REMEDIAL INVESTIGATION/FEASIBILITY STUDY

REMEDIAL INVESTIGATION (RI) REPORT

- TEXT

VacAir Alloys Division
Frewsburg, New York

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1.0 INTRODUCTION

1.1 GENERAL

The VacAir Alloys Division of the Keywell Corporation (Keywell) owns and operates a high grade metal processing plant site (Site) located on the outskirts of Frewsburg, New York. The Site occupies approximately 93 acres of property adjacent to the Conewango Creek. The Frewsburg municipal water supply wells are located on property across Frewsburg-Falconer Road to the west.

At the request of the New York State Department of Environmental Conservation (NYSDEC), a comprehensive Site Investigation (SI) was performed at the Site in 1990-1991 under the terms and conditions of an Order on Consent entered into by Keywell and the NYSDEC. The program was developed to investigate the potential presence of environmental contaminants at the Site.

In the fall of 1991, the NYSDEC requested that a remedial investigation/feasibility study (RI/FS) and an interim response actions (IRA) program be developed and implemented for the Site. As a result of volatile organic compounds (VOCs) being detected in the Frewsburg municipal supply wells located immediately west of the Site, a groundwater IRA program was developed prior to an RI/FS program. Pursuant to an order on consent entered into by Keywell and the NYSDEC, the IRA program was implemented in March 1992 and a final report was submitted in July 1992. The IRA Final Report was approved on September 16, 1992.

Development of an RI/FS program for the Site began in early 1992. Taking into consideration comments received from representatives from the NYSDEC and the New York State Department of Health (NYSDOH), an RI/FS Work Plan and associated project-specific plans were prepared and submitted to the NYSDEC by letter dated August 24, 1992. By letter dated October 9, 1992, the NYSDEC approved the RI/FS Work Plan and associated project-specific plans as modified by letters dated September 21, 1992 and October 9, 1992.

Implementation of the RI/FS for the Site began in the fall of 1992 under the terms and conditions of an Order on Consent (Order), Index No. B9-0333-90-05, entered into by the NYSDEC and Keywell. The RI was performed by Conestoga-Rovers & Associates (CRA).

This RI report has been prepared to summarize and present data and information obtained during the RI and the results of the public health evaluation and environmental assessment.

1.2 PROGRAM DESCRIPTION

During the RI, information was obtained to define the nature and extent of any existing or potential threat to public health or welfare or to the environment that may occur as a result of a release or threatened release of hazardous substances from the Site. The information obtained during the RI, as presented herein, will be used in the FS to assess the potential effects of various corrective and mitigative strategies on the Site.

The RI work tasks performed included:

i) development and submission of the RI/FS project specific plans;

ii) performance of community relation tasks;

iii) description of current conditions;

iv) procurement of qualified contractors and subcontractors;

v) performance of RI activities including soil gas survey, soil sampling, hydrogeologic investigation, surface water and sediment sampling, related air monitoring and biota inventory;

vi) sample analyses;

vii) data evaluation;

viii) assessment of risks (public health evaluation and environmental assessment);

ix) identification of preliminary remedial action objectives;

x) preliminary evaluation for treatability studies; and

xi) preparation of the RI report.

During performance of the RI work tasks, it was determined that additional interim remedial measures (IRM) were not necessary as no significant sources of contamination were determined to require a response prior to completion of the RI/FS process.

The RI/FS work tasks were performed in accordance with the terms and conditions of the Order and with the following documents:

i) "Remedial Investigation/Feasibility Study, Work Plan, VacAir Alloys Division, Frewsburg, New York", dated August 1992, as revised by "Addendum No. 1, Remedial Investigation/Feasibility Study (RI/FS) Work Plan, VacAir Alloys Division, Frewsburg, New York", dated November 5, 1992 (RI/FS Work Plan);

ii) "Quality Assurance Project Plan, Remedial Investigation/Feasibility Study, VacAir Alloys Division, Frewsburg, New York", dated August 1992 (QAPP); and

iii)) "Health and Safety Plan, Remedial Investigation/Feasibility Study, VacAir Alloys Division, Frewsburg, New York", dated August 1992 (HASP).

1.3 RI REPORT ELEMENTS

This RI report summarizes the data collected and the conclusions drawn from the RI and previous investigations, and includes the following information:

i) an updated Site description and background;

ii) description of the regional setting;

iii) description of the RI field investigation activities;

iv) presentation of Site data and analytical results;

v) characterization of Site contamination; and

vi) the results of the public health evaluation and environmental risk assessment.

The results of RI tasks consisting of the identification of preliminary remedial action objectives and a preliminary evaluation for treatability studies have been reported under separate cover and will be incorporated into the FS report.

Analytical reports, as provided by the laboratory, will be submitted to the NYSDEC under separate cover, if requested.

2.0 BACKGROUND

2.1 SITE DESCRIPTION

VacAir owns approximately 93 acres (Site) on the outskirts of Frewsburg, New York (see Figure 2.1); of the 93 acres, approximately 15 acres were developed into the present VacAir plant (Plant). The remaining 78 acres consist of undeveloped lowlying and wooded areas. The present VacAir Plant is bounded by a 10 foot high chain linked fence with one guarded entry point from the Frewsburg-Falconer Road. The boundaries of the VacAir Site are shown on Figure 2.2 and a Plant layout is shown on Figure 2.3.

The Site is bounded to the north by the Conewango Creek, to the east by lowlying and wooded areas, to the south by residential and industrial development, and the west by Frewsburg-Falconer Road. The Frewsburg Water District (District) municipal supply wells (Production Wells #1 and #2A) are located approximately 300 feet west of the Site. Also located on this well field is a standpipe/well (T-3) installed into the Frewsburg Aquifer. Production Well #3 is located approximately one-half mile north of the Site and Production Well #4 is located approximately one and one-half miles southwest of the Site.

Buildings on the Plant Site include a guard house at the plant entrance, a 112,000 square foot building complex (Main Building) that houses the main process operation and administration offices and an 8,000 square foot metal clad building (Metal Building) that houses additional process operations. An active septic tank and sandbed are located south of the Main Building. A partially covered drainage culvert/swale runs through the center of the Site. The ditch collects runoff from lands south of the Site and drains into a low swampy area which discharges to the Conewango Creek. A manmade fresh water pond is located in the southwest corner of the Site.

Operations at the Plant Site consist of grading, sorting, cleaning, blending, and packaging high grade scrap metal. Scrap metal handled consists of stainless steel alloys, titanium alloys and nickel bearing metal. Some scrap metal is cleaned after sorting by either shot blasting or degreasing with trichloroethylene (TCE). Waste produced from the process operations include iron dust, TCE sludge, spent TCE, waste lubricating oil and hydraulic oil.

Surface water runoff from the concrete pads (where scrap metals are stored in bins) is treated on Site by an oil-water separator and discharged to the Conewango Creek under the terms and conditions of the facility's State Pollutant Discharge Elimination System (SPDES) permit.

2.2 SITE HISTORY

VacAir began its metal processing/recycling operations in 1969. Prior to 1969, the Site was used for the manufacturing of wafer board. Keywell purchased the VacAir Site in 1987.

Historically, one or more geotechnical investigations are known to have been performed for structural design as the Main Building was expanded. Several hydrogeologic studies have also been performed in the vicinity of the Site by VacAir and the District for siting of water production wells. In addition, sediment and tap water sampling were performed in 1987 prior to Keywell purchasing the VacAir property.

In 1990, the NYSDEC initiated an investigation of possible environmental contamination at the Site and decided that a field investigation was warranted. In December 1990, a SI was implemented at the VacAir Property by Keywell to investigate areas of potential contamination. The SI was conducted in accordance with SI Work Plan documents approved by the NYSDEC and under the terms and conditions of an Order on Consent (Index #B9-0333-90-05).

The results of the activities conducted during the SI indicated the presence of VOCs, metals and total petroleum hydrocarbons in the groundwater (Water Table Aquifer) and soil beneath the Site and in surface water and sediment at the Site. The primary contaminants of concern were TCE and its degradation products. Groundwater samples collected from District Production Well #1 during the SI did not contain contaminants above drinking water quality standards. The results of the SI were presented in the "Site Investigation Report, VacAir Alloys Division, Frewsburg, New York", dated October 1, 1991 and approved by NYSDEC.

The NYSDEC requested by letter dated August 1, 1991, that Keywell implement additional investigative activities regarding the District water supply. These actions included:

i) the installation and sampling (for VOCs) of a groundwater monitoring well (MW-7) between the District well field and the plant Site; and

ii) the collection of groundwater samples for analyses of VOCs from the District's water supply Production Well #1 and #2A on a monthly basis.

In a letter dated August 9, 1991, Keywell agreed to implement the NYSDEC's requested actions. In September 1991, monitoring well MW-7 was installed near the northeast corner of the District well field into the Water Table Aquifer. The purpose of this well was to determine if TCE was present in the shallow groundwater regime (Water Table Aquifer) in the vicinity of Production Well #1 and #2A. A groundwater sample was collected for analyses of the Target Compound List (TCL) VOCs from MW-7 on September 23, 1991. Neither TCE or any other TCL VOCs were detected in the groundwater sample. In November 1991, the NYSDEC resampled well MW-7 to confirm the September 1991 results. The NYSDEC's sample results also showed that TCE was not present in well MW-7.

On September 5, 1991, water samples were collected and analyzed for TCL VOCs from the District's two active production wells (Well #1 and #2A) under the observation of the NYSDEC. These samples indicated the presence of TCE above drinking water standards in both wells.

As a result, Production Wells #1 and #2A were immediately shut down and Well #4 was put into service. The water supply sampling program was expanded to include each of the four District wells and several locations throughout the District's water supply system. Also, the water supply sampling frequency was temporarily increased to an approximate weekly basis. (Currently, the District's water supply production wells are sampled quarterly as part of the IRA Program).

The details and procedures used during implementation of these actions were confirmed in a letter to the NYSDEC, dated September 4, 1991 and were consistent with the procedures presented in the approved SI Work Plan document.

Based on the results of the District water supply sampling program, the NYSDEC requested that Keywell develop and implement certain additional investigations and related interim activities concerning the District water supply. A final scope of work for the IRA was agreed upon, and an Order on Consent (Index #B9-0333-90-05) for implementation was entered into by NYSDEC and Keywell, effective January 13, 1992.

The NYSDEC approved the IRA Work Plan by letter dated February 25, 1992. Implementation of the IRA Work Plan began in March 1992 and was completed in June 1992. The results of the IRA program are summarized in the "Interim Response Actions Final Report, VacAir Alloys Division, Frewsburg, New York", dated July 21, 1992. By letter dated September 16, 1992, the NYSDEC approved the IRA Final Report.

Development of an RI/FS program for the Site began in early April 1992. By letter dated October 9, 1992, the NYSDEC approved the RI/FS Work Plan documents, dated August 1992, with modified pages presented in Addendum No. 1, dated November 5, 1992. Implementation of the approved RI/FS Work Plan began in October 1992 under the terms and conditions of an Order on Consent (Index No. B9-033-90-05), effective November 30, 1992.

2.3 PREVIOUS INVESTIGATIONS

2.3.1 General

Two principal investigation activities have been performed at the Site. The SI was conducted in 1990-1991 to investigate areas of potential contamination. The IRA was conducted in 1992 to develop and implement certain additional investigations and related interim activities concerning the District water supply.

2.3.2 Site Investigation (SI)

The SI was a comprehensive program which included soil, groundwater, surface water, and sediment sampling. The SI field investigation activities were conducted in several phases beginning in December 1990. The SI field activities generally focused on suspected areas of potential contamination (see Figure 2.4) and were as follows:

i) excavation and sampling of test pits;

ii) collection of surface and subsurface soil samples;

iii) implementation of a hydrogeologic investigation program including installation and sampling of groundwater monitoring wells; and

iv) collection of surface water and sediment samples.

A total of 45 investigative samples were collected and analyzed for all or some of the following parameters:

i) TCL VOCs;
ii) TCL base, neutral, acid extractable compounds (BNAs);
iii) TCL pesticides and polychlorinated biphenyls (PCBs);

iv) Target Analyte List (TAL) metals;
v) TAL cyanide; and/or
vi) total petroleum hydrocarbons (TPH).

A detailed description of the results of the SI is provided in the SI Report dated October 1, 1991. A summary of the SI results are presented in the subsections which follow.

2.3.2.1 SI Soil Investigation

The SI soil investigation consisted of soil description, sample collection and chemical analyses. Test pitting and soil boring activities were performed in areas of suspected contamination to investigate the subsurface conditions beneath the Site. In addition, surface and shallow subsurface soils were collected and analyzed to establish soil chemistry background data for the local area. These soil sample locations are shown on Figures 2.5 and 2.6.

A total of 17 test pits were excavated in seven different areas suspected to be contaminated. Based on elevated organic vapor levels (as measured in the field by a photoionization detector or flame ionization detector), ten soil samples were collected from selected test pits and submitted for chemical analyses. Eight of the samples were analyzed for TPH and the TCL and TAL parameters. Two samples were analyzed for TCL VOCs only.

A total of 12 soil borings were drilled and continuously sampled in five different areas suspected to be contaminated. The boring depths ranged from 2.5 to 28 feet below ground surface (BGS). Nine subsurface soil samples were selected and submitted for chemical analyses for TPH and the TCL and TAL parameters.

Three surface soil samples were collected from 0 to 0.5 feet below grade from three locations south of the Site. Each of the surface samples were submitted for chemical analyses for TPH and the TCL and TAL parameters.

The following conclusions were made based on the SI soil investigation:

i) fill material and/or disturbed native soil is evident over the developed portion of the Site (which is approximately 15 acres of the total 93 acres that the entire property occupies). Fill material primarily consists of silty soils, gravel, sand, wood and metal debris. Fill materials were found on Site to depths up to 9 feet BGS;

ii) soil contamination may be attributed to the presence of fill material at the Site. Crushed drums and/or pieces of drums were found in Areas 1, 2 and 4. Deteriorated drums and metal debris were also found along the northern embankment of the Site along the lowlying swampy area;

iii) the soil investigation revealed that areas the subsurface soils in specific areas are primarily contaminated with VOCs, TPH and metals to depths up to 11.0 feet BGS. The area with the highest level of contamination is located north of the Main Building in the vicinity of Area 1 (adjacent to the large 001 oil/water separator) and Area 2. The samples collected from test pits excavated in Area 1 and Area 2 contained total VOC concentrations of 3,280 ppm and 17,620 ppm, respectively. To a lesser degree, subsurface soils in Areas 4, 5A and 5B were also contaminated; and

iv) Areas 3, 8 and 11 contained total VOC levels less than 0.050 ppm. No VOCs were detected in soil samples collected in Areas 12 and 13.

2.3.2.2 SI Hydrogeologic Investigation

The SI hydrogeologic investigation consisted of the installation of seven groundwater monitoring wells, determination of field hydraulic conductivities, and collection and chemical analyses of groundwater from the newly installed wells and from District production wells.

A total of seven groundwater wells (MW-1 through MW-7, inclusive) were drilled and installed for the purpose of monitoring the Water Table Aquifer (see Figure 2.7). Monitoring well depths range from 14 feet (MW-2) to 24 feet (MW-7) BGS. The screened length of the wells ranged from 5 to 10 feet long. The length of the screen interval was chosen to monitor the most waterbearing portion of the Water Table Aquifer.

Well MW-1 is located upgradient of the Site and serves to provide Site background data for groundwater within the Water Table Aquifer. Five monitoring wells (MW-2 through MW-6) are situated near the downgradient edge of the Site, along the northern and western fence line. Well MW-7 is located off-Site between District Production Wells #1 and #2A, and the western Site fence line.

As part of the SI, groundwater samples were collected from monitoring wells MW-1 through MW-6 and a drinking water sample from District Production Well #1. These water samples were analyzed for TPH and the TCL and TAL parameters. Well MW-7 was sampled and analyzed for the TCL VOCs only.

Slug tests were performed on monitoring wells MW-1 through MW-6 in order to determine hydraulic conductivity values for the Water Table Aquifer.

The following conclusions were made based on the SI hydrogeologic investigation:

i) the first waterbearing zone encountered beneath the Site is an alluvial sand, silt and gravel unit (Water Table Aquifer) which varies in thickness from 3.5 feet to 20.5 feet. Underlying the Water Table Aquifer is a confining layer of silt and clay which is approximately 15 to 20 feet thick. A sand and gravel artesian aquifer (Frewsburg Aquifer), which is the drinking water source for the Village of Frewsburg is believed present below the confining layer at certain locations beneath and adjacent to the Site;

ii) based upon the slug test data, the hydraulic conductivities of the Water Table Aquifer unit range from 2.6×10^{-3} cm/sec to 1.6×10^{-5} cm/sec with a geometric mean of 5.5×10^{-4} cm/sec;

iii) groundwater flow in the Water Table Aquifer is generally to the north toward the Conewango Creek;

iv) the groundwater beneath the Site in the Water Table Aquifer contains elevated levels of VOCs, some BNAs and metals. Maximum Contaminant Levels (MCLs) were exceeded for 1,2-dichloroethane, 1,1-dichloroethene, 1,2-dichloroethene, ethylbenzene, tetrachloroethane, toluene, 1,1,2-trichloroethane, trichloroethene, vinyl chloride, phenol, 4-methylphenol, iron, lead, sodium, manganese, and magnesium in one or more of the monitoring wells. The most predominant groundwater contaminants in the Water Table Aquifer are trichloroethene, and its degradation products, 1,2-dichloroethene and vinyl chloride. Monitoring wells MW-2, MW-3 and MW-4 contained the highest levels of VOCs. Monitoring wells MW-1 (upgradient well) and MW-6 did not exceed established MCLs except for iron; and

v) the municipal water samples collected (from Production Well #1) in May 1991, as part of the SI, did not contain contaminants above drinking water standards.

2.3.2.3 SI Surface Water and Sediment Investigation

A total of eight surface water and seven sediment samples were collected as part of the SI. These sample locations are shown on Figure 2.8. These 15 samples were analyzed for TPH and the TCL and TAL parameters. One background sediment sample and one surface water sample were collected from upstream locations in the drainage swale which flows through the Site. A background surface water sample was also collected in the Conewango Creek from a location upstream of the Site. The remaining six surface water and six sediment samples were collected in selected areas suspected of potential contamination. Surface water sample SW-5 (see Figure 2.8) was collected from the discharge of a stormwater sewer line at the northwestern corner of the Plant Site fence and not from Conewango Creek. Sediment samples SED-6 and SED-7 were collected from stained areas immediately adjacent to the existing and former 001 oil/water separator discharge point on the slope/bank of the Site above the water level of the Conewango Creek.

The following conclusions were made based on a review of the results from the SI surface water and sediment investigation:

i) the sediment samples collected from the Site are primarily contaminated with VOCs, predominately TCE and its degradation products (1,2-dichloroethene and vinyl chloride). Sediment samples collected from the drainage swale (Sample SED-4) and stained area (Sample SED-1) along the northern perimeter of the Site contained the highest total VOC levels at 239,900 ppb and 142,570 ppb, respectively. Sample SED-5, located upstream of sample location SED-4 contained substantially lower levels of VOCs than Sample SED-4;

ii) surface water samples collected on Site contained elevated levels of VOCs and metals. Trichloroethene and its degradation products (1,2-dichloroethene and vinyl chloride) are the most predominant VOCs detected in surface water at the Site. The highest VOC concentrations of 197,300 ppb and 14,515 ppb were detected in surface water samples SW-1 and SW-2, respectively. These samples were collected from the lowlying area in the northeast portion of the Site. To a lesser degree, VOC contamination was also evident in surface water at the discharge point of the drainage swale/culvert in the northeast portion of the Site and from the stormwater culvert at the northwest corner of the Site;

iii) the total VOC concentration (4 ppb) in the surface water sample (SW-4) collected in the Conewango Creek upstream of discharges from the Site is consistent with the total VOC concentration (6 ppb) in the sample (SW-3) collected downstream of the Site. Surface water samples collected from the Conewango Creek did not exceed any established New York State Ambient Water Quality Standards (NYSAWQS) except for iron; and

iv) surface water quality in the Conewango Creek has not been significantly impacted by the Site contaminants based on the data collected during the SI.

2.3.3 Interim Response Action (IRA)

The IRA primarily focused on the investigation and monitoring of the Frewsburg Aquifer, from which District Production Wells #1 and #2A draw. The results of the IRA program are presented in the IRA Final Report, dated July 21, 1992.

The general objectives of the IRA Program were to monitor the District water supply quality and to investigate the source of contamination detected in Production Wells #1 and #2A. In order to accomplish these objectives, the following tasks were performed:

i) Task A - Water Supply Monitoring;
ii) Task B - Production Well #3 Evaluation;
iii) Task C - Alternative Water Supply Data Review; and

iv) Task D - Contaminant Source Study.

As part of the IRA tasks, the following activities were performed:

i) collection and analyses of drinking water samples from the District water supply production wells;

ii) inspection, evaluation and disinfection of Production Well #3;

iii) review of available and pertinent information for the location of alternative water supply wells;

iv) the installation of groundwater monitoring wells and/or boreholes into the Frewsburg Aquifer;

v) the performance of a pumping test at Production Wells #1/#2A;

vi) the collection and analyses of groundwater samples during the pumping test from Production Wells #1/#2A, from the newly installed monitoring well (MW-5D); and

vii) the collection and analyses of soil samples for physical characterization of the geologic units.

The IRA tasks were performed in accordance with the procedures and protocols used during the 1990-91 SI program, as presented in the Site Investigation Work Plan, Volume I; Volume II, Quality Assurance Project Plan (QAPP); and Volume III, Health and Safety Plan (HASP), all dated December 7, 1990 and in subsequent letter submittals dated January 8, 1991 and April 5, 1991, except as noted in the approved IRA Work Plan. Figure 2.7 illustrates the locations of boreholes and monitoring wells installed as part of the IRA Program.

The results of the IRA are summarized below.

2.3.3.1 Task A - Water Supply Monitoring

IRA Task A, Water Supply Monitoring, provides for the continued monitoring of the District water supply wells. As stated in the IRA Work Plan, District Production Wells #3 and #4 were sampled for analysis of the drinking water VOCs (by USEPA Method 502.1) at 30-day intervals. Although not required in the IRA Work Plan, Production Wells #1 and #2A were also sampled and analyzed at 30-day intervals. (The District production wells are currently being sampled and analyzed quarterly.)

Drinking water samples were collected for analyses of VOCs beginning in September 1991. Table 2.1 summarizes the results for detected VOCs in water samples collected to date from the District Production wells and other sampling locations.

TCE was detected above drinking water standards in District Production Wells #1 and #2A in September 1991 which resulted in the shutdown of these production wells. TCE was last detected above drinking water standards in Production Wells #1 and #2A on September 26, 1991. Low levels of TCE (1.2 to 3.5 ppb) were detected only in Well #1 in October 1991. No TCE has been detected in Production Wells #1 and #2A during any of the 14-plus sampling events conducted since November 15, 1991 and September 26, 1991, respectively. No VOCs were detected in Production Wells #3 and #4.

As part of the water supply monitoring task, a "sentry well" was to be installed into the Frewsburg Aquifer between the Site and Production Well #3. Two attempts (BH-8D and BH-9D) were made to install the "sentry well", but the Frewsburg Aquifer was not encountered. Accordingly, the "sentry well" was not installed and groundwater sampling could not be performed.

Based on a review of the results of the water supply monitoring task of the IRA investigation the following conclusions were reached:

i) based on the latest chemical groundwater data collected during the IRA, Production Wells #1, #2A, #3, and #4 currently do not contain VOCs; and

ii) the absence of the Frewsburg Aquifer at locations BH-8D and BH-9D indicates that the Site does not currently pose a serious threat to the water quality of Production Well #3.

2.3.3.2 Task B - Production Well #3 Evaluation

IRA Task B, Production Well #3 Evaluation, involved the implementation of activities to ensure Production Well #3 is an adequate standby water supply well for use in the District's water supply system. These activities were performed by the Frewsburg Water District and/or its contractors (District) during the month of February 1992.

The mechanical and physical components of Production Well #3 were inspected and evaluated by the District. The pump was found to be in good working condition and only minor servicing was performed. Production Well #3 was cleaned and sanitized using muriatic acid and chlorine in accordance with acceptable industry standards. A short-term pumping test was performed on Production Well #3 to determine if a sufficient well yield could be maintained. Based on the results of this short-term (approximately three hour) pumping test, the District concluded that Well #3 is capable of sustaining a long-term pumping rate of approximately 200 gallons per minute (GPM) and that the well was currently as efficient as when the well and pump were originally installed.

Water samples were collected from Well #3 on February 10, 1992 and March 3, 1992, for analysis of bacteria. The analyses were performed by the Environmental Health Water Bacteriology Laboratory of the Chautauqua County Health Department (CCHD). The results indicated that Well #3 complies with the New York State bacterial MCLs. Well #3 was also sampled on February 27, 1992 for analysis of total iron and on March 26, 1992 samples were 0.81 ppm and 0.93 ppm, respectively. The March 26, 1992 sample was found to have a threshold odor number of 2 units and a manganese concentration of 0.06 ppm. In addition, Well #3 was sampled and analyzed for the drinking water VOCs, but none were detected.

Based upon the results of the well evaluation activities performed by the District, the CCHD granted the Frewsburg Water District permission to use Well #3 as a drinking water supply source. The Frewsburg Water District placed Well #3 into active service in early April 1992.

2.3.3.3 Task C - Alternate Water Supply Data Review

Task C, Alternate Water Supply Data Review, involved the compilation and review of existing and readily available hydrogeologic data and other information required to evaluate the location of an alternate water supply production well(s) for the District.

A domestic water well inventory was conducted as part of the IRA. An inventory of water well locations and property owners within a one mile radius was obtained from a file search of the CCHD records.

The general conclusions based upon the results of the Alternate Water Supply Data Review Task of the IRA Program include the following:

i) a waterbearing gravel zone is known to exist in the Frew's Run Valley and may be a potential water supply source for the District;

ii) the water well inventory performed indicates that the distribution of portions of the Frewsburg Aquifer which are capable of yielding sufficient quantities of groundwater for municipal uses appears to be inconsistent in the Frewsburg area; and

iii) based on performance of the District's water supply, further activities under this task are not required.

2.3.3.4 Task D - Contaminant Migration Study

The Contaminant Migration Study (IRA Task D) was performed to obtain additional information on the Frewsburg Aquifer in the immediate vicinity of the Site and to determine if the Site was the source of VOC contaminants found in the District's Production Wells #1 and #2A during the 1991 sampling and/or a potential source of contamination of Production Well #3. This task involved the following activities:

i) drilling of four boreholes (BH-1D, BH-6D, BH-8D and BH-9D) and one monitoring well (MW-5D) into the Frewsburg Aquifer (see Figure 2.7);

ii) collection of soil samples from the Frewsburg Aquifer and the confining clay layers for analysis of physical and chemical properties;

iii) collection of groundwater samples from the newly installed Frewsburg Aquifer monitoring well MW-5D for chemical analysis; and

iv) performance of pumping tests on Production Wells #1 and/or #2A.

Details of the field activities are presented in the IRA Report.

Three soil samples were collected from borehole MW-5D and were analyzed for Total Organic Carbon (TOC) and total solids. One sample was collected from the upper confining layer; another from the Frewsburg Aquifer; the third from the lower confining unit.

Four soil samples were collected and analyzed for permeability, moisture content before and after permeability testing, and grain size. Two of the samples were obtained from the upper confining layer; one from the Frewsburg Aquifer; and one from the lower confining clay layer.

Figure 2.7 provides the locations for the soil borings and monitoring well. Groundwater samples were collected from the newly installed Frewsburg Aquifer monitoring well MW-5D and from the existing stand pipe T-3. The groundwater samples were analyzed for the TCL VOCs. Benzene was the only parameter detected. Benzene was detected at a level of 3.7 ppb in MW-5D and at 0.6 ppb in T-3.

Aquifer testing was performed on District Production Wells #1 and #2A. The testing consisted of pre-test hydraulic monitoring, a step-drawdown test and a 24-hour constant rate pumping test by pumping both wells simultaneously.

A total of six groundwater samples were collected and analyzed for TCL VOCs throughout the 24-hour pumping test. Five of the samples were collected from the discharge water produced during the test (from Production Wells #1 and #2A). One sample was collected from MW-5D after the test was terminated. No VOCs were detected.

Based on the results of the Contaminant Migration Study, the following conclusions were made:

i) the Frewsburg Aquifer exists beneath part of the Site (southwestern quadrant). However, the exact areal extent of the Frewsburg Aquifer has not been fully defined;

ii) the Water Table Aquifer and the Frewsburg Aquifer are separated by a confining clay layer. This clay layer has a low permeability and ranges in thickness from 13.5 feet to more than 41.0 feet. A confining clay unit underlying the Frewsburg Aquifer and was found to have a very high clay content (90.9 percent) and a low hydraulic conductivity. The physical properties of the confining layers below and above the Frewsburg Aquifer significantly limit the vertical movement of groundwater beneath the Site; and

iii) since no physical or direct vertical hydraulic connection was found between the shallow Water Table Aquifer and the Frewsburg Aquifer beneath the Site, the source and migration pathway of TCE in Production Wells #1 and #2A is not known and could not be determined during the IRA field activities.

3.0 REGIONAL SETTING

This section presents a discussion of the regional setting. This supersedes all prior discussions of the regional setting presented in previously issued documents (e.g., Interim Response Actions Final Report).

3.1 DEMOGRAPHICS

The Site is located approximately one mile north of the Hamlet of Frewsburg in the Town of Carroll in Chautauqua County, New York. According to the 1990 Census of Population and Housing, prepared by the New York State Data Center, Department of Economic Development, the Town of Carroll has a population of 3,539. The population of the Hamlet of Frewsburg, as estimated by the Town of Carroll Town Clerk, is approximately 2,100 residents. The Hamlet of Frewsburg primarily consists of residential areas, commercial and industrial areas and agricultural areas. Dairy farming and agriculture are major occupations in this region.

The Site is located within an area zoned for light industrial development. Figure 3.1 illustrates the zoning classification (as provided by the Town of Carroll) in the vicinity of the Site. The lands immediately north and east of the Site are zoned agricultural-residential while the lands located immediately west and south of the Site are zoned light industrial.

3.2 PHYSIOGRAPHY

The Frewsburg area is located in a broad, flat-bottomed valley between areally extensive rolling uplands. The elevation of the valley bottom is approximately 1,250 feet above mean sea level (AMSL). The uplands in the area rise to heights of 1,500 feet AMSL or greater. The Conewango Creek flows through the valley in a generally southward direction.

3.3 CLIMATE

The climate of the Frewsburg area is classified as humid-continental, characterized by cold, wet winters and warm, wet summers. Table 3.1 presents a summary of 1992 precipitation and temperature data. The 1992 total precipitation, as provided by the Northeast Regional Climate Center for Jamestown, New York, was approximately 50 inches. The average annual temperature in 1992 was approximately 44°F with the coldest average temperature occurring in January and the warmest average temperature occurring in July. Mean monthly temperature and precipitation data have not been compiled by the Northeast Regional Climate Center and are not available. However, based on 1960 data compiled by the United States Weather Bureau (as referenced in Crain, 1966), the average annual precipitation for Jamestown, New York is approximately 43 inches and the mean annual temperature is 49.1°F.

According to the Northeast Region Climate Center, no prevailing wind direction is available for Jamestown, New York. However, the prevailing wind directions for Erie, Pennsylvania and Buffalo, New York are from the south and southwest, respectively.

3.4 REGIONAL GEOLOGY

The regional geology of the Chautauqua County area consist of unconsolidated deposits over bedrock which originated during the Ice Age.

In pre-glacial times, streams flowed north through the area creating valleys. During the time of glaciation, fingers of the ice sheets advancing and retreating through the area deepened and widened the valleys. As the glaciers advanced, huge amounts of soil and bedrock were moved. At the end of the Ice Age, moraines were formed. As the glaciers retreated, glacial debris (till) was deposited directly upon the bedrock. As the glaciers melted, lakes laden with sediment, were formed. Over time, the sediments settled to the lake bottom forming beds of clays and silts. Within these lacustrine deposits, interbeds of sands and gravels were formed from tributaries flowing into the glacial lakes and from the erratic movements of the glaciers. As the warming of the climate continued, the glaciers continued to melt back until eventually the lakes overflowed their morianic dams and began to flow toward the south. The moraines were severed by overflow streams and eventually the lakes were drained, leaving behind broad flat valleys containing unconsolidated deposits, hundreds of feet in thickness.

The unconsolidated deposits in the lower Conewango Valley, estimated to be approximately 200 to 600 feet thick (Crain, 1966) include glacial till which overlies the bedrock. The till is generally a heterogeneous mixture of varying proportions of clays, silts, sands, gravels and boulders. Overlying the till are lacustrine deposits consisting of clays and silts. Within the lacustrine deposits are interbeds of coarse-textured sediments, mostly sand and gravel, which resulted from stream flow into the lakes, glacial outwash and glacial drift (Crain, 1966). Overlying the lacustrine deposits is a surficial mantle of sands and gravels. These deposits of sand and gravel probably were the result of weathering and erosion of the bedrock in the surrounding uplands and from glacial melt water.

The upper bedrock underlying the overburden in Chautauqua County, New York, consists of sandstones, siltstones and shales of the Upper Devonian Conewango Group of the Chautauqua Series. Siltstone and sandstone outcrop in the extreme southeast part of the County. Soft fissile shales outcrop along a northeast-trending section in the northern part of Chautauqua County. The upper bedrock dips to the south at 50 feet per mile and is approximately 2,000 feet thick (Crain, 1966).

3.5 REGIONAL HYDROGEOLOGY

Availability of groundwater in any part of Chautauqua County is largely dependent on the aerial extent of the underlying sediments, their stratigraphic arrangement and the relative location of groundwater recharge and discharge zones. The topography and the surface drainage determine to a large extent the direction of groundwater movement through permeable sediments from areas of recharge to areas of discharge along streams.

The topography of Chautauqua County is variable showing gentle and sharp undulations which largely reflect the rapid environmental changes during the Quaternary Period. Elevations in excess of 2,000 feet AMSL are encountered on the east part of Chautauqua County. The lowest elevations, on the order of 600 feet AMSL are encountered parallel to the shoreline of Lake Erie.

The main body of surface water within the County is Chautauqua Lake. Several rivers and creeks run across Chautauqua County, such as the Conewango and Cassadaga Creeks and the Chadakoin River. These creeks and rivers flow south and discharge into the Allegheny-Ohio-Mississippi River System (Crain, 1966).

Local groundwater flow takes place toward local discharge areas, namely Chautauqua Lake and major rivers and creeks (Crain, 1966). Unconsolidated glacial sediments consisting of sands and/or gravel form aquifers within the Conewango and Cassadaga Valleys. The Jamestown Aquifer, located within the Cassadaga Valley, is the most important source of groundwater in the area (Crain, 1966).

The main components of the Jamestown Aquifer are sand and gravel deposits which exhibit high permeabilities. The Jamestown Aquifer extends from the Towerville Corners area to the Hartson swamp, along the Cassadaga Creek Valley (Crain, 1966). The Jamestown Aquifer is closer to the surface to the south and dips to depths of 100 feet BGS toward the north (Crain, 1966). The Jamestown Aquifer is generally overlain by silt and clay glacial lake deposits that act as a confining layer which results in artesian conditions in certain areas of the aquifer (USGS, 1982). The saturated thickness of the Jamestown Aquifer is generally less than 20 feet in the confined areas of the aquifer and is in excess of 20 feet in unconfined areas (uplands) of the aquifer.

The major source of recharge for the Jamestown Aquifer is precipitation which enters the groundwater system through permeable stratas which originate in the uplands, particularly from stream tributary deltas and coarse deposits along the valley walls (Crain, 1966). As the groundwater moves from the unconfined portion to the elevationally lower confined portion of the aquifer, artesian pressure is created In areas where artesian pressure is great, the water level of the confined aquifer may be above the ground surface.

Historically, the major source of discharge from the Jamestown Aquifer was a slow upward flow through the confining layer. In recent times, the Jamestown Aquifer has been tapped as a source of municipal water and the Jamestown municipal well network is now presumably the major source of groundwater discharge.

Groundwater flow in the Jamestown Aquifer is strongly influenced by the pumping of drinking water supply well fields installed in area municipalities. Pumping of the Jamestown well field has resulted in a cone of depression around the well field. The perennial yield of the Jamestown Aquifer range from about 6,000,000 gpd (gallons per day) to 30,000,000 gpd (Crain, 1966).

One of the largest and most important aquifers within the Conewango Valley is the Poland Center Aquifer (Crain, 1966) which consists of sand and gravel deposits. The thickness of the Poland Center Aquifer ranges from 5 to 70 feet (Crain, 1966). The Poland Center Aquifer exhibits both artesian and unconfined conditions which may yield from 20 to 100 gallons per minute (USGS, 1982). Groundwater in the Conewango Valley generally flows toward the slight cone of depression created by the Poland Center well field and, in the vicinity of the Hartson swamp, toward the cone of depression within Cassadaga Valley created by the Jamestown well field (USGS, 1982).

The Hamlet of Frewsburg and the Site are situated within the lower Conewango Creek Valley, south of Poland Center. The main aquifer studied within the lower Conewango Valley is the sand and gravel unit from which the Frewsburg Municipal wells draw.

3.6 GROUNDWATER USAGE

The Frewsburg public water supply has been obtained from four wells, Well Nos. 1, 2A (Well No. 2A was installed in January 1991 to replace Well No. 2), 3 and 4, installed in a sand and gravel aquifer at depths of about 35 to 41 feet BGS. Available stratigraphic and instrumentation logs for these wells, as provided by the Frewsburg Municipal Water Supply District, are presented in Appendix A of the SI Report. Wells #1 and #2A are located approximately 300 feet west of the Site. Two other water supply wells (Well Nos. 3 and 4) are also used by the Frewsburg Water District. Well No. 3 is located north of the Conewango Creek approximately 1/2 mile northwest of the Site. Well No. 4 is located approximately 1-1/2 miles southwest of the Site.

The two wells (Well Nos. 1 and 2A) located west of the Site were originally the primary supply wells for Frewsburg and were pumped alternately. These two Frewsburg Water Supply Wells produced approximately 190,000 gpd. The well north of the Conewango Creek (Well No. 3) is currently used as a supplementary well. Well No. 3 is capable of pumping up to 288,000 gpd. Well No. 4 is currently being used as the primary municipal well and is currently being pumped at the rate of 216,000 gpd.

3.7 SURFACE WATER USAGE

The Conewango Creek is located along the northern edge of the Site. The Conewango Creek is classified as a Class "C" stream. The NYSDEC has established standards and guidance values for specific classes of fresh and saline surface waters and fresh groundwaters for protection of the best usages assigned to each class. Class "C" streams are designated and protected for fish propagation and for human and wildlife consumption of fish. The Conewango Creek does not serve as a source of drinking water. The Conewango Creek is utilized for recreational purposes (i.e. fishing and boating).

Portions of three New York State freshwater wetlands and a number of mapped Federal wetland areas occur within two miles of the Site. A number of small streams run through these wetlands and through the Site. Seasonal water level fluctuations are common in the wetlands and streams. Additionally, an eutrophic pond is located within two miles of the Site and a manmade pond is located on the Site. None of the streams or ponds are utilized as a source of drinking water.

4.0 DESCRIPTION OF RI FIELD ACTIVITIES

4.1 GENERAL

The RI is the data collection mechanism of the RI/FS process. The primary objective of this RI was to collect additional data to establish a more competent and complete data base and fulfill the data gaps identified from the existing database.

The following is a list of field activities performed as part of this RI:

i) site mapping;
ii) underground utility/storage tank survey;
iii) water well inventory;
iv) soil investigation:
  - soil gas survey,
  - confirmatory soil sampling;
v) hydrogeologic investigation:
  - Frewsburg Aquifer delineation,
  - monitoring well installations,
  - field permeability testing,
  - hydraulic monitoring,
  - groundwater sampling;
vi) surface water and sediment sampling;
vii) air monitoring; and
viii) biota inventory.

Table 4.1 presents an identification key for samples collected for chemical analyses.

Test pitting operations were not performed during the RI. Test pits were to be considered as part of the RI to investigate areas of suspected drum burial only if determined to be required based on the results of the soil gas survey. Because the soil gas survey did not identify any areas suspected of drum burial, test pit excavation was not determined to be necessary.

The proposed 24-hour pumping test was not performed during the RI. The purpose of the test was to pump groundwater from proposed monitoring well MW-10D (Frewsburg Aquifer Well) to confirm the lack of a direct vertical hydraulic connection between the Frewsburg Aquifer and the shallow Water Table Aquifer. Since the Frewsburg Aquifer was not encountered at the proposed MW-10D well location, the well was not installed. Thus, the pumping test could not be performed.

4.2 SITE MAPPING

4.2.1 General

During the SI program, a property boundary survey (see Figure 2.2) was conducted of the VacAir property. This included the establishment of vertical and horizontal control points and the location and surveying of the property boundary and important features and structures located on Site. In addition, all of the boreholes, monitoring wells, test pits, surface water and sediment sampling locations were surveyed.

During the IRA program, additional survey activities included the locations and elevations of new monitoring wells and boreholes. Additional property boundary surveying was performed as required in order to locate wells and lands which were not owned by VacAir.

4.2.2 Topographic Survey

Preparations to perform a topographic survey of the Site began in the fall of 1991. Vertical and horizontal control points were established in the field in preparation for an aerial photo to be taken. Due to a late fall and early winter in 1991, the aerial photos were not taken until

April 29, 1992. Using the aerial photos, a topographic map of the Site was prepared showing 1-foot contour intervals. Work on the topographic survey was completed in July of 1993. Plan 1 illustrates the Site topography.

4.2.3 RI Surveying Activities

During the performance of the RI, several field surveying activities took place. Prior to the start of the soil gas survey, a grid was placed in the field. The grid was spaced at 100-foot intervals in the non-production areas of the Site and at 50-foot intervals in the production areas of the Site. Coordinates were established for all of the grid points. These coordinates were used to develop the base map used during the soil gas survey.

At the completion of the RI field activities, the locations of boreholes, monitoring wells, surface water and sediment samples were surveyed. It should be noted that due to high water levels in the lowlying swampy area, four surface water and sediment sampling locations could not be surveyed. All of the survey data obtained to date was used to develop the figures included in this RI Report.

4.3 UNDERGROUND UTILITY/STORAGE TANK INVESTIGATION

4.3.1 General

Existing and former underground utilities (i.e. storm sewers, process piping, sanitary sewer, watermains, etc.) and tanks were identified based on available information provided by VacAir personnel, the Frewsburg Water District, the Chautauqua County Highway Department, the Town of Carroll, Niagara Mohawk, Alltell, National Fuel Gas, and the NYSDEC. A description of each of the major features identified is presented in the subsections which follow. Plan 2 illustrates the locations of the existing and former utilities/tanks located at the Site.

Information gathered on these utilities/tanks were used, as appropriate to evaluate their potential as a significant migration pathway (see Section 7.0).

4.3.2 Utilities

Utilities which enter the Site include gas, water, electric, and telephone. Representatives of Niagara Mohawk, Alltell, National Fuel Gas and the Frewsburg Water District identified and, where appropriate, staked their respective utility locations on Site. Additionally, blueprints were examined and employees of VacAir provided information on the location of existing and former utilities on Site.

The gas, water, electric and telephone lines all enter the Site from the west along the Falconer-Frewsburg Road. Buried utility lines are shown on Plan 2. The depths of these utilities are approximately 4 to 6 feet BGS.

4.3.3 Tanks

Former and existing storage tanks located on Site were identified by examining blueprints, interviewing various personnel at the Site, and by performing a visual inspection of the Site. A total of one abandoned in place and nine former storage tanks (now removed from the Site) were found to have been present at the Site. In addition, six existing storage tanks were observed on Site.

An abandoned 1,000 gallon underground gasoline storage tank is shown at the southeast corner of the Main Building on blueprints (dated 1962) for the original construction of the Main Building. The blueprints indicated that the 1,000 gallon tank was buried to an approximate depth of 3 feet BGS. The tank reportedly was used from the early 1960s until

1977. The tank was evacuated and crushed in place sometime in 1985. No other evidence of such a tank was observed during the survey.

A small (unknown size) TCE tank was formerly located near the southwest corner of the Main Building. The tank was installed in 1972 and was removed in 1975. The tank was replaced by a 2,500 gallon aboveground steel TCE tank. The tank was installed in 1975 and had no secondary containment. The tank was in use at this location until 1985 when it was moved approximately 200 feet north to an area adjacent to the existing TCE tank. A secondary containment dike was installed around the tank at this new location. The tank was in use at this new location from 1985 to 1992. The tank was removed in March 1992. No spills or releases from this tank at either location were reported to have occurred according to VacAir personnel.

A 3,000 gallon aboveground steel tank was located on the concrete pad at the northwest corner of the Main Building. This tank was installed in 1976 for the storage of TCE. No secondary containment system was installed. The tank supplied TCE to degreasing operations which took place in the northeast portion of the Main Building for 18 months from 1976 through 1977. The tank reportedly was removed in 1977. No visible signs of leakage or soil contamination were observed during tank removal according to VacAir personnel.

A diked No. 2 fuel oil storage system consisting of two 6,000-gallon aboveground steel tanks was formerly located adjacent to the southeastern section of the Main Building complex near the existing offices. The tanks were installed in the early 1970's and sat on a concrete pad surrounded by a cinder block wall. The tanks were in use from 1973 until 1989. The tank and adjacent soils were removed from the Site in 1991.

An aboveground 5,000-gallon steel diesel fuel storage tank was formerly located adjacent to the southwestern portion of the Main Building. The tank was initially installed in 1982 to 1983 and was in use at this location from 1983 until it was moved to a fuel pumping station at the northwest corner of the concrete pad north of the Main Building in 1985.

An aboveground fuel storage pumping station was formerly located at the northwest corner of the concrete pad north of the Main Building. The station consisted of one 300-gallon steel gasoline tank installed in 1984, one 500-gallon steel diesel fuel tank installed in 1984, and a 5,000-gallon steel diesel fuel storage tank which was removed from the area adjacent to the southwestern portion of the Main Building in 1985. The 300 and 500-gallon tanks were removed by Danielson Gas Company in 1990. The 5,000-gallon tank was removed in 1988.

An aboveground 1,000-gallon steel diesel fuel storage tank is located at the southeastern edge of the concrete pad northeast of the Main Building. The tank was installed in 1989 and a dike was installed in 1991.

A small gasoline storage tank (of unknown size), formerly located southeast of the Main Building, was initially installed in 1977. The gasoline tank was in use at this location from 1977 until 1988. The tank was then stored at the fuel pumping station located at the northwestern corner of the concrete pad north of the Main Building until it was removed in 1990.

An existing 2,500-gallon aboveground rectangular double-wall steel trichloroethylene storage tank is located along the west side of the Main Building and was installed in the spring of 1992. The tank is self-contained (double wall) and sits on a 4-foot thick concrete pad/containment base.

A 900-gallon aboveground liquid argon tank was installed in June 1989 and is located along the western portion of the Main Building. In addition, a 1,000-gallon aboveground liquid oxygen tank is located adjacent to the southeastern corner of the Main Building. The tank was installed in the late 1980s. An 800-gallon aboveground steel propane tank is located between the Main Building and the Metal Building. The tank was formerly located at the northwest corner of the concrete pad north of the Main Building from the early 1970s until the early 1980s.

A 1,000-gallon concrete tank, used to collect oil and grease from the western portion of the Main Building, was installed in 1979. According to VacAir personnel, the tank is located approximately 40 feet west of the northwest corner of the Main Building. The tank reaches a maximum depth of 2 feet BGS. A 6-inch PVC drain pipe ran from the loading dock located adjacent to the northwest corner of the Main Building to the concrete tank. This 6-inch PVC pipe was plugged in 1985 when the 002 oil/water separator was installed. A 24-inch culvert pipe, located along the western portion of the plant property, currently runs through the concrete tank. According to VacAir personnel, the tank has not been cleaned or removed. No evidence of this tank was observed during a Site inspection.

4.3.4 Sanitary Discharges

Sanitary discharges were located by reviewing relevant blueprints, interviewing VacAir personnel, and by performing a visual inspection of the Site.

A new septic sand filter was installed in the southern portion (see Area 12 on Figure 2.4) of the Site in 1991. All of the Site's sanitary sewer flow is pumped to the sand filter, chlorinated and discharged to the culvert running between the Main Building and the Metal Building. The sand filter is primarily located above grade but reaches a maximum depth of 6 feet 2 inches BGS. Soil samples were collected in the vicinity of the discharge point of the sand filter during the SI activities. No VOCs were found in the samples.

A former leaching field was located east of the Main Building and west of the Metal Building. The exact location of this field is not known. The septic tank for this system was located just south of the former leaching field. This leaching field was a receptacle for most of the Main Building's sanitary and stormwater discharges until the early 1980s. The leaching field and septic tank both reached a maximum depth of approximately 4 feet BGS. The sewer line leading to the septic tank and leaching field was not removed or plugged. It is likely that the sewer was broken off during construction activities at the Site since the time that the sewer was abandoned. The leaching field was brought to grade when the concrete pad was installed in the mid 1980s.

Another former leaching field (Area 13 on Figure 2.4) was located due north of the Metal Building. It was abandoned and left in place in the early 1980s. This leaching field received the sanitary and storm discharges from the Metal Building. The leaching field reached a maximum depth of 4 feet BGS. No degreasing operations have reportedly occurred in the Metal Building.

In addition to utilities, tank and sanitary discharges, several other features of potential concern were noted at the Plant Site.

A "soakaway" trench was formerly located at the southern portion of the Main Building complex. According to blueprints dated 1962, the soakaway trench was similar to a French drain in design and contained a perforated pipe embedded in a matrix of various gravels and soil. The soakaway trench was a receptacle for discharges from floor drains located throughout the Main Building complex. These floor drains serviced a number of operations including several degreasing operations. The trench displayed a maximum depth of 3 feet BGS and extended roughly 20 feet south of the Main Building complex. The trench was installed in the early 1960s and was in use until it was decommissioned in the 1970s. Portions of the trench have been excavated during on-Site construction activities, however, it is unknown what portions of the trench have been left in place.

An unlined manmade cooling pond is located southeast of the Main Building complex. It was constructed in the mid 1980s and was utilized for cooling water for less than one year. The pond was found to be too small to effectively cool the volume of water that was required by the plant operations. The piping circulation system from the cooling pond to the Main Building has been left in place. The electric power line which ran underground to the pump for the system (northeast of the pond) was removed in 1991.

A sump is located under the former truck scale located west of the Main Building complex. The depth of the sump is approximately 6 feet BGS. The sump discharged groundwater to the ground surface/driveway adjacent to the scale when the scale was in operation. The pump was removed in April 1993 after the scale was removed from service. The area surrounding the sump was investigated during the RI soil gas survey. Soil gas samples collected from the sump area did not contain VOCs.

An 8-inch corrugated metal pipe (CMP) runs eastward from the northeast corner of the Main Building and discharges into the culvert that runs through the center of the Site. This CMP currently services the roof drains in the northern portion of the main building. Prior to 1984 this CMP was tied to both the floor drains and roof drains from the northern portion of the Main Building. The floor drains in this area serviced degreasing operations which were located in the northeastern portion of the main building until degreasing operations were ended at this location in 1977. Two of the floor drains located in the northeastern portion of the Main Building have been plugged with cement. These two floor drains were located in the former boiler room and in the former crushing area. All other floor drains in this area have been sealed off with brass screw caps. In 1984, a 6-inch PVC pipe was installed to service the floor drains in this area. At that time, all of the floor drains connected to the CMP were closed. Since 1984, the CMP has serviced only the roof drains in this area.

The abandoned 6-inch PVC sewer pipe is reported to run from the east/northeast edge of the Main Building and discharged into the abandoned small oil/water separator (known as the 002 Separator) located northeast of the Main Building. This 6-inch PVC pipe was tied into a floor drain system which underlies the northern portion of the Main Building. The floor drains serviced an area in which degreasing operations were present prior to 1977. According to employees at VacAir, the PVC pipe was cut and plugged at the edge of the building and at the 002 oil/water separator on October 22, 1991. The pipe was cleaned and sampled during closure and a NYSDEC Representative was on-Site during closure. A 1-foot section of the pipe was cut from both ends and the ends were then plugged with PVC caps.

A small oil/water separator (002 Separator) is located northeast of the Main Building and northwest of the Metal Building and is currently out of service. The 002 Separator was only in use from 1984 until 1985. The 002 Separator lies on a concrete pad at an approximate depth of 6 feet BGS. Clean fill of various types was reportedly utilized for the void surrounding the separator including gravel and soils. The footings beneath the concrete pad are believed to extend 15 feet BGS.

During installation of the 002 Separator, drain pipes were installed to dewater the area around the separator. A 4-inch PVC drain line was installed beneath the 002 Separator and discharged to an area adjacent to the downstream end of the 36-inch culvert (at the lowlying area). The 002 Separator was later removed and reinstalled at grade. The discharge pipe (6-inch PVC pipe) from the 002 Separator extends north from the 002 Separator to the Conewango Creek. The 002 Separator was abandoned in 1992. The 6-inch diameter discharge pipe and the 4-inch diameter drain line were not plugged and remain functional. The foundation drain line and the discharge pipe from the 002 Separator may provide a preferential pathway for migration of groundwater to the lowlying wet area and the Conewango Creek.

A second larger oil/water separator is located north of the Main Building and is known as the 001 Separator. It was installed in 1984. Stormwater from the active portions (e.g., storage bins/pad) of the facility, drains into the 001 Separator for oil removal and is then discharged to Conewango Creek pursuant to the plant SPDES permit. The total capacity of the 001 Separator is approximately 8,000 gallons including a 1,000-gallon oil storage vessel. The bottom of the separator is at an approximate depth of 6 feet BGS. It sits on a 4-foot thick concrete pad with 2-foot high containment walls. Clean gravel and soil were used as fill material during the installation of the unit. Telephone pole footings were constructed beneath the concrete base of the separator to an approximate depth of 30 feet BGS. It is not known if the Frewsburg Aquifer exists beneath the 001 Separator.

A former dip degreasing pit is located in the ground adjacent to the southeastern corner of the Main Building. The pit was constructed of concrete and is 4 feet deep by 4 feet wide. The pit was utilized as a containment area for two small dip tanks. Materials were degreased by dipping into the two small dip tanks which contained TCE. The pit was installed in 1976 and was in use until 1986. In 1986, the two degreasing dip tanks were drained and removed from the concrete containment pit and the pit was backfilled with clean gravel and soil. It is not likely that the tanks or the pit were a significant source of TCE contamination based on soil sampling data collected from boreholes BH-T, BH-S and BH-P, and groundwater data collected from MW-10. TCE was not detected in the soil and groundwater samples collected from these boreholes/monitoring well.

4.3.5 Culverts/Stormwater Sewers

Two drainage culverts run through the Site in a northerly direction. One of the culverts is located along the western boundary of the Site. This 24-inch diameter culvert receives surface water runoff from the western portion of the Site along the Main Building. The culvert discharges into the Conewango Creek at the northwestern corner of the Site. A surface water sample was collected from the culvert discharge during the SI. Two VOCs were detected in this sample including 1,2-dichloroethene (total) at a concentration of 230 ppb and TCE at a concentration of 290 ppb.

Another culvert (36-inch diameter) is located between the Main Building complex and the Metal Building. The culvert begins as a swale upstream (south) and runs underneath a concrete storage pad located between the Main Building complex and the Metal Building. The swale/culvert collects stormwater from areas south the plant. Drainage pipes from the Main Building discharge into the culvert (see Plan 2). The culvert discharges into the lowlands northeast of the concrete pad.

A sewer pipe collects stormwater roof drains and water from floor drains in the Metal Building and discharges to the ground surface northeast of the Metal Building. This area was sampled during the RI. TCE nor its degradation products were detected in surface water and sediment samples collected from this discharge area.

4.3.6 Miscellaneous

Information on the construction of the former railroad bridge and Frewsburg-Falconer Road bridge across the Conewango Creek was obtained from the Chautauqua County Department of Highways and Conrail. Foundations for the bridges were extended to an approximate depth of 30 feet BGS (below the base of the Conewango Creek). It is not known if the Frewsburg Aquifer is present beneath these foundations.

4.4 WATER WELL INVENTORY

An inventory of water wells located in the Town of Carroll within a one mile radius of the Site was performed in order to identify potential groundwater users, if any, which could potentially be impacted by a release from the Site. A listing of all Town of Carroll property owners within one mile of the Site was compiled by reviewing tax maps obtained from the Town of Carroll offices. A questionnaire was mailed to each property owner. The following questions were included in the mail survey:

i) name;
ii) address;
iii) location of well on property;
iv) depth of well;
v) uses of water from well;
vi) well age;

vii) well construction detail;
viii) well yield;
ix) well usage; and
x) additional comments.

A total of 822 questionnaires were mailed out, of which 471 were completed and returned. This translates to a 57 percent rate of return. Based upon this response, the NYSDEC agreed that a door-to-door survey of non-responding property owners was not necessary. In addition to the mail survey, representatives of the Hamlet of Frewsburg Water District and the Chautauqua County Health Department were contacted regarding any information they had involving water wells within a one mile radius of the Site.

Table A-1 of Appendix A identifies water supply wells located within one mile of the Site. Plan 3 shows the locations of these wells.

There are three domestic water supply wells, four industrial wells, and 23 wells not in use located within the Frewsburg Water District. In addition, a number (approximately 30) of domestic water supply wells exist east, south and north of the Site outside of the Frewsburg Water District. It is not known if the Frewsburg Aquifer is the source for these domestic wells.

4.5 SOIL INVESTIGATION

The soil investigations at the Site consisted of a soil gas survey followed by a confirmatory soil sampling program. The scope of the confirmatory soil sampling program was based on the results of the soil gas survey. Additionally, an organic vapor screening survey was performed in several areas on Site to further delineate the extent of VOC presence in the soil.

4.5.1 Soil Gas Survey

As part of the RI, a soil gas survey for 11 Site-specific volatile organic compounds was performed over the Site, between October 27, 1992 and November 3, 1992. The soil gas survey was performed by Target Environmental Services, Inc. (Target). The primary objective of the survey was to delineate the horizontal extent of VOC contamination in the soil.

The survey was conducted based on a grid spaced at 50-foot intervals in the areas of known VOC contamination (northeastern and southeastern quadrants of the facility). In the remaining areas, the sampling points for the survey were based on a grid spaced at 100-foot intervals. A total of 187 locations were to be sampled, however, 35 locations could not be sampled due to saturated soil conditions encountered in the field. A total of 152 soil gas samples were collected during the survey (see Plan 4). The soil gas samples were collected at an approximate depth of 4 feet BGS.

Soil gas was analyzed by utilizing a mobile on-Site analytical gas chromatograph. The soil gas sampling procedures and specifications were performed in accordance with the RI/FS QAPP. The target list of VOCs analyzed, consisted of: trichloroethene, total 1,2-dichloroethene, tetrachloroethene, vinyl chloride, 1,1-dichloroethane, 1,1,1-trichloroethane, benzene, 1,1-dichloroethene, ethylbenzene, toluene and xylenes.

Preliminary soil gas concentrations were reviewed daily in the field. Based upon these preliminary results, additional samples were collected adjacent to grid points having elevated soil gas reading which deviated from the standard grid layout. Total VOC levels detected in the soil gas samples are presented on Plan 4.

Appendix B presents the soil gas survey report prepared by Target which details all sampling activities and provides the analytical data derived from the survey.

Elevated levels of VOCs were detected in soil gas samples collected from the areas north of the Main Building and the area east of the Main Building, west of the drainage culvert/swale. Section 6.3.1 describes the results of the soil gas survey.

4.5.2 Confirmatory Soil Sampling

Based on the results of the soil gas survey, a confirmatory soil sampling program was developed and approved by the NYSDEC. Surface and subsurface soil samples were collected to confirm the results of the soil gas survey and to better define the vertical and horizontal limits of soil contamination on Site. All sample locations were selected with concurrence from the NYSDEC Field Representative.

4.5.2.1 Subsurface Soil Sampling

A total of 23 boreholes were advanced on and adjacent to the Site. Thirty-one subsurface soil samples were collected and analyzed for TCL VOCs. Four of the 31 samples were also analyzed for PCBs. Additionally, composite samples were collected from two boreholes and were analyzed for TOC, grain size, moisture, porosity and bulk density. Soil samples were collected in accordance with the procedures outlined in the QAPP. Drilling activities were performed by Empire Soils Investigations (Empire) of Hamburg, New York from November 16, 1992 through December 15, 1992. The locations of the boreholes are presented on Figure 4.1. Table 4.1 presents a sample identification key.

Each borehole was advanced into the top of the silt and clay confining layer. Soil samples were continuously collected at 2 foot intervals. In order to determine the vertical extent of VOC contamination, each soil sample was screened for organic vapors with a Photoionization Detector (PID) (MSA Photon) or a Flame Ionization Detector (FID) (Foxboro

OVA) immediately upon opening the split-spoon. The soil sample from the first interval in each borehole where organic vapor screening indicated that organic vapor levels were at or near background levels was submitted for chemical analysis. These samples were analyzed to confirm that the vertical extent of contamination had been defined. Additional samples were collected from visually contaminated surficial or subsurface soils with elevated organic vapor levels to confirm and quantify the results of the soil gas survey. Soil samples which were submitted for chemical analyses were collected with the concurrence of the NYSDEC Field Representative.

Samples were collected in accordance with the procedures outlined in the QAPP. Soil samples were submitted to H2M Laboratories (H2M) in Melville, New York, for chemical analyses.

At the completion of drilling activities the bottom portion of each borehole was grouted using positive placement techniques in order to seal off the portion of the borehole which had been advanced into the confining layer. After grouting of the bottom of the borehole, the augers were removed and the drilling cuttings were returned to the borehole from which it came. All excess drilling cuttings were placed into 55-gallon drums and staged at the Site.

Stratigraphic logs for each of the boreholes installed as part of the RI are presented in Appendix C. The organic vapor results are presented on the borehole stratigraphic logs and are summarized on Table 4.2.

Appendix D presents the analytical results for the RI soil samples. Section 6.3.2.2 discusses the subsurface soil sample results.

4.5.2.2 Surface Soil Sampling

Five surface soil samples were collected on-Site on December 22, 1992. Two samples, SSoil-A and SSoil-J, were collected to obtain background surface soil data. Surface soil samples SSoil-M, SSoil-N and

SSoil-O were collected from the north end of the Site. The surface soil sampling locations are shown on Figure 4.2.

Surface soil samples were collected two to three feet from boreholes that had been previously drilled. After removing the surface cover (i.e. grass, leaves, gravel, etc.) if any, a sample was collected from the uppermost 2-inches of material encountered. Samples SSoil-A and SSoil-J were submitted for TCL VOC analysis only. Samples SSoil-M, SSoil-N and SSoil-O were submitted for analysis of TCL VOCs and PCBs. Appendix D presents the analytical results obtained. Section 6.3.2.1 discusses the results of surface soil samples.

4.5.3 Supplemental Soil Gas Sampling

A supplemental soil gas screening program was performed by CRA at the Site between April 14, 1993 and April 15, 1993 to further define the presence of VOCs in the soil in three areas. The three areas investigated were the former "soakaway" trench, the active storm sewer line (12-inch CMP) which runs eastward from the southeast corner of the Main Building to the culvert between the Main Building and the Metal Building, and the active 8-inch corrugated metal stormwater pipe which runs northeast from the Main Building to the culvert.

The sample locations are shown on Plan 4. At each sample location, a stainless steel retractable soil gas sampling point was driven to a depth of approximately 3.5 to 4.0 feet BGS. The soil vapors were conducted to the surface using teflon tubing connected to the sampling point. A hand operated vacuum pump was used to evacuate the tubing and assess soil moisture conditions at each sampling location. Following evacuation of the tubing and verification of the lack of groundwater in the sample tubing, a photoionization detector (PID) for organic vapors which was equipped with a positive displacement sample pump attached to the sampling tubing. Organic vapor readings were taken over a period of five minutes with the peak readings recorded during the zero to one minute interval; one to three minute interval; and three to five minute interval.

Following sampling at each location, the stainless steel gas sampling point was cleaned using laboratory soap and water and was then thoroughly dried prior to reuse. Periodically, a clean sampling point was checked for residual contamination by "reading" the point and the tubing in ambient air. Any sampling point with organic vapor readings which were higher than those of the ambient air were recleaned and the tubing was replaced.

The "soakaway" trench area could not be sampled due to high water table levels. This area also could not be sampled during Target's soil gas survey due to high water table levels.

A total of 11 samples (2, 3, 4, 5, 6, 7, 8, 9, 10, 11 and 12) were taken along various portions of the 8-inch diameter CMP which runs northeast of the Main Building to the 36-inch culvert (see Plan 4). This 8-inch CMP was connected to a floor drain system that serviced degreasing operations in the northeast portion of the Main building prior to 1977. Organic vapor readings for each of the 11 samples taken along the 8-inch CMP are presented on Table 4.3.

The highest organic vapor reading from sample numbers 2 to 12 was 77.1 ppm (meter units) at sample location number 4 during the first minute of screening. Several sample locations had no detectable organic vapors. Six of the 12 sample locations had detectable organic vapors.

A total of four samples were taken along the 12-inch CMP storm sewer which runs from the southeast portion of the Main Building eastward to the culvert. Sample numbers 13, 14, 15 and 16 were collected from various locations along the storm sewer line (see Plan 4). This storm sewer services the roof drains from the Main Building. Organic vapors were detected at three of the four sample locations. Sample location 16 had organic vapor levels of 84.7 ppm in the first minute of screening, which was the highest organic vapor level for any sample taken in the organic screening program.

4.6 HYDROGEOLOGIC INVESTIGATION

4.6.1 Frewsburg Aquifer Delineation

Hager-Richter Geoscience, Inc. (Hager-Richter) conducted a resistivity geophysical survey on a portion of the Site in October 1992. A copy of Hager-Richter's report detailing the geophysical survey is included in Appendix E.

The objective of the geophysical survey was to determine the areal extent of the Frewsburg Aquifer which is present beneath a portion of the Site at a depth of approximately 35 feet.

The resistivity survey consisted of 33 vertical electric soundings spaced approximately 100 feet apart along four lines. A Wenner array was used for the resistivity soundings. Figure 12 of Hager-Richter's report presents the predicted lateral extent of the Frewsburg Aquifer.

Based on the sounding-profiling resistivity survey at the Site, Hager-Richter concluded the following:

i) the Frewsburg Aquifer appears to be present in the southwestern portions of the Site. The depth and thickness of the Aquifer, where present on-Site, appear to be variable. The Aquifer appears to be shallower and thicker toward the south along the western boundary of the Site and appears to be thinner and shallower toward the east;

ii) models for the resistivity data for six stations in the southwestern portion of the Site are equally consistent either with or without the presence of the Aquifer; thus the presence of the Aquifer at those points is uncertain; and

iii) the resistivity data for several stations could not be used for interpretation because of cultural effects.

A review of the data reveals that the resistivity survey does not accurately predict the presence of the Frewsburg Aquifer. This conclusion is based on the following:

i) the area (see Figure 12 of Hager-Richter's report) representing "possibly present" for the lateral extent of the Frewsburg Aquifer covers a relatively large area compared to the area representing "present". This "possibly present" area represents a relatively large area of uncertainty; and

ii) although monitoring well MW-4D encountered the Frewsburg Aquifer, Figure 12 of Hager-Richter's report predicts that the aquifer should not be present at this location.

4.6.2 Monitoring Well Installations

4.6.2.1 Frewsburg Aquifer Monitoring Wells

As part of the RI, attempts were made to install two on-Site monitoring wells into the Frewsburg Aquifer. The purpose of the two wells was to:

i) substantiate the reliability of the resistivity survey for predicting the presence of the Frewsburg Aquifer;

ii) collect groundwater samples to determine whether the Frewsburg Aquifer in these two locations contained residual VOCs; and

iii) determine if a hydraulic connection exists at the Site between the Water Table Aquifer and the Frewsburg Aquifer.

The locations for the two proposed Frewsburg Aquifer monitoring wells were selected with NYSDEC concurrence.

At proposed location MW-10D, situated in the central portion of the Site near well MW-10 (see Figure 4.3), the Frewsburg Aquifer was not encountered. The boring was terminated at 56 feet BGS and was grouted up to the ground surface. The surficial and intermediate casings were cut off at the ground surface and abandoned in place. This boring is now referred to as BH-10D.

At proposed location MW-4D, located on the west side of the Site adjacent to MW-4, the Frewsburg Aquifer was encountered at a depth of approximately 35.8 feet BGS. At this location, the Frewsburg Aquifer was observed to be approximately 6.9 feet thick. Based upon visual observations, the lithology of the Aquifer material at MW-4D appeared to be coarser in nature than that which was encountered approximately 400 feet south at MW-5D. A monitoring well was installed at MW-4D to a depth of 42.9 feet BGS. The well screen extended from 42.9 to 37.9 feet BGS and the sandpack was installed from 42.9 to 35 feet BGS. MW-4D was observed to be a non-flowing artesian well.

A soil sample was collected during the drilling of MW-4D to determine the vertical extent of soil contamination in this area. The sample collected from 20 to 22 feet BGS was analyzed for the TCL VOCs (see Table 4.1).

Monitoring well MW-4D was installed in accordance with the protocols specified in Appendix B of the RI/FS Work Plan and the QAPP. Upon completion of the well installation, MW-4D was developed, purged and sampled. Appendix F contains the stratigraphic and instrumentation log for MW-4D. Table 4.4 summarizes the monitoring well instrumentation.

4.6.2.2 Water Table Aquifer Monitoring Wells

Four additional on-Site and one off-Site shallow monitoring wells were installed into the shallow sand/silt Water Table Aquifer during the RI. The purpose for these wells was to further delineate the extent of groundwater contamination in the Water Table Aquifer. The number and locations of the wells were determined based upon the results of the soil gas survey. Locations for the shallow monitoring wells were approved by the NYSDEC Field Representative. The locations of these shallow wells are shown on Figure 4.3.

MW-8, located south of the Main Building, was installed to a depth of 18 feet BGS. MW-9 was installed through the concrete pad located north of the Main Building to a depth of 23.9 feet BGS. MW-10 is located near the southeast corner of the Main Building and was installed to a depth of 22.9 feet BGS. MW-11 was installed through the concrete pad between the Main Building and the Metal Building. The location for MW-11 was selected based upon high VOC levels identified during the soil gas survey. MW-11 was installed to a depth of 15 feet BGS.

MW-12 was installed off-Site west of Frewsburg-Falconer Road, at the north end of the parking area used for the boat access to the Conewango Creek on June 11, 1993, at the request of the NYSDEC. MW-12 was installed to a depth of 13.8 feet BGS. The well was installed west of borehole BH-G which was installed previously as part of the RI. A soil sample collected from the 12 to 14 foot interval of borehole BH-G was found to contain 111 ppb of total VOCs.

Appendix F contains the stratigraphic and instrumentation logs for the monitoring wells. Table 4.4 summarizes the instrumentation of monitoring wells installed during the IRA, the SI and the RI.

As part of the soil investigation, selected soil samples were collected for chemical analysis from the boreholes advanced during the shallow monitoring well installation. Soil samples were collected from selected intervals based upon organic vapor screening. Samples were submitted for the analysis of the TCL VOCs. Table 4.1 presents a sample identification key.

Two composite soil samples of the Water Table Aquifer were collected for analysis to provide additional chemical and physical data on the properties of the Water Table Aquifer. One composite sample of the Water Table Aquifer material was collected from borehole MW-10 from 6 feet to 22 feet BGS. A second composite sample of the Water Table Aquifer material was collected from a borehole advanced immediately adjacent to MW-4 from 4 to 17 feet BGS. Both composite samples were analyzed for TOC, grain size distribution (by sieve and hydrometer), percent moisture content, specific gravity, bulk density and porosity by Huntingdon Analytical Services (HAS) in Middleport, New York. Appendix G contains the data report provided by HAS.

All drilling activities performed during the installation of the shallow aquifer monitoring wells were performed in accordance with the protocols described in Appendix B of the RI/FS Work Plan.

4.6.3 Well Development

Following installation, each newly installed well was developed to a sediment-free condition (where possible) according to the protocols established in Appendix B of the RI/FS Work Plan and in the QAPP.

Each well was developed by removing a minimum of 10 well volumes of groundwater. All wells were developed by hand using a precleaned bottom loading stainless steel bailer to remove the groundwater from the well. During development, the bailer was also used to surge the screened interval within each well to draw in and remove as much fines as possible from the sandpack surrounding the well screen.

At MW-4D, a peristaltic pump, fitted with new silicone and teflon tubing, was used to pump water from the top of the water column within the well while a bailer was lowered to the bottom of the well and simultaneously used to surge the screened interval. As each volume of water was removed, field measurement of pH, conductivity, temperature and turbidity was performed. Summary sheets for well development are presented in Appendix H.

4.6.4 Groundwater Sampling

Groundwater wells samples were from the new and existing monitoring wells. The samples, except those collected from MW-12, were analyzed for the following analytes:

i) TCL VOCs;

ii) selected total and dissolved TAL metals;

iii) selected inorganics including:
  a) chloride,
  b) ammonia,
  c) nitrite,
  d) nitrate,
  e) total phosphorus,
  f) sulfate,
  g) sulfide,
  h) hardness ($CaCO_3$),
  i) bicarbonate,
  j) alkalinity (total);

iv) TOC;

v) TDS (total dissolved solids);

vi) TSS (total suspended solids);

vii) BOD (biochemical oxygen demand); and

viii) COD (chemical oxygen demand).

Table 4.1 presents a sample identification key of the groundwater samples collected during the RI.

Prior to the collection of groundwater samples, purging was performed from the top of the water column within each well. As each well volume was removed field measurements of pH, conductivity, temperature and turbidity were performed and recorded in a log book. Purging was completed when each well was purged of a minimum of five well volumes. A summary of well purging measurements is presented on Table 4.5.

Immediately following purging, groundwater samples were collected from all of the newly installed and existing monitoring wells. Sampling was performed using precleaned stainless steel bottom loading bailers.

The sample containers were labeled and placed into coolers with ice. Samples were shipped for analysis via overnight courier to H2M.

Groundwater samples collected from well MW-12 were analyzed for TCL VOCs only, as agreed to with the NYSDEC in letters dated May 5, 1993 and May 20, 1993.

Verbal results for TCL VOC analysis were received on December 18, 1992 from the lab for the groundwater samples. These results indicated that TCE and 1,2-dichloroethene were non-detect (ND) in the groundwater sample collected from well MW-4D. However, the duplicate sample collected from well MW-4D reportedly contained TCE at 4 ppb and total 1,2-dichloroethene at 10 ppb. In order to verify these results, well MW-4D was purged and re-sampled on January 14, 1993. A duplicate sample was also collected from well MW-4D and submitted for analysis. Both of these groundwater samples were analyzed for TCL VOCs only. Both samples were non-detect (ND) for TCE and 1,2-dichloroethene.

All purging, sampling, sample handling and decontamination procedures were performed in accordance with the RI protocols presented in the RI/FS Work Plan and QAPP. Analytical results collected as part of the RI are presented in Appendix D. Section 6.4.1 discusses the results of the groundwater samples.

4.6.5 Hydraulic Monitoring

Hydraulic monitoring was performed on the eight existing and five newly installed wells at the Site. Eleven of the wells monitor the Water Table Aquifer. Two of the wells monitor the Frewsburg Aquifer. In addition, a monitoring point was established to measure the surface elevation of Conewango Creek at the northwest corner of the southern abutment for the former railroad which ran adjacent to the northwest corner of the Site. A total of three rounds of static water levels were collected beginning at the completion of RI Field activities and then at approximate 30-day periods thereafter. Water level rounds were measured on December 22, 1992, January 21, 1993, February 19, 1993, and June 14, 1993.

Water levels were measured using either an electronic water level indicator or a tape and plopper. Water levels (to ±0.01 foot) from monitoring wells were measured from the top of the well casing (reference elevations established during survey) to the water surface in the well. Water levels were recorded in a field book and were later reduced to elevations. Table 4.6 presents the water level data collected as part of the RI and previous investigations.

4.6.6 Field Hydraulic Conductivity

Following monitoring well development, purging and sampling, slug tests were performed in each of the five monitoring wells installed during the RI Hydrogeologic Investigation. The slug test involved displacement of the water in the wells by inserting or removing a known volume ("slug"). The slugs that were used consisted of a section of solid PVC rod. Prior to slug testing, the static water level in the well was measured and a continuous recording pressure transducer was installed in the well. The transducer and water level were monitored until the water level in the well returned to static. The slug was then quickly lowered into the water column, displacing a known volume of water and raising the water level instantaneously. The decrease in the water level (falling head test) was monitored continuously by the transducer. Once the well returned to static, the slug was quickly removed from the well, instantaneously dropping the water level. The increasing water level (rising head test) was monitored continuously until the well returned to static. Upon completion of the slug testing the water level recorder data were down-loaded to a computer disc. The data were then used to calculate an estimated hydraulic conductivity using the method developed by Bouwer and Rice (1979). A summary of the estimated hydraulic conductivities for the monitoring wells is provided in Table 4.7. Slug test data, graphs and calculations of hydraulic conductivity are provided in Appendix I.

Prior to use and between wells, the slug, pressure transducer and cable was thoroughly cleaned using a phosphate-free detergent wash and deionized demonstrated analyte-free water rinse.

4.6.7 Pumping Test

According to the RI/FS Work Plan a pumping test was to be performed at well MW-10D. However, as discussed in Section 4.6.2.1 of this report, the Frewsburg Aquifer was not encountered at this location and well MW-10D could not be installed. Accordingly, the proposed pumping test was not performed.

4.7 SURFACE WATER AND SEDIMENT SAMPLING

A total of 12 surface water and sediment samples were collected from locations on and adjacent to the Site on October 28 to October 30, 1992. All sampling locations were selected in consultation with the NYSDEC Field Representative. The sampling locations are identified on Figure 4.4. The primary objective of this task was to determine the impact of the site contaminants on the surface water and sediment quality in the following areas:

i) freshwater pond;
ii) on-Site drainage swale;
iii) lowlying swampy area at the north end of the Site; and
iv) Conewango Creek.

Background surface water and sediment samples (SW-B, SED-B, SW-M, SED-M, SW-N duplicate of SW-M, and SED-N duplicate of SED-M) were collected from two locations during the RI.

Sample location SW/SED-B was located within the drainage swale in topographically low areas in which water ponds during the wet seasons. Water 6 to 7 inches deep was encountered running through the swale at the time of sampling.

Sample locations SW/SED-M was located in the Conewango Creek north of the Site. Water depth was approximately 12 feet at the sample locations.

Sample location SW/SED-A was located at the cooling water pond and was taken off of the dock located on the western shore of the pond.

Sample location SW/SED-C was located within the drainage swale that runs northward through the center of the Site. Water 6 to 7 inches deep was encountered running in the swale at the time of sampling.

Sample location SW/SED-D was situated within an intermittently ponded depression located northeast of the Metal Building. Storm sewers from the Metal Building and adjacent areas discharge into the depression. Ponded water encountered in this area was approximately 2 to 3 inches deep and a sheen was observed on the surface of the water at the time of sampling.

Location SW/SED-E was situated in a semi-ponded topographic depression located approximately 35 feet east of the drainage culvert/swale discharge point in the north-central portion of the Site. The location was a collection point for a small drainage channel originating at the edge of the concrete pad at the northeastern portion of the Plant Site. Water within this area was approximately 5 to 6 inches deep and a sheen was observed on the surface of the water during sampling.

Location SW/SED-F was located approximately 30 feet south of the point where the drainage ditch swale discharges into Conewango Creek. Water depth was roughly 4 to 6 feet at the location. A gray surface layer was observed on the water during sampling.

Locations SW/SED-G, SW/SED-H, and SW/SED-I were situated within the lowlying area northeast of the developed plant facilities. The locations were within a drainage swale that winds through the lowlands. Soils throughout the lowlands were predominantly saturated and water depths in the swale were roughly 5 to 10 inches deep. A sheen was observed on the surface of the water during sampling.

Sample location SW/SED-J was located in the lowlands east of sample locations SW/SED-G, SW/SED-H and SW/SED-I, approximately 40 feet east of the drainage swale. Water at the location was roughly 3 inches deep. A sheen was observed on the surface of the water during sampling. Additionally, a rust colored flocculant-like material was observed on the sediment/vegetation surface within this ponded area.

Sample locations SW/SED-K, SW/SED-L, and SW/SED-M were located at various points in the Conewango Creek in the vicinity of Site. Water depth was approximately 10 to 15 feet at each of the sample locations.

Surface water samples SW-A, SW-B, SW-C, SW-D, and SW-E were collected and analyzed for the following parameters:

i) TCL VOCs;

ii) metals (cadmium, calcium, chromium, copper, iron, lead, magnesium, manganese, mercury, nickel, sodium); and

iii) hardness.

In addition to the above parameters, surface water samples SW-F, SW-G, SW-H, SW-I, SW-J, SW-K, SW-L, SW-M, and SW-N were also analyzed for PCBs.

Sediment samples SED-A, SED-B, SED-C, SED-D, and SED-E were collected and analyzed for the following parameters:

i) TCL VOCs;
ii) TOC; and
iii) TAL metals.

In addition to the above parameters sediment samples SED-F, SED-G, SED-H, SED-I, SED-J, SED-K, SED-L, SED-M, and SED-N were analyzed for PCBs.

All sediment and surface water samples were collected in accordance with the protocols outlined in the QAPP. Table 4.1 presents a sample identification key. All samples were submitted to H2M for chemical analyses. Appendix D presents the data obtained from the sediment and surface water samples. Section 6.5.1 discusses the results of the sediment and surface water samples.

4.8 AIR MONITORING

4.8.1 Organic Vapor Monitoring

During ground invasive activities, air monitoring was performed in accordance with the HASP. Modifications to the air monitoring action levels were made in the field with NYSDEC concurrence and are as follows:

i) in areas where contamination was not suspected to be present based upon previous investigations and, the soil gas survey results, respirators were not worn unless levels of organic vapors above background concentrations were detected in the breathing zone;

ii) in areas where contamination was known to exist at low levels, based upon previous investigations and the soil gas survey results, respirators were not worn unless organic vapors detected in the breathing zone exceeded background levels; and

iii) in areas known or suspected to contain high levels of VOCs, respirators were donned prior to the start of drilling activities. Periodic air monitoring was performed to ensure that organic vapor levels in the breathing zone did not exceed 10 ppm above background.

In general, most organic vapor monitoring performed in the breathing zone was at or near background levels. During all of the ground invasive activities, the only location where the organic vapor monitoring action level was exceeded was at BH-N, located north of the Main Building. Organic vapors in excess of 1,000 ppm, as measured by an PID, were detected at the top of the auger. At this time, drilling activities were halted and the boring was backfilled with absorbent material (Speedy-Dry) and capped with cement/ bentonite grout.

During the soil investigation and hydrogeologic investigation, the split-spoon samples collected from the borings were screened for organic vapor. Air monitoring activities in the breathing zone were performed when detectable levels of organic vapors above background concentrations were encountered in the soil cores.

A summary of organic vapor air monitoring data obtained during the RI and previous investigations is presented on Table 4.8.

4.8.2 Dust Monitoring

Due to frequent precipitation resulting in wet ground conditions on Site, air monitoring for dust was not performed during the RI field activities with the concurrence of the NYSDEC Field Representative.

4.9 BIOTA INVENTORY

A qualitative inventory of the biota, on and immediately adjacent to the Keywell property, was performed during the field investigation of the RI/FS Program. The inventory was performed by Fineline Technical Services, Inc. of Medina, New York. The inventory consisted of a field survey of the wildlife and vegetation occurring in areas of known/suspected contamination on the Keywell property and immediately adjacent areas; a review of pertinent information from appropriate sources (i.e. NYSDEC, USEPA, United States Fish and Wildlife Services, and the documenting of stress (i.e. lack of vegetation, leachate seeps, stained soils)) potentially related to Site contaminants. The survey was performed in accordance with the NYSDEC guidance document entitled, "Fish and Wildlife Impact Analysis for Inactive Hazardous Waste Sites", dated June 18, 1991.

Appendix J presents a report developed by Fineline Technical Services which summarizes the results of the biota inventory.

5.0 SITE CONDITIONS

5.1 GENERAL

The following section of the RI report presents a description and assessment of the Site conditions based on data collected during the SI, IRA and RI. This supersedes all prior discussions of Site conditions presented in previously issued documents (e.g., Interim Response Actions Final Report). The section includes the following topics:

i) surface features;
ii) geology;
iii) hydrogeology; and
iv) hydrology.

5.2 SITE FEATURES

Section 2.1 describes the Plant Site and operations.

Active plant operation areas are all paved except for the northern end of the plant Site and along the western boundary of the Site. These areas have a packed soil and gravel ground surface. Three large concrete pads are present on the Plant Site immediately north of the Main Building, between the Main Building and the Metal Building, and immediately east of the Metal Building (see Figure 2.3). Two truck scales are located west of the Main Building. The southern portion of the Plant Site, south of the Main Building, has been landscaped consisting of mainly well-maintained grass land and some trees.

A partially covered drainage culvert/swale runs through the center of the Plant Site between the Main Building and the Metal Building. The drainage culvert/swale collects runoff from lands south of the Site and drains into a lowlying area which ultimately discharges to the Conewango Creek. A manmade freshwater pond (Pond) is located in the southwest corner of the Site and drains into the drainage culvert/swale which traverse the Site. Originally, this Pond was constructed to hold cooling water for Plant processes. It is no longer being used for that purpose and currently is stocked with fish (bass). The perimeter of the Pond is also restricted by a 10 foot high chain link fence with a locked gate. An active septic tank and sandbed are located south of the Main Building.

Surface water runoff from the concrete pads (where scrap metals are stored in bins) is treated on Site by a large oil/water separator (001 Separator) located north of the Main Building, and discharged to the Conewango Creek under the terms and conditions of the Facility's SPDES Permit. An abandoned small oil/water separator (002 Separator) is located northeast of the Main Building.

The undeveloped portion of the Site (outside the Plant fence) consists of generally lowlying land consisting of a variety of forested and more open community types.

The elevation of the northern portion of the Plant Site adjacent to Conewango Creek, is approximately 12 feet above the elevation of the lowlying swampy area. As such, the Site drops off sharply toward the creek and swampy area as is indicated by the contours shown on the Site topographic map (see Plan 1). Several groundwater seeps or leachate breakouts have been observed along the break of the slope of the Plant Site adjacent to the Conewango Creek and adjacent to the western edge of the lowlying swampy area.

Groundwater also discharges into the swale/culvert which runs south to north through the middle of the Site. The elevation of the invert of the culvert at the south (upstream) end of the culvert is approximately 1,246 feet AMSL while the groundwater elevation in this area is typically on the order of 1,249 feet AMSL. The elevation at the north end of the culvert is approximately 1,239 feet AMSL while groundwater contours in this area are typically 1,245 to 1,247 feet AMSL. The groundwater which is intercepted by the culvert flows northerly and is eventually discharged to the

Conewango Creek. Groundwater also discharges throughout the lowlying swampy area northeast of the Site.

5.3 SITE GEOLOGY

5.3.1 General

The geologic setting of the Site has been interpreted from the results of the surface and subsurface investigations conducted during the SI, the IRA and the RI and from other available stratigraphic and hydrogeologic information available for the region. The geologic sequence encountered at the Site consists of:

i) surficial overburden unit consisting of native soils and fill materials;
ii) upper sand and gravel unit;
iii) confining clay unit;
iv) lower sand and gravel unit; and
v) bedrock.

The distribution of the geologic units is illustrated on four geologic cross-sections. The orientations of the cross-sections are presented on Figure 5.1, while the cross-sections themselves are presented on Figures 5.2 to 5.5, inclusive.

During the course of the subsurface investigations conducted at the Site, selected soil samples from each geologic unit have been tested for various geotechnical and chemical parameters that aid in the definition of contaminant transport. Table 5.1 presents a stratigraphic summary of all boreholes installed at or near the Site. A summary of the grain-size distribution results from all studies is presented on Table 5.2. Table 5.3 summarizes all remaining geotechnical parameters evaluated.

5.3.2 Surficial Overburden Unit

The uppermost geologic unit beneath the Site is the surficial overburden unit. This unit is generally continuous across the Site.

The thickness of the surficial overburden unit throughout the Site ranges from 0 to 6 feet. It is thickest in the central portion of the Site and thins to one foot or less south and east of the Site. It continues to the west with a thickness of four feet at Production Well #2. The surficial overburden unit consists of a variety of material including fill, topsoil, and a mixture of sand, silt, and gravel. The sand, silt , and gravel mixture generally occurs throughout the southern portion of the Site. The surface overburden layer throughout the northern portion of the Site generally consists of fill material. The fill material is comprised of a wide range of natural and manmade materials including wood, slag, metal turnings, and debris within a loamy topsoil containing silt, gravel, and clay.

5.3.3 Upper Sand and Gravel Unit

Underlying the surficial overburden unit is the Upper Sand and Gravel Unit. This unit is laterally continuous beneath the Site and throughout the surrounding area. The material within the Upper Sand and Gravel Unit varies in composition and grain-size across the study area. Throughout the south central Site area and the region south and west of the Site, the material generally consists of a coarse sand and gravel with a discrete silt layer near the base of the unit. Traveling northward from the center of the Site, the unit contains progressively higher percentages of silt and clay. The Upper Sand and Gravel Unit is predominately silt and fine to medium grained sand, with a higher percentage of clay throughout the northern portion of the Site and the areas to the north and east of the Site.

The sand and gravel portion of the Upper Sand and Gravel Unit is typically brown with occasional orange staining and becomes progressively gray as the silt and clay content increases. This color contrast is indicative of the higher degree of oxidation which has occurred in the sand and gravel intervals and presumably correlates with the higher flow rate of aerated surface water percolating downward and laterally through the more permeable material.

Examination of Table 5.2 shows that two composite soil samples from this unit have been evaluated for grain-size distribution. The sample from MW-10 contained 35.3 percent sand and gravel and 64.7 percent silt and clay. At MW-4D, the sand and gravel content consisted of 70 percent while 30 percent is silt and clay-sized particles. This variation is consistent with the visible observations made during drilling.

The thickness of the this unit varies across the Site. Figure 5.6 is an isopach map of the Upper Sand and Gravel Unit. As shown on the isopach map, the unit is thickest at borehole BH-9D (25 feet thick), located northwest of the Site. It also increases in thickness, ranging from 20 to 22 feet thick, along the southern edge of the Site at boreholes BH-A, BH-J, and BH-1. At borehole BH-W the unit is 20.5 feet thick, but thins in every direction away from this location. The Upper Sand and Gravel Unit is interpreted to be 3 feet thick at Production Well #3, located north of the Site. There is a Y-shaped thin zone extending east from Production Well #2A located west of the Site which bifurcates at the western Site boundary extending southeast toward borehole BH-U, and northeast toward well MW-3. The unit along this Y-shaped thin zone ranges from 5 feet thick at Production Well #2A, to 8 feet thick at borehole BH-U, to 10.5 feet thick at well MW-3. There is no obvious correlation between the grain size distribution of the sediments and the thickness of the aquifer.

5.3.4 Confining Unit

Underlying the Upper Sand and Gravel Unit is the Confining Unit. The unit is composed of silt and clay throughout the south and central areas of the Site, and contains clay with gravel in the area north of the Site. The Confining Unit is likely lacustrine in origin based on the presence of distinct layers or varves in undisturbed soil samples (see Appendix G) and the geologic history of the Jamestown area (see Section 3.4). This Confining Unit separates the overlying Upper Sand and Gravel Unit from the underlying Lower Sand and Gravel Unit. The unit is laterally continuous beneath the Site and throughout the adjacent areas. In areas where the Lower Sand and Gravel Unit is not present, the Confining Unit is continuous vertically as well as in the horizontal direction.

This Confining Unit was originally described in the SI Report as two distinct confining units: the Upper Confining Unit and the Lower Confining Unit. These two layers are indistinguishable except when the Lower Sand and Gravel Unit is present. For this report, the Confining Unit includes the entire section of silt and clay above and below the Lower Sand and Gravel Unit. Test boring No. T-3, the test boring for Production Well #1, is the only borehole near the Site that penetrated the base of the Confining Unit. (Refer to Appendix A of the SI Report for the lithologic description of borehole T-3.) Borehole T-3 was drilled to a total depth of 190 feet BGS. The bottom of the Confining Unit at this location was 106 feet BGS. The thickness of the Confining Unit at this location is 92 feet. The Confining Unit separating the Upper and Lower Sand and Gravel Unit and the Frewsburg Aquifer ranges in thickness from 13.5 feet at boreholes MW-4D and MW-5D to 28 feet at Production Wells #2A and #3.

Figure 5.7 presents a contour map of the top of the Confining Unit. The trends and patterns of this clay surface contour map generally corresponds to the trends and patterns of the isopach map of the overlying Upper Sand and Gravel Unit (see Figure 5.6), with few exceptions. The lowest on-Site point for the top of the clay layer occurs between borehole BH-W and MW-9, which is where the Upper Sand and Gravel Unit is thickest throughout the Site. The Y-shaped thin zone of the overlying aquifer corresponds to an elevated Y-shaped ridge for the clay surface. The clay surface contour map does not correlate very well with the Upper Sand and Gravel Unit isopach map. A topographic high area is observed for the clay surface at borehole BH-A, whereas the Upper Sand and Gravel Unit also becomes thicker in this area. This is because the ground surface is topographically higher to the south, resulting in an elevated clay surface and also a thicker section of Upper Sand and Gravel Unit.

During the SI investigation, thin-walled tube samples of the Confining Unit were collected from three boreholes located throughout the Site (Tables 5.2 and 5.3). The material was described by the geotechnical laboratory as glacial lake sediments, based on the presence of distinct layers or varves observed within the undisturbed samples. The alternating light and dark colored varves measured approximately 3/4-inch to 1-inch thick.

The grain size distribution analyses presented on Table 5.2 show that the silt and clay content was very high for samples collected from the Confining Unit, ranging from 94.6 to 100 percent.

5.3.5 Lower Sand and Gravel Unit

At certain locations beneath and adjacent to the Site, a sand and gravel unit is located within the Confining Unit. This unit was encountered in Production Wells #1, #2A and #3, and in on-Site monitoring wells MW-4D and MW-5D. Five additional on-Site boreholes (BH-1D, BH-6D, BH-8D, BH-9D and BH-10D) were drilled to define the unit, but the unit was not present at these locations. The actual orientation and lateral extent of this unit is not well understood based on available data. It is postulated that the unit consists of sand and gravel occurring as one or more distinct "channel-shaped" lobes which meander east and west across the present day Conewango Creek valley along narrow sinuous north-to-south oriented continuous pathways within the surrounding Confining Unit. This channel is thought to be the result of a former stream which originated northward from the glacial melt waters and flowed southward into a former lake and along the lake bottom. This stream evidently carried sand and gravel sized material into the former lake where it was deposited and subsequently buried to form the current confined conditions of the Lower Sand and Gravel Unit. According to Crain (1966), the origin of this sand and gravel is from glacial outwash. If true, then the Unit is geologically equivalent to the Jamestown Valley Fill Aquifer.

Based on the existing data, the Unit occurs beneath the Monarch Plastics facility southwest of the Site, and extends northward along the western edge of the Site between Production Wells #1 and #2A and monitoring wells MW-4D and MW-5D. It is also present to the north in Production Well #3.

The following information presents two possible hypotheses for predicting the orientation of the Frewsburg Aquifer throughout the study area. Neither hypothesis can be verified based on the data collected to date. Additionally, it would be difficult to verify the hypothesis due to the characterization of the Site and the nature of formation of the Frewsburg Aquifer.

One hypothesis is that the Lower Sand and Gravel Unit is a single channel which curves northwest from well MW-4D and west of borehole BH-D, then loops back around to the northeast and extends to Production Well #3. Based on this hypothesis, the Unit is not present beneath the Site. This hypothesis is supported by the fact that the Unit was not encountered in boreholes BH-8D and BH-9D.

