.3.7 Control System

The groundwater-extraction wells and air-stripping unit will be controlled by PLC and motor control-center panels. The panels will contain an array of controls (e.g., motor starters, thermal-overload protection, Grundfos CU-300 controllers with R-100 infrared remote for the well pumps, hand switches, and alarm lights). This equipment will be connected to and controlled by the proposed PLC panel. The proposed system will feature the following operational characteristics:

- Shut down the groundwater-extraction pumps at dry-run conditions. The extraction pumps will automatically restart one hour later.
- Shut down the entire system if the air-stripping unit's blower pressure switches (high or low pressure) are tripped.
- Shut down the air-stripper blower if power is lost to the groundwater-extraction pumps and DPE pump. The control panel is equipped with a zero to 30-minute time delay for restart of the stripper blower to protect the motor.

6.3.8 Cleanup Time

As shown in Appendix H, the estimated time to remediate the chlorinated ethene-affected intermediate zone on site is 2.5 years following removal of continuing sources. That is, the hydraulic-control system will have to operate for approximately 2.5 years following completion of the remediation of the source areas. This estimate is based upon an assumed volume of 168,000 gallons of water in the intermediate zone on-site and a retardation factor of 5 for the chlorinated ethenes. A safety factor of 10 is also included to account for inefficiencies in water released from the aquifer.

Given that it is estimated that the cleanup time of the shallow zone will be closer to ten years considering the effects of NAPL in the shallow zone and the shallow and intermediate zones are connected, the intermediate hydraulic-control system will likely operate for 13 years.

A determination of when to shut down the system will be made in the future based upon effluent-monitoring results and upon approval of the NYSDEC. Once the effluent concentrations reach asymptotic levels (groundwater concentrations have stabilized and are no longer decreasing), the system will be shut down. Confirmation groundwater sampling will be performed to confirm that the cleanup objectives have been met.

6.4 Surface-Soil Excavation

Surface soil exceeds the SCG of 10 mg/kg for total cPAHs in four locations across the Site as shown on Figure 9. Two feet of PAH-affected surface soils exceeding the SCG will be excavated by NiMO in accordance with an access agreement with JCI to use the Site for their staging and decontamination of remedial-construction equipment. The excavated soils will be placed under the NiMo's proposed surface cap on the former Water Gas Plant. The location of the proposed surface-soil excavation is shown on Figure 15. Between 600 to 1,000 tons of soil will be excavated and consolidated with other source material and placed beneath the surface at the former Water Gas Plant. Following the excavation of the PAH-affected surface soils, a sufficient number of confirmation soil samples will be collected to ensure that the SCGs are achieved. The areas will be backfilled by JCI with a minimum of 24 inches of suitable fill.

6.5 Monitored Natural Attenuation

Protocols for evaluating monitored natural attenuation were described in the RD/RA Work Plan (LFR 2003). Samples from the12 selected shallow- and intermediate-depth monitoring wells along the groundwater flow path (MC-3, MWI-18, MC-5, MWI-6, MWS-10, OW-2I, OW-1S, OW-1I, MWS-23, MWI-24, MW-415S, and MW-416I) were collected and analyzed at CAS Laboratories for natural attenuation indicator parameters listed below. Dissolved ferrous iron and sulfide were measured in the field using Hach kits. The analytical results are presented in Table 3; physical field parameters are presented in Table 4.

6.5.1 Processes

Natural attenuation is defined as the biodegradation, dispersion, advection, dilution, sorption, volatilization, and/or chemical and biochemical stabilization of contaminants to effectively reduce contaminant toxicity, mobility, or volume to levels that are protective of human health and the ecosystem. Biodegradation is generally considered to be the primary mechanism for attenuating biodegradable contaminants.

Chlorinated solvents may undergo biodegradation through three different pathways:

- through use as an electron acceptor (reductive dechlorination)
- through use as an electron donor
- through cometabolism

Although all pathways may be present in the subsurface, reductive dechlorination is the most important process for the natural biodegradation of the highly chlorinated solvents. During reductive dechlorination, the chlorinated hydrocarbon is used as an electron acceptor (not as a source of carbon) and replaced with a hydrogen atom. Reductive dechlorination generally occurs by sequential dechlorination from PCE to TCE to DCE to vinyl chloride (Nyer and Duffin 1997).

Biodegradation is generally evaluated by collecting and analyzing site-specific natural attenuation indicator parameters to document contaminant loss and geochemical trends favoring natural attenuation. Typically, natural attenuation indicator parameters are measured along the axis of the plume, as well as transverse to it, and compared to the established background levels. For example, if dissolved-oxygen levels within the plume are below background levels, it is generally an indication of anaerobic conditions. Nitrate and sulfate concentrations below background levels in the plume indicate anaerobic biodegradation through dentrification and sulfate reduction. Higher than background concentrations of ferrous iron and methane in the plume indicate ferric iron reduction and methanogenesis. Reportedly, methanogenesis under reductive and anaerobic conditions is most effective for reductive dechlorination of chlorinated solvents. Values of oxidation-reduction potential (Eh) are used to evaluate oxidative and reductive conditions in the subsurface; low Eh values are indicative of reductive conditions.

6.5.2 Evidence

Strong evidence of dechlorination is apparent in a review of the historical groundwater-sampling data, which demonstrates sequential degradation of PCE. The geochemistry at the Site supports the reductive-dechlorination processes. For example, the dissolved-oxygen values at the Site are generally relatively low less than 1 mg/l within the source area (Table 3), indicating anaerobic conditions within the plume. Nitrate and sulfate concentrations within the groundwater plume are relatively low, indicating occurrences of nitrate and sulfate reduction processes. The elevated ferrous iron and methane levels also indicate presence of iron reduction or methanogenesis processes. The low Eh values suggest reductive conditions. Chlorinated solvents are effectively biodegraded under anaerobic and reducing conditions. Weighting of natural attenuation indicator parameters was conducted using site-specific data. The scoring sheets are presented in Appendix M. The scores (ranging between 12 and 22; greater than 15 in a majority of the wells) indicate that there is adequate to strong evidence for biodegradation at the Site.

- Dechlorination is occurring at the Site as evidenced by the presence of PCE degradation products (TCE, cis-1,2-DCE, 1,1-DCE, and vinyl chloride). Historical sampling data (Table 2) indicate that PCE and TCE concentrations have decreased over time.
- The presence of dissolved gases ethene and ethane in some samples indicates that complete dechlorination is occurring.
- Elevated sulfide and methane values in the groundwater plume indicate sulfate-reduction and methanogenesis are the important reductive pathways.

6.6 Institutional Controls

Deed restrictions will be required for potable use of on-site groundwater. This deed restriction will be required to remain in affect until the groundwater cleanup objectives are met. Additionally, a deed restriction will be required to manage in-place the cPAH subsurface soil exceeding 500 mg/kg.

6.7 Reductive Dechlorination (Ethanol Injection)

After implementation of remedial systems, three years of monitoring data will be collected and evaluated to assess whether ethanol injection is necessary to promote reductive dechlorination. If the monitoring data indicates that ethanol injection may be necessary to aggressively treat the “hot spots,” a remedial design (including an OM&M

plan for ethanol injection or other appropriate enhancement) will be prepared and submitted to NYSDEC for review and approval.

7.0 IMPLEMENTATION AND SYSTEM STARTUP

JCI will request bids from qualified remedial-action contractors to install the proposed remediation systems. The remedial-action contractor will install the equipment as specified in the construction drawings. The groundwater and DPE wells will be installed by a licensed drilling contractor. Subcontractor personnel conducting intrusive work will be required to be trained in accordance with Occupational Safety and Health Administration 29 Code of Federal Regulations 1910.120. Personnel will be required to read and sign the site-specific HSP.

7.1 System Construction

The remedial systems will be installed in general accordance with the construction drawings presented in Appendix A and specifications presented in Appendix B. The treatment equipment will be installed in a prefabricated building. By enclosing the equipment in a building, it will protect the equipment from rain, freezing temperatures, and direct sunlight and provide a sound barrier. Hazardous-waste warning signs will be mounted on the building.

The PCE concentrations in soil where trenching for piping and electrical conduit will be placed are expected to be below the Universal Treatment Standard (UTS) criteria; however, minimal soil above the UTS concentration may be encountered in the source area. If this occurs, the soil will be used as backfill material for the trenching in the source area and remediated by the DPE system.

LFR will oversee construction activities, including the installation of piping, equipment, and electricity. LFR will also monitor health and safety and conduct health and safety meetings. A daily record of field activities will be kept in a field notebook. The selected remedial-action contractor will be responsible for the labor, materials, equipment, and subcontractors necessary to install the remedial systems. The contractor will also be responsible for providing and installing the equipment. The contractor will obtain local building permits as necessary to complete specified work.

Upon completing system installation, the contractor will be required to perform equipment startup to verify that each component has been installed properly and is performing satisfactorily. A startup report, along with as-built drawings, will be prepared and submitted upon system startup.

7.2 Well Installation

JCI will obtain a quote for installation of the groundwater-extraction wells and DPE recovery wells from a licensed driller. Investigation-derived waste soil from the installation of the wells will be tested and properly managed. Groundwater generated from the installation of the groundwater-extraction wells will be treated on site with the proposed air-stripping unit, then discharged to the sanitary sewer.

7.3 System Startup

After completion of construction, the DPE and hydraulic-control systems will be started. It is projected that system-startup activities will take three days to complete.

7.3.1 Dual-Phase Extraction System

System startup of the DPE system will be conducted in accordance with recommendations of the manufacturers of all components. During startup, the vacuum and height of the draw-tube at each recovery well will be adjusted to provide the desired water-table drawdown and vadose-zone ROI. Groundwater elevations will be measured from monitoring wells daily and used to estimate drawdown and hydraulic capture. Monitoring wells MW-403S, MW-415S, MC-5, MWS-8, OW-1S, MWS-10, MWS-15, and MWS-14 will be used to evaluate the capture zone of the shallow DPE system. Vacuum levels at monitoring wells will be measured daily for the first three days and used to estimate the ROI. Based on the data collected, vacuum-level adjustments may be made to enhance the performance of the system.

The volume of water and air transferred to the treatment system will be monitored daily during startup. Water samples will be collected daily for the first three days after startup from the influent and effluent of the tray air-stripping unit as discussed below. Air samples will be collected from the DPE influent and effluent at startup, and on the second and third days of operation. The air samples will be analyzed by a fixed-base laboratory for PCE, TCE, cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride by using EPA Method TO-14 on a 24-hour turnaround basis. The system flow rate will be monitored and vacuum readings will be measured each day for two days at selected monitoring wells. Air samples and flow measurements will be collected periodically during startup from each recovery well to assess contaminant removal rates and the performance of the treatment system.

7.3.2 Intermediate-Zone Hydraulic Control

System startup of the hydraulic-control system will also be conducted in accordance with recommendations of the component manufacturers. During startup, the flow rate from each intermediate-zone groundwater-extraction well will be adjusted to maximize flow rate and drawdown without causing cavitation of pumps and, therefore, cycling of the pump. Groundwater elevations will be measured in selected on-site monitoring wells at least twice per day for three days to evaluate the zone of influence of the remediation system. Monitoring wells MWI-5, MWI-6, MWI-7, MW-416I, MWI-9, OW-1I, and OW-2I will be used to determine the capture zone of the intermediate groundwater-extraction system. Based on the data collected, flow and pressure adjustments may be made to enhance the performance of the hydraulic-control system.

Air samples will be also be collected from the air stripper effluent at start-up, and on the second and third days of operation. The air samples will also be analyzed by a fixed-base laboratory for PCE, TCE, cis-1,2-DCE, trans-DCE, and vinyl chloride using EPA Method TO-14 on a 24-hour turnaround basis.

The intermediate-zone groundwater-extraction system will operate continuously for at least the first six months of operation. Treatment-system water samples will be collected from the influent and effluent of the air stripper on a daily basis for at least the first three days. The first three daily samples will be shipped overnight and analyzed using EPA Method 8021 on a 24-hour turnaround basis for PCE, TCE, cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride. These data will be used to evaluate the mass-recovery rate of the remediation system, to evaluate the performance of the air stripper, and to determine whether permit discharge standards are being met. Long-term sampling will be described in Section 8.0.

8.0 OPERATION, MAINTENANCE, AND MONITORING

OM&M of the proposed remedial systems will be required to ensure that the equipment is operating efficiently and removing chlorinated ethenes from soil and groundwater at an acceptable rate. Large fluctuations in the DPE-system flow rates, vapor concentrations, or temperatures are likely indicators that occlusions or short-circuiting may be occurring in the formation, piping system, knockout tank, or GAC vapor-treatment vessels.

8.1 Schedule and Activities

OM&M events will be conducted monthly for the first quarter and then every four months (routine OM&M). During each routine OM&M event, the equipment should be inspected and preventive maintenance conducted in accordance with manufacture specifications provided in the manuals to be supplied by the equipment manufacturers. Monitoring data should be collected during each routine OM&M visit and equipment repairs should be made as necessary.

The scheduled OM&M events will be weekly for the first month of operation, then monthly for two months, and then every four months thereafter. Groundwater sampling of monitoring wells will be conducted every four months for the first year. Based on the annual OM&M data, a newer monitoring well sampling frequency will be determined.

The following tasks should be conducted during the routine OM&M events:

- The depths to groundwater and vacuum will be measured in select on-site monitoring wells.
- Air samples will be collected from the effluent of the air-stripping unit and influent and effluent of the DPE GAC adsorbers during each weekly and monthly OM&M

event for the first quarter. Thereafter, samples will be collected every four months until the GAC is removed or air concentrations are below detection limits. These samples will be analyzed using EPA Method TO-14.

- Groundwater samples will be collected from the influent and effluent of the tray air-stripping unit during each weekly and monthly OM&M event for the first quarter. Thereafter, samples will be collected every four months for the first year. These samples will be analyzed using EPA Method 8021.
- The run-time hours, vacuum, and temperature of influent vapor, and pressure and temperature of effluent vapor, should be recorded at the DPE blower system.
- The vapor-flow rate and vacuum at each extraction well should be measured.
- An OVA should be used to measure vapor concentrations from the extraction wells.
- The airflow rate, temperature, and pressure of the GAC vessels will be measured.
- The water-flow rate and total volume recovered will be recorded.
- The total volume of water discharged to the sewer or infiltration gallery will be recorded.

During OM&M visits, fine-tuning and adjustments of the vacuum pressures in the recovery wells, the height of the draw-tube in the recovery wells, and operating time cycles will be made to the system based on the data collected. These adjustments are intended to maximize system performance. The field data collected during each event, modifications to the operational profile of the remedial systems, and repairs to the systems will be recorded on a site-specific OM&M checklist. Eight-month status reports will be provided to the NYSDEC.

The DPE system is expected to operate approximately ten years. The GAC vessels for vapor-phase treatment are predicted to be replaced within the first 14 days of operation (Section 6.2.6.1). Thereafter, the GAC vessels may not have to be replaced if the influent vapor concentration significantly decreases. The air-stripping unit GAC canisters are expected to be replaced after the first 30 days of operation. As the influent concentration decreases, the frequency of carbon replacement will decrease.

8.2 Monitoring Program

To monitor the effectiveness of the remediation systems, monitoring wells (OW-2I, OW-1S, OW-1I, MWS-10, MWS-14, MWS-15, MWI-9, MWI-6, MC-5, MWS-8, MW-415S, MW-416I, MW-403S, and MW-404I) will be sampled every four months during the first year of operation. Following the evaluation of the first year OM&M data, a newer sampling frequency will be determined. Passive diffusion bags (PDBs) will be used to monitor the groundwater. The PDBs will be inserted into each well below the water table for a minimum of 14 days. The wells will be sampled by pulling out the PDBs and transferring the water into laboratory-provided vials. New PDBs will then be reinserted into the monitoring well for sampling during the next scheduled event. The collected groundwater samples will be analyzed for PCE, TCE, cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride using EPA Method 8021. The field monitoring and analytical data, along with any recommendations for modifications to the remediation system, will be presented in eight-month status reports.

Influent and effluent air and water samples will be collected every four months during the system operation or until data indicate concentrations are below detectable limits. The air samples will be analyzed for PCE, TCE, cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride using EPA Method TO-14, and the water samples will be analyzed using EPA Method 8021. The data will be used to evaluate the mass-removal rates and treatment-system efficiencies.

8.3 Post-Remediation Monitoring

Post-remediation monitoring will be conducted upon discontinuing the active remedial systems. Twenty soil samples from the source-area vadose zone would be collected using direct-push technology and analyzed using EPA Method 8021. The soil samples would be collected from various depths to confirm meeting the SCGs. The post-remediation groundwater monitoring will be based upon the semiannual monitoring data.

9.0 SCHEDULE

The following table presents the draft schedule for implementation and startup of the proposed remedial action systems and monitoring. Construction timeframe of the proposed remedial systems is contingent upon the completion of NiMo's barrier wall construction:

Task Description	Project Schedule Duration (Days)
Final 100% RD Report	60 [1]
NYSDEC approval of Final RD Report	*
Solicit bids	100 days
Award remedial-action contract	60
Initiate remedial construction	**
Install extraction and recovery wells, piping, and trenching	120
Install the remedial systems to treat vapor and groundwater streams	120
Startup	25
Remedial action DPE	3,650 [2]
Remedial action hydraulic-control/MNA	4,745 [2]

Notes:

* NYSDEC-dependent

** Timeframe begins upon NYSDEC approval of RD Report and NiMo's completion of on-site remedial activities.

[1] after receipt of NYSDEC comments of 95% RD report

[2] after system startup

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Table 1
Monitoring Well Construction Data
Former Monarch Chemicals, Inc.
Utica, New York

Well ID	Top of Casing Elevation (feet NGVD)	Total Depth (feet bgs)	Monitoring Zone	Screen Interval (feet bgs)	Well Diameter (inches)	Casing Material	Sump Depth (feet bgs)	Date Installed	Installed By	Location
MC-1	409.61	17.0	Shallow	7-17	2	PVC	None	Aug-90	URS	MCI
MWI-13	410.07	36.0	Intermediate	29-34	2	PVC	34-36	Oct-96	LFR	MCI
MC-2	409.64	17.0	Shallow	7-17	2	PVC	None	Jul-90	URS	MCI
MC-3	411.06	16.75	Shallow	6.75-16.75	2	PVC	None	Aug-90	URS	MCI
MWI-18	410.66	29.5	Intermediate	22.5-27.5	2	PVC	27.5-29.5	Nov-96	LFR	MCI
MC-4	411.26	17.5	Shallow	7.5-17.5	2	PVC	None	Aug-90	URS	MCI
MWI-5	411.29	36.0	Intermediate	31-36	2	PVC	None	Oct-96	LFR	MCI
MC-5	408.62	17.0	Shallow	7-17	2	PVC	None	Aug-90	URS	MCI
MWI-6	407.65	36.0	Intermediate	29-34	2	PVC	34-36	Oct-96	LFR	MCI
SC-4	410.00	17.6	Shallow	NA	2	NA	NA	NA	NA	MCI
MWI-7	409.16	33.4	Intermediate	26.4-31.4	2	PVC	31.4-33.4	Oct-96	LFR	MCI
MWS-8	410.65	14.0	Shallow	4.0-14	2	PVC	None	Oct-96	LFR	MCI
MWI-9	410.19	34.0	Intermediate	27-32	2	PVC	32-34	Oct-96	LFR	MCI
MWS-10	412.14	14.0	Shallow	4.0-14	2	PVC	None	Oct-96	LFR	MCI
OW-2I	NS	35.0	Intermediate	25-35	2	PVC	None	May-04	LFR	MCI; Pump Test Obs. Well
MWS-11	410.16	14.0	Shallow	4.0-14	2	PVC	None	Oct-96	LFR	MCI
MWI-12	409.71	34.0	Intermediate	27-32	2	PVC	32-34	Oct-96	LFR	MCI
MWS-14	410.59	14.0	Shallow	4.0-14	2	PVC	None	Oct-96	LFR	MCI
MWS-15	411.75	15.5	Shallow	5.0-15	2	PVC	15-15.5	Oct-96	LFR	MCI

Table 1
Monitoring Well Construction Data
Former Monarch Chemicals, Inc.
Utica, New York

Well ID	Top of Casing Elevation (feet NGVD)	Total Depth (feet bgs)	Monitoring Zone	Screen Interval (feet bgs)	Well Diameter (inches)	Casing Material	Sump Depth (feet bgs)	Date Installed	Installed By	Location
MWS-16	410.21	14.0	Shallow	4.0-14	2	PVC	None	Oct-96	LFR	MCI
MWI-17	410.17	34.0	Intermediate	27-32	2	PVC	32-34	Nov-96	LFR	MCI
MWS-19	411.04	15.0	Shallow	5.0-15	2	PVC	None	Nov-96	LFR	MCI
MWI-20	410.51	24.0	Intermediate	17-22	2	PVC	22-24	Oct-96	LFR	MCI
MWS-21	411.13	14.0	Shallow	4-14	2	PVC	None	Oct-98	LFR	MCI
MWI-22	410.67	32.0	Intermediate	27-32	2	PVC	None	Oct-98	LFR	MCI
MWS-23	411.96	14.0	Shallow	4-14	2	PVC	None	Oct-98	LFR	MCI
MWI-24	411.90	27.5	Intermediate	22.5-27.5	2	PVC	None	Oct-98	LFR	MCI
MW-3	411.63	16.1	Shallow	NA	2	PVC	NA	NA	NA	Texaco
MW-4	410.90	16.1	Shallow	NA	4	PVC	NA	NA	NA	Texaco
MW-415S	409.04	14.0	Shallow	8-13	2	SS	13-14	Jan-95	PES	MVO
MW-416I	409.14	38.0	Intermediate	27-37	2	SS	37-38	Feb-95	PES	MVO
MW-403S	408.27	12.0	Shallow	5.7-10.7	2	SS	10.7-12	May-94	PES	MVO
MW-404I	408.54	30.0	Intermediate	18.7-28.7	2	SS	28.7-30	May-94	PES	MVO
MW-411S	409.10	17.0	Shallow	5-15	2	SS	15-17	May-94	PES	MVO
MW-410I	408.68	32.0	Intermediate	20.5-30.5	2	SS	30.5-32	May-94	PES	MVO
MW-13S	409.35	14.0	Shallow	8-14	2	SS	None	Nov-84	AES	Washington/Lee Street
MW-13I	409.10	35.0	Intermediate	23-25	2	SS	None	Nov-84	AES	Washington/Lee Street

Table 1
Monitoring Well Construction Data
Former Monarch Chemicals, Inc.
Utica, New York

Well ID	Top of Casing Elevation (feet NGVD)	Total Depth (feet bgs)	Monitoring Zone	Screen Interval (feet bgs)	Well Diameter (inches)	Casing Material	Sump Depth (feet bgs)	Date Installed	Installed By	Location
MW-15S	406.28	15.0	Shallow	10.0-15.0	2	SS	None	Nov-84	AES	SW bank of harbor
MW-15I	406.37	35.0	Intermediate	25.0-35.0	2	SS	None	Nov-84	AES	SW bank of harbor
MW-43S	409.35	16.5	Shallow	11.5-16.5	2	SS	None	Nov-84	AES	W bank of harbor
MW-43I	409.36	35.0	Intermediate	25.0-35.0	2	SS	None	Nov-84	AES	W bank of harbor
OW-1S	NS	20	Shallow	5-20	2	PVC	None	May-04	LFR	MCI; Pump Test Obs. Well
OW-1I	NS	35	Intermediate	25-35	2	PVC	None	May-04	LFR	MCI; Pump Test Obs. Well
RW-1S	NS	20	Shallow	5-20	5	PVC	None	May-04	LFR	MCI; Pump Test Obs. Well
RW-1I	NS	35	Intermediate	25-35	5	PVC	None	May-04	LFR	MCI; Pump Test Obs. Well

Notes:

NGVD = National Geodetic Vertical Datum
bgs = below ground surface
PVC = polyvinyl chloride
SS = stainless steel
LFR = LFR Levine·Fricke
URS = URS Consultants, Inc.
AES = Atlantic Environmental Services, Inc.

PES = Parsons Engineering Service, Inc.
MCI = Monarch Chemicals, Inc. site
WGP = Former water gas plant site
MVO = Mohawk Valley Oil site
NA = not available
NS = not surveyed

Table 2
Monitoring Well Analytical Results for Chlorinated Solvents
Former Monarch Chemicals, Inc.
Utica, New York

Well ID	Date	PCE	TCE	1,2-DCE (total)	cis-1,2-DCE	trans-1,2-DCE	1,1-DCE	Vinyl Chloride	Total Ethenes	TCA	DCA
MC-1	Nov-96	34J	42J	3,900			100	3,500	7,500	1,800	6,100
	Oct-98	72	21	3,400			39	1,700	5,232	1,100	5,800
MWI-13	Nov-96	<50	<50	19			<50	<50	19	40	46
	May-97	<10	<10	4			<10	<10	4	1	4
	Oct-98	54	3	<20			<20	<20	57	<20	<20
MC-2	Nov-96	<50	<50	<50			<50	18	18	<50	58
	Oct-98	<10	<10	3			<10	<10	3	<10	99
MC-3	Nov-96	<10	2	210			<10	58	270	<10	36
	Oct-98	12	5	210			<10	48	275	<10	53
	Jun-04	<5	<5		32	<5	<5	26	58	<5	<10
MWI-18	Nov-96	520	410	800			8	89	1,827	32	43
	May-97	120	75	530			<50	65	790	10	33
	Oct-98	21	16	230			1	66	334	<10	20
Dup	Oct-98	21	18	310			<20	62	411	<20	21
	Jun-04	<5	<5		23	<5	<5	22	45	<5	<5
MC-4	Nov-96	<10	<10	<10			<10	<10	0	<10	<10
	Oct-98	<10	<10	1			<10	<10	1	<10	<10
	Jun-04	<5	<5		<5	<5	<5	<5	0	<5	<5
MWI-5	Nov-96	<10	<10	<10			<10	<10	0	<10	<10
Dup	Nov-96	<10	<10	<10			<10	<10	0	<10	<10
	May-97	<10	<10	<10			<10	<10	0	<10	<10
	Oct-98	<10	<10	<10			<10	<10	0	<10	<10
	Jun-04	<5	<5		<5	<5	<5	<5	0	<5	<5
MC-5	Nov-96	37	990	6,200			94	1,600	8,921	2,000	420
	Oct-98	19	520	4,600			34	650	5,823	1,100	240
	Jun-04	<25	470		3,200	<25	<25	570	4,240	680	230
MWI-6	Nov-96	75	840	9,000			63	770	10,748	130	220
	May-97	<500	590	8,900			58	560	10,108	<500	270
	Oct-98	77	210	3,600			39	100	4,026	12	180
	Jun-04	<50	120		9,500	<50	63	1,300	10,983	<50	
SC-4	Nov-96	18	28	430			<50	75	551	69	230
	Oct-98	17	35	490			<50	39	581	46	250

Table 2
Monitoring Well Analytical Results for Chlorinated Solvents
Former Monarch Chemicals, Inc.
Utica, New York

Well ID	Date	PCE	TCE	1,2-DCE (total)	cis-1,2-DCE	trans-1,2-DCE	1,1-DCE	Vinyl Chloride	Total Ethenes	TCA	DCA
MWI-7	Nov-96	<50	11	2,900			24	250	3,185	<50	110
	May-97	<200	21	4,900			43	200	5,164	<200	170
	Oct-98	<10	55	6,100			62	190	6,407	<10	150
MWS-8	Nov-96	5,900	1,700	15,000			140	1,700	24,440	<50	48
	May-97	690	300	2,000			16	120	3,126	9	22
	Oct-98	610	410	4,600			42	240	5,902	<10	34
	Jun-04	51	68		1,100	<13	<13	83	1,302	<13	<13
Dup	Jun-04	57	78		1,300	<13	<13	91	1,526	<13	<13
MWI-9	Nov-96	46	380	5,500			48	190	6,164	<50	130
	May-97	32	460	4,500			38	110	5,140	<50	130
	Oct-98	24	620	5,400			48	170	6,262	1	160
	Jun-04	<100	<100		3,400	<100	<100	150	3,550	<100	<100
MWS-10	Nov-96	91,000	4,400	6,900			89	170	102,559	<50	<50
	May-97	150,000	4,700	9,700			71	71	164,542	<50	<50
	Oct-98	84,000	5,300	7,300			65	110	96,775	<10	<10
Dup	Oct-98	84,000	5,600	7,300			67	110	97,077	<10	<10
	Jun-04	50,000	3,700		8,900	<1,000	<1,000	<1000	62,600	<1000	<1000
OW-2I	Jun-04	<25	<25		<25	2,700	38	150	2,888	99	260
OW-1S	Jun-04	490	190		1,400	<13	<13	33	2,113	<13	<13
OW-1I	Jun-04	<10	<10		3,700	25	28	270	4,023	<10	69
MWS-11	Nov-96	21	140	790			900	430	2,281	98	200
	May-97	14	170	740			670	510	2,104	68	160
	Oct-98	8	110	380			520	160	1,178	47	170
MWI-12	Nov-96	<10	<10	<10			<10	<10	0	<10	<10
	May-97	<10	<10	<10			<10	<10	0	<10	<10
	Oct-98	65	5	4			<10	<10	74	<10	<10

Table 2
Monitoring Well Analytical Results for Chlorinated Solvents
Former Monarch Chemicals, Inc.
Utica, New York

Well ID	Date	PCE	TCE	1,2-DCE (total)	cis-1,2-DCE	trans-1,2-DCE	1,1-DCE	Vinyl Chloride	Total Ethenes	TCA	DCA
MWS-14	Nov-96	92	300	370			< 50	21	783	35	17
	May-97	79	230	290			2	2	603	43	16
	Oct-98	62	200	390			3	12	667	30	22
	Jun-04	39	140		90	< 5	< 5	5.7	275	11	6.7
MWS-15	Nov-96	370	80	2,000			< 100	1,400	3,850	< 100	110
	May-97	12,000	4,400	7,200			< 50	1,200	24,800	120	150
	Oct-98	16	62	3,800			19	730	4,627	< 10	100
	Jun-04	230	430		8,600	< 50	< 50	1,200	10,460	< 50	< 50
MWS-16	Nov-96	< 10	< 10	59			6	25	90	< 10	62
	May-97	< 10	< 10	29			15	11	55	< 10	36
	Oct-98	< 10	< 10	61			19	26	106	< 10	37
	Jun-04	< 5	< 5		96	< 5	< 5	54	150	< 5	14
MWI-17	Nov-96	2	< 10	3			< 10	3	8	< 10	1
	May-97	3	< 10	2			< 10	4	9	< 10	2
Dup	May-97	3	< 10	3			< 10	4	10	< 10	2
	Oct-98	21	< 10	2			< 10	5	28	< 10	6
	Jun-04	< 5	< 5		29	< 5	< 5	11	40	< 5	32
Dup	Jun-04	< 5	< 5		52	< 5	< 5	20	72	< 5	36
MWS-19	Nov-96	< 10	< 10	< 10			< 10	< 10	0	< 10	< 10
	May-97	< 1200	< 1200	< 1200			< 1200	< 1200	0	< 1,200	< 1,200
MWI-20	Nov-96	< 10	< 10	< 10			< 10	< 10	0	< 10	< 10
	May-97	< 100	< 100	< 100			< 100	< 100	0	< 100	< 100
MWS-21	Oct-98	< 10	1	4			< 10	< 10	5	< 10	< 100
	Jun-04	< 5	< 5		< 5	< 5	< 5	< 5	0	< 5	< 5
MWI-22	Oct-98	< 10	< 10	< 10			< 10	< 10	0	< 10	< 10
	Jun-04	< 5	< 5		< 5	< 5	< 5	< 5	0	< 5	< 5
MWS-23	Oct-98	< 10	3	9			< 10	< 10	12	< 10	15
	Jun-04	< 5	6.5		< 5	< 5	< 5	< 5	7	< 5	< 5

Table 2
Monitoring Well Analytical Results for Chlorinated Solvents
Former Monarch Chemicals, Inc.
Utica, New York

Well ID	Date	PCE	TCE	1,2-DCE (total)	cis-1,2-DCE	trans-1,2-DCE	1,1-DCE	Vinyl Chloride	Total Ethenes	TCA	DCA
MWI-24	Oct-98	< 10	< 10	< 10			< 10	< 10	0	< 10	< 10
	Jun-04	< 5	< 5		< 5	< 5	< 5	< 5	0	< 5	< 5
MW-3	Nov-96	< 10	< 10	5			< 10	3	8	< 10	< 10
	Oct-98	< 10	< 10	6			< 10	< 10	6	9	3
MW-4	Nov-96	< 10	< 10	22			< 10	7	29	< 10	4
MW-415S	Nov-96	< 10	< 10	56			< 10	83	139	< 10	54
	Oct-98	< 10	< 10	2			< 10	< 10	2	< 10	14
	Apr-04	ND	ND		< 0.5		< 0.5	< 1	0	< 0.5	< 0.75
MW-416I	Nov-96	4	6	4,000			43	80	4,133	77	760
	Oct-98	16	7	7,000			120	140	7,283	280	1,100
Dup	Oct-98	< 1,000	< 1,000	8,700			< 1,000	< 1,000	8,700	290	1,300
	Apr-04	ND	ND		19000		< 1000	< 2000	19,000	1100	2700
MW-403S	Nov-96	< 10	< 10	< 10			< 10	< 10	0	< 10	< 10
	Oct-98	< 10	< 10	< 10			< 10	< 10	0	< 10	< 10
	Apr-04	ND	ND		< 0.5		< 0.5	< 1	0	< 0.5	< 0.75
MW-404I	Nov-96	< 50	< 50	540			< 50	210	750	< 50	31
Dup	Nov-96	< 50	< 50	570			< 50	240	810	< 10	17
	Oct-98	< 10	< 10	320			2	69	391	< 50	31
	Apr-04	ND	ND		520		< 20	92	612	< 20	< 30
MW-411S	Nov-96	< 10	< 10	< 10			< 10	< 10	0	< 10	< 10
	Oct-98	< 50	< 50	< 50			< 50	< 50	0	< 50	< 50
	Apr-04	ND	ND		< 12		< 12	< 25	0	< 12	< 19
MW-410I	Nov-96	< 50	7	3,400			28	1,600	5,035	< 50	430
	Oct-98	< 1,000	< 1,000	500			< 1,000	< 1,000	500	< 1,000	200
Dup	Oct-98	< 1,000	< 1,000	810			< 1,000	< 1,000	810	< 1,000	220
	Apr-04	ND	ND		2700		< 50	1300	4,000	< 50	200
MW-13S	Nov-96	< 50	< 50	< 50			< 50	< 50	0	< 50	< 50
	Oct-98	< 500	< 500	< 500			< 500	< 500	0	< 500	< 500

Table 2
Monitoring Well Analytical Results for Chlorinated Solvents
Former Monarch Chemicals, Inc.
Utica, New York

Well ID	Date	PCE	TCE	1,2-DCE (total)	cis-1,2-DCE	trans-1,2-DCE	1,1-DCE	Vinyl Chloride	Total Ethenes	TCA	DCA
MW-13I	Nov-97	<50	44	23,000			210	2,100	25,354	<50	1,400
	Oct-98	<1,000	<1,000	9,400			<1.000	640	10,040	<1,000	640
	Apr-04	ND	ND		6000		52	1500	7,552	<50	740
MW-43S	Oct-98	<10	<10	1			<10	<10	1	<10	<10
	Apr-04	ND	ND		<0.5		<0.5	<1	0	<0.5	<0.75
MW-43I	Oct-98	<10	<10	<10			<10	<10	0	<10	<10
	Apr-04	ND	ND		<0.5		<0.5	<1	0	<0.5	<0.75
MW-15S	Oct-98	<10	<10	3			<10	<10	3	<10	<10
	Apr-04	ND	ND		<0.5		<0.5	<1	0	<0.5	<0.75
MW-15I	Oct-98	<10	<10	43			<10	370	413	<10	22
	Apr-04	ND	ND		<1.2		<1.2	2.6	3	<1.2	<1.9

Notes:

Concentrations presented in micrograms per liter.
April 04 samples were collected by CDM for NiMo.

DCA = dichloroethane
DCE = dichloroethene
Dup = duplicate sample
ND = not detected
PCE = tetrachloroethene
TCA = trichloroethane
TCE = trichloroethene

Table 3
Monitored Natural Attenuation Indicator Parameters
Former Monarch Chemicals, Inc.
Utica, New York

Parameter	Method	Monitoring Well Identification, Screened Interval, and Date Sampled					
		MC-3	MWI-18	MC-5	MWI-6	MWS-10	OW-2I
		Shallow	Intermediate	Shallow	Intermediate	Shallow	Intermediate
		6/15/04	6/15/04	6/15/04	6/15/04	6/14/04	6/14/04
pH (standard units)	Field	6.98	7.01	6.97	6.83	6.67	7.23
Temperature (degrees Celsius)	Field	12.1	NM	15.8	11.3	14.6	12.0
Oxidation Reduction Potential (mV)	Field	-148.2	-88.6	-155	-139.5	-2.6	-80.6
Dissolved Oxygen (mg/l)	Field	0.48	1.17	6.97	0.29	0.35	0.33
Total Alkalinity	EPA 310.1	245	525	330	330	330	430
Ferrous Iron	Field - Hach Kit	2.96	2.7	5.1	5.1	1.9	4.37
Sulfate	EPA 300	<2	<2	28.1	47.7	141	598
Sulfide	Field - Hach Kit	1.8	15.4	0.6	0.6	0	2.2
Nitrate	EPA 300	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Nitrite	EPA 353.2	0.0302	0.0119	0.0751	0.274	<0.0100	0.0628
Soluble Organic Carbon	EPA 9060	8.73	7.02	8.23	7.19	6.33	13.4
Methane	Modified RSK-175 (EPA)	4.7	6	0.3	1.6	0.15	1.7
Ethene	Modified RSK-175 (EPA)	<0.001	<0.001	0.07	0.74	0.0042	0.12
Ethane	Modified RSK-175 (EPA)	<0.001	<0.001	0.039	0.24	0.0045	0.05

Notes:

Concentrations are presented in milligrams per liter.

< = less than

mV = millivolts

NM = not measured due to equipment malfunction

Table 3
Monitored Natural Attenuation Indicator Parameters
Former Monarch Chemicals, Inc.
Utica, New York

Parameter	Method	Monitoring Well Identification, Screened Interval, and Date Sampled					
		OW-1S	OW-1I	MWS-23	MWI-24	MW-415S	MW-416I
		Shallow	Intermediate	Shallow	Intermediate	Shallow	Intermediate
		6/15/04	6/15/04	6/17/04	6/15/04	6/17/04	6/17/04
pH (standard units)	Field	6.96	6.76	7.18	6.83	7.07	6.82
Temperature (degrees Celsius)	Field	13.5	14.5	12.6	12.2	13.8	12.4
Oxidation Reduction Potential (mV)	Field	-148.3	-41.6	-108.2	-82.1	-111.3	-108.2
Dissolved Oxygen (mg/l)	Field	0.09	0.25	0.85	0.4	0.53	0.25
Total Alkalinity	EPA 310.1	390	615	280	615	275	485
Ferrous Iron	Field - Hach Kit	5.1	1.16	3.09	3.82	3.48	2.81
Sulfate	EPA 300	21.7	109	5.52	<2	7.88	120
Sulfide	Field - Hach Kit	0.4	0	2.3	0	0.4	0.8
Nitrate	EPA 300	<0.5	<0.5	1.38	<0.5	<0.5	<0.5
Nitrite	EPA 353.2	<0.0100	0.0597	<0.0100	0.0348	0.0301	0.0651
Soluble Organic Carbon	EPA 9060	2.8	13.3	4	14.7	4.36	14
Methane	Modified RSK-175 (EPA)	0.24	1.3	2.2	36	2.4	8.1
Ethene	Modified RSK-175 (EPA)	0.0044	0.15	<0.025	<0.5	<0.050	0.21
Ethane	Modified RSK-175 (EPA)	0.017	0.16	<0.025	<0.5	<0.050	0.37

Notes:

Concentrations are presented in milligrams per liter.

< = less than

mV = millivolts

NM = not measured due to equipment malfunction

Table 4
Groundwater Sampling Physical Parameters
Former Monarch Chemicals, Inc.
Utica, New York

Well ID	Sampling Date	Time	Temperature (°C)	pH (SU)	Specific Conductance (μmhos/cm)	Dissolved Oxygen (mg/l)	Eh (mV)	Turbidity (NTU)
MC-3	6/15/04	10:09	12.1	6.98	790	0.48	-148.2	24.1
MWI-18	6/15/04	9:30	NR	7.01	860	1.17	-88.6	1029
MC-4	6/17/04	12:51	12	6.95	1,390	0.44	-105.9	3.87
MWI-5	6/17/04	13:20	11.7	6.86	1,880	0.22	-98.6	6.78
MC-5	6/15/04	15:44	15.8	6.97	760	0.94	-155	6.77
MWI-6	6/15/04	15:17	11.3	6.83	1,080	0.29	-139.5	14.3
MWS-8	6/16/04	14:41	13.6	6.76	790	0.12	-56	3.67
MWI-9	6/16/04	16:02	13.1	6.82	1,290	0.24	-82.6	3.3
MWS-10	6/14/04	15:05	14.6	6.67	900	0.35	-2.6	31.2
OW-2I	6/14/04	16:13	12	7.23	420	0.33	-80.6	36.3
MWS-14	6/14/04	17:47	13.8	6.59	460	1.34	88.2	1.36
MWS-15	6/14/04	17:00	12.7	6.51	770	0.32	-141.9	11.3
MWS-16	6/16/04	13:37	13.4	6.88	660	0.25	-144.9	6.25
MWI-17	6/16/04	16:04	11.2	7.04	1,010	0.19	-96.7	7.51
MWS-21	6/16/04	12:22	15.2	7.04	650	0.27	-166.2	5.12
MWI-22	6/16/04	16:59	11.4	6.97	1,150	0.14	-114.5	7.14
MWS-23	6/17/04	8:24	12.6	7.18	560	0.85	-108.2	17.8
MWI-24	6/15/04	16:55	12.2	6.83	1,440	0.4	-82.1	7.41
MW-415S	6/17/04	9:40	13.8	7.07	800	0.53	-111.3	108.9
MW-416I	6/17/04	10:22	12.4	6.82	1,610	0.25	-108.2	50.2
OW-1S	6/15/04	13:09	13.5	6.96	1,510	0.09	-148.3	6.43
OW-1I	6/15/04	13:06	14.5	6.76	760	0.25	-41.6	0.95

Notes:
°C = degrees Celsius
μmhos/cm = micromhos per centimeter
mg/l = milligrams per liter
mV = millivolt
NR = not reported
NTU = nephelometric turbidity unit
SU = standard unit

JONES/3445SITE\WDB\05-01-03

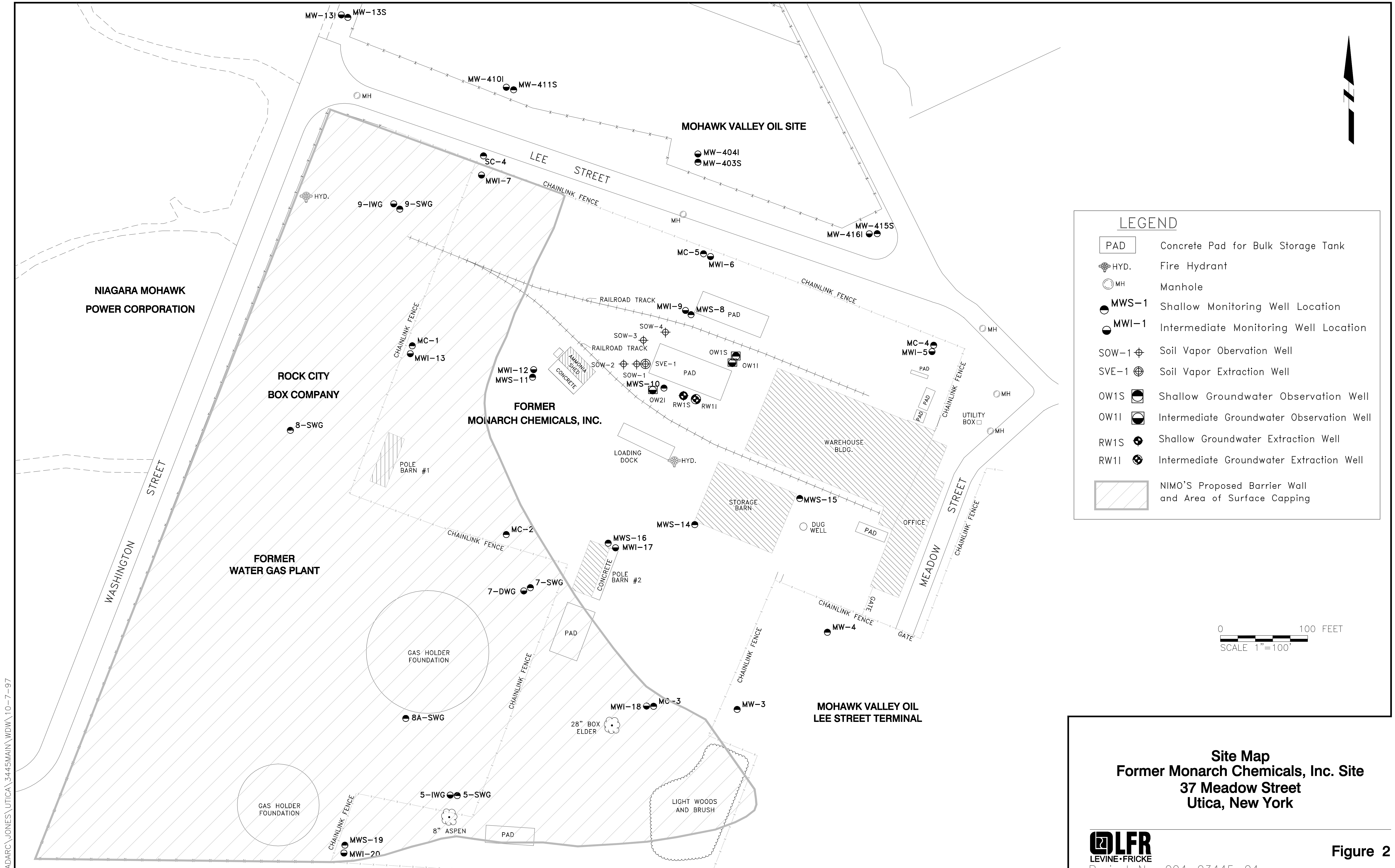
Source USGS National Mapping Program.
New York State.

SCALE 1:50000

LFR
LEVINE · FRICKE
Project No. 004-03445-03

Figure 1

Site Location Map
Former Monarch Chemicals, Inc. Site
37 Meadow Street
Utica, New York

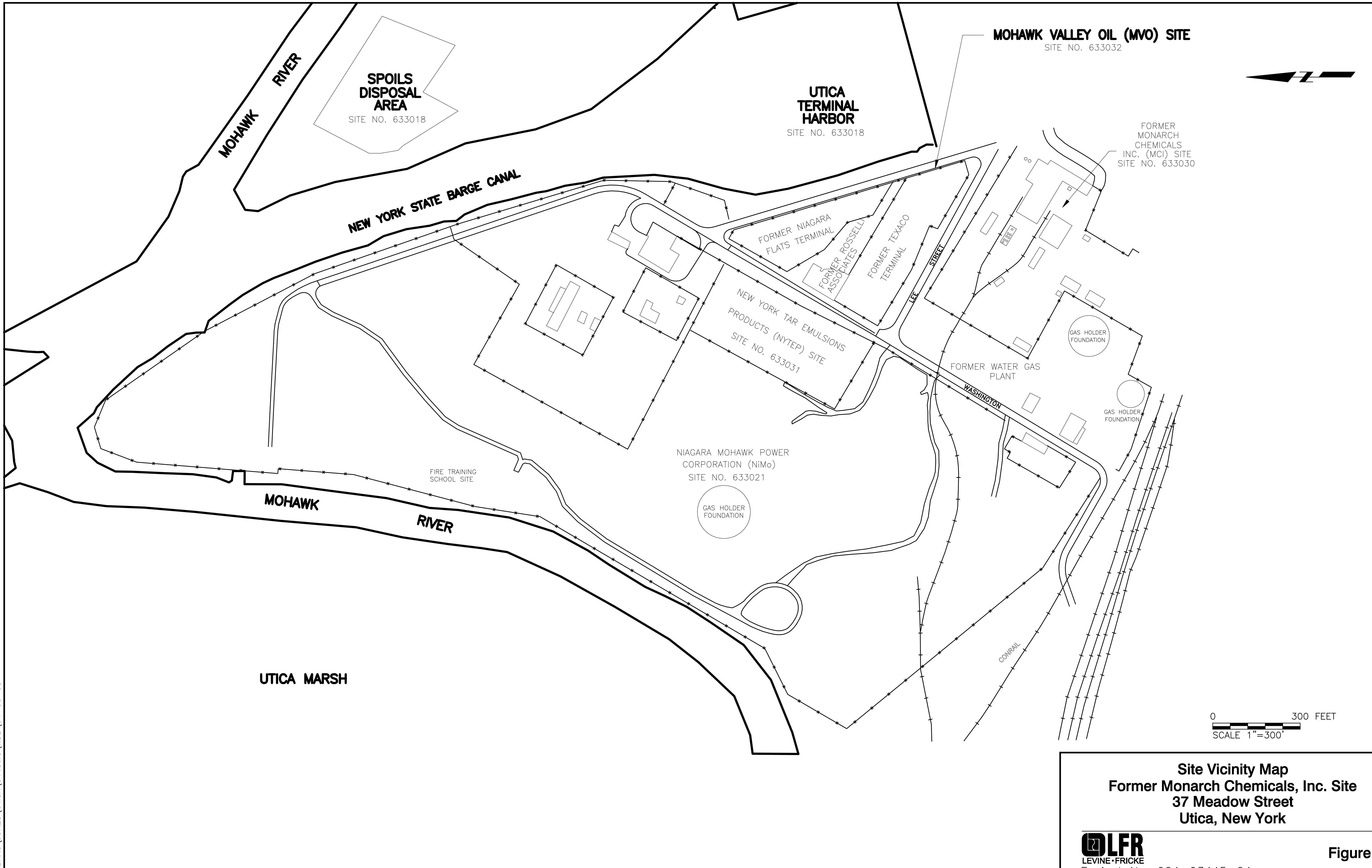


Site Map
Former Monarch Chemicals, Inc. Site
37 Meadow Street
Utica, New York

LFR LEVINE·FRICKE

Project No. 004-03445-04

Figure 2



Site Vicinity Map
Former Monarch Chemicals, Inc. Site
37 Meadow Street
Utica, New York

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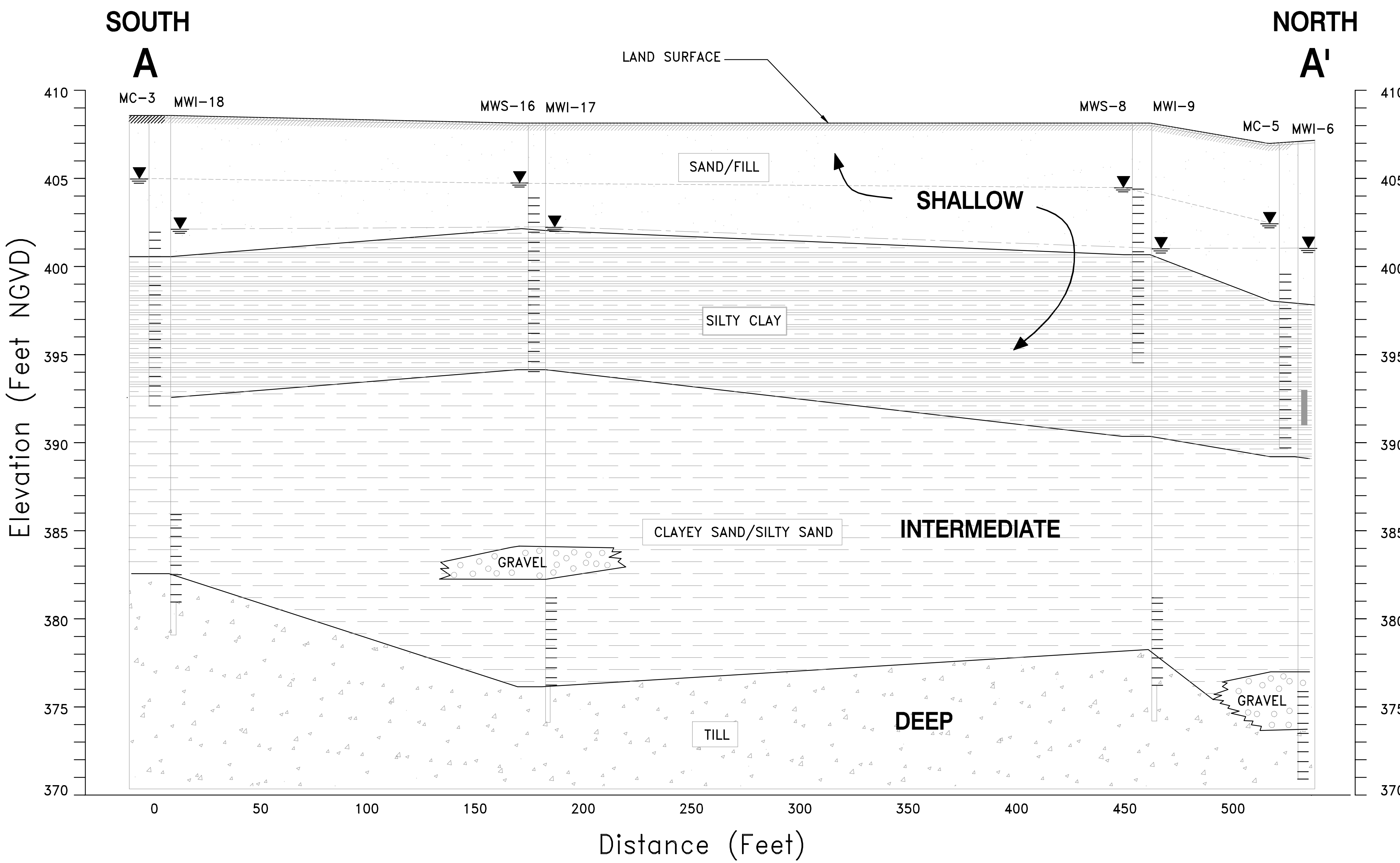
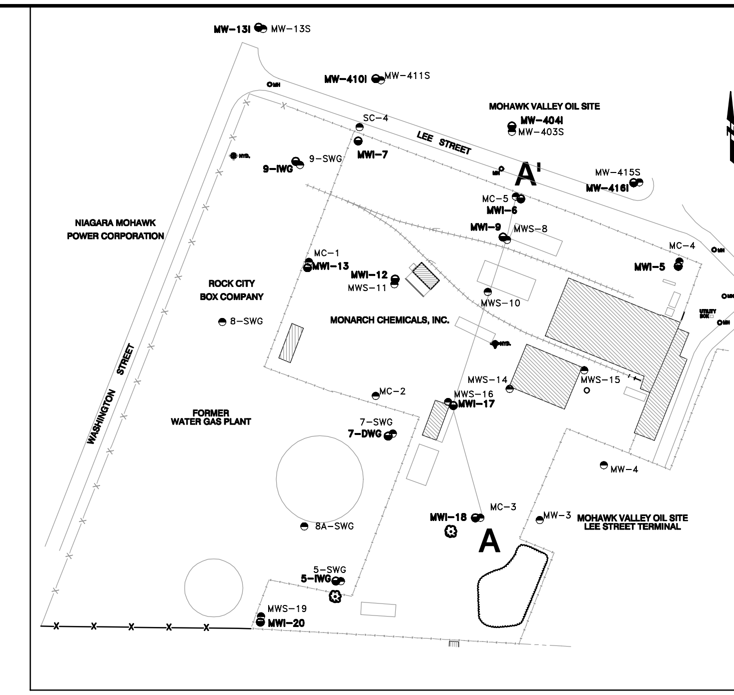
Figure 3

Project No. 004-03445-04





Geologic Cross Section Location

LEGEND

Coal Tar Product

Location of Monitoring Well Screen

Sump

Groundwater Elevation in Shallow Monitoring Wells on 5-6-97

Groundwater Elevation in Intermediate Monitoring Wells on 5-6-97

NGVD National Geodetic Vertical Datum

North-South Geologic Cross Section (A-A')
Former Monarch Chemicals, Inc. Site
37 Meadow Street
Utica, New York

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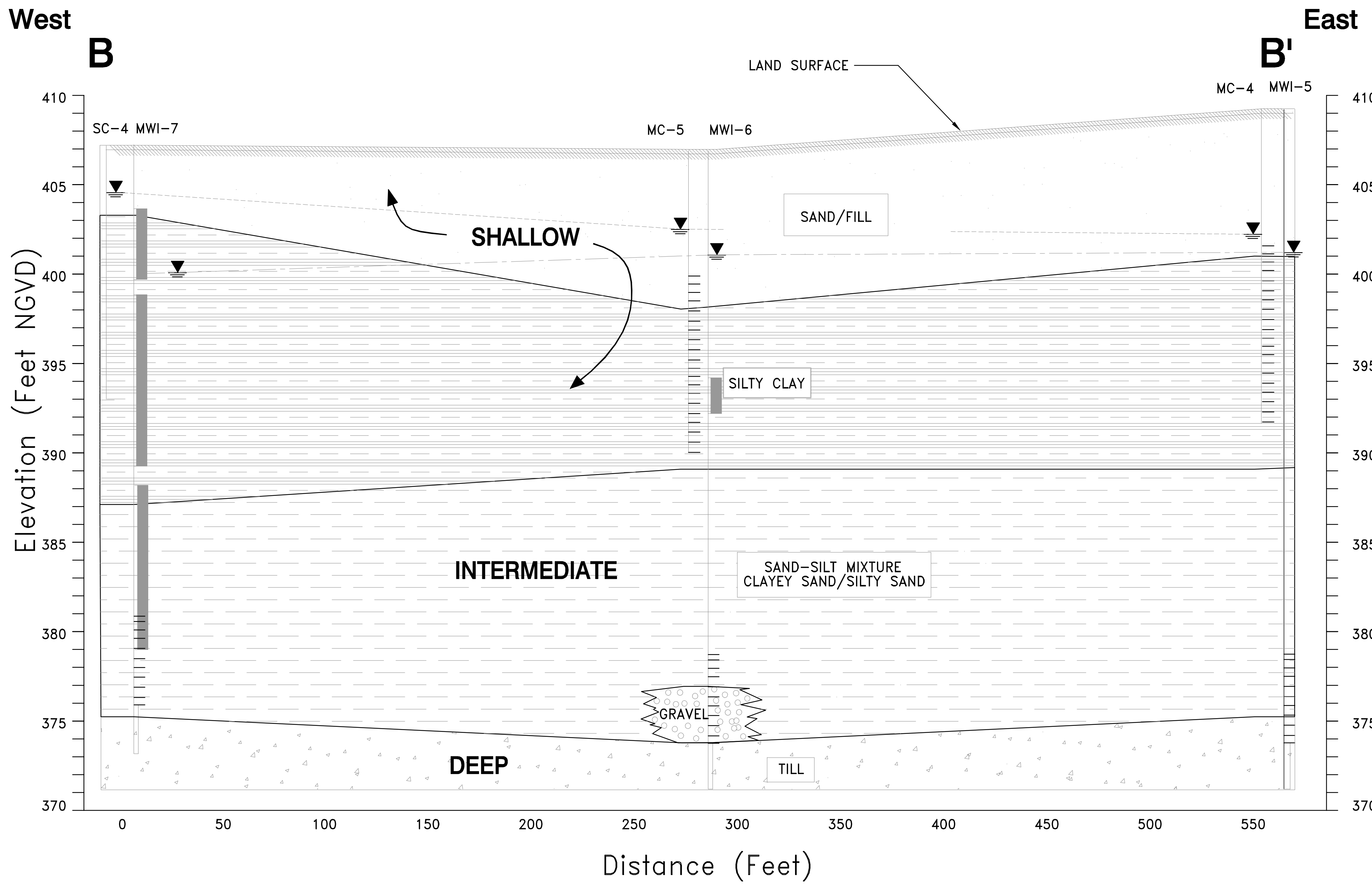
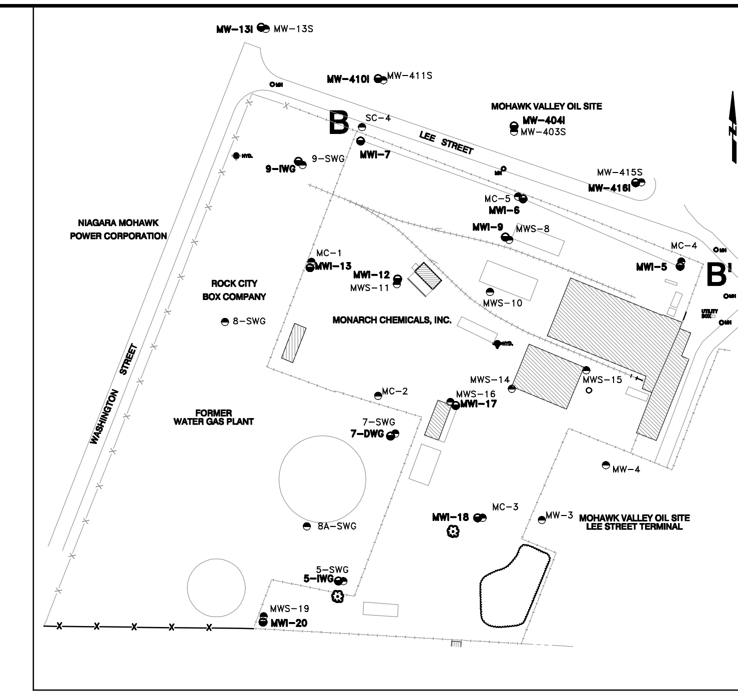
Figure 4

Project No. 004-03445-04

CADARC\JONES\UTICA\3445SECT\WDB\04-30-03





Geologic Cross Section Location

LEGEND

Coal Tar Product

Location of Monitoring Well Screen

Sump

Groundwater Elevation in Shallow Monitoring Wells on 5-6-97

Groundwater Elevation in Intermediate Monitoring Wells on 5-6-97

NGVD National Geodetic Vertical Datum

East-West Geologic Cross Section (B-B')
Former Monarch Chemicals, Inc. Site
37 Meadow Street
Utica, New York

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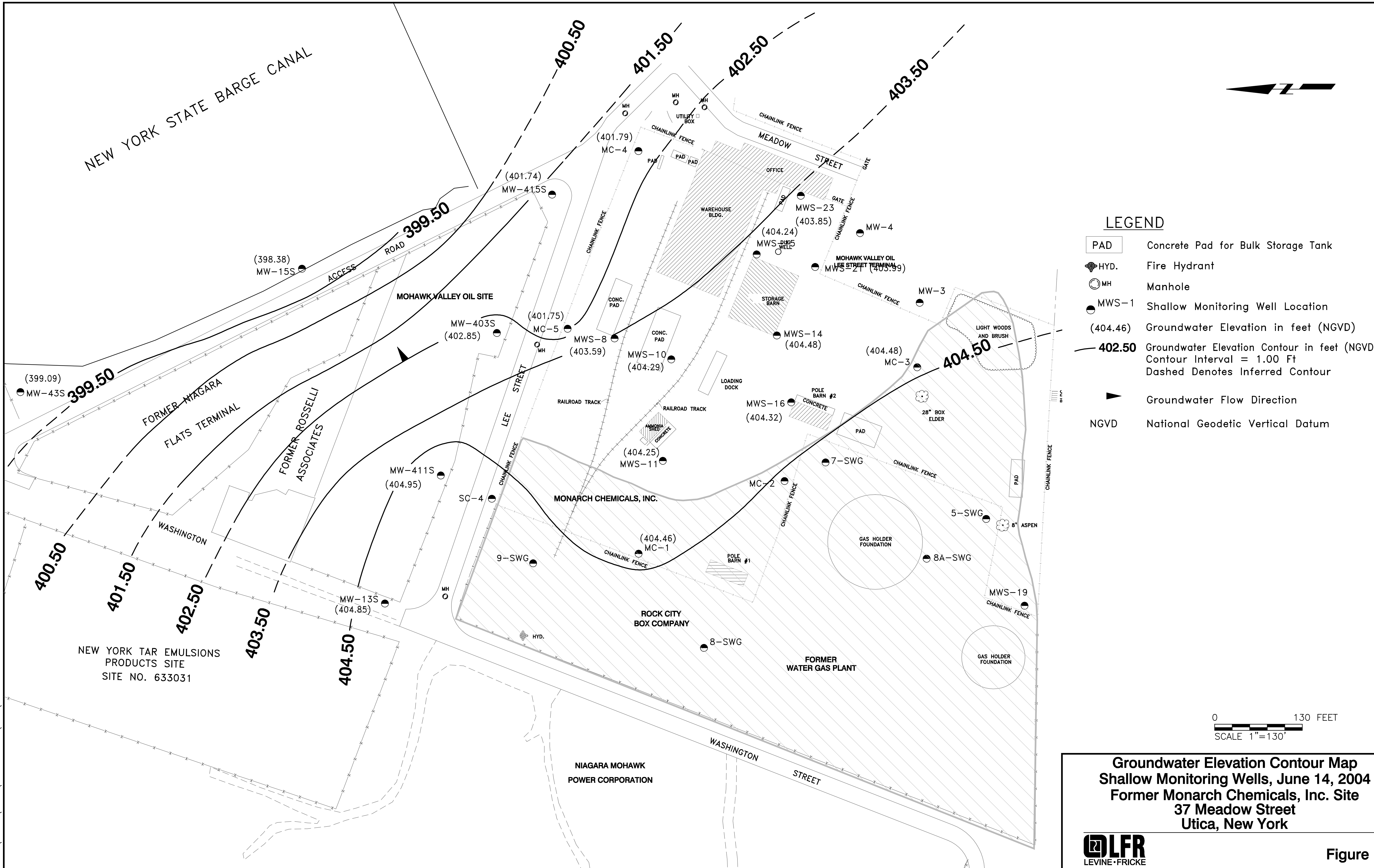
Project No. 004-03445-04

Figure 5

CADARC\JONES\UTICA\3445SECT\WDB\04-30-03



Groundwater Elevation Contour Map
Shallow Monitoring Wells, June 14, 2004
Former Monarch Chemicals, Inc. Site
37 Meadow Street
Utica, New York

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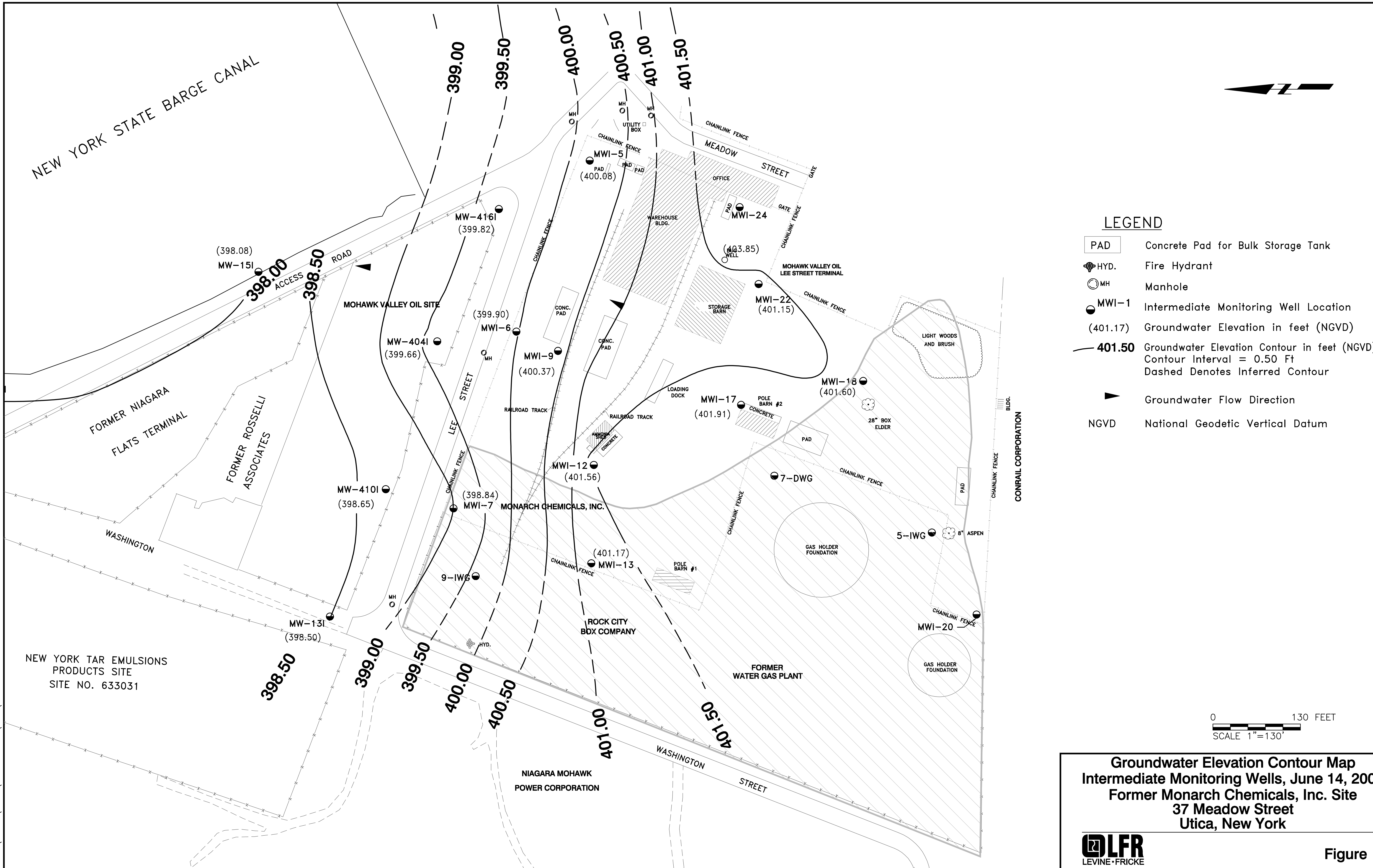
Project No. 004-03445-03

Figure 6



Groundwater Elevation Contour Map
Intermediate Monitoring Wells, June 14, 2004
Former Monarch Chemicals, Inc. Site
37 Meadow Street
Utica, New York