Another hypothesis is that the orientation of the Unit is indicated by the Y-shaped bifurcating ridge observed on the clay surface contour map of the Confining Unit and on the isopach map of the Upper Sand and Gravel Unit. According to this hypothesis, the Unit occurs as a braided stream configuration and not a distinct single narrow channel. One segment of the braided stream may trend southward and enters the Site beneath well MW-3 and extends south-southwest beneath well MW-7 toward Production Wells #1 and #2A. A second segment of the braided stream may trend southwestward and enters the Site immediately east of borehole BH-K. This segment then extends beneath borehole BH-U, where it curves sharply toward the west-northwest continuing beneath borehole BH6-1 and intersects the other segment beneath well MW-7. Once deposited, the braided stream sand and gravel sediments were then buried by the silts and clays of the glacial lake sediments. As the lake deposits (water-rich mud) accumulated, the overlying weight of the water-saturated fine-grained material compressed, reducing its thickness) by releasing water. But the sand and gravel sediments were relatively non-compressible and maintained their original thickness. As a result, a topographic high mound was created along the surface of the glacial lake deposits which currently exists today as a Y-shaped ridge.

Beneath the Confining Unit is another 50 feet of varying amounts of sand, gravel and clay. Four waterbearing strata were noted within this zone; however, none of these strata yielded water of sufficient quantities for use as a municipal water supply.

5.3.6 Bedrock

At test boring T-3, which is located off-Site in the area of District Production Wells #1 and #2A, bedrock was encountered at about 156 feet BGS. The bedrock was described as gray shale and fine grained sandstones. This bedrock unit is believed to be part of the Upper Devonian Conewango Group (Crain 1966).

5.4 SITE HYDROGEOLOGY

5.4.1 General

In order to define the groundwater flow system beneath the Site, the identified geologic units are grouped into hydrostratigraphic units according to their waterbearing properties. Those units which have a significant capacity to transmit water are termed aquifers, while materials with a low hydraulic conductivity are termed aquitards.

The geologic units have been grouped into hydrostratigraphic units as follows:

i) Water Table Aquifer - an aquifer consisting of the Upper Sand and Gravel Unit;

ii) Frewsburg Aquifer - an aquifer consisting of the Lower Sand and Gravel Unit; and

iii) Confining Unit - an aquitard separating the two aquifers.

These units are discussed below.

5.4.2 Water Table Aquifer

The Water Table Aquifer can be described as a shallow unconfined waterbearing zone of "terrace-like" deposits of interbedded sands containing varying amounts of silt and gravel.

All available water level measurements collected during the SI, IRA and RI programs are presented on Table 4.6. Examination of these data indicates that seasonal fluctuation of water table elevation occurs. The magnitude of the fluctuations are in the order of three to four feet across the Site.

Water table contour plans were prepared for December 23, 1992, January 21, 1993, February 19, 1993, and June 14, 1993 (Figures 5.8, 5.9, 5.10, and 5.11 respectively). Examination of these figures clearly shows that the groundwater flow pattern is consistent between these dates. In general, groundwater flows in the Water Table Aquifer in a north to northwest direction. Groundwater ultimately discharges to Conewango Creek.

One manmade feature which influences the groundwater flow in the Water Table Aquifer is the drainage swale/culvert which traverses the Site. Direct evidence of this is the continuous discharge from the culvert, even during dry weather periods. Also, an evaluation of the elevation of the culvert (based on the Site topographic plan) indicates the inlet to the culvert has an invert elevation of approximately 1,246 feet AMSL, while at the outlet the invert elevation is approximately 1,234 feet AMSL. The water table elevations in monitoring wells adjacent to the drainage swale/culvert at the inlet and outlet are approximately 1,249 feet AMSL and 1,247 feet AMSL, respectively. Based on the elevation differences between the water table and the drainage swale/culvert, it is evident that the swale/culvert is a control on local groundwater flow.

The horizontal hydraulic gradient across the Site ranged from 0.010 feet per foot for the December 1992 (Figure 5.8) to 0.012 feet per foot for the February 1993 (Figure 5.10) data. This hydraulic gradient was measured along a line from well MW-1 to near well MW-2 in the downgradient groundwater flow direction for the three sets of water level data. The horizontal hydraulic gradient beneath the area between well MW-2 and Conewango Creek sharply increases toward the creek. The gradient near Conewango Creek ranged from 0.038 (in June) to 0.096 (in January) feet per foot. Based on the data, it is apparent that groundwater discharges from the Water Table Aquifer into Conewango Creek.

As part of the SI and RI, single well response tests were performed on the on-Site groundwater monitoring wells which are screened within the Water Table Aquifer. The results of these tests are presented on Table 4.7. Based on all results, the hydraulic conductivity values (K-value) of the Water Table Aquifer ranged from 7.9×10^{-3} (MW-8) to 1.3×10^{-6} (MW-11) cm/sec. The geometric mean K-value is 5.2×10^{-4} cm/sec.

The screened intervals for the Water Table Aquifer monitoring wells are located within the varying intervals of sand, silt and clay. For example, the 10 foot section of screen for well MW-8 is positioned adjacent to six feet of a fine grained sand and four feet of silt and clay. Thus, this calculated K-value is an average value based on cumulative groundwater recharge (for rising head tests) from the six foot sand and from the four foot interval of silt and clay. Thus, these K-values represent an average value for the overall aquifer. (The sand intervals would have a somewhat higher K-value, whereas the silt and clay intervals would have a lower K-value.)

Two composite soil samples from two boreholes (MW-4D and MW-10) were collected from the Water Table Aquifer for geotechnical testing. The samples tested contained 25.1 and 18.4 percent water for MW-10 and MW-4D, respectively. The specific gravity for both composite samples was 2.7. Both composite samples were collected from the saturated portion of the Water Table Aquifer. Using the values for moisture content as a range for this aquifer, the range of porosity values can be estimated using the following relationships:

$$e = \frac{W*Gs}{Sr} \text{ and}$$

$$n = \frac{e}{1+e}$$

Where:

W = moisture content
Gs = specific gravity
Sr = degree of saturation (assumed to be 1)
e = void ratio
n = porosity.

Based on these results, the calculated porosity values for the Water Table Aquifer ranges from 40.4 percent for the finer grained silty material to 33.2 percent for the more sandy material. These values agree with the laboratory results for porosity for the two composite samples were 39.3 and 36.2 percent, respectively (see Table 5.3).

A reasonable estimate for the porosity of the Water Table Aquifer as a whole is 0.30. The average linear groundwater flow velocity was estimated using the following form of Darcy's Law:

$$v = \frac{Ki}{ne}$$

Where:

K = hydraulic conductivity (cm/sec);
i = average hydraulic gradient;
ne = effective porosity; and
v = resultant estimated average linear groundwater flow velocity (cm/sec).

Substituting the K-mean of 5.2×10^{-4} cm/sec, the average hydraulic gradient of 0.010 and a porosity of 0.30 into the above equation an average linear groundwater flow velocity of 1.73×10^{-5} cm/sec (0.05 feet/day) is obtained. This velocity is consistent with that determined during the SI (0.06 feet/day).

The TOC for the MW-4D and MW-10 composite samples were 1,790 and 4,260 ppm (0.179 and 0.426 percent), respectively. This parameter indicates the adsorptive potential the material possesses which will impact the mobility of organic compounds flowing through the material.

5.4.3 Confining Unit

The Confining Unit consists of clay and silt and underlies the Upper Sand and Gravel Unit and separates the two aquifers beneath the Site.

Two monitoring well nests (MW-4/MW-4D, and MW-5/MW-5D) are completed on Site with monitoring wells completed in the Water Table and Frewsburg Aquifers. The comparison of water level elevations in each well nest for the three sets of data indicates that the vertical hydraulic gradient (VHG) was upward in December 1992 and was downward in January and February. The magnitude of the VHG ranged from +0.039 (upward) to -0.092 (downward).

The vertical hydraulic conductivity was measured on Shelby tube samples of clay from the Confining Unit during the IRA (see Table 5.3). The results indicate a very low vertical hydraulic conductivity value, ranging from 1.8×10^{-8} to 3.0×10^{-8} cm/sec. This very low hydraulic conductivity would limit the migration of contaminated groundwater from the Water Table Aquifer to the Frewsburg Aquifer.

Moisture content was also measured during the IRA. The moisture content for these samples ranged from 24 to 35 percent. Using the above equations, the total porosity of the Confining Unit ranges from 39 to 49 percent. The effective porosity would be less.

At the location of the well nests, the thickness of the Confining Unit is approximately 20 feet. Therefore, the travel time for the migration of water through this Confining Layer between aquifers is extremely long (in excess of 1,000 years).

TOC was measured on a sample from the Confining Unit. The sample was collected from borehole MW-5D from 32 to 34 feet BGS. The TOC value measured 949 ppm (0.16 percent).

5.4.4 Frewsburg Aquifer

The lower aquifer is called the Frewsburg Aquifer. Locally, this aquifer is confined and exhibits artesian conditions. Crain (1966) reported the results of a 145 gpm pumping test which was conducted for approximately 12 hours on Frewsburg Production Well #1. The calculated transmissitivity of the aquifer ranges from 6,900 to 7,400 gpd per foot. With a 5-foot thickness, the hydraulic conductivity would range from 6.5×10^{-2} to 7.0×10^{-2} cm/sec, based on the pumping test data. The hydraulic conductivity for the Frewsburg Aquifer was calculated to be between 2.3×10^{-3} to 7.9×10^{-3} cm/sec based on a single well response test at monitoring well MW-4D. This slug test was performed as part of the IRA. The storage coefficient was calculated to range from 0.00006 and 0.0004 which confirms confined conditions.

As described in the IRA Report, water wells screened within the Frewsburg Aquifer reveal that they are hydraulically connected locally. Continuous static water level monitoring of wells screened within the Frewsburg Aquifer (during a pumping test performed at Production Wells #1 and #2A) reveal that the following wells are hydraulically connected:

i) Frewsburg Production Wells #1, #2A and #3;
ii) on-Site monitoring well MW-5D; and
iii) Monarch Plastic's Frewsburg Water Wells.

Continuous monitoring of selected Upper Sand and Gravel Unit monitoring wells during the same period indicate that there is no identifiable or direct vertical hydraulic connection between the Frewsburg Aquifer and the Upper Sand and Gravel Unit. Given the artesian nature of the Frewsburg Aquifer and the pumping of the Monarch Plastic water wells, the direction of groundwater flow in the Frewsburg Aquifer cannot be accurately determined.

Based on Site conditions, the Frewsburg Aquifer is interpreted to consist of deposits of sand and gravel occurring as distinct "channel-like" lobes confined within the clay and silt Confining Unit. This zone of sand and gravel is very permeable and contains water under artesian conditions. The presence of the Frewsburg Aquifer cannot be predicted because of its apparent meandering "channel-like" shape and occurrence. A resistivity survey conducted to identify the location and boundary of the Frewsburg Aquifer beneath the Site could not accurately determine the presence or absence of the Frewsburg Aquifer. In addition, five exploratory boreholes (BH-1D, BH-6D, BH-8D, BH-9D and BH-10D) were drilled on and off the Site for the purpose of locating and monitoring the Frewsburg Aquifer. Only two of the boreholes (MW-4D and MW-5D) encountered the aquifer.

Further evidence of the discontinuous nature of the Frewsburg is the difference in the piezometric level in MW-5D and MW-4D. These wells are approximately 400 feet apart, however, the piezometric level is consistently 4 feet lower in MW-4D. This larger difference in hydraulic head over such a short distance is not typical of a continuous aquifer with a hydraulic conductivity of approximately 1×10^{-2} cm/sec.

5.4.5 Groundwater Flow System

The Site is located over the Water Table Aquifer. Precipitation infiltrating through the Site will reach the water table and flows to the north and northwest. Groundwater ultimately discharges to the Conewango Creek. Groundwater flow in the Water Table Aquifer is also affected by the drainage swale/culvert. The culvert was placed below the water table and collects groundwater. The culvert discharges to the lowlying area north of the plant and ultimately reaches Conewango Creek.

The potential for groundwater migration from the Water Table Aquifer through the Confining Unit to the Frewsburg Aquifer is limited by the presence of the clay confining unit and the artesian nature of the Frewsburg Aquifer. The groundwater flux is limited by the extremely low vertical hydraulic conductivity of the Confining Unit (approximately 1×10^{-8} cm/sec) and the low vertical hydraulic gradients across the Site.

5.5 SITE HYDROLOGY

5.5.1 General

The Site is located within the lower Conewango Creek Valley. Drainage of Conewango Creek is southward into the Allegheny-Ohio-Mississippi River System. The Site is located within the 100-year flood plain of the Conewango Creek (Flood Insurance Rate Map, Town of Carroll, Chautauqua County, New York, Community Panel

No. 360994 0005 B, Federal Emergency Management Agency, October 29, 1982). The creek level typically is lowest in the fall (October) and highest during the spring (April) as a result of melt waters from the winter snow and ice.

The Conewango Creek Valley is generally flat-bottomed. The stream has a gradient of 2 feet per mile or less. This low gradient and flat valley bottom results in the meandering of the creek back and forth across the valley. Groundwater beneath this area is recharged from precipitation and from overland runoff from adjacent uplands and discharges into the Conewango Creek.

The following table provides USGS summary statistics of water resources data for Conewango Creek. These statistics are of annual mean data for water years 1940 to 1992. These data were collected from a water-stage recorder placed along the creek at Russell, Pennsylvania. This stream gage station is located approximately 9 miles downstream of the Site. The data units are in cubic feet per second unless otherwise indicated.

Summary Statistics	*Water Years 1940-1992*
Annual Mean	1,526
Highest Annual Mean	2,057
Lowest Annual Mean	974
Highest Daily Mean	14,100
Lowest Daily Mean	57
Annual Seven-Day Minimum	59
Instantaneous Peak Flow	14,400
Instantaneous Peak Stage	10.69
Annual Runoff (CFSM)	1.87
Annual Runoff (Inches)	25.42
10 Percent Exceeds	3,810
50 Percent Exceeds	1,000
90 Percent Exceeds	161

Based on the data obtained during the RI and previous Site investigations, the bottom elevation of the Conewango Creek is believed to be approximately 1,230 to 1,235 feet ASML.

5.5.2 Site Drainage

Surface water runoff for the Site is directed primarily to the south-north running swale/culvert which traverses the Site. This swale/culvert collects runoff from lands south of the Site and from southern of the Site and discharges to a lowlying area northeast of the Plant and ultimately reaches Conewango Creek.

Surface water runoff within the Plant Site, generally, drains northward to the lowlying area and the Conewango Creek. Stormwater from the concrete pads which are used to store scrap metal is directed into a stormwater line which discharges into an oil/water separator. The oil/water separator removes any residual oils in the stormwater and discharges the stormwater into the Conewango Creek in accordance with the facility's SPDES permit.

Stormwater catchbasins and roof drains along the western portion of the Plant Site drain into a buried 24-inch corrugated metal culvert which discharges into the Conewango Creek at the northwestern corner of the Site (sample location SW-5, as illustrated on Figure 2.8).

Stormwater from roof drains and floor drains in the Metal Building are collected in a buried sewer pipe which discharges to the lowlying area at the northeast of the Metal Building (sample location SED/SW-D on Figure 4.4).

6.0 NATURE AND EXTENT OF CONTAMINATION

6.1 GENERAL

This section presents and evaluates the analytical data collected during the RI activities and discusses the nature and extent of contamination, if any, in the soil, groundwater, surface water, sediment and air. Data and information collected during the SI, IRA and RI were used to characterize and assess the nature and extent of contamination, if any.

Appendix D presents the analytical data for samples collected during the RI. The data for samples collected during the SI and IRA were presented and were evaluated in the SI and IRA reports. Tables 6.1, 6.2, 6.3, 6.5, 6.7 and 6.8, summarize the SI, IRA and RI data for the detected parameters only. Plans 4 through 8, inclusive, present the sample locations and total VOC concentrations.

6.2 RI ANALYTICAL DATA ASSESSMENT

6.2.1 General

A sample identification key is presented on Table 4.1 along with the analyses performed during the RI. Samples collected for chemical and/or physical analyses included:

i) soil samples;
ii) groundwater samples;
iii) surface water samples; and
iv) sediment samples.

Those samples submitted for chemical analyses were analyzed by H2M Laboratories (H2M) located in Melville, New York. All samples were collected and analyzed in accordance with the NYSDEC September 1989 Analytical Services Protocols (ASP) and the approved QAPP.

The analytical methods used are summarized in Table 1 of the RI analytical data validation report contained in Appendix K.

The complete analytical data report for the RI data, as provided by H2M, will be submitted under separate cover, if required. Completed chain of custody forms are identified in Appendix L. Appendix D presents the data tables for the groundwater, surface water, sediment and soil samples collected during the RI/FS.

6.2.2 Data Quality Summary

The analytical data received were assessed and validated based on review of standard quality control criteria which included sample holding times, instrument calibration and performance, surrogate recoveries, laboratory blank analyses, quality control (QC) check standards, matrix spike/matrix spike duplicate analyses, duplicate analyses, and field blank analyses. A summary of the analytical assessment and validation results is presented in Appendix K.

Problems encountered during the analyses of the RI samples included:

i) high moisture content in sediment samples;

ii) outlying VOC continuing calibration data (53 out of 76 investigative samples);

iii) outlying internal standard area counts (6 of 76 investigative samples);

iv) outlying surrogate spike recoveries (3 of 76 investigative samples);

v) laboratory contamination of samples (18 of 76 investigative samples);

vi) outlying interference check sample recoveries (13 of 76 investigative samples);

vii) outlying laboratory and field duplicate data (7 of 76 investigative samples); and

viii) outlying serial dilution and MSA analyses (13 of 76 investigative samples).

The effect of these problems upon the RI data was calculated using the following formula for completeness:

$$\text{Completeness} = \frac{\text{valid data obtained}}{\text{total data planned}} \times 100 \text{ percent}$$

Approximately 89 percent of the analytical data met QA/QC criteria and did not require qualification as specified in the data validation. The remaining data was qualified as estimated values based on the criteria specified in the data validation report (Appendix K). None of the analytical data was qualified as unusable.

The USEPA typically finds that 80-85 percent of the analytical data generated during RI/FS studies meet associated QA/QC requirements. In comparison, the amount of analytical data meeting all QA/QC criteria (89 percent) exceeds this acceptable range.

On the basis of the formal data validation identified above, all data generated during the RI are acceptable for use with the specific qualifications noted herein.

6.3 SOILS

6.3.1 Soil Gas Survey Results

In order to delineate the horizontal extent of VOC contamination, a soil gas survey was performed in the subsurface soils at the Site by Target Environmental Services, Inc. (Target), as discussed in Section 4.5.1. Soil gas samples were collected from subsurface soils at approximately 4 feet BGS and were analyzed for the target analyte list of compounds (known herein as the "Target VOC List") consisting of: trichloroethene, total 1,2-dichloroethene, tetrachloroethene, vinyl chloride, 1,1-dichloroethane, 1,1,1-trichloroethane, benzene, 1,1-dichloroethene, ethylbenzene, toluene, and xylenes. Detected concentrations for methylene chloride, chloroform, carbon tetrachloride, 1,1,2-trichloroethane, and the remaining total flame ionization detector (FID) volatiles were also reported for all samples analyzed. Target's soil gas survey report is presented in Appendix B.

Of the 187 locations to be sampled, 35 locations could not be sampled due to high groundwater levels. A total of 152 locations were sampled. Plan 4 presents the sample points and the total soil gas VOC concentrations. The total soil gas VOC concentrations were calculated by summing the total detected quantity of each Target VOC List analyte as well as methylene chloride, chloroform, carbon tetrachloride, 1,1,2-trichloroethane, and the total FID volatiles. The total FID volatile value represents the concentration of remaining volatiles which were detected but were not analyzed for specifically (see Appendix B for Target's report). Background soil gas samples were collected from the southern portion of the Site and contained no detectable VOCs.

None of the Target VOC List analytes were detected above the associated detection limits at 95 of the 152 points sampled. The most predominant VOCs detected in the soil gas survey were TCE, cis-1,2-dichloroethene, 1,1-dichloroethene, xylene, ethylbenzene, and vinyl chloride. The highest total target VOC concentrations were at sample locations P-6+50, X-6+50, Y-6 and Z-6. The total soil gas VOC concentrations at these locations ranged from 3,063.6 $\mu g/L_{air}$ at soil gas location X-6+50 to 229,455.9 $\mu g/L_{air}$ at soil gas location Y-6.

Total VOC concentrations varied considerably across the Site (see Plan 4). Aside from one minor detection at location E-5, no total VOC concentrations were detected above 2.0 $\mu g/L_{air}$ at the southern portion of the Site. Elevated total VOC concentrations were found in three areas of the Site: west of the Main Building in the vicinity of the existing TCE tank; east of the Main Building and west of the Site drainage culvert/swale; and north of the Main Building.

The highest total VOC concentrations were found in the soil gas samples collected in the northern end of the Site (north of the concrete pad), and east of the 001 Separator. The highest total VOC concentration in this area was 229,455.9 $\mu g/L_{air}$ at location Y-6. Soil gas samples collected from beneath the western portion of the concrete pad located north of the Main Building also contained notable high levels of VOC. The highest total soil gas VOC concentration detected in this area was 1,831.9 $\mu g/L_{air}$ at sample location U-3+30. TCE was the primary VOC detected in the soil gas samples collected in these areas.

The highest total VOC concentrations detected in the soil gas samples collected from the area east of the Main Building and west of the Site drainage culvert/swale was 3,615.7 $\mu g/L_{air}$ at sample location P-6+50. The most predominant VOC detected in this area was TCE and to a lesser degree, ethylbenzene and xylenes. Components of petroleum products, were also detected.

Soil gas samples collected in the area west of the Main Building contained total VOC levels which were considerably lower than those recorded in the areas discussed above. The highest total VOC concentration found in this area was 207 $\mu g/L_{air}$ at soil gas sample location Q-2.

Soil gas samples collected from the remainder of the Site contained VOCs at levels comparable to background levels, with little or no VOCs present.

6.3.2 RI Soil Analytical Data

6.3.2.1 Surface Soil Samples

Background surface soil samples were collected during the RI at the south end of the Site in locations which reportedly have not been impacted by plant activities. Background surface soil samples (0 to 2 inches BGS) were collected from sample locations SSoil-A adjacent to BH-A and SSoil-J adjacent to BH-J. The locations of these samples are shown on Figures 4.1 and 4.2. These background surface soil samples were analyzed for TCL VOCs. Table D-1 of Appendix D presents the analytical results for the surface soil samples collected during the RI. Table 6.1 summarizes the RI and SI data for compounds detected in the surface soil samples.

The two background surface soil samples (SSoil-A and SSoil-J) collected contained low levels of VOCs. Surface soil sample SSoil-A contained 2-butanone at an estimated concentration of 8J ppb (below the detection limit). Surface soil sample SSoil-J contained methylene chloride at an estimated concentration of 17J ppb. Acetone was detected in both background samples which may be a result of laboratory contamination since acetone is a common lab solvent and was not pervasive in samples collected during the SI and IRA programs.

In addition to the two background surface soil samples, three investigative surface soil samples were collected during the RI. Surface soil samples SSoil-M, SSoil-N and SSoil-O were collected from the area north of the concrete pad in the general vicinity of the 001 Separator. Sample locations are shown on Figure 4.1. The three surface soil samples collected were analyzed for TCL VOCs and PCBs. Table D-1 of Appendix D presents the analytical results and Table 6.1 presents the results for detected compounds only.

VOCs were detected in surface soil samples SSoil-M and SSoil-N at estimated concentrations below the detection limit. Aroclor 1260 was detected at an estimated concentration of 37J ppb and 36J ppb in samples SSoil-M and SSoil-N, respectively. The source of the PCBs or Aroclors is not known. Surface soil sample SSoil-O was collected adjacent to BH-O. No VOCs or PCBs were detected in this sample.

6.3.2.2 RI Subsurface Soil Samples

Background subsurface soil samples were collected during the RI from areas south of the plant Site. RI background subsurface soil samples were collected from soil sample locations BH-A (2 to 4 foot interval) and BH-J (14 to 16 foot interval and the 20 to 22 foot interval). The location of these samples are shown on Figure 4.2. These background soil samples were analyzed for the TCL VOCs.

The background subsurface soil samples did not contain VOCs above the detection limits. Acetone was detected in samples BH-A (2 to 4 foot interval) and BH-J (20 to 22 foot interval) at estimated concentrations of 4J ppb (below the detection limit) and 16J ppb, respectively. The acetone in these samples is believed to be a result of laboratory contamination since it was not detected pervasively in samples collected during the SI and IRA.

During the RI, subsurface soil samples were collected from 20 boreholes advanced throughout the Site. The locations of the boreholes are shown on Figure 4.2. Each of the subsurface soil samples were analyzed for TCL VOCs. Additionally, soil samples collected from boreholes BH-L (4 to 6 foot interval), BH-P (4 to 6 foot interval) and MW-11 (10 to 12 foot interval) were analyzed for PCBs. Table D-2 of Appendix D presents the analytical results for the subsurface soil samples collected during the RI.

Table 6.2 summarizes the data for compounds detected in the subsurface soil samples collected during both the SI and RI.

Ten of the TCL VOCs were detected in the RI subsurface soil samples as shown in the following:

VOC	*Frequency of Detection*	*Range (ppb or µg/kg)*	*Borehole Containing Highest Detection*
Acetone	14	4J - 380J	BH-M
1,2-Dichloroethene (total)	5	11J - 170	BH-D
2-Butanone	2	9J - 100J	BH-M
1,1,1-Trichloroethane	2	9J - 16J	BH-M
Trichloroethene	11	11J - 85000	MW-11
Tetrachloroethene	2	4J - 93	MW-11
Benzene	1	470J	BH-P
Toluene	3	5J - 5900J	BH-P
Ethylbenzene	1	6000J	BH-P
Xylene (total)	2	28J - 39000J	BH-P

Note:
J Associated value is qualified as estimated based on the data validation and assessment results.

Benzene and ethylbenzene were only detected in sample BH-P (4 to 6 foot interval). Tetrachloroethene was only detected above the detection limit in sample MW-11. Acetone was the most frequently detected compound with the highest concentration of 380J ppb in sample BH-M. However, the acetone levels found in the soil samples may be a result of laboratory contamination since acetone is a common lab solvent and was not detected pervasively in the SI soil samples. Trichloroethene was detected in 11 samples with the highest concentration of 85,000 ppb found in sample MW-11. 1,2-Dichloroethene (total) was detected in a total of five samples with the highest concentration (170 ppb) being found in sample BH-D.

Total detected VOC levels for each subsurface soil sample are presented on Table 6.2. No PCBs were detected in any of the RI subsurface soil samples.

6.3.3 Soil Characterization

6.3.3.1 General

This section describes the nature and extent of contamination in the soils at the Site. Data from the soil investigations performed during the SI and RI are utilized in this discussion. Tables 6.1, 6.2 and 6.3 summarize the analytical results for compounds detected in the SI and RI samples. Plans 5 and 6 illustrate the total VOC concentrations for RI and SI soil samples collected from the Shallow Sand and Gravel Unit and the Confining Unit, respectively.

6.3.3.2 Nature of Soil Contamination

Background surface soil and subsurface soil samples were collected during the SI and RI at the southern portion of the Site from locations which have not been impacted by plant activities. Background surface soil samples were collected from locations SSoil-A, SSoil-J, SS-1, SS-2, SS-3, and SS-4, and background subsurface soil samples from BH-1, BH-A, and BH-J (see Plan 5 and Plan 6).

Background soil samples contained low levels of VOCs. TCE was detected in two SI background samples (SS-1 and BH-1) and only at a maximum concentration of 38 ppb. The source of the TCE at this sample location is unknown. Methylene chloride and 2-butanone were detected in sample SSoil-J and SSoil-A, respectively at estimated concentrations below the detection limits.

Background surface soil sample SS-1 and subsurface soil sample BH-1 (2 to 4 foot interval) were analyzed for the TCL BNAs during the SI. The TCL pesticides and PCBs were analyzed for in background surface soil samples SS-1, SS-2, SS-3 and SS-4 and in subsurface soil sample BH-1 (2 to 4 foot interval).

Low levels (below the detection limits) of BNAs were reported in background soil sample BH-1 (2 to 4 foot interval) and consisted of phthalate esters and polynuclear aromatic hydrocarbons (PAHs). TCL pesticides were detected in only one background sample (SS-2) which showed detections of alpha-BHC, beta-BHC, and delta-BHC (see Tables 6.1 and 6.2). PCBs were not detected in any of the background samples.

The TAL metals and cyanide were analyzed for in samples BH-1, SS-1, SS-2, SS-3, and SS-4 (cyanide was not detected in any of these samples). Metals were detected in the SI background soil samples at concentrations similar to published concentrations for uncontaminated soils. Table 6.4 presents a summary of background metal concentrations in soils. The background soil sample data were compared to the data obtained from the investigative soil samples (i.e. test pit and borehole samples).

Tables 6.1, 6.2 and 6.3 summarize the data obtained from the SI and RI soil samples. A review of these data indicates that the primary soil contaminants are VOCs. None of the TCL pesticides were detected in the investigative soil samples collected during the SI.

The primary VOCs detected in the on-Site soils include TCE and its degradation product, 1,2-dichloroethene (total). Soil samples collected from the area southeast of the Main Building contained elevated levels of benzene, toluene, ethylbenzene and xylene (BTEX) compounds which are likely related to the presence of petroleum products in the soils. Other VOCs were detected less frequently and at generally low concentrations. Total VOCs reported in the soil ranged from ND to a high of 17,620,000J ppb in TP-2A.

BNAs were generally non-detect or detected at estimated trace concentrations (below the detection limits) with the exception of several samples collected from test pits excavated in areas of known soil contamination (north end of the Site). The primary BNAs detected at these locations included fluoranthene, bis(2-ethylhexyl)phthalate, pyrene, and di-n-octyl phthalate. The BNA levels detected in the investigative soil samples and test pit samples were generally consistent with those detected in background samples BH-1 and SS-1, and were all significantly less than (two to three orders of magnitude) the respective NYSDEC recommended soil cleanup levels (NYSDEC TAGM HWR-92-4046, dated November 16, 1992).

Metals which were detected above published background levels for uncontaminated soils and Site background levels (see Table 6.4) included cadmium, chromium, cobalt, copper, iron, lead, nickel, vanadium, and manganese. Elevated levels of metals in the soils are attributable to the presence of metallic chips, turnings and debris found in the fill soils at the Site. Soil samples collected from the remaining areas of the Site generally contained metals at levels similar to published values for uncontaminated soils.

PCBs were detected in surface soil samples (SSoil-M, SSoil-N) collected from two locations at the north end of the Site at levels ranging from 0.029J ppm to 0.037J ppm. Low levels (0.013J ppm to 12J ppm) of PCBs were also detected in test pit samples collected from the northern end of the Site, northwest of the Main Building and southeast of the Metal Building. No PCBs were detected in the remaining subsurface soil samples. However, the detected PCB levels were less than the recommended action levels(1) (10 to 25 ppm) for PCBs in soils in an industrial area, as established by the USEPA.

6.3.3.3 Extent of Contamination in Soils

Plan 5 and Plan 6 illustrate the total VOC concentrations in soil samples collected from the Shallow Sand and Gravel Unit and the Confining Unit, respectively. Plan 4 illustrates the areal distribution of VOC contamination in the soil based on the soil gas results. Figures 6.1 through 6.5, inclusive, illustrate cross-sectional views of total VOC concentrations detected in Site soils. Review of these drawings indicates that there are four

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(1) USEPA "Guidance on Remedial Action for Superfund Sites with PCB Contamination", August 1990.

areas of VOC soil contamination at the Site. These areas consist of the following:

- Area A - an area of VOC contamination located at the southeast corner of the Main Building;
- Area B - an area of TCE contamination underneath the concrete pad east of the Main Building and west of the drainage culvert/swale;
- Area C - an area of TCE contamination in the area north of the Main Building; and
- Area D - an area of TCE contamination in the vicinity of well MW-4.

The approximate boundaries of these areas are shown on Figure 6.6 and are discussed below.

A. Area at the Southeast Corner of the Main Building (Area A)

The area designated as Area A consists of soils containing VOC contamination located at the southeast corner of the Main Building near the location of the former gasoline storage tank. Soil samples collected from BH-P, adjacent to the former gasoline storage tank, confirmed the presence of benzene, toluene, ethylbenzene and xylene (BTEX) which are components of petroleum products. No TCE was found in borehole BH-P. The total VOC concentration from the soils collected from BH-P (4 to 6-foot interval) was 51,370 ppb comprised entirely of BTEX compounds. The presence of petroleum contamination in this area was further confirmed by elevated organic vapor levels (as measured by a PID or FID) in soil samples collected from BH-P, BH-Q, BH-S, and BH-T. Organic vapor concentrations from soil samples collected from BH-F and BH-U were similar to background levels and apparently are not affected by petroleum contamination. In addition, the lack of organic vapors in soil gas from these two boreholes appear to define the southern and eastern limits of the petroleum contamination in this area.

The results of the soil gas survey defines the western limits of the petroleum contamination in this area. The approximate area of impacted soils is estimated to be 4,000 yd^2. The highest concentrations of total VOCs (above 10 ppm) in the soils within Area A are in the immediate vicinity of BH-P. The vertical extent of petroleum contamination in this area appears to be about 18 feet BGS which is near the top of the clay Confining Unit. The approximate volume of impacted soils[1] in Area A is estimated to be 24,000 yd^3.

B. Area East of the Main Building (Area B)

The area designated as Area B consists of subsurface soils containing VOC contamination located east of the Main Building, in the vicinity of well MW-11, and west of the Site drainage culvert/swale is primarily contaminated with TCE and its degradation products. At the 10 to 12-foot interval of borehole MW-11, TCE was detected at a concentration of 85,000 ppb, total 1,2-dichloroethane was detected at an estimated concentration of 130 ppb, tetrachloroethene was detected at a concentration of 93 ppb, and total xylene was detected at an estimated concentration of 28 ppb.

Borehole BH-F, located southeast of MW-11, had only a very minor organic vapor reading from samples collected to a depth of 20 feet BGS and thus does not appear affected by the VOC contamination in the vicinity of MW-11. Only acetone (estimated at 20 ppb) was detected in the soil sample collected at the 16 to 18-foot interval from BH-F. Borehole BH-P (4 to 6-foot interval) had only BTEX compounds and no TCE present, thus this area also appears to be unaffected by the TCE present in the vicinity of MW-11. Soil gas survey data and the organic vapor screening verified the presence of VOCs in the areas adjacent to MW-11 and to the south and east of MW-11. The eastern limits of VOC soil contamination in this area appears to extend up to the Site drainage culvert/swale. Boreholes BH-5B-1, BH-5B-2

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[1] Impacted soils are all soils potentially containing contaminants above the chemical-specific New York State Standards, Criteria, and Guidelines for soils, as presented in NYSDEC Technical and Administrative Guidance Memorandum (TAGM) No. 4046: Determination of Soil Cleanup Objectives and Cleanup Levels, dated January 24, 1994.

and BH-5B-3, located along the culvert/swale, exhibited relatively low total VOC concentrations in comparison to that found in borehole MW-11. Assuming that the northern extent of VOC contamination in this area coincides with the north wall of the Main Building, the area of impacted soils[1] is estimated to be approximately 6,000 yd^2. The highest concentrations of total VOCs (above 10 ppm) in the soils within Area B are in the vicinity of well MW-11.

The vertical extent of VOC contamination in the soils in this area is limited by the confining clay layer. This is evidenced by the high (>10 ppm) organic vapor levels detected in soil samples collected above the clay, and no organic vapors detected in the clay confining unit (16 feet BGS) in borehole MW-11. This was confirmed by the analytical results for soil samples collected in borehole MW-11 at the 10 to 12-foot interval (above the clay Confining Unit contact) and at the 14 to 16-foot interval (within the Confining Unit). The 10 to 12-foot sample from MW-11 had a total estimated VOC level of 85,251 ppb, while no VOCs were detected in the underlying 14 to 16-foot interval.

Thus, the total volume of impacted soils in Area B is estimated to be 29,000 yd^3.

C. Area North of the Main Building (Area C)

The area designated as Area C consists of the soils at the northern end of the Site which contain elevated levels of VOCs primarily consisting of TCE and its degradation products. This area is located topographically above the Conewango Creek and the lowlands located north/northeast of the Plant area.

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[1] Impacted soils are all soils potentially containing contaminants above the chemical-specific New York State Standards, Criteria, and Guidelines for soils, as presented in NYSDEC Technical and Administrative Guidance Memorandum (TAGM) No. 4046: Determination of Soil Cleanup Objectives and Cleanup Levels, dated January 24, 1994.

A number of test pits were excavated within the northern area of the Site during the SI. Fill material primarily consisting of gravel, slag, metal debris (i.e. turnings and filings), wood debris and some silty soils were encountered in the majority of test pits. A few crushed drums or parts of drums were excavated in the test pits excavated in areas along the north/northeast fence line, all of which also exhibited organic vapor readings above background levels. However, no large drum disposal/burial area was found in this area or any other areas of the Site. The highest TCE concentration detected was 17,000,000J ppb in the sample collected from test pit TP-2A. The highest total 1,2-dichloroethene level was 2,400,000J ppb in the sample collected from test pit TP-1A. The area of impacted soils in this northern area (assuming that the southern extent of VOC contamination in this area coincides with the north wall of the Main Building) is estimated to be approximately 14,000 yd^2. The highest levels of total VOCs (above 10 ppm) in soils within Area C are within the vicinity of well MW-2.

Surface soil samples collected from locations SSoil-M, SSoil-N and SSoil-O contained trace levels of VOCs while subsurface soil samples collected from these locations contained significantly higher levels of VOCs. VOC contamination in the subsurface soils within the area north of the Main Building was present up to an approximate depth of 22 feet. The vertical extent of VOC contamination is clearly retarded by the presence of the Confining Unit as indicated by the organic vapor levels detected in borehole BH-O. Thus, the approximate volume of impacted soils[1] in Area C is estimated to be 101,000 yd^3.

D. Area in the Vicinity of MW-4 (Area D)

The area designated as Area D consists of soils in the vicinity of MW-4, northwest of the Main Building, which is contaminated with low levels of TCE and its degradation products. Total VOC

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[1] Impacted soils are all soils potentially containing contaminants above the chemical-specific New York State Standards, Criteria, and Guidelines for soils, as presented in NYSDEC Technical and Administrative Guidance Memorandum (TAGM) No. 4046: Determination of Soil Cleanup Objectives and Cleanup Levels, dated January 24, 1994.

concentrations in Area D soils are several orders of magnitude less than those in Areas B and C.

Soil samples from boreholes BH-L and BH-C contained elevated levels of TCE. Total VOC levels in soil samples collected from these boreholes range from 63J ppb to 4,930 ppb. VOC contamination extends westward from approximately midway between MW-9 and BH-L to boreholes BH-H and BH-G across the Frewsburg-Falconer Road. VOC contamination in this area extends northward up to the Conewango Creek and southward to BH-E. No VOCs were detected in the 8 to 10-foot interval in BH-E. Low levels of acetone (19J ppb) were detected in the 22 to 24-foot sample interval, but no other VOCs were detected. The area of impacted soils[1] is estimated to be approximately 16,000 yd^2. However, the highest concentrations of total VOCs in the immediate vicinity of MW-4 and BH-D.

Total VOC levels in the Confining Unit at borehole locations BH-L and BH-D are approximately two orders of magnitude higher than those found in the overlying soil samples. This appears to be anomalous as the general trend of VOC contamination in the Site soils indicates much lower (several order of magnitude) total VOC levels in the Confining Unit than in the overlying silt and sand unit.

The approximate volume of impacted soils in Area D is estimated to be 104,000 yd^3.

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[1] Impacted soils are all soils potentially containing contaminants above the chemical-specific New York State Standards, Criteria, and Guidelines for soils, as presented in NYSDEC Technical and Administrative Guidance Memorandum (TAGM) No. 4046: Determination of Soil Cleanup Objectives and Cleanup Levels, dated January 24, 1994.

6.4 GROUNDWATER

6.4.1 RI Groundwater Data

6.4.1.1 Water Table Aquifer Data

As part of the RI, groundwater samples were collected from the five newly installed Water Table Aquifer wells (MW-8 through MW-12) and from seven previously installed Water Table Aquifer wells (MW-1 through MW-7). Table D-3 of Appendix D presents the RI groundwater data.

Groundwater samples collected from the monitoring wells were analyzed for TCL VOCs, total and dissolved metals (TAL), and a variety of inorganic parameters. Groundwater samples collected from wells MW-1, MW-5, MW-6, MW-7 and MW-8 did not contain any VOCs. The only VOCs detected in MW-10 were toluene (2J ppb) and xylene (4J ppb) which were detected at estimated concentrations below the detection limits. A total of 13 VOCs were detected in the six remaining Water Table Aquifer wells as shown in the following:

VOC	*Frequency of Detection*	*Range (ppb)*	*Monitoring Well Containing Highest Detection*
Trichloroethene	6	41-170000	MW-11
1,2-Dichloroethene (Total)	7	10-62000	MW-2
Vinyl chloride	6	6J-1200	MW-2
1,1-Dichloroethene	6	4J-170	MW-2
1,1-Dichloroethane	1	4J	MW-11
1,2-Dichloroethane	1	7J	MW-11
1,1,1-Trichloroethane	1	3J	MW-4
1,1,2-Trichloroethane	3	4J-29	MW-4
Benzene	2	36J-11	MW-2
Tetrachloroethene	4	4J-57	MW-11
Toluene	2	2J-4J	MW-11
Ethylbenzene	2	6J	MW-2/MW-11
Xylene (Total)	4	2J-24	MW-11

Note:

J Associated value is qualified as estimated based on the data validation and assessment results.

The total VOC levels detected in the monitoring wells presented on Table 6.5 and Plan 7.

Metals

Both filtered (dissolved) and unfiltered (total) metal samples were collected from the Water Table Aquifer monitoring wells, except for MW-12, during the RI.

A comparison of the detected total metals levels in the Water Table Aquifer monitoring wells to background levels detected in upgradient monitoring well MW-1 is as follows:

Total Metals	*Background MW-1 (µg/L)*	*Detected Ranges (µg/L)*	*Well with Highest Level*
Aluminum	360	388J-90,500	MW-6
Antimony	ND	ND-52.4	MW-6
Barium	117	174-1,410	MW-6
Beryllium	0.70	1.1J-8.4	MW-6
Cadmium	ND	ND-41.5	MW-6
Calcium	59,400	76,500-257,000	MW-6
Chromium	ND	ND-150	MW-7
Cobalt	ND	ND-99.5	MW-6
Copper	5.8	16.2J-240	MW-6
Iron	556	866J-190,000	MW-6
Lead	ND	ND-222	MW-6
Magnesium	9,840	13,500J-99,900	MW-6
Manganese	24.0	30.7-20,400	MW-2
Mercury	ND	ND-0.22	MW-11
Nickel	ND	10.4-254	MW-7
Potassium	992	1,420-16,000	MW-6
Silver	ND	ND	ND at all wells
Sodium	3,400	6,380-22,900	MW-4
Vanadium	ND	ND-174	MW-6
Zinc	ND	22.7J-525	MW-6

Note:
NA - Not Available.

Elevated total metals concentrations in the groundwater samples are likely attributable to the presence of suspended sediments in the samples.

A comparison of the detected dissolved metals levels to background levels detected in upgradient monitoring well MW-1 is as follows:

Dissolved Metals	*Background Well MW-1 (μg/L)*	*Detected Ranges (μg/L)*	*Well w/Highest Level*
Aluminum	ND(16.7)	ND(11.4)-424	MW-2
Antimony	ND(25.9)	ND(25.9)	-
Barium	109	167-641	MW-11
Beryllium	ND(1.4)	ND(1.1)-2.6	MW-2
Cadmium	ND(2.7)	ND(2.7)-7.5	MW-2
Calcium	56,900	49,600-141,000	MW-2
Chromium	ND(8.4)	ND(8.4)	-
Cobalt	ND(5.1)	ND(5.1)	-
Copper	4.7	4.0-9.1	MW-9
Iron	ND(8.7)	ND(8.7)-48,500	MW-2
Lead	ND(1.9)	ND(1.9)	-
Magnesium	9,400	8,820-31,400	MW-2
Manganese	25.9	5.0-20,000	MW-2
Mercury	ND(0.10)	ND(0.10)	-
Nickel	9.4	ND(6.9)-60.4	MW-2
Potassium	818	1,180-5,310	MW-2
Silver	ND(2.2)J	ND(2.2)J-ND(4.3)J	-
Sodium	3,250	5,890-22,300	MW-4
Vanadium	ND(2.9)	ND(2.9)	-
Zinc	32.8	5.4-48.9	MW-2

Note:
NA - Not Available.

Based on the dissolved metals data, only manganese, and iron levels in the groundwater samples collected for the Water Table Aquifer exceeded those levels in upgradient well MW-1 and New York State (NYS) Water Quality Standards and/or Guidance Values (see Table 6.6).

General Inorganic Parameters

Groundwater samples collected during the RI were analyzed for many inorganic parameters including: Biochemical Oxygen Demand (BOD5), chloride, Chemical Oxygen Demand (COD), hardness, bicarbonate, ammonia, nitrite, nitrate, total phosphorus, sulfide, sulfate, TSS, alkalinity, TDS, and TOC. Inorganic samples were collected primarily to provide data for waste stream treatability assessments and as such will not be discussed in depth. Inorganic analytical results can be found on Table 6.5 and Table D-3 of Appendix D.

6.4.1.2 Frewsburg Aquifer Data

During the RI, samples were collected from monitoring wells MW-4D and MW-5D. Duplicate samples were also collected from MW-4D. Samples from the Frewsburg Aquifer wells were analyzed for TCL VOCs, total and dissolved metals, and selected inorganic parameters.

VOCs

No VOCs were detected in groundwater samples collected from MW-5D during the RI. MW-4D was sampled twice. On December 18, 1992, MW-4D was sampled and analyzed for TCL VOCs. A duplicate sample was also collected. Results from this sampling event indicated that the analytical sample from MW-4D was non-detect for all of the TCL VOCs. However, the duplicate sample contained 10 ppb of total 1,2-dichloroethene and 4J ppb of TCE. In order to clarify this discrepancy, MW-4D was resampled for TCL VOCs only on January 14, 1993. Results from this sampling event indicated that MW-4D and its duplicate sample did not contain TCE or its degradation products. None of the remaining VOCs (acetone and 1,1,1-trichloroethene) detected in the January 14, 1993 MW-4D sample exceeded the NYS Class GA (for potable water) groundwater standards (see Table 6.6).

Total Metals

Groundwater samples collected from MW-4D (and a duplicate sample) and MW-5D were analyzed for total metals during the RI. Antimony, cadmium, mercury, and silver were not detected in either well. MW-4D and MW-5D contained the following analytes below the respective NYS Class GA groundwater standards: barium, beryllium, chromium, copper, lead, magnesium, manganese, sodium, and zinc. MW-4D and MW-5D contained total iron at levels above the Class GA standard of 300 ppb. MW-4D and its duplicate contained 8,670 ppb and 8,340 ppb, respectively, of iron, while MD-5D had 1,930 ppb of iron. Although no specific NYS Class GA standards are available, both MW-4D and MW-5D contained aluminum, calcium, nickel, and potassium. MW-4D also contained 5.4/5.1 ppb of cobalt and 8.3/7.4 ppb of vanadium. Neither cobalt or vanadium was detected in MW-5D.

Dissolved Metals

Samples from MW-4D and MW-5D were also analyzed for dissolved metals during the RI. Antimony, cadmium, chromium, cobalt, lead, mercury, nickel, silver, and vanadium were not detected in either MW-4D or MW-5D.

Barium, beryllium, copper, iron, magnesium, manganese, sodium, and zinc were detected in one or more of the samples at levels below the Class GA standards. Calcium was detected in both wells at levels of 69,800 ppb/68,200 ppb and 71,800 ppb, respectively. Potassium was also detected in both wells at levels of 1,720 ppb/1,730 ppb and 1,880 ppb, respectively. MW-4D contained 229J ppb of aluminum.

Inorganic Parameters

Monitoring wells MW-4D and MW-5D were also sampled for selected inorganic parameters during the RI. Since these parameters were included mainly to provide additional data for evaluation of treatment technologies, if required, these results will not be included in the discussion. The results of the samples collected and analyzed for inorganic parameters can be found in Appendix D, Table D-3.

6.4.2 Water Table Aquifer Characterization

6.4.2.1 Nature of Contamination

Table 6.5 presents analytical results for compounds detected in groundwater samples collected during the RI, SI and IRA programs. Plan 7 illustrates the distribution of VOCs in the Water Table Aquifer along with the total VOC concentrations.

Groundwater samples collected during the SI (1990 to 1991) were analyzed for the TCL, the TAL, and TPH. Review of these data indicates that the most predominant groundwater contaminants in the Water Table Aquifer are TCE and its degradation products, 1,2-dichloroethene, and vinyl chloride. Low levels of BNAs were found only in well MW-2 at levels near the practical quantitation levels. Pesticides, PCBs, cyanide, and some metals (antimony, cadmium, mercury, selenium, and thallium) were not detected in any of the SI samples.

During the RI, groundwater samples from the Water Table Aquifer monitoring wells were analyzed for the TCL VOCs and total and dissolved metals. Review of these data confirmed that TCE, vinyl chloride, and 1,2-dichloroethene were the most predominant contaminants detected in the groundwater. Additional compounds such as 1,1-dichloroethene, acetone, 1,1,1-trichloroethane, 1,1,2-trichloroethane, tetrachloroethene, and BTEX were also detected at lower levels.

During both the SI and RI sampling events, total iron was the only compound in upgradient monitoring well MW-1 which exceeded the NYS Class GA groundwater standard. However, iron was not detected in the filtered sample collected from MW-1. This is likely attributable to the presence of sediment in the groundwater samples.

During the SI, all of the total metals were detected at levels above background in one or more of the downgradient monitoring wells. Similarly, during the RI, all of the total metals were detected in the groundwater at levels above background in one or more of the monitoring wells except silver, which was not detected in any of the samples.

The following total metals were detected above background levels and the Class GA Standards: antimony, barium, beryllium, cadmium, chromium, copper, iron, lead, magnesium, manganese, and zinc. The presence of these total metals in the groundwater samples are likely attributable to suspended sediment in the samples. This is evident as shown by the dissolved metals results. Iron and manganese were the only dissolved metals detected in the Water Table Aquifer samples above the Class GA Standards.

6.4.2.2 Extent of Contamination in the Water Table Aquifer

Plan 7 illustrates the distribution of VOC contamination in the Water Table Aquifer monitoring wells. Figures 6.7, 6.8 and 6.9 depict the TCE, total 1,2-dichloroethene and vinyl chloride levels, respectively, in the Water Table Aquifer.

No VOCs were detected in groundwater samples collected from the upgradient monitoring well MW-1, downgradient well MW-6, off-Site well MW-7, and on-Site well MW-8. Low levels of VOCs (42J ppb) were found in MW-5 in the 1991 SI sampling event; however, no VOCs were detected in MW-5 during the RI sampling event. Accordingly, the Water Table Aquifer is primarily contaminated in the immediate vicinity of the Main Building.

The highest levels of total VOCs were found in wells MW-11, MW-4, and MW-2 which are located near potential former source areas.

The north-south extent of on-Site contaminant presence in the Water Table Aquifer is well defined. The Water Table Aquifer flows northward and discharges into Conewango Creek. The southern limit of the

VOC contamination is approximately midway between wells MW-8 and MW-11.

VOC contamination in the Water Table Aquifer does not appear to extend east of the Site drainage culvert/swale as is evident by the lack of VOCs in well MW-6. The culvert/swale is a preferential pathway (see Section 5.4) for groundwater flow in the area between the Main Building and the Metal Building and thus precludes further migration of contaminants to the east.

No VOCs were detected in off-Site monitoring well MW-7 which is located in the District Well field west of the Site. Subsurface soils in the area north of well MW-7 were found to have total VOCs of 111J ppb at BH-C (12 to 14 foot interval) and 12J ppb at BH-H (10 to 12 foot interval). The presence of VOCs in the soils within this area is likely attributable to the migration of contaminated groundwater in the Water Table Aquifer from the Site. This was verified by the installation and sampling of a new Water Table Aquifer monitoring well, MW-12, in this area. The total detected VOC concentration in well MW-12 is 3,441 ppb (3,537 ppb in a duplicate sample). Figure 6.7 depicts the approximate distribution of TCE in the Water Table Aquifer.

The concentrations of TCE in the Water Table Aquifer, where detected, ranged from 1.6 percent to 15.5 percent of pure phase aqueous solubility (1,100 mg/L). According to the USEPA fact sheet[2], groundwater concentration of Dense Non-Aqueous Phase Liquid (DNAPL)-related chemicals greater than 1 percent of the pure phase or effective solubility limit may indicate the presence of DNAPLs. However, it should be noted that DNAPL was not observed during drilling and groundwater sampling activities. Moreover, no DNAPL was observed at the clay interface in any of the 50 boreholes installed and sampled on or near the Site.

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[2] Estimating the occurrence of DNAPL at Superfund Sites: USEPA Fact Sheet. Publication: 9355.4-07PS, January 1992.

While the field activities and sampling data do not indicate the presence of DNAPL, if it is assumed that there is DNAPL at the Site, the area most likely for DNAPL to be present is in the vicinity of MW-11 based on groundwater concentrations only. This area once contained a septic system which was connected to floor drains located near former degreasing operations (see Plan 2). If DNAPLs were introducted into the Water Table Aquifer in sufficient quantities, flow along the top of the Confining Unit may occur. MW-11 is located in a topographic high in the clay surface. Therefore, potential DNAPL flow would be radially away from this location. Given the fact that DNAPL-related chemicals were not detected in the groundwater at MW-6 and MW-10, it is obvious that DNAPL flow has not reached these locations. Therefore, it appears that if DNAPL is present, it would be limited to the area of MW-11 and between MW-11 and MW-9. Based on this potentially limited distribution, no further delineation of potential DNAPL is required.

6.4.3 Frewsburg Aquifer Characterization

Prior to September 1991, there was no known VOC contamination in the Frewsburg Aquifer. District Production Well #2A was installed as a replacement of Production Well #2 in January 1991. Following installation, District Well #2A was sampled and approved for use as a potable water supply well. District Well #1 was sampled during the SI on May 1, 1991 and no VOCs were detected in that sample. In September 1991, samples from District Wells #2A and #1 were found to contain TCE above the drinking water standards. Subsequently, the District Wells #1 and #2A were shut down and the District water supply was obtained from District Well #4.

Following the shutdown of District Wells #1 and #2A, a District water supply was sampled routinely as part of the IRA program. Table 2.1 summarizes the IRA water supply sampling. No VOCs have been detected in District Wells #1 and #2A since December 1991. No VOCs were ever detected in District Wells #3 or #4.

As part of the IRA program, attempts were made to install monitoring wells into the Frewsburg Aquifer on Site. During the RI Program, two additional locations were investigated and attempts were made to monitor the Frewsburg Aquifer. To date, two wells (MW-5D and MW-4D) have been installed into the Frewsburg Aquifer on the western portion of the Site. VOCs (see Table 6.5) were not detected above the NYS Class GA groundwater standards in either of these wells.

Examination of Table 6 5 shows that TCE and 1,2-dichloroethene (1,2-DCE) were only detected on one occasion in MW-4D at 4J µg/L and 10 µg/L, respectively. However, duplicate and confirmatory analysis confirmed that these chemicals were not present. The chemicals were never detected in MW-5D. Since TCE was detected in the Frewsburg Aquifer in District Wells #1 and #2A in the fall of 1991 at concentrations as high as 465 µg/L, one would reasonably expect that TCE would be present at similar or higher concentrations in the Frewsburg Aquifer beneath the Site. This was not the case. Therefore, the sources and migration pathway of the TCE found in the District wells are not known and cannot be conclusively determined for the following reasons:

i) the exact hydrogeologic conditions under which the TCE appeared in the production wells cannot be duplicated and studied;

ii) no physical or hydraulic connection between the Frewsburg Aquifer and Water Table Aquifer was identified during any of the testing activities performed;

iii) because of the discontinuous nature of the Frewsburg Aquifer, the location of the Frewsburg Aquifer beneath the Site cannot be accurately predicted;

iv) because of the artesian nature of the Frewsburg Aquifer and the use of the Frewsburg Aquifer as a water supply source, the direction of the groundwater flow in the Frewsburg Aquifer cannot be accurately determined; and

v) the lack of any current presence of TCE in the Frewsburg Aquifer near or beneath the Site.

6.5 SURFACE WATER/SEDIMENT

6.5.1 RI Surface Water/Sediment Analytical Data

6.5.1.1 RI Surface Water Sample Results

Surface water samples (SW-A, SW-C, SW-D, SW-E, SW-F, SW-G, SW-H, SW-I (duplicate of SW-H), SW-J, SW-K, and SW-L) were collected from 10 locations potentially impacted by Site activities during the RI. Background surface water samples (SW-B, SW-M and SW-N (duplicate of SW-M)) were collected from two locations upgradient of Site discharges. These locations are shown on Plan 8 and Table 4.1 describes the sample locations and parameters. Each of the surface water samples collected were analyzed for TCL VOCs, metals, and hardness. In addition, surface water samples (SW-F, SW-G, SW-H, SW-I, SW-J, SW-K, SW-L, SW-M and SW-N) were analyzed for PCBs. Table D-4 of Appendix D presents the RI surface water data and Table 6.5 presents the data for compounds detected in these samples.

VOCs were detected in seven (SW-D, SW-E, SW-F, SW-G, SW-H, SW-J, SW-I (duplicate of SW-H)) of the 14 samples collected. The four VOCs detected in the surface water samples are shown in the following.

VOC	*Frequency of Detection*	*Range (ppb)*	*Surface Water Location Containing Highest Detection*
Trichloroethene	4	160 to 770	SW-H
1,2-Dichloroethene (total)	6	9J to 720	SW-H
Vinyl chloride	4	48 to 140	SW-E
Styrene	1	2J	SW-D

Notes:
J Associated value is qualified as estimated.

No VOCs were detected in surface water sample SW-A, SW-B, SW-C, SW-K, SW-L, SW-M and SW-N. Styrene was the only VOC detected in SW-D at a concentration of 2J ppb, which is qualified as estimated below the detection limit. Total VOC levels in the remaining RI surface water samples ranged from 11 ppb to 1,620 ppb (see Plan 8).

PCBs were not detected in any of the surface water samples.

Surface water samples collected during the RI were analyzed for cadmium, calcium, chromium, copper, iron, lead, magnesium, manganese, mercury, nickel and sodium. A summary of the metals results is as follows:

	Frequency of Detection	*Range (ppb)*	*Sample with Highest Concentration*
Cadmium	3	5.1 - 166	SW-E
Calcium	14	28,700 - 261,000	SW-E
Chromium	6	9.4 - 2,900	SW-E
Copper	14	2.8 - 1,850	SW-E
Iron	9	426 - 172,000	SW-E
Lead	6	2.2 - 1,390	SW-E
Magnesium	14	17.9 - 55,600	SW-E
Manganese	14	4.1 - 11,000	SW-D
Mercury	3	0.14 - 10.7	SW-E
Nickel	7	13.4 - 5,670	SW-E
Sodium	14	5,730 - 35,000	SW-E

Surface water sample SW-E contained the highest levels of metals which may be attributable to the presence of suspended sediments in the sample.

The NYS water quality standards/guidance values for Class C and Class D surface waters are presented on Table 6.6.

6.5.1.2 RI Sediment Samples Results

Sediment samples were collected from all the locations at which surface water samples were collected.

Sediment samples SED-A, SED-C, SED-D, SED-E, SED-F, SED-G, SED-H, SED-I (duplicate of SED-H), SED-J, SED-K, and SED-L were collected from 10 locations during the RI. Background sediment samples SED-B, SED-M and SED-N (duplicate of SED-M) were collected from two locations upgradient of Site discharges. These locations are shown on Plan 8. Each sediment sample collected was analyzed for TCL VOCs, TOC, and selected metals. In addition, sediment samples SED-F, SED-G, SED-H, SED-I, SED-J, SED-K, SED-L, SED-M and SED-N, collected from the lowlying wet area and Conewango Creek, were analyzed for PCBs. Table D-5 of Appendix D presents the RI sediment sample results and Table 6.8 the analytical results for compounds detected in these samples.

VOCs were detected in nine of the 14 samples collected The VOCs detected in the sediment samples are described in the following.

VOC	*Frequency Detection*	*Range (ppb)*	*Sediment Sample Locations Containing Highest Detection*
Trichloroethene	4	26J to 380J	SED-H
1,2-Dichloroethene (total)	4	270 to 9900	SED-H
Vinyl chloride	3	300J to 1100J	SED-H
Acetone	7	110J to 530J	SED-C
1,1-Dichloroethene	2	39J to 53J	SED-H
2-Butanone	3	79 to 180	SED-C
Toluene	1	14J	SED-D

Note:
J The associated value is qualified as estimated based on the data validation and assessment results .

No VOCs were detected in samples SED-A, SED-B, SED-I, SED-K, SED-L and SED-N. Acetone, the only VOC detected in sediment sample SED-M, was reported at 19J ppb which is below the detection limit.

The VOCs which were detected at the highest concentrations in sediment samples are TCE and its degradation products, total 1,2-dichloroethene and vinyl chloride. Acetone was detected in seven of the 14 samples. However, the presence of acetone is likely due to laboratory contamination since acetone is a common lab solvent and was not widely used by plant operations. Furthermore, acetone was not pervasive in samples collected during the SI. The highest total VOC concentration was detected in sediment sample SED-I (10,333 ppb) which is a duplicate for sample SED-H. These samples (SED-I and SED-H) were collected from the swale in the center of the lowlying wet area northeast of the Main Building (see Plan 3). TCE and its degradation products (1,2-dichloroethene and vinyl chloride) were only detected in samples SED-F, SED-G, SED-H, and SED-I, all of which were collected from the lowlying wet area.

All sediment samples except SED-K and SED-L (collected from Conewango Creek) contained cadmium, calcium, chromium, copper, iron, lead, magnesium, nickel, and sodium at levels higher than those of the background sediment samples. No PCBs were detected in the sediment samples collected from the lowlying wet area and Conewango Creek (background samples SED-B, SED-M, and SED-N). Samples SED-D, SED-E, SED-F, SED-G, SED-H, and SED-I showed concentrations of manganese above those of the background samples.

6.5.2 Surface Water/Sediment Characterization

6.5.2.1 General

This section describes the nature and extent of contamination in the surface water and sediment at the Site. Data obtained from surface water and sediment investigations performed during the SI and RI are utilized in this discussion. Plan 8 shows all of the RI and SI sediment and surface water sampling locations along with the respective total VOC concentrations. RI and SI surface water and sediment data for the detected compounds are presented on Tables 6.7 and 6.8.

Areas investigated include:

i) the on-Site pond (sample location SED/SW-A);

ii) the on-Site drainage culvert/swale (sample locations SED/SW-B, SED-5, SW-8, SED/SW-C, SED-4, SW-6, and SW-7);

iii) the Conewango Creek (sample locations SW-4, SED/SW-M, SED/SW-N, SED/SW-L, SW-3, and SED/SW-K);

iv) the lowlying area (sample locations SED/SW-E, SED/SW-F, SED/SW-G, SED/SW-H, SED/SW-I, SED/SW-J, and SED/SW-D) at the northeast portion of the Site including groundwater seep areas at the base of the slope along the north (sample locations SED-6 and SED-7) and the northeast (sample locations SED-1, SW-1, SED-2, SED-3, and SW-2) fence lines; and

v) the discharge (surface water sample SW-5) from the corrugated metal pipe at the northwest corner of the Site which collects stormwater from the western portion of the Site.

6.5.2.2 Nature of Surface Water and Sediment Contamination

Background surface water and sediment samples were collected during both the RI and SI from areas on and off-Site which were determined to be upgradient from potential contaminant releases from the Site or from areas not impacted by plant operations. One surface water sample and one sediment sample was collected at location SW/SED-B in the drainage swale southeast of the Main Building to provide background data for this drainage swale/culvert. Two surface water samples (SW-M and SW-4) and one sediment sample (SED-M) were collected from the Conewango Creek upstream from discharge points from the lowlying wet areas at the northeast portion of the Site. Data from these background samples were used as a basis of comparison for the remaining investigative samples.

The VOCs having the highest concentrations in surface water samples are trichloroethene and its degradation products, vinyl chloride and total 1,2-dichloroethane. Samples SW-1 and SW-2 had the highest levels of total VOCs (see Plan 8). Vinyl chloride levels were highest in samples SW-1 and SW-2, with levels of 5,300J and 1,500 ppb, respectively. Sample SW-1 also had the highest level of trichloroethene, measuring 62,000 ppb. Samples SW-6, SW-7, SW-G, and SW-H had total VOC levels exceeding 1,000 ppb. Samples SW-1, SW-2, SW-6, and SW-7 were collected from areas of groundwater seeps at the base of the northeastern slope/bank of the Plant Site. SW-G and SW-H were collected along the swale, downgradient from where these groundwater seeps enter into the swale.

A total of seven BNAs were detected in surface water samples and consisted of 2-methylphenol, 4-methylphenol, benzoic acid, 4-chloro-3-methylphenol, di-n-butyl phthalate, and bis(2-ethylhexyl)phthalate. These BNAs were detected at estimated levels below the detection limits. No PCBs or pesticides were detected in surface water.

Metals which were detected above the background levels and the NYS water quality standards guidance values (see Table 6.7) include cadmium (SW-D, SW-E), chromium (SW-D, SW-E), copper (SW-D, SW-E), iron (16 of 18 samples), lead (SW-D, SW-G), mercury (SW-D, SW-E), sodium (SW-E), manganese (seven of 18 samples), and magnesium (SW-1, SW-2, SW-D, SW-E). Samples SW-D, SW-E, SW-1 and SW-2 generally had the highest levels of metals and were all collected from areas of groundwater seeps.

The VOCs having the highest concentration in sediment samples are trichloroethene, 1,2-dichloroethene (total), 1,1-dichloroethene, and vinyl chloride. Samples SED-1 and SED-4 had the highest levels of VOCs. Sample SED-2, SED-3, SED-6, and SED-7 had a total VOC concentration exceeding 1,000 ppb.

Samples SED-1, SED-2, SED-3, SED-4 are located adjacent to groundwater seeps near the swale at the northern edge of the Site. Samples SED-6 and SED-7 were collected adjacent to Site water discharge pipes near the southern bank of Conewango Creek, along the northern Site boundary.

Three sediment samples contained BNAs at low levels (estimated below the detection limits).

Only two sediment samples (SED-2 and SED-3) contained PCBs (Aroclor 1260) levels of 160J and 86J ppb, respectively. Additional sediment samples were collected for analyses of PCBs during the RI and no PCBs were detected. No pesticides were detected.

Each of the 16 sediment samples contained lead and iron at levels above background. Thirteen sediment samples contained cadmium, copper, and nickel at levels above background. Eight samples contained calcium, chromium, magnesium, and sodium at levels above background. Six samples contained barium, cobalt, and magnesium above background.

6.5.2.3 Extent of Surface Water/Sediment Contamination

On-Site Pond

Surface water (SW-A) and sediment (SED-A) samples were collected from the center of the pond located at the southeastern portion of the Site. No VOCs were in either of these samples. Detected metals concentrations in the surface water of the pond were generally consistent with the background levels for Conewango Creek (samples SW-M and SW-4) and the Site drainage swale (SW-B). None of the NYS Class C surface water standards were exceeded. Copper and nickel levels in the sediment sample collected from the pond were approximately one order of magnitude higher than the background levels for Conewango Creek and the drainage swale.

Based on these results, it is concluded that Site activities have not significantly or adversely impacted the on-Site pond. Further discussion on the potential impacts, if any, to the biota in the pond is presented in Section 9.0 of this RI report.

Conewango Creek

Analytical results for surface water samples (SW-L, SW-3, SW-K) collected from the Conewango Creek at locations downstream of discharges from the Site were generally equivalent to those of the Creek background samples SW-M (SW-N duplicate) and SW-4. Table 6.7 and Plan 8 summarize the analytical results.

The only VOCs reported in surface water samples collected from Conewango Creek were found in SI samples SW-3 and SW-4 and consisted of 1,2-dichloroethene (total) and TCE. These two contaminants were detected at low levels estimated below the detection limit. Total VOC level in upgradient sample SW-4 was 4J ppb and in downgradient sample SW-3 was 6J ppb. No VOCs were detected in any of the RI samples. Metals concentrations in the samples collected downgradient of the Site were consistent with the Creek background metal levels. No PCBs were detected in any of the samples collected from Conewango Creek. Based upon examination of surface water sample data collected during the SI and RI, contaminants from the Site appear to have had a negligible effect on the water quality within the Conewango Creek.

With the exception of iron, none of the water quality standards for Class C waters were exceeded. Iron concentrations in surface water samples collected at upgradient and downgradient locations exceeded the Class C water quality standard of 300 µg/L. Since the iron concentrations in the surface water samples collected downgradient of the Site were consistent with those levels found in the upgradient samples, it is concluded that the presence of iron in the Creek is due to natural conditions.

Analytical results for sediment samples collected from the Conewango Creek downgradient of Site discharge were also consistent to those in the Creek background sediment samples. Contaminants from the Site appear to have had little or no impact on Conewango Creek sediments.

Site Drainage Swale/Culvert

Surface water quality within the Site drainage swale/culvert has been affected by Site contamination. Total VOCs in samples collected at locations downstream from background sample location SW-B are up to several orders of magnitude higher. Surface water samples SW-H, SW-I (duplicate of SW-H), SW-6 and SW-7 (duplicate of SW-6) contained the highest total VOCs levels (see Plan 8) in the swale/culvert.

These samples were collected in the swale adjacent to the discharge of the Site drainage swale/culvert to the lowlying area. Elevated VOCs levels in the swale/culvert discharge are likely attributable to contaminated groundwater migration along the underground culvert toward the lowlying area north of the Site.

Cadmium, copper, iron, lead, mercury, and nickel were detected in surface water samples collected from the swale which meanders through the lowlying wet areas at levels above the swale/culvert background levels (SW-B) and above NYS Water Quality Standards for Class C waters.

Sediment quality within the drainage swale/culvert has also been affected by Site contaminants. Sample SED-4 contains elevated levels of VOCs, particularly TCE, and metal (cadmium, chromium, copper, iron, lead, manganese, mercury and nickel) concentrations were notably higher in sediment sample SED-4 than in background sample SED-B.

The source of contamination to the swale/culvert is likely contaminated groundwater in the Water Table Aquifer migrating along the culvert. As discussed in Sections 5.2 and 5.4, groundwater is intercepted by the culvert and flows northerly toward the lowlying wet area.

VOC and metal concentrations in surface water and sediment samples collected from this swale in the lowlying wet area generally tend to decrease with increasing distance (north and east) from these seeps and the drainage swale/culvert outfall. Surface water and sediment samples SW/SED-H, SW/SED-G and SW-SED-F were collected from locations along the swale in the lowlands significantly further downstream from the seeps and swale/culvert outlet. Surface water sample SW-F collected from the swale in the lowlands near the Conewango Creek had total VOCs of 330 ppb (see Plan 8) which is significantly lower than the total VOC concentration of upstream sample SW-G (1,188 ppb). This same trend is observed in the sediment samples collected at locations SED-F and SED-G.

Section 9.0 further discusses the presence of site-related contaminants in the drainage swale/culvert and the potential impacts, if any, on the environment.

Lowlying Wet Area

Surface water and sediment samples (SW-1/SED-1 and SW-2/SED-2/SED-3) collected from the seep areas northeast of the Main Building (see Plan 8) contained elevated concentrations of VOCs and metals. Elevated levels of VOCs were also detected in sediment samples (SED-6 and SED-7) collected from seep areas along the southern bank of the Conewango Creek at the north fenceline of the Site.

Surface water and sediment samples collected from location SW/SED-J at the eastern edge of the grassy area within the lowlands contained little or no VOCs. Metal concentrations in these samples was significantly lower compared to sample location SW/SED-H (SW/SED-I duplicate sample), but were notably higher than background levels.

Surface water sample SW-D located in the lowlands northeast of the Metal Building had only one VOC present. Styrene was reported at an estimated concentration of 2J ppb (below the detection limit) in sample SW-D. Metals were also close to background levels except for cadmium, chromium, iron, lead, mercury, and nickel. Stormwater from areas surrounding the Metal Building discharges to this sample location. Low levels of VOCs were detected in sediment sample SED-5, however, no TCE was detected in the sample.

Based upon data from the SI and RI, contamination within the lowland surface water and sediment is primarily concentrated along the groundwater seep areas immediately north of the outlet of the Site swale/culvert. VOCs and metal contamination exists in surface water and sediments throughout the swale in the lowlands. Contaminant levels generally in the swale decrease further away from the seeps and the culvert outfall toward the Conewango Creek.

Section 9.0 further discusses the presence of site-related contaminants in the lowlands and the potential impacts, if any, to the environment.

Northwest Stormwater Pipe

Surface water sample SW-5 was collected during the SI from the discharge of the pipe which collects stormwater from the western portion of the Site. TCE and 1,2-dichloroethane were detected at 290 ppb and 230 ppb, respectively in sample SW-5 which indicated the Site contaminants have impacted this discharge.

6.6 ON-SITE AIR

Total VOCs were measured in the worker breathing zone and around the perimeter of active work areas during ground intrusive actions conducted at the Site. Although VOCs were detected in the immediate vicinity of some soil disturbed during the investigation, total VOC concentrations rapidly dissipated and no effects on air quality were noted downwind of the active work zones. Moreover, as discussed in Section 4.8, almost all organic vapor levels monitored in the worker breathing zone was at background levels.

7.0 CONTAMINANT FATE TRANSPORT

7.1 POTENTIAL CONTAMINANT MIGRATION PATHWAYS

Site-related chemicals have been detected in surface soil, subsurface soil, surface water, sediment and groundwater.

The potential contaminant migration pathways which exist at the Site include:

i) atmospheric dispersion from surface soils;
ii) surface water runoff; and
iii) groundwater flow.

Each of these potential migration pathways is discussed in the following pages.

Atmospheric Dispersion

Atmospheric dispersion of chemicals from the Site is restricted to chemicals present in the surface zones. The chemicals may be released to the atmosphere by volatilization and/or by atmospheric entrainment of chemicals adsorbed onto particulate matter. Once released, the chemicals may be transported by the wind.

The areas of highest soil contamination on Site occurs in the area of the Plant within the fence line. Since most of the surface within the Plant area is paved or grassed, only a limited area (north end of the Plant) has exposed soils. The north end of the Plant Site has a packed soil and gravel surface. Surface soil samples collected from this northern area of the Plant contained minimal amounts of VOCs. Total VOC concentrations in surface soils ranged up to 0.094J ppm. In other areas of the Site, the presence of paving and vegetation cover minimize the erosion of surface soils and reduces the transport of soil particulates to the atmosphere.

Site-related chemicals are generally volatile. During the subsurface investigative activities of the RI, where penetration and disturbance of the soil occurred during augering, air monitoring was performed in accordance with the HASP. As discussed in Section 4.8, almost all organic vapor monitoring in the worker breathing zone was at background levels. Therefore, volatilization of Site-related VOCs in the soils has a minimal effect on ambient air quality.

However, at the request of the NYSDEC, it was agreed that theoretical emission rates and ambient air concentrations would be estimated for key volatile organic compounds. These estimated emission rates and ambient air concentrations are summarized in Section 7.3.

Surface Water Runoff

Surface water runoff or overland flow may carry particulates or dissolved contaminants from the surficial soil. Surface water drainage on Site is primarily controlled by a partially covered culvert/swale. The drainage culvert/swale collects runoff from lands south of the Site and the grassed area at the south end of the plant. Surface water runoff from the concrete pads (where scrap metals are stored in bins) is collected and treated on Site by a large oil/water separator (001 Separator) and discharged to Conewango Creek under the terms and conditions of the plant SPDES permit.

The only significant levels of Site-related chemicals in the surface water/sediment occurs in the lowlying area north of the plant, particularly at the outlet of the culvert/swale. As described in Section 5.4, the presence of Site-related chemicals in the lowlying area is the result of the discharge of contaminated groundwater into or around the culvert/swale and to seeps on the slope adjacent to the lowlying area. However, surface water and sediment samples collected from the Conewango Creek indicate that the Site has had no measurable impact on Conewango Creek.

In summary, contaminated groundwater migration has impacted the water and sediment quality of the lowlying wet area; however, there has been no measurable impact on the water and sediment quality of Conewango Creek. Because the discharge of contaminated groundwater into the surface water is the source of VOC contamination in the runoff, it is believed that by preventing the migration of groundwater into the surface water, the VOC contamination of the lowlying area will be adequately addressed and the residual volatile contaminants in the surface water and sediments will be attenuated.

Groundwater Migration

Site-related contaminants have been released to the Water Table Aquifer beneath the Site from the presence of VOCs in the fill materials and/or subsurface soils.

Water soluble organic Site-related compounds occur in the groundwater (Water Table Aquifer) beneath the Site. These compounds are present, above NYS Class GA groundwater standards, in the vicinity and downgradient of the Main Plant Building. Contaminated groundwater has been shown to be discharging to the lowlying area adjacent to Conewango Creek. However, this discharge has not adversely affected the water quality in the Creek.

As described in Section 5.4, the potential for contaminant migration from the Water Table Aquifer to the Frewsburg Aquifer is limited by the extremely low vertical hydraulic conductivity of the Confining Clay Unit (approximately 1 x 10^{-8} cm/sec) and the artesian nature of the Frewsburg Aquifer. Theoretical travel times for water across the Confining Clay Unit are extremely large. (At the location of well nests where the thickness of the Confining Clay Layer is approximately 20 feet, the travel time for migration of water between the Water Table Aquifer and the Frewsburg Aquifer is in excess of 1,000 years.) Furthermore, at the areas where the Frewsburg Aquifer is known to exist beneath the Site (southern and eastern portions of the Site) review of information presented in Section 4.3 (underground utilities/tanks) did not identify any physical connection to the Frewsburg Aquifer or any pathways for downward migration of contaminant groundwater from the

Water Table Aquifer. Moreover, pumping tests performed in the Frewsburg Aquifer did not identify any vertical hydraulic connection between the Water Table Aquifer and the Frewsburg Aquifer at any of the on-Site well nest locations nor at the well nest on the nearby District well field. In addition, there are currently no contaminants present in the Frewsburg Aquifer on Site or in the off-Site District Production Wells #1 and #2A. TCE was previously detected in District Wells #1 and #2A; however, as discussed in Section 6.4.3, it appears that the Site may not be the source of TCE in the District Production Wells #1 and #2A.

In summary, groundwater migration through the Water Table Aquifer to Conewango Creek is the most significant contaminant migration pathway. The potential impact of the discharge of contaminated groundwater into Conewango Creek is described in Section 7.2.

7.2 GROUNDWATER CONTAMINANT MIGRATION

7.2.1 PHYSICAL AND CHEMICAL PROPERTIES OF FACILITY-RELATED COMPOUNDS

Contaminant mobility, a factor in contaminant migration, depends upon the physical and chemical properties of both the contaminants and the media in which they are identified. Properties which affect contaminant mobility include, but are not limited to, solubility, liquid density, vapor pressure and chemical affinity. The partitioning of chemicals between media is controlled by a variety of factors such as adsorption, absorption, volatilization, solubility and chemical affinity.

Chemicals released to a soil medium may be adsorbed by the soil until the adsorptive capacity of the soil is reached. Under continued release(s) of the chemicals, the chemicals may migrate both horizontally and vertically, expanding the area of contaminated soils as the adsorptive capacity of the soil in the vicinity of the release is attained. Similarly, infiltration of precipitation or release(s) of other chemicals may cause the initial chemical to migrate at a rate primarily controlled by the adsorptive capacity of the soil and by the solubility of the initial chemical in the transport media.

Chemicals which have migrated to the groundwater may solubilize in the groundwater to the aqueous solubility limit of the chemical. The solubilized chemical may migrate with the groundwater and sorb onto adjacent soils. Under continued migration to the groundwater from the soils above the water table, the extent of groundwater contamination may expand as the adsorptive capacity of the soils beneath the water table in the vicinity of the release is attained.

The physical/chemical properties of representative Site-related chemicals are summarized on Table 7.1, while the significance of the properties is presented on Table 7.2, examination of these tables indicates the Site-related chemicals in the groundwater are highly soluble, highly mobile and moderately to highly volatile.

7.2.2 MASS FLUX CALCULATIONS

A requirement of the Risk Assessment (Section 8.0) is the determination of exposure point concentrations. To estimate the maximum potential exposure point concentration in Conewango Creek, the groundwater mass flux discharging to the Creek was calculated. A detailed description of the methods and results of these calculations are presented in Appendix M, while the following subsections present a summary of the evaluation.

Migration Pathway

The major hydrostratigraphic unit beneath the Site is the Water Table Aquifer. The portion of this aquifer that is impacted by Site-related chemicals above Class GA standards is shown on Figure M.1 of Appendix M. The groundwater flow through this area across a section between MW-7 and the culvert/swale, passing through MW-11 was considered representative of flow of contaminated groundwater to Conewango Creek. The aquifer parameters used to estimate the groundwater flow are presented in Appendix M. The resultant groundwater flux is approximately 0.0024 cfs (1.1 gpm).

Attenuation Mechanisms

Along the migration pathway a number of attenuation mechanisms may occur which affect the mobility of the Site-related compounds. Possible attenuation mechanisms include:

i) volatilization;
ii) leaching/adsorption;
iii) degradation;
iv) precipitation;
v) advection; and
vi) diffusion/dispersion.

The physical and chemical properties of Site-related chemicals that affect their mobility were previously present on Tables 7.1 and 7.2. For this evaluation only advection and adsorption were considered. While other processes will likely occur, they are difficult to quantify and disregarding them will result in conservative (e.g., higher) estimated in-stream concentrations.

Retardation factors were calculated for the Site-related organic contaminants of concern based on aquifer and chemical properties. The retardation factors are presented on Table M.2 in Appendix M. The retardation factors indicate that the organic contaminants considered will migrate at approximately one-half to one-third of the groundwater flow velocity.

Source Considerations

For this evaluation, it was assumed that current conditions would be maintained. The contaminant source was assumed to be a continuous release resulting in groundwater concentrations held constant at presently observed levels. This is an extremely conservative assumption since there are no continuing releases of organic chemicals with the current Plant operation and since residual contamination in the soil would, even under a no action scenario, degrade with time.

Potential In-Stream Concentrations

The calculated potential in-stream concentrations of the selected organic contaminants are summarized on Table 7.3. All predicted concentrations are below relevant Class C surface water standards.

7.3 AIR CONTAMINANT MIGRATION

As requested by the NYSDEC, theoretical emission rates and ambient air concentrations were estimated for key volatile organic compounds (TCE, vinyl chloride, 1,2-dichloroethene (cis and trans isomers)) using soil gas data obtained from the unpaved areas of the Plant Site (the areas north and west of the Main Building). The emission rates and ambient air concentrations were estimated as specified in the following guidance documents:

i) NYSDEC Division of Air, "Air Pathway Analysis Requirements in the Remedial Investigation", dated April 2, 1991;

ii) Draft "New York State Air Guide I", dated 1991 (refered to herein as "AG-I"; and

iii) USEPA Air/Superfund Technical Guidance Study Series "Guidelines for Predicting Baseline Emissions Estimation Procedures for Superfund Sites", dated January 1992 (refered to herin as "USEPA Guideline".

Appendix N presents the detailed calculations for the emission rates and ambient air concentrations.

7.3.1 Indicator Contaminants and Source Areas

Based on review of the soil data obtained to date, it was agreed with the NYSDEC that the following Chemicals of Concern (COCs) would be evaluated in the air pathway analyses:

i) trichloroethene (TCE);
ii) vinyl chloride;
iii) cis-1,2-dichloroethene (c1,2DCE); and
iv) trans-1,2-dichloroethene (t1,2DCE).

Soil gas data obtained from the unpaved areas of the Site (the areas north and west of the Main Building) were evaluated. The soil gas samples were collected from approximately 4 feet BGS. These soil gas sample locations are shown on Plan 4 of the RI Report and the soil gas data used is presented in Appendix B of the RI Report.

Review of the soil gas data obtained reveal that a small unpaved area within the northern portion of the Site has distinctly different soil gas concentrations than the remaining areas. Therefore, this area was evaluated as a separate source area (Area I). The remaining unpaved areas north and west of the Main Buiding were evaluated as one area, Area II. Plan 4 delineates Areas I and II.

The mean soil gas concentration detected in the respective areas were used in the calculations since it is more representative of the actual Site soil conditions. The mean soil gas concentrations are calculated as described in Appendix N. Where duplicate analyses were performed, an average of the results were used in the calculation of the mean soil gas concentration. Where no contaminant was detected, half of the detection limit was used in the calculation of the mean soil gas concentrations.

Table 7.4 summarizes the chemical and physical properties and parameters used in the calculation of the theoretical emission rates and ambient air concentrations. Table 7.5 summarizes the soil gas concentrations used in the calculations of the emission rate.

7.3.2 Estimated Air Emission Rates and Ambient Air Concentrations

The emission rates for TCE, vinyl chloride, and 1,2-dichloroethene (cis and trans isomers) were calculated using the theoretical model presented in the USEPA Guidelines, which consists of the following equation:

$$E_i = \frac{D_i C_i A (P_t^{4/3})}{d_{sc}}$$

where:

E_i = Emission rate of component i, g/s

D_i = Diffusion coefficient of component i in air, cm^2/s

C_i = Soil gas concentration of component i, g/cm^3

A = Exposed surface area of source, cm^2

P_t = Total soil porosity, dimensionless

d_{sc} = Effective depth of soil cover, cm

Table 7.5 presents the calculated theoretical emission rates for the two source areas. Appendix N presents the detailed calculations.

The estimated emission rates were used to calculate the estimated annual average concentrations of the COCs, based on the following equation:

$$X_i = \frac{(X/Q)\,Q}{A}$$

where:

X_i = The annual average concentrations of component i, µg/m3

X/Q = Value for the appropriate downwind receptor distance and source size determined from Figure 4 of the USEPA Guideline.

Q = Annual emission rate, kg/m^3 yr

$$= \frac{E_i \times 31536}{A}$$

where:

E_i = Emission rate of component i, g/s

A = Exposed surface area of source, m^2

The nearest downwind receptor, based on prevailing winds blowing to the north, was the private well owners north of the Site (see Plan 3 in Appendix A).

The calculated theoretical ambient air concentrations for the COCs and respective source areas are summarized on Table 7.5.

The theoretical annual average air concentrations calculated for each of the two source areas were combined and compared to the NYSDEC's Ambient Guideline Concentrations (AGCs) for the respective COCs (see Table 7.6). This comparison indicates that none of the calculated theoretical air concentrations exceeded the AGCs.

8.0 RISK ASSESSMENT

8.1 IDENTIFICATION OF CHEMICALS OF POTENTIAL CONCERN (COCs)

8.1.1 General Site-Specific Data

The Site history and conditions as presented in Sections 2.0, 3.0 and 5.0 of this report and the validated analytical results from environmental sampling were utilized to identify Site-related chemicals of concern.

The primary Site-related facts applied to this evaluation are summarized as follows:

i) VacAir property consists of approximately 93 acres of which 15 acres was developed as the present Plant Site and the remaining 72 acres outside the plant fence consist of undeveloped lowlying and wooded areas;

ii) the Plant is bounded on the north by Conewango Creek, on the east and south by undeveloped land zoned industrial and on the west by Frewsburg-Falconer Road. The Frewsburg Water District Supply Wells (Well #1 and #2A) are located west of Frewsburg-Falconer Road. The nearest residential area is approximately one-half mile south of the Plant;

iii) the Plant processes waste metal and generates waste products including spent TCE and sludges, lubricating oil and hydraulic oil;

iv) a major portion of the Plant Site is covered by structures and paved or graveled areas;

v) a drainage swale/culvert runs from south to north through the center of the Plant Site. The portion immediately east of the Main Building beneath the paved area is a covered culvert. The swale/culvert receives the permitted discharge from the active sand filter/septic system. Areas south of the Plant Site also drain into this swale. This swale discharges to a lowlying area north of the Plant which ultimately drains into Conewango Creek;

vi) the primary scrap processed consists of stainless steel, titanium alloys and nickel bearing materials;

vii) a pond originally constructed to hold cooling water is located on the south edge of the Plant area. This pond contains fish (bass) which were introduced;

viii) the entire Plant Site area, including the manmade pond located on the Plant Site, is surrounded by a chain link fence with a guarded entrance/gate;

ix) the nearby portion of the Conewango Creek flows southwesterly past the Plant and can support sport fishing. The Creek is classified as a NYS Class C surface water body and is not a known drinking water supply source; and

x) the lowlying area north and east of the Plant is a floodplain area of the Conewango Creek, and generally does not contain standing water during the drier periods of the year. The streams flowing through the flood plain are continuous throughout the year.

8.1.2 Environmental Data

Information on Site characteristics and data from analysis of groundwater, surface water, soil and sediment samples obtained during the SI, IRA and the RI were examined to evaluate the chemicals present, their distribution and concentrations at the Site. All validated data for soil, sediment, surface water and groundwater samples collected during implementation of the RI were evaluated in the identification of chemicals of concern (COC) and are summarized and discussed in Section 6.0 of this RI Report.

In the procedure to identify COCs, mean concentrations reported in non-background samples were evaluated against the criteria described herein.

For the identification of COCs, duplicate samples were considered as one sample.

8.1.3 Identification of Background Sample Locations

8.1.3.1 Soil Background

Surface soil samples SS-1, SS-2, SS-3, SS-4, SSoil-A and SSoil-J were collected from locations south of the Plant Site boundary or near the southern boundary of the Site and upgradient from contaminant releases and not impacted by the Site. Therefore, the samples from these locations were believed to represent natural soil and/or areas not contaminated by Plant activities.

Subsurface soil samples BH-1, BHA-1 and BH-J were upgradient of the Site and were not believed to be impacted by releases on the Site. Therefore, samples from these locations were believed to represent unaffected subsurface soil and natural conditions in the area of the Site.

The data from both surface and subsurface background locations were combined to represent the background soil for the area around the Site.

8.1.3.2 Sediment Background

Sediment sampling location SED-B is upgradient of the discharge from the on-Site pond and the active sandbed/septic system. Therefore, only sediment and surface water samples collected above the pond discharge point are considered background samples for surface water and sediment. Sediment sample location SED-M (and SED-N which is a duplicate sample of SED-M), collected from the Conewango Creek, is upgradient of discharges from the Plant Site and the lowlying swampy area. Therefore, sampling location SED-M (and duplicate sample SED-N) was identified as background sediment for Conewango Creek.

8.1.3.3 Surface Water Background

As noted above, only surface water sampling locations located upgradient of the discharge from the on-Site pond were considered to be unaffected background samples. Sampling location SW-B which are located upstream of the discharge point was identified as background surface water.

For the evaluation of Conewango Creek, samples SW-4 and SW-M (and duplicate sample SW-N) were upgradient of any potential discharge from the Plant and were identified as background for Conewango Creek.

8.1.3.4 Groundwater Background

Groundwater monitoring well location MW-1 is the only background groundwater monitoring well. This sampling location is also identified as MW1.

8.1.4 Procedure for the Identification of COCs

The identification of COCs may use several objective approaches which numerically evaluate the concentrations, frequency of occurrence and toxicity of the reported chemicals and, by applying selected criteria, identify the primary chemicals in a specific media. This is consistent with USEPA guidance document RAGS, Volume I, "Human Health Evaluation Manual (Part A)", Section 5.0.

The primary criteria used to identify Site-specific COCs were:

i) detection frequency/concentration/toxicity criteria; and
ii) background concentration criteria.

Chemicals which met both the detection frequency/concentration/toxicity criteria and the background concentration criteria, as described in the sub-sections which follow, were identified as COCs.

8.1.4.1 Detection Frequency/Concentration/Toxicity-Based Criteria

Chemicals identified in each media were scored on both their estimated carcinogenic potency and their potential to cause non-carcinogenic effects. Chemicals were qualified on the basis of either their carcinogenic or non-carcinogenic scores. Those chemicals which contributed 1 percent or greater to the total score for either carcinogens or non-carcinogens met the toxicity criteria. Chemicals with relatively low carcinogenic or non-carcinogenic scores are excluded from the risk assessment, as their contribution to the total health risk from the Site is expected to be low. Therefore, COCs identified represent those chemicals which pose the highest potential risk and account for the vast majority of the total risk.

The detection frequency/concentration/toxicity score for a suspected carcinogen was calculated using the following equation:

$$\text{Score} = DF \times C \times CSF$$

where:

DF = Detection Frequency which is the number of detections per total number of samples.

C = Mean concentration reported in non-background samples of the media evaluated.

CSF = Cancer Slope Factor which is an estimate of the cancer producing potency of a chemical and is modeled based on the data from experimental and epidemiological data which show carcinogenic effects of specific chemicals.

The detection frequency/concentration/toxicity score for the non-carcinogenic effects of a chemical was calculated using the following equation:

$$\text{Score} = DF \times \frac{C}{RfD}$$

where:

DF = Detection Frequency which is the number of detections per total number of samples.

C = Mean concentration reported in non-background samples of the media evaluated.

RfD = Reference Dose or the dose that is believed to not produce adverse effects even after long-term exposure.

Note that the inclusion of the chemical-specific detection frequencies in the carcinogenic or non-carcinogenic scores address the prevalence of the chemical in the media of interest. Therefore, if a chemical was detected in only a few samples at low concentrations, the chemical is less apt to be identified as a COC. Chemicals which have high toxicity and high concentrations in only a few samples will still be evaluated because of high scores.

Organic and inorganic chemicals were evaluated separately since concentration units (ppb vs. ppm) reported in media varied between organic and inorganic chemicals. This generated inaccurate scores due to inconsistent concentration limits which were incompatible with a reasonable evaluation of the data and produced an imbalance between organic chemicals and inorganic chemicals identified as COCs.

8.1.4.2 Background Criteria

To be identified as a COC, a chemical had to be reported as present in at least one sample of the media being evaluated at a concentration greater than twice the concentration reported in the Site-related background samples for the same media (consistent with selection procedures identified in the USEPA 1989). The mean concentrations reported were evaluated against mean concentrations in the Site-related background samples.

The background concentrations were determined for each media by determining arithmetic average of the compounds in the designated background samples (see Tables 8.1 to 8.4, inclusive).

8.1.5 Identification of COCs

The results of the evaluation process are summarized in Tables 8.1 to 8.4, inclusive. The chemicals identified by this selection process for each media evaluated are summarized in Table 8.5.

8.1.5.1 COCs in Soils

The data for soils is presented in Tables 6.1, 6.2 and 6.3 and summarized in Table 8.1. Preliminary evaluation of the analytical data for soil samples showed that trichloroethene (TCE) and total 1,2-dichloroethene (1,2-DCE) were, by far, the major organic chemical contaminants in both surface and subsurface soil samples.

VOCs other than TCE and total 1,2-DCE were reported above background concentrations, but these other VOCs were present in only a few scattered locations at much lower concentrations than were reported for TCE and 1,2-DCE. Vinyl chloride, a degradation product of TCE, was reported in two test pit samples and in one subsurface soil sample. TCE was also reported in all samples where vinyl chloride was reported, and TCE was present at concentrations generally two or three orders of magnitude greater than the concentrations of vinyl chloride. Acetone and methylene chloride were reported in several soil samples, including background samples, and were believed to be laboratory and sampling artifacts. Other VOCs were reported in only a few samples and scattered locations, and were not considered important Site-related chemicals in soil samples. Carbon disulphide and vinyl chloride satisfied the detection frequency/concentration/toxicity criteria and are identified as COCs.

Notably high concentrations of petroleum-related VOCs (xylene, ethylbenzene, toluene and benzene) were reported in a single borehole soil sample identified as (BHP-1, 4 feet to 6 feet). Although the soil samples from boreholes BH-Q, BH-T and BH-S were not collected for chemical analysis, these samples and samples from adjacent boreholes were screened in the field for organic vapors. The extent of volatile organic vapors was delineated in the BTEX area based on the organic vapor readings. These chemicals were not reported in combination or in similarly high concentrations in any other samples. Other reported detections of these chemicals were few in number, scattered, and at low concentrations.

Moreover, monitoring wells downgradient from this area of BTEX contamination and well MW-10, located within the BTEX contaminated area, did not contain significant levels of BTEX. The highest total BTEX concentration found in the on-Site monitoring wells is estimated to be 34 ppb. Because of the low concentrations reported, the apparently limited area involved and the comparatively low toxicity of the chemicals at the highest concentration, these chemicals did not meet the detection frequency/concentration/toxicity criteria and were not considered chemicals of concern for evaluation of the Site.

BNAs were generally reported near or below the concentrations reported in the background soil samples. Bis(2-ethylhexyl)phthalate was reported in the majority of the soil samples in which it was analyzed. Although, bis(2-ethylhexyl)phthalate is often present as a laboratory contaminant and considered an artifact, there appears to be a correlation with the concentrations of TCE. However, it failed to meet the detection frequency/concentration/toxicity criteria. Failure to satisfy the detection frequency/concentration/toxicity criteria eliminates all BNAs as COCs.

PCBs were reported at low concentrations in two surface soil samples and five test pit samples. Most samples were less than 1 ppm and the average of all detects was 2.1 ppm, which is well below the 10 ppm guideline for limited access industrial areas. The average for all samples, including non-detects is 1 ppm and is equivalent to the guideline soil cleanup concentration for a residential area. PCBs accounted for a major percentage of the detection frequency/concentration/toxicity score and are included as a COC in soils.

Comparisons of metal concentrations in non-background soil samples and background samples reveal that beryllium, cadmium, chromium, cobalt, copper, lead, mercury, nickel, thallium, selenium, vanadium and zinc were above background concentrations . Only beryllium, cadmium, copper, nickel, thallium and vanadium satisfied the detection frequency/concentration/toxicity criteria and were identified as COCs in soils.

In summary, the above evaluation identified the following as chemicals of concern in affected soils and chemicals which should be evaluated in the risk assessment.

VOCs
Carbon Disulphide
1,2-Dichloroethene (Total)
Trichloroethene
Vinyl Chloride

PCBs (Total)

Metals
Beryllium
Cadmium
Copper
Nickel
Thallium
Vanadium

8.1.5.2 COCs in Sediments

The data for sediments is presented in Table 6.8 and summarized in Table 8.2. As with soil data, preliminary evaluation of the analytical data for sediment samples showed that 1,1-DCE and 1,2-DCE Total were major organic chemical contaminants in sediment samples. In addition, vinyl chloride was reported at elevated concentrations in several samples.

VOCs other than 1,1-DCE, 1,2-DCE Total and vinyl chloride were reported above background concentrations. Dichloroethane was present in only one sample location at lower concentrations. Methylene chloride was reported in two sediment samples, including one background sample, and was believed to be a laboratory and sampling artifact. Other VOCs such as acetone, 2-butanone, toluene and xylene were reported in several samples but at lower concentrations. None of these VOCs satisfied the detection frequency/concentration/toxicity criteria, therefore, these VOCs were not identified as COCs.

There were no background sediment samples for the BNAs and the BNAs were only analyzed in sediment samples from the Site

Investigation so there is minimal data to evaluate. Because of the elevated concentrations reported, benz(a)anthracene, benzo(b)fluoranthene, benzo(a)pyrene and bis(2-ethylhexyl)phthalate detected in samples SED-4 and SED-7, result in detection frequency/concentration/toxicity scores greater than 1 percent of the total, they are included as COCs in sediments.

PCBs were reported at concentrations less than 1 ppm in only one sediment sample. The average of detected concentrations was 0.12 ppm, which is well below the 1.0 ppm guideline for residential areas. PCBs were reported as ND with detection limits from 0.049 to 3.7 ppm. The average for all samples, including non-detects, would be far below 1 ppm, the guideline concentration for a residential area. PCBs do account for slightly more than 1 percent of the detection frequency/concentration/toxicity score and will be included in the evaluation as a COC in sediment.

Comparisons of metal concentrations in non-background sediment samples and background samples reveal that arsenic, barium, beryllium, cadmium, copper, lead, manganese, mercury and nickel concentrations in non-background samples are well above the concentrations reported in sediments identified as Site-specific background and also satisfy the detection frequency/concentration/toxicity criteria. These metals are included as COCs in the evaluation of sediments.

In summary, the above evaluation identified the following as chemicals of concern in affected sediments and as chemicals which should be evaluated in the risk assessment:

VOCs	***Metals***
1,1-Dichloroethene	Arsenic
1,2-Dichloroethene (Total)	Barium
Vinyl Chloride	Beryllium
	Cadmium

BNAs
Benzo(a)anthracene
Benzo(b)fluoranthene
Benzo(a)pyrene
Bis(2-ethylhexyl)phthalate

Copper
Lead
Manganese
Mercury
Nickel

PCBs (Total)

8.1.5.3 COCs in Surface Water

Because Conewango Creek is not within the Plant Site perimeter and only receives discharge from the lowlying area north of the Plant Site, the potential health risk and hazard from surface water in Conewango Creek will be evaluated separately.

With respect to Conewango Creek, the midstream and downstream samples collected in Conewango Creek did not present any chemical concentration exceeding those reported in the upstream samples, SW-M (and duplicate sample SW-N) and SW-4. It was concluded that the Plant Site and disposal areas do not impact the water quality of Conewango Creek, therefore there are no COCs identified in Conewango Creek.

The data for surface water is presented in Table 6.5 and summarized in Table 8.3. The detection frequency/concentration/toxicity-based criteria is applied to the surface water data from the lowlying area north of the Plant Site. The mean surface water concentrations are also compared to the Federal Ambient Water Quality Criteria (AWQC) and the NYS AWQC for Class C waters. According to NYSDEC, the drainage swale which traverses the Site and the lowlying wet area is classified as 'Class C surface water. This classification is a conservative estimate of the usage of surface waters in the lowlying area north of the Plant fence. This area remains dry for most of the year and is not likely to sustain sizable fish. It is also unlikely to be used for recreational purposes.

Based on a comparison of on-Site VOC concentrations with background VOC concentrations, it is apparent that 1,2-DCE Total, trichloroethene and vinyl chloride were observed at elevated concentrations which resulted in detection frequency/concentration/toxicity scores greater than 1 percent of the total. Therefore, they were identified as COCs. 1,1-Dichloroethene, 1,2-dichloroethane and styrene were detected at low concentrations and each chemical was reported in only one sample. These three chemicals did not qualify under the detection frequency/concentration/toxicity criteria and were not considered as COCs.

Several BNAs were detected at very low concentrations in five surface water samples analyzed. The very low concentrations and the comparatively low toxicity of the chemicals reported resulted in detection frequency/concentration/toxicity scores that did not meet the criteria and indicated that BNAs were not COCs.

On the basis of the reported concentrations of metals, cadmium, manganese and nickel exceeded background and AWQC, satisfied the detection frequency/concentration/toxicity criteria and were identified as COCs. Several of the samples (SW-1, SW-2, SW-D, SW-E) contained elevated levels which may be the result of cloudy samples contaminated with sediment.

In summary, the above evaluation identified the following as chemicals of concern in affected surface water and as chemicals which should be evaluated in the risk assessment:

VOCs	*Metals*
1,2-Dichloroethene (Total)	Cadmium
Trichloroethene	Manganese
Vinyl Chloride	Nickel

8.1.5.4 COCs in Groundwater

The data for groundwater are presented in Table 6.8 and summarized in Table 8.4. Comparing VOC concentrations in samples from on-Site and downgradient monitoring wells with upgradient VOC concentrations, it is apparent that 1,2-DCE Total, TCE and vinyl chloride were observed at elevated concentrations and were identified as COCs. Benzene, ethylbenzene, 1,2-dichloroethane, toluene, tetrachloroethene, 1,1,2-trichloroethane, 1,1,1-trichloroethene, and xylene (total) were detected at low concentrations in samples from several wells and were not identified as COCs since they will play a minor part in the total health risk and hazard assessment. Acetone, bromodichloromethane, chloroform and 1,1-dichloroethane, were reported at low concentrations and each chemical was reported in only one sample. These four chemicals were not considered as COCs.

Several BNAs were detected at very low concentrations in five groundwater samples analyzed. The very low concentrations and the comparatively low toxicity of the chemicals reported resulted in detection frequency/concentration/toxicity scores that did not meet the criteria and indicated that BNAs were not COCs.

On the basis of the comparisons of reported concentrations of metals to background concentrations and NYS groundwater standards/maximum contaminant levels (MCLs) for the metals, aluminum, calcium, iron, magnesium, manganese, potassium and sodium were identified as exceeding background and/or MCLs. However, only manganese satisfied the detection frequency/concentration/toxicity criteria and is identified as a COC.

In summary, the above evaluation identified the following as chemicals of concern in groundwater and as chemicals which should be evaluated in the risk assessment:

VOCs	***Metals***
1,1-Dichloroethene	Manganese
1,2-Dichloroethene (total)	
Trichloroethene	
Vinyl Chloride	

8.1.5.5 Summary of Identification of COCs

The evaluation of the data base and comparison with background concentrations identified chemicals of concern (COCs) in surface and subsurface soil, sediments, surface water and groundwater. The COCs for all media are summarized in Table 8.5. The identified list of chemicals does not include all the chemicals reported in each media but the COCs are believed to account for the vast majority (>95 percent) of the potential adverse effects on human health and the environment from any probable exposure.

8.2 EXPOSURE ASSESSMENT

8.2.1 Characterization of Exposure Setting

8.2.1.1 Physical Setting

The physical setting of the Site is discussed in Section 2.1 and Section 5.0 of this report.

Access to the Plant Site (the 15 acre developed portion of the Site) is restricted by a 10-foot chain-linked fence with one entrance point from Frewsburg-Falconer Road and this gate is either locked or guarded by a security person. Accordingly, the exposure on the Plant Site is expected to be different than the exposure on the unrestricted and undeveloped areas of the Site.

Based on the varying physical conditions and the apparent physical division (e.g., existence of fence) at the Site, the evaluation of potential risks was conducted for the following two sectors:

- the Plant Site, and
- the undeveloped areas of the Site (hereafter referred to as "outside the Plant fence").

Therefore, the health risk evaluation of surface soils, subsurface soils, sediments, and surface waters will be evaluated separately for these sectors. However, the groundwater beneath the Site will be considered as a single unit.

8.2.1.2 Current and Future Land Use Factors

The current and possible or probable future land uses of the Site are critical in the development of current and future public health scenarios. Exposure estimates such as the type of exposure, exposure frequency and duration were determined based upon current land use, current zoning and planning, local populations and future land use plans predicated on the Reasonable Maximum Exposure (RME) Concept.

The entire Site is located within an area which is zoned for industrial development and which has a low population density. The Site is bounded to the north by the Conewango Creek, to the east by lowlying and wooded areas, to the south by residential and industrial development, and to the west by the Frewsburg-Falconer Road. Based on these factors, the residential use of the Site is highly unlikely. However, it is recognized that without deed restrictions in place, there is a possibility, although highly improbable, that there may be a change in future land use. Therefore, a notation has been made on the property deed for the Site which makes the current and prospective property owner aware of the property's history and restricted land uses.

There is no expected change in the land use pattern of the Site under future conditions. Therefore, for the purposes of this risk assessment, the exposure scenarios developed and evaluated for the Site property were limited to trespasser and worker-type exposure scenarios for industrial properties.

8.2.2 Potentially Exposed Populations

Because the Site is presently an industrial site and the area is zoned industrial, there is no reason to believe this land will change. The potential populations which would enter the Plant Site would be company employees, contract workers (construction, maintenance, etc.), visitors or trespassers. Potential populations which may be exposed to Site-related contaminants outside the Plant fence would be trespassers/hikers and/or local residents. Potentially exposed populations evaluated for each media of concern are identified below.

Soils Within the Plant Site

The reported contamination in surface soil is limited to an area extending just outside the northwest, north and northeast portions of the paved areas within the Plant Site. Since exposure to soils under the paved areas would require excavations, the evaluation of exposure to surface soil will be limited to this northern area outside the cement pad. Exposure to affected surface soils within the Plant Site is limited to on-Site workers.

Because of the existing chain-linked fence and the guarded gate, it is highly unlikely that trespassers could gain access through the perimeter fence. Although the probability is low, unauthorized access of the Plant Site by trespassers is evaluated for exposure to surface soils within the Plant Site (see Section 8.2.3).

The evaluation of subsurface soils within the Plant includes both surface and subsurface soils which may be involved in excavation activities. Although some areas would not be suitable or preferred for Plant expansion activities, the entire Plant area will be evaluated which is a conservative and health-protective approach. The only potential future direct-contact exposure to subsurface soils would occur if construction activities require excavation of the subsurface soils. During the excavation, construction workers would be exposed to surface and subsurface soils within the Plant Site. A construction worker exposure scenario was developed with the assumption that the construction worker will work on one construction project on this Site.

Soils - Outside the Plant Fence

With respect to the undeveloped areas of the Site, outside the Plant fence, trespasser/hiker exposure to surface soils located in the north and northeast of the Site is evaluated (see Section 8.2.3). Exposure of trespassers/hikers to subsurface soils located outside the Plant fence was not evaluated. It is not likely that subsurface soils would be exposed since the areas are well vegetated. In addition, soil samples collected from boreholes BH-I, BH-K, BH-G and BH-H, showed minimal contamination. Therefore, evaluation of construction worker exposure to subsurface soils outside the fenceline is not necessary as the construction worker scenario is evaluated for potential exposure to soils within the Plant Site which contain higher levels of contaminants.

Sediments Within the Plant Site

Sediment samples collected from locations SED-A, SED-C and SED-5 located in the on-Site Pond and the drainage swale, respectively, do not show significant levels of Site-related contamination. There were no reported BNAs or PCBs in either sampling location SED-A and SED-C. Acetone and 2-butanone were detected in SED-C at low concentrations. The reported levels of VOCs and BNAs in sampling location SED-5 were low. The detected levels of inorganics were comparable to background concentrations. Therefore, potential exposure by on-Site employees and unauthorized trespassers is limited, if not negligible. It is also expected that consumption of fish caught from the on-Site Pond will not pose any potential health risks to those consuming the fish.

Sediments - Outside the Plant Site

With respect to the undeveloped areas of the Site, outside the Plant fence, trespasser/hiker exposure to sediments located in the lowlying area north of the Site is evaluated (see Section 8.2.3).

Surface Water - Within the Plant Site

Surface water samples collected from location SW-A, SW-C and SW-8, located in the on-Site Pond and the drainage swale, respectively, do not show any reported levels of VOCs, BNAs or PCBs. TCE was detected once in SW-8 at low concentrations (3 µg/L). Therefore, potential exposure by on-Site employees and unauthorized trespassers is limited, if not negligible. It is also expected that consumption of fish caught from the on-Site Pond will not pose any potential health risks to those consuming the fish.

Surface Water - Outside the Plant Site

With respect to the undeveloped areas of the Site, outside the Plant fence, trespasser/hiker exposure to surface water located in the lowlying area north of the Site is evaluated (see Section 8.2.3).

Groundwater - Water Table Aquifer

Groundwater in the Water Table Aquifer is not used on-Site or off-Site as a water supply since the Water Table Aquifer is not a productive water supply aquifer. Accordingly, the exposure pathway is incomplete. However, since the Water Table Aquifer beneath a small off-Site area north of MW-7 and west of Frewsburg-Falconer Road may be contaminated with Site-related chemicals and since Keywell does not control the usage of this property, it is conceivable that, in the future, residents may potentially use groundwater from the Water Table Aquifer in this area. Accordingly, exposure to groundwater in the Water Table Aquifer, outside the Plant fence, is evaluated (see Section 8.2.3).

Another potential exposure to contaminated groundwater in the Water Table Aquifer is via discharge to Conewango Creek. Conewango Creek is classified as a 'Class C' surface water (non-potable) suitable for recreational use such as fishing, boating and swimming. To date, analytical data collected from Conewango Creek indicate that upgradient levels of COCs is comparable to downgradient levels. This demonstrates that the Creek has not been impacted by contaminants at the Plant. However, the future potential impact of groundwater discharging to Conewango Creek was evaluated via the consumption of fish caught from the Creek by recreational fishermen and swimming exposure (see Section 8.2.3).

Construction workers may potentially be exposed on-Site to groundwater in the Water Table during construction activities involving the excavation of subsurface soils. Depending on the location and depth of the excavation, contaminated groundwater may enter the excavation and workers may come in contact with the groundwater. Appropriate health and safety precautions for construction workers should be considered, as necessary, prior to initiating any ground intrusive activities within the Site. Since a construction worker exposure scenario is evaluated for potential exposure to soils within the Plant Site, the potential construction exposure to groundwater will not be quantitatively evaluated in this risk assessment.

Groundwater - Frewsburg Aquifer

Trichloroethene and cis-1,2-dichloroethene were detected in the District Production Wells #1 and #2A in September 1991 which resulted in the shutdown of these two wells. The highest detected trichloroethene (TCE) concentration was 465 µg/L. No VOCs have been detected above the drinking water standards in Production Wells #1 and #2A since October 1991. In addition, TCE was not detected above drinking water standards in on-Site monitoring wells (MW-4D and MW-5D) installed in the Frewsburg Aquifer.

Investigation activities performed to date did not identify any physical connection or hydraulic connection between the Frewsburg Aquifer and the Water Table Aquifer. In addition, based on the hydrogeological characterization performed to date, the potential for contaminant migration from the Water Table Aquifer to the Frewsburg Aquifer is limited by the Confining Clay Unit with theoretical travel times for the migration of water across this clay unit estimated to be greater than 1,000 years. Because of the complex physical and hydrogeological characteristics of the Frewsburg Aquifer, the migration pathway and the source of the TCE detected in Production Wells #1 and #2A cannot be determined (see Section 7.1).

Although the contaminant migration pathway cannot be determined and the water quality of the Frewsburg Aquifer currently does not show any impact, there may be some chance that at some time in the future, VOC contamination may reappear in the Frewsburg Aquifer by some unknown source or pathway and that humans may potentially be exposed to these contaminants. However, potential risks associated with the possible future occurrence of this exposure scenario cannot be predicted or quantified and therefore, will not be in this risk assessment.

Air

Contaminants generally migrate into the air by two mechanisms: volatilization and fugitive dust generation.

Site-related chemicals are naturally volatile in the environment. During ground invasive activities, air monitoring was performed in accordance with the HASP. As discussed in Section 4.8, most organic vapor monitoring performed in the breathing zone was at or near background levels. During all of the ground invasive activities, the only location where the organic vapor monitoring action level was exceeded was at BH-N, located north of the Main Building. At BH-N, refusal was encountered at approximately 5 feet BGS. While attempting to auger through the obstruction, the top of the augers was about 6 feet above ground. Air monitoring performed at the top of the auger indicated organic vapors in excess of 1,000 ppm; organic vapor levels measured at the breathing zone was 6.8 ppm. At this time, drilling activities were halted, the augers were removed from the borehole and the boring was backfilled with adsorbent material (Speedy-Dri) and capped with cement/bentonite grout.

During the soil investigation and hydrogeologic investigation, the split-spoon samples collected from the borings were screened for organic vapor concentrations in the soil cores above background concentrations triggered. Air monitoring activities in the breathing zone were performed when detectable levels of organic vapors above background concentrations were encountered in the soil cores. A summary of organic vapor air monitoring data (in the breathing zone) is presented on Table 4.8. In addition, theoretical emission rates and ambient air concentrations of the most predominant VOCs that may volatilize from soils at the Site were calculated as described in Section 7.3. The estimated theoretical ambient air concentrations of these VOCs were below the respective NYSDEC AGCs. It should be noted that AGCs, as presented in the draft Air Guide-1 (1991 Edition), were conservatively developed based on an excess cancer risk of one in one million (1E-06) after a lifetime exposure.

Since the organic vapor levels measured during ground intrusive activities were low or non-detect and since the estimated theoretical ambient air concentrations for TCE, vinyl chloride and 1,2-dichloroethene (cis and trans isomers) were below NYSDEC's AGCs, it is concluded that volatization of COCs and the potential exposure to air contaminants from the undisturbed soils within the Plant Site is minimal.

If the subsurface soils within the impacted areas of the Plant site are disturbed (i.e. construction worker exposure scenario), there is a potential for human exposure to Site-related contamination by the inhalation route. Therefore, health and safety precautions should be considered, as required, prior to initiating any ground intrusive activities within the Plant Site. A construction worker exposure scenario is evaluated for potential exposures to soils within the Plant Site.

The risks associated with potential worker exposure to air (via volatization or fugitive dust) will not be quantitatively evaluated since models specific to a construction worker exposure are not available.

Site-related chemicals sorbed to soil particulates can be transported into the air in the form of fugitive dust as a result of human activities or wind erosion. However, the generation of dust on the Site is expected to be minimal as most unpaved area of the Site is well vegetated with little exposed soil or are generally moist or wet. The presence of vegetation minimizes the erosion of surface soils and reduces the transport of soil particulates to the atmosphere. The presence of water/moisture in the soil would result in little or no generation of dust. Furthermore, surface soil samples collected at the Site contained very low levels or no VOCs.

Since volatization of COCs and fugitive dust generation are expected to be minimal, the inhalation of COCs will not be further quantitatively evaluated in this risk assessment.

8.2.3 Identification of Exposure Pathways

The potential exposures under present and future land use which are quantitatively evaluated in this risk assessment are summarized as follows:

Media	*Exposure Pathway*	*Receptor Population(s)*	*Land Use*
Plant Site			
Surface Soil	Dermal Contact	On-Site Workers	Present/Future
	Incidental Ingestion	Trespassers	Present/Future
General Soil (Surface & Subsurface Soils)	Dermal Contact Incidental Ingestion	Construction Workers	Future
Outside the Plant Fence			
Surface Soil	Dermal Contact Incidental Ingestion	Trespasser/Hiker	Present/Future
Sediments (Lowlying Area)	Dermal Contact Incidental Ingestion	Trespasser/Hiker	Present/Future
Surface Water (Lowlying Area)	Incidental Ingestion Dermal Contact	Trespasser/Hiker	Present/Future

Groundwater (Water Table Aquifer)	Ingestion as Drinking Water	Residents Off-Site	Future
Groundwater Discharge to Conewango Creek	Dermal Contact (swimming)	Trespasser/Hiker	Future
	Incidental Ingestion (swimming)		Future
	Fish Ingestion	Local Residents	Future

8.2.4 Exposure Point Concentrations

Tables 8.6 through 8.10, inclusive, present the arithmetic mean of the concentrations in all samples, the maximum detected concentration and the 95th percent upper confidence limit (95% UCL) of the mean for each COC, in each media, in the areas evaluated.

For this evaluation, a most likely exposure scenario and a reasonable maximum exposure (RME) scenario were evaluated to provide a range of potential impacts. USEPA has defined the mean or average concentration as appropriate for the exposure concentration for the most likely exposure scenario. For this evaluation, the average concentration was calculated by averaging results for all samples using the detected concentrations and counting all non-detects (ND) as half the detection limit for constituents which were reported as both positive and non-detect in different samples from a single study area. In the event that duplicate samples were analyzed, the duplicates were averaged and included in the calculations as a single sample.

USEPA has defined the RME concentration as the upper 95th percentile of the mean of concentrations reported in the media/area being evaluated. Since the number of samples was small for some chemicals and the detection limits were high, the 95% UCL of the mean concentration was frequently greater than the maximum concentration reported. In such instances, USEPA guidance indicates the maximum concentration reported should be used as the RME to define the exposure of the individual exposed to a reasonable maximum contaminant level. Therefore, in the event that the 95% UCL concentration exceeded the maximum detected concentration, the maximum reported concentration was used to represent the RME concentration. This is a very conservative, health-protective approach. The RME exposure scenario should be considered a highly unlikely exposure scenario.

8.2.4.1 Soil Exposure Point Concentrations

Surface Soils - On Plant Site

For the Plant Site, surface soil samples evaluated in the exposure scenarios were from locations between the Site and concrete pad at the northwest, north and northeast limits of the Plant Site. Data from BH-M (0 to 2 feet), BH-N (0 to 2 feet), SSoil-M, SSoil-N, SSoil-O, and all test pit samples were used in the evaluation of surface soil. Only borehole samples identified as being taken from 0 to 2 feet were included since some surface soil was included in this sample interval. This is a conservative approach as contaminant levels are higher in the deeper soils. The test pit samples are included since a number of samples are composite (soil stockpile) samples and may represent surface soil. In addition, test pits were generally shallow and more reasonably represent surface conditions than the borehole samples from depth. Table 8.6 presents the exposure point concentrations used in the evaluation of subsurface soils.

For the area outside the Plant perimeter, surface soil data evaluated in the exposure scenarios were from locations TP3-A, TP3-B and TP10B-B outside the Plant fence. Table 8.6 present the exposure point concentrations.

General Soils - On the Plant Site

Table 8.7 presents the exposure point concentrations used in the evaluation of general soils (surface soil and subsurface soil) within the Plant Site and the undeveloped areas outside the Plant fence. General soil conditions were used to evaluate the exposure of construction workers on the

Plant Site. The data from surface soil samples and from boreholes: BH12-1, BH-B, BH-E, BH-F, BH-L, BH-M, BH-N, BH-O, BH-P, BH-Q, BH-R, BH-S, BH-T, BH-U, BH-V, and BH-W, all located from within the Plant Site, were used to evaluate exposure of construction workers. Although some of the borehole soil samples were taken at depths below levels that excavations would reasonably reach, the vertical definition of contamination is not complete and the entire data set was used. This is a conservative approach used in the absence of a more complete understanding of the subsurface soil conditions.

8.2.4.2 Sediment Exposure Point Concentrations

Table 8.8 presents the exposure point concentrations used in the evaluation of sediments in the undeveloped areas outside the Plant fence. Sediment data used were from sampling locations: SED-1, SED-2, SED-3, SED-4, SED-6, SED-7, SED-E, SED-F, SED-G and SED-H, located outside the Plant fence at the northwest, north and northeast side of the Plant Site. Sediments in the samples upgradient of the concrete pad and from Conewango Creek were not impacted by the Site and are not included in any exposure assessment.

8.2.4.3 Surface Water Exposure Point Concentrations

Table 8.9 presents the exposure point concentrations used in the evaluation of surface water in the undeveloped areas outside the Plant fence. Surface water data used were from sampling locations: SW-1, SW-2, SW-3, SW-6, SW-7, SW-E, SW-F, SW-G and SW-H, located outside the Plant fence at the northwest, north and northeast side of the Plant Site. Surface water in the samples upgradient of the concrete pad and from Conewango Creek showed minimal, if any, impact from the Site and are not included in any exposure assessment.

8.2.4.4 Groundwater Exposure Point Concentrations

Although highly unlikely, groundwater use of this shallow Water Table Aquifer is evaluated for off-Site areas. Data from monitoring wells MW-7 and MW-12 both located off the Plant Site, were used to calculate the mean, maximum and the 95% UCL exposure point concentrations for off-Site groundwater use. Table 8.10 presents the exposure point concentrations used in evaluating the drinking water use of groundwater off-Site.

Potential future groundwater discharge to Conewango Creek is also evaluated. To date, analytical data indicate that there are no significant differences between COC concentrations from upgradient sampling locations and downgradient sampling locations. However, exposure to surface waters of Conewango Creek was evaluated via consumption of fish by recreational fishermen and swimming. Instream concentrations in Conewango Creek were calculated based on mean annual stream flow and the mean COC concentrations in groundwater using data from all the most important monitoring wells on the Plant Site (MW-2, MW-3, MW-4, MW-9 and MW-11). Table 8.11 presents the exposure point concentrations used in evaluating potential future groundwater discharge to Conewango Creek. The details of the calculations are discussed in Section 7.0 and presented in Appendix M.

8.2.5 Quantification of Exposure

For each exposure scenario, two levels of assumptions are presented. "Level 1" assumptions present the average or mean value for the assumption approximating the average expected exposure conditions. "Level 2" presents assumptions which are more conservative, approximating the reasonable maximum exposure. The Level 2 assumptions are based on the 90th or 95th percentile confidence level for factors such as exposure duration, ingestion rates and total exposed skin surface areas.

To quantify exposures, potential exposure scenarios were developed using exposure assumptions presented in the USEPA documents entitled, "*Risk Assessment Guidance for Superfund* (RAGS)", Part I: Human Health Evaluation Manual, EPA/540/1-89/002, December 1989; "*RAGS Supplemental Guidance Standard Default Exposure Factors*", OSWER Directive 9285.6-03, March 25, 1991; "*Exposure Factors Handbook*", EPA/600/8-89/043, March 1990; "*Dermal Exposure Assessment: Principles and Applications*", EPA/600/8-91/011B, January 1992; and "*Superfund Exposure Assessment Manual*", EPA/540/1-88/001, April 1988. In some instances where the USEPA documents did not present necessary assumptions and where specific appropriate exposure information were available, professional judgement was applied to develop conservative assumptions which are protective of human health.

Tables 8.12 through 8.16, inclusive, summarize the exposure scenarios, and the mean and RME assumptions utilized in the evaluation. Appendix O presents the detailed risk calculations.

8.3 TOXICITY ASSESSMENT

This section presents scientific evidence of toxicity and information that relates chemical exposure (dose) to anticipated health effects (responses) for each chemical of concern. Toxicity data derived from dose-response data are used in the next section to estimate the carcinogenic and non-carcinogen risks associated with exposure to these chemicals of concern.

Toxicity information was obtained from the scientific literature, USEPA Integrated Risk Information System (IRIS, January 1993) database and USEPA Health Effects Assessment Summary Tables (HEAST, 1992).

A summary of the physicochemical properties and relevant dose-response criteria for all COCs evaluated in the risk assessment is presented in Table 8.17. The table contains available oral cancer slope factors (CSFs) for evaluating carcinogenic risks, and oral chronic reference doses (RfDs) used to evaluate non-carcinogen risks.

8.3.1 Toxicity Information - Non-Carcinogen

In evaluating the hazard from the non-carcinogen effects of the chemicals of concern, the average daily exposure is based on potential shorter-term, non-lifetime exposure estimates.

The averaging time for the non-carcinogen assessment is 365 days per exposure year.

At present, there are no promulgated reference doses for individual aroclors. Therefore for this evaluation, the reference dose of 0.01 mg/kg-day was used as a reference value for total PCBs.

8.3.2 Toxicity Information - Carcinogen

In evaluating the incremental lifetime cancer risks associated with exposures, the average daily lifetime exposure is based on a 70-year lifetime.

Three PAHs, classified as Class B2 (probable human carcinogens) carcinogens, were detected in the sediments sampled outside the Plant fence. The slope factor for Benzo(a)pyrene was used for this group of compounds. Toxicity equivalency factors (TEFs) were applied to the Benzo(a)pyrene slope factor as follows (ICF-Clements, 1987):

Benzo(a)anthracene	0.145
Benzo(b)fluoranthene	0.14

The Benzo(a)pyrene CSF of 7.3 $(mg/kg\text{-}day)^{-1}$ currently available on IRIS (IRIS, 1993) was used in the evaluation.

8.3.3 Toxicity Summaries

The following subsections provide a brief summary of the occurrence and toxicity of the chemicals which were evaluated at the Site.

8.3.3.1 Carbon Disulphide

Carbon disulphide is a natural product of anaerobic biodegradation and is released to the atmosphere from oceans and land masses. It also may be released as emissions and in wastewater during its production and use, in the production of viscose rayon, cellophane, and carbon tetrachloride, and as a solvent and fumigant.

Carbon disulphide vapour in sufficient quantities is severely irritating to eyes, skin and mucous membranes. Intoxication from carbon disulfide is primarily manifested by psychological, neurological, and cardiovascular disorders (Sittig, 1985).

Carbon disulphide is not classified as a carcinogen. The oral RfD is 0.1 mg/kg/day (IRIS, 1993).

8.3.3.2 1,1-Dichloroethene (1,1-DCE)

1,1-Dichloroethene (DCE) is widely used to make certain plastic products such as packaging materials and flame retardant fabrics. 1,1-DCE is released into the environment primarily as a result of air and water emissions coming from factories where 1,1-DCE is manufacured, hazardous waste sites, and as a result of accidental spills. 1,1-DCE can also be found as a breakdown product of other chemicals (e.g., trichloroethene) present in the environment. Although high percentages of 1,1-DCE in soil and water will quickly escape to the air, small concentrations will remain and undergo biodegradation into other compounds. It is estimated that 1,1-DCE released into the atmosphere will persist for only about two days (ATSDR, 1989a).

The human health effects of 1,1-DCE are unknown. In animal studies at high concentrations, 1,1-DCE has caused liver, kidney, heart and lung damage and has also caused nervous system disturbances and death after brief exposure. An increased risk for cancer has been demonstrated in animals exposed to 1,1-DCE (ATSDR, 1989a).

1,1-DCE is classified as a C carcinogen (limited evidence in animal studies). It has an oral RfD of 0.009 mg/kg/day (IRIS, 1993).

8.3.3.3 1,2-Dichloroethene (1,2-DCE)

1,2-DCE is a colourless liquid with a sharp, harsh odour that is readily flammable. There are two forms of 1,2-DCE: cis-1,2-DCE and trans-1,2-DCE. 1,2-DCE is widely used as a low-temperature extraction solvent for organic materials such as dyes, perfumes, lacquers and thermoplastics. Primary use of 1,2-DCE is as an intermediate in the synthesis of other chlorinated solvents and other chemical production. It is often the by-product in the manufacture of chlorinated compounds. Direct chlorination of acetylene at about 40°C can also produce 1,2-DCE.

1,2-DCE is released to the environment from its production and use, emissions from contaminated wastewaters, waste disposal sites and from pyrolysis/combustion of polyvinyl chloride and some vinyl copolymers. 1,2-DCE can also be found as a breakdown product of other chemicals (e.g., trichloroethene) in the environment.

The general population may be exposed to low levels (0.013-0.076 ppb) of 1,2-DCE through inhalation of affected air in urban areas. These exposure levels correspond to an average daily intake of 1-6 µg/day assuming an average daily intake of 20 m^3 of air.

Inhalation of high levels of 1,2-DCE causes nausea, drowsiness, fatigue, and death at very high levels. The health effects resulting from short- and long-term human exposure to specific levels of 1,2-DCE are unknown. Additionally, the health effects resulting from long-term exposure to low concentrations (ie. environmental levels) of 1,2-DCE are unknown.

Laboratory animals subjected to 1,2-DCE in air showed liver, lung and heart damage after short-term (200-3,000 ppm for 8 hours) and long-term exposure (200 ppm for 16 weeks); increasing severity with the length of exposure duration. Liver and lung damage were observed in animals that were fed 1,2-DCE and extremely high doses of 1,2-DCE (66,000 ppm to 433,000 ppm in food) caused death.

1,2-DCE is not classified by USEPA and has an oral RfD of 0.009 mg/kg-day (IRIS, 1993).

8.3.3.4 Trichloroethylene (TCE)

Trichloroethene (TCE) is widely used as an extraction solvent for greases, oils, fats, waxes, and tars and is used by the textile processing industry to scour cotton, wool, and other fabrics. The textile industry also uses TCE as a solvent in waterless dying and finishing operations. As a general solvent or as a component of solvent blends, TCE is used with adhesives, lubricants, paints, varnishes, paint strippers, pesticides and cold metal cleaners.

TCE is released to the environment from its production and use, emissions from vapour degreasing operations, manufacture of other chemicals, and solvent evaporation losses from adhesives, paints, coatings and miscellaneous uses.

The general population may be exposed to low levels of TCE (typical concentration range of 100-300 ppt) through inhalation of affected air. These exposure levels correspond to an average daily intake of 11-33 μg/day assuming an average daily intake of 20 m^3 of air. Average daily water intake of TCE (assuming a typical concentration range of 1-10 ppb and a consumption of 2 L of water/day) is 2-20 μg/day.

Because inhalation of TCE at very high levels causes unconsciousness, it once was used as an anesthetic. If exposure to high levels of TCE occurs, it may cause dizziness or sleepiness. The health effects resulting from long-term exposure to low concentrations (ie. environmental levels) of TCE are unknown. The data regarding reproductive and genotoxic effects from TCE exposure are inconclusive, and the mechanisms for carcinogenicity are not known.

TCE is classified by USEPA as a ("B2") probable human carcinogen with sufficient evidence in animal studies. USEPA IRIS has not established an oral RfD and an oral CSF for TCE exposure. The previous oral CSF of 0.011 $(mg/kg\text{-}day)^{-1}$ is included in this report so that TCE is evaluated with the other COCs at the Site.

8.3.3.5 Vinyl Chloride

Vinyl chloride is a manmade product with a mild, sweet odour. It is widely used in the production of polyvinyl chloride (PVC) which is a component of plastic products such as automotive parts, accessories, furnitures, pipes, wires, cable coatings, and packaging materials. At one time, vinyl chloride was used as a coolant, a propellant in spray cans, and in some cosmetics. It is no longer used for these purposes.

Vinyl chloride is released to the environment from its production and use, emissions from contaminated wastewaters, waste disposal sites and from pyrolysis/combustion of polyvinyl chloride and some vinyl copolymers. Vinyl chloride can also be found as a breakdown product of other chemicals (e.g., trichloroethene) in the environment.

Segments of the general population living in the vicinity of emission sources may be exposed to low levels of vinyl chloride through inhalation of affected air. These exposure levels correspond to an average daily intake of 2100 μg/day assuming an average daily intake of 20 m^3 of air.

Human exposure to vinyl chloride occurs primarily through inhalation and less frequently through skin absorption. Acute inhalation exposure to high concentrations of vinyl chloride causes light headedness, some nausea, and possible dulling of visual and auditory responses. These effects may occur within 5 minutes at about 10,000 ppm of vinyl chloride (ATSDR, 1992c).

Chronic high level skin exposure may result in the triad of acroosteolysis, Raynaud's phenomenon, and sclerodermatous skin changes. These skin changes occur almost exclusively on workers who are exposed to high concentrations and are not relevant to low level environmental exposures.

Chronic exposure to vinyl chloride has also been associated with hepatic damage. A number of animal studies revealed characteristic hepatic lesions produced by vinyl chloride exposure. The incidence and severity of the effects correlated well with the duration of exposure (ATSDR, 1992c).

Acute exposure of animals to extremely high concentrations of vinyl chloride via inhalation has been demonstrated to cause hepatic damage such as increased liver to weight body ratio, liver congestion, fatty degeneration and hypertrophy. Acute exposure (30 minutes) of guinea pigs, mice and rats to concentrations of vinyl chloride ranging from

100,000 ppm to 300,000 ppm caused liver congestion or severe fatty degeneration followed by death (ATSDR, 1992c). Exposure of rats to 50,000 ppm for 4 to 6 hours produced no observable effects in the liver.

A single 1-hour exposure of mice to 500, 5,000 or 50,000 ppm of vinyl chloride, followed by an 18-month observation period, resulted in an increased incidence of hepatocellular hypertrophy in the animals at terminal sacrifice (ATSDR, 1992c). The hypertrophy was not dose-dependent, thus, the significance of this effect is uncertain.

Chronic exposure studies to low concentrations of vinyl chloride via inhalation have produced hepatic toxicity such as degeneration, swelling of hepatocytes with compression of sinusoids, dilation of rough endoplasmic reticulum, proliferation of smooth endoplastic reticulum, changes in metabolic enzymic activities and increased liver to body weight ratio (ATSDR, 1992). For example, exposure of rats to 500 ppm for 7 hours per day, 5 days per week, for 4.5 months resulted in an increase in liver to body weight ratio and granular degeneration. Exposure of rats to 500 ppm for 5 hours per day, 5 days per week for 10 months caused swelling of hepatocytes and proliferation of reticuloendothelial cells, increased liver weight, and degeneration. An increased 10 ppm of vinyl chloride for 6 hours per day, 6 days per week for 6 months.

Following a 6-month exposure to vinyl chloride, the relative NOAELS for a number of species fall in this order: mice and rats (NOAEL = 50 ppm) < rabbits (NOAEL = 100 ppm) < guinea pigs and dogs (NOAEL >200 ppm).

Vinyl chloride is regarded as a human carcinogen. The most compelling evidence for the carcinogenic potential of vinyl chloride in humans comes from the cluster of reports of greater than expected incidences of angiosarcoma of the liver in workers occupationally exposed to vinyl chloride.

Vinyl chloride is classified as ("A") a known human carcinogen and has an oral CSF of 1.9 $(mg/kg\text{-}day)^{-1}$ (IRIS, 1993).

8.3.3.6 Arsenic

Arsenic is a naturally occurring element, occurs in the general earth's crust at 2 mg/kg and occurs in surface soil at generally less than 40 mg/kg. In certain areas, concentrations in soil may be elevated because of naturally high levels in mineral deposits in the area. Arsenic is present in many foods and the daily intake from a typical diet is 0.19 mg/person/day (Friberg, Nordberg and Vouk, 1986).

Higher exposures to inorganic arsenic related to arsenical poisoning or industrial exposures can cause characteristic skin lesions, dark and light patches, and small corns on heavily cornified skin such as palms and soles of feet (ATSDR, 1992a).

There is some evidence that low levels of arsenic exposure in the normal diet of 10 to 50 ppb may be beneficial to good health (ATSDR, 1992a).

Arsenic is recognized as a known human carcinogen and the USEPA has published an oral CSF of 1.75 $(mg/kg/day)^{-1}$, and an oral RfD of 0.003 mg/kg/day (IRIS, 1992).

8.3.3.7 Barium

Barium occurs naturally as $BaSO_4$ and $BaCO_3$, which is comparatively insoluble and therefore non-toxic. Barium is present as 0.05 percent of the earth's crust and is in agricultural soils at mg/kg levels. It concentrates in plants and has been measured in some grains at 10 mg/kg and in Brazil nuts at 3,000 to 4,000 mg/kg. The daily intake from the diet of the general population may be as high as 1.33 mg/kg (Friberg, Nordberg, and Vouk, 1986).

At toxic levels, barium is a muscle poison causing an initial stimulation and finally a paralysis. The threshold toxic dose is 200 to 500 mg barium as a soluble salt (Friberg, Nordberg, and Vouk, 1986).

Barium is not a carcinogen. The oral RfD is 0.07 mg/kg/day (IRIS, 1993).

8.3.3.8 Beryllium

Beryllium is one of the less common metals in our environment. It is found in ordinary agricultural soils in µg/kg concentrations. Because of its unique qualities (light weight, stable, high melting point) and its ability to impart special qualities to alloys, beryllium has found many uses in modern, high technology equipment. Twenty (20) percent of the beryllium produced is used as the free metal in missile and nuclear reactor components, rocket nozzles, aircraft brakes, electrical relays, space vehicle re-entry cones, x-ray windows, inertial guidance parts, and classified weapons parts. Seventy-two (72) percent of the beryllium produced is used in special metal alloys and the remaining 8 percent, as the oxide, is used in special ceramics. At pH values 5 to 8, the element tends to form insoluble hydroxides or hydrated compounds. In some alkaline conditions, berylliates tend to form (Friberg, Nordberg, and Vouk, 1986).

Beryllium is more hazardous by inhalation than by ingestion. It is not easily adsorbed from the digestive tract and tends to form insoluble precipitates at the physiological pH. Beryllium has caused an allergic type dermatitis as well as acute and chronic pulmonary reactions. Beryllium apparently causes neoplasia only after inhalation exposures. Beryllium protein complexes cause immune responses which are apparently related to the pulmonary reactions noted in exposed individuals (Friberg, Nordberg, and Vouk, 1986).

Beryllium has a USEPA B2 carcinogenic classification, an oral CSF of 4.3 (mg/kg/day)$^{-1}$, and an oral RfD of 0.005 mg/kg/day (IRIS, 1993).

8.3.3.9 Cadmium

Cadmium is present generally throughout the environment and in many materials. Elevated concentrations are generally related to non-ferrous mining and refining. It is used in steel manufacturing and in pigments for plastics. Cadmium concentrations in soil are increased by the application of sewage sludge and phosphate fertilizers. The average daily intake of cadmium from air, food and water by the human population is estimated at 10 to 20 µg/day (Friberg, et. al., 1986).

Long term exposure to excessive cadmium (200 µg/day) causes adverse kidney effects and effects on calcium metabolism. An association has been shown between occupational exposure and an increased incidence of lung and prostate cancer in workers. Teratogenic effects have been observed in test animals after very high doses (3 to 10 mg/kg) (Friberg, et. al., 1986).

Cadmium is classed as a B1 carcinogen (some evidence in humans and adequate evidence in animal studies) only by inhalation. It has an oral RfD of 0.001 mg/kg/day in food and 0.0005 mg/kg/day in water (IRIS, 1993).

8.3.3.10 Copper

Copper occurs naturally as sulfides, oxides and carbonates. Sulfide ores constitute 75 percent of the total copper production (Friberg, et. al., 1986).

Approximately half of all copper production is used in electrical equipment. Another common use for copper is in plumbing and heating equipment. Copper salts also function as pesticides for fungi or algae (1 to 2 percent solution) and as herbicides (Friberg, et. al., 1986).

Surface waters (American rivers) have reported copper concentrations as 0.83 to 105 µg/L (5.8 µg/L median). Natural concentrations of copper in soil vary from 2 to 100 mg/kg (Friberg, et. al., 1986).

Copper is an essential element and forms part of several enzymes. The daily requirement is about 2 mg for adult humans (Friberg, et. al., 1986).

Accidental exposure to large amounts of copper can cause gastrointestinal disturbances. Copper fumes can cause irritation of the respiratory tract or metal fume fever, a reversible flu-like response (Friberg, et. al., 1986).

Chronic effects from even high level industrial exposure have not been documented (Friberg, et. al., 1986).

An RfD of 0.037 mg/kg/day has been established for copper (IRIS, 1993). This RfD is equivalent to approximately 120 percent of the estimated daily requirement for adult humans.

8.3.3.11 Lead

A major use of lead is the production of alkyl lead for leaded gas. This use has made lead essentially ubiquitous in areas of highways and streets. It was also common pigment in paints which resulted in significant exposures in homes. These uses are being limited by regulations to decrease potential environmental lead exposures. Lead in soils is adsorbed on soil particles and organic carbon and is comparatively immobile (Friberg, et. al., 1986).

Chronic exposure to elevated lead intake can cause anemia, renal effects and encephalopathy (Friberg, et. al., 1986). The dose levels necessary to cause these effects have not been well defined and biological monitoring (blood level) is recommended to determine if safe levels of exposure have been exceeded. Blood levels of 10 to 20 µg/dl have been suggested as levels of concern by USEPA and World Health Organization (WHO) (ATSDR 1986). Attempts have been made to correlate the oral intake with blood levels which indicate approximate blood levels of 4 to 18 µg/ml from a continuous daily lead oral intake of 100 µg/day. Because the relationship between intake and blood level is not linear, safe oral doses have not been designated.

USEPA IRIS has not established an oral RfD for lead exposure. The previous RfD (0.0014 mg/kg/day) is included in this report so that lead is included in a comparable evaluation with the other chemicals evaluated at the Site.

8.3.3.12 Manganese

Manganese is widely distributed and found naturally as the oxides, carbonates, and silicates. It is used in metallurgy, chemical manufacture, tanning, textile bleaching and welding rods. It is added as a trace element in fertilizers for certain crops. Manganese is an essential trace element in the diet, but deficiencies have not been reported (Friberg, et. al., 1986). The estimated required daily intake is 2 to 3 mg/day.

Manganese is neurotoxic at adequate dose levels. However, neurological disorders are well-documented via inhalation route by workers. The general public is primarily exposed to manganese by ingestion of foods and water or inadvertent ingestion of soil. Very little information is available concerning manganese poisoning by the oral route. Dermal exposure has not been noted as a concern except in the case of potassium permanganate which may cause severe irritation or is corrosive when it contacts skin or mucous membrane (ATSDR, 1991).

Health Effects - Animals

Even under an acute exposure scenario, manganese is considered comparatively non-toxic. Daily oral doses in food of 930 to 2300 mg/kg/day for a number of months did not cause mortality in rats. By gavage, the LD_{50} values range from 223 to 820 mg/kg/day.

Chronic studies on rats and mice at doses of 930 to 810 mg manganese/kg/day showed no respiratory, cardiovascular, haematological, musculoskeletal, hepatic, renal, or dermal effects. A mild epidermal hypertrophy was noted in the stomach of the mice. This was possibly due to irritation of the gastrointestinal epithelium. Dose levels of 10 to 600 mg manganese/kg/day are reported to cause neurological (primarily hypo- or hyperactivity) in controlled animal studies (ATSDR, 1991).

Rats fed diets containing 3,500 mg/kg manganese showed minimal effects on reproduction. Repeated oral doses at 14 ug manganese/kg/day for 80 days did not cause any chromosomal changes in sperm or bone marrow. Studies on the carcinogenic potential of manganese in rats and mice are equivocal and under review (ATSDR, 1991).

Health Effects - Humans

Health impacts of manganese generally involve effects on the lungs or the Central Nervous System (CNS) (ie. neurological effects) from prolonged inhalation exposure to large amounts of manganese oxide (Friberg et al., 1986). No studies were reported regarding systemic effects on humans following oral exposure other than the possible neurological effects related to oral ingestion (ATSDR, 1991).

Several toxicokinetic factors which could explain the apparent lower toxicity from ingestion exposure compared to inhalation are:

(1) altered absorption rate; (2) liver storage; (3) excretion in bile; and (4) metabolic valence change. These factors would act equally well for manganese in water or in food.

The absorption of manganese from the digestive tract is inversely related to the dose. In other words, the percent of the dose absorbed decreases as the amount administered orally increases (Friberg et. al, 1986). This would appear to decrease the toxic effect of high doses of manganese.

The liver is a major depository of manganese in the body for all ages (Friberg et. al, 1986). With oral ingestion and absorption from the intestinal tract, the portal circulation would carry the manganese directly to the liver. Since the liver can store large amounts, it can function as a reservoir for excess manganese while it is being metabolized and/or excreted. In this manner, the absorbed manganese from high oral intake would not enter the general circulation directly.

A similar condition exists where manganese absorbed from the intestinal tract and in the portal blood can be shunted directly to the bile and excreted without entering the general circulation where toxic effects could be induced (Friberg et. al., 1986).

If the conversion of Mn^{+2} and Mn^{+4} to Mn^{+3} results in a less toxic, more easily excreted form of manganese, shunting the manganese from the intestinal tract directly to the liver would allow this metabolic alteration to occur before the manganese enters the general circulation.

Since inhaled manganese can be absorbed from the lungs directly into the general circulation (ATSDR, 1991) there is an opportunity for this manganese to be distributed throughout the body before it is subjected to the moderating effects of the liver.

Three studies are reported that suggest that oral exposure to manganese may cause neurological effects. The first study is related to the observation of neurological symptoms typical of manganism in an aboriginal population in an island near Australia. Excess manganese intake is likely an etiological factor, other factors such as genetics, diet and alcoholism are also involved. Inhalation exposure as well as oral exposure may also be involved (ATSDR, 1991).

A second study of six families which reported excessive manganese intake from a contaminated well, is also questionable due to the abnormal very early appearance of symptoms, the very rapid course of the disease from early symptom to death, and the fact that the symptoms subsided in the survivors even before the source of excess manganese was removed (ATSDR, 1991).

A third-report, Kondakis et. al. (Kondakis et. al., 1989), covers an epidemiological study of communities in Greece. Three populations were defined that had low (3.6-14.6 ug/L), medium (8.68-252.6 ug/L) and high (1,800-2,300 ug/L) concentrations of manganese in their drinking water. The populations were evaluated as to manganese levels in blood and hair. The differences in blood levels were not significant, but the differences in manganese content in hair was significant. The populations were also evaluated regarding social information and considered to be uniform. The individuals in the populations were examined for a select group of neurological symptoms which had specific scores weighted for importance. The average scores for the populations were significantly different, with the population on the high manganese water showing the highest average score. The authors concluded that increased intake of manganese in drinking water was associated with an increased prevalence of neurological signs and an increased concentration of manganese in the hair (Kondakis et al., 1989).

The Kondakis et. al. study was critically reviewed by the Agency for Toxic Substances and Disease Registry (ATSDR, 1991) and the USEPA work groups preparing the Integrated Risk Information System (IRIS, 1991) reference dose reviewed and finalized September 1, 1990. Questions related to the study and its conclusions are summarized below.

- No details were presented to allow an evaluation of which neurological signs were increased, so an evaluation of the importance of the differences (were the effects observed due to manganism or nonspecific) was not possible (ATSDR, IRIS).

- The weighting factors assigned to the symptoms were largely arbitrary and could have affected the ultimate results (ATSDR).

- Many of the parameters included in the scoring were subjective and could have lead to bias. Little effort was indicated to avoid bias (ATSDR, IRIS).

- There is no evidence that individuals that experienced neurological signs actually ingested more manganese than the individuals in the other populations (ATSDR, IRIS).

- There is a lack of information provided on social and other dietary and drinking water factors (IRIS).

- The populations studied were very small (ATSDR, IRIS).

Although the authors suggested that the increased concentration of manganese in hair indicate higher manganese intake (Kondakis et. al., 1989), there was no effort to control for potential exogenous contamination of the hair from soil or washing the hair and allowing water to dry on the hair. Use of hair as a biomarker is not recommended. "Exogenous contamination may yield values that do not reflect absorbed dose" (ATSDR, 1991a). Although blood levels in the three groups were discounted as being too sensitive to recent intake (Kondakis et. al., 1989), this does not agree with the homeostatic regulation via changes in absorption and/or excretion or with the comparatively long half-life reported for manganese in blood (Friberg et al., 1986).

Manganese is not known to be a carcinogen, mutagen, or teratogen. For this RA, the current EPA RfD for manganese in water of

0.005 mg/kg/day will be used to evaluate the manganese drinking water intake.

8.3.3.13 Mercury

Mercury (Hg) occurs as elemental mercury and as inorganic and organic compounds. Mercury metal is in a liquid state at room temperature. Mercury occurs in the Earth's crust mainly in the form of sulfides (e.g., cinnabar). Mercury has a variety of uses including electrical components, paints, control systems, agriculture, density, laboratory, and military.

Mercury is a silver-white metallic liquid. Properties include:

• atomic weight	200.6 g/mole
• atomic number	80
• density	13.6 g/cm^3
• melting point	-38.9°C
• boiling point	356.6°C
• oxidation states	+1,+2

Metallic mercury is considered volatile.

The solubility of mercury in lipids is on the order of 5 to 50 mg/L. In the presence of oxygen, metallic mercury is rapidly oxidized to ionic form. Mercuric salts such as halides, sulfates and nitrates are water soluble. Mercuric ion is able to form many stable complexes.

Mercury can exist in the natural environment in one of three oxidation states (0,1^+ and 2^+). Elemental mercury is relatively volatile. Both organic and inorganic mercury compounds exhibit volatility.

The oral RfD for mercury is 0.0003 mg/kg/day.

8.3.3.14 Nickel

Agricultural soils, world wide, contain from 3 to 1000 mg nickel per kg. Nickel is found in many foods and the average daily intake in the U.S.A. is reported to be from 300 to 500 μg. In a U.S. drinking water survey, 3 percent of the samples contained 20 μg/L and more than 20 percent of the samples contained 10 μg/L or more (Friberg, Nordberg, and Vouk, 1986).

Less than 10 percent of the ingested inorganic nickel is adsorbed from the digestive tract. Nickel has been shown to be an essential element in the diet of some animal species but this has not been proven for the human species. Large oral doses are tolerated by animals and systemic effects from oral ingestion are unlikely. Nickel can cause pulmonary inflammation and dermal contact has caused dermatitis in nickel workers (Friberg, Nordberg, and Vouk, 1986).

Nickel is classified as a known human carcinogen (Class A) by USEPA and the inhalation CSF is 0.84 $(mg/kg/d)^{-1}$ per Table 8.16 for soluble salts. The oral RfD for soluble salts is 0.02 mg/kg/day (IRIS, 1993).

8.3.3.15 Thallium

Pure thallium is a soft, bluish-white metal that is widely distributed in trace amounts in the earth's crust. Thallium is used mostly in the manufacture of electronic devices, switches, and closures. It also has limited use in the manufacture of special glasses and for medical procedures that evaluate heart disease. The average daily intake of thallium from food by the human population is estimated at 5 μg/day (ATSDR, 1991b).

Thallium salts may be skin irritants and sensitizers, but these effects occur rarely in industry. In non-fatal occupational cases of moderate or long-term exposure, early symptoms usually include fatigue, limb pain, metallic taste in the mouth and loss of hair (ATSDR, 1991b).

Thallium is not a carcinogen and has an RfD of 0.00008 mg/kg/day (IRIS 1993).

8.3.3.16 Vanadium

Most vanadium is produced from residues of iron and titanium extraction. Vanadium is found in soils from 5 to 140 mg/kg. Fly ash contains high concentrations up to 400 mg/kg. U.S. coal averaged 30 mg/kg (weighted average), but some coal may have up to 1 percent vanadium. Crude oil and peat may also contain significant concentrations of vanadium (Friberg, Nordberg and Vouk, 1986).

Vanadium is not adsorbed well from the digestive tract; adsorption not exceeding 1 to 2 percent. Vanadium is considered an essential element in chickens and rats but requirements in man are uncertain. Adsorbed vanadium is, in part, rapidly excreted. Adverse effects are generally related to inhalation exposure. Dietary concentrations of 500 to 1,000 mg/kg caused changes in metabolic processes in rats. Occupational exposures of humans have been reported to cause nervous system effects, cardiac abnormalities, hematological changes, and changes in blood chemistry. No dose levels were reported for occupational exposures (Friberg, Nordberg, and Vouk, 1986).

USEPA has not classified vanadium as a carcinogen. The RfD for vanadium is 0.007 mg/kg/day (IRIS, 1992).

8.4 RISK CHARACTERIZATION

The results of the quantitative risk assessments are summarized in Tables 8.12 to 8.16 and the detailed calculations are presented in Appendix O.

The quantitative health risk assessment was performed for the most likely exposure scenario (Level 1) based on mean exposure point concentrations and average exposure conditions as well as the reasonable maximum exposure (RME) scenario (Level 2) based on the 95% UCL concentration or the maximum level reported, whichever is lower, and reasonable maximum conditions.

The risk assessment provides a theoretical relative evaluation of the additional risk of contracting cancer due to estimated exposure to specific contaminants. The procedure yielded a negative exponential number that represents the estimated additional cancer risk; for instance, 1E-06 (or 1×10^{-6}) implies one additional case of cancer will result for every 1,000,000 individuals exposed to the specific contaminant. As the negative exponent increases, the associated risk decreases. USEPA has accepted residual risk levels, calculated by this risk assessment process, which fall within the conservative range of 1×10^{-6} to 1×10^{-4}.

The estimated additional lifetime carcinogenic risks (R) were calculated according to the following general equation:

$$R = CDI * CSF$$

where:

R = Upper Bound Additional Lifetime Cancer Risks
CDI = Chronic Daily Intake (mg/kg-day)
CSF = Cancer Slope Factor [1/(mg/kg-day)].

The slope factor represents the carcinogenic potency of a chemical (see Table 8.17). The dose, or intake, represents the amount of contaminant to which a receptor is exposed. When evaluating carcinogenic risks, the dose in all exposure scenarios is the estimated daily intake of each chemical, received during the specified period of exposure, and averaged over a 70-year lifetime.

Incremental cancer risk was calculated for each chemical of concern having a designated slope factor and all applicable exposure pathways (ingestion and dermal contact with soil). Risk values for all contaminants assessed were summed by exposure pathway to provide total pathway-specific risks.

USEPA has not identified a single value that represents a significant incremental cancer risk. However, the NCP acceptable risk range for Superfund sites has been set at 1×10^{-4} to 1×10^{-6} per environmental medium (NCP, 1990). In other words, the goal of the NCP is to reduce the cancer risk associated with site contaminants in a given medium to within or below a range of 1 in 10,000 to 1 in 1,000,000 .

Potential non-carcinogen effects were evaluated based on a comparison of chemical-specific chronic exposure doses (depending on the scenario-specific exposure duration) with corresponding reference doses derived from health criteria (see Table 8.17). The result of this comparison is expressed as the Hazard Quotient (HQ):

$$HQ = \frac{\text{Exposure Dose}}{\text{Protective Dose}} = \frac{CDI}{RfD}$$

where :

HQ = Hazard Quotient
CDI = Chronic Daily Intake (mg/kg-day)
RfD = Reference Dose (mg/kg-day).

A Hazard Quotient (HQ) that exceeds unity (1.0) suggests a greater likelihood of developing an adverse chronic effect. However, the uncertainty factors built into the reference doses result in conservative protective dose values. Therefore, the reference dose is likely well below that for which adverse effects will be seen.

Hazard Quotients were calculated for each contaminant for which health criteria are currently available. The HQs for each contaminant were summed to produce a rough estimate of the exposure pathway-specific risk, the Hazard Index (HI). In estimating total non-carcinogen risk, potential responses were conservatively assumed to be additive. However, all chemicals of concern do not have the same or similar toxic endpoints and responses may not be additive. Therefore, in those cases where the HI exceeded one, further analyses were undertaken to evaluate which specific chemicals might exhibit toxic effects and whether the potential health effects estimated for each chemical were potentially additive.

Estimated risk numbers calculated as part of the risk assessment are compared to USEPA value ranges (USEPA range and hazard index).

8.4.1 Surface Soils

8.4.1.1 Trespasser Exposure

Trespasser exposure to surface soils within the Plant Site and outside the Plant fence were evaluated. The detailed assumptions used to estimate the risk numbers are summarized in Table 8.12. Unless noted otherwise, the following conservative and health-protective assumptions were used to calculate exposures, as appropriate:

- Exposure point concentrations are the mean concentration of surficial soils for the Level 1 or average most likely exposure scenario and the

95% UCL or the maximum concentration in surface soil, whichever is lower, for the Level 2 or RME exposure scenario.

Note: Surface soil results (0 to 2 feet BGS) from sampling locations were used to calculate the mean (Level 1) and 95% UCL or maximum (Level 2) concentrations.

- Only adults and older children will gain unauthorized access to the Site.

- Inadvertent soil ingestion rate assumed for an adult and older child is 100 milligrams (mg) of soil per event for both Levels 1 and 2.

- Surface area of the body contacted by soil during outdoor activities includes the head and hands for Level 1 (2000 cm^2), and the head, hands, forearm and lower legs for Level 2 (5300 cm^2).

- Soil-to-skin adherence factor is 0.2 mg/cm^2 for Level 1 and 1.0 mg/cm^2 for Level 2 (USEPA, 1992).

- Matrix factor on skin contact equals 0.15 (e.g., 15 percent of chemical is available for absorption) (Hawley, 1985) for both Levels 1 and 2, respectively.

- When chemical-specific information is not available, the absorption efficiency applicable to ingestion is assumed to be 100percent for volatile organic compounds and 50 percent for other organic chemicals, PCBs, pesticides, or inorganics (MDNR, 1991).

- When chemical-specific information is not available, the absorption efficiency applicable to dermal contact is assumed to be 10 percent for volatile organic compounds and 1 percent for other organic chemicals, PCBs, pesticides, or inorganics (MDNR, 1991).

- Exposure duration for older child and adults:
  9 years (Level 1) and 25 years (Level 2) for carcinogens;
  1 year (Levels 1 and 2) for non-carcinogens.

- Body weight of adult and older child is assumed to be 70 kg.

- Averaging time is 25,550 days or 70 years (Levels 1 and 2) for carcinogens and 365 days (Levels 1 and 2) for non-carcinogens.

The assumptions outlined above were used to evaluate trespasser exposure to COCs in the Plant Site and outside the Plant fence. Since access to the Plant Site is restricted by a 10-foot chain-linked fence and one access gate which is either locked or guarded by a security person, the trespasser exposure frequency within the Plant Site in comparison to the undeveloped areas outside the Plant fence is expected to be significantly different.

For a trespasser who gains unauthorized access to the Plant Site, the total assumptions (see Table 8.12) used to calculate the risk numbers include those presented above and the following additional assumptions:

- Exposure frequency equals 2 days per year (Level 1) and 4 days per year (Level 2).

- It was assumed that the trespasser would walk across the Plant area and would not spend a significant period of time on the Plant property. The time spent on the Plant Site is limited by the presence of a security person. Therefore, the percent time factor assumed is 5 percent for Level 1 and 10 percent for Level 2.

The estimated cancer risks and hazards are summarized in Table 8.12 while the scenario details, assumptions and calculation tables are presented in Appendix O, Tables 1 through 4, inclusive. Applying the conservative assumptions, the estimated additional risk of cancer and non-carcinogenic hazard are below the USEPA acceptable value ranges. The additional lifetime upper limit of cancer risks were estimated to be 6.33E-09 and 1.03E-07 for Levels 1 and 2, respectively. The hazard indices were 4.30E-05 and 4.66E-04 for Levels 1 and 2, respectively.

For a trespasser who gain unauthorized access to the undeveloped area outside the Plant fence, the total assumptions (see Table 8.12) used to calculate the risk numbers include those presented above and the following additional assumptions:

- Exposure frequency equals 10 days per year (Level 1) and 40 days per year (Level 2). Surficial soil exposure will only occur during the summer months since factors such as precipitation, snow cover and vegetation will limit activity patterns and exposure. This assumes that the individual will visit the area once a week (Level 1) and twice a week (Level 2) during the summer months, from May to August.

- It was assumed that the trespasser would walk across the undeveloped area outside the Plant fence. The COC composition and distribution outside the Plant fence is not uniform, and it is expected that trespassers will not remain in any one area for a prolonged period of time. Therefore, the percent time factor assumed is 25 percent for Level 1 and 50 percent for Level 2.

The estimated cancer risks and hazards are summarized in Table 8.12 while the scenario details, assumptions and calculation tables are presented in Appendix O, Tables 5 through 8, inclusive. Applying the conservative assumptions, the estimated additional risk of cancer and non-carcinogenic hazard are below the USEPA acceptable value ranges. The additional lifetime upper limit of cancer risks were estimated to be 2.00E-09 and 6.77E-08 for Levels 1 and 2, respectively. The hazard indices were 9.82E-05 and 1.15E-03 for Levels 1 and 2, respectively.

8.4.1.2 Worker Exposure

Worker exposure is limited to surface soils within the Plant Site. The detailed assumptions used to estimate the risk numbers are summarized in Table 8.12. The following conservative and health-protective assumptions were used to calculate exposures:

- Exposure point concentrations are the mean concentration of surficial soils for the Level 1 or average most likely exposure scenario and the 95% UCL or the maximum concentration in surface soil, whichever is lower, for the Level 2 or RME exposure scenario.

  Note: Surface soil results (0 to 2 feet BGS) from sampling locations were used to calculate the mean (Level 1) and 95% UCL or maximum (Level 2) concentrations.

- Inadvertent soil ingestion rate for adult workers is assumed to be 50 mg of soil per day for Levels 1 and 2.

  Note: USEPA guidance document entitled "RAGS Supplemental Guidance, Standard Default Exposure Factors" (USEPA, 1991) states that "50 mg of soil per day was chosen as the standard default value for adult soil ingestion in the workplace". Although the ingestion rate value of 50 mg of soil per day is intended to be used in conjunction with 250 days per year for 25 years, this ingestion rate maintains a conservative assumption based on the rationale that the Plant Site consists of grassed and paved areas which will further limit the soil exposure. Additionally, daily activities of workers on the Plant Site, more specifically in the vicinity of the Metal Building and the concrete pad, include operation of loading trucks and fork lifts to move large scraps of metals, metal alloys and empty storage tanks.

- Surface area of the body contacted by soil during outdoor activities includes the head and hands (2000 cm^2) for Level 1, and the head, hands, and forearms (3,140 cm^2) for Level 2.

Note: USEPA guidance states that "clothing is expected to limit the extent of the exposed surface area in cases of soil contact (USEPA, 1992)". At the Plant Site, workers are required to wear hard hats, safety glasses, gloves and steel-toe boots, thus, the exposed skin surface is limited.

- Soil-to-skin adherence factor is 0.2 mg/cm^2 for Level 1 and 1.0 mg/cm^2 for Level 2 (USEPA, 1992).

- Matrix factor on skin contact equals 0.15 (e.g., 15 percent of chemical is available for absorption) (Hawley, 1985) for both Levels 1 and 2.

- When chemical-specific information is not available, the absorption efficiency applicable to ingestion is assumed to be 100 percent for volatile organic compounds and 50 percent for other organic chemicals, PCBs, pesticides, or inorganics (MDNR, 1991).

- When chemical-specific information is not available, the absorption efficiency applicable to dermal contact is assumed to be 10 percent for volatile organic compounds and 1 percent for other organic chemicals, PCBs, pesticides, or inorganics (MDNR, 1991).

- Exposure frequency equals 200 days per year for Levels 1 and 2. Reasonably, maximum surficial soil exposure will only occur during the summer months since factors such as precipitation, snow cover and vegetation will limit activity patterns and exposure. To maintain a conservative approach, it is assumed that exposure to surface soils will occur daily.

- Exposure duration:
  9 years (Level 1) and 25 years (Level 2) for carcinogens;
  1 year (Level 1 and 2) for non-carcinogens.

- Adult body weight is assumed to be 70 kg.

- Averaging time is 25,550 days or 70 years (Levels 1 and 2) for carcinogens and 365 days (Levels 1 and 2) for non-carcinogens.

- The percent time factor assumed is 50 percent for Level 1 and 75 percent for Level 2.

The estimated cancer risks and hazards are summarized in Table 8.12 while the scenario details, assumptions and calculation tables are presented in Appendix O, Tables 9 through 12, inclusive. Applying the applicable conservative assumptions, the estimated additional risk of cancer and non-carcinogenic hazard are within or below the USEPA value ranges. The additional lifetime upper limit of cancer risks were estimated to be 3.35E-06 and 2.10E-05 for Levels 1 and 2, respectively. The hazard indices were 2.21E-02 and 9.18E-02 for Levels 1 and 2, respectively.

8.4.2 General Soils

8.4.2.1 Construction Worker Exposure

Risks associated with potential exposure by construction workers to contaminated surface and subsurface soils within the Plant Site were assessed. This exposure scenario was considered as a potential scenario which may occur in the future.

The detailed assumptions used to estimate the risk numbers are summarized in Table 8.13. The following conservative and health-protective assumptions were used to calculate exposures:

- Subsurface soils and surficial soils on the Plant Site are disturbed/excavated.

- Exposure point concentrations for Levels 1 and 2 are the mean and 95% UCL or the maximum reported concentration of surface and subsurface soil data collected from the Plant Site.

Note: Soil data taken from all depths were used in the evaluation based on the assumption that excavation activities on the Plant Site will result in the mixing of soils at depth with the subsoils being exposed at surface.

- The construction worker inadvertently ingests 50 mg and 100 mg of soil per event for Levels 1 and 2, respectively.

  Note: USEPA guidance document entitled: "RAGS Supplemental Guidance, Standard Default Exposure Factors (USEPA, 1991)" states that "50 mg of soil per day was chosen as the standard default value for adult soil ingestion in the workplace."

- The surface area of the body contacted by soil during construction activities includes the head and hands (2000 cm^{2}) for Level 1, and the head, hands and forearms (3140 cm^{2}) for Level 2.

  Note: USEPA guidance states that "clothing is expected to limit the extent of the exposed surface area in cases of soil contact (USEPA, 1992)". Workers are required to wear hard hats, safety glasses, gloves and steel-toe boots, thus, the exposed skin surface is limited.

- Soil-to-skin adherence factor is 0.2 mg/cm^2 and 1.0 mg/cm^2 (USEPA, 1992) for Levels 1 and 2, respectively.

- Matrix factor on skin equals 0.15 (e.g., 15 percent of chemical is available for absorption) (Hawley, 1985) for both Levels 1 and 2.

- When chemical-specific information is not available, the absorption efficiency applicable to ingestion is assumed to be 100 percent for volatile organic compounds and 50 percent for other organic chemicals, PCBs, pesticide, or an inorganic parameter (MDNR, 1991).

- When chemical-specific information is not available, the absorption efficiency applicable to dermal contact is assumed to be 10 percent for volatile organic chemical and 1 percent for other organic chemicals, PCBs, a pesticide, or an inorganic parameter (MDNR, 1991)".

- The exposure time for Levels 1 and 2 is 8 hours/day which represents an average work day.
- The exposure frequency is 30 days/year for Level 1 and 120 days/year for Level 2.
- The exposure duration for a given construction program including excavation is one year for Levels 1 and 2.
- Adult body weight is assumed to be 70 kg.
- Averaging time is 25,550 days or 70 years (Level 1 and 2) for carcinogen and 365 days (Levels 1 and 2) for non-carcinogens.
- The percent time factor assumed is 50 percent for Level 1 and 75 percent for Level 2.

The estimated cancer risks and hazards are summarized in Table 8.13 while the scenario details, assumptions and calculation tables are presented in Appendix O, Tables 13 through 16, inclusive. Applying these conservative assumptions, the estimated additional risk of cancer and non-carcinogenic hazard are below the USEPA value ranges. The additional lifetime upper limit of cancer risks were estimated to be 1.70E-08 and 3.27E-07 for Levels 1 and 2, respectively. The hazard indices were 1.41E-03 and 4.28E-02 for Levels 1 and 2, respectively.

8.4.3 Sediments

8.4.3.1 Trespasser Exposure

The risks associated with exposure to sediments within the lowlying area north of the Plant Site were assessed. The detailed assumptions used to estimate the risk numbers are summarized in Table 8.14. The following conservative and health-protective assumptions were used to calculate exposure:

- Exposure point concentrations are the mean (Level 1) and 95% UCL or maximum reported concentrations (Level 2), whichever is lower, in sediment samples collected along the streambed north of the Plant Site.

- Only adults and older children will gain unauthorized access to the Site.

- The individual inadvertently ingests 50 mg of soil for both Levels 1 and 2.

- The skin surface area exposed includes the head and hands (2000 cm^2) for Level 1, and the head, hands, forearms and lower legs (5300 cm^2) for Level 2.

- Soil-to-skin adherence factor is 0.2 mg/cm^2 for Level 1 and 1.0 mg/cm^2 for Level 2 (USEPA, 1992).

- Matrix factor on skin contact equals 0.15 (e.g., 15 percent of chemicals is available for absorption) (Hawley, 1985) for both Levels 1 and 2, respectively.

- When chemical-specific information is not available, the absorption efficiency applicable to ingestion is assumed to be 100 percent for volatile organic compounds and 50 percent for other organic chemicals, PCBs, pesticides, or inorganics (MDNR, 1991).

- When chemical-specific information is not available, the absorption efficiency applicable to dermal contact is assumed to be 10 percent for volatile organic compounds and 1 percent for other organic chemicals, PCBs, pesticides, or inorganics (MDNR, 1991).

- Exposure frequency equals 10 days per year (Level 1) and 40 days per year (Level 2). Exposure to sediments will only occur during the summer months since factors such as precipitation, snow cover and vegetation will limit activity patterns and exposure. This assumes that the individual will visit the area once a week (Level 1) and twice a week (Level 2) during the summer months, from May to August.

- Exposure duration for older child and adults:
  9 years (Level 1) and 25 years (Level 2) for carcinogens;
  1 year (Levels 1 and 2) for non-carcinogens.

- Body weight of an adult and older child is assumed to be 70 kg.

- Averaging time is 25,550 days or 70 years (Levels 1 and 2) for carcinogens and 365 days (Levels 1 and 2) for non-carcinogens.

- It was assumed that the trespasser would traverse across the undeveloped area outside the Plant fence. The COC composition and distribution outside the Plant fence is not uniform, and it is expected that trespassers will not remain in any one area for a prolonged period of time. Therefore, the percent time factor assumed is 25 percent for Level 1 and 50 percent for Level 2.

The estimated cancer risks and hazards are summarized in Table 8.14 while the scenario details, assumptions and calculation tables are presented in Appendix O, Tables 17 through 20, inclusive. Applying the conservative assumptions, the estimated additional risk of cancer and non-carcinogenic hazard are below the USEPA value ranges. The additional lifetime upper limit of cancer risks were estimated to be 2.05E-08 and 9.38E-07 for Levels 1 and 2, respectively. The hazard indices were 3.05E-04 and 4.26E-03 for Levels 1 and 2, respectively.

Approximately 94 percent of the total cancer risks is attributable to vinyl chloride. Note that vinyl chloride was reported at high concentrations only in the very limited area of the seeps (SW1 and SW2) located immediately outside the Plant fence. An apparent concentration gradient exists such that COC levels decrease with distance from the Plant fence.

8.4.4 Surface Water

8.4.4.1 Trespasser Exposure

The risks associated with exposure to surface waters within the lowlying area north of the Plant Site were assessed. Considering the low levels of water in this area, it is more likely to assume that individuals would walk across the area, get their feet and possibly the lower legs (up to the knees) exposed. The detailed assumptions used to estimate the risk numbers are summarized in Table 8.15. The following conservative and health-protective assumptions were used to calculate exposure:

- Exposure point concentrations are the mean (Level 1) and 95% UCL or maximum reported concentrations (Level 2), whichever is lower, in surface water samples collected along the streambed north of the Plant Site.

- The skin surface area exposed includes the feet and lower legs (3190 cm^2) for older children and adults (Levels 1 and 2).

- Permeability constant for concentrations of COCs in water is assumed to be the permeability constant for water of 0.0008 cm/hr (Levels 1 and 2).

- The individual remains in this area for 1 hour and 2 hours per visit for Levels 1 and 2, respectively.

- The individual visits the area for 10 days (Level 1) and 40 days (Level 2) per year. This assumes that the individual visits the area once a week (Level 1) and twice a week (Level 2) during the summer months, from May to August.

- Exposure duration for older children and adults:
  9 years (Level 1) and 25 years (Level 2) for carcinogens,
  1 year (Level 1 and 2) for non-carcinogens.

- Averaging time is 25,550 day or 70 years (Levels 1 and 2) for carcinogens and 365 days (Levels 1 and 2) for non-carcinogens.

- Body weight is assumed to be 70 kg for both older children and adults.

The estimated cancer risks and hazards are summarized in Table 8.15 while the scenario details, assumptions and calculation tables are presented in Appendix O, Table 21 through 24, inclusive. Applying the conservative assumptions, the estimated additional risk of cancer and non-carcinogenic hazard are below or within the USEPA value ranges. The additional lifetime upper limit of cancer risks were estimated to be 1.87E-07 and 8.34E-06 for Levels 1 and 2, respectively. The hazard indices were 2.94E-03 and 4.62E-02 for Levels 1 and 2, respectively.

8.4.5 Groundwater

8.4.5.1 Drinking Water Use of Groundwater Off-Site

As discussed in Section 8.2.2, there are no current groundwater users of the shallow Water Table Aquifer nor will this aquifer ever be used under the future Site condition. This shallow aquifer is not considered a productive aquifer for developing a groundwater and there is minimal potential for use of this aquifer off-Site in an area north of MW-7 and west of Frewsburg Road. Although highly unlikely, groundwater use of this shallow aquifer off-Site was evaluated.

The detailed assumptions used to estimate the risk numbers are summarized in Table 8.16. The scenario for the drinking water use of groundwater off-Site includes the following conservative and health-protective assumptions:

- Exposure point concentrations are the mean (Level 1) and the 95% UCL or the maximum reported concentrations (Level 2), whichever is lower, of groundwater data from sampling locations MW-12 and MW-7.

- Ingestion rates are:
  children = 1 L/day (Levels 1 and 2), and
  adults = 1.4 L/day (Level 1) and 2 L/day (Level 2).

- The individual (children and adults) drinks the groundwater daily, 365 days per year, for Levels 1 and 2.

- Exposure duration is 5 years (Levels 1 and 2) for children and 5 and 25 (Levels 1 and 2) years for adults.

- The averaging time for the non-carcinogen assessment is 365 days per year (Levels 1 and 2) for both children and adults.

- The averaging time for the carcinogen assessment is 25,550 days or 70 years for both children and adults.

- children weigh 16 kg and adults weigh 70 kg.

The estimated cancer risk and hazards are summarized in Table 8.16 and presented in Appendix O, Tables 25 through 28, inclusive. Applying the conservative assumptions, the estimated additional risks of cancer and non-carcinogenic hazard are above the USEPA value ranges. The additional lifetime upper limit of cancer risks were estimated to be 1.12E-04 and 5.65E-04 for Levels 1 and 2, respectively. The hazard indices were 0.39 and 0.63 for Levels 1 and 2, respectively.

Note that approximately 100 percent of the total risks from groundwater consumption off-Site is attributable to TCE exposure.

8.4.5.2 Potential Groundwater Discharge to Conewango Creek

Conewango Creek is classified as a 'Class C' surface water suitable for recreational use such as fishing, boating and swimming. To date, analytical data collected from Conewango Creek indicate that upgradient levels of COCs is equal to downgradient levels. This demonstrates that the Creek has not been impacted by activities on the Plant. However to evaluate the future potential impact of groundwater discharging to Conewango Creek, exposure via the consumption of fish caught from the Creek by recreational fishermen and swimming are evaluated.

8.4.5.2.1 Swimming Exposure Scenario

The detailed assumptions used to estimate the risk numbers are summarized in Table 8.16. The scenario for the swimming exposure includes the following conservative and health-protective assumptions:

- The surface water concentrations were modelled assuming groundwater discharges to Conewango Creek. The mean annual streamflow were used to estimate the instream COC concentrations.
- The total body surface area is 8640 cm^2 (Levels 1 and 2) for children and 19400 cm^2 (Levels 1 and 2) for adults.

- Permeability constants for concentrations of COCs in water is assumed to be the permeability constant for water of 0.0008 cm/hr (Levels 1 and 2).

- The individual swims for 2.6 hours per swimming event for both Levels 1 and 2.

- The individual swims 7 days per year for both Levels 1 and 2.

- Exposure duration is 5 years (Levels 1 and 2) for children and 5 and 25 (Levels 1 and 2, respectively) years for adults.

- The averaging time for the non-carcinogen assessment is 365 days per exposure year (Levels 1 and 2) for both children and adults.

- The averaging time for the carcinogen assessment is 25,550 days or 70 years for both children and adults.

- Children weigh 16 kg and adults weigh 70 kg.

The exposure scenario, assumptions and calculation tables are summarized in Table 8.16 and presented in Appendix O, Tables 29 through 32, inclusive. Applying the conservative assumptions, the estimated additional risks of cancer and non-carcinogenic hazard are well below the USEPA value ranges. The additional lifetime upper limit of cancer risks were estimated to be 1.35E-11 and 2.88E-11 for Levels 1 and 2, respectively. The hazard index was 9.28E-08 for both Levels 1 and 2.

8.4.5.2.2 Consumption of Fish Scenario

The detailed assumptions used to estimate the risk numbers are summarized in Table 8.16. The potential consumption of contaminated fish includes the following conservative and health-protective assumptions:

- The surface water concentrations were modelled assuming groundwater discharges to Conewango Creek. The mean annual streamflow were used to estimate the instream COC concentrations. The details of the calculations are discussed in Section 7.0 and presented in Appendix M.

- Average daily fish consumption for adult population is 6.5 grams per day for 365 days per year (Levels 1 and 2).
  Note: This is the average per capita daily consumption of fish established for setting Ambient Water Quality Criteria (USEPA 1980; PT1 1987).

- Children consume 3.25 grams per day (50 percent of the quantity consumed by adults) for Levels 1 and 2.

- Local population obtains 1 percent or 5 percent of the total annual quantity fish consumed from Conewango Creek in the area potentially impacted by the Plant Site for Levels 1 and 2, respectively.

- The chemical-specific bioconcentration factors (BCF) are applied.

- Exposure duration is 5 years (Levels 1 and 2) for children and 5 and 25 (Levels 1 and 2) years for adults.

- The averaging time for the non-carcinogen assessment is 365 days (Levels 1 and 2) for both children and adults.

- The averaging time for the carcinogen assessment is 25,550 days or 70 years for both children and adults.

- Children weigh 16 kg and adult individual weighs 70 kg.

The exposure scenario, assumptions and calculation tables are summarized in Table 8.16 and presented in Appendix O, Tables 33 through 36, inclusive. Applying the conservative assumptions, the estimated additional risk of cancer and non-carcinogenic hazard are well below the USEPA value ranges. The additional lifetime upper limit of cancer risks were estimated to be 2.07E-12 and 2.33E-11 for Levels 1 and 2, respectively. The hazard indices were 8.22E-09 and 4.11E-08 for Levels 1 and 2, respectively.

8.5 UNCERTAINTIES IN THE RISK ASSESSMENT

The risk assessment procedures generate a numerical value to represent the probability of an additional case of cancer developing above the background cases expected in a population exposed to a specific concentration of a given chemical in the environment. The mathematical models used to estimate this numerical value are intentionally biased to estimate a higher risk value than would be expected. The models used are also highly dependent upon assumptions made throughout the process as well as the accuracy of the variables put into the model. The use of conservative assumptions throughout each step in the process cumulatively generates a risk value which is overly conservative.

The various uncertainties are discussed below in the following sections:

8.5.1 Sampling Locations and Procedures
8.5.2 Exposure Scenario Assumptions
8.5.3 Dose Response
8.5.4 Manganese Absorption/Distribution/Metabolism/Excretion
8.5.5 The Validity of the Derived RfD for Manganese
8.5.6 The Theoretical Nature of Risk Estimates
8.5.7 Synergism and Additivity

8.5.1 Sampling Locations and Procedures

Sampling locations and procedures, including the number of samples collected, can significantly influence the results of the risk assessment. The collection of samples from immediately beneath the concrete areas as opposed to bare earth conditions contributes further uncertainties to the process because the soils sampled are stable and not readily mobile or available for contact due to the concrete cover. Sampling is also directed at areas which are suspect such as stained areas where disposal or spills were reported.

8.5.2 Exposure Scenario Assumptions

The purpose of this evaluation is to evaluate the uncertainty associated with the primary exposure scenario assumptions such as land use and frequency of exposure.

Because the assumptions used in the scenarios are generally not based on objective test data but are subjective estimates based on judgment and experience applied to the data, available, the tendency is to select conservative, health-protective values to guard against under-estimating exposure. This leads to a general over-estimating in all assumptions. When the over-estimates of individual assumptions are included in the scenario equations, they are multiplied. This exaggerates the over-estimation of each assumption and over-states the total exposure to an even greater degree. The exposure scenarios are therefore conservative in nature thereby providing the necessary factor of safety which is protective of health.

The intent of this baseline risk assessment was to estimate the potential exposure point intakes for both the "average" (Level 1) and the "RME" (Level 2) exposure scenarios. In order to accomplish this goal, a series of standardized USEPA exposure assumptions were utilized (when available). In the absence of available USEPA exposure assumptions, professional judgment was used to establish necessary assumptions which are protective of health.

The Level 1 exposure scenario represents the "average" exposure scenario which may reasonably be expected to occur.

The Level 2 exposure scenario represents the Reasonable Maximum Exposure (RME) expected to occur. The RME exposure scenario presented in this RA was developed in conformance with USEPA RAGS.

The exposure scenarios (Levels 1 and 2) were developed to represent the exposures which could possibly occur under both current and future land use conditions.

The major uncertainties recognized in the risk assessment regarding the physical exposure scenarios are summarized as follows:

- The actual exposure frequency of trespassers/hikers to soils on the Plant Site and outside the Plant Site under the present and future condition is unknown. As a result, professional judgment based upon Site-specific experience was used to estimate a conservative exposure frequency and duration.

- The future land use conditions of the Site and its environs were assumed to be the same as the present conditions. This assumption is appropriate given the current or future contemplated land use for the Site. There is no reason to expect that the use of this land will change in the foreseeable future.

- The utilization of present exposure point concentrations for future exposure scenarios is conservative. Natural degradation processes includes adsorption, volatilization, biodegradation, chemical degradation, and photodegradation. The use of steady state also overestimates the exposure.

- The dermal bioavailability factor (BAF) was assumed to be 10 percent for volatile organics compounds and 1 percent for other organic chemicals, pesticides, PCBs and inorganics. This value may overestimate the actual amount of absorption, especially for shorter term events.

- The oral bioavailability factor (BAF) was assumed to be 100 percent for volatile organic compounds and 50 percent for other organic chemicals, pesticides, PCBs and inorganics. Actual absorption rates from ingested contaminants may vary from 5 to 100 percent. The magnitude of the uncertainties associated with the assumption of 50 or 100 percent absorption of ingested contaminants is unknown. Therefore, the use of these BAFs may underestimate or overestimate the associated risks.

8.5.3 Dose Response

One of the major uncertainties in the quantification of risk involves the application of toxicity information. Examples of the uncertainties associated with the toxicity values are presented as follows:

- chemicals may be assumed to be human carcinogens based on animal studies even when limited or no available human studies exist;
- CSFs are derived from high concentration animal studies and therefore may not be applicable to low concentration exposures;
- CSFs are developed in a conservative manner; and
- RfDs are also established with a conservative factor of safety in comparison to actual studies.

8.5.4 Manganese Absorption/Distribution/Metabolism/Excretion

Although inhalation exposure to high levels of manganese is known to result in manganism, a syndrome of neurological effects in humans, there is limited evidence that oral exposure produces the same effects in humans. The presence or absence of health effects is due in part to the relative amounts of manganese absorbed across the lung in comparison to the gastrointestinal tract.

Absorption

There are no quantitative studies available regarding the amount of manganese absorbed by humans or animals following inhalation exposure. Since manganese dioxide and other inhaled manganese compounds are insoluble in water, only manganese affected-particulates of certain size that reach the alveolar lining will be absorbed into the blood. A fraction of the inhaled particles will be cleared from the lung via mucociliary action and eventually swallowed.

If manganese is ingested orally, manganese absorption is controlled by homeostatic mechanisms. The amount of manganese absorbed across the gastrointestinal tract in humans is rather variable, but typically averages about 3 percent to 5 percent. The ATSDR toxicological profile for manganese states that "there does not appear to be a marked difference between manganese ingested in food or water." Manganese absorption is affected by a number of factors such as the amount of ingested manganese, tissue levels and dietary iron intake. Generally, those individuals with iron deficiency have increased manganese absorption. This is because iron and manganese are absorbed by the same transport system in the gut.

Oral absorption in animal studies generally produced similar results to those in humans. Gastrointestinal uptake of $MnCl_2$ in rats has been estimated to be 2.5 percent to 5.5 percent. Uptake is increased by iron deficiency and decreased by pre-exposure to high dietary levels of manganese.

There were no studies available regarding absorption in humans or animals after dermal exposure to manganese.

Distribution/Metabolism

Manganese is a normal component of human and animal tissues. In humans and animals, manganese is distributed as follows: liver > pancreas > kidney > bone and fat.

Excretion

Predominant excretion is through the feces for either inhaled or ingested manganese.

8.5.5 The Validity of the Derived RfD for Manganese

To develop an RfD for a chemical, it is necessary to evaluate exposure/response data of the chemical (animal tests and/or epidemiology studies) to establish a no-observed-adverse-effect-level (NOAEL) dose for the chemical. From this NOAEL, an RfD is determined by applying adjustments as dictated by the original data set(s) used.

SEPTEMBER 1, 1990 - The EPA RfD published in January 1, 1991 was based on a revision dated September 1, 1990 (IRIS, 1991). This RfD was based on a studies showing an average NOAEL for neurological effects of 0.14 mg/kg/day. With uncertainty factor of 1 and a modifying factor of 1, this equates to an RfD of 0.1 mg/kg/day. The NOAEL was based on the composite of results from the several studies.

The IRIS reviewers also examined the paper by Kondakis et. al. (Kondakis et. al. 1989) and concluded "In summary, this study raises some questions about acceptable levels of manganese in drinking water, but is inadequate to serve as the basis for a separate water RfD."

JANUARY 1, 1993 - The current EPA RfD for manganese in water (0.005 mg/kg/d), is the present IRIS value (IRIS, 1993).

The RfD of 0.005 mg/kg/d for manganese is based on the epidemiological study by Kondakis et. al. of three populations in Greece. See section 4.2, above. The NOAEL dose used to calculate the RfD was 334 µg/day based on manganese drinking water intake for one population believed to show no effects from manganese when compared to other populations reported to show marginal effects. The drinking water of the population showing no effects was reported to contain 81.6-252.6 µg manganese/L or an average concentration of 167 µg/L. The estimate of the NOAEL for this population studied utilized only water intake to calculate the manganese intake. Manganese in water was only part of the actual intake of manganese by this population. The estimates of exposures ignored the reported intake of manganese in food which was estimated in the report to be 10,000 to 15,000 µg/day. If this intake of manganese from food was included in the dose calculated for the epidemiology study, the NOAEL would range from 10,334 to 15,334 µg/day and the RfD derived from this NOAEL would be between 0.148 and 0.219 mg/kg/day. Although it was reported that the manganese in water was more bioavailable than manganese in foods, it is inappropriate to completely ignore the food source.

In evaluating the dose level of an exposed population to a specific chemical in an epidemiology study, it is essential to examine the intake and dose of the chemical from all sources. The approach presented in January 1, 1993 IRIS review is flawed since it takes into consideration only a small portion of the manganese consumed by the populations studied in evaluating their total dose. In addition to this flawed calculation, the study on which this evaluation was based has been critically reviewed earlier by the staff of IRIS and it was concluded that the study "is inadequate to serve as the basis for a separate water RfD" (IRIS, 1991).

The overly conservative nature of the current RfD (0.005 mg/kg/day) for water published in IRIS can be demonstrated by the following examples. For example, the hazard index for the reported average daily intake of manganese from all sources (3 to 7 mg per day) would range from 8.6 to 20 (NRC, 1980). Although the RfD of 0.005 mg/kg/day is for drinking water from which manganese is possibly more available for absorption, it is likely that the manganese absorbed from food sources would far exceed the manganese absorbed from 0.005 mg/kg/day in water.

"The intake of manganese estimated by the Food and Nutrition Board of the National Research Council as adequate and safe is 2.5 to 5.0 mg for adults" (NRC, 1989). The NRC also reported that "Assuming a daily water intake of 2 liters, typical drinking water sources should contribute anywhere from 0.040 to 0.064 mg to the total daily intake of manganese. The higher amount would be less that 3 percent of that derived from the usual dietary sources" (NRC, 1980).

8.5.6 The Theoretical Nature of Risk Estimates

As indicated previously, the results of a health risk assessment assigns a numerical value to the probability of a case of cancer developing in a population exposed to a specific amount of chemical which is a known or suspect carcinogen. This numerical value was presented as an upper limit excess cancer risk of 1×10^{-6}, or one additional cancer case in a million people exposed to the designated chemical and at the designated chemical concentration for their entire lifetime which is assumed to be 70 years. The model that is applied to calculate this numerical risk value is intentionally biased to give a high value so the true value would not likely be greater and, in fact, may be zero. The Cancer Risk Model and the assumptions used to estimate exposure are protective of the most sensitive populations.

For example, let us imagine that one hundred people who live in 30 houses are exposed to a chemical, a suspect carcinogen, at a concentration that is reported to cause an estimated cancer risk of 1×10^{-6} or one in a million. The one hundred people would have a 1 in 10,000 chance of developing a single cancer in any one individual during one lifetime. In other words, these houses could be occupied for 10,000 lifetimes or 10,000 generations and have the same continual chemical concentration in question and the probability would be that no more than one and possibly no additional cancer cases would be expected to develop from the chemical exposure. In contrast to the single added cancer from the chemical exposure, the expected number of cancers in that population would be approximately 250,000 due to the known cancer incidence in our population which is one cancer case during the lifetime of every four people.

8.5.7 Synergism and Additivity

There is always a concern for synergistic effects when a receptor is exposed to several chemicals at the same time. In other words, there is concern that the several chemicals interact in the receptor to cause an effect significantly greater than the sum of effects of the individual chemicals. When synergism occurs and is not accounted for in the assessment, the evaluation will underestimate the real health risk.

Polynuclear Aromatic Hydrocarbons and other Site-related constituents are treated as if they all affect the receptor in a similar manner. Their potential risk and hazard ratios are added.

There is no apparent biological reason to suspect volatile organic compounds will have any synergistic effect with the polynuclear aromatic hydrocarbons. Although the non-carcinogen hazard ratios are added, there is no basis to suspect the toxic effects are additive. This suggests that the hazard index may be higher than the toxicological facts would suggest and the evaluation overestimates the actual risk.

8.6 SUMMATION OF RISKS

A given population may be exposed to a chemical from several exposure routes. The purpose of this section is to identify the risks associated with population who may be exposed to a combination of the pathways which were evaluated.

RAGS (at pg. 8-15) provides that risks should be combined across exposure pathways only where the following occurs:

a) reasonable exposure pathway combinations are identified; and

b) it appears likely that the same individuals would consistently face the "reasonable maximum exposure" ("RME") by more than one pathway.

Under the present and future Site conditions, exposure of individuals residing in the vicinity of the Site is considered.

The following scenarios are assessed:

A. Present/Future Conditions

It is reasonable to assume that a trespasser/hiker will visit the lowlying area north of the Plant Site en route to Conewango Creek. Therefore, a plausible scenario to assess the cumulative risks across the various pathways is addressed in the following exposure scenario:

Present Cumulative Risk Scenario

1. Trespasser - surface soil outside the Plant fence
2. Trespasser - sediment in the stream
3. Trespasser - surface water in the stream
4. Surface water - swimming in Conewango Creek
5. Fish Consumption - Conewango Creek.