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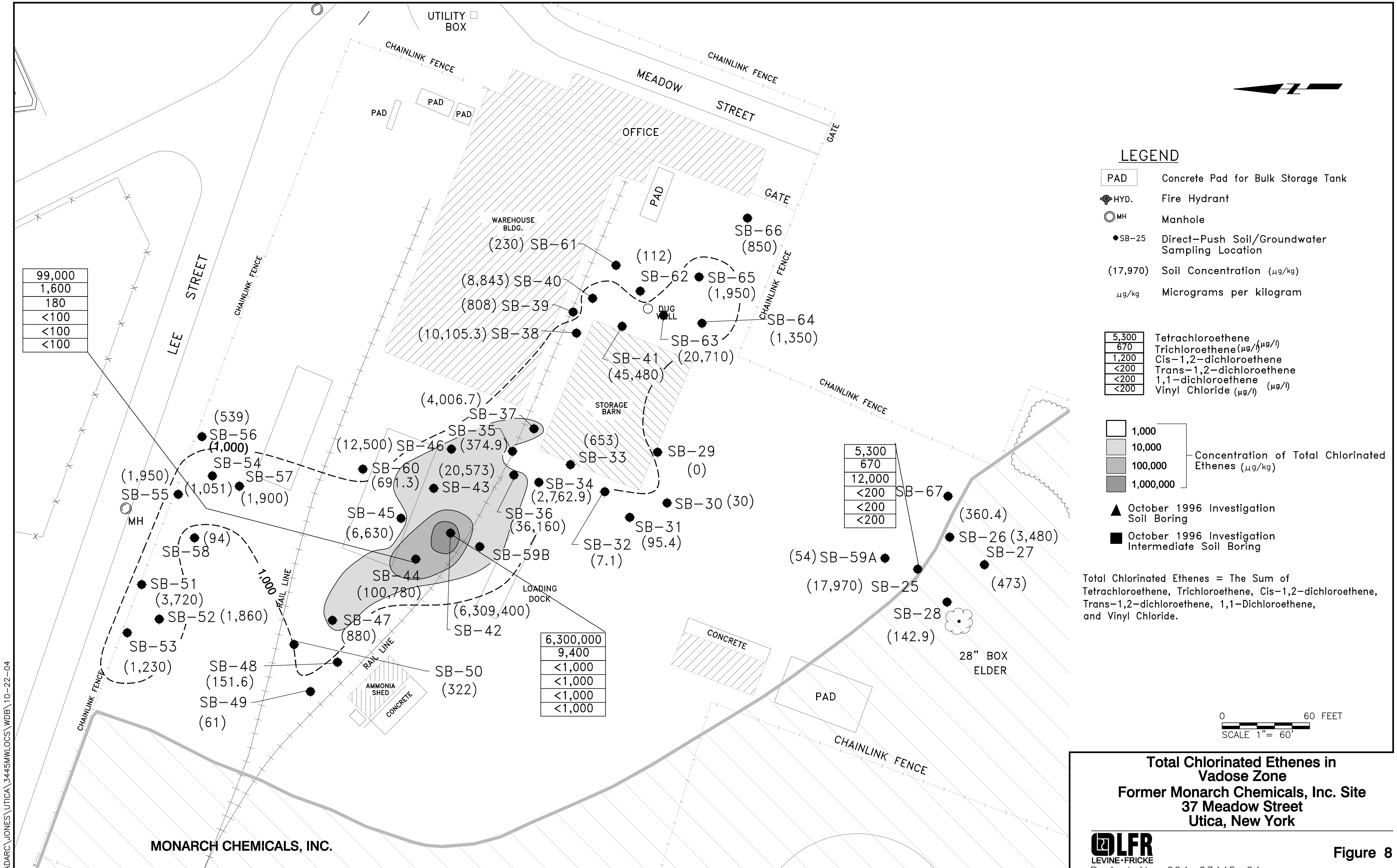
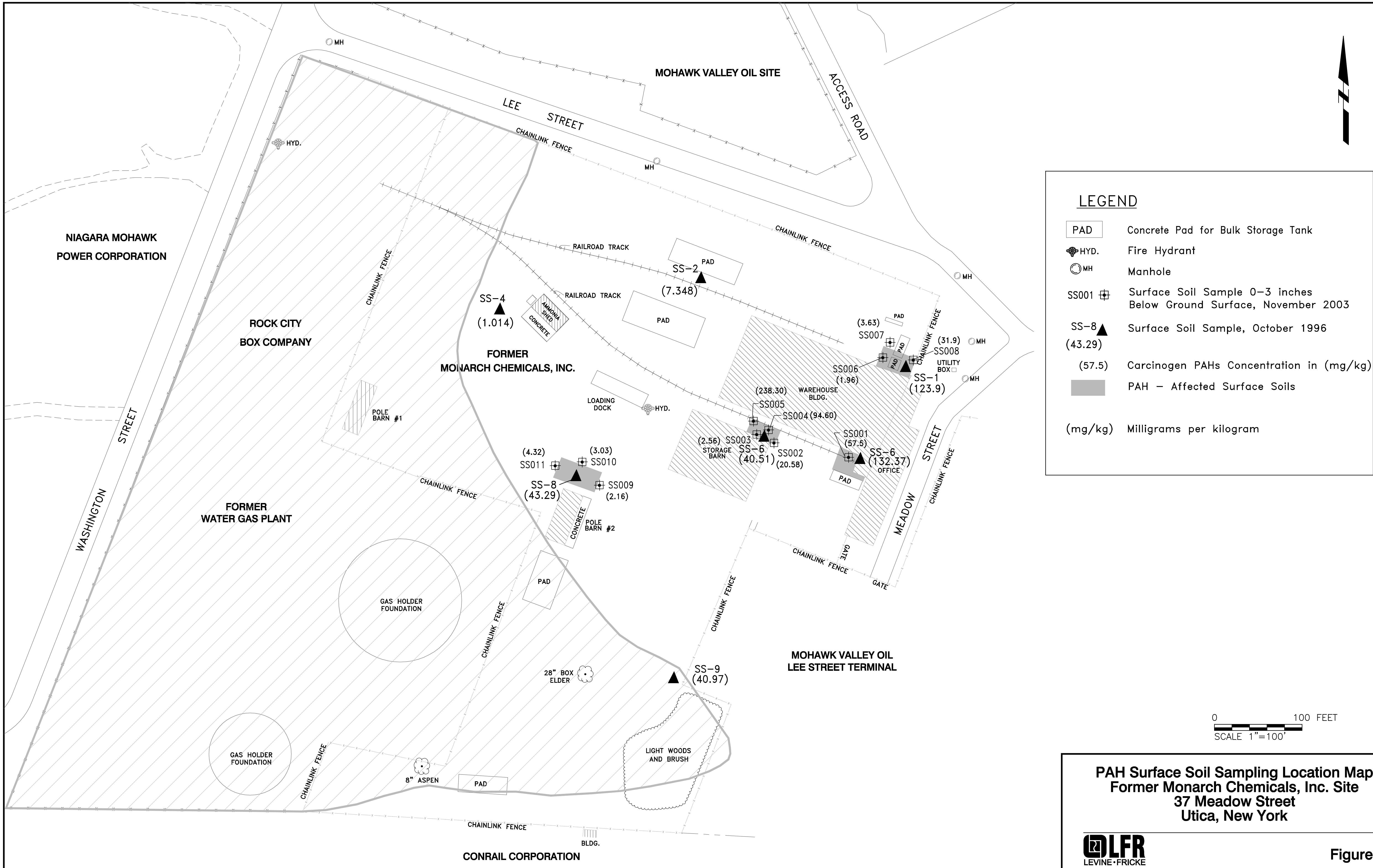
Project No. 004-03445-03

Figure 7



Total Chlorinated Ethenes in Vadose Zone
Former Monarch Chemicals, Inc. Site
37 Meadow Street
Utica, New York

Figure 8



PAH Surface Soil Sampling Location Map
Former Monarch Chemicals, Inc. Site
37 Meadow Street
Utica, New York

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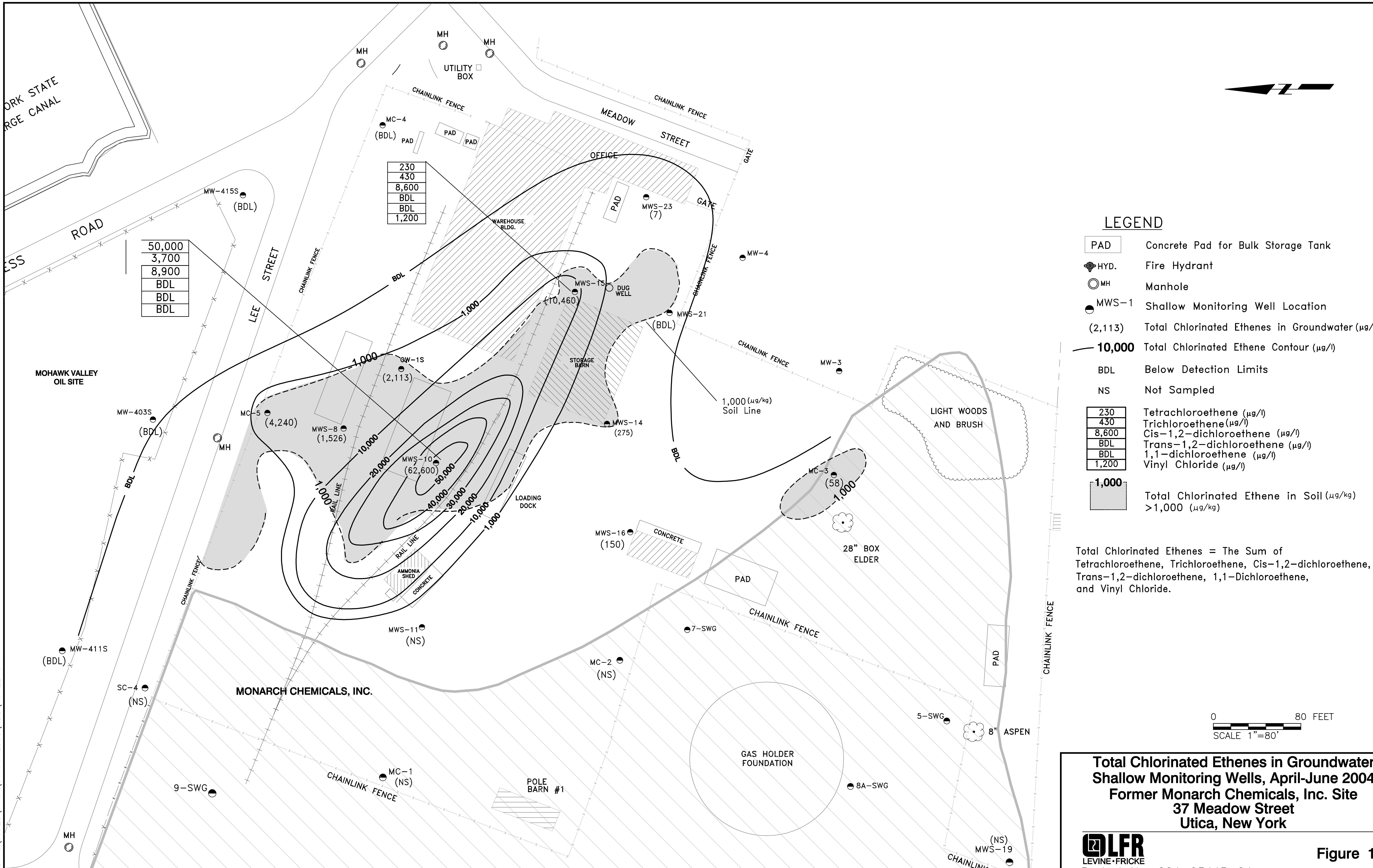
Figure 9

Project No. 004-03445-03



Total Chlorinated Ethenes in Groundwater
Shallow Monitoring Wells, April-June 2004
Former Monarch Chemicals, Inc. Site
37 Meadow Street
Utica, New York

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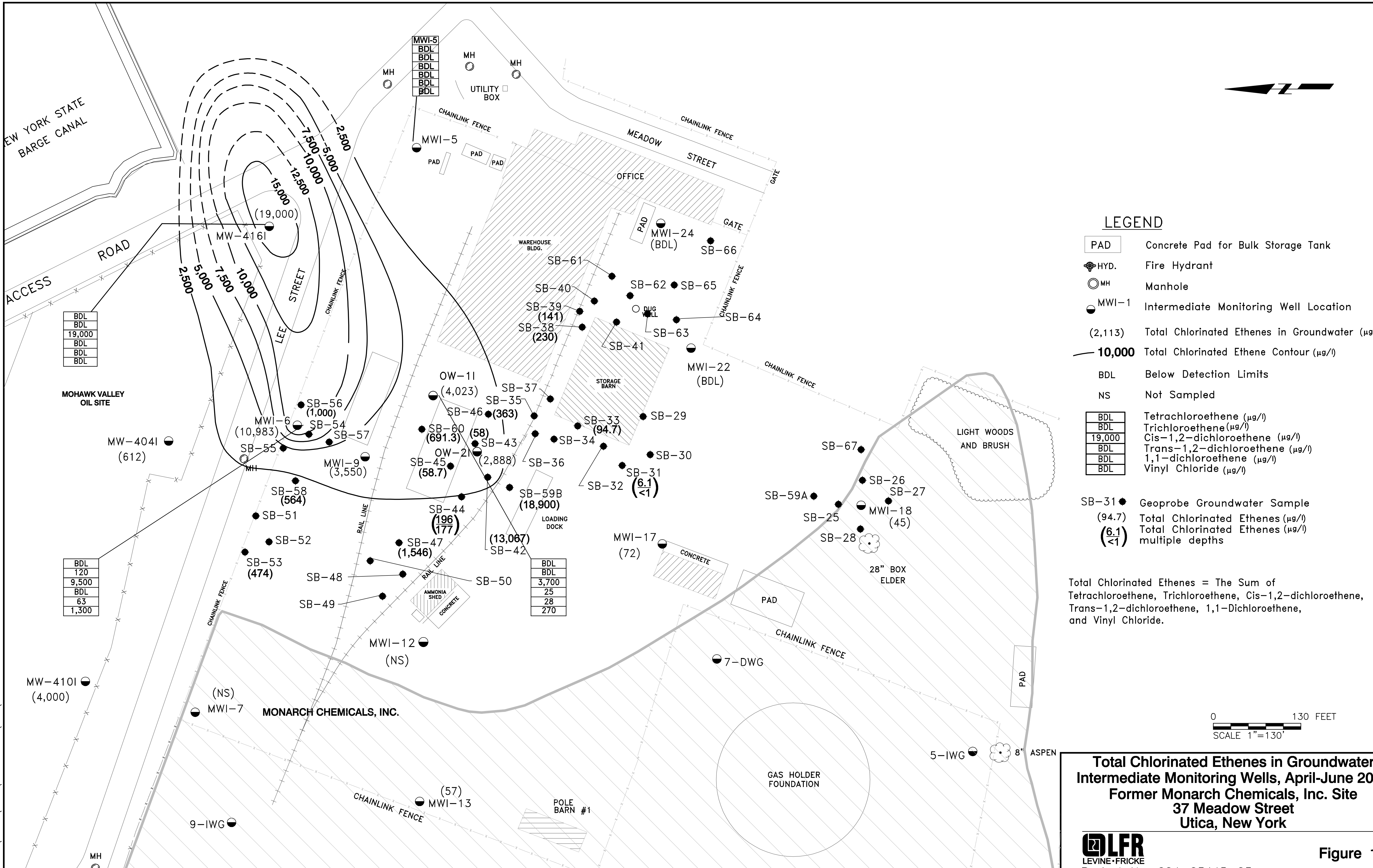
Figure 10

Project No. 004-03445-04



Total Chlorinated Ethenes in Groundwater
Intermediate Monitoring Wells, April-June 2004
Former Monarch Chemicals, Inc. Site
37 Meadow Street
Utica, New York

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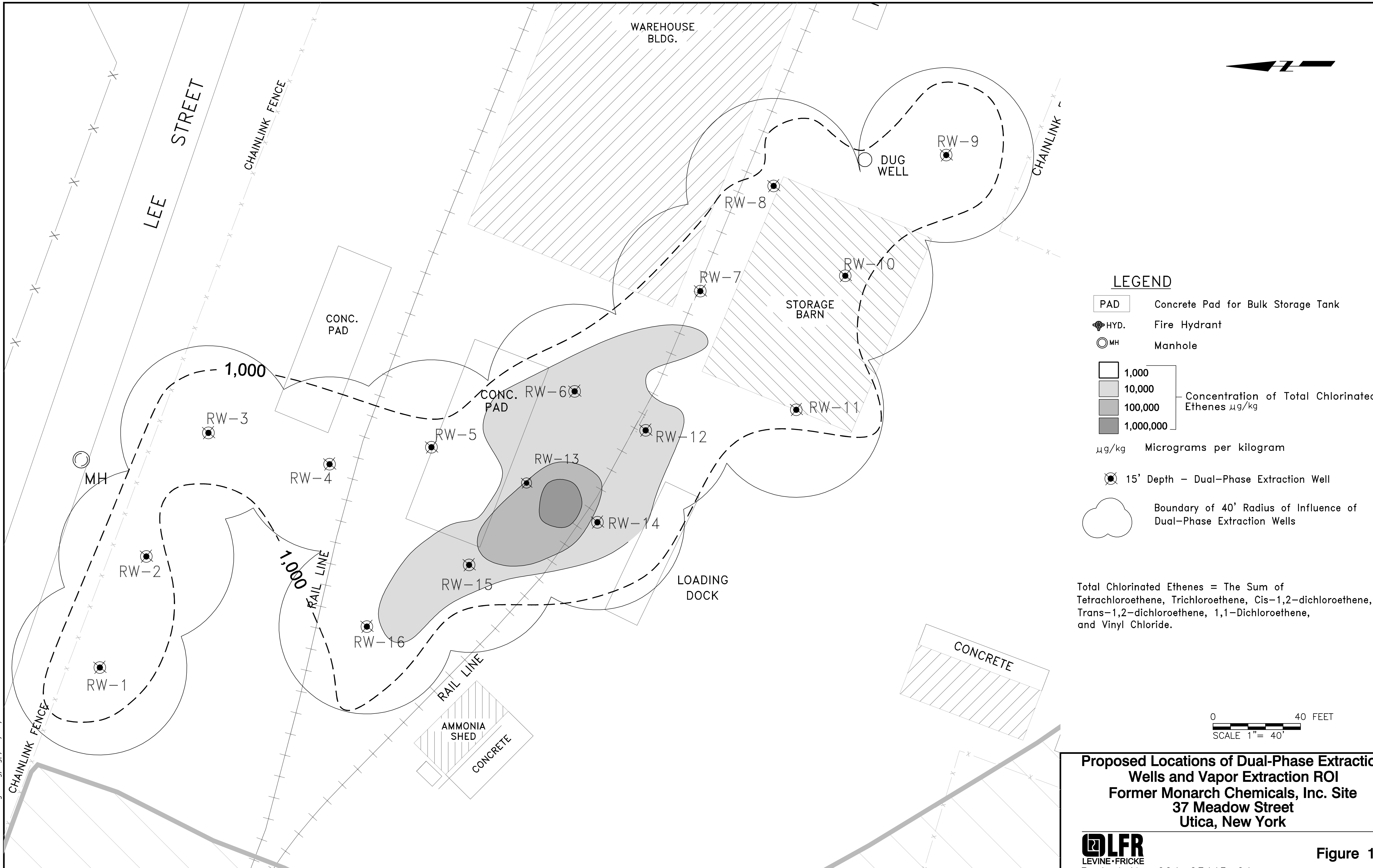
Figure 11

Project No. 004-03445-03



Proposed Locations of Dual-Phase Extraction Wells and Vapor Extraction ROI
Former Monarch Chemicals, Inc. Site
37 Meadow Street
Utica, New York

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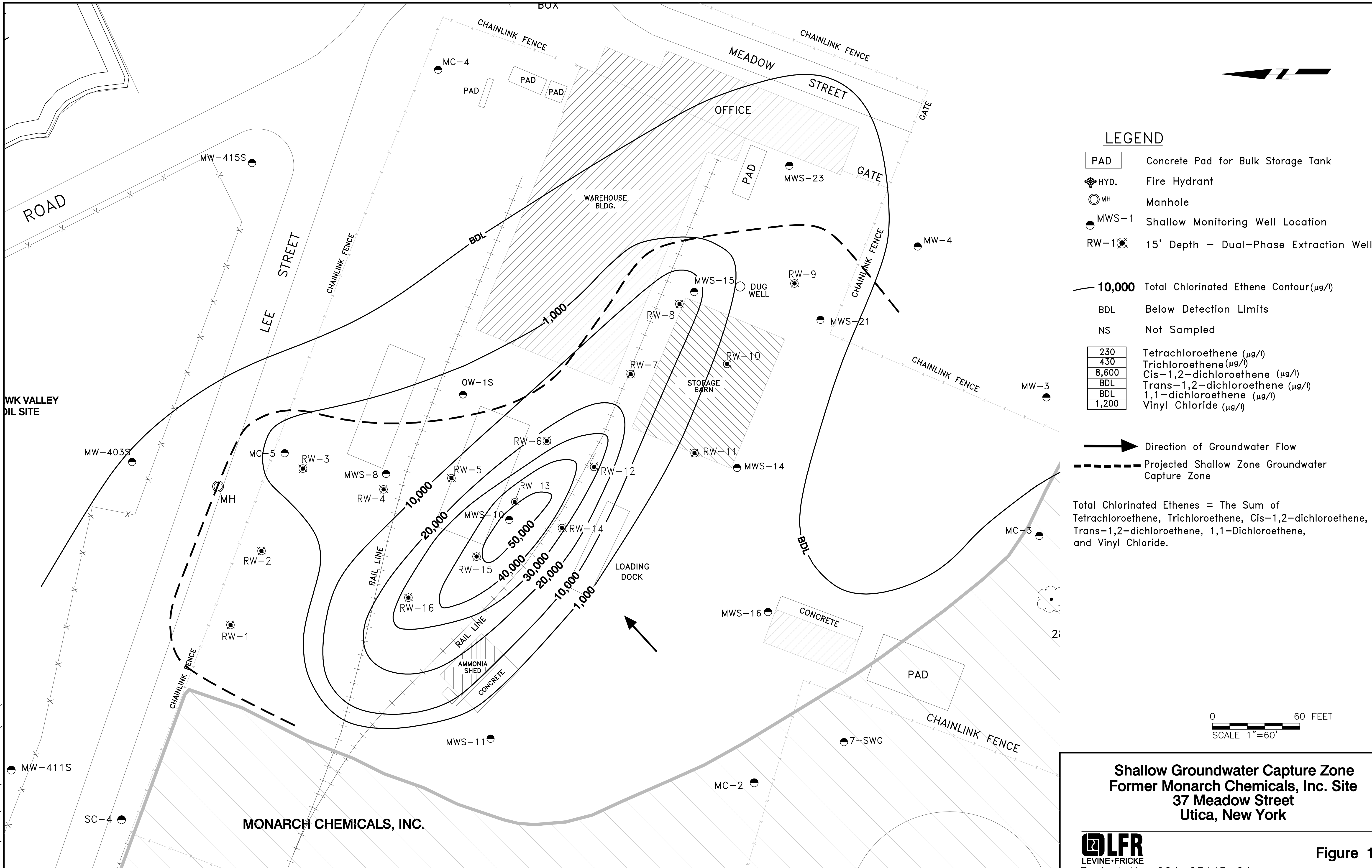
Figure 12

Project No. 004-03445-04



Shallow Groundwater Capture Zone
Former Monarch Chemicals, Inc. Site
37 Meadow Street
Utica, New York

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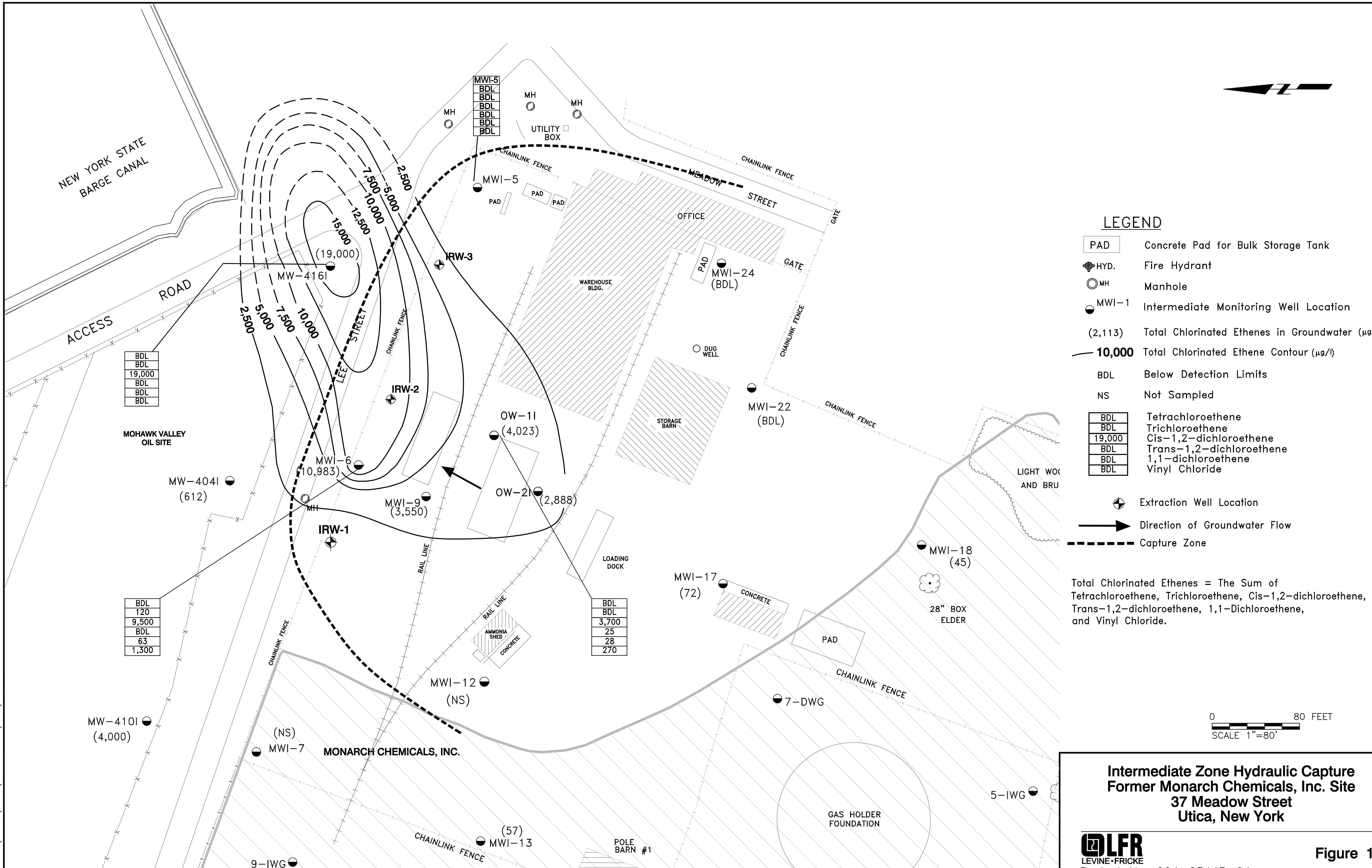
Figure 13

Project No. 004-03445-04



Intermediate Zone Hydraulic Capture
Former Monarch Chemicals, Inc. Site
37 Meadow Street
Utica, New York

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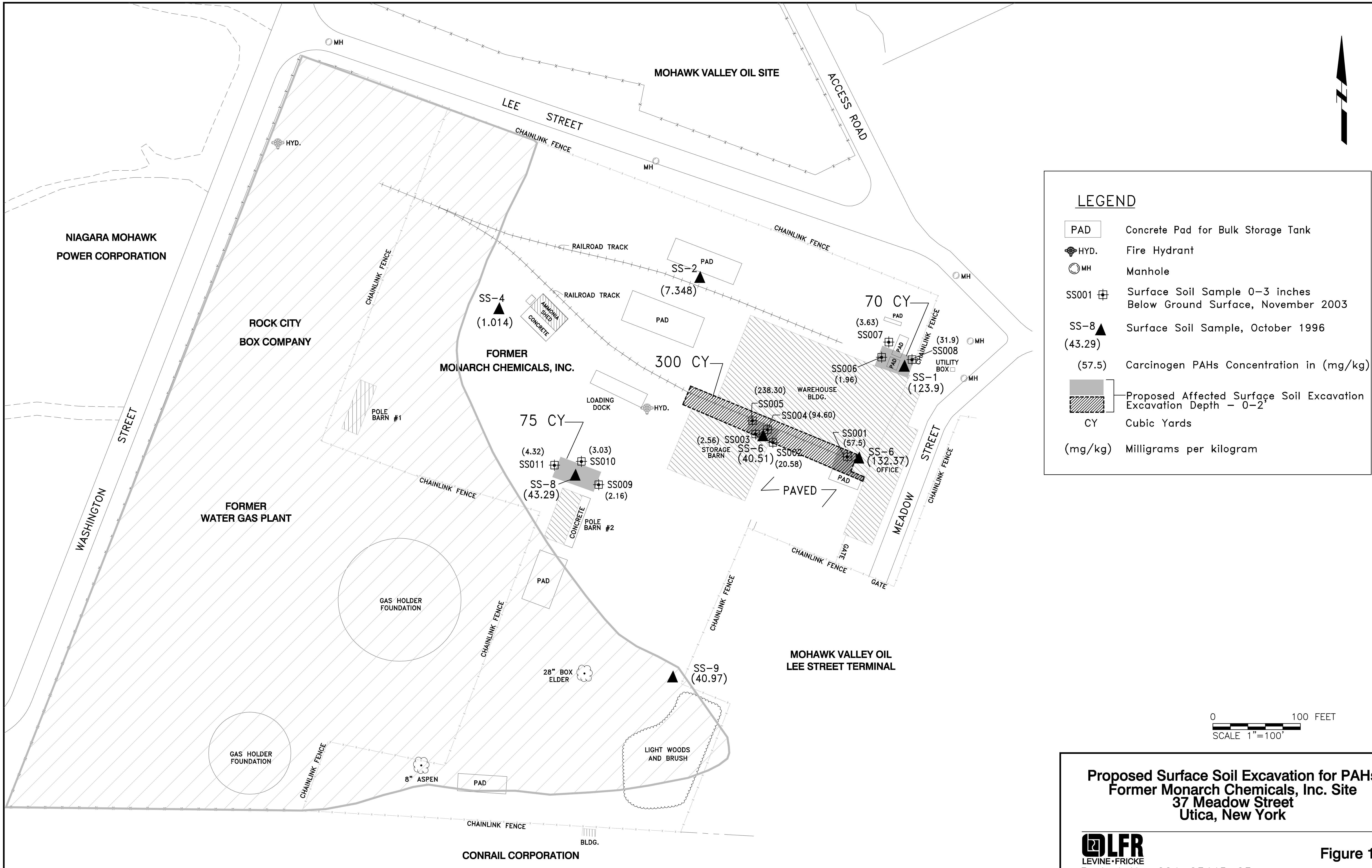
Figure 14

Project No. 004-03445-04



Proposed Surface Soil Excavation for PAHs
Former Monarch Chemicals, Inc. Site
37 Meadow Street
Utica, New York

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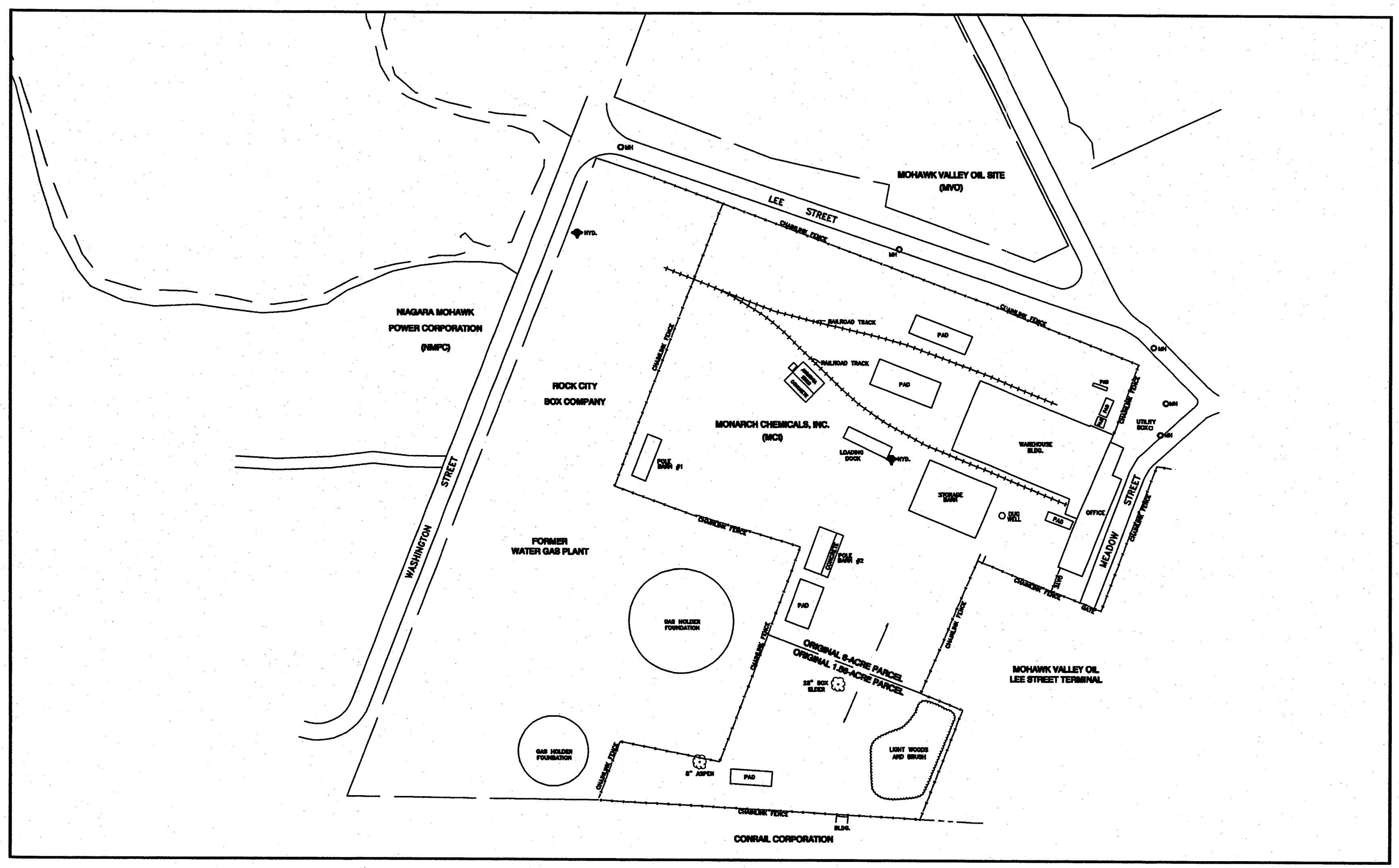
Figure 15

Project No. 004-03445-03

Appendix A

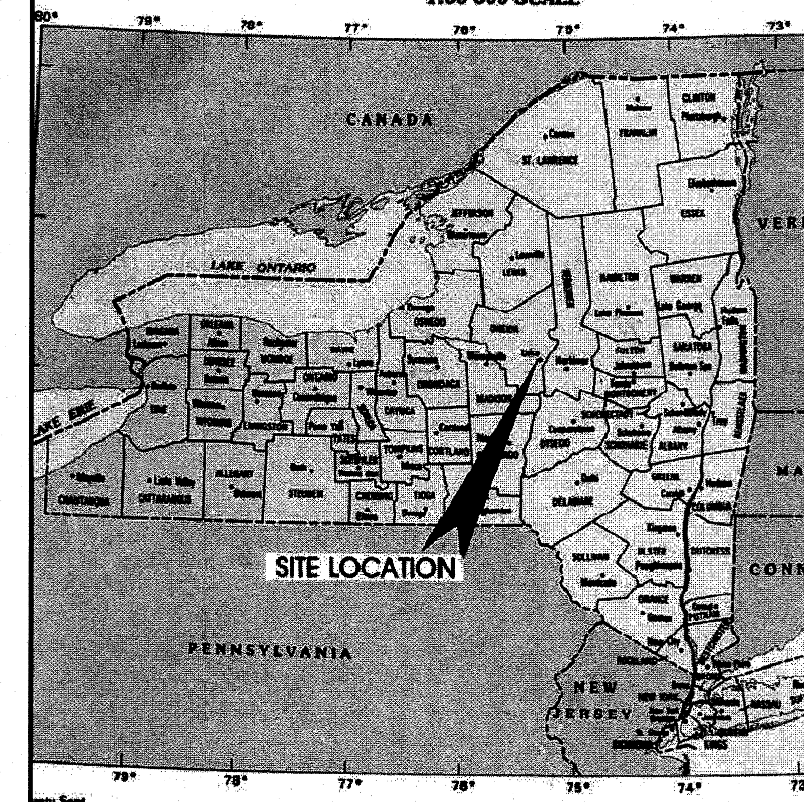
Construction Drawings

CONSTRUCTION DRAWINGS FOR THE DUEL-PHASE EXTRACTION AND HYDRAULIC CONTROL SYSTEMS



Former Monarch Chemicals, Inc. Site
37 Meadow Street
Utica, New York

COUNTY MAP SERIES
1:50 000 SCALE



INDEX OF DRAWINGS

STATE OF NEW YORK
A. SCOTT STARR
078821-1
LICENSED PROFESSIONAL ENGINEER

LFR LEVINE•FRICKE FORMER MONARCH CHEMICALS, INC. SITE 37 MEADOW STREET UTICA, NEW YORK	TITLE SHEET, VICINITY MAP, AND INDEX OF DRAWINGS REVISED 5/15/05	SCALE NTS DATE 02/07/05	PROJECT NO.	SHEET 1 OF 12

A. Scott Starr
6/7/05

3445NOTES.DVG/KGP/02/07/05

GENERAL NOTES

1. CONTRACTOR RESPONSIBLE FOR OBTAINING AND COMPLYING WITH ALL REQUIRED PERMITS INCLUDING, BUT NOT LIMITED TO, CONSTRUCTION AND ELECTRICAL ACTIVITIES. CONTRACTOR EXPECTED TO COMPLY WITH APPLICABLE LOCAL, STATE, AND FEDERAL LAWS, CODES, RULES, AND REGULATIONS.
2. CONTRACTOR RESPONSIBLE FOR COMPLIANCE WITH THE LATEST NATIONAL ELECTRIC CODE (NEC) NFPA 70, NFPA 30 AND 30A AND APPROPRIATE CITY, COUNTY, STATE, AND FEDERAL ELECTRICAL CODES.
3. CONTRACTOR RESPONSIBLE FOR PROVIDING SAFE ACCESS TO SITE AT ALL TIMES.
4. CONTRACTOR RESPONSIBLE FOR PROVIDING LIGHTED BARRICADES AND OTHER SAFETY EQUIPMENT AS NECESSARY TO PROTECT THE PUBLIC 24 HOURS A DAY DURING CONSTRUCTION. BARRICADES TO BE IN ACCORDANCE WITH MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES FOR STREETS AND HIGHWAYS (MUTCD), FEDERAL HIGHWAY ADMINISTRATION (FHA).
5. CONTRACTOR ACCEPTS LIABILITY AND IS RESPONSIBLE FOR REPAIR AS NECESSARY TO ORIGINAL CONDITION OF ANY AND ALL DAMAGED UTILITIES, STRUCTURES, PAVEMENT, CURBS, AND VEGETATED AREAS; VEGETATED AREAS TO INCLUDE TREES, SHRUBS, AND GRASS.
6. CONTRACTOR TO CLEAN SITE TO ORIGINAL CONDITION, ACCEPTABLE TO LFR AND JONES.
7. CONTRACTOR'S WORKERS SHALL CONFORM WITH OSHA REGULATIONS CFR 29, PART 1910: 120, HAZARDOUS WASTE OPERATIONS AND EMERGENCY RESPONSE.
8. THE FOLLOWING IS A LIST OF MATERIALS AND EQUIPMENT FOR WHICH MANUFACTURER'S OR SUPPLIER'S DATA SHEETS MUST BE SUBMITTED PRIOR TO COMMENCEMENT OF WORK:

   CONCRETE
   PIPING AND VALVES
   APPURTENANCES
   ANCHOR BOLTS AND GROUTING SYSTEMS FOR PIPING SUPPORTS
   PIPE SUPPORTS
   MODULAR BUILDING DESIGN LOADS
   PAVEMENT AND BASE MATERIAL

9. OUTSIDE WORK TO BE PERFORMED DURING NORMAL BUSINESS HOURS (7:00am – 5:00pm, MONDAY THROUGH FRIDAY) UNLESS SPECIFIC WRITTEN APPROVAL IS GIVEN BY LFR. INSIDE WORK WILL BE CONDUCTED AFTER NORMAL BUSINESS HOURS. CONTRACTOR TO COORDINATE WITH OWNER AND LFR TO CONDUCT INSIDE WORK.
10. ALL WORK UNDER THIS CONTRACT SHALL BE PERFORMED IN A MANNER WHICH DOES NOT DISRUPT THE OWNERS' NORMAL BUSINESS ACTIVITIES.
11. CONTRACTOR MUST PREPARE A SITE SPECIFIC HEALTH AND SAFETY PLAN ACCEPTABLE TO LFR.
12. CONTRACTOR TO PROVIDE RESTROOM FACILITY DURING CONSTRUCTION ACTIVITIES
13. SITE MEETING/PRE BID MEETING

ELECTRICAL

1. ALL ABOVEGROUND ELECTRICAL EQUIPMENT AND APPURTENANCES TO BE HOUSED IN GALVANIZED AND FLEX CONDUIT MEETING REQUIREMENTS IN NO. 2, GENERAL NOTES.
2. CONTRACTOR TO SUBMIT PROPOSED ELECTRICAL LAYOUT FOR EQUIPMENT AND APPURTENANCES TO LFR FOR REVIEW PRIOR TO CONSTRUCTION.
3. CONTRACTOR TO SUBCONTRACT WITH LOCAL POWER COMPANY OR ELECTRICIAN TO PROVIDE 460 VOLT THREE PHASE AND 110/220 VOLT SINGLE PHASE SERVICE. CONTRACTOR RESPONSIBLE FOR PROVIDING CORRECT AMPERAGE REQUIRED FOR EQUIPMENT SPECIFIED IN THE TREATMENT BUILDING.
4. CONTRACTOR RESPONSIBLE FOR PROVIDING ALL ELECTRIC APPURTENANCES ASSOCIATED WITH POWER SERVICE, INCLUDING, BUT NOT LIMITED TO, POWER POLE, METER BOX, AND BREAKER BOX. CONTRACTOR TO PROVIDE LOCKABLE ON/OFF SWITCH ON POWER POLE.
5. CONTRACTOR TO INSTALL LOCKING LOCAL DISCONNECT ON/OFF SWITCHES TO ALL ELECTRICAL APPURTENANCES WITHIN COMPOUND AREA.
6. ALL ELECTRICAL EQUIPMENT SHALL BE UNDERWRITERS LABORATORY (UL) LISTED.
7. ALL ELECTRICAL EQUIPMENT, CONDUIT, WIRING, ETC. SHALL MEET NATIONAL ELECTRIC MANUFACTURERS ASSOCIATION (NEMA) STANDARDS.

CIVIL

1. CONTRACTOR TO FIELD VERIFY ALL HORIZONTAL AND VERTICAL DIMENSIONS AND LOCATIONS; ANY DISCREPANCIES SHALL BE REPORTED TO THE LFR PRIOR TO CONSTRUCTION.
2. ELEVATION POINTS AND CONTOURS ARE NOT SHOWN.
3. CONTRACTOR RESPONSIBLE FOR VERIFYING LOCATION OF ALL UNDERGROUND UTILITIES PRIOR TO EXCAVATION ACTIVITIES. CONTRACTOR SHALL HAVE UNDERGROUND UTILITIES LOCATED BY A QUALIFIED UTILITIES CONTRACTOR.
4. ALL CONCRETE TO BE 3,500 PSI, TYPE I, STANDARD DESIGN. USE A MINIMUM OF 3" COVER ON STEEL WHERE CONCRETE IS CONTACTING SOIL.
5. CONTRACTOR TO VERTICAL SAW CUT ASPHALT/CONCRETE PAVEMENT AT TRENCH/VAULT LOCATIONS PRIOR TO EXCAVATION.
6. CONTRACTOR RESPONSIBLE FOR OBTAINING ALL PERMITS NECESSARY FOR TRENCHING.
7. SLAB SUBGRADE AND PAVEMENT SUBGRADE, SHALL BE COMPACTED TO 98% ASTM D698 MAX. DENSITY.
8. DPE AND GROUNDWATER EXTRACTION WELLS ARE TO BE INSTALLED BY OWNER. CONTRACTOR TO COMPLETE WELL HEADS AS SHOWN.

MECHANICAL

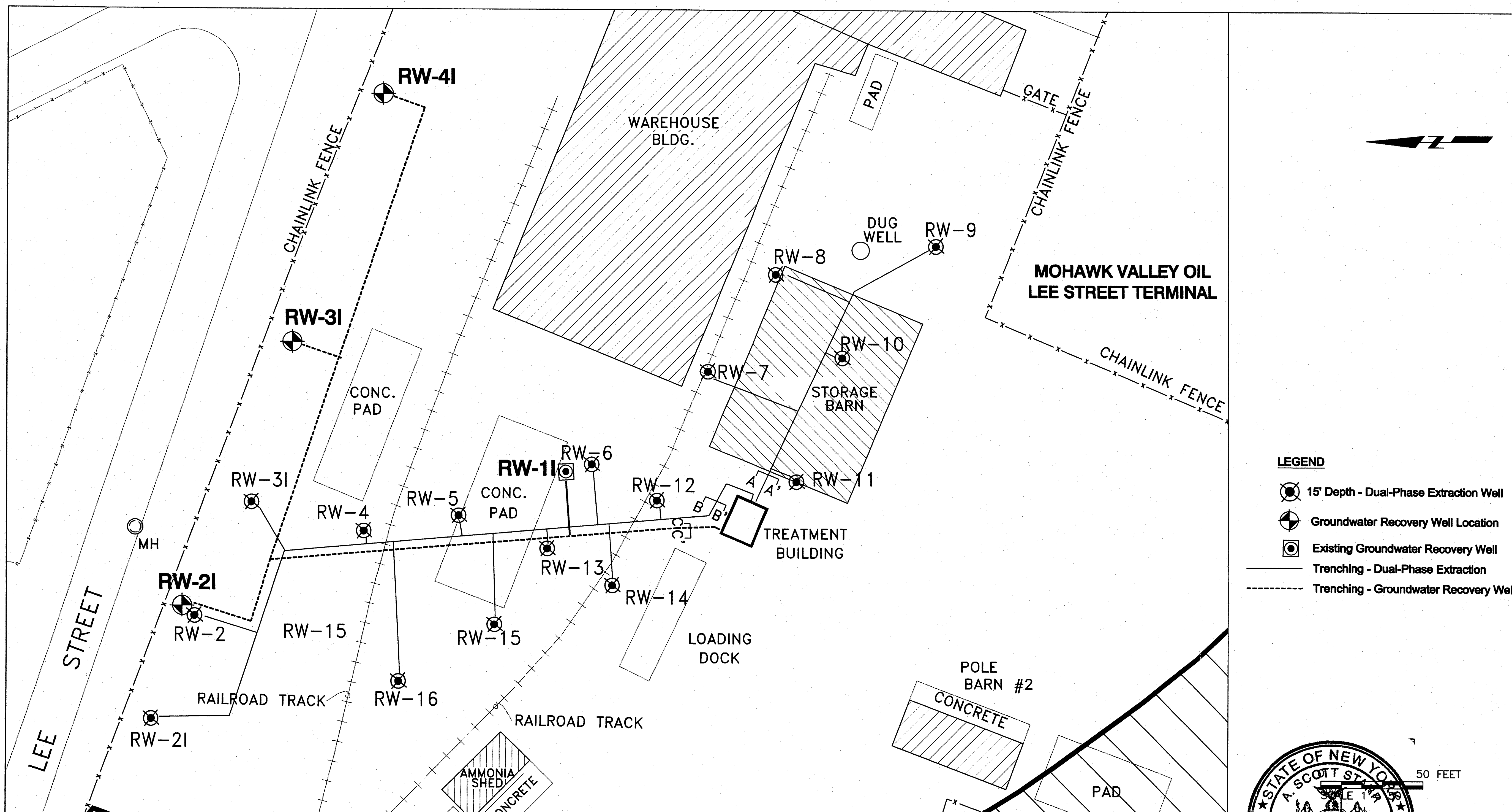
1. CONTRACTOR RESPONSIBLE FOR SUPPLY AND ASSEMBLY OF ALL PIPING AND APPURTENANCES FROM WELL HEADS TO TREATMENT SYSTEM BUILDINGS.
2. ALL LIQUIDS PIPING INCLUDING APPURTENANCES TO BE HYDROSTATICALLY PRESSURE TESTED FOR ONE HOUR @ 100 PSI. ALL PIPING INCLUDING APPURTENANCES SHALL BE PRESSURE TESTED @ 30 PSI FOR ONE HOUR. ALL TESTING SHALL BE WITNESSED BY LFR AND LFR SHALL BE NOTIFIED 24 HOURS PRIOR TO TESTING.
3. ALL PIPING AND ELECTRICAL CONDUITS ON OR IN EXISTING FACILITY BUILDINGS TO BE SECURED TO SLAB OR WALL WITH UNISTRUT AND STRAPS OR EQUIVALENT. MAXIMUM UNSUPPORTED LENGTH OF PIPING SHALL BE LESS THAN 6 FEET.
4. EQUIPMENT/APPURTENANCES ON DETAILS ARE GENERIC ONLY. SIZE OF UNITS MAY BE DIFFERENT THAN SHOWN.
5. ALL APPURTENANCES, CONNECTIONS, GASKETS, SEALS ETC. TO BE PETROLEUM RESISTANT. LEVEL AND GROUT ALL SKIDS AS NECESSARY FOR PROPER SUPPORT.
6. CONTRACTOR TO PROVIDE ALL PIPE FITTINGS NOT SHOWN (REDUCERS, BUSHINGS, ETC.)
7. PIPE SUPPORTS TO BE PROVIDED WITHIN 6-INCHES OF ALL VALVES AND FITTINGS.
8. PIPE CONNECTIONS NOT SHOWN ON DRAWINGS. PROVIDE AND INSTALL UNION CONNECTIONS AS NECESSARY.

STATE OF NEW YORK
A. SCOTT STARR
078821-1
LICENSED PROFESSIONAL ENGINEER
SEAL

A. Scott Starr
6/7/05

LFR LEVINE•FRICKE FORMER MONARCH CHEMICALS, INC. SITE 37 MEADOW STREET UTICA, NEW YORK	GENERAL NOTES REVISED 5/15/05	SCALE NTS DATE 02/07/05	PROJECT NO. / SHEET 2 OF 12

3445NOTES.DWG/KGP/02/07/05



LFR LEVINE·FRICKE

FORMER MONARCH CHEMICALS, INC. SITE
37 MEADOW STREET
UTICA, NEW YORK

GROUNDWATER EXTRACTION AND DUAL-PHASE EXTRACTION WELLS LAYOUT

REVISED 5/15/05

STATE OF NEW YORK · A. SCOTT ST... · 078821-1 · LICENSED PROFESSIONAL ENGINEER

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6/7/05

SCALE	AS SHOWN
DATE	02/07/05
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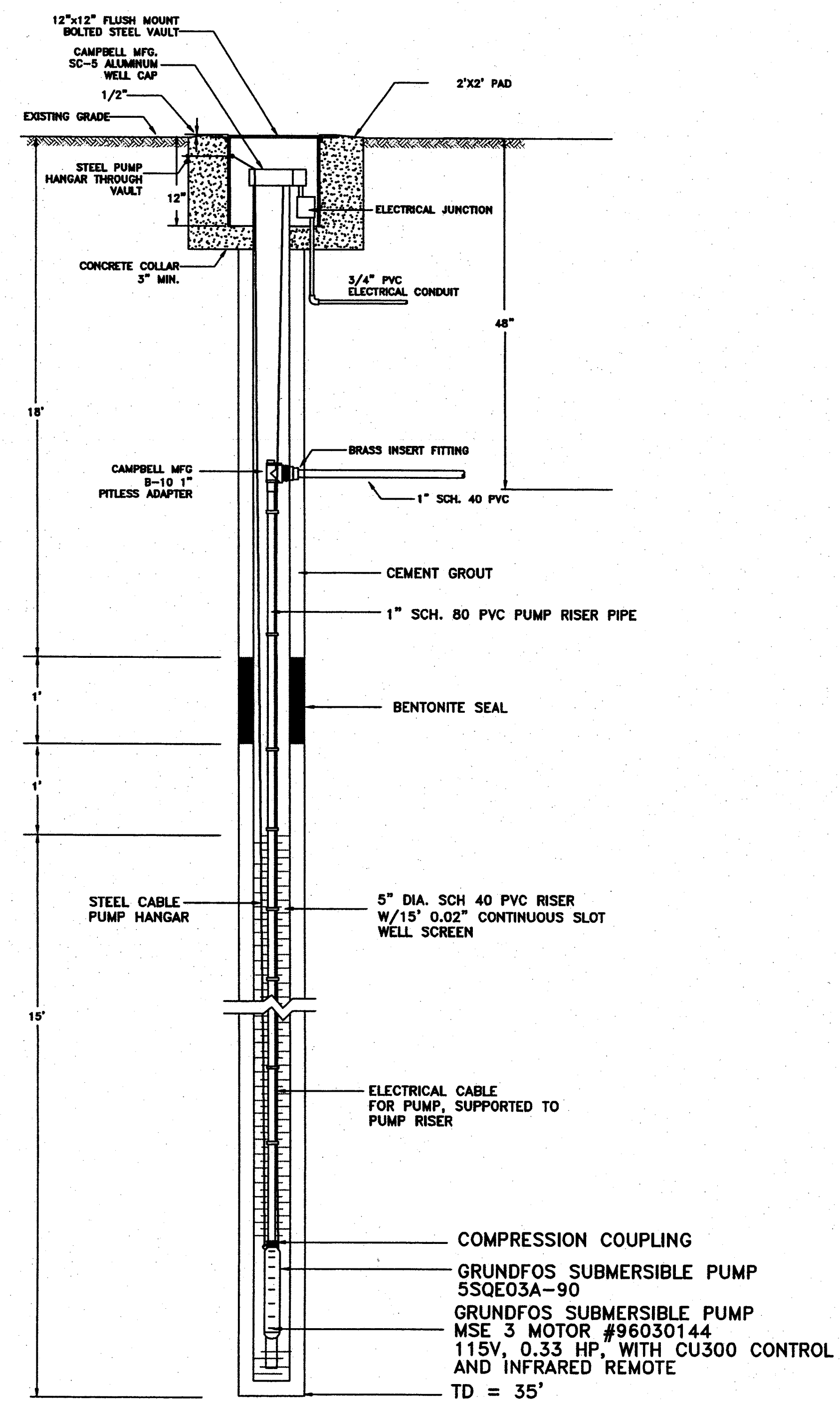
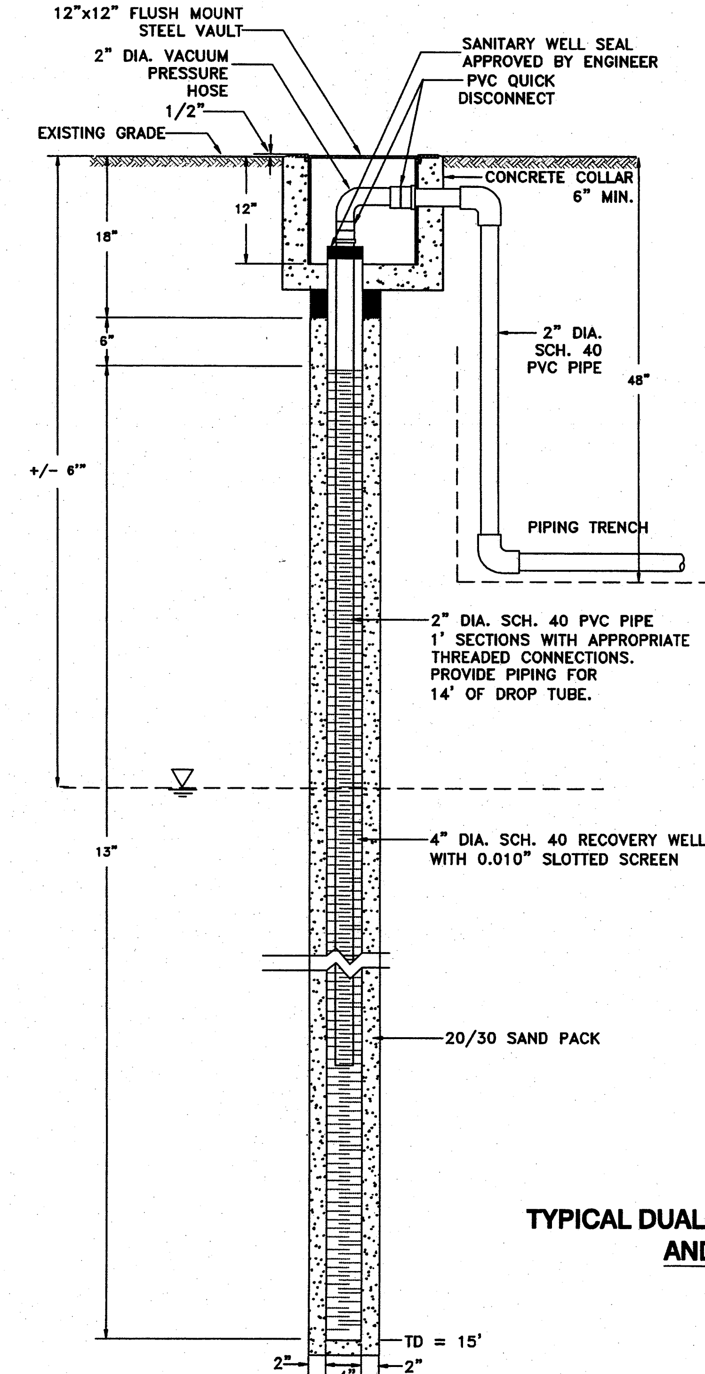
3445-remedial.DWG/GPW/2/14/05



INTERMEDIATE GROUNDWATER EXTRACTION WELL AND VAULT DETAIL

NOT TO SCALE

NOTES:
1) THE FOLLOWING REQUIRE ENGINEERS APPROVAL PRIOR TO INSTALLATION.
   - QUICK DISCONNECTS
   - REINFORCED HOSE
2) WELLS INSTALLED BY OTHERS. CONTRACTORS RESPONSIBLE FOR ALL OTHER WORK.



TYPICAL DUAL-PHASE EXTRACTION WELL AND VAULT DETAIL

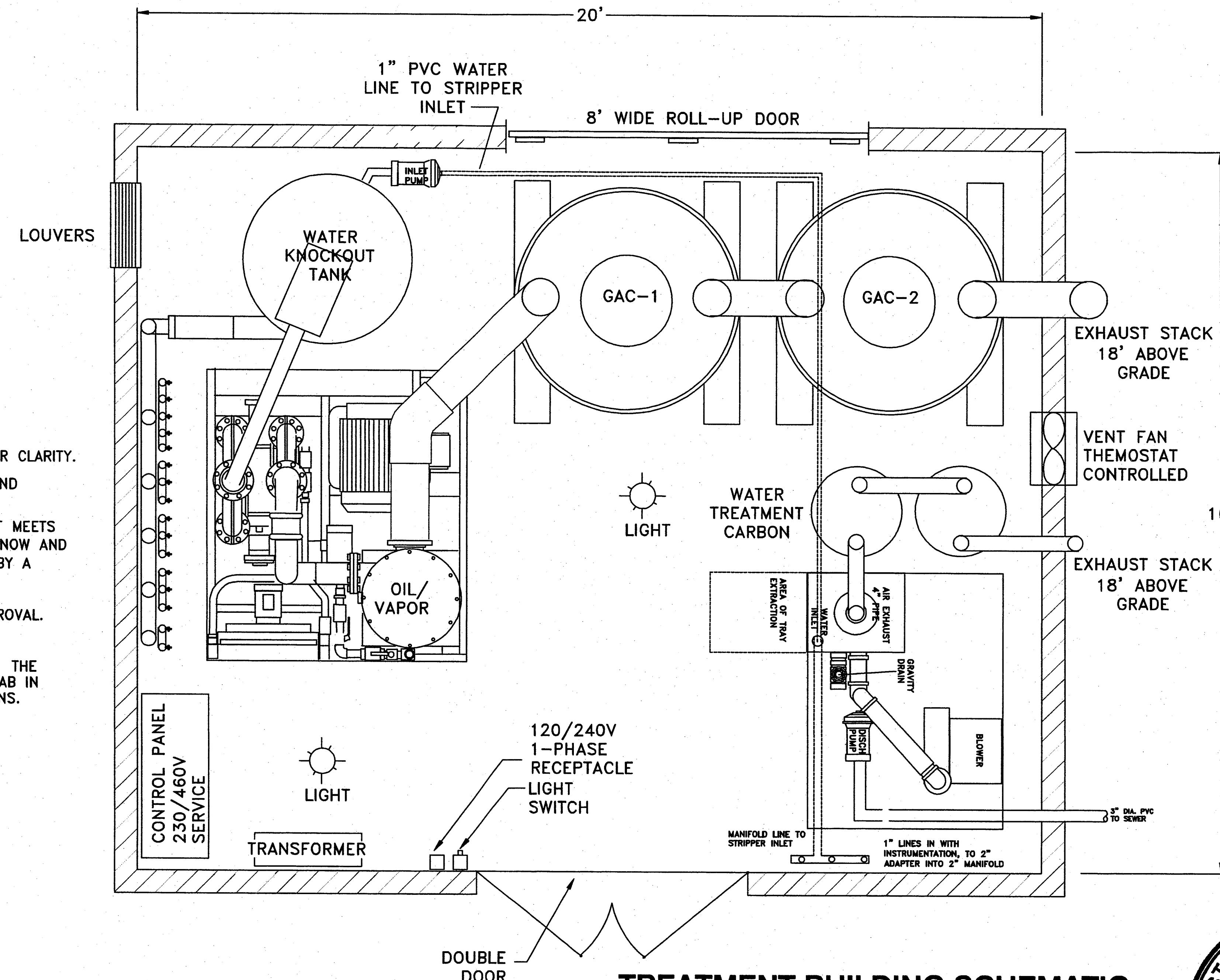
NOT TO SCALE

LFR LEVINE·FRICKE FORMER MONARCH CHEMICALS, INC. SITE 37 MEADOW STREET UTICA, NEW YORK	GROUNDWATER EXTRACTION AND DUAL-PHASE EXTRACTION WELLS DETAILS	SCALE NTS DATE 02/07/05	PROJECT NO.	SHEET 4 OF 12

STATE OF NEW YORK ★ A. SCOTT STARR ★ LICENSED PROFESSIONAL ENGINEER 078821-1 SEAL

6/7/05

utica-trench.DWG/KGP/02/14/05



NOTES:

1.) ELECTRICAL LINES AND APPURTENANCES NOT SHOWN FOR CLARITY.

2.) CONTRACTOR SHALL INSTALL ALL ELECTRICAL DEVICES AND COMPONENTS IN COMPLIANCE WITH NEC.

3.) CONTRACTOR SHALL PROVIDE A MODULAR BUILDING THAT MEETS NEW YORK STATE BUILDING CODE REQUIREMENTS FOR SNOW AND WIND LOAD. DESIGN OF BUILDING SHALL BE CERTIFIED BY A REGISTERED NEW YORK P.E.

4.) PLANS SHALL BE SUBMITED TO THE ENGINEER FOR APPROVAL.

5.) CONTRACTOR SHALL CONSTRUCT AN 8-INCH, 3,500 PSI CONCRETE SLAB WITH #4 REBAR AT 12-INCH O.C.E.W. THE TREATMENT BUILDING SHALL BE ANCHORED TO THE SLAB IN ACCORDANCE WITH STRUCTURAL ENGINEER SPECIFICATIONS.

TREATMENT BUILDING SCHEMATIC

APPROXIMATE SCALE 1"=3'

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37 MEADOW STREET
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TREATMENT BUILDING LAYOUT

STATE OF NEW YORK ★ A. SCOTT STARR ★ LICENSED PROFESSIONAL ENGINEER 078821-1

SCALE	AS SHOWN
DATE	02/14/05
PROJECT NO.	SHEET
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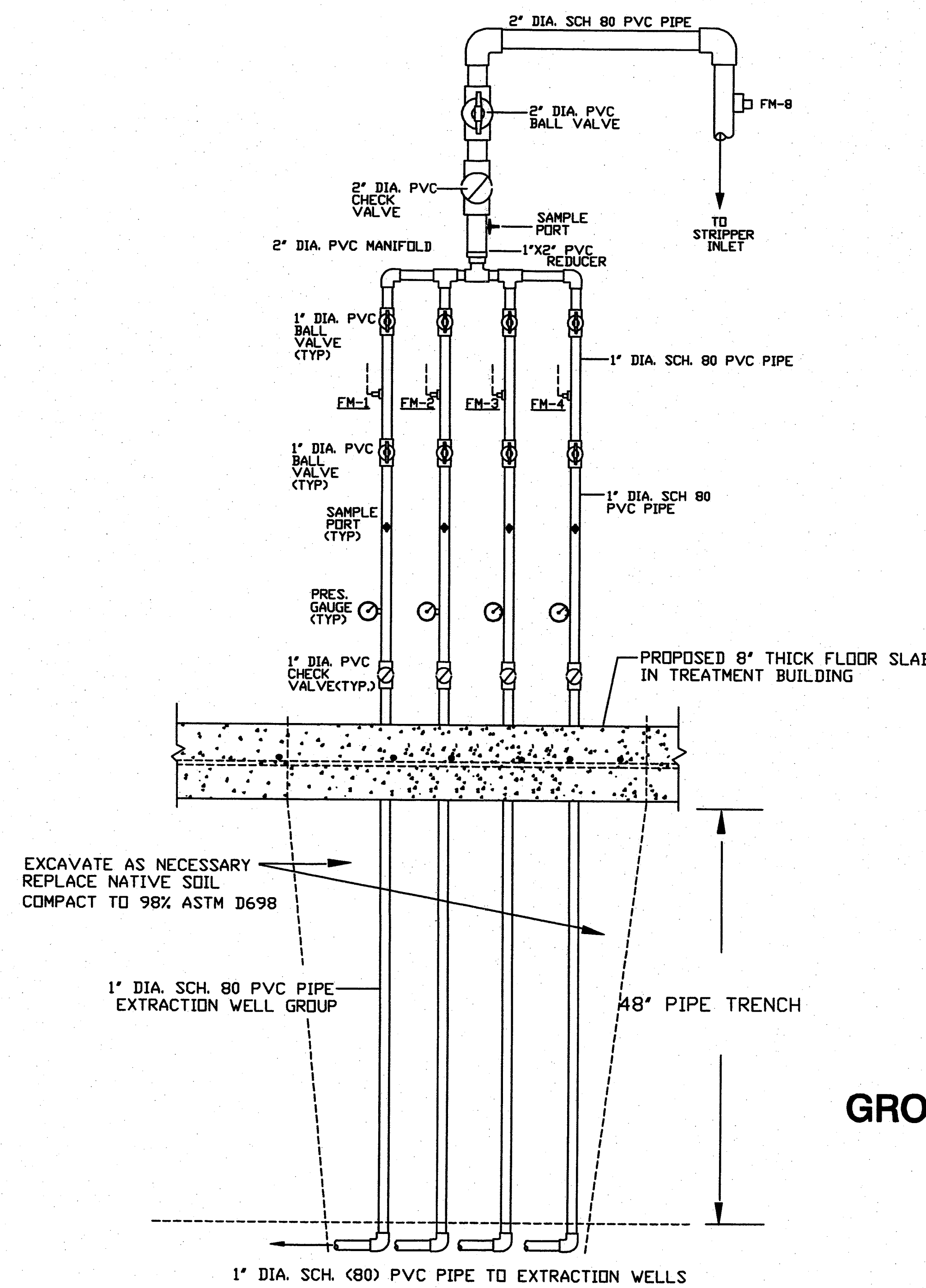
6/7/05

JONES-UTICA-BUILDING.DWG/KGP/02/07/05



GROUNDWATER EXTRACTION WELL STUB-UP AND MANIFOLD DETAIL

NOT TO SCALE

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A. SCOTT STARR
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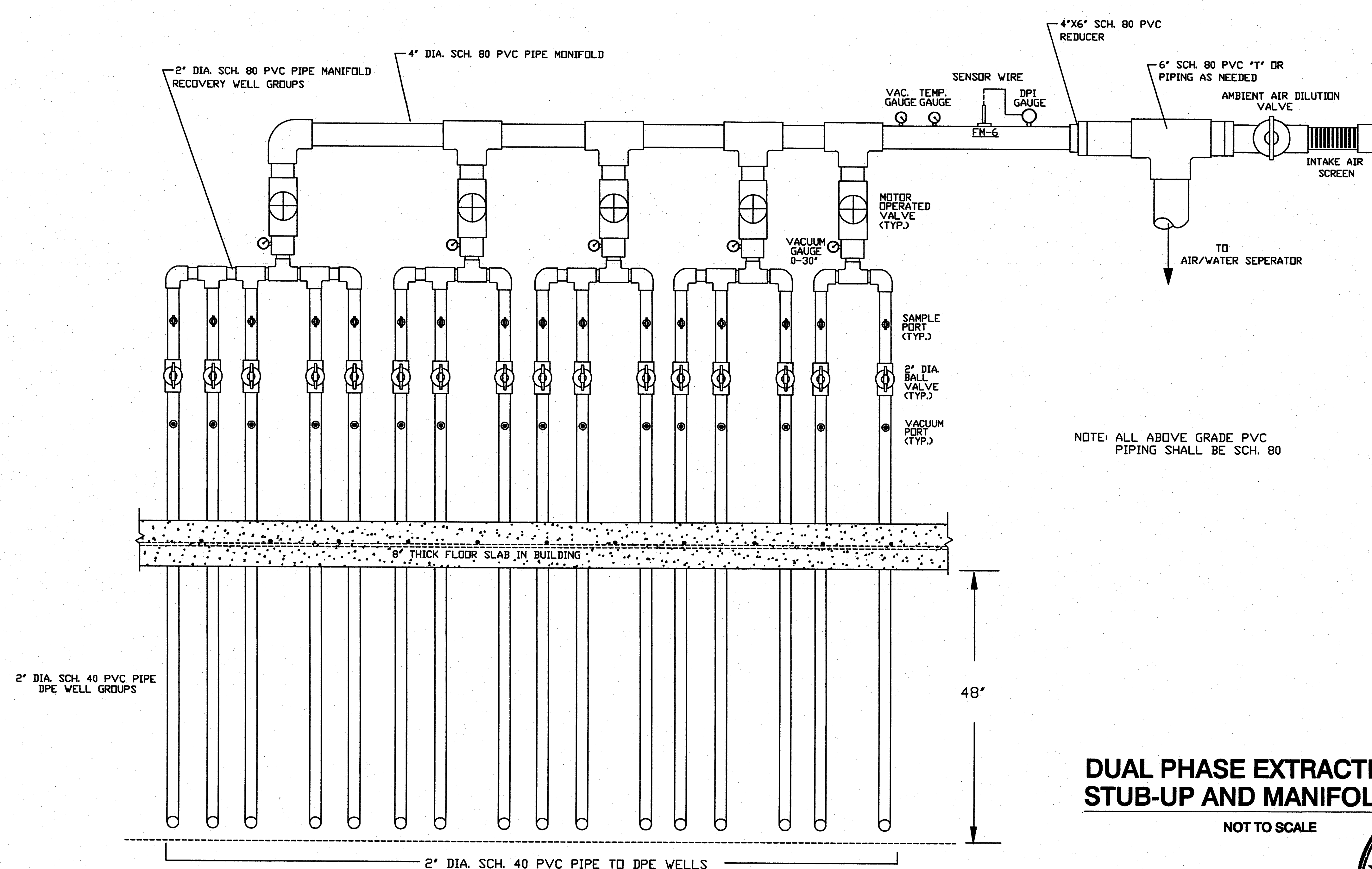
LFR LEVINE·FRICKE FORMER MONARCH CHEMICALS, INC. SITE 37 MEADOW STREET UTICA, NEW YORK	GROUNDWATER EXTRACTION WELL STUB-UP AND MANIFOLD DETAIL REVISED 5/15/05	SCALE NTS DATE 02/14/05	
		PROJECT NO.	SHEET 6 OF 12

JONES-UTICA-BUILDING.DWG/KGP/02/14/05



NOTE: ALL ABOVE GRADE PVC PIPING SHALL BE SCH. 80

DUAL PHASE EXTRACTION WELLS STUB-UP AND MANIFOLD DETAIL

NOT TO SCALE

STATE OF NEW YORK ★ A. SCOTT STARR ★ LICENSED PROFESSIONAL ENGINEER 078821-1

LFR LEVINE·FRICKE	DUAL PHASE EXTRACTION WELLS STUB-UP AND MANIFOLD DETAIL		SCALE NTS	
FORMER MONARCH CHEMICALS, INC. SITE 37 MEADOW STREET UTICA, NEW YORK			DATE 02/07/05	
			PROJECT NO.	SHEET 7 OF 12

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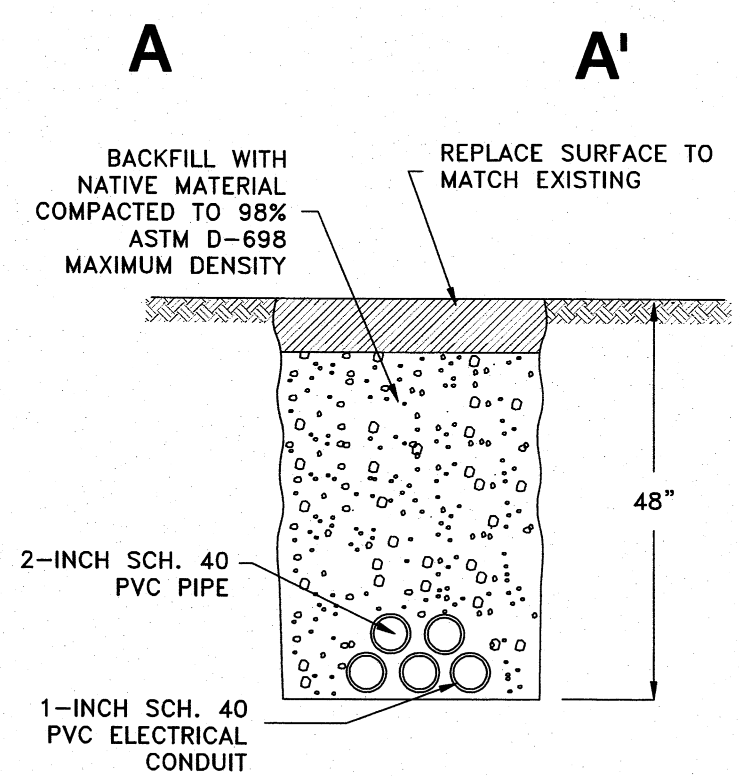
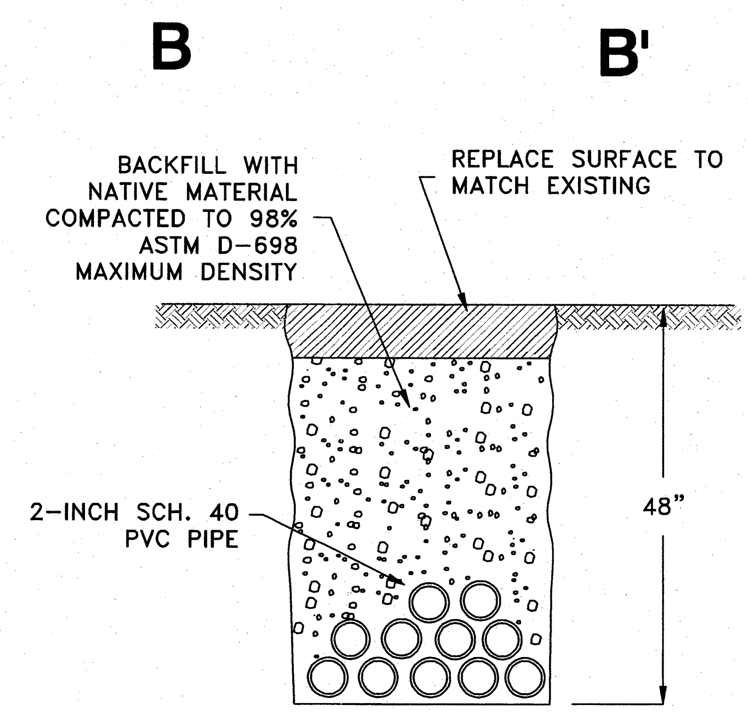
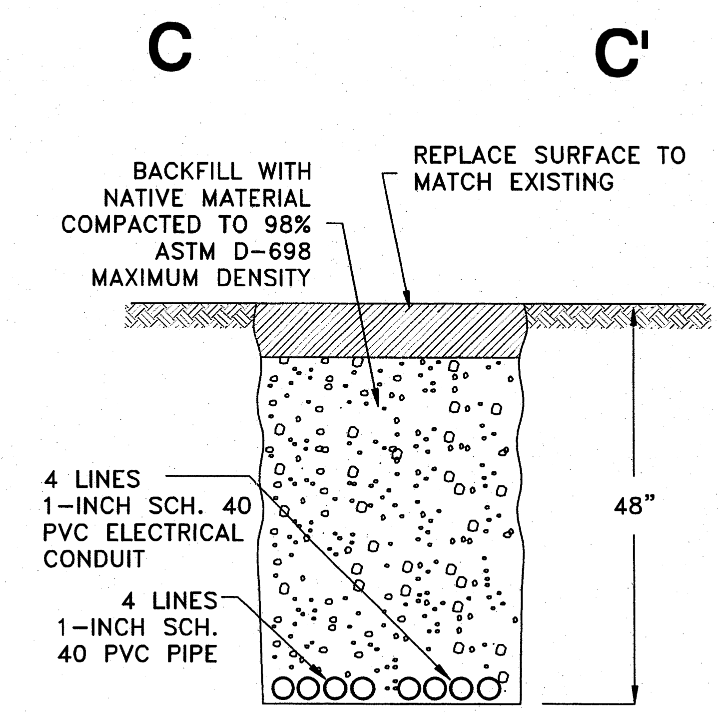


A-A' TRENCH DETAIL
NOT TO SCALE



B-B' TRENCH DETAIL
NOT TO SCALE



C-C" TRENCH DETAIL
NOT TO SCALE

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6/7/05

LFR LEVINE·FRICKE	PIPING TRENCH DETAILS	SCALE NTS	
FORMER MONARCH CHEMICALS, INC. SITE 37 MEADOW STREET UTICA, NEW YORK	REVISED 5/15/05	DATE 02/07/05	
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utica-trench.DWG/KGP/02/14/05

IRW-1, 2, & 3
Grundfos Submersible Pump
5SQ/SQE03A-90
1Ø/115V/0.33 HP

LRP-1
Dekker Liquid Ring Pump
w/VFD Model VMX1203KAI
3Ø/460V/100 HP

TP-1
Goulds Centrifugal Pump
Model 3643
3Ø/230V/0.75 HP

TP-2
Continental Progressive Cavity Pump
Model CP-56
3Ø/230V/1 HP

FM-1,2,3,4,&5
GF signet 515 Rotor-X
Flow Sensor w/8550
Flow Transmitter (Panel mounted)

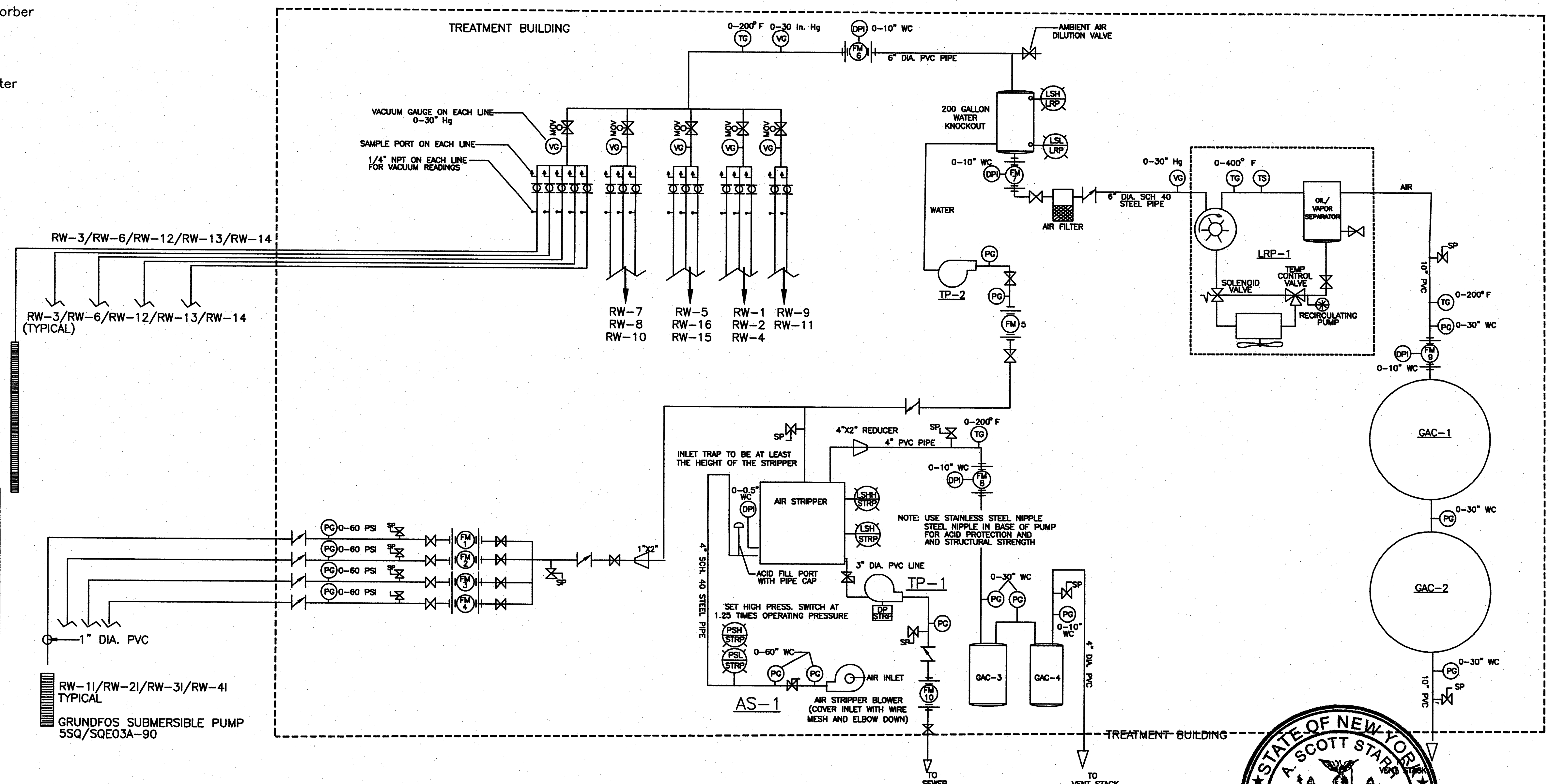
FM-6,7,8,&9
Accutube SMT Averaging Pitot Tube
with Differential Pressure Gauge

FM-10
(FM-7 to be provided by city)

AS-1
QED EZ-Tray Low Profile
Air Stripper Model 4.4
25 GPM

GAC-1&2
Carbtrol 3,000 lbs. G-9 Adsorber
2,000 CFM

GAC-3&4
Carbtrol 170 lbs. G-2 Canister
300 CFM



LEGEND
- TG TEMPERATURE GAUGE
- TS TEMPERATURE SENSOR
- VG VACUUM GAUGE
- PG PRESSURE GAUGE
- DPI DIFFERENTIAL PRESSURE GAUGE
- SP SAMPLE PORT
- MOV MOTOR OPERATED VALVE
- REDUCER
- CHECK VALVE
- VALVE
- GATE VALVE
- FM FLOW METER WITH TRUE UNIONS

LFR LEVINE•FRICKE

FORMER MONARCH CHEMICALS, INC. SITE
37 MEADOW STREET
UTICA, NEW YORK

REMEDIAL SYSTEM P&ID

REVISED 5/15/05

STATE OF NEW YORK · A. SCOTT STARR · 078821-1 · LICENSED PROFESSIONAL ENGINEER
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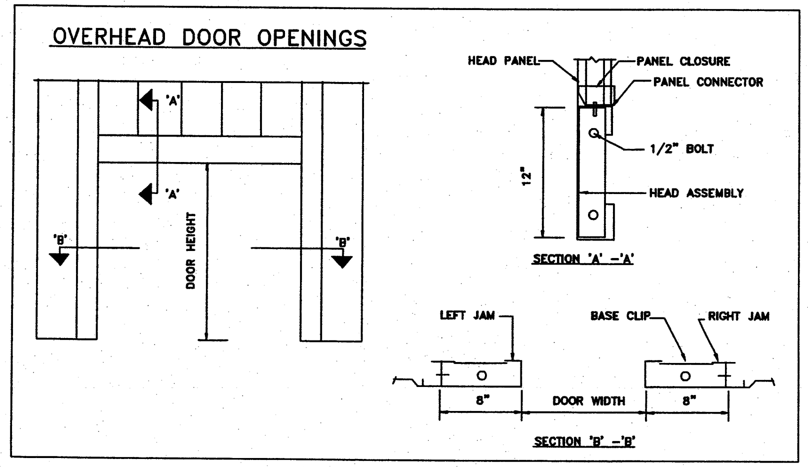
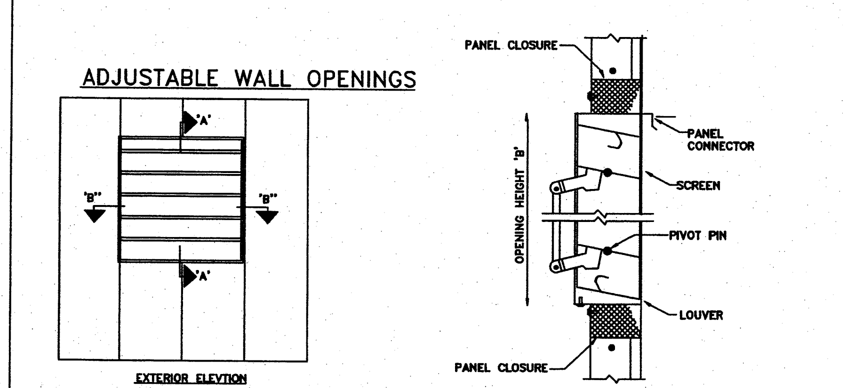
JONE-UTICA-PID.DWG/KGP/02/14/05

OVERHEAD DOOR OPENINGS

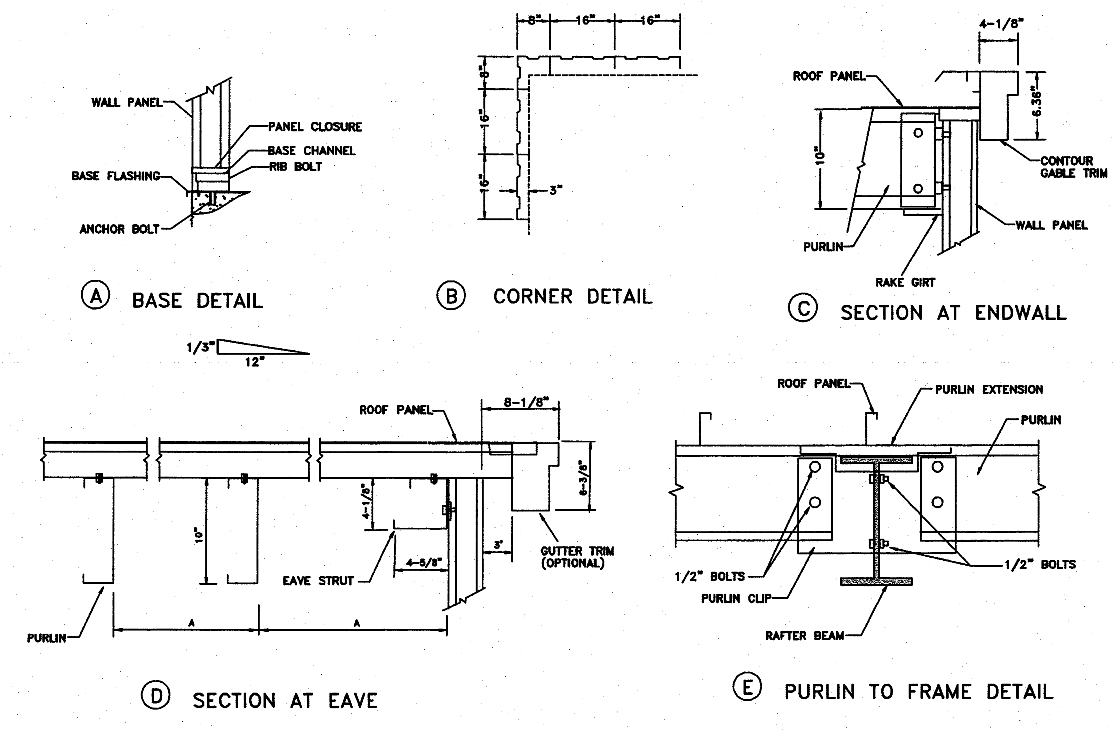


ADJUSTABLE WALL OPENINGS

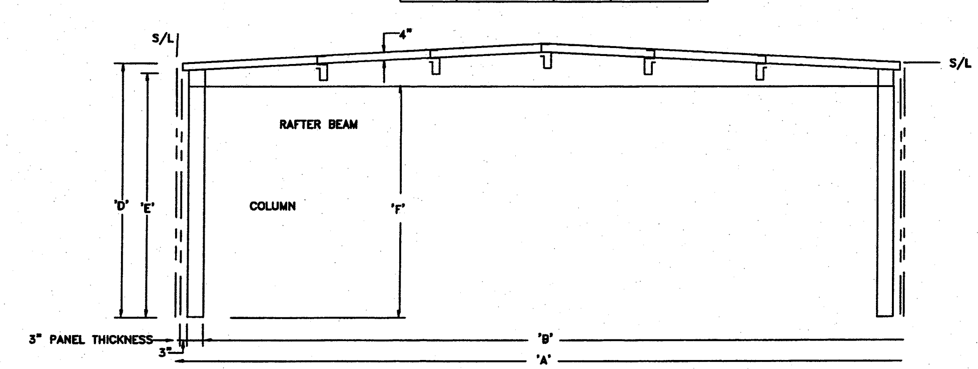


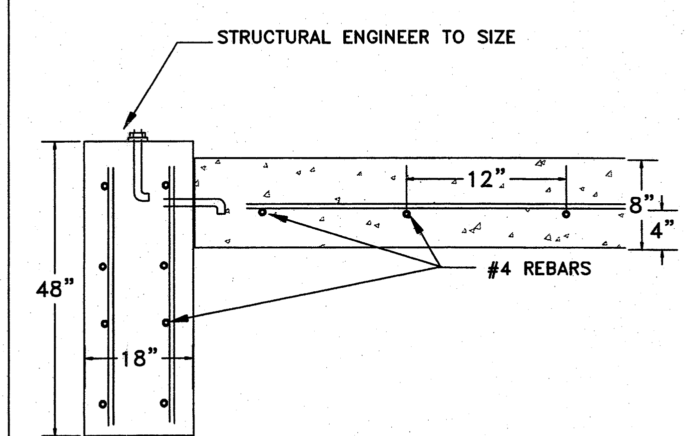
LOUVER SIZES		FREE AREA
WIDTH 'A'	WIDTH 'B'	
16"	24"	1.3 Sq. Ft.
32"	24"	2.8 Sq. Ft.
48"	24"	8.1 Sq. Ft.

NOTE: CUSTOMER MUST SPECIFY LOUVER SILL HEIGHT. MINIMUM SILL OR HEAD HEIGHT IS 6"



PURLIN SPACING			
BLDG. WIDTH	'A'	BLDG. WIDTH	'A'
12'	2'-10 1/2"	24'	3'-11"
16'	3'-10 1/2"	28'	4'-7"
20'	4'-10 1/2"	32'	3'-11 1/4"



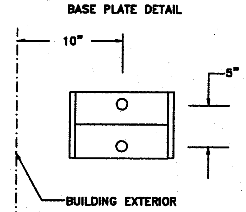


BUILDING FOOTER AND SLAB DETAIL

WIDTH DIMENSIONS	
BLDG. WIDTH 'A'	WIDTH BETWEEN COLUMNS
12'	9'-8"
16'	13'-8"
20'	17'-8"
24'	21'-8"
28'	25'-8"
32'	29'-8"

HEIGHT DIMENSIONS		
BLDG. EST. EAVE HEIGHT 'D'	INT. CL. HT. @EAVE STRUT 'E'	INT. CLEAR HT. @ FRAME 'F'
8'-0"	7'-8"	6'-9 1/8"
10'-0"	9'-8"	8'-9 1/8"
12'-0"	11'-8"	10'-9 1/8"
14'-0"	13'-8"	12'-9 1/8"

BASE PLATE DETAIL



JONE-UTICA-PID.DWG/KGP/02/14/05

LFR LEVINE·FRICKE

FORMER MONARCH CHEMICALS, INC. SITE
37 MEADOW STREET
UTICA, NEW YORK

REVISED 5/15/05

TREATMENT BUILDING DETAILS

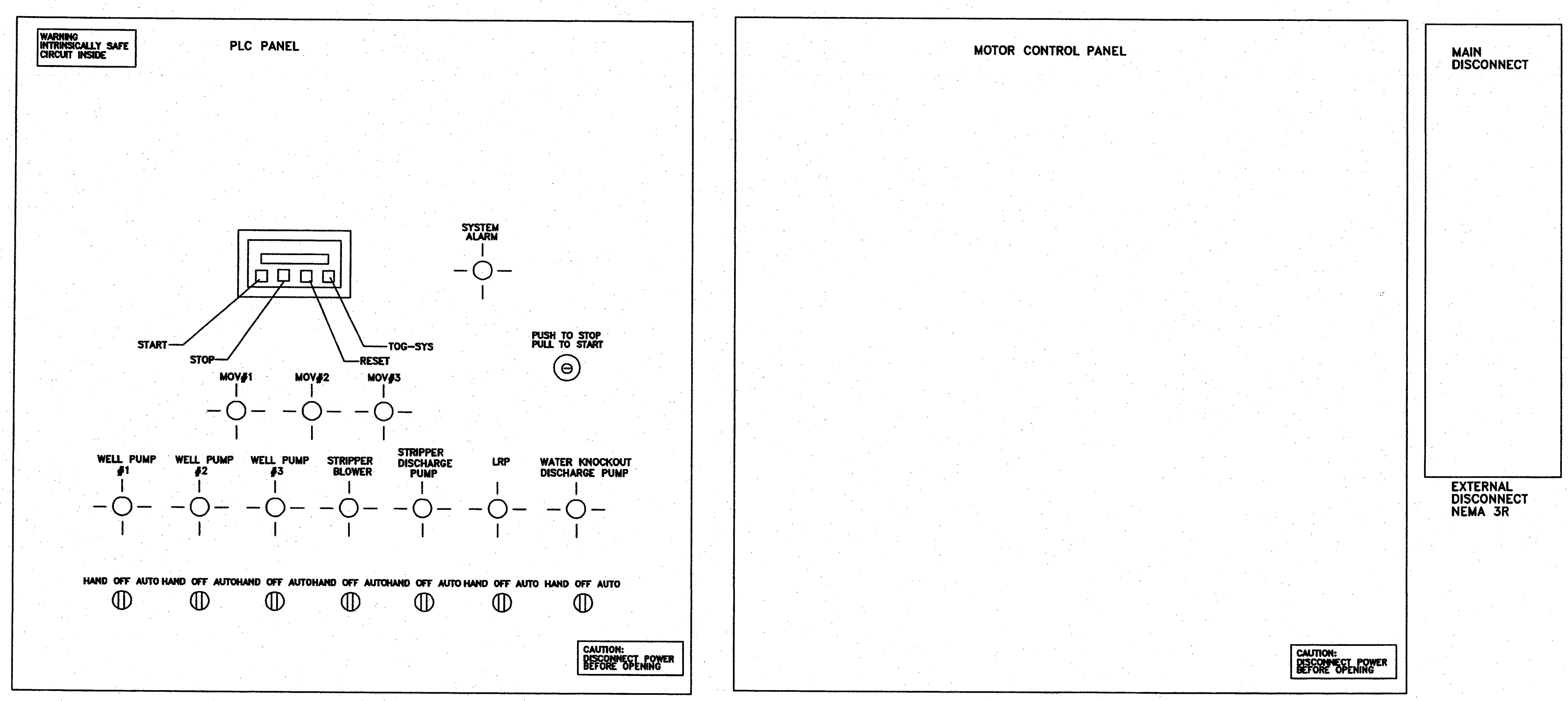
SCALE NTS

DATE 02/07/05

PROJECT NO.

SHEET 10 OF 12

6/7/05



EXTERNAL DISCONNECT NEMA 3R

NEMA 4 PANEL

LIGHTS AND SWITCHES MOUNTED ON INNER SWING PANEL DOOR

NEMA 4 PANEL

Contractor to design and provide programmable logic controller (PLC) panel and motor control center panel that are Underwriters Laboratories listed. The electrical controls shall consist of a NEMA 4 motor control panel that includes surge protector, motor starters, overcurrent protection, and fuses/breakers. The PLC panel shall consist of simple input/output components intended to perform the following functions:

DPE System Control

- Shut down the DPE transfer pump if the water level in the tray stripper sump reaches a preset level. The DPE transfer pump shall restart when the water level in the tray stripper sump reaches a low-level set point.
- Shut down the entire DPE system if the high water switch in the water-knockout tank is tripped.
- Shut down the entire DPE system if the tray stripper?s blower fails.
- shutdown the DPE system if the oil reservoir high or low level switches are tripped
- An interval timer shall be installed to allow cyclic operation of the motor operated valves of the DPE system manifold
- Transducer that indicates the vacuum
- Exhaust temperature indicated
- Status of level switches in water knock-out
- Pulse flow reading from discharge pump effluent
- Timer on all motors

Groundwater Recovery

Grundfos CU-300 controllers with an R-100 infrared remote shall be supplied for the well pumps. This equipment shall be connected to and controlled by the proposed PLC panel. The proposed system shall feature the following operational characteristics:

- Shut down the groundwater extraction pumps at dry run conditions. The extraction pumps shall automatically restart one-hour later.
- Shut down the entire system if the air stripper?s blower pressure switches (high or low pressure) are tripped.
- Shut down the air-stripper blower at loss of the groundwater extraction pumps and MPE pump. The control panel shall be equipped with a zero to 30 minute time delay for restart of the stripper blower to protect the motor.

STATE OF NEW YORK · A. SCOTT STARR · 078821-1 · LICENSED PROFESSIONAL ENGINEER

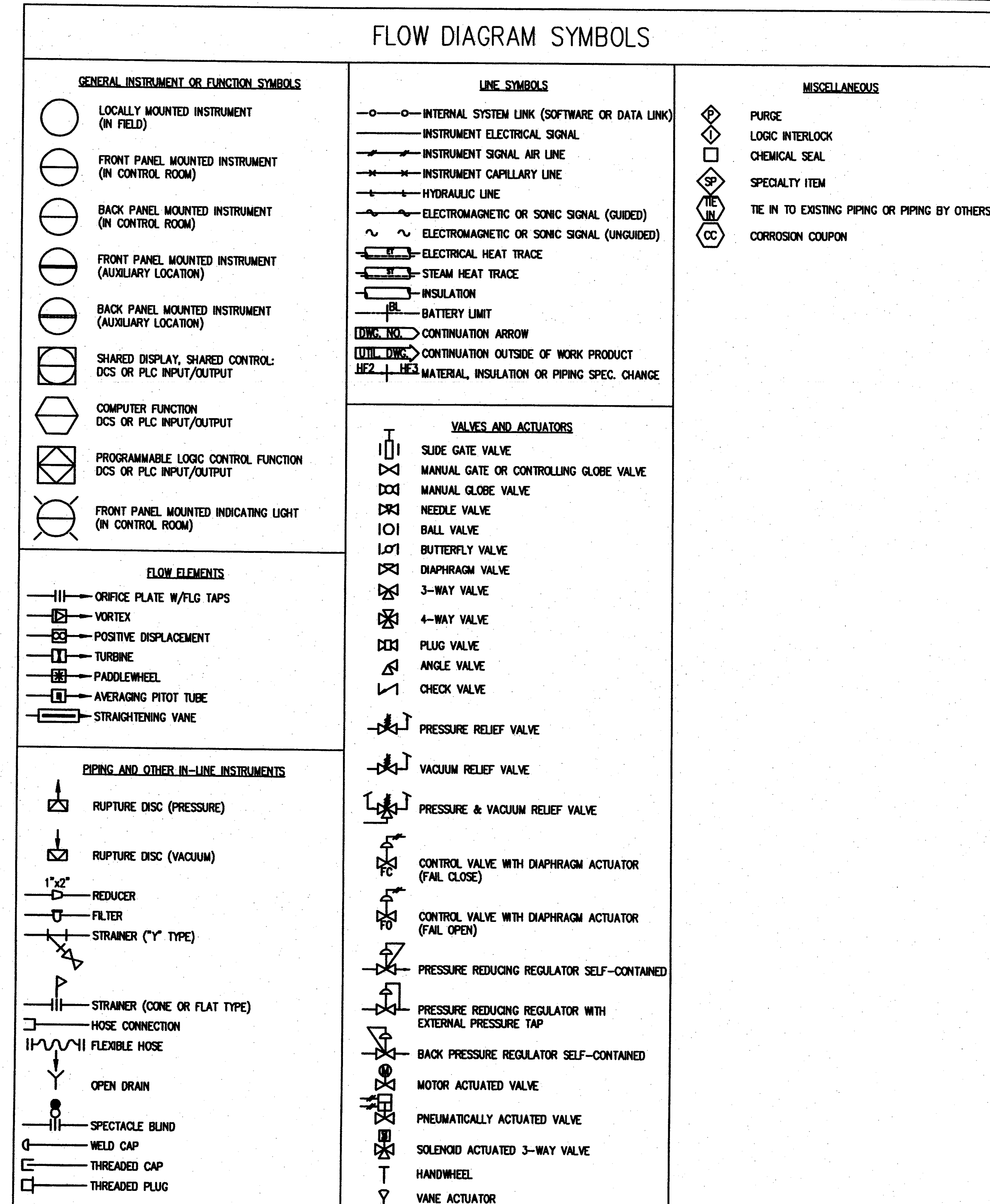
SEAL

6/7/05

LFR LEVINE·FRICKE FORMER MONARCH CHEMICALS, INC. SITE 37 MEADOW STREET UTICA, NEW YORK	ELECTRICAL PANEL LAYOUT REVISED 5/15/05	SEAL	SCALE NTS DATE 02/07/05 PROJECT NO.	SHEET 11 OF 12

JONE-UTICA-PID.DWG/KGP/02/14/05

FLOW DIAGRAM SYMBOLS



EXPLANATION OF IDENTIFICATION LETTERS

(1) ANY FIRST LETTER, IF USED IN COMBINATION WITH MODIFYING LETTERS D(DIFFERENTIAL), F(RATIO), M(MOMENTARY), K(TIME RATE OF CHANGE), Q(INTEGRATE OR TOTALIZE), OR ANY COMBINATION OF THESE IS INTENDED TO REPRESENT A NEW AND SEPARATE MEASURED VARIABLE, AND THE COMBINATION IS TREATED AS A FIRST LETTER ENTITY. THUS, INSTRUMENTS TDI AND TI INDICATE TWO DIFFERENT VARIABLES, NAMELY, DIFFERENTIAL TEMPERATURE AND TEMPERATURE. MODIFYING LETTERS ARE USED WHEN APPLICABLE.

(2) LEVEL GAUGE NOMENCLATURE:

NUMBER OF SECTIONS — (2) LG XXX 46" — VISIBLE GLASS LENGTH

ILLUMINATOR — I

(3) IDENTIFY RELAYS WITH FUNCTIONAL SUPERSCRIPT. FY XXX

(4) IDENTIFY ANALYZERS AND EQUIPMENT WITH SUPERSCRIPT OUTSIDE OF CIRCLE I.E. CO_2, PH, H_2S, ETC. AE XXX 2

(5) FOR VACUUM OR DRAFT INSTRUMENTS ADD SUPERSCRIPT OUTSIDE OF CIRCLE PI XXX PI XXX

(6) EXCEPTIONS TO SCHEDULE OF IDENTIFICATION LETTERS:

FA – FLAME ARRESTOR
LD – LIQUID DRAINER
ST – STEAM TRAP
SP – SET POINT
BL – BATTERY LIMIT
TC – THERMOCOUPLE
RTD – RESISTANCE TEMPERATURE DETECTOR
ESD – EMERGENCY SHUTDOWN
USD – UNIT SHUTDOWN
SD – SHUTDOWN
PB – PUSHBUTTON
HOA – HAND-OFF-AUTO SELECTOR SWITCH
LOR – LOCAL-OFF-REMOTE SELECTOR SWITCH
JOA – JOG-OFF-AUTO SELECTOR SWITCH
I/P – CURRENT TO PNEUMATIC CONVERTER
HSD – HAND SHUTDOWN
SS – SELECTOR SWITCH
FC – FAIL CLOSED
FO – FAIL OPEN
NC – NORMALLY CLOSED
NO – NORMALLY OPEN
SC – SAMPLE CONNECTION
SO – STEAM OUT CONNECTION
TSO – TIGHT SHUT OFF
TS – TEMPORARY STRAINER
VFD – VARIABLE FREQUENCY DRIVE

(7) SUPPLY DESIGNATIONS:

AS – AIR SUPPLY
ES – ELECTRIC SUPPLY
GS – GAS SUPPLY
HS – HYDRAULIC SUPPLY
IA – INSTRUMENT AIR
NS – NITROGEN SUPPLY
SS – STEAM SUPPLY
WS – WATER SUPPLY
PG – PROCESS GAS
PW – PROCESS WATER

(8) ELECTRICAL RELAYS, SWITCHES AND MISC. ITEMS IDENTIFIED WITH AN INSTRUMENT TAG BALLOON AND AN (E) SHOWN IN PLACE OF THE INSTRUMENT TAG NUMBER ARE TO BE SPECIFIED AND FURNISHED BY ELECTRICAL.

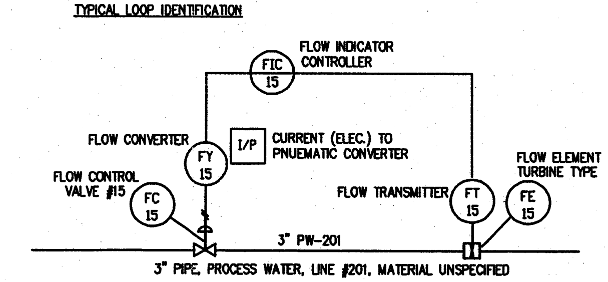
HOA (E) HOA XXX

(9) INSULATION DESIGNATIONS:

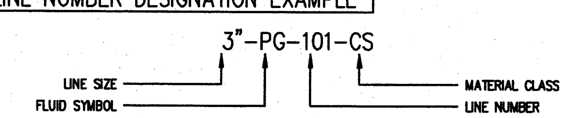
H – HIGH TEMP. MAINTENANCE
C – LOW TEMP. MAINTENANCE
PP – PERSONAL PROTECTION
FP – FREEZE PROTECTION
NP – NOISE PROTECTION

	FIRST LETTER (1)		SUCCEEDING LETTERS		
	MEASURED OR INITIATING VARIABLE	MODIFIER	READOUT OR PASSIVE FUNCTION	OUTPUT FUNCTION	MODIFIER
A	ANALYSIS		ALARM		
B	BURNER, FLAME		USER'S CHOICE	USER'S CHOICE	USER'S CHOICE
C	CONDUCTIVITY			CONTROL	
D	DENSITY (MASS) OR SPECIFIC GRAVITY	DIFFERENTIAL			
E	VOLTAGE		PRIMARY ELEMENT		
F	FLOW RATE	RATIO (FRACTION)			
G	GAUGING (DIMENSIONAL)		GLASS VIEWING DEVICE		
H	HAND (MANUAL)				HIGH
I	CURRENT (ELECTRICAL)		INDICATE		
J	POWER	SCAN			
K	TIME, TIME SCHEDULE	TIME RATE OF CHANGE		CONTROL STATION	
L	LEVEL		LIGHT		LOW
M	MOISTURE OR HUMIDITY	MOMENTARY			MIDDLE INTERMEDIATE
N	USER'S CHOICE		USER'S CHOICE	USER'S CHOICE	USER'S CHOICE
O	USER'S CHOICE		ORIFICE RESTRICTION		
P	PRESSURE VACUUM		POINT (TEST) CONNECTION		
Q	QUANTITY	INTEGRATE, TOTALIZE			
R	RADIATION		RECORD		
S	SPEED, FREQUENCY	SAFETY		SWITCH	
T	TEMPERATURE			TRANSMIT	
U	MULTIVARIABLE		MULTIFUNCTION	MULTIFUNCTION	MULTIFUNCTION
V	VIBRATION, MECH. ANALYSIS			VALVE, DAMPER, LOUVER	
W	WEIGHT, FORCE		WELL		
X	UNCLASSIFIED	X AXIS	UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED
Y	EVENT, STATE, PRESENCE	Y AXIS		RELAY, COMPUTE, CONVERT	
Z	POSITION, DIMENSION	Z AXIS		DRIVER, ACTUATOR, UNCLASSIFIED FINAL CONTROL ELEMENT	

TYPICAL LOOP IDENTIFICATION



LINE NUMBER DESIGNATION EXAMPLE



LFR
LEVINE•FRICKE

FORMER MONARCH CHEMICALS, INC. SITE
37 MEADOW STREET
UTICA, NEW YORK

PROCESS & INSTRUMENTATION LEGEND

SCALE	NTS
DATE	02/14/05
PROJECT NO.	SHEET
	12 OF 12

A. Scott Starr
6/7/05

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Appendix B

Construction Technical Specifications

SECTION 01110

SUMMARY OF WORK

PART 1 GENERAL

1.1 SUMMARY

The work to be performed under this project consists of providing the labor, equipment, and materials to install remediation systems as shown on the Contract Documents prepared by LFR Levine-Fricke.

The work consists of sitework, concrete, plumbing, mechanical, electrical, and other items defined in the Contract Documents.

1.1.1 Project Informational Drawings

a. Construction Drawings are provided for information to indicate the proposed layout and the overall equipment for the remediation systems.
b. Process flow diagrams are provided. Proposed systems shall comply with concept shown on these drawings.

1.1.2 Performance Requirements

a. Provide and install all equipment and supporting structures as specified for the Multi-Phase extraction (MPE) system and groundwater extraction system.
b. Test, check-out and calibrate all components of the supplied systems.
c. Provide installation assistance, start-up assistance, and training as required by individual specification sections. Also, provide a minimum of 2 days installation and startup assistance.
d. At system start-up provide three copies of the Operation and Manintenance Manuals for each remediation system. The O&M Manual shall include:
1.Operational description
2.Equipment cut sheets including manufacturer's O&M requirements
3.System startup and shut-down requirements/procedures
4.Weekly and monthly maintenance requirements
5.System troubleshooting procedures

1.2 EXISTING WORK

Protect existing vegetation, structures, equipment, utilities, pavement and improvements.

Remove or alter existing work in such a manner as to prevent injury or damage to any portions of the existing work which remain.

Repair or replace portions of existing work which have been altered during construction operations to match existing or adjoining work, as approved by the Contracting Officer. At the completion of operations, existing work shall be in a condition equal to or better than that which existed before new work started.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, SUBMITTAL PROCEDURES in sufficient detail to show full compliance with the specification:

SD-01 Preconstruction Submittals

Contractor's Health and Safety Plan.
Preliminary Construction Schedule

Submit the following items to the Engineer for Review:

Product Data
Shop Drawings
Samples for Selection
Samples for Verificaiton

1.4 CONTRACT DRAWINGS

The following drawings accompany this specification and are a part thereof.

Construction Drawings for the Multi-Phase Extraction and Hydraulic Control Systems.
Sheets 1 through 10

One sets of full size contract drawings, maps, and specifications will be furnished to the Contractor without charge. Reference publications will not be furnished.

Contractor shall immediately check furnished drawings and notify the Engineer of any discrepancies.

1.5 WORK SCHEDULING

Normal duty hours for work shall be from 7:00 a.m. to 6:00 p.m., Monday through Friday. Requests for additional work shall require written approval from the Engineer 7 days in advance of the proposed work period.

1.6 OCCUPANCY OF PREMISES

Building(s) will not be occupied during performance of work under this Contract.

Before work is started, the Contractor shall arrange with the Owner a sequence of procedure, means of access, space for storage of materials and equipment.

1.7 ON-SITE PERMITS

1.8.1 Utility Connection Requests

Notify the Engineer at least 5 days prior to starting excavation work. Contractor is responsible for marking and verifying all utilities not marked.

The Contractor shall verify the elevations of existing piping, utilities, and any type of underground obstruction not indicated or specified to be removed. But indicated in locations to be transversed by piping, ducts, and other work to be installed.

Utility outages and connections required during the prosecution of work that affect existing systems shall be arranged for at the convenience of the Owner.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01315

PROJECT MEETINGS

PART 1 GENERAL

1.1 SUMMARY

The requirements of this Section apply to, and are a component part of, each section of the specifications.

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES in sufficient detail to show full compliance with the specification:

SD-01 Preconstruction Submittals

A Project Submittal Schedule shall be submitted in accordance with paragraph entitled, "Project Meetings," of this section.

The Contractor shall submit a Monthly Progress Report at the first meeting of each month.

1.3 PRECONSTRUCTION CONFERENCE

The Contractor shall attend a preconstruction conference scheduled by the Engineer. Work shall not commence prior to the conference.

The Contractor shall address project orientation, personnel contact, safety issues, permits, deficiencies, and the location of the Contractor's office.

1.4 PROJECT MEETINGS

The Contractor shall attend weekly project meetings scheduled by the Engieer. The Contractor's Project Manager shall attend scheduled project meetings.

A Monthly Progress Report shall be submitted with the progress schedule, and shall address potential factors of delay, deficiencies, material delivery schedules, submittals, and safety issues.

A Project Submittal Schedule shall be submitted showing full coordination with the project schedule. All products and tests under each submittal number shall be prioritized and linked to the progress schedule.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01330

SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 SUMMARY

Requirements of this Section apply to, and are a component part of, each section of the specifications.

1.2 SUBMITTALS

A standard transmittal form shall be used to transmit each submittal.

Submittal Description (SD): Drawings, diagrams, layouts, schematics, descriptive literature, illustrations, schedules, performance and test data, and similar materials to be furnished by the Contractor explaining in detail specific portions of the work required by the contract.

The following items, SD-01 through SD-11, are descriptions of data to be submitted for the project. The requirements to actually furnish the applicable items will be called out in each specification.

However, as a minimum, provide test reports, installation, operation and maintenance submittals and manuals as original data bound in three ring binders. Equipment actually installed will be clearly marked.

Provide only those submittals considered critical to assure quality and compliance to the contract as "approval" processing. All other submittals include are for record only.

SD-01 Preconstruction Submittals

Submittals which are required prior to a notice to proceed on a new contract. Submittals required prior to the start of the next major phase of the construction on a multi-phase contract. Schedules or tabular list of data or tabular list including location, features, or other pertinent information regarding products, materials, equipment, or components to be used in the work, submitted prior to contract notice to proceed or next major phase of construction.

SD-02 Shop Drawings

Submittals which graphically show relationship of various components of the work, schematic diagrams of systems, detail of fabrications, layout of particular elements, connections, and other relational aspects of the work.

SD-03 Product Data

Data composed of catalog cuts, brochures, circulars, specifications and product data, and printed information in sufficient detail and scope to verify compliance with requirements of the contract documents.

SD-04 Samples

Samples, including both fabricated and unfabricated physical examples of materials, products, and units of work as complete units or as portions of units of work.

SD-05 Design Data

Design calculations, mix design analyses, or other data, written in nature, and pertaining to a part of the work.

SD-06 Test Reports

Written reports of a manufacturer's findings of his product during field inspections, attesting that the products are installed in accordance with the manufacturer's installation instructions, shop drawings, or other manufacturer's requirements. Written reports by a general contractor or his subcontractors including daily logs reporting on the progress of daily activities or attesting that the work has been installed in accordance with the contract plans and specifications.

SD-07 Certificates

A document, required of the Contractor, or through the Contractor by way of a supplier, installer, manufacturer, or other Lower Tier Contractor, the purpose of which is to further the quality or orderly progression of a portion of the work by documenting procedures, acceptability of methods or personnel, qualifications, or other verification of quality.

Statements signed by responsible officials of a manufacturer of a product, system, or material attesting that the product, system or material meet specified requirements. Statements must be dated after the award of this contract, name the project, and list the specific requirements which it is intended to address.

SD-08 Manufacturer's Instructions

Preprinted material describing installation of a product, system, or material, including special notices and material safety data sheets, if any concerning impedances, hazards, and safety precautions.

SD-10 Operation and Maintenance Data

Data intended to be incorporated in an operations and maintenance manual.

SD-11 Closeout Submittals

Special requirements necessary to properly close out a construction contract. For example, as-built record drawings, manufacturer's help and product lines necessary to maintain and install equipment. Also, submittal requirements necessary to properly close out a major phase of construction on a multi-phase contract.

1.3 PREPARATION

1.3.1 Marking

Prepare, review and stamp with Contractor's approval all specified submittals.

Permanently mark each submittal to identify it; transmittal date; Contractor's, Subcontractor's, and supplier's name, address(es) and telephone number(s); submittal name; specification or drawing reference; and similar information to distinguish it from other submittals. Submittal identification shall include space to receive the review action by the Engineer.

1.3.2 Drawing Format

Drawing submittals shall be prepared on reproducible sheets, not less than 8-1/2 by 11 inches nor larger than 30 by 42 inches in size, except for full size patterns or templates. Drawings shall be prepared to accurate size, with scale indicated, unless other form is required. Drawings shall have dark lines on a white background.

Copies of each drawing shall have the following information clearly marked thereon:

a. Job name, which shall be the general title of the contract drawings.

b. Date of the drawings and revisions.

c. Name of Contractor.

d. Name of Subcontractor.

e. Name of the item, material, or equipment detailed thereon.

f. Submittal number (e.g., first submittal to last submittal) in a uniform location adjacent to the title block.

g. Specification section to which submittal applies.

Drawings shall be numbered in logical sequence. Contractor may use his own number system. Each drawing shall bear the number of the submittal in a uniform location adjacent to the title block.

1.3.3 Data Format

Required data submittals for each specific material, product, unit of work, or system shall be collected into a single submittal and marked for choices, options, and portions applicable to the submittal. Marking of each copy of product data submitted shall be identical. Partial submittals will be accepted for expedition of construction effort.

1.3.4 Samples

Samples shall be physically identical with the proposed material or product to be incorporated in the work, fully fabricated and finished in the specified manner, and full scale. Where variations in color, finish, pattern, or texture are inherent in the material or product represented by the sample, multiple units of the sample, showing the near-limits of the variations and the "average" of the whole range (not less than 3 units), shall be submitted. Each unit shall be marked to describe its relation to the range of the variation. Where samples are specified for selection of color, finish, pattern, or texture, the full set of available choices shall be submitted for the material or product specified. Sizes and quantities of samples shall represent their respective standard unit.

1.4 SUBMISSION REQUIREMENTS

1.4.1 Schedules

At the Preconstruction conference, provide, for approval by the Engineer, the following schedule of submittals:

a. A schedule of shop drawings and technical submittals required by the specifications and drawings. Indicate the specification or drawing reference requiring the submittal; the material, item, or process for which the submittal is required; the "SD" number and identifying title of the submittal; the Contractor's anticipated submission date and the approval need date.

1.4.2 Drawings Submittals

Submit two blackline print(s) of each drawing. Two prints, marked with review notations by the Engineer, will be returned to the Contractor. All required installation, fabrication and connection drawings shall be submitted and approved prior to the start of work detailed on these drawings.

1.4.3 Data Submittals

Submit Five complete sets of indexed and bound product data. One set, marked with review notations by the Engineer, will be returned to the Contractor.

1.4.4 Samples

Submit one set of identified samples. A copy of the transmittal form, marked with review notations including selections by the Contracting Officer, will be returned to the Contractor.

Samples that are intended or permitted to be returned and actually incorporated in the work are so indicated in the individual technical sections. These samples will be returned to the Contractor, at his expense, to be clearly labeled, with installation location recorded. Samples shall be in undamaged condition at the time of installation.

1.5 OWNER'S REVIEW

1.5.1 Review Notations

Engineer will review submittals and provide pertinent notation within five calendar days after date of submission. Submittals will be returned to the Contractor with the following notations:

a. Submittals marked "approved" authorize the Contractor to proceed with the work covered.

b. Submittals marked "approved as noted" authorize the Contractor to proceed with the work covered provided he takes no exception to the corrections. Notes shall be incorporated prior to submission of the final submittal.

c. Submittals marked "return for correction" require the Contractor to make the necessary corrections and revisions and to re-submit them for approval in the same routine as before, prior to proceeding with any of the work depicted by the submittal.

d. Submittals marked "not approved" or "disapproved" indicate noncompliance with the contract requirements and shall be re-submitted with appropriate changes. No item of requiring a submittal shall be accomplished until the submittals are approved or approved as noted.

e. Contractor shall make corrections required by the Engineer. If the Contractor considers any correction or notation on the returned submittals to constitute a change to the contract drawings or specifications; notice as required under the clause entitled, "Changes" shall be given to the Engineer. Approval of the submittals by the Engineer shall not be construed as a complete check, but will indicate only that the general method of construction and detailing is satisfactory. Contractor shall be responsible for the dimensions and design of connection details and construction of work. Failure to point out deviations may result in the Owner requiring rejection and removal of such work at the Contractor's expense.

f. If changes are necessary to approved submittals, the Contractor shall make such revisions and submission of the submittals in accordance with the procedures above. No item of work requiring a submittal change shall be accomplished until the changed submittals are approved.

1.5.2 Sample Approval

Furnish, for the approval of the Engineer, samples required by the specifications. Shipping charges shall be paid by the Contractor. Materials or equipment requiring sample approval shall not be delivered to the site or used in the work until approved in writing by the Engineer.

Each sample shall have a label indicating:

a. Name of project

b. Name of Contractor

c. Material or equipment

d. Place of origin

e. Name of producer and brand

f. Specification section to which samples applies

g. Samples of furnished material shall have additional markings that will identify them under the finished schedules.

Contractor shall submit to the Engineer two samples of materials where samples are requested. Transmit to the Engineer with each sample a letter, original and two copies, containing the above information.

Approval of a sample shall be only for the characteristics or use named in such approval and shall not be construed to change or modify any contract requirements. Before submitting samples, the Contractor shall assure that the materials or equipment will be available in quantities required in the project. No change or substitution will be permitted after a sample has been approved.

Materials and equipment incorporated in the work shall match the approved samples. If requested, approved samples, including those which may be damaged in testing, will be returned to the Contractor, at his expense, upon completion of the contract. Samples not approved will also be returned to the Contractor at its expense, if so requested.

Failure of any materials to pass the specified tests will be sufficient cause for refusal to consider, under this contract, any further samples of the same brand or make of that material. Owner reserves the right to disapproved any material or equipment which previously has proved unsatisfactory in service.

Variations from contract requirements shall be specifically pointed out in transmittal letters. Failure to point out deviations may result in the Owner requiring rejection and removal of such work at no additional cost to the Owner.

Approval of the Contractor's samples by the Engineer shall not relieve the Contractor of his responsibilities under the contract.

1.6 PROGRESS SCHEDULE

1.6.1 Bar Chart

a. Submit the progress chart, for approval by the Engineer, at the Preconstruction Conference in one reproducible and 4 copies.

b. Include no less than the following information on the progress chart:

(1) Break out by major headings for primary work activity.

(2) A line item break out under each major heading sufficient to track the progress of the work.

(3) A line item showing contract finalization task which includes punch list, clean-up and demolition, and final construction drawings.

(6) Separate line items for mobilization and drawing submittal and approval.

d. Update the progress schedule in one reproduction and 4 copies every 30 calendar days throughout the contract performance period.

1.6.2 Project Network Analysis

Submit the initial progress schedule within 21 calendar days of notice to proceed. Schedule shall be updated and resubmitted monthly beginning 7 calendar days after return of the approved initial schedule. Updating shall entail complete revision of the graphic and data displays incorporating changes in scheduled dates and performance periods. Redlined updates will only be acceptable for use as weekly status reviews.

Contractor shall provide a single point contact from his on-site organization as his Schedule Specialist. Schedule Specialist shall have the responsibility of updating and coordinating the schedule with actual job conditions. Schedule Specialist shall participate in weekly status meetings and present current information on the status of purchase orders, shop drawings, off-site fabrication, materials deliveries, Subcontractor activities, and any problem which may impact the contract performance period.

Include the following in the project network analysis:

a. Schedule shall be of sufficient detail to facilitate the Contractor's control of the job and to allow the Engineer to readily follow progress for portions of the work.

1.7 STATUS REPORT ON MATERIALS ORDERS

Within five calendar days after notice to proceed, submit, for approval by the Engineer, an initial material status report on all materials orders. This report will be updated and re-submitted every 30 calendar days as the status on material orders changes.

Report shall list, in chronological order by need date, materials orders necessary for completion of the contract. The following information will be required for each material order listed:

a. Material name, supplier, and invoice number.

b. Current delivery date agreed on by supplier.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01411

GENERAL SAFETY REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

The requirements of this Section apply to, and are a component part of, each section of the specifications.

1.1.1 Conditions

Construction/remediation activities may place Contractor's personnel, personnel of other subcontractor's hired by Owner to perform work at site, and public in potentially hazardous situations due to exposure to soil and er containing chlorinated ethenes and petroleum hydrocarbons.

1.1.2 Responisbilities

Contractor is responsible for implementation and enforcement of safe work practices including but not limited to personnel exposure to hazardous materials; use of trenching, sheeting, and shoring; operation of equipment; and safety of public during progress of work.

1.2 REFERENCES

The publications listed below form a part of this section to the extent referenced:

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910	(2001) Occupational Safety and Health Standards
29 CFR 1926	(2001) Safety and Health Regulations for Construction

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES in sufficient detail to show full compliance with the specification:

SD-01 Preconstruction Submittals

Contractor's Health and Safety Plan

SD-07 Certificates

Statements shall be submitted for the following items in accordance with paragraphs entitled, "Contractor's Safety Plan" of this section.

Contractor's Health and Safety Plan

License Certificates for hazardous waste operations shall be submitted to the Engineer prior to the start of work.

1.3.1 Contractor's Health and Safety Plan

Contractor shall submit a safety plan to the Engineer for approval within 5 calendar days after notice to proceed and prior to start of construction at project site.

Comply with the requirements in 29 CFR 1926 and 29 CFR 1910.

Safety plan shall include, as a minimum, the following:

a. Safety program objectives.

b. Methods to attain safety objectives.

c. Responsibility of key personnel for the Contractor.

d. Safety meetings, surveys, inspections, and reports.

e. Contingency and emergency programs.

f. Lists of key personnel to be contacted in times of emergency.

g. Program to show compliance with Federal OSHA Safety and Health Standards 29 CFR 1910 and 29 CFR 1926.

1.4 GENERAL SAFETY PROVISIONS

Contractor shall take safety and health measures in performing work under this Contract. Contractor shall meet with the Engineer to develop a mutual understanding relative to administration of the safety plan. Contractor is subject to applicable federal, state, and local laws, regulations, ordinances, codes, and orders relating to safety and health in effect on the date of this Contract.

During the performance of work under this Contract, the Contractor shall comply with procedures prescribed for control and safety of persons visiting the project site. Contractor is responsible for his personnel and for familiarizing each of his subcontractors with safety requirements. Contractor shall advise the Engineer of any special safety restriction he has established.

1.5 ENGINEER'S RESPONSIBILITIES

a. When Engineer is required to be present on Project site to perform engineering services, Engineer will comply with Contractor's safety plans, programs, and procedures.

b. If Engineer determines Contractor's safety plans, programs, and procedures do not provide adequate protection for Engineer, Engineer may direct its employees to leave Project site or implement additional safeguards for Engineer's protection. If taken, these actions will be in furtherance of Engineer's responsibility to its employees only, and Engineer will not assume responsibility for protection of any other persons affected by Work.

C. If Engineer observes situations which appear to have potential for immediate and serious injury to persons, Engineer may warn persons who appear to be affected by such situations. Such warnings, if issued, shall be given based on general humanitarian concerns, and Engineer will not by issuance of any such warnings assume any responsibility to issue future warnings or any general resoponsibility for protection of persons affected by Work.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01500

TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.1 SUMMARY

Requirements of this Section apply to, and are a component of, each section of the specifications.

1.2 SUBMITTALS

Not Used

PART 2 PRODUCTS

2.1 CONSTRUCTION SIGN

Not Used

PART 3 EXECUTION

3.1 TEMPORARY UTILITIES

Contractor shall provide temporary utilities required for construction. Materials may be new or used, shall be adequate for the required usage, shall not create unsafe conditions, and shall not violate applicable codes and standards.

3.1.1 Electricity

Contractor shall provide means of electricity to meets its power requirements during construction. Electricity is not available at the Site.

3.1.2 Water

Contractor shall make arrangements with the City of Utica to make connection to a fire hydrant to provide water for construction purposes. Water used will not be furnished by the Owner.

3.1.3 Telephone Service

Contractor shall provide telephone service. Contractor shall pay costs of service.

3.1.4 Sanitary Facilities

Contractor shall provide temporary sanitary facilities and shall service, clean, and maintain these facilities and enclosures. Temporary facilities shall be removed from the site at the completion of the work.

3.2 TRAFFIC PROVISIONS

3.2.1 Maintenance of Traffic

Contractor shall conduct his operations in a manner that will not close any thoroughfare or interfere in any way with traffic on railways or highways except with written permission of the Engineer.

3.2.2 Dust Control

Contractor's dust control methods and procedures shall be approved by the Engineer. Dust abatement on access roads shall be treated with applications of calcium chloride, water sprinklers, or similar methods or treatment.

3.3 PROTECTION OF EXISTING SYSTEMS

3.3.1 Utility

Connection to existing utilities, identified on the drawings to the Contractor, shall be protected from damage during construction activity.

3.3.2 Safety

Contractor shall protect the integrity of any installed safety systems or personnel safety devices.

-- End of Section --

SECTION 01600

PRODUCT REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

Requirements of this Section apply to, and are a component part of, each section of the specifications.

1.2 SUBMITTALS

Not Used

1.3 SHIPMENT AND PROTECTION OF MATERIAL AND EQUIPMENT

Shipments shall be addressed to the Contractor who shall be responsible for their receipt, unloading, handling, and storage at the site. Owner will not accept deliveries on behalf of the Contractor or his subcontractors or assume responsibility for security of materials, equipment, or supplies delivered to the site.

Contractor shall protect and preserve materials, supplies, and equipment of every description (including property which may be Owner-furnished or -owned) and work performed.

1.4 STORAGE AND PROTECTION OF MATERIAL

1.4.1 New Material and Construction Equipment

Only material and construction equipment designated for performance of contract work may be stored at the construction site.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Materials and equipment to be provided under this contract shall be standard catalogue products of manufacturers regularly engaged in the manufacture of the products. All material "cut sheets" and factory acceptance test data shall be provided to the Engineer.

Material and equipment shall be installed in accordance with the requirements of the contract drawings , contract specifications and referenced standards and specifications.

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01750

STARTING AND ADJUSTING

PART 1 GENERAL

1.1 SUMMARY

Requirements of this Section apply to, and are a component part of, each section of the specifications.

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES in sufficient detail to show full compliance with the specification:

SD-06 Test Reports

Test reports shall be submitted in accordance with the paragraphs entitled, "Factory Tests", "Functional Test" and "Final Acceptance Test," of this section.

Test procedures and the recording forms shall be submitted according to paragraph entitled, "Test Procedures."

1.2.1 Tests Required

Tests shall be performed to verify proper functioning of electrical, fluid and gas systems, pump/motor combinations, electical motor controls, condition/performance monitoring systems, and other assemblies and components that need to be tested as an interrelated whole.

1.2.2 Factory Tests

Tests shall be performed at the factory to verify proper build. These test results will be used in the "Final Acceptance Test" section to verify no shipping damage and proper installation.

1.2.3 Functional Test

Contractor shall perform an "in-house" test to verify that the system and components have been properly installed and are functioning properly. Test shall be performed in the presence of the Engineer. Test shall be completed and found acceptable when system has performed per other sections and referenced industry standards.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01780

CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.1 SUMMARY

The requirements of this Section apply to, and are a component part of each section of the specifications.

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES in sufficient detail to show full compliance with each section of the project's specification:

SD-01 Preconstruction Submittals

The following shall be submitted in accordance with paragraph entitled, "General," of this section.

Reproducible Drawings
CAD System Drawings

SD-02 Shop Drawings

As-Built Drawings shall be submitted in accordance with paragraph entitled, "General," of this section.

SD-03 Product Data

Spare Parts Data shall indicate manufacturer's name, part number, nomenclature, and stock level recommended for maintenance and repair. List those items that may be standard to the normal maintenance of the system.

SD-08 Manufacturer's Instructions

The following shall be submitted in accordance with paragraph entitled, "General," of this section.

Preventative Maintenance and Condition Monitoring (Predictive Testing) and Inspection schedules shall be submitted by the Contractor with instructions that state when systems should be retested.

Schedule shall define the anticipated length of each test, test apparatus, number of personnel identified by responsibility, and a testing validation procedure permitting the record operation capability requirements. Each test feature; e.g., gpm, rpm, psi, shall have a signoff blank for the Contractor and Engineer. A remarks column of the testing validation procedure shall include references to operating limits of time, pressure, temperature, volume, voltage, current, acceleration, velocity, alignment, calibration, adjustments, cleaning, or special system notes. Procedures for preventative maintenance, condition monitoring (predictive testing) and inspection, adjustment, lubrication and cleaning necessary to prevent failure shall be delineated.

Posted Instructions

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals shall be submitted in accordance with paragraph entitled, "Operation and Maintenance," of this section.

1.3 GENERAL

Reproducible Drawings and CAD System Drawings shall be submitted as follows:

Three reproducible copy(s) of each drawing, product data record shall be submitted for historical record.

Final drawings shall incorporate contract changes and plan deviations. Lines, letters, and details will be sharp, clear, and legible. Additions or corrections to the drawings will be drawn to the scale of the original drawing. One copy, marked with review notations by the Engineer, will be returned to the Contractor. Drawings are to be resubmitted within 30 calendar days after the completion of the representative work effort.

Documents shall be current. Contractor shall not conceal record information until as-built drawings have been made. Record drawings shall be submitted with a transmittal letter containing date, project title, Contractor's name and address, document list, and Contractor's signature.

As-Built Drawings shall be submitted under the following criteria:

After completion of all construction and before final payment is made under this contract, the Contractor shall provide the Engineer with one complete full size reproduction, on paper, of alterations shown in red pencil.

Preventative Maintenance and Condition Monitoring (Predictive Testing) and Inspection schedules shall be submitted by the Contractor with instructions that state when systems should be retested.

Schedule shall define the anticipated length of each test, test apparatus, number of personnel identified by responsibility, and a testing validation procedure permitting the record operation capability requirements. Each test feature; e.g., gpm, rpm, psi, shall have a signoff blank for the Contractor and Engineer. A remarks column of the testing validation procedure shall include references to operating limits of time, pressure, temperature, volume, voltage, current, acceleration, velocity, alignment, calibration, adjustments, cleaning, or special system notes. Procedures for preventative maintenance, inspection, adjustment, lubrication and cleaning necessary to minimize corrective maintenance and repair shall be delineated.

Repair requirements shall inform operators how to check out, troubleshoot, repair, and replace components of the system. Instructions shall include electrical and mechanical schematics and diagrams and diagnostic techniques necessary to enable operation and troubleshooting of the system after acceptance.

Posted Instructions shall be submitted by the Contractor with labels, signs, and templates of operating instructions that are required to be mounted or installed on or near the system for normal, safe operation.

Contractor shall submit six copies of the project operation and maintenance manuals 30 calendar days prior to testing the system involved. Data shall be updated and resubmitted for final approval no later than 30 calendar days prior to contract completion.

Spare Parts Data shall indicate manufacturer's name, part number, nomenclature, and stock level required for maintenance and repair. List those items that may be standard to the normal maintenance of the system.

Contractor shall supply two items of each part for spare parts inventory. Provision of spare parts does not relieve the Contractor of responsibilities listed under the contract guarantee provisions.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 OPERATION AND MAINTENANCE

Operation and Maintenance Manuals shall be consistent with the manufacturer's standard brochures, schematics, printed instructions, general operating procedures, and safety precautions. Information shall be bound in manual format and grouped by technical sections. Test data shall be legible and of good quality. Light-sensitive reproduction techniques are acceptable provided finished pages are clear, legible, and not subject to fading. Pages for vendor data and manuals shall have 0.3937-inch holes and be bound in 3-ring, loose-leaf binders. Data shall be organized by separate index and tabbed sheets, in a loose-leaf binder. Binder shall lie flat with printed sheets that are easy to read. Caution and warning indications shall be clearly labeled.

Contractor shall submit classroom and field instructions in the operation and maintenance of systems equipment where required by the technical provisions. These services shall be directed by the Contractor, using the manufacturer's factory-trained personnel or qualified representatives. Engineer shall be given 7 calendar days written notice of scheduled instructional services. Instructional materials belonging to the manufacturer or vendor, such as lists, static exhibits, and visual aids, shall be made available to the Engineer.

-- End of Section --

SECTION 02150

PIPING; MULTI-PHASE EXTRACTION

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN PETROLEUM INSTITUTE (API)

API Spec 6D	(2002) Specification for Pipeline Valves

AMERICAN WATER WORKS ASSOCIATION(AWWA)

AWWA C218	(2002) Coating the Exterior of Aboveground Steel Water Pipelines and Fittings

ASME INTERNATIONAL (ASME)

ASME B1.20.1	(1983; R 2001) Pipe Threads, General Purpose, Inch
ASME B16.11	(2002) Forged Fittings, Socket-Welding and Threaded
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.40	(2002) Manually Operated Thermoplastic Gas Shutoffs and Valves in Gas Distribution Systems
ASME B16.5	(1996) Pipe Flanges and Flanged Fittings
ASME B16.9	(2001) Factory-Made Wrought Steel Buttwelding Fittings
ASME B31.8	(2000) Gas Transmission and Distribution Piping Systems

ASTM INTERNATIONAL (ASTM)

ASTM A 123/A 123M	(2002) Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(2003) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 181/A 181M	(2001) Carbon Steel Forgings, for General-Purpose Piping
ASTM A 53	(1999b) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

ASTM C 920	(2002) Elastomeric Joint Sealants
ASTM D 1598	(2002) Time-to-Failure of Plastic Pipe Under Constant Internal Pressure
ASTM D 1784	(2003) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 2466	(2002) Poly(Vinyl Chloride)(PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2513	(2003a) Thermoplastic Gas Pressure Pipe, Tubing, and Fittings
ASTM D 2564	(2002) Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 2672	(1996a) Joints for IPS PVC Pipe Using Solvent Cement
ASTM D 2774	(2001) Underground Installation of Thermoplastic Pressure Piping
ASTM D 2855	(1996; R 2002) Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D 3139	(1998) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D 3308	(2001) PTFE Resin Skived Tape
ASTM D 3892	(1993; R 1998) Packaging/Packing of Plastics
ASTM D 3915	(1999ae1)Rigid Poly(Vinyl Chloride) (PVC) and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds for Plastic Pipe and Fittings Used in Pressure Applications
ASTM F 402	(1993; R 1999) Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings
ASTM F 656	(2002) Primers for Use in Solvent Cement Joints of Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-25	(1998) Standard Marking System for Valves, Fittings, Flanges and Unions
MSS SP-58	(2002) Pipe Hangers and Supports - Materials, Design and Manufacture

MSS SP-69	(2002) Pipe Hangers and Supports - Selection and Application
MSS SP-72	(1999) Ball Valves with Flanged or Butt-Welding Ends for General Service
MSS SP-89	(1998) Pipe Hangers and Supports - Fabrication and Installation Practices

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 6	(2000) Commercial Blast Cleaning

UNDERWRITERS LABORATORIES (UL)

UL Gas&Oil Dir	(2003)Flammable and Combustible Liquids and Gases Equipment Directory

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Materials and Equipment

Manufacturer's descriptive data and technical literature for each piping system, including design recommendations, pressure and temperature ratings, dimensions, type, grade and strength of pipe and fittings, thermal characteristics (coefficient of expansion and thermal conductivity) and chemical resistivity for each chemical constituent in the off-gas stream. Manufacturer's recommended installation procedures including materials preparation, and installations.

SD-06 Test Reports

Pressure Testing

Reports of inspections or test, including analysis and interpretation of test results. Each report shall be properly identified. Test methods used shall be identified and test results shall be recorded.

SD-07 Certificates

Off-gas Piping System

A written certificate from the testing agency stating that the items have been tested and that they conform to the applicable requirements of the specifications. The certificate shall indicate the methods of testing used by the testing agency. In lieu of a certificate from a testing agency, published catalog specification data, accompanied by the manufacturer's certified statement that the items are in accordance with the applicable requirements of the specifications will be acceptable as evidence that the items conform with agency requirements.

Manufacturer's Representative

The name and qualifications of the manufacturer's representative and written certification from the manufacturer that the representative is technically qualified.

SD-10 Operation and Maintenance Data

Off-gas Piping System

Six copies, in indexed booklet form, of site specific operation and maintenance manual for the piping system including system operation, system maintenance, equipment operation, and equipment maintenance manuals described below. If operation and maintenance manuals are provided in a common volume, they shall be clearly differentiated and separately indexed.

a. The Equipment Operation Manual shall include but not be limited to detail drawings, equipment data, and manufacturer supplied operation manuals for equipment, valves and system components.

b. The Equipment Maintenance Manuals shall include but not be limited to the following:

(1) Identification of valves and other equipment by materials, manufacturer, vendor identification and location.

(2) Maintenance procedures and recommended maintenance tool kits for valves and equipment.

(3) Recommended repair methods, either field repair, factory repair, or whole-item replacement for each valve component or piece of equipment or component item.

(4) Routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guide.

1.3 SYSTEM DESCRIPTION

The off-gas piping system shall consist of buried and above ground pipe, pipe supports, fittings, equipment and accessories.

1.4 QUALIFICATIONS

1.4.1 Contractor

Contractor shall have had a minimum of 2 years of experience in the construction of piping systems for sour gas, condensable gas, off-gas or vapor.

1.4.2 Single Source Supplier

The Contractor shall assign to a single supplier full responsibility for the furnishing of the off-gas piping system. The designated single supplier, however, need not manufacture the system but shall coordinate the selection, assembly, installation, and testing of the entire system as specified herein.

1.4.3 Manufacturer's Representative

Services of a manufacturer's field service representative who is experienced in the installation of the materials and equipment furnished and who has complete knowledge of the proper operation and maintenance of the system shall be provided.

1.4.4 Jointing Plastic Pipe

Manufacturer's prequalified joining procedures shall be used.

1.5 GENERAL REQUIREMENTS

Piping material and appurtenances shall be as specified and as shown on the drawings, and shall be suitable for the service intended. Materials and equipment shall be new and unused, except for testing equipment. Components that serve the same function and are the same size shall be identical products of the same manufacturer.

1.5.1 Standard Products

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Pipe, valves, fittings and appurtenances shall be supported by a service organization that is, in the opinion of the Engineer, reasonably convenient to the site.