The cumulative risks for an individual exposed through multiple pathways is summarized as follows:

Present/Future Cumulative Risk Scenario

		RME Carcinogenic Risk	RME Hazard Index
1.	Trespasser - soil outside the Plant fence	6.77E-08	1.15E-03
2.	Trespasser - sediment in the stream	9.38E-07	4.26E-03
3.	Trespasser - surface water in the stream or seep	8.34E-06	4.62E-02
4.	Surface Water - swimming in Conewango Creek	2.88E-11	9.28E-08
5.	Fish Consumption - Conewango Creek	2.33E-11	4.11E-08
	Summation	9.31E-06	5.13E-02

The estimated RME cancer risk for the present and future cumulative risk scenario is 9.31E-06. This estimated cancer risk falls within the target cancer risk range of 1.0E-06 to 1.0E-04 as established by USEPA. The hazard index is below 1.0, which is considered the level of concern.

8.7 SUMMARY

The average and RME cancer risks associated with exposures to surficial soils, general soils, sediments and surface water for all current and future land uses, summarized on Table 8.18, are well below the 1×10^{-6} to 1×10^{-4} range as established by USEPA. The hazard indices associated with exposures to surficial soils, general soils, sediments and surface water are all well below 1.0.

The evaluation of potential long-term ingestion of off-Site groundwater in the Water Table Aquifer generated excess lifetime cancer risks of 1.12×10^{-4} and 5.65×10^{-4} for Levels 1 and 2, respectively. These estimated theoretical cancer risks marginally exceed the 1 x 10^{-6} to 1 x 10^{-4} target range established by USEPA. The hazard indices associated with this exposure scenario were 0.39 and 0.63 for Levels 1 and 2, respectively and are below the USEPA acceptable hazard level of 1.0. Given the conservative nature of the mathematical models, parameters and assumptions used to estimate the risks, the results of the risk assessment likely overestimate the potential risks that could occur if the off-Site groundwater in the Water Table Aquifer ever would be used as a drinking water supply. Furthermore, the shallow Water Table Aquifer in the vicinity of the Site is not a productive aquifer and is not being used as a potable water supply because of the hydrogeologic characteristics of the aquifer and since the water supplies in the area are from the deeper Frewsburg Aquifer.

Approximately 100 percent of the total risks from groundwater consumption off-Site is attributable to TCE exposure.

8.8 REFERENCES

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9.0 ECOLOGICAL EVALUATION

9.1 INTRODUCTION

The objective of this section is to present an evaluation of the potential ecological impact, if any, posed by chemicals of concern in and around the vicinity of the Site.

A Biotic Survey of areas in the vicinity of the Site was conducted during August and September 1992 by Fineline Technical Services, Inc.. The results of the Biotic Survey are presented in Appendix J and summarized in Section 9.2. The purpose of the survey was to provide a qualitative description of fish and wildlife resources in and around the vicinity of the Site.

Based on the information from this survey, Site visits and data from the Site Investigation, an assessment of the potential exposure, bioavailability and toxicity of COCs to resident plant, animal and aquatic communities possibly existing on or in the vicinity of the Site will be discussed. This assessment was performed in accordance with Steps I and II of the New York State Department of Environmental Conservation (NYSDEC) guidance document titled "Fish and Wildlife Impact Analysis for Inactive Hazardous Waste Sites", dated June 18, 1991 (Guidance).

9.2 SITE DESCRIPTION (STEP I)

Fineline Technical Services, Inc. (Fineline) completed a Biotic Survey of selected areas in the vicinity of the Site during August and September 1992. The results of this Biotic Survey are presented in Appendix J and are summarized in the following subsections.

9.2.1 Topographical Map

The Site map (Figure 2.1 of Appendix J) as presented in the Fineline report (see Appendix J) indicates the location of the Plant Site and the area within two miles of the perimeter of the Plant Site. The map was prepared using United States Geological Survey 7.5 minute series topographical quadrangle maps titled "Jamestown, N.Y." and "Ivory, N.Y." as base maps. Major documented natural features such as streams, open water and wetlands within this area were identified through consultation with NYSDEC staff and review of existing agency information. Agency resource information is presented as Appendix A of the Fineline report, Appendix J.

9.2.1.1 Fish and Wildlife Resources Within Two Miles of the Plant Site

Major natural resources within two miles of the Plant Site include freshwater wetlands and Conewango Creek. Portions of three NYS freshwater wetlands and a number of mapped federal wetland areas occur in the area within two miles of the Plant Site. Boundaries of mapped NYS wetlands and of federal jurisdictional wetland areas are shown on Figure 2.1 of Appendix J. State wetlands are classified according to a classification system set forth by NYSDEC. This system establishes four separate classes that rank wetlands according to their ability to perform wetland functions and provide wetland benefits. A more detailed description of this classification system is in Appendix P. State wetlands JA-6, JA-9 and JA-10 are shown on Figure 2.1 of Appendix J. State wetlands JA-6 and JA-9 are identified as Class I wetlands. State wetland JA-10 is identified as a Class II wetland.

As shown on Figure 2.1 of Appendix J, State wetland JA-6 is located within close proximity to the Plant Site. This wetland borders the north, northeast, east and south perimeter of the Plant Site, and includes the drainage swale/culvert north of the Plant Site. This drainage swale/culvert runs through the Plant Site.

A number of federal jurisdictional wetlands have also been mapped in this area. These areas were identified from the United States Fish and Wildlife Service, National Wetland Inventory map titled "Jamestown, New York" and are shown on Figure 2.2 of Appendix J. Federal classifications for these wetlands are identified in the Fineline report, Appendix J (Page 3).

In addition to the main channel, a number of tributaries to Conewango Creek occur within a two mile radius of the Plant Site boundary. These resources are identified on Figure 2.1 of Appendix J and are listed in the Fineline report, Appendix J (Page 4). The drainage swale/culvert which transverses the Plant Site and which meanders through the lowlying area north of the Plant Site also discharges into Conewango Creek.

9.2.1.2 Fish and Wildlife Resources More Than Two Miles Downstream From The Plant Site

Major natural resources more than two miles downstream from the perimeter of the Plant Site include freshwater wetlands and tributaries to Conewango Creek. Mapped NYS freshwater wetlands include JA-4 and JA-17, which are designated as Class I wetlands. Information regarding these wetland areas is presented in Appendix J (Page 2-3).

Tributaries occurring more than two miles downstream of the Plant Site are identified in the Fineline report, Appendix J (Page 5).

9.2.1.3 Vegetation Covertype - 0.5 Mile Radius from the Perimeter of the Plant Site

A description of vegetation cover type is provided in the Fineline report, Appendix J (Page 5). Natural vegetative cover types and locations of field survey observation points in the area within one-half mile radius of the Plant Site perimeter are shown in Figure 2.3 of Appendix J. Generally, grasslands including vegetations such as annual and perennial herbs, shrubs and trees characterize the majority of the Site. Mixed plant communities, typical of wetland and drier upland, occur in these areas as a result of seasonal wet and dry conditions.

9.2.2 Description of Fish and Wildlife Resources

9.2.2.1 Description of Resources and Covertypes

Fish and wildlife resources in the vicinity of the Plant Site include components of riverine, lacustrine, palustrine and terrestrial systems. The Biotic Survey (Fineline report, Appendix J, Page 5-19) presents a detailed description of fish and wildlife resources of natural communities that occur on the Plant Site and within a one-half mile radius of the perimeter of the Plant Site.

9.2.2.2 Description of Fauna Expected Within Each Covertype

A description of fauna expected within each cover type was included in the Biotic Survey (Appendix J, Page 20-32) in accordance with Step I of the NYSDEC guidance document titled: "Fish and Wildlife Impact Analysis for Inactive Hazardous Waste Sites", dated June 18, 1991.

Several protected species of wildlife may be associated with habitats within the vicinity of the Plant Site. The Biotic Survey presented in the Fineline report, Appendix J (Page 20-32) identifies these species. Osprey represent the only wildlife which may reside in the vicinity of the Plant Site and are classified as threatened under the New York State Protective Status. However, no ospreys were observed during the Biotic Survey. Ospreys hunt for their prey by scanning waters and diving for fish. It has been documented that during storms in Florida Bay when water becomes turbid, ospreys are forced to hunt over calmer, clearer ponds (Poole, 1989). It is possible that ospreys would not select this area as preferred habitat if hunting success was affected by the turbidity of the water.

9.2.2.3 Observations of Stress Potentially Related to Site Contaminants

Two areas of stress, Observation points 26 and 27, were observed during the Biotic Survey conducted by Fineline in the summer of 1991.

Observation Point 26, as reported by Fineline, was located approximately 200 feet outside the Plant fence between an abandoned railway right-of-way and crushed stone stockpiles adjacent to the Frewsburg-Falconer Road. The area included an artificial roadside drainage swale leading to Conewango Creek. Stressed vegetation consisting of dead trees was observed in the swale. However, it is not known if this stressed vegetation is related to Site-related contaminants. Adjacent vegetation appeared normal and no evidence of stressed wildlife was observed. Stressed vegetation at Observation Point 26 could not be located during Site reconnaissance on May 7, 1993 by CRA.

The second area (Observation Point 27) of observed stress was located at the Plant fenceline near monitoring well location MW-4. Fineline reported that observations of disturbance included bare and sparsely vegetated soil in an area approximately 15 feet by 15 feet extending approximately 46 feet from the Plant fenceline. Adjacent vegetation appeared normal and no evidence of stressed wildlife was observed.

During field reconnaissance on May 7, 1993 by CRA, the area at Observation Point 27 appeared heavily silted. Observation Point 27 did not appear to be significantly impacted as described in the Fineline report, Appendix J (Page 32-33). The difference in appearance of vegetation at Observation Point 27 compared to vegetation in adjacent areas was a layer of silt covering most of the vegetation found at Observation Point 27. Vegetation was sparse at Observation Point 27 and appeared affected by silt loading and the related surface water runoff. It is therefore possible that the vegetation in this area is impacted by the sedimentation and excess moisture caused by surface water discharge. This hypothesis is based on observations made during field reconnaissance on May 7, 1993. The soil sample collected from borehole BH-C located near Observation Point 27 contained total 1,2-DCE concentrations of 130 ppb and 4,800 ppb of TCE. However, these soil samples were taken at a depth of 12 to 14 feet and therefore, exposures by plant communities are not realistic.

9.2.3 Description of Value of Fish and Wildlife Resources

9.2.3.1 Value of Habitat to Associated Fauna

A detailed description of fish and wildlife resource values are provided in the Fineline report, Appendix J (Page 5-32). The wildlife resources provided by the area surrounding the Plant Site consist of a variety of aquatic, wetland and upland covertypes that support a diverse population of wildlife species. The resources of these communities are valuable to wildlife due to their diversity, their interactions through transitional areas, or ecotones, and due to seasonal variations in water level. Resident and migratory wildlife that utilize these resources include fish, water dependent and terrestrial species. It should also be noted that according to the NYSDEC's Freshwater Wetland Data and Classification Form for NYS Wetland JA-6, this wetland contains "an unusual animal species abundance or diversity" for the county.

9.2.3.2 Value of Resources to Humans

Resources in the vicinity of the Plant Site have recreational and economic values to humans. Conewango Creek provides a source of recreational activities such as fishing and boating. Although the land surrounding the Plant Site is mostly undeveloped land, farming and selective logging do occur in some areas. Refer to the Fineline report, Appendix J (Page 36-37), for a more detailed description of these areas.

9.2.4 Area of Potential Concern

A detailed Site description is discussed in Sections 2.0, 3.0 and 5.0 of this report.

The area of the Plant Site is developed. The Plant Site is entirely enclosed with a 10-foot chain-linked fence and includes existing buildings, concrete pads, paved areas as well as regularly-manicured grasslands. However, the remaining Site area outside the Plant fence is undeveloped and consist of a variety of forested and more open community types. Based on the Biotic Survey conducted by Fineline, the varying physical conditions and the apparent physical division (e.g., existence of a fence) of the Site, the EA will evaluate the Site following a sectorwise approach consistent with the risk assessment. These sectors include:

- the Plant Site (developed and fenced portion of the Site), and
- the undeveloped areas of the Site (hereafter referred to as "outside of the Plant fence").

Plant Site

Since a large portion of the Plant Site is developed and covered by buildings, cement pads or paved areas, the Plant Site will not provide suitable habitat for wildlife. Additionally, the Plant Site is entirely enclosed by a 10-foot chain-linked fence which will restrict potential entry of any larger mammals, such as deer. Some small mammals and birds may enter the Plant Site property. The areas located northwest, north and northeast within the Plant Site were found to have high levels of COCs in the subsurface soils. These areas are not likely to provide suitable habitat for small mammals or birds since they are without vegetation and within an area of disturbance due to constant Site industrial activities. Areas to the east, southeast and south of the Plant Site are grassed and well maintained. These areas could be used by birds and small mammals for feeding but exposure to COCs would be minimal, if not negligible, due to low levels of COCs.

Therefore, potential exposure by terrestrial animals and birds to COCs within the Plant Site will not be significant.

Aquatic plants and animals are exposed to surface water and sediments. The only sources of aquatic habitat on the Plant Site are the manmade/artificial pond in the south-east corner of the Plant Site and the drainage swale which runs through the Plant Site.

The drainage swale is shallow and does not provide suitable habitat to aquatic life. It is not a suitable wildlife resource and does not sustain sizable fish. In addition, the portion of the drainage swale located within the Plant Site was found to contain low levels of COCs. This exposure pathway will not be further evaluated.

Only the artificial pond provides any remarkable habitat for wildlife and this habitat would be limited to water fowl and aquatic species. However, the artificial pond is restricted from providing a permanent residence to water fowl due to it small size and absence of protective cover on or near the shoreline. Organic contaminants were not detected in the surface water or sediments of the pond, and thus, there is no evidence of impact from Plant activities. It should be noted that the pond was only used as a source of non-contact cooling water and that no disposal activities were known to occur within the pond. Nickel and copper concentrations in sediments of the pond did exceed the NYS Severe Effect Level sediment criteria. The exceedances of the Severe Effect Levels by nickel and copper do not necessarily represent that there has been some adverse impact to the aquatic organisms in the pond by these two metals since the basis used in the development of the Severe Effect Level criteria are overly conservative. However, all metals detected in the surface water of the pond were well below NYS and Federal Ambient Water Quality criteria which indicates that the presence of these metals in the sediment has not adversely impacted the water quality of the pond.

Outside of the Plant Fence

The more important wildlife areas exist outside the Plant fence. A detailed description of the varying plant communities and resident wildlife in the undeveloped areas outside the Plant fence is included in the Fineline Report, Appendix J (Page 5-32).

The purpose of this ecological evaluation (EA) is to determine any potential impact of Site-related COCs, if any, to plant communities and resident wildlife. Based on operations at the Plant Site and the investigative results completed to date, potential releases of COCs from the Plant Site into the lowlying area north of the Plant Site could occur from the following sources.

- As described in Section 8.0, the drainage swale/culvert which runs through the Plant Site, discharges into a lowlying area north of the Plant Site. The discharge from this drainage swale/culvert enters a small stream which meanders through the lowlying area before discharging into Conewango Creek.

- Surface water runoffs from the concrete pad north of the Metal Building flows outside the Plant fence and into the small stream within the lowlying area north of the Plant Site.

- Groundwater discharge from the Water Table Aquifer to the lowlying area north of the Plant Site.

The lowlying area north of the Plant Site was dry during the field reconnaissance on May 7, 1993, with only the shallow streambed running through it into Conewango Creek (see Figure 9.1 taken during Site reconnaissance on May 7, 1993). When Conewango Creek floods, this lowlying area receives additional flow from the Creek. The water level in Conewango Creek is unusually high during the early spring months as a result of snow melting. During these months, the lowlying area is inundated with water but other times of the year, this area is dry. The water flow in the streambed is continuous throughout the year, with seasonal variation in the streambed water level. Due to its limited size and shallow water level, the streambed impacted by the Plant Site is small and is not likely to sustain sizable fish but may be appropriate for smaller fish or for use as a nursery area.

Therefore, the qualitative discussions presented herein, will focus on the lowlying undeveloped area immediately north of the Plant Site. The media of primary environmental concern to resident wildlife and plant communities include sediments and surface water in the streambed which originates as the swale and culvert in the Plant Site, runs through the lowlying area north of the Plant Site and Conewango Creek.

The remaining areas of the Site are not expected to be impacted by Site-related contaminants since there are no other points of releases and no transport mechanism to carry COCs to more distant regions of the wetland.

9.3 CONTAMINANT - SPECIFIC IMPACT ANALYSIS (STEP II)

The objectives of Section 9.3 is to determine the impacts of Site-related contaminants on fish and wildlife resources. The impacts on fish and wildlife resources are dependent on the distribution of the COCs, their concentrations in various media, the exposure of biota to contaminants, and toxicological effects. The discussions below will cover the following areas:

i) exposure pathway analysis; and

ii) characterization of potential impact on environmental health which includes criteria-specific analysis.

This is in accordance with Step 2 of the NYSDEC guidance document titled: "Fish and Wildlife Impact Analysis for Inactive Hazardous Waste Sites", dated June 18, 1991.

9.3.1 Exposure Pathway Analysis

The potential risks to resident flora, terrestrial animals and aquatic animals are associated with potential direct exposure to the sediments and surface water in the streambed and Conewango Creek. In addition, the carnivores and insectivores would be exposed to food chain prey animals which have been exposed to affected media.

Terrestrial mammals would be exposed to soils/sediments via ingestion and dermal contact. Ingestion of soils/sediments would occur primarily by grooming actions which involve cleaning fur and paws by licking. Some soil/sediment particles could also be ingested with food (seeds and other plant materials) which may be contaminated with soils/sediments. Food species, plants or animals, can take up chemicals from contaminated media and, in turn, expose terrestrial animals that consume them.

Birds would be exposed to Site-related COCs in surface soils/sediments by the same routes as terrestrial mammals, namely, directly by ingestion and dermal contact and, indirectly by contaminated food sources. Ingestion from grooming actions would be minor for birds, but there would be a greater portion of soil ingested when birds feed on the ground or ingest insects and seeds contaminated with soil particles.

Consumption and dermal contact with surface water by terrestrial animals and birds is another exposure pathway to COCs. Consumption of surface water in the streambed and Conewango Creek as a drinking water source, is a probable exposure pathway for animal and bird species while dermal contact to surface waters would occur to varying degrees.

In the aquatic environment, sediment dwelling or benthic organisms are at the base of the food chain. These organisms are in immediate contact with the sediments. Further, in all aquatic organisms, contact with water through respiration is an important route of uptake.

To summarize, the exposure pathways that may be applied to terrestrial and/or aquatic animal populations include:

- i) direct contact with affected surface water and/or sediments;
- ii) ingestion of surface water as a drinking water source;
- iii) ingestion of sediments with food materials; and
- iv) ingestion of affected terrestrial and/or aquatic animals and plants.

9.3.2 Characterization of Potential Impact on Environmental Health

The purpose of this section is to provide an overview of the potential ecotoxicological effects on plants, terrestrial animals and aquatic organisms which have been reported for the COCs (see Section 8.1.5) identified in the lowlying area north of the Plant Site and Conewango Creek.

9.3.2.1 Organics

This section presents an evaluation of the ecotoxicological effects of the following organics:

- i) Volatile organics:
    - a. 1,1-Dichloroethene,
    - b. 1,2-Dichloroethene,
    - c. Trichloroethylene,
    - d. Vinyl chloride;

- ii) Semi-volatile organics:
    - a. Polycyclic aromatic hydrocarbons (PAHs): benzo(a)anthracene, benzo(a)pyrene and benzo(b)fluoranthene,
    - b. Bis(2-ethylhexyl) phthalate; and

- iii) Polychlorinated biphenyls (PCBs).

9.3.2.1.1 1,1-Dichloroethene

Use and Occurrence

1,1-Dichloroethene (1,1-DCE) is a clear colorless liquid that evaporates quickly at room temperature to form a vapor. 1,1-DCE has a mild, sweet odor resembling that of chloroform. It is widely used to make certain plastic products such as packaging materials and flame retardant fabrics. 1,1-DCE is released into the environment primarily as a result of air and water emissions from factories where 1,1-DCE is manufactured, from hazardous waste sites, and as a result of accidental spills. 1,1-DCE can also be found as a breakdown product of other chemicals present in the environment.

Environmental Fate

The behavior of 1,1-DCE in the environment is influenced to a large degree by its high volatility. The majority of 1,1-DCE released to the environment partitions to the atmosphere. In the atmosphere, 1,1-DCE reacts rapidly with hydroxyl radicals. Photolysis of 1,1-DCE in the presence of nitrogen oxides is also rapid. The atmospheric lifetime predicted by Cupitt (1980) is two days (ATSDR, 1993).

When released to water, 1,1-DCE will partition readily into the atmosphere. Because of this, 1,1-DCE is generally not persistent in surface water in high concentrations. Adsorption to sediments is not expected to be significant as indicated by a low K_{OC} value of 64.79 mL/g. 1,1-DCE is also unlikely to partition significantly into aquatic organisms (ATSDR, 1993).

When released to soil, 1,1-DCE will be removed primarily by volatilization, while some of the chemical will percolate into subsurface soil. Once in the subsurface soil, 1,1-DCE will partition between soil and water. 1,1-DCE has a high water solubility and a low K_{OC} value of 64.79 mL/g, indicating that 1,1-DCE will readily solubilize in water and migrate through soil without significant adsorption. Similarly, 1,1-DCE will solubilize and migrate relatively freely within groundwater. No information was found regarding the bioconcentration of 1,1-DCE in plants, aquatic organisms or animals. On the basis of the log octanol/water partition coefficient value of 2.13, bioconcentration of the compound will not be significant in aquatic organisms (ATSDR, 1993).

Absorption, Distribution and Excretion in Mammals

1,1-DCE is easily absorbed into the body from ingested food and water, or from inhaled air. Dermal absorption is minimal since most of the material on the skin would volatilize before absorption would occur. In animal studies, following inhalation and oral exposure, rats accumulated 1,1-DCE in the liver and kidneys, with only small amounts present in other tissues (ATSDR, 1993). Elimination of 1,1-DCE in rats was rapid, with the bulk of the absorbed material eliminated as metabolites in the urine, and very little (1 percent of the administered dose) of the parent compound was eliminated unchanged in the expired air at low levels of exposure (ATSDR, 1993).

Toxicity

No effects of 1,1-DCE on terrestrial plants were reported in the sources reviewed. The lethality of 1,1-DCE in animals following inhalation exposure varies considerably and is influenced by such factors as species, strain, sex and food intake. LC_{50} values for rats range from ≈ 6,000 - 8000 ppm in males and 10,000 ppm in females (ATSDR, 1993).

In the aquatic environment, 96-hr LC_{50} values were reported for two fish, *Lepomis macrochirus*, at 220 ppm and *Menidia beryllina* at 250 ppm (CCME, 1993).

9.3.2.1.2 1,2-Dichloroethene

Use and Occurrence

1,2-DCE is a colorless liquid with a sharp, harsh odour that is readily flammable. There are two forms of 1,2-DCE: cis-1,2-DCE and trans-1,2-DCE. 1,2-DCE is widely used as a low-temperature extraction solvent for organic materials such as dyes, perfumes, lacquers and thermoplastics. Primary use of 1,2-DCE is as an intermediate in the synthesis of other chlorinated solvents and other chemical production. It is often the by-product in the manufacture of chlorinated compounds. Direct chlorination of acetylene at about 40°C can also produce 1,2-DCE.

1,2-DCE is released to the environment from its production and use, emissions from contaminated wastewaters, waste disposal sites and from pyrolysis/combustion of polyvinyl chloride and some vinyl copolymers.

Environmental Fate

1,2-DCE evaporates rapidly. When released to soil surfaces or to lakes, rivers, streams, etc., volatilization to air will be the main fate process. The half-life of 1,2-DCE in a model river was estimated to be three hours and in air to be about four to eight days. Low K_{OC} values indicate that 1,2-DCE will not adsorb significantly to soil or sediment. Without significant adsorption in soil, leaching to groundwater is likely (Howard, 1990). Bioconversion factors in fish range from 5 to 23 L/kg, suggesting that 1,2-DCE will not concentrate significantly in aquatic organisms (Howard, 1990).

Absorption, Distribution and Excretion in Mammals

Limited information exist on the absorption, distribution and excretion of 1,2-DCE in animals. In humans, 72 percent to 75 percent of inhaled trans-1,2-DCE was absorbed following exposure.

Toxicity

No toxic effects of 1,2-DCE on terrestrial plants were reported in the sources reviewed.

Laboratory animals subjected to 1,2-DCE in air showed liver, lung and heart damage after short-term (200-3,000 ppm for eight hours) and long-term exposure (200 ppm for 16 weeks); increasing severity with the length of exposure duration. Liver and lung damage were observed in animals that were fed 1,2-DCE and extremely high doses of 1,2-DCE (66,000 ppm to 433,000 ppm in food) caused death.

No information was located on toxic effects of 1,2-DCE to aquatic life.

9.3.2.1.3 Trichloroethylene

Use and Occurrence

Trichloroethylene (TCE) is a nonflammable liquid with a chloroform-like odor. It is used as a solvent and in solvent extraction by several industries, in degreasing and dry cleaning, and in the manufacture of chemicals and pharmaceuticals.

Environmental Fate

TCE released to the atmosphere will exist primarily in the vapor phase based on its relatively high vapor pressure value of 69 mm Hg at 25°C. The primary removal process of TCE from water will be by evaporation with a half-life of minutes to hours, depending upon turbulence (Howard, 1990). Biodegradation, hydrolysis, and photooxidation are extremely slow by comparison. Adsorption to sediment and bioconcentration in aquatic organisms are not important processes (Howard, 1990).

Absorption, Distribution and Excretion in Mammals

Absorption of TCE following oral exposure in both humans and animals is rapid and extensive. In animal studies, absorption from the gastrointestinal tract has been measured at 91 percent to 98 percent, and peak TCE blood levels are attained within a matter of hours. Considerable absorption also occurs in animals following inhalation exposure, however quantitative estimates were not available. Limited studies suggest that once TCE is absorbed following oral and inhalation exposure, it is deposited in fat tissues. Oral studies in rats and mice indicate that the biological half-life of elimination of TCE from the blood is between 1.75 and 2.25 hrs (ATSDR, 1992g). Excretion occurs mainly through the urine and exhaled air (ATSDR, 1992g).

Toxicity

No toxic effects of TCE on terrestrial plants were reported in the sources reviewed. The oral LD_{50} for dogs was reported at 5.86 grams/kg of body weight. An inhalation LC_{50} was reported for rats at 8,000 ppm (4 hours).

In the aquatic environment, a concentration of 55 ppm stupified fish within 10 minutes. 96-hr LC_{50} values for fathead minnows ranged between 40.7 ppm and 66.8 ppm (Verchueren, 1983). A concentration of 660 ppm TCE killed *Daphnia* in 40 hours, but 99 ppm had no effect (McKee & Wolf, 1963).

9.3.2.1.4 Vinyl Chloride

Use and Occurrence

Vinyl chloride is a manmade product with a mild, sweet odor. It is widely used in the production of polyvinyl chloride (PVC) which is a component of plastic products such as automotive parts, accessories, furnitures, pipes, wires, cable coatings, and packaging materials. At one time, vinyl chloride was used as a coolant, a propellant in spray cans, and in some cosmetics. It is no longer used for these purposes.

Environmental Fate

If released to the atmosphere, vinyl chloride will exist mainly in the vapor phase. Gas phase vinyl chloride is expected to degrade rapidly in air by reaction with photochemically-produced hydroxyl radicals with an estimated half-life of 1.5 days (Howard, 1989).

The predominant removal process of vinyl chloride from water will be by evaporation. A half-life of 0.805 hrs was estimated for evaporation of vinyl chloride from a river 1 m deep with a current of 3 m/sec and a wind velocity of 3 m/sec (Howard, 1989). Adsorption to sediments and bioconcentration in aquatic organisms are not expected to be significant removal processes for vinyl chloride in rivers, lakes and ponds (Howard, 1989). Limited existing data indicates that vinyl chloride is resistant to biodegradation in aerobic systems and therefore, it may not be subject to biodegradation in natural waters.

When released to soil, vinyl chloride will be subject to rapid volatilization. Half-lives of 0.2 and 0.5 days were reported for volatilization from soil at 1 and 10 cm incorporation, respectively. Any vinyl chloride which does not evaporate will be expected to be highly mobile in soil and may leach to groundwater, as indicated by a low K_{OC} value of 29.73 mL/g and a high solubility of 2,763 mg/L.

Absorption, Distribution and Excretion in Mammals

Several animal studies indicate that vinyl chloride is rapidly and virtually completely absorbed from the gastrointestinal tract (ATSDR, 1992h). Inhalation absorption of vinyl chloride also occurs readily but the extent of absorption has not yet been quantified (ATSDR, 1992h). In animals, excretion of unchanged vinyl chloride was generally complete within 3-4 hours, but excretion of metabolites continued for days (ATSDR, 1992h).

Toxicity

No effects of vinyl chloride on terrestrial plants were reported in the sources reviewed. Brief inhalation exposures of experimental animals such as guinea pigs, mice, and rats to concentrations of vinyl chloride ranging from 100,000 ppm to 300,000 ppm have been shown to be fatal within 30-60 minutes (ATSDR, 1992h). Liver degeneration was reported in rabbits exposed by inhalation to 200 ppm vinyl chloride for 7 hr/day for 6 months.

No information was located on the effects of vinyl chloride on aquatic organisms.

9.3.2.1.5 Polycyclic aromatic hydrocarbons: benzo(a)anthracene, benzo(a)pyrene and benzo(b)fluoranthene

Use and Occurrence

Polycyclic Aromatic Hydrocarbons (PAHs) are a group of chemicals formed during the incomplete combustion of virtually all forms of organic materials. The combustion of fuels in cars and in furnaces produces PAHs. Waste incinerators produce PAHs. Natural sources include volcanoes, forest fires, crude oil and shale oil. PAHs can also be found in substances such as crude oil, coal tar pitch, creosote, road and roofing tar. A major source of exposure for humans is cigarette smoking, both active and passive. Therefore, PAHs are ubiquitous in the environment and the increasing levels found in the environment parallel industrial and urban development.

As pure chemicals, PAHs generally exist as colorless, white or pale yellow-green solids. Most PAHs do not occur alone in the environment, rather they are found as mixtures of two or more PAHs.

Environmental Fate

Some of the transport and partitioning characteristics of the PAHs are roughly correlated to their molecular weights. The Site-related PAHs are considered high molecular weight compounds ranging from 228 g/mol to 278 g/mol.

In air, PAHs are present in the gaseous phase or sorbed to particulates. The atmospheric residence time and transport distance depend on the size of the particles to which PAHs are adsorbed. That is, the larger the particulate size, the shorter the residence time and transport distance. PAHs can undergo photochemical oxidation with the formation of nitrated PAHs, phenols, and other compounds. Atmospheric half lives are generally less than 30 days.

PAH compounds tend to be removed from the water column by volatilization to the atmosphere, adsorption to particulates or sediments, biodegradation or bioaccumulation into aquatic organisms. Half-lives for volatilization of benzo(a)anthracene and benzo(a)pyrene (high molecular weight PAHs) from water have been estimated to be greater than 100 hours.

High molecular weight PAHs have a strong tendency to adsorb to organic carbon. Due to their low water solubilities, PAHs are primarily found adsorbed to sediments or soils. Adsorption of PAHs is a function of organic carbon content and particle size. The environmental fate of PAHs is described by USEPA in the document "Ambient Water Quality Criteria for Polynuclear Aromatic Hydrocarbons" which states:

> *"PAH will adsorb strongly onto suspended particulates and biota and their (PAH) transport will be determined largely by the hydrogeologic condition of the aquatic system. PAH dissolved in the water column will probably undergo direct photolysis at a rapid rate. The ultimate fate of those which accumulate in the sediment is believed to be*

> *biodegradation and biotransformation by benthic organisms (USEPA, 1979)."*

This is restated in the USEPA document "Health Effects Assessment for Polycyclic Aromatic Hydrocarbons (PAHs)" which states:

> *"The predominant mechanism that is likely to dictate the fate of most PAHs in aquatic media is sorption to particulate matter and subsequent sedimentation and microbial degradation."*

Since PAHs are most likely to stay in the sediment or soil, microbial degradation is the most likely ultimate environmental fate in contrast to photolysis and volatilization. Compounds with four cyclic rings or less are most amenable to microbial degradation. Benzo(a)pyrene (five cyclic rings) has a half life in soil inoculated with bacteria of less than eight days. The half-life reported for benzo(a)pyrene in soil reported in Superfund Public Health Evaluation Manual (SPHEM, 1986) is 420 to 480 days but there is no reference to the microbial content in the soil.

Absorption, Distribution and Excretion

In mammals, intestinal absorption of PAHs occurs relatively rapidly whereas dermal absorption is a relatively slow process. Once absorbed, PAHs are concentrated mainly in the liver, but are also detected in most other tissues including the lungs. Excretion occurs mainly via the bile and the feces, with lesser amounts being excreted in the urine.

Toxicity

Biological effects of PAHs on terrestrial vegetation have been reviewed by EPA (1980), Lee and Grant (1981), Wang and Meresz (1982), Edwards (1983), and Sims and Overcash (1983). In general these authorities agreed on several points. First, plants and vegetables can absorb PAHs from soils through their roots, and translocate them to other parts such as developing shoots. Uptake rates are governed, in part, by PAH concentration, water solubility, soil type, and PAH physicochemical state (vapor or particulate). Lower molecular weight PAHs are absorbed by plants more readily than higher molecular weight PAHs such as benzo(a)anthracene, benzo(a)pyrene and benzo(a)fluoranthene. Second, above-ground parts of vegetables, especially the outer shell or skin, contained more PAHs than underground parts, and this was attributed to airborne deposition and subsequent adsorption. Third and most importantly, PAH-induced phytotoxic effects were rare. Fourth, most higher plants can catabolize benzo(a)pyrene, and possibly other PAHs (Eisler, 1987).

Numerous PAHs have been shown to produce tumors in skin and in most epithelial tissues of practically all animal species tested; malignancies were often induced by acute exposures to microgram quantities. An acute oral LD_{50} value for rodents was reported at 40 mg/kg body weight for benzo(a)pyrene (Eisler, 1987).

PAHs vary substantially in their toxicity to aquatic organisms. The 96-hour LC_{50} reported for the sandworm, *Neanthes arenceodentata*, was >1 ppm. The toxicity of PAHs in sediment are substantially less toxic to aquatic life than PAHs found in solution due to their limited bioavailability (Eisler, 1987). For example, severe acute toxicity of benzo(a)anthracene to aquatic life was observed with concentrations of 10 ppm or greater (Long and Morgan, 1991).

Although PAHs are known to be bioaccumulated, most aquatic species are also known to rapidly metabolize and excrete PAHs. Biomagnification is therefore not significant for PAHs (Eisler, 1987).

9.3.2.1.6 Bis(2-ethylhexyl) phthalate

Use and Occurrence

Bis(2-ethylhexyl) phthalate (BEHP) is used in large quantities as a plasticizer for polyvinyl chloride (PVC) and other plastics.

Disposal of PVC and other plastic materials by incineration or landfilling will result in release of BEHP into the environment. Because of its wide use and distribution, it is essentially ubiquitous in the urban and suburban environments.

Environmental Fate

BEHP released to water systems will biodegrade rapidly (half-life 2-3 weeks) following a period of acclimation. It will also strongly adsorb to sediments (log K_{OC} of 4 to 5) and bioconcentrate in aquatic organisms (log BCF of 2 to 4 in fish and invertebrates). Evaporation and hydrolysis are not significant aquatic processes (Howard, 1990).

BEHP released to soil will neither evaporate nor leach into groundwater. It will have a strong tendency to sorb and will not be mobile. BEHP is rapidly biodegraded in soil under aerobic conditions following acclimation (Howard, 1990).

Absorption, Distribution and Excretion in Mammals

Studies in animals suggest that rodents absorb BEHP better than other animal species. Based on urinary excretion of metabolites, rats can absorb at least 55 percent of a 2,000 mg/kg oral dose of BEHP (ATSDR, 1992c). The liver, kidney, testes and blood have been identified as sites of BEHP metabolism or utilization in several animal studies (ATSDR, 1992c). Excretion occurs in the urine and feces (ATSDR, 1992c).

Toxicity

No information on the effects of BEHP on terrestrial plants was reported in the sources reviewed.

In mammals, LD_{50} values for rabbits and rats are quite high, ranging from 30,600 - 33,900 mg/kg (ATSDR, 1992c).

Limited information exists on toxicity effects of BEHP to fish and wildlife. Bioconcentration and accumulation of BEHP have been observed in invertebrates, fish, and terrestrial organisms. Reported bioconversion factors for aquatic organisms range from 54 to 2,700 L/kg (ATSDR, 1992c). Residues of BEHP have been found in the organs of terrestrial animals such as rats, rabbits, dogs, cows, and humans. However, accumulation of BEHP is likely to be minimized by metabolism and extensive biomagnification of BEHP in the food chain is not expected to occur (ATSDR, 1992c).

9.3.2.1.7 Polychlorinated Biphenyls

Use and Occurrence

Polychlorinated biphenyls (PCBs) are a group of 209 stable, fat-soluble chemicals. In the past, PCBs have been used in the manufacturing of capacitors, transformers, carbonless copying paper, paints and hydraulic fluid.

Environmental Fate

Environmental fate is of great importance in determining the environmental impact of PCBs. Sorption, volatilization and bioaccumulation are important fate processes. PCBs strongly adsorb to organic rich sediment and soil as indicated by a high K_{OC} value of 5.3×10^5. Volatilization is also an important fate process but may occur only at a relatively slow rate. PCBs bioaccumulate in aquatic biota. Bioconversion factors in aquatic species such as fish, shrimp and oyster range from 26,000 to 660,000 L/kg (ATSDR, 1987).

Absorption, Distribution and Excretion in Mammals

PCBs are readily absorbed across the gastrointestinal tract and somewhat less readily through the skin. Gastrointestinal absorption in rats is greater than 90% for a wide range of isomers. Once absorbed, PCBs are distributed through the bloodstream initially to the liver, but within a few days liver concentrations are greatly reduced as redistribution and metabolism occur. Lesser chlorinated biphenyl isomers are metabolized, but biphenyl isomers with higher percentages of chlorine tend to redistribute to other organs, adipose tissue, and skin. Conjugated PCB metabolites are excreted in the urine and bile. Excretion in urine is more prominent for lesser chlorinated biphenyl isomers, while bile becomes significant for more highly chlorinated compounds (EPA, 1989).

Toxicity

PCBs are not highly toxic when given as a single dose to mammals, and would be classified as only slightly toxic based on their acute oral toxicity. The more significant toxic effects of PCBs are observed after repeated exposure over a period a time. Single-dose oral LC_{50} values for PCBs have been reported for rats and mink. The lowest values are 750 mg/kg for Aroclor-1221 in mink and 1010 mg/kg for Aroclor-1254 in rats (ATSDR, 1987).

In the aquatic environment, concentrations causing acute mortality, using flow-through tests, to three invertebrate species ranged from 10 g/L for the scud (*Gammarus fasciatus*) to 400 g/L for the damselfly (*Ischnura verticalis*). PCBs depressed growth in the alga *Chlamydomonas* at concentrations ranging from 11 to 111 g/L (CCME 1993).

9.3.2.2 Inorganics

This section presents an evaluation of the ecotoxicological effects of the following inorganics:

i) arsenic;
ii) barium;
iii) beryllium;

iv) cadmium;
v) copper;
vi) lead;
vii) manganese;
viii) mercury; and
ix) nickel.

9.3.2.2.1 Arsenic

Use and Occurrence

The elemental form of arsenic is found to a small extent in nature. Arsenic occurs mostly as the arsenides of true metals or as pyrites. It is generally recovered as a by-product from the processing of other ores, e.g., copper, lead, zinc, tin. Upon smelting of these ores, arsenic is oxidized and liberated in the flue dust, chiefly as arsenic trioxide. It also forms a tetraoxide and pentoxide. Hence, arsenic may have valencies of +3, +4 and +5. Arsenic is used in metallurgy to increase hardening and heat resistance, in glassware and ceramics, in tanneries, in dye manufacture, and in chemical industries. Its major use, however, has been for pesticides (insects, weeds ,fungi) and as a wood preservative.

Environmental Fate

Arsenic in the atmosphere exists as particulate matter, mostly as particles less than 2 µm in diameter. These particles are transported by wind and air currents until they are returned to earth by wet or dry deposition. The residence time of particulate-bound arsenic depends on particle size and meteorological conditions, but a typical value is about nine days (ATSDR, 1992a).

The fate of arsenic in water depends upon its chemical form (oxidation state and counter ion) and its interactions with other materials present. Soluble forms move with water, and may be carried long distances through rivers. However, arsenic may be adsorbed from water onto sediments, especially clays, iron oxides, aluminum hydroxides, manganese compounds and organic material. Under most conditions, coprecipitation or sorption of arsenic with hydrous iron oxides is probably the predominant process in the removal of dissolved arsenic in the water column (CCME, 1993). Sediment-bound arsenic may be released back into the water column by chemical or biological interconversions of arsenic species.

Bioconcentration of arsenic occurs in aquatic organisms, primarily in algae and lower invertebrates. Bioconversion factors measured in freshwater invertebrates and fish for several arsenic compounds ranged from 0 to 17 L/kg. Biomagnification in aquatic food chains does not appear to be significant (ATSDR, 1992a). There is no evidence that photolysis and volatilization are important removal mechanisms of arsenic in the aquatic environment.

Although arsenic and its compounds are readily soluble, migration of arsenic through soil is greatly limited due to the strong sorption by clays, hydroxides, and organic matter.

Absorption, Distribution and Excretion in Mammals

Absorption of orally administered arsenic is a function of solubility of the specific compound administered and the dosing rate. Soluble inorganic arsenic is rapidly and almost completely absorbed from the gastrointestinal tract in rats (ATSDR, 1992a). Several studies indicate that 95 percent of ingested inorganic arsenic is absorbed in mammals (ATSDR, 1992a). Absorption of inhaled arsenic, in the form of an aerosol or a dust, is dependent upon particle size. Once absorbed, arsenic is widely distributed to other tissues by the blood. Arsenic is generally cleared rapidly and excretion in mammals is predominantly through the urine.

Toxicity

A significant depression in crop yields was observed at soil concentrations of 25 to 85 mg/kg of total arsenic (Eisler, 1988). Forage plants grown in soils contaminated with up to 80 ppm total arsenic from arsenical orchard sprays contained up to 5.8 mg arsenic/kg dry weight; however, these plants were considered nonhazardous to grazing ruminants (Eisler, 1988).

For rats and mice, 96-hour LD_{50} doses of arsenic trioxide varied from 15.1 to 214 mg/kg based on oral administration. Doses of 324 mg have killed experimental chickens in 24 hours.

In the aquatic environment, concentrations of arsenic (III) caused an acute toxic response in fish which ranged upward from 13.34 mg/L for rainbow fingerling trout. The lowest known acutely toxic concentration of arsenic (V) for fish is 10.8 mg/L for rainbow trout (CCME, 1993). Invertebrates are generally more sensitive to arsenic than adult fish. Acute toxicity of arsenic (III) occurred at concentrations that ranged upwards from two fairly similar values: 812 g/L for a cladoceran and 874 g/L for an amphipod. In sediment, the minimum concentration of arsenic above which toxic effects have been observed was 22.1 mg/kg (Long and Morgan, 1991). The National Oceanic and Atmospheric Administration (NOAA) reports arsenic concentrations in sediment that range from 22.1 to 2257 mg/kg to be associated with adverse biological effects (Long and Morgan, 1991).

9.3.2.2.2 Barium

Use and Occurrence

Barium is a dense alkaline earth metal which occurs naturally in ore deposits and makes up 0.05 percent of the earth's crust (ATSDR, 1991b). Barium and its compounds may be found in nature or produced industrially for various uses. Barium sulfate ore is mined and used in several industries. It is used mostly by the oil and gas industries to make drilling muds. Barium sulfate is also used to make paints, bricks, tiles, glass, rubber, and other barium compounds. Some barium compounds, such as barium carbonate, barium chloride, and barium hydroxide, are used to make ceramics, insect and rat poisons, additives for oils and fuels, and many other useful products. Barium sulfate is sometimes used by doctors to perform medical tests and take x-ray photographs of the stomach and intestines.

Barium is present as 0.04 percent of the earth's crust and is in agricultural soils at mg/kg levels.

Environmental Fate

In the atmosphere, barium is likely to be present in particulate form. Although chemical reactions may cause changes in speciation of barium in air, the main mechanisms for the removal of barium compounds from the atmosphere are likely to be wet and dry deposition.

In water, barium is likely to precipitate out of solution as an insoluble salt (i.e., as $BaSO_4$ or $BaCO_3$). Waterborne barium may also adsorb to suspended particulate matter. Sedimentation of suspended solids removes a large portion of the barium content from surface waters (ATSDR, 1991b).

Barium is not very mobile in most soil systems. Barium reacts with metal oxides and hydroxides in soil and is subsequently adsorbed onto soil particulates. Barium can also form salts with acetate, nitrate, chloride, and hydroxide ions in soil. The mobility of barium in soils increases upon formation of these water soluble salts (ATSDR, 1991b). In general, the solubility of barium compounds increases with decreasing pH.

Absorption, Distribution and Excretion in Mammals

Soluble barium compounds are rapidly absorbed from the lungs. The result of a hamster study indicated that after inhalation of barium chloride, 65 percent of the administered dose was deposited in the nasal region and was eventually absorbed into the body (ATSDR, 1991b). As with other metals, barium is probably very poorly absorbed from the gastrointestinal tract. Gastrointestinal absorption in dogs has been calculated to about 7 percent (ATSDR, 1991b). Once absorbed, barium is distributed to the lungs and internal organs. The majority is accumulated in the skeleton, urine and feces. Excretion of barium in mammals is in the feces and (secondarily) urine, sweat and other routes (Carson et al., 1986).

Toxicity

Although barium is commonly present in plants, it is apparently not an essential component of plant tissues. Only a few reports exist on toxic barium concentrations in plants. Chaundry et al. gave 1 to 2 percent barium in plants as highly toxic, while Brooks stated that 220 ppm dry weight is moderately toxic (Kabata-Pendias et al., 1985). Barium concentrates in plants and has been measured in some grains at 10 mg/kg and in Brazil nuts at 3,000 to 4,000 mg/kg.

Mortality has been observed in experimental animals following acute and chronic oral exposure to barium chloride and barium acetate. The acute oral LD_{50} was determined in one study to be 269 and 277 mg/kg for female and male rats, respectively. Reduced lifespan (approximately 11 percent) has been noted in male mice but not in female mice treated chronically with 0.95 mg barium /kg/day as barium acetate in drinking water. No significant effects on mortality were noted in an intermediate exposure study in which rats were treated with 35 mg barium/kg/day as barium chloride in drinking water (ATSDR, 1991b).

Limited information was available on toxicity effects of barium to aquatic life. USEPA reports that the soluble barium concentration in fresh and marine water generally would have to exceed 50 mg/L before toxicity to aquatic life would be expected. In most natural waters, there is sufficient sulphate or carbonate to precipitate the barium present in the water as a virtually insoluble, non-toxic compound (CCME, 1993).

9.3.2.2.3 Beryllium

Use and Occurrence

Beryllium is one of the less common metals in our environment. It is found in ordinary agricultural soils in µg/kg concentrations. Because of its unique qualities (light weight, stable, high melting point) and its ability to impart special qualities to alloys, beryllium has found many uses in modern, high technology equipment. Twenty (20) percent of the beryllium produced is used as free metal in missile and nuclear reactor components, rocket nozzles, aircraft brakes, electrical relays, space vehicle re-entry cones, x-ray windows, inertial guidance parts, and classified weapons parts. Seventy-two (72) percent of the beryllium produced is used in special metal alloys and the remaining 8 percent, as oxides, is used in special ceramics (ATSDR, 1992b).

Environmental Fate

At pH values of 5 to 8, the element tends to form insoluble hydroxides or hydrated compounds. In some alkaline conditions, berylliates tend to form (Friberg et al., 1979). Because of the formation of insoluble beryl and insoluble oxides, beryllium would tend not to migrate in the environment. In most aquatic environments, beryllium is present in particulate rather than dissolved form. Although little information is available on sorption of beryllium, surveys have shown that it is concentrated in sediments relative to the water column (CCME, 1993).

Bioconversion factors range from 19 L/kg for bluegill sunfish to 100 L/kg for freshwater plants, invertebrates and fish. No evidence of biomagnification in freshwater ecosystems has been found (CCME, 1993).

Absorption, Distribution and Excretion in Mammals

Beryllium is more hazardous by inhalation than by ingestion. It is not easily absorbed from the digestive tract and tends to form insoluble precipitates at physiological pH. Only 20 percent of the beryllium in drinking water is absorbed, probably from the stomach, and the remainder is precipitated in the intestinal tract and excreted in the feces. Beryllium is not expected to be absorbed dermally.

Toxicity

It has been reported to translocate into plants and accumulate in plant tissues such as birch, aspen and willow trees. In accumulator plants, beryllium concentrations have been reported to be as high as 250 ppm. Its concentration in plants under natural conditions is reported to range from 0.001 to 0.4 ppm (Kabata-Pendias et al., 1985). Toxic beryllium concentrations in mature leaves range most often from 10 to 50 ppm dry weight.

Oral LD_{50} values in animals vary according to the compound. LD_{50} values for beryllium sulfate were 120 mg beryllium/kg in rats and 140 mg beryllium/kg in mice. LD_{50} values for beryllium fluoride were 18.8 mg beryllium/kg in rats and 18-20 mg beryllium/kg in mice. The difference in the LD_{50} values for these beryllium compounds is due to differences in solubility and the potential to form insoluble beryllium phosphate in the gastrointestinal tract (ATSDR, 1992b).

In the aquatic environment, acutely toxic concentrations for the most sensitive species of fish, the guppy, ranged from 130 g/L to 450 g/L at a hardness of 23 mg/L. The acute toxicity of beryllium to the only invertebrate species studied, *Daphnia magna*, was comparable to its acute toxicity to fish (CCME, 1993).

9.3.2.2.4 Cadmium

Use and Occurrence

Cadmium is an element that occurs naturally in the earth's crust. Pure cadmium is a soft, silver-white metal. Elevated concentrations are generally related to zinc and lead mining and refining. It is used in metal plating, pigments, batteries, plastic stabilizers and other uses. Cadmium concentrations in soil are increased by the application of sewage sludge and phosphate fertilizers.

Environmental Fate

Cadmium may exist in air as suspended particulate matter derived from sea spray, industrial emissions, combustion of fossil fuels, or the erosion of soils. Cadmium-containing particles from smelters and other pollutant sources are removed by gravitational settling, with substantial deposition in areas downwind of the pollutant source. Cadmium-containing particulates may also dissolve in atmospheric water droplets and be removed by wet deposition.

Cadmium is more mobile in aquatic environments than most heavy metals, such as lead. In fresh waters, cadmium exists principally as free Cd^{2+} ion, cadmium chloride and cadmium carbonate. Sorption is probably the most important process for the removal of cadmium from the water column (ATSDR, 1992d). Depending upon its availability for uptake by biota, cadmium may be accumulated by a number of aquatic organisms, including macrophytes, phytoplankton, zooplankton, invertebrates and fish.

Cadmium in soils may leach into water, especially under acidic conditions. Cadmium-containing soil particles may be entrained into the air or eroded into water, resulting in the dispersion of cadmium into these media (ATSDR, 1992d).

Absorption, Distribution and Excretion in Mammals

Gastrointestinal absorption following oral exposure to environmental cadmium is poor (Carson et al., 1986). In mice, 0.5 to 3.2 percent of an oral dose of cadmium was retained after 5 days and in rats, 2 to 3 percent of a single oral dose of cadmium chloride was retained (ATSDR, 1992d). Once absorbed, cadmium is widely distributed in the body, with the major accumulation of the body burden located in the liver and kidney. Excretion in mammals of cadmium occurs in the urine and feces (ATSDR, 1992d).

Toxicity

Although cadmium is considered to be a nonessential element for plants, it is effectively absorbed by both the root and leaf systems. Symptoms induced by elevated cadmium contents of plants are growth retardation and root damage, chlorosis of leaves, and red-brown coloration of leaf margins or veins. The cadmium content of plants is, however, of the greatest concern as a cadmium reservoir and as the pathway of cadmium to man and animals. The highest cadmium values reported for wheat grains and brown rice were 14.2 and 5.2 ppm, respectively (Kabata-Pendias et al., 1985).

In rats and mice, acute oral LD_{50} values for cadmium range from about 100 to 300 mg/kg. Oral doses of 100 mg/kg or higher have also been observed to cause testicular damage in laboratory animals (ATSDR, 1992d).

In the aquatic environment, acute toxicity of cadmium to animal species in 44 genera range upwards from 1.0 g/L for exposure to rainbow trout. Aquatic plants are affected by cadmium at concentrations as low as 2.0 g/L. Bioconversion factors range from 164 L/kg to 4190 L/kg for invertebrates and from 3 L/kg to 2213 L/kg for fish. Cadmium is taken up in large amounts by aquatic plants, but very little evidence was found for biomagnification (CCME, 1993).

A relatively large amount of data exists for cadmium in sediments. It is mainly the free or dissolved, uncomplexed form of cadmium that appears to be the most toxic form of this metal. Based on available information on the toxicity of cadmium in sediments, Long and Morgan (1991) report adverse biological effects associated with cadmium concentrations in sediments ranging from 4.3 to 96 ppm.

9.3.2.2.5 Copper

Use and Occurrence

Copper and its compounds are naturally present in the earth's crust, primarily found as sulphides and oxides.

Natural, uncontaminated surface water have been reported to contain trace levels to 0.05 mg/L. Copper is found in trace amounts in all plant and animal life and is believed to be essential for nutrition. Sixty (60) mg/day was used as therapy for anemic pigs (McKee and Wolf, 1963). Copper concentrations in surface waters (American rivers) were reported to range from 0.83 to 105 µg/L (5.8 µg/L median). Natural concentrations of copper in soil vary from 2 to 100 mg/kg (Friberg et. al., 1979).

Metallic copper is prepared by smelting and electrolytic refining. Approximately half of all copper production is used in electrical equipment. Another common use for copper is in plumbing and heating equipment. Copper salts also function as pesticides for fungi or algae (1 to 2 percent solution) and as herbicides (Friberg et. al., 1979).

Environmental Fate

Copper is released to the atmosphere in the form of particulate matter. It is removed mainly by gravitational settling and washout by rain. The removal rate and distance traveled from the source will depend on source characteristics, particle size, and wind velocity. Gravitational settling governs the removal of large particles (>5 μm), whereas smaller particles are removed by the other forms of dry and wet deposition.

In natural waters, copper is predominantly in its Cu(II) state. Most of it is complexed or tightly bound to organic matter; little is present in the free (hydrated) or readily exchangeable form. The chemical conditions in most natural waters are such that, even at relatively high copper concentrations, these processes will reduce the free [Cu(II)] concentrations to extremely low values. Sediment is an important sink and reservoir for copper. Copper is bioaccumulated by some aquatic species. Bioconversion factors of copper range from 0 L/kg for the bluegill to 2,000 L/kg for the alga, *Chlorella regularis* (CCME, 1993).

Most copper deposited in soil from the atmosphere, agricultural use, solid waste and sludge disposal will be strongly adsorbed and remain in the upper few centimeters of soil. Sandy soils with low pH have the greatest potential for leaching. In most temperate soil, the pH, organic matter, and ionic strength of the soil solutions are the key factors affecting adsorption.

Absorption, Distribution and Excretion in Mammals

Copper is absorbed in the stomach and small intestine. Typically, about half is absorbed, but this can be decreased by competition with zinc and binding by ascorbic acid and other compounds. Once absorbed, copper will be stored mainly in the liver, brain and muscles. The major route of excretion in mammals occurs in the bile.

Toxicity

Minute quantities of copper are beneficial or essential for plant growth. Some plant species have a great tolerance to increased concentrations of copper and can accumulate extremely high amounts of this metal in their tissues (Kabata-Pendias et al., 1985). However, 0.17 to 0.20 mg/L concentrations have been toxic to sugar beets and barley grown in solution.

It would seem that copper toxicosis in mammals is not a major problem. Animals have a great ability to store copper in the liver without resultant damage (Goyer et al., 1977). Studies have been conducted on the administration of high levels of copper to rats. Elliot and Bowland (1972) have found no deleterious effects by feeding 250 ppm copper to this species. Smith et al. (1975) reported yearling ponies fed up to 791 ppm copper for 6 months showed no toxic effects even though liver concentration was 3,445 to 4,294 ppm copper on a dry weight basis (Goyer et al., 1977).

The minimum level reported to be toxic for chickens was 500 mg/kg in the diet. 2500 mg/L copper sulfate in water was harmful to turkeys if it was the only water available (McKee and Wolf, 1963). These concentrations could be expected to be marginally toxic to avian wildlife.

Acute toxicity data available for aquatic species in 41 genera range in sensitivity to copper between 16.74 and 10,240 g/L. The lowest acute toxicity concentration for a single test was 6.5 g/L for exposure of the cladoceran *Daphnia magna* in hard water. Fish are reported to tolerate from 0.14 mg/L (trout) to 2.0 mg/L (black bass) (McKee and Wolf, 1963). Chronic toxicity data available for 5 invertebrate and 10 fish species range from 3.873 g/L in an early-life-stage test with brook trout to 60.36 g/L in an early-life-stage test with northern pike. Invertebrate species showed adverse biological effects when exposed to copper concentrations within or slightly above this range.

A considerable amount of data exist in which the concentration of copper in sediments can be associated with measures of effects. Long and Morgan (1991) reports copper concentration in sediments ranging from 15.0 to 2820.0 ppm which correlated with adverse biological effects. LC_{50} values of the midge, C. *tentans* and amphipods, *H. azteca* and G. lacustis, in 10 day bioassays ranged from 857 to 1078 ppm (Long and Morgan, 1991). In studies of Wisconsin lakes after use of copper sulfate, 438 mg/kg copper in the mud was not believed to affect the benthal populations (McKee and Wolf, 1963).

9.3.2.2.6 Lead

Use and Occurrence

Lead is a naturally occurring bluish-gray metal found in only limited quantities in the earth's crust. Lead and its compounds can be detected in all parts of the environment primarily as a result of human activities. Lead has a wide variety of uses including: batteries, ammunition, metal products and chemical manufacture. Some chemicals containing lead, such as tetraethyl lead and tetramethyl lead, are used as gasoline additives. This use has made lead essentially ubiquitous in areas of highways and streets. It was also a common pigment in paints which resulted in significant exposures in homes. These uses are being limited by regulations to decrease potential environmental lead exposures.

Environmental Fate

It is believed that combustion of leaded gasoline is responsible for over 90 percent of the lead in the environment. In the atmosphere, lead exists primarily in the particulate form. Upon release to the atmosphere, lead particles are dispersed and ultimately removed from the atmosphere by wet or dry deposition.

Lead has a tendency to form compounds of low solubility with the major anions found in natural waters. In the natural environment, the divalent form (Pb^{2+}) is the stable ionic species of lead. Hydroxide, carbonate, sulfide, and more rarely, sulfate may act as solubility controls in precipitating lead from water. Lead is readily adsorbed to numerous solid surfaces in sediment including organic matter, clay, silica, iron and manganese oxides. Sorption is the dominant mechanism controlling the distribution of lead in the aquatic environment. Lead is bioaccumulated by aquatic organisms, including benthic bacteria, freshwater plants, invertebrates and fish. Bioconversion factors for these organisms range from 20 to 360 L/kg (CCME, 1993).

Most lead is retained strongly in soil, and very little is transported into surface water or groundwater (ATSDR, 1992e). Lead is strongly sorbed to organic matter in soil, and although not subject to leaching, it may enter surface waters as a result of erosion of lead-containing soil particulates.

Absorption, Distribution and Excretion in Mammals

There is evidence to suggest that gastrointestinal absorption in animals is controlled by a saturation phenomena, as well as influenced by fasting. In fasted rats, absorption was estimated at 42 percent and 2 percent following single oral administration of 1 and 100 mg lead/kg, respectively, as lead acetate. In mice, absorption was 14 percent in fasted mice versus 7.5 percent in fed mice, 4 hours following an oral gavage dose of 0.003 mg lead/kg as lead acetate (ATSDR, 1992e). Once absorbed, lead is initially distributed to soft tissues then redistributed and accumulated in the bones. Any dietary lead not absorbed by the gastrointestinal tract is eliminated in the feces. Six days after inhalation of 0.01 mg/m^3 lead for 30-45 minutes rats, 40 percent and 15 percent of the dose was eliminated in the feces and urine, respectively.

Toxicity

Bioavailability of lead in soils to plants is limited, but is enhanced by reduced soil pH, reduced content of organic matter and inorganic colloids, reduced iron oxide and phosphorus content, and increased amounts of lead in soils. Damage to plants with elevated lead content is usually negligible, but varies widely among species. A reduction in yield of corn or soybeans has been reported in low-binding capacity soils with lead levels greater than 200 mg/kg (Eisler, 1988).

The veterinary medical literature on lead toxicosis is abundant for domestic livestock and small laboratory animals. Some oral LD_{LO} (lowest dose expected to cause death) values for lead compounds are as follows:

Compound	*Species*	*LD_{LO} (mg lead/kg)*
Lead acetate	Dog	191
Lead chloride	Guinea Pig	1,490
Lead nitrate	Guinea Pig	313
Lead oxide	Dog	1,300
Lead sulfate	Dog	1,366
Lead sulfate	Guinea Pig	20,500

The primary toxic effects associated with exposure to lead are alterations in the hematopoietic, nervous and cardiovascular systems. Intermediate-duration studies in animals indicate that adverse hematological effects occur following oral exposure. Adverse effects were observed in rats administered 318 mg lead/kg/day in their daily diet. The literature on the neurobehavioural effects of oral exposure to lead in animals is extensive. Reported LOAELs (lowest observed adverse effect levels) for serious effects in rats range from 0.05 to 50 mg/kg/day (ATSDR, 1992e). There is a large database that describes cardiovascular effects in laboratory animals resulting from exposure to lead. Reported LOAELs in rats range from 0.009 to 873 mg/kg/day (ATSDR, 1992e).

In the aquatic environment, waterborne lead is the most toxic form. Adverse effects were noted on daphnid reproduction at 1.0 Pb^{2+} g/L, on rainbow trout survival at 3.5 g tetraethyl lead/L, and on growth of marine algae at 5.1 g Pb^{2+}/L (CCME, 1993).

In sediment, the minimum concentration of lead above which toxic effects have been observed was 27 ppm; significant toxicity to *Daphnia magna* was reported at this concentration. Long and Morgan (1991) reports lead concentrations in sediment ranging from 27 mg/kg to 3360 mg/kg associated with adverse biologic effects (Long and Morgan, 1991).

9.3.2.2.7 Manganese

Use and Occurrence

Manganese is an abundant element comprising about 0.1 percent of the earth's crust. Above-average exposures to manganese are most likely to occur in or near a factory or a waste site that releases significant amounts of manganese dust into the air. Manganese is also released into the air by combustion of leaded gasoline.

Environmental Fate

Manganese may exist in air as suspended particulate matter and are mainly removed from the atmosphere by gravitational settling. Removal by washout mechanisms such as rain may also occur, but is less important in removing manganese from the atmosphere than dry deposition.

The tendency of soluble manganese compounds to adsorb to soils and sediments depends mainly on the carbon exchange capacity and the organic composition of the soil. Soil adsorption contents for Mn(2+) span five orders of magnitude, ranging from 0.2 to 10,000 mL/g, increasing as a function of the organic content and the ion exchange capacity of the soil. Thus, adsorption may be highly variable.

The chemical fate and transport of manganese in water is controlled by the solubility of the specific chemical form present, which in turn is determined by pH, Eh (oxidation-reduction potential), and the characteristics of available anions. The metal may exist in water in any of four oxidation states (2+, 3+, 4+ or 7+). Divalent manganese Mn(2+) predominates in most waters with pH of 4 to 7, but may become oxidized at pH greater than 8 or 9. The principal anion associated with Mn(2+) in water is usually carbonate (CO_3^{-2}), and the concentration of manganese is limited by the relatively low solubility (65 mg/L) of $MnCO_3$. Manganese is often transported in rivers as suspended sediments.

Absorption, Distribution and Excretion in Mammals

Oral absorption of manganese in the diet is slow and uncomplete (Carson et al., 1986). Gastrointestinal uptake of $MnCl_2$ in rats has been estimated to be 2.5 to 5.5 percent. Manganese may also be absorbed both in the lungs and in the gastrointestinal tract following inhalation of manganese dust. Once absorbed, manganese is widely distributed among the organs. Highest manganese concentrations are in the bone, liver and kidney and within cells (ATSDRa, 1991). Excretion in mammals occurs mainly in the feces. Rats exposed to $MnCl_2$ or Mn_3O_4 by intratracheal instillation excreted about 50 percent of the dose in the feces within 3-7 days (ATSDR, 1991a).

Toxicity

Manganese is an essential trace element for micro-organisms, plants and animals, and, hence is contained in all or nearly all organisms. The critical manganese deficiency level for most plants ranges from 15 to 25 ppm. The toxic concentration of manganese to plants is more variable, depending on both plant and soil factors. Generally, most plants are affected by a manganese content around 500 ppm on a dry weight basis. However, the accumulation above 1000 ppm also has been reported for several more resistant species or genotypes (Kabata-Pendias et al., 1985).

In mammals, manganese is considered comparatively non-toxic even under an acute exposure scenario. Daily oral doses in food of 930 to 2,300 mg/kg/day for a number of months did not cause mortality in rats. By gavage, the LD_{50} values range from 223 to 820 mg/kg/day (ATSDR, 1991a). Chronic studies on rats and mice at doses of 930 to 810 mg manganese/kg/day showed no respiratory, cardiovascular, hematological, musculoskeletal, hepatic, renal, or dermal effects. Dose levels of 10 to 600 mg manganese/kg/day are reported to cause neurological (primarily hypo or hyperactivity) in controlled animal studies (ATSDR, 1991a). Studies on the carcinogenic potential of manganese in rats and mice are equivocal and under review (ATSDR, 1991a).

Limited information was available on the toxicity of manganese to aquatic biota. Manganese seldom reaches concentrations of 1 mg/L in natural waters, and is usually present in quantities of 0.2 mg/L or less. McKee and Wolf (1963) summarized data on toxicity of manganese to freshwater aquatic life. Concentrations of manganese ranging from 1 mg/L to 2,700 mg/L have been tolerated by fish (McKee and Wolf, 1963). Thus, manganese is not considered to be a problem in fresh waters (EPA 1986).

9.3.2.2.8 Mercury

Use and Occurrence

Mercury (Hg) occurs as elemental mercury and as inorganic and organic compounds. Mercury metal is in a liquid state at room temperature. Mercury occurs in the earth's crust mainly in the form of sulfides (i.e. cinnabar). Mercury has a variety of uses including electrical components, paints, control systems, agriculture, density, laboratory, and military. Anderson (1979) reviewed investigations of the mercury content of virgin and cultivated surface soils from a number of countries and found that the average concentrations ranged from 20 to 625 ppb (ATSDR, 1989a).

Environmental Fate

The transport and partitioning of mercury in surface waters and soils is influenced by the particulate form of the compound. Volatile forms (e.g. metallic mercury and dimethylmercury) are expected to evaporate to the atmosphere, whereas solid forms partition to particulates or are transported in the water column, depending upon their solubility. However, the dominant process controlling the distribution of mercuric compounds in the environment appears to be the sorption of non-volatile forms to soil and sediment particulates. The sorption process has been found to be related to the organic matter content of the soil or sediment; the pH of the medium apparently does not affect the process. Inorganic mercury sorbed to particulate material is not readily desorbed; thus, freshwater and marine sediments are important repositories for inorganic forms of the compound, and leaching is a relatively insignificant transport process (ATSDR, 1989a).

Absorption, Distribution and Excretion in Mammals

Elemental mercury is well absorbed by inhalation, but poorly absorbed by ingestion. Inorganic mercury compounds are absorbed after ingestion and, in part, after dermal application. Organomercurials (especially short-chain alkyls) are well absorbed by all routes (Carson et al., 1986). Once absorbed, mercury is generally distributed throughout the body, binding to the sulfhydryl groups of many proteins. Mercury is eventually excreted in the urine and feces.

Toxicity

Plants differ in their ability to take up mercury and can develop a tolerance to high mercury concentrations in their tissues when grown in soils contaminated with mercury (Kabata-Pendias et al., 1985). The toxicity of volatilized elemental mercury and of some methylated compounds are known to be the most serious for plants. Toxic effects in young barley were observed at a mercury level of 3 ppm dry weight (Kabata-Pendias et al., 1985).

In mammals, the central nervous system is the critical organ upon long-term exposure to toxic levels of mercury vapor. Organomercury compounds, especially methylmercury, were the most toxic mercury species tested. Among sensitive species of mammals, death occurred at daily organomercury concentrations of 0.1 to 0.5 mg/kg body weight, or 1.0 to 5.0 mg/kg in the diet. Larger animals such as mule deer and harp seals appear to be more resistant to mercury than smaller mammals such as mink, cats, dogs, pigs, monkeys, and river otters; the reasons for this difference are unknown, but may be related to differences in metabolism and detoxification rates (Eisler, 1987).

In the aquatic environment, toxic concentrations of mercury salts ranged from less than 0.1 g/L to more than 200 g/L for representative species of marine and freshwater organisms (Eisler, 1987). Long and Morgan (1991) report lead concentrations in sediment ranging from 0.032 mg/kg to 13.1 mg/kg to be associated with adverse biologic effects (Long and Morgan, 1991).

9.3.2.2.9 Nickel

Use and Occurrence

Nickel is a hard, silvery white metal which occurs naturally in the earth's crust. Nickel is alloyed with iron, copper, chromium and zinc to make items such as valves and heat exchangers. Most nickel is used to make stainless steel. Nickel is also combined with other substances such as chlorine, sulfur, and oxygen to form nickel compounds. These compounds are used for nickel plating, to color ceramics, to make batteries and as catalysts (ATSDR, 1992f). Agricultural soils, world wide, contain nickel ranging from 3 ppm to 1000 ppm.

Environmental Fate

Nickel is released to the atmosphere in the particulate matter form. It is dispersed by wind and removed by gravitational settling, dry and wet deposition.

Nickel may occur in oxidation states ranging from 1- to 4+ in aqueous systems; however, it occurs predominantly in the divalent state (2+). Nickel occurs in aqueous systems as relatively soluble salts associated with suspended solids and in combination with organic material. Although nickel has been shown to coprecipitate with manganese and iron oxides and sorb to suspended organic matter, it is still considered highly mobile in aqueous systems with sorption playing a relatively minor role in water below pH 6.0 (CCME, 1993). Nickel is bioaccumulated by some aquatic organisms. Bioconversion factors measured in freshwater invertebrates and fish ranged from 36 L/kg to 259 L/kg. However, biomagnification is not significant in the aquatic environment. Tissue residues of nickel decreased in concentration at increasing levels of the food web (CCME, 1993).There is no evidence to suggest that either photolysis or volatilization of nickel compounds play an important role in removing nickel from the water column.

Nickel is strongly adsorbed by soil. Soil properties such as texture, bulk density, pH, organic matter, the type and amount of clay minerals, and certain hydroxides influence the retention and release of metals, such as nickel, by soil (ATSDR, 1992f).

Absorption, Distribution and Excretion in Mammals

The degree of absorption of ingested nickel generally depends on the solubility of the compound (Carson et al., 1986). Studies in rats and dogs indicate that 1 to 10 percent of nickel, given as nickel, nickel sulfate hexahydrate, or nickel chloride in the diet or by gavage, is rapidly absorbed by the gastrointestinal tract (ATSDR, 1992f). In animals, nickel was found primarily in the kidneys following both short-term and long-term oral exposure to various soluble nickel compounds. Substantial levels of nickel were also found in the liver, heart, lung and fat as well as the peripheral nervous tissues and in the brain. Excretion of absorbed nickel is in the urine regardless of exposure (ATSDR, 1992f).

Toxicity

Nickel is readily taken up by plants from soil, and until certain nickel concentrations in plant tissues are reached, the absorption is positively correlated with the soil nickel concentrations. Generally, the range of excessive or toxic amounts of nickel in most plant species varies from

10 ppm to 100 ppm dry weight. It should also be noted that some species of plants are known for their great tolerance and hyperaccumulation of nickel, sometimes accumulating up to 6,542 ppm nickel in their leaves (Kabata-Pendias et al., 1985).

Nickel has been shown to be an essential element in the diet of some animal species. Pathological signs of nickel deficiency have been produced in chickens, rats and swine. Retarded growth, anemia and decreased enzyme activities are among such signs in the rat. The toxicity of nickel or nickel salts through oral intake is low, ranking with such elements as zinc, chromium, and manganese. Excessive exposure to nickel compounds may cause a variety of both local and systemic effects in experimental animals. Oral LD_{50} values reported for both rats and mice range from 66 to 136 mg Ni/kg/day. Nickel acetate and nickel chloride may be somewhat more toxic to rats. Decreased body weight and reduced food and water intake were observed in several studies in rats, mice, and dogs after acute, intermediate, and chronic-duration exposure to 0.35 mg nickel/kg/day as nickel salts (ATSDR, 1992f).

The USEPA (1980) compiled data on the acute toxicity of nickel to 22 species of aquatic animals. For invertebrates, concentrations causing acute toxicity ranged from a low of 510 µg/L for *Daphnia magna* to a high of 33.5 mg/L for the stonefly, *Acroneuria lycorias*. Concentrations causing acute toxicity to fish ranged upwards from 2.48 mg/L for the rock bass (*Ambloplites rupestis*) (CCME, 1993). Chronic toxicity values ranged from 14.8 µg/L for *Daphnia magna* in soft water to 530 µg/L for the fathead minnow in hard water (CCME 1993). Reduced growth of several freshwater alga species occurred at concentrations ranging from 100 to 700 µg/L (CCME, 1993).

Benthic species richness was reported as being moderate in Massachusetts Bay sediments with a mean nickel concentration of 21 mg/kg. No other studies were located reporting biological effects below this concentration. Long and Morgan (1991) reports a correlation of adverse biological effects with nickel concentration in sediment ranging from 21 to 350 mg/kg.

9.3.3 Comparison of COC Concentrations to ARARs

9.3.3.1 Applicable Fish and Wildlife Regulatory Criteria

Potential impact of COCs to wildlife will be through exposure to soils, sediments and surface water. Soil criteria for the protection of wildlife do not exist for the State of New York. The following regulatory criteria were used to evaluate potential impact of COCs:

i) criteria for screening sediments developed by the NYSDEC (NYSDEC Sediment Screening Guidance, 1993); and

ii) Ambient Water Quality Standards and Guidance Values for the protection of aquatic life (6 NYCRR Part 701 and TOGs 1.1.1).

When utilizing any criteria it is important to keep in mind the purpose for which the criteria were established. The above-mentioned criteria do not represent cleanup goals. As stated in the preamble to the NYSDEC document entitled "Technical Guidance for Screening Contaminated Sediment" (NYSDEC Sediment Screening Guidance, 1993):

> *"Sediments with contaminant concentrations that exceed the criteria .... are considered to be contaminated .... These criteria do not necessarily represent the final concentrations that must be achieved through sediment remediation."*

The purpose of the NYSDEC sediment criteria is clearly stated to be "screening". In other words, *"to identify areas of sediment contamination and make a preliminary assessment of the risks posed"* (page iii). It is further stated in the NYSDEC Guidance (page 2):

> *"While attainment of the EP-based sediment criteria will provide maximum assurance of environmental protection, it is not necessary in all cases and at all times to achieve these criteria through remediation efforts."*

If all established sediment criteria are met, one can be quite certain that no environmental effects will occur given the overly conservation methods used to establish the criteria. Risk management, as stated in the NYSDEC Guidance, must be applied after criteria have identified areas of concern.

> *"Once a sediment has been identified as contaminated (exceeds criteria), a site-specific evaluation procedure must be employed to quantify the level of risk, establish remediation goals, and determine the appropriate risk management actions." (page 4)*

Areas to consider in determining the need for an/or extent of remediation are:

i) areal extent of contamination; (i.e. is a significant area or ecosystem affected?);

ii) potential for contaminant migration (i.e. will contamination be transported and affect other areas?); and

iii) natural processes associated with the area in which the contaminated sediments are located (i.e. removal of sediments by erosion or being covered by sediment deposition); and

iv) persistence of contaminants (i.e. biological or chemical degradation of contaminants).

9.3.3.1.1 Applicable Surface Water Criteria

Surface water concentrations were compared to NYS and Federal Ambient Water Quality Criteria (AWQC) for the protection of aquatic life.

Conewango Creek is classified as a 'Class C' surface water. The definition of Class C surface water by NYSDEC is as follows:

> "The best usage of Class C waters is fishing. These waters shall be suitable for fish propagation and survival. The water quality shall be suitable for primary and secondary contact recreation, although other factors may limit the use for these purposes."

According to the NYSDEC, the tributaries entering Conewango Creek, including the swale which meanders through the lowlying area in the vicinity of the Site, are classified as Class C surface waters.

This classification is a conservative estimate of the usage of surface waters in the lowlying area north of the Plant fence. During the early spring months, the lowlying area is inundated with water as a result of snow melting and rainfall, but other times of the year, this area remains dry. The water flow in the streambed is continuous throughout the year, with seasonal variation in the streambed water level. Due to its limited size (approximately two feet wide) and shallow water level, the streambed is not likely to sustain sizable fish but may be appropriate for smaller fish or use as a nursery area.

Since sampling was conducted when water flow was low and impact of seep water was at a maximum, the concentrations present during high water would be much lower than those reported in the RI. During flood events when the wetland area is inundated, the water is primarily from Conewango Creek and drains to the east of the Site.

9.3.3.1.2 Applicable Sediment Criteria

Sediment concentrations were compared to the following NYSDEC screening criteria for sediment:

i) for non-polar organic COCs, the NYSDEC recommended sediment criteria/standards based on equilibrium partitioning; and

Note: The EP-based sediment criteria are tied to water quality standards, guidance values. There are five primary levels of protection which are as follows:

- protection of human health from acute or chronic toxicity;
- protection of human health from toxic effects of bioaccumulation;
- protection of aquatic life from acute toxicity;
- protection of aquatic life from chronic toxicity; and
- protection of wildlife from toxic effects of bioaccumulation.

This is a reflection of the varied environmental protection objectives of the ambient water standard or guidance value (AWQS/GV) used to calculate the criteria.

ii) for inorganic COCs, the sediment criteria for metals which are as follows:

- the mean value of the 'lowest effect' level, and

- the 'severe effect' level.

For non-polar organic chemicals, the methodology used for deriving sediment criteria is known as the equilibrium partitioning (EP) approach. It is based on the theory that toxics in sediments will exert their effect, either toxicity or bioaccumulation, to the extent that the chemical becomes freely bioavailable in the sediment interstitial (pore) water. The fundamental assumption of this approach is that the pore water and sediment concentrations exist in equilibrium and that the concentrations are related by the K_{OC}. In addition, this approach recognized that the exposure to the sediment pore water equilibrium system and the water-only exposure system are equal since chemical activity is the same in each system at equilibrium.

The EP-based sediment criteria are determined by setting the pore water concentration equal to the water quality standard or criterion and calculating back to the sediment concentration using the following equation:

$$\text{Sediment Quality Criterion} = (\text{AWQS/GV}, \mu\text{g/L}) \times (K_{OW} \times 1/\text{kg}) \times \frac{1\ \text{kg}}{1000\text{g OC}}$$

(SQC in μg/g OC)

AWQS/GV = the ambient water quality standard or guidance value for a chemical,

K_{OW} = the octanol/water partition coefficient for the chemical; units are those for K_{OC}; and

$\frac{1\ \text{kg}}{1000\text{g organic carbon (OC)}}$ = a unit conversion factor.

Note that in the calculation presented above, the K_{OW} is substituted for the K_{OC}. This is based on the NYSDEC Sediment Screening Guidance which states that few K_{OC}s are accurately known, but the K_{OW} (octanol/water partition coefficient) has been determined to be very nearly equal to K_{OC}.

For metals, the primary concern in sediments is toxicity to benthic (bottom) organisms. The NYSDEC sediment criteria for metals are based on the chronic long-term effects of contaminants on benthic organisms. Other water quality and guidelines will also be met at this level. A 'lowest effect' level indicates a level of sediment contamination that can be tolerated by the majority of benthic organisms. A 'severe effect' level indicates the level at which pronounced disturbance of the sediment-dwelling community can be expected. This is the sediment concentration of a compound that would be detrimental to the majority of benthic species. The severe effect and lowest effect levels established in the NYSDEC Guidance are based on field studies of benthic organisms in certain types of ecosystems. Based on these studies, the concentration of metals which caused an observed adverse ecological effect was measured and used as the basis for the sediment criteria. As stated in the NYSDEC Guidance, the reported effects levels *"were associated with bulk sediment concentrations without normalizing for any toxicity mitigating factors."* These mitigating factors can include the grain size distribution of the sediments, the soil composition, available oxygen levels, and bioavailability of the metals. For example, it is stated in USEPA's Risk Assessment Guidance for Superfund, Volume II, Environmental Evaluation Manual that the organic content of some of the wetland soils can bind large amounts of heavy metals rendering them unavailable to biota. As a result, in certain ecological settings/conditions, these effects levels may be overprotective.

For the purposes of this evaluation, the 'lowest effect' levels and the 'severe effect' levels were compared to the metal data from Conewango Creek and the lowlying area north of the Plant fence.

9.3.3.2 Comparison of COC Surface Water Concentrations to AWQC

Table 9.1 presents a comparison of COC concentrations in surface water of Conewango Creek to the NYS AWQC and Federal AWQC. As is apparent in Table 9.1, COC concentrations in Conewango Creek are comparable to upstream background concentrations. Most importantly, COC levels in Conewango Creek do not exceed NYS and Federal AWQCs. Manganese exceeds Federal AWQC but does not exceed upstream background concentrations. 1,1-DCE and vinyl chloride were not detected in samples taken downstream from the Plant Site (SW-3 and SW-K). Trichloroethene concentrations were comparable in samples taken upstream (SW-4 and SW-M/SW-N) to samples taken downstream (SW-3 and SW-K) of the Plant Site. Similarly, metal concentrations were comparable in samples taken upstream (SW-4 and SW-M/SW-N) to samples taken downstream (SW-3 and SW-K) of the Plant Site. Therefore, it may be concluded from these comparisons that there is no measurable impact to the water quality and sediment in Conewango Creek by contamination from the Plant Site.

Table 9.2 presents a comparison of COC concentrations in the streambed surface water located within the lowlying area north of the Plant fence to background concentration, NYS AWQC and Federal AWQC. Table 9.2 presents the sampling locations according to their physical location in the drainage swale/culvert which flows across the Plant Site into the lowlying north of the Plant Site, such that SW-6/SW-7 are located immediately outside the Plant fence and SW-F at the confluence of the stream and Conewango Creek. Sampling locations, SW-J and SW-D are not located in the streambed. As discussed, the lowlying area north of the Plant fence is dry for the most part of the year except for the narrow streambed. The only time this area is inundated with water is during the spring months when the water level in Conewango Creek is high due to snow melting or during periods of heavy rain.

Comparison of analytical data from individual sampling locations to NYS and Federal AWQC indicate that volatile organic COC concentrations from seeps closest to the north perimeter of the Plant fence (SW-1 and SW-2) exceed the Federal AWQC. There are no available NYS and Federal AWQC for vinyl chloride. However, vinyl chloride is a very volatile and reactive compound as is evident in the concentration gradient that exist in the streambed. A half life of 0.805 hrs was estimated for evaporation of vinyl chloride in a model river (Howard, 1989). Table 9.2 shows that vinyl chloride is not detected at sampling location SW-F which is located at the confluence of the stream and Conewango Creek.

For inorganic COCs, an apparent non-linear concentration gradient also exists such that COC levels decrease with distance from the Plant fence. Generally, metal concentrations are highest at SW-E located at the north fence and concentrations at sampling locations in the streambed (SW-H, SW-G and SW-F) are lower. Levels reported at SW-H, SW-G, SW-F and SW-J meet the NYS and Federal AWQC, with the exception of manganese. NYS and Federal SWQC for metals were exceeded at surface water sample location SW-D and SW-E which receive stormwater discharges from the Plant Site. However, the presence of elevated levels of metals in the surface water samples collected from these locations may be attributable to the presence of sediments in these samples.

9.3.3.3 Comparison of COC Sediment Concentrations to Criteria

As discussed in Section 9.2.4, only the manmade/artificial pond provides any remarkable habitat for wildlife within the Plant Site and this habitat would be limited to aquatic species. There were no organics reported in the sediments of the pond. Reported levels of cadmium, copper, lead and nickel exceeded the lowest effect levels, with only copper and nickel exceeding the severe effect levels. The exceedance of the severe effect levels for copper and nickel does not necessarily represent adverse impact to the aquatic organisms in the pond by these two metals, since the basis used in the development of the severe effect levels are overly conservative. The impact of the presence of copper and nickel in the pond sediments to the aquatic organisms cannot be accurately characterized or quantified given the limited theoretical information and methods available for use in such an evaluation.

Table 9.4 presents a comparison of COC concentrations in drainage swale sediments of the Plant Site (SED-C and SED-5) to available NYS sediment criteria. As is apparent in Table 9.4, organic COCs are not detected. Low levels of acetone (530 ppb) and 2-butanone (180 ppb) were reported in sediment samples from the drainage swale/ditch on the Plant Site. However, acetone and 2-butanone are often used as cleaning and laboratory solvents and these reportedly low levels could potentially be analytical and/or laboratory artifacts. Detected levels of cadmium, copper and nickel exceeded the lowest effect levels but not the severe effect levels.

Table 9.3 presents a comparison of COC concentrations in sediments of Conewango Creek to available NYS sediment criteria. As is apparent in Table 9.3, there were no organic COCs reported in sediments of Conewango Creek. The inorganic reported in Conewango Creek, midstream by Plant (SED-L) and downstream of Plant (SED-K), exceeded the lowest effect levels but did not exceed the severe effect levels. However, reported levels of inorganics in the Conewango Creek sediments are typical of background; with levels of lead, manganese and nickel slightly exceeding Site-specific or literature-based background concentrations. Site-specific background concentrations were taken from sampling locations upstream of the Plant Site. Even background concentrations of copper, manganese and nickel exceeded the lowest effect levels. It can be concluded from these comparisons that sediments of Conewango Creek have not been impacted by contamination from the Plant Site.

Table 9.4 presents a comparison of COC concentrations in sediments of the streambed north of the Plant fence to NYS sediment criteria. COC concentrations were also compared to background concentrations in sediment samples taken at sampling location SED-B. Table 9.4 presents the sampling locations according to their physical location in the streambed north of the Plant Site, such that SED-4 are located immediately outside the Plant fence and SED-F at the confluence of the stream and Conewango Creek. As shown in Table 9.4, an apparent non-linear concentration gradient exists within the drainage swale/stream of the lowlying area such that COC levels decrease with distance from the Plant fence (see Figures 9.2 to 9.7).

Comparison of analytical data from individual sampling locations to mean background levels and NYS sediment criteria indicate that organic COC concentrations from seep location, SED-1, closest to the north perimeter of the Plant fence, have higher reported concentrations in comparison to reported levels from locations SED-H, SED-G and SED-F. Volatile COCs were found at higher concentrations at sampling location SED-H in comparison to location SED-F at the confluence of the stream and Conewango Creek. There were no available NYS sediment criteria for these organic COCs. The NYSDEC guidance document entitled: "Technical Guidance for Screening Contaminated Sediments", dated November 1993, states that chemicals with log K_{OW}s of less than three (3) can be expected to be non-persistent in sediments. In this case, *"further remedial investigation or sediment remediation is not necessary if the source of contamination will be eliminated and the sediment will cleanse itself"* (page 17 of NYSDEC Sediment Screening Guidance). Volatile COCs detected in the sediments of the streambed have log K_{OW}s of 1.84, 0.7, 1.38 and 2.38 for 1,1-dichloroethene (1,1-DCE), 1,2-dichloroethene (1,2-DCE), vinyl chloride and TCE, respectively. Therefore, it can be concluded that these volatile COCs will not persist in sediments and will not pose a long-term problem to benthic organisms in the streambed and lowlying area north of the Plant Site.

PCBs were only reported at one sample location (SED-2 and its duplicate sample, SED-3). Data from other sampling locations were all non-detected. Therefore, PCBs are not of significant ecological concern in the lowlying area.

The distribution of inorganic COCs in the sediments of the streambed north of the Plant Site show a non-linear gradation with concentrations decreasing with increasing distance from the Plant (see Figures 9.2 to 9.7). All reported metal concentrations were above the Site-specific mean background concentrations and literature-based background concentrations. The literature-based background concentrations were derived from a 1984 U.S. Geological Survey document which reported surficial soil concentrations for this approximate area of New York State (USGS, 1984). Beryllium, copper and lead did not exceed these literature-based background concentrations. Reported levels of cadmium, copper, lead, manganese, mercury and nickel exceeded the lowest effect levels and the severe effect levels.

Sediment samples were also taken from sampling locations SED-E, SED-D and SED-J, located in close proximity to the streambed within the lowlying area north of the Plant Site. Organic COCs in these sediment samples were not detected and inorganic COC levels exceeded the lowest effect levels and the severe effect levels. The highest levels of inorganic COCs were observed in the sediment samples collected from locations SED-D and SED-E. Both of these locations directly receive stormwater discharges from the Plant Site.

9.4 CONCLUSIONS

In the Plant Site, only the artificial pond provides any remarkable habitat for wildlife and this habitat would be limited to aquatic species. There was no evidence of impact by organic contaminants on the water or sediment quality in the pond due to Plant activities. It should be noted that the pond was only used as a source of non-contact cooling water and that no disposal activities were known to occur within the pond. The exceedance of the Severe Effect Level sediment criteria for nickel and copper does not necessarily represent adverse impact to the aquatic organisms in the pond by these two metals, since the bases used in the development of the Severe Effect Levels are overly conservative. The impact of the presence of nickel and copper in the pond sediment to the aquatic organisms cannot be accurately characterized or quantified given the limited theoretical information and methods available for use in such an evaluation. However, all metals detected in the surface water of the pond were well below NYS and Federal AWQC which indicates that the presence of these metals in the sediment has not adversely impacted the water quality of the pond. On this basis, it is concluded that the presence of Site-related inorganic contaminants in the pond are not of significant ecological concern.

Only the areas north and east of the Plant Site, outside the Plant fence, provide habitat for a variety of wildlife species as outlined in Section 9.2. Vegetation in these areas is lush and varied and provides adequate cover, nesting areas and feed for a large number of terrestrial species. The habitat for aquatic species is limited in this area by the fact that streams and marsh areas are intermittently dry. This limits the presence of fish to those high water periods when the area is inundated, or at least, to the streambeds when there is adequate water depth to provide adequate habitat for fish. During periods of inundation, the primary source of water is Conewango Creek and the secondary source is the drainage from areas south and east of the Site. Drainage from the Plant Site would not increase in comparison. Only Conewango Creek provides permanent habitat for fish and their propagation.

The stream directly north of the Plant Site which drains through the Plant Site is impacted by the operations at the Plant Site. The results reported for metals and organic volatiles in sediment from this streambed show elevated concentrations which generally decrease with distance from the Plant. Although some sediment values exceed the published or estimated sediment criteria, the surface water quality in this stream related to these sediment values is not seriously impacted even though water samples were taken at a time of low water flow and, therefore, low dilution. The surface water appears to have two sources of impact, namely, the contaminated groundwater discharge from the culvert for the organics and the discharge from the concrete pads for the metals.

Limited information exist on toxicity effects of the organic COCs to aquatic life. 1,1 DCE, 1,2-DCE, TCE and vinyl chloride are highly volatile with rapid degradation rates in soil, air and water. As a result, these COCs may not remain long enough in water or sediments to significantly impact aquatic life. Bioaccumulation of these COCs are not expected to be significant and biomagnification is unlikely. Other organic COCs, such as PAHs: benzo(a)pyrene, benzo(b)fluoranthene and benzo(a)anthracene, were also detected in sediment at less than 550 ppb at sampling location SED-4. Information compiled in our ecotoxicological summaries indicate that toxicity to aquatic life will not likely occur at these concentrations. Furthermore, although PAHs may be accumulated, most aquatic species rapidly metabolize and excrete PAHs. Biomagnification will therefore not be significant for PAHs. Bis(2-ethylhexyl)phthalate was only detected in the seep locations SED-2/SED-3 and sampling location SED-4 in the lowlying area north of the Site. Although limited information exist on its toxicity to aquatic life, it is known that, similar to the PAHs, biomagnification is not likely to occur. It is also known to degrade significantly in soil, air and water (Table 8.17c).

Cadmium, copper, lead, manganese, mercury and nickel were the inorganic COCs found at concentrations of concern at sampling locations in the streambed north of the Plant Site and across the lowlying area north of the Site. These metals, under natural conditions in the environment, are relatively immobile. When released into the environment, they have a tendency to form insoluble complexes and adsorb to sediment or soil particles. This is also indicated by the fact that these metals were not found at significantly elevated concentrations in the surface water. Although, metal concentrations in the streambed closest to the Site may be present at elevated concentrations, it should be noted that there is no evidence to suggest that these metals are transported beyond the streambed of the lowlying area north of the Plant since there is no measurable impact to the Conewango Creek sediment and water quality. Exposure to wildlife is therefore limited to only a small area in or near the stream that flows through the Plant Site and lowlying area north of the Site. Furthermore, bioconcentration may not be significant due to comparatively low bioconcentration factors for these metals (Table 8.17c). The ecotoxicological summaries presented in Section 9.3.2 also indicate that these metals are not likely to biomagnify in the environment.

Although Site-related contaminants are present at elevated concentrations in the sediment and surface water of the lowlying area and the streambed, biota and wildlife have not been significantly impacted. Vegetation is lush in the lowlying area with no stressed areas observed. The area of the contaminated streambed and the contaminated areas within the lowlying area is small in comparison to the remaining unimpacted area of the total ecosystem (wetlands) which is available for wildlife use. Figure 2.3 of Appendix J illustrates this point by highlighting the limited size of the contaminated area in comparison to the surrounding unimpacted habitat. As such, it is reasonable to assume that most wildlife species would not spend their entire time in contaminated areas. Furthermore, it is not likely that a significant number of wildlife would be so adversely affected by the presence of Site-related contaminants within the lowlying area that the wildlife population or community would be impaired.

The surface water and sediment samples collected from Conewango Creek, including the samples collected just below the discharge from the impacted stream, show no impact from this discharge or other potential discharges from the Plant Site or property. The evaluation of upstream and downstream concentrations of COCs in Conewango Creek show no measurable impact from inorganic chemicals from the Plant Site.

It is recognized that the surface water and sediment samples collected from the seep locations contained elevated levels of Site-related contaminants. These contaminated areas are very small and their small size and location would suggest minimal contact by wildlife. Figures 9.2 to 9.7 show the relatively minor contribution of contamination of the seeps in comparison to other locations in the lowlying area north of the Plant Site.

This EA qualitatively assessed the potential exposure of terrestrial organisms to COC levels in sediments and surface water of the stream north of the Plant Site. It is difficult to quantify exposure and determine potential impact to wildlife. As previously discussed, the lowlying area north and east of the Plant Site provide habitat for a variety of wildlife species. However, the most impacted areas within the lowlying area are immediately adjacent to the Plant Site fenceline. Given the fact that the surrounding areas where there are no ongoing human activities are much larger than the contaminated areas, the majority of wildlife in the area would not frequent the contaminated areas on a regular basis or as often as the surrounding undisturbed areas. It is recognized that some wildlife may visit the impacted areas. However, the frequency and duration of any visits to the impacted areas would not be as much or as long as visits to the surrounding larger undisturbed areas. Also, there are abundant and better feed, water and cover in areas away from the Plant Site, in areas with no apparent contamination. Therefore, due to the minimal area of contamination in comparison to the available habitat in and around the vicinity of the Site, it is concluded that the presence of contamination in the lowlying area would not significantly impair any terrestrial populations in the area.

9.5 REFERENCES

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10.0 CONCLUSIONS AND RECOMMENDATIONS

10.1 CONCLUSIONS

Based on the evaluation of the information and analytical results obtained during the RI, SI and IRA, the following conclusions are made:

i) the uppermost geologic unit beneath the Site is the surficial overburden unit, which ranges in thickness from 0 to 6 feet throughout the Site. This unit consists of a sand, silt and gravel mixture throughout the southern portion of the Site and fill materials throughout the northern portion of the Site. The fill material is comprised of a wide range of natural and manmade materials including wood, slag, metal turnings and debris, with a loamy topsoil of silt, gravel and clay;

ii) the first waterbearing zone encountered beneath the Site is the Upper Sand and Gravel Unit which varies in thickness from 3.5 to 25.1 feet. The material within the Upper Sand and Gravel Unit varies in composition and grain size across the Site, with the northern portion of the Site consisting of higher percentages of silt and clay. The hydraulic conductivities of this unit range from 7.9×10^{-3} cm/sec to 1.3×10^{-6} cm/sec with a geometric mean of 5.2×10^{-4} cm/sec. Groundwater flow in the Upper Sand and Gravel Unit (Water Table Aquifer) is in a northerly direction toward the Conewango Creek. Groundwater flow in the Water Table Aquifer within the Plant fenceline is controlled by the drainage swale/culvert which traverses the Site. Groundwater flows into and/or along the swale/culvert and discharges into the lowlying area which eventually drains into the Conewango Creek;

iii) the Frewsburg Aquifer (lower sand and gravel unit) is discontinuous in nature and exists at certain locations adjacent to the Site and beneath the south and western portions of the Site. Because of the nature of the

Plant Site and the fact that the Frewsburg Aquifer is extremely discontinuous, the location of the Frewsburg Aquifer at the Site cannot be accurately predicted. The Frewsburg Aquifer is confined and exhibits artesian conditions;

iv) a Confining Clay Unit underlies the Water Table Aquifer and is primarily composed of clay and silt. Measured vertical hydraulic conductivities of the Confining Clay Unit range from 1.8×10^{-8} cm/sec to 2.9×10^{-8} cm/sec. This low permeability clay layer separates the Water Table Aquifer and the Frewsburg Aquifer, where present, beneath the Site and limits the downward migration of groundwater and contaminants from the Site. At well nest locations where both the Frewsburg Aquifer and the Water Table Aquifer exist, the thickness of the Confining Unit is approximately 20 feet. Travel time for migration of water through the clay Confining Unit at these locations is estimated to be in excess of 1000 years. In addition, no physical or direct vertical hydraulic connection was found between the Water Table Aquifer and the Frewsburg Aquifer during the investigative activities;

v) the primary Site contaminants are VOCs, consisting of trichloroethene (TCE) and its degradation products, total 1,2-dichloroethene (1,2-DCE), vinyl chloride, and 1,1,-dichloroethene. The most predominant Site contaminant is TCE;

vi) subsurface soils are primarily contaminated with VOCs consisting of TCE and 1,2-DCE. VOC contamination is present to a depth of approximately 24 feet BGS and its downward migration is retarded by the presence of the Confining Clay Unit. There are four areas of VOC soil contamination at the Site. These areas consist of an area of petroleum (benzene, toluene, ethylbenzene, and xylene) contamination located at the southeast corner of the Main Building, an area of TCE contamination underneath the concrete pad east of the Main Building and west of the drainage culvert/swale, an area of TCE contamination in the unpaved area north of the Main Building, and an area of VOC contamination in the vicinity of well MW-4.

Subsurface soils in the unpaved area north of the Main Building contained VOC levels several orders of magnitude higher than the other three areas. Soils outside of the Plant Site fence generally do not exhibit VOC levels above background;

vii) the Water Table Aquifer is primarily contaminated with VOCs consisting of TCE and its degradation products, vinyl chloride and 1,2-DCE. Additional compounds such as 1,1-dichloroethene, acetone, 1,1,1-trichloroethane, tetrachloroethene, benzene, toluene, ethylbenzene, and xylenes were detected in various samples at lower concentrations. Of all the dissolved metals detected, only iron and manganese exceed the NYS Class GA standards. VOC contamination of the Water Table Aquifer is concentrated in the immediate vicinity of the Main Building. The limits of VOC contamination within this aquifer appear to be the Conewango Creek to the north, midway between MW-8 and MW-11 to the south, and the drainage swale/culvert to the east. The drainage swale/culvert limits the eastward migration of contaminants by serving as a control of local groundwater flow. The western limit of groundwater contamination is believed to be east of MW-7 and MW-12. This presence of VOC in this off-Site area is likely the result of off-Site migration in the Water Table Aquifer;

viii) TCE was detected in District Production Wells #1 and #2A in September 1991 which resulted in the shutdown of these production wells. TCE was last detected above drinking water standards in Production Wells #1 and #2A on September 26, 1991. Low levels (ranging from 1.2 to 3.5 ppb) of TCE were only detected in Production Well #1 through the end of October 1991. No TCE has been detected in Production Wells #1 and #2A since the November 15, 1991 and September 26, 1991 sampling events, respectively. In addition, on-Site monitoring wells MW-4D and MW-5D installed into the Frewsburg Aquifer did not contain TCE above drinking water standards. Based on the extensive investigations performed to date, it is concluded that the source and migration pathway of the TCE found in District Production

Wells #1 and #2A are not known and cannot be determined for the following reasons:

a) the exact hydrogeologic conditions under which the TCE appeared in the production wells cannot be duplicated and studied;

b) no physical or hydraulic connection between the Frewsburg Aquifer and Water Table Aquifer was identified during any of the testing activities performed;

c) because of the discontinuous nature of the Frewsburg Aquifer, the location of the Frewsburg Aquifer beneath the Site cannot be accurately predicted;

d) because of the artesian nature of the Frewsburg Aquifer and the use of the Frewsburg Aquifer as a water supply source, the direction of the groundwater flow in the Frewsburg Aquifer cannot be accurately determined; and

e) the lack of any current presence of TCE in the Frewsburg Aquifer near or beneath the Site.

Furthermore, the hydrogeologic characterization performed to date indicates that the presence of the confining clay unit and the artesian nature of the Frewsburg Aquifer limits the potential for downward migration of contaminants from the Water Table Aquifer to the Frewsburg Aquifer with theoretical travel time for the migration of water across this clay unit estimated to be greater than 1,000 years.

ix) surface water and sediment samples collected from the on-Site manmade/artificial pond and sections of the swale/culvert (at the south end of the Site) within the Plant fence line showed little or no contamination. Although detected nickel and copper concentrations in the pond sediments exceeded NYSDEC's screening criteria for sediments, it does not necessarily represent that there has been some adverse impact to the biota in the pond since the NYSDEC's screening criteria for sediment are very conservative. However, metals detected in the surface water of the pond were well below NYS and Federal Ambient Water Quality Criteria. Therefore it is concluded that the presence of elevated levels of nickel and copper in the on-Site pond is not of significant ecological concern;

x) VOC contamination in the Site soils are expected to have negligible effect on ambient air quality due to the minimal VOC levels in surface soils and the presence of vegetative cover and pavement over the majority of the contaminated areas of the Site. Using subsurface soil gas data collected from the unpaved western and northern portions of the Site, theoretical emission rates and ambient air concentrations for key VOCs found in the soil were estimated and were found to be less than the respective NYS ambient air guideline concentrations;

xi) contaminated groundwater migration has impacted the water and sediment quality of the lowlying wet area north of the Plant fence, however, there has been no measurable impact on the water and sediment quality of Conewango Creek. Because the discharge of contaminated groundwater is the source of VOC contamination in the surface water within the lowlying area, it is believed that by preventing or mitigating the migration of contaminated groundwater into the surface water, the VOC contamination of the lowlying area will be adequately addressed and the residual volatile contaminants in the surface water and sediments will be attenuated;

xii) VOCs and metals are present in the lowlying area north of the Plant Site at elevated concentrations which generally decrease with distance from the Plant Site. Although COC concentrations in the sediment samples collected from the lowlying area exceed NYSDEC screening criteria for sediments, the COC concentrations in the corresponding surface water samples are generally less than or near the NYS and Federal Water Quality criteria;

xiii) surface water and sediment samples collected in Conewango Creek upgradient and downgradient of the Site indicate that the Site contamination has had no measurable impact to the sediment and water quality in Conewango Creek;

xiv) the environmental/ecological assessment performed qualitatively evaluated the potential ecological impacts of the presence of contaminants in the lowlying area. VOCs are present in sediments at levels above background. However, the VOCs (TCE and its degradation products) present in the sediments are not persistent in the environment and have not significantly impacted the water quality in the lowlying area. Except for the groundwater seep areas, detected VOC concentrations in surface water samples collected from the lowlying wet areas were generally below NYS and Federal Ambient Water Quality standards. The sediments in the lowlying area north of the Site contain metals above the NYSDEC screening criteria for sediments. However, the vegetation is lush in the lowlying area with no stressed areas observed. Given the small area of contaminated sediment in comparison to the total ecosystem available in and around the Site, it is concluded that the presence of metals in the sediments would not significantly impair any terrestrial populations in the area; and

xv) the public health evaluation showed that cancer risks associated with average and reasonable maximum exposures to surficial soils, general soils, sediments and surface water for current and future land uses are well below or within the 1×10^{-6} to 1×10^{-4} range which has been established by USEPA as being an acceptable risk range. Non-cancer risks associated with these exposures were also well below the USEPA acceptable value of 1.0. Therefore, it is concluded that the presence of Site-related contaminants in on- and off-Site soils, sediments and surface water do not present a public health threat. Evaluation of potential future use of off-Site groundwater in the Water Table Aquifer as a drinking water source generated cancer risks 1.12×10^{-4} and 5.65×10^{-4} for average exposure and RME, respectively, which are marginally above the USEPA acceptable value. However, it should be noted that groundwater in the Water Table Aquifer is not a potable water supply source and is not a productive aquifer.

10.2 RECOMMENDATIONS

Based on the results of the RI, the following recommendations are made:

i) the quarterly sampling and analysis of Frewsburg Production Wells #3 and #4, which is currently being performed by Keywell, should be eliminated;

ii) prevent or mitigate, to the maximum extent practicable, the migration of contaminants from the Water Table Aquifer beneath the Plant Site to the lowlying area and to off-Site areas; and

iii) since the general objectives of the RI have been achieved, additional investigative work is not required at this time and the Feasibility Study should be finalized.

11.0 CERTIFICATION

All activities conducted as part of the Remedial Investigation (RI) for the VacAir Alloys Division's Frewsburg, New York Plant Site were performed in accordance with the New York State Department of Environmental Conservation (NYSDEC) approved document entitled, "Remedial Investigation/Feasibility Study Work Plan, VacAir Alloys Division, Frewsburg, New York", dated August 1992, as modified by Addendum No. 1 (dated November 5, 1992) to the Work Plan. Due to field conditions encountered, some modifications to the program were made with approval of the NYSDEC and are described in this RI Report.

All of Which is Respectfully Submitted,

CONESTOGA-ROVERS & ASSOCIATES

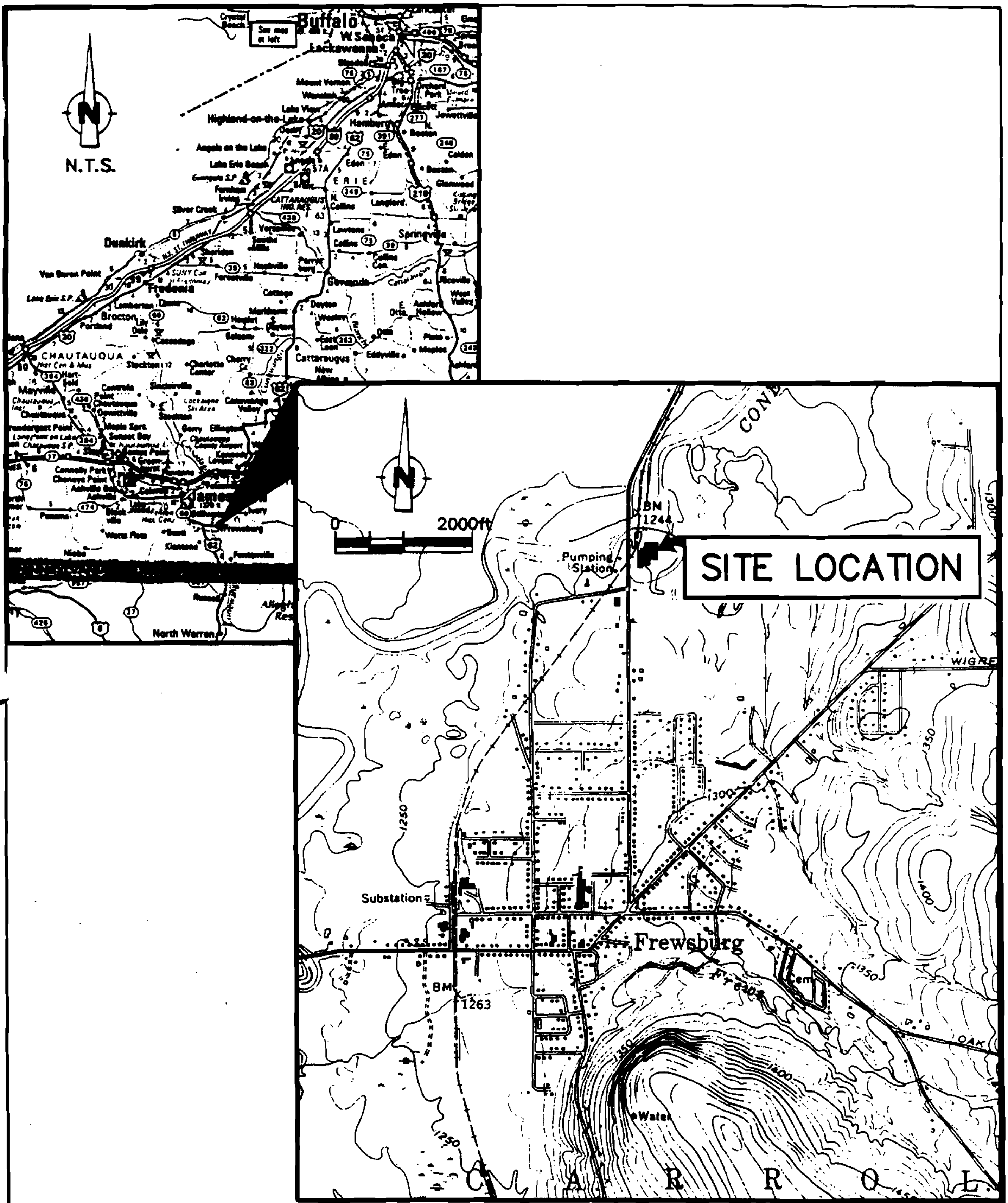
WaiChin Lachell

WaiChin Lachell

Michael G. Mateyk /per dh

Michael G. Mateyk, P. Geol.

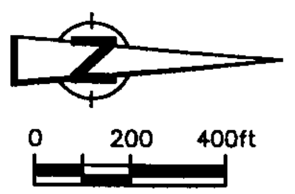
FIGURES



SOURCE: JAMESTOWN, N.Y.
N4200—W7907.5/7.5

figure 2.1
SITE LOCATION
REMEDIAL INVESTIGATION PROGRAM
VACAIR ALLOYS DIVISION
Frewsburg, New York

CRA



DRAWING BASED ON A SURVEY
DONE BY GARY E. KRULL,
MARILLA, NEW YORK
DATED 24 JULY, 1991

A Survey of the Lands of
Samuel G. Keywell Company, Inc.
Part of Lot 55, Township 1, Range 10
Holland Land Company Survey
Town of Carroll
County of Chautauqua
State of New York
July 24, 1991. Scale: 1"=100'

Title References for Boundary Survey Preparation:

L 1612 – P 159, Oct. 10, 1978, Edward F. Moore to Vac Air Alloys Corp. Current Parcel is the same as described in this deed exclusive of exceptions listed there in.

L 2147 – P 300, Dec. 18, 1987, Vac Air Alloys Corp. to Samuel G Keywell Company, Inc.

• Area at northwest corner of this survey which lies east of Frewsburg Road and west of the former west line of the Dunkirk, Allegany Valley and Pittsburg Railroad Company (see L 172 – P 85) is not severed by the above mentioned deed. Chautauqua County Tax Mapping lists this area as being owned by Samuel G. Keywell Company Inc.

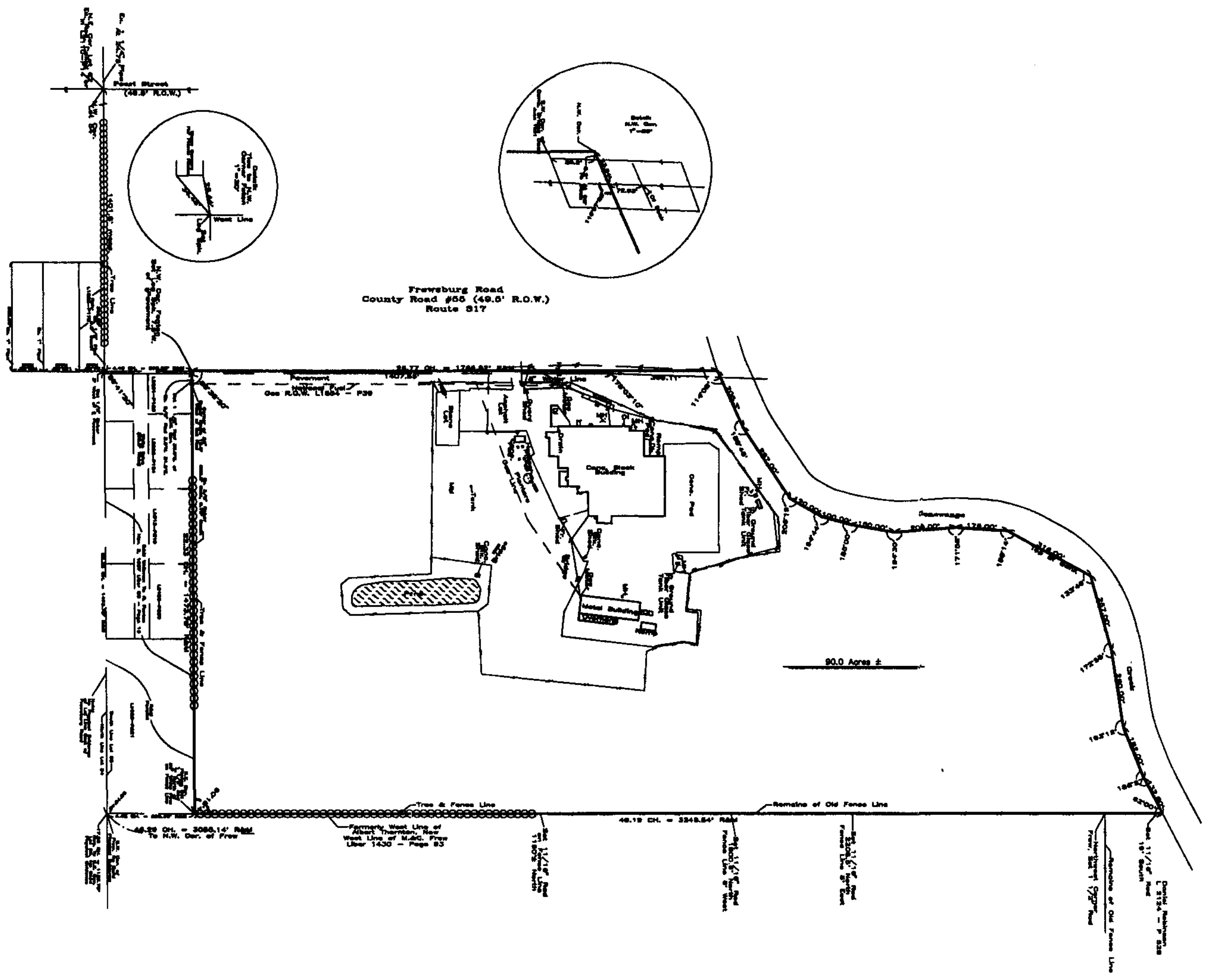


figure 2.2

VACAIR PROPERTY BOUNDARY
REMEDIAL INVESTIGATION PROGRAM
VACAIR ALLOYS DIVISION
Frewsburg, New York

CRA

2326 (19) MAR 21/94(NF) REV.0 (P-27)

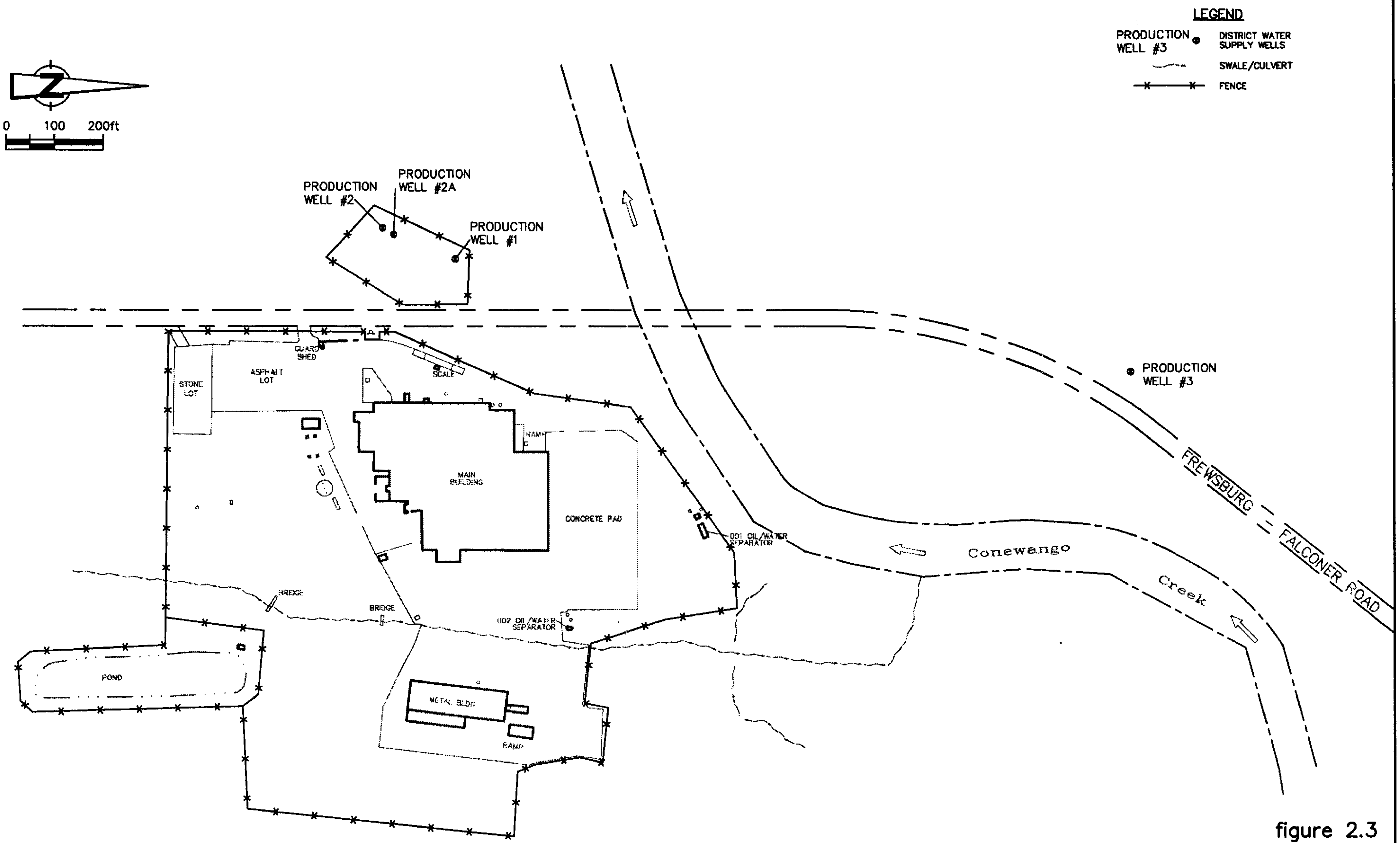


figure 2.3

SITE LAYOUT
REMEDIAL INVESTIGATION PROGRAM
VACAIR ALLOYS DIVISION
Frewsburg, New York

CRA

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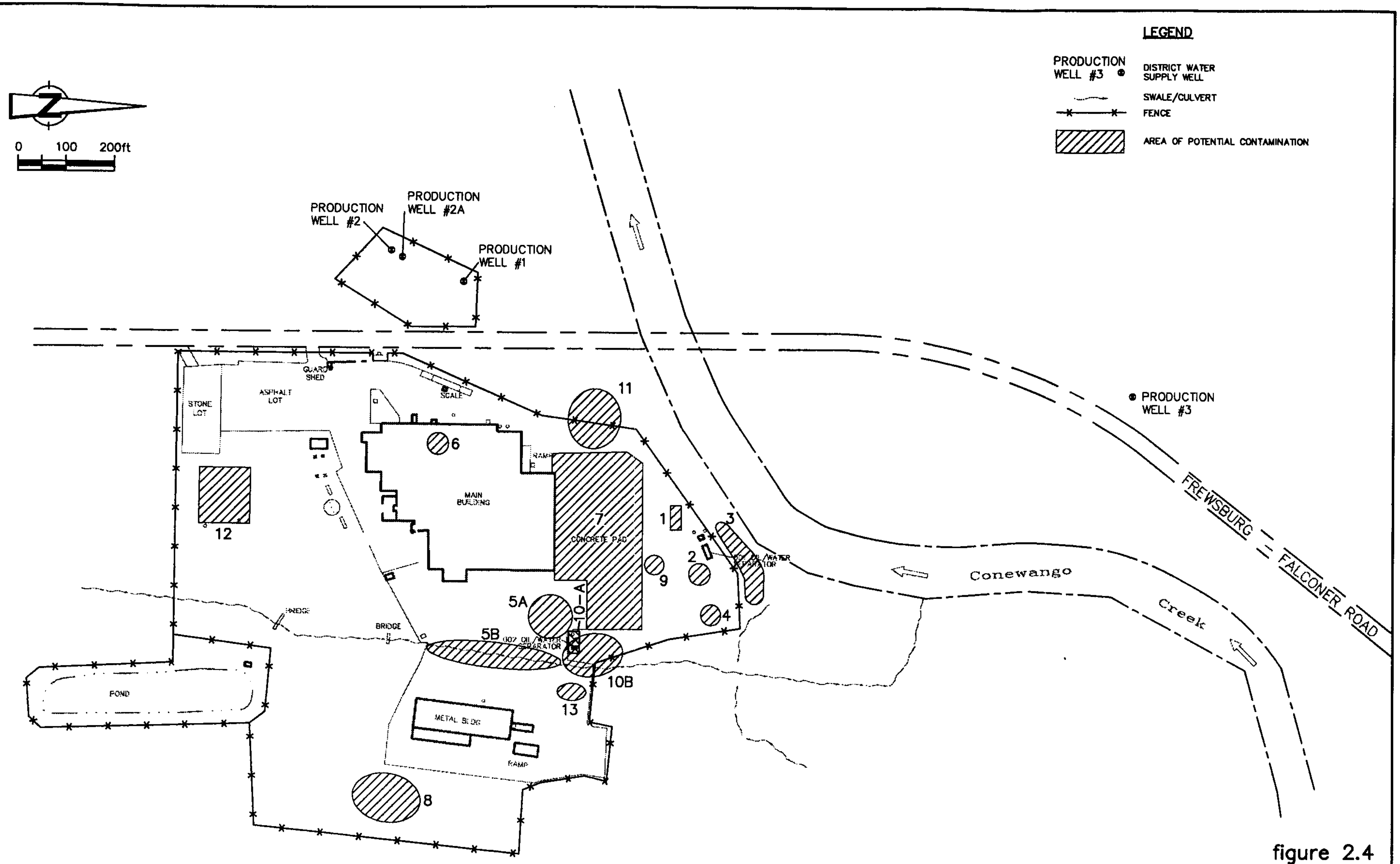

figure 2.4

AREAS OF POTENTIAL CONTAMINATION
REMEDIAL INVESTIGATION PROGRAM
VACAIR ALLOYS DIVISION
Frewsburg, New York

CRA

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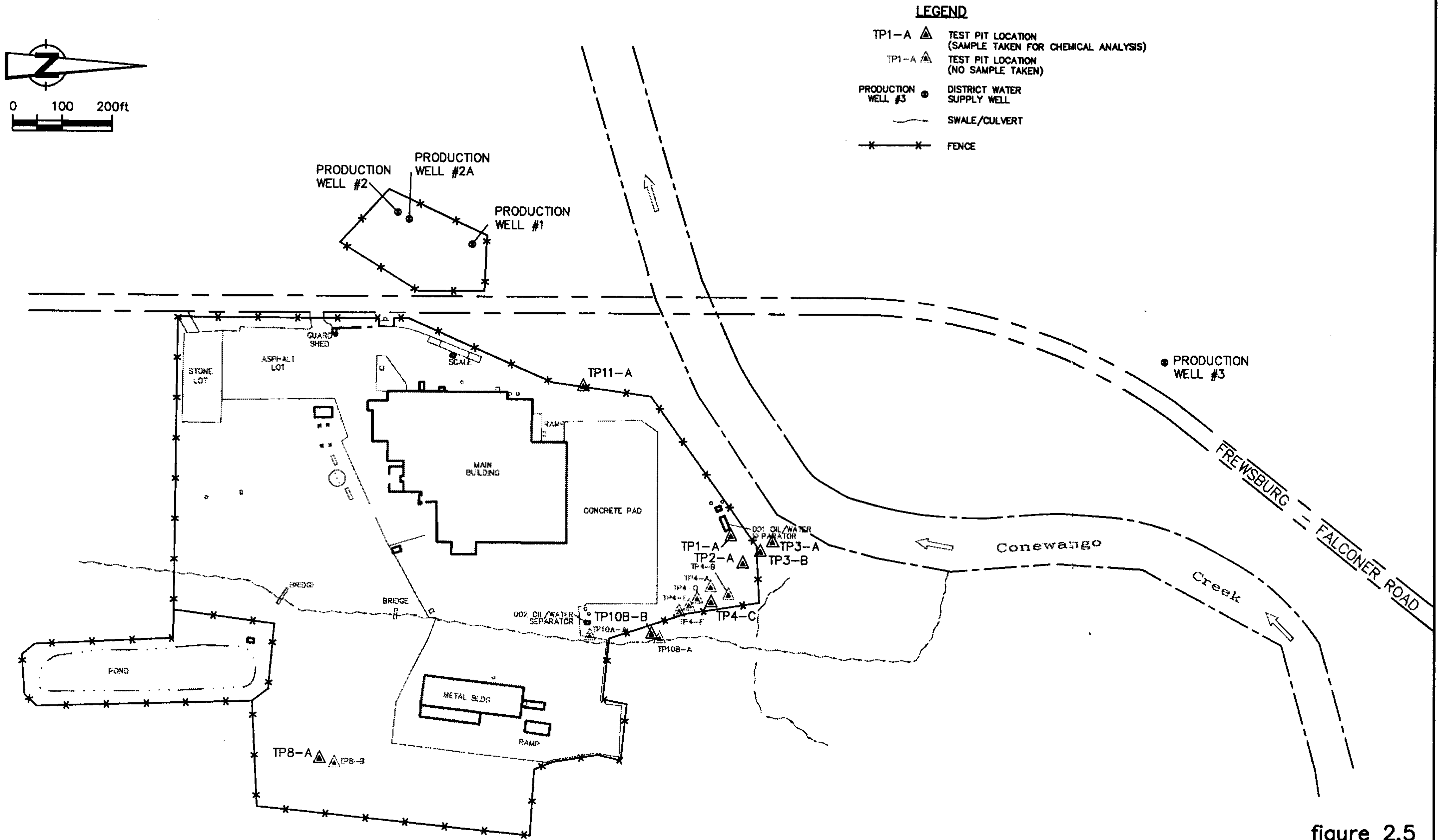

figure 2.5

SI TEST PIT PROGRAM
REMEDIAL INVESTIGATION PROGRAM
VACAIR ALLOYS DIVISION
Frewsburg, New York

CRA

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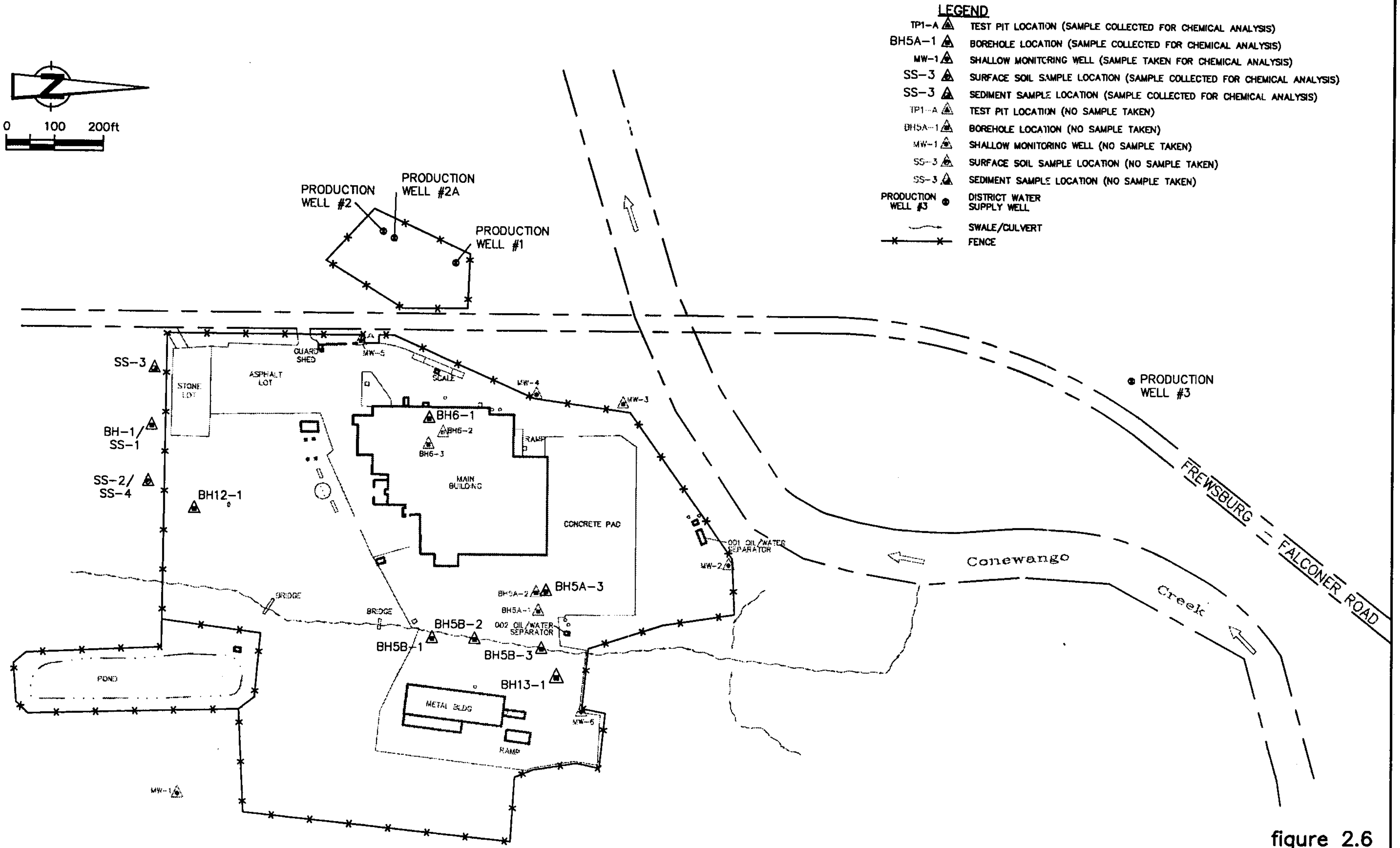

figure 2.6

SI SOIL SAMPLING LOCATIONS
REMEDIAL INVESTIGATION PROGRAM
VACAIR ALLOYS DIVISION
Frewsburg, New York

CRA

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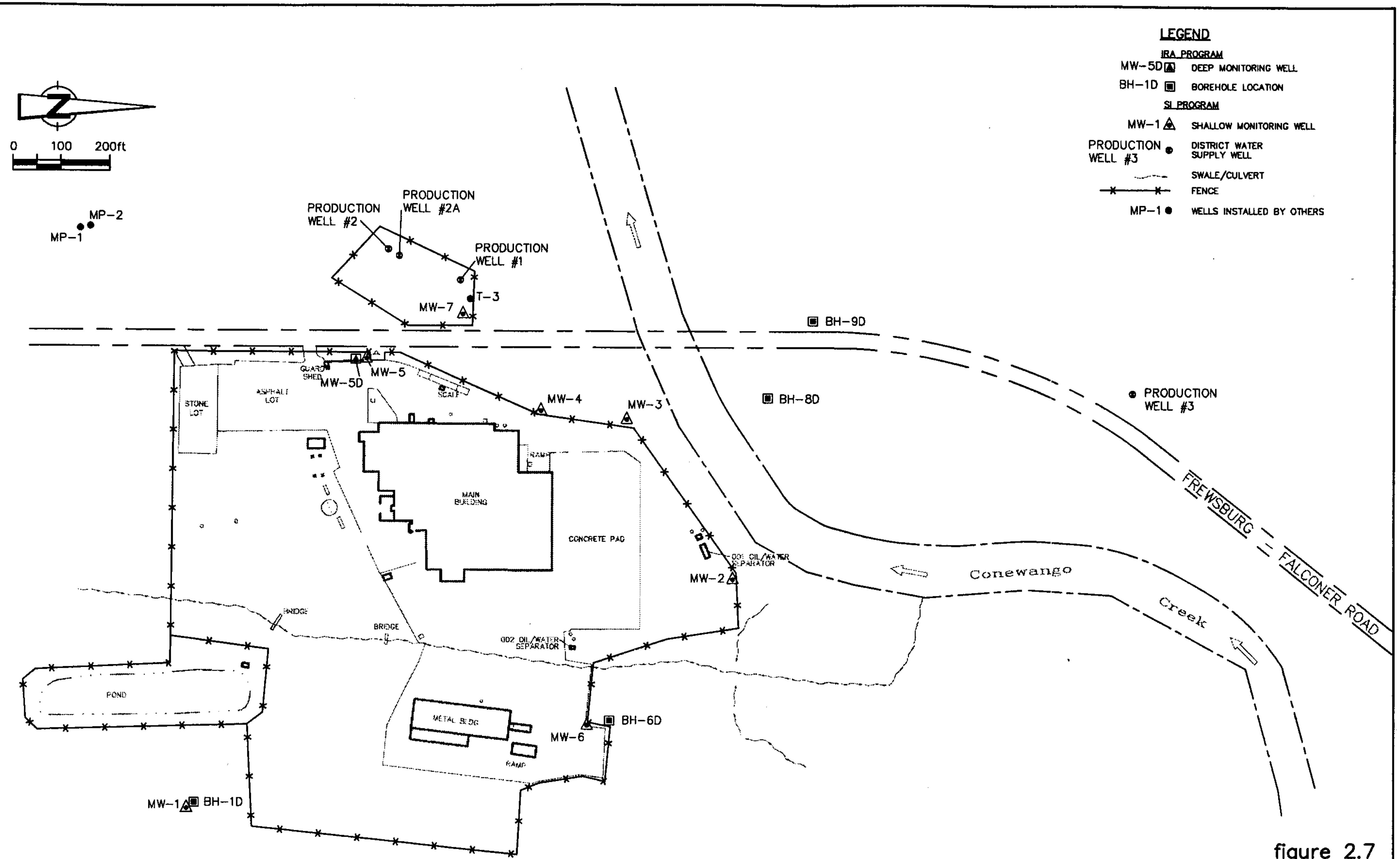


figure 2.7

SI MONITORING WELL/IRA BOREHOLE AND MONITORING WELL LOCATIONS
REMEDIAL INVESTIGATION PROGRAM
VACAIR ALLOYS DIVISION
Frewsburg, New York

CRA

2326 (19) MAR 17/94(NF) REV.0 (P-32)

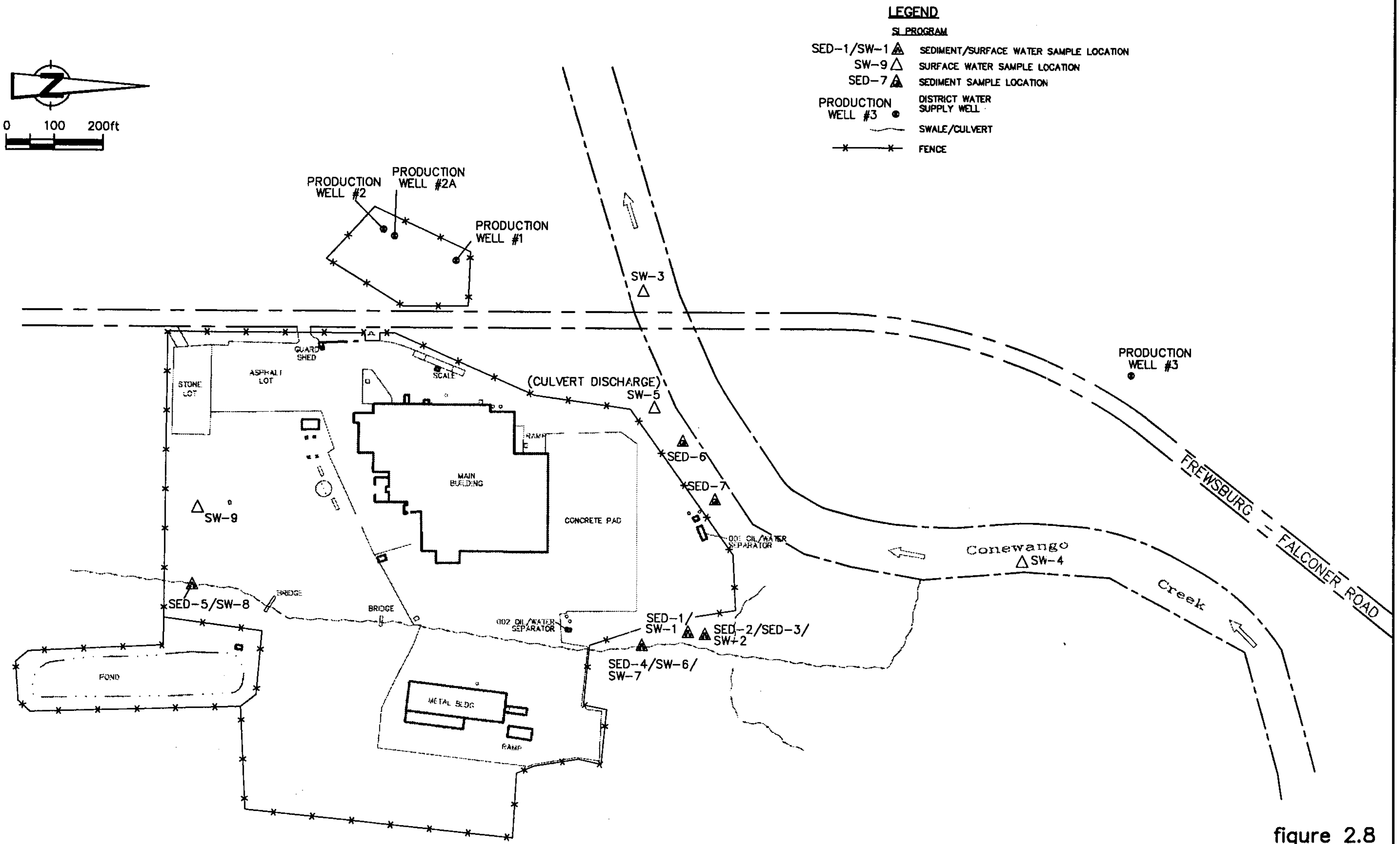
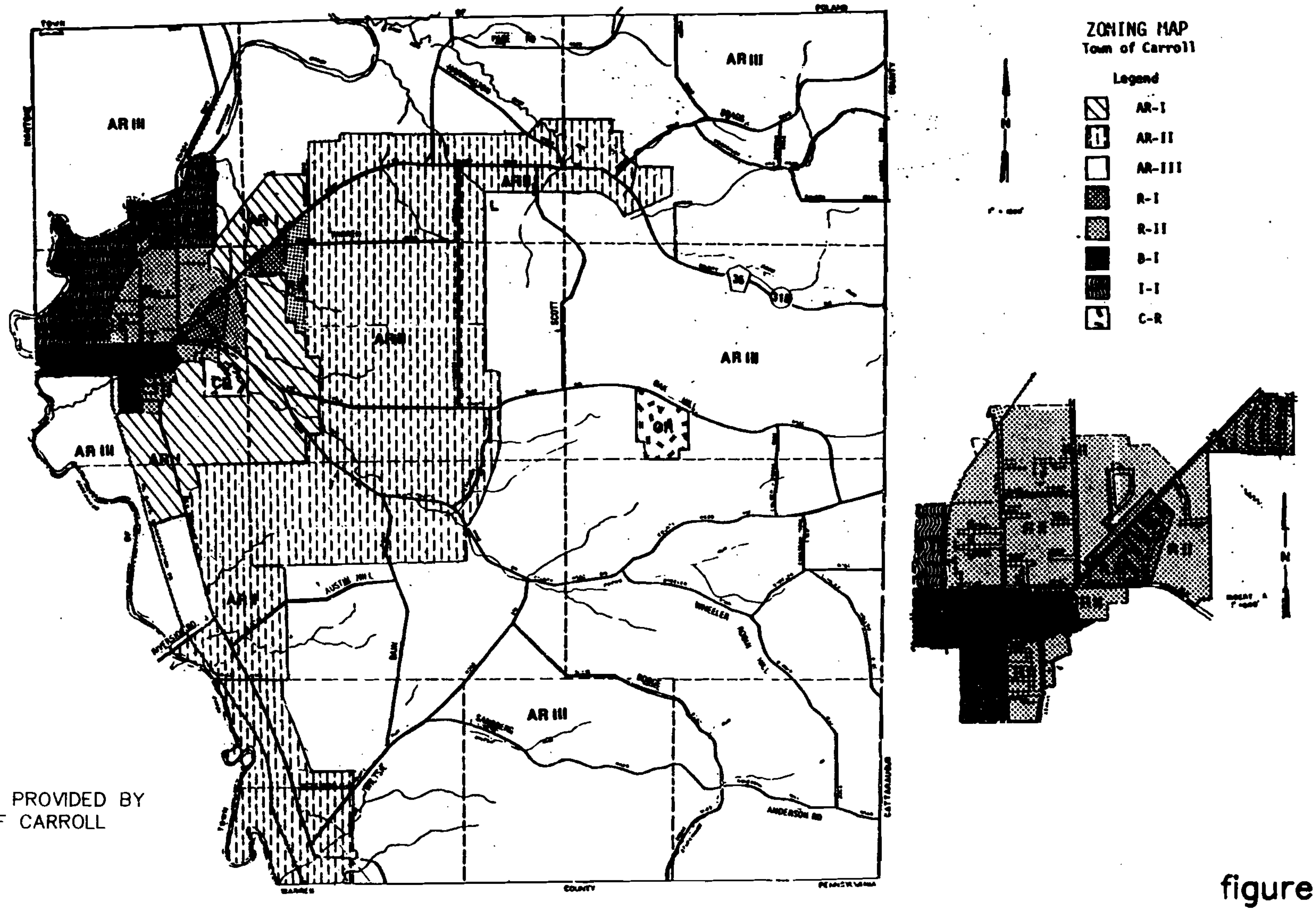


figure 2.8

SI SURFACE WATER/SEDIMEMT SAMPLING LOCATIONS
REMEDIAL INVESTIGATION PROGRAM
VACAIR ALLOYS DIVISION
Frewsburg, New York

CRA



SOURCE:

INFORMATION PROVIDED BY
THE TOWN OF CARROLL

CRA

figure 3.1

ZONING MAP
REMEDIAL INVESTIGATION PROGRAM
VACAIR ALLOYS DIVISION
Frewsburg, New York

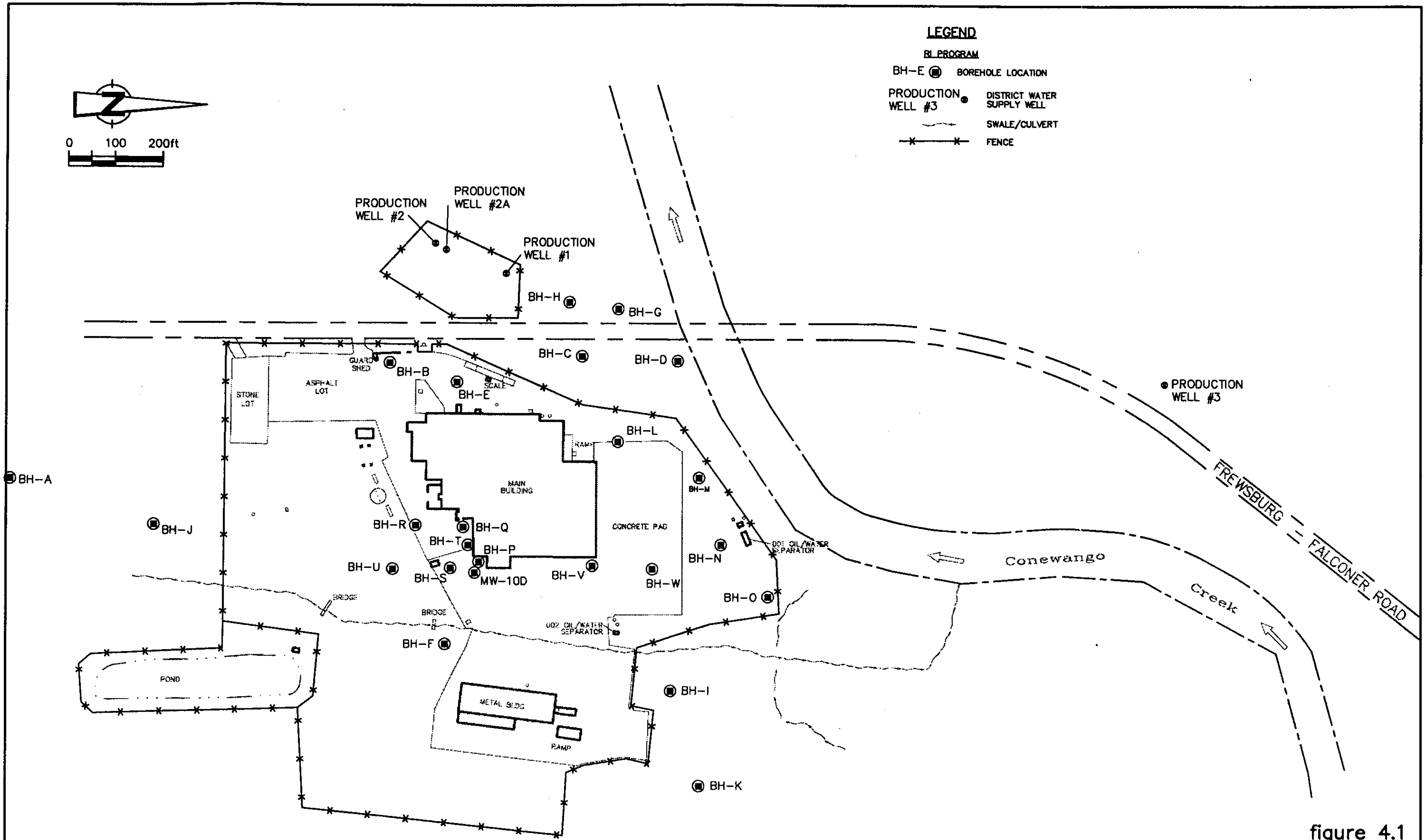


figure 4.1

RI BOREHOLE LOCATIONS
REMEDIAL INVESTIGATION PROGRAM
VACAIR ALLOYS DIVISION
Frewsburg, New York

CRA

2326 (19) MAR 21/94(NF) REV.0 (P-34)

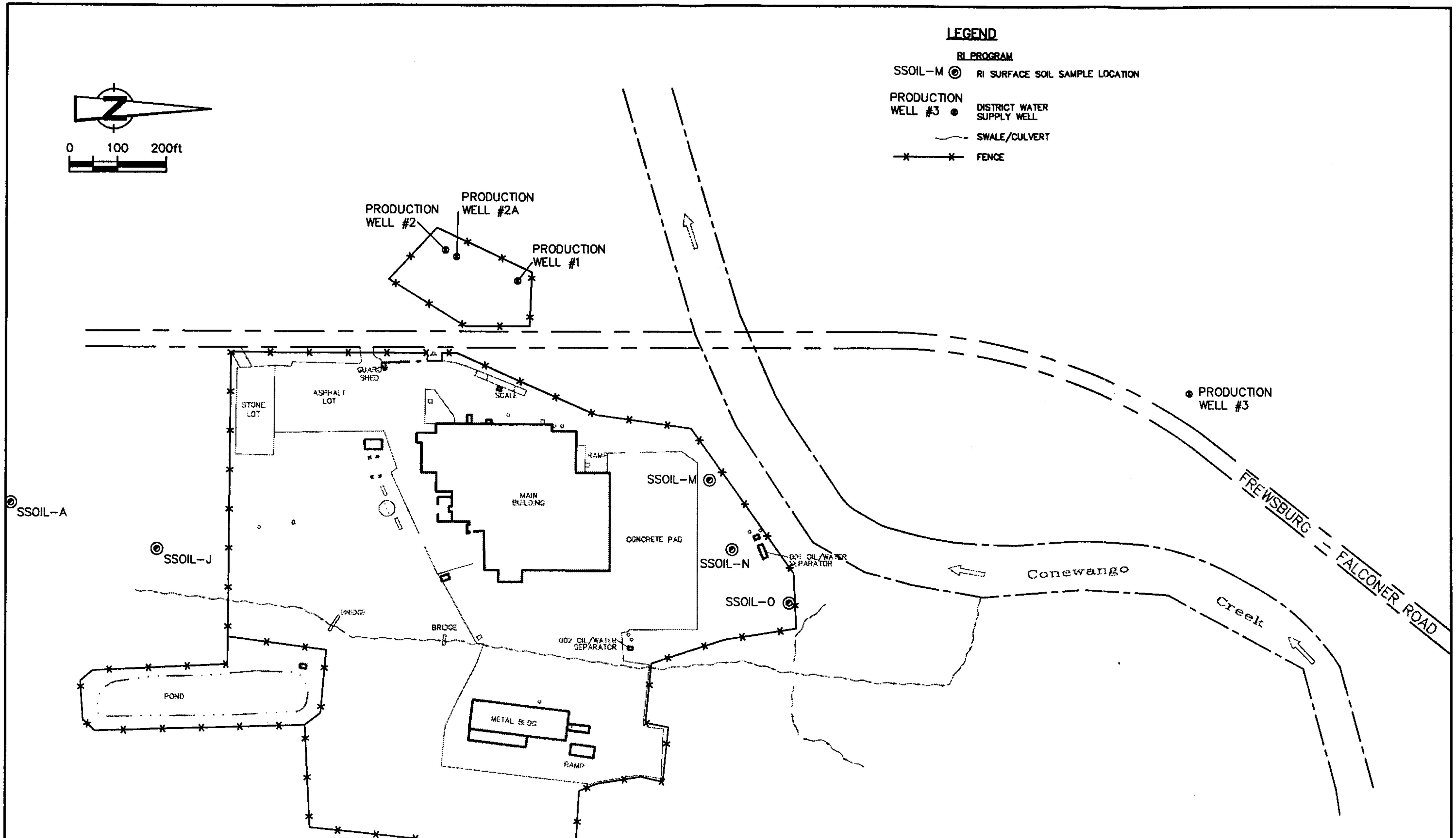


figure 4.2

RI SURFACE SOIL SAMPLE LOCATIONS
REMEDIAL INVESTIGATION PROGRAM
VACAIR ALLOYS DIVISION
Frewsburg, New York

CRA

2326 (19) MAR 21/94(NF) REV.0 (P-35)

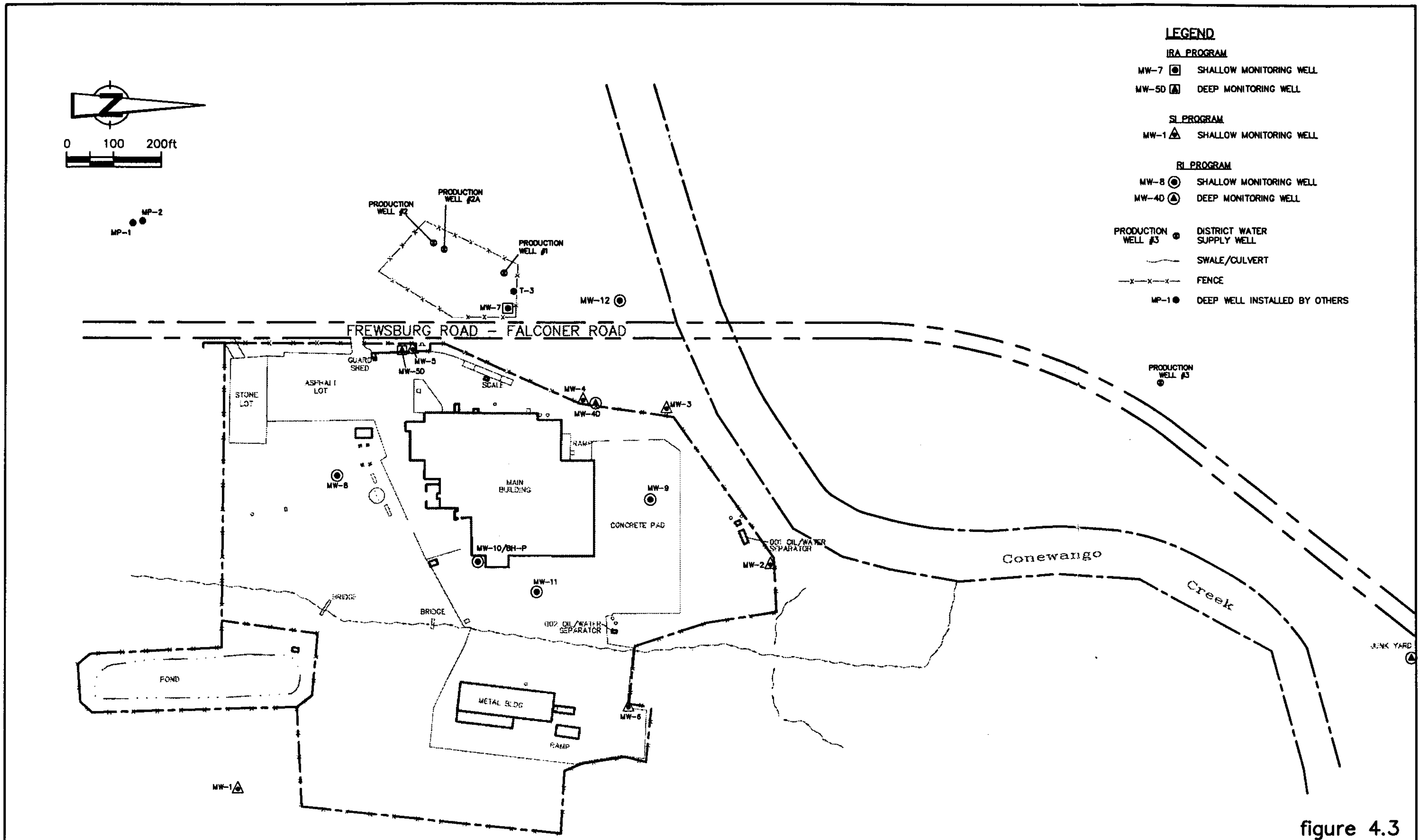


figure 4.3

MONITORING WELL LOCATIONS
REMEDIAL INVESTIGATION PROGRAM
VACAIR ALLOYS DIVISION
Frewsburg, New York

CRA

2326 (19) MAR 17/94(NF) REV.0 (P-36)

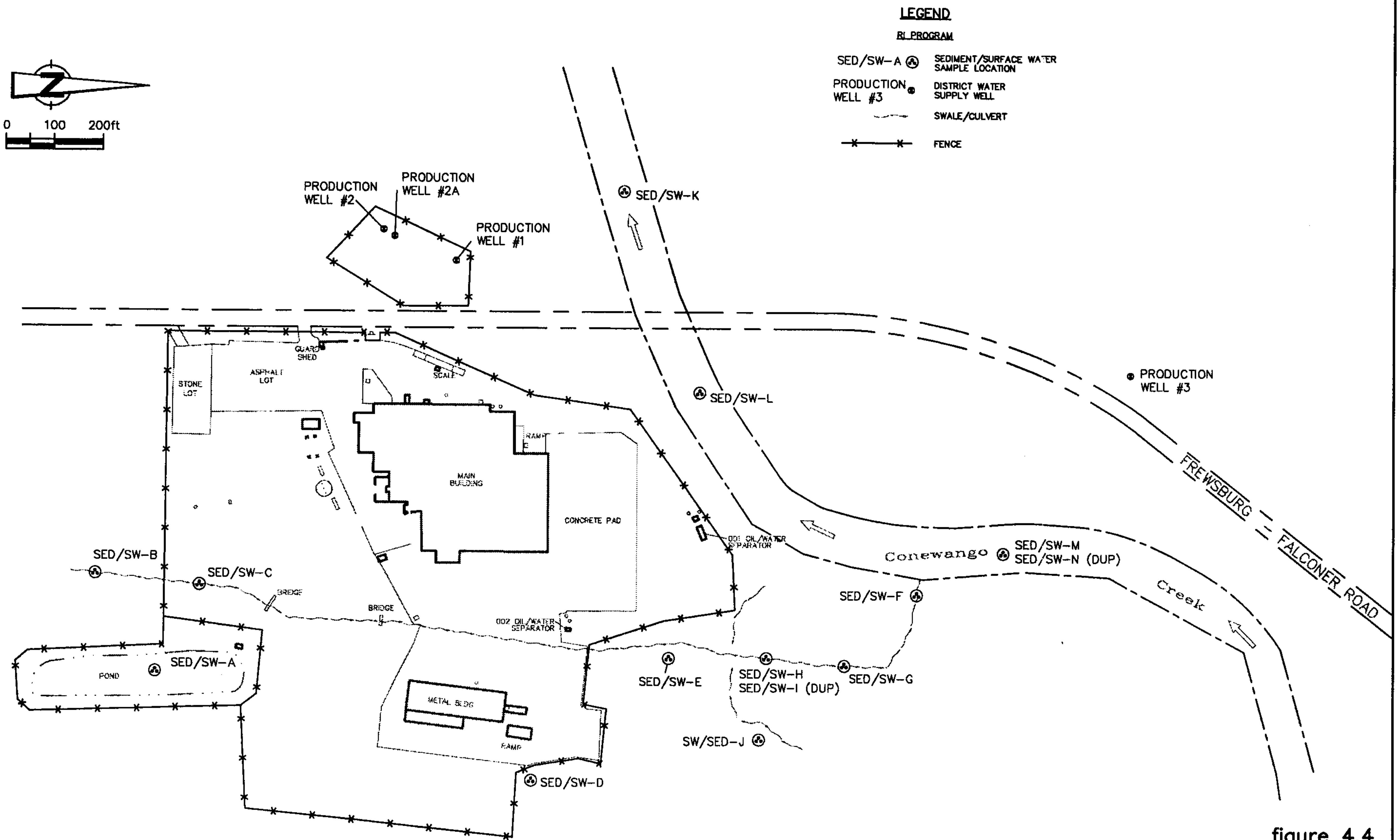


figure 4.4

RI SURFACE WATER/ SEDIMENT LOCATIONS
REMEDIAL INVESTIGATION PROGRAM
VACAIR ALLOYS DIVISION
Frewsburg, New York

CRA

2326 (19) MAR 17/94(NF) REV.0 (P-37)

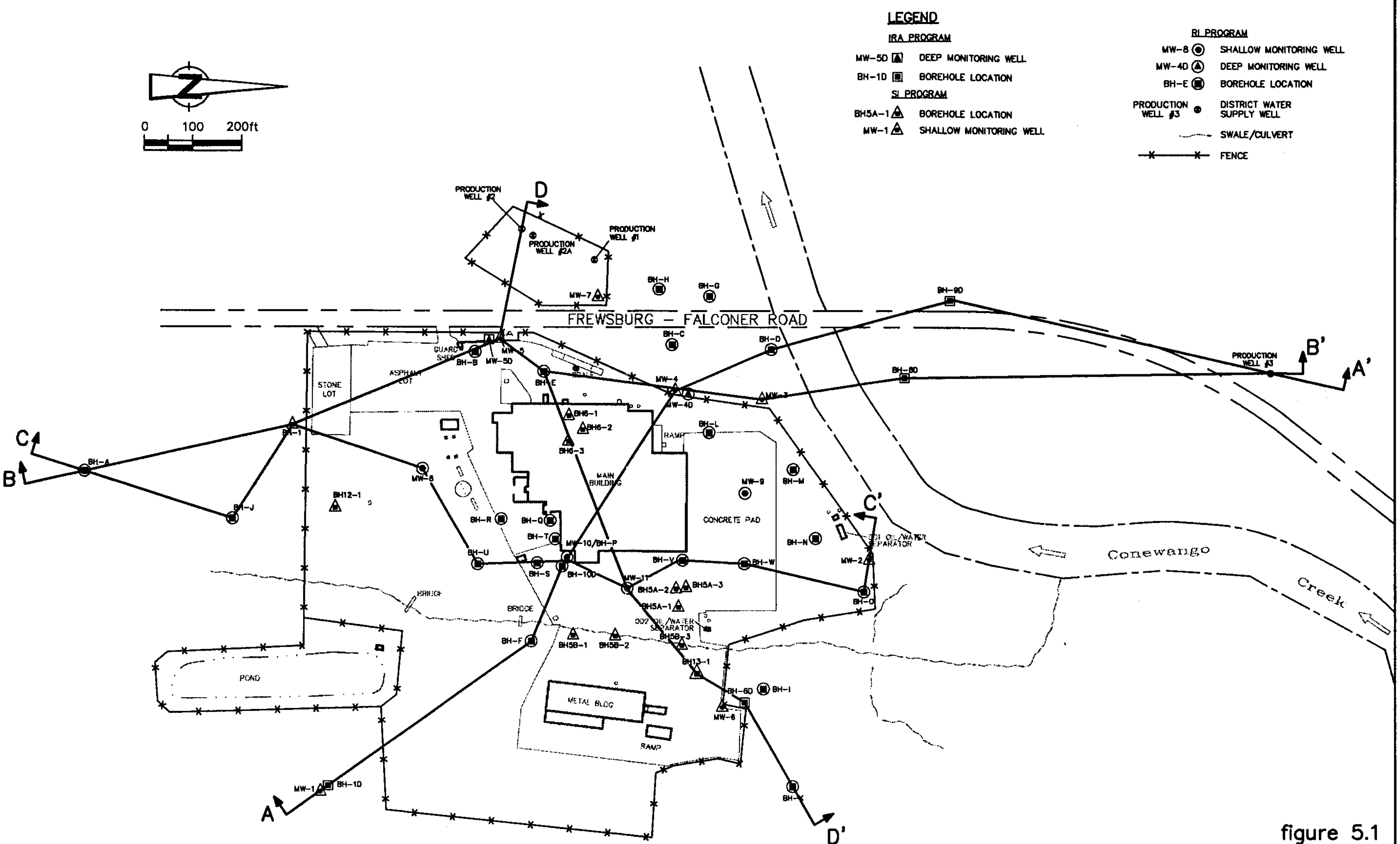


figure 5.1

GEOLOGIC CROSS-SECTION ALIGNMENTS
REMEDIAL INVESTIGATION PROGRAM
VACAIR ALLOYS DIVISION
Frewsburg, New York

CRA

2326 (19) MAR 21/94(NF) REV.0 (P-38)

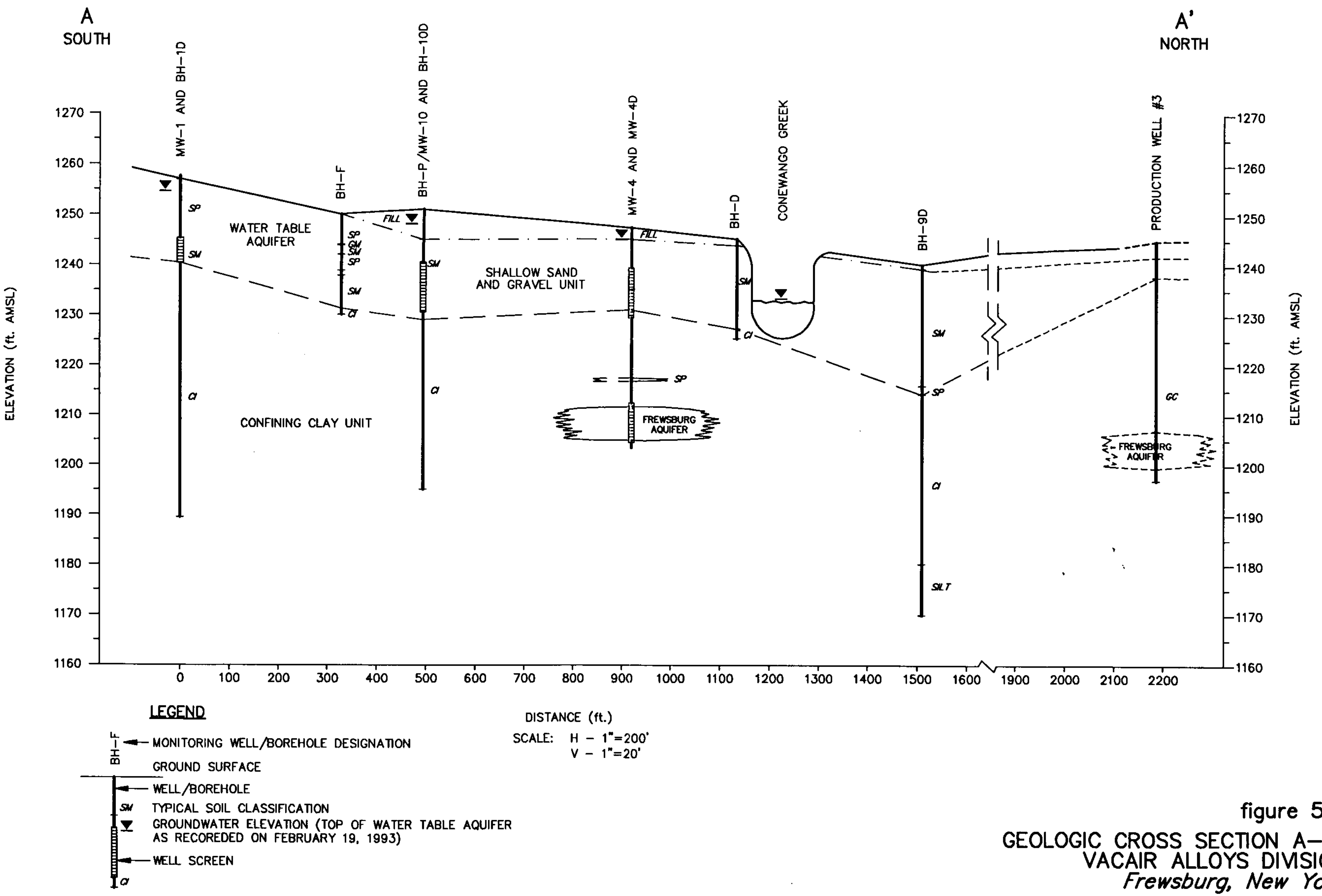


figure 5.2

GEOLOGIC CROSS SECTION A–A'
VACAIR ALLOYS DIVISION
Frewsburg, New York

CRA

2326 (19) MAR 20/94(NF) REV.0 (X-11)

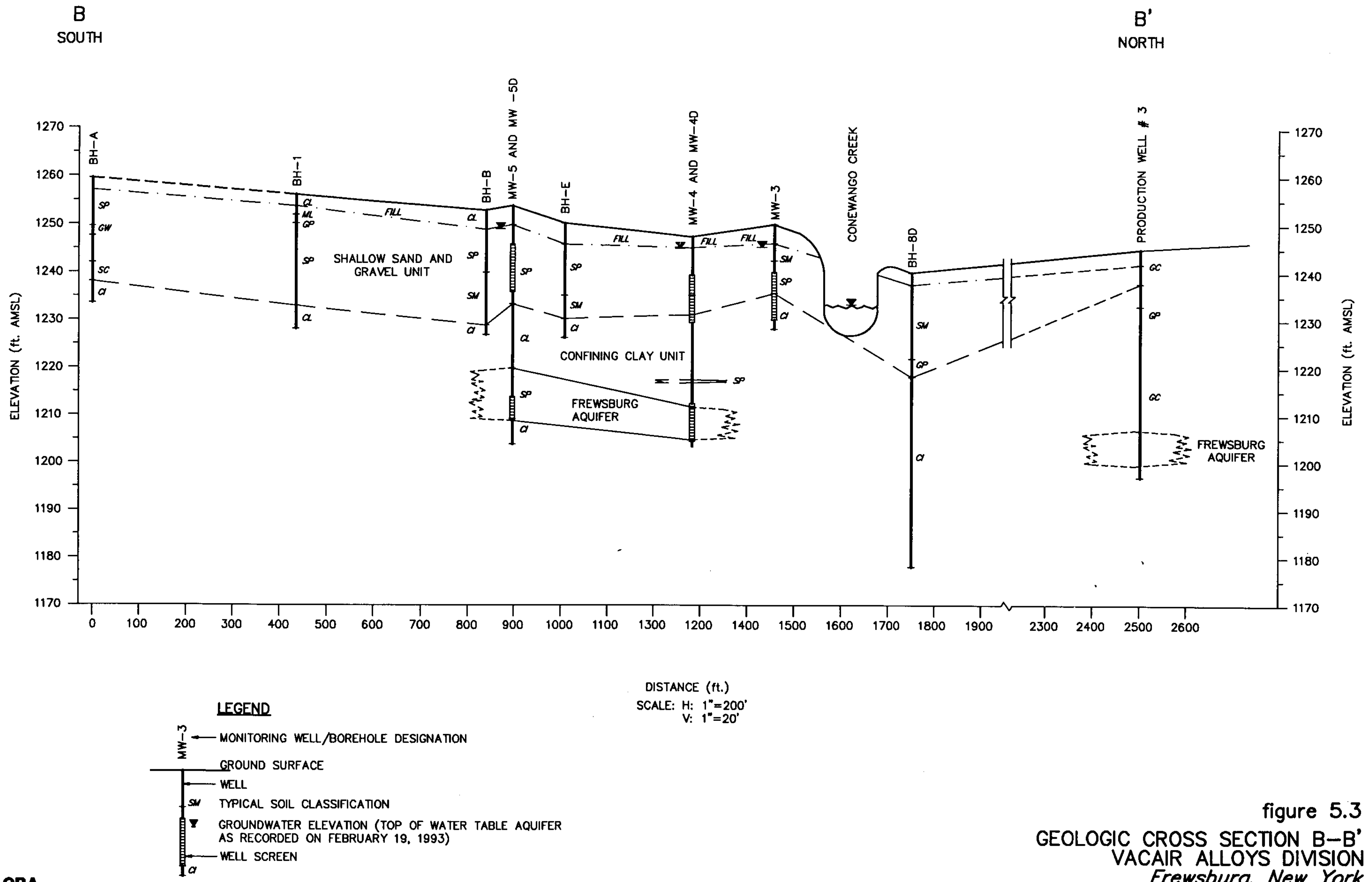


figure 5.3

GEOLOGIC CROSS SECTION B–B'
VACAIR ALLOYS DIVISION
Frewsburg, New York

CRA

2326 (19) MAR 20/94(NF) REV.0 (X-12)

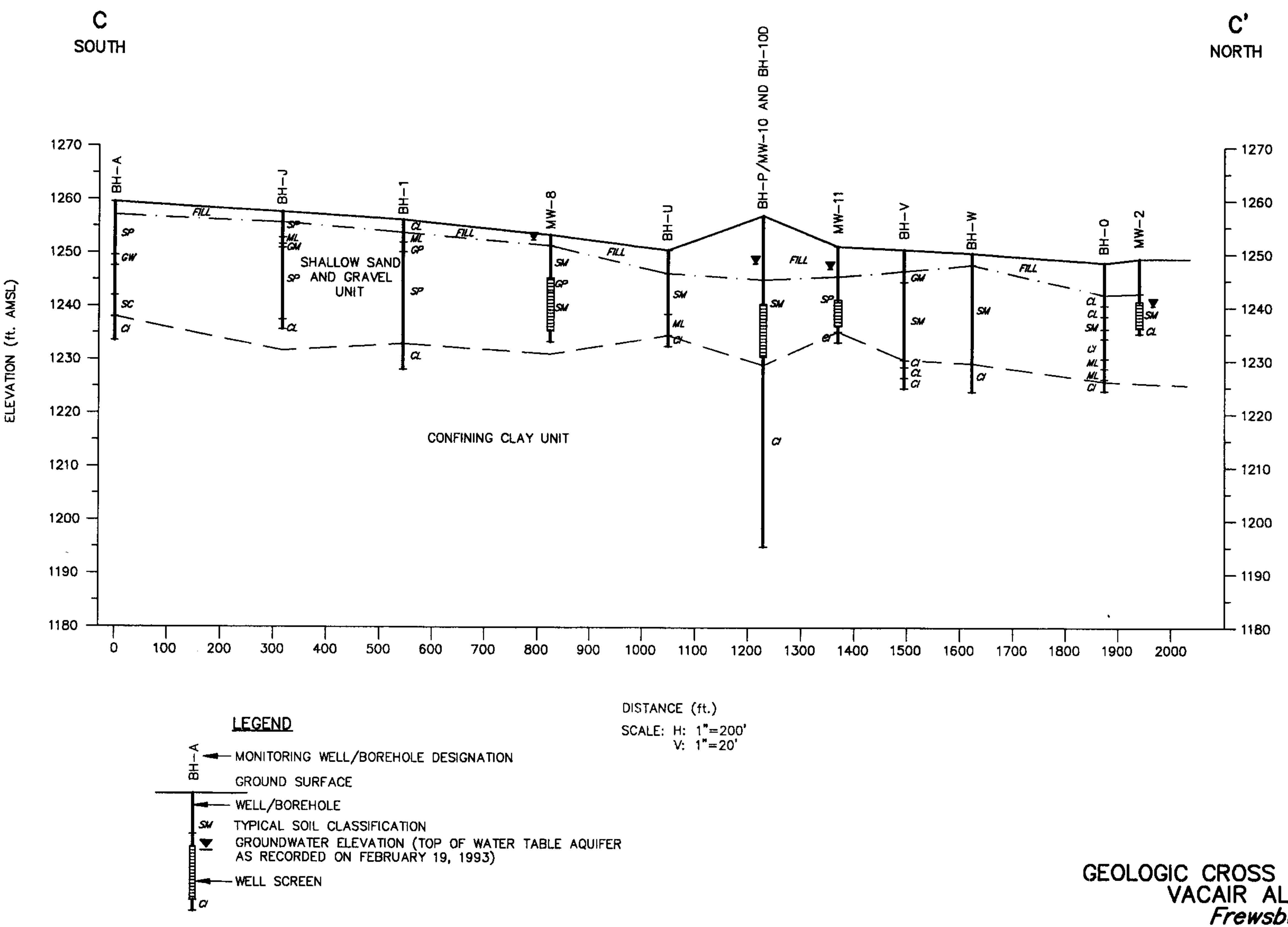


figure 5.4

GEOLOGIC CROSS SECTION C–C'
VACAIR ALLOYS DIVISION
Frewsburg, New York

CRA

2326 (19) MAR 20/94(NF) REV.0 (X-13)

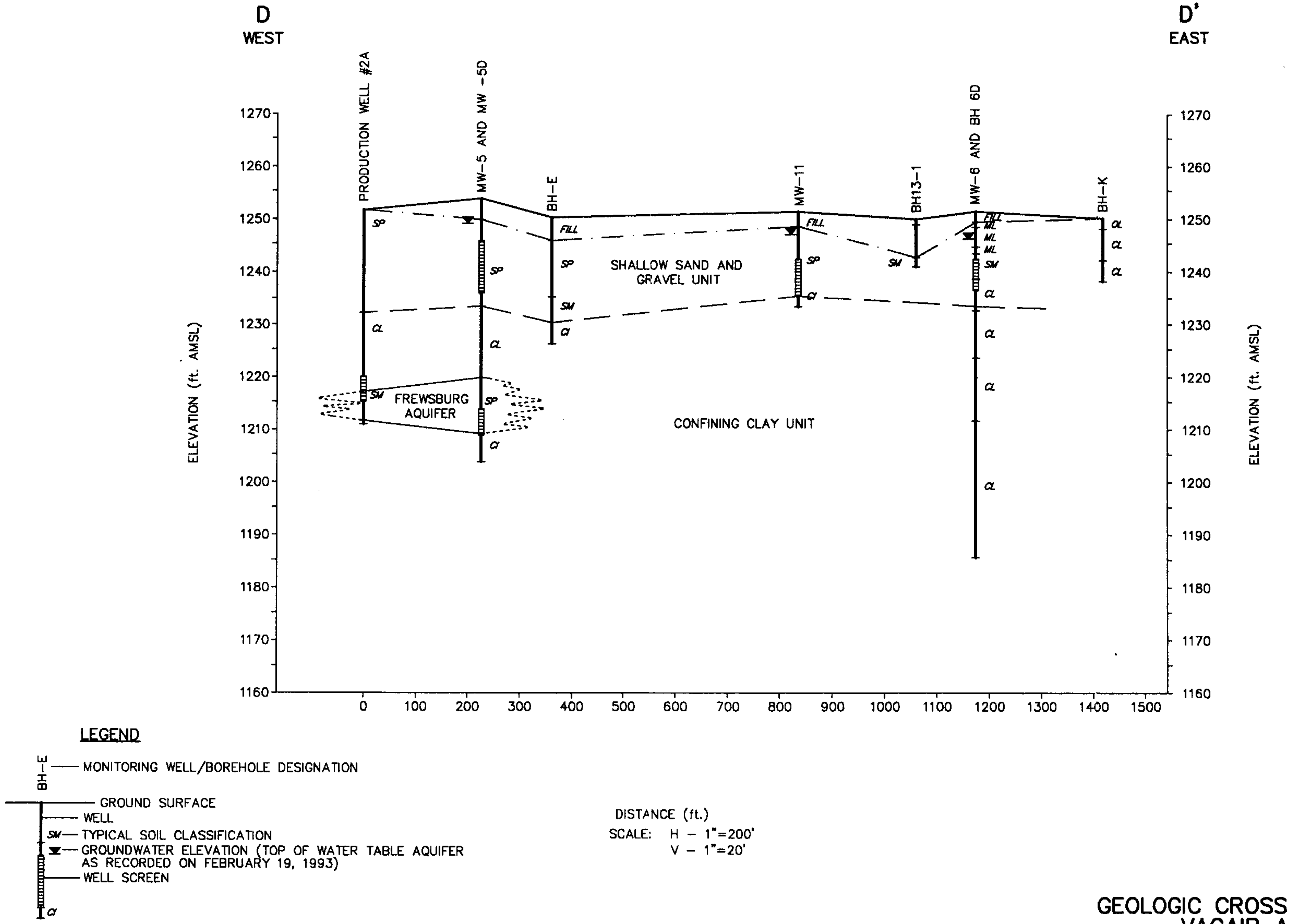


figure 5.5

GEOLOGIC CROSS SECTION D–D'
VACAIR ALLOYS DIVISION
Frewsburg, New York

CRA

2326 (19) MAR 20/94(NF) REV.0 (X–14)

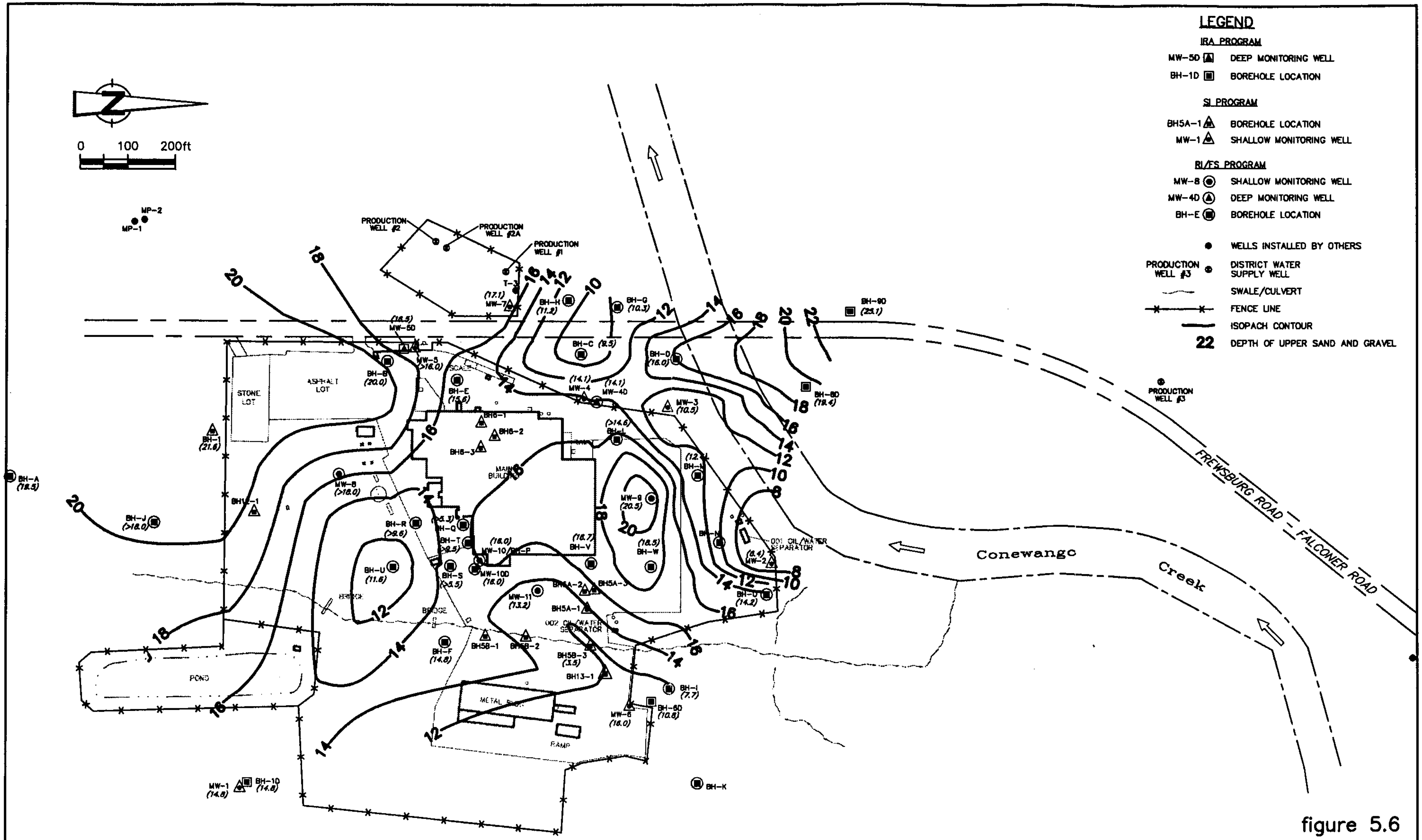


figure 5.6

ISOPACH MAP OF UPPER SAND AND GRAVEL UNIT
REMEDIAL INVESTIGATION PROGRAM
VACAIR ALLOYS DIVISION
Frewsburg, New York

CRA

2326 (19) MAR 21/94(NF) REV.0 (P-39)

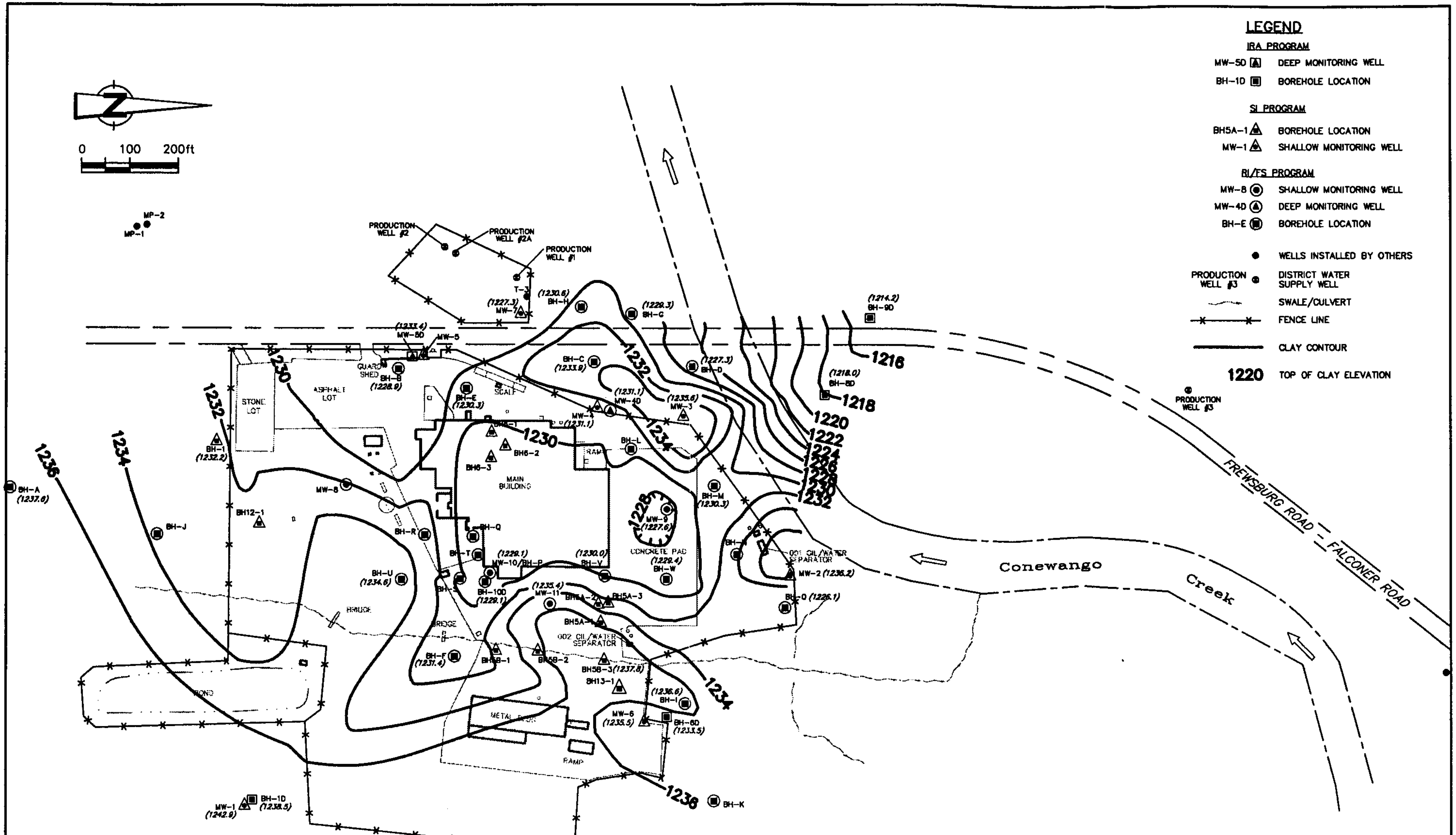


figure 5.7

TOP OF CONFINING UNIT CONTOURS
REMEDIAL INVESTIGATION PROGRAM
VACAIR ALLOYS DIVISION
Frewsburg, New York

CRA

2326 (19) MAR 21/94(NF) REV.0 (P-40)

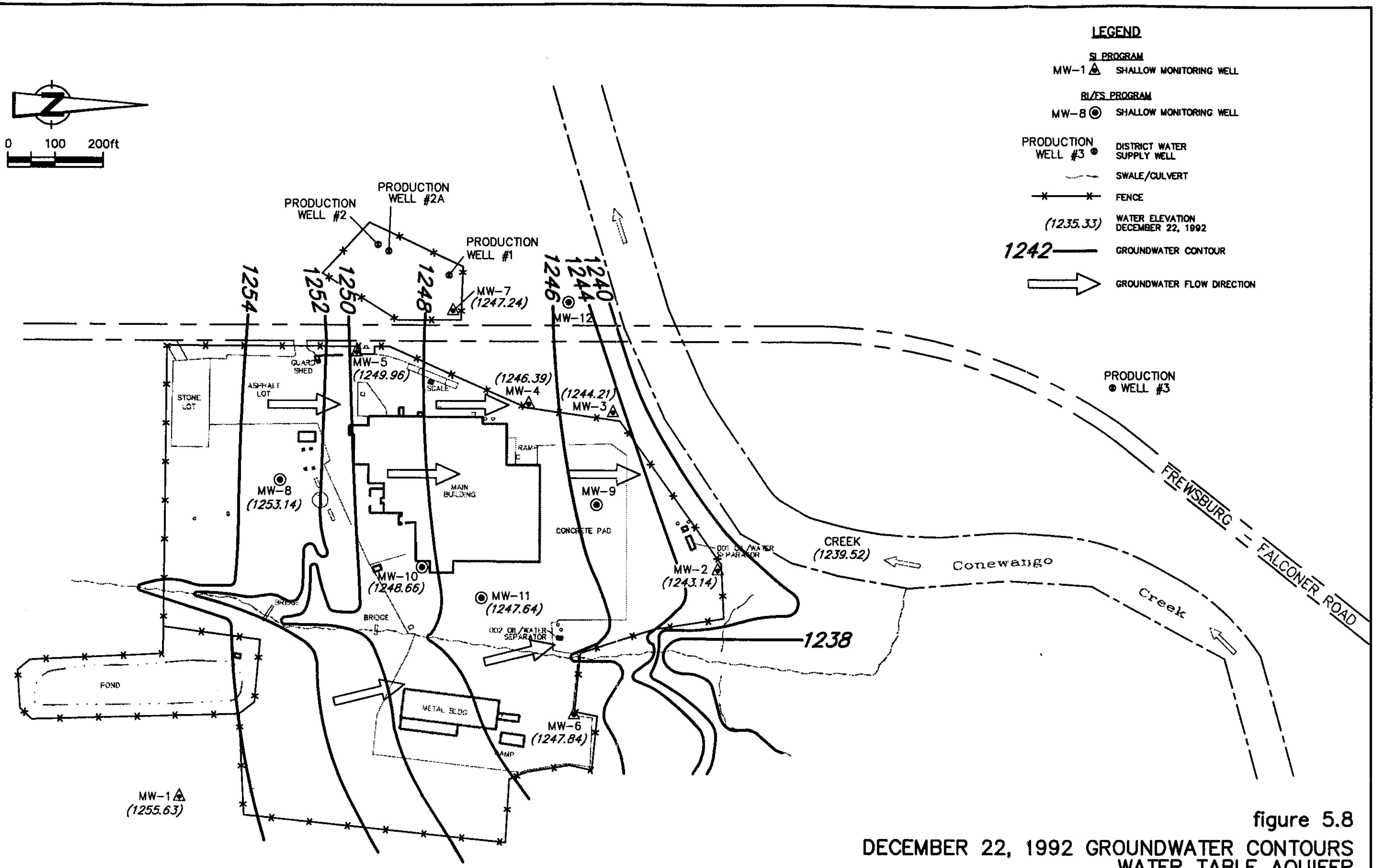


figure 5.8

DECEMBER 22, 1992 GROUNDWATER CONTOURS
WATER TABLE AQUIFER
REMEDIAL INVESTIGATION PROGRAM
VACAIR ALLOYS DIVISION
Frewsburg, New York

CRA

2326 (19) MAR 17/94(NF) REV.0 (P-41)