1.5.2 Identification

Each piece of pipe shall bear the ASTM designation and the ASTM markings required for that designation. Each valve shall be marked in accordance with MSS SP-25 to identify the manufacturer, size, pressure rating, body disc and seat material. A tag with the manufacturer's name, catalog number and valve identification shall be securely attached.

1.5.3 Verification of Dimensions

The Contractor shall become familiar with details of the work, verify all dimensions in the field, and shall advise the Engineer of any discrepancy before performing the work.

1.6 DELIVERY AND STORAGE

1.6.1 Packaging

Plastic pipe shall be packed, packaged and marked in accordance with ASTM D 3892.

1.6.2 Storage

Materials shall be stored with protection from puncture, dirt, grease, moisture, mechanical abrasions, excessive heat, ultraviolet (UV) damage, or other damage. Pipe and fittings shall be handled and stored in accordance with the manufacturer's recommendations. Piping bundles shall be stored on a prepared surface and should not be stacked more than two bundles high.

1.7 PARTNERING/PRE-INSTALLATION CONFERENCE

Pre-installation conference will be required. The Contractor shall ensure that involved subcontractors, suppliers, and manufacturers are notified. The date and time of the conference shall be furnished to the Engineer for approval.

PART 2 PRODUCTS

2.1 DESIGN STRENGTH

Design strength of piping shall be suitable for the operating pressure and temperature ranges indicated and/or shown.

2.2 STEEL PIPE

Steel pipe shall be Schedule 40 conforming to Grade A or B, Type E or S of ASTM A 53. Pipe threads shall conform to ASME B1.20.1. Fittings for pipe 1-1/2 inches and smaller shall conform to ASME B16.11. Buttweld fittings for pipe 1-1/2 inches or less shall conform to ASME B16.9. Joint sealing compound shall conform to UL Gas&Oil Dir, Class 20 or less. Polytetrafluoroethylene tape shall conform to ASTM D 3308. Weld neck flanges shall be used. Connections shall conform to ASTM A 181/A 181M, Class 60, carbon steel. Carbon steel components shall be coated with corrosion resistant materials. Coatings and finishes shall be 100 percent holiday free.

2.2.1 Carbon Steel Located Above Grade

Surfaces of aboveground carbon steel components shall be coated in accordance with AWWA C218.

2.2.2 Silicone Coating

Surfaces of carbon steel components shall be blasted in accordance with SSPC SP 6. Surface shall have an alkyd primer 2.5 mils dry film thickness followed by two alkyd modified silicone final coats.

2.2.3 Zinc Coating

Surfaces of carbon steel components shall be coated with zinc in accordance with ASTM A 123/A 123M or ASTM A 153/A 153M.

2.3 POLYVINYL CHLORIDE (PVC) PIPING

Design and fabrication of below grade components of the off-gas piping system shall be in accordance with ASTM D 2513 except as modified herein.

2.3.1 PVC Pipe

Pipe shall be in accordance with Schedule 40 and Schedule 80. Materials shall conform to ASTM D 3915, ASTM D 1784, Type IV, Grade 1, rigid (23447-B). The maximum eccentricity of the inside and outside circumferences of the pipe walls shall be 12 percent. Pipe shall be provided which does not fail, balloon, burst, or weep as defined in ASTM D 1598.

2.3.2 PVC Joints

Joints shall be pressure rated solvent cemented bell joints in accordance with ASTM D 2672 except where flanged or threaded fittings are required at expansion joints, valves, flowmeter, equipment connections or otherwise shown. Flanges shall be joined to pipe by solvent cementing. Primer shall conform to ASTM F 656. Solvent cement shall conform to ASTM D 2564.

2.3.3 PVC Fittings

Fittings shall be in accordance with ASTM D 2466.

2.4 FLANGED CONNECTIONS

2.4.1 Flanges

Flanges shall be Class 150, socket weld, flat face in accordance with ASME B16.5. Drilling and dimensions of flanges, bolts, nuts, and bolt patterns shall be in accordance with ASME B16.5, Class 150. Bolts and nuts shall conform be 304 stainless steel.

2.4.2 Gaskets

Gaskets shall be full face, non-asbestos compressed material compatible with the expected condensates in accordance with ASME B16.21, 1/8 inch minimum thickness, full face or self-centering flat ring type. Gaskets shall be aramid fibers bonded with nitrile butadiene rubber (NBR) or glass fibers bonded with polytetrafluoroethylene suitable for 600 degrees F service and meeting applicable requirements of ASME B31.8. Florin rubber (i.e. Viton) or nitrile rubber shall be suitable for 320 degrees F service.

2.4.3 Sealants

Sealants shall conform to ASTM C 920.

2.5 EQUIPMENT AND APPURTENANCES

2.5.1 Manually Operated Valves

Ball valves shall be in accordance with MSS SP-72. Gate, plug, ball, and check valves shall be in accordance with API Spec 6D. Thermoplastic gas shutoffs and valves shall be in accordance with ASME B16.40.

2.5.2 Relief Valves

Relief valve with manually adjustable pressure differential shall be provided for each blower or vacuum pump. Relief valve shall be spring operated type. Relief valve diameter shall be line sized or as otherwise indicated and shall be rated to relieve 1,200 actual cubic feet per minute at a set a vacuum of 27 inches Hg. Materials shall be bronze, stainless steel, or cast iron body, bronze or 316 stainless steel trim, and Buna-N, nitrile, Viton, or Teflon elastomers. Maximum operating temperature and pressure shall be 200 degrees F and 20 pound per square inch.

2.5.3 Dielectric Fittings

Dielectric fittings shall be installed between threaded ferrous and nonferrous metallic pipe, fittings and valves, except where corporation stops join mains. Dielectric fittings shall prevent metal-to-metal contact of dissimilar metallic piping elements and shall be suitable for the required working pressure.

2.5.4 Supports for Aboveground Piping

Pipe hangers and supports shall be furnished complete with necessary inserts, bolts, nuts, rods, washers, and accessories. Design and construction shall be in accordance with MSS SP-58. Specific application shall be in accordance with MSS SP-69. Hanger and supports shall be capable of adjustment after placement of piping. Hangers and supports shall be the product of one manufacturer. Hangers, supports and accessories shall be hot dip galvanized in accordance with ASTM A 123/A 123M unless copper or plastic coated. Restrained joints and thrust protection shall be provided. Concrete and metal cradles, collars, floor stands, supports, kickers, and block shall be provided as recommended by manufacturer. Pipe cradle cushion material shall be elastomer sheet strapped to pipe to prevent chafing at pipe support. Elastomer sheet shall be utilized around top of pipe to prevent chafing of pipe strap.

PART 3 EXECUTION

3.1 CONDENSATE CONTROL

Off-gas piping shall be sloped uniformly back to the recovery wells to enhance the removal of liquids.

3.2 Vents

Discharge stacks, vents, or outlet ports of devices shall be located where gas can be discharged into the atmosphere without undue hazard. Vents shall terminate in the outside air in rain and insect resistant fittings. Stacks and vents shall be provided with fittings to preclude entry of water.

3.3 INSTALLING PIPE UNDERGROUND

Installation shall be as specified in Section 02312 EXCAVATION, BACKFILLING, AND COMPACTION except as modified herein; and as required by ASTM F 402 and ASTM D 2855 for using solvents and cleaners, ASTM D 2774 for polyvinyl chloride.

3.3.1 Magnetic Tape

When non-metallic piping is installed underground, foil backed magnetic tape shall be placed above the pipe to permit locating with a magnetic detector.

3.3.2 Pipe Coatings

Any damage to the protective covering during transit and handling shall be repaired before installation.

3.4 INSTALLING PIPE ABOVEGROUND

Vertical pipe shall be installed plumb in all directions. Perpendicular piping shall be installed parallel to building walls. Piping at angles and 45 degree runs across corners will not be accepted unless specifically shown. Small diameter piping shall be installed generally as shown when specific locations and elevations are not indicated. A minimum headroom clearance of 7 feet shall be provided under piping unless otherwise indicated. Temporary caps or plugs shall be provided at pipe openings at the end of each day's work. Piping shall be run in groups where practicable. Minimum clearance shall be 1 in between pipe and other work.

3.4.1 Hangers and Supports

Pipe hangers and supports shall be installed in accordance with MSS SP-89 and MSS SP-69. Hangers or supports shall be installed at locations where pipe changes direction. Hanger rods shall be installed straight and vertical. Chain, wire, strap or perforated bar hangers will not be permitted. Hangers shall not be suspended from piping. Where proper hanger or support spacing does not correspond with joist or rib spacing, pipe shall be suspended from structural steel channels attached to joists or ribs. Contact between dissimilar metals shall be prevented when supporting copper tubing, by use of copper plated, rubber or vinyl coated, or stainless steel hangers or supports. Thin walled stainless steel piping shall be isolated from carbon steel by use of plastic coated hangers or supports or by taping at points of contact with PVC or vinyl. Galvanized or stainless steel hangers and supports shall be used in basins or submerged locations. Maximum support spacing unless otherwise shown or approved for standard weight steel pipe shall be as follows:

Pipe Size	Spacing
Up to size 1-1/2 in	6 feet
2 to 3 in	10 feet
Greater than 3-1/2 in	12 feet

Maximum support spacing for pipe other than standard weight steel shall be two-thirds of the corresponding spacing for steel pipe unless otherwise shown or approved.

3.4.2 Insulation

Insulation shall be furnished and installed as specified.

3.4.3 Coatings or Finishes

Damage to the factory covering during transit and handling shall be repaired before installation. Painting is not required where piping is insulated, stainless steel, galvanized steel or nonferrous. Factory painted items requiring touching-up in the field shall be cleaned of foreign material and shall be primed and top coated with the manufacturer's standard factory finish. Exposed ferrous surfaces shall be painted with two coats of enamel paint. Factory primed surfaces shall be solvent cleaned before painting. Surfaces that have not been factory primed shall be prepared and primed in accordance with the enamel paint manufacturer's recommendations.

3.5 JOINTING PIPE

Non-metallic piping shall be joined by performance qualified joiners. Joints shall be inspected by an inspector qualified in the joining procedures being used.

3.5.1 O-Ring Joints

Jointing surfaces and adjacent areas shall be cleaned before making joint. Gaskets and "O"-rings shall be lubricated and adjusted in accordance with manufacturer's recommendations. Each gasket shall be checked for proper position around full circumference of the joint after "O"-rings are compressed and before pipe is brought fully home. Jointing pipe shall be done in accordance with ASTM D 3139 and manufacturer's recommendations.

3.5.2 Mechanical Joints

The plain end shall be centered and pushed into the bell. The gasket shall be firmly pressed evenly into the bell. The gland shall be slipped to the bell for bolting. The bolt threads shall be oiled. Bolts shall be tightened alternately 180 degrees opposite to each other to seat the gasket evenly. Bituminous coating shall be applied to ferrous bolts and nuts before assembly. The maximum torque on bolts shall be as follows:

Bolt Size	Applied Torque
5/8 in	50 ft-lb
3/4 in	80 ft-lb
1 in	90 ft-lb
1-1/4 in	110 ft-lb

3.5.3 Flanged Joints

Hexagon head nuts and bolts shall be used. Bolt projection through the end of the nut shall be limited to 1/4 inchmaximum. Manufacturer's rating and instructions for specified service shall be followed.

3.6 CONNECTIONS

3.6.1 Transitions Between Types of Pipe

Necessary adapters, specials and connector pieces shall be provided when connecting different types and sizes of pipe or pipe furnished by different manufacturers. Connections between piping and equipment, where required, shall be made using approved fittings to suit the actual conditions.

3.7 PRESSURE TESTS

Tests shall be performed on the system as a whole. Joints shall be tested in sections prior to backfilling when trenches must be backfilled before the completion of other pipeline sections. Labor, materials and equipment for conducting the tests shall be furnished by the Contractor and shall be subject to inspection during the tests. The Contractor shall be responsible for the cost of repair, replacement, and retesting required because of failure to meet testing requirements. Prior to testing the system, the interior shall be blown out, cleaned and cleared of foreign materials. The Contractor shall maintain safety precautions for pressure testing during the tests. Contractor shall notify Engineer 48 hours in advance of pressure, leakage and/or vacuum testing. Tests shall be conducted in the presence of the Engineer unless otherwise directed. During the test, the entire system shall be completely isolated from compressors and other sources of pressure. Testing shall be done with due regard for the safety of employees and the public during the test. Persons not working on the test operations shall be kept out of the testing area while testing is proceeding.

3.7.1 Pressure Testing

Backfill shall be placed and compacted to at least the pipe centerline before testing. Concrete for blocking shall be allowed to reach design strength and shall be backfilled and compacted to assure restraint by harnessed joints before testing. Section to be tested shall be slowly filled with air. Corporation cocks shall be installed as necessary to remove air. Test pressure shall be applied for one hour and gauge pressure shall be observed. Leaks shall be continuously checked while test pressure is being maintained. The off-gas piping system shall be tested after construction and before being placed in service using air as the test medium. The pressure test shall continue for at least one hour from the time of the initial readings to the final readings of pressure and temperature. The initial test readings of the instrument shall not be made for at least 1 hour after the pipe has been subjected to the full test pressure, and neither the initial nor final readings shall be made at times of rapid changes in atmospheric conditions. The temperatures shall be representative of the actual trench conditions. There shall be no indication of reduction of the test pressure, 30 psig, applied at the lowest elevation of the pipeline section, during the test after corrections have been made for changes in atmospheric conditions in conformity with the relationship $T(1)P(2)=T(2)P(1)$, in which T and P denote absolute temperature and pressure, respectively, and the numbers denote initial and final readings. Lines which fail to hold specified test pressure or which exceed the allowable leakage rate shall be repaired and retested.

3.7.2 Demonstration

Upon completion of the work and at a time designated by the Engineer, the services of a qualified engineer shall be provided by the contractor for a period of not less than 8 hours to instruct a representative of the Owner in the operation and maintenance of equipment furnished under this section. The field instructions shall cover the items contained in the bound instructions.

-- End of Section --

SECTION 02312

EXCAVATION, BACKFILLING, AND COMPACTING FOR UNDERGROUND PIPING

PART 1 GENERAL

This section includes excavating for piping from extraction wells to the treatment building.

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 145	(1991; R 2003) Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes
AASHTO T 180	(2001) Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittal Procedures," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

As-Built Drawings shall be submitted in accordance with paragraph entitled, "Drawings," of this section.

1.3 QUALITY ASSURANCE

Not Used

1.4 PLANS

A Work Plan shall be submitted including proposed methods of excavation, earth support, utility construction, and backfilling at least 48 hours in advance of the work, for approval by the Engineer.

1.5 DRAWINGS

As-Built Drawings shall be submitted in accordance with Section 01780, "Closeout Submittals."

1.6 RECORDS OF EXISTING CONDITIONS

The Contractor shall verify the existing conditions are correct as shown on the plans and mentioned in the specification. Any discrepancies found shall be noted immediately, and notification given to the Engineer.

PART 2 PRODUCTS

2.1 BACKFILL MATERIAL

Backfill material shall consist of sandy clay, sand, gravel, soft shale, or other satisfactory soil materials.

2.1.1 Satisfactory Materials

Satisfactory soil materials - AASHTO M 145 Soil Classification Groups A-1, A-2-4, A-2-5, and A-3.

2.1.2 Unsatisfactory Materials

Unsatisfactory soil materials - AASHTO M 145 Soil Classification Groups A-2-6, A-2-7, A-4, A-5, A-6, and A-7, highly organic soils, and soil materials of any classification that have a moisture content at the time of compaction beyond the range of 1 percentage point below and 3 percentage points above the optimum moisture content of the soil material as determined by moisture-density relations test.

2.2 TOPSOIL

Topsoil shall be any soil removed from the project site which consists of clay or sandy loam. The topsoil shall be reasonably free from subsoil, clay lumps, brush, objectionable weeds, and other litter, and shall be free from stones, stumps, roots, and other objectionable materials larger than 2 inch in any dimension.

2.3 TOPSOIL BLEND

Where insufficient topsoil is removed from the project site the topsoil removed shall be stockpiled and blended with compost at the site to achieve the required volume.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

Before starting earthwork, the location of underground utilities shall be carefully verified by hand methods. Utilities to be left in place shall be protected from damage.

Excavation, filling, backfilling, and grading shall be to subgrade elevations specified.

Excavated materials suitable for backfill shall be piled in an orderly manner sufficiently distant from excavations to prevent overloading, slides, and cave-ins.

Excavations shall be done in ways that will prevent surface water and subsurface water from flowing into excavations and will also prevent flooding of the site and surrounding area.

3.2 PROTECTION OF PERSONS AND PROPERTY

Excavations shall be barricaded and posted with warning signs for the safety of persons. Warning lights shall be provided during hours of darkness.

Structures, utilities, sidewalks, pavements, and other facilities immediately adjacent to excavations shall be protected against damage including settlement, lateral movement, undermining, and washout.

Topsoil removal operations shall be conducted to ensure safety of persons and to prevent damage to existing structures and utilities, construction in progress, trees and vegetation to remain standing, and other property.

3.3 TRENCH EXCAVATION

Trenches shall be of adequate width and depth for the specified purpose. Side slopes of the trenches shall be as nearly vertical as practicable. Care shall be taken not to overexcavate. Bottoms of the trenches shall be accurately graded to provide uniform bearing and support for each section of pipe on undisturbed soil at every point along its entire length except where it is necessary to excavate for bell holes and for proper sealing of pipe joints. Bell holes and depressions for joints shall be dug after the trench bottom has been graded to ensure that the pipe rests on the prepared bottom for as much of its full length as practicable. Bell holes and depressions shall be only of such length, depth, and width as required to make the joint. Stones shall be removed, as necessary, to avoid point bearing. Where rock excavation is required in trenches for pipe, the rock shall be excavated to a minimum overdepth of 6-inches below the trench depth specified. Except as specified for wet or otherwise unstable material, overdepths shall be backfilled with materials specified for backfilling the lower portion of trenches. Whenever wet or otherwise unstable material that is incapable of properly supporting the pipe, as determined by the Engineer, is encountered in the bottom of the trench, it shall be removed and the trench shall be backfilled to the proper grade with coarse sand, fine gravel, or other suitable, approved material.

Trench excavations in surfaced areas shall be by open cut, unless otherwise shown. The pavement shall be cut by concrete saw or other approved method. Cuts shall be in straight lines parallel to the utility line location and shall be to a depth of at least one quarter of the pavement thickness. The remainder of the pavement shall be broken out. Pavement shall be removed a minimum of 12 inches on each side of the trench and 6 inches beyond where the base course is to be removed.

3.4 WATER REMOVAL

Water shall not be permitted to accumulate in excavations. Dewatering systems shall be provided by the Contractor to convey water away from excavations so that softening of foundation bottoms, footing undercutting, and soil changes detrimental to subgrade stability and foundation will not occur. Dewatering systems and methods of disposal shall be approved by the Engineer.

Water removal from excavations shall be conveyed to approved collecting areas. Temporary drainage ditches and other diversions as necessary shall be provided and maintained outside of excavation limits.

Trench excavations for utilities shall not be used for temporary drainage ditches.

3.5 EXCAVATION FOR PIPING

The width of the trench at and below the top of the pipe shall be such that the clear space between the barrel of the pipe and the trench wall shall not exceed 8 inches or be less than 5 inches on either side of the pipe. The width of the trench above that level shall be as wide as necessary for the proper performance of the work.

For pipe indicated resting on the trench bottom, the bottom of the trench shall be rounded so that the pipe shall nest firmly on undisturbed soil for as nearly the full length of the barrel (as proper jointing operations will permit). This part of the excavation shall be done manually only a few feet in advance of the pipe being laid.

Trenches shall be graded to avoid high points that necessitate placing vacuum and relief valves in the waterlines. If a profile of the pipes is not provided, trenches shall be of a depth to provide a minimum cover over the top of the pipe of 3.5 feet from the existing ground surface or the indicated finished grade (whichever is lower).

3.6 EXCAVATION FOR ELECTRICAL UTILITIES

Excavation of trenches for electrical cables shall provide vertical walls, unless otherwise approved by the Engineer, and the trench shall be only as wide as necessary for workers to install the cables. Abrupt changes in grade of the trench bottom shall be avoided. Trenches shall be of a depth to provide a minimum cover over the top of the cables of 2-feet below finished grade, and at additional depth if necessary to avoid interference of the electrical cables or ducts with other utilities.

3.7 EXCAVATION FOR APPURTENANCES

Excavation for manholes and similar structures shall be sufficient to leave at least 12 inches in the clear between the outer surfaces and the embankment or timber used to hold and protect the walls. Any overdepth excavation below such appurtenances that has not been directed will be considered unauthorized and shall be refilled with select bedding material or concrete, as directed by the Engineer, at no additional cost to the Owner.

3.8 BACKFILLING AND COMPACTION

Trenches shall not be backfilled until required tests are performed and until the utilities systems, as installed, conform to the requirements for the installation of the various utilities. Trenches improperly backfilled shall be reopened to the depth required for proper compaction, then refilled and compacted as specified, or the condition shall be otherwise corrected as directed.

3.8.1 Bedding

Where the trench is excavated in rocks, a minimum of 6 inches of specified bedding material shall be placed on the rock surface before laying conduit or electrical cable.

3.8.2 Backfill Around Pipe

Backfill around pipe shall be applied to 6-inches above pipe with the specified bedding material.

3.8.3 Lower Portion of Trench

Backfill material shall be deposited in 8-inch uncompacted layers and compacted to the density of the adjacent soil until there is a cover of not less than 1 foot. The backfill material in this portion of the trench shall consist of sandy clay, sand, gravel, soft shale, or other approved materials, free from hard clods and stones larger than 1 inch in any dimension.

3.8.4 Remainder of Trench

The remainder of the trench shall be backfilled with material that is free of stones larger than 3 inches in any dimension. Backfill material shall be deposited in layers not exceeding the thickness specified, and each layer shall be compacted to the minimum density specified.

Under concrete slabs and paved parking areas:

6-inch layers, 95 percent of maximum density prescribed in AASHTO T 180, Method B or D

Under other areas:

8-inch layers, 90 percent of maximum density prescribed in AASHTO T 180, Method B or D

3.9 RESTORATION OF SURFACES

Areas within the limits of earthwork under this section, including adjacent transition areas, shall be uniformly graded. The finished surface shall be smooth within the specified tolerances, compacted, and with uniform levels or slopes between points where elevations are indicated or between such points and existing grades.

Grassed areas:

The finished surface of areas to receive topsoil blend shall be not more than 0.10-foot above or below the specified finish elevations.

Walks:

The surface of areas under walks shall be shaped to line, grade, and cross section, and the finished surface shall be not more then 0.0 foot above or 0.10-foot below the specified finish elevations.

Pavements:

The surface of areas under pavements shall be shaped to line, grade, and cross section, and the finished surface shall be not more than 1/2-inch above or below the specified finish elevations.

-- End of Section --

SECTION 02525

EXTRACTION WELLS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C 117	(2004) Materials Finer Than 75 micrometer (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 136	(2004) Sieve Analysis of Fine and Coarse Aggregates
ASTM C 150	(2004a) Portland Cement
ASTM D 1785	(2004a) Poly(Vinyl Chloride)(PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D 5088	(2002) Decontamination of Field Equipment Used at Nonradioactive Waste Sites
ASTM D 5092	(2004e1) Design and Installation of Ground Water Monitoring Wells in Aquifers
ASTM F 480	(2002) Thermoplastic Well Casing Pipe and Couplings Made in Standard Dimension Ratios (SDR), SCH 40 and SCH 80
ASTM F 883	(2004) Padlocks

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 600-4-89-034	(1990) Handbook of Suggested Practices for the Design and Installation of Groundwater Monitoring Wells

1.2 DESCRIPTION OF WORK

Owner to provide extraction well[s] including drilling, casing, well screen, gravel packing, grouting, development, and incidental related work complete and ready for operation.

1.3 GENERAL REQUIREMENTS

Each system, including equipment, materials, installation, and performance, shall be in accordance with local, State, and Federal regulations, ASTM D 5092, and EPA 600-4-89-034 except as modified herein. Mark and secure extraction well[s] to avoid unauthorized access and tampering.

1.4 SUBMITTALS

The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Well construction

SD-07 Certificates

Health and Safety Plan;

Well Development Report

SD-11 Closeout Submittals

Well Construction Permit

Shipment manifests

Treatment and disposal certificates

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver materials in an undamaged condition. Unload and store with minimal handling. Store materials in on-site enclosures or under protective coverings. Store plastic piping and jointing materials, and rubber gaskets under cover, out of direct sunlight. Store materials off the ground. Keep insides of pipes and fittings free of dirt and debris. Replace defective or damaged materials with new materials.

PART 2 PRODUCTS

2.1 WELL CASING

2.1.1 PVC Piping

ASTM F 480, Type 1, Grade 1, PVC, Schedule 40, with flush threaded joint fittings. Threaded joints shall be wrapped with flouropolymer tape, and provided with nitrile O-ring gaskets.

2.2 WELL SCREEN

Well screens shall be located as indicated. The length of the screen shall be as indicated. Slot size shall be 0.02 inch. Slotted openings shall be distributed uniformly around the circumference of the screen. Open area shall approach the formation's natural porosity.

2.2.1 PVC Screens

ASTM D 1785, PVC Schedule 40, screen, machine-slotted construction, flush threaded joint ends. Slots shall be even in width, length, and separation.

2.3 PRIMARY FILTER PACK

Provide clean, durable, well-rounded, and washed quartz or granite, with less than 5 percent non-siliceous material. The filter pack shall not contain organic matter or friable materials. The filter pack shall allow free flow of water in the well, and shall prevent the infiltration of aquifer materials. Filter pack shall have a uniformity coefficient less than 2.5, in accordance with ASTM C 117 and ASTM C 136.

2.4 ANNULAR SEALANTS

2.4.1 Bentonite Seal

Provide powdered, granular, pelletized, or chipped sodium montmorillonite in sealed containers from a commercial source, free of impurities. Diameter of pellets shall be less than one fifth the diameter of the borehole annular space to prevent bridging. Bentonite base grout shall be in accordance with ASTM D 5092.

2.4.2 Neat Cement Grout

Provide neat cement grout in accordance with ASTM D 5092. Cement shall be in accordance with ASTM C 150. Quick setting admixtures shall not be allowed. Drilling mud or cuttings shall not be used as a sealing material.

2.5 BOTTOM PLUGS

Provide flush threaded solid plug at the bottom of the well. Plug shall be the same material as the well screen to which it is attached. Joints shall be wrapped with fluoropolymer tape and provided with nitrile O-ring gaskets.

2.6 LOCKING WELL CAP

Provide flush threaded, weatherproof, and non-removable locking well cap on the top of the well. Well cap shall be of the same material as the well casing to which it is attached. Well cap shall accommodate padlock. Provide a long shackled padlock in accordance with ASTM F 883. Provide two keys for the padlock, and turn them over to the Engineer. Locks at the well site shall be keyed alike.

2.7 WELL HEAD COMPLETIONS

Clearly mark and secure the well to avoid unauthorized access and tampering.

2.7.1 At-Grade Completions

Provide cast iron vault box, 12 by 12 inches, with watertight frame and cover. Vault shall support H-20 loading for traffic areas. The frame shall be 6 inches deep, and shall be set in a concrete collar a minimum of 8 inches thick, and extending 3 inches beyond the edge of the frame in all directions. Frame and concrete collar shall be set flush with the level of the existing pavement. Locking well cap shall be provided on top of the well casing, which will terminate inside the vault as indicated.

PART 3 EXECUTION

3.1 GENERAL

Drilling, installation, and development of the extraction well[s] shall be supervised, directed, and monitored by the Engineer. Drilling, sampling, and well development equipment introduced to the well shall be decontaminated before and after each use in accordance with ASTM D 5088.

3.2 DRILLING

Borehole shall be advanced using conventional 10 inch hollow-stem auger drilling methods. Drill crew shall be experienced and trained in drilling and safety requirements for contaminated sites.

3.2.1 Alignment

Verify that the well is straight by lowering a 10 foot section of two inch diameter steel pipe in to the well.

3.3 SOIL REMOVED FROM THE BOREHOLE

3.3.1 Temporary Containment of Soil Removed from the Borehole

Soil removed from the borehole shall be placed in a temporary containment area. Cover containment area with 10 mil reinforced polyethylene sheeting. Place soil removed from the borehole[s] on the impervious barrier and cover with 6 mil reinforced polyethylene sheeting. Provide a straw bale berm around the outer limits of the containment area and cover with polyethylene sheets. Secure edges of sheets with weights to keep the polyethylene sheeting in place. Water runoff shall be diverted from the stockpiled material. As an option, soil may be stockpiled in trucks suitable for transporting contaminated soils as specified herein.

3.3.2 Testing Requirements for Stockpiled Soils

3.3.2 Sampling

A minimum of one composite sample shall be developed and analyzed for each required test for every 100 cubic yards or fraction thereof from a composite stockpile of soil removed from all well sites. To develop a composite sample of the size necessary to run the required tests, the Contractor shall take several samples from different areas along the surface and in the center of the stockpile. These samples shall be combined and thoroughly mixed to develop the composite sample.

3.4 WELL INSTALLATION

Well installation shall be in accordance with ASTM D 5092 and EPA 600-4-89-034. Borehole shall be stable and shall be verified straight before beginning installation.

3.4.1 Casings and Screens

Well casings, screens, plugs, and caps shall be decontaminated prior to delivery by the manufacturer and shall be certified clean. Materials shall be delivered, stored, and handled in such manner as to ensure that grease, oil, or other contaminants do not contact any portion of the well screen and casing assembly prior to installation. If directed by the Contracting Officer, the well screen and casing assembly shall be cleaned with high pressure water prior to installation. Personnel shall wear clean cotton or surgical gloves while handling the assembly. Centralizers shall be used to ensure that the well screen and casing assembly is installed concentrically in the borehole. When the assembly has been installed at the appropriate elevation, it shall be adequately secured to preclude movement during placement of the filter packs and annular seals. The top of the well casing shall be capped during filter pack placement.

3.4.2 Primary and Secondary Filter Packs

Primary and secondary filter packs shall be placed as indicated on the approved well construction drawings to fill the entire annular space between the screen and casing assembly and the outside wall of the borehole. Place both the primary and secondary filters with a tremie pipe in accordance with EPA 600-4-89-034 and ASTM D 5092. Placement of the primary and secondary filters by gravity or free fall methods is not allowed. Control speed of filter placement to prevent bridging and to allow for settlement. Prior to commencement of work, equipment and methods required to place filters shall be approved by the Engineer.

3.4.3 Bentonite Seal

Bentonite shall be placed as a slurry through a tremie pipe. Control speed of bentonite placement to prevent bridging or segregation of slurry. Additional water shall be added to the annular space to ensure complete hydration of the bentonite. Bentonite shall cure a minimum of 48 hours before the placement of cement grout to ensure complete hydration and expansion of the bentonite.

3.4.4 Neat Cement Grout

Cement grout shall be placed in the annular space above the bentonite seal as indicated on the well construction drawings. Cement grout shall be placed as a slurry through a tremie pipe, and injected under pressure to reduce chance of voids. Grout shall be injected in one continuous operation until full strength grout flows out at the ground surface without evidence of drilling cuttings or fluid. Cement grout shall cure a minimum of 24 hours before beginning well development operations.

3.4.5 Well Head Completions

Well head completions shall be as indicated and as specified herein.

3.5 WELL DEVELOPMENT

Well development shall be in accordance with EPA 600-4-89-034 and ASTM D 5092 except as modified herein. Bailing, surging, and pumping/overpumping/backwashing are acceptable development methods. Air surging and jetting are prohibited. Method of development shall be chosen by the Engineer. Well development operations shall be conducted continuously until development water flows clear and free of drilling fluids, cuttings, or other materials.

3.6 WATER FROM WELL DEVELOPMENT OPERATIONS

Water from the well development operations shall be containerized in Owner supplied tanks for treatment and discharge by Owner.

3.7 TRANSPORTATION OF CONTAMINATED SOIL AND WATER

The Owner shall be solely responsible for complying with Federal, State, and local requirements for transporting contaminated materials through the applicable jurisdictions and shall bear responsibility and cost for any noncompliance. In addition to those requirements, the Owner shall do the following:

a. Inspect and document vehicles and containers for proper operation and covering.

b. Inspect vehicles and containers for proper markings, manifest documents, and other requirements for waste shipment.

c. Perform and document decontamination procedures prior to leaving the worksite and again before leaving the disposal site.

3.8 DISPOSAL OF CONTAMINATED SOIL AND WATER

Contaminated materials removed from the site shall be disposed of in a treatment/disposal facility permitted to accept such materials.

3.9 INSTALLATION SURVEY

Upon completion of well installation and development and acceptance by the Engineer therefor, the vertical and horizontal position of each well shall be determined by a registered land surveyor licensed in the State of New York. The survey shall document the vertical elevations of the top of the casing pipe and the ground surface elevation adjacent to each well. The survey shall also determine the horizontal location of each well. Survey shall be accurate to the nearest .01 foot. This data shall be submitted with a well location map as the Installation Survey Report.

3.10 CLEANUP

Upon completion of the well construction, remove debris and surplus materials from the jobsite.

-- End of Section --

SECTION 02532

FORCE MAINS (EXTRACTION WELL PIPING)

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WATER WORKS ASSOCIATION(AWWA)

AWWA C508	(2001) Swing-Check Valves for Waterworks Service, 2 In. (50 mm) Through 24 In. (600 mm) NPS

ASME INTERNATIONAL (ASME)

ASME B16.1	(1998) Cast Iron Pipe Flanges and Flanged Fittings

ASTM INTERNATIONAL (ASTM)

ASTM C 478	(2003) Precast Reinforced Concrete Manhole Sections
ASTM D 1785	(1999) Poly(Vinyl Chloride)(PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2241	(2000) Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D 2464	(1999) Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2564	(2002) Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 3139	(1998) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM F 477	(2002e1) Elastomeric Seals (Gaskets) for Joining Plastic Pipe

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-06 Test Reports

Pressure Tests.

Copies of test results.

1.3 DELIVERY AND STORAGE

Pipe, fittings and accessories, and pipe coatings shall not be damaged during delivery, handling, and storage.

PART 2 PRODUCTS

2.1 PIPE AND FITTINGS

Piping for force mains less than 4 inches in diameter shall be polyvinyl chloride (PVC) plastic. Piping less than 4 inches in diameter inside treatment building shall be Schedule 80 PVC. Pipe shall conform to the respective specifications and other requirements specified below.

2.1.1 Plastic Pipe

2.1.1.1 PVC Pipe

a. PVC Pipe and Fittings Less Than 4 inches Diameter: ASTM D 1785, Schedule 40 and 80, or ASTM D 2241, with screw joints, push-on joints, or solvent weld joints.

2.2 JOINTS

2.2.1 PVC Piping

a. Screw Joint Fittings: ASTM D 2464, Schedule 80.

b. Push-On Joint Fittings: ASTM D 3139, with ASTM F 477gaskets.

c. Solvent Cement: ASTM D 2564.

d. Couplings for use with plain end pipe shall have centering rings or stops to ensure the coupling is centered on the joint.

2.3 VALVES

2.3.1 Check Valves

Check valves shall permit free flow of water forward and provide a positive check against backflow. Check valves shall be designed for a minimum working pressure of 150 psi or as indicated. The body shall be iron or plastic. The manufacturer's name, initials, or trademark and also the size of the valve, working pressure, and direction of flow shall be directly cast on the body.

a. Ball Check Valves shall be iron or plsatic body, shall have flanged or union ends, and shall be the non-slam type. Flanges shall be the 125 pound type complying with ASME B16.1. Ball shall be stainless steel or plastic unless otherwise specified.

b. Swing Check Valves shall comply with AWWA C508 and shall be iron or plastic body, and shall have flanged or union ends. Flanges shall be the 125 pound type complying with ASME B16.1.

2.4 VALVE BOXES

Valve boxes shall be cast iron or concrete, except that concrete boxes may be installed only in locations not subject to vehicular traffic. Cast iron boxes shall be the extension type with slide type adjustment and with flared base. The minimum thickness of metal shall be 3/16 inch. The box length shall be adaptable, without full extension, to the depth of cover over the pipe at the valve locations. Concrete boxes shall be the standard product of a manufacturer of precast concrete equipment. The word "SEWER" shall be cast in the cover.

2.5 VALVE VAULTS

Valve vaults shall be precast concrete units conforming to ASTM C 478 and Oneida County specifications.

PART 3 EXECUTION

3.1 INSTALLATION

Pipe, pipe fittings, and appurtenances shall be installed at the locations indicated. Excavation, trenching, and backfilling shall be as specified in Section 02312 EXCAVATION, BACKFILLING, AND COMPACTION.

3.1.1 Cutting

Pipe shall be cut in a neat manner with mechanical cutters. Wheel cutters shall be used where practicable. Sharp and rough edges shall be ground smooth and loose material removed from the pipe before laying.

3.1.2 Laying

Except where otherwise authorized, pipe shall be laid with bells facing the direction of laying. Before lowering and while suspended, the pipe shall be inspected for defects. Defective material shall be rejected. Pipe shall be laid in compliance with the following:

a. Polyvinyl Chloride: Manufacturer's instructions.

3.1.3 Jointing

3.1.3.1 Joints for PVC Pipe

a. Threaded joints shall be made by wrapping the male threads with joint tape or by applying an approved thread lubricant, then threading the joining members together. The joint shall be tightened with strap wrenches which will not damage the pipe and fittings. The joint shall be tightened no more than 2 threads past hand-tight.

b. Push-on joints: The ends of pipe for push-on joints shall be beveled to facilitate assembly. Pipe shall be marked to indicate when the pipe is fully seated. The gasket shall be lubricated to prevent displacement. The gasket shall remain in proper position in the bell or coupling while the joint is made.

c. Solvent-weld joints shall comply with the manufacturer's instructions.

3.1.4 Thrust Restraint

Plugs, caps, tees and bends deflecting 11-1/4 degrees or more, either vertically or horizontally, shall be provided with thrust restraint. Valves shall be securely anchored or shall be provided with thrust restraints to prevent movement. Thrust restraints shall be thrust blocks.

3.1.4.1 Thrust Blocks

Thrust blocking shall be concrete of a mix not leaner than: 1 cement, 2-1/2 sand, 5 gravel; and having a compressive strength of not less than 2000 psi after 28 days. Blocking shall be placed between solid ground and the fitting to be anchored. Unless otherwise indicated or directed, the base and thrust bearing sides of thrust blocks shall be poured directly against undisturbed earth. The sides of thrust blocks not subject to thrust may be poured against forms. The area of bearing shall be as shown or as directed. Blocking shall be placed so that the fitting joints will be accessible for repair. Steel rods and clamps, protected by galvanizing or by coating with bituminous paint, shall be used to anchor vertical down bends into gravity thrust blocks.

3.2 Pressure Test

The pipeline shall be subjected to a pressure test. Testing shall be the responsibility of the Contractor. The test may be witnessed by the Engineer. The Engineer shall be notified at least 7 days in advance of equipment tests. The final test report shall be delivered to the Engineer within 30 days of the test.

3.2.1 Pressure Test

After the pipe has been installed, joints completed, thrust blocks have been in place for at least two days, and the trench has been partially backfilled, leaving the joints exposed for examination, the pipe shall be filled with air. The pipeline shall be subjected to a test pressure of 100 psi or 150 percent of the working pressure, whichever is greater, for a period of at least one hour. Each valve shall be opened and closed several times during the test. The exposed pipe, joints, fitting, and valves shall be examined for leaks. Visible leaks shall be stopped or the defective pipe, fitting, joints, or valve shall be replaced.

3.2.2 Retesting

If any deficiencies are revealed during the test, such deficiencies shall be corrected and the tests shall be reconducted until the results of the tests are acceptable to the Owner.

-- End of Section --

SECTION 02985

ASPHALT-PAVING REPAIR

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

ASPHALT INSTITUTE (AI)

AI ES-12	(1982; R 1997) Asphalt Surface Treatment - Construction Techniques

ASTM INTERNATIONAL (ASTM)

ASTM D 2399	(1983; R 1999) Standard Practice for Selection of Cutback Asphalts
ASTM D 946	(1982; R 1999) Standard Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction
ASTM D 977	(2003) Standard Specification for Emulsified Asphalt

1.2 SYSTEM DESCRIPTION

This section applies where asphalt is to be repaired due to trenching activities.

1.3 SUBMITTALS

Not Used

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Tack Coat

Asphaltic emulsion shall be Grade RS-1 or SS-1 according to ASTM D 977.

2.1.2 Prime Coat

Liquid asphalt shall be Grade MC-70 according to ASTM D 2399.

2.1.3 Aggregate

Maximum size of aggregate shall be 3/8-inch, graded in accordance with the local highway department specifications.

2.1.4 Asphalt

Asphalt shall be 40 to 50 Penetration Grade ASTM D 946, 5.0 to 6.5 percent by weight of aggregate.

2.2 MIXES

Hot-plant mix shall be from a commercial asphalt plant and shall be uniform throughout.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Temperature

Hot-mix temperature shall not exceed 325 degrees F when applied. Asphaltic concrete paving shall be laid in one course.

3.1.2 Tack Coat

A tack coat shall be applied at the rate of 0.05 to 0.10 gallon per square yard of the surface covered where asphaltic concrete is to be placed over or against existing asphaltic pavement or concrete surfaces.

3.1.3 Paving

A paving machine shall be used for accessible and sizable areas. Raking shall be used only to remove excess material. Where the paving is hand spread, a sufficient labor force shall be used for rapid and smooth operation to prevent chilling of the mix before spreading and rolling are completed. Paving shall not be laid at an ambient temperature below 40 degrees F or during unfavorable weather. Only hot tools shall be used.

3.1.4 Prime Coat

A prime coat for repair work shall be applied to the prepared base course. Coating shall be pressure-applied at a rate of 0.3 gallon per square yard.

3.1.5 Cracks in Asphalt

Cracks less than 1/8 inch shall be repaired by removing loose and defective material with a broom or compressed air and replacing with a hot-plant-mixed patching material (such as a rapid setting asphalt emulsion). Larger areas to be patched shall be saw cut square or rectangular. Sawn edges shall be painted with asphalt, ASTM D 2399, Grade MC-70.

3.1.6 Existing Surfaces

Existing surfaces shall be prepared in accordance with AI ES-12.

3.1.7 Joining Existing Paving

Edges of existing pavement shall be saw cut to straight vertical surfaces and cleaned, where new and existing paving intersect. Juncture of the new and existing paving shall be flush and made in a manner to ensure a continuous bond. Apply tack coat to sawn edges prior to placing adjoining pavement.

3.1.8 Compaction of Asphaltic Concrete

Rolling with a 5- to 8-ton steel-wheeled tandem roller or rollers sufficient in size and number shall start immediately after placing has been completed, temperature of hot-mix permitting, and when asphaltic mixture will not pick up and adhere to the rollers. Rolling shall continue, as the temperature allows, until the surface texture has completely closed and roller marks are removed. Areas inaccessible to the roller shall be completed by hand methods, continuing until the mixture is compacted and the surface smooth. Minimum density of the paving when compacted shall be not less than 90 percent of the calculated voidless density of the mixture.

3.1.9 Finish

Upon completion of compaction, smoothness of the finished surface (except where breaks in grade are required) shall vary not more than 3/16 inch when tested with a 10-foot straightedge in both directions. Completed surfaces shall be free of all standing water when flood-tested. If water stands or ponds on any surface, the asphalt concrete surface shall be corrected to eliminate this condition without additional cost to the Government.

3.2 FIELD QUALITY CONTROL

3.2.1 Tests

Tests will not be required of aggregate, paving, or emulsified asphalts provided these materials have been obtained from approved sources and processed by acceptable plants and methods.

-- End of Section --

SECTION 03305

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

ACI INTERNATIONAL (ACI)

ACI 211.1	(1997) Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
ACI 304R	(2000) Guide for Measuring, Mixing, Transporting, and Placing Concrete
ACI 305R	(1999) Hot Weather Concreting
ACI 308R	(2001) Standard Practice for Curing Concrete
ACI 315	(1999) Details and Detailing of Concrete Reinforcement
ACI 318/318R	(2002) Building Code Requirements for Structural Concrete and Commentary
ACI 347R	(2003) Guide to Formwork for Concrete

ASTM INTERNATIONAL (ASTM)

ASTM A 615/A 615M	(2004) Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM C 143/C 143M	(2003) Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C 172	(1999) Standard Practice for Sampling Freshly Mixed Concrete
ASTM C 260	(2001) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C 309	(2003) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 494/C 494M	(2004) Standard Specification for Chemical Admixtures for Concrete
ASTM C 618	(2003) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan

	for Use as a Mineral Admixture in Concrete
ASTM C 94/C 94M	(2003a) Standard Specification for Ready-Mixed Concrete
ASTM C 989	(2004) Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
ASTM D 1752	(2004) Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

1.2 GENERAL

All work shall be in accordance with ACI 318/318R.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES in sufficient detail to show full compliance with the specification:

SD-06 Test Reports

Test reports shall be in accordance with tests as described in the paragraph entitled, "Field Testing," of this section for the following items:

Slump

SD-07 Certificates

Bill of Lading for Ready-Mix Concrete deliveries.

Certificates of compliance shall be provided showing conformance with referenced standards contained in this section for the following:

Fly Ash
Air-Entraining Admixtures
Steel Reinforcement
Waterstops
Curing Compound

PART 2 PRODUCTS

2.1 READY-MIX CONCRETE

Concrete shall be ready-mix concrete and mix design data shall conform to ACI 304R

Non-exposed concrete elements: 3,500 psi minimum compressive strength.

Slump: 1 inch to 4 inch according to ASTM C 143/C 143M and ACI 211.1.

One brand and type of cement shall be used for formed concrete having exposed-to-view finished surfaces.

Air-Entraining Admixtures shall conform to ASTM C 260. Exterior concrete exposed to freezing shall be air-entrained 5 to 6 percent by volume. Nonair-entrained interior concrete shall have total air content of 2 to 4 percent by volume.

Water-reducing admixtures, retarding admixtures, accelerating admixtures, water-reducing and accelerating admixtures, and water-reducing and retarding admixtures shall conform to ASTM C 494/C 494M.

Fly Ash used as an admixture shall conform to ASTM C 618, Class C or F with 4 percent maximum loss on ignition and 35 percent maximum cement replacement by weight.

Ground granulated blast furnace slag used as an admixture shall conform to ASTM C 989, Grade 120 with between 25 to 50 percent maximum cement replacement by weight.

2.2 STEEL REINFORCEMENT

2.2.1 Deformed Steel Bars

Steel bars shall conform to ASTM A 615/A 615M, Grade 60 ksiand ACI 318/318R.

2.3 FORMS

Forms shall be of wood, steel, or other approved material and shall conform to ACI 318/318R.

Form release shall conform to ACI 347R.

2.4 ACCESSORIES

2.4.1 Waterstops

Waterstops shall be the flat dumbbell type not less than 3/16-inch thick for widths up to 5 inches and not less than 3/8-inch thick for widths 5 inches and over.

Waterstops shall be made of rubber and shall conform to ASTM D 1752.

2.4.2 Curing Compound

Curing compound shall conform to ASTM C 309.

PART 3 EXECUTION

3.1 FORM WORK

Form work shall be in addition to ACI 318/318R, ACI 308R, and ACI 347R.

3.1.1 Preparation of Form Surfaces

Forms shall be true to line and grade, mortar-tight, and sufficiently rigid to prevent objectionable deformation under load. Form surfaces for permanently exposed faces shall be smooth, free from irregularities, dents, sags, or holes. Exposed joints and exposed edges shall be chamfered. Internal ties shall be so arranged that when the forms are removed, the form ties will be not less than 2 inches from concrete surfaces permanently exposed to view or exposed to water on the finished structure.

3.1.2 Form Coating

Forms for exposed surfaces shall be coated with a nonstaining form release coating which shall be applied shortly before concrete is placed. Forms for unexposed surfaces may be wetted in lieu of coating immediately before the placing of concrete, except that in freezing weather form release coating shall be used.

3.1.3 Removal of Forms

Forms shall be removed carefully to prevent damage to the concrete. Forms shall not be removed before the expiration of the minimum time indicated below:

Arches, beams and deck-type slabs	144 hours

3.2 STEEL REINFORCING

3.2.1 General

Reinforcement shall be free from loose, flaky rust and scale, and free from oil, grease, or other coating which might destroy or reduce the reinforcement's bond with the concrete.

3.2.2 Fabrication

Steel reinforcement shall be shop fabricated in accordance with ACI 315. Shop details and bending shall be in accordance with ACI 318/318R.

3.2.3 Splicing

Splices shall be in accordance with ACI 318/318R.

3.2.4 Supports

Reinforcement shall be secured in place by the use of metal or concrete supports, spacers, or ties.

3.3 EMBEDDED ITEMS

Before placing concrete, care shall be taken to determine that all embedded items are firmly and securely fastened in place. Embedded items shall be free of oil and other foreign matter such as loose coatings of rust, paint and scale. Embedding of wood in concrete will be permitted only when specifically authorized or directed.

3.4 BILL OF LADING

Bill of Lading for each ready-mix concrete delivery shall be in accordance with ASTM C 94/C 94M.

3.5 CONCRETE CONVEYING

Concrete shall be conveyed from mixers to forms as rapidly as practical by methods that will prevent segregation or loss of ingredients.

3.6 CONCRETE PLACING

3.6.1 General Placing Requirements

Concrete shall be placed in accordance with ACI 318/318R.

Concrete shall be worked into the corners and angles of the forms and around reinforcement and embedded items without permitting the materials to segregate. Concrete shall be placed within 90 minutes after it has been mixed. It shall be placed on clean, damp surfaces free from water, ice, frost, mud, debris, or objectionable coatings. Concrete shall be consolidated with the aid of mechanical vibrating equipment supplemented by handspading and tamping. Vibrating equipment shall be of the internal type.

3.6.2 Lifts in Concrete

Concrete Slabs shall be placed in one lift.

3.6.3 Hot-Weather Placement

When hot weather conditions exist that would impair quality and strength of concrete, place concrete complying with ACI 305R and as specified.

a. Cool ingredients before mixing to maintain concrete temperature at time of placement to below 90 degrees F. Mixing water may be chilled or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using Liquid nitrogen to cool concrete is Contractor's option.

b. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedding in concrete.

c. Fog spray forms, reinforcing steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without puddles or dry areas.

d. Use water-reducing retarding admixture when required by high temperatures, low humidity, or other adverse placing conditions, as acceptable to Contracting Officer.

3.7 FINISHING

Defective concrete, voids left by the removal of tie rods, and ridges and local bulging on concrete surfaces permanently exposed to view or exposed to water on the finished structure shall be repaired immediately after the removal of forms. Voids left by the removal of the tie rods shall be reamed and completely filled with dry-patching mortar. Defective concrete shall be repaired by cutting out the unsatisfactory material and placing new concrete secured with keys, dovetails, or anchors. Excessive rubbing of formed surfaces will not be permitted. Unformed surfaces of concrete exposed in the completed work shall have a wood float finish without additional mortar and shall be true to indicated elevations. Other surfaces shall be brought to specified elevations and left true and regular.

3.8 TROWEL FINISH

A trowel finish shall be applied to slab surfaces that are to be exposed to view or covered with resilient flooring, paint, or other finish coating systems.

Final troweling shall be started when a ringing sound is produced as trowel is moved over the surface. Surface shall be consolidated by hand troweling operation. Finished surfaces shall be free of trowel marks, uniform in texture and appearance. Surface defects of sufficient magnitude to show through floor covering shall be removed by grinding.

3.9 CURING AND PROTECTION

Concrete shall be cured in accordance with ACI 308R.

Curing shall be accomplished by moist curing, by moisture-retaining cover curing, by membrane curing, or by combinations thereof.

Moist curing shall be accomplished by keeping surface of concrete wet or by covering with absorptive cover saturated with water and kept wet.

Moisture-retaining cover curing shall be accomplished by covering concrete surfaces with moisture-retaining cover for curing concrete.

Membrane curing shall be accomplished by applying specified membrane-forming curing compound to damp concrete surfaces as soon as moisture film has disappeared.

3.10 FIELD TESTING

Sampling of fresh concrete for testing shall be in accordance with ASTM C 172.

Slump shall be tested at the plant for each design mix in accordance with ASTM C 143/C 143M.

-- End of Section --

SECTION 11211

PUMPS: GROUNDWATER, SUBMERSIBLE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2002) National Electrical Code

1.2 GENERAL REQUIREMENTS

1.2.1 Standard Products

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate equipment that has been in satisfactory waterworks operation at least 2 years prior to bid opening. Pumps and motors of the same types shall each be the product of one manufacturer.

1.2.2 Description

The submersible pump and motor shall be designed for continuous submerged operation.

The pump shall be driven by a motor attached below the pump section.

The pump unit shall be equal to Grundfos® pump model SQ/SQE03A-90.

1.2.3 Nameplates

Pumps and motors shall have a standard nameplate securely affixed in a conspicuous place showing the manufacturer's name, address, type or style, model, serial number, and catalog number. Such other information as the manufacturer may consider necessary to complete identification shall be shown on the nameplate.

1.2.4 Electrical Work

Electrical motor driven equipment specified herein shall be provided complete with motors, motor starters, and controls. Motor starters shall be provided complete with properly sized thermal overload protection in each phase and other appurtenances necessary for the motor control specified. Each motor shall be of sufficient capacity to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor when operating at proper electrical system voltage and frequency. Manual or automatic control and protective or signal devices required for the operation herein specified and any control wiring required for controls and devices but not shown on electrical plans shall be provided under this section of the specifications.

1.2.5 Selection Criteria

The pump shall have a capacity of 2 US GPM when operating against a total dynamic head of 120 feet of water.

The motor shall be 0.33 horsepower, rated for 100-115 volts, 1 phase, 60 hertz, 1.75 S.F.

The cable between the motor and service entry shall be at least 50 feet, 14 AWG with three conductors, 600-volt insulation.

1.2.6 Pump Design

There shall be a check valve integrally designed into the pump discharge housing.

The pump shall have integrated protection against upthrust.

The pumping downthrust shall be absorbed by the motor thrust bearing.

Each impeller shall be fitted with a seal ring around its eye or skirt to prevent hydraulic losses.

A filter screen shall be included as part of the suction inlet assembly.

1.2.7 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field and shall advise the Engineer of any discrepancy before performing the work.

1.2.8 Factory Tests

Pumps shall be tested by the manufacturer or a nationally recognized testing agency in compliance with Hydraulic Institute Standards. Where two or more identical pumps are specified, only one representative pump shall be tested. Certified test results shall be submitted to the Engineer.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation

Drawings containing complete wiring and schematic diagrams and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearances for maintenance and operation. A complete listing of equipment and materials shall be provided.

SD-03 Product Data

Materials and Equipment

Manufacturer's descriptive data and technical literature, performance charts and curves for all impeller sizes for a given casing, catalog cuts, and installation instructions.

Instructions

Proposed diagrams, instructions, and other sheets, prior to posting. Approved wiring and control diagrams showing the complete layout of the entire system, including equipment, piping valves, and control sequence, framed under glass or in approved laminated plastic, shall be posted where directed. Condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system shall be prepared in typed form, framed as specified above for the wiring and control diagrams, and posted beside the diagrams.

Training Period

Training course curriculum and training instructions shall be furnished to the Engineer prior to the start of training.

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals

Six complete sets of instructions containing the manufacturer's operating and maintenance instructions for each piece of equipment. Each set shall be permanently bound and shall have a hard cover. The following identification shall be inscribed on the covers: the words "OPERATING AND MAINTENANCE INSTRUCTIONS," name and location of the building, name of the Contractor. Flysheets shall be placed before instructions covering each subject. Instruction sheets shall be approximately 8-1/2 by 11 inches, with large sheets of drawings folded in. Instructions shall include, but not be limited to, the following:

a. System layout showing piping, valves, and controls.

b. Approved wiring and control diagrams.

c. A control sequence describing startup, operation, and shutdown.

d. Operating and maintenance instructions for each piece of equipment, including lubrication instructions and troubleshooting guide.

e. Manufacturer's bulletins, cuts, and descriptive data; and parts list and recommended spare parts.

1.4 DELIVERY AND STORAGE

All equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, or other contaminants.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Materials and equipment shall be as specified below and as shown, and shall be suitable for the service intended. Materials and equipment shall be new and unused, except for tests. Where two or more pieces of equipment performing the same function are required, they shall be duplicate products of the same manufacturer.

2.2 Pump Construction

The pump bowls, impellers, guide vanes, strainer, and check valve shall be 300 Series stainless steel. The shaft and coupling shall be 300 or 400 Series stainless steel. No moving parts shall be constructed from plastic or other brittle material.

The intermediate and top bearings shall be Teflon.

2.3 Pump Characteristics

The pumps shall be capable of discharging quantities at total discharge heads measured at the discharge coupling, between the following limits:

Pump No.	gpm at total discharge head, ft. H(2)O	gpm at total discharge head, ft. H(2)O
__1___	and _2____	__120__
_2__	and __2___	__120___
__3__	and _2____	_120

Pumps shall operate at optimum efficiencies to produce the most economical pumping system under the conditions encountered.

2.4 ELECTRICAL EQUIPMENT

Electrical motor driven equipment herein specified shall be provided complete with motors, motor starters, and controls. Motor controls, equipment, and wiring shall be in accordance with NFPA 70.

2.4.1 Electric Motors

Each electric motor-driven pump shall be driven by a continuous-duty electric motor. Motor shall have a 1.75 service factor. Motors shall be squirrel-cage induction motors having normal-starting-torque and low-starting-current characteristics, and shall be of sufficient size so that the nameplate horsepower rating will not be exceeded throughout the entire published pump characteristic curve. Motor bearings shall provide smooth operations under the conditions encountered for the life of the motor. Adequate thrust bearing shall be provided in the motor to carry the weight of all rotating parts plus the hydraulic thrust and shall be capable of withstanding upthrust imposed during pump starting. Motors shall be rated 115 volts, single phase, 60 Hz and such rating shall be stamped on the nameplate.

The motor diaphragm shall be Nitrile Rubber or Type 100 Hydrin.

The shaft seal shall be a Nitrile Rubber or Type 100 Hydrin.

The motor shall be of 300 Series stainless steel.

2.4.2 Control Equipment

Automatically controlled pumps shall have three-position "MANUAL-OFF-AUTOMATIC" selector switch in cover. Additional controls or protective devices shall be as indicated.

The total fluids pump system control shall be provided as an integral part of the system. The control shall utilize a down well intrinsically safe sensor to start and stop the pump.

The control circuit shall be UL listed and mounted in a NEMA 4 rated enclosure. The control circuit shall be 120 VAC single phase. The enclosure shall be an industrial control panel relating to hazardous locations with intrinsically safe circuit extensions for use in Class 1, Division 1, Groups ABCD and Class 2, Groups EFG. Non-UL listed panels shall not be considered an equal. The control circuit shall include, but is not limited to:

On/off switch
Status indicating lights
Intrinsic module
On-delay timer
Motor starter
Thermal overload protection
Down well pump control sensor
Shutdown pumps if air stripper blower pressure switches are high/low tripped

PART 3 EXECUTION

3.1 INSTALLATION

Each pump and motor shall be installed in accordance with the written instructions of the manufacturer.

3.2 TESTS

After installation of the pumping units and appurtenances is complete, operating tests shall be carried out to assure that the pumping installation operates properly. Each pumping unit shall be given a running field test in the presence of the Engineer for a minimum of 2 hours. Each pumping unit shall be operated at its rated capacity or such other point on its head-capacity curve selected by the Engineer. For submersible pumping units, an insulation resistance test of the cable and the motor shall be conducted prior to installation of the pump, during installation of the pump, and after installation is complete. The resistance readings shall not be less than 10 megohms. Tests shall assure that the units and appurtenances have been installed correctly, that there is no objectionable heating, vibration, or noise from any parts, and that all manual and automatic controls function properly. If any deficiencies are revealed during any tests, such deficiencies shall be corrected and the tests shall be reconducted.

-- End of Section --

SECTION 11215

LIQUID RING PUMP

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 52.1	(1992) Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter

ASME INTERNATIONAL (ASME)

ASME B16.1	(1998) Cast Iron Pipe Flanges and Flanged Fittings
ASME B16.5	(1996) Pipe Flanges and Flanged Fittings
ASME B40.100	(2000) Pressure Gauges and Gauge Attachments
ASME BPVC SEC VIII D1	(2001) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage
ASME PTC 19.3	(1974; R 1998) Temperature Measurement

ASTM INTERNATIONAL (ASTM)

ASTM F 1508	(1996) Angle Style, Pressure Relief Valves for Steam, Gas, and Liquid Services

ISA - THE INSTRUMENTATION, SYSTEMS AND AUTOMATION SOCIETY (ISA)

ISA MC96.1	(1982) Temperature Measurement Thermocouples

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-25	(1998) Standard Marking System for Valves, Fittings, Flanges and Unions

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 6	(1993; R 2001) Industrial Control and Systems: Enclosures

NEMA MG 1	(2003) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2002) National Electrical Code

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST SP 250	(1998) Calibration Services Users Guide

1.2 SYSTEM DESCRIPTION

1.2.1 Design Requirements

The Liquid Ring Pump (LRP) system shall be a standard product of a manufacturer regularly engaged in the production of equipment of this nature. The LRP manufacturer shall be experienced in the design and construction of LRP systems for a period of not less than five years.

1.2.2 Performance Requirements

The LRP system shall utilize a liquid ring pump to withdraw chlorinated hydrocarbon vapors and water out of contaminated soil and groundwater. The pump shall be sized for 20 inches Hg vacuum at 1,200 ACFM. The LRP system shall include as a minimum, but is not limited to:

a. TEFC motor
b. Skid-mounted system
c. Auto pump-out system
d. Moisture separator
e. UL listed controls
f. Inline particulate filter
g. Heat exchanger
h. Variable Frequency Drive

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detailed Drawings

Drawings showing dimensions of the equipment and layout of the off-gas system and subsystems, as specified.

Detailed Process Flow Diagrams

Flow diagram for process equipment associated with the off-gas system, as specified.

Piping and Instrumentation Diagram

Piping and instrumentation diagram (P&ID), as specified.

Control System

Wiring and ladder diagrams. Control sequences showing the control of the entire system.

SD-03 Product Data

Rating, capacity and pressure differentials. Make and model, catalog cuts, manufacturer's descriptive and technical literature including installation instructions.

Instrumentation

Detailed manufacturer's data on the overall controls, sensors, process controllers, control operators, valves, interlocks and alarms. Data describing in detail the equipment used.

Air Moving Equipment

Capacities and pressure differentials; performance charts and curves. Make and model, catalog cuts, manufacturer's descriptive and technical literature, including installation instructions.

Approved diagrams showing the complete layout of the entire system, including equipment, piping, valves, wiring and control sequence. Condensed operating instructions in typed form explaining preventative maintenance procedures, safe methods of checking the equipment for normal operation, and safe procedures for starting and stopping the equipment. Diagrams and instructions, framed under glass or in approved laminated plastic, shall be posted where directed before acceptance testing of the systems.

Complete list of equipment and materials. A listing covering component items forming a system or items that are interrelated and scheduled to be coordinated and submitted concurrently. Certifications to be submitted with the pertinent drawings shall be so scheduled. Data shall include tabular lists showing location, features, or other pertinent information regarding products, materials, equipment, or components to be used in the work.

Variable Speed Controls

Capacities and capacity ranges; performance charts and curves. Make and model, catalog cuts, manufacturer's descriptive and technical literature, including installation instructions.

Field Training

Training course curriculum and training instructions at start-up.

SD-06 Test Reports

Testing

Test reports in booklet form showing field tests performed to adjust each component and field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed equipment. Test methods used shall be identified and test results shall be recorded. Each test report shall indicate the final position of controls.

SD-07 Certificates

Air Moving Equipment

Written certification signed by an official authorized to certify on behalf of the manufacturer of the product, equipment or material, attesting that equipment has been tested and that it conforms to the specified requirements. The certificate shall indicate the methods of testing used. In lieu of a certificate, a seal or label from a nationally recognized testing agency will be acceptable as evidence that the equipment conforms to agency requirements.

SD-10 Operation and Maintenance Data

Operating and Maintenance Instructions

Six complete copies of operating instructions outlining the step-by-step procedures required for system startup, operation and shutdown. The operating instructions shall include the following for system components: manufacturer's name, model number, service manual, parts list, and brief description of each piece of equipment and its basic operating features; flow diagrams; system layout showing piping, valves, and controls; as-built wiring and control diagrams; control sequence describing startup, operation, and shutdown; manufacturer's bulletins, cuts, and descriptive data.

Six complete copies of maintenance instructions for each piece of equipment including the following: manufacturer's complete list of parts, recommended spare parts and supplies, with current unit prices and source of supply; routine maintenance procedures, as a minimum; possible breakdowns and repairs; a troubleshooting guide to help the operator determine what steps must be taken to correct any equipment problems.

1.4 QUALIFICATIONS

1.4.1 Single Source Supplier

The Contractor shall assign to a single supplier full responsibility for the furnishing of the off-gas moving system. The designated single supplier, however, need not manufacture the system but shall coordinate the selection, assembly, installation, and testing of the entire system as specified herein.

1.4.2 Manufacturer's Representative

Services of a manufacturer's field service representative who is experienced in the installation of the equipment furnished and who has complete knowledge of the proper operation and maintenance of the system shall be provided.

1.5 GENERAL REQUIREMENTS

1.5.1 Standard Products

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate equipment that has been in satisfactory operation at least 2 years prior to bid opening. Equipment shall be supported by a service organization that is reasonably convenient to the site. Pieces of equipment of the same types shall be products of the same manufacturer. Equipment shall be new and unused, except for test equipment. Materials may be reprocessed/recycled with equivalent durability and product warranty/guarantee.

1.5.2 Nameplates

Each piece of equipment shall have a standard nameplate securely affixed in a conspicuous place showing the manufacturer's name, address, type or style, model, serial number, and catalog number. In addition, the nameplate for each air moving unit shall show the capacity in standard cubic feet per minute (SCFM) at rated speed in rpm and head in inches of mercury vacuum. Nameplate for each electrical motor shall show, at least, the minimum information required by paragraph 10.38 of NEMA MG 1. Any other information that the manufacturer may consider necessary to complete identification shall be shown on the nameplate.

1.5.3 Verification of Dimensions

After becoming familiar with details of the work, the Contractor shall verify all dimensions in the field and shall advise the Engineer of any discrepancy before performing the work.

1.6 DELIVERY AND STORAGE

Equipment delivered and placed in storage shall be stored in a clean, dry location and covered for protection against dust and moisture. Equipment stored longer than 60 days shall have silica bags suspended in the outlet and inlet of unit, bearings shall be filled full of grease, unit shall be filled with oil, machine surfaces shall be coated with grease, and entire unit shall be enclosed with plastic or tarps. Shaft of rotating equipment including motors shall be turned every two weeks to prevent flat spots on bearings.

1.7 PARTNERING/PRE-INSTALLATION CONFERENCE

Pre-installation conference will be required. The Contractor shall ensure that involved subcontractors, suppliers, and manufacturers are notified. The date and time of the conference shall be furnished to the Engineer for approval.

1.8 SEQUENCING AND SCHEDULING

Details of and requirements for vapor extraction well construction and treatment equipment are included in other sections of this specification. The Contractor shall notify the Engineer of any deviations from head conditions specified for the source and discharge to ensure coordination with this Section. Pipe and valves not specified in this Section shall be in accordance with Section 02150 PIPING; OFF-GAS.

1.9 EXTRA MATERIALS

Auxillary equipment, tools and spare parts shall be delivered at the same time as the equipment to which they pertain. The Contractor shall protect and safeguard the equipment, tools and parts until completion of the work, at which time they shall be delivered to the Engineer. Auxiliary equipment and spare parts shall be furnished as follows:

a. Spare parts for each different item of material and equipment specified including the parts recommended by the manufacturer to be replaced after 1 and 3 years service.

b. For each air mover: one extra of each part used that is made from glass, hard rubber, or clear plastic; one complete set of gaskets; 4 air intake filter replacement cartridges.

c. One complete set of special tools, calibration devices, and instruments as recommended by the manufacturer for field maintenance of the system shall be provided. Special tools are considered to be those tools which, because of their limited use, are not normally available but which are necessary for the particular equipment. Special tools shall be high-grade, smooth, forged, alloy, tool steel.

PART 2 PRODUCTS

2.1 AIR MOVING EQUIPMENT

Air moving equipment shall be furnished and installed complete with drive units, filters, controls and appurtenances indicated or specified. Equipment shall be capable of operating at partial-load conditions without increased vibration over the normal vibration at full load operation and shall be capable of continuous operation down to the lowest step of unloading. Each unit shall be provided with unloading, vibration isolators, thermal overloads, high-and-low pressure safety cutoffs, low oil pressure cutout, internal motor-winding temperature sensing protection device, internal pressure relief valve, a complete oil charge, and protection against short cycling.

2.2 VACUUM PUMPS

2.2.1 Liquid Ring

A liquid ring vacuum pump is allowed for vacuum flows of 1,200 acfm at -20 inches of mercury column. Water injection systems and outlet water separation systems shall be included for each liquid ring vacuum pump.

2.3 Connections

2.3.1 Inlet and Discharge Connections

Inlet and discharge connections shall be ASME B16.1 or ASME B16.5 125 pound drilled and tapped flanges and shall be an integral part of the head. Connections 3 inches in diameter and smaller shall be threaded.

2.3.2 Casing Drains

Tapped and plugged drains shall be provided at the low points in the casing.

2.3.3 Lifting Eyes

Casing shall have lifting eyes capable of supporting the equipment for installation and maintenance purposes.

2.4 INTAKE FILTER

Intake screen and filter shall be installed on inlet to each unit.

2.4.1 Efficiency

Intake filter shall be at least 90 percent efficient when tested in compliance with ASHRAE 52.1 dust spot method. High volume bag intake filter shall be provided for filtration down to 2 mils on vacuum pump intake.

2.4.2 Surface Area

Minimum filter surface area shall be 1 square foot per 25 cubic feet/minute to produce a filter flow through velocity of less than 25 feet per minute.

2.4.3 Media

Filter media shall be disposable dry type felt material made from glass fiber, or polyester, fiber resistant to moisture and chemicals to which it will be exposed with 1 inch pleat separation.

2.4.4 Weather Hood

Steel intake hood and filter housings shall be coated with a chemically resistant coating and entire unit element shall be resistant to moisture and chemicals to which it will be exposed.

2.5 NOISE MINIMIZATION

Flexible connections and silencers, muffler or sound barriers shall be installed on the equipment inlet and discharge to attenuate sound level.

2.5.1 Silencer

Each blower shall be provided with inlet and discharge silencers. Silencers shall be for standard grade silencing. Intake silencers shall be of the absorption, cannister, or chamber type. Discharge silencers shall be of the absorption, cannister, chamber or combination chamber-absorption type. Canister type silencer shall be constructed of two concentric perforated cylinders lined with high temperature acoustical packing forming an annular flow path, with an internal plug creating a blocked line of sight. Silencer size shall be as recommended by the silencer manufacturer and shall be compatible with the blower requirements. Silencer connections shall match the adjacent piping. Mounting brackets shall be provided as required for silencer support. Silencer shall be constructed of heavy-duty rolled and welded steel plate with the inner liner welded to the outer shell to acoustically deaden the outer shell.

2.5.2 Muffler

Hot-gas muffler shall be installed in-line and shall minimize the transmission of hot-gas pulsations.

2.6 MONITORING

Each unit shall be equipped for monitoring the flow downstream of any bypass connections. Calibration of sensors shall be with standards traceable to NIST and in conformance with NIST SP 250.

2.6.1 Flow

A turbine type flow meter equipped with transmitter and recorder shall be provided for continuous metering of the process flow. Accuracy shall be within 0.5 percent of full scale.]