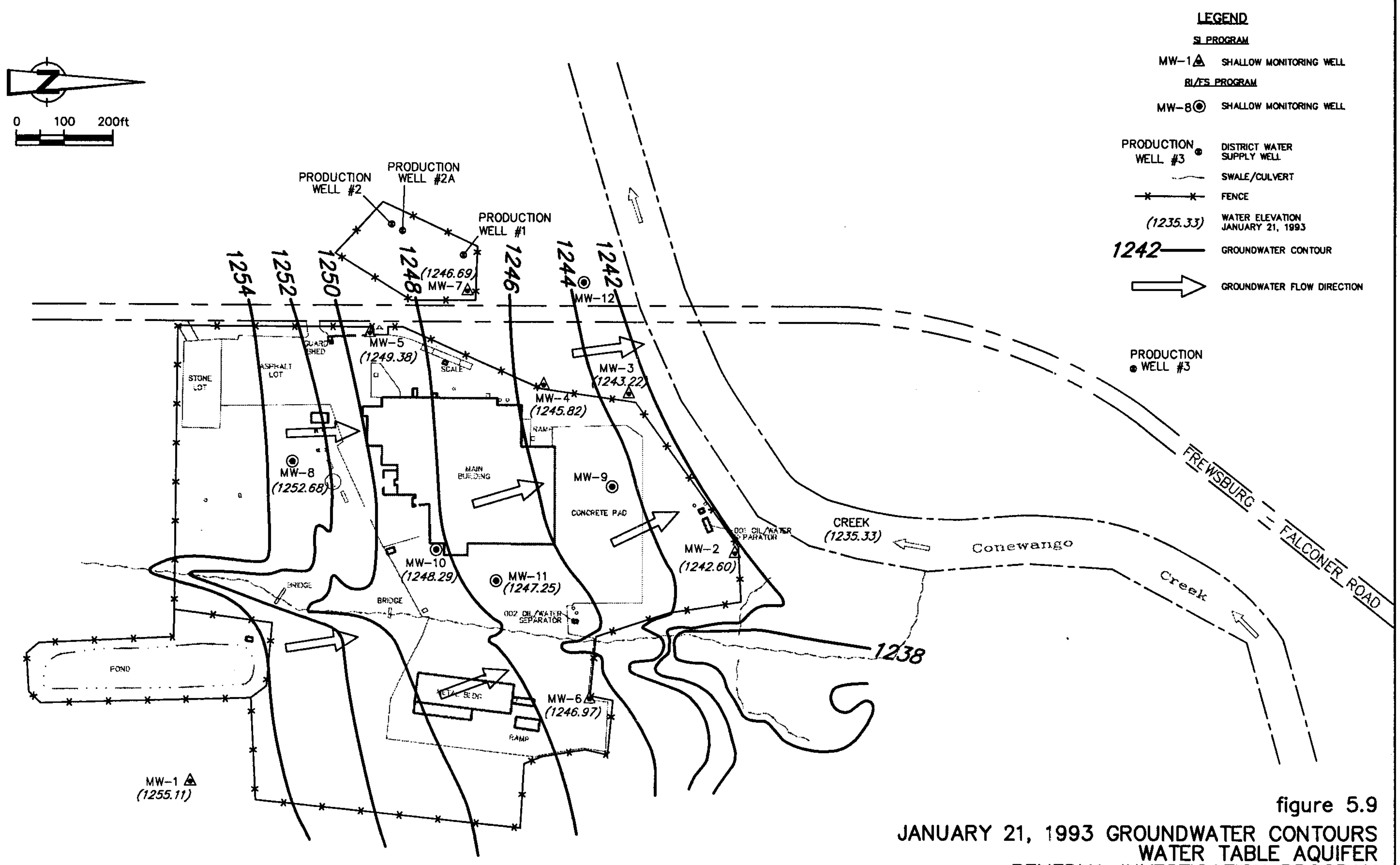


figure 5.9

JANUARY 21, 1993 GROUNDWATER CONTOURS
WATER TABLE AQUIFER
REMEDIAL INVESTIGATION PROGRAM
VACAIR ALLOYS DIVISION
Frewsburg, New York

CRA

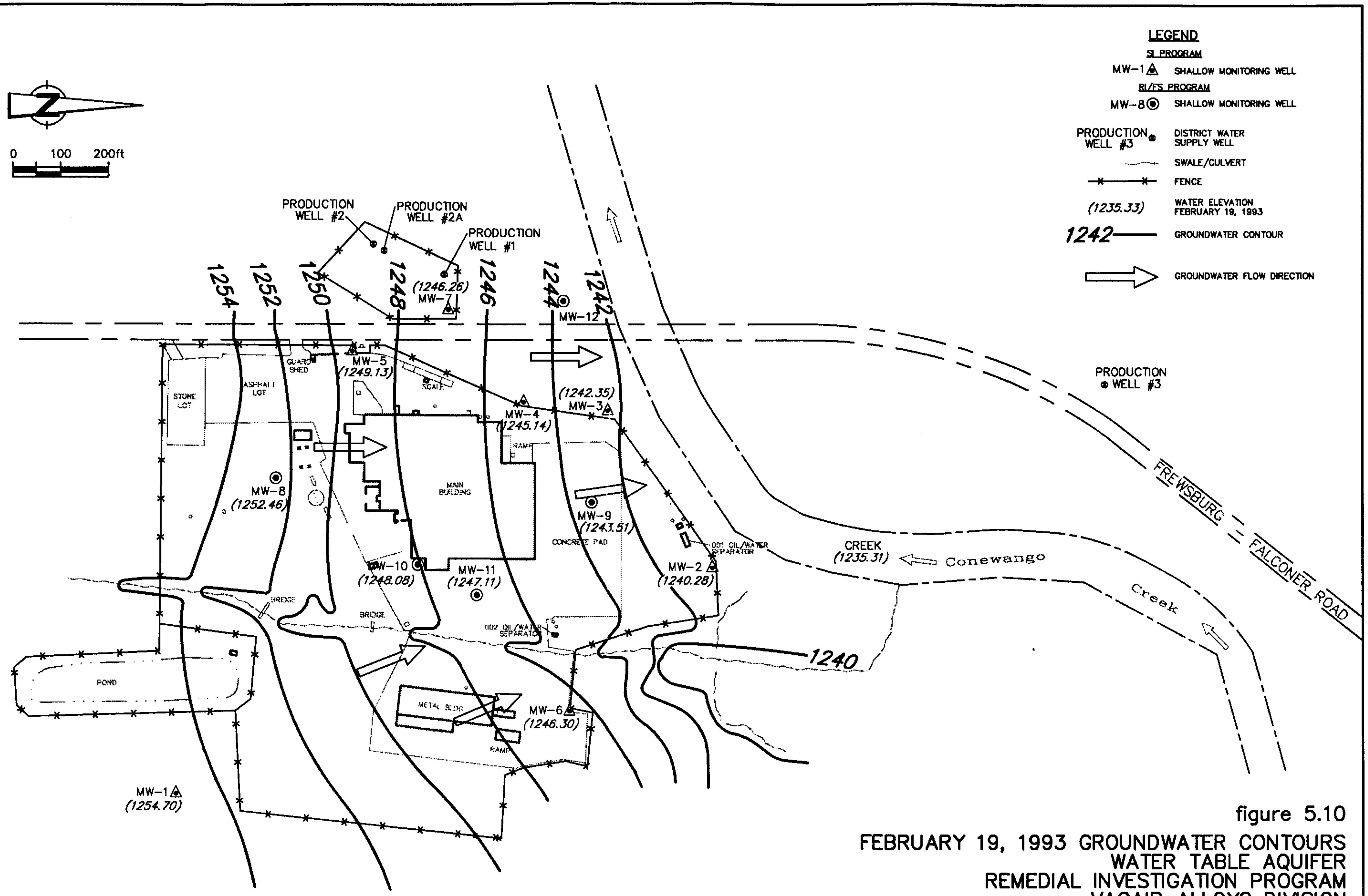


figure 5.10

FEBRUARY 19, 1993 GROUNDWATER CONTOURS
WATER TABLE AQUIFER
REMEDIAL INVESTIGATION PROGRAM
VACAIR ALLOYS DIVISION
Frewsburg, New York

CRA

2326 (19) MAR 17/94(NF) REV.0 (P-43)

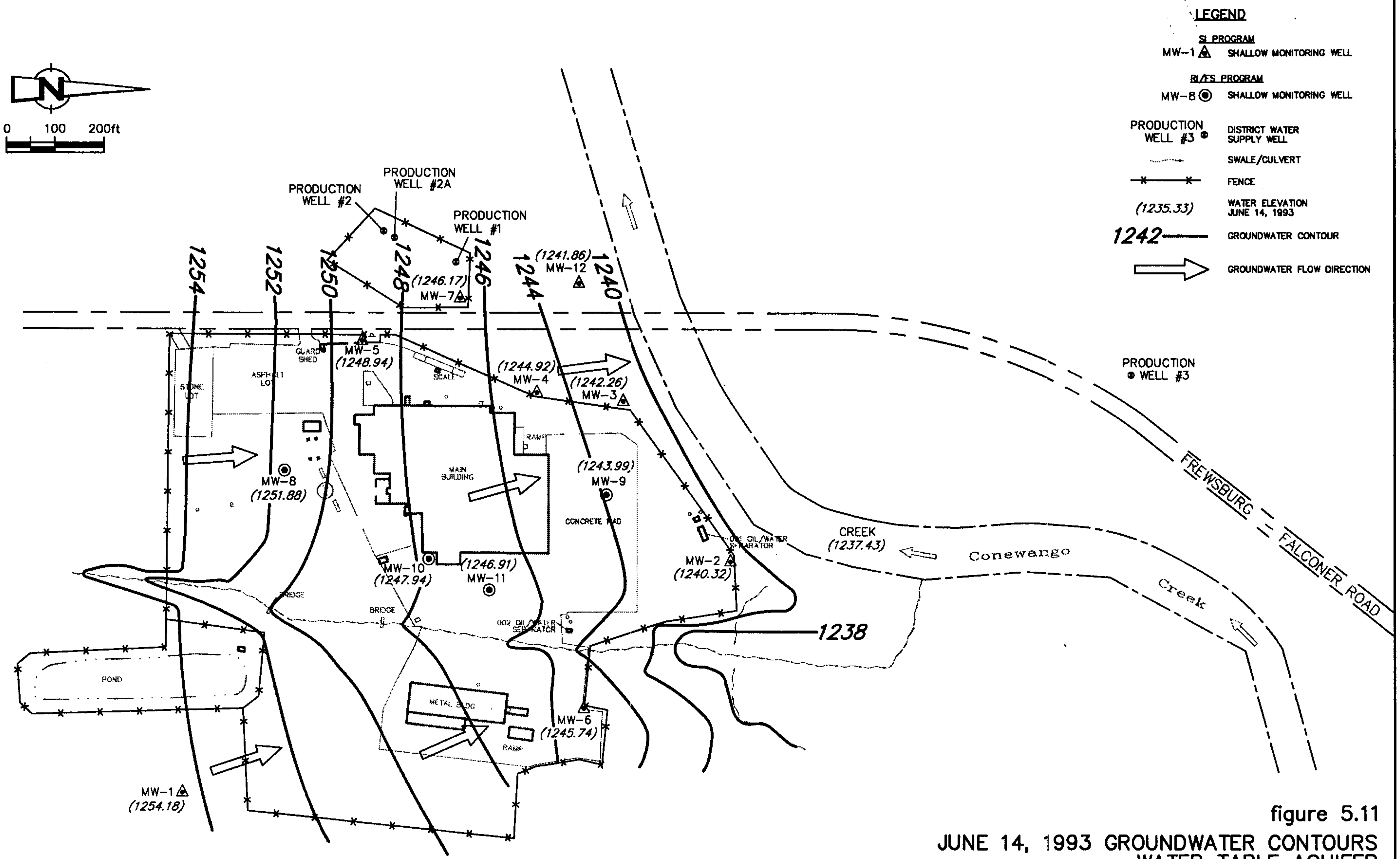


figure 5.11

JUNE 14, 1993 GROUNDWATER CONTOURS
WATER TABLE AQUIFER
REMEDIAL INVESTIGATION PROGRAM
VACAIR ALLOYS DIVISION
Frewsburg, New York

CRA

2326 (19) MAR 21/94(NF) REV.0 (P-44)

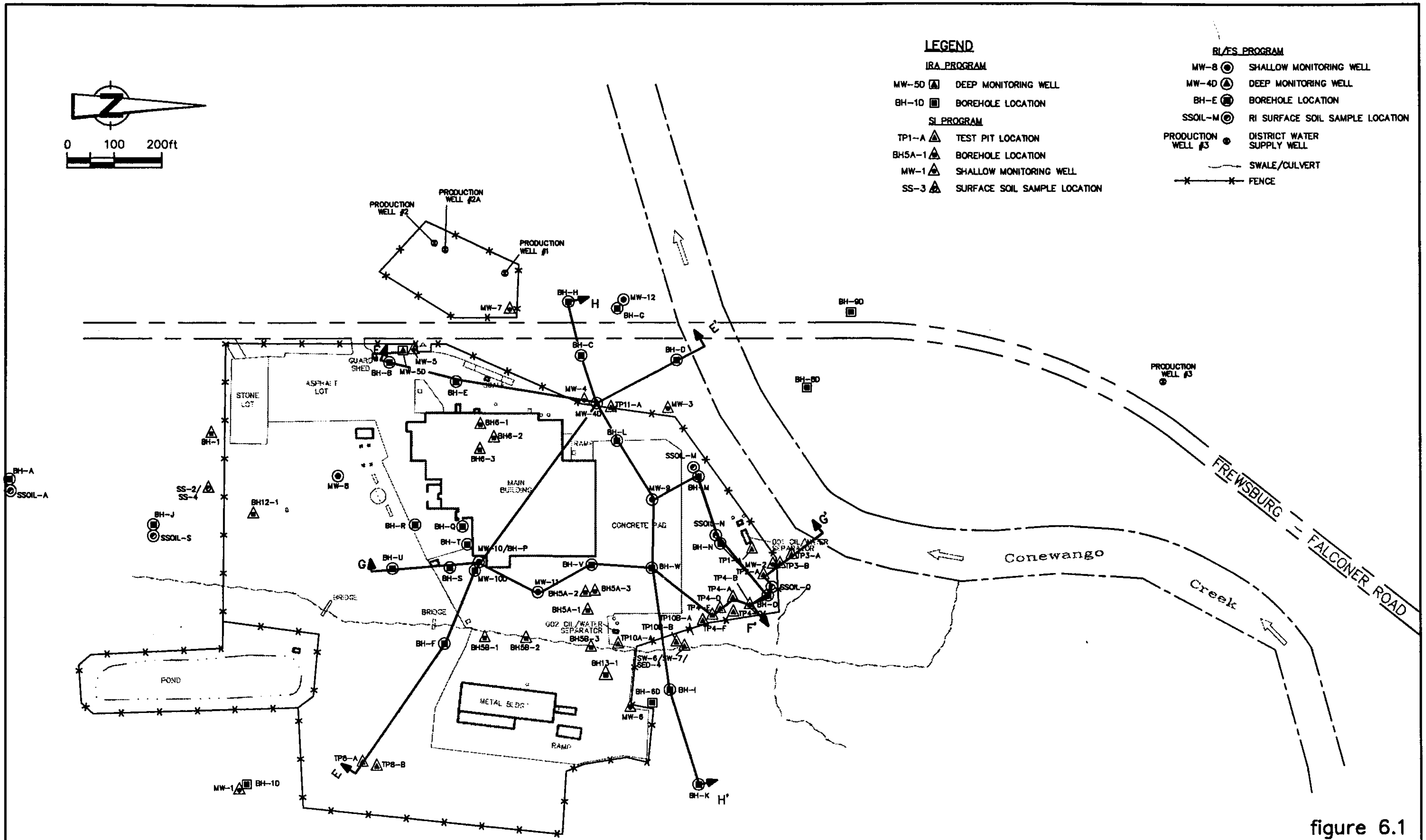


figure 6.1

SOIL VOC CONCENTRATIONS
CROSS SECTION ALIGNMENTS
VACAIR ALLOYS DIVISION
Frewsburg, New York

CRA

2326 (19) MAR 17/94(NF) REV.0 (P-45)

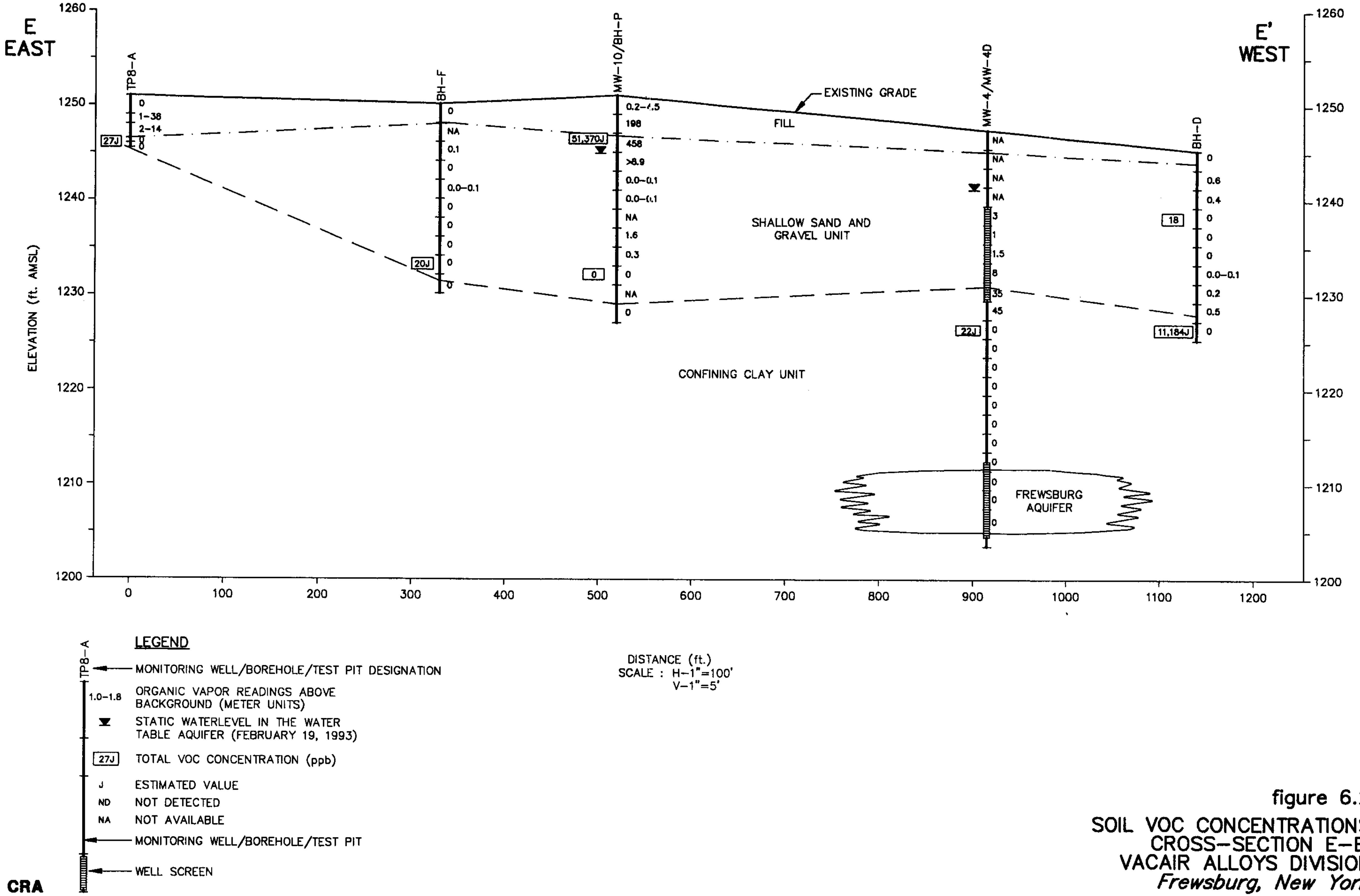
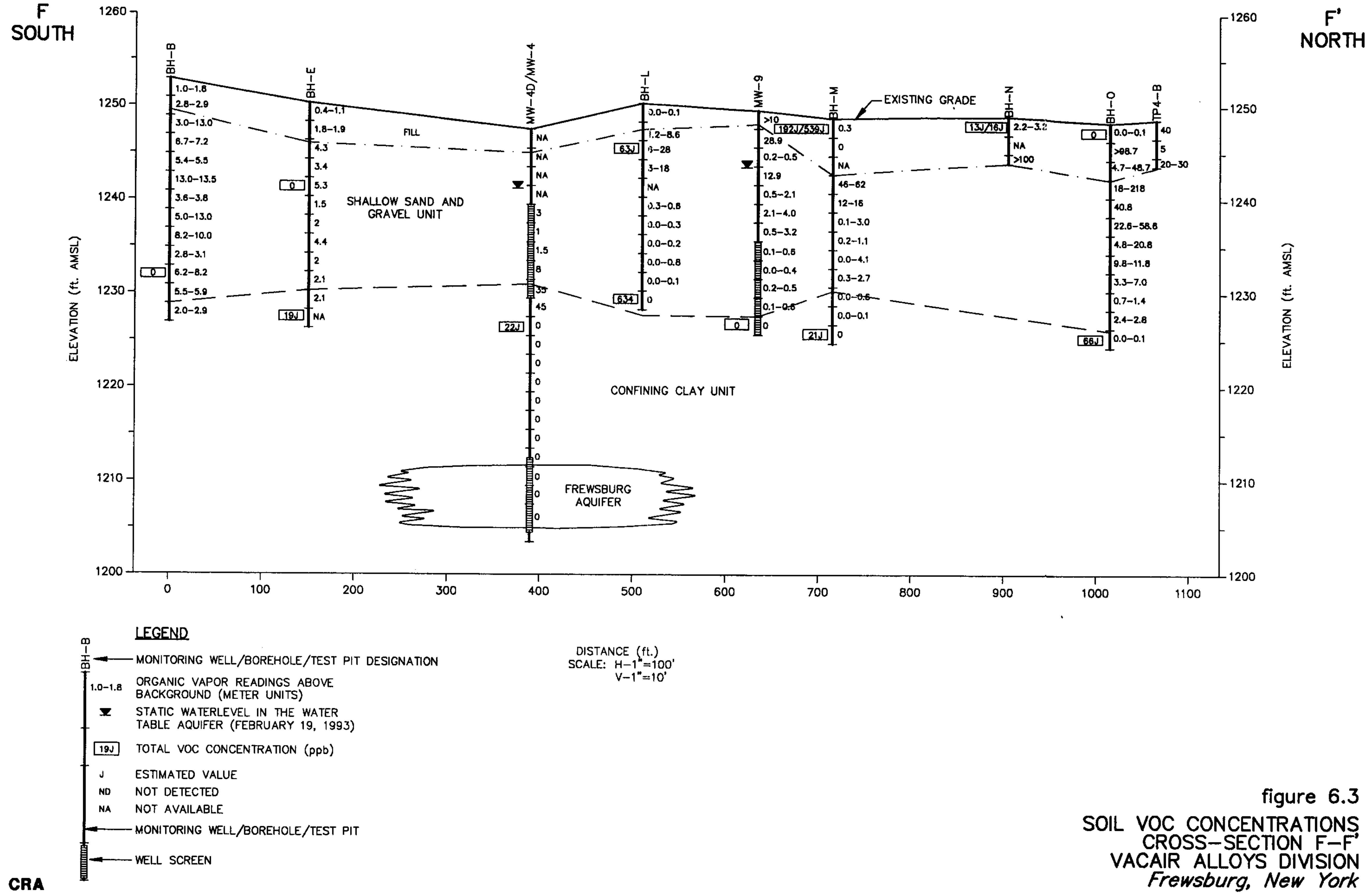


figure 6.2

SOIL VOC CONCENTRATIONS
CROSS-SECTION E-E'
VACAIR ALLOYS DIVISION
Frewsburg, New York

2326 (19) MAR 17/94(NF) REV.0 (X-15)



CRA

figure 6.3

SOIL VOC CONCENTRATIONS
CROSS-SECTION F-F'
VACAIR ALLOYS DIVISION
Frewsburg, New York

2326 (19) MAR 20/94(NF) REV.1 (X-16)

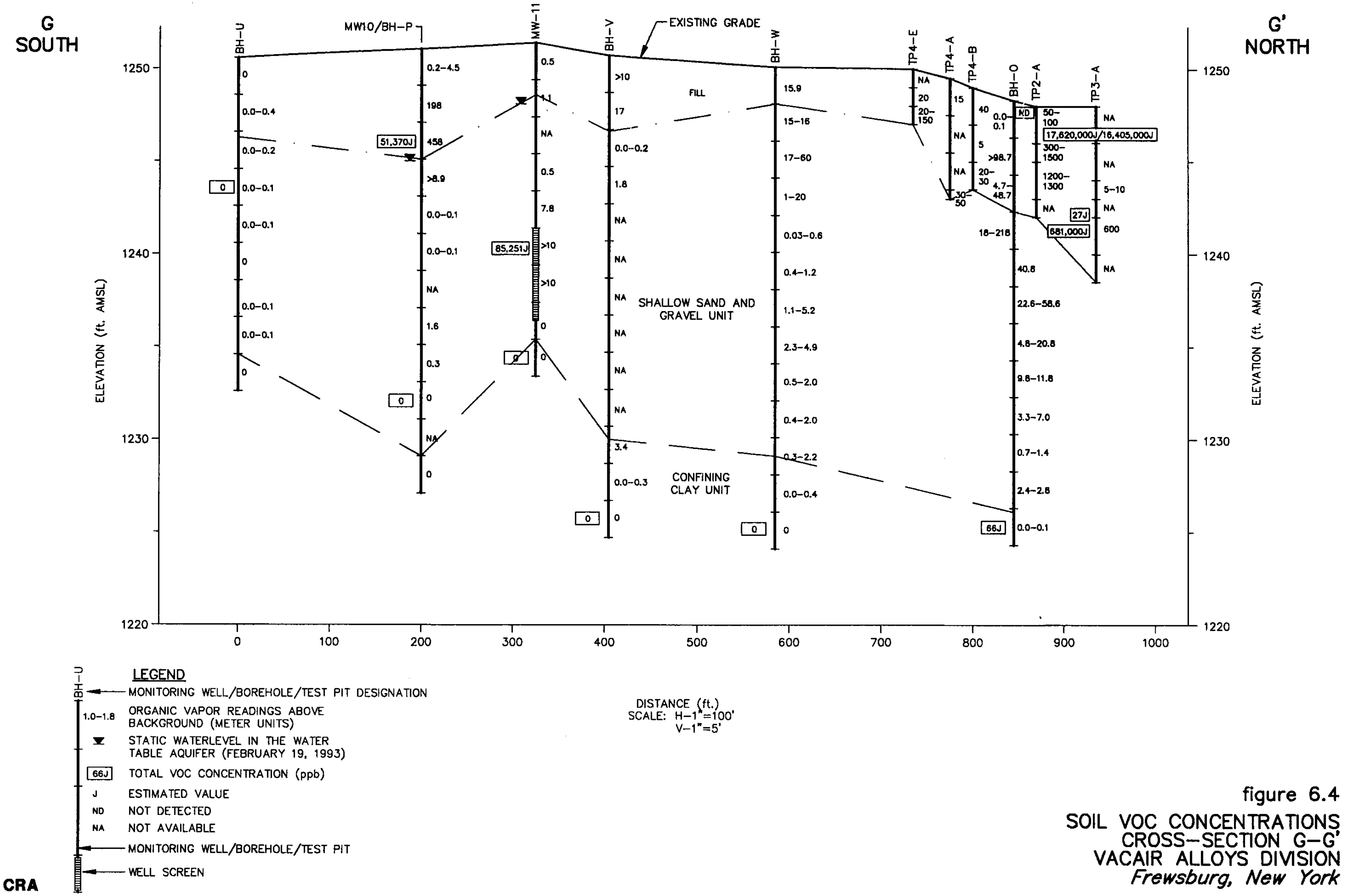


figure 6.4

SOIL VOC CONCENTRATIONS
CROSS-SECTION G-G'
VACAIR ALLOYS DIVISION
Frewsburg, New York

CRA

2326 (19) MAR 17/94(NF) REV.0 (X-17)

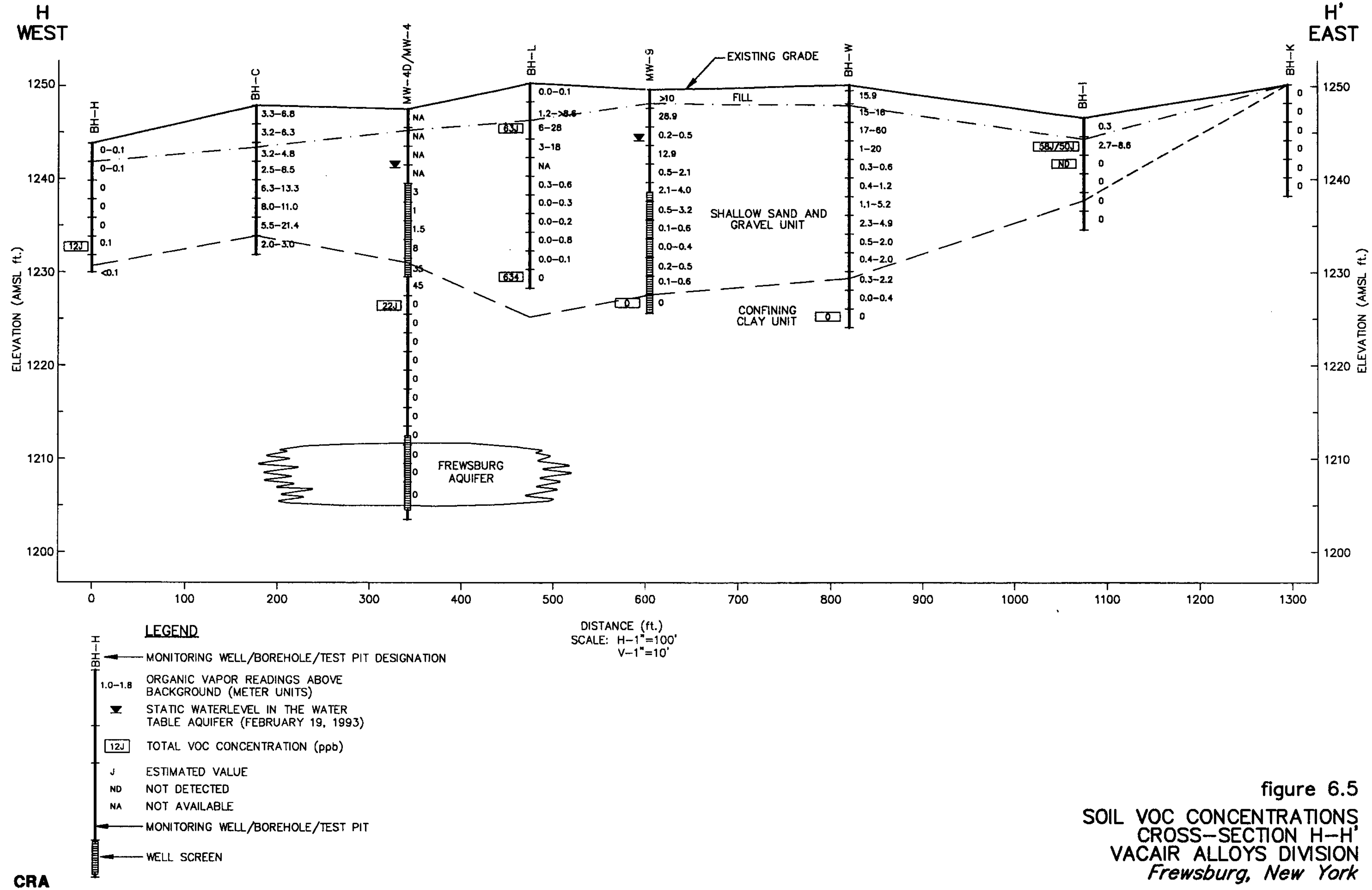


figure 6.5

SOIL VOC CONCENTRATIONS
CROSS-SECTION H-H'
VACAIR ALLOYS DIVISION
Frewsburg, New York

2326 (19) MAR 17/94(NF) REV.0 (X-18)

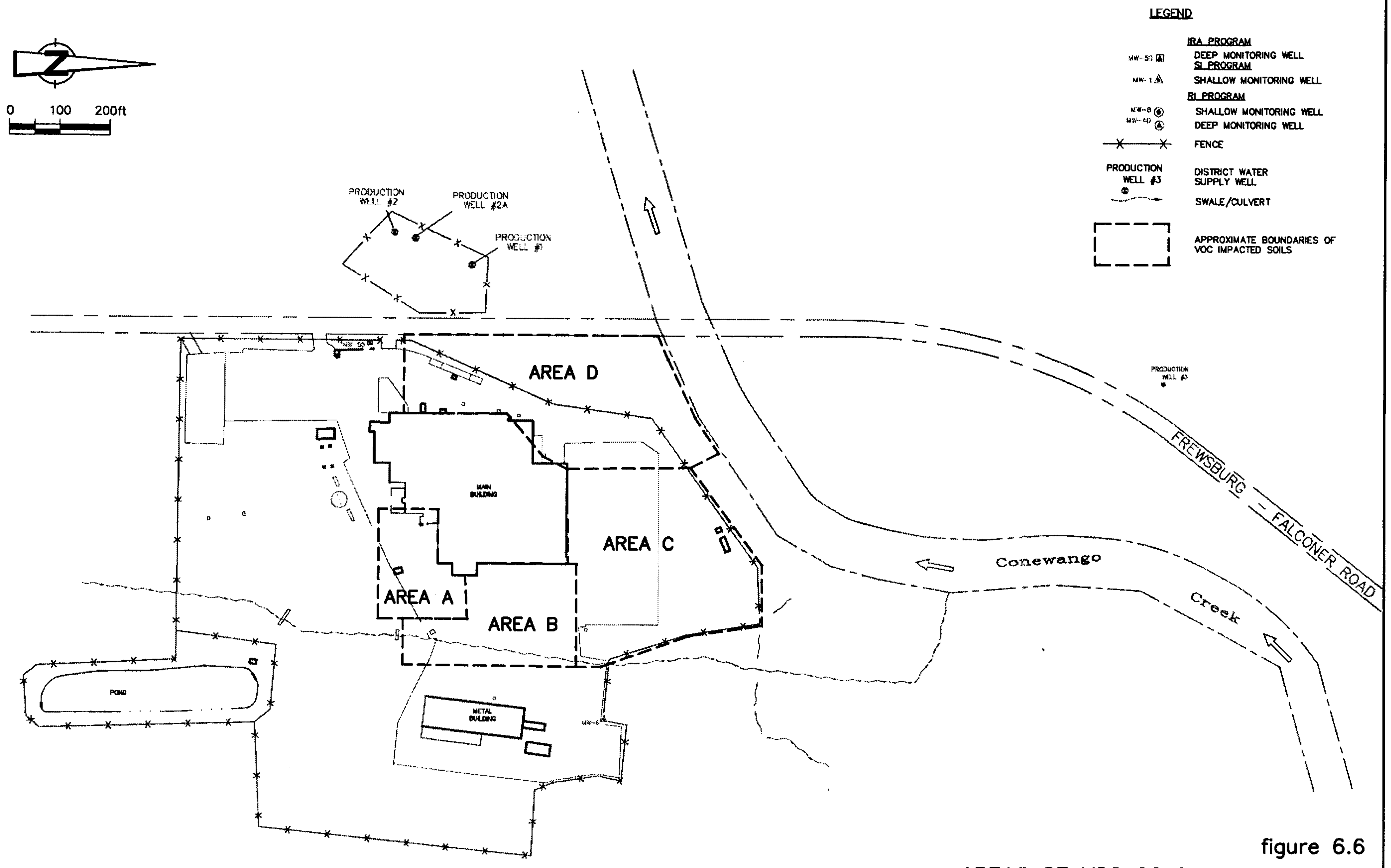


figure 6.6

AREAS OF VOC CONTAMINATED SOILS
REMEDIAL INVESTIGATION PROGRAM
VACAIR ALLOYS DIVISION
Frewsburg, New York

CRA

2326 (19) MAR 17/94(NF) REV.0 (P-26)

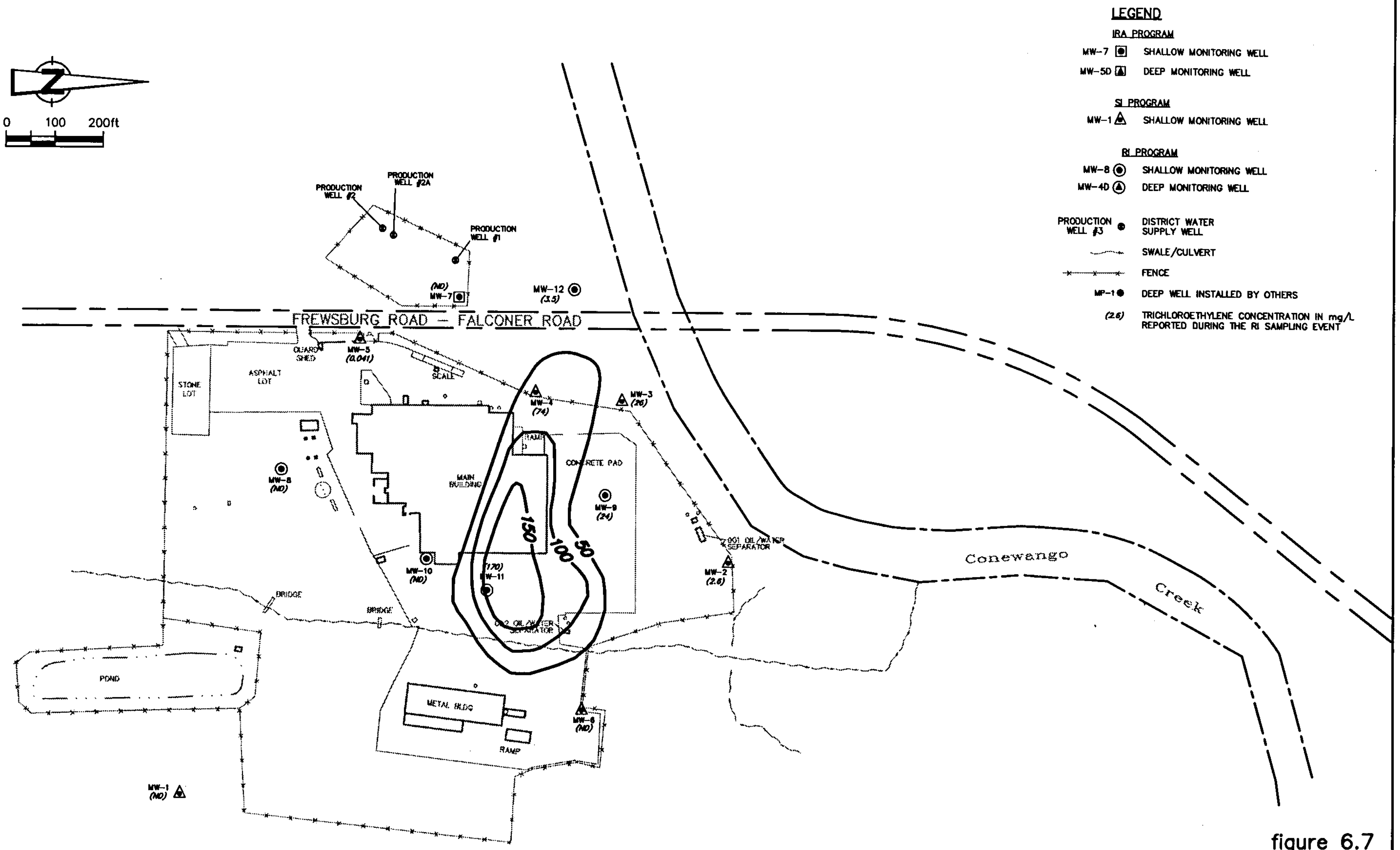


figure 6.7

TRICHLOROETHYLENE ISOPLETH – WATER TABLE AQUIFER
REMEDIAL INVESTIGATION PROGRAM
VACAIR ALLOYS DIVISION
Frewsburg, New York

CRA

2326 (19) MAR 17/94(NF) REV.0 (P-46)

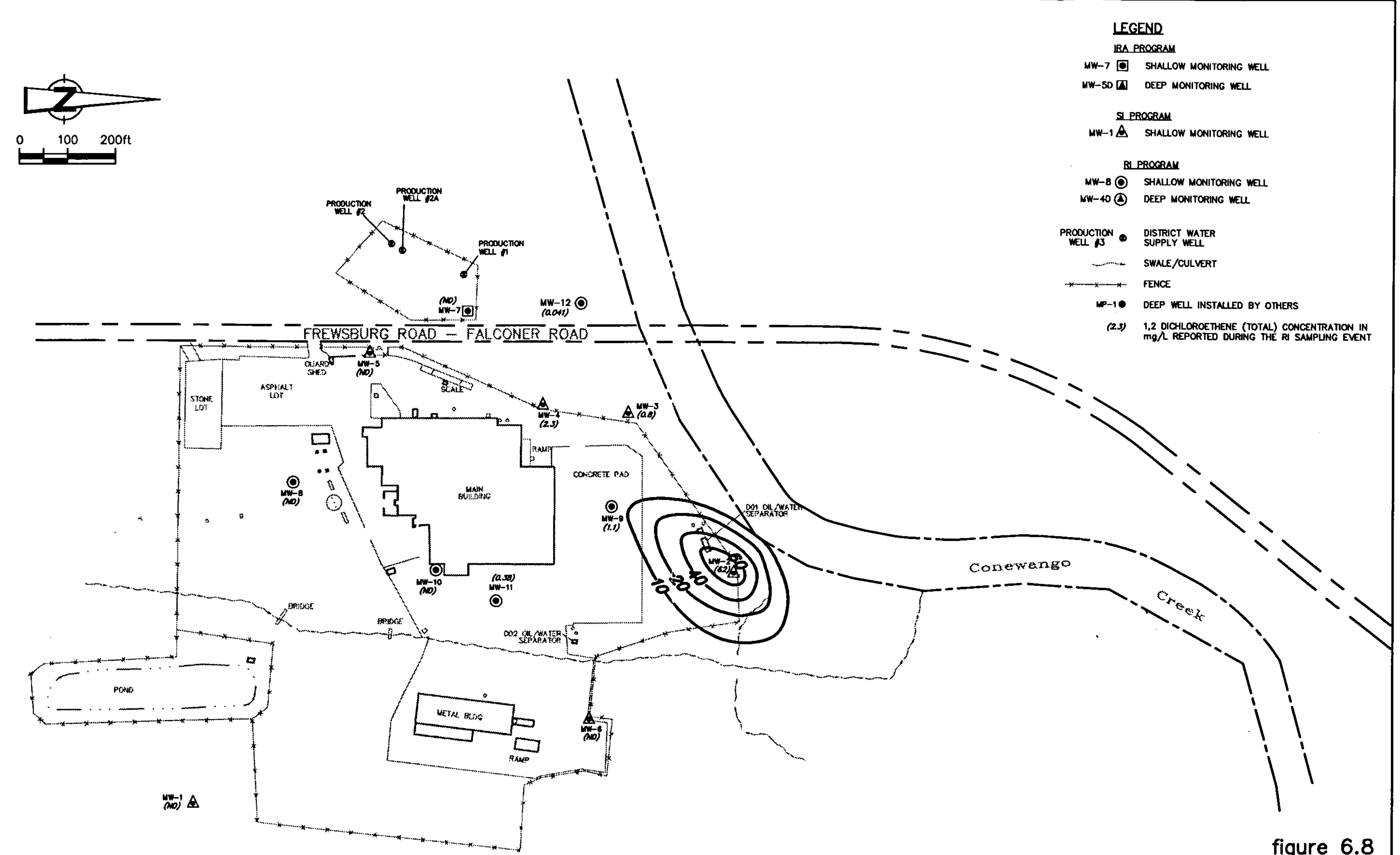


figure 6.8

1,2 DICHLOROETHENE (TOTAL) ISOPLETH – WATER TABLE AQUIFER
REMEDIAL INVESTIGATION PROGRAM
VACAIR ALLOYS DIVISION
Frewsburg, New York

CRA

2326 (19) MAR 17/94(NF) REV.0 (P-47)

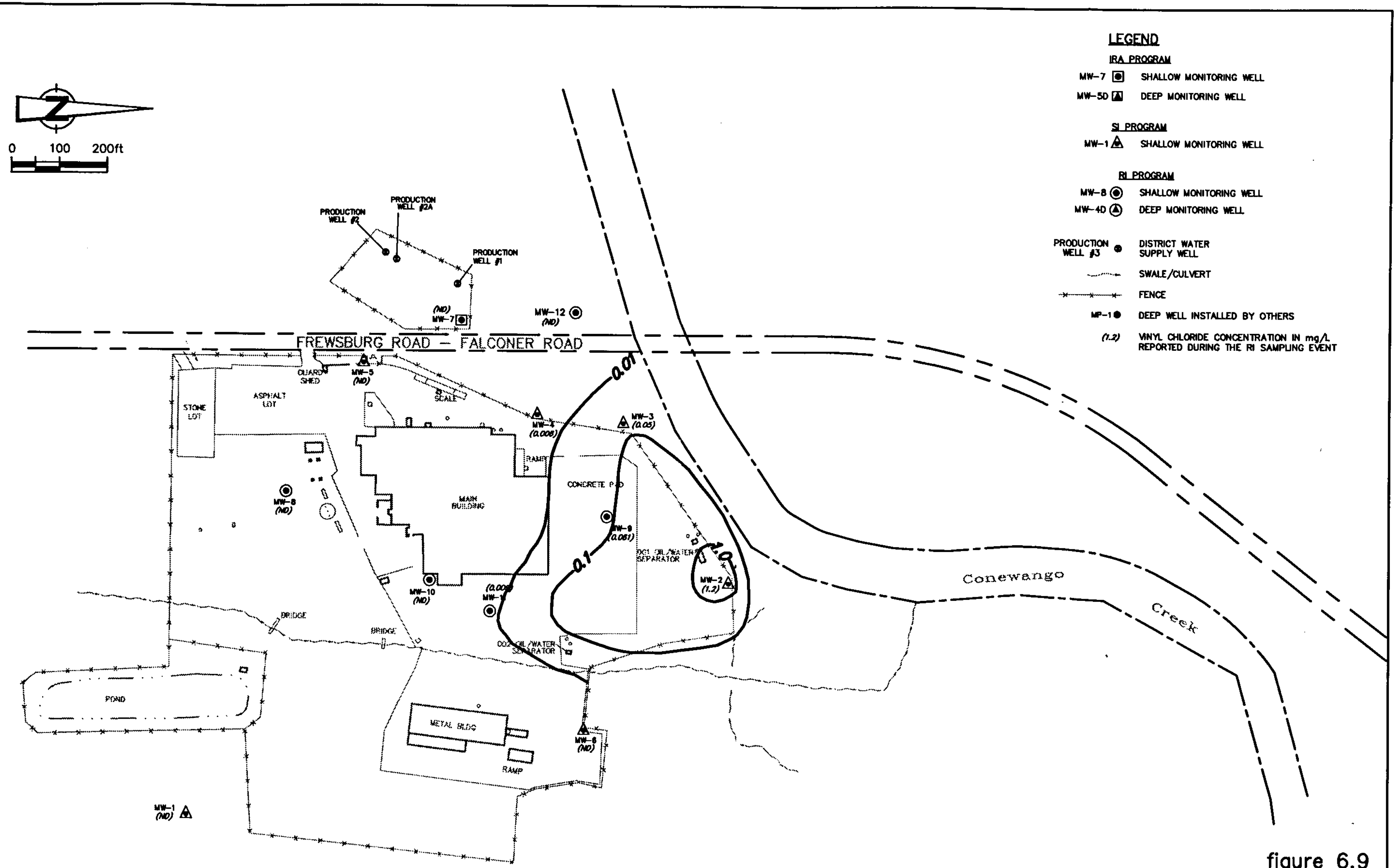


figure 6.9

VINYL CHLORIDE ISOPLETH – WATER TABLE AQUIFER
REMEDIAL INVESTIGATION PROGRAM
VACAIR ALLOYS DIVISION
Frewsburg, New York

CRA

2326 (19) MAR 17/94(NF) REV.0 (P-48)

PHOTOGRAPH No. 1 – SITE RECONNAISSANCE MAY 7, 1993

figure 9.1

PHOTOGRAPHIC LOG – LOW LYING AREA
REMEDIAL INVESTIGATION PROGRAM
VacAir Allous Division, Frewsburg, New York

CRA

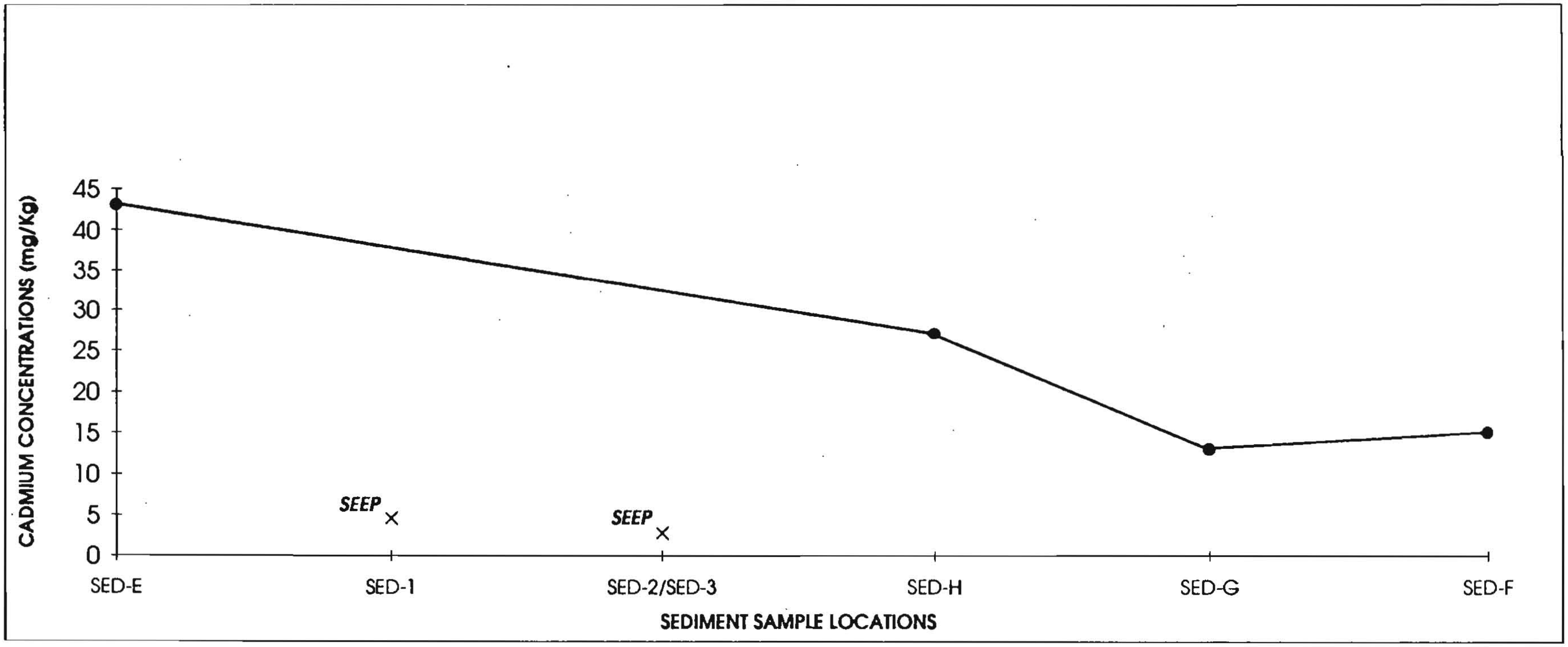


figure 9.2

CADMIUM CONCENTRATIONS IN SEDIMENTS OF THE STREAM BED IN THE LOW–LYING AREA
VACAIR ALLOYS DIVISION
Frewsburg, New York

CRA

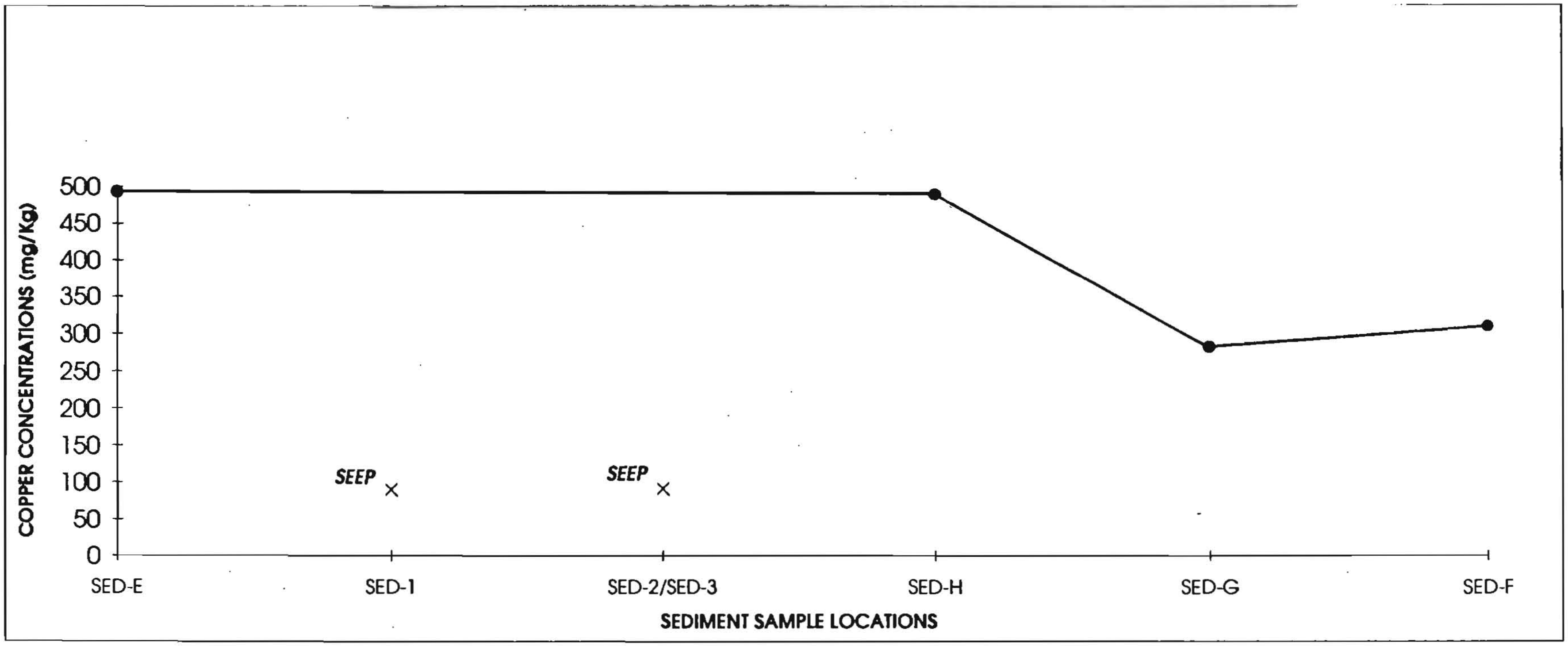


figure 9.3

COPPER CONCENTRATIONS IN SEDIMENTS OF THE STREAM BED IN THE LOW–LYING AREA
VACAIR ALLOYS DIVISION
Frewsburg, New York

CRA

2326 (19) MAR 21/94(NF) REV.0 (G–02)

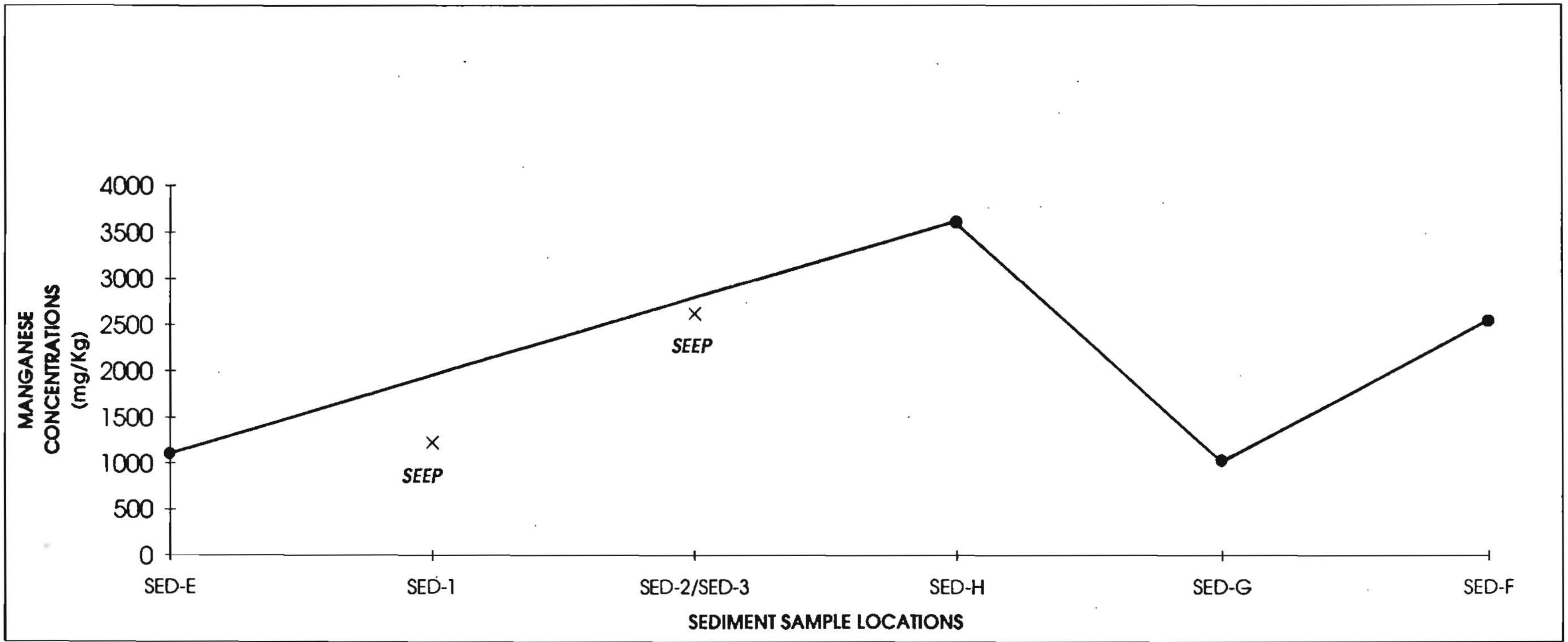


figure 9.4

MANGANESE CONCENTRATIONS IN SEDIMENTS OF THE STREAM BED IN THE LOW–LYING AREA
VACAIR ALLOYS DIVISION
Frewsburg, New York

CRA

2326 (19) MAR 21/94(NF) REV.0 (G–03)

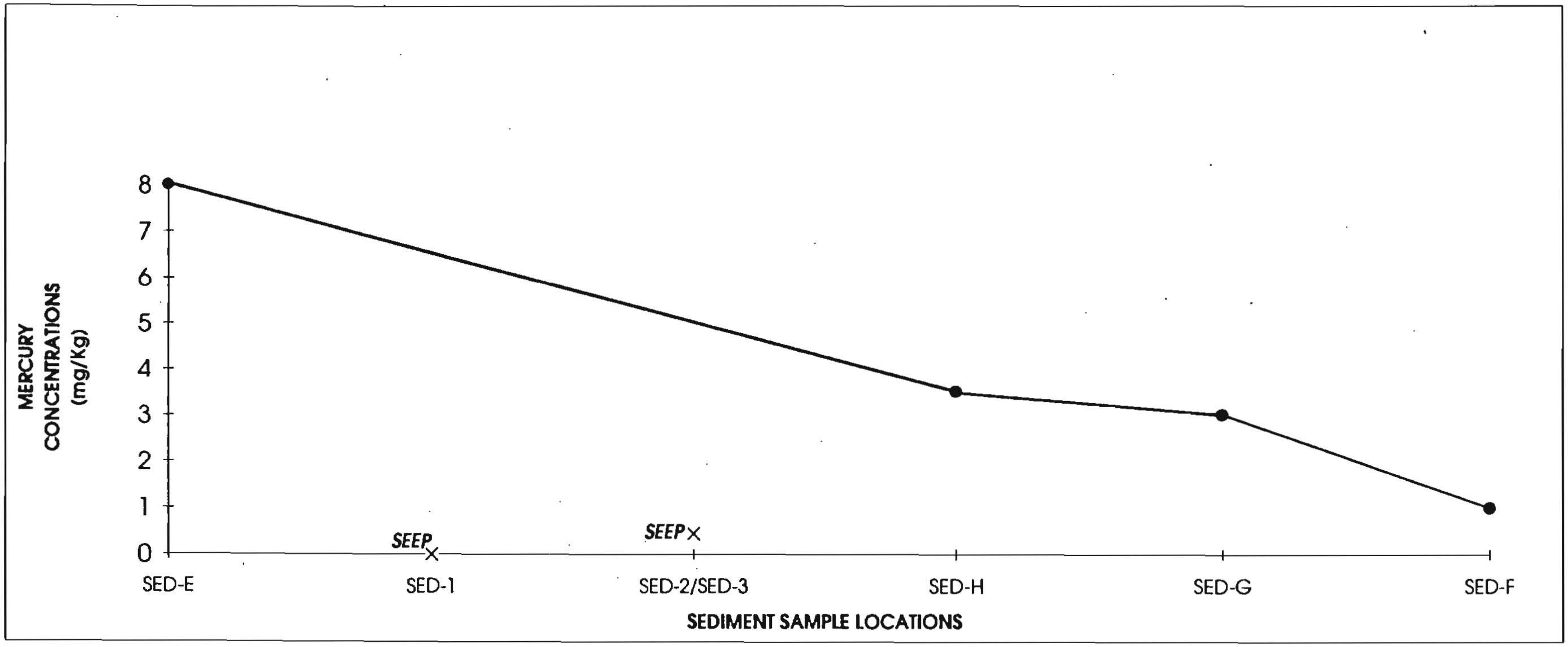


figure 9.5

MERCURY CONCENTRATIONS IN SEDIMENTS OF THE STREAM BED IN THE LOW–LYING AREA
VACAIR ALLOYS DIVISION
Frewsburg, New York

CRA

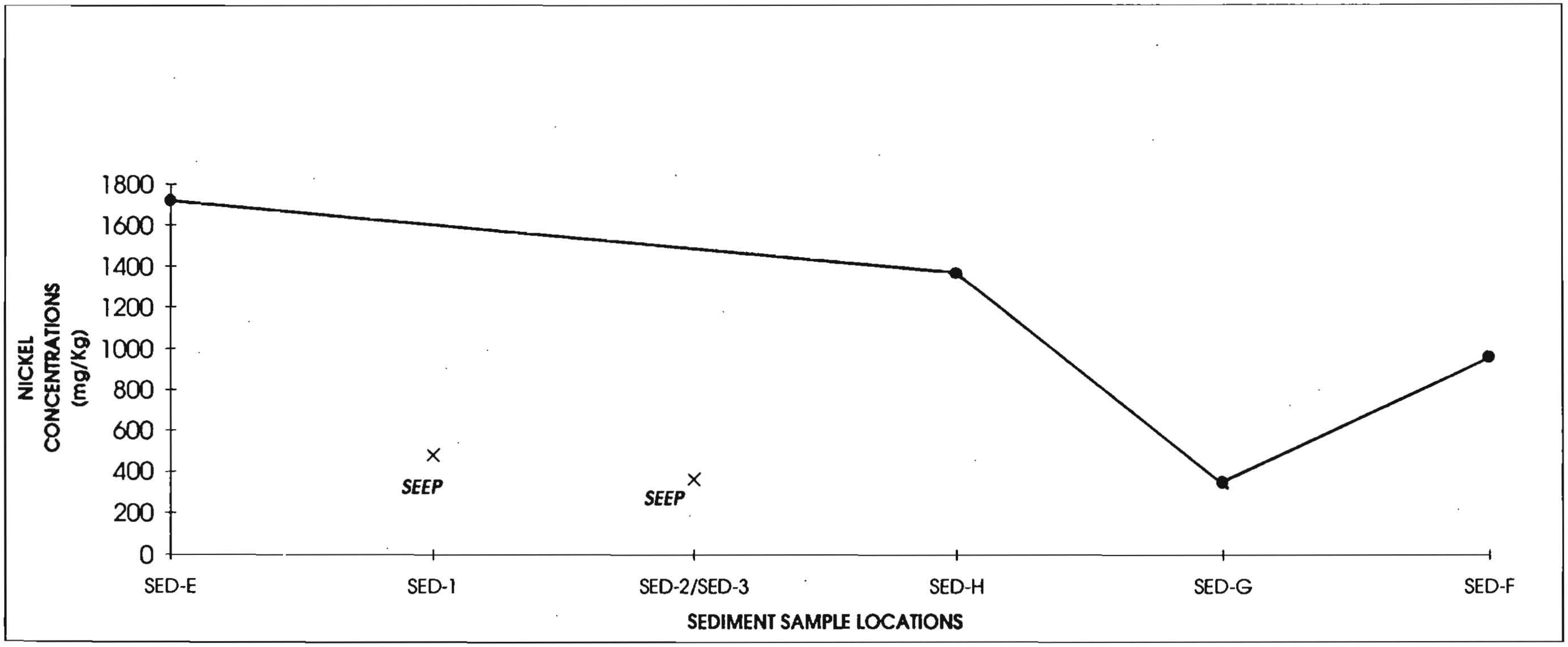


figure 9.6

NICKEL CONCENTRATIONS IN SEDIMENTS OF
THE STREAM BED IN THE LOW-LYING AREA
VACAIR ALLOYS DIVISION
Frewsburg, New York

CRA

2326 (19) MAR 21/94(NF) REV.0 (G-05)

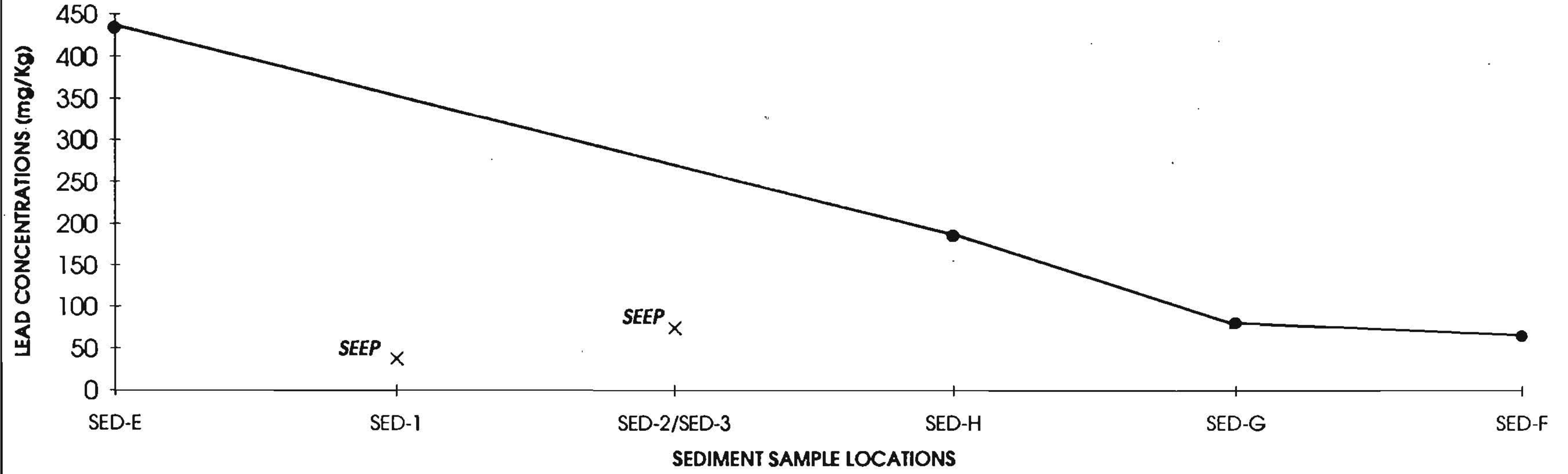


figure 9.7

LEAD CONCENTRATIONS IN SEDIMENTS OF THE STREAM BED IN THE LOW-LYING AREA
VACAIR ALLOYS DIVISION
Frewsburg, New York

CRA

2326 (19) MAR 21/94(NF) REV.0 (G-06)

TABLES

TABLE 2.1

DISTRICT WATER SUPPLY SAMPLING
VACAIR ALLOYS DIVISION
FREWSBURG, NEW YORK

Well No./ Location	*Sample Date*	*Analytical Lab*	*Volatile Organic Compounds Detected (µg/L)* *Methylene Chloride*	*Trichloro-ethene*	*cis-1,2-Di-chloroethene*	*Toluene*	*Chloroform*	*Ethyl-benzene*	*Benzene*	*Comments*
1	09/05/91	FLI	1	44	6	<0.5	ND	ND	ND	
	09/18/91	NYSDOH	ND	ND	ND	ND	1.0	ND	ND	
	09/19/91	Microbac	ND	465	28.1	ND	ND	ND	ND	
	09/19/91	FLI	ND	118	ND	ND	ND	ND	ND	
	09/19/91	FLI	ND	112	ND	ND	ND	ND	ND	Duplicate Analysis
	09/26/91	Microbac	ND	10.1	ND	ND	ND	ND	ND	Vial #1
	09/26/91	Microbac	ND	13.2	ND	ND	ND	ND	ND	Vial #2
	09/26/91	NYSDOH	ND	10	0.5	ND	ND	ND	ND	
	09/26/91	FLI	ND	5	ND	ND	ND	<0.5	ND	
	10/03/91	Microbac	ND	3.5	ND	ND	ND	ND	ND	Vial #1
	10/03/91	Microbac	ND	3.2	ND	ND	ND	ND	ND	Vial #2
	10/03/91	FLI	ND	2	ND	ND	ND	ND	ND	
	11/15/91	Microbac	ND	1.2	ND	ND	ND	ND	ND	
	12/30/91	Microbac	ND	ND	ND	ND	ND	ND	ND	
	01/29/92	Microbac	ND	ND	ND	ND	ND	ND	ND	
	02/27/92	Microbac	ND	ND	ND	ND	ND	ND	ND	
	03/26/92	Microbac	ND	ND	ND	ND	ND	ND	ND	
	04/23/92	Microbac	ND	ND	ND	ND	ND	ND	ND	
	05/21/92	Microbac	ND	ND	ND	ND	ND	ND	ND	
	06/18/92	Microbac	ND	ND	ND	ND	ND	ND	ND	
	07/16/92	Microbac	ND	ND	ND	ND	ND	ND	ND	
	08/13/92	Microbac	ND	ND	ND	ND	ND	ND	ND	
	09/09/92	Microbac	ND	ND	ND	ND	ND	ND	ND	
	10/07/92	Microbac	ND	ND	ND	ND	ND	ND	ND	
	11/06/92	Microbac	ND	ND	ND	ND	ND	ND	ND	
	02/03/93	Microbac	ND	ND	ND	ND	ND	ND	ND	
	04/29/93	Microbac	ND	ND	ND	ND	ND	ND	ND	

TABLE 2.1

DISTRICT WATER SUPPLY SAMPLING
VACAIR ALLOYS DIVISION
FREWSBURG, NEW YORK

Well No./ Location	*Sample Date*	*Analytical Lab*	*Volatile Organic Compounds Detected (µg/L)*							*Comments*
			Methylene Chloride	*Trichloro-ethene*	*cis-1,2-Di-chloroethene*	*Toluene*	*Chloroform*	*Ethyl-benzene*	*Benzene*	
2A	09/05/91	FLI	2	5	ND	0.6	ND	<0.5	ND	
	09/18/91	NYSDOH	ND	ND	ND	ND	1.0	ND	ND	
	09/19/91	Microbac	ND	33.6	1.0	ND	ND	ND	ND	
	09/19/91	FLI	ND	9	ND	ND	ND	ND	ND	
	09/19/91	FLI	ND	10	ND	ND	ND	ND	ND	Duplicate Analysis
	09/26/91	Microbac	ND	116	4.1	ND	ND	ND	ND	
	09/26/91	Microbac	ND	101	3.6	ND	ND	ND	ND	Duplicate Sample
	09/26/91	NYSDOH	ND	140	6	ND	ND	ND	ND	
	09/26/91	FLI	ND	17	ND	ND	ND	ND	<0.5	
	10/03/91	Microbac	ND	ND	ND	ND	ND	ND	ND	Vial #1
	10/03/91	Microbac	ND	ND	ND	ND	ND	ND	ND	Vial #2
	10/03/91	FLI	ND	ND	ND	ND	ND	ND	ND	
	11/15/91	Microbac	ND	ND	ND	ND	ND	ND	ND	
	12/30/91	Microbac	ND	ND	ND	ND	ND	ND	ND	
	01/29/92	Microbac	ND	ND	ND	ND	ND	ND	ND	
	02/27/92	Microbac	ND	ND	ND	ND	ND	ND	ND	
	03/26/92	Microbac	ND	ND	ND	ND	ND	ND	ND	
	04/23/92	Microbac	ND	ND	ND	ND	ND	ND	ND	
	05/21/92	Microbac	ND	ND	ND	ND	ND	ND	ND	
	06/18/92	Microbac	ND	ND	ND	ND	ND	ND	ND	
	07/20/92	Microbac	ND	ND	ND	ND	ND	ND	ND	
	08/13/92	Microbac	ND	ND	ND	ND	ND	ND	ND	
	09/09/92	Microbac	ND	ND	ND	ND	ND	ND	ND	
	10/07/92	Microbac	ND	ND	ND	ND	ND	ND	ND	
	11/06/92	Microbac	ND	ND	ND	ND	ND	ND	ND	
	02/03/93	Microbac	ND	ND	ND	ND	ND	ND	ND	
	04/29/93	Microbac	ND	ND	ND	ND	ND	ND	ND	

TABLE 2.1

DISTRICT WATER SUPPLY SAMPLING
VACAIR ALLOYS DIVISION
FREWSBURG, NEW YORK

			Volatile Organic Compounds Detected (µg/L)							
Well No./ Location	***Sample Date***	***Analytical Lab***	***Methylene Chloride***	***Trichloro-ethene***	***cis-1,2-Di-chloroethene***	***Toluene***	***Chloroform***	***Ethyl-benzene***	***Benzene***	***Comments***
3	09/26/91	Microbac	ND	ND	ND	ND	ND	ND	ND	
	09/26/91	NYSDOH	ND	ND	ND	ND	ND	ND	ND	
	09/26/91	FLI	ND	ND	ND	ND	ND	ND	ND	
	10/03/91	Microbac	ND	ND	ND	ND	ND	ND	ND	
	10/03/91	FLI	ND	ND	ND	ND	ND	ND	ND	
	11/15/91	Microbac	ND	ND	ND	ND	1.5	3.6	ND	
	11/15/91	Microbac	ND	ND	ND	ND	1.7	2.8	ND	Duplicate Analysis
	12/30/91	Microbac	ND	ND	ND	ND	ND	ND	ND	
	01/29/92	Microbac	ND	ND	ND	ND	ND	ND	ND	
	02/27/92	Microbac	ND	ND	ND	ND	ND	ND	ND	
	03/26/92	Microbac	ND	ND	ND	ND	ND	ND	ND	
	04/23/92	Microbac	ND	ND	ND	ND	ND	ND	ND	
	05/21/92	Microbac	ND	ND	ND	ND	ND	ND	ND	
	06/18/92	Microbac	ND	ND	ND	ND	ND	ND	ND	
	07/20/92	Microbac	ND	ND	ND	ND	ND	ND	ND	
	08/13/92	Microbac	ND	ND	ND	ND	ND	ND	ND	
	09/09/92	Microbac	ND	ND	ND	ND	ND	ND	ND	
	10/07/92	Microbac	ND	ND	ND	ND	ND	ND	ND	
	11/06/92	Microbac	ND	ND	ND	ND	ND	ND	ND	
	02/03/93	Microbac	ND	ND	ND	ND	ND	ND	ND	
	04/29/93	Microbac	ND	ND	ND	ND	ND	ND	ND	

TABLE 2.1

DISTRICT WATER SUPPLY SAMPLING
VACAIR ALLOYS DIVISION
FREWSBURG, NEW YORK

			Volatile Organic Compounds Detected (µg/L)							
Well No./ Location	*Sample Date*	*Analytical Lab*	*Methylene Chloride*	*Trichloro-ethene*	*cis-1,2-Di-chloroethene*	*Toluene*	*Chloroform*	*Ethyl-benzene*	*Benzene*	*Comments*
4	09/19/91	Microbac	ND	ND	ND	ND	ND	ND	ND	
	09/19/91	FLI	ND	ND	ND	ND	ND	ND	ND	
	09/26/91	Microbac	ND	ND	ND	ND	ND	ND	ND	
	09/26/91	NYSDOH	ND	ND	ND	ND	ND	ND	ND	
	09/26/91	FLI	ND	ND	ND	ND	ND	ND	ND	
	10/03/91	Microbac	ND	ND	ND	ND	ND	ND	ND	
	10/03/91	FLI	ND	ND	ND	ND	ND	ND	ND	
	11/15/91	Microbac	ND	ND	ND	ND	ND	ND	ND	
	12/30/91	Microbac	ND	ND	ND	ND	ND	ND	ND	
	01/29/92	Microbac	ND	ND	ND	ND	ND	ND	ND	
	02/27/92	Microbac	ND	ND	ND	ND	ND	ND	ND	
	03/26/92	Microbac	ND	ND	ND	ND	ND	ND	ND	
	04/23/92	Microbac	ND	ND	ND	ND	ND	ND	ND	
	05/21/92	Microbac	ND	ND	ND	ND	ND	ND	ND	
	06/18/92	Microbac	ND	ND	ND	ND	ND	ND	ND	
	07/16/92	Microbac	ND	ND	ND	ND	ND	ND	ND	
	08/13/92	Microbac	ND	ND	ND	ND	ND	ND	ND	
	09/09/92	Microbac	ND	ND	ND	ND	ND	ND	ND	
	10/07/92	Microbac	ND	ND	ND	ND	ND	ND	ND	
	11/06/92	Microbac	ND	ND	ND	ND	ND	ND	ND	
	02/03/93	Microbac	ND	ND	ND	ND	ND	ND	ND	
	04/29/93	Microbac	ND	ND	ND	ND	ND	ND	ND	

TABLE 2.1

DISTRICT WATER SUPPLY SAMPLING
VACAIR ALLOYS DIVISION
FREWSBURG, NEW YORK

Well No./ Location	*Sample Date*	*Analytical Lab*	*Volatile Organic Compounds Detected (μg/L)*							*Comments*
			Methylene Chloride	*Trichloro-ethene*	*cis-1,2-Di-chloroethene*	*Toluene*	*Chloroform*	*Ethyl-benzene*	*Benzene*	
Town Hall (1)	09/19/91	Microbac	ND	38.0	1.0	ND	ND	ND	ND	
	09/19/91	Microbac	ND	34.9	1.2	ND	ND	ND	ND	Duplicate Sample
	09/19/91	FLI	ND	21	<0.5	ND	ND	ND	ND	
	09/19/91	FLI	ND	28	ND	ND	ND	ND	ND	Duplicate Sample
	09/26/91	Microbac	ND	ND	ND	ND	ND	ND	ND	
	09/26/91	NYSDOH	ND	ND	ND	ND	ND	ND	ND	
	09/26/91	FLI	ND	ND	ND	ND	ND	ND	ND	
	10/03/91	Microbac	ND	ND	ND	ND	ND	ND	ND	
	10/03/91	FLI	ND	ND	ND	ND	ND	ND	ND	
	11/15/91	Microbac	ND	ND	ND	ND	ND	ND	ND	
Elementary School (1)	09/26/91	NYSDOH	ND	2	ND	ND	ND	ND	ND	
	09/26/91	Microbac	ND	ND	ND	ND	1.5	ND	ND	
	09/26/91	FLI	ND	1	ND	ND	ND	ND	ND	
	10/03/91	Microbac	ND	ND	ND	ND	ND	ND	ND	
	10/03/91	FLI	ND	ND	ND	ND	ND	ND	ND	
	11/15/91	Microbac	ND	ND	ND	ND	ND	ND	ND	
Cemetary(1)	09/20/91	NYSDOH	ND	1	ND	ND	ND	ND	ND	
	09/26/91	Microbac	ND	ND	ND	ND	0.5	ND	ND	
	09/26/91	FLI	ND	<0.5	ND	ND	ND	ND	ND	
	10/03/91	Microbac	ND	ND	ND	ND	ND	ND	ND	
	10/03/91	FLI	ND	ND	ND	ND	ND	ND	ND	
Monarch Plastics	10/03/91	Microbac	ND	ND	ND	ND	ND	ND	ND	
	10/03/91	FLI	ND	ND	ND	ND	ND	ND	ND	

Notes:
ND Non-Detect
(1) Sample collected from the Frewsburg Water District's distribution system.

TABLE 3.1

1992 CLIMATOGIGAL DATA SUMMARY (1)
VACAIR ALLOYS
FREWSBURG, NEW YORK

Total Preciptation (Inches)	
01/92	2.61
02/92	2.05
03/92	2.91
04/92	4.85
05/92	1.98
06/92	1.83
07/92	8.40
08/92	8.24
09/92	5.26
10/92	2.84
11/92	5.92
12/92	3.25
1992 Total Precipitation:	**50.14**

Average Temperature (°F)	
01/92	25.50
02/92	26.20
03/92	29.60
04/92	42.10
05/92	53.50
06/92	59.40
07/92	64.90
08/92	62.50
09/92	58.60
10/92	44.80
11/92	37.30
12/92	27.90
1992 Average Temperature:	**44.40**

Notes:

(1) Source: Northeast Regional Climate Center for Jamestown, New York.

TABLE 4.1

SAMPLE IDENTIFICATION SUMMARY KEY
REMEDIAL INVESTIGATION
VACAIR ALLOYS
FREWSBURG, NEW YORK

Sample I.D.	*Sample Date*	*Sample Matrix*	*Sample Source*	*Sample Interval (ft. BGS)*	*Sample Analyses*	*Notes (1)*
SW-A	10/28/92	Surface Water	cooling water pond	-	TCL VOCs, metals, hardness	
SED-A	10/28/92	Sediment	cooling water pond	0 - 0.5	TCL VOCs, TOC, metals	
SED-B	10/28/92	Sediment	swale upstream from pond discharge	0 - 0.5	TCL VOCs, TOC, metals	Slight sheen observed on surface
SW-B	10/28/92	Surface Water	swale upstream from pond discharge	-	TCL VOCs, metals, hardness	Slight sheen observed on surface
SED-C	10/28/92	Sediment	downstream swale between bridge and south fence	0 - 0.5	TCL VOCs, TOC, metals	
SW-C	10/28/92	Surface Water	downstream swale between bridge and south fence	-	TCL VOCs, metals, hardness	
SED-D	10/28/92	Sediment	NE discharge/NE of metal building	0-0.5	TCL VOCs, TOC, metals	
SW-D	10/28/92	Surface water	NE dishcarge/NE of metal building	-	TCL VOCs, metals, hardness	
SED-E	10/28/92	Sediment	surface water discharge concrete pad	0-0.5	TCL VOCs, TOC, metals	
SW-E	10/28/92	Surface Water	surface water discharge concrete pad	-	TCL VOCs, metals, hardness	Heavy sheen on surface
SW-F	10/29/92	Surface Water	downstream drainage ditch (lowlands)	-	TCL VOCs, metals, hardness, PCBs	Grayish surface layer observed
SED-F	10/29/92	Sediment	downstream drainage ditch (lowlands)	0-0.5	TCL VOCs, TOC, metals, PCBs	
SW-G	10/29/92	Surface Water	downstream in lowland swale		TCL VOCs, metals, hardness PCBs	MS/MSD
SED-G	10/29/92	Sediment	downstream in lowland swale	0-0.5	TCL VOCs, TOC, metals, PCBs	MS/MSD
SW-H	10/29/92	Surface Water	swale in center of lowland		TCL VOCs, metals, hardness, PCBs	Slight sheen observed on surface
SED-H	10/29/92	Sediment	swale in center of lowland	0-0.5	TCL VOCs, TOC, metals, PCBs	
SED-I	10/29/92	Sediment	swale in center of lowland	0-0.5	TCL VOCs. TOC, metals, PCBs	Duplicate sample (SED-H)
SW-I	10/29/92	Surface Water	swale in center of lowland	-	TCL VOCs, metals, hardness, PCBs	Slight sheen observed on surface, duplicate sample (SW-H)
SED-J	10/29/92	Sediment	eastern edge of lowland	0-0.5	TCL VOCs, TOC, metals, PCBs	
SW-J	10/29/92	Surface Water	eastern edge of lowland	-	TCL VOCs, metals, hardness, PCBs	Sheen observed on surface, rust colored "flocculant" observed
SW-K	10/30/92	Surface Water	Conewango Creek downstream from bridge		TCL VOCs, metals, hardness, PCBs	
SED-K	10/30/92	Sediment	Conewango Creek downstream from bridge	0-0.5	TCL VOCs, TOC, metals, PCBs	
SW-L	10/30/92	Surface Water	Conewango Creek at railroad bridge footings		TCL VOCs, metals, hardness PCBs	
SED-L	10/30/92	Sediment	Conewango Creek at railroad bridge footings	0-0.5	TCL VOCs, TOC, metals, PCBs	

TABLE 4.1

SAMPLE IDENTIFICATION SUMMARY KEY
REMEDIAL INVESTIGATION
VACAIR ALLOYS
FREWSBURG, NEW YORK

Sample I.D.	*Sample Date*	*Sample Matrix*	*Sample Source*	*Sample Interval (ft. BGS)*	*Sample Analyses*	*Notes (1)*
SW-M	10/30/92	Surface Water	Conewango Creek upstream of 2 swale discharge points	-	TCL VOCs, metals, hardness PCBs	
SED-M	10/30/92	Sediment	Conewango Creek upstream of 2 swale discharge points	0-0.5	TCL VOCs, TOC, metals, PCBs	
SED-N	10/30/92	Sediment	Conewango Creek upstream of 2 swale discharge points	0-0.5	TCL VOCs, TOC, metals, PCBs	Duplicate of SED-M
SW-N	10/30/92	Surface Water	Conewango Creek upstream of 2 swale discharge points	-	TCL VOCs, metals, hardness, PCBs	Duplicate of SW-M
9234794	10/30/92	Water	trip blank	-	TCL VOCs	Collected from a clean water sample bottle
SED1030	10/30/92	Water	rinse blank	-	TCL VOCs, TOC, metals, PCBs	
BH-A,1S	11/16/92	Soil	BH-A	2-4	TCL VOCs	Shallow sand/gravel unit
BH-B,11S	11/17/92	Soil	BH-B	20-22	TCL VOCs	Confining unit
BH-C,7S	11/17/92	Soil	BH-C	12-14	TCL VOCs	Shallow sand/gravel unit
BH-D,S-1	11/18/92	Soil	BH-D	6-8	TCL VOCs	Shallow sand/gravel unit
BH-D,S-2	11/18/92	Soil	BH-D	18-20	TCL VOCs	Confining unit
BH-E,S-1	11/18/92	Soil	BH-E	8-10	TCL VOCs	Shallow sand/gravel unit
BH-E,S-2	11/18/92	Soil	BH-E	22-24	TCL,VOCs	Confining unit
BH-F,S-1	11/19/92	Soil	BH-F	16-18	TCL VOCs	Confining unit
BH-G,S-1	11/19/92	Soil	BH-G	12-14	TCL VOCs	Confining unit
BH-H,S-2	11/19/92	Soil	BH-H	10-12	TCL VOCs	Shallow sand/gravel unit
BH-I,S-1	11/19/92	Soil	BH-I	2-4	TCL VOCs	Shallow sand/gravel unit
BH-I, S-2	11/19/92	Soil	BH-I	4-6	TCL VOCs	Shallow sand/gravel unit
BH-AB,S-1	11/19/92	Soil	BH-I	2-4	TCL VOCs	Duplicate of BH-I, 2-4 ft. BGS
BH-J,S-1	11/20/92	Soil	BH-J	14-16	TCL VOCs	Shallow sand/gravel unit
BH-J,S-2	11/20/92	Soil	BH-J	20-22	TCL VOCs	Confining unit
BH-L,S-1	11/23/92	Soil	BH-L	4-6	TCL VOCs, PCBs	Shallow sand/gravel unit
BH-L,S-2	11/23/92	Soil	BH-L	20-22	TCL VOCs	MS/MSD requested, confining unit
BH-M,S-1	11/23/92	Soil	BH-M	2-4	TCL VOCs	Shallow sand/gravel unit
BH-M,S-2	11/23/92	Soil	BH-M	22-24	TCL VOCs	Confining unit
BH-BC,S-1	11/23/92	Soil	BH-M	6-8	TCL VOCs	Duplicate of BH-M, 0-2 ft. BGS, shallow sand/gravel unit
RB-1124	11/24/92	Water	-	-	TCL VOCs, PCBs	Rinse blank
BH-O,S-1	11/24/92	Soil	BH-O	22-24	TCL VOCs,	Confining unit
BH-P,S-1	11/24/92	Soil	BH-P	4-6	TCL VOCs, PCBs	Shallow sand/gravel unit
BH-P,S-2	11/24/92	Soil	BH-P	18-20	TCL VOCs	Confining unit
BH-U,S-1	11/30/92	Soil	BH-U	6-8	TCL VOCs	Shallow sand/gravel unit

TABLE 4.1

SAMPLE IDENTIFICATION SUMMARY KEY
REMEDIAL INVESTIGATION
VACAIR ALLOYS
FREWSBURG, NEW YORK

Sample I.D.	*Sample Date*	*Sample Matrix*	*Sample Source*	*Sample Interval (ft. BGS)*	*Sample Analyses*	*Notes (1)*
BH-V,S-1	12/01/92	Soil	BH-V	24-26	TCL VOCs	Confining unit
MW-11,S-1	12/01/92	Soil	borehole for MW-11	10-12	TCL VOCs, PCBs	Shallow sand/gravel unit
MW-11,S-2	12/01/92	Soil	borehole for MW-11	14-16	TCL VOCs	Confining unit
MW-12,S-2	12/02/92	Soil	borehole for MW-9	22-24	TCL VOCs	Mislabelled MW-12, confining unit
MW-8,S-1	12/02/92	Soil	borehole for MW-8	2-4	TCL VOCs	Shallow sand/gravel unit
MW-8,S-2	12/02/92	Soil	borehole for MW-8	16-18	TCL VOCs	Confining unit
BH-W,S-2	12/03/92	Soil	BH-W	24-26	TCL VOCs	Confining unit
BH/MSW5D, S1	12/08/92	Soil	borehole for MW-4D	20-22	TCL VOCs	Mislabelled-should be MW-4D, confining unit
MW-10,S1-8	12/09/92	Soil	borehole for MW-10	6-22	TOC, Physical Testing	Density, moisture content, grain size
MW-4,S1-7	12/15/92	Soil	borehole adjacent to MW-4/4D	4-17	TOC, Physical Testing	Density, moisture content, grain size, shallow sand/gravel unit
SSoil-CD	12/22/92	Soil	SSoil-N, adjacent to BH-N	0 - 0.2	TCL VOCs, PCBs	Duplicate of SSoil-N
SSoil-A	12/22/92	Soil	SSoil-A, adjacent to BH-A	0 - 0.2	TCL VOCs	
SSoil-J	12/22/92	Soil	adjacent to BH-J	0 - 0.2	TCL VOCs	
SSoil-M	12/22/92	Soil	adjacent to BH-M	0 - 0.2	TCL VOCs, PCBs	
SSoil-N	12/22/92	Soil	adjacent to BH-N	0 - 0.2	TCL VOCs, PCBs	
RB-1222	12/22/92	Water	-	-	TCL VOCs	Rinse blank
SSoil-O	12/22/92	Soil	adjacent to BH-O	0 - 0.2	TCL VOCs, PCBs	MS/MSD requested
MW-8	12/16/92	Water	MW-8	-	TCL VOCs, metals, inorganics	
MW-1	12/16/92	Water	MW-1	-	TCL VOCs, metals, inorganics	
MW-6	12/16/92	Water	MW-6	-	TCL VOCs, metals, inorganics	
MW-7	12/16/92	Water	MW-7	-	TCL VOCs, metals, inorganics	
MW-10	12/17/92	Water	MW-10	-	TCL VOCs, metals , inorganics, sulfide	
MW-5	12/17/92	Water	MW-5	-	TCL VOCs, metals, inorganics, sulfide	
MW-5D	12/17/92	Water	MW-5D	-	TCL VOCs, metals, inorganics, sulfide	
MW-13	12/18/92	Water	MW-4D	-	TCL VOCs, metals, inorganics, TOC, sulfide	
MW-4D	12/18/92	Water	MW-4D	-	TCL VOCs, metals, inorganics, TOC, sulfide	
MW-2	12/18/92	Water	MW-2	-	TCL VOCs, metals, inorganics, TOC, sulfide	
RB-1218	12/18/92	Water	RB-1218	-	TCL VOCs, metals, inorganics, TOC, sulfide	
MW-4	12/21/92	Water	MW-4	-	TCL VOCs, metals, inorganics, TOC, sulfide	MS/MSD requested
MW-3	12/21/92	Water	MW-3	-	TCL VOCs, metals, inorganics, TOC, sulfide	
MW-11	12/21/92	Water	MW-11	-	TCL VOCs, metals, inorganics, TOC, sulfide	
RB-1221	12/21/92	Water	-	-	TCL V?Os	Rinse blank
MW-9	12/21/92	Water	MW-9	-	TCL VOCs, metals, inorganics, TOC, sulfide	
MW-14	12/21/92	Water	MW-9	-	TCL VOCs, metals, inorganics, TOC, sulfide	
MW-4D-93	01/14/93	Water	MW-4D	-	TCL VOCs	

TABLE 4.1

SAMPLE IDENTIFICATION SUMMARY KEY
REMEDIAL INVESTIGATION
VACAIR ALLOYS
FREWSBURG, NEW YORK

Sample I.D.	*Sample Date*	*Sample Matrix*	*Sample Source*	*Sample Interval (ft. BGS)*	*Sample Analyses*	*Notes (1)*
MW-12-93	01/14/93	Water	MW-4D	-	TCL VOCs	Duplicate of MW-4D
MW-12	06/14/93	Water	MW-12	-	TCL VOCs	
MW-13	06/14/93	Water	MW-12	-	TCL VOCs	Duplicate of Sample MW-12 which was collected on 6/14/93
RB-61493	06/14/93	Water	Rinse blank	-	TCL VOCs	Rinse blank

Notes:

BGS	Below Ground Surface
TCL	USEPA Target Compound List
TOC	Total Organic Carbon
VOCs	Volatile Organic Compounds
PCBs	Polychlorinated Biphenyls
MS/MSD	Matrix Spike/Matrix Spike Duplicate
(1)	All chemical analyses were performed by H2M Laboratories and physical testing (e.g., grain size) were performed by Huntingdon Analytical Services.

TABLE 4.2

BOREHOLE ORGANIC VAPOR READINGS
REMEDIAL INVESTIGATION
VACAIR ALLOYS DIVISION
FREWSBURG, NEW YORK

Borehole Number	*Sample Interval (Ft. BGS)*	*Photon Reading Above Background (Meter Units)*	*OVA Readings Above Background (Meter Units)*	*Comments*
BH-A	0-2	3.3 - 4.6	-	Readings affected by moisture
	2-4	6.0-6.2	-	Readings affected by moisture
	4-6	8.8	-	Readings affected by moisture
	6-8	7.8	-	Readings affected by moisture
	8-10	9.7	-	Readings affected by moisture
	10-12	10.4	-	Readings affected by moisture
	12-14	12.2	-	Readings affected by moisture
	14-16	10.4	-	Readings affected by moisutre
	16-18	7.3	-	Readings affected by moisture
	18-20	3.3	-	Readings affected by moisture
	20-22	11.3	-	Readings affected by moisture
	22-24	7.9	-	Readings affected by moisture
	24-26	6.1	-	Readings affected by moisture
BH-B	0-2	1.0-1.8	-	Readings affected by moisture
	2-4	2.8-2.9	-	Readings affected by moisture
	4-6	3.0-13.0	-	Readings affected by moisture
	6-8	6.7-7.2	-	Readings affected by moisture
	8-10	5.4-5.5	-	Readings affected by moisture
	10-12	13.0-13.5	-	Readings affected by moisture
	12-14	3.6-3.8	-	Readings affected by moisture
	14-16	5.0-13.0	-	Readings affected by moisture
	16-18	8.2-10.0	-	Readings affected by moisture
	18-20	2.8-3.1	-	Readings affected by moisture
	20-22	6.2-8.2	-	Readings affected by moisture
	22-24	5.5-5.9	-	Readings affected by moisture
	24-26	2.0-2.9	-	Readings affected by moisture
BH-C	0-2	3.3-6.8	-	Readings affected by moisture
	2-4	3.2-6.3	-	Readings affected by moisture
	4-6	3.2-4.8	-	Readings affected by moisture
	6-8	2.5-8.5	-	Readings affected by moisture
	8-10	6.3-13.3	-	Readings affected by moisture
	10-12	8.0-11.0	-	Readings affected by moisture
	12-14	5.5-21.4	-	Readings affected by moisture
	14-16	2.0-3.0	-	Readings affected by moisture

TABLE 4.2

BOREHOLE ORGANIC VAPOR READINGS
REMEDIAL INVESTIGATION
VACAIR ALLOYS DIVISION
FREWSBURG, NEW YORK

Borehole Number	*Sample Interval (Ft. BGS)*	*Photon Reading Above Background (Meter Units)*	*OVA Readings Above Background (Meter Units)*	*Comments*
BH-D	0-1.4	-	0	
	2-4	-	0.6	
	4-6	-	0.4	
	6-8	-	0	
	8-10	-	0	
	10-12	-	0	
	12-14	-	0.0-0.1	
	14-16	-	0.2	
	16-18	-	0.5	
	18-20	-	0	
BH-E	0-2	0.4-1.1	-	
	2-4	1.8-1.9	-	
	4-6	4.3	-	
	6-8	3.4	-	
	8-10	5.3	-	
	10-12	1.5	-	
	12-14	2	-	
	14-16	4.4	-	
	16-18	2	-	
	18-20	2.1	-	
	20-22	2.1	-	
	22-24	-	0	
BH-F	0-2	-	0	
	2-4	-	-	No recovery
	4-6	-	0.1	
	6-8	-	0	
	8-10	-	0.0-0.1	
	10-12	-	0	
	12-14	-	0	
	14-16	-	0	
	16-18	-	0	
	18-20	-	0	

TABLE 4.2

BOREHOLE ORGANIC VAPOR READINGS
REMEDIAL INVESTIGATION
VACAIR ALLOYS DIVISION
FREWSBURG, NEW YORK

Borehole Number	*Sample Interval (Ft. BGS)*	*Photon Reading Above Background (Meter Units)*	*OVA Readings Above Background (Meter Units)*	*Comments*
BH-G	0-2	-		No recovery
	2-4	-	0	
	4-6	-	0	
	6-8	-	0	
	8-10	-	0	
	10-12	-	0	
BH-H	0-2	-	0.0-0.1	
	2-4	-	0.0-0.1	
	4-6	-	0	
	6-8	-	0	
	8-10	-	0	
	10-12	-	0.1	
	12-14	-	<0.1	
BH-I	0-2	-	0.3	
	2-4	-	2.7-8.6	
	4-6	-	0	
	6-8	-	0	
	8-10	-	0	
	10-12	-	0	
BH-J	0-2	-	0	
	2-4	-	0	
	4-6	-	0	
	6-8	-	0	
	8-10	-	0	
	10-12	-	0	
	12-14	-	0	
	14-16	-	0.0-0.4	One brief 0.4 ppm spike
	16-18	-	0	
	18-20	-	0	
	20-22	-	0	

TABLE 4.2

BOREHOLE ORGANIC VAPOR READINGS
REMEDIAL INVESTIGATION
VACAIR ALLOYS DIVISION
FREWSBURG, NEW YORK

Borehole Number	*Sample Interval (Ft. BGS)*	*Photon Reading Above Background (Meter Units)*	*OVA Readings Above Background (Meter Units)*	*Comments*
BH-K	0-2	-	0	
	2-4	-	0	
	4-6	-	0	
	6-8	-	0	
	8-10	-	0	
	10-12	-	0	
BH-L	0-2	-	0.0-0.1	
	2-4	-	1.2->8.6	Reading >10 PPM
	4-6	-	6-28	
	6-8	-	3-18	
	8-10	-	-	No recovery
	10-12	-	0.3-0.6	
	12-14	-	0.0-0.3	
	14-16	-	0.0-0.2	
	16-18	-	0.0-0.8	
	18-20	-	0.0-0.1	
	20-22	-	0	
BH-M	0-2	-	0.3	
	2-4	-	0	
	4-6	-	-	No recovery
	6-8	-	46-62	
	8-10	-	12-16	
	10-12	-	0.1-3.0	
	12-14	-	0.2-1.1	
	14-16	-	0.0-4.1	
	16-18	-	0.3-2.7	
	18-20	-	0.0-0.6	
	20-22	-	0.0-0.1	
	22-24	-	0	
BH-N	0-2	-	2.2-3.2	
	2-4	-	-	No recovery
	4-4.9	-	>100	

TABLE 4.2

BOREHOLE ORGANIC VAPOR READINGS
REMEDIAL INVESTIGATION
VACAIR ALLOYS DIVISION
FREWSBURG, NEW YORK

Borehole Number	*Sample Interval (Ft. BGS)*	*Photon Reading Above Background (Meter Units)*	*OVA Readings Above Background (Meter Units)*	*Comments*
BH-O	0-2	-	0.0-0.1	
	2-4	-	>98.7	
	4-6	-	4.7-48.7	
	6-8	-	18-218	
	8-10	-	40.8	
	10-12	-	22.6-58.6	
	12-14	-	4.8-20.8	
	14-16	-	9.8-11.8	
	16-18	-	3.3-7.0	
	18-20	-	0.7-1.4	
	20-22	-	2.4-2.8	
	22-24	-	0.0-0.1	
BH-P	0.5-2	-	0.2-4.5	
	2-4	-	198	
	4-6	-	458	
	6-8	-	>8.9	
	8-10	-	0.0-0.1	
	10-12	-	0.0-0.1	
	12-14	-	-	
	14-16	-	1.6	
	16-18	-	0.3	
	18-20	-	0	
	20-22	-	-	No recovery
	22-24	-	0	
BH-Q	0.5-2	-	1.5	
	2-4	-	258.7	
	4-6	-	-	No recovery
	6-8	-	4.2-19.8	
	8-10	-	0	
	10-12	-	0	
BH-R	0.5-2	-	86.8	
	2-4	-	32.6	
	4-6	-	6.6-34.6	
	6-8	-	0.6-3.4	
	8-10	-	0.3-0.6	
	10-12	-	0.0-0.1	

TABLE 4.2

BOREHOLE ORGANIC VAPOR READINGS
REMEDIAL INVESTIGATION
VACAIR ALLOYS DIVISION
FREWSBURG, NEW YORK

Borehole Number	*Sample Interval (Ft. BGS)*	*Photon Reading Above Background (Meter Units)*	*OVA Readings Above Background (Meter Units)*	*Comments*
BH-S	0.5-2	-	48.5-58.5	
	2-4	-	68-113	
	4-6	-	9-56	
	6-8	-	0.0-0.4	
	8-10	-	1	
BH-T	0.5-2.0	-	78-88	
	2-4	-	21-74	
	4-6	-	2.0-9.8	
	6-8	-	7-12	
	8-10	-	0.0-0.8	
	10-12	-	0.0-0.5	
	12-14	-	0	
	14-16	-	0	
BH-U	0-2	-	0	
	2-4	-	0.0-0.4	
	4-6	-	0.0-0.2	
	6-8	-	0.0-0.1	
	8-10	-	0.0-0.01	
	10-12	-	0	
	12-14	-	0.0-0.1	
	14-16	-	0.0-0.1	
	16-18	-	0	
BH-V	0.5-2	-	>8.4	
	2-4	-	17	
	4-6	-	0.0-0.2	
	6-8	-	1.8	
	8-10	-	-	OVA not working
	10-12	6.1	-	
	12-14	0	-	
	14-16	0	-	
	16-18	5.6	-	
	18-20	2.5	-	
	20-22	-	3.4	
	22-24	-	0.0-0.3	
	24-26	-	0	

TABLE 4.2

BOREHOLE ORGANIC VAPOR READINGS
REMEDIAL INVESTIGATION
VACAIR ALLOYS DIVISION
FREWSBURG, NEW YORK

Borehole Number	*Sample Interval (Ft. BGS)*	*Photon Reading Above Background (Meter Units)*	*OVA Readings Above Background (Meter Units)*	*Comments*
MW-11	1-2	-	0.5	
	2-4	-	1.1	
	4-6	-	-	No recovery
	6-8	-	0.5	
	8-10	-	7.8	
	10-12	-	>10	
	12-14	-	>10	
	14-16	-	0	
	16-18	-	0	
MW-9	0.5-2	-	>10	
	2-4	-	28.9	
	4-6	-	0.2-0.5	
	6-8	-	12.9	
	8-10	-	0.5-2.1	
	10-12	-	2.1-4.0	
	12-14	-	0.5-3.2	
	14-16	-	0.1-0.6	
	16-18	-	0.0-0.4	
	18-20	-	0.2-0.5	
	20-22	-	0.1-0.6	
	22-24	-	0	
MW-8	0-2	-	8.7	
	2-4	-	>100	
	4-6	-	0.0-4.4	
	6-8	-	0.0-0.1	
	8-10	-	0.0-0.1	
	10-12	-	0.0-0.6	
	12-14	-	0.0-0.4	
	14-16	-	0	
	16-18	-	0	
	18-20	-	0	

TABLE 4.2

BOREHOLE ORGANIC VAPOR READINGS
REMEDIAL INVESTIGATION
VACAIR ALLOYS DIVISION
FREWSBURG, NEW YORK

Borehole Number	*Sample Interval (Ft. BGS)*	*Photon Reading Above Background (Meter Units)*	*OVA Readings Above Background (Meter Units)*	*Comments*
BH-W	0.5-2	-	15.9	
	2-4	-	15-16	
	4-6	-	17-60	
	6-8	-	1-20	
	8-10	-	0.03-0.6	
	10-12	-	0.4-1.2	
	12-14	-	1.1-5.2	
	14-16	-	2.3-4.9	
	16-18	-	0.5-2.0	
	18-20	-	0.4-2.0	
	20-22	-	0.3-2.2	
	22-24	-	0.0-0.4	
	24-26	-	0	
BH-10D	24-26	-	-	Not sampled
	26-28	-	0	
	28-30	-	0	
	30-32	-	0	
	32-34	-	0	
	34-35	-	-	Not sampled
	35-36	-	0	
	36-38	-	0	
	38-40	-	0	
	40-42	-	0	
	42-44	-	0	
	44-46	-	0	
	46-48	-	0	
	48-50	-	0	
	50-52	-	0	
	52-54	-	0	
	54-56	-	0	

TABLE 4.2

BOREHOLE ORGANIC VAPOR READINGS
REMEDIAL INVESTIGATION
VACAIR ALLOYS DIVISION
FREWSBURG, NEW YORK

Borehole Number	*Sample Interval (Ft. BGS)*	*Photon Reading Above Background (Meter Units)*	*OVA Readings Above Background (Meter Units)*	*Comments*
MW-4D	18-20	-	<0.1	
	20-22	-	0	
	22-24	-	0	
	24-26	-	0	
	26-28	-	0	
	28-30	-	0	
	30-32	-	0	
	32-34	-	0	
	34-36	-	0	
	36-38	-	0	
	38-40	-	0	
	40-42	-	0	
	42-44	-	0	

TABLE 4.3

SUPPLEMENTAL SOIL GAS DATA
REMEDIAL INVESTIGATION
VACAIR ALLOYS
FREWSBURG, NEW YORK

Sample Number	*Maximum Organic Vapor Readings (1) (Meter Units of ppm)* *(0-1 Minute)*	*(1-3 Minutes)*	*(3-5 Minutes)*	*Notes*
1	NS	NS	NS	High water table.
2	8.0	17.7	19.0	
3	40.6	41.7	41.3	
4	77.1	75.5	66.1	
5	0	0	0	Photoionization detector drawing hard.
6	12.4	9.1	7.9	
7	7.8	8.0	7.6	
8	0	0	0	Water encountered at 2.5 ft. below ground surface (BGS).
9	0	0	0	Probe pulled up to 2.0 ft. BGS, vacuum held.
10	15.0	10.8	8.1	
11	0	0	0	
12	NS	NS	NS	High water table.
13	0	0	0	
14	6.5	9.6	9.4	
15	11.3	4.8	0	
16	84.7	83.1	79.9	

Notes:
NS No Sample Obtained.
(1) As recorded by an MSA Photon PID equipped with a 10.6 ev lamp.

TABLE 4.4

MONITORING WELL INSTRUMENTATION SUMMARY
REMEDIAL INVESTIGATION
VACAIR ALLOYS
FREWSBURG, NEW YORK

Well No.	*Ground Elevation (Ft. AMSL)*	*Top of Casing Elevation (Ft. AMSL)*	*Sandpack Interval (Ft. BGS)*	*Sandpack Interval (Ft. AMSL)*	*Well Screen Interval (Ft. BGS)*	*Well Sreen Interval (Ft. AMSL)*
MW-1	1258.4	1260.6	10.0 - 18.0	1248.4 - 1240.4	13.0 - 18.0	1245.4 - 1240.4
MW-2	1249.1	1251.6	6.5 - 14.0	1242.6 - 1235.1	8.0 - 13.0	1241.1 - 1236.1
MW-3	1250.1	1252.3	7.0 - 20.0	1243.1 - 1230.1	10.0 - 20.0	1240.1 - 1230.1
MW-4	1247.5	1250.1	6.6 - 18.0	1240.9 - 1229.5	8.0 - 18.0	1239.5 - 1229.5
MW-4D	1247.5	1249.37	35.0 - 43.0	1204.5 - 1212.5	37.9 - 42.9	1209.6 - 1204.6
MW-5	1253.9	1256.5	6.0 - 20.0	1247.9 - 1233.9	8.0 - 18.0	1245.9 - 1235.9
MW-5D	1253.9	1255.14	34.0 - 45.5	1219.9 - 1208.4	40.0 - 45.0	1213.9 - 1208.9
MW-6	1251.5	1253.7	6.5 - 16.0	1245.0 - 1235.5	9.0 - 16.0	1242.5 - 1235.5
MW-7	1251.3	1253.76	8.0 - 24.0	1243.3 - 1227.3	14.0 - 24.0	1237.3 - 1227.3
MW-8	1253.4	1256.65	6.0 - 18.0	1247.4 - 1235.4	8.0 - 18.0	1245.4 - 1235.4
MW-9	1249.6	1249.20	11.0 - 24.0	1238.6 - 1225.6	13.9 - 23.9	1235.7 - 1225.7
MW-10	1251.1	1253.5	7.0 - 23.0	1244.1 - 1228.1	12.9 - 22.9	1238.2 - 1228.2
MW-11	1251.4	1251.02	8.0 - 15.0	1243.4 - 1236.4	10.0 - 15.0	1241.4 - 1236.4
MW-12	1241.9	1243.08	7.5 - 14.0	1239.4 - 1240.9	8.8 - 13.8	1241.1 - 1246.1

Notes:
Ft. AMSL - Feet Above Mean Sea Level.
Ft. BGS - Feet Below Ground Surface.

TABLE 4.5

MONITORING WELL PURGING SUMMARY
VACAIR ALLOYS DIVISION
FREWSBURG, NEW YORK

Well No.	*Date*	*Time*	*Water Level (Ft. BTOC)*	*Initial Well Volume (Gallons)*	*Total Volume Purged (Gallons)*	*pH*	*Conductivity (μmhos/cm3)*	*Temperature (°C)*	*Turbidity (NTU)*
MW-1	12/16/92	1200	5.23	2.0	0	NM	NM	8.2	NM
					2	6.9	NM	8.3	121
					4	7.5	604	8.5	124
					6	7.1	4.4	8.6	53
					8	7.1	404	8.8	41
					10	8.2	393	9.4	37
MW-2	12/18/92	1400		1.0	0	5.6	1400	5.4	>50
					1	5.8	1220	5.6	>50
					2	6.0	1170	5.9	>50
					3	6.1	1180	6.0	>50
					4	6.0	1170	6.0	>50
					5	6.2	1170	6.0	>50
MW-3	12/18/92	1530	7.98	3.0	0	6.2	623	4.7	50
					3	6.4	628	6.5	>50
					6	6.2	639	5.5	>50
	12/21/92				9	7.8	581	9.3	>50
					12	7.4	621	9.2	>50
					15	6.6	625	8.4	>50
MW-4	12/21/92	0900	3.56	2.5	0	6.7	661	7.1	>50
					2.5	6.6	678	8.1	>50
					5	6.8	690	8.2	>50
					7.5	6.5	695	8.1	>50
					10	6.5	698	8.2	>50
					12.5	6.4	723	8.2	>50
MW-4D	12/17/92	1630	2.37	6.8	0	6.6	435	9.7	56
					7	8.0	480	8.9	>50
					14	8.2	466	8.2	>50
					21	8.3	474	8.0	>50
					28	8.7	477	7.7	>50
					35	8.8	475	7.3	>50
					42	8.5	480	7.8	>50
					49	8.4	480	7.6	>50
					56	8.6	480	7.4	>50
					63	8.8	484	7.3	>50
	12/18/92	1300	2.97		0	8.8	984	7.3	>50
					7	6.8	486	6.3	>50
					14	6.5	488	6.6	>50
					21	6.7	491	6.5	>50
					28	6.2	506	6.6	>50
					35	6.9	502	6.9	>50
	01/14/93		1.69		55	NM	NM	NM	NM
MW-5	12/17/92	0930		2.5	0	8.0	493	9.9	>50
					2.5	7.9	505	9.9	>50
					5	7.7	507	10.2	>50
					7.5	7.8	502	10.2	>50
					10.0	7.6	507	10.8	>50
					12.5	7.6	500	9.8	>50

TABLE 4.5

MONITORING WELL PURGING SUMMARY
VACAIR ALLOYS DIVISION
FREWSBURG, NEW YORK

Well No.	*Date*	*Time*	*Water Level (Ft. BTOC)*	*Initial Well Volume (Gallons)*	*Total Volume Purged (Gallons)*	*pH*	*Conductivity (µmhos/cm3)*	*Temperature (°C)*	*Turbidity (NTU)*
MW-5D	12/17/92	1030		6.0	0	7.6	457	8.8	20
					6	7.1	480	9.8	20
					12	7.7	467	8.3	20
					18	7.0	465	8.4	20
					24	7.3	467	8.0	20
					30	7.5	467	8.4	20
MW-6	12/16/92	1330		2.0	0	4.7	696	8.2	70
					2	4.3	675	8.3	47
					4	4.6	704	8.6	40
					6	4.7	710	8.5	80
					8	4.1	716	8.5	63
					10	4.6	694	8.5	71
MW-7	12/16/92	1400	6.65	3.0	0	7.4	490	9.7	13
					3	6.2	494	10.9	40
					6	6.9	489	11.2	52
					9	7.1	490	11.3	44
					12	7.1	490	11.2	40
					15	7.0	488	11.2	27
MW-8	12/15/92	-	3.75	3.0	3	NM	NM	NM	>50
					6	NM	NM	NM	>50
					9	NM	NM	NM	>50
					12	NM	NM	NM	>50
					15	NM	NM	NM	>50
					18	NM	NM	NM	>50
					21	NM	NM	NM	>50
					24	NM	NM	NM	>50
					27	NM	NM	NM	>50
					30	NM	NM	NM	>50
	12/16/92	0800	3.58	3.0	0	6.5	620	9.8	>50
					3	6.9	627	9.5	>50
					6	6.8	645	9.5	>50
					9	7.1	636	9.4	>50
					12	7.3	640	9.5	>50
					15	7.5	645	9.5	>50
MW-9	12/18/92	1030	4.92	2.9	0	5.8	753	8.8	>50
					3	5.8	740	8.6	>50
					6	6.5	780	6.9	>50
					9	6.6	781	8.1	>50
					12	6.5	740	8.7	>50
					15	6.7	744	7.8	>50
					18	6.7	745	8.4	>50
					21	7.2	735	8.2	>50
					24	6.5	744	8.3	>50
					27	6.7	729	8.1	>50
					30	6.8	744	8.0	>50

TABLE 4.5

MONITORING WELL PURGING SUMMARY
VACAIR ALLOYS DIVISION
FREWSBURG, NEW YORK

Well No.	*Date*	*Time*	*Water Level (Ft. BTOC)*	*Initial Well Volume (Gallons)*	*Total Volume Purged (Gallons)*	*pH*	*Conductivity (µmhos/cm3)*	*Temperature (°C)*	*Turbidity (NTU)*
	12/21/92	1300	4.72	2.9	0	6.4	804	10.8	>50
					3	6.0	810	11.3	>50
					6	5.8	800	11.9	>50
					9	5.9	800	11.8	>50
					12	5.8	805	11.9	>50
					15	5.8	800	11.9	>50
MW-10	12/16/92	1730		3.0	0	NM	NM	12.2	>50
					3	9.6	265	12.6	>50
					6	11.5	278	12.9	>50
					9	9.8	278	12.7	>50
					12	9.7	264	12.9	>50
					15	9.9	281	12.8	>50
					18	9.3	249	12.8	>50
					21	9.7	241	12.8	>50
					24	9.7	243	12.8	>50
					27	9.8	277	12.8	>50
					30	9.8	277	12.7	>50
	12/17/92	0900		3.0	0	5.6	309	11.2	>50
					3	5.9	313	11.7	>50
					6	6.0	333	12.3	>50
					9	6.3	349	12.5	>50
					12	6.5	358	12.5	>50
					15	6.5	375	12.5	>50
MW-11	12/18/92	0900	3.51	1.9	0	5.5	248	6.3	>50
					2	5.9	286	7.7	>50
					4	5.9	280	7.7	>50
					6	6.3	298	8.0	>50
					8	6.2	334	7.7	>50
					10	6.4	364	7.8	>50
					12	6.2	402	7.9	>50
					14	6.6	375	8.1	>50
					16	6.2	385	8.3	>50
					18	6.3	396	8.7	>50
					20	6.1	420	8.2	>50
	12/21/92	1100	-	2.0	0	7.9	352	7.6	92
					2	7.2	342	9.0	>50
					4	6.8	305	9.9	>50
					6	6.0	381	10.0	>50
					8	6.1	391	10.0	>50
					10	6.5	405	10.6	>50
MW-12	06/14/93	1324	-	2.3	2.3	6.7	418	-	89
					4.6	6.5	411	11.7	125
					6.9	6.5	403	11.6	142
					9.2	6.6	408	12.0	100
					11.5	6.6	428	11.5	45

Note:
NM Not measured due to equipment malfunction.

TABLE 4.6

GROUNDWATER ELEVATION DATA
REMEDIAL INVESTIGATION
VACAIR ALLOYS
FREWSBURG, NEW YORK

	Water Level Elevation (Ft. AMSL)												
	4/26/91 (1)	*4/29/91 (1)*	*4/30/91 (1)*	*05/03/91*	*06/13/91*	*06/25/91*	*08/19/91*	*04/15/92*	*06/17/92*	*12/22/92*	*01/21/93*	*02/19/93*	*06/14/93*
MW-1	-	1255.41	1254.98	1255.05	1253.76	1253.40	1252.30	-	1253.72	1255.63	1255.11	1254.70	1254.18
MW-2	1242.5	-	1242.34	1241.80	1239.22	1239.00	1239.23	-	1239.31	1243.14	1242.60	1240.28	1240.32
MW-3	-	1242.95	1243.28	1243.00	1241.71	1241.01	1240.77	-	1241.45	1244.21	1243.32	1242.35	1242.26
MW-4	-	1246.02	1246.02	1245.67	1243.95	1243.60	1243.14	-	1244.19	1246.39	1245.82	1245.14	1244.92
MW-4D	-	-	-	-	-	-	-	-	-	1247.48	1245.24	1242.63	1240.35
MW-5	-	1249.85	1249.82	1249.56	1248.38	1248.11	1247.48	1245.70	1248.30	1256.50	1249.96	1249.13	1248.94
MW-5D			-	-	-	-	-	-	1242.76	1251.04	1249.29	1246.42	1244.16
MW-6	-	1247.33	1247.44	1246.83	1244.91	1244.64	1244.32	-	1245.09	1247.84	1246.97	1246.30	1245.74
MW-7	-	-	-	-	-	-	-	-	1245.54	1247.24	1246.69	1246.26	1246.17
MW-8	-	-	-	-	-	-	-	-	-	1253.14	1252.68	1252.46	1251.88
MW-9	-	-	-	-	-	-	-	-	-	1244.49	1244.34	1243.51	1243.99
MW-10	-	-	-	-	-	-	-	-	-	1248.66	1248.29	1248.08	1247.94
MW-11	-	-	-	-	-	-	-	-	-	1247.64	1247.25	1247.11	1246.91
MW-12	-	-	-	-	-	-	-	-	-	-	-	-	1241.86
Conewango Creek	-	-	-	-	1230.95	1230.72	1230.47	-	-	1239.52	1235.33	1233.31	1237.43

Note:
(1) Measured prior to development.

TABLE 4.7

SUMMARY OF CALCULATED HYDRAULIC CONDUCTIVITIES
REMEDIAL INVESTIGATION
VACAIR ALLOYS
FREWSBURG, NEW YORK

Well No.	*Date of Test*	*Type of Test*	*Elevations Tested Interval (Ft. AMSL)*	*Calculated Hydraulic Conductivity (2)*
On-Site Water Table Aquifer:				
MW-1	04/29/91	Rising Head	1248.4 - 1240.4	5.3 x 10-4 cm/sec
MW-2	04/26/91	Rising Head	1242.6 - 1235.1	3.5 x 10-3 cm/sec
MW-3	04/29/91	Rising Head	1243.1 - 1230.1	1.6 x 10-5 cm/sec
MW-4	04/29/91	Falling Head	1240.9 - 1229.5	7.4 x 10-4 cm/sec
MW-5	04/29/91	Rising Head	1247.9 - 1233.9	2.6 x 10-3 cm/sec
MW-6	04/29/91	Rising Head	1245.0 - 1235.5	4.9 x 10-4 cm/sec
MW-8	01/14/93	Rising Head	1245.4 - 1235.4	5.1 x 10-3 cm/sec
MW-9	01/14/93	Rising Head	1235.7 - 1225.7	5.5 x 10-4 cm/sec
MW-10	01/14/93	Rising Head	1238.2 - 1228.2	1.3 x 10-4 cm/sec
MW-11	01/14/93	Rising Head	1241.4 - 1236.4	1.4 x 10-4 cm/sec
		WATER TABLE AQUIFER - GEOMETRIC MEAN		5.2 x 10-4 cm/sec
Frewsburg Aquifer:				
MW-4D	01/14/93	Rising Head	1209.6 - 1204.6	7.9 x 10-3 cm/sec

Notes:
(1) Based on slug tests performed on the monitoring wells.
(2) Hydraulic conductivity calculated using Bouwer and Rice (1976) method.

TABLE 4.8

AIR MONITORING DATA (1)
REMEDIAL INVESTIGATION
VACAIR ALLOYS DIVISION
FREWSBURG, NEW YORK

Borehole/ Test Pit Number	*Date*	*Time*	*Organic (2) Vapor OVA/PID (Units)*	*Dust (2) Sibata (mg/m3 air)*	*Oxygen (Percent)*	*LEL (Percent)*	*Notes*
BH-A	11/16/92	1518	0.0	-	-	-	Readings affected by moisture.
BH-B	11/17/92	-	0.0	-	-	-	Readings affected by moisture.
BH-C	11/17/92	-	0.0	-	-	-	Readings affected by moisture.
BH-D	11/18/92	0820	0.0	-	-	-	
	11/18/92	0908	0.0	-	-	-	
BH-E	11/18/92	1113	0.0	-	-	-	
	11/18/92	1141	0.0	-	-	-	
BH-F	11/18/92	1535	0.0	-	-	-	
BH-G	11/19/92	0905	0.0	-	-	-	
BH-H	11/19/92	1235	0.0	-	-	-	
BH-I	11/19/92	1540	0.0	-	-	-	
	11/20/92	0810	0.0	-	-	-	
BH-J	11/20/92	0940	0.0	-	-	-	
BH-K	11/20/92	1350	0.0	-	-	-	
BH-L	11/23/92	0845	0.0	-	-	-	
	11/23/92	0902	0.0	-	-	-	
	11/23/92	0918	0.0	-	-	-	
	11/23/92	0935	0.0	-	-	-	
BH-M	11/23/92	1120	0.0	-	-	-	
	11/23/92	1202	0.0	-	-	-	
	11/23/92	1239	0.0	-	-	-	
BH-N	11/23/92	1453	0.0-0.1	-	-	-	
	11/23/92	1510	6.8	-	-	-	

TABLE 4.8

AIR MONITORING DATA (1)
REMEDIAL INVESTIGATION
VACAIR ALLOYS DIVISION
FREWSBURG, NEW YORK

Borehole/ Test Pit Number	*Date*	*Time*	*Organic (2) Vapor OVA/PID (Units)*	*Dust (2) Sibata (mg/m3 air)*	*Oxygen (Percent)*	*LEL (Percent)*	*Notes*
BH-O	11/24/92	0835	0.0	-	-	-	
	11/24/92	0845	0.0-0.5	-	-	-	
	11/24/92	0850	0.0-1.5	-	-	-	
	11/24/92	0905	0-5.0	-	-	-	
	11/24/92	0911	2.8	-	-	-	
	11/24/92	0925	1.8	-	-	-	
	11/24/92	0934	4.6-6.6	-	-	-	
	11/24/92	0941	0.0-1.0	-	-	-	
	11/24/92	0950	0.0-0.1	-	-	-	
BH-P	11/24/92	1221	0.0-0.2	-	-	-	
	11/24/92	1230	0.0	-	-	-	
BH-Q	11/25/92	0917	0.0	-	-	-	
	11/25/92	0958	0.0	-	-	-	
BH-R	11/25/92	1150	0.0	-	-	-	
BH-S	11/25/92	1454	0.0	-	-	-	
BH-T	11/30/92	0840	0.0	-	-	-	
BH-U	11/30/92	1045	0.0	-	-	-	
BH-V	11/30/92	-	-	-	-	-	OVA not functioning.
BH-W	12/03/92	0830	0.1-0.9	-	-	-	
MW-11	12/01/92	0850	0.0	-	-	-	
MW-9	12/02/92	0930	0.1-0.3	-	-	-	
MW-8	12/02/92	1350	0.1-0.3	-	-	-	

TABLE 4.8

AIR MONITORING DATA (1)
REMEDIAL INVESTIGATION
VACAIR ALLOYS DIVISION
FREWSBURG, NEW YORK

Borehole/ Test Pit Number	*Date*	*Time*	*Organic (2) Vapor OVA/PID (Units)*	*Dust (2) Sibata (mg/m3 air)*	*Oxygen (Percent)*	*LEL (Percent)*	*Notes*
MW-10D	12/07/92	1035	0.0	-	-	-	
	12/08/92	0805	0.0	-	-	-	
MW-4D	12/08/92	0955	0.0	-	-	-	
MW-1D	03/16/92	0930	0.0	-	-	-	
	03/18/92	1433	0.0	-	-	-	
	03/20/92	0935	0.0	-	-	-	
MW-6D	03/24/92	0919	0.0	-	-	-	
	03/31/92	1355	0.0	-	-	-	
	04/01/92	0845	0.0	-	-	-	
MW-5D	03/25/92	0910	0.0	-	-	-	
	03/25/92	1035	0.0	-	-	-	
	04/06/92	1244	0.0-0.2	-	-	-	
	04/07/92	1203	0.0	-	-	-	
MW-8D	03/26/92	1330	0.0	-	-	-	
	04/02/92	0957	0.0	-	-	-	
Test Pit 1	12/11/90	1400	1.0	0.187	21.1	0	
	12/11/90	1415	2.0	0.029	21.1	0	
	12/11/90	1425	2.8	0.038	21.1	0	
	12/11/90	1445	3.6	-	21.1	0	
	12/11/90	1515	1.0	.029	21.1	0	
	12/11/90	1530	0.4	-	21.1	0	

TABLE 4.8

AIR MONITORING DATA (1)
REMEDIAL INVESTIGATION
VACAIR ALLOYS DIVISION
FREWSBURG, NEW YORK

Borehole/ Test Pit Number	*Date*	*Time*	*Organic (2) Vapor OVA/PID (Units)*	*Dust (2) Sibata (mg/m3 air)*	*Oxygen (Percent)*	*LEL (Percent)*	*Notes*
Test Pit 4A	12/12/90	0900	1.0	0.066	21.1	0	
	12/12/90	0920	0.6	0.047	21.1	0	
	12/12/90	0935	0.2	0.059	21.1	0	
Test Pit 4B	12/12/90	0945	2.0	0.050	21.1	0	
	12/12/90	1010	2.0	0.048	21.1	0	
	12/12/90	1030	3.0	0.044	21.1	0	
Test Pit 4C	12/12/90	1100	1.0	0.060	21.1	0	
	12/12/90	1115	2.0	0.065	21.1	0	
Test Pit 4D	12/12/90	1130	2.0	0.060	21.1	0	
Test Pit 4E	12/12/90	1205	15.0	-	21.1	0	
Test Pit 4F	12/12/90	1440	4.0	0.064	21.1	0	
Test Pit 2A	12/12/90	1545	4.0	-	21.1	0	
	12/12/90	1600	2.0	-	21.1	0	
	12/12/90	1620	0.8	-	21.1	0	
Test Pit 8A	12/13/90	0810	1.0	0.042	21.0	0	
Test Pit 8B	12/13/90	0850	2.0	-	21.0	0	
Test Pit 10A	12/13/90	1110	2.0	0.038	21.0	0	
	12/14/90	1325	0	0.038	21.0	0	
	12/14/90	1335	1.0	0.042	21.0	0	
Test Pit 10B	12/13/90	1140	1.0	0.043	21.0	0	
	12/13/90	1215	0.8	0.046	21.0	0	
	12/13/90	1225	1.0	0.047	21.0	0	

TABLE 4.8

AIR MONITORING DATA (1)
REMEDIAL INVESTIGATION
VACAIR ALLOYS DIVISION
FREWSBURG, NEW YORK

Borehole/ Test Pit Number	*Date*	*Time*	*Organic (2) Vapor OVA/PID (Units)*	*Dust (2) Sibata (mg/m3 air)*	*Oxygen (Percent)*	*LEL (Percent)*	*Notes*
Test Pit 3A	12/14/90	0915	1.5	0.032	21.1	0	
	12/14/90	0930	2.0	0.029	21.1	0	
	12/14/90	0945	0.5-1.0	-	21.1	0	
	12/14/90	1015	1.0	0.040	21.1	0	
Test Pit 3B	12/14/90	1100	0-1.0	0.059	21.1	0	
	12/14/90	1115	8	0.045	21.1	0	
	12/14/90	1130	1-2	-	21.1	0	
	12/14/90	1200	1-5	0.036	21.1	0	
Test Pit 11A	12/14/90	1415	1.0	0.038	21.1	0	
	12/14/90	1430	0	0.058	21.1	0	
	12/14/90	1435	0	0.031	21.1	0	
BH-1	01/22/91	1438	0	0.036	21.4	0	
	01/22/91	1453	0	0.064	21.4	0	
	01/22/91	1510	0	0.035	21.4	0	
	01/22/91	1525	0	0.034	21.5	0	
	01/22/91	1542	0	0.031	21.6	0	
	01/22/91	1600	0	0.032	21.7	0	
	01/22/91	1632	0	0.032	21.6	0	
	01/23/91	1335	0	0.060	21.3	0	
	01/23/91	1350	0	0.050	21.1	0	
	01/23/91	1420	0	-	21.1	0	

TABLE 4.8

AIR MONITORING DATA (1)
REMEDIAL INVESTIGATION
VACAIR ALLOYS DIVISION
FREWSBURG, NEW YORK

Borehole/ Test Pit Number	*Date*	*Time*	*Organic (2) Vapor OVA/PID (Units)*	*Dust (2) Sibata (mg/m3 air)*	*Oxygen (Percent)*	*LEL (Percent)*	*Notes*
BH-5B-1	01/24/91	0924	0	0.048	21.3	0	
	01/24/91	0944	0	0.045	21.4	0	
BH-5B-2	01/24/91	1112	0	0.043	21.3	0	
BH-5B-3	01/24/91	1450	0	0.053	21.5	0	
BH-5A-1	01/25/91	0955	0	0.037	21.3	0	
BH-5A-2	01/25/91	1330	0	0.074	21.4	1.0	
	01/25/91	1345	3.0	0.044	21.5	1.0	
	01/25/91	1400	8.0	0.060	21.5	1.0	
BH-5A-3	01/25/91	1500	0	0.052	21.6	1.0	
	01/25/91	1515	0	0.047	21.7	0	
	01/25/91	1515	0	0.032	21.7	0	
BH-13-1	01/28/91	0945	0	0.040	21.4	1.0	
	01/28/91	1000	0	0.040	21.4	1.0	
	01/28/91	1015	0	0.038	21.4	1.0	
	01/28/91	1030	0	0.049	21.3	2.0	
	01/28/91	1045	0	0.036	21.3	2.0	
	01/28/91	1100	0	0.035	21.3	1.0	

TABLE 4.8

AIR MONITORING DATA (1)
REMEDIAL INVESTIGATION
VACAIR ALLOYS DIVISION
FREWSBURG, NEW YORK

Borehole/ Test Pit Number	*Date*	*Time*	*Organic (2) Vapor OVA/PID (Units)*	*Dust (2) Sibata (mg/m3 air)*	*Oxygen (Percent)*	*LEL (Percent)*	*Notes*
BH-12-1	01/28/91	1330	0	0.029	21.1	2.0	
	01/28/91	1400	0	0.028	21.2	2.0	
	01/28/91	1415	0	0.030	21.2	3.0	
	01/28/91	1430	0	0.030	21.2	2.0	

Notes:
- Not Sampled.
(1) As measured in the Breathing Zone.
(2) As measured above background levels.

TABLE 5.1
BOREHOLE STRATIGRAPHIC SUMMARY
REMEDIAL INVESTIGATION
VACAIR ALLOYS DIVISION
FREWSBURG, NEW YORK

Well/ Borehole No.	*Ground Elevation (Ft. AMSL)*	*Borehole Bottom (Ft. AMSL)*	*Shallow Sand/Gravel Unit*			*Confining Clay Unit*			*Lower Sand and Gravel Unit*				
			Top Depth (Ft. BGS)	*Top Elevation(1) (Ft. AMSL)*	*Thickness (Feet)*	*Top Depth (Ft. BGS)*	*Top Elevation(1) (Ft. AMSL)*	*Thickness (Feet)*	*Top Depth (Ft. BGS)*	*Top Elevation(1) (Ft. AMSL)*	*Thickness (Feet)*	*Bottom Depth (Ft. BGS)*	*Bottom Elevation (1) (Feet)*
MW-1	1258.4	1240.4	0.7	1257.7	14.8	15.5	1242.9	-	-	-	-	-	-
MW-2	1249.1	1235.1	6.5	1242.6	6.4	12.9	1236.2	-	-	-	-	-	-
MW-3	1250.1	1228.1	4.0	1246.1	10.5	14.5	1235.6	-	-	-	-	-	-
MW-4	1247.5	1227.5	2.3	1245.2	14.1	16.4	1231.1	-	-	-	-	-	-
MW-4D	1247.5	1203.5	2.3	1245.2	14.1	16.4	1231.1	19.4	35.8	1211.7	6.9	42.7	1204.8
MW-5	1253.9	1233.9	4.0	1249.9	>16.0	-	-	-	-	-	-	-	-
MW-5D	1253.9	1203.9	4.0	1249.9	16.5	20.5	1233.4	13.5	34.0	1219.9	10.7	44.7	1209.2
MW-6	1251.5	1233.5	2.0	1249.5	16.0	16.0	1235.5	-	-	-	-	-	-
MW-7	1251.3	1225.3	0.2	1251.1	17.1	24.0	1227.3	-	-	-	-	-	-
MW-8	1253.4	1233.4	2.0	1251.4	>18.0	-	-	-	-	-	-	-	-
MW-9	1249.6	1225.6	1.5	1248.1	20.5	22.0	1227.6	-	-	-	-	-	-
MW-10	1251.1	1228.1	6.0	1245.1	16.0	22.0	1229.1	-	-	-	-	-	-
MW-11	1251.4	1233.4	2.8	1248.6	13.2	16.0	1235.4	-	-	-	-	-	-
Well #1 (3)	1251.7	1211.5	(4)	(4)	(4)	19.0	1232.7	15.5	34.5	1217.2	5.7	40.2	1211.5
Well #2 (3)	1251.7	1211.7	(4)	(4)	(4)	19.0	1232.7	15.5	34.5	1217.2	5.5	40.0	1211.7
Well #3 (3)	1248.8	1197.9	11.0	1241.8	4.0	11.0	1237.8	29.5	40.5	1208.3	9.4	49.9	1198.9
Well #4 (3)	1248.7	(4)	(4)	(4)	(4)	0.0	1248.7	41.0	41.0	1207.7	6.0	47.0	1201.7
BH-1	1256.2	1228.2	2.4	1253.8	21.6	24.0	1232.2	-	-	-		-	-
BH-1D	1258.5	1189.5	0.7	1257.7	14.8	20.0	1238.5	>49.0	(2)	(2)	(2)	-	-
BH-5A-1	1250.6	1239.6	7.0	1243.6	-		-	-	-	-	-	-	-
BH-5A-2	1250.6	1239.6	9.0	1241.6	-		-	-	-	-	-	-	-
BH-5A-3	1250.4	1241.4	1.9	1248.5	-		-	-	-	-	-	-	-
BH-5B-1	1250.1	1241.1	7.2	1242.9	-		-	-	-	-	-	-	-
BH-5B-2	1250.6	1239.0	7.0	1243.6	-		-	-	-	-	-	-	-
BH-5B-3	1248.6	1237.6	7.3	1241.3	3.5	10.8	1237.8	-	-	-	-	-	-
BH-6D	1248.7	1185.7	0.8	1249.5	10.8	15.2	1233.5	>47.8	(2)	(2)	(2)	-	-
BH-8D	1240.0	1178.0	2.6	1237.4	19.4	22.0	1218.0	>40.0	(2)	(2)	(2)	-	-
BH-9D	1240.2	1170.2	0.9	1239.3	25.1	26.0	1214.2	>44.0	(2)	(2)	(2)	-	-
BH-10D	1251.1	1195.1	6.0	1245.1	16.0	22.0	1229.1	>34.0	(2)	(2)	(2)	-	-
BH-12-1	1256.6	1248.6	3.1	1253.5	-	-	-	-	-	-	-	-	-
BH-13-1	1250.0	1241.0	7.2	1242.8	-	-	-	-	-	-	-	-	-
BH-A	1259.6	1233.6	2.5	1257.1	19.5	22.0	1237.6	-	-	-	-	-	-
BH-B	1252.9	1226.9	4.0	1248.9	20.0	24.0	1228.9	-	-	-	-	-	-
BH-C	1247.9	1231.9	4.5	1243.4	9.5	14.0	1233.9	-	-	-	-	-	-
BH-D	1245.3	1225.3	2.0	1243.3	16.0	18.0	1227.3	-	-	-	-	-	-
BH-E	1250.3	1226.3	4.4	1245.9	15.6	20.0	1230.3	-	-	-	-	-	-
BH-F	1250.2	1230.2	4.0	1246.2	14.8	18.8	1231.4	-	-	-	-	-	-
BH-G	1241.9	1227.9	2.3	1239.6	10.3	12.6	1229.3	-	-	-	-	-	-
BH-H	1243.8	1229.8	2.0	1241.8	11.2	13.2	1230.6	-	-	-	-	-	-

TABLE 5.1
BOREHOLE STRATIGRAPHIC SUMMARY
REMEDIAL INVESTIGATION
VACAIR ALLOYS DIVISION
FREWSBURG, NEW YORK

			Shallow Sand/Gravel Unit			*Confining Clay Unit*			*Lower Sand and Gravel Unit*				
Well/ Borehole No.	***Ground Elevation (Ft. AMSL)***	***Borehole Bottom (Ft. AMSL)***	***Top Depth (Ft. BGS)***	***Top Elevation(1) (Ft. AMSL)***	***Thickness (Feet)***	***Top Depth (Ft. BGS)***	***Top Elevation(1) (Ft. AMSL)***	***Thickness (Feet)***	***Top Depth (Ft. BGS)***	***Top Elevation(1) (Ft. AMSL)***	***Thickness (Feet)***	***Bottom Depth (Ft. BGS)***	***Bottom Elevation (1) (Feet)***
BH-I	1246.6	1234.6	2.3	1244.3	7.7	10.0	1236.6	-	-	-	-	-	-
BH-J	1257.7	1235.7	2.0	1255.7	>18.0	-	-	-	-	-	-	-	-
BH-K	1250.2	1238.2	-	-	-	-	-	-	-	-	-	-	-
BH-L	1250.3	1228.3	4.0	1246.3	>14.6	-	-	-	-	-	-	-	-
BH-M	1248.7	1224.7	6.0	1242.7	12.4	18.4	1230.3	-	-	-	-	-	-
BH-N	1249.0	1244.1	-	-	-	-	-	-	-	-	-	-	-
BH-O	1248.3	1224.3	8	1240.3	14.2	22.2	1226.1	-	-	-	-	-	-
BH-P	1251.1	1227.1	6	1245.1	16	22	1229.1	-	-	-	-	-	-
BH-Q	1251.1	1239.1	6.7	1244.4	>5.3	-	-	-	-	-	-	-	-
BH-R	1250.5	1238.5	2.4	1248.1	>9.6	-	-	-	-	-	-	-	-
BH-S	1250.2	1240.2	4.5	1245.7	>5.5	-	-	-	-	-	-	-	-
BH-T	1251.1	1235.1	6.5	1244.6	>9.5	-	-	-	-	-	-	-	-
BH-U	1250.6	1232.6	4.4	1246.2	11.6	16.0	1234.6	-	-	-	-	-	-
BH-V	1250.7	1224.7	4.0	1246.7	16.7	20.7	1230.0	-	-	-	-	-	-
BH-W	1250.1	1224.1	2.2	1247.9	18.5	20.7	1229.4	-	-	-	-	-	-

Notes:

Ft. BGS - Feet Below Ground Surface.
Ft. AMSL - Feet Above Mean Sea Level.
(1) Elevation at top of stratigraphic layer.
(2) Frewsburg Aquifer not encountered.
(3) Frewsburg Water District Production Well.
(4) Not noted on logs.

TABLE 5.2

SUMMARY OF GRAIN SIZE DISTRIBUTION (1)
REMEDIAL INVESTIGATION
VACAIR ALLOYS DIVISION
FREWSBURG, NEW YORK

Well/ Borehole No.	*Interval (Ft. BGS) (2)*	*Gravel (Percent)*	*Sand (Percent)*	*Silt/Clay (Percent)*	*Geologic Unit*
BH-1D	31 - 33	0	0.2	99.8	Confining Clay
MW-5D	48 - 50	0	0	100	Confining Clay
BH-8D	44 - 46	2.9	2.5	94.6	Confining Clay
MW-5D	36 - 44	44.9	31.9	23.2	Lower Sand and Gravel
MW-10	6 - 22	7.6	27.7	64.7	Upper Sand and Gravel
MW-4	4 - 17	5.8	64.2	30.0	Upper Sand and Gravel

Notes:

(1) Testing performed by Huntingdon Analytical Services, Inc. of Middleport, New York.

(2) Ft. BGS - Feet Below Ground Surface.

TABLE 5.3

SUMMARY OF GEOTECHNICAL SOIL TESTING
REMEDIAL INVESTIGATION
VACAIR ALLOYS DIVISION
FREWSBURG, NEW YORK

Well/ Borehole No.	*Sample Interval (Ft. BGS) (1)*	*TOC (2) (Percent)*	*Moisture Content (Percent)*	*Specific Gravity*	*Porosity (Percent)*	*Vertical Permeability (cm/s)*	*Geologic Unit*
MW-10	6 - 22	0.426	25.1	2.72	39.3	-	Upper Sand and Gravel
MW-4	4 - 17	0.179	18.4	2.75	36.4	-	Upper Sand and Gravel
MW-5D	44 - 46	0.16	-	-	-	-	Lower Sand and Gravel
	32 -34	0.095	-	-	-	-	Confining Clay
	48 - 50	0.41	32.5	-	4.5	2.26x10-8 - 2.43x10-8	Confining Clay
MW-5D	36 -44	-	8.8	-	18 c	-	Lower Sand and Gravel
BH-8D	44 - 46	-	23.1	-	24	2.90x10-8 - 2.83x10-8	Confining Clay
BH-1D	31 - 33	-	35.3	-	48 c	1.75x10-8 - 1.66x10-8	Confining Clay

Notes:
(1) Ft. BGS - Feet Below Ground Surface.
(2) TOC - Total Organic Compound.
c Calculated.

TABLE 6.1

SURFACE SOIL SAMPLE DATA SUMMARY
VACAIR ALLOYS DIVISION
FREWSBURG, NEW YORK

Location:	***SS-1***	***SS-2***	***SS-3***	***SS-4***	***SSoil-A***	***SSoil-J***	***SSoil-M***	***SSoil-N***	***SSoil-N***	***SSoil-O***
Sample I.D.:	***SS-1***	***SS-2***	***SS-3***	***SS-4***	***SSoil-A***	***SSoil-J***	***SSoil-M***	***SSoil-N***	***SSoil-CD***	***SSoil-O***
Date Sampled:	***01/28/91***	***01/28/91***	***01/28/91***	***01/28/91***	***12/22/92***	***12/22/92***	***12/22/92***	***12/22/92***	***12/22/92***	***12/22/92***
VOCs (µg/kg)										
Methylene Chloride	-	NA	NA	NA	-	17 J	-	-	-	-
Acetone	-	NA	NA	NA	86	48 J	11 J	4 J	-	-
Carbon Disulfide	-	NA	NA	NA	-	-	4 J	1 J	3 J	-
1,2-Dichloroethene (Total)	-	NA	NA	NA	-	-	5 J	-	2 J	-
2-Butanone	-	NA	NA	NA	8 J	-	-	-	-	-
Trichloroethene	38	NA	NA	NA	-	-	8 J	3 J	5 J	-
4-Methyl-2-Pentanone	-	NA	NA	NA	-	-	4 J	2 J	2 J	-
Ethylbenzene	-	NA	NA	NA	-	-	3 J	-	-	-
Xylene (Total)	-	NA	NA	NA	-	-	3 J	3 J	4J	-
Total VOCs (µg/kg)	38	NA	NA	NA	94 J	65J	38 J	13 J	16 J	0

TABLE 6.1

SURFACE SOIL SAMPLE DATA SUMMARY
VACAIR ALLOYS DIVISION
FREWSBURG, NEW YORK

Location:	***SS-1***	***SS-2***	***SS-3***	***SS-4***	***SSoil-A***	***SSoil-J***	***SSoil-M***	***SSoil-N***	***SSoil-N***	***SSoil-O***
Sample I.D.:	***SS-1***	***SS-2***	***SS-3***	***SS-4***	***SSoil-A***	***SSoil-J***	***SSoil-M***	***SSoil-N***	***SSoil-CD***	***SSoil-O***
Date Sampled:	***01/28/91***	***01/28/91***	***01/28/91***	***01/28/91***	***12/22/92***	***12/22/92***	***12/22/92***	***12/22/92***	***12/22/92***	***12/22/92***
BNAs										
4-Chloro-3-methylphenol	60 J	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Nitrophenol	250 J	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pentachlorophenol	220 J	NA	NA	NA	NA	NA	NA	NA	NA	NA
Phenanthrene	220 J	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fluoranthene	480 J	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pyrene	480 J	NA	NA	NA	NA	NA	NA	NA	NA	NA
Butylbenzylphthalate	89 J	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	160 J	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	190 J	NA	NA	NA	NA	NA	NA	NA	NA	NA
bis(2-Ethylhexyl)phthalate	240 J	NA	NA	NA	NA	NA	NA	NA	NA	NA
Di-n-Octyl phthalate	190 J	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	170 J	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	190 J	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	170 J	NA	NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	90 J	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(g,h,i)perylene	96 J	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides and PCBs (µg/kg)										
Alpha-BHC	NA	190J	NA	NA	NA	NA	NA	NA	NA	NA
Beta-BHC	NA	9.0	NA	NA	NA	NA	NA	NA	NA	NA
Delta-BHC	NA	2.3J	NA	NA	NA	NA	NA	NA	NA	NA
Arochlor 1260	NA	-	NA	NA	NA	NA	37J	36J	29J	-

TABLE 6.1

SURFACE SOIL SAMPLE DATA SUMMARY
VACAIR ALLOYS DIVISION
FREWSBURG, NEW YORK

Location:	*SS-1*	*SS-2*	*SS-3*	*SS-4*	*SSoil-A*	*SSoil-J*	*SSoil-M*	*SSoil-N*	*SSoil-N*	*SSoil-O*
Sample I.D.:	*SS-1*	*SS-2*	*SS-3*	*SS-4*	*SSoil-A*	*SSoil-J*	*SSoil-M*	*SSoil-N*	*SSoil-CD*	*SSoil-O*
Date Sampled:	*01/28/91*	*01/28/91*	*01/28/91*	*01/28/91*	*12/22/92*	*12/22/92*	*12/22/92*	*12/22/92*	*12/22/92*	*12/22/92*
Total Metals (mg/kg)										
Aluminum	4050	4360	5020	4650	NA	NA	NA	NA	NA	NA
Arsenic	4.90	1.40	3.00	4.70	NA	NA	NA	NA	NA	NA
Barium	4.66	90.6 J	53.0	61.4 J	NA	NA	NA	NA	NA	NA
Beryllium	-	0.330	0.220	0.270	NA	NA	NA	NA	NA	NA
Calcium	8520	72800 J	8990	17100 J	NA	NA	NA	NA	NA	NA
Chromium	5.80	1.50	9.70	1.30	NA	NA	NA	NA	NA	NA
Cobalt	7.10	5.80	12.5	4.50	NA	NA	NA	NA	NA	NA
Copper	16.0	10.9	18.7	12.6	NA	NA	NA	NA	NA	NA
Iron	11400	12500	12700	12100	NA	NA	NA	NA	NA	NA
Lead	19.2	5.20 J	25.9	10.6 J	NA	NA	NA	NA	NA	NA
Magnesium	3450	3260	2160	3790	NA	NA	NA	NA	NA	NA
Manganese	439	1890 J	420	441 J	NA	NA	NA	NA	NA	NA
Nickel	-	-	84.2	-	NA	NA	NA	NA	NA	NA
Potassium	-	-	192	-	NA	NA	NA	NA	NA	NA
Silver	-	-	2.30	-	NA	NA	NA	NA	NA	NA
Sodium	227	218	166	149	NA	NA	NA	NA	NA	NA
Zinc	40.4	38.2	38.2	30.0	NA	NA	NA	NA	NA	NA
Total Petroleum Hydrocarbon (mg/kg)										
Total Petroleum Hydrocarbons	34	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

J	Associated value is estimated.
-	Not detected
NA	Not Analyzed

TABLE 6.2

SUBSURFACE SOIL SAMPLE DATA SUMMARY
VACAIR ALLOYS
FREWSBURG, NEW YORK

Concentration

Location:	***BH-1***	***BH6-1***	***BH5A-3***	***BH5B-1***	***BH5B-2***	***BH5B-3***	***BH12-1***	***BH13-1***	***BH13-1***	***BH-A***	***BH-B***	***BH-C***
Sample Interval:	***2-4 Ft.***	***1.2-3.5 Ft.***	***9-11 Ft.***	***7.2-9 Ft.***	***9-11 Ft.***	***7.3-9 Ft.***	***6-8 Ft.***	***7.2-9.0 FT.***	***7.2-9 Ft.***	***2-4 Ft.***	***20-22 Ft.***	***12-14 Ft.***
Sample I.D.:	***BH-1***	***6-1***	***BH5A-3***	***BH5B-1***	***BH5B-2***	***BH5B-3***	***BH12-1***	***BH13-1***	***BHA-1***	***BH-A-1S***	***BH-B-11S***	***BH-C-7S***
Date Sampled:	***01/22/91***	***01/23/91***	***01/25/91***	***01/24/91***	***01/24/91***	***01/24/91***	***01/28/91***	***01/28/91***	***01/28/91***	***11/16/92***	***11/17/92***	***11/17/92***
Volatile Organic Compounds (µg/kg)												
Vinyl Chloride	-	-	41 J	-	-	-	-	-	-	-	-	-
Methylene Chloride	-	-	290	-	-	-	-	-	-	-	-	-
Acetone	-	-	400 J	-	-	-	-	-	-	4J	-	-
1,2-Dichloroethene (total)	-	-	780	22	-	5J	-	-	-	-	-	130
2-Butanone	-	-	-	-	-	-	-	-	-	-	-	-
1,1,1-Trichloroethane	-	-	-	-	-	-	-	-	-	-	-	-
Trichloroethene	14 J	110	12000	2000	13	4900	-	-	4 J	-	-	4800
Benzene	-	-	-	-	-	-	-	-	-	-	-	-
Tetrachloroethene	-	-	-	4 J	3 J	6	-	-	-	-	-	-
Toluene	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	-	-	-	-	-	-	-	-	-	-	-	-
Xylene (total)	-	-	-	-	-	-	-	-	-	-	-	-
Total VOCs (µg/kg)	14J	110	13511J	2026J	16J	4911 J	0	0	4J	4J	0	4930
Base Neutral Acid Extractable Compounds (µg/kg)												
Pentachlorophenol	-	-	-	-	-	-	-	56 J	-	NA	NA	NA
Phenanthrene	-	-	-	-	-	-	-	44 J	-	NA	NA	NA
Di-n-Butylphthalate	54 J	-	-	-	-	-	-	50 J	-	NA	NA	NA
Fluoranthene	62 J	-	-	-	50 J	-	-	55 J	-	NA	NA	NA
Pyrene	60 J	-	-	-	47 J	-	-	71 J	-	NA	NA	NA
bis(2-Ethylhexyl)phthalate	-	-	-	-	-	-	61 J	65 J	42 J	NA	NA	NA
Di-n-Octyl phthalate	56 J	63 J	-	-	-	-	-	41 J	-	NA	NA	NA
Total Petroleum Hydrocarbon (mg/kg)												
	10	19	6.2	4.6J	55	3.3J	-	5.2	-	NA	NA	NA

TABLE 6.2

SUBSURFACE SOIL SAMPLE DATA SUMMARY
VACAIR ALLOYS
FREWSBURG, NEW YORK

Concentration

Location:	***BH-D***	***BH-D***	***BH-E***	***BH-E***	***BH-F***	***BH-G***	***BH-H***	***BH-I***	***BH-I***	***BH-I***
Sample Interval:	***6-8 Ft.***	***18-20 Ft.***	***8-10 Ft.***	***22-24 Ft.***	***16-18 Ft.***	***12-14 Ft.***	***10-12 Ft.***	***2-4 Ft.***	***2-4 Ft.***	***4-6 Ft.***
Sample I.D.:	***BH-D, S-1***	***BH-D, S-2***	***BH-E, S-1***	***BH-E,S-2***	***BH-F, S-1***	***BH-G, S-1***	***BH-H***	***BH-AB, S-1***	***BH-I, S-1***	***BH-I, S-2***
Date Sampled:	***11/18/92***	***11/18/92***	***11/18/92***	***11/18/92***	***11/19/92***	***11/19/92***	***11/19/92***	***11/19/92***	***11/19/92***	***11/19/92***
Volatile Organic Compounds (µg/kg)										
Vinyl Chloride	-	-	-	-	-	-	-	-	-	-
Methylene Chloride	-	-	-	-	-	-	-	-	-	-
Acetone	-	14J	-	19J	20J	17J	-	50J	58J	-
1,2-Dichloroethene (total)	-	170	-	-	-	-	-	-	-	-
2-Butanone	-	-	-	-	-	-	-	-	-	-
1,1,1-Trichloroethane	-	-	-	-	-	-	-	-	-	-
Trichloroethene	18	11000	-	-	-	94	12 J	-	-	-
Benzene	-	-	-	-	-	-	-	-	-	-
Tetrachloroethene	-	-	-	-	-	-	-	-	-	-
Toluene	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	-	-	-	-	-	-	-	-	-	-
Xylene (total)	-	-	-	-	-	-	-	-	-	-
Total VOCs (µg/kg)	18	11184 J	0	19 J	20 J	111 J	12 J	50 J	58 J	0
Base Neutral Acid Extractable Compounds (µg/kg)										
Pentachlorophenol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Phenanthrene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Di-n-Butylphthalate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fluoranthene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pyrene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
bis(2-Ethylhexyl)phthalate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Di-n-Octyl phthalate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Petroleum Hydrocarbon (mg/kg)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 6.2

SUBSURFACE SOIL SAMPLE DATA SUMMARY
VACAIR ALLOYS
FREWSBURG, NEW YORK

Concentration

Location:	*BH-J*	*BH-J*	*BH-L*	*BH-L*	*BH-M*	*BH-M*	*BH-M*	*BH-O*	*BH-P*	*BH-P*
Sample Interval:	**14-16 Ft.**	**20-22 Ft.**	**4-6 Ft.**	**20-22 Ft.**	**0-2 Ft.**	**0-2 Ft.**	**22-24 Ft.**	**22-24 Ft.**	**4-6 Ft.**	**18-20 Ft.**
Sample I.D.:	**BH-J, S-1**	**BH-J, S-2**	**BH-L,S-1**	**BH-L,S-2**	**BH-M, S-1**	**BHBC, S-1**	**BH-M, S-2**	**BH-O, S-1**	**BH-P, S-1**	**BH-P, S-2**
Date Sampled:	**11/20/92**	**11/20/92**	**11/23/92**	**11/23/92**	**11/23/92**	**11/23/92**	**11/23/92**	**11/24/92**	**11/24/92**	**11/24/92**
Volatile Organic Compounds (µg/kg)										
Vinyl Chloride	-	-	-	-	-	-	-	-	-	-
Methylene Chloride	-	-	-	-	-	-	-	-	-	-
Acetone	-	16J	54J	-	160J	380J	-	66J	-	-
1,2-Dichloroethene (total)	-	-	-	24	-	11J	-	-	-	-
2-Butanone	-	-	9J	-	-	100J	-	-	-	-
1,1,1-Trichloroethane	-	-	-	-	16J	-	9J	-	-	-
Trichloroethene	-	-	-	610	11J	36J	12J	-	-	-
Benzene	-	-	-	-	-	-	-	-	470J	-
Tetrachloroethene	-	-	-	-	-	-	-	-	-	-
Toluene	-	-	-	-	5J	12J	-	-	5900J	-
Ethylbenzene	-	-	-	-	-	-	-	-	6000J	-
Xylene (total)	-	-	-	-	-	-	-	-	39000J	-
Total VOCs (µg/kg)	0	16J	63J	634	192J	539J	21J	66J	51370J	0
Base Neutral Acid Extractable Compounds (µg/kg)										
Pentachlorophenol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Phenanthrene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Di-n-Butylphthalate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fluoranthene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pyrene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
bis(2-Ethylhexyl)phthalate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Di-n-Octyl phthalate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Petroleum Hydrocarbon (mg/kg)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 6.2

SUBSURFACE SOIL SAMPLE DATA SUMMARY
VACAIR ALLOYS
FREWSBURG, NEW YORK

Concentration

Location:	***BH-U***	***BH-V***	***BH-W***	***MW-8***	***MW-8***	***MW-9***	***MW-11***	***MW-11***	***MW-4D***
Sample Interval:	***6-8 Ft.***	***24-26 Ft.***	***24-26 Ft.***	***2-4 Ft.***	***16-18 Ft.***	***22-24 Ft.***	***10-12 Ft.***	***10-12 Ft.***	***20-22 Ft.***
Sample I.D.:	***BH-U, S-1***	***BH-V, S-1***	***BH-W, S-2***	***MW-8, S-1***	***MW-8, S-2***	***MW-9***	***MW-11***	***MW-11***	***BH/MW5D, S-1***
Date Sampled:	***11/30/92***	***12/01/92***	***12/03/92***	***12/02/92***	***12/16/92***	***12/21/92***	***12/01/92***	***12/21/92***	***12/08/92***
Volatile Organic Compounds (µg/kg)									
Vinyl Chloride	-	-	-	-	-	-	-	-	-
Methylene Chloride	-	-	-	-	-	-	-	-	-
Acetone	-	-	-	16J	-	-	-	-	6J
1,2-Dichloroethene (total)	-	-	-	-	-	-	130J	-	-
2-Butanone	-	-	-	-	-	-	-	-	-
1,1,1-Trichloroethane	-	-	-	-	-	-	-	-	-
Trichloroethene	-	-	-	-	-	-	85000	-	12
Benzene	-	-	-	-	-	-	-	-	-
Tetrachloroethene	-	-	-	-	-	-	93	-	4J
Toluene	-	-	-	-	-	-	-	-	-
Ethylbenzene	-	-	-	-	-	-	-	-	-
Xylene (total)	-	-	-	-	-	-	28J	-	-
Total VOCs (µg/kg)	0	0	0	16J	0	0	85251J	0	22J
Base Neutral Acid Extractable Compounds (µg/kg)									
Pentachlorophenol	NA	NA	NA	NA	NA	NA	NA	NA	NA
Phenanthrene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Di-n-Butylphthalate	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fluoranthene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pyrene	NA	NA	NA	NA	NA	NA	NA	NA	NA
bis(2-Ethylhexyl)phthalate	NA	NA	NA	NA	NA	NA	NA	NA	NA
Di-n-Octyl phthalate	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Petroleum Hydrocarbon (mg/kg)	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 6.2

SUBSURFACE SOIL SAMPLE DATA SUMMARY
VACAIR ALLOYS
FREWSBURG, NEW YORK

Concentration

Location:	***BH-1***	***BH6-1***	***BH5A-3***	***BH5B-1***	***BH5B-2***	***BH5B-3***	***BH12-1***	***BH13-1***	***BH13-1***
Sample Interval:	***2-4 Ft.***	***1.2-3.5 Ft.***	***9-11 Ft.***	***7.2-9 Ft.***	***9-11 Ft.***	***7.3-9 Ft.***	***6-8 Ft.***	***7.2-9 Ft.***	***7.2-9 Ft.***
Sample I.D.:	***BH-1***	***6-1***	***BH5A-3***	***BH5B-1***	***BH5B-2***	***BH5B-3***	***BH12-1***	***BH13-1***	***BHA-1***
Date Sampled:	***01/22/91***	***01/23/91***	***01/25/91***	***01/24/91***	***01/24/91***	***01/24/91***	***01/28/91***	***01/28/91***	***01/28/91***
Total Metals (mg/kg) (1)									
Aluminum	8900 J	6270	3100	3680	3120	4330	3220	4780	5600
Arsenic	18.9 J	6.20	2.0	3.20	1.90	1.90	2.80	3.20	3.90
Barium	71.7	35.10	47.9	29.7	57.3	37.1	46.0	32.6	38.2
Beryllium	0.52	0.43	-	0.26	-	-	-	0.250	0.340
Cadmium	-	-	-	-	-	0.637	-	-	-
Calcium	2180	564	25800	20800	29000	21000	64100	20100	18700
Chromium	2.3	21.5	-	1.2	1.20	13.5	1.50	1.40	2.50
Cobalt	8.3	9.50	3.9	5.00	4.30	23.3	3.90	6.30	7.20
Copper	11.9 J	16.2	7.9	11.3	9.20	13.6	7.50	12.9	13.8
Iron	21900 J	14500	9330	10500	8700	11600	9460	13500	14900
Lead	16.7	5.70	4.6	6.90	5.30	5.90	5.80	8.0	10.1
Magnesium	2050	1740	4250	5570	3480	4360	2640	5330	5780
Manganese	400 J	390	324	299	389	226	2670	449	619
Nickel	-	73.6	-	-	-	51.8	-	-	-
Potassium	345	270	401	321	210	347	-	388	548
Sodium	164	148	229	200	143	163	142	166	164
Vanadium	-	-	-	-	-	9.7	-	-	-
Zinc	54.3	32.1	26.2	25.5	25.0	31.4	21.4	30.9	36.3

Notes:
J Associated value is estimated.
- Not detected
NA - Not Applicable.
(1) Soil samples collected in 1992 as part of the RI were not analyzed for total metals, base/neutral acid extractable compounds or total petroleum hydrocarbons.

TABLE 6.3

TEST PIT SOIL SAMPLE DATA SUMMARY
VACAIR ALLOYS
FREWSBURG, NEW YORK

Chemical Parameters					*Concentration*					
Location:	***TP1-A***	***TP2-A***	***TP2-A***	***TP2-A (1)***	***TP3-A***	***TP3-B (1)***	***TP4-C***	***TP8-A***	***TP10B-B***	***TP11-A***
Sample Interval (Ft. BGS):	***6.0***	***2.0***	***2.0***	***6.0***	***6.0-6.5***	***6.0-7.0***	***1.5-2.0***	***Stockpile***	***5.0***	***3.0***
Sample I.D.:	***TP-1A***	***TP-2A***	***TP-2AA***	***TP-2A-2***	***TP-3A***	***TP-3B***	***TP-4C***	***TP-8A***	***TP-10BB***	***TP-11A***
Date Sampled:	***12/11/90***	***12/12/90***	***12/12/90***	***12/12/90***	***12/14/90***	***12/14/90***	***12/14/90***	***12/13/90***	***12/13/90***	***12/14/90***
<u>Volatile Organic Compounds (ug/kg)</u>										
Vinyl Chloride	-	-	5000 J	-	-	-	70	-	-	-
Acetone	-	-	-	-	-	-	220	-	-	-
Carbon Disulfide	500000 J	-	-	-	-	-	23	-	19	-
1,2-Dichloroethene (total)	2400000 J	620000 J	400000 J	210000	-	-	900	9	19	2 J
2-Butanone	-	-	-	11000 J	25	-	52	-	-	-
Trichloroethene	380000 J	17000000 J	16000000 J	460000	2 J	7	170	11	20	22 J
4-Methyl-2-pentanone	-	-	-	-	-	-	-	-	4 J	-
Tetrachloroethene	-	-	-	-	-	4 J	27	7	14	8
Toluene	-	-	-	-	-	-	4 J	-	3 J	-
Ethylbenzene	-	-	-	-	-	-	2 J	-	4 J	-
Xylene (total)	-	-	-	-	-	-	8 J	-	16	-
Total VOCs (µg/kg)	3280000 J	17620000 J	16405000 J	681000 J	27 J	11 J	1476 J	27	99 J	32 J
<u>PCB (ug/kg)</u>										
Aroclor-1254	12000 J	2300	2200	NA	44 J	NA	-	190	-	-
Aroclor-1260	-	-	-	NA	-	NA	-	-	-	13 J
<u>Total Petroleum Hydrocarbon (mg/kg)</u>										
Total Petroleum Hydrocarbons	56000	21000	20000	NA	1000	NA	5500	18	980	26

TABLE 6.3

TEST PIT SOIL SAMPLE DATA SUMMARY
VACAIR ALLOYS
FREWSBURG, NEW YORK

Chemical Parameters				*Concentration*				
Location:	*TP1-A*	*TP2-A*	*TP2-A*	*TP3-A*	*TP4-C*	*TP8-A*	*TP10B-B*	*TP11-A*
Sample Interval (Ft. BGS):	*6.0*	*2.0*	*2.0*	*6.0-6.5*	*1.5-2.0*	*Stockpile*	*5.0*	*30.0*
Sample I.D.:	*TP-1A*	*TP-2A*	*TP-2AA*	*TP-3A*	*TP-4C*	*TP-8A*	*TP-10BB*	*TP-11A*
Date Sampled:	*12/11/90*	*12/12/90*	*12/12/90*	*12/14/90*	*12/14/90*	*12/13/90*	*12/13/90*	*12/14/90*
Base Neutral Acid Extractable Compounds (ug/kg)								
4-Methylphenol	-	-	-	-	170 J	-	-	-
Benzoic acid	-	-	-	48 J	420 J	-	-	-
Napthalene	-	-	-	-	150 J	-	-	-
4-Chloro-3-methylphenol	-	-	-	-	380 J	-	-	-
2-Methylnaphthalene	-	-	-	-	320 J	-	-	-
2,4,6-Trichlorophenol	-	-	-	-	79 J	-	-	-
2,4,5-Trichlorophenol	-	-	-	-	150 J	-	-	-
Acenapthene	-	-	-	-	77 J	-	-	-
Dibenzofuran	-	-	-	-	71 J	-	-	-
Fluorene	-	-	-	-	80 J	-	-	-
Pentachlorophenol	-	-	-	51 J	-	-	-	-
Phenanthrene	-	-	-	85 J	250 J	-	-	-
Anthracene	-	-	-	-	73 J	-	-	-
Di-n-Butylphthalate	-	-	-	-	-	63 J	-	-
Fluoranthene	-	-	-	120 J	110 J	-	-	-
Pyrene	-	-	-	130 J	280 J	-	-	-
Benzo(a)anthracene	-	-	-	80 J	87 J	-	-	-
Chrysene	-	-	-	110 J	110 J	-	-	-
bis(2-Ethylhexyl) phthalate	5200 J	3400 J	4300 J	78 J	450 J	93 J	1200 J	-
Benzo(b)fluoroanthene	-	-	-	75 J	120 J	-	-	-
Benzo(k)fluoroanthene	-	-	-	71 J	110 J	-	-	-
Benzo(a)pyrene	-	-	-	65 J	120 J	-	-	-
Indeno(1,2,3-cd)pyrene	-	-	-	-	300 J	-	-	-
Dibenzo(a,h)anthracene	-	-	-	-	85 J	-	-	-
Benzo(g,h,i)perylene	-	-	-	-	410 J	-	-	-

TABLE 6.3

TEST PIT SOIL SAMPLE DATA SUMMARY
VACAIR ALLOYS
FREWSBURG, NEW YORK

Chemical Parameters				*Concentration*				
Location:	***TP1-A***	***TP2-A***	***TP2-A***	***TP3-A***	***TP4-C***	***TP8-A***	***TP10B-B***	***TP11-A***
Sample Interval (Ft. BGS):	***6.0***	***2.0***	***2.0***	***6.0-6.5***	***1.5-2.0***	***Stockpile***	***5.0***	***3.0***
Sample I.D.:	***TP-1A***	***TP-2A***	***TP-2AA***	***TP-3A***	***TP-4C***	***TP-8A***	***TP-10BB***	***TP-11A***
Date Sampled:	***12/11/90***	***12/12/90***	***12/12/90***	***12/14/90***	***12/14/90***	***12/13/90***	***12/13/90***	***12/14/90***
Total Metals (mg/kg)								
Aluminum	6650	11000	9040	6710	6270	10100	6130	7240
Arsenic	6.3	4.4 J	6.3 J	5.2	5	7.1	4.8	3.6
Barium	296	130	93.7	65.5	71.7	74.5	84.6	37.2
Beryllium	0.61	0.73	0.77	0.85	5.2	0.51	0.42	0.38
Cadmium	4.2	3.4 J	1.9 J	1.8	4	0.7	1.5	-
Calcium	6670	11000	12800	4900	17400	1730	7080	902 J
Chromium	162	568 J	287 J	36.4	3050	2.3	216	3.3
Cobalt	144	146 J	94.5 J	26.4	1020	15.1	68.3	6.9
Copper	112	338 J	84.1 J	36.9	339	11.9	53.3	10.7
Iron	64800	26200 J	18000 J	17600	74000	26200	19800	12700
Lead	121	181 J	94 J	111	178	21.6	47.2	13.2 J
Magnesium	1820	3400	4460	2030	4060	1890	2860	1580
Manganese	1220	645	532	690	1460	3600	529	406 J
Mercury	0.69	0.32 J	0.18 J	-	0.33	-	0.23	-
Nickel	896	1760 J	805 J	220	1530	16.2	440	12.1 J
Potassium	757	537	444	278	390	475	655	413
Selenium	1.8	0.57	0.44	-	0.79	-	-	-
Silver	-	-	-	-	0.93	-	-	-
Sodium	122	89.9	90	57.8	101	57.1	58.1	36.4
Thallium	-	-	-	-	7.8	-	-	-
Vanadium	4.4	-	-	-	961	-	-	-
Zinc	310	288 J	141 J	60.5	103	48.1	64.8	29.6 J
Cyanide	-	-	-	-	1.5	-	-	-

Notes:

J	Associated value is estimated.
-	Not detected
(1)	Analyzed for TCL volatile organic compounds only.

TABLE 6.4

BACKGROUND METAL CONCENTRATIONS IN SOILS
REMEDIAL INVESTIGATION
VACAIR ALLOYS DIVISION
FREWSBURG, NEW YORK

Chemical Parameter	*Published Concentrations (1) (2)*		*NYSDEC (3) (4) Published Concentrations*		*VacAir Background (5) (6) Concentrations*	
	Range	*Mean*	*Range*	*Mean*	*Range*	*Mean*
Silver	NR	NR	NR	NR	ND-2.3	2.3
Aluminum	4,500-100,000	NR	1,000-25,000	33,000	4,050-8,900	5,396
Arsenic	<1.0-93.2	7.0	3-12	5	1.40-18.9	6.6
Barium	>0-3,000	560	15-600	290	4.66-90.6	56.3
Beryllium	<1-5	1.6	0-1.75	0.6	ND-0.52	0.34 (4)
Calcium	NR	NR	130-35,000	1,651	2,180-72,800	21,918
Cadmium	0.4-1.1	0.5	0.01-0.88	0.21	ND	ND
Cobalt	3-50	10.5	2.5-60	5.9	4.50-12.5	7.6
Chromium	7-1500	50	1.5-40	33	1.50-9.70	4.1
Copper	3-300	26	5-38	13	10.9-18.7	14.0
Iron	0.5-5%	NR	2,000-550,000	14,000	11,400-21,900	14,120
Mercury	0.02-1.5	0.17	0.042-0.066	0.081	ND	ND
Potassium	NR	NR	8,500-43,000	12,000	ND-345	269 (4)
Magnesium	NR	NR	100-5,000	2,300	2,050-3,790	2,942
Manganese	20-3,000	490	50-5,000	285	400-1,890	718
Sodium	NR	NR	<500-50,000	2,500	149-227	185
Nickel	<5-150	18.5	0.5-25	19.5	ND-84.2	84.2
Lead	<10-70	26	4-61	17	5.20-25.9	15.5
Antimony	0.25-0.6	NR	NR	NR	ND	ND
Selenium	<0.1-4.0	0.31	<1-3.9	0.3	ND	ND
Thallium	0.02-2.8	NR	NR	NR	ND	ND
Vanadium	0.7-98	NR	1-300	43	ND	ND
Zinc	13-300	73.5	9-50	40	30.0-54.3	40.2
Cyanide	NR	NR	NR	NR	ND	ND

Notes:

(1) Data are reported in "Trace Elements in Soils and Plants", Kabata Pendias, Alina and Itenryk Pendias, CRC Press, Inc., Boca Raton, Florida, 1985.

(2) Data are reported for various types of surface soils in the United States.

(3) Data reported in "Background Concentrations of 20 Elements in Soils with Special Regard to New York State", E. Carol McGovern, NYSDEC.

(4) Data reported for uncontaminated soils in New York State or eastern United States.

(5) Based on soil sample numbers BH-1, SS-1, SS-2, SS-3 and SS-4 collected during the SI.

(6) Mean of detected concentrations.

NR Not Reported.

ND Not Detected.

TABLE 6.5

GROUNDWATER SAMPLE DATA SUMMARY (1)
VACAIR ALLOYS
FREWSBURG, NEW YORK

Chemical Parameters					*Concentration*					
Location:	***MW-1***	***MW-1***	***MW-2***	***MW-2***	***MW-3***	***MW3***	***MW-4***	***MW-4***	***MW-4D***	***MW-4D***
Sample I.D.:	***MW-1***	***MW-1***	***MW-2***	***MW-2***	***MW-3***	***MW3***	***MW-4***	***MW-4***	***MW-4D***	***MW-13***
Date Sampled:	***04/30/91***	***12/18/92***	***04/30/91***	***12/18/92***	***04/30/91***	***12/21/92***	***04/30/91***	***12/21/92***	***12/18/92***	***12/18/92***
Volatile Organic Compounds (µg/L)										
Chloromethane	-	-	-	-	-	-	2 J	-	-	-
Vinyl Chloride	-	-	17000	1200	-	50	8 J	6 J	-	-
Acetone	-	-	-	-	-	-	-	-	-	-
1,1-Dichloroethene	-	-	450	170	-	6J	2 J	4 J	-	-
1,1-Dichloroethane	-	-	-	-	-	-	-	-	-	-
1,2-Dichloroethene (Total)	-	-	170000	62000	1400	800 J	940 J	2300 J	10	-
Chloroform	-	-	-	-	-	-	2 J	-	-	-
1,2-Dichloroethane	-	-	19 J	-	-	-	-	-	-	-
1,1,1-Trichloroethane	-	-	-	-	-	-	3 J	3 J	-	-
Bromodichloromethane	-	-	-	-	-	-	4 J	-	-	-
Trichloroethene	-	-	2600 J	-	34000	26000	55000	74000	4 J	-
1,1,2-Trichloroethane	-	-	13 J	-	-	16	-	29	-	-
Benzene	-	-	-	11	-	-	-		-	-
Tetrachloroethene	-	-	-	-	-	5 J	10	4 J	-	-
Toluene	-	-	12 J	-	-	-	-	-	-	-
Ethylbenzene	-	-	14 J	6 J	-	-	-	-	-	-
Xylene (Total)	-	-	-	17	-	-	-	-	-	-
Total VOCs (µg/kg)	-	-	190108J	63404J	35400	26877J	55971J	76346J	14J	-
Base Neutral Acid Extractable Compounds (µg/L)										
Phenol	NA	NA	16	NA	-	NA	-	NA	NA	NA
4-Methylphenol	NA	NA	34	NA	-	NA	-	NA	NA	NA
Benzoic acid	NA	NA	15 J	NA	-	NA	-	NA	NA	NA
Napthalene	NA	NA	1 J	NA	-	NA	-	NA	NA	NA
4-Chloro-3-methylphenol	NA	NA	3 J	NA	-	NA	-	NA	NA	NA
2-Methylnaphthalene	NA	NA	3 J	NA	-	NA	-	NA	NA	NA
Di-n-butylphthalate	NA	NA	4 J	NA	2 J	NA	-	NA	NA	NA
bis(2-Ethylhexyl)phthalate	NA	NA	2 J	NA	2 J	NA	-	NA	NA	NA
Total Petroleum Hydrocarbons (mg/L)										
	-	NA	0.89	NA	-	NA	-	NA	NA	NA

TABLE 6.5

GROUNDWATER SAMPLE DATA SUMMARY (1)
VACAIR ALLOYS
FREWSBURG, NEW YORK

Chemical Parameters	*Concentration*									
Location:	*MW4D (2)*	*MW-4D (2)*	*MW-5*	*MW-5*	*MW-5D (2)*	*MW-5D (2)*	*MW-5D*	*MW-6*	*MW-6*	*MW-6*
Sample I.D.:	*MW-4D-93*	*MW-12-93*	*MW-5*	*MW-5*	*MW-5D*	*MW-5D*	*MW-5D*	*MW-6*	*MW-7*	*MW-6*
Date Sampled:	*01/14/93*	*01/14/93*	*04/30/91*	*12/17/92*	*04/15/92*	*04/15/92*	*12/17/92*	*04/30/91*	*04/30/91*	*12/16/92*
Volatile Organic Compounds (μg/L)										
Chloromethane	-	-	-	-	-	-	-	-	-	-
Vinyl Chloride	-	-	-	-	-	-	-	-	-	-
Acetone	7J	6J	-	-	-	-	-	-	-	-
1,1-Dichloroethene	-	-	-	-	-	-	-	-	-	-
1,1-Dichloroethane	-	-	-	-	-	-	-	-	-	-
1,2-Dichloroethene (Total)	-	-	1 J	-	-	-	-	-	-	-
Chloroform	-	-	-	-	-	-	-	-	-	-
1,2-Dichloroethane	-	-	-	-	-	-	-	-	-	-
1,1,1-Trichloroethane	1J	1J	-	-	-	-	-	-	-	-
Bromodichloromethane	-	-	-	-	-	-	-	-	-	-
Trichloroethene	-	-	41	-	-	-	-	-	-	-
1,1,2-Trichloroethane	-	-	-	-	-	-	-	-	-	-
Benzene	-	-	-	-	3.7J	3.6J	-	-	-	-
Tetrachloroethene	-	-	-	-	-	-	-	-	-	-
Toluene	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	-	-	-	-	-	-	-	-	-	-
Xylene (Total)	-	2J	-	-	-	-	-	-	-	-
Total VOCs (μg/kg)	8J	9J	42J	-	3.7J	3.6J	-	-	-	-
Base Neutral Acid Extractable Compounds (μg/L)										
Phenol	NA	NA	-	NA	NA	NA	NA	-	-	NA
4-Methylphenol	NA	NA	-	NA	NA	NA	NA	-	-	NA
Benzoic acid	NA	NA	-	NA	NA	NA	NA	-	-	NA
Napthalene	NA	NA	-	NA	NA	NA	NA	-	-	NA
4-Chloro-3-methylphenol	NA	NA	-	NA	NA	NA	NA	-	-	NA
2-Methylnaphthalene	NA	NA	-	NA	NA	NA	NA	-	-	NA
Di-n-butylphthalate	NA	NA	-	NA	NA	NA	NA	-	-	NA
bis(2-Ethylhexyl)phthalate	NA	NA	-	NA	NA	NA	NA	-	-	NA
Total Petroleum Hydrocarbons (mg/L)	NA	NA	-	NA	NA	NA	NA	-	-	NA

TABLE 6.5

GROUNDWATER SAMPLE DATA SUMMARY (1)
VACAIR ALLOYS
FREWSBURG, NEW YORK

Chemical Parameters	*Concentration*								
Location:	***MW-7 (2)***	***MW-7***	***MW-8***	***MW-9***	***MW-9***	***MW-10***	***MW-11***	***MW-12 (2)***	***MW-12 (2)***
Sample I.D.:	***MW-7***	***MW-7***	***MW-8***	***MW-9***	***MW-14***	***MW-10***	***MW-11***	***MW-12***	***MW-13***
Date Sampled:	***09/24/91***	***12/16/92***	***12/16/92***	***12/21/92***	***12/21/92***	***12/17/92***	***12/21/92***	***06/14/93***	***06/14/93***
Volatile Organic Compounds (µg/L)									
Chloromethane	-	-	-	-	-	-	-	-	-
Vinyl Chloride	-	-	-	53	61	-	9 J	-	-
Acetone	-	-	-	-	-	-	-	-	-
1,1-Dichloroethene	-	-	-	11	12	-	5 J	-	-
1,1-Dichloroethane	-	-	-	-	-	-	4 J	-	-
1,2-Dichloroethene (Total)	-	-	-	1100 J	670 J	-	380	41	37
Chloroform	-	-	-	-	-	-	-	-	-
1,2-Dichloroethane	-	-	-	-	-	-	7 J	-	-
1,1,1-Trichloroethane	-	-	-	-	-	-	-	-	-
Bromodichloromethane	-	-	-	-	-	-	-	-	-
Trichloroethene	-	-	-	18000	24000	-	170000	3400	3500
1,1,2-Trichloroethane	-	-	-	4 J	-	-	-	-	-
Benzene	-	-	-	-	-	-	-	-	-
Tetrachloroethene	-	-	-	4 J	4 J	-	57	-	-
Toluene	-	-	-	-	-	2 J	4J	-	-
Ethylbenzene	-	-	-	-	-	-	6 J	-	-
Xylene (Total)	-	-	-	-	-	4 J	24	-	-
Total VOCs (µg/kg)	-	-	-	19172J	24747J	6	170496J	3441	3537
Base Neutral Acid Extractable Compounds (µg/L)									
Phenol	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Methylphenol	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzoic acid	NA	NA	NA	NA	NA	NA	NA	NA	NA
Napthalene	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Chloro-3-methylphenol	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Methylnaphthalene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Di-n-butylphthalate	NA	NA	NA	NA	NA	NA	NA	NA	NA
bis(2-Ethylhexyl)phthalate	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Petroleum Hydrocarbons (mg/L)	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 6.5

GROUNDWATER SAMPLE DATA SUMMARY (1)
VACAIR ALLOYS
FREWSBURG, NEW YORK

Chemical Parameters	***Concentration***									
Location:	***MW-1***	***MW-1***	***MW-2***	***MW-2***	***MW-3***	***MW-3***	***MW-4***	***MW-4***	***MW-4D***	***MW-4D***
Sample I.D.:	***MW-1***	***MW-1***	***MW-2***	***MW-2***	***MW-3***	***MW-3***	***MW-4***	***MW-4***	***MW-4D***	***MW-13***
Date Sampled:	***04/30/91***	***12/16/92***	***04/30/91***	***12/18/92***	***04/30/91***	***12/21/92***	***04/30/91***	***12/21/92***	***12/18/92***	***12/18/92***
<u>Total Metals (µg/L)</u>										
Aluminum	193	360	2990	6830	8350	30000	4520	11700	5270	4640
Antimony	-	-	-	-	-	-	-	-	-	-
Arsenic	-	-	4.7	-	7.70	-	2.50	-	-	-
Barium	111	117	704	561	440	804	217	349	267	257
Beryllium	-	0.70	-	2.3	-	3.0	-	1.8	1.1	1.2
Cadmium	-	-	-	11.7	-	12.4	-	3.6	-	-
Calcium	57700	59400	179000	146000	110000	127000	98400	105000	78300	76500
Chromium	-	-	-	22.0	31.6	123	17.2	51.1	13.8	14.2
Cobalt	-	-	12.2	-	12.0	30.0	6.1	11.7J	5.4	5.1
Copper	-	5.8	-	32.8	53.8	124	24.3	48.3	26.1J	16.9J
Iron	545	556	88600	58300	20200	55700	11400	21400	8670	8340
Lead	-	-	-	5.3	9.60	57.4	7.10	17.9	4.7J	1.9J
Magnesium	9150	9840	38400	33500	24500	35700	19500	21800	13800	13500
Manganese	92.4	24.0	33700	20400	861	2110	1470	1560	161	160
Mercury	-	-	-	0.11	-	0.13	-	-	-	-
Nickel	-	-	14.4	72.3	40.6	124	22.6	43.9	14.2	10.4
Potassium	-	992	8250	6560	5180	8230	5750	7670	3280	2940
Silver	-	-	8.40 J	-	-	-	-	-	-	-
Sodium	3600	3400	12700	10400	26400	18500	23000	22900	10400	10200
Vanadium	-	-	-	13.2	9.30	57.2	8.20	20.0	8.3	7.4
Zinc	56.1	-	26.1 J	54.2	78.0	176	49.1	74.1	69.3	79.3

TABLE 6.5

GROUNDWATER SAMPLE DATA SUMMARY (1)
VACAIR ALLOYS
FREWSBURG, NEW YORK

Chemical Parameters	***Concentration***									
Location:	***MW-5***	***MW-5***	***MW-5D***	***MW-6***	***MW-6***	***MW-6***	***MW-7***	***MW-8***	***MW-9***	***MW-9***
Sample I.D.:	***MW-5***	***MW-5***	***MW-5D***	***MW-6***	***MW-7***	***MW-6***	***MW-7***	***MW-8***	***MW-9***	***MW-14***
Date Sampled:	***04/30/91***	***12/17/92***	***12/17/92***	***04/30/91***	***04/30/91***	***12/16/92***	***12/16/92***	***12/16/92***	***12/21/92***	***12/21/92***
<u>Total Metals (µg/L)</u>										
Aluminum	21200	17600	54.2	1140	971	90500	56800	12400	48900J	388J
Antimony	-	-	-	-	-	52.4	33.0	-	34.1	-
Arsenic	4.20	-	-	-	-	-	-	-	-	-
Barium	845	613	225	112	106	1410	374	365	366	348
Beryllium	1.40	1.9	0.97	-	-	8.4	5.2	2.1	5.0J	1.1J
Cadmium	-	7.7	-	-	-	41.5	25.0	5.6	22.3J	-
Calcium	113000	94100	82300	95200	95000	257000	172000	112000	181000J	82100J
Chromium	18.9	68.4	-	4.50	4.60	133	150	23.5	113J	12.0J
Cobalt	41.2	18.7	-	-	-	99.5	63.3	9.1	55.4J	-
Copper	99.6	145	8.2	9.90	8.90	240	157	153	156J	16.2J
Iron	52900	33500	1930	2030	1690	190000	112000	21100	99400J	866J
Lead	61.2	28.0	-	-	-	222	159	33.8	132J	-
Magnesium	30400	21400	12400	18000	18100	99900	53300	20200	53800J	13500J
Manganese	7190	3720	30.7	9080	9000	6230	3720	501	3860J	57.2J
Mercury	-	-	-	-	-	-	-	-	0.11	-
Nickel	81.2	62.4	14.2	ND (7)	-	212	254	31.7	205J	67.0J
Potassium	6380	8010	2070	-	-	16000	12500	4760	10400J	4190J
Silver	-	-	-	-	-	-	-	-	-	-
Sodium	13100	14300	11300	22800	22600	6380	17600	22000	17200J	10600J
Vanadium	16.9	31.2	ND(2.9)	11.8	11.4	174	110	20.3	95.4J	-
Zinc	158	108	27.6	18.4	18.9	525	316	80.1	297J	22.7J

TABLE 6.5

GROUNDWATER SAMPLE DATA SUMMARY (1)
VACAIR ALLOYS
FREWSBURG, NEW YORK

Chemical Parameters	*Concentration*	
Location:	***MW-10***	***MW-11***
Sample I.D.:	***MW-10***	***MW-11***
Date Sampled:	***12/17/92***	***12/21/92***
<u>Total Metals (µg/L)</u>		
Aluminum	24500	940
Antimony	-	-
Arsenic	-	-
Barium	482	174
Beryllium	2.2	1.4
Cadmium	9.3	-
Calcium	82500	112000
Chromium	54.2	-
Cobalt	21.5	-
Copper	70.3	72.3
Iron	48100	1650
Lead	54.2	-
Magnesium	25700	20800
Manganese	1370	10500
Mercury	-	0.22
Nickel	58.6	30.0
Potassium	10100	1420
Silver	-	-
Sodium	12100	19700
Vanadium	47.0	-
Zinc	147	33.9

TABLE 6.5

GROUNDWATER SAMPLE DATA SUMMARY (1)
VACAIR ALLOYS
FREWSBURG, NEW YORK

Chemical Parameters					*Concentration*				
Location:	***MW-1***	***MW-2***	***MW-3***	***MW-4***	***MW-4D***	***MW-4D***	***MW-5***	***MW-5D***	***MW-6***
Sample I.D.:	***MW-1***	***MW-2***	***MW-3***	***MW-4***	***MW-4D***	***MW-13***	***MW-5***	***MW-5D***	***MW-6***
Date Sampled:	***12/16/92***	***12/18/92***	***12/21/92***	***12/21/92***	***12/18/92***	***12/18/92***	***12/17/92***	***12/17/92***	***12/16/92***
Dissolved Metals (µg/L) (1)									
Aluminum	-	424	-	-	229J	-	-	-	-
Barium	109	554	460	216	274	263	386	202	167
Beryllium	-	2.6	-	-	-	1.1	-	-	-
Cadmium	-	7.5	-	-	-	-	-	-	-
Calcium	56900	141000	80700	88600	69800	68200	70500	71800	106000
Copper	4.7	7.9	5.8	5.2	5.8	4.2	4.4	5.9	8.0
Iron	-	48500	-	-	-	62.3J	-	-	-
Magnesium	9400	31400	15000	15600	11300	11200	11300	11400	20000
Manganese	25.9	20000	33.4	46.5	14.7	9.7	5.0	14.8	10200
Nickel	9.4	60.4	-	-	-	-	-	-	30.4
Potassium	818	5310	2810	4820	1720	1730	3840	1880	1180
Sodium	3250	10200	17400	22300	10400	10300	13800	10400	19200
Zinc	32.8	48.9	44.2	32.1	32.4	38.3	39.7	11.0	8.1

TABLE 6.5

GROUNDWATER SAMPLE DATA SUMMARY (1)
VACAIR ALLOYS
FREWSBURG, NEW YORK

Chemical Parameters			*Concentration*			
Location:	***MW-7***	***MW-8***	***MW-9***	***MW-9***	***MW-10***	***MW-11***
Sample I.D.:	***MW-7***	***MW-8***	***MW-9***	***MW-14***	***MW-10***	***MW-11***
Date Sampled:	***12/16/92***	***12/16/92***	***12/21/92***	***12/21/92***	***12/17/92***	***12/21/92***
Dissolved Metals (µg/L) (1)						
Aluminum	-	-	-	-	-	-
Barium	333	355	217	212	350	641
Beryllium	-	-	1.7	1.6	0.83	1.2
Cadmium	-	-	-	-	-	-
Calcium	78800	91300	101000	102000	49600	66600
Copper	5.3	5.1	7.4	9.1	4.8	4.0
Iron	-	45.1	-	-	-	-
Magnesium	13500	12300	18400	18600	8820	11400
Manganese	12.2	74.0	604	596	86.7	139
Nickel	-	-	10.8	9.8	-	-
Potassium	4170	1510	1970	2230	5110	1240
Sodium	11000	22200	15800	16600	11700	5890
Zinc	5.4	37.0	45.7	41.8	6.1	47.8

TABLE 6.5

GROUNDWATER SAMPLE DATA SUMMARY (1)
VACAIR ALLOYS
FREWSBURG, NEW YORK

Chemical Parameters	*Concentration*									
Location:	***MW-1***	***MW-2***	***MW-3***	***MW-4***	***MW-4D***	***MW-4D***	***MW-5***	***MW-5D***	***MW-6***	***MW-7***
Sample I.D.:	***MW-1***	***MW-2***	***MW-3***	***MW-4***	***MW-4D***	***MW-4D***	***MW-5***	***MW-5D***	***MW-6***	***MW-7***
Date Sampled:	**12/16/92**	**12/18/92**	**12/21/92**	**12/21/92**	**12/18/92**	**12/18/92**	**12/17/92**	**12/17/92**	**12/16/92**	**12/16/92**
Inorganics (μg/L) (1)										
BOD5	-	22	-	-	-	-	-	-	-	-
Chloride	8.0	154	37	43	31	32	26	30	59	33
COD	50	180	110	50	-	-	45	-	70	20
Hardness (Total)	189	502	464	352	252	247	323	257	1050	649
Bicarbonate	150	381	312	252	164	161	190	159	303	211
Ammonia	-	8.4	2.7	0.89	0.02	0.02	0.02	-	0.10	-
Nitrite	-	-	-	-	-	-	-	-	-	-
Nitrate	1.8	-	0.8	0.3	7.7	7.7	4.9	8.4	-	1.8
Phosphorus (Total)	-	-	0.07	-	0.07	-	0.12	-	0.09	-
Sulfide	-	-	-	-	-	-	-	-	-	-
Sulfate	18.3	18.1	34.0	52.2	23.6	27.2	30.6	26.1	74.4	36.4
Total Suspended Solids	-	68	1500	401	160	169	23	-	-	7
Alkalinity (Total)	151	381	313	253	166	162	191	161	303	212
Total Dissolved Solids	219	848	365	393	295	288	308	297	530	316
Total Organic Carbon	4.9	43.0	9.1	11.3	1.3	1.4	2.1	1.2	17.0	6.5

TABLE 6.5

GROUNDWATER SAMPLE DATA SUMMARY (1)
VACAIR ALLOYS
FREWSBURG, NEW YORK

Chemical Parameters			*Concentration*		
Location:	***MW-8***	***MW-9***	***MW-9***	***MW-10***	***MW-11***
Sample I.D.:	***MW-8***	***MW-9***	***MW-14***	***MW-10***	***MW-11***
Date Sampled:	**12/16/92**	**12/21/92**	**12/21/92**	**12/17/92**	**12/21/92**
<u>Inorganics (µg/L) (1)</u>					
BOD5	-	-	4	-	-
Chloride	31	43	46	5	12
COD	65	220J	150J	40	210
Hardness (Total)	363	673J	261J	312	365
Bicarbonate	241	323	307	130	225
Ammonia	0.08	0.09	0.09	0.18	0.12
Nitrite	-	-	-	-	-
Nitrate	8.9	0.1	-	-	-
Phosphorus (Total)	0.12	-	0.10	0.12	0.05
Sulfide	-	-	-	-	-
Sulfate	35.0	44.2	50.4	60.4	30.6
Total Suspended Solids	14	2230	1990	50	1880
Alkalinity (Total)	241	324	308	138	226
Total Dissolved Solids	367	450	452	232	291
Total Organic Carbon	5.9	18.1J	10.1J	1.9	23.1

Notes:

J	Associated value is estimated.
-	Not detected
NA	Not Analyzed.
(1)	Only the RI samples were analyzed for dissolved metals and inorganics.
(2)	Samples collected were analyzed for VOCs only.