2.6.2 Temperature

2.6.2.1 Thermometers

Thermometers shall conform to ASME PTC 19.3 with wells and temperature range suitable for the use encountered. Thermometers shall be provided to indicate inlet air temperature, discharge air temperature, and lubrication oil temperature. Thermometers shall be either red-reading mercury-in-glass type or dial type. Scale range shall include full range of expected operation and up to 125 percent, but not more than 150 percent of maximum. Accuracy shall be within 0.5 percent of full scale.

2.6.2.2 Thermocouples

Sensors shall conform to ISA MC96.1, Type K, and shall be provided downstream of each blower or as otherwise directed. The thermocouple shall be suitable for continuous operation and control at temperatures up to 400 degrees F, shall be accurate to 0.75 percent of full scale, and shall be long enough to be inserted 6 inches into the air flow. The thermocouple shall be provided with an adjustable flange and with a protecting tube suitable for insertion into the air flow without support of the projecting end. Compensating lead wire 16 gauge in diameter and 100 feet long with a weatherproof braid shall be supplied for connecting the thermocouple to the instrument. The installed unit shall indicate gas passage temperatures and shall activate the high temperature alarm when the set point temperature is exceeded.

2.6.3 Pressure

High and low pressure connections shall be 1/4 inch NPT female with a suitable shutoff cock at each connection. The high pressure connection to the gauge shall have a 10 micron pleated paper filter and the low pressure connection shall have a fine mesh stainless steel strainer.

2.6.3.1 Draft Gauge

Gauge shall conform to ASME B40.100 with a diaphragm or bellows actuating system, a circular scale and a zero adjustment screw. Inlet gauges shall have a range of 0 to 30 inches water gauge vacuum. Gauges shall include the accessories for pipe or mounting.

2.6.3.2 Pressure Gauge

Gauges shall conform to ASME B40.100 with a single Bourdon tube style actuating system, a circular scale and a zero adjustment screw. Discharge gauges shall have a range of 0 to 11 psi. Gauges shall include the accessories for pipe mounting.

2.6.3.3 Differential Pressure Gauge

The housing of each unit shall be equipped with a direct-reading gauge that measures the differential pressure range of 0 to -10 inches water column with an accuracy of plus or minus 2 percent of full scale, calibrated linearly with necessary to operate in conjunction with the corresponding venturi tube. During operating conditions the pointer shall be within the mid-range of the gauge. Accuracy shall be within 0.5 percent of full scale.

2.7 CONTROL SYSTEM

Unit shall have an automatic control system. Automatic controls shall be responsible for the balancing of the capacity with system requirements. These controls shall automatically balance the equipment capacity with the load. The system shall be provided with the necessary control devices required for normal operation. The automatic controls shall also include each of the following: a safe system operating mode when controls fail, indications for system failure, protective mechanisms and controls that are required for the safe operation of system equipment in an enclosure conforming to NEMA ICS 6.

2.7.1 Sequence of Control

The sequence of control shall be as follows: .

2.7.2 Sequence of Equipment Operation

Instrumentation to modulate the pressure and volume output as well as start or stop units shall be included to meet pressure and/or volume demands. Off-gas systems with process controls shall be subject to automatic control logic permissives. Controls shall include start and stop push button switches, hand-off-automatic (H-O-A) switches where the system controls operation, safety features such as blade and belt guards, vibration or temperature switches, surge warning and shutdown, low oil pressure, high oil temperature switches, process oriented switches such as upstream or downstream process equipment failure shutdown or emission detection shutdown. Additional controls or protective devices shall be as indicated.

2.7.3 Intake Volume Control

Automatically controlled line sized butterfly valve shall be installed on blower inlet to create inlet head losses and reduce the volumetric flow rate.

2.7.4 Outlet Volume Control

Variable speed control shall be installed to control output volume.

2.7.5 Panel

A NEMA 4 control panel enclosing relays, contractor, timers, and selector switches shall be wall mounted and provided with hinged cover and latch. Instruments shall be of the direct reading type and shall be factory mounted and connected. Shutdown feature shall be connected to the annunciator on the instrument panel and each shutdown feature shall be identified. Panel shall include the following features and instruments:

a. Running time meter.

b. Alarm annunciator with contacts to operate a remote alarm and individual lights for each alarm condition.

2.7.6 Protective Devices

Blower protective devices, upon alarm condition, shall cause immediate de-energization of the motor, shall initiate the automatic shutdown sequence, and shall provide audible and visual alarm indication.

2.7.6.1 Bearing Temperature

Temperature sensors with switches shall be installed on each bearing. The control relay, selector switch, test push buttons, and running indicator, or light, on the panel shall indicate bearing status. High temperature of any bearing shall initiate protective shutdown and the indicator, or light, shall indicate the affected bearing.

2.7.6.2 Surge and Overload Protection

A set-point controller shall monitor current input to the motor. The controller shall open and close the inlet butterfly valve in response to current. The controller shall initiate automatic shutdown sequence and give visual indication of reason for shutdown if surge conditions are indicated by the motor current. Manual control and override shall be provided to enable equipment startup and shutdown.

2.7.6.3 Oil Temperature and Pressure

Temperature and pressure sensors with switches shall be installed on each oil pump. The control relay, selector switch, test push buttons, and running indicator, or light, on the panel shall indicate status. High oil temperature, high oil pressure or low oil pressure shall initiate protective shutdown and the indicator, or light, shall indicate the affected setting.

2.8 ELECTRICAL EQUIPMENT

Electrical motor driven equipment herein specified shall be provided complete with motors, motor starters, and controls. Electrical equipment and wiring shall be in accordance with NFPA 70, with proper consideration given to environmental conditions such as moisture, dirt, corrosive agents, and hazardous area classification.

2.8.1 Electric Motors

Motors shall be synchronous having normal-starting-torque and low-starting-current characteristics, and shall be sized to avoid exceeding the nameplate power rating throughout the entire published characteristic curve. Motor bearings shall provide smooth operations under the conditions encountered for the life of the motor. Adequate thrust bearing shall be provided in the motor to carry the weight of the rotating parts plus the hydraulic thrust and shall be capable of withstanding upthrust imposed during starting and under variable head conditions specified. Motors shall be rated 460 volts, 3 phase, 60 Hz and such rating shall be stamped on the nameplate. Motors shall conform to NEMA MG 1.

2.8.2 Control Equipment

Automatically controlled units shall have three-position MANUAL-OFF-AUTOMATIC selector switch in cover. Additional controls or protective devices shall be as indicated.

2.8.3 Variable Speed Controls

The variable speed motor controller shall convert 460 volt plus 15 percent, minus 5 percent, three phase, 60 Hz (plus or minus 2 Hz) utility power to adjustable voltage/frequency, three phase, ac power for stepless motor control from 5 percent to 105 percent of base speed.

2.8.3.1 Description

The variable speed drive shall produce an adjustable ac voltage/frequency output for complete motor speed control. The variable speed drive shall be automatically controlled by a grounded electronic control signal. The variable speed drive shall be self contained, totally enclosed in a NEMA MG 1 ventilated cabinet and shall be capable of operation between 32 and 104 degrees F. The variable speed drive maximum output current rating shall be equal to or exceed the motor nameplate full load. The manufacturer shall advise the maximum recommended motor sine wave current for each controller rating. Variable speed drive multiple motor operation at same frequency/speed shall be possible as long as the sum of connected motor full load sine wave currents are less than or equal to the variable speed drive maximum continuous current rating. Variable speed drive shall be 95 percent efficient at 100 percent of rated output power.

2.8.3.2 Governing Requirements

Variable speed drive shall comply with 47 CFR 15 regulation of RF1/EM1 emission limits for Class A computing devices. The FCC label of compliance shall be displayed on the variable speed drive. Variable speed drive and option design and construction thereof shall comply with the applicable provisions of NFPA 70, Article 43D, Sections A-L.

2.8.3.3 Basic Features

The variable speed drive shall have the following basic features:

a. Hand/off/auto operation.

b. Manual/auto speed reference switch.

c. Minimum/maximum adjustable speeds.

d. Speed potentiometer.

e. Auto restart.

f. Linear timed acceleration and deceleration for soft starting and stopping.

g. Controlled speed range 3-63 Hz. (Factory set at 15 Hz minimum).

h. Terminal connections for time clock control, fire, smoke, freeze detectors, and EP relay pre-set speed override.

i. Output frequency terminals for remote metering.

2.8.3.4 Protective Circuits and Features

The variable speed drive controller shall include the following protective circuits/features:

a. Current limits to 100 percent design by slowing the down motor.

b. Instantaneous electronic trip to automatically shut down the motor if current exceeds 120 percent of design or phase-to-phase output short circuit occurs.

c. The variable speed drive will restart automatically when input line returns to normal in the event of intermittent power outage or phase loss or overvoltage shutdown.

d. Input power protection shuts down the unit on low input line voltage or loss of an input phase.

e. Insensitive to incoming power phase.

f. Fast acting current limiting input fuses, (Class J) rated with 200,000 interrupting amperes capability.

g. Isolated 115 volt control circuit and dedicated control transformer.

h. Line-to-line fault protection.

i. Line-to-ground short circuiting and accidental motor grounding protection.

j. Output thermal overload relay trip.

2.8.3.5 Adjustments

The variable speed drive shall have 0 to 75 percent of minimum speed, and 100 percent of maximum speed, adjustments available via potentiometers located on the faceplate of a single, regulator printed circuit board.

2.9 APPURTENANCES

2.9.1 Dielectric Fittings

Dielectric fittings shall be installed between threaded ferrous and nonferrous metallic pipe, fittings and valves. Dielectric fittings shall prevent metal-to-metal contact of dissimilar metallic piping elements and shall be suitable for the required working pressure.

2.9.2 Isolation Joints

Isolation joints shall be installed between nonthreaded ferrous and nonferrous metallic pipe, fittings and valves. Isolation joints shall consist of a sandwich-type flange isolation gasket of the dielectric type, isolation washers, and isolation sleeves for flange bolts. Isolation gaskets shall be full faced with outside diameter equal to the flange outside diameter. Bolt isolation sleeves shall be full length. Units shall be of a shape to prevent metal-to-metal contact of dissimilar metallic piping elements.

2.9.2.1 Sleeve-type Couplings

Sleeve-type couplings shall be used for joining plain end pipe sections. The two couplings shall consist of one steel middle ring, two steel followers, two gaskets, and the necessary steel bolts and nuts to compress the gaskets.

2.9.2.2 Split-sleeve Type Couplings

Split-sleeve type couplings shall be used in aboveground installations when approved in special situations, and shall consist of gaskets and a housing in two or more sections with the necessary bolts and nuts.

2.9.3 Valves

Valve diameter shall be equal to the diameter of the pipe in which the valve is located unless otherwise indicated. Valves shall be screw or flange connected. Valves shall be marked in accordance with MSS SP-25 to identify the manufacturer, valve sizes, pressure rating, body and seat material.

2.9.3.1 Relief Valve

Relief valve capable of maintaining a constant upstream pressure regardless of the downstream demand shall be provided for each air mover. Valve shall be ASTM F 1508 angle spring loaded differential pressure relief valve. Valve shall be rated to relieve the full capacity of the air moving equipment. Valve shall be factory-set to open at the gauge vacuum of -27 inches mercury column and shall be field adjustable within a minimum range of plus or minus 20 percent. Valve shall be located within five feet upstream of vacuum equipment or downstream of pressure equipment.

2.9.3.2 Unloading Valve

Unloading valve shall be pilot-operated diaphragm valve with auxiliary solenoid operatoractuated by the system controls and shall be field adjustable within a minimum range of plus or minus 20 percent. Unloading valve shall be set to relieve 1,200 cubic feet/minute at a set gage vacuum of -27 inches Hg.

2.9.3.3 Combination Relief and Unloading Valve

Combination relief and unloading valve shall be set to relieve at a set vacuum of -27 inches mercury column.

2.9.3.4 Purge Valve

Each vacuum unit shall be equipped with a manually adjustable, normally closed automatic purge valve. Valve shall be factory-set to open at at the gauge pressure of 0.15 inches Hg and shall be field adjustable within a minimum range of plus or minus 20 percent. Valve shall be located within 3.3 feet downstream of vacuum equipment.

2.9.3.5 Control Valve

Valve shall be a butterfly valve actuated by system controls.

2.9.3.6 Manual Valve

Non-automatic valve shall be as required by Section 02150 PIPING; OFF-GAS.

2.9.4 Inlet and Discharge Elbows

Inlet and discharge elbows shall be of the long sweep type with ASME B16.1, Class 125 flanges.

2.9.5 Expansion Coupling

The inlet and the outlet of each unit shall be provided with flexible expansion couplings of extra heavy gauge rubber, wire reinforced type suitable for temperature range of minus 20 to plus 250 degrees F and pressure range from 29 inches of mercury vacuum to 15 psig.

2.9.6 Heat Exchanger

An air-to-air heat exchanger shall be provided on the blower outlet with sufficient capacity to reduce the air temperature 120 degrees F.

2.9.7 Liquid Receiver

Liquid receivers shall be designed, fitted, and rated for 50 psi working pressure. Each receiver shall have a storage capacity not less than 200 gal. Each receiver shall be equipped with inlet and outlet drop pipe, drain with valve, relief valve and two bull's-eye liquid-level sight glasses. Sight glasses shall be in the same vertical plane, 90 degrees apart, perpendicular to the axis of the receiver, and not over 3 inches horizontally from the drop pipe measured along the axis of the receiver. In lieu of bull's-eye sight glass, external gauge glass with metal glass guard and automatic closing stop valves shall be provided. The outside of liquid receivers shall be galvanized or supplied with commercial enamel finish.

2.9.8 Air Receiver

Receiver shall be designed for 50 psi working pressure. Receivers shall be equipped with safety relief valves and accessories, including pressure gauges and automatic and manual drains. Receivers shall be designed and constructed in accordance with ASME BPVC SEC VIII D1 and shall have the design working pressures specified herein. A display of the ASME seal on the receiver or a certified test report from an approved independent testing laboratory indicating conformance to the ASME Code shall be provided. The outside of air receivers shall be galvanized or supplied with commercial enamel finish.

2.10 BASE PLATE

Each unit shall be mounted on all-welded structural steel or cast iron base complete with vibration isolators with published load rating. The base plate shall have vertical jacking screws to facilitate leveling. The entire unit shall be isolated from the building structure.

2.11 COATINGS OR FINISHES

Motors, casings and similar parts of equipment finished in the shop shall be cleaned, primed and given two finish coats with paint suitable for the environment in which the unit is to be placed at the factory. Ferrous surfaces not painted at the factory shall be given a shop coat of grease or other suitable rust resistant coating.

2.12 FACTORY TESTS

Equipment shall be subject to in-plant shop and quality control inspections before approval for shipment from manufacturer's facilities. Rotating parts of the equipment shall operate throughout the required range without excessive end thrust, vibration or noise.

The LRP system shall be functionally tested by the manufacturer prior to shipment and these tests shall include as a minimum:

a. Vacuum test at design
b. Flow test at design
c. Moisture separator leak test
d. Moisture separator pump on/off test
e. High water shutdown
f. Control panel interlocks
g. Vacuum relief
h. High temperature shutdown
j. High and low oil shutdown

PART 3 EXECUTION

3.1 INSTALLATION

Vibration dampener shall be installed in sufficient quantity to isolate each unit from the structural base on which the unit is installed. Each air moving unit and motor shall be installed, aligned and leveled in accordance with the written instruction of the manufacturer. Flexible couplings shall not be used to compensate for misalignment between driver and driven unit.

3.1.1 Concrete Foundations

Concrete for equipment foundations shall have a minimum compressive strength of at least 3,500 psi. Concrete foundations shall be integral with and of the same class as that of the building floor. Foundation bolts, as required, shall be furnished for proper positioning during the placement of the concrete.

3.1.2 Detailed Drawings

The Contactor shall submit detailed drawings including location of components, layout and anchorage of equipment and appurtenances, equipment relationship to other parts of the work, clearances for maintenance and operation. Drawings shall be to the approved scale.

3.1.3 Detailed Process Flow Diagrams

The Contractor shall submit detailed process flow diagrams and data including, but not limited to: air and off-gas stream flows, direction of flow, range of flow rate and range of composition, identified by lines and arrows denoting the direction and destination of the flow; material, mass and energy balances for the entire air and off-gas system; subsystem equipment, operating capacity and operating conditions; blowers and pumps, valves and other in-line devices; sizes of conveying devices (pipe, ducts, etc.).

3.1.4 Piping and Instrumentation Diagram

The Contractor shall submit a piping and instrumentation diagram indicating: process equipment; instrumentation; piping and valves; stacks, vents and dampers; control equipment (including sensors, process controllers, control operators, valves, interlocks, and alarms); labels and other necessary information to correlate to the process flow diagram. The P&ID shall include blowers and pumps, valves and other in-line devices.

3.2 FIELD PAINTING

Stainless steel, galvanized steel, and nonferrous surfaces shall not be painted.

3.2.1 Touch-Up Painting

Factory painted items, requiring touching up in the field, shall be cleaned of foreign material and shall be primed top-coated with the manufacturer's standard factory finish, provided it does not discolor in the presence of hydrogen sulfide fumes, high water vapor atmosphere, alkaline water vapor, and concentrated chlorine (oxidizing) conditions.

3.3 TESTING

3.3.1 Deficiencies

If any deficiencies are revealed during any tests, such deficiencies shall be corrected and the tests shall be reconducted.

3.3.2 Correct Installation

Tests shall assure that the units and appurtenances have been installed correctly, there is no objectionable heating or vibration, noise from any part is not excessive, and manual and automatic controls function properly.

3.3.3 Field Equipment Test

After installation of the air moving units and appurtenances is complete, operating tests shall be carried out to ensure that the installation operates properly. Each unit shall be given a running field test in the presence of the Engineer for a minimum of 4 hours at its rated capacity. The Contractor shall provide an accurate and acceptable method of measuring the discharge flow and pressure.

3.4 MANUFACTURER'S FIELD SERVICES

The Contractor shall obtain the services of a manufacturer's representative experienced in the installation, adjustment, and operation of the equipment specified. The representative shall supervise the installing, adjusting, and testing of the equipment.

3.5 FIELD TRAINING

The Contractor shall conduct a field training course. Training shall be provided for a total period of 8 hours of normal working time and shall start after the system is functionally complete but prior to final acceptance tests. Field training shall cover the items contained in the operating and maintenance instructions.

-- End of Section --

SECTION 11226

VAPOR PHASE ACTIVATED CARBON ADSORPTION UNITS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASME INTERNATIONAL (ASME)

ASME B40.100	(2000) Pressure Gauges and Gauge Attachments

ASTM INTERNATIONAL (ASTM)

ASTM D 2652	(1994; R 1999) Activated Carbon
ASTM D 2862	(1997) Particle Size Distribution of Granular Activated Carbon
ASTM D 2866	(1994; R 1999) Total Ash Content of Activated Carbon
ASTM D 2867	(1999) Moisture in Activated Carbon
ASTM D 3802	(1979; R 1999) Ball-Pan Hardness of Activated Carbon
ASTM D 4607	(1994; R 1999) Determination of Iodine Number of Activated Carbon
ASTM D 5228	(1992; R 2000) Determination of the Butane Working Capacity of Activated Carbon

1.2 SYSTEM DESCRIPTION

The vapor phase activated carbon adsorption system shall be a complete once-through forced flow system. The system shall be capable of reducing the chlorinated organic contaminants. The unit shall be filled with granular activated carbon for removal of organic contaminants from soil vapor extraction air/gas and air stripping air/gas. Equipment shall include, but shall not be limited to, vessels containing activated carbon, supporting equipment and accessories. Terminology is in conformance with ASTM D 2652. The system shall be complete with 2 carbon vessels in series for treatment of dual phase extraction effluent and 2 carbon vessels in series for treatment of the air stripper effluent, activated carbon, instruments, controls, valves, piping, and other specified appurtenances.

1.2.1 Performance Requirements

1.2.1.1 Physical Requirements

	Minimum	Maximum	Unit
Air/gas flow rate	1	1,250	scfm
Air/gas temperature	0	140	degrees F
Inlet Pressure		10	psig

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Vapor Phase Activated Carbon Adsorption Units

Instrumentation and controls; capacities and pressure drop; make and model; complete list of equipment and materials, including manufacturer's descriptive and technical literature; spare parts data; performance charts and curves; catalog cuts; and installation instructions. Isotherm and design calculations or manufacturer's computer models shall be provided to estimate the mass of carbon required and the breakthrough curves.

A complete list of parts, supplies, special tools, instruments and accessories and special lifting and handling devices required for periodic maintenance, repair, adjustment and calibration and recommended spare parts for each different item of material and equipment specified, with current unit prices and source of supply, and a list of the parts recommended by the manufacturer to be replaced after one and three years of service.

Vapor Phase Activated Carbon

Type of activated carbon, with isotherms for the selected carbon, with each of the volatile organic compounds listed in the effluent requirements for the anticipated temperature range at 50 percent relative humidity. Design calculations or vendor computer models shall be used to estimate the mass of carbon required and the breakthrough curves for the listed organic compounds in the carbon bed.

SD-07 Certificates

Vapor Phase Activated Carbon

Manufacturer's certificates attesting that the activated carbon furnished meets the specified requirements.

SD-10 Operation and Maintenance Data

Operating and Maintenance Manuals

Six complete copies of operating instructions outlining the step-by-step procedures required for system startup, operation and shutdown. The instructions shall include layout, wiring, and control diagrams of the system as installed. The manufacturer's name, model number, service manual, parts list, brief description of all equipment and their basic operation features, and operating instructions for each piece of equipment and bulletins, cut sheets and descriptive data. Six complete copies of maintenance instructions listing routine preventative maintenance procedures, possible breakdowns and repairs, and trouble shooting guides list showing lubricants for each item of mechanical equipment, approximate quantities needed per year and recommended lubrication intervals.

1.4 QUALIFICATIONS

1.4.1 Single Source Supplier

The Contractor shall assign to a single supplier full responsibility for furnishing of the activated carbon system.

1.5 GENERAL REQUIREMENTS

1.5.1 Standard Products

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall essentially duplicate items that have been in satisfactory use for at least 2years prior to bid opening.

1.5.2 Nameplates

Major equipment items such as adsorption vessels shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the item of equipment.

1.5.3 Verification of Dimensions

The Contractor shall, after becoming familiar with the details of the work, verify all dimensions in the field, and shall advise the Engineer of any discrepancies before performing the work.

1.5.4 Operation

The system shall be designed to operate continuously, 24 hours per day, 7 days per week.

1.6 DELIVERY, STORAGE AND HANDLING

Parts shall be preassembled to the largest extent possible, compatible with transportation limitations and equipment protection considerations. Field assembly, if any, shall require merely bolting together of match-marked components. Equipment shall be crated and delivered to protect against damage during shipping. Flange faces shall be protected from damage. All openings shall be covered to prevent entrance of dirt, water and debris. All parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and until the units and equipment are ready for operation. Finished iron or steel surfaces shall be properly protected to prevent rust and corrosion. All equipment delivered and placed in storage shall be stored with protection from the weather (humidity and temperature), dirt and dust, and other contaminants.

PART 2 PRODUCTS

2.1 VAPOR PHASE ACTIVATED CARBON

Material shall conform to the following:

a. The initial charge of carbon shall be virgin v carbon. Subsequent charges shall be virgin or regenerated carbon.

d. Minimum butane working capacity of new activated carbon of 23.8 percent by weight shall be as determined by ASTM D 5228.

e. Minimum iodine number of virgin or reactivated carbon of 1000 shall be as determined by ASTM D 4607.

f. Maximum moisture content of 2 percent by weight shall be as determined by ASTM D 2867.

g. Maximum total ash content of 10 percent by weight shall be as determined by ASTM D 2866.

h. Minimum hardness number of 90 necessary for the required life in vapor phase applications shall be as determined by ASTM D 3802.

i. Activated carbon particle size shall be uniform for consistent pressure drop characteristics. Maximum particle size shall be 0.2 inch diameter as determined by ASTM D 2862.

j. The granular activated carbon shall be of the type that can be accepted for offsite regeneration of the spent activated carbon by an approved carbon regeneration facility.

n. Material shall be free from impurities that affect the serviceability and appearance of the finished product.

2.2 VAPOR PHASE ACTIVATED CARBON ADSORPTION UNITS

2.2.1 Vessel

The following requirements shall be met for the dual phase extraction effluent treatment:

a. Minimum Number of Vessels: 2 Carbtrol G-9 Adsorbers.

b. Minimum Adsorber Diameter: 5 ft.

c. Material of Construction: carbon steel.

d. Maximum Allowable Working Pressure: 3 psig.

e. Minimum Carbon Quantity per Vessel: 3,000 lbs.

f. Minimum Carbon Bed Depth: 72 inches.

g. Flow Direction: downflow.

h. Inlet Distributor: Integral

The following requirements shall be met for the air stripper effluent treatment:

a. Minimum Number of Vessels: 2 Carbtrol G-2S Canisters.

b. Minimum Adsorber Diameter: 2 ft.

c. Material of Construction: carbon steel.

d. Maximum Allowable Working Pressure: 10 psig.

e. Minimum Carbon Quantity per Vessel: 170 lbs.

f. Minimum Carbon Bed Depth: 36 inches.

g. Flow Direction: downflow.

Each unit greater than 200 lbs shall be skid-mounted. Skids shall be fabricated of steel channels and shall be designed to support the equipment and to distribute the weight in transit and in service without loading on the tank or concrete slab; and pre-piped internally. Each vessel greater than 200 lbs shall be secured to a structural steel frame suitable for shipment or transport with a forklift or crane and set on a level area for operation. Exterior structural steel surfaces shall be coated with a suitable primer and top coat to resist corrosion due to water spray. Each unit shall have a minimum of one ground connection. Each unit shall be provided with an inlet air/gas distributor,if required. Sampling ports shall be provided on the inlet and outlet pipes of each vessel to allow independent sampling and measurement of breakthrough for each unit.

2.3 ACCESSORIES

2.3.1 Sampling Valves

Sampling valves shall be provided at the inlet and outlet of each carbon unit.

2.3.2 Piping

Piping shall be in accordance with Section 02150 PIPING; OFF-GAS.

2.4 VAPOR PHASE ACTIVATED CARBON INSTRUMENTATION AND CONTROLS

2.4.1 Pressure Gauges

Pressure gauges shall conform to ASME B40.100.

2.4.2 Thermometers

Thermometers shall be dial type, 3-1/2 inch diameter, chromium plated case; remote or direct-type bulb as required; plus or minus 1 degree F accuracy; white face with black digits graduated in 2 degree F increments. Thermometer wells of the separable socket type shall be provided for each thermometer with direct-type bulb. Range of thermometers shall be 0 to 200 degrees F.

PART 3 EXECUTION

3.1 EQUIPMENT INSTALLATION

Equipment shall be installed as shown and in accordance with written instructions of the manufacturer. Each vessel shall be [anchored to a footing isolated from the floor slab] [mounted on a skid base]. Anchor brackets, anchor rods or straps shall be provided to hold the shell to anchors in the footing. Reinforced concrete foundations for each carbon unit shall be designed to support the unit and shall be in accordance with Section 03300A CAST-IN-PLACE STRUCTURAL CONCRETE.

3.2 FIELD QUALITY CONTROL

3.2.1 Equipment Tests

After installation of the carbon adsorption system is complete, operating tests shall be carried out to ensure that the unit installed operates properly. All products shall be carefully inspected for defects in workmanship and material; debris and foreign matter shall be cleaned out of all equipment; all operating mechanisms shall be tested to check their proper functioning; and all nuts and bolts shall be checked for tightness. Valves and other equipment which do not operate easily or are otherwise defective shall be repaired or replaced. Tests shall assure that there is no vibration, or noise from any parts. If deficiencies are revealed during tests, such deficiencies shall be corrected and the tests shall be reconducted at the Contractor's expense.

-- End of Section --

SECTION 11301

AIR STRIPPER

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASME INTERNATIONAL (ASME)

ASME B40.100	(2000) Pressure Gauges and Gauge Attachments

1.2 SYSTEM DESCRIPTION

The air stripping equipment shall be as specified in PART 2 of this section.

1.2.1 Operating Schedule

Capacity and design of the air stripper and accessories shall allow the system to operate continuously for 24 hours per day, 7 days per week.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Process Flow Diagrams

Process flow diagrams showing all major pieces of process equipment with flow rates and material balances.

Process and Instrumentation Diagram (P&ID)

Process and instrumentation diagram (P&ID) showing all instrumentation and control locations functions and settings.

Equipment Installation

Drawings containing complete wiring and schematic diagrams and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearances for maintenance and operation.

SD-03 Product Data

Air Stripping System

A complete list of material, including manufacturer's descriptive and technical literature, catalog cuts, drawings, and installation instructions, performance charts, technical literature, catalog cuts for mist eliminator, perforated trays and number, stripper, instrumentation and controls, including capacities, make and model, materials of construction, valving, and pressure gauges.

Field Training

Training course curriculum and training instructions, 14 days prior to the start of training.

SD-08 Manufacturer's Instructions

Air Stripping System

Installation, operating and maintenance instructions as provided by the manufacturer.

SD-10 Operation and Maintenance Data

Air Stripping System
Maintenance

The following information can either be included in the manual or manufacturer literature that contains the information and is furnished with the O&M Manuals. Each manual shall have an index listing the contents. Manuals shall be bound in sturdy three-ring, loose-leaf binders.

Six complete copies of operating instructions outlining the step-by-step procedures required for system startup, normal operation, short- and long-term deactivation, and shutdown. An introduction and overall equipment description, purpose, functions, and simplified theory of operation shall be included in the beginning of the instructions. The instructions shall include the manufacturer's name, model number, service manual, parts list and brief description of each piece of equipment and its basic theory and operating features. The instructions shall include piping and component layouts and wiring and control diagrams for the systems as installed. Performance test data shall be reflected in the operating instructions.

Six complete copies of maintenance instructions listing routine maintenance procedures, calibration procedures, possible breakdowns and repairs and trouble shooting guides. Procedures for cleaning and removal of scale shall be included.

1.4 QUALIFICATIONS

1.4.1 Single Source Supplier

The Contractor shall assign to a single supplier full responsibility for the furnishing of the air stripping system. The designated single supplier, however, need not manufacture the system but shall coordinate the design, assembly, installation, and testing of the entire system as specified herein.

1.4.2 Manufacturer's Representative

Services of a manufacturer's field service representative who is experienced in the installation, adjustment, and operation of the equipment furnished and who has complete knowledge of the proper operation and maintenance of the system shall be provided.

1.5 DELIVERY, STORAGE, AND HANDLING

Parts shall be preassembled to the extent practical, compatible with transportation limitations and equipment protection considerations. Field assembly, if any, shall require merely bolting together of match-marked components. Equipment shall be crated and protected against damage during shipping and delivery. Flange faces shall be protected from damage. Openings shall be covered to prevent entrance of dirt, water and debris. Parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and the units and equipment are ready for operation. Finished iron or steel surfaces shall be properly protected to prevent rust and corrosion. All equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variation, dirt and dust, and other contaminants.

1.6 GENERAL REQUIREMENTS

1.6.1 Standard Products

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall essentially duplicate equipment that has been in satisfactory operation for at least 2 years prior to bid opening. The manufacturer shall furnish a low profile, multi-tray air stripper to remove volatile organic compounds from water. The system shall be manufactured by QED Environmental Systems, Inc. or pre-approved equivalent.

1.6.2 Nameplates

Major equipment items shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the item of equipment. Each piece of equipment shall bear the approval designation and the markings required for that designation. Valves shall be marked and shall bear a securely attached tag with the manufacturer's name, catalog number and valve identification permanently displayed.

1.6.3 Field Measurements

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the Engineer of any discrepancy before performing the work.

PART 2 PRODUCTS

2.1 SYSTEM COMPONENTS

The air stripper shall be an E-Z Tray™ Removable-Tray Air Stripper Model 4.4 or pre approved equivalent (low profile, multiple sieve tray design using pressure rather than vacuum to generate airflow).

2.1.1 Pipe Connections

Influent pipe connections shall be full line diameter of the connecting pipe. Effluent pipe connections shall be made with standard reducing fittings only if there is adequate vertical run to avoid back-up. Air and off-gas piping shall be as specified in Section 02150 PIPING; OFF-GAS. Liquid piping shall be as specified in Section 15200 PIPELINES, LIQUID PROCESS PIPING.

2.1.2 Mist Eliminator

The mist eliminator shall have the minimum separation efficiency stated in the performance requirements. Materials shall be as specified for the stripper internals.

2.1.3 Exhaust Stack

Exhaust stack shall be sized for gas velocity between 10 and 25 feet/second. Materials shall be as specified for the stripper.

2.1.4 Off-Gas Control

Off gas from the air stripper column shall be conveyed to an air pollution control unit for treatment as specified in Section 11226 VAPOR PHASE ACTIVATED CARBON ADSORPTION UNITS .

2.1.5 Instrumentation and Controls

Instrumentation and controls shall conform to the requirements of the Construction Drawings and the requirements specified for each piece of the equipment with the interlocks and control devices specified herein.

a. Gauges shall have 6 inch dials, shall be stem mounted, and shall conform to ASME B40.100. Accuracy of gauges shall be Grade A or better. Gauges shall be calibrated in inches water column in not more than 2 inch water column increments from 0 to 50 inches water in excess of the normal operating pressure at the tank.

b. Control to shut down the system and activate an alarm if the blower fails.

c. Interlock for concurrent operation of blowers and influent pumps.

d. Water flow indicators 0 to 25 gpm.

e. Effluent water temperature gauge 0 to 100 degrees F.

f. Pressure drop instrument 0 to 50 inch water.

g. Air flow gauge of differential pressure type, 0 to 0.5 inches water column range with pitot tube air flow sensor

h. Direct reading pressure gauges in the air inlet and outlet throats.

i. Digital in-line liquid flow meter

j. Sump sight gauge

k. Sump high level switch

l. Sump high/low pressure switch

2.1.6 Assembly

The system shall be factory pre-assembled into reasonably sized modules for easy field assembly and mounted on a skid. The skid shall have a welded steel frame with 1/4 inch thick steel plate.

2.2 STRIPPER

The stripper system shall consist of 1 perforated plate (sieve tray)] air stripper to transfer volatile organic compounds from the water phase to the air base. The Contractor shall use manufacturer's standard size units whenever possible.

2.2.1 Materials

2.2.1.1 Shell

The air stripper shall be constructed of 304 stainless steel of suitable thickness to prevent deformation. Shop Fabrication shall conform the manufacturer's recommended fabbrication procedures.

2.2.1.2 Internals

The air stripper internals shall be constructed or 304 stainless steel.

2.2.2 Perforated Plate (Sieve Tray) Stripper

The stripper shall have the following features: Vertically stacked trays with horizontal perforated plate (sieve trays) bottoms that are enclosed in a shell and are separated vertically. Contaminated water is introduced at the top, flows across a perforated plate, over a weir and down to the next lower plate. The process is repeated for each tray until the water reaches the bottom of the unit and enters the sump. Air is introduced at the bottom of the unit and is forced up through the perforations in the trays to form bubbles. Volatile organic chemicals in the water phase transfer to the bubbles in the air phase. The air phase containing the volatile chemicals then leaves the top of the column.

2.2.2.1 Perforated Plates (Sieve Trays)

Materials for perforated plates, downcomers, downcomer seals, baffles and other components shall be constructed of materials allowed by paragraph Internals of suitable thickness to prevent deformation. Tray design shall prevent short-circuiting of air or water. The number and size of perforations shall provide for maximum mass transfer.

2.2.2.2 Gsskets

The trays shall have gaskets that prevent air and water leakage in and out of the shell and between trays. Gaskets shall be of a material compatible with the influent and with the cleaning methods.

2.2.2.3 Disassembly

The strippers must be easily disassembled for cleaning or shall have hatches for access to the individual trays or other internal components for inspection and cleaning.

PART 3 EXECUTION

3.1 FOUNDATIONS

Reinforced concrete foundation for air stripper system equipment shall be designed to support the stripper full of water and shall be in accordance with Sections 03305 CAST-IN-PLACE CONCRETE.

3.2 EQUIPMENT INSTALLATION

Equipment shall be installed as shown and in accordance with the written instructions of the manufacturer, under the direct supervision of the manufacturer's representative.

3.3 PAINTING FOR CORROSION PREVENTION

3.3.1 Touch-up Painting

Factory painted items shall be touched up as needed. These items shall be cleaned of all foreign material and shall be primed and top coated with the manufacturer's standard factory finish.

3.3.2 Corrosion Resistant Metals

Painting of corrosion resistant materials such as copper, brass, bronze, copper-nickel, and stainless steel shall not be performed unless otherwise specified.

3.4 MANUFACTURER'S FIELD SERVICE

Prior to startup, the equipment shall be inspected for alignment and connections by a factory representative. The manufacturer's representative shall inspect the final installation and supervise the adjustment and testing of the equipment.

3.5 STARTUP

After completion of all testing, the manufacturer's representative shall assist the plant operators in plant startup.

3.6 ADJUSTING AND CLEANING

Adjustments within the control range shall be made to obtain optimum performance under actual field conditions.

3.7 DEMONSTRATION

The manufacturer's representative shall demonstrate that the system meets the performance requirements.

3.8 FIELD TRAINING

The Contractor shall conduct a training course. The training period, for a total of 8 hours of normal working time, shall start after the system is functionally complete but prior to final acceptance tests. The field instructions shall cover the topics included in the Operating and Maintenance Manuals.

-- End of Section --

SECTION 13121

PRE-ENGINEERED BUILDINGS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 317	(1992) Manual of Steel Construction, Volume II, Connections

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI SG-671	(1989) Specification & Commentary for the Design of Cold-Formed Steel Structural Members

ASTM INTERNATIONAL (ASTM)

ASTM A 525	(1993) Standard Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
ASTM A 526/A 526M	(1990) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Commercial Quality

METAL BUILDING MANUFACTURERS ASSOCIATION (MBMA)

MBMA Low Rise Manual	(1986; Errata; Supple 1990) Low Rise Building Systems Manual

1.2 GENERAL REQUIREMENTS

The building supplier shall furnish a complete set of building erection drawings, illustrating the step-by-step sequence for the erection of the building. The erection drawings shall be prepared specifically for the building covered by these specifications, showing the exact location for all roof and wall accessories and all anchor bolt locations.

Manufacturer's Standard Color Charts and Color Panels shall be submitted by the Contractor for Exterior Panels, Interior Panels, Accessories and Trim.

Design analysis and calculations for Pre-Engineered Metal Buildings, Structural Steel Members and Metal Roofing and Siding Panels shall be prepared and certified by a registered professional structural engineer.

Certificates shall be submitted for Materials, Equipment and Accessories showing conformance with the referenced standards contained in this section.

Each building shall be supplied with all necessary component parts, including foundation anchors, to form a complete building system. All parts shall be new and free from defects.

The building width and length shall be measured from the outside of the building wall panels and the height of the building shall be the distance measured from the bottom surface of the base channel to the exterior juncture of the roof and sidewall panels.

1.3 DESIGN CRITERIA

Structure shall be designed to withstand a live load on the roof, in accordance with local code requirements and wind and seismic loading and in accordance with MBMA Low Rise Manual. Loads shall be combined for determining maximum stress in accordance with MBMA Low Rise Manual.

Allowable stresses may be increased one-third for design-load combinations involving wind.

Structural steel members shall be designed in accordance with AISC 317and AISI SG-671.

Design of pre-engineered metal buildings shall be in accordance with the MBMA Low Rise Manual.

Deflection of metal roofing and siding panels shall not exceed 1/180 of the span on single span loading under the total live and wind load.

All buildings shall be designed in accordance with the applicable sections of the latest edition of the AISC Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings and the AISI Specifications for the Design of Cold Formed Steel Structural Members (CAN/CSA-S136 Cold Formed Steel Structural Members and the CAN/CSA-SI 6.1 Limit States Design of Steel Structures).

1.3.1 Roof Panel Design

Roof panels shall be supplied in a single continuous length from eave line to eave line and shall be designed to tightly interlock so that no fasteners are required at intermediate points along the panel side laps. Roof panels shall be a maximum of 16" wide with a flat surface between the interlocking side ribs. The interlocking ribs shall be a minimum 3" high, and shall be turned upward.

Roof panels shall be nominal 24 gauge steel coated on both sides with a Galvalume® coating of corrosion resistant aluminum-zinc alloy applied by a continuous hot dipping process (ASTM A 792). Coating weight shall be a minimum of 0.55 oz. Of aluminum zinc alloy per square foot of coated steel (both sides) - equivalent to nominal 0.80 mil thickness on each side. Minimum yield strength of panel material shall be 50,000 psi (345 MPa).

1.3.2 Wall Panel Design

Exterior wall panels of the building shall be a single continuous length from the base channel to the roofline of the building at the sidewalls and end walls of the building, except where interrupted by wall openings. Wall panels shall be 16" wide with a 3" deep inward turned interlocking side rib. Panels shall contain two 3/4" deep by 3-1/8" wide fluted recesses, each starting 2-7/16" from each panel edge. Wall panels shall be fastened internally at the base and eave of the building with 3/8" diameter electrogalvanized machine bolts placed within the panel interlock. The fastening system shall be designed so that no wall fasteners are exposed on the exterior surfaces of the wall.

Wall panels shall be nominal 24 gauge galvanized steel conforming to ASTM A 653 with a galvanized coating conforming to G90 (.9 oz.) standards. Minimum yield strength of panel material shall be 40,000 psi (275Mpa). Panel material shall be embossed with a random pattern pebble embossure of approximately .007" - .008" depth.

The bases of the wall panels shall be sealed with foam closures conforming to the panel profile.

1.3.3 Wall Panel Finish Coating

The exterior surface of the wall panels shall be finished with Butler-Cote® 500 finish system, a full strength, 70% Kynar 500® or Hylar 5000® fluoropolymer coating. Manufacturer shall warrant that the coating will not peel (loss of adhesion), crack or check for 20 years. For a period of 20 years, chalking shall not exceed #8 ASTM and fading shall be a 5 DE Color Difference Units or less.

The exterior wall color shall be Country Wheat.

1.4 Design Specifications

The building shall be designed in strict accordance with the New York State Building Code/International Building Code and the following loads in addition to the weight of the building:

> The roof snow/live load of the building shall be based upon a snow ground load of 55 pounds per square foot calculated by Section 7 of ASCE 7.
>
> The wind load shall be 95 miles per hour.
>
> All combining and distributing of auxiliary equipment loads imposed on the building system shall be done in accordance with the MBMA publication titled "Low Rise Building Systems Manual" or National Building Code of Canada, as applicable.

1.5 FRAMING SYSTEM

The building shall utilize the structural strength of the interlocking wall system to support the building vertical live load and wind loads and shall not require column, rafter, or wall girt supporting members.

The roof panels of the building shall be supported by nominal 12 gauge by 10" deep galvanized steel "C" purlins spaced on maximum 5'-0" centers. Purlins shall be supported at the end walls of the building by a pre-punched nominal 14 gauge galvanized steel "Z" rake girt.

The transmission of horizontal wind loads shall be made through the interlocking panel roof system and no separate roof or wall diagonal bracing will be permitted.

The building roof line shall be a "double slope" type with a maximum roof rise of 1/3" to 12".

Contour gable trim shall be provided at the end walls of the building. Trim shall be nominal 26 gauge galvanized steel, factory finished in Birch White.

Contour eave trim shall be provided at the eave lines of the building. Trim shall be nominal 26 gauge galvanized steel in the same finish and color as the Contour gable trim.

1.6 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittal Procedures," in sufficient detail to show full compliance with the specification:

SD-01 Preconstruction Submittals

Manufacturer's Instructions shall be submitted in accordance with paragraph entitled, "General Requirements," of this section.

SD-02 Shop Drawings

Fabrication drawings shall be submitted for the following items:

Installation drawings shall also be submitted for the following items and shall be in accordance with the paragraph entitled, "Assembly and Erection," of this section.

Roofing and Siding
Accessories
Steel Doors and Frames
Overhead Door Frames
Louvers
Gutters and Downspouts
Pre-Engineered Metal Buildings

SD-03 Product Data

Manufacturer's catalog data shall be submitted for the following items, including accessories and installation materials.

Roofing and Siding
Accessories
Insulating Materials
Steel Doors and Frames
Weatherstripping
Overhead Door Frames
Louvers
Gutters and Downspouts

SD-04 Samples

Manufacturer's Standard Color Charts shall be submitted in accordance with paragraph entitled, "General Requirements," of this section.

Color Panels
Exterior Panels
Accessories

SD-05 Design Data

Design analysis and calculations for the following items shall be in accordance with the paragraph entitled, "General Requirements," of this section.

Pre-Engineered Metal Buildings
Structural Steel Members
Metal Roofing and Siding Panels

PART 2 PRODUCTS

Contractor to provide and erect as shown on Construction Drawings a Panl-Line building manaufactured by Butler Manufacturing or approved equivalent.

2.1 INSULATING MATERIALS

2.1.1 Fiberglass Roof Insulation

Roof insulation shall consist of 48 inches wid, 6# desnsity fiberglass faced on its exposed side with a white metaized polypropylene scrimkraft facing.

The faced insulation material shall have a UL Flame Spread Rating of 25 or less when tested in accordance UL723 or ASTM E-84 procedures.

The "U" value through the insulated roof shall be 0.10 BTU's per square foot (R=5.3) when measured in accordance with the "Zone Method" contained in ASHRAE "Handbook of Fundamentals", 1981 edition.

2.1.2 Roll-In Inuslation

The interior of the building shall be insulated with 3 inches thick fiberglass faced on its exposed side with a white metalized polypropylene scrimkraft. The insulation shall be retained between the interlocking panel ribs with a white PVC hat clip.

The "U" value of the finished wall system shall be 0.19 BTU's per square foot (R=5.3) when measured in accordance with the "Zone Method" contained in ASHRAE "Handbook of Fundamentals", 1981 edition.

2.2 STEEL DOORS AND FRAMES

Door shall be 1-3/4" thick full flush type. Door panels shall be nominal 20 gauge galvanized steel welded to nominal 16 gauge flush-mounted end channels. The door shall be manufactured in accordance with ANSI/SDI 100-85, Grade 1, Model 1, and ANSI A151.1-87, Class C.

Door leaf core shall be resin impregnated honeycomb laminated to the door panels. Calculated "U" value shall be 0.41 (R = 2.4) and sound transmission shall be STC 30 per ASTM E90-70 and E 413-73 tests.

Door frames shall be 4-3/4" deep double rabbeted type of nominal 16 gauge galvanized steel. Door frames shall be attached to the floor with clip angles. Jambs shall have welded brackets for attachment of jambs to the building wall systems.

Door and frames shall be painted with one coat of white baked-on primer. All doors shall be provided "assembled in their frames with all hardware, except door knobs, installed on the door leaf."

2.3 FINISH HARDWARE

Standard door hardware shall consist of:

Mortise cylinder lockset per ANSI A156.13, Series 100 Grade 1, Function F13, 626 satin chrome finish.

4-1/2" X 4-1/2", STD. WT., plain bearing, hinges per ANSI A5133, 630 satin stainless steel finish with non-rising pins (3 per door leaf).

3-11/16" wide X 5/8" high extruded aluminum threshold with vinyl weather stripping.

¼" X ½" silicon rubber weather-stripping.

Door type shall be Solid.

2.4 WEATHERSTRIPPING

Weatherstripping for the heads, jambs, meeting stiles, and sills of exterior doors shall be the manufacturer's standard.

2.5 OVERHEAD DOOR FRAMES

Framed openings shall be nominal 12 gauge high strength galvanized steel. The jambs and head shall provide a minimum 2-12 inches wide inside surface for field mounting of door track hardware. Head and jamb covers shall be provided of nominal 24 gauge galvanized steel prefinished in the wall panel color and finish.

2.6 LOUVERS

Adjustable louvers shall be general purpose type of self framing design. The louver frame shall be of nominal 14 gauge formed aluminum and the louver blades shall be nominal 12 gauge extruded aluminum. Finish shall be natural mill.]

Blades shall be pivoted on 1/2 inch diameter aluminum pivot pins through nylon flanged bearings and operated by means of a pull bar operating handle.

All louvers shall be complete with an exterior mounted 18inch - 14 inch aluminum mesh insect screen.

2.7 GUTTERS AND DOWNSPOUTS

Gutters and downspouts shall conform to ASTM A 526/A 526M. Zinc coating shall be in accordance with ASTM A 525, G90. Material shall be not less than 26-gage.

PART 3 EXECUTION

3.1 ASSEMBLY AND ERECTION

Assembly and erection shall be on a prepared foundation in accordance with the manufacturer's instructions and recommendations.

Manufacturer shall furnish either templates or an anchor bolt layout drawing that must be used for the location of anchor bolts.

-- End of Section --

SECTION 15003

GENERAL MECHANICAL PROVISIONS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

ASTM INTERNATIONAL (ASTM)

ASTM A 123/A 123M	(2002) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM B 766	(2003) Standard Specification for Electrodeposited Coatings of Cadmium

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1650	(1998) Seismic Restraint Manual: Guidelines for Mechanical Systems

UNDERWRITERS LABORATORIES (UL)

UL 6	(2003) UL Standard for Safety for Electrical Rigid Metal Conduit-Steel
UL Bld Mat Dir	(2003) Building Materials Directory

1.2 SUBMITTALS

Not Used

1.3 COORDINATION

Contractor shall coordinate the work of the different trades so that interference between piping, equipment, structural, and electrical work will be avoided. All necessary offsets in piping and ductwork, and all fittings, and other components, required to install the work properly shall be furnished complete in place at no additional cost to the Owner.

1.4 MECHANICAL SYSTEMS IDENTIFICATION

1.4.1 Identification Tags

Identification tags made of brass or aluminum indicating function of a control or similar component shall be installed on such system devices. Tags shall be 2 inches in diameter and marking shall be stamped.

Equipment shall be provided with metal identification tags displaying an equipment designation number matching drawing or control diagram designation.

Tags shall be wired to valve or equipment items with No. 12 AWG 0.0808-inch diameter corrosion-resistant steel wire.

1.4.2 Service Labeling

All piping, exposed, bare and painted; and insulated, shall be labeled to designate service. Each label shall include an arrow or arrows to indicate flow direction. Labels and valve tag schedule shall be in accordance with the typical examples below:

SERVICE	LABEL AND TAG DESIGNATION
Groundwater Recovery Wells	INTERMEDIATE ZONE GROUNDWATER
Multi-Phase Extraction Inlet	GROUNDWATER/VAPOR MIXTURE
Multi-Phase Extraction Outlet	VAPOR
WATER KNOCK-OUT TANK EFFLUENT	GROUNDWATER

Piping shall be labeled and arrowed in accordance with the following:

Each change in direction, i.e., elbows, tees

In congested or hidden areas and at all access panels at each point required to clarify service or indicated hazard.

In long straight runs, labels shall be located at distances within eyesight of each other. All labels shall be visible and legible from the primary service and operating area.

For Bare or Insulated Pipes for Outside Diameters of	Lettering
1/2 thru 1-3/8 inch	1/2 inch
1-1/2 thru 2-3/8 inch	3/4 inch
2-1/2 inch and larger	1-1/4 inch

Labels shall be made of self-sticking, plastic film designed for permanent installation.

1.5 APPROVAL REQUIREMENTS

Except as otherwise specified, approval of materials and equipment will be based on manufacturer's published data.

Where materials and equipment are specified to conform to the standards of the Underwriters Laboratories, the label of or listing with reexamination in UL Bld Mat Dir, and UL 6 will be acceptable as sufficient evidence that the items conform to Underwriters Laboratories requirements. In lieu of such label or listing, the Contractor may submit a written certificate from any nationally recognized testing agency, adequately equipped and competent to perform such services, stating that the items have been tested and that the units conform to the specified requirements. Methods of testing used by the specified agencies shall be outlined.

Where materials or equipment are specified to be constructed or tested, or both, in accordance with the standards of the ASTM International (ASTM), the ASME International (ASME), or other standards, a manufacturer's certificate of compliance of each item will be acceptable as proof of compliance.

Conformance to such agency requirements does not relieve the item from compliance with other requirements of these specifications.

1.6 PREVENTION OF CORROSION

Metallic materials shall be protected against corrosion. Equipment enclosures shall be given rust-inhibiting treatment and standard finish by the manufacturer. Aluminum shall not be used in contact with earth, and where connected to dissimilar metal, shall be protected by approved fittings, barrier material, or treatment. Ferrous parts such as anchors, bolts, braces, boxes, bodies, clamps, fittings, guards, nuts, pins, rods, shims, thimbles, washers, and miscellaneous parts not of corrosion-resistant steel or nonferrous materials shall be hot-dip galvanized in accordance with ASTM A 123/A 123M for exterior locations and cadmium-plated in conformance with ASTM B 766 for interior locations.

PART 2 PRODUCTS

2.1 IDENTIFICATION PLATES

In addition to standard manufacturer's identification plates, engraved laminated phenolic identification plates shall be provided for each piece of mechanical equipment. Identification plates shall designate the function of the equipment. Designation shall be submitted with the shop drawings.

Identification plates shall be three layers, black-white-black, engraved to show white letters on black background. Letters shall be upper case. Identification plates 1-1/2-inches high and smaller shall be 1/16-inch thick, with engraved lettering 1/8-inch high; identification plates larger than 1-1/2-inches high shall be 1/8-inch thick, with engraved lettering of suitable height. Identification plates 1-1/2-inches high and larger shall have beveled edges. Identification plates shall be installed using a compatible adhesive.

2.2 ANCHOR BOLTS

Anchor bolts shall be provided for equipment placed on concrete equipment pads or on concrete slabs. Bolts shall be of the size and number recommended by the equipment manufacturer and shall be located by means of suitable templates. Installation of anchor bolts shall not degrade the surrounding concrete.

2.3 SEISMIC ANCHORAGE

Equipment shall be anchored in accordance with applicable seismic criteria for the area and as defined in SMACNA 1650

2.4 PAINTING

Equipment units shall be painted in accordance with approved equipment manufacturer's standards unless specified otherwise. Field retouching shall be accomplished only if approved; otherwise equipment shall be returned to the factory for refinishing.

PART 3 EXECUTION

3.1 INSTALLATION

Materials and equipment shall be installed in accordance with the requirements of the contract drawings and approved recommendations of the manufacturers. Installation shall be accomplished by workers skilled in this type of work. Installation shall be made so that there is no degradation of the designed fire ratings of walls, partitions, ceilings, and floors.

No installation shall be permitted which blocks or otherwise impedes access to any existing machine or system. All hinged doors shall swing open a minimum of 120 degrees. The area in front of all access doors shall be clear a minimum of 3 feet. The area in front of all access doors to electrical circuits shall be clear the minimum distance to energized circuits as specified in OSHA Standards, part 1910.333(Electrical-Safety Related work practices)and an additional 3 feet.

Except as otherwise indicated, emergency switches and alarms shall be installed in conspicuous locations. All indicators, to include gauges, meters, and alarms shall be mounted in order to be easily visible by people in the area.

3.2 EQUIPMENT PADS

Equipment pads shall be provided and shall be of dimensions shown or, if not shown, they shall conform to the shape of each piece of equipment served with a minimum 3-inch margin around the equipment and supports. Equipment bases and foundations, when constructed of concrete or grout, shall cure a minimum of 14 calendar days before being loaded.

3.3 CUTTING AND PATCHING

Contractor shall install his work in such a manner and at such time as will require a minimum of cutting and patching of the building structure.

Holes in exposed locations, in or through existing floors, shall be drilled and smoothed by sanding. Use of a jackhammer will be permitted only where specifically approved.

3.4 CLEANING

Exposed surfaces of piping and equipment that have become covered with dirt, plaster, or other material during handling and construction shall be thoroughly cleaned before such surfaces are prepared for final finish painting or are enclosed within the building structure.

Before final acceptance, mechanical equipment, including piping, ducting, and fixtures, shall be clean and free from dirt, grease, and finger marks.

-- End of Section --

SECTION 15050

BASIC MECHANICAL MATERIALS AND METHODS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B40.1	(1991; R 1997) Gauges - Pressure Indicating Dial Type - Elastic Element

AMERICAN WELDING SOCIETY (AWS)

AWS WHB-2.8	(1991; 8th Ed) Welding Handbook; Volume Two - Welding Processes

ASME INTERNATIONAL (ASME)

ASME B16.1	(1998) Cast Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250
ASME B16.3	(1998) Malleable Iron Threaded Fittings Classes 150 and 300
ASME B31.3	(2002) Process Piping
ASME BPVC SEC IX	(2001) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications
ASME BPVC SEC VIII D1	(2001) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage

ASTM INTERNATIONAL (ASTM)

ASTM A 126/A 126M	(1995) Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A 197/A 197M	(2000) Standard Specification for Cupola Malleable Iron
ASTM A 307	(2003) Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
ASTM A 53/A 53M	(2002) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 563	(2004) Standard Specification for Carbon

	and Alloy Steel Nuts
ASTM A 6/A 6M	(2004a) Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
ASTM B 62	(2002) Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM C 109/C 109M	(2002) Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens)
ASTM C 404	(2003) Standard Specification for Aggregates for Masonry Grout
ASTM C 476	(2002) Standard Specification for Grout for Masonry
ASTM C 553	(2002) Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM C 67	(2003a) Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile
ASTM C 920	(2002) Standard Specification for Elastomeric Joint Sealants
ASTM D 2308	(2002) Standard Specification for Thermoplastic Polyethylene Jacket for Electrical Wire and Cable
ASTM E 1	(2003a) Standard Specification for ASTM Liquid-in-Glass Thermometers
ASTM E 814	(2002) Standard Test Method for Fire Tests of Through-Penetration Fire Stops
ASTM F 104	(2003) Standard Classification System for Nonmetallic Gasket Materials

FLUID SEALING ASSOCIATION (FSA)

FSA-0017	(1995) Non-Metallic Expansion Joints and Flexible Pipe Connectors Technical Handbook, 6th Edition

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE Std 515	(1997) Standard for the Testing, Design, Installation, and Maintenance of Electrical Resistance Heat Tracing for Industrial Applications

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58	(2002) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-67	(2002) Butterfly Valves
MSS SP-69	(2002) Pipe Hangers and Supports - Selection and Application
MSS SP-70	(1998) Cast Iron Gate Valves, Flanged and Threaded Ends
MSS SP-71	(1997) Gray Iron Swing Check Valves, Flanged and Threaded Ends
MSS SP-72	(1999) Ball Valves with Flanged or Butt-Welding Ends for General Service
MSS SP-85	(2002) Cast Iron Globe and Angle Valves Flanged and Threaded Ends

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS FF-S-325	(Int Amd 3) Shield, Expansion; Nail, Expansion; and Nail, Drive Screw (Devices, Anchoring, Masonry)

UNDERWRITERS LABORATORIES (UL)

UL 1479	(2003) UL Standard for Safety Fire Tests of Through-Penetration Fire Stops

1.2 GENERAL REQUIREMENTS

Section 15003 GENERAL MECHANICAL PROVISIONS applies to work specified in this section.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, SUBMITTAL PROCEDURES in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

The following shall be submitted for pipes, valves and specialties showing conformance with the referenced standards contained within this section.

As-Built Drawings
Connection Diagrams
Fabrication Drawings

Installation Drawings shall be submitted for pipes, valves and specialties in accordance with the paragraph entitled, "Pipe Installation," of this section.

SD-03 Product Data

Equipment and performance data shall be submitted for the following items consisting of corrosion resistance, life expectancy, gage tolerances, and grade line analysis.

Manufacturer's catalog data shall be submitted for the following items:

Pipe and Fittings
Piping Specialties
Valves
Miscellaneous Materials
Supporting Elements

Equipment Foundation Data shall be in accordance with paragraph entitled, "General Requirements," of this section.

SD-06 Test Reports

Test reports on the following tests shall be submitted in accordance with paragraph entitled, "Piping Installation," of this section.

Air Tests
System Operation Tests

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals shall be submitted in accordance with paragraph entitled, "Operation and Maintenance," of this section.

PART 2 PRODUCTS

2.1 ELECTRICAL HEAT TRACING

Heat trace systems for pipes, valves, and fittings shall be in accordance with IEEE Std 515 and shall be UL listed. System shall consist of all necessary components, including heaters and controls to prevent freezing.

Self-regulating heaters shall consist of two 16 AWG tinned-copper bus wires embedded in parallel in a self-regulating polymer core that varies its power output to respond to temperature along its length. Heater shall be able to be crossed over itself without overheating and shall be approved before used directly on plastic pipe. Heater shall be covered by a radiation cross-linked modified polyolefin dielectric jacket in accordance with ASTM D 2308.

For installation on plastic piping, the heater shall be applied using aluminum tape. Heater shall have an outer braid of tinned-copper and an outer jacket of modified polyolefin in accordance with ASTM D 2308, to provide a good ground path and to enhance the heater's ruggedness.

Heater shall have a self-regulating factor of at least 90 percent, in order to provide energy conservation and to prevent overheating.

Heater shall operate on line voltages of 120 volts without the use of transformers.

Heater shall be sized according to the following table:

Pipe Size (Inch, Diameter)	Minus 10 degrees F	Minus 20 degrees F
3 inches or less	5 watts per foot (wpf)	5 wpf
4 inch	5 wpf	8 wpf
6 inch	8 wpf	8 wpf
8 inch	2 strips/5 wpf	2 strips/8 wpf
12 inch to 14 inch	2 strips/8 wpf	2 strips/8 wpf

System shall be controlled by an ambient sensing thermostat set at 40 degrees F either directly or through an appropriate contactor.

2.2 PIPE AND FITTINGS

2.2.1 Type GCS, Galvanized Carbon Steel

Pipe (1/2 through 10 inches, and where indicated) shall be Schedule 40 seamless or electric-resistance welded galvanized steel conforming to ASTM A 53/A 53M, Type E, Grade B (electric-resistance welded) or Type S (seamless).

Pipe (12 inches and over) shall be 0.375-inch wall, seamless, galvanized steel, conforming to ASTM A 53/A 53M, Grade B.

Fittings (2 inches and under) shall be 150-psig wsp banded galvanized malleable iron screwed, conforming to ASTM A 197/A 197M and ASME B16.3.

Unions (2 inches and under) shall be 150-psig wsp female, screwed, galvanized malleable iron with brass-to-iron seat and ground joint.

Fittings (2-1/2 inches and over) shall be 125-psig wsp cast-iron flanges and flanged fittings, conforming to ASTM A 126/A 126M, Class A and ASME B16.1.

Grooved pipe couplings and fittings shall conform to paragraph entitled, "Grooved Pipe Couplings and Fittings."

Contractor has the option of using 150-psig wsp banded galvanized malleable iron screwed fittings, conforming to ASTM A 197/A 197M and ASME B16.3.

2.3 PIPING SPECIALTIES

2.3.1 Air Separator

Commercially constructed separator shall be designed and certified to separate not less than 80 percent of entrained air on the first passage of water and not less than 80 percent of residual on each successive pass. Shop drawings shall detail piping connections proposed for this work.

Air separator shall be carbon steel, designed, fabricated, tested, and stamped in conformance with ASME BPVC SEC VIII D1 for service pressures not less than 125 psi.

2.3.2 Dielectric Connections

Dissimilar pipe metals shall be electrically insulated from each other by couplings, unions, or flanges commercially manufactured for that purpose and rated for the service pressure and temperature.

2.3.3 Expansion Vibration Isolation Joints

Single or multiple arch-flanged expansion vibration isolation joints shall be constructed of steel-ring reinforced chloroprene-impregnated cloth materials. Joint shall be designed to absorb the movement of the pipe sections in which installed with no detrimental effect on the pipe or connected equipment. Flanges shall be backed with ferrous-metal backing rings. Control rod assemblies shall be provided to restrict joint movement. All nonmetallic exterior surfaces of the joint shall be coated with chlorosulphinated polyethylene. Grommets shall be provided in limit bolt hole to absorb noise transmitted through the bolts.

Joints shall be suitable for continuous-duty working temperature of at least 250 degrees F .

Arches shall be filled with soft chloroprene.

Joint, single-arch, movement limitations and size-related, pressure characteristics shall conform to FSA-0017.

2.3.4 Pressure Gages

Pressure gages shall conform to ANSI B40.1 and to requirements specified herein. Pressure-gage size shall be 3-1/2 inches nominal diameter. Case shall be corrosion-resistant steel, conforming to any of the AISI 300 series of ASTM A 6/A 6M, with an ASM No. 4 standard commercial polish or better. Gages shall be equipped with adjustable red marking pointer and damper-screw adjustment in inlet connection. Service-pressure reading shall be at midpoint of gage range. All gages shall be Grade B or better and be equipped with gage isolators.

2.3.5 Sight-Flow Indicators

Sight-flow indicators for pressure service on 3-inch ips and smaller shall be constructed of bronze with specially treated single- or double-glass sight windows and shall have a bronze, nylon, or tetrafluoroethylene rotating flow indicator mounted on an AISI Type 304 corrosion-resistant steel shaft. Body may have screwed or flanged end. Assembly shall be pressure- and temperature-rated for the applied service. Flapper flow-type indicators are not acceptable.

2.3.6 Sleeve Couplings

Sleeve couplings for plain-end pipe shall consist of one steel middle ring, two steel followers, two chloroprene or Buna-N elastomer gaskets, and the necessary steel bolts and nuts.

2.3.7 Thermometers

Thermometers shall conform to ASTM E 1, except for being filled with a red organic liquid. Thermometers shall be an industrial pattern armored glass model, (well-threaded and seal-welded). Thermometers installed 6 feet or higher above the floor shall have an adjustable angle body. Scale shall be not less than 4 inches long. Case face shall be manufactured from manufacturer's standard polished aluminum or AISI 300 series polished corrosion-resistant steel. Thermometer range shall be as specified. Thermometers shall be provided with nonferrous separable wells. Lagging extension to accommodate insulation thickness shall be provided.

2.4 VALVES

2.4.1 Ball and Butterfly Valves

Ball valves shall conform to MSS SP-72 for Figure [1A], 1 piece body [1B], vertically split body [1C], top entry [1D], three piece body and shall be rated for service at not less than 175 psig at 200 degrees F. Valve bodies in sizes 2 inches and smaller shall be screwed-end connection-type constructed of Class A copper alloy. Valve bodies in sizes 2-1/2 inches and larger shall be flanged-end connection type, constructed of Class [D] [E] [F] material. Balls and stems of valves 2 inches and smaller shall be manufacturer's standard with hard chrome plating finish. Balls and stems of valves 2-1/2 inches and larger shall be manufacturer's standard Class C corrosion-resistant steel alloy with hard chrome plating. Balls of valves 6 inches and larger may be Class D with 900 Brinell hard chrome plating. Valves shall be suitable for flow from either direction and shall seal equally tight in either direction. Valves with ball seals held in place by spring washers are not acceptable. All valves shall have adjustable packing glands. Seats and seals shall be tetrafluoroethylene.

Butterfly valves shall conform to MSS SP-67. Valves shall be wafer type for mounting between specified flanges and shall be rated for 150-psig shutoff and nonshock working pressure. Bodies shall be cast ferrous metal conforming to ASTM A 126/A 126M, Class B, and to ASME B16.1 for body wall thickness. Seats and seals shall be of the resilient elastomer type designed for field removal and replacement.

2.4.2 Drain, Vent, and Gage Cocks

Drain, vent, and gage cocks shall be lever handle, ground key type, with washer and screw, constructed of polished ASTM B 62 bronze, and rated 125-psi wsp. End connections shall be rated for specified service pressure.

Pump vent cocks, and where spray control is required, shall be UL umbrella-hood type, constructed of manufacturer's standard polished brass. Cocks shall be 1/2-inch ips male, end threaded, and rated at not less than 125 psi at 225 degrees F.

2.4.3 Gate Valves (GAV)

Gate valves 2 inches and smaller shall conform to MSS SP-72. Valves located in tunnels, equipment rooms, factory-assembled equipment, and where indicated shall be union-ring bonnet, screwed-end type. Packing shall be made of non-asbestos type materials. Valves shall be rising stem type.

Gate valves 2-1/2 inches and larger, shall be Type I, (solid wedge disc, tapered seats, steam rated); Class 125 (125-psig steam-working pressure at 353 degrees F saturation); and 200-psig, wog (nonshock), conforming to MSS SP-70 and to requirements specified herein. Valves shall be flanged, with bronze trim and outside screw and yoke (OS&Y) construction. Packing shall be made of non-asbestos type materials.

2.4.4 Globe and Angle Valves (GLV-ANV)

Globe and angle valves 2 inches and smaller, shall be 125-pound, 125-psi conforming to MSS SP-85 and to requirements specified herein. Valves located in tunnels, equipment rooms, factory-assembled equipment, and where indicated shall be union-ring bonnet, screwed-end type. Disc shall be free to swivel on the stem in all valve sizes. Composition seating-surface disc construction may be substituted for all metal-disc construction. Packing shall be made of non-asbestos type materials. Disk and packing shall be suitable for pipe service installed.

Globe and angle valves 2-1/2 inches and larger, shall be cast iron with bronze trim. Valve bodies shall be cast iron conforming to ASTM A 126/A 126M, Class A, as specified for Class 1 valves under MSS SP-70. Valve ends shall be flanged in conformance with ASME B16.1. Valve construction shall be outside screw and yoke (OS&Y) type. Packing shall be made of non-asbestos type materials.

2.4.5 Standard Check Valves (SCV)

Standard check valves in sizes 2 inches and smaller shall be 125-psi swing check conforming to MSS SP-71, except as otherwise specified. Lift checks shall be provided where indicated. Swing-check pins shall be nonferrous and suitably hard for the service. Discs shall be composition type. Swing-check angle of closure shall be manufacturer's standard unless a specific angle is needed.

Check valves in sizes 2-1/2 inches and larger shall be cast iron, bronze trim, swing type. Valve bodies shall be cast iron, conforming to ASTM A 126/A 126M, Class A. Valve ends shall be flanged in conformance with ASME B16.1. Swing-check pin shall be AISI Type 304 or approved equal corrosion-resistant steel. Angle of closure shall be manufacturer's standard unless a specific angle is needed. Valves shall have bolted and gasketed covers.

Check valves shall be provided with external spring-loaded or lever-weighted, positive-closure devices and valve ends shall be mechanical joint, push-on, or flanged.

2.5 MISCELLANEOUS MATERIALS

2.5.1 Bolting

Flange and general purpose bolting shall be hex-head and shall conform to ASTM A 307, Grade B (bolts, for flanged joints in piping systems where one or both flanges are cast iron). Heavy hex-nuts shall conform to ASTM A 563. Square-head bolts and nuts are not acceptable. Threads shall be coarse-thread series.

2.5.2 Elastomer Calk

Polysulfide- or polyurethane-base elastomer calking material shall be two-component type, conforming to ASTM C 920.

2.5.3 Flange Gaskets

Compressed non-asbestos sheet, conforming to ASTM F 104, coated on both sides with graphite or similar lubricant, with nitrile composition, binder rated to 750 degrees F.

2.5.4 Grout

Shrink-resistant grout shall be a premixed and packaged metallic-aggregate, mortar-grouting compound conforming to ASTM C 404 and ASTM C 476.

Shrink-resistant grout shall be a combination of premeasured and packaged epoxy polyamide or amine resins and selected aggregate mortar grouting compound conforming to the following requirements:

Tensile strength		1,900 psi, minimum
Compressive strength	ASTM C 109/C 109M	14,000 psi, minimum
Shrinkage, linear		0.00012 inch per inch, maximum
Water absorption	ASTM C 67	0.1 percent, maximum
Bond strength to steel in shear minimum		1,000 psi, minimum

2.5.5 Pipe Thread Compounds

Tetrafluoroethylene tape not less than 2 to 3 mils thick shall be used in potable and process water and in chemical systems for pipe sizes to and including 1-inch ips. Tetrafluoroethylene dispersions and other suitable compounds may be used for all other applications upon approval by the Contracting Officer; however, no lead-containing compounds may be used in potable water systems.

2.6 SUPPORTING ELEMENTS

All necessary piping systems and equipment supporting elements shall be provided, including but not limited to: building structure attachments; supplementary steel; hanger rods, stanchions, and fixtures; vertical pipe attachments; horizontal pipe attachments; anchors; guides; and spring-cushion, variable, or constant supports. All supporting elements shall be suitable for stresses imposed by systems pressures and temperatures and natural and other external forces normal to this facility without damage to supporting element system or to work being supported.

Supporting elements shall conform to requirements of ASME B31.3, FS FF-S-325, MSS SP-58, and MSS SP-69 except as noted.

Attachments welded to pipe shall be made of materials identical to that of pipe or materials accepted as permissible raw materials by referenced code or standard specification.

Supporting elements exposed to weather shall be hot-dip galvanized or stainless steel. Materials shall be of such a nature that their apparent and latent-strength characteristics are not reduced due to galvanizing process. Supporting elements in contact with copper tubing shall be electroplated with copper.

Type designations specified herein are based on MSS SP-58 and MSS SP-69. Masonry anchor group-, type-, and style-combination designations shall be in accordance with FS FF-S-325. Support elements, except for supplementary steel, shall be cataloged, load rated, commercially manufactured products.

2.6.1 Building Structure Attachments

2.6.1.1 Anchor Devices, Concrete

Anchor devices shall conform to FS FF-S-325 for the following types:

Group I - shield, expansion (lead, bolt and stud anchors)

Group II - shield, expansion (bolt anchors)

Type 2 - machine bolt expansion shield anchors

Class 2 - open-end expansion shield anchors

Style 1 - single-end expansion shield anchors

Style 2 - double-end expansion shield anchors

Group III - shield, expansion (self-drilling

tubular expansion shell bolt anchors)

Group VIII - anchors, expansion (nondrilling)

Cast-in, floor mounted, equipment anchor devices shall provide adjustable positions.

Powder-actuated anchoring devices shall not be used to support any mechanical systems components.

2.6.2 Horizontal Pipe Attachments

2.6.2.1 Single Pipes

Piping in sizes to and including 2-inch ips shall be supported by MSS SP-58 Type 6 solid malleable iron pipe rings, except that split-band-type rings may be used in sizes up to 1-inch ips.

Piping in sizes through 8-inch ips inclusive shall be supported by MSS SP-58 Type 1 attachments.

Piping in sizes larger than 8-inch ips shall be supported with MSS SP-58 Type 41.

MSS SP-58 Type 40 shields shall be used on all insulated piping. Area of the supporting surface shall be such that compression deformation of insulated surfaces does not occur. Longitudinal and transverse shield edges shall be rolled away from the insulation.

Insulated piping without vapor barrier on roll supports shall be provided with MSS SP-58 Type 39 saddles.

Spring supports shall be as indicated.

2.6.2.2 Parallel Pipes

Trapeze hangers fabricated from structural steel shapes, with U-bolts, shall be used in congested areas and where multiple pipe runs occur.

Structural steel shapes shall conform to supplementary steel requirements.

2.6.3 Vertical Pipe Attachments

Vertical pipe attachments shall be MSS SP-58 Type 8.

Shop drawing data shall include complete fabrication and attachment details of any spring supports.

2.6.4 Hanger Rods and Fixtures

Only circular cross section rod hangers may be used to connect building structure attachments to pipe support devices. Pipe, straps, or bars of equivalent strength shall be used for hangers only where approved by the Contracting Officer.

Turnbuckles, swing eyes, and clevises shall be provided as required by support system to accommodate temperature change, pipe accessibility, and adjustment for load and pitch. Rod couplings are not acceptable.

PART 3 EXECUTION

3.1 PIPE INSTALLATION

Test reports for Air Tests and System Operation Tests shall be provided by the Contractor, in compliance with referenced standards contained within this section.

Piping systems shall be fabricated and installed in accordance with ASME B31.3, MSS SP-69, and AWS WHB-2.8.

Installation Drawings shall be submitted for pipes, valves and specialties. Drawings shall include the manufacturer's design and construction calculations, forces required to obtain rated axial, lateral, or angular movements, installation criteria, anchor and guide requirements for equipment, and equipment room layout and design. Drawing shall specifically advise on procedures to be followed and provisions required to protect expansion joints during specified hydrostatic testing operations.

Final connections to equipment shall be made with flanges. Unions shall be provided in the line downstream of screwed- and welded-end valves.

All pipe ends shall be reamed before joint connections are made.

Screwed joints shall be made up with specified joint compound and not more than three threads shall show after joint is made up.

Joint compounds shall be applied to the male thread only and care shall be exercised to prevent compound from reaching the unthreaded interior of the pipe.

Screwed unions, welded unions, or bolted flanges shall be provided wherever required to permit convenient removal of equipment, valves, and piping accessories from the piping system for maintenance.

Piping systems shall be securely supported with due allowance for thrust forces, thermal expansion and contraction, and shall not be subjected to mechanical, chemical, vibrational or other damage as specified in ASME B31.3.

Field welded joints shall conform to the requirements of the AWS WHB-2.8, ASME B31.3, and ASME BPVC SEC IX.

All necessary precautions shall be taken during installation of flexible pipe and hose including flushing and purging with water, steam, and compressed air to preclude bellows failure due to pipe line debris lodged in bellows. Installation shall conform to manufacturer's instructions.

3.2 VALVES

Valves shall be provided in piping mains and all branches and at equipment where indicated and as specified.

Valves shall be provided to permit isolation of branch piping and each equipment item from the balance of the system.

Riser and downcomer drains above piping shutoff valves in piping 2-1/2 inches and larger shall be provided. Shutoff valve body shall be tapped and fitted with a 1/2-inch plugged globe valve.

Valves unavoidably located in furred or other normally inaccessible places shall be provided with access panels adequately sized for the location and located so that concealed items may be serviced, maintained, or replaced.

3.3 SUPPORTING ELEMENTS INSTALLATION

Supporting elements shall be provided in accordance with the referenced codes and standards.

Piping shall be supported from building structure. No piping shall be supported from roof deck or from other pipe.

Piping shall run parallel with the lines of the building. Piping and components shall be spaced and installed so that a threaded pipe fitting may be removed between adjacent pipes and so that there shall be no less than 1/2 inch of clear space between the finished surface and other work and between the finished surface of parallel adjacent piping. Hangers on different adjacent service lines running parallel with each other shall be arranged to be in line with each other and parallel to the lines of the building.

Piping support elements shall be installed at intervals specified hereinafter, at locations not more than 3 feet from the ends of each runout, and not over 1 foot from each change in direction of piping.

Load rating for all pipe-hanger supports shall be based on insulated weight of lines filled with water and forces imposed. Deflection per span shall not exceed slope gradient of pipe. Supports shall be in accordance with the following minimum rod size and maximum allowable hanger spacing for specified pipe. For concentrated loads such as valves, the allowable span shall be reduced proportionately:

PIPE SIZE INCHES	ROD SIZE INCHES	STEEL PIPE FEET	COPPER PIPE FEET
1 and smaller	3/8	8	6
1-1/4 to 1-1/2	3/8	10	8

PIPE SIZE INCHES	ROD SIZE INCHES	STEEL PIPE FEET	COPPER PIPE FEET
2	3/8	10	8
2-1/2 to 3-1/2	1/2	12	12
4 to 5	5/8	16	14
6	3/4	16	16
8 to 12	7/8	20	20
14 to 18	1	20	20
20 and over	1-1/4	20	20

Vibration isolation supports shall be provided where needed.

Vertical risers shall be supported independently of connected horizontal piping, whenever practicable, with fixed or spring supports at the base and at intervals to accommodate system range of thermal conditions. Risers shall be guided for lateral stability. For risers subject to expansion, only one rigid support shall be provided at a point approximately one-third down from the top. Clamps shall be placed under fittings unless otherwise specified. Carbon-steel pipe shall be supported at each floor and at not more than 15-foot intervals for pipe 2 inches and smaller and at not more than 20-footintervals for pipe 2-1/2 inches and larger.

3.4 SLEEVES

Sleeves shall be provided where piping passes through roofs, masonry, concrete walls and floors.

Sleeves passing through steel decks shall be continuously welded to the deck.

Sleeves that extend through floors, roofs, load bearing walls, and fire barriers shall be continuous and fabricated from Schedule 40 steel pipe, with welded anchor lugs. All other sleeves shall be formed by molded linear polyethylene liners or similar materials that are removable. Diameter of sleeves shall be large enough to accommodate pipe, insulation, and jacketing without touching the sleeve and shall provide a minimum 3/8-inch clearance. Sleeve size shall accommodate mechanical and thermal motion of pipe to preclude transmission of vibration to walls and the generation of noise.

Space between a pipe, bare or insulated, and the inside of a pipe sleeve or a construction surface penetration shall be packed solid with a mineral fiber conforming to ASTM C 553 Type V (flexible blanket), (to 1,000 degrees F). This packing shall be provided wherever the piping passes through firewalls, equipment room walls, floors, and ceilings connected to occupied spaces, and other locations where sleeves or construction-surface penetrations occur between occupied spaces. Where sleeves or construction surface penetrations occur between conditioned and unconditioned spaces, the space between a pipe, bare or insulated, and the inside of a pipe sleeve or construction surface penetration shall be filled with an elastomer calk to a depth of 1/2 inch. All surfaces to be calked shall be oil- and grease-free.

Through-Penetration fire stop materials and methods shall be in accordance with ASTM E 814 and UL 1479.

Exterior wall sleeves shall be calked watertight with lead and oakum or mechanically expandable chloroprene inserts with mastic-sealed metal components.

3.5 FLASHINGS

Flashings shall be provided at penetrations of building boundaries by mechanical systems and related work.

3.6 UNDERGROUND PIPING INSTALLATION

Prior to being lowered into a trench, all piping shall be cleaned, visually inspected for apparent defects, and tapped with a hammer to audibly detect hidden defects.

Changes in direction shall be made with long sweep fittings.

Necessary socket clamping, piers, bases, anchors, and thrust blocking shall be provided. Rods, clamps, and bolting shall be protected with a coating of bitumen.

On excavations that occur near and below building footings, the backfilling material shall consist of 2,000-psi cured compressive-strength concrete poured or pressure-grouted up to the level of the footing.

Vertical vent stacks; water risers; and similar work shall be properly supported on approved piers at the base and provided with approved structural supports attached to building construction.

3.7 HEAT TRACE CABLE INSTALLATION

Heater tape shall be field applied and cut to fit as necessary, linearly along the length of pipe after piping has been pressure tested and approved by the Engineer. Secure the heater to piping with fiberglass tape or cable ties. Thermal insulation shall be labeled on the outside, "Electrical Heat Trace."

Power connection, end seals, splice kits and tee kit components shall be installed in accordance with IEEE Std 515 to provide a complete workable system. Connection to the thermostat and ends of the heat tape shall be terminated in a junction box. Cable and conduit connections shall be raintight.

3.8 OPERATION AND MAINTENANCE

Operation and Maintenance Manuals shall be consistent with manufacturer's standard brochures, schematics, printed instructions, general operating procedures and safety precautions. Test data shall be clear and readily legible.

-- End of Section --

SECTION 15107

PLASTIC PIPE AND FITTINGS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

ASTM INTERNATIONAL (ASTM)

ASTM D 1784	(2003) Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
ASTM D 1785	(2003) Standard Specification for Poly (Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2464	(1999) Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2466	(2002) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2467	(2002) Standard Specification for Socket-Type Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2564	(2002) Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 2855	(1996; R 2002) Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings

1.2 GENERAL REQUIREMENTS

Section 15003 GENERAL MECHANICAL PROVISIONS applies to work specified in this section.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES in sufficient detail to show full compliance with the specification:

SD-03 Product Data

Manufacturer's Catalog Data shall be submitted in accordance with paragraph entitled, "General Requirements," of this section.

1.4 GENERAL REQUIREMENTS

Manufacturer's Catalog Data shall be submitted for plastic pipe and fittings, for each size and type.

PART 2 PRODUCTS

2.1 POLYVINYLCHLORIDE (PVC) PIPE

PVC pipe shall be in accordance with ASTM D 1785.

2.1.1 Schedule Pipe (PVC)

Pipe shall be Schedule 40 and 80 as specified.

Material shall be PVC Class 12454-B in accordance with ASTM D 1784.

2.1.2 Fittings (PVC)

2.1.2.1 Socket-Type, Schedule 40

Material shall be PVC in accordance with ASTM D 2466.

2.1.2.2 Socket-Type, Schedule 80

Material shall be PVC in accordance with ASTM D 2467.

2.1.2.3 Threaded, Schedule 80

Material shall be PVC in accordance with ASTM D 2464.

2.1.3 Cement and Lubricant

Solvent cement for pipe and fittings shall be in accordance with ASTM D 2564. Thread lubricant shall be in accordance with the pipe manufacturer's recommendations.

PART 3 EXECUTION

3.1 PIPE LAYOUT

Installation shall present a neat, orderly appearance. Openings or passageways shall not be blocked.

Piping shall be parallel to exterior walls of building.

3.2 INSTALLATION

Plastic piping shall be installed in accordance with the manufacturer's installation instructions.

3.2.1 Vertical Piping

All PVC piping shall be supported at intervals of not more than 4 feet.

Piping shall be secured at sufficiently close intervals to keep pipe in alignment and to support weight of pipe and contents.

Supports shall be installed at each floor.

Piping shall be secured in position by approved stakes or braces when piping is to stand free, or when no structural element is available for providing stability during construction.

3.2.2 Horizontal Piping, Suspended

All piping shall be supported at intervals in accordance with the manufacturer's instructions and in no case not more than 3 feet.

Hangers shall be installed at ends of runs or branches and at each change of direction or alignment.

3.2.3 Horizontal Piping, Underground

Piping shall be laid on a firm bed for the entire trench length, except where otherwise supported.

Partial backfilling and cradling shall be employed to secure piping during backfilling operations.

Piping laid on grade shall be firmly braced prior to embedment in concrete.

3.2.4 Cutting

Cuts shall be made square with pipe and burrs shall be removed by smoothing edges.

3.2.5 Joints

Joints shall be solvent cemented in accordance with ASTM D 2855.

Junction with other materials shall be the type of adapter and technique as recommended by the pipe manufacturer.

-- End of Section --

SECTION 16003

GENERAL ELECTRICAL PROVISIONS
06/04

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z535.1	(2002) Safety Color Code

ASTM INTERNATIONAL (ASTM)

ASTM A 123/A 123M	(2002) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2002) National Electrical Safety Code

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2002) National Electrical Code

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS A-A-59214	(2004) Junction Box: Extension, Junction Box; Cover, Junction Box (Steel, Coated With Corrosion-Resistant Finish)

UNDERWRITERS LABORATORIES (UL)

UL Elec Const Dir	(2003) Electrical Construction Equipment Directory

1.2 SUBMITTALS

Not Used

1.3 INTERPRETATION OF DRAWINGS AND SPECIFICATIONS

It is the intent of these specifications and the contract drawings to provide a complete and workable remediation system and building.

Contractor to provide design drawings for the building and motor control electrical service.

Except where shown in dimensional detail, the locations of switches, receptacles, lights, motors, outlets, and other equipment shown on plans are approximate. Such items shall be placed to eliminate interference with piping and equipment. Exact locations shall be determined in the field. Door swings shall be verified to ensure that light switches are properly located.

Equipment sizes indicated are minimum. Before installing any wire or conduit, the Contractor shall obtain the exact equipment requirements and shall install wire, conduit, disconnect switches, motor starters, heaters, circuit breakers, and other items of the correct size for the equipment actually installed. Wire and conduit sizes shown on the drawings shall be taken as a minimum and shall not be reduced without written approval.

1.4 CODES AND STANDARDS

Equipment design, fabrication, testing, performance, and installation shall, unless shown or specified otherwise, comply with the applicable requirements of NFPA 70 and IEEE C2 to the extent indicated by the references.

1.5 COORDINATION

Installation of the electrical work shall be coordinated with the work of other trades.

1.6 APPROVAL REQUIREMENTS

Where materials and equipment are specified to conform to the standards of the Underwriters Laboratories (UL), Inc., the label of, or listing with re-examination, in UL Elec Const Dir will be acceptable as sufficient evidence that the items conform to the requirements.

Where materials or equipment are specified to be constructed or tested in accordance with the standards of NEMA, ANSI, ASTM, or other recognized standards, a manufacturer's certificate of compliance indicating complete compliance of each item with the applicable NEMA, ANSI, ASTM, or other commercial standards specified will be acceptable as proof of compliance.

1.7 PREVENTION OF CORROSION

Metallic materials shall be protected against corrosion. Equipment enclosures shall be given a rust-inhibiting treatment and the standard finish by the manufacturer when used for most indoor installations. Aluminum shall not be used in contact with earth or concrete. Dissimilar metals in intimate contact shall be protected by approved fittings, barrier material, and treatment. Ferrous metals such as anchors, bolts, braces, boxes, bodies, clamps, fittings, guards, nuts, pins, rods, shims, thimbles, washers, and miscellaneous parts not of corrosion-resistant steel or nonferrous materials shall be hot-dip galvanized in accordance with ASTM A 123/A 123M for exterior locations and cadmium-plated in conformance with FS A-A-59214 for interior locations.

1.8 HAZARDOUS AREA

Electrical work is not expected within any hazardous locations.

PART 2 PRODUCTS

2.1 IDENTIFICATION PLATES

Identification plates shall be 2-layer black-white, engraved to show black letters on a white background. Letters shall be uppercase. Identification plates 1-1/2 inches high and smaller shall be 1/16-inch thick with engraved lettering 1/8-inch high. Identification plates larger than 1-1/2 inches high shall be 1/8-inch thick with engraved lettering not less than 3/16-inch high. Identification plates having edges of 1-1/2 inches high and larger shall be beveled.

2.2 WARNING SIGNS

Each item of electrical equipment operating at 480 volts and above shall be provided with conspicuously located warning signs conforming to the requirements of Occupational Safety and Health Agency (OSHA) standards.

Any equipment with externally powered wiring shall be marked with a laminated plastic nameplate having 3/16-inch high white letters on a red background as follows:

DANGER - EXTERNAL VOLTAGE SOURCE

Safety color coding for identification of warning signs shall conform to ANSI Z535.1.

2.3 ANCHOR BOLTS

Anchor bolts shall be provided for equipment placed on concrete equipment pads or slabs.

2.4 SEISMIC ANCHORAGE

Electrical equipment, except communications, emergency, and standby equipment, shall be anchored to withstand a lateral force of 0.3 times the weight of the equipment.

Communications, emergency, and standby equipment shall be anchored to withstand a lateral force of 0.6 times the weight of the equipment.

The following standard anchoring should be adequate for equipment not classified as communications, emergency, or standby:

Dry transformers - floor-mounted with four anchor bolts

		BOLT DIAMETER
Under 150 kVA	-	3/8
150 to 500 kVA	-	1/2
Over 500 kVA	-	5/8

Panels - floor-mounted with four 1/2-inch diameter anchor bolts

PART 3 EXECUTION

3.1 INSTALLATION

Installation shall be accomplished by workers skilled in this type of work. Installation shall be made so that there is no degradation of the designed fire ratings of walls, partitions, ceilings, and floors. Except as otherwise indicated, emergency switches and alarms shall be installed in conspicuous locations.

3.2 PAINTING APPLICATION

Exposed conduit, supports, fittings, cabinets, pull boxes, and racks, if not factory painted, shall be thoroughly cleaned and painted. Work shall be left in a neat and clean condition at final completion of the contract.

3.3 IDENTIFICATION PLATE INSTALLATION

Identification plates shall be fastened by means of corrosion-resistant steel or nonferrous metal screws. Hand lettering, marking, or embossed self-adhesive tapes are not acceptable.

3.4 EQUIPMENT PADS

Equipment pads shall be constructed with a minimum 4-inch margin around the equipment and supports.

3.5 CUTTING AND PATCHING

Contractor shall install his work in such a manner and at such time as will require a minimum of cutting and patching on the building structure.

Holes in or through existing masonry walls and floors in exposed locations shall be drilled and smoothed by sanding. Use of a jackhammer will be permitted only where specifically approved.

3.6 DAMAGE TO WORK

Required repairs and replacement of damaged work shall be done as directed by and subject to the approval of the Contracting Officer, and at no additional cost to the Government.

3.7 CLEANING

Exposed surfaces of wireways, conduit systems, and equipment that have become covered with dirt, plaster, or other material during handling and construction shall be thoroughly cleaned before such surfaces are prepared for final finish or painting or are enclosed within the building structure.

Before final acceptance, electrical equipment, including lighting fixtures and glass, shall be clean and free from dirt, grease, and fingermarks.

3.8 FIELD TESTING AND TEST EQUIPMENT

All Field testing specified in Divisions 16 electrical specification shall be made with test equipment specially designed and calibrated for the purpose. Test equipment used shall be calibrated and certified by an approved testing laboratory. Date of last calibration and certification shall not be more than 90 calendar days old at the time of field testing.

-- End of Section --

Appendix C

Design Calculations for Dual-Phase Extraction

DESIGN CALCULATIONS FOR MULTI PHASE EXTRACTION

The following parameters from the Pre-RD Sampling Summary Report (LFR 2004) for the shallow zone were used in the engineering calculations:

K = hydraulic conductivity; 0.3 ft/day or 2.2 gpd/ft^2
B = saturated thickness; 10 feet
T = transmissivity; 30 gpd/ft
i = groundwater gradient; 0.005 ft/ft
n = porosity; 0.1

ESTIMATE GROUNDWATER EXTRACTION RATE

1. Estimate the volume of groundwater to be extracted assuming a plume area on-site of 60,000 ft^2. The aquifer's total porosity is assumed to be 0.10 based upon site lithology and the thickness of affected groundwater is 10 feet. Therefore, the volume of affected groundwater is estimated to be 448,800 gallons.

2. Estimate pumping rate for one single extraction well to capture 250 feet of the plume at the down gradient edge of the plume using the Javendel and Tsang equation (Fetter 1999) as follows:

$$Q = 2 \cdot Y_L \cdot k \cdot B \cdot i$$

where:
Q = Pumping rate (ft^3/day)
Y_L = Plume width (feet)
k = hydraulic conductivity (ft/day)
B = saturated thickness (ft)
i = hydraulic gradient

It is assumed that the extraction wells will fully penetrate the shallow aquifer to a total depth of 15 feet below ground surface. The extraction wells will be screened from 2 to 15 feet below ground surface. Based upon a maximum plume width of 250 feet, hydraulic conductivity of 0.3 ft/day, saturated thickness of 10 ft, and groundwater gradient of 0.005, the minimum pumping rate would need to be 0.04 gpm to capture a 250 ft wide plume. However, the pump test did not demonstrate a radius of influence beyond 20 feet from the extraction well during a short pumping interval. Therefore, a theoretical radius of influence for a single well after 30-days of pumping is estimated to be 45 feet as follows:

$$R_0 = r_s + \sqrt{\frac{Tt}{4790C_s}}$$

where:

R_0 = radius of influence (ft)
r_s = well radius (feet)
T = Transmissivity (gpd/ft^2)
t = time (min)
C_s = storativity coefficinet (0.1)

Assuming that each well will have a radius of influence of 45 feet was used to estimate the hydraulic capture zone of the system.

3. To expedite remediation and expose the vadose zone to vapor extraction, the maximum extraction rate to achieve the desired drawdown of 7 feet at each well after 7 days of pumping given a wet season saturated thickness equal to 10 ft and hydraulic conductivity of 0.3 ft/day (22.4 gpd/ft^2) is estimated using the Cooper-Jacobs straight line method as follows:

$$s = \frac{264Q}{T}\log\left[\frac{0.3Tt}{r^2S}\right]$$

where:
s = drawdown (ft)
Q = pumping rate (gpm)
T = transmissivity (gpd/ft)
r = well radius; 0.17 ft
S = strorativity; 0.1
t = time; 7 days

Solving for Q at a 7 feet of drawdown at the extraction well indicates a required pumping rate of 0.14 gpm. The pump test indicated that shallow zone had a specific capacity of 0.066 gpm/ft of drawdown; therefore, the pumping rate required would be 0.5 gpm. Based upon an evaluation between the two pumping rates, 0.5 gpm per well will be used for design.

4. The downstream stagnation point at a pumping rate of 0.5 gpm is estimated to be over 1,000 feet as follows:

$$SP = \frac{Q}{2\pi Bki}\times 1440$$

where:
SP = Stagnation Point; (ft)
Q = pumping rate; (gpm)
B = saturated thickness; 10 ft
k = hydraulic conductivity, 2.2 gpd/ft^2
i = groundwater gradient, 0.005
1440 = conversion factor; gpm to gpd

A more conservative stagnation point of 45-feet beyond the most down gradient extraction well was used to show the capture zone. The capture zone of the system will be monitored and confirmed after system start-up.

5. Estimate the time to remediate the groundwater assuming PCE has a retardation factor of 10. Use a safety factor of 10 to account for inefficiencies and maintenance down time.

$$t = \frac{VR}{Q} \times SF \times 6.94 \times 10^{-4}$$

where:
t = time (days)
V = volume of affected groundwater; 448,000 gal
Q = extraction rate; 16 wells x 0.5 gpm = 8 gpm
R = retardation factor; 10
SF = safety factor; 10

The estimated time to remediate the affected groundwater via groundwater extraction only is over 10 years assuming no NAPL.

DETERMINE REQUIRED VACUUM

Each extraction well will be connected to a manifold at the pump by 2-inch diameter Sch 40 PVC. Water will need to be raised 15 feet from the depressed water table to the surface. The furthest extraction well from the treatment building will be 420 feet.

1. Estimate head loss across piping.

Static Head = 12 ft + 8 ft (height of air/water separator) = 20 ft

Calculate equivalent feet of piping for valves and fittings:

No. of Fittings	Fitting	Equivalent ft per fitting	Total Equivalent (ft)
7	90 Elbow	7.4	52
1	Ball Valves	1.2	1.2

The total length of piping is equal to 420 + 52 + 1.2 = 473 ft

Total head loss is estimated as follows:

$$h_T = StaticHead + f\,\frac{L}{D}\frac{V^2}{2g}$$

where:
V = velocity (ft/s)
f = friction factor; 0.015
D = pipe diameter (ft)
g = acceleration due *to* gravity (ft/s^2)

Using 2-inch diameter SCH 40 PVC at 0.5 gpm (0.05 ft/s), a head loss of 20 ft was estimated. Therefore, the extraction pump will be required to provide a minimum of 18 inches of mercury.

Appendix D

Vapor-Extraction System Design Calculation

Project No.: 004-03445-05
Date: January 12, 2005
Computed By: AYS
Checked By: AYS

Project: Monarch Chemical – Utica, NY

Subject: VE Design Calculations

Vapor Extraction System Design

The SVE flow rate calculations are based on Johnson, et al., 1990 equation as follows:

$$Q = \pi H \left[\frac{P_w k \left(1 - \left(\frac{P_{atm}}{P_W} \right)^2 \right)}{u \left[\ln \left(\frac{R_W}{R_I} \right) \right]} \right]$$

The parameters in this equation are as follows:

Q = volumetric flow rate of air per extraction well. (standard cubic feet per second (scfs))

H = the well screen height. (ft); H = 10 ft

u = absolute viscocity of air. (lbs-second per square foot); $u = 4x10^{-7}$

P_{atm} = atmospheric air pressure. (lbs/ft^2); P_{atm} = 2,117

P_W = pressure at the extraction well. (lbs/ft^2); $P_W = P_{atm}$ – vac = 1127

P_W is based on an estimated 14 inches of mercury vacuum at the extraction well

R_i = estimated radius of influence. (ft); R_I = 40

R_W = effective radius of the extraction well. (ft); R_W = 3/12

R_W in this estimate includes the radius of the well plus the filter pack = 3 inches

k = soil intrinsic permeability. (ft^2) Calculated as follows:

K_W = hydraulic conductivity. (ft/sec); $K_W = 3.5 \text{ x } 10^{-6}$

K_W is based on a hydraulic conductivity of 0.3 ft/d

U = absolute viscocity of water. (lbs-sec/ft^2); $U = 2.1x10^{-5}$

G_W = unit weight of water. (lbs/ft^3); G_W = 62.4

$$k = K_W \frac{U}{G_W}$$

$k = 1.2 \text{ x } 10^{-12}$ ft^2 or

$k = 1.1 \text{ x } 10^{-9}$ cm^2

However, the pilot test data indicated $k = 3.3 \times 10^{-10}$ ft^2. Because the flow rate was most likely exaggerated because of the lack of a surface seal, the actual intrinsic permeability likely falls between the observed pilot test data and estimated value using the hydraulic conductivity. Therefore, an assumed $k = 1.7 \times 10^{-11}$ ft^2

Q = 1.2 scfs or 72 standard cubic feet per minute

Assuming a safety factor of 1.1, the design flow rate per well will be 80 scfm.

Vacuum head loss calculation is as follows:

It is estimated that the VE flow rate will be 80 scfm per well and that each well will be manifolded individually. The longest length of 2-inch conveyance piping carrying 80 scfm will be approximately 420 feet. There will be 7 90-degree elbows in this line. Based upon the friction nomograph on the next page, the equivalent length of piping is approximately 435 feet of two-inch piping. At a flow rate of 80 scfm, the friction loss is 0.125 inches-water per foot of piping (see nomograph). This gives a vacuum loss of approximately 54-inches of water (4-inches mercury) vacuum column. In addition, it is estimated that there will be approximately 10-inches water vacuum loss across the moisture separator and the flow meter. Therefore, the total vacuum required by the MPE blower is 14-inches of mercury at the well head plus 5-inches of mercury for headloss. Therefore, the pump must be capable of a minimum 19-inches of mercury vacuum to handle the vapors.

Determine activated carbon usage

From Carbtrol, the adsorption capacity of granular activated carbon (GAC), q, is 0.35 lbs of PCE/lbs GAC; however, the adsorption capacity for TCE is approximately 0.2 lbs of TCE/lbs GAC and DCE is 0.1 lbs DCE/lbs GAC. Therefore it is assumed that the adsorption capacity for total chlorinated ethenes would be 0.2 lbs/lbs GAC. The amount of chlorinated ethenes that can be retained by 2-3,000 lb cannisters in series before it becomes exhausted is:

> (3,000 lbs/container)(0.2 lbs chlorinated ethenes/lbs GAC) = 600 lbs chlorinated ethenes/container.

The total estimated mass of total chlorinated ethenes is estimated be 1,995 lbs. Therefore the carbon will have to be changed out in each vessels once during the expected operation. The first change-out is expected within two weeks based upon a maximum removal rate of less than 3 lbs/hr.

Estimated Cleanup Time

Assuming that the total 1,995 pounds of chlorinated ethenes is PCE. If we also assume that the initial vapor extraction concentration will 220 ppm based upon pilot test data and the concentration after 180 days of continuous operation will be 1 ppm, then the time to remove 1,995 pounds can be estimated as follows:

$$C = C_0 e^{\lambda t}$$

where:

C = vapor concentration at time t (ppm_v)
C_0 = initial vapor concentration at time t (ppm_v)
λ = first order degradation constant (1/days)
t = time (days)

Solving for λ at time equal 30 days = 0.03 $days^{-1}$. Using this value and substituting it into the following equation with the above condition, the time to remove 1,995 lbs can be estimated.

$$M_{removal} = \eta \cdot Q \cdot 4.6x10^{-7} \cdot C_0 \int_0^t e^{\lambda t}$$

where:

$M_{removal}$ = Mass removed (2,100 lbs)
C_0 = initial vapor concentration at time t (220 ppm_v)
η = efficiency (unitless)
Q = vapor flow rate; 640 scfm
t = time (days)
$4.6x10^{-7}$ = conversion factor from ppm_v to lbs/ft^3

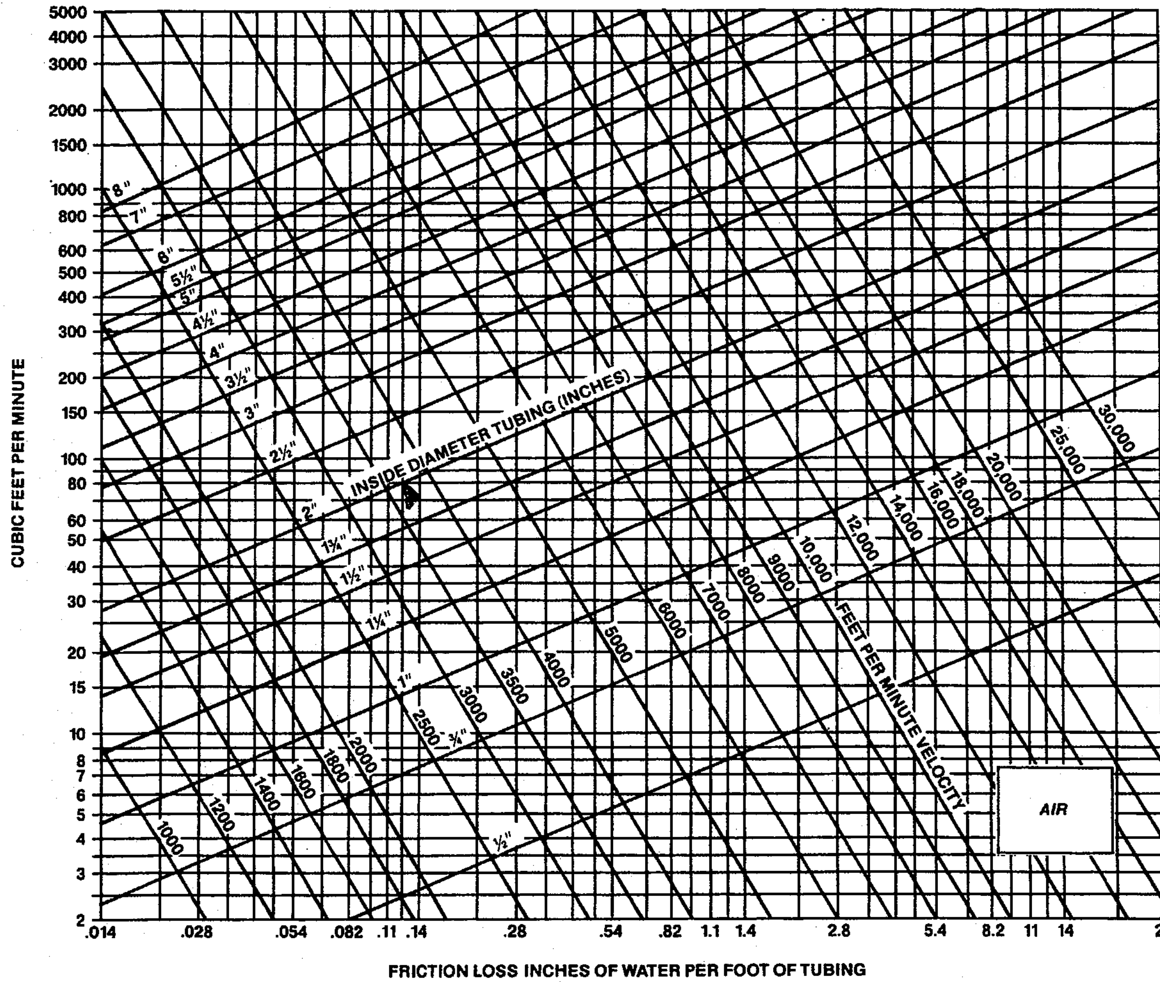
Assuming an efficiency of 10% due to variability in subsurface strata and chlorinated ethene concentrations and a flow rate of 640 scfm, the cumulative mass removal rate may be calculated at time *t* as follows:

$$1{,}995\,\text{lbs} = 0.215 \cdot e^{0.03t}\Big|_0^t$$

The time is estimated to equal 300 days. Including a safety factor of 2 would indicate that the system will operate for 2 years to address the vadose zone.

Application Engineering Basics

Friction Loss Per Foot of Tubing



Friction Loss in Fittings

435 ft × 0.13 in/ft → 56.55 in H_2O

= 4 in Hg

To calculate friction loss in fittings use chart below. This chart will yield equivalent lengths (in feet) of tubing. Use this length with graph above to find friction loss in inches of water column.

NOMINAL PIPE SIZE (INCHES)	EQUIVALENT TUBING LENGTH (FEET)	
	90° EL	45° EL
1 1/4	3	1.5
1 1/2	4	2
2	5	2.5
2 1/2	6	3
3	7	4
4	10	5
5	12	6
6	15	7.5
8	20	10

Rev. 2/01

Appendix E

Liquid-Ring Pump Cut-Sheets

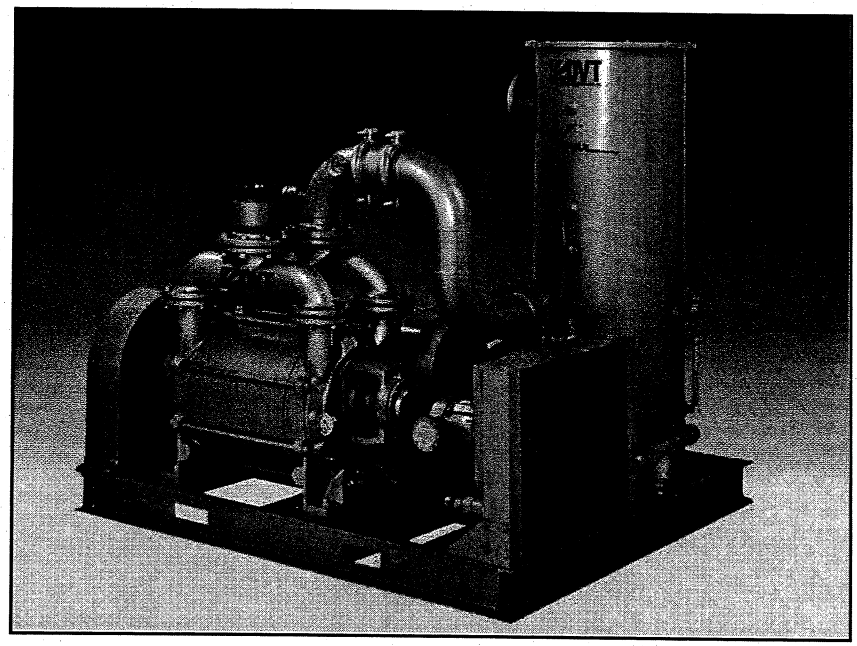
DVT

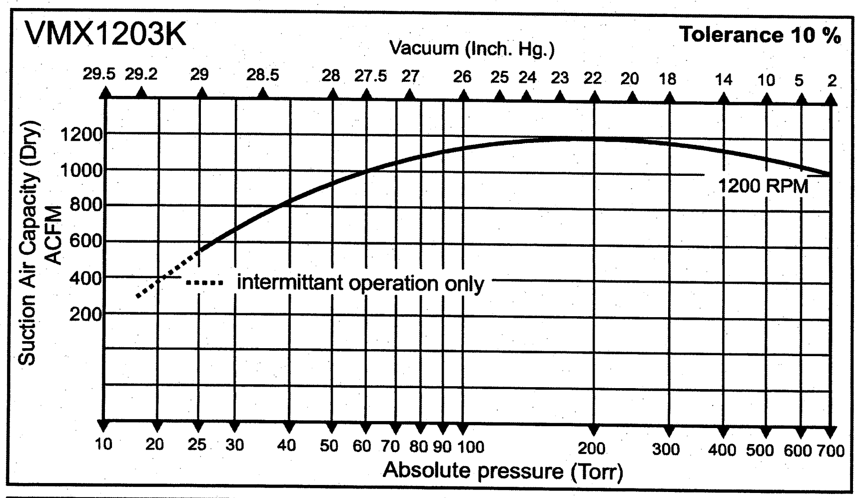
DEKKER VACUUM TECHNOLOGIES, INC.

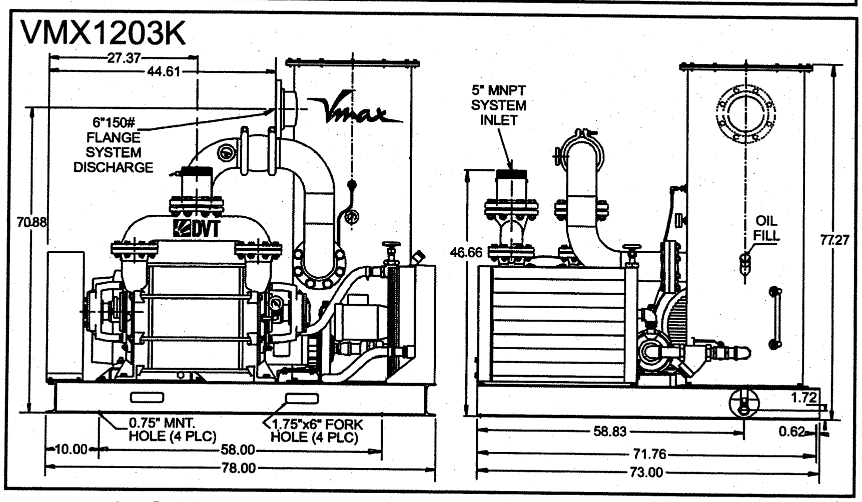
Vmax oil-sealed vacuum pump system VMX1203K

Why more and more customers are switching to the Vmax system:

- The only system on the market with a **full 3-year warranty!**
- New, patented, **high-efficiency DX-5 separator** eliminates oil carry-over concerns.
- Rugged, **high-quality, industrial system**, offering years of **trouble free operation**.
- **Extended-life seal-fluid** is not used as a lubricant. Change interval is not critical, resulting in a minimum of **10,000 hours of continuous operation.**
- **Extremely low operating noise** level makes this system desirable in today's workplace.
- **Continuous operation over the full vacuum range** without overheating.
- **Carry-over** of soft solids and/or minimal amounts of liquid **does not cause damage** to the internal parts of the pump.
- **Electrical control panel** is **standard**.
- **Air-cooled design** is **standard** with water-cooling available at no extra charge.







Performance Characteristics	
Nominal capacity:	1200CFM
Motor:	100HP
Speed:	1200RPM
Maximum vacuum:	29.5"Hg
Weight:	4000 Lbs
Maximum gas inlet temperature:	212°F/100°C
Maximum noise level (at 3 feet):	80dBA
Oil capacity (approximate):	35 GAL

Performance based on atmospheric pressure equal to 29.92"Hg

Information contained in this document is for reference only. Subject to change without notice.

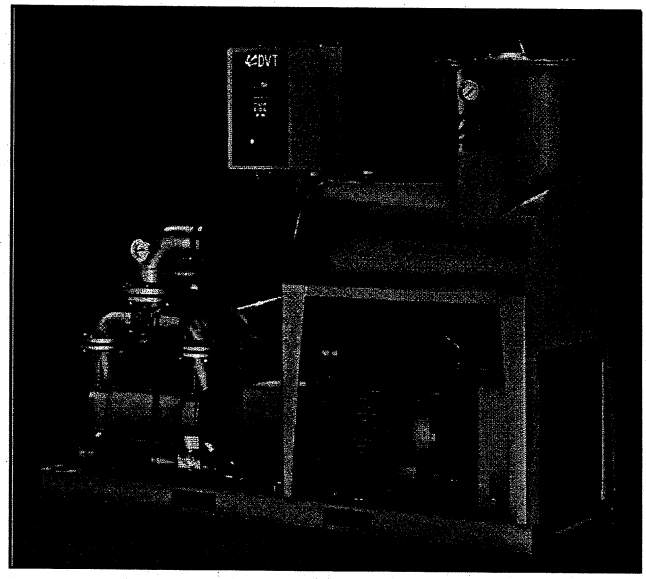
DEKKER
VACUUM TECHNOLOGIES, INC.

VMAX SYSTEMS

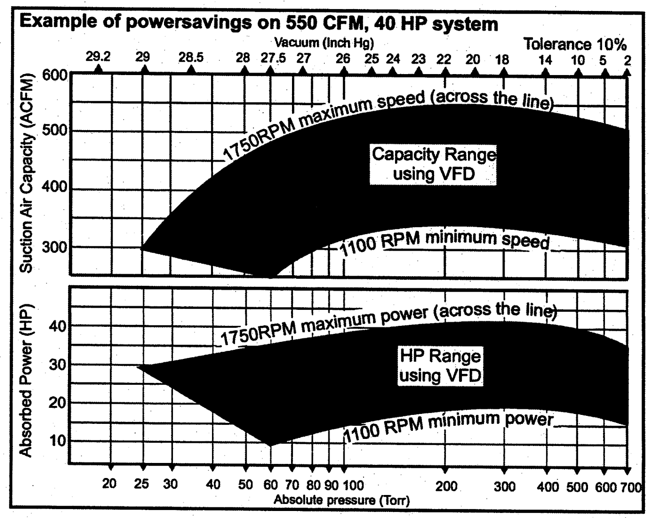
Vmax VFD

Oil-sealed liquid ring vacuum pump systems with Variable Frequency Drive

Vmax VFD oil-sealed vacuum pump systems are liquid ring vacuum pump systems using oil as the seal-liquid. The systems (in capacities ranging from 150-4500 CFM) operate with a **Variable Frequency Drive** which reduces the speed of the vacuum pump when demand for vacuum decreases, **resulting in substantial savings**.



- **Control of Power Consumption** (up to a 50 percent turndown in power, resulting in substantial savings)
- **Control of Inrush** (soft starting reduces wear on system components and eliminates inrush duringstartup)
- **Control of Material Damage and Waste** (reduced slippage results in less material damage and waste)
- **Control of Cost and Return on Investment** (guaranteed quick payback of new system investment)
- Still the only system on the market with a **full 3-year warranty!**



Performance Characteristics	
Nominal capacity:	150-4400CFM
Motor:	10-250HP
Maximum vacuum:	29"Hg
Performance based on atmospheric pressure equal to 29.92"Hg	

Capacity Table

System model	Installed HP	Minimum HP	Maximum RPM	Minimum RPM (at 27.5"Hg maximum)	at 15" Hg Minimum capacity CFM	at 15" Hg Maximum capacity CFM	at 20" Hg Minimum capacity CFM	at 20" Hg Maximum capacity CFM	at 25" Hg Minimum capacity CFM	at 25" Hg Maximum capacity CFM
VMX0153KA1	10	6	1750	1150	95	145	95	145	92	140
VMX0203KA1	15	8	1750	1150	125	190	131	200	131	200
VMX0303KA1	20	10	1750	1100	179	285	185	295	176	280
VMX0453KA1	25	13	1750	1100	264	420	267	425	248	395
VMX0553KA1	40	20	1750	1100	340	540	346	550	339	540
VMX0653KA1	40	25	960	750	516	660	516	660	477	610
VMX0753KA1	50	25	1200	750	481	770	491	785	456	730
VMX1103KA1	75	50	1100	750	689	1010	743	1090	307	1080
VMX1203KA1	100	50	1200	750	713	1140	747	1195	738	1180

For larger capacity systems contact factory.

Information contained in this document is for reference only. Subject to change without notice.

Appendix F

Ambient Air Quality Impact Screening Evaluation

Air Quality Impact Screening Analysis

Although no air permit is required, JCI Jones Chemical, Inc. is required to comply with the substantiative requirements of 6NYCRR Part 212 for General Process Emission Sources and the New York State Division of Air Resources (DAR) Guidelines for the Control of Toxic Ambient Air Contaminants (Guidelines; Issued November 12, 1997). Therefore, LFR has evaluated the requirements for emissions controls on the air stripper and proposed MPE system. Our analysis was performed in accordance with Appendix B of the Guidelines.

Air Stripper

1. Evaluate building cavity impacts.

   Building cavity impacts occur when the stack height is less than 2.5 times the building height. According to the Basic Cavity Impact Method (Appendix B.II.A.), if the shortest distance from the building to the nearest property line is greater than 3 times the height of the building then the building cavity impact does not need to be evaluated. Since the height of the building where the air stripper will be located is12 feet and the nearest property line is 200 feet from the building, cavity impacts are not considered.

2. Use the Standard Point Source Method (Appendix B.III.A) to estimate actual and potential annual impact.

   a) Since the stack height is 18 ft which is equal to 1.5 times the building height (12 ft), the buoyancy flux parameter is calculated.

   $$F = \frac{V^2 R^2}{T}(T - 510)$$

   Where:

   F = buoyancy flux parameter (m^4/sec^3)
   V = exit velocity (ft/s) = Q_{air}/A_{stack}
   R = stack outlet radius (ft)
   T = stack exit temperature (° Rankine = °F +460)

   Given a stack diameter of 4 inches and an air flow of 210 standard cubic feet per minute (scfm), V has a value of 40 ft/sec. Assuming an operating temperature of 55° F, then F is estimated to be 1.7 m^4/sec^3.

   b) Estimate effective stack height, h_e.

   Since F is less than 55, h_e is estimated in accordance with Appendix B.III.A.1.b. as follows:

   $$h_e = h_s + 1.1F_m{}^{0.33}$$

Given a stack height, h_s, of 18 ft, h_e is 19 ft.

c) Estimate maximum allowable emission rate using the QED modeled removal rate of the following contaminants:

Compound	Air Emissions (lbs/hr)
Tetrachloroethene	0.051
Trichloroethene	0.005
Cis-1,2- dichloroethene	0.036
Trans-1,2-dichloroethene	0.00224
Vinyl chloride	0.00292

$$C_a = \frac{6xQ_a x0.75}{h_e^{2.25}} \times 8{,}760$$

Where:

Q_a = emission rate (lbs/hr)
Ca = actual annual ($\mu g/m^3$)
8,760 = conversion factor lbs/hr to lbs/yr
0.75 = rate reduction factor per Appendix B.III.A.4

The actual annual impact for PCE is estimated to be 2.7 $\mu g/m^3$. Similarily, C_a is calculated for the other contaminants: TCE (0.26 $\mu g/m^3$), cis-DCE (1.7 $\mu g/m^3$), trans-DCE (0.15 $\mu g/m^3$), and vinyl chloride (0.1 $\mu g/m^3$).

d) Estimate the short-term guideline concentration (SGC; for PCE and its degradation products.

$$C_{ST} = \frac{52500xQ_a x0.75}{h_e^{2.25}} x65$$

Where:

Q_a = emission rate (lbs/hr)
C_{ST} = short-term impact ($\mu g/m^3$)
0.75 = rate reduction factor per Appendix B.III.A.4

The maximum short-term guideline concentration, C_{ST}, is equal to 173 $\mu g/m^3$ for PCE. Similarily, C_{ST} is calculated for the other contaminants: TCE (17 $\mu g/m^3$), cis-DCE (112 $\mu g/m^3$), trans-DCE (9.5 $\mu g/m^3$), and vinyl chloride (6.8 $\mu g/m^3$). These values are higher than the AGC and SGC; therefore, emissions treatment is required.

e) Estimate when air emission treatment will not be required.

Assume that the stripper removes 100% of the PCE from the groundwater.

Since the proposed water flow rate to the stripper is 18 gpm, assuming an allowable actual annual emission rate of 1.0 μg/m^3, the maximum concentration of PCE in groundwater without air treatment can be calculated as follows assuming 100% of the PCE is removed.

$$1.0\mu g/m^3 = \frac{18 gal/\min(3.785 l/gal)(60\min/hr)(Cmg/l)}{1000 mg/g(453.6 g/lb)} = 111 mg/l$$

Applying the 75% reduction factor in accordance with Appendix III.A.4.b, the allowable PCE influent concentration is 83 mg/l. Therefore, when the average PCE concentration decreases below 83 mg/l, then air emissions control technology on the air stripper may be discontinued. Activated carbon is proposed to treat the air emissions.

Soil Vapor Extraction

Given the expected high concentration of PCE in the vapors at SVE start-up and over the first weeks of operation, granular activated carbon will be used to treat the extracted vapors prior to discharge to the atmosphere. After the first few weeks, the extracted vapors are estimated to have an emission rate without treatment of less than 0.1 lbs/hr of PCE. This emission rate was calcualated as follows using the pilot study data:

$$R_{removal} = \eta \cdot G \cdot Q \cdot 4.6x10^{-7}$$

where:

$R_{removal}$ = removal rate (lbs/min)
G = vapor concentration (ppm_v)
η = efficiency (unitless)
Q = vapor flow rate; 640 cfm
$4.6x10^{-7}$ = conversion factor from ppm_v to lbs/ft^3

The vapor concentration, G, in ppm_v was determined to be 220 ppm_v or 1,626 mg/m^3 during the pilot test. This is estimated to be a worst case scenario and that the vapor concentrations will rapidly decrease after start-up. Inputting this worst-case value into the removal rate equation and assuming that 50% of the vapors are from the most-affected zone, the removal rate is estimated to be 0.032 lbs/min or 1.9 lbs/hr.

The activated carbon is expected to capture greater than 99% of the PCE in the air stream prior to discharge to the atmosphere.

1. Evaluate building cavity impacts.

   Building cavity impacts occur when the stack height is less than 2.5 times the building height. According to the Basic Cavity Impact Method (Appendix B.II.A.), if the shortest distance from the building to the nearest property line is greater than 3 times the height of the building then the building cavity impact does not need to be evaluated. Since the height of the proposed remediation building where the SVE system will be located is 12 feet and the nearest property line is over 200 feet from the building, cavity impacts are not considered.

2. Use the Standard Point Source Method (Appendix B.III.A) to estimate actual and potential annual impact.

   a) Since the proposed stack height is 18 ft which is 1.5 times the building height (12 ft), the effective height is calculated.

$$h_e = h_s + 1.1F_m^{0.33}$$

Where:

F_m = momentum flux (ft^4/sec^2)

$$F_m = \frac{V^2 R^2 T_a}{T}$$

V = exit velocity (ft/s) = Q_{air}/A_{stack}
R = stack outlet radius; 0.75 ft
T = stack exit temperature (° Rankine = 110 °F +460)
T_a = ambient temperature (° Rankine = 55° F +460)

Given a stack diameter of 8 inches and an air flow of 640 standard cubic feet per minute (scfm), V has a value of 31 ft/sec, then F_m is estimated to 488 ft^4/sec^2 and the effective height is equal to 26.5 ft.

   b) Estimate maximum allowable emission rate using the annual guideline concentration (AGC; 1.0 $\mu g/m^3$) for PCE.

$$C_a = \frac{6xQ_a x.75}{h_e^{2.25}}$$

Where:

Q_a = annual emission rate (lbs/yr)
C_a = actual annual impact set to the AGC (1.0 $\mu g/m^3$)
0.75 = rate reduction factor per Appendix B.III.A.4

The maximum allowable annual emission rate, Q_a, is equal to 354 lbs/yr or 0.04 lbs/hr assuming 8760 hours of operation per year.

c) Estimate the maximum allowable emission rate using the short-term guideline concentration (SGC; 1,000 $\mu g/m^3$) for PCE.

$$C_{ST} = \frac{52500 x Q_a x 0.75}{h_e^{2.25}} x 65$$

Where:

Q_a = annual emission rate (lbs/hr)

C_{ST} = short-term impact set to the SGC (1,000 $\mu g/m^3$)

0.75 = rate reduction factor per Appendix B.III.A.4

The maximum allowable annual emission rate, Q_a, is equal to 0.62 lbs/hr which is higher than the emission standard based on the C_a; therefore, select the C_a based annual allowable emission rate of 0.04 lbs/hour.

Since the emission rate is anticipated to be greater than 0.04 lbs/hr, emission control technology is required. Activate carbon is proposed to treat the effluent to below 0.04 lbs/hr before discharge.

Appendix G

Dual-Phase Extraction System
Air-Treatment Equipment Cut-Sheets

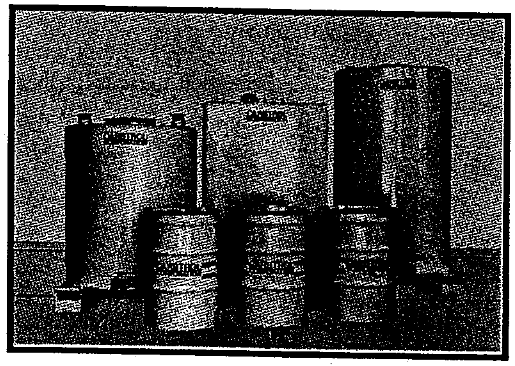
CARBTROL®

ACTIVATED CARBON PRODUCTS

CARBTROL supplies only the highest capacity activated carbons produced to exacting specification. Our carbons typically have a 10 to 40 percent greater adsorption capacity than most industrial grade products. See page two of this brochure for a discussion of activated carbon quality.

BULK ACTIVATED CARBONS

	Mesh Size	Activity/ Capacity	Apparent Density	Total Surface Area
VAPOR:				
CSV (Virgin)	4 x 8	60-65 CCl_4	30-32 lbs./cf	1400-1600 m^2/g
CSVR (Reactivated)	4 x 10	60 CCl_4	30-32 lbs./cf	1200-1400 m^2/g
LIQUID:				
CSL (Virgin	8 x 20	1100 I_2	30-32 lbs./cf	1200-1400 m^2/g
CSLR (Reactivated)	8 x 30	1000 I_2	30-32 lbs./cf	1000-1200 m^2/g



STANDARD ADSORPTION VESSELS

	Model	Maximum Flow	Amount of Carbon	Design Pressure	Approximate Dimensions	Weight
LIQUID:						
Canisters						
	L-1	10 gpm	200 lbs.	10 psi	24"Ø x 34" H	250 lbs.
	HP-90	10 gpm	90 lbs.	75 psi	12"Ø x 53" H	125 lbs.
	HP-200	10 gpm	200 lbs.	75 psi	22"Ø x 48" H	250 lbs.
Adsorbers						
	L-4	50 gpm	1000 lbs.	11 psi	4'Ø x 62" H	1500 lbs.
	L-5	50 gpm	1800 lbs.	11 psi	4'Ø x 86" H	2400 lbs.
	L-6	100 gpm	3000 lbs.	11 psi	5'Ø x 88" H	4000 lbs.
	HP-1000	50 gpm	1000 lbs.	75 psi	3'Ø x 90" H	1500 lbs.
	HP-1700	100 gpm	1700 lbs.	75 psi	4'Ø x 101" H	2300 lbs.
VAPOR:						
Canisters						
	G-1S	100 CFM	200 lbs.	10 psi.	24"Ø x 36" H	240 lbs.
	G-2S	300 CFM	170 lbs.	10 psi.	24"Ø x 36" H	210 lbs.
	G-3S	500 CFM	140 lbs.	10 psi.	24"Ø x 36" H	180 lbs.
Adsorbers						
	G-4	600 CFM	1000 lbs.	11 psi	4'Ø x 62" H	1500 lbs.
	G-5	1000 CFM	2000 lbs.	2 psi	4'Ø x 75" H	2650 lbs.
	G-6	600 CFM	1800 lbs.	11 psi	4'Ø x 86" H	2500 lbs.
	G-7	4000 CFM	1600 lbs.	3 psi	4'Ø x 86" H	2200 lbs.
	G-8	5000 CFM	2600 lbs.	3 psi	5'Ø x 88" H	3300 lbs.
	G-9	2000 CFM	3000 lbs.	3 psi	5'Ø x 88" H	3700 lbs.
	G-10	750 CFM	600 lbs.	5 psi	3'Ø x 48" H	755 lbs.
	G-11	1500 CFM	500 lbs.	5 psi	3'Ø x 48" H	675 lbs.

 AT-00#2

CARBTROL® CORPORATION

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Westport, CT 06880

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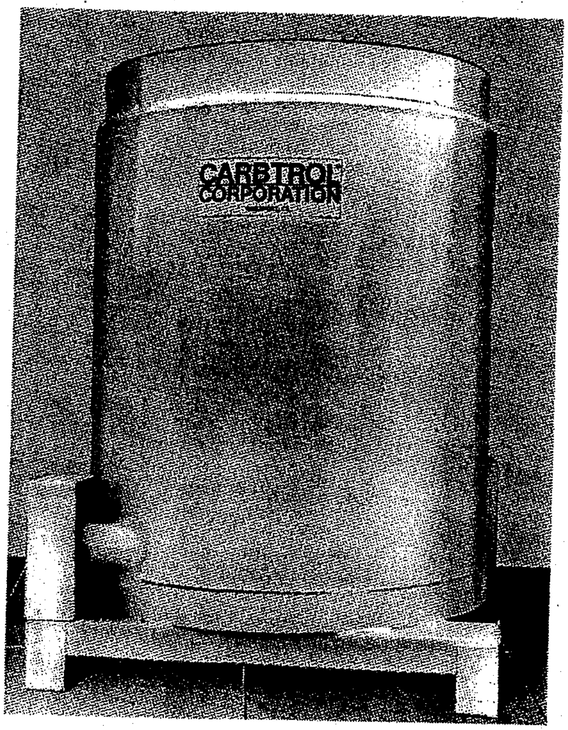
Web Address: http://www.carbtrol.com

CARBTROL®

AIR PURIFICATION ADSORBERS

1,000 - 3,000 LB. ACTIVATED CARBON

MODELS
G-4
G-6
G-9



FEATURES

- Low pressure drop.
- Epoxy lined mild steel construction.
- High activity carbon.
- Fork lift fittings for easy handling.
- 4"Ø slotted inlet distributor.
- Acceptable for transport of hazardous spent carbon.

OPTIONS

- Plastisol (PVC) lining.
- Interconnecting piping.

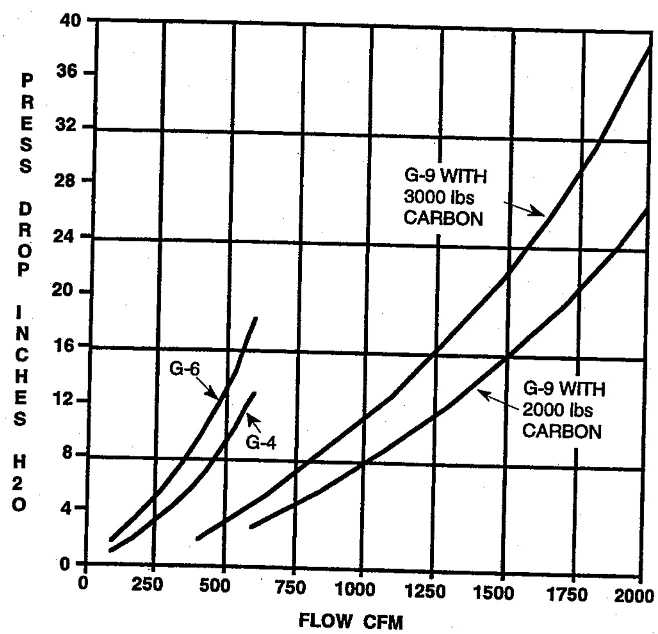
SPECIFICATIONS

MODEL G-4
CARBON: 1,000 lbs.
DIMENSIONS: 45-1/2" Ø x 64" H
SHIPPING WT: 1,500 lbs. Dry

MODEL G-6
CARBON: 1,800 lbs. *
DIMENSIONS: 45-1/2" Ø x 88" H
SHIPPING WT: 2,500 lbs. Dry

MODEL G-9
CARBON: 3,000 lbs. *
DIMENSIONS: 60" Ø x 93" H
SHIPPING WT: 3,500 lbs. Dry

* 2,000 lbs. option available



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CARBTROL®

AIR PURIFICATION ADSORBERS

1,000 - 3,000 LB. ACTIVATED CARBON

MODELS
G-4
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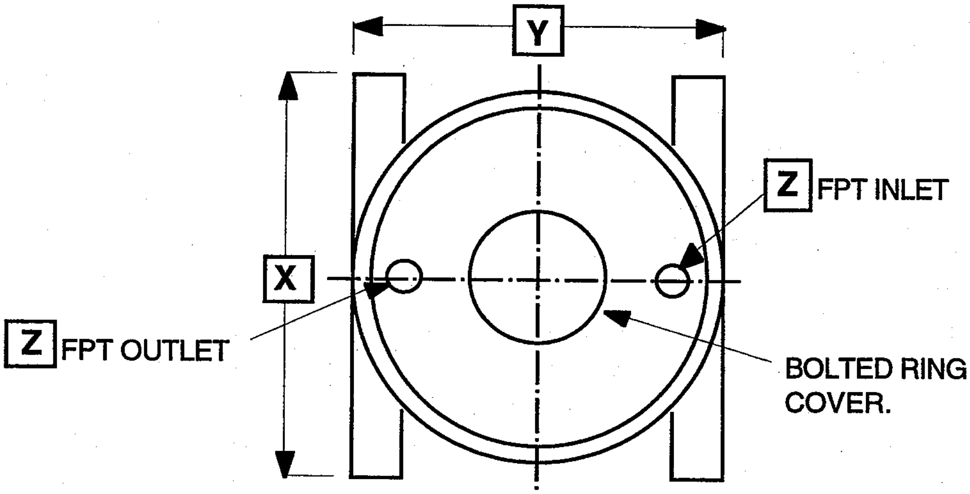
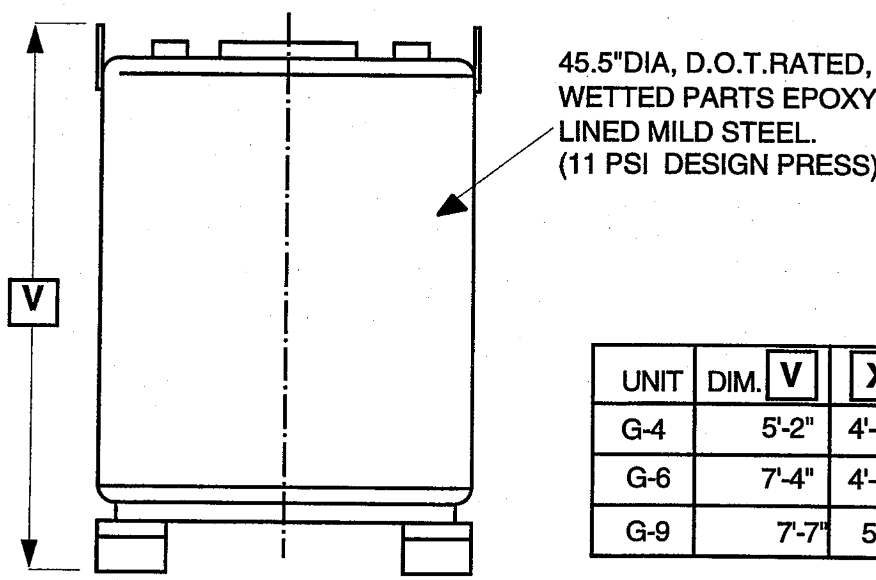
G-9





UNIT	DIM. V	X	Y	Z
G-4	5'-2"	4'-0"	3'-8"	4"
G-6	7'-4"	4'-0"	3'-8"	4"
G-9	7'-7"	5'-0"	5'-0"	10"

SAFETY

Certain chemical compounds in the presence of activated carbon may oxidize, decompose or polymerize. This could result in temperature increases sufficient to cause ignition of the activated carbon or adsorbed material. If a compounds reaction with activated carbon is unknown, appropriate tests should be considered.

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Appendix H

Design Calculations for Intermediate-Zone Hydraulic Control

DESIGN CALCULATIONS FOR INTERMEDIATE ZONE HYDRAULIC CONTROL

The following parameters from the Pre-RD Sampling Summary Report (LFR 2004) for the shallow zone were used in the engineering calculations:

K = hydraulic conductivity; 6.42 ft/day or 48 gpd/ft^2
B = saturated thickness; 20 feet
T = transmissivity; 960 gpd/ft
i = groundwater gradient; 0.007 ft/ft
n = porosity; 0.2
C_s = Storativity; 0.0023

ESTIMATE GROUNDWATER EXTRACTION RATE

1. Estimate the volume of groundwater to be extracted from the intermediate zone assuming a plume area on-site of 42,000 ft^2. The aquifer's total porosity is assumed to be 0.20 based upon site lithology and the thickness of affected groundwater is 20 feet. Therefore, the volume of affected groundwater is estimated to be 168,000 gallons.

2. Estimate capture zone from three extraction wells at the down gradient property line using the Javendel and Tsang equation (Fetter 1999) as follows:

where:
Q = Pumping rate (ft^3/day)
Y_L = Plume width (feet)
k = hydraulic conductivity (ft/day)
B = saturated thickness (ft)

$$Y_L = \frac{1.5 \cdot Q}{B \cdot k \cdot i}$$

i = hydraulic gradient

It is assumed that the extraction wells will fully penetrate the intermediate aquifer to a total screened length of 20 feet below ground surface. Based upon a hydraulic conductivity of 6.42 ft/day, saturated thickness of 20 ft, and groundwater gradient of 0.007, a pumping rate of 1.5 gpm per well from the pump test, the cross gradient capture zone would be 480 feet. The pump test confirmed this likely capture zone with effects observed approximately 100 feet from the extraction well during a short pumping interval.

3. The optimum distance between three extraction wells is as follows:

$$W_L = \frac{0.4 \cdot Q}{B \cdot k \cdot i}$$

where:
Q = Pumping rate (ft^3/day)
W_L = Optimum distance between wells (feet)
k = hydraulic conductivity (ft/day)
B = saturated thickness (ft)
i = hydraulic gradient

Solving for W_L at a 1.5 gpm, indicates that the optimum distance between wells is 125 feet. The pump test indicated that intermediate zone had a specific capacity of 0.16 gpm/ft of drawdown; therefore, the pumping rate required (1.5 gpm) would result in 10 feet of drawdown.

4. The downstream stagnation point at a pumping rate of 1.5 gpm is estimated to be 50 feet as follows:

$$SP = \frac{Q}{2\pi Bki} \times 1440$$

where:
SP = Stagnation Point; (ft)
Q = pumping rate; (gpm)
B = saturated thickness; 20 ft
k = hydraulic conductivity, 48 gpd/ft^2
i = groundwater gradient, 0.007
1440 = conversion factor; gpm to gpd

The capture zone of the system will be monitored and confirmed after system start-up.

5. Estimate the time to remediate the groundwater assuming the primary contaminants are DCE and vinyl chloride in the intermediate zone. Also assume these constituents have a retardation factor of 5. Use a safety factor of 10 to account for inefficiencies in water release from the aquifer and maintenance down time.

$$t = \frac{VR}{Q} \times SF \times 6.94 \times 10^{-4}$$

where:
t = time (days)
V = volume of affected groundwater; 168,000 gal
Q = extraction rate; 4 wells x 1.5 gpm = 6 gpm
R = retardation factor; 5
SF = safety factor; 10

The estimated time to remediate the affected groundwater via groundwater extraction only is over 2.5 years after the continuing source is remediated.

DETERMINE REQUIRED HEAD

Each extraction well will be connected to a manifold at the pump by 1-inch diameter Sch 40 PVC. Water will need to be raised 30 feet from the depressed water table to the surface. The furthest extraction well from the treatment building will be 300 feet.

1. Estimate head loss across piping.

Static Head = 30 ft + 8 ft (height of air stripper) = 38 ft

Calculate equivalent feet of piping for valves and fittings:

No. of Fittings	Fitting	Equivalent ft per fitting	Total Equivalent (ft)
5	90 Elbow	7.4	37
1	Ball Valves	1.2	3.6

The total length of piping is equal to 37 + 3.6 + 300 = 340 ft

Total head loss is estimated as follows:

$$h_T = StaticHead + f \frac{L}{D}\frac{V^2}{2g}$$

where:
V = velocity (ft/s)
f = friction factor; 0.015
D = pipe diameter (ft)
g = acceleration due *to* gravity (ft/s^2)

Using 1-inch diameter SCH 40 PVC at 1.5 gpm (0.61 ft/s), a head loss of 38.5 ft was estimated. Therefore, the extraction pump will be designed to provide 1.5 gpm at 45 feet of head including a safety factor.

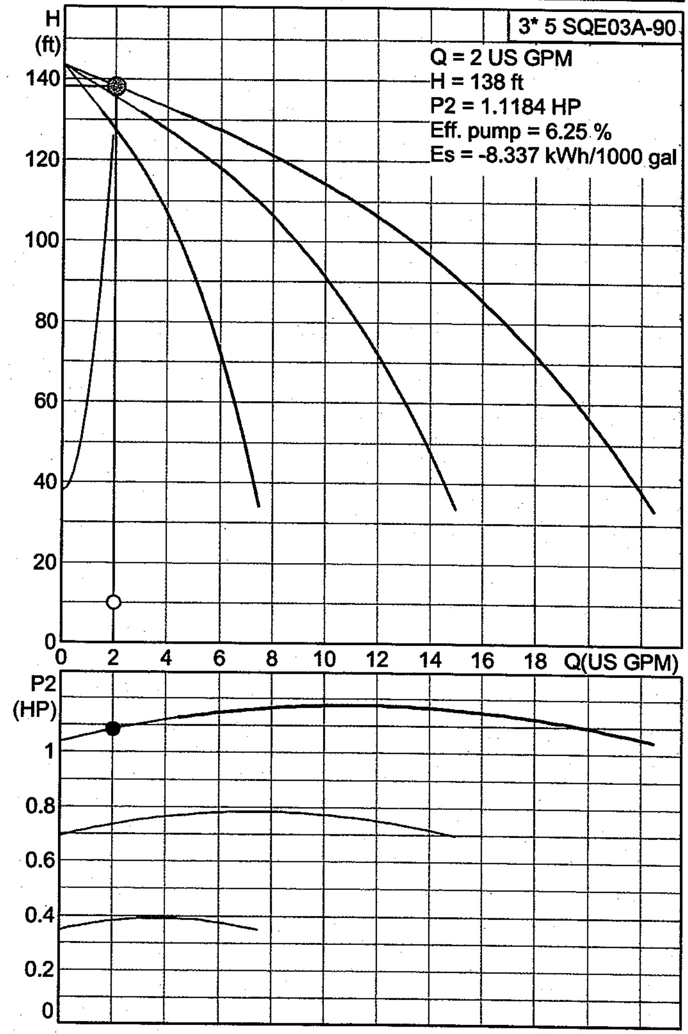
Appendix I

Groundwater-Extraction Well Pump Specifications

Project: Monarch Chemical
Reference Number: 004-03445-05
Position:

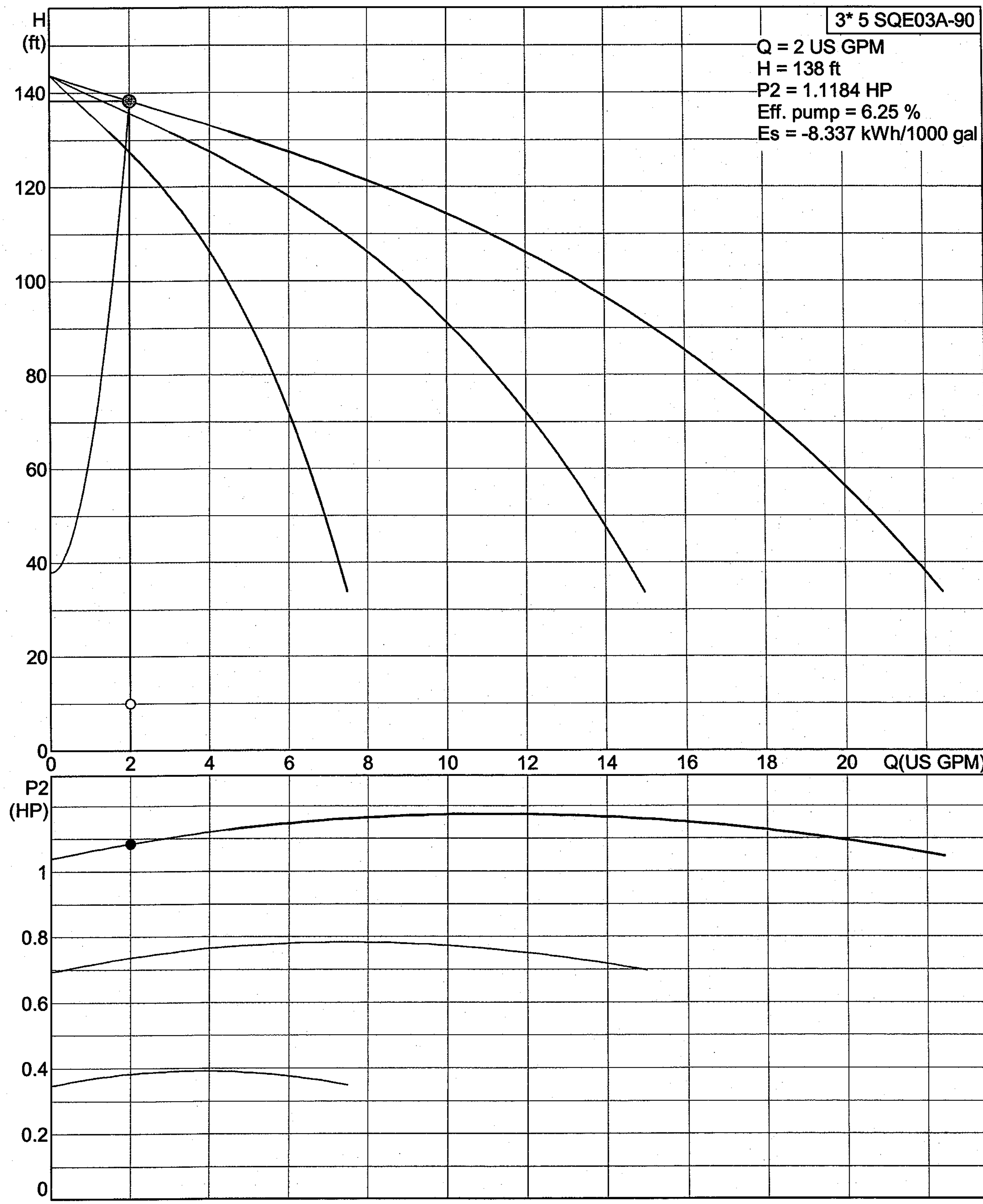
Client: JCI
Client Number:
Contact:

Product Number	96080293
Product name	5 SQE03A-90
EAN number	5700395213195
Approvals	UL, cUL
Approvals motor	CE,UL,CUL
Borehole	2.99 in
Cable length	4.922 ft
CU 300/CU 301	Y
Dry run code	A
Impeller	Polyethylene
Insulation	F
IP Class	IP68
Liquid max temp	104 °F
Model	B
Motor	Stainless steel
	1.4301 DIN W.-Nr.
	304 AISI
Motor Number	96030144
Motor protection	Y
Motor type	MSE3
n	10700 rpm
Phase	1
Pump	Polyethylene/Stainless steel
	1.4301 DIN W.-Nr.
Pump Number	96080414
Pump outlet	1" NPT
Rated flow	4.403 US GPM
Rated head	112 ft
Sales region	Namreg
Stages	2
Start. method	DOL
Thermal protec	INT
Valve	Y
Eff. 1/1	68.0-70.0 %
f	60 Hz
n	10700 rpm
P1	0.29-0.99 kW
P2	0.3-0.5 HP
Power factor	1,00
Rated current	2,90-11,1 A
Service factor	1,60
U	100-115 V



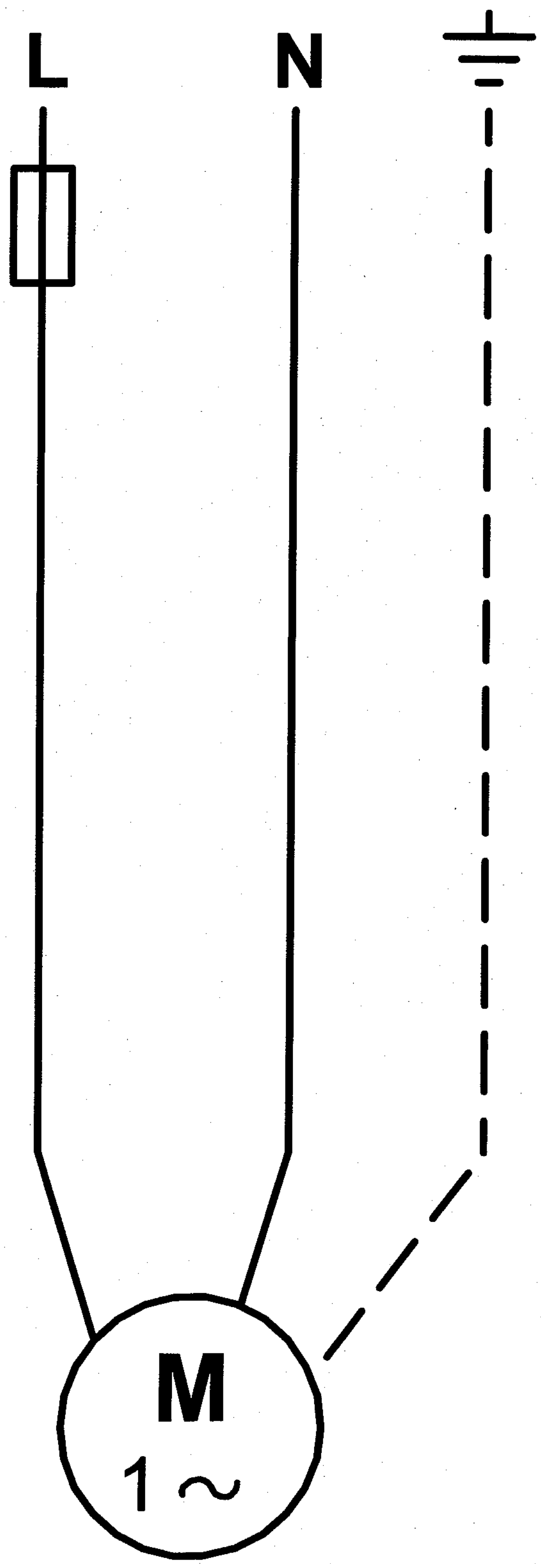
Project:	Monarch Chemical	**Client:**	JCI
Reference Number:	004-03445-05	**Client Number:**	
Position:		**Contact:**	

96080293 5 SQE03A-90



Project:	Monarch Chemical	**Client:**	JCI
Reference Number:	004-03445-05	**Client Number:**	
Position:		**Contact:**	

96080293 5 SQE03A-90



Grundfos SQ/SQE Data Book

GRUNDFOS

Table of Contents

Features and Benefits

SQ/SQE Submersible Pumps

SQ/SQE pumps are suitable for both continuous and intermittent operation for a variety of applications:
- Domestic water supply
- Small waterworks
- Irrigation
- Tank applications

SQ, SQE pumps offer the following features:

- Dry-Run protection
- High efficiency pump and motor
- Excellent wear resistance, and sand handling capabilities
- Protection against up-thrust
- Soft-start
- Over-voltage and under-voltage protection
- Overload protection
- Over-temperature protection
- High starting torque

Additionally, the SQE pumps offer:

- Constant pressure control
- Variable speed
- Electronic control and communication

The SQ and SQE pump models incorporate a totally new motor design. With the use of permanent-magnet technology within the motor, the SQ/SQE pumps deliver unmatched performance. By combining permanent-magnet motors and Grundfos's own micro frequency converter, we are now able to control and communicate with the pump in ways never before possible. A few of the features that come out this combination are Constant Pressure Control, Soft-Start, and integrated Dry-Run protection. These are just a few of the many features that the SQ/SQE pumps can offer.

The SQ pump models are a simple pump that operates at a constant speed much like today's conventional pumps. The difference between it and todays' pumps is you get all the benefits of an electronically controlled permanent - magnet motor that cannot be accomplished with a conventional induction motor. The SQ pumps are available for single phase power. They use a simple 2-wire design making installation easy.

The SQE uses the Grundfos "Smart Motor". Like the SQ model, we still use the high efficiency permanent magnet motor, but we give this motor the ability to communicate. The "Smart Motor" communicates via the CU300 status box through the power leads. It is not necessary to run any additional wires down the well. By being able to communicate with the pump you can have Constant Pressure Control and the ability to change the pump performance while the pump is installed in the well. Like the SQ motor, this is also a 2-wire motor designed for single-phase operation.

The CU300 status box also allows you to communicate with the "Smart Motor" with the R100 infrared remote control. The R100 gives you the ability to monitor and setup your pumping system to meet the specific needs of your application. It is also important to note the "Smart Motor" can operate without the CU300, but you will loose some of the functions that are only possible by using the CU300.

The CU300 provides full control of the SQE pumps. If the pump stops, the CU300 will illuminate a light on the front panel. If you have an R100 you will be able to trouble shoot the system and recall the last five causes of failure.

Pump and Motor Range

Product	Description	Material
SQ/SQE Pump	5,10,15,22,30 gpm	Stainless steel AISI 304
SQ-MS 3 Motor	Single-phase 1/3 - 1.5 Hp	Stainless steel AISI 304
SQE-MSE 3 Motor "Smart Motor"	Single-phase 1/3 - 1.5 Hp	Stainless steel AISI 304

Pipe Connection

Pump Type	Threaded Connection
SQ/SQE 5	1" NPT
SQ/SQE 10,15	1 1/4" NPT
SQ/SQE 22, 30	1 1/2" NPT

Type key

Example 10 SQ E 05 A 160 -NE
Nominal flow GPM
Type range
Electronic control/communication
Horsepower
Motor designation
Head in ft at nominal flow rate
Material specification

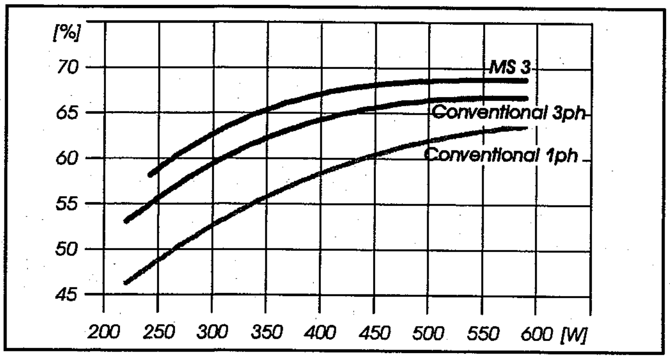
Operating Conditions

Flow velocity past motor	Max. liquid temperature
0.0 f/s (Free convection)	86°F (30°C)
Min. 0.5 f/s	104° F (40°C)

Dry-Run Protection
The SQ and SQE incorporate integrated Dry-Run protection. When the water level falls below the inlet of the pump the pump will shut off. After a period of time, the pump will then automatically start up again.

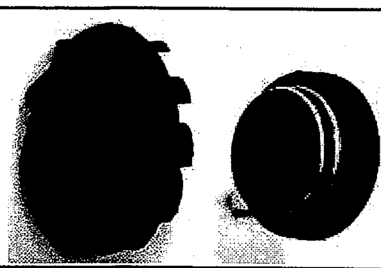
For the SQ pumps the cut-off level is factory-set. For the SQE pumps you must set this level by using a CU300 and R100.

High Motor Efficiency
The SQ and SQE motors are based on a permanent magnet rotor which produce high efficiency within a wide load range. The high and flat efficiency curve of the Permanent-Magnet motor allows for a coverage of a wide power range with the same motor, as compared to conventional AC motors. For SQE pumps, this means three motors to cover the horsepower range from 1/3 to 1.5Hp.



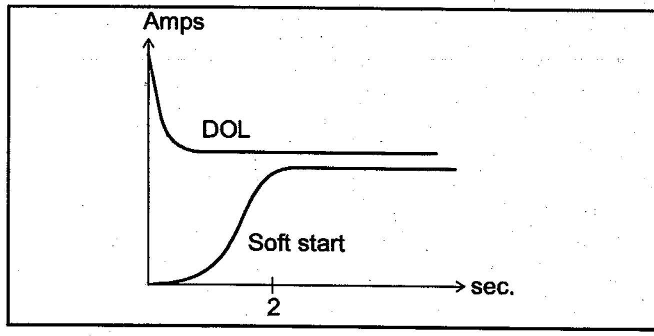
High Pump Efficiency
The pump components are made from a 30% glass filled engineered composite. The pumps are designed to deliver at peak efficiency levels. Because of high pump efficiencies, overall power consumption will be reduced.

Excellent Wear Resistance
The SQ/SQE pump design uses "floating" impellers. Each impeller has its own tungsten carbide/ceramic bearing. This design and the high quality materials make the pump very wear resistant especially in sandy conditions.



Protection against up-thrust
During start-up many pumps start in an up-thrust condition. To prevent damage caused by up-thrust a top bearing has been placed in the motor to protect both the pump and the motor against up-thrust.

Soft-Start
Both the SQ and SQE motors have a soft start because of the integrated electronics. Soft start reduces the starting current and gives the pump a smooth and steady acceleration.



The soft-start will reduce your chance of water hammer, minimizes the risk of wear and prevent overloading of your circuit during start-up.

High Starting Torque
Because of the permanent-magnet motor the SQ/SQE pumps have excellent starting capabilities. The high locked rotor torque produced by the PM motor provides a starting torque that is 1.5 times greater than conventional pump motors. Even if the voltage is low the PM motor will still maintain a high starting torque.

Overvoltage and Undervoltage Protection
Overvoltage and undervoltage may occur at anytime especially if you have an unstable voltage supply.

The integrated voltage protection of the SQ and SQE motors protects the motors when the voltage falls outside the permissible voltage range.

The 230V pump will cut out if voltage falls below 150V or above 280V. The motor will automatically start when the voltage is within the permissible voltage range. It is not necessary to have additional voltage protection.

Overload Protection
When the pump load rises above the maximum amp level, the motor will automatically compensate and reduce the speed to maintain its maximum amp level. If the speed drops to 65% of the nominal speed, the motor will shut off.

Features and Benefits

Overtemperature Protection
Permanent-magnet motors emit very little heat because of their high efficiency. The SQ and SQE motors are designed with an internal circulation system to effectively cool all the internal motor components.

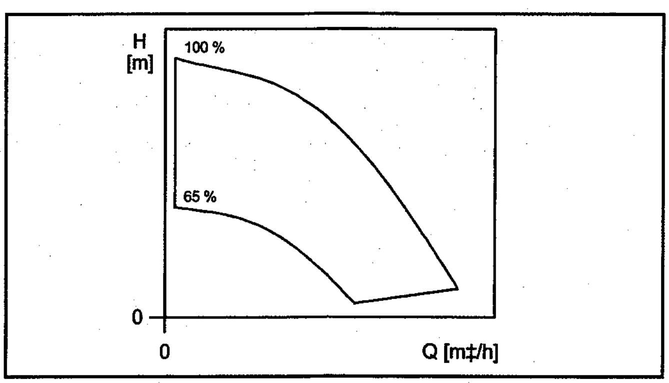
As extra protection, the electronic unit also has a built-in temperature sensor. When the temperature rises too high, the motor will shut off; when the temperature drops, the motor will automatically restart.

Reliability
The SQ and SQE motors have been designed to withstand the toughest of applications and provide reliability. Some of those features are:

- Tungsten carbide/ceramic bearings
- Thrust bearings protecting against down-thrust
- Product lifetime equal or greater than conventional AC motors and 4"pumps

Variable Speed
The SQE "Smart Motor" enables continuous variable speed control within 65% - 100%(7000-10700 rpm) of motor speed. The pump can be set to operate at any duty point in the range between 65% and 100% of the pump's performance curve. Your pump can then be adapted to any specific requirement. The variable speed control requires the CU300 control unit and the R100.
To help you decide on the proper speed, we have made available a speed calculation program called "SQE – Speed Calculation". This program is available as an option.

Variable Speed Range of Operation



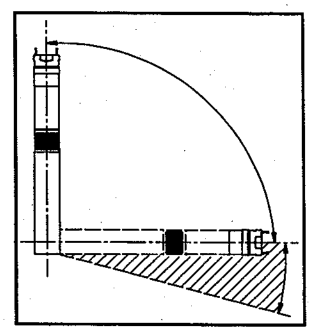
Installation
The SQ and SQE may be installed vertically or horizontally.
Note: The pump must not fall below the horizontal level in relation to the motor.

The following features ensure simple installation of the SQ and SQE pumps:

- Built-in spring loaded check-valve
- Light weight makes it easy to install
- Fits in 3" or larger wells

For horizontal installation, a flow sleeve is recommended in order to:

- Ensure sufficient flow past the motor to provide sufficient cooling
- Prevent the unit from being buried in sand or mud

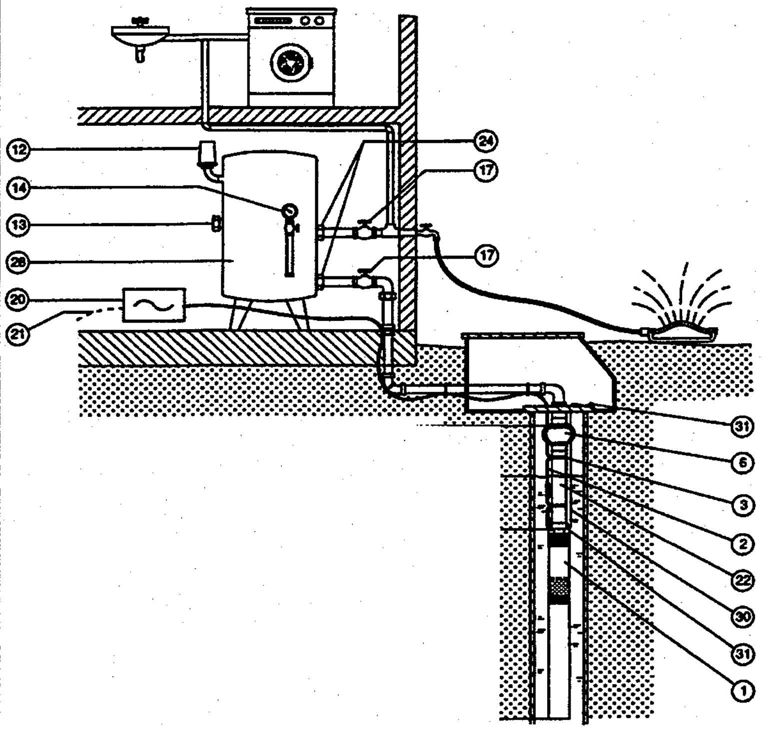


Service
The modular design of the pump and motor makes it easy to repair and service. The motor lead is also replaceable.

SQ with Pressure Switch and Diaphragm Tank

SQ is the perfect pump for domestic water supply. The SQ is easy to sell, install and operate.

Replacement in Existing Installation
SQ and SQE pumps can be installed as replacement of a 4" submersible pump in an existing installation.
By replacing an existing 4" pump with an SQ or SQE, you not only get the most advanced pump on the market, but you also have the ability to upgrade your system to a constant pressure system as shown on page 8.



1	Pump, SQ
2	Cable
3	Cable clips
6	Aerator with non-return valve
12	Pressure switch
13	Air vent
14	Pressure gauge
17	Isolating valve
20	Mains switch
21	Mains connection.
22	Riser pipe
24	Union
28	Pressure tank
30	Straining wire
31	Wire clamp

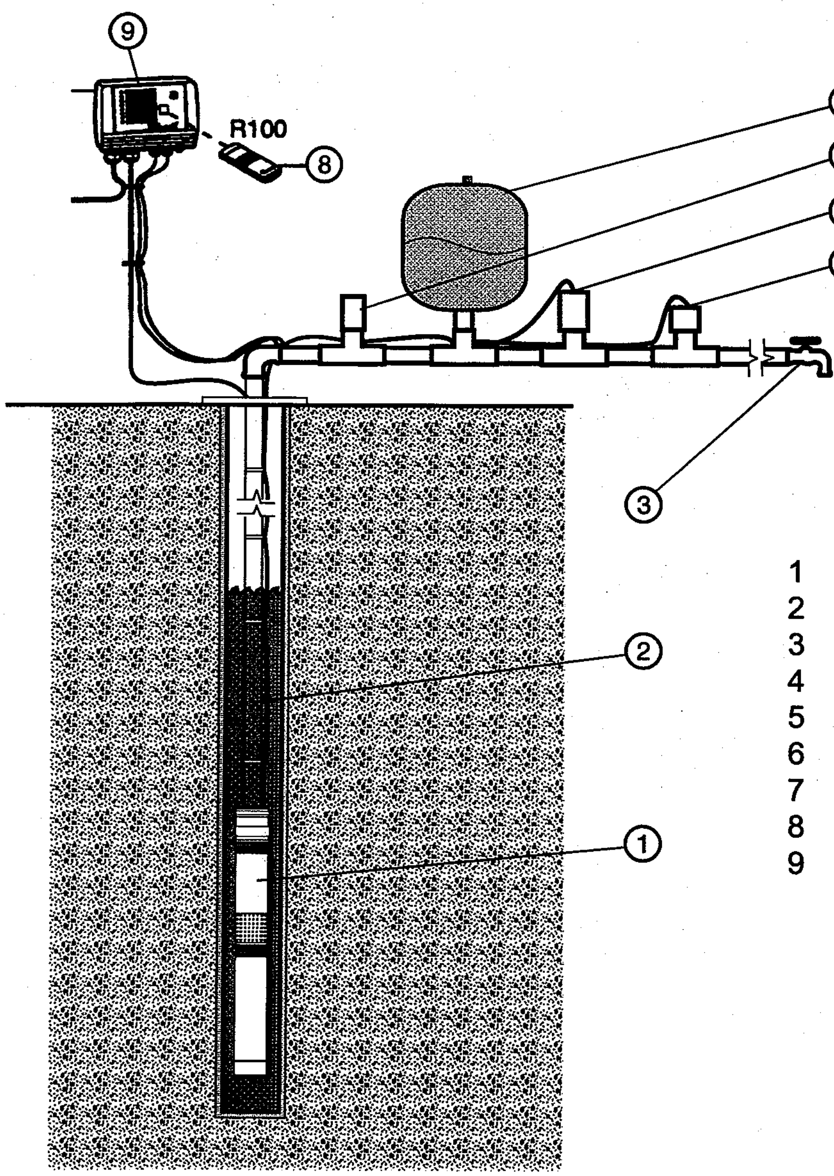
TM01 2698 2698

SQE with Constant Pressure Control

Function and Benefits
Constant pressure can be maintained in the system to provide you with "city like" water pressure. A flow switch starts the pump once the tap is opened. A preset pressure is maintained via the pressure sensor and the CU300. When the flow switch detects no flow, the tank is filled with water and the pump stops.
If consumption is below 0.8 gpm, the CU300 will start the pump when the pressure is 7 psi below the set-point. The pump will then stop when the pressure is 7 psi above the set-point.

When consumption is above 0.8 gpm, the CU300 will control the pump performance to keep the pressure within 3 psi of the set-point.

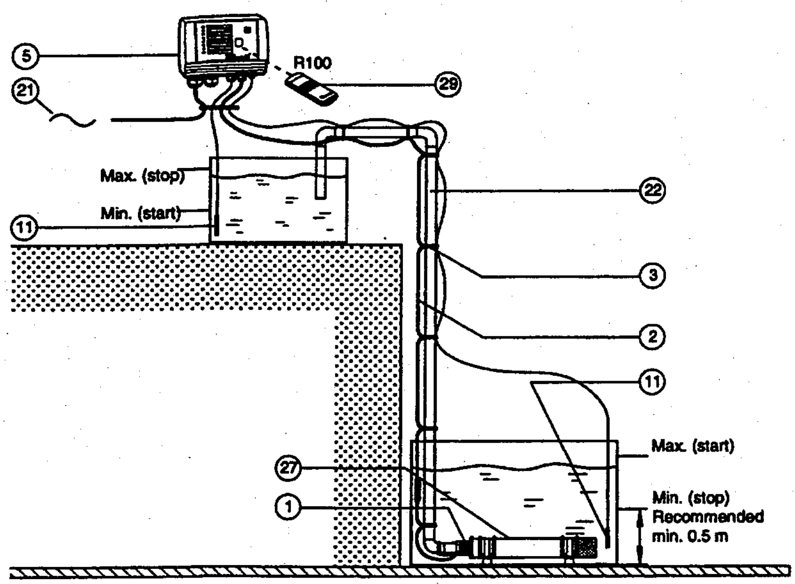
Constant pressure control reduces pressure variations, and allows you to use a tank as small as 2 gal. Without loss of comfort. In installations incorporating filters, pump operation will gradually adjust as the filter becomes plugged.



1 SQE Pump
2 Drop Pipe
3 Supply
4 Flow Switch
5 Pressure Transducer
6 Relief Valve
7 Diaphragm Tank
8 R100 Remote
9 CU300

Pumping from One Tank to Another

The SQE pump is ideal where there is a need to move water from one tank to another.



1 Pump, SQE
2 Cable
3 Cable clips
5 Control unit, CU 300
11 Level sensor
21 Mains connection
22 Riser pipe
27 Flow sleeve with strainer and supporting brackets
29 Remote control, R100

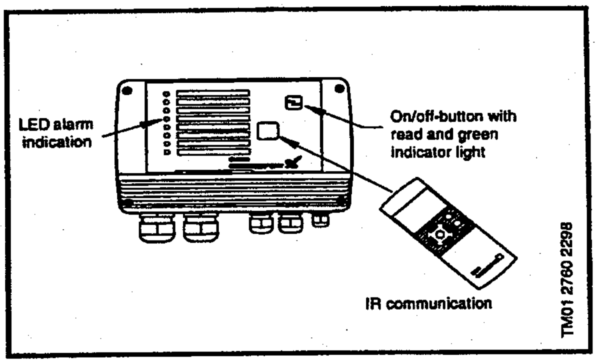
TM01 2454 1798

Communication CU300

CU300 Status Box
The CU300 status box is a control and communication unit especially developed for the SQE submersible pumps.

The CU300 status box provides:

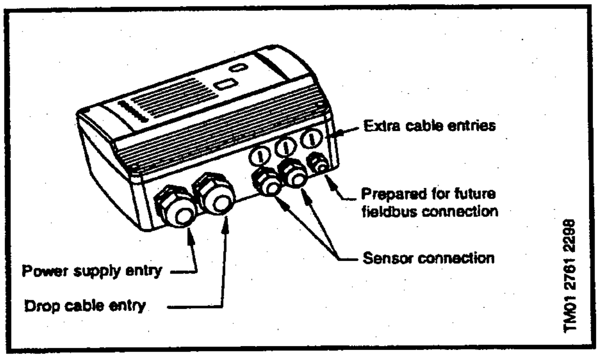
- Easy adjustment to a specific well
- Full control of the SQE pumps
- Two-way communication with the SQE pumps
- Indicator lights on the front to indicate alarms
- The ability to start and stop the pump with the push of a button



The CU300 communicates with the pump using the power leads. It is not necessary to run any extra cables between the pump and the CU300 status box.

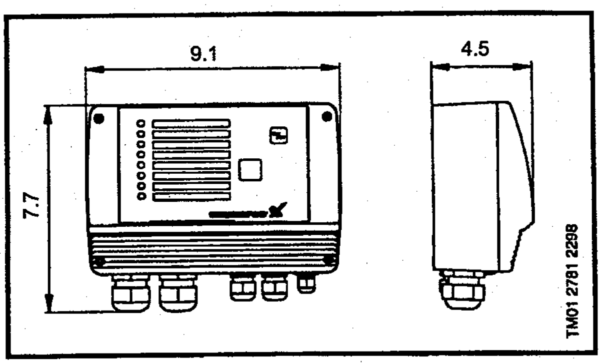
The following alarms can be indicated by the CU300:

- No contact
- Overvoltage
- Undervoltage
- Dry-Run
- Speed reduction
- Overtemperature
- Overload
- Sensor alarm



The CU300 incorporates:

- External signal input for three sensors
- Relay output for external alarm indication
- Control according to the signals received, e.g. flow pressure, water level and conductivity



The CU300 can communicate with the R100 infrared remote control.

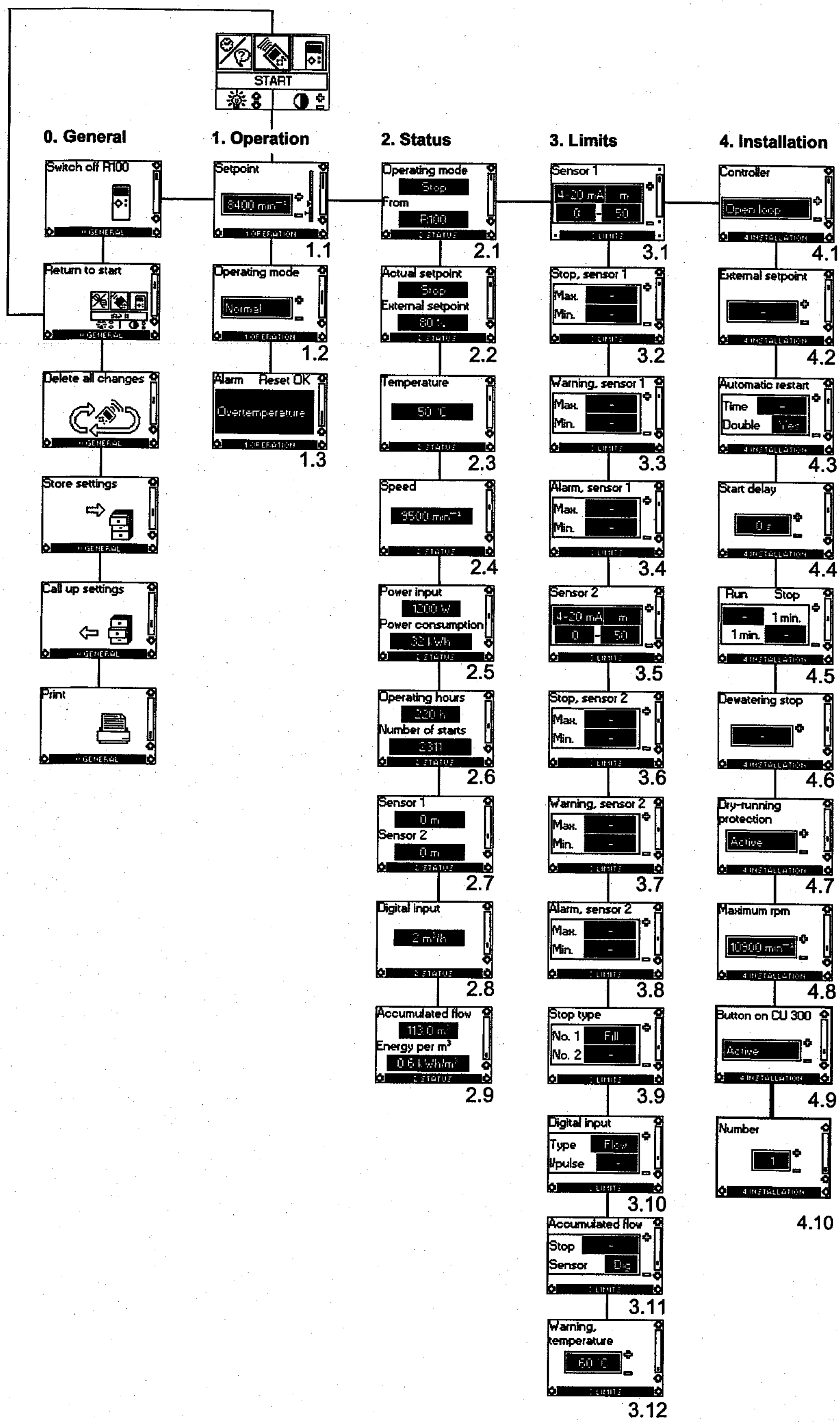
R100 Remote control

The R100 allows you to monitor the installation by reading current operating parameters, such as:

- Power consumption
- Energy consumption
- Number of operating hours

It allows you to change factory settings. A number of settings can be made, such as:

- Speed (performance)
- Constant pressure control mode
- De-watering function
- Automatic restart time


START
0. General
1. Operation
2. Status
3. Limits
4. Installation
Switch off R100
Return to start
Delete all changes
Store settings
Call up settings
Print
Setpoint
8400 min⁻¹
1.1
Operating mode
Normal
1.2
Alarm Reset OK
Overtemperature
1.3
Operating mode
Stop
From
R100
2.1
Actual setpoint
Stop
External setpoint
80 %
2.2
Temperature
50 °C
2.3
Speed
9500 min⁻¹
2.4
Power input
1200 W
Power consumption
32 kWh
2.5
Operating hours
220 h
Number of starts
2311
2.6
Sensor 1
0 m
Sensor 2
0 m
2.7
Digital input
2 m³/h
2.8
Accumulated flow
113.0 m³
Energy per m³
0.6 kWh/m³
2.9
Sensor 1
4-20 mA m
0 - 50
3.1
Stop, sensor 1
Max.
Min.
3.2
Warning, sensor 1
Max.
Min.
3.3
Alarm, sensor 1
Max.
Min.
3.4
Sensor 2
4-20 mA m
0 - 50
3.5
Stop, sensor 2
Max.
Min.
3.6
Warning, sensor 2
Max.
Min.
3.7
Alarm, sensor 2
Max.
Min.
3.8
Stop type
No. 1 Fill
No. 2
3.9
Digital input
Type Flow
l/pulse
3.10
Accumulated flow
Stop
Sensor Dig
3.11
Warning, temperature
60 °C
3.12
Controller
Open loop
4.1
External setpoint
4.2
Automatic restart
Time
Double Yes
4.3
Start delay
0 s
4.4
Run Stop
1 min.
1 min.
4.5
Dewatering stop
4.6
Dry-running protection
Active
4.7
Maximum rpm
10900 min⁻¹
4.8
Button on CU 300
Active
4.9
Number
1
4.10

R100 Menu Structure

R100 Menu Structure for the CU300

0. General

1. Operation
1.1 Set-point setting
1.2 Selection of operating mode
1.3 Alarm indication

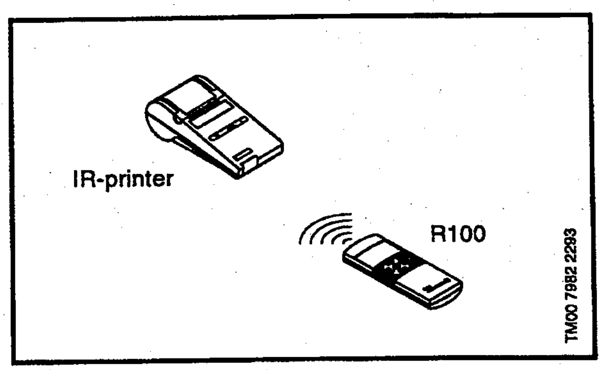
2. Status
The indication of:
2.1 Actual operating mode
2.2 Actual and external set point
2.3 Actual motor temperature
2.4 Actual motor speed
2.5 Actual power input and accumulated motor power consumption
2.6 Accumulated number of operating hours and accumulated number of starts
2.7 Actual values of sensors 1 and 2 respectively
2.8 Actual values of the digital input
2.9 Accumulated flow, and the power used to pump 1 gal.

R100 allows you to make a number of settings:

3. Limits
The setting of:
3.1 Sensor 1
3.2 Min. and max. stop limit of sensor 1
3.3 Min. and max. warning limit of sensor 1
3.4 Min. and max. alarm limit of sensor 1
3.5 Sensor 2
3.6 Min. and max. stop limit of sensor 2
3.7 Min. and max. warning limit of sensor 2
3.8 Min. and max. alarm limit of sensor 2
3.9 Filling or emptying
3.10 Setting of the function of the digital sensor connected to the digital input
3.11 The setting of the water quantity stop limit and the setting of the sensor to detect water quantity
3.12 The setting of the temperature warning limits of the motor electronics

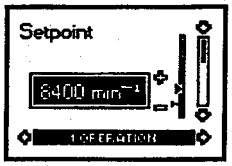
4. Installation
4.1 Selection of controller
4.2 Setting of external set-point
4.3 Setting of automatic restart time
4.4 Allocation of individual start delays
4.5 Setting of the stop and run times for the de-water ing function.
4.6 Setting of the minimum value of the pump power input
4.7 Activating or deactivating the Dry-Run protection.
4.8 Setting of the maximum motor speed
4.9 Activating or deactivating the on/off-button on the CU 300.
4.10 Allocation of number where more than one CU 300 is installed.

Status report
All settings and measured values can be transferred to a portable printer via wireless infrared communication and be printed in a status report.



Examples of R100 displays

Menu OPERATION



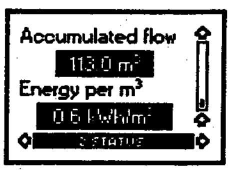
1.1

Set-point Setting
From the factory, the pump is set to maximum speed, 10,700 rpm. R100 allows you to reduce the pump speed by changing the setpoint. The speed can be set from 7,000 – 10,700 rpm, at 100 rpm intervals.

The unit of the set-point is automatically changed according to the unit of the sensor connection to sensor input no. 1.

EXAMPLE: Sensor input no. 1 is connected to a pressure sensor using the unit feet (ft.) and the range 0 – 200. Therefore, the set-point of display 1.1 can be set to between 0 – 200 ft.

Menu STATUS



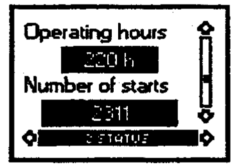
2.9

The displays appearing in this menu are status displays only. You cannot change settings in this menu.

Accumulated Flow
In display 2.9, the water quantity (gal.) pumped is shown. The value shown is the accumulated flow registered by the sensor selected in display 3.11.

The power used to pump 1 gal. is shown in the display as energy per gal. (kWh/gal.).

Accumulated Number of Operating Hours and Number of Starts



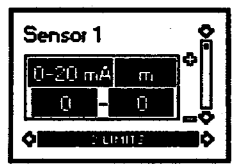
2.6

The value of operating hours and the number of starts are values accumulated from the time of installation and they cannot be reset.

Both values are stored in the motor electronics, and are kept even if the CU300 is replaced.

The number of operating hours is registered every two minutes of continuous operation.

Menu LIMITS



3.1

The Setting of Sensor 1.

Depending on the type of sensor, the following settings can be made:

Sensor outputs:
(not active), 0-10V, 2-10V, 0-20 mA, 4-20mA.

Setting range unit: M^3/h, m, %, gpm, ft.

Grundfos SQ/SQE Performance Data

5 SQ/SQE

SELECTION CHARTS

(Ratings are in GALLONS PER MINUTE-GPM)

FLOW RANGE

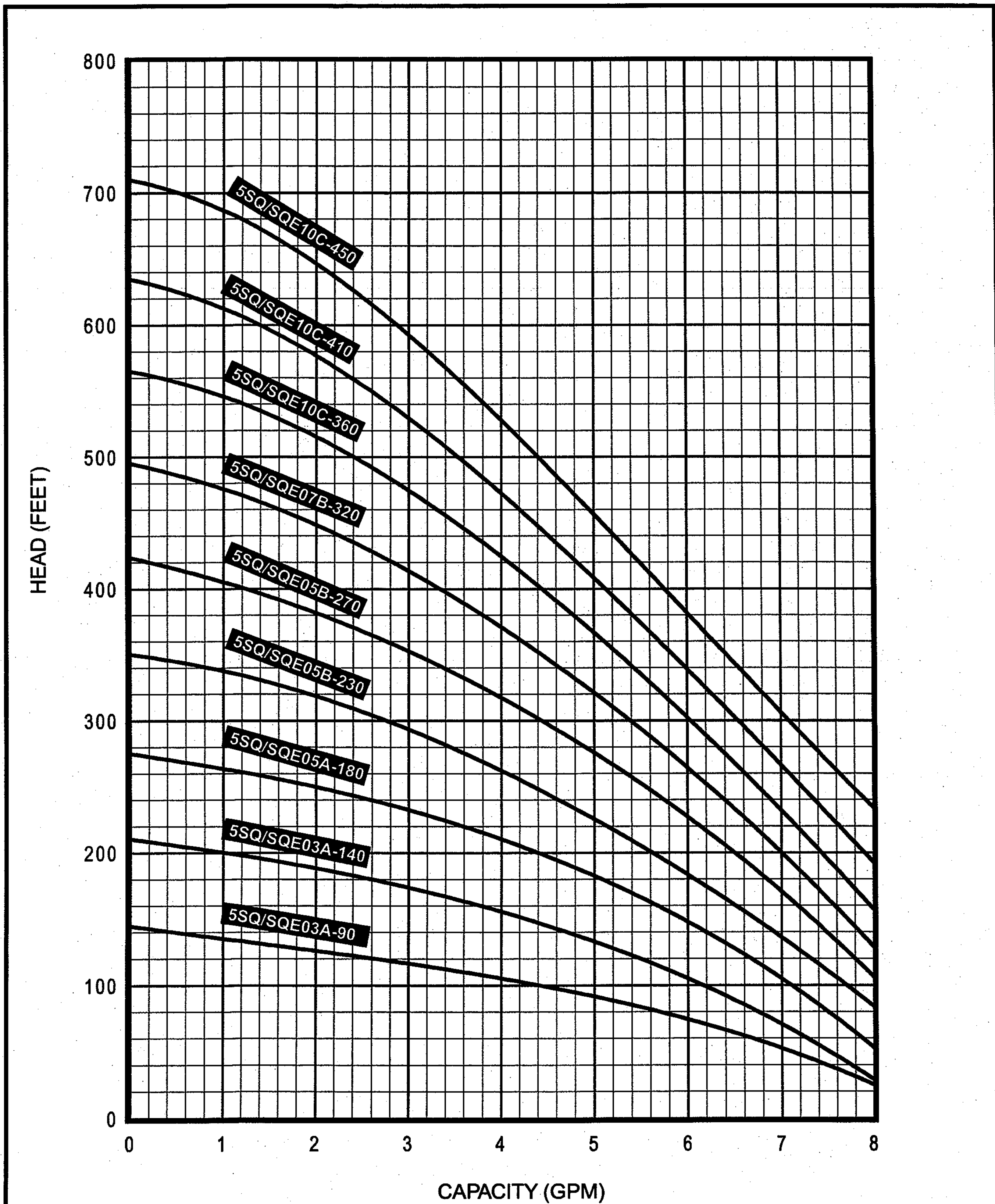
(1.5 TO 8 GPM)

PUMP OUTLET

1" NPT

			DEPTH TO PUMPING WATER LEVEL (LIFT) IN FEET																								
PUMP MODEL	HP	PSI	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	340	400	460	520	600	700	800	900	1000	1100
5SQ/SQE03A-90	1/3	0	8	7.5	6.7	5.7	4.4	2.6	0.4																		
		20	6.5	5.5	4.2	2.3	0.1																				
		30	5.1	3.6	1.6																						
		40	3.6	1.5																							
		50	1																								
		60																									
SHUT-OFF PSI:			97	89	78	71	20	11	2																		
5SQ/SQE03A-140	1/3	0	8	7.7	7.3	6.7	6.1	5.5	4.7	3.7	2.6	1															
		20	7.1	6.6	6	5.3	4.5	3.5	2.2	0.6																	
		30	6.5	5.9	5.1	4.3	3.3	1.9																			
		40	5.8	5.1	4.1	3.2	1.8																				
		50	4.9	4	3	1.4																					
		60	3.8	2.6	1																						
SHUT-OFF PSI:			82	74	65	56	48	39	30	22	13	4															
5SQ/SQE05A-180	1/2	0			7.9	7.5	7.1	6.7	6.2	5.6	5.1	4.4	3.6	2.6	1.1												
		20	7.8	7.4	7	6.5	6.1	5.5	4.9	4.2	3.3	2.3	0.8														
		30	7.3	6.9	6.5	5.9	5.4	4.8	4.1	3.2	2	0.2															
		40	6.9	6.5	5.9	5.4	4.7	4	3.1	2	0.1																
		50	6.3	5.8	5.3	4.6	3.8	2.9	1.6																		
		60	5.7	5.1	4.4	3.6	2.6	1.2																			
SHUT-OFF PSI:			110	102	93	84	76	67	58	50	41	33	24	15	7												
5SQ/SQE05B-230	1/2	0				8	7.7	7.3	6.9	6.5	6.1	5.6	5.1	4.6	4.1	3.4	2.8	0.8									
		20		8	7.6	7.1	6.8	6.3	5.9	5.4	5	4.5	3.9	3.3	2.6	1.8	0.6										
		30	7.9	7.5	7.1	6.7	6.3	5.9	5.4	4.9	4.4	3.8	3.1	2.4	1.5												
		40	7.5	7.1	6.7	6.3	5.8	5.4	4.9	4.3	3.7	3.1	2.3	1.4													
		50	7	6.6	6.2	5.8	5.3	4.8	4.2	3.6	2.9	2.2	1.2														
		60	6.5	6.1	5.6	5.1	4.6	4.1	3.4	2.8	2	0.9															
SHUT-OFF PSI:			143	134	126	117	108	100	91	82	74	65	56	48	39	30	22	4									
5SQ/SQE05B-270	1/2	0					8	7.8	7.5	7.2	6.8	6.5	6.1	5.8	5.3	4.9	4.4	3.4	1.2								
		20			8	7.7	7.4	7.1	6.7	6.4	6	5.6	5.2	4.8	4.3	3.8	3.2	1.8									
		30		8	7.7	7.3	7	6.7	6.3	5.9	5.5	5.1	4.7	4.2	3.7	3.1	2.4	0.8									
		40	8	7.7	7.3	7	6.7	6.3	5.9	5.5	5.1	4.7	4.2	3.7	3.1	2.4	1.6										
		50	7.6	7.3	6.9	6.6	6.2	5.9	5.2	5	4.6	4.1	3.5	3	2.2	1.5	0.6										
		60	7.2	6.9	6.5	6.1	5.7	5.3	4.9	4.4	3.9	3.4	2.7	2.1	1.2	0.2											
SHUT-OFF PSI:			175	167	158	149	141	132	123	115	106	97	89	80	71	63	54	37	11								
5SQ/SQE07B-320	3/4	0							7.9	7.6	7.3	7	6.7	6.4	6.1	5.7	5.4	4.6	3.4	1.6							
		20					7.8	7.5	7.2	6.9	6.6	6.3	6	5.6	5.3	4.9	4.5	3.9	2.1								
		30			8	7.7	7.5	7.1	6.9	6.5	6.2	5.9	5.5	5.2	4.8	4.4	4	3.1	1.2								
		40		8	7.7	7.5	7.1	6.9	6.5	6.2	5.9	5.5	5.2	4.8	4.4	4	3.5	2.5	0.2								
		50	7.9	7.6	7.4	7.1	6.8	6.5	6.1	5.8	5.5	5.1	4.7	4.3	3.9	3.5	3	1.9									
		60	7.6	7.3	7	6.7	6.4	6	5.7	5.4	5	4.6	4.2	3.8	3.3	2.8	2.2	0.8									
SHUT-OFF PSI:			249	240	232	223	214	206	197	188	180	171	162	154	145	136	128	110	84	58							
5SQ/SQE10C-360	1	0								8	7.7	7.4	7.2	6.9	6.6	6.3	6	5.4	4.4	3.3	1.9						
		20						7.9	7.6	7.3	7.1	6.8	6.5	6.2	5.9	5.6	5.3	4.7	3.8	2.3							
		30				8	7.8	7.6	7.3	7	6.7	6.5	6.2	5.9	5.6	5.3	4.9	4.3	3.1	1.6							
		40			8	7.8	7.5	7.3	7	6.7	6.5	6.1	5.9	5.6	5.3	4.9	4.6	3.9	2.6	0.8							
		50		0.8	7.8	7.5	7.2	7	6.7	6.4	6.1	5.8	5.5	5.2	4.9	4.5	4.2	3.3	2								
		60	8	7.7	7.4	7.2	6.9	6.6	6.3	6	5.7	5.4	5.1	4.8	4.4	4.1	3.7	2.9	1.2								
SHUT-OFF PSI:			234	227	219	210	201	193	184	175	167	158	149	141	132	123	115	97	71	46	20						
5SQ/SQE10C-410	1	0										7.9	7.6	7.4	7.1	6.8	6.5	6	5.1	4.2	3.2	1.4					
		20								7.8	7.6	7.3	7	6.7	6.5	6.2	5.9	5.3	3.6	3.4	2.3						
		30						8	7.8	7.5	7.3	7	6.7	6.4	6.1	5.9	5.6	5	4.1	3	1.7						
		40					8	7.8	7.5	7.3	7	6.7	6.4	6.1	5.8	5.6	5.3	4.7	3.7	2.6	1.1						
		50				8	7.7	7.4	7.2	6.9	6.6	6.3	6.1	5.8	5.5	5.2	4.9	4.3	3.3	2.1							
		60			7.9	7.6	7.4	7.1	6.8	6.5	6.3	6	5.7	5.4	5.1	4.8	4.5	3.9	2.8	1.4							
SHUT-OFF PSI:					249	240	232	223	214	206	197	188	180	171	162	154	145	128	102	76	50	15					
5SQ/SQE10C-450	1	0												7.9	7.6	7.4	7.1	6.6	5.8	5	4.1	2.9					
		20										7.9	7.6	7.3	7	6.7	6.5	6	5.1	4.3	3.4	2					
		30								8	7.8	7.5	7.2	6.9	6.7	6.4	6.1	5.6	4.8	4	3.1	1.6					
		40							8	7.8	7.5	7.2	7	6.7	6.4	6.2	5.9	5.4	4.5	3.7	2.7	0.8					
		50						8	7.7	7.5	7.2	6.9	6.6	6.4	6.1	5.9	5.6	5	4.2	3.3	2.3						
		60					7.9	7.6	7.4	7.1	6.8	6.6	6.3	6	5.8	5.5	5.2	4.7	3.8	7.9	1.7						
SHUT-OFF PSI:							264	255	247	238	229	221	212	203	194	186	177	160	134	108	82	48					

FLOW RANGE: 1.5 - 8 GPM | **OUTLET SIZE: 1" NPT** | **NOMINAL DIA. 3"**



SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

PERFORMANCE CONFORMS TO ISO 2548 ANNEX B.

DIMENSIONS AND WEIGHTS

MODEL NO.	FIG.	HP	MOTOR SIZE	DISCH. SIZE	DIMENSIONS IN INCHES A	B	C	D	E	APPROX. SHIP WT.
5SQ/SQE03A-90	A	1/3 A	3"	1" NPT	30.4	19.8	10.6	2.6	2.9	12
5SQ/SQE03A-140	A	1/3 A	3"	1" NPT	30.4	19.8	10.6	2.6	2.9	12
5SQ/SQE05A-180	A	1/2 A	3"	1" NPT	31.5	19.8	11.6	2.6	2.9	12
5SQ/SQE05B-230	A	1/2 B	3"	1" NPT	33.6	19.8	13.7	2.6	2.9	13
5SQ/SQE05B-270	A	1/2 B	3"	1" NPT	33.6	19.8	13.7	2.6	2.9	13
5SQ/SQE07B-320	A	3/4 B	3"	1" NPT	34.6	19.8	14.8	2.6	2.9	13
5SQ/SQE10C-360	A	1 C	3"	1" NPT	38.2	21.3	16.9	2.6	2.9	16
5SQ/SQE10C-410	A	1 C	3"	1" NPT	38.2	21.3	16.9	2.6	2.9	16
5SQ/SQE10C-450	A	1 C	3"	1" NPT	39.3	21.3	18.0	2.6	2.9	16

NOTES: All models suitable for use in 3" wells, unless otherwise noted.
Weights include pump end with motor in lbs.

MATERIALS OF CONSTRUCTION

COMPONENT	SPLINED SHAFT
Valve Casing	Polyamide
Discharge Chamber	304 Stainless Steel
Valve Guide	Polyamide
Valve Spring	316LN Stainless Steel
Valve Cone	Polyamide
Valve Seat	NBR Rubber
O-ring	NBR Rubber
Lock ring	310 Stainless Steel
Top Bearing	NBR Rubber
Top Chamber	Polyamide
Guide Vanes	Polyamide
Impeller	Polyamide w/tungsten carbide bearings
Bottom Chamber	Polyamide
Neck Ring	Polyamide
Bearing	Ceramic
Suction Interconnector	Polyamide
Ring	304 Stainless Steel
Pump Sleeve	304 Stainless Steel
Cone for pressure equalization	Polyamide
Spacer	Polyamide
Sand Trap	316 Stainless Steel
Shaft w/coupling	304 Stainless Steel
Cable Guard	304 Stainless Steel

NOTES: Specifications subject to change without notice.

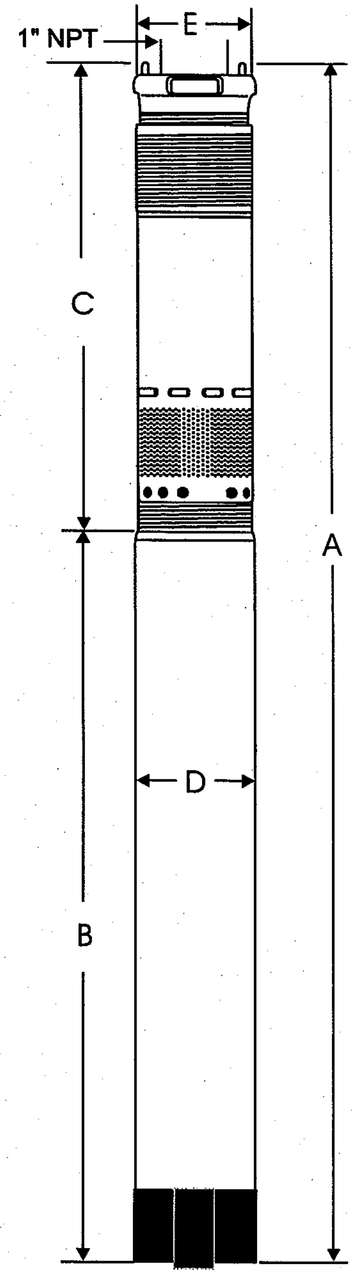


Fig. A

Grundfos SQ/SQE Technical Data & Accessories

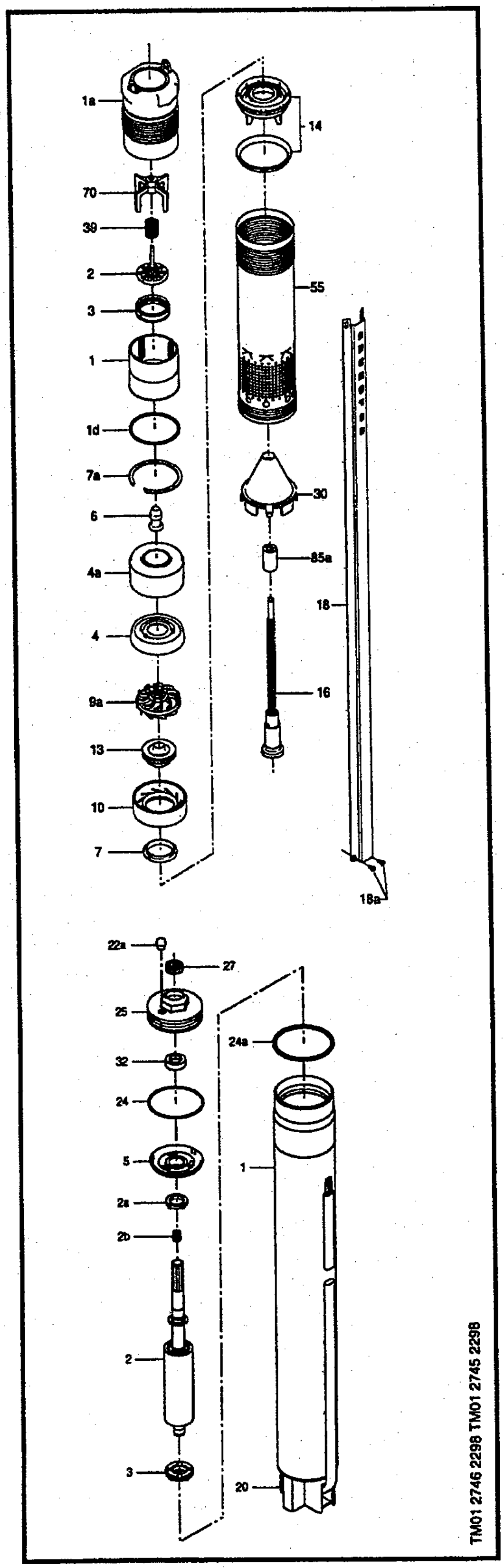
Material specification (Pump)

Pos.	Component	Material	DIN W.-Nr.	AISI
1	Valve casing	Polyamide		
1a	Discharge chamber	Stainless steel	1.4301	304
1d	O-ring	NBR rubber		
2	Valve cone	Polyamide		
3	Valve seat	NBR rubber		
4	Top chamber	Polyamide		
4a	Empty chamber	Polyamide		
6	Top bearing	NBR rubber		
7	Neck ring	Polyamide		
7a	Lock ring	Stainless spring steel	1.4310	310
9a	Guide vanes	Polyamide		
10	Bottom chamber	Polyamide		
13	Impeller with tungsten carbide bearing	Polyamide		
14	Suction interconnector	Polyamide		
14a	Ring	Stainless steel	1.4301	304
16	Shaft with coupling	Stainless steel	1.4301	304
		Sintered steel		
18	Cable guard	Stainless steel	1.4301	304
18a	Screws for cable guard	Stainless steel	1.4401	316
30	Cone for pressure equalisation	Polyamide		
39	Valve spring	Stainless spring steel	1.4406	
55	Pump sleeve	Stainless steel	1.4301	304
70	Valve guide	Polyamide		
85a	Spacer	Polyamide		

Material specification (Motor)

Pos.	Component	Material	DIN W.-Nr.	AISI
1	Stator	Stainless steel	1.4301	304
2	Rotor	Stainless steel	1.4301	304
2a	Stop ring	PP		
2b	Filter	Polyester		
3	Thrust bearing	Carbon		
5	Radial bearing	Ceramic/tungsten carbide		
20	Motor cable with plug	EPR		
22a	Filling plug	MS 3: NBR MSE 3: FPM		
24	O-ring	FPM		
24a	O-ring	FPM		
25	Top cover	PPS		
27	Filter	Polyester		
32	Shaft seal	MS 3: NBR MSE 3: FPM		
	Motor liquid	SML-2		

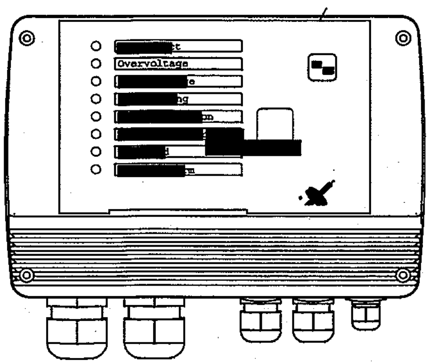
Example: SQ



SQ/SQE Technical Data

ELECTRIC	
Supply Voltage:	1x200-240V +6%/-10%, 50/60 Hz, PE 1x100-115V +6%/-10%, 50/60 Hz, PE
Operation via Generator:	As a minimum, the generator output must be equal to the motor P1[KW] +10%
Starting Current:	The motor starting current is equal to the highest value stated on the motor nameplate
Starting:	Soft-start
Run-up Time:	Maximum : 2 seconds
Motor Protection:	The motor is protected against: Dry running, overvoltage, undervoltage, overload, overtemperature
Power Factor:	PF= 1
Service Factor:	0.33-0.50A[Hp]-1.75 at 115V/230V 0.50-0.75A[Hp]-1.4 at 230V 1.0 -1.5C[Hp] -1.15 at 230V
Motor Cable:	3 Wire, 14 AWG XLPE
Motor Liquid:	Type SML 2
pH Values:	SQ and SQE: 5 to 9
Liquid Temperature:	The temperature of the pumped liquid must not exceed 104°F.
Note: if liquids with a viscosity higher than that of water are to be pumped, please contact GRUNDFOS	
PIPING CONNECTION	
Discharge Port:	5SQ/SQE- 1"NPT 10-15SQ/SQE- 1 1/4" NPT 22-30SQ/SQE- 1 1/2" NPT
STORAGE CONDITIONS	
Minimum Ambient Temperature:	-4°F
Maximum Ambient Temperature:	+140°F
Frost Protection:	If the pump has to be stored after use, it must be stored on a frost-free location or it must be ensured that the motor liquid is frost-proof. The motor must be stored without being filled with motor liquid.
OPERATING CONDITIONS	
Minimum Ambient Fluid Temperature:	34°F
Maximum Ambient Fluid Temperature:	+104°F
APPROXIMATE DIMENSIONS AND WEIGHT	
Motor Dimensions (MS 3 & MSE 3):	
0.33-0.50A[Hp]	20.9" length x 2.68" diameter
0.50-0.75B[Hp]	20.9" length x 2.68" diameter
1.0-1.5C[Hp]	22.3" length x 2.68" diameter
Motor Weights (MS 3 & MSE 3):	
0.33-0.50A[Hp]	6.0 lbs
0.50-0.75B[Hp]	7.1 lbs
1.0-1.5C[Hp]	8.2 lbs
Pump End Dimensions:	
Pump Diameter:	2.68"
Pump Diameter, incl. cable guard:	2.91"
Pump End Dimensions(min. and max.):	
5SQ/SQE	10.6" to 18.0"
10SQ/SQE	10.6" to 16.9"
15SQ/SQE	10.6" to 16.9"
22SQ/SQE	10.6" to 16.9"
30SQ/SQE	10.6" to 13.7"
Pump End Weights (min. and max.):	
All SQ/SQE Models	2.2 lbs to 3.5 lbs
Well Diameter (minimum):	3"
Installation Depth (Maximum):	500 feet, below static water level

CU300 Status Box



Description	Product no.
CU300 Status Box	96422776

Constant Pressure Kit

Description	Product no.
5-15 SQE (Includes CU300, pressure transducer & .5 gpm flow switch)	96022968
22-30 SQE (Includes CU300, pressure transducer & 1 gpm flow switch)	96022971

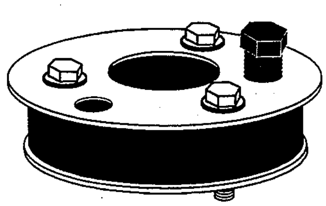
Flow Switch

Description	Product no.
5-15 SQE .5 GPM	96022967
22-30 SQE 1 GPM	96022970

Pressure Transducer

Description	Product no.
Pressure Transducer 0-90 psi (0-6 bar)	96026030

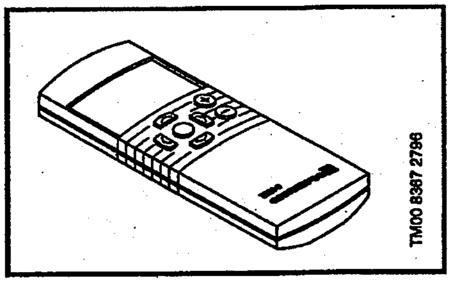
3" Well Seal



Description	Product no.
3" Sanitary Well Seal	1B5102

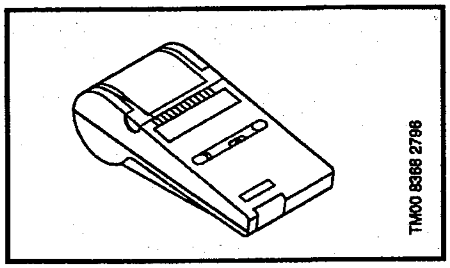
SQ/SQE Accessories

R100 remote control



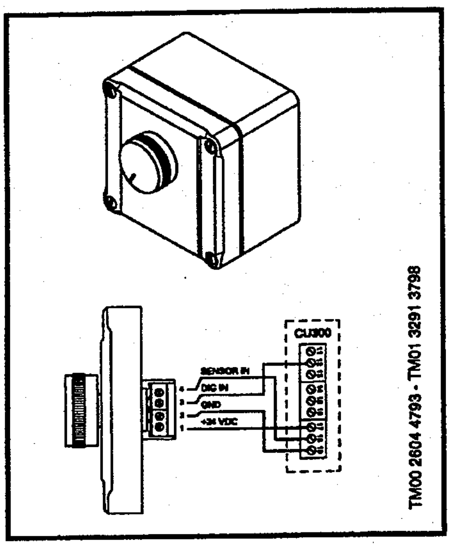
Description	Product no.
The R100 is used for wireless infrared communication with the CU300	6253333

Printer



Description	Product no.
Printer for R100, infrared communication Type: Hewlett Packard, HP 82240B	620480
Paper Roll	620481

Potentiometer

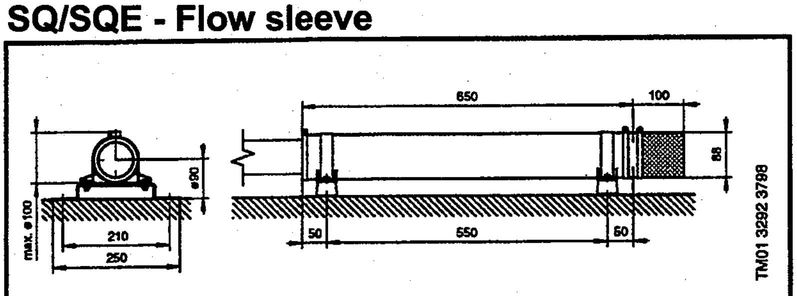


Description	Version	Product no.
External potentiometer with cabinet for wall mounting. Screened cables, 4-wire cable, max. length of cable: 100m	Grundfos potentiometer, SPP1 Enclosure class: IP 55	655468

SQE - Speed calculation software

Description	Product no.
Speed calculation program (Windows95) including: • PC Tool SQE speed calculation, two diskettes • Operating manual	96426840

SQ/SQE - Flow sleeve



Description	Product no.
Flow Sleeve Complete	96037505

Appendix J

Air-Stripping Unit Design

Air Stripper Design

1. Estimate average concentration of chlorinated ethenes in extracted groundwater from shallow and intermediate zones.

Assumptions:

An evaluation of 2004 groundwater sampling data indicate PCE and its breakdown product concentrations in the areas of the proposed extraction wells are as follows:

Shallow Zone

Compound	MWS-10 (μg/l)	MWS-15 (μg/l)	OW-1S (μg/l)	MWS-8 (μg/l)	MC-5 (μg/l)	Average (μg/l)
Tetrachloroethene	50,000	230	490	57	<25	10,158
Trichloroethene	3,700	430	190	78	470	974
Cis-1,2- dichloroethene	8,900	8,600	1,400	1,300	3,200	4,680
Trans-1,2-dichloroethene	<1,000	<50	<13	<13	<25	Non-Detect
Vinyl chloride	<1,000	1,200	33	91	570	479

Intermediate Zone

Compound	MWI-6 (μg/l)	MWI-9 (μg/l)	OW-1I (μg/l)	OW-2I (μg/l)	MWI--17 (μg/l)	Average (μg/l)
Tetrachloroethene	<50	<100	<10	<25	<5	Non-Detect
Trichloroethene	120	<100	<10	<25	<5	38
Cis-1,2- dichloroethene	9,500	3,400	3,700	<25	52	3,333
Trans-1,2-dichloroethene	<50	<100	25	2,700	<5	560
Vinyl chloride	63	150	270	150	20	130

The design pumping rates in the shallow zone is 10 gpm and the design pumping rate from the intermediate zone is 8 gpm. Therefore the average chlorinated ethene concentrations can be estimated as follows:

$$PCEave = \frac{10(10{,}158) + 8(0))}{10 + 8}$$

$PCE_{ave=}$ =5,643 µg/l

Similarily, the average concetrations of TCE (558 µg/l), cis-DCE (4,081 µg/l), trans-DCE (249 µg/l), and vinyl chloride (324 µg/l) are calculated.

2. Size Air Stripper.

Assumptions:

Groundwater flow rate is 18 gpm
Average chlorinated ethene concentration in groundwater listed above
Effluent standard is 5 μg/l for PCE, TCE, and DCE, and 2 μg/l for VC

Based upon these assumptions, a QED EZ-Tray 4.4 is recommended as determined by the QED Air Stripper Model version C1.10. The model calculations for this air stripper are attached. The model indicates that the groundwater will be treated to below discharge limits for each constituent.

3. Design Air Treatment for the Air Stripper.

From Carbtrol, the adsorption capacity of granular activated carbon (GAC), q, is 0.35 lbs of PCE/lbs GAC; however, the adsorption capacity for TCE is approximately 0.2 lbs of TCE/lbs GAC and DCE is 0.1 lbs DCE/lbs GAC. Therefore it is assumed that the adsorption capacity for total chlorinated ethenes would be 0.2 lbs/lbs GAC.

The total estimated mass of total chlorinated ethenes to be removed from groundwater is estimated be 0.098 lbs/hour per the QED Air Stripper Model.

Compound	Average (lbs/hr)
Tetrachloroethene	0.051
Trichloroethene	0.005
Cis-1,2- dichloroethene	0.037
Trans-1,2-dichloroethene	0.0029
Vinyl chloride	0.002

Therefore the carbon usage will be 0.49 lbs/hr. It is proposed to pipe the air stripper vapor emissions (210 cfm) through the two 170 lb. GAC vessels. The carbon will not remove vinyl chloride; however, this constituent will be emitted at concentrations well below its guideline concentration.

QED Air Stripper Model ver. c1.10

1/17/2005

Site Data

Name: Scott Starr
e-mail: Scott.Starr@lfr.com
Project: Monarch Chemical
Units: English
Altitude: 250 ft
Air Temp: 45 F
Flow: 16 gpm
Water Temp: 55 F
Stripper: EZ-Tray 4.x - Click for details
Stripper Air Flow: 210 cfm
Stripper Max Flow: 25 gpm

Water Results

Contaminant	Influent (ppb)	Target (ppb)	4-Tray Results (ppb)	4-Tray % Removal	6-Tray Results (ppb)	6-Tray % Removal
trichloroethylene (TCE)	623	5	< 1	100.000	< 1	100.000
tetrachloroethylene (PERC,PCE)	6350	5	< 1	100.000	< 1	100.000
c-1,2-dichloroethylene	4175	5	< 1	100.000	< 1	100.000
vinyl chloride (chloroethylene)	348	2	< 1	100.000	< 1	100.000
t-1,2-dichloroethylene	244	5	< 1	100.000	< 1	100.000

Air Results

Contaminant	4-Tray (ppmV)	4-Tray (lb/hr)	6-Tray (ppmV)	6-Tray (lb/hr)
trichloroethylene (TCE)	1.1204	0.00499	1.1204	0.00499
tetrachloroethylene (PERC,PCE)	9.0482	0.05087	9.0482	0.05087
c-1,2-dichloroethylene	10.1743	0.03344	10.1765	0.03344
vinyl chloride (chloroethylene)	1.3157	0.00279	1.3157	0.00279
t-1,2-dichloroethylene	0.5946	0.00195	0.5947	0.00195

Notes

PH-> 1-800-624-2026 or 1-734-995-2547, FX-> 1-734-995-1170. E-mail->info@qedenv.com. WEB->www.qedenv.com.

The QED modeler estimates unit performance for the listed contaminants.
Results assume -

1. *dissolved-phase contaminant within a water matrix*
2. *clean stripper air*
3. *no surfactants, oil, grease or other immiscible phase(s) in the influent*
4. *unit operated within the given parameters and as instructed in the*

O&M manual

Stripper performance shall meet or exceed either the required effluent concentration(s) or effluent estimates, whichever is greater, for the conditions supplied and assumes the influent concentrations of each contaminant are less than 25% solubility in water. QED makes no claim of the model's accuracy beyond the 25% solubility in water limit.

Contact Us

Fill out your contact and project information and click Send to have a QED Treatment application specialist contact you.

Name - Scott Starr

Company - Company

Phone - Phone **Fax -** Fax

e-mail - Scott.Starr@lfr.com **Project -** Monarch Chemical

Application Notes

Save Data

Use the following URL to reconstruct your data form for future remodeling with changes. This URL can be saved in any text file for record keeping and later retrieval. This run's URL:

```
http://www.qedenv.com/cgi-bin/remodel.pl?
u=e&tw=55&ta=45&f=16&a=250&s=4.x&n=Scott&e=Scott.Starr@lfr.com&p=Monar
&c=35,623;40,6350;200,4175;445,348;405,244;
```

Appendix K

Air-Stripping Unit Equipment Cut-Sheets

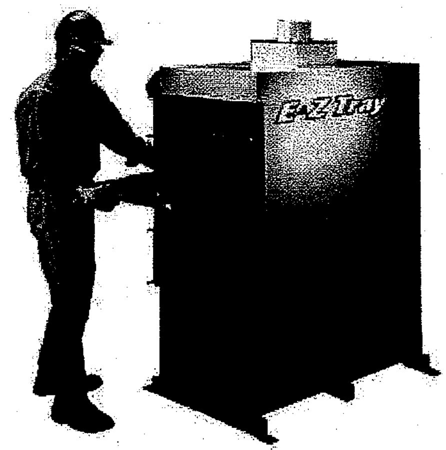
EZ-Tray Low Profile Air Stripper

Removable tray high-efficiency air stripper for VOC removal

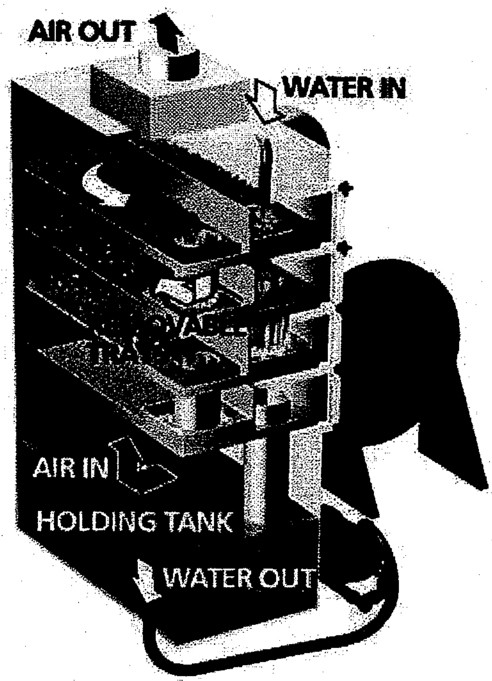
The EZ-Tray is a low profile stainless steel air stripper used to remove volatile organic compounds (VOC) from groundwater. The exclusive design of the EZ-Tray stripper results in VOC removal rates up to 99%.

The EZ-Tray air stripper uses lightweight, front slideout trays. This unique feature provides many advantages, such as one man operation and cleaning, and installation is small areas.

The EZ-Tray air strippers are available in configurations with 4 or 6 trays, with maximum flow rates from 1 - 25 GPM (4 - 100 LPM) to 1 - 200 GPM (4 - 757 LPM).



How the EZ-Tray Air Stripper Works



As contaminated groundwater enters through the top of the air stripper, millions of air bubbles are forced by the blower pressure up through the perforated trays, vigorously aerating the water to a froth and removing volatile contaminants (VOC) as gravity pulls the water down through each tray.

This simple, revolutionary technology delivers up to 99% VOC removal, while the low maintenance and easy access cut O & M costs dramatically.

EZ-Tray Advantages

- ✓ Single person cleaning
- ✓ Easy accessibility
- ✓ Space and construction cost savings
- ✓ High efficiency VOC removal - up to 99%

Specifications

Model Number	Maximum Flow	Dry Weight	Oper. Weight	Shell Dimension (LxWxH)	Trays per Tier	Active Area	Nominal Air Flow	Required Clearance	Drawings
4.4	1 - 25 GPM (4 - 95 LPM)	630 lb (285 Kg)	985 lb (447 Kg)	29 x 27 x 82 in (73.6 x 68.6 x 208 cm)	4	2.8 sq.ft ($0.26 m^2$)	210 cfm (5.93 m3/min)	4 x <27 in (10 x <68.5cm)	
	1 - 25 GPM	780 lb	1,219 lb	29 x 27 x 102 in		2.8 sq.ft	210 cfm	4 x <27 in	

4.6	(4 - 95 LPM)	(353 Kg)	(553 Kg)	(73.6 x 68.6 x 259 cm)	6	(0.26m^2)	(5.93 m3/min)	(10 x <68.5cm)	
6.4	1 - 60 GPM (4 - 227 LPM)	790 lb (358 Kg)	1,285 lb (583 Kg)	37 x 27 x 82 in (94 x 68.6 x 208 cm)	4	3.8 sq.ft (0.35m^2)	320 cfm (9.06 m3/min)	4 x <35 in (10 x <88.9cm)	
6.6	1 - 60 GPM (4 - 227 LPM)	978 lb (443 Kg)	1,591 lb (721 Kg)	37 x 27 x 102 in (94 x 68.6 x 259 cm)	6	3.8 sq.ft (0.35m^2)	320 cfm (9.06 m3/min)	4 x <35 in (10 x <88.9cm)	
8.4	1 - 60 GPM (4 - 227 LPM)	955 lb (433 Kg)	716 lb (583 Kg)	49 x 27 x 82 in (124 x 68.6 x 208 cm)	4	5.6 sq.ft (0.52m^2)	420 cfm (11.89 m3/min)	4 x <47 in (10 x <119.4cm)	
8.6	1 - 100 GPM (4 - 378 LPM)	1,182 lb (536 Kg)	1,956 lb (887 Kg)	49 x 27 x 102 in (124 x 68.6 x 259 cm)	6	5.6 sq.ft (0.52m^2)	420 cfm (11.89 m3/min)	4 x <47 in (10 x <119.4cm)	
12.4	1 - 100 GPM (4 - 378 LPM)	1,165 lb (528 Kg)	2,105 lb (954 Kg)	73 x 27 x 82 in (185 x 68.6 x 208 cm)	4	8.8 sq.ft (0.82m^2)	600 cfm (16.99m3/min)	4 x <71 in (10 x <180.3cm)	
12.6	1 - 100 GPM (4 - 378 LPM)	1,142 lb (654 Kg)	2,606 lb (1182 Kg)	73 x 27 x 102 in (185 x 68.6 x 259cm)	6	8.8 sq.ft (0.82m^2)	600 cfm (16.99m3/min)	4 x <47 in (10 x <119.4cm)	
16.4	1 - 120 GPM (4 - 454 LPM)	1,625 lb (737 Kg)	2,870 lb (1.302 Kg)	49 x 52 x 84 in (124 x 132 x 213.4 cm)	8	11.1 sq.ft (1.03m^2)	850 cfm (24.07m3/min)	4 x <47 in (10 x <119.4cm)	
16.6	1 - 120 GPM (4 - 454 LPM)	2,011 lb (912 Kg)	3,553 lb (1.611 Kg)	49 x 52 x 104 in (124 x 132 x 264 cm)	12	11.1 sq.ft (1.03m^2)	850 cfm (24.07m3/min)	4 x <47 in (10 x <119.4cm)	
24.4	1 - 200 GPM (4 - 757 LPM)	2,100 lb (952 Kg)	3,980 lb (1.805 Kg)	73 x 52 x 84 in (185 x 132 x 213.4 cm)	8	17.5 sq.ft (1.63m^2)	1300 cfm (36.81m3/min)	4 x <72in (10 x <182.8cm)	
24.6	1 - 200 GPM (4 - 757 LPM)	2,599 lb (1.179 Kg)	4,926 lb (2.234 Kg)	73 x 52 x 104 in (185 x 132 x 264 cm)	12	17.5 sq.ft (1.63m^2)	1300 cfm (36.81m3/min)	4 x <72in (10 x <182.8cm)	

* Required clearance (back/sides by front, installed on a standard skid)

Complete EZ-Tray Engineering Specifications

On Line Air Stripper Modeler

The exclusive QED On Line Air Stripper Modeler has been developed to assist you in selecting the most efficient air stripping package for your groundwater cleanup project.

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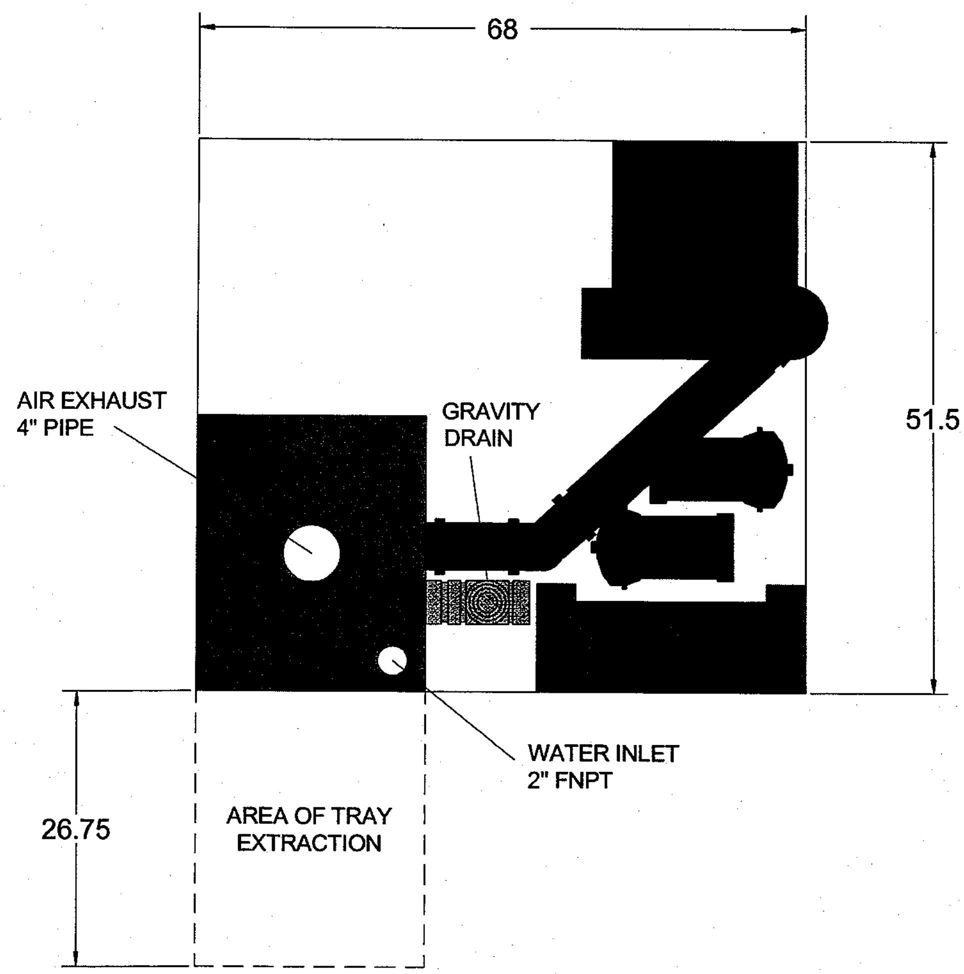
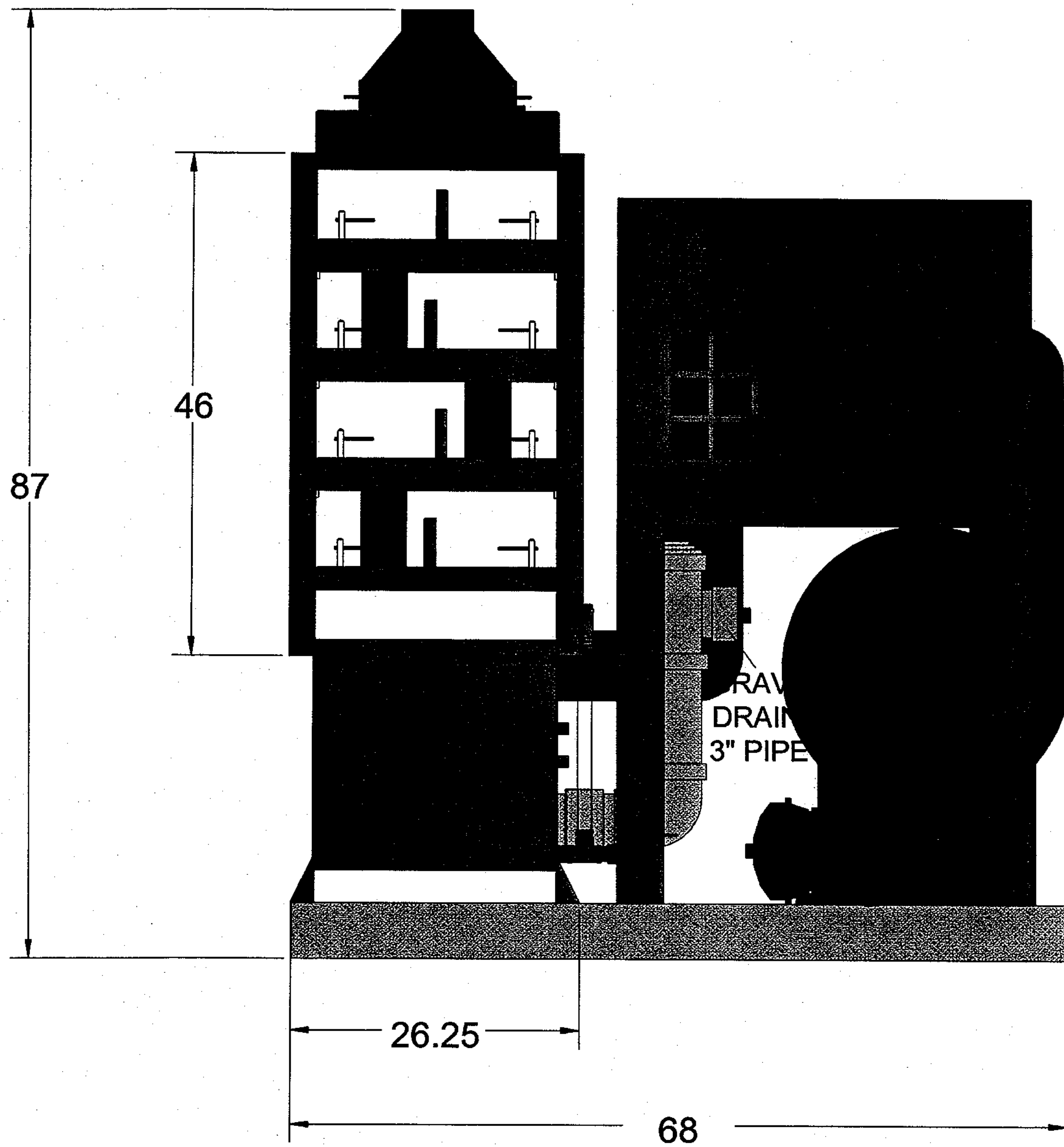
QED EZ-Tray Model 4.4 - Top View



QED EZ-Tray Model 4.4 - Front View



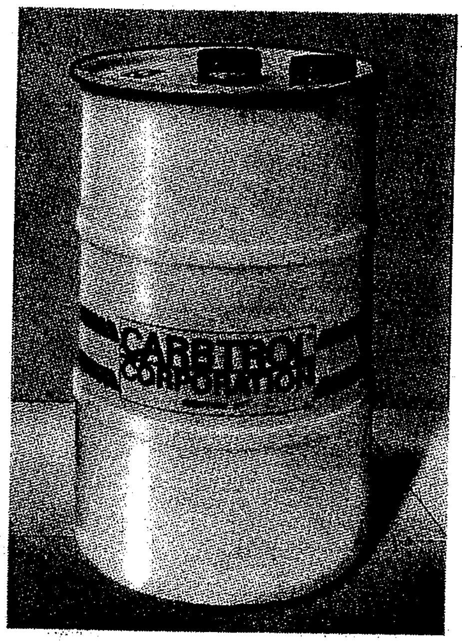
Appendix L

Air-Treatment Equipment Cut-Sheets

CARBTROL®

AIR PURIFICATION CANISTERS 140-200 LB. ACTIVATED CARBON

G-1
G-2
G-3



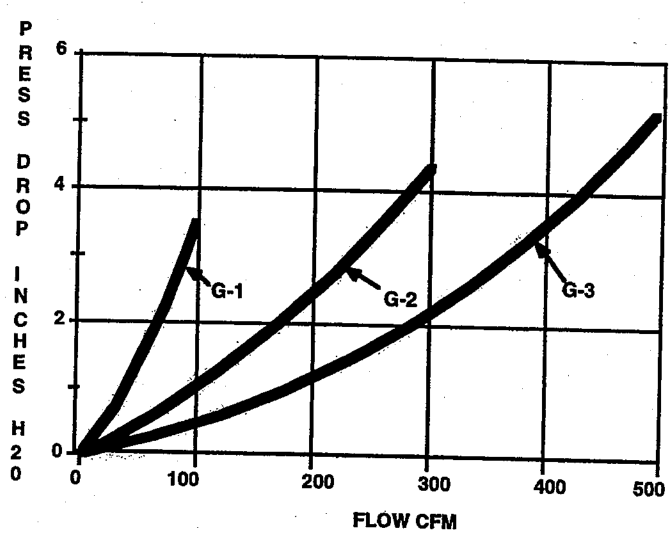
The CARBTROL "G" Canisters handles flows up to 500 CFM.

FEATURES

- High activity carbon.
- Epoxy lined steel or polyethylene construction.
- Acceptable for transport of hazardous spent carbon.
- Side drain for removal of accumulated condensate.
- Low pressure drop.
- PVC internal piping.
- High temperature (180°F) steel units available.

APPLICATIONS

- Soil vapor remediation
- Air stripper exhausts
- Tank vents
- Exhaust hoods
- Work area purification
- Sewage plant odor control



CARBTROL® CORPORATION

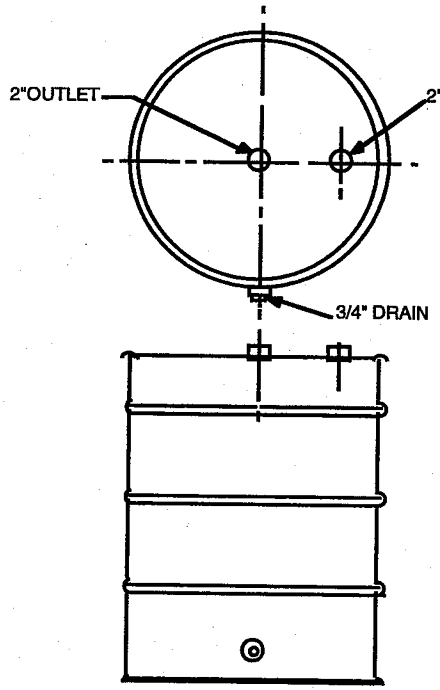
51 Riverside Avenue
Westport, CT 06880

1-800-242-1150 • Fax # (203) 226-5322
Web Address: http://www.carbtrol.com

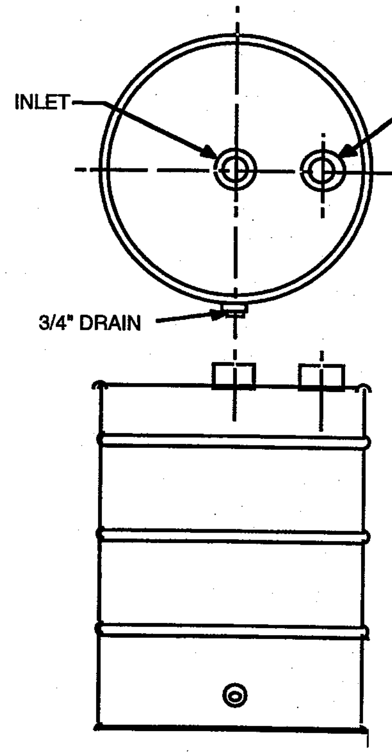
CARBTROL®

AIR PURIFICATION CANISTERS 140-200 LB. ACTIVATED CARBON

G-1
G-2
G-3



MODEL G-1



MODEL G-2,G-3

SPECIFICATIONS

MODEL	DIAMETER/HEIGHT	CARBON WEIGHT	INLET/OUTLET	MAXIMUM RATED FLOW	APPROXIMATE SHIP WEIGHT
G-1*	24"/36"	200 lbs.	2"/2"	100 CFM	240 lbs.
G-2*	24"/36"	170 lbs.	4"/4"	300 CFM	210 lbs.
G-3P	24"/36"	140 lbs.	6"/6"	500 CFM	180 lbs.
G-3S	24"/34"	140 lbs.	4"/4"	500 CFM	180 lbs.

* Specify: Polyethylene (P) or Epoxy Lined Steel (S)

SAFETY

Certain chemical compounds in the presence of activated carbon may oxidize, decompose or polymerize. This could result in temperature increases sufficient to cause ignition of the activated carbon or adsorbed material. If a compounds reaction with activated carbon is unknown, appropriate tests should be considered.

CARBTROL® CORPORATION

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Westport, CT 06880

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Appendix M

Weighting of Natural Attenuation Indicator Parameter Worksheet

Weighting of Natural Attenuation Parameters[a]
MC-3
Former Monarch Chemicals, Inc.
Utica, New York

Analyte	Concentration Criteria (mg/l)*	Concentration Detected at the Site (mg/l)*	Interpretation	Criteria Points Awarded	Actual Points Awarded
Oxygen	<0.5	0.48	Tolerated; suppresses reductive dechlorination at higher concentrations	3	3
Oxygen	>1		Vinyl chloride may be oxidized aerobically, but reductive dechlorination will not occur	-3	
Nitrate	<1	<0.5	May compete with reductive pathway at higher concentrations	2	2
Iron (II)	>1	2.96	Reductive pathway possible	3	3
Sulfate	<20	<2	May compete with reductive pathway at higher concentrations	2	2
Sulfide	>1	1.8	Reductive pathway possible	3	3
Methane	>0.1		Ultimate reductive daughter product	2	
	>1	4.7	Vinyl chloride accumulates	3	3
	<1		Vinyl chloride oxidizes		
Oxidation reduction potential	<50	-148.2	Reductive pathway possible	<50 = 1 <-100 = 2	2
pH	5 < pH < 9	6.98	Tolerated range for reductive pathway		0
DOC[c]	>20	8.73	Carbon and energy source; drives dechlorination; can be natural or anthropogenic	2	0
Temperature	>20°C	12.1	At T>20°C, biochemical process is accelerated	1	0
Alkalinity	>2x background	245	Results from interaction of carbon dioxide with aquifer minerals	1	0

Weighting of Natural Attenuation Parameters[a]
MC-3
Former Monarch Chemicals, Inc.
Utica, New York

Analyte	Concentration Criteria (mg/l)*	Concentration Detected at the Site (mg/l)*	Interpretation	Criteria Points Awarded	Actual Points Awarded
Chloride[c]	>2x background	NM	Daughter product of organic chlorine; compare chloride in plume to background conditions	2	0
Perchloroethene		<0.005	Material released		0
Trichloroethene		<0.005	Material released or daughter product of perchloroethene	2[b]	0
Dichloroethene		0.032	Material released or daughter product of trichloroethene; if amount of *cis*-1,2-dichloroethene is greater than 80% of total dichloroethene, it is likely a daughter product of trichloroethene	2[b]	2
Vinyl chloride		0.026	Material released or daughter product of dichloroethenes	2[b]	2
Ethene/Ethane	<0.1	<0.001	Daughter product of vinyl chloride/ethene	>0.01 = 2[b] >0.1 = 3[b]	0
Chloroethane		NA	Daughter product of vinyl chloride under reducing conditions	2[b]	0

Weighting of Natural Attenuation Parameters[a]
MC-3
Former Monarch Chemicals, Inc.
Utica, New York

Analyte	Concentration Criteria (mg/l)*	Concentration Detected at the Site (mg/l)*	Interpretation	Criteria Points Awarded	Actual Points Awarded
1,1,1-Trichloroethane		<0.005	Material released		0
1,1-Dichloroethene		<0.010	Daughter product of trichloroethene or chemical reaction of 1,1,1-trichloroethane		0

Total Points Awarded: 22

Score	Interpretation
0 to 5	Inadequate evidence for biodegradation of chlorinated compounds.
6 to 14	Limited evidence for biodegradation of chlorinated organics.
15 to 20	Adequate evidence for biodegradation of chlorinated organics.
Greater than 20	Strong evidence for biodegradation of chlorinated organics.

[a] Source: Wiedemeier, T.H. et al., 1996.
[b] Points awarded only if the chemical is a breakdown product.
[c] Points not awarded because of equipment blank contamination.

DOC = dissolved organic carbon
U = the analyte was analyzed for, but was not detected above the reported sample quantitation limit
NA = not applicable; not analyzed
μg/l = micrograms per liter

All analyses required, with the exception of alkalinity.
*All concentrations in milligrams per liter (mg/l), except where noted or for oxidation reduction potential (reported in millivolts against Ag/AgCl), pH (reported in standard units), and temperature (reported in degrees Celsius).

Weighting of Natural Attenuation Parameters[a]
MWI-18
Former Monarch Chemicals, Inc.
Utica, New York

Analyte	Concentration Criteria (mg/l)*	Concentration Detected at the Site (mg/l)*	Interpretation	Criteria Points Awarded	Actual Points Awarded
Oxygen	<0.5		Tolerated; suppresses reductive dechlorination at higher concentrations	3	
Oxygen	>1	1.17	Vinyl chloride may be oxidized aerobically, but reductive dechlorination will not occur	-3	-3
Nitrate	<1	<0.5	May compete with reductive pathway at higher concentrations	2	2
Iron (II)	>1	2.7	Reductive pathway possible	3	3
Sulfate	<20	<2	May compete with reductive pathway at higher concentrations	2	2
Sulfide	>1	15.4	Reductive pathway possible	3	3
Methane	>0.1		Ultimate reductive daughter product	2	
	>1	6	Vinyl chloride accumulates	3	3
	<1		Vinyl chloride oxidizes		
Oxidation reduction potential	<50	-88.6	Reductive pathway possible	<50 = 1 <-100 = 2	1
pH	5 < pH < 9	7.01	Tolerated range for reductive pathway		0
DOC[c]	>20	7.02	Carbon and energy source; drives dechlorination; can be natural or anthropogenic	2	0
Temperature	>20°C	NA	At T>20°C, biochemical process is accelerated	1	0
Alkalinity	>2x background	525	Results from interaction of carbon dioxide with aquifer minerals	1	0

Weighting of Natural Attenuation Parameters[a]
MWI-18
Former Monarch Chemicals, Inc.
Utica, New York

Analyte	Concentration Criteria (mg/l)*	Concentration Detected at the Site (mg/l)*	Interpretation	Criteria Points Awarded	Actual Points Awarded
Chloride[c]	>2x background	NM	Daughter product of organic chlorine; compare chloride in plume to background conditions	2	0
Perchloroethene		<0.005	Material released		0
Trichloroethene		<0.005	Material released or daughter product of perchloroethene	2[b]	0
Dichloroethene		0.023	Material released or daughter product of trichloroethene; if amount of *cis*-1,2-dichloroethene is greater than 80% of total dichloroethene, it is likely a daughter product of trichloroethene	2[b]	2
Vinyl chloride		0.022	Material released or daughter product of dichloroethenes	2[b]	2
Ethene/Ethane	<0.1	<0.001	Daughter product of vinyl chloride/ethene	>0.01 = 2[b] >0.1 = 3[b]	0
Chloroethane		NA	Daughter product of vinyl chloride under reducing conditions	2[b]	0

Weighting of Natural Attenuation Parameters[a]
MWI-18
Former Monarch Chemicals, Inc.
Utica, New York

Analyte	Concentration Criteria (mg/l)*	Concentration Detected at the Site (mg/l)*	Interpretation	Criteria Points Awarded	Actual Points Awarded
1,1,1-Trichloroethane		<0.005	Material released		0
1,1-Dichloroethene		<0.005	Daughter product of trichloroethene or chemical reaction of 1,1,1-trichloroethane		0

Total Points Awarded: **15**

Score	**Interpretation**
0 to 5	Inadequate evidence for biodegradation of chlorinated compounds.
6 to 14	Limited evidence for biodegradation of chlorinated organics.
15 to 20	Adequate evidence for biodegradation of chlorinated organics.
Greater than 20	Strong evidence for biodegradation of chlorinated organics.

[a] Source: Wiedemeier, T.H. et al., 1996.
[b] Points awarded only if the chemical is a breakdown product.
[c] Points not awarded because of equipment blank contamination.

DOC = dissolved organic carbon
U = the analyte was analyzed for, but was not detected above the reported sample quantitation limit
NA = not applicable; not analyzed
μg/l = micrograms per liter

All analyses required, with the exception of alkalinity.
*All concentrations in milligrams per liter (mg/l), except where noted or for oxidation reduction potential (reported in millivolts against Ag/AgCl), pH (reported in standard units), and temperature (reported in degrees Celsius).

Weighting of Natural Attenuation Parameters[a]
MC-5
Former Monarch Chemicals, Inc.
Utica, New York

Analyte	Concentration Criteria (mg/l)*	Concentration Detected at the Site (mg/l)*	Interpretation	Criteria Points Awarded	Actual Points Awarded
Oxygen	<0.5	0.94	Tolerated; suppresses reductive dechlorination at higher concentrations	3	3
Oxygen	>1		Vinyl chloride may be oxidized aerobically, but reductive dechlorination will not occur	-3	
Nitrate	<1	<0.5	May compete with reductive pathway at higher concentrations	2	2
Iron (II)	>1	5.1	Reductive pathway possible	3	3
Sulfate	<20	28.1	May compete with reductive pathway at higher concentrations	2	0
Sulfide	>1	0.6	Reductive pathway possible	3	0
Methane	>0.1	0.3	Ultimate reductive daughter product	2	3
	>1		Vinyl chloride accumulates	3	
	<1		Vinyl chloride oxidizes		
Oxidation reduction potential	<50	-155	Reductive pathway possible	<50 = 1 <-100 = 2	2
pH	5 < pH < 9	6.97	Tolerated range for reductive pathway		0
DOC[c]	>20	8.23	Carbon and energy source; drives dechlorination; can be natural or anthropogenic	2	0
Temperature	>20°C	15.8	At T>20°C, biochemical process is accelerated	1	0

Weighting of Natural Attenuation Parameters[a]
MC-5
Former Monarch Chemicals, Inc.
Utica, New York

Analyte	Concentration Criteria (mg/l)*	Concentration Detected at the Site (mg/l)*	Interpretation	Criteria Points Awarded	Actual Points Awarded
Alkalinity	>2x background	330	Results from interaction of carbon dioxide with aquifer minerals	1	0
Chloride[c]	>2x background	NM	Daughter product of organic chlorine; compare chloride in plume to background conditions	2	0
Perchloroethene		<0.005	Material released		0
Trichloroethene		0.470	Material released or daughter product of perchloroethene	2[b]	2
Dichloroethene		3.2	Material released or daughter product of trichloroethene; if amount of *cis*-1,2-dichloroethene is greater than 80% of total dichloroethene, it is likely a daughter product of trichloroethene	2[b]	2
Vinyl chloride		0.570	Material released or daughter product of dichloroethenes	2[b]	2
Ethene/Ethane	<0.1	0.07	Daughter product of vinyl chloride/ethene	>0.01 = 2[b] >0.1 = 3[b]	2 0
Chloroethane		NA	Daughter product of vinyl chloride under reducing conditions	2[b]	0

Weighting of Natural Attenuation Parameters[a]
MC-5
Former Monarch Chemicals, Inc.
Utica, New York

Analyte	Concentration Criteria (mg/l)*	Concentration Detected at the Site (mg/l)*	Interpretation	Criteria Points Awarded	Actual Points Awarded
1,1,1-Trichloroethane		0.680	Material released		0
1,1-Dichloroethene		0.230	Daughter product of trichloroethene or chemical reaction of 1,1,1-trichloroethane		0
				Total Points Awarded:	21

Score	Interpretation
0 to 5	Inadequate evidence for biodegradation of chlorinated compounds.
6 to 14	Limited evidence for biodegradation of chlorinated organics.
15 to 20	Adequate evidence for biodegradation of chlorinated organics.
Greater than 20	Strong evidence for biodegradation of chlorinated organics.

[a] Source: Wiedemeier, T.H. et al., 1996.
[b] Points awarded only if the chemical is a breakdown product.
[c] Points not awarded because of equipment blank contamination.

DOC = dissolved organic carbon
U = the analyte was analyzed for, but was not detected above the reported sample quantitation limit
NA = not applicable; not analyzed
μg/l = micrograms per liter

All analyses required, with the exception of alkalinity.
*All concentrations in milligrams per liter (mg/l), except where noted or for oxidation reduction potential (reported in millivolts against Ag/AgCl), pH (reported in standard units), and temperature (reported in degrees Celsius).

Weighting of Natural Attenuation Parameters[a]
MWI-6
Former Monarch Chemicals, Inc.
Utica, New York

Analyte	Concentration Criteria (mg/l)*	Concentration Detected at the Site (mg/l)*	Interpretation	Criteria Points Awarded	Actual Points Awarded
Oxygen	<0.5	0.29	Tolerated; suppresses reductive dechlorination at higher concentrations	3	3
Oxygen	>1		Vinyl chloride may be oxidized aerobically, but reductive dechlorination will not occur	-3	
Nitrate	<1	<0.5	May compete with reductive pathway at higher concentrations	2	2
Iron (II)	>1	5.1	Reductive pathway possible	3	3
Sulfate	<20	47.7	May compete with reductive pathway at higher concentrations	2	0
Sulfide	>1	0.6	Reductive pathway possible	3	0
Methane	>0.1		Ultimate reductive daughter product	2	
	>1	1.6	Vinyl chloride accumulates	3	3
	<1		Vinyl chloride oxidizes		
Oxidation reduction potential	<50	-139.5	Reductive pathway possible	<50 = 1 <-100 = 2	2
pH	5 < pH < 9	6.83	Tolerated range for reductive pathway		0
DOC[c]	>20	7.19	Carbon and energy source; drives dechlorination; can be natural or anthropogenic	2	0
Temperature	>20°C	11.3	At T>20°C, biochemical process is accelerated	1	0

Weighting of Natural Attenuation Parameters[a]
MWI-6
Former Monarch Chemicals, Inc.
Utica, New York

Analyte	Concentration Criteria (mg/l)*	Concentration Detected at the Site (mg/l)*	Interpretation	Criteria Points Awarded	Actual Points Awarded
Alkalinity	>2x background	330	Results from interaction of carbon dioxide with aquifer minerals	1	0
Chloride[c]	>2x background	NM	Daughter product of organic chlorine; compare chloride in plume to background conditions	2	0
Perchloroethene		<0.005	Material released		0
Trichloroethene		0.120	Material released or daughter product of perchloroethene	2[b]	2
Dichloroethene		9.5	Material released or daughter product of trichloroethene; if amount of *cis*-1,2-dichloroethene is greater than 80% of total dichloroethene, it is likely a daughter product of trichloroethene	2[b]	2
Vinyl chloride		1.4	Material released or daughter product of dichloroethenes	2[b]	2
Ethene/Ethane	<0.1	0.74	Daughter product of vinyl chloride/ethene	>0.01 = 2[b] >0.1 = 3[b]	3
Chloroethane		NA	Daughter product of vinyl chloride under reducing conditions	2[b]	0

Weighting of Natural Attenuation Parameters[a]
MWI-6
Former Monarch Chemicals, Inc.
Utica, New York

Analyte	Concentration Criteria (mg/l)*	Concentration Detected at the Site (mg/l)*	Interpretation	Criteria Points Awarded	Actual Points Awarded
1,1,1-Trichloroethane		<0.050	Material released		0
1,1-Dichloroethene		0.270	Daughter product of trichloroethene or chemical reaction of 1,1,1-trichloroethane		0

Total Points Awarded: 22

Score	Interpretation
0 to 5	Inadequate evidence for biodegradation of chlorinated compounds.
6 to 14	Limited evidence for biodegradation of chlorinated organics.
15 to 20	Adequate evidence for biodegradation of chlorinated organics.
Greater than 20	Strong evidence for biodegradation of chlorinated organics.

[a] Source: Wiedemeier, T.H. et al., 1996.
[b] Points awarded only if the chemical is a breakdown product.
[c] Points not awarded because of equipment blank contamination.

DOC = dissolved organic carbon
U = the analyte was analyzed for, but was not detected above the reported sample quantitation limit
NA = not applicable; not analyzed
μg/l = micrograms per liter

All analyses required, with the exception of alkalinity.
*All concentrations in milligrams per liter (mg/l), except where noted or for oxidation reduction potential (reported in millivolts against Ag/AgCl), pH (reported in standard units), and temperature (reported in degrees Celsius).

Weighting of Natural Attenuation Parameters[a]
MWS-10
Former Monarch Chemicals, Inc.
Utica, New York

Analyte	Concentration Criteria (mg/l)*	Concentration Detected at the Site (mg/l)*	Interpretation	Criteria Points Awarded	Actual Points Awarded
Oxygen	<0.5	0.35	Tolerated; suppresses reductive dechlorination at higher concentrations	3	3
Oxygen	>1		Vinyl chloride may be oxidized aerobically, but reductive dechlorination will not occur	-3	
Nitrate	<1	<0.5	May compete with reductive pathway at higher concentrations	2	2
Iron (II)	>1	1.9	Reductive pathway possible	3	3
Sulfate	<20	141	May compete with reductive pathway at higher concentrations	2	0
Sulfide	>1	0	Reductive pathway possible	3	0
Methane	>0.1	0.15	Ultimate reductive daughter product	2	2
	>1		Vinyl chloride accumulates	3	
	<1		Vinyl chloride oxidizes		
Oxidation reduction potential	<50	-2.6	Reductive pathway possible	<50 = 1 <-100 = 2	1
pH	5 < pH < 9	6.67	Tolerated range for reductive pathway		0
DOC[c]	>20	6.33	Carbon and energy source; drives dechlorination; can be natural or anthropogenic	2	0
Temperature	>20°C	14.6	At T>20°C, biochemical process is accelerated	1	0

Weighting of Natural Attenuation Parameters[a]
MWS-10
Former Monarch Chemicals, Inc.
Utica, New York

Analyte	Concentration Criteria (mg/l)*	Concentration Detected at the Site (mg/l)*	Interpretation	Criteria Points Awarded	Actual Points Awarded
Alkalinity	>2x background	330	Results from interaction of carbon dioxide with aquifer minerals	1	0
Chloride[c]	>2x background	NM	Daughter product of organic chlorine; compare chloride in plume to background conditions	2	0
Perchloroethene		50	Material released		0
Trichloroethene		3.7	Material released or daughter product of perchloroethene	2[b]	2
Dichloroethene		8.9	Material released or daughter product of trichloroethene; if amount of *cis*-1,2-dichloroethene is greater than 80% of total dichloroethene, it is likely a daughter product of trichloroethene	2[b]	2
Vinyl chloride		<1	Material released or daughter product of dichloroethenes	2[b]	2
Ethene/Ethane	<0.1	<0.0042	Daughter product of vinyl chloride/ethene	>0.01 = 2[b] >0.1 = 3[b]	0
Chloroethane		NA	Daughter product of vinyl chloride under reducing conditions	2[b]	0

Weighting of Natural Attenuation Parameters[a]
MWS-10
Former Monarch Chemicals, Inc.
Utica, New York

Analyte	Concentration Criteria (mg/l)*	Concentration Detected at the Site (mg/l)*	Interpretation	Criteria Points Awarded	Actual Points Awarded
1,1,1-Trichloroethane		<1	Material released		0
1,1-Dichloroethene		<1	Daughter product of trichloroethene or chemical reaction of 1,1,1-trichloroethane		0

Total Points Awarded: 17

Score	Interpretation
0 to 5	Inadequate evidence for biodegradation of chlorinated compounds.
6 to 14	Limited evidence for biodegradation of chlorinated organics.
15 to 20	Adequate evidence for biodegradation of chlorinated organics.
Greater than 20	Strong evidence for biodegradation of chlorinated organics.

[a] Source: Wiedemeier, T.H. et al., 1996.
[b] Points awarded only if the chemical is a breakdown product.
[c] Points not awarded because of equipment blank contamination.

DOC = dissolved organic carbon
U = the analyte was analyzed for, but was not detected above the reported sample quantitation limit
NA = not applicable; not analyzed
μg/l = micrograms per liter

All analyses required, with the exception of alkalinity.
*All concentrations in milligrams per liter (mg/l), except where noted or for oxidation reduction potential (reported in millivolts against Ag/AgCl), pH (reported in standard units), and temperature (reported in degrees Celsius).

Weighting of Natural Attenuation Parameters[a]
OW-2I
Former Monarch Chemicals, Inc.
Utica, New York

Analyte	Concentration Criteria (mg/l)*	Concentration Detected at the Site (mg/l)*	Interpretation	Criteria Points Awarded	Actual Points Awarded
Oxygen	<0.5	0.33	Tolerated; suppresses reductive dechlorination at higher concentrations	3	3
Oxygen	>1		Vinyl chloride may be oxidized aerobically, but reductive dechlorination will not occur	-3	
Nitrate	<1	<0.5	May compete with reductive pathway at higher concentrations	2	2
Iron (II)	>1	4.37	Reductive pathway possible	3	3
Sulfate	<20	598	May compete with reductive pathway at higher concentrations	2	0
Sulfide	>1	2.2	Reductive pathway possible	3	3
Methane	>0.1		Ultimate reductive daughter product	2	
	>1	1.7	Vinyl chloride accumulates	3	3
	<1		Vinyl chloride oxidizes		
Oxidation reduction potential	<50	-80.6	Reductive pathway possible	<50 = 1 <-100 = 2	1
pH	5 < pH < 9	7.23	Tolerated range for reductive pathway		0
DOC[c]	>20	13.4	Carbon and energy source; drives dechlorination; can be natural or anthropogenic	2	0
Temperature	>20°C	13.5	At T>20°C, biochemical process is accelerated	1	0

Weighting of Natural Attenuation Parameters[a]
OW-2I
Former Monarch Chemicals, Inc.
Utica, New York

Analyte	Concentration Criteria (mg/l)*	Concentration Detected at the Site (mg/l)*	Interpretation	Criteria Points Awarded	Actual Points Awarded
Alkalinity	>2x background	390	Results from interaction of carbon dioxide with aquifer minerals	1	0
Chloride[c]	>2x background	NM	Daughter product of organic chlorine; compare chloride in plume to background conditions	2	0
Perchloroethene		<0.025	Material released		0
Trichloroethene		<0.025	Material released or daughter product of perchloroethene	2[b]	0
Dichloroethene		2.7	Material released or daughter product of trichloroethene; if amount of *cis* -1,2-dichloroethene is greater than 80% of total dichloroethene, it is likely a daughter product of trichloroethene	2[b]	2
Vinyl chloride		0.150	Material released or daughter product of dichloroethenes	2[b]	2
Ethene/Ethane	<0.1	0.12	Daughter product of vinyl chloride/ethene	>0.01 = 2[b] >0.1 = 3[b]	3
Chloroethane		NA	Daughter product of vinyl chloride under reducing conditions	2[b]	0

Weighting of Natural Attenuation Parameters[a]
OW-2I
Former Monarch Chemicals, Inc.
Utica, New York

Analyte	Concentration Criteria (mg/l)*	Concentration Detected at the Site (mg/l)*	Interpretation	Criteria Points Awarded	Actual Points Awarded
1,1,1-Trichloroethane		0.099	Material released		0
1,1-Dichloroethene		0.260	Daughter product of trichloroethene or chemical reaction of 1,1,1-trichloroethane		0
				Total Points Awarded:	**22**

Score	**Interpretation**
0 to 5	Inadequate evidence for biodegradation of chlorinated compounds.
6 to 14	Limited evidence for biodegradation of chlorinated organics.
15 to 20	Adequate evidence for biodegradation of chlorinated organics.
Greater than 20	Strong evidence for biodegradation of chlorinated organics.

[a] Source: Wiedemeier, T.H. et al., 1996.
[b] Points awarded only if the chemical is a breakdown product.
[c] Points not awarded because of equipment blank contamination.

DOC = dissolved organic carbon
U = the analyte was analyzed for, but was not detected above the reported sample quantitation limit
NA = not applicable; not analyzed
μg/l = micrograms per liter

All analyses required, with the exception of alkalinity.
*All concentrations in milligrams per liter (mg/l), except where noted or for oxidation reduction potential (reported in millivolts against Ag/AgCl), pH (reported in standard units), and temperature (reported in degrees Celsius).

Weighting of Natural Attenuation Parameters[a]
OW-1S
Former Monarch Chemicals, Inc.
Utica, New York

Analyte	Concentration Criteria (mg/l)*	Concentration Detected at the Site (mg/l)*	Interpretation	Criteria Points Awarded	Actual Points Awarded
Oxygen	<0.5	0.09	Tolerated; suppresses reductive dechlorination at higher concentrations	3	3
Oxygen	>1		Vinyl chloride may be oxidized aerobically, but reductive dechlorination will not occur	-3	
Nitrate	<1	<0.5	May compete with reductive pathway at higher concentrations	2	2
Iron (II)	>1	5.1	Reductive pathway possible	3	3
Sulfate	<20	21.7	May compete with reductive pathway at higher concentrations	2	0
Sulfide	>1	0.4	Reductive pathway possible	3	0
Methane	>0.1	0.24	Ultimate reductive daughter product	2	2
	>1		Vinyl chloride accumulates	3	
	<1		Vinyl chloride oxidizes		
Oxidation reduction potential	<50	-148.3	Reductive pathway possible	<50 = 1 <-100 = 2	2
pH	5 < pH < 9	6.96	Tolerated range for reductive pathway		0
DOC[c]	>20	2.8	Carbon and energy source; drives dechlorination; can be natural or anthropogenic	2	0
Temperature	>20°C	13.5	At T>20°C, biochemical process is accelerated	1	0

Weighting of Natural Attenuation Parameters[a]
OW-1S
Former Monarch Chemicals, Inc.
Utica, New York

Analyte	Concentration Criteria (mg/l)*	Concentration Detected at the Site (mg/l)*	Interpretation	Criteria Points Awarded	Actual Points Awarded
Alkalinity	>2x background	390	Results from interaction of carbon dioxide with aquifer minerals	1	0
Chloride[c]	>2x background	NM	Daughter product of organic chlorine; compare chloride in plume to background conditions	2	0
Perchloroethene		0.490	Material released		0
Trichloroethene		0.190	Material released or daughter product of perchloroethene	2[b]	2
Dichloroethene		1.4	Material released or daughter product of trichloroethene; if amount of *cis* -1,2-dichloroethene is greater than 80% of total dichloroethene, it is likely a daughter product of trichloroethene	2[b]	2
Vinyl chloride		0.033	Material released or daughter product of dichloroethenes	2[b]	2
Ethene/Ethane	<0.1	0.0044	Daughter product of vinyl chloride/ethene	>0.01 = 2[b] >0.1 = 3[b]	0
Chloroethane		NA	Daughter product of vinyl chloride under reducing conditions	2[b]	0

Weighting of Natural Attenuation Parameters[a]
OW-1S
Former Monarch Chemicals, Inc.
Utica, New York

Analyte	Concentration Criteria (mg/l)*	Concentration Detected at the Site (mg/l)*	Interpretation	Criteria Points Awarded	Actual Points Awarded
1,1,1-Trichloroethane		<0.013	Material released		0
1,1-Dichloroethene		<0.013	Daughter product of trichloroethene or chemical reaction of 1,1,1-trichloroethane		0

Total Points Awarded: 18

Score	**Interpretation**
0 to 5	Inadequate evidence for biodegradation of chlorinated compounds.
6 to 14	Limited evidence for biodegradation of chlorinated organics.
15 to 20	Adequate evidence for biodegradation of chlorinated organics.
Greater than 20	Strong evidence for biodegradation of chlorinated organics.

[a] Source: Wiedemeier, T.H. et al., 1996.
[b] Points awarded only if the chemical is a breakdown product.
[c] Points not awarded because of equipment blank contamination.

DOC = dissolved organic carbon
U = the analyte was analyzed for, but was not detected above the reported sample quantitation limit
NA = not applicable; not analyzed
μg/l = micrograms per liter

All analyses required, with the exception of alkalinity.
*All concentrations in milligrams per liter (mg/l), except where noted or for oxidation reduction potential (reported in millivolts against Ag/AgCl), pH (reported in standard units), and temperature (reported in degrees Celsius).

Weighting of Natural Attenuation Parameters[a]
OW-1I
Former Monarch Chemicals, Inc.
Utica, New York

Analyte	Concentration Criteria (mg/l)*	Concentration Detected at the Site (mg/l)*	Interpretation	Criteria Points Awarded	Actual Points Awarded
Oxygen	<0.5	0.25	Tolerated; suppresses reductive dechlorination at higher concentrations	3	3
Oxygen	>1		Vinyl chloride may be oxidized aerobically, but reductive dechlorination will not occur	-3	
Nitrate	<1	<0.5	May compete with reductive pathway at higher concentrations	2	2
Iron (II)	>1	1.16	Reductive pathway possible	3	3
Sulfate	<20	109	May compete with reductive pathway at higher concentrations	2	0
Sulfide	>1	0	Reductive pathway possible	3	0
Methane	>0.1		Ultimate reductive daughter product	2	
	>1	1.3	Vinyl chloride accumulates	3	3
	<1		Vinyl chloride oxidizes		
Oxidation reduction potential	<50	-41.6	Reductive pathway possible	<50 = 1 <-100 = 2	1
pH	5 < pH < 9	6.76	Tolerated range for reductive pathway		0
DOC[c]	>20	13.3	Carbon and energy source; drives dechlorination; can be natural or anthropogenic	2	0
Temperature	>20°C	14.5	At T>20°C, biochemical process is accelerated	1	0

Weighting of Natural Attenuation Parameters[a]
OW-1I
Former Monarch Chemicals, Inc.
Utica, New York

Analyte	Concentration Criteria (mg/l)*	Concentration Detected at the Site (mg/l)*	Interpretation	Criteria Points Awarded	Actual Points Awarded
Alkalinity	>2x background	615	Results from interaction of carbon dioxide with aquifer minerals	1	0
Chloride[c]	>2x background	NM	Daughter product of organic chlorine; compare chloride in plume to background conditions	2	0
Perchloroethene		<0.010	Material released		0
Trichloroethene		<0.010	Material released or daughter product of perchloroethene	2[b]	0
Dichloroethene		3.7	Material released or daughter product of trichloroethene; if amount of *cis*-1,2-dichloroethene is greater than 80% of total dichloroethene, it is likely a daughter product of trichloroethene	2[b]	2
Vinyl chloride		0.270	Material released or daughter product of dichloroethenes	2[b]	2
Ethene/Ethane	<0.1	0.15	Daughter product of vinyl chloride/ethene	>0.01 = 2[b] >0.1 = 3[b]	3
Chloroethane		NA	Daughter product of vinyl chloride under reducing conditions	2[b]	0

Weighting of Natural Attenuation Parameters[a]
OW-1I
Former Monarch Chemicals, Inc.
Utica, New York

Analyte	Concentration Criteria (mg/l)*	Concentration Detected at the Site (mg/l)*	Interpretation	Criteria Points Awarded	Actual Points Awarded
1,1,1-Trichloroethane		<0.010	Material released		0
1,1-Dichloroethene		<0.069	Daughter product of trichloroethene or chemical reaction of 1,1,1-trichloroethane		0

Total Points Awarded: 19

Score	Interpretation
0 to 5	Inadequate evidence for biodegradation of chlorinated compounds.
6 to 14	Limited evidence for biodegradation of chlorinated organics.
15 to 20	Adequate evidence for biodegradation of chlorinated organics.
Greater than 20	Strong evidence for biodegradation of chlorinated organics.

[a] Source: Wiedemeier, T.H. et al., 1996.
[b] Points awarded only if the chemical is a breakdown product.
[c] Points not awarded because of equipment blank contamination.

DOC = dissolved organic carbon
U = the analyte was analyzed for, but was not detected above the reported sample quantitation limit
NA = not applicable; not analyzed
μg/l = micrograms per liter

All analyses required, with the exception of alkalinity.
*All concentrations in milligrams per liter (mg/l), except where noted or for oxidation reduction potential (reported in millivolts against Ag/AgCl), pH (reported in standard units), and temperature (reported in degrees Celsius).

Weighting of Natural Attenuation Parameters[a]
MWS-23
Former Monarch Chemicals, Inc.
Utica, New York

Analyte	Concentration Criteria (mg/l)*	Concentration Detected at the Site (mg/l)*	Interpretation	Criteria Points Awarded	Actual Points Awarded
Oxygen	<0.5	0.85	Tolerated; suppresses reductive dechlorination at higher concentrations	3	3
Oxygen	>1		Vinyl chloride may be oxidized aerobically, but reductive dechlorination will not occur	-3	
Nitrate	<1	1.38	May compete with reductive pathway at higher concentrations	2	0
Iron (II)	>1	3.09	Reductive pathway possible	3	3
Sulfate	<20	5.52	May compete with reductive pathway at higher concentrations	2	2
Sulfide	>1	2.3	Reductive pathway possible	3	3
Methane	>0.1		Ultimate reductive daughter product	2	
	>1	2.2	Vinyl chloride accumulates	3	3
	<1		Vinyl chloride oxidizes		
Oxidation reduction potential	<50	-108.2	Reductive pathway possible	<50 = 1 <-100 = 2	2
pH	5 < pH < 9	7.18	Tolerated range for reductive pathway		0
DOC[c]	>20	4	Carbon and energy source; drives dechlorination; can be natural or anthropogenic	2	0
Temperature	>20°C	12.6	At T>20°C, biochemical process is accelerated	1	0

Weighting of Natural Attenuation Parameters[a]
MWS-23
Former Monarch Chemicals, Inc.
Utica, New York

Analyte	Concentration Criteria (mg/l)*	Concentration Detected at the Site (mg/l)*	Interpretation	Criteria Points Awarded	Actual Points Awarded
Alkalinity	>2x background	280	Results from interaction of carbon dioxide with aquifer minerals	1	0
Chloride[c]	>2x background	NM	Daughter product of organic chlorine; compare chloride in plume to background conditions	2	0
Perchloroethene		<0.005	Material released		0
Trichloroethene		0.0065	Material released or daughter product of perchloroethene	2[b]	0
Dichloroethene		<0.005	Material released or daughter product of trichloroethene; if amount of *cis*-1,2-dichloroethene is greater than 80% of total dichloroethene, it is likely a daughter product of trichloroethene	2[b]	0
Vinyl chloride		<0.005	Material released or daughter product of dichloroethenes	2[b]	0
Ethene/Ethane	<0.1	<0.025	Daughter product of vinyl chloride/ethene	>0.01 = 2[b] >0.1 = 3[b]	0
Chloroethane		NA	Daughter product of vinyl chloride under reducing conditions	2[b]	0

Weighting of Natural Attenuation Parameters[a]
MWS-23
Former Monarch Chemicals, Inc.
Utica, New York

Analyte	Concentration Criteria (mg/l)*	Concentration Detected at the Site (mg/l)*	Interpretation	Criteria Points Awarded	Actual Points Awarded
1,1,1-Trichloroethane		<0.005	Material released		0
1,1-Dichloroethene		<0.005	Daughter product of trichloroethene or chemical reaction of 1,1,1-trichloroethane		0

Total Points Awarded: 16

Score	Interpretation
0 to 5	Inadequate evidence for biodegradation of chlorinated compounds.
6 to 14	Limited evidence for biodegradation of chlorinated organics.
15 to 20	Adequate evidence for biodegradation of chlorinated organics.
Greater than 20	Strong evidence for biodegradation of chlorinated organics.

[a] Source: Wiedemeier, T.H. et al., 1996.
[b] Points awarded only if the chemical is a breakdown product.
[c] Points not awarded because of equipment blank contamination.

DOC = dissolved organic carbon
U = the analyte was analyzed for, but was not detected above the reported sample quantitation limit
NA = not applicable; not analyzed
μg/l = micrograms per liter

All analyses required, with the exception of alkalinity.
*All concentrations in milligrams per liter (mg/l), except where noted or for oxidation reduction potential (reported in millivolts against Ag/AgCl), pH (reported in standard units), and temperature (reported in degrees Celsius).

Weighting of Natural Attenuation Parameters[a]
MWI-24
Former Monarch Chemicals, Inc.
Utica, New York

Analyte	Concentration Criteria (mg/l)*	Concentration Detected at the Site (mg/l)*	Interpretation	Criteria Points Awarded	Actual Points Awarded
Oxygen	<0.5	0.4	Tolerated; suppresses reductive dechlorination at higher concentrations	3	3
Oxygen	>1		Vinyl chloride may be oxidized aerobically, but reductive dechlorination will not occur	-3	
Nitrate	<1	<0.5	May compete with reductive pathway at higher concentrations	2	0
Iron (II)	>1	3.82	Reductive pathway possible	3	3
Sulfate	<20	<2	May compete with reductive pathway at higher concentrations	2	2
Sulfide	>1	0	Reductive pathway possible	3	0
Methane	>0.1		Ultimate reductive daughter product	2	
	>1	36	Vinyl chloride accumulates	3	3
	<1		Vinyl chloride oxidizes		
Oxidation reduction potential	<50	-82.1	Reductive pathway possible	<50 = 1 <-100 = 2	1
pH	5 < pH < 9	6.83	Tolerated range for reductive pathway		0
DOC[c]	>20	14.7	Carbon and energy source; drives dechlorination; can be natural or anthropogenic	2	0
Temperature	>20°C	12.2	At T>20°C, biochemical process is accelerated	1	0

Weighting of Natural Attenuation Parameters[a]
MWI-24
Former Monarch Chemicals, Inc.
Utica, New York

Analyte	Concentration Criteria (mg/l)*	Concentration Detected at the Site (mg/l)*	Interpretation	Criteria Points Awarded	Actual Points Awarded
Alkalinity	>2x background	615	Results from interaction of carbon dioxide with aquifer minerals	1	0
Chloride[c]	>2x background	NM	Daughter product of organic chlorine; compare chloride in plume to background conditions	2	0
Perchloroethene		<0.005	Material released		0
Trichloroethene		<0.005	Material released or daughter product of perchloroethene	2[b]	0
Dichloroethene		<0.005	Material released or daughter product of trichloroethene; if amount of *cis*-1,2-dichloroethene is greater than 80% of total dichloroethene, it is likely a daughter product of trichloroethene	2[b]	0
Vinyl chloride		<0.005	Material released or daughter product of dichloroethenes	2[b]	0
Ethene/Ethane	<0.1	<0.5	Daughter product of vinyl chloride/ethene	>0.01 = 2[b] >0.1 = 3[b]	0
Chloroethane		NA	Daughter product of vinyl chloride under reducing conditions	2[b]	0

Weighting of Natural Attenuation Parameters[a]
MWI-24
Former Monarch Chemicals, Inc.
Utica, New York

Analyte	Concentration Criteria (mg/l)*	Concentration Detected at the Site (mg/l)*	Interpretation	Criteria Points Awarded	Actual Points Awarded
1,1,1-Trichloroethane		<0.005	Material released		0
1,1-Dichloroethene		<0.005	Daughter product of trichloroethene or chemical reaction of 1,1,1-trichloroethane		0

Total Points Awarded: 12

Score	Interpretation
0 to 5	Inadequate evidence for biodegradation of chlorinated compounds.
6 to 14	Limited evidence for biodegradation of chlorinated organics.
15 to 20	Adequate evidence for biodegradation of chlorinated organics.
Greater than 20	Strong evidence for biodegradation of chlorinated organics.

[a] Source: Wiedemeier, T.H. et al., 1996.
[b] Points awarded only if the chemical is a breakdown product.
[c] Points not awarded because of equipment blank contamination.

DOC = dissolved organic carbon
U = the analyte was analyzed for, but was not detected above the reported sample quantitation limit
NA = not applicable; not analyzed
μg/l = micrograms per liter

All analyses required, with the exception of alkalinity.
*All concentrations in milligrams per liter (mg/l), except where noted or for oxidation reduction potential (reported in millivolts against Ag/AgCl), pH (reported in standard units), and temperature (reported in degrees Celsius).

Weighting of Natural Attenuation Parameters[a]
MW-415S
Former Monarch Chemicals, Inc.
Utica, New York

Analyte	Concentration Criteria (mg/l)*	Concentration Detected at the Site (mg/l)*	Interpretation	Criteria Points Awarded	Actual Points Awarded
Oxygen	<0.5	0.53	Tolerated; suppresses reductive dechlorination at higher concentrations	3	3
Oxygen	>1		Vinyl chloride may be oxidized aerobically, but reductive dechlorination will not occur	-3	
Nitrate	<1	<0.5	May compete with reductive pathway at higher concentrations	2	0
Iron (II)	>1	3.48	Reductive pathway possible	3	3
Sulfate	<20	7.88	May compete with reductive pathway at higher concentrations	2	2
Sulfide	>1	0.4	Reductive pathway possible	3	0
Methane	>0.1		Ultimate reductive daughter product	2	
	>1	2.4	Vinyl chloride accumulates	3	3
	<1		Vinyl chloride oxidizes		
Oxidation reduction potential	<50	-111.3	Reductive pathway possible	<50 = 1 <-100 = 2	2
pH	5 < pH < 9	7.07	Tolerated range for reductive pathway		0
DOC[c]	>20	4.36	Carbon and energy source; drives dechlorination; can be natural or anthropogenic	2	0
Temperature	>20°C	13.8	At T>20°C, biochemical process is accelerated	1	0

Weighting of Natural Attenuation Parameters[a]
MW-415S
Former Monarch Chemicals, Inc.
Utica, New York

Analyte	Concentration Criteria (mg/l)*	Concentration Detected at the Site (mg/l)*	Interpretation	Criteria Points Awarded	Actual Points Awarded
Alkalinity	>2x background	275	Results from interaction of carbon dioxide with aquifer minerals	1	0
Chloride[c]	>2x background	NM	Daughter product of organic chlorine; compare chloride in plume to background conditions	2	0
Perchloroethene		ND	Material released		0
Trichloroethene		ND	Material released or daughter product of perchloroethene	2[b]	0
Dichloroethene		<0.0005	Material released or daughter product of trichloroethene; if amount of *cis*-1,2-dichloroethene is greater than 80% of total dichloroethene, it is likely a daughter product of trichloroethene	2[b]	0
Vinyl chloride		<0.001	Material released or daughter product of dichloroethenes	2[b]	0
Ethene/Ethane	<0.1	<0.050	Daughter product of vinyl chloride/ethene	>0.01 = 2[b] >0.1 = 3[b]	0
Chloroethane		NA	Daughter product of vinyl chloride under reducing conditions	2[b]	0

Weighting of Natural Attenuation Parameters[a]
MW-415S
Former Monarch Chemicals, Inc.
Utica, New York

Analyte	Concentration Criteria (mg/l)*	Concentration Detected at the Site (mg/l)*	Interpretation	Criteria Points Awarded	Actual Points Awarded
1,1,1-Trichloroethane		<0.0005	Material released		0
1,1-Dichloroethene		<0.00075	Daughter product of trichloroethene or chemical reaction of 1,1,1-trichloroethane		0
				Total Points Awarded:	**13**

Score	Interpretation
0 to 5	Inadequate evidence for biodegradation of chlorinated compounds.
6 to 14	Limited evidence for biodegradation of chlorinated organics.
15 to 20	Adequate evidence for biodegradation of chlorinated organics.
Greater than 20	Strong evidence for biodegradation of chlorinated organics.

[a] Source: Wiedemeier, T.H. et al., 1996.
[b] Points awarded only if the chemical is a breakdown product.
[c] Points not awarded because of equipment blank contamination.

DOC = dissolved organic carbon
U = the analyte was analyzed for, but was not detected above the reported sample quantitation limit
NA = not applicable; not analyzed
μg/l = micrograms per liter

All analyses required, with the exception of alkalinity.
*All concentrations in milligrams per liter (mg/l), except where noted or for oxidation reduction potential (reported in millivolts against Ag/AgCl), pH (reported in standard units), and temperature (reported in degrees Celsius).

Weighting of Natural Attenuation Parameters[a]
MW-416I
Former Monarch Chemicals, Inc.
Utica, New York

Analyte	Concentration Criteria (mg/l)*	Concentration Detected at the Site (mg/l)*	Interpretation	Criteria Points Awarded	Actual Points Awarded
Oxygen	<0.5	0.25	Tolerated; suppresses reductive dechlorination at higher concentrations	3	3
Oxygen	>1		Vinyl chloride may be oxidized aerobically, but reductive dechlorination will not occur	-3	
Nitrate	<1	<0.5	May compete with reductive pathway at higher concentrations	2	0
Iron (II)	>1	2.81	Reductive pathway possible	3	3
Sulfate	<20	120	May compete with reductive pathway at higher concentrations	2	0
Sulfide	>1	0.8	Reductive pathway possible	3	0
Methane	>0.1		Ultimate reductive daughter product	2	
	>1	8.1	Vinyl chloride accumulates	3	3
	<1		Vinyl chloride oxidizes		
Oxidation reduction potential	<50	-108.2	Reductive pathway possible	<50 = 1 <-100 = 2	2
pH	5 < pH < 9	6.82	Tolerated range for reductive pathway		0
DOC[c]	>20	14	Carbon and energy source; drives dechlorination; can be natural or anthropogenic	2	0
Temperature	>20°C	12.4	At T>20°C, biochemical process is accelerated	1	0

Weighting of Natural Attenuation Parameters[a]
MW-416I
Former Monarch Chemicals, Inc.
Utica, New York

Analyte	Concentration Criteria (mg/l)*	Concentration Detected at the Site (mg/l)*	Interpretation	Criteria Points Awarded	Actual Points Awarded
Alkalinity	>2x background	485	Results from interaction of carbon dioxide with aquifer minerals	1	0
Chloride[c]	>2x background	NM	Daughter product of organic chlorine; compare chloride in plume to background conditions	2	0
Perchloroethene		ND	Material released		0
Trichloroethene		ND	Material released or daughter product of perchloroethene	2[b]	0
Dichloroethene		19	Material released or daughter product of trichloroethene; if amount of *cis*-1,2-dichloroethene is greater than 80% of total dichloroethene, it is likely a daughter product of trichloroethene	2[b]	2
Vinyl chloride		<2	Material released or daughter product of dichloroethenes	2[b]	0
Ethene/Ethane	<0.1	0.21	Daughter product of vinyl chloride/ethene	>0.01 = 2[b] >0.1 = 3[b]	3
Chloroethane		NM	Daughter product of vinyl chloride under reducing conditions	2[b]	0

Weighting of Natural Attenuation Parameters[a]
MW-416I
Former Monarch Chemicals, Inc.
Utica, New York

Analyte	Concentration Criteria (mg/l)*	Concentration Detected at the Site (mg/l)*	Interpretation	Criteria Points Awarded	Actual Points Awarded
1,1,1-Trichloroethane		1.1	Material released		0
1,1-Dichloroethene		2.7	Daughter product of trichloroethene or chemical reaction of 1,1,1-trichloroethane		0
				Total Points Awarded:	**16**

Score	Interpretation
0 to 5	Inadequate evidence for biodegradation of chlorinated compounds.
6 to 14	Limited evidence for biodegradation of chlorinated organics.
15 to 20	Adequate evidence for biodegradation of chlorinated organics.
Greater than 20	Strong evidence for biodegradation of chlorinated organics.

[a] Source: Wiedemeier, T.H. et al., 1996.
[b] Points awarded only if the chemical is a breakdown product.
[c] Points not awarded because of equipment blank contamination.

DOC = dissolved organic carbon
U = the analyte was analyzed for, but was not detected above the reported sample quantitation limit
NA = not applicable; not analyzed
μg/l = micrograms per liter

All analyses required, with the exception of alkalinity.
*All concentrations in milligrams per liter (mg/l), except where noted or for oxidation reduction potential (reported in millivolts against Ag/AgCl), pH (reported in standard units), and temperature (reported in degrees Celsius).