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TABLE 6.6A

NEW YORK STATE WATER QUALITY CRITERIA FOR METALS IN GROUNDWATER AND SURFACE WATER
VAC ALLOYS DIVISION
FREWSBURG, NEW YORK

Metals	*Class GA Groundwater (2) (µg/L)*	*Class C Surface Water (21) (µg/L)*	*Class D Surface Water (13) (µg/L)*
Aluminum	NA	100	NA
Antimony	3 (3)	NA	NA
Arsenic	25	190	360
Barium	1000	NA	NA
Beryllium	3 (3)	1100*	NA
Cadmium	10	2.79* (14)	14.29* (6)
Calcium	NA (4)	NA	NA
Chromium	50	529.16* (15)	4439 (16)
Cobalt	NA	5	110 (3)
Copper	200	31.5* (17)	52.1* (7)
Iron	300 (5)	300	300
Lead	25	13.73* (18)	352* (8)
Magnesium	35000 (3)	NA	NA
Manganese	300 (5)	NA	NA
Mercury	2	0.2 (3)	0.2 (3)
Nickel	NA	228.36* (19)	4407* (9)
Potassium	NA	NA	NA
Selenium	10	1.0	NA
Silver	50	0.1 (20)	29.14* (10)
Sodium	20000	NA	NA
Thallium	4 (3)	8	20
Vanadium	NA	14	190
Zinc	300	219* (22)	314* (11)
Cyanide	100	5.2 (12)	22 (12)

Notes:

* Site-specific criteria calculated by using reported hardness concentration of 314.59 ppm. Aquatic standards apply to acid-soluble form.

(1) From NYSDEC "Ambient Water Quality Standards and Guidance Values", Division of Water, Technical Operational Guidance Series (1.1.1), dated October 22, 1993.

(2) Standards are for drinking (potable) water:
Class GA - groundwater.

(3) Value is a guidance value.

(4) NA - Not Available.

TABLE 6.6A

NEW YORK STATE WATER QUALITY CRITERIA FOR METALS IN GROUNDWATER AND SURFACE WATER VAC ALLOYS DIVISION FREWSBURG, NEW YORK

Metals	*Class GA Groundwater (2) (μg/L)*	*Class C Surface Water (21) (μg/L)*	*Class D Surface Water (13) (μg/L)*

Notes Continued:

(5) Standard is 500 μg/L for the combined total of iron and manganese.
(6) Criteria: exp(1.128[ln (ppm hardness)]-3.828)
(7) Criteria: exp(0.9422[ln (ppm hardness)]-1.464)
(8) Criteria: exp(1.266[ln (ppm hardness)]-1.416)
(9) Criteria: exp(0.76[ln (ppm hardness)]+4.02)
(10) Criteria: exp(1.72[ln (ppm hardness)]-6.52)
(11) Criteria: exp(0.85[ln (ppm hardness)]+0.86)
(12) As free cyanide - the sum of HCN and CN expressed as CN.
(13) Standards are for fishing and fish survival: Class D surface water.
(14) Criteria: exp(0.7852[ln (ppm hardness)]-3.490)
(15) Criteria: exp(0.819[ln (ppm hardness)]+1.561)
(16) Criteria: exp(0.819[ln (ppm hardness)]+3.688)
(17) Criteria: exp(0.8545[ln (ppm hardness)]-1.465)
(18) Criteria: exp(1.266[ln (ppm hardness)]-4.661)
(19) Criteria: exp(0.76[ln (ppm hardness)]+1.06)
(20) Ionic silver.
(21) Standards are for fishing and fish propagation: Class C surface water.
(22) Criteria: exp(0.85[ln (ppm hardness)]+0.50)

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TABLE 6.6B

NEW YORK STATE WATER QUALITY CRITERIA
FOR VOLATILE ORGANIC COMPOUNDS IN GROUNDWATER AND SURFACE WATER
VAC ALLOYS DIVISION
FREWSBURG, NEW YORK

VOCs	*Class GA Groundwater (2) (μg/L)*	*Class C Surface Water (3) (μg/L)*	*Class D Surface Water (4) (μg/L)*
Chloromethane	5	NA	NA
Bromomethane	5	NA	NA
Vinyl chloride	2	NA	NA
Chloroethane	5	NA	NA
Methylene chloride	5	NA	NA
Acetone	50 (5)	NA	NA
Carbon disulfide	NA	NA	NA
1,1-Dichloroethene	5	NA	NA
1,1-Dichloroethane	5	NA	NA
1,2-Dichloroethene (total)	NA	NA	NA
Chloroform	7	NA	NA
1,2-Dichloroethane	5	NA	NA
2-Butanone	NA	NA	NA
1,1,1-Trichloroethane	5	NA	NA
Carbon tetrachloride	5	NA	NA
Bromodichloromethane	50 (5)	NA	NA
1,2-Dichloropropane	5	NA	NA
cis-1,3-Dichloropropene	5	NA	NA
Trichloroethene	5	11 (5)	11 (5)
Dibromochloromethane	50 (5)	NA	NA
1,1,2-Trichloroethane	5	NA	NA
Benzene	0.7	6 (5)	6 (5)
Bromoform	50 (5)	NA	NA
2-Methyl-2-pentanone	NA	NA	NA
2-Hexanone	50 (5)	NA	NA
Tetrachloroethene	5	1 (5)	1 (5)
1,1,2,2-Tetrachloroethane	5	NA	NA
Toluene	5	NA	NA
Chlorobenzene	5	5	50
Ethylbenzene	5	NA	NA
Styrene	5	NA	NA
Xylene (total)	5	NA	NA

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TABLE 6.6B

NEW YORK STATE WATER QUALITY CRITERIA FOR VOLATILE ORGANIC COMPOUNDS IN GROUNDWATER AND SURFACE WATER
VAC ALLOYS DIVISION
FREWSBURG, NEW YORK

Notes:

(1)	From NYSDEC "Ambient Water Quality Standards and Guidance Values", Division of Water, Technical Operational Guidance Series (1.1.1), dated October 22, 1993.
(2)	Standards are for drinking (potable) water: Class GA - groundwater.
(3)	Standards are for fishing and fish propagation: Class C surface water.
(4)	Standards are for fishing and fish survival: Class D surface water.
(5)	Value is a guidance value.
NA	Not Available.

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TABLE 6.6C

NEW YORK STATE WATER QUALITY CRITERIA FOR BASE/NEUTRAL ACID EXTRACTABLE COMPOUNDS IN GROUNDWATER AND SURFACE WATER
VAC ALLOYS DIVISION
FREWSBURG, NEW YORK

BNAs	*Class GA Groundwater (2) (µg/L)*	*Class C Surface Water (3) (µg/L)*	*Class D Surface Water (4) (µg/L)*
Acenaphthene	50 (5)	NA	NA
Anthracene	50 (5)	NA	NA
Benzo(a)anthracene	0.002 (5)	NA	NA
Benzo(a)pyrene	ND	0.0012 (5)	0.0012 (5)
Benzo(b)fluoranthene	0.002 (5)	NA	NA
Benzo(g,h,i)perylene	NA	NA	NA
Benzo(k)fluoranthene	0.002 (5)	NA	NA
Benzoic acid	NA	NA	NA
bis(2-Ethylhexyl)phthalate	50	0.6	NA
4-Chloro-3-methylphenol	NA	NA	NA
Chrysene	0.002 (5)	NA	NA
Di-n-butylphthalate	50	NA	NA
Di-n-octylphthalate	50 (5)	NA	NA
Dibenzo(a,h)anthracene	NA	NA	NA
Dibenzofuran	NA	NA	NA
Fluoranthene	50 (5)	NA	NA
Fluorene	50 (5)	NA	NA
Indeno(1,2,3-cd)pyrene	0.002 (5)	NA	NA
2-Methylnaphthalene	NA	NA	NA
4-Methylphenol	NA	NA	NA
Naphthalene	10 (5)	NA	NA
Pentachlorophenol	1 (7)	0.4	1 (8)
Phenanthrene	50 (5)	NA	NA
Phenols (total)	1	(8)	(8)
Pyrene	50 (5)	NA	NA
2,4,5-Trichlorophenol	NA	NA	NA
2,4,6-Trichlorophenol	NA	NA	NA

Notes:

ND Not detected.

(1) From NYSDEC "Ambient Water Quality Standards and Guidance Values", Division of Water, Technical Operational Guidance Series (1.1.1), dated October 22, 1993.

(2) Standards are for drinking (potable) water:
Class GA - groundwater.

(3) Standards are for fishing and fish propagation: Class C surface water.

(4) Standards are for fishing and fish survival: Class D surface water.

(5) Value is a guidance value.

(6) NA - Not Available.

(7) Phenolic compounds (total phenols).

(8) Total chlorinated phenols - 1.0 µg/L
Total unchlorinated phenols - 5.0 µg/L

TABLE 6.7

SURFACE WATER SAMPLE DATA SUMMARY
VACAIR ALLOYS
FREWSBURG, NEW YORK

Concentration

Location:	*SW-1*	*SW-2*	*SW-3*	*SW-4*	*SW-5*	*SW-6*	*SW-6*	*SW-8*	*SW-9*	*SW-A*
Sample I.D.:	*SW-1*	*SW-2*	*SW-3*	*SW-4*	*SW-5*	*SW-6*	*SW-7*	*SW-8*	*SW-9*	*SW-A*
Date Sampled:	*05/01/91*	*05/01/91*	*05/06/91*	*05/06/91*	*05/06/91*	*05/06/91*	*05/06/91*	*05/06/91*	*05/07/91*	*10/28/92*
Volatile Organic Compounds (µg/L)										
Vinyl Chloride	5300 J	1500	-	-	-	14 J	10 J	-	-	-
1,1-Dichloroethene	-	10	-	-	-	-	-	-	-	-
1,2-Dichloroethene (total)	130000	13000	3 J	-	230	250	250	-	-	-
1,2-Dichloroethane	-	1 J	-	-	-	-	-	-	-	-
Trichloroethene	62000	4 J	3 J	4 J	290	890	850	3 J	4 J	-
Styrene	-	-	-	-	-	-	-	-	-	-
Total VOCs (µg/kg)	197300J	14515 J	6 J	4 J	520	1154 J	1110 J	3 J	4 J	0
Base Neutral Acid Extractable Compounds (µg/L)										
2-Methylphenol	1 J	-	-	-	-	-	-	-	-	NA
4-Methylphenol	4 J	-	-	-	-	-	-	-	-	NA
Benzoic acid	-	4 J	-	-	-	-	-	-	-	NA
4-Chloro-3-methylphenol	3 J	-	-	-	-	-	-	-	-	NA
Di-n-Butylphthalate	4 J	3 J	-	1 J	-	-	-	-	-	NA
bis(2-Ethylhexyl)phthalate	3 J	2 J	-	-	-	-	-	-		NA
Total Petroleum Hydrocarbon (mg/L)										
Total Petroleum Hydrocarbons	5.9	1.8	-	-	-	-	-	-	-	NA

TABLE 6.7

SURFACE WATER SAMPLE DATA SUMMARY
VACAIR ALLOYS
FREWSBURG, NEW YORK

Concentration

Location:	***SW-B***	***SW-C***	***SW-D***	***SW-E***	***SW-F***	***SW-G***	***SW-H***	***SW-H***	***SW-J***	***SW-K***
Sample I.D.:	***SW-B***	***SW-C***	***SW-D***	***SW-E***	***SW-F***	***SW-G***	***SW-H***	***SW-I***	***SW-J***	***SW-K***
Date Sampled:	***10/28/92***	***10/28/92***	***10/28/92***	***10/28/92***	***10/29/92***	***10/29/92***	***10/29/92***	***10/29/92***	***10/29/92***	***10/30/92***
Volatile Organic Compounds (ug/L)										
Vinyl Chloride	-	-	-	140	-	48	130	130	-	-
1,1-Dichloroethene	-	-	-	-	-	-	-	-	-	-
1,2-Dichloroethene (total)	-	-	-	9 J	170	540	720	510	11	-
1,2-Dichloroethane	-	-	-	-	-	-	-	-	-	-
Trichloroethene	-	-	-	-	160	600	770	540	-	-
Styrene	-	-	2 J	-	-	-	-	-	-	-
Total VOCs (μg/kg)	0	0	2 J	149 J	330	1188	1620	1180	11	0
Base Neutral Acid Extractable Compounds (ug/L)										
2-Methylphenol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Methylphenol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzoic acid	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Chloro-3-methylphenol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Di-n-Butylphthalate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
bis(2-Ethylhexyl)phthalate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Petroleum Hydrocarbon (mg/L)										
Total Petroleum Hydrocarbons	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 6.7

SURFACE WATER SAMPLE DATA SUMMARY
VACAIR ALLOYS
FREWSBURG, NEW YORK

	Concentration		
Location:	***SW-L***	***SW-M***	***SW-M***
Sample I.D.:	***SW-L***	***SW-M***	***SW-N***
Date Sampled:	***10/30/92***	***10/30/92***	***10/30/92***
Volatile Organic Compounds (µg/L)			
Vinyl Chloride	-	-	-
1,1-Dichloroethene	-	-	-
1,2-Dichloroethene (total)	-	-	-
1,2-Dichloroethane	-	-	-
Trichloroethene	-	-	-
Styrene	-	-	-
Total VOCs (µg/kg)	0	0	0
Base Neutral Acid Extractable Compounds (µg/L)			
2-Methylphenol	NA	NA	NA
4-Methylphenol	NA	NA	NA
Benzoic acid	NA	NA	NA
4-Chloro-3-methylphenol	NA	NA	NA
Di-n-Butylphthalate	NA	NA	NA
bis(2-Ethylhexyl)phthalate	NA	NA	NA
Total Petroleum Hydrocarbon (mg/L)			
Total Petroleum Hydrocarbons	NA	NA	NA

TABLE 6.7

SURFACE WATER SAMPLE DATA SUMMARY
VACAIR ALLOYS
FREWSBURG, NEW YORK

	Concentration									
Location:	***SW-1***	***SW-2***	***SW-3***	***SW-4***	***SW-5***	***SW-6***	***SW-6***	***SW-8***	***SW-9***	***SW-A***
Sample I.D.:	***SW-1***	***SW-2***	***SW-3***	***SW-4***	***SW-5***	***SW-6***	***SW-7***	***SW-8***	***SW-9***	***SW-A***
Date Sampled:	***05/01/91***	***05/01/91***	***05/06/91***	***05/06/91***	***05/06/91***	***05/06/91***	***05/06/91***	***05/06/91***	***05/07/91***	***10/28/92***
Total Metals (ug/L)										
Aluminum	1800 J	1290	-	-	-	-	-	-	-	NA
Arsenic	11.4	2.80	-	-	-	-	-	-	3.50	NA
Barium	783	1390	95.5	96.5	116	146	155	152	119	NA
Beryllium	-	-	-	-	-	-	-	-	-	NA
Cadmium	3.10 J	-	-	-	-	-	-	-	-	-
Calcium	164000	403000	36100	35500	73300	74900	79300	76600	72100	34000
Chromium	21.8 J	-	-	-	3.5	4.20	-	-	14.4	-
Cobalt	95.5	66.7	-	-	7.2	4.40	-	-	-	NA
Copper	99.3	38.9	-	-	7.8	-	-	-	11.7	5.4
Iron	115000	103000	991	1090	571	537	565	60.2	4240	-
Lead	37.3 J	17.8	-	-	-	-	-	-	-	-
Magnesium	60100	136000	6380	6310	11600	10200	10800	9540	10900	7700
Manganese	9780	29900	176	164	178	228	251	6.10	544	4.1
Mercury	0.490 J	-	-	-	-	-	-	-	-	-
Nickel	540	262	-	-	14.9	-	8.00	-	72.7	-
Potassium	6620	13100	1150	1630	3780	1820	1800	1490	8340	NA
Silver	13.0 J	9.10	-	-	-	-	-	-	-	NA
Sodium	14700	15900	8480	8400	15800	12500	12900	10200	42500	5730
Zinc	258	99.4	14.7	15.2	46.4	14.3	10.8	12.3	22.4	NA
Cyanide	-	-	-	-	-	-	-	-	23.6	NA
Inorganics (ug/L)										
Total Hardness	NA	NA	NA	NA	NA	NA	NA	NA	NA	116000

TABLE 6.7

SURFACE WATER SAMPLE DATA SUMMARY
VACAIR ALLOYS
FREWSBURG, NEW YORK

	Concentration									
Location:	***SW-B***	***SW-C***	***SW-D***	***SW-E***	***SW-F***	***SW-G***	***SW-H***	***SW-H***	***SW-J***	***SW-K***
Sample I.D.:	***SW-B***	***SW-C***	***SW-D***	***SW-E***	***SW-F***	***SW-G***	***SW-H***	***SW-I***	***SW-J***	***SW-K***
Date Sampled:	***10/28/92***	***10/28/92***	***10/28/92***	***10/28/92***	***10/29/92***	***10/29/92***	***10/29/92***	***10/29/92***	***10/29/92***	***10/30/92***
Total Metals (µg/L)										
Aluminum	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Barium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	-	-	24.7	166	-	-	-	-	5.1	-
Calcium	80100	84800	150000	261000	64400	75000	68100	68700	50300	32700
Chromium	-	-	272	2900	-	9.4	15.3	17.8	10.7	-
Cobalt	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Copper	2.8	3.5	318	1850	6.9	6.2	45.8J	22.0J	19.6	3.5
Iron	-	-	53200	172000	1280	426	2220	1960	15000	649
Lead	-	-	289	1390	-	-	11.3	14.8	6.7	-
Magnesium	10100	10800	42000	55600	9860	11400	10700	10600	9130	6000
Manganese	24.4	17.9	11000	6770	356	140	270	264	713	90.9
Mercury	-	-	3.0	10.7	-	-	-	-	0.14	-
Nickel	-	-	892	5670	13.4	17.9	74.8	69.0	49.8	-
Potassium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Silver	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sodium	11500	11600	17400	35000	9560	11700	11400	11000	8900	8370
Zinc	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cyanide	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inorganics (µg/L)										
Total Hardness	241000	256000	547000	881000	202000	234000	214000	215000	163000	106000

TABLE 6.7

SURFACE WATER SAMPLE DATA SUMMARY
VACAIR ALLOYS
FREWSBURG, NEW YORK

Concentration

Location:	***SW-L***	***SW-M***	***SW-M***
Sample I.D.:	***SW-L***	***SW-M***	***SW-N***
Date Sampled:	***10/30/92***	***10/30/92***	***10/30/92***
Total Metals (µg/L)			
Aluminum	NA	NA	NA
Arsenic	NA	NA	NA
Barium	NA	NA	NA
Beryllium	NA	NA	NA
Cadmium	-	-	-
Calcium	30000	31600	28700
Chromium	-	-	-
Cobalt	NA	NA	NA
Copper	5.5	4.0	4.2
Iron	1100	504	849
Lead	-	-	2.2
Magnesium	5670	5960	5450
Manganese	152	85.2	165
Mercury	-	-	-
Nickel	-	-	-
Potassium	NA	NA	NA
Silver	NA	NA	NA
Sodium	7940	8220	7610
Zinc	NA	NA	NA
Cyanide	NA	NA	NA
Inorganics (µg/L)			
Total Hardness	98300	103000	94100

Notes:

J Associated value is estimated.
\- Not Detected.
NA Not Applicable.

TABLE 6.8

SEDIMENT SAMPLE DATA SUMMARY
VACAIR ALLOYS
FREWSBURG, NEW YORK

Chemical Parameters	*Concentration*											
Location:	***SED-1***	***SED-2***	***SED-2***	***SED-4***	***SED-5***	***SED-6***	***SED-7***	***SED-A***	***SED-B***	***SED-C***	***SED-D***	***SED-E***
Sample I.D.:	***SED-1***	***SED-2***	***SED-3***	***SED-4***	***SED-5***	***SED-6***	***SED-7***	***SED-A***	***SED-B***	***SED-C***	***SED-D***	***SED-E***
Date Sampled:	***05/01/91***	***05/01/91***	***05/01/91***	***05/06/91***	***05/06/91***	***05/07/91***	***05/07/91***	***10/28/92***	***10/28/92***	***10/28/92***	***10/28/92***	***10/28/92***
Volatile Organic Compounds (µg/kg)												
Vinyl Chloride	31000	-	28 J	7600	-	2300 J	-	-	-	-	-	-
Methylene Chloride	-	110	-	-	120 J	-	-	-	-	-	-	-
Acetone	-	850	750	-	-	380 J	1700	-	-	530J	390J	270J
1,1-Dichloroethene	830 J	-	-	1300 J	-	-	-	-	-	-	-	-
1,2-Dichloroethene (total)	110000	45 J	150 J	230000	330 J	610 J	-	-	-	-	-	-
Chloroform	-	-	-	-	-	-	-	-	-	-	-	-
1,2-Dichloroethane	-	4 J	-	-	-	-	-	-	-	-	-	-
2-Butanone	-	320 J	110 J	-	-	-	160	-	-	180	79	100
1,1,1-Trichloroethane	-	-	-	-	32 J	-	-	-	-	-	-	-
Trichloroethene	740 J	-	-	1000 J	-	-	-	-	-	-	-	-
Toluene	-	18 J	22 J	-	-	2J	-	-	-	-	14 J	-
Xylene (total)	-	3 J	-	-	-	-	22 J	-	-	-	-	-
Total VOCs (µg/kg)	142570 J	1350 J	1060 J	239900 J	482 J	3292 J	1882 J	0	0	710 J	483 J	370 J
Base Neutral Acid Extractable Compounds (µg/kg)												
Phenol	-	-	-	-	1900 J	-	-	NA	NA	NA	NA	NA
4-Methylphenol	-	-	-	110 J	-	-	-	NA	NA	NA	NA	NA
Benzoic acid	-	-	-	650 J	3000 J	-	410 J	NA	NA	NA	NA	NA
Phenanthrene	-	-	-	620 J	-	-	120 J	NA	NA	NA	NA	NA
Di-n-Butylphthalate	-	-	-	340 J	3500	-	330 J	NA	NA	NA	NA	NA
Fluoranthene	-	-	-	1200	-	-	230 J	NA	NA	NA	NA	NA
Pyrene	-	-	-	1300	-	-	280 J	NA	NA	NA	NA	NA
Butylbenzylphthalate	-	-	-	360 J	-	-	-	NA	NA	NA	NA	NA
Benzo(a)anthracene	-	-	-	550 J	-	-	-	NA	NA	NA	NA	NA
Chrysene	-	-	-	530 J	-	-	150 J	NA	NA	NA	NA	NA
bis(2-Ethylhexyl)phthalate	-	-	-	34000J	-	-	1200	NA	NA	NA	NA	NA
Di-n-octyl phthalate	-	-	-	270 J	-	-	-	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	-	-	-	520 J	-	-	-	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	-	-	-	320 J	-	-	-	NA	NA	NA	NA	NA
Benzo(a)pyrene	-	-	-	400 J	-	-	-	NA	NA	NA	NA	NA
PCB (µg/kg)												
Aroclor-1260	-	160 J	86 J	-	-	-	-	NA	NA	NA	NA	NA

TABLE 6.8

SEDIMENT SAMPLE DATA SUMMARY
VACAIR ALLOYS
FREWSBURG, NEW YORK

Chemical Parameters					*Concentration*					
Location:	***SED-F***	***SED-G***	***SED-H***	***SED-H***	***SED-H***	***SED-J***	***SED-K***	***SED-L***	***SED-M***	***SED-M***
Sample I.D.:	***SED-F***	***SED-G***	***SED-H***	***SED-H***	***SED-I***	***SED-J***	***SED-K***	***SED-L***	***SED-M***	***SED-N***
Date Sampled:	***10/29/92***	***10/29/92***	***10/29/92***	***10/29/92***	***10/29/92***	***10/29/92***	***10/30/92***	***10/30/92***	***10/30/92***	***10/30/92***
Volatile Organic Compounds (µg/kg)										
Vinyl Chloride	300J	310J	1100J	-	-	-	-	-	-	-
Methylene Chloride	-	-	-	-	-	-	-	-	-	-
Acetone	110J	230J	120J	-	-	200J	-	-	19J	-
1,1-Dichloroethene	-	-	39 J	53 J	-	-	-	-	-	-
1,2-Dichloroethene (total)	270	470	3400	9900	-	-	-	-	-	-
Chloroform	-	-	-	-	-	-	-	-	-	-
1,2-Dichloroethane	-	-	-	-	-	-	-	-	-	-
2-Butanone	-	-	-	-	-	-	-	-	-	-
1,1,1-Trichloroethane	-	-	-	-	-	-	-	-	-	-
Trichloroethene	26 J	66	290J	380J	-	-	-	-	-	-
Toluene	-	-	-	-	-	-	-	-	-	-
Xylene (total)	-	-	-	-	-	-	-	-	-	-
Total VOCs (µg/kg)	706 J	1076 J	4949 J	10333 J	0	200 J	0	0	19 J	0
Base Neutral Acid Extractable Compounds (µg/kg)										
Phenol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Methylphenol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzoic acid	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Phenanthrene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Di-n-Butylphthalate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fluoranthene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pyrene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Butylbenzylphthalate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
bis(2-Ethylhexyl)phthalate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Di-n-octyl phthalate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PCB (µg/kg)										
Aroclor-1260	-	-	-	-	-	-	-	-	-	-

TABLE 6.8

SEDIMENT SAMPLE DATA SUMMARY
VACAIR ALLOYS
FREWSBURG, NEW YORK

Chemical Parameters	*Concentration*										
Location:	***SED-1***	***SED-2***	***SED-2***	***SED-4***	***SED-5***	***SED-6***	***SED-7***	***SED-A***	***SED-B***	***SED-C***	***SED-D***
Sample I.D.:	***SED-1***	***SED-2***	***SED-3***	***SED-4***	***SED-5***	***SED-6***	***SED-7***	***SED-A***	***SED-B***	***SED-C***	***SED-D***
Date Sampled:	***05/01/91***	***05/01/91***	***05/01/91***	***05/06/91***	***05/06/91***	***05/07/91***	***05/07/91***	***10/28/92***	***10/28/92***	***10/28/92***	***10/28/92***
Total Metals (mg/kg)											
Aluminum	2290	5510	6300	3890	4930	NA	5190	NA	NA	NA	NA
Arsenic	15.9	18.7	16.6	9.00	11.1	NA	12.5 J	NA	NA	NA	NA
Barium	682	218	277	138	197	NA	129	NA	NA	NA	NA
Beryllium	0.710	0.680	0.600	1.10	-	NA	0.520	NA	NA	NA	NA
Cadmium	4.60	2.80	2.80	4.90	-	NA	1.90	4.9	1.8	4.7	49.3
Calcium	5570	9660	7600	22200	20200	NA	9270	34400	6300	18200	55800
Chromium	-	59.3	6.40	441	6.30	NA	30.8	47.1	10.1	21.7	1130
Cobalt	78.0	73.6	62.3	149	11.4	NA	29.6	NA	NA	NA	NA
Copper	90.2	94.1	89.2	323	2.80	NA	31.3	796	8.8	27.7	774
Iron	143000	86500	89000	26800	22400	NA	32300	15700	8900	19200	73400
Lead	38.2	72.7	75.1	129	24.7	NA	29.9	47.5	15.2	28.6	800
Magnesium	859	1900	2080	3450	2080	NA	2600	5990	1460	2210	12700
Manganese	1230	3440 J	1800 J	992	498	NA	855	211	569	267	2060
Mercury	-	0.439 J	0.431 J	1.84 J	-	NA	-	-	-	-	6.4
Nickel	481	399	325	1320	44.1	NA	131	90.4	11.5	30.1	1660
Selenium	-	0.61	0.560	-	-	NA	-	NA	NA	NA	NA
Silver	10.6	9.10	9.50	2.90	-	NA	-	NA	NA	NA	NA
Sodium	58.0	91.5	89.6	128	237	NA	145	407J	122J	276J	375J
Vanadium	-	-	-	15.5	-	NA	-	NA	NA	NA	NA
Zinc	388	144	117	491	214	NA	90.5	NA	NA	NA	NA
Total Petroleum Hydrocarbons (mg/kg)											
Total Petroleum Hydrocarbons	6300	950	820	2900	200	NA	8200	NA	NA	NA	NA
Total Organic Carbon (mg/kg)	NA	NA	NA	NA	NA	NA	NA	53600	38600	67700	94600

TABLE 6.8

SEDIMENT SAMPLE DATA SUMMARY
VACAIR ALLOYS
FREWSBURG, NEW YORK

Chemical Parameters					*Concentration*					
Location:	***SED-E***	***SED-F***	***SED-G***	***SED-H***	***SED-H***	***SED-J***	***SED-K***	***SED-L***	***SED-M***	***SED-M***
Sample I.D.:	***SED-E***	***SED-F***	***SED-G***	***SED-H***	***SED-H***	***SED-J***	***SED-K***	***SED-L***	***SED-M***	***SED-N***
Date Sampled:	***10/28/92***	***10/29/92***	***10/29/92***	***10/29/92***	***10/29/92***	***10/29/92***	***10/30/92***	***10/30/92***	***10/30/92***	***10/30/92***
Total Metals (mg/kg)										
Aluminum	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Barium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	43.1	15.2	13.3	22.3	31.6	19.9	3.6	3.2	3.2	4.3
Calcium	33500	17700	13900	22600	29300	6480	3940	4110	3580	4100
Chromium	772	427	340	523	710	228	20.3	16.0	23.2	25.9
Cobalt	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Copper	492	310	282	426	549	489	25.7	22.3	39.7	40.6
Iron	46200	30900	23200	40800J	52200J	26900	18700	15200	19700	22400
Lead	433J	64.0	80.0	166	201	106	35.5	15.2	24.5	24.5
Magnesium	7300	3720	3850	4660	6390	3230	3160	3450	3840	4390
Manganese	1100	2540	1020	3250	3960	297	580	426	509	599
Mercury	8.0	1.4	2.8	1.9J	5.0J	2.8	-	-	-	-
Nickel	1720	958	349	1240	1490	259	48.4	19.8	24.3	27.1
Selenium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Silver	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sodium	278J	198J	251J	249J	353J	349J	117J	117J	155J	138J
Vanadium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Petroleum Hydrocarbons (mg/kg)										
Total Petroleum Hydrocarbons	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Organic Carbon (mg/kg)	72900	71700	102000	94100	117000	77700	17600	4180	18600	13000

Notes:

J	Associated value is estimated.
-	Not Detected.
NA	Not Applicable.

TABLE 7.1

PHYSICAL AND CHEMICAL PROPERTIES - GROUNDWATER CONTAMINANT MIGRATION
VACAIR ALLOYS DIVISION
FREWSBURG, NEW YORK

Parameter	*Molecular Weight*	*Aqueous Solubility (mg/L)*	*Vapor Pressure (mm of Hg)*	*Henry's Law Constant (ats.M^3/mol)*	*KOC (ml/g)*	*Liquid Density*
Vinyl chloride	62.5	2,670[a]	2,660	0.0819	57[a]	0.9106
1,1-Dichloroethene	97	600[a]	2,250[a]	0.034[a]	65[a]	11.213[b]
1,2-Dichloroethene (Total)	97[a]	6,300[a]	324[a]	0.00656[a]	54	1.28[b]
Trichloroethene	131[a]	1,100[a]	57.9[a]	0.0091[a]	126a	1.46[b]

Notes:
[a] USEPA (1986).
[b] Merck Index (1983), 10th Edition.

TABLE 7.2

SIGNIFICANCE OF PHYSICAL AND CHEMICAL PROPERTIES
VACAIR ALLOYS DIVISION
FREWSBURG, NEW YORK

Property	*Description*	*Units*	*Descriptive Ranges*	*Examples of Site Contaminants*
Liquid Density	The density of a chemical in its pure liquid form, relative to water.	D (g/cm^3)	<1 - less dense than water >1 - more dense than water	1,1-Dichloroethene Trichloroethene
Aqueous Solubility	The amount of a chemical at equilibrium that will be dissolved in pure water.	S (mg/l)	high - soluble in water low - insoluble in water	Trichloroethene, vinyl chloride
Vapor Pressure	The partial pressure of a vapor at equilibrium with the chemical in its pure state; describes the tendency of a chemical to evaporate.	Vp (mm Hg)	high - volatile low - non-volatile	VOCs
Partitioniong Between Air/Water	The proportion of a chemical at equilibrium in the vapor phase in the space above an aqueous solution of the chemical; describes the tendency of a chemical to transfer between air and water.	Henry's Law constant, H (atm m^3/mol)	$<3 \times 10^{-7}$ - non-volatile 3×10^{-7} to 10^{-5} - low volatility $>10^{-3}$ - high volatility	None None Trichloroethene

TABLE 7.2

SIGNIFICANCE OF PHYSICAL AND CHEMICAL PROPERTIES
VACAIR ALLOYS DIVISION
FREWSBURG, NEW YORK

Property	*Description*	*Units*	*Descriptive Ranges*	*Examples of Site Contaminants*
Partitioning Between Organic Matter and Water	The proportion of a chemical at equilibrium sorbed to organic material in a water-soil or water-sediment system; more strongly sorbed chemicals tend to be less mobile.	K_{OC} (ml/g)	0 - 50 - very high mobility 50 to 100 - high mobility 100 to 500 - moderate mobility 500 to 2,000 - low mobility 2,000 to 20,000 - slight mobility >20,000 - immobile	None Vinyl chloride, Trichloroethene

TABLE 7.3

COMPARISON OF POTENTIAL CHEMICAL CONCENTRATIONS IN CONEWANGO CREEK TO AMBIENT WATER QUALITY CRITERIA
VACAIR ALLOYS DIVISION
FREWSBURG, NEW YORK

Chemical Compound	*Annual Mean Streamflow*	*Minimum Daily Streamflow*	*Class C NYS AWQC*	*Federal AWQC*	
				Acute	*Chronic*
Vinyl Chloride	0.0017	0.045	NA	NA	NA
1,1-Dichloroethene	0.0001	0.0026	NA	11,600	NA
Total-1,2-Dichloroethene	0.022	0.59	NA	11,600	NA
Trichloroethene	0.034	0.89	11	45,000	21,900

Notes:
Concentrations are reported in units of µg/L.
NYS New York State.
AWQC - Ambient Water Quality Criteria to protect aquatic life, as reported in Table 9.1 of this report.
NA Not Available.

TABLE 7.4

CHEMICAL AND PHYSICAL PROPERTIES/PARAMETERS FOR THE EMISSION RATE AND AIR CONCENTRATION ESTIMATIONS
VACAIR ALLOYS DIVISION
FREWSBURG, NEW YORK

1. D_i - Diffusion Coefficients in Air

Trichloroethene	0.07638 cm^2/s
Vinyl chloride	0.10094 cm^2/s
cis 1,2-Dichloroethene	0.07442 cm^2/s
trans 1,2-Dichloroethene	0.07442 cm^2/s

2. P_t = Total Soil Porosity = 0.3

3. A, Exposed Surface Area

Area I = 3,135m^2
Area II = 22,586 m^2

4. Distance to Nearest Downwind Receptor *

Area I = 2,500 feet or 760 m
Area II = 2,500 feet or 760 m

5. d_{sc}, Effective Depth of Soil Cover

d_{sc} = 4 feet or 122 cm which is the approximate distance at which the soil gas samples were collected.

Notes:
* Based on prevailing winds blowing to the north, as reported by the Erie, Pennsylvania and Buffalo, New York weather stations.

TABLE 7.5

ESTIMATED EMISSION RATES AND AMBIENT AIR CONCENTRATIONS
REMEDIAL INVESTIGATION
VACAIR ALLOYS
FREWSBURG, NEW YORK

Component	*Soil Gas Concentration,* C_i *(g/cm³)*	*Emission Rate,* E_i *(g/s)*	*Annual Emission Rate,* Q_i *(kg/m³-yr)*	*Annual Average Concentration,* X_i *µg/m³*
Area I				
Trichloroethylene	1.1137E-05	4.39E-02	4.42E-01	4.42E-03
Vinyl Chloride	2.994E-06	1.56E-02	1.57E-01	1.57E-03
cis-1,2-Dichloroethene	2.472E-06	9.49E-03	9.54E-02	9.54E-04
trans-1,2-Dichloroethene	1.9E-06	7.30E-03	7.34E-02	7.34E-04
Area II				
Trichloroethylene	6.9E-09	1.96E-04	2.74E-04	1.37E-03
Vinyl Chloride	1.1E-08	4.13E-04	5.77E-04	2.89E-03
cis-1,2-Dichloroethene	1.5E-09	4.15E-05	5.79E-05	2.90E-04
trans-1,2-Dichloroethene	5.0E-10	1.38E-05	1.93E-05	9.65E-05

TABLE 7.6

COMPARISON OF ESTIMATED THEORETICAL AVERAGE CONCENTRATIONS TO AMBIENT AIR QUALITY
REMEDIAL INVESTIGATION
VACAIR ALLOYS
FREWSBURG, NEW YORK

	Combined Calculated Annual Average Concentration ($\mu g/m^3$)	*AGCs (1) ($\mu g/m^3$)*
Trichloroethylene	0.00579	0.45
Vinyl Chloride	0.00446	0.02
cis-1,2-Dichloroethene	0.00124	1900
trans-1,2-Dichloroethene	0.000831	360

Notes:

(1) Annual Guidance Concentrations (AGCs) as provided in NYSDEC's Draft Air Guide-1, 1991.

TABLE 8.1

IDENTIFICATION OF CHEMICALS OF CONCERN IN GENERAL SOILS
VACAIR ALLOY DIVISION
FREWSBURG, NEW YORK

	Reported Concentrations (1)							Toxicity Scores		Percent of Total		Background Concentrations (2)							
	Number of Detections A	*Total number of Samples B*	*Range of Detects (µg/Kg)*	*Mean (4) C (µg/Kg)*	*Maximum (µg/Kg)*	*Cancer Slope Factor D 1/(mg/kg-day)*	*Reference Dose E mg/kg-day*	*Carc. Score (A/B)*C*D*	*Non-Carc. Score (A/B)*(C/E)*	*Carc. Score*	*Non-Carc. Score*	*Detection Frequency (3)*	*Range of Detects (µg/Kg)*	*Mean (4) (ug/Kg)*	*Maximum (µg/Kg)*	*Carc. Score*	*Non-Carc. Score*	*2*Bkd*	*Chemicals of Concern*
VOCs																			
Acetone	12	42	4J-380J	92	380J	-	0.1	-	262	-	0.003	4/6	4J-86	39	86			x	
Benzene	1	42	470J	470	470J	0.029	-	0.32	-	0.00	-	0/6	-	-	-			x	
2-Butanone	5	42	9J-11,000J	2,237	11,000J	-	0.05	-	5,327	-	0.055	1/6	8J	8	8			x	
Carbon Disulphide	5	42	1J-500,000J	100,010	500000J	-	0.01	-	1,190,590	-	12.256	0/6	-	-	-		x	x	x
1,2-Dichloroethene(total)	17	42	2J-2,400,000J	183,659	2,400,000J	-	0.009	-	8,259,812	-	85.026	0/6	-	-	-		x	x	x
Ethylbenzene	4	42	2J-6000J	1,502	6000J	-	0.1	-	1,431	-	0.015	0/6	-	-	-			x	
Methylene Chloride	1	42	290	290	290	0.0075	0.06	0.05	115	0.00	0.001	1/6	17J	17	17			x	
4-Methyl-2-pentanone	3	42	2J-4J	3	4J	-	-	-	-	-	-	0/6	-	-	-			x	
Tetrachloroethene	10	42	3J-93	17	93	0.051	0.01	0.21	405	0.00	0.004	0/6	-	-	-			x	
Toluene	4	42	3J-5900J	1,479	5900J	-	0.2	-	704	-	0.007	0/6	-	-	-			x	
Trichloroethene	25	42	2J-17,000,000J	698,429.94	17,000,000J	0.011	-	4,573	-	21.73	-	2/6	14J-38	26	38	x		x	x
1,1,1-Trichloroethane	2	42	9J-16J	13	16J	-	0.035	-	17	-	0.000	0/6	-	-	-			x	
Vinyl Chloride	3	42	41J-5000J	1,704	5000J	1.9	-	231	-	1.10	-	0/6	-	-	-	x		x	x
Xylene(total)	6	42	3J-39,000J	6,510	39000J	-	2	-	465	-	0.005	0/6	-	-	-			x	
BNAs																			
Acenaphthene	1	14	77J	77	77J	-	0.06	-	92	-	0.001	0/3	-	-	-			x	
Anthracene	1	14	73J	73	73J	-	0.3	-	17	-	0.000	0/3	-	-	-			x	
Benz(a)anthracene	2	14	80J-87J	84	87J	1.06	-	13	-	0.06	-	1/3	160J	160J	160J				
Benzo(a)pyrene	2	14	65J-120J	93	120J	7.3	-	96	-	0.46	-	1/3	170J	170J	170J				
Benzo(b)fluoranthene	2	14	75J-120J	98	120J	1.02	-	14	-	0.07	-	1/3	170J	170J	170J				
Benzo(g,h,i)perylene	1	14	410J	410	410J	0.16	-	5	-	0.02	-	1/3	96J	96J	96J			x	
Benzo(k)fluoranthene	2	14	71J-110J	91	110J	0.48	-	6	-	0.03	-	1/3	190J	190J	190J				
Benzoic Acid	2	14	48J-420J	234	420J	-	4	-	8	-	0.000	0/3	-	-	-			x	
bis(2-ethylhexyl)phthalate	8	14	65J-5200J	1,373	5,200	0.014	0.02	11	39,234	0.05	0.404	2/3	42J-240J	141	240J			x	
4-Chloro-3-methylphenol	2	14	380J	380	380J	-	-	-	-	-	-	1/3	60J	60J	60J			x	
Chrysene	2	14	110J	110	110J	0.032	-	1	-	0.00	-	1/3	190J	190J	190J				
Di-n-Butylphthalate	2	14	50J-63J	57	63J	-	0.1	-	81	-	0.001	1/3	54J	54J	54J				
Di-n-Octyl phthalate	1	14	41J-63J	52	63J	-	-	-	-	-	-	2/3	56J - 190J	123	190J				
Dibenzo(a,h)anthracene	1	14	85J	85	85J	8.1	-	49	-	0.23	-	0/3	-	-	-			x	
Dibenzofuran	1	14	71J	71	71J	-	-	-	-	-	-	0/3	-	-	-			x	
Fluoranthene	4	14	50J-120J	84	120J	-	0.04	-	598	-	0.006	2/3	62J-480J	271	480J				
Fluorene	1	14	80J	80	80J	-	0.04	-	143	-	0.001	0/3	-	-	-			x	
Indeno(1,2,3-cd)pyrene	1	14	300J	300	300J	1.7	-	36	-	0.17	-	1/3	90J	90J	90J			x	
2-Methylnaphthalene	1	14	320J	320	320J	-	0.03	-	762	-	0.008	0/3	-	-	-			x	
4-Methylphenol	1	14	170J	170	170J	-	0.005	-	2,429	-	0.025	0/3	-	-	-			x	
Naphthalene	1	14	150J	150	150J	-	0.004	-	2,679	-	0.028	0/3	-	-	-			x	
Pentachlorophenol	2	14	51J-56J	54	56J	0.12	-	1	-	0.00	-	1/3	220J	220J	220J				
Phenanthrene	3	14	44J-250J	126	250J	-	-	-	-	-	-	1/3	220J	220J	220J				
Pyrene	4	14	47J-280J	132	280J	-	0.03	-	1,257	-	0.013	2/3	60J-480J	270	480J				
2,4,5-Trichlorophenol	1	14	150J	150	150J	-	0.1	-	107	-	0.001	0/3	-	-	-			x	
2,4,6-Trichlorophenol	1	14	79J	79	79J	0.01	-		-	-	-	0/3	-	-	-			x	

TABLE 8.1

IDENTIFICATION OF CHEMICALS OF CONCERN IN GENERAL SOILS
VACAIR ALLOY DIVISION
FREWSBURG, NEW YORK

	Reported Concentrations (1)							*Toxicity Scores*		*Percent of Total*		*Background Concentrations (2)*							
	Number of Detections A	***Total number of Samples B***	***Range of Detects***	***Mean (4) C***	***Maximum***	***Cancer Slope Factor D***	***Reference Dose E***	***Carc. Score (A/B)*C*D***	***Non-Carc. Score (A/B)*(C/E)***	***Carc. Score***	***Non-Carc. Score***	***Detection Frequency (3)***	***Range of Detects***	***Mean (4)***	***Maximum***	***Carc. Score***	***Non-Carc. Score***	***2*Bkd***	***Chemicals of Concern***
Pesticides and PCBs								-	-										
Total Aroclors	6	7	13J-12000J	2,426	12000J	7.7	0.01	16,009	207,907	76.07	2.140	0/5	-	-	-	x	x	x	x
alpha-BHC	0	14	-	-	-	6.3	-	-	-	-	-	1/5	190J	190J	190J				
beta-BHC	0	14	-	-	-	1.8	-	-	-	-	-	1/5	9	9	9				
delta-BHC	0	14	-	-	-	-	-	-	-	-	-	1/5	2.3J	2.3J	2.3J				
TPH			*(mg/Kg)*	*(mg/Kg)*	*(mg/Kg)*								*(mg/Kg)*	*(mg/Kg)*	*(mg/Kg)*				
Total Petroleum Hydrocarbons	13	14	3.3J-56000	6,471	56000	-	-	-	-	-	-	2/3	10-34	22	34			x	
						TOTAL (ORGANICS):		21045.92	9714441.58	100.00	100.00								
Inorganics																			
Total Organic Carbon	5	5	949-4260	2,532	4260	-	-	-	-	-	-								
Total Metals																			
Aluminum	14	14	3100-11,000	79,490	11,000	-	-	-	-	-	-	5/5	4050-8900J	5,615	8,900			x	
Arsenic	14	14	1.90-7.1	4	7	1.75	0.0003	7	14,024	71.18	23.363	5/5	3.0-18.9J	7	19	x	x		
Barium	14	14	29.7-296	72	296	-	0.07	-	1,023	-	1.705	5/5	4.66-90.6J	49	90.6J		x		
Beryllium	10	14	0.26-5.2	1	5.2	4.3	0.005	3	139	28.82	0.231	4/5	0.220-0.520	0.35	1	x		x	x
Cadmium	7	14	0.637-4.2	2	4.2	-	0.001	-	1,106	-	1.843	0/5	-	-	-		x	x	x
Calcium	14	14	564J-64100	16,518	64,100	-	-	-	-	-	-	5/5	2180-72800J	16,668	72800J				
Chromium	13	14	1.2-3050	303	3,050	-	1	-	281	-	0.469	5/5	1.30-9.70	4	10			x	
Cobalt	14	14	3.9-1020	1,454	1,020	-	-	-	-	-	-	5/5	5.15-12.5	8	13			x	
Copper	14	14	7.5-339	61	339	-	0.037	-	1,648	-	2.746	5/5	11.9-18.7	14	19		x	x	x
Iron	14	14	8700-74000	22,535	74000	-	-	-	-	-	-	5/5	11400-21900J	14,640	21900J				
Lead	14	14	4.60-181	48	181	-	0.1	-	481	-	0.801	5/5	5.2-25.9	16	26			x	
Magnesium	14	14	1580-5570	3,269	5,570	-	-	-	-	-	-	5/5	2050-5780	3,393	5,780				
Manganese	14	14	226-3600	924	3600	-	0.14	-	6,600	-	10.995	5/5	400J-1165.5	609	1,166		x		
Mercury	4	14	0.18-0.69	0	0.69	-	0.0003	-	357	-	0.595	0/5	-	-	-			x	
Nickel	9	14	12.1J-1760J	502	1760J	-	0.02	-	16,151	-	26.906	1/5	84.2	84	84		x	x	x
Potassium	13	14	210-757	421	757	-	-	-	-	-	-	3/5	192-548	447	548				
Selenium	3	14	0.44-1.8	1	1.8	-	0.005	-	44	-	0.074	0/5	-	-	-			x	
Silver	1	14	0 93	1	0.93	-	0.005	-	13	-	0.022	1/5	2.30	2	2				
Sodium	14	14	36.4-229	122	229	-	-	-	-	-	-	5/5	164-227	181	227				
Thallium	1	14	7.8	8	7.8	-	7.00E-05	-	7,959	-	13.260	0/5	-	-	-		x	x	x
Vanadium	3	14	4.4-961	325	961	-	0.007	-	9,950	-	16.576	0/5	-	-	-		x	x	x
Zinc	14	14	21.4-310	73	310	-	0.3	-	244	-	0.407	5/5	34.1-54.3	41	54				
Cyanide	1	14	1.5	2	1.5	-	0.02	-	5	-	0.009	0/5	-	-	-			x	
						TOTAL (INORGANICS):		10.34	60026.14	100.00	100.00								

Notes:
(1) Based on the following sample locations:
SSOIL-M, SSOIL-N, SSOIL-O, All Test Pit Samples, BHG-1, BH5A-3, BH5B-1, BH5B-2, BH5B-3, BH12-1, BH13-1, BHB-1, BH-C, BHD-1, BHD-2, BHE-1, BHE-2, BH-F, BHL-1, BHL-2, BHP-1, BHP-2, MWU-1, MW11-2, BH-M-1, BH-M-2, BH-O, MW-8, MW-8-2, MW-5D, BH11-1, BHV-1, BH, MW9-2
(2) Note: Means were calculated using Detect samples only
Background locations for VOCs: SS-1, SS-2 (Dup. of SS-4), SS-3, SS-4, SSOIL-A, SSOIL-J, BH-1, BHA-1, BH-J
Background locations for BNAs: SS-1, BH-1, BHA-1
Background locations for Metals: BH-1, BHA-1, SS-1, SS-2 (Dup SS-4), SS-3 and SS-4.
(3) Number of positive detections per total number of samples. Duplicates are counted as one sample.
(4) Mean concentrations were calculated using positive detections only.

TABLE 8.2

IDENTIFICATION OF CHEMICALS OF POTENTIAL CONCERN IN SEDIMENT
VACAIR ALLOY DIVISION
FREWSBURG, NEW YORK

	Reported Concentrations (1)							Toxicity Scores		Percent of Total		Background Concentrations (2)							
	Number of Detections A	Total Sample Number B	Range of Detects (ug/Kg)	Mean (4) C (ug/Kg)	Maximum (ug/Kg)	Cancer Slope Factor D 1/(mg/kg-day)	Reference Dose E mg/kg-day	Carc. Score (A/B)*C*D	Non-Carc. Score (A/B)*(C/E)	Carc. Score	Non-Carc. Score	Detection Frequency (3)	Range of Detects (ug/Kg)	Mean (4) (ug/Kg)	Maximum (ug/Kg)	Carc. Score	Non-Carc. Score	2*Bkd	Chemicals of Concern
VOCs																			
Acetone	10	13	110J-1700	473	1700	-	0.1	-	3,638	-	0.10	0/2	-	-	-			x	
2-Butanone	5	13	79-320	147	320	-	0.05	-	1,129	-	0.03	0/2	-	-	-			x	
Chloroform	0	13	-	-	-	0.0061	0.01	-	-	-	-	0/2	-	-	-				
1,1-Dichloroethene	3	13	39J-1300J	725	1300J	0.6	0.009	100	18,598	1.31	0.53	0/2	-	-	-	x		x	x
1,2-Dichloroethene(total)	7	13	45J-230000	49728	230000	-	0.009	-	2,975,192	-	84.76	1/2	330J	330J	330J		x	x	x
1,2-Dichloroethane	1	13	4J	4	4	0.091	-	0	-	0.00	-	0/2	-	-	-			x	
Methylene Chloride	1	13	110	110	110	0.0075	0.06	0	141	0.00	0.00	1/2	120J	120J	120J				
1,1,1-Trichloroethane	0	13	-	-	-	-	0.035	-	-	-	-	1/2	32J	32J	32J				
Trichloroethene	5	13	26J-1000J	433	1000J	0.011	-	2	-	0.02	-	0/2	-	-	-			x	
Toluene	3	13	2J-22J	12	22J	-	0.2	-	14	-	0.00	0/2	-	-	-			x	
Vinyl Chloride	7	13	28J-31000	6091	31000	1.9	-	6,232	-	81.58	-	0/2	-	-	-	x		x	x
Xylene(total)	2	13	3J-22J	13	22J	-	2	-	1	-	0.00	0/2	-	-	-			x	
BNAs																			
Benz(a)anthracene	1	4	550J	550	550J	1.06	-	146	-	1.91	-	0/1	-	-	-	x		x	x
Benzoic Acid	2	4	410J-650J	530	650J	-	4	-	66	-	0.00	1/1	3000J	3000J	3000J				
Benzo(b)fluoranthene	1	4	520J	520	520J	1.02	-	133	-	1.74	-	0/1	-	-	-	x		x	x
Benzo(k)fluoranthene	1	4	320J	320	320J	0.48	-	38	-	0.50	-	0/1	-	-	-			x	
Benzo(a)pyrene	1	4	400J	400	400J	7.30	-	730	-	9.56	-	0/1	-	-	-	x		x	x
bis(2-ethylhexyl)phthalate	4	4	1200J-34000J	9600	34000J	0.014	0.02	134	480,000	1.76	13.68	0/1	-	-	-	x	x	x	x
Butylbenzylphthalate	1	4	360J	360	360J	-	0.20	-	450	-	0.01	0/1	-	-	-			x	
Chrysene	2	4	150J-530J	340	530J	0.032	-	5	-	0.07	-	0/1	-	-	-			x	
Di-n-Butylphthalate	2	4	330J-340J	335	340J	-	0.1	-	1,675	-	0.05	1/1	3500	3500	3500				
Di-n-octylphthalate	1	4	270J	270	270J	-	-	-	-	-	-	0/1	-	-	-			x	
Fluoranthene	2	4	230J-1200	715	1200	-	0.04	-	8,938	-	0.25	0/1	-	-	-			x	
4-Methylphenol	1	4	110J	110	110J	-	0.005	-	5,500	-	0.16	0/1	-	-	-			x	
Phenanthrene	2	4	120J-620J	370	620J	-	-	-	-	-	-	0/1	-	-	-			x	
Phenol	0	4	-	-	-	-	0.6	-	-	-	-	1/1	1900J	1900J	1900J				
Pyrene	2	4	280J-1300	790	1300	-	0.03	-	13,167	-	0.38	0/1	-	-	-			x	
PCBs																			
Aroclor-1260	1	8	86J-160J	123	160J	7.7	0.01	118	1,538	1.55	0.04	0/1	-	-	-	x		x	x
Total Petroleum Hydrocarbons																			
Total Petroleum Hydrocarbons	4	4	820-8200	4571	8200							1/1	200	200	200				
						TOTAL (ORGANICS):		7639.041038	3510047.041	100	100								

TABLE 8.2

IDENTIFICATION OF CHEMICALS OF POTENTIAL CONCERN IN SEDIMENT
VACAIR ALLOY DIVISION
FREWSBURG, NEW YORK

	Reported Concentrations (1)							Toxicity Scores		Percent of Total		Background Concentrations (2)							
	Number of Detections A	Total Sample Number B	Range of Detects (mg/Kg)	Mean (4) C (mg/Kg)	Maximum (mg/Kg)	Cancer Slope Factor D 1/(mg/kg-day)	Reference Dose E mg/kg-day	Carc. Score (A/B)*C*D	Non-Carc. Score (A/B)*(C/E)	Carc. Score	Non-Carc. Score	Detection Frequency (3)	Range of Detects (ug/Kg)	Mean (4) (ug/Kg)	Maximum (ug/Kg)	Carc. Score	Non-Carc. Score	2*Bkd	Chemicals of Concern
Total Organic Carbon (TOC)																			
TOC	8	8	53600-117000	80719	117000							1/1	38600	38600	38600				
Total Metals																			
Aluminum	4	4	2290-6300	4319	6300	-	-	-	-	-	-	1/1	4930	4930	4930				
Antimony	0	4	-	-	-	-	0.0004	-	-	-	-	0/1	-	-	-				
Arsenic	4	4	9J-18.7	14	19	1.75	0.0003	24	45,875	88.30	34.17	1/1	11	11	11	x	x		
Barium	4	4	129-682	299	682	-	0.07	-	4,273	-	3.18	1/1	197	197	197		x		
Beryllium	4	4	0.52-1.10	1	1	4.3	0.005	3	149	11.70	0.11	0/1	-	-	-	x		x	x
Cadmium	12	12	1.90-49.3	16	49.3	-	0.001	-	15,963	-	11.89	1/2	1.8	1.8	1.8		x	x	x
Calcium	12	12	5570-55800	20967	55800	-	-	-	-	-	-	2/2	6300-20200	13250	20200				
Chromium	11	12	6.4-1130	372	1130	-	1	-	341	-	0.25	2/2	6.3-10.1	8	10			x	
Cobalt	4	4	29.6-78.0	81	78	-	-	-	-	-	-	1/1	11	11	11			x	
Copper	12	12	27.7-796	350	796	-	0.037	-	9,447	-	7.04	2/2	2.80-8.8	6	9		x	x	x
Iron	12	12	15700-143000	47654	143000	-	-	-	-	-	-	2/2	8900-22400	15650	22400			x	
Lead	12	12	28.6-800	168	800	-	0.1	-	1,678	-	1.25	2/2	15.2-24.7	20	25		x	x	x
Magnesium	12	12	859-12700	4452	12700	-	-	-	-	-	-	2/2	1460-2080	1770	2080			x	
Manganese	12	12	211-3960	1400	3960	-	0.14	-	9,998	-	7.45	2/2	498-569	534	569		x	x	x
Mercury	8	12	0.431J-8.0	3	8	-	0.0003	-	7,535	-	5.61	0/2	-	-	-		x	x	x
Nickel	12	12	30.1-1720	727	1720	-	0.02	-	36,356	-	27.08	2/2	11.5-44.1	28	44		x	x	x
Selenium	1	4	0.56-0.61	1	1	-	0.005	-	29	-	0.02	0/1	-	-	-			x	
Silver	3	4	2.90-10.6	8	11	-	0.005	-	1,140	-	0.85	0/1	-	-	-			x	
Sodium	12	12	58.0-407J	238	407J	-	-	-	-	-	-	2/2	122J-237	180	237				
Vanadium	1	4	15.5	16	16	-	0.007	-	554	-	0.41	0/1	-	-	-			x	
Zinc	4	4	90.5-491	275	491	-	0.3	-	917	-	0.68	1/1	214	214	214				
						TOTAL (INORGANICS):		27	134253	100	100								

Notes:

(1) Based on sampling locations: SED-1, SED-2, (Duplicate of SED-2), SED-3, SED-4, SED-6, SED-7, SED-A, SED-C, SED-D, SED-E, SED-F, SED-G, SED-H, SED-I, (Duplicate of SED-H), SED-J.
(2) Based on background sampling locations: SED-5 and SED-B.
(3) Number of positive detection per total number of samples.
(4) Mean concentrations were calculated using positive detections only.

Revised June 6, 1994

TABLE 8.3

IDENTIFICATION OF CHEMICALS OF POTENTIAL CONCERN IN SURFACE WATER
VACAIR ALLOY DIVISION
FREWSBURG, NEW YORK

	Reported Concentrations (1)							Toxicity Scores		Percent of Total		Ambient Water Quality Criteria			Background Concentrations (2)							
	Number of Detections A	Total Sample # B	Range of Detects	Mean (4) C	Maximum	Cancer Slope Factor D	Reference Dose E	Carc. Score (A/B)*C*D	Non-Carc. Score (A/B)*(C/E)	Carc. Score	Non-Carc. Score	Federal Acute	Federal Chronic	NY State Class C	Detection Frequency (3)	Range of Detects	Mean (4)	Maximum	Carc. Score	Non-Carc. Score	2*Bkd and >AWQC	Chemicals of Concern
			(ug/L)	(ug/L)	(ug/L)	1/(mg/kg-day)	mg/kg-day					(ug/L)		(ug/L)		(ug/L)	(ug/L)	(ug/L)				
VOCs																						
1,1-Dichloroethene	1	13	10	10	10	0.6	0.009	0.46	85	0.04	0.01	11600	-	-	0/2	-	-	-				
1,2-Dichloroethene(total)	9	13	9J-130000	16,092	130,000	-	0.009	-	1237821	-	99.97	11,600(5)	-	-	0/2	-	-	-		x	x	x
1,2 Dichloroethane	1	13	1J	1	1	0.091	-	0.01	-	0.00	-	18000	20000	-	0/2	-	-					
Styrene	1	13	2J	2	2	0.03	0.2	0.00	1	0.00	0.00	-	-	-	0/2	-	-	-			x	
Trichloroethene	8	13	4J-62000	8,073	62,000	0.011	-	55	-	4.98	-	45000	21900	11	1/2	3J	3J	3J	x			
Vinyl Chloride	6	13	10J-5300J	1188	5,300	1.9	-	1042	-	94.97	-	-	-	-	0/2	-	-	-	x		x	x
BNAs																						
Benzoic Acid	1	5	4J	4	4	-	4	-	0.20	-	0.00	-	-	-	0/1	-	-	-			x	
bis(2-ethylhexyl)phthalate	2	5	2J-3J	3	3	0.014	0.02	0.01	50	0.00	0.00	940	3	-	0/1	-	-	-				
4-Chloro-3-methylphenol	1	5	3J	3	3			-	-	-	-	-	-	-	0/1	-	-	-			x	
Di-n-Butylphthalate	2	5	3J-4J	4	4	-	0.1	-	14	-	0.00	-	-	-	0/1	-	-	-			x	
2-Methylphenol	1	5	1J	1	1	-	0.05	-	4	-	0.00	-	-	-	0/1	-	-	-			x	
4-Methylphenol	1	5	4J	4	4	-	0.005	-	160	-	0.01	-	-	-	0/1	-	-	-			x	
Total Petroleum Hydrocarbons			(mg/L)	(mg/L)	(mg/L)											(mg/L)	(mg/L)	(mg/L)				
Total Petroleum Hydrocarbons	2	5	1.8-5.9	4	6							-	-	-	0/1	-	-	-				
						TOTAL (ORGANICS):		1096.9189	1238134.952	100	100											
Inorganics			(ug/L)	(ug/L)	(ug/L)											(ug/L)	(ug/L)	(ug/L)				
Total Hardness	8	8	116000-881000	314,594	881,000							-	-	-	1/1	241000	241000	241000				
Total Metals																						
Aluminum	2	5	1290-1800J	1,545	1,800	-	-	-	-	-	-	-	-	-	0/1	-	-	-			x	
Antimony	0	5	-	-	-	-	0.0004	-	-	-	-	8.8	3	-	0/1	-	-	-				
Arsenic	3	5	2.8-11.4	6	11	1.75	0.0003	6	11800	100.00	1.18	360	190	190	0/1	-	-	-	x	x		
Barium	5	5	116-1390	550	1,390	-	0.07	-	7859	-	0.79	-	-	-	0/1	-	-	-			x	
Cadmium	4	13	3.10J-166	50	166	-	0.001	-	15300	-	1.53	3.9	1.1	2.79*(8)	0/2	-	-	-		x	x	x
Calcium	13	13	34000-403000	121,338	403,000	-	-	-	-	-	-	-	-	-	2/2	76,600-80100	78,350	80100			x	
Chromium	9	13	3.5-2900	361	2,900	-	1	-	250	-	0.03	0.984(6)/16(7)	117(6)/11(7)	529*(9)	0/2	-	-	-			x	
Cobalt	4	5	4.40-95.5	43	96	-	-	-	-	-	-	-	-	-	0/1	-	-	-			x	
Copper	12	13	3.5-1850	200	1,850	-	0.037	-	4992	-	0.50	9	6.5	31.5*(10)	1/2	2.8	2.8	2.8		x	x	x
Cyanide	1	5	23.6	24	24	-	0.02	-	236	-	0.02	22	5.2	5.2	0/1	-	-	-				
Iron	11	13	426-172000	42,487	172,000	-	-	-	-	-	-	-	1000	300	1/2	60.2	60.2	60.2			x	
Lead	6	13	6.7-1398	292	1,390	-	0.1	-	1349	-	0.14	-	-	13.7*(11)	0/2	-	-	-		x	x	x
Magnesium	13	13	6310-136000	29,711	136,000	-	-	-	-	-	-	-	-	-	2/2	9540-10100	9,820	10100			x	
Manganese	13	13	4.1-29900	4,608	29,900	-	0.005	-	921685	-	92.39	82	3.2	-	2/2	6.10-24.4	15	24.4		x	x	x
Mercury	4	13	0.14-10.7	4	11	-	0.0003	-	3674	-	0.37	2.4	0.012	-	0/2	-	-	-			x	
Nickel	11	13	8-5670	692	5,670	-	0.02	-	29279	-	2.93	1400	-	228(14)	0/2	-	-	-		x	x	x
Potassium	5	5	1800-13100	6,730	13,100	-	-	-	-	-	-	-	-	-	1/1	1490	1,490	1,490			x	

TABLE 8.3

IDENTIFICATION OF CHEMICALS OF POTENTIAL CONCERN IN SURFACE WATER
VACAIR ALLOY DIVISION
FREWSBURG, NEW YORK

	Reported Concentrations (1)							*Toxicity Scores*		*Percent of Total*		*Ambient Water Quality Criteria*			*Background Concentration- (2)*							
	Number of Detections A	*Total Sample #* B	*Range of Detects* (ug/L)	*Mean (4)* C (ug/L)	*Maximum* (ug/L)	*Cancer Slope Factor* D 1/(mg/kg-day)	*Reference Dose* E mg/kg-day	*Carc. Score* (A/B)*C*D	*Non-Carc. Score* (A/B)*(C/E)	*Carc. Score*	*Non-Carc. Score*	*Federal Acute* (ug/L)	*Federal Chronic*	*NY State Class C* (ug/L)	*Detection Frequency* (3)	*Range of Detects* (ug/L)	*Mean (4)* (ug/L)	*Maximum* (ug/L)	*Carc. Score*	*Non-Carc. Score*	*2*Bkd and >AWQC*	*Chemicals of Concern*
Metals con't																						
Silver	2	5	9.10-13.0J	11	13	-	0.005	-	884	-	0.09	0.92	-	0.1*(12)	0/1	-	-	-			x	
Sodium	13	13	5730-42500	16,361	42,500	-	-	-	-	-	-	-	-	-	2/2	10200-11500	10,850	11500				
Zinc	5	5	10.8-258	88	258	--	0.3	-	293	-	0.03	120	110	219*(13)	1/1	12.3	12	12			x	
						TOTAL (INORGANICS):		6	997601	100	100											

Notes:

- * Site specific criteria calculated by using reported hardness concentration of 314.59 ppm.
  Aquatic Standards apply to acid-soluble form
- (1) Based on sampling locations: SW-1, SW-2, SW-3, SW-4, SW-5, SW-6, SW-7 (Duplicate of SW-6), SW-9, SW-A, SW-C, SW-D, SW-E, SW-F, SW-G, SW-H, SW-I (Duplicate of SW-H), SW-J.
- (2) Based on background sampling locations: SW-B and SW-8.
- (3) Number of positive detections per total number of samples. Duplicates are counted as one sample.
- (4) Mean concentrations were calculated using positive detections only.
- (5)Dichloroethylene, cis 1,2-
- (6) Chromium III
- (7) Chromium VI
- (8) Criteria: exp(0.7852[ln(ppm hardness)] - 3.4909)
- (9) Criteria: exp(0.819[ln(ppm hardness)] + 1.561)
- (10) Criteria: exp(0.8545[ln(ppm hardness)] - 1.465)
- (11) Criteria: exp(1.266[ln(ppm hardness)] - 4.661)
- (12) Criteria: exp(1.72[ln(ppm hardness)] - 6.52)
- (13) Criteria: exp(0.85[ln(ppm hardness)] + 0.5)
- (14) Criteria: exp(0.76[ln(ppm hardness)]+1.06)

TABLE 9.2

COMPARISON OF COCs IN SURFACE WATER OF LOW LYING AREA NORTH OF THE PLANT FENCE TO NYS AND FEDERAL AWQCs
VACAIR ALLOY DIVISION
FREWSBURG, NEW YORK

	Reported Concentration (µg/L)											*Background Concentration (1) (µg/L)*	**NYS AWQC Class C (µg/L)*	***Federal AWQC (µg/L)*	
	Upstream from Culvert		*Seeps*		*Discharge from Culvert*	*Discharge from Concrete Pads*		*Swale through Wetland*			*Wetland*				
Chemicals of Concern	*SW-C*	*SW-8*	*SW1*	*SW2*	*SW-6/SW-7 (2)*	*SW-D*	*SW-E*	*SW-H*	*SW-G*	*SW-F*	*SW-J*	*SW-B*		*Acute*	*Chronic*
VOCs															
1,1-Dichloroethene	ND	ND	ND	10	ND	ND	ND	ND	ND	ND	ND	ND	–	11,600	–
1,2-Dichloroethene (total)	ND	ND	130,000	13,000	250	ND	9	615	540	170	11	ND	–	11,600	–
Trichloroethene	ND	3	62,000	4	870	ND	ND	655	600	160	ND	ND	11	45,000	21,900
Vinyl Chloride	ND	ND	5,300	1,500	12	ND	140	130	48	ND	ND	ND	–	–	–
Metals															
Cadmium	ND	ND	3.10	ND	ND	24.7	166	ND	ND	ND	5.1	ND	3.3 (3)	3.9	1.1
Manganese	17.9	6.10	9,780	29,900	240	11,000	6,770	267	140	356	713	24.4	–	82	3.2
Nickel	ND	ND	540	262	8	892	5,670	71.9	17.9	13.4	49.8	ND	265 (4)	1,400	--

Notes:

-- Not available
ND - Not Detected
(1) Taken from background sample location: SW-B.
(2) Concentrations listed are the average concentrations for sampling locations SW-6 and SW-7.
(3) exp (0.7852 [Ln (ppm hardness)] - 3.490), hardness is 382.875 ppm
(4) exp (0.76 [Ln (ppm hardness)] + 1.06), hardness is 382.875 ppm

Reference:

* "Ambient Water Quality Criteria" and "Guidance Values" NYSDBC Division of Water TOGS 1.1.1., dated October 22, 1993.
** IRIS-EPA Integrated Risk Information System Database, January 1993.

TABLE 8.4

IDENTIFICATION OF CHEMICALS OF POTENTIAL CONCERN IN GROUNDWATER
VACAIR ALLOY DIVISION
FREWSBURG, NEW YORK

	Reported Concentrations (1)							*Toxicity Scores*		*Percent of Total*		*MCLs*		*Background Concentrations (2)*							
	Number of Detections A	*Total Sample number. B*	*Range of Detects (ug/L)*	*Mean (4) C (ug/L)*	*Maximum (ug/L)*	*Cancer Slope Factor D 1/(mg/kg-day)*	*Reference Dose E mg/kg-day*	*Carc. Score (A/B)*C*D*	*Non-Carc. Score (A/B)*(C/E)*	*Carc. Score*	*Non-Carc. Score*	*Federal (5) (ug/L)*	*NY State (6) (ug/L)*	*Detection Frequency (3)*	*Range of Detects (ug/L)*	*Mean (4) (ug/L)*	*Maximum (ug/L)*	*Carc. Score*	*Non-Carc. Score*	*2*BKD and > MCL*	*Chemicals of Concern*
VOCs																					
Acetone	0	16	-	-	-	-	0.1	-	-	-	-	-	-	0/2	-	-	-				
Benzene	2	16	0.6-11	6	11	0.029	-	0.021	-	0.00	-	5	5	0/2	-	-	-			x	
Bromodichloromethane	1	16	4J	4	4	0.13	0.02	0.033	13	0.00	0.00	100(p)	-	0/2	-	-	-				
Chloroform	1	16	2J	2	2	0.0061	0.01	0.001	13	0.00	0.00	100	-	0/2	-	-	-				
Chloromethane	1	16	2J	2	2	0.013	-	0.002	-	0.00	-	-	-	0/2	-	-	-			x	
1,1-Dichloroethene	7	16	2J-450	649	450	0.6	0.009	170	31524	6.83	1.86	7	5	0/2	-	-	-	x	x	x	x
1,1-Dichloroethane	1	16	4J	4	4	-	0.1	-	3	-	0.00	-	5	0/2	-	-	-				
1,2-Dichloroethene(total)	9	16	1J-170,000	26523	170,000	-	0.009	-	1657681	-	97.94	-	5	0/2	-	-	-		x	x	x
1,2-Dichloroethane	2	16	7J-19J	13	19	0.091	-	0.148	-	0.01	-	5	5	0/2	-	-	-			x	
Ethylbenzene	3	16	6J-14J	9	14	-	0.1	-	16	-	0.00	700	5	0/2	-	-	-			x	
Tetrachloroethene	5	16	4J-57	16	57	0.051	0.01	0.255	500	0.01	0.03	5	5	0/2	-	-	-			x	
Toluene	3	16	2J-12J	6	12	-	0.2	-	6	-	0.00	1000	5	0/2	-	-	-				
1,1,1-Trichloroethane	2	16	3J	3	3	-	0.035	-	11	-	0.00	200	5	0/2	-	-	-				
Trichloroethene	7	16	41-74,000	30377	74,000	0.011	-	146	-	5.86	-	5	5	0/2	-	-	-	x		x	x
1,1,2-Trichloroethane	4	16	4J-29	16	29	0.057	0.004	0.233	1021	0.01	0.06	5	5	0/2	-	-	-			x	
Vinyl Chloride	7	16	6J-17000	2619	17,000	1.9	-	2177	-	87.28	-	2	2	0/2	-	-	-	x		x	x
Xylene (Total)	3	16	4J-24	15	24	-	2	-	1	-	0.00	10,000	5	0/2	-	-	-				
BNAs																					
2-Methylnaphthalene	1	5	3J	3	3	-	-	-	-	-	-	-	-	0/1	-	-	-			x	
4-Chloro-3-methylphenol	1	4	3J	3	3			-	-	-	-	-	-	0/1	-	-	-			x	
4-Methylphenol	1	4	34	34	34	-	0.005	-	1700	-	0.10	-	-	0/1	-	-	-			x	
Benzoic Acid	1	4	15J	15	15	-	4	-	1	-	0.00	-	-	0/1	-	-	-			x	
bis(2-ethylhexyl)phthalate	2	5	2J	2	2	0.014	0.02	0.011	40	0.00	0.00	4	-	0/1	-	-	-				
Di-n-Butylphthalate	2	5	2J-4J	3	4	-	0.1	-	12	-	0.00	800(pg)	-	0/1	-	-	-				
Napthalene	1	5	1J	1	1	-	0.004	-	50	-	0.00	-	-	0/1	-	-	-			x	
Phenol	1	4	16	16	16	-	0.6	-	7	-	0.00	-	-	0/1	-	-	-			x	
Total Petroleum Hydrocarbons																					
Total Petroleum	1	5	0.89J	0.9	0.9							-	-	0/1	-	-	-				
Hydrocarbons																					
Total Suspended Solids	9	9	7-2230	796	2230							-	-	0/1	-	-	-				
Total Dissolved Solids	9	9	232-848	409	848							500,000(SMCL)	-	1/1	219	219	219				
Total Organic Carbon	9	9	1.9-43.0	14	43							-	-	1/1	4.9	4.9	4.9				
						TOTAL (ORGANICS):		2494	1692597	100	100										

TABLE 8.4

IDENTIFICATION OF CHEMICALS OF POTENTIAL CONCERN IN GROUNDWATER
VACAIR ALLOY DIVISION
FREWSBURG, NEW YORK

	Reported Concentrations (1)							Toxicity Scores		Percent of Total		MCLs		Background Concentrations (2)							
Dissolved Metals	Number of Detections A	Total Sample number B	Range of Detects (ug/L)	Mean (4) C (ug/L)	Maximum (ug/L)	Cancer Slope Factor D 1/(mg/kg-day)	Refrence Dose E mg/kg-day	Carc. Score (A/B)*C*D	Non-Carc. Score (A/B)*(C/E)	Carc. Score	Non-Carc. Score	Federal (5) (ug/L)	NY State (6) (ug/L)	Detection Frequency (3)	Range of Detects (ug/L)	Mean (4) (ug/L)	Maximum (ug/L)	Carc. Score	Non-Carc. Score	2*BKD and > MCL	Chemicals of Concern
Aluminum	1	10	424	424	424	-	-	-	-	-	-	50-200(SMCL)	-	0/1	-	-	-			x	
Antimony	0	10	-	-	-	-	0.0004	-	-	-	-	6	-	0/1	-	-	-				
Barium	10	10	167-641	368	641	-	0.07	-	5252	-	0.83	2000	1000	1/1	109	109	109				
Beryllium	4	10	0.83-2.6	2	2.6	4.3	0.005	3	126	100.00	0.02	4	-	0/1	-	-	-	x			
Cadmium	1	10	7.5	8	7.5	-	0.005	-	150	-	0.02	5	10	0/1	-	-	-				
Calcium	10	10	49600-141000	87460	141,000	-	-	-	-	-	-	-	-	1/1	56900	56900	56900			x	
Copper	10	10	4.0-9.1	6	9	-	0.037	-	159	-	0.03	1300(AL)	1000(SMCL)	1/1	4.7	4.7	4.7				
Iron	3	10	45.1-48500	16202	48,500	-	-	-	-	-	-	300(SMCL)	300(SMCL)	0/1	-	-	-			x	
Magnesium	10	10	8820-31400	15782	31,400	-	-	-	-	-	-	-	-	1/1	9400	9400	9400			x	
Manganese	10	10	5.0-20000	3120	20,000	-	0.005	-	623936	-	99.00	50(SMCL)	300(SMCL)	1/1	25.9	25.9	25.9		x	x	x
Nickel	3	10	9.8-60.4	34	60	-	0.02	-	505	-	0.08	100	-	1/1	9.4	9.4	9.4				
Potassium	10	10	1240-5310	3209	5310	-	-	-	-	-	-	-	-	1/1	818	818	818			x	
Sodium	10	10	5890-22300	9703	22,300	-	-	-	-	-	-	-	-	1/1	3250	3250	3250			x	
Zinc	10	10	5.4-48.9	31	49	-	0.3	-	104	-	0.02	5000	5000	1/1	32.8	32.8	32.8				
							TOTAL (INORGANICS) :	3	630232	100	100										

Notes:

MCLS = Maximum Contaminant Levels
SMCL = Secondary Maximum Contaminant Levels bases on aesthetics.
p = Proposed MCL
ps = Proposed SMCL
pg = Proposed MCL Goal
AL = Action Level
(1) Based on the following samples: MW-2, MW-3, MW-4, MW-5, MW-6 (Duplicate of MW-7), MW-7, MW2, MW3, MW4, MW5, MW6, MW7, MW8, MW9 (Duplicate of MW14), MW14, MW10, MW11, Well T-3.
(2) Based on background samples: MW1
(3) Number of positive detections per total number of samples. Duplicates are counted as one sample.
(4) Mean concentrations were calculated using positive detections only.
(5) Reference: U.S. EPA National Primary and Secondary Drinking Water Regulations 40 CFR 141-3 (56 FR No. 20). July 17, 1992
(6) Reference: NYS Sanitary Code Chapter 1, Part 5, Subpart 5-1. February 1992.

TABLE 8.5

SUMMARY OF CHEMICALS OF POTENTIAL CONCERN
VACAIR ALLOY DIVISION
FREWSBURG, NEW YORK

General Soils

VOCs

Carbon Disulphide
1,2-Dichloroethene (Total)
Trichloroethene

PCBs (Total)

Metals

Beryllium
Cadmium
Copper
Nickel
Thallium
Vanadium

Groundwater

VOCs

1,1-Dichloroethene
1,2-Dichloroethene (Total)
Trichloroethene
Vinyl Chloride

Metals

Manganese

Sediment

VOCs

1,1-Dichloroethene
1,2-Dichloroethene (Total)
Vinyl Chloride

BNAs

Benz(a)anthracene
Benzo(b)fluoranthene
Benzo(a)pyrene
Bis(2-ethylhexyl)phthalate

PCBs (Total)

Metals

Beryllium
Cadmium
Copper
Lead
Manganese
Mercury
Nickel

Surface Water

VOCs

1,2-Dichloroethene (Total)
Trichloroethene
Vinyl Chloride

Metals

Cadmium
Copper
Lead
Manganese
Nickel

TABLE 8.6

EXPOSURE POINT CONCENTRATIONS FOR SURFACE SOILS
VACAIR ALLOY DIVISION
FREWSBURG, NEW YORK

	On Plant Site (1)			*Outside the Plant Fence (2)*		
	Mean (3) (mg/kg)	*Maximum (mg/kg)*	*95% UCL (4) (mg/kg)*	*Mean (3) (mg/kg)*	*Maximum (mg/kg)*	*95% UCL (4) (mg/kg)*
VOCs						
Carbon Disulphide	72	500	191	0.008	0.019	0.03
1,2-Dichloroethene (total)	312	620	850	ND	--	ND
Trichloroethene	1,734	17,000	5,450	0.0097	0.02	0.03
PCBs (Total)	2	12	5	0.07	0.04	0.36
Metals						
Beryllium	2	5	4	0.6	0.9	3
Cadmium	2	4	5	2	1.8	4
Copper	137	339	311	45	53	149
Nickel	747	1,530	1,620	330	440	1,730
Thallium	5	8	7	ND	--	ND
Vanadium	196	961	727	ND	--	ND

Note:

ND - Not Detected
(1) Based on sampling locations: SSOIL-M, SSOIL-N, SSOIL-O, BHM-1 (Dup of BHBC-1), TP1-A, TP2-A (Dup of TP2A-A), TP4-A, TP4-B, TP4-C, TP4-D, TP4-E, TP4-F, TP8-A, TP8-B, TP11A-A.
(2) Based on sampling lcoations: TP3-A, TP3-B, TP10B-B.
(3) Arithmetic average of all values including non-detects. For non-detects, one-half of the detection limit is used.
(4) 95 Percent Upper Confidence Limit (95% UCL) on the arithmetic average.

TABLE 8.7

EXPOSURE POINT CONCENTRATIONS FOR GENERAL SOILS
VACAIR ALLOY DIVISION
FREWSBURG, NEW YORK

	On Plant Site (1)		
	Mean (3) (mg/kg)	*Maximum (mg/kg)*	*95% UCL (4) (mg/kg)*
VOCs			
Carbon Disulphide	21	500	53
1,2-Dichloroethene (total)	92	620	238
Trichloroethene	513	17,000	1,500
PCBs (Total)	1	12	3
Metals			
Beryllium	0.8	5	1.8
Cadmium	1	4	2
Copper	69	339	143
Nickel	353	1,530	752
Thallium	2.6	8	4.5
Vanadium	92	961	286

Notes:

ND - Not Detected

1. (1) Based on sampling locations: SSOIL-M, SSOIL-N, SSOIL-O, MW5D-1, MW8-1, MW8-2, MW9-2, MW11-1, MW11-2 BH5A-1, BH5A-2, BH5A-3, BH5B-1, BH5B-2, BH5B-3, BH6-1, BH6-2, BH6-3, BH13-1, BH-B, BH-E, BH-F, BH-L, BH-M, BH-N, BH-O, BH-P, BH-Q, BH-R, BH-S, BH-T, BH-U, BH-V, BH-W, TP1-A, TP2-A (TP-2AA), TP4-A, TP4-B, TP4-C, TP4-D, TP4-E, TP4-F, TP8-A, TP8-B, TP-11A.

(2) Based on sampling locations: BH-C, BH-D, BH-I, TP3-A, TP3-B, TP10B-B.

(3) Arithmetic average of all values including non-detects. For non-detects, one-half of the detection limit is used.

(4) 95 Percent Upper Confidence Limit (95% UCL) on the arithmetic average.

TABLE 8.8

EXPOSURE POINT CONCENTRATIONS FOR SEDIMENTS
VACAIR ALLOY DIVISION
FREWSBURG, NEW YORK

	On Plant Site (1)			*Outside the Plant Fence (2)*		
	Mean (3) (mg/kg)	*Maximum (mg/kg)*	*95% UCL (4) (mg/kg)*	*Mean (3) (mg/kg)*	*Maximum (mg/kg)*	*95% UCL (4) (mg/kg)*
VOCs						
1,1-Dichloroethene	ND	--	ND	0.21	1	0.5
1,2-Dichloroethene (total)	0.13	0.33	0.56	32	230	81
Vinyl Chloride	ND	--	ND	4	31	10
BNAs						
Benzo(a)anthracene	ND	--	NA	1.4	0.55	3
Benzo(a)pyrene	ND	--	NA	1.3	0.40	3
Benzo(b)fluoranthene	ND	--	NA	1.4	0.52	3
Bis(2-ethylhexyl)phthalate	ND	--	NA	10	34	36
PCBs (Total)	ND	--	NA	0.4	0.16	0.97
Metals						
Arsenic	11.1	11.1	11.1	14	18.7	2
Barium	197	197	197	299	682	714
Beryllium	ND	--	NA	0.74	1	1
Cadmium	3.8	5	8	18	49	30
Copper	276	796	1400	340	774	500
Lead	34	48	64	194	800	368
Manganese	325	498	703	1,632	3,605	2,370
Mercury	ND	--	ND	3	8	5
Nickel	55	90	133	232	1,720	532

Notes:

ND - Not Detected
NA - Not Analyzed
(1) Based on sampling locations: Sed-A, Sed-C and Sed-5.
(2) Based on sampling locations: Sed-E, Sed-F, Sed-G, Sed-H, Sed-1, Sed-2, Sed-3, Sed-4, Sed-6, Sed-7.
(3) Arithmetic average of all values including non-detects. For non-detects, one-half of the detection limit is used.
(4) 95 Percent Upper Confidence Limit (95% UCL) on the arithmetic average.

TABLE 8.9

EXPOSURE POINT CONCENTRATIONS FOR SURFACE WATER
VACAIR ALLOY DIVISION
FREWSBURG, NEW YORK

	On Plant Site (1)			*Outside the Plant Fence (2)*		
	Mean (3) (mg/L)	*Maximum (mg/L)*	*95% UCL (4) (mg/L)*	*Mean (3) (mg/L)*	*Maximum (mg/L)*	*95% UCL (4) (mg/L)*
VOCs						
1,2-Dichloroethene (total)	ND	–	ND	15	130	44
Trichloroethene	0.004	0.004	0.006	8	62	26
Vinyl Chloride	ND	–	ND	0.72	5	1.9
Metals						
Cadmium	ND	–	ND	0.02	0.17	0.06
Manganese	0.143	0.544	0.568	6	29.9	13
Nickel	0.021	0.073	0.076	0.75	5.67	2

Note:

ND - Not Detected
(1) Based on sampling locations: SW-A, SW-C, SW-8 and SW-9.
(2) Based on sampling locations: SW-E, SW-F, SW-G, SW-H, SW-1, SW-2, SW-5, SW-6, SW-7
(3) Arithmetic average of all values including non-detects. For non-detects, one-half of the detection limit is used.
(4) 95 Percent Upper Confidence Limit (95% UCL) on the arithmetic average.

TABLE 8.10

EXPOSURE POINT CONCENTRATIONS FOR GROUNDWATER OFF-SITE
VACAIR ALLOY DIVISION
FREWSBURG, NEW YORK

	Mean (1) (2) (mg/L)	*Maximum (mg/L)*	*95% UCL (3) (mg/L)*
VOCs			
1,1-Dichloroethene (4)	ND	ND	NV
1,2-Dichloroethene (total)	0.0214	0.041	0.054
Trichloroethene	1.73	3.5	4.9
Vinyl Chloride (4)	ND	ND	NV
Metals			
Manganese	0.012	0.012	NV

Notes:

NV No value
ND Not detected
(1) Arithmetic average of all values including non-detects. For non-detects, one-half of the detection limit is used.
(2) Based on samples: MW-7 (sampled on 9/24/91 and 12/10/92) and MW-12 (sampled on 6/14/93) and MW-13 (duplicate sample of MW-12, collected on 6/14/93).
(3) 95 Percent Upper Confidence Limit (95% UCL) on the arithmetic average.
(4) This VOC was not detected in any of the groundwater samples collected from MW-12 and MW-7 and therefore will not be included in the risk calculations.

TABLE 8.11

POTENTIAL GROUNDWATER DISCHARGE TO CONEWANGO CREEK
MODELLED INSTREAM CONCENTRATIONS
VACAIR ALLOY DIVISION
FREWSBURG, NEW YORK

VOCs	*Mean (1)* *(mg/L)*
1,1-Dichloroethene	1.00E-07
1,2-Dichloroethene (total)	2.24E-05
Trichloroethene	3.38E-05
Vinyl Chloride	1.70E-06

Notes:

(1) Modelled instream concentrations in Conewango Creek based on mean annual stream flow and the mean COC concentrations in groundwater using data from all the most important monitoring wells on the Plant Site (MW-2, MW-3, MW-4, MW-9 and MW-11).

TABLE 8.12

SUMMARY OF EXPOSURE SCENARIOS, ASSUMPTIONS, ESTIMATED CANCER RISKS AND HAZARDS SURFACE SOILS VACAIR ALLOY DIVISION FREWSBURG, NEW YORK

Exposure Scenario:	*On Plant Site*		*Outside the Plant Fence*	
	Mean	*RME*	*Mean*	*RME*
1. **Trespasser**				
Exposed Population(s)	older children and adults		older children and adults	
Route(s)	ingestion and dermal		ingestion and dermal	
Ingestion Rate (mg/day)	100	100	100	100
Skin Surface Area (cm^2)	2000	5300	2000	5300
Conversion Factor (kg/mg)	1.00E-06	1.00E-06	1.00E-06	1.00E-06
Exposure Frequency (days/yr)	2	4	10	40
Exposure Duration (yrs)				
• Carcinogen Assessment	9	25	9	25
• Non-Carcinogen Assessment	1	1	1	1
Body Weight (kg)	70	70	70	70
Averaging Time (days)				
• Carcinogen Assessment	25550	25550	25550	25550
• Non-Carcinogen Assessment	365	365	365	365
Adherence Factor (mg/kg)	0.2	1.0	0.2	1.0
Matrix Factor (%/100)	0.15	0.15	0.15	0.15
Absorption Factor - Oral	chemical-specific		chemical-specific	
Absorption Factor - Dermal	chemical-specific		chemical-specific	
Percent time Factor (%/100)	0.05	0.10	0.25	0.50
Estimated Cancer Risks	1.67E-09	9.36E-08	1.99E-09	6.77E-08
Hazard Indices	4.30E-05	4.66E-04	9.82E-05	1.15E-03
2. **Worker**				
Exposed Population(s)	adults		--	--
Route(s)	ingestion and dermal		--	--
Ingestion Rate (mg/day)	50	50	--	--
Skin Surface Area (cm^2)	2000	3140	--	--
Conversion Factor (kg/mg)	1.00E-06	1.00E-06	--	--
Exposure Frequency (days/yr)	200	200		
Exposure Duration (yrs)			--	--
• Carcinogen Assessment	9	25	--	--
• Non-Carcinogen Assessment	1	1	--	--
Body Weight (kg)	70	70	--	--
Averaging Time (days)				
• Carcinogen Assessment	25550	25550	--	--
• Non-Carcinogen Assessment	365	365	--	--
Adherence Factor (mg/kg)	0.2	1.0	--	--
Matrix Factor (%/100)	0.15	0.15	--	--
Absorption Factor - Oral	chemical-specific		--	--
Absorption Factor - Dermal	chemical-specific		--	--
Percent time Factor (%/100)	0.5	0.75	--	--
Estimated Cancer Risks	8.89E-07	1.91E-05	--	--
Hazard Indices	2.21E-02	9.18E-02	--	--

Notes:

-- Did not evaluate

TABLE 8.13

SUMMARY OF EXPOSURE SCENARIOS, ASSUMPTIONS, ESTIMATED CANCER RISKS AND HAZARDS
GENERAL SOILS
VACAIR ALLOY DIVISION
FREWSBURG, NEW YORK

Exposure Scenario:	*On Plant Site* *Mean*	 *RME*
1. Construction Worker		
Exposed Population(s)	adults	
Route(s)	ingestion and dermal	
Ingestion Rate (mg/day)	50	100
Skin Surface Area (cm ^{2})	2000	3140
Conversion Factor (kg/mg)	1.00E-06	1.00E-06
Exposure Frequency (days/yr)	30	120
Exposure Duration (yrs)		
• Carcinogen Assessment	1	1
• Non-Carcinogen Assessment	1	1
Body Weight (kg)	70	70
Averaging Time (days)		
• Carcinogen Assessment	25550	25550
• Non-Carcinogen Assessment	365	365
Adherence Factor (mg/kg)	0.2	1.0
Matrix Factor (%/100)	0.15	0.15
Absorption Factor - Oral	chemical-specific	
Absorption Factor - Dermal	chemical-specific	
Percent time Factor (%/100)	0.5	0.75
Estimated Cancer Risks	5.39E-09	2.56E-07
Hazard Indices	1.41E-03	4.28E-02

TABLE 8.14

SUMMARY OF EXPOSURE SCENARIOS, ASSUMPTIONS, ESTIMATED CANCER RISKS AND HAZARDS SEDIMENTS VACAIR ALLOY DIVISION FREWSBURG, NEW YORK

Exposure Scenario:	*Outside the Plant Fence* *Mean*	 *RME*
1. Trespasser		
Exposed Population(s)	older children and adults	
Route(s)	ingestion and dermal	
Ingestion Rate (mg/day)	50	50
Skin Surface Area (cm^2)	2000	5300
Conversion Factor (kg/mg)	1.00E-06	1.00E-06
Exposure Frequency (days/yr)	10	40
Exposure Duration (yrs)		
• Carcinogen Assessment	9	25
• Non-Carcinogen Assessment	1	1
Body Weight (kg)	70	70
Averaging Time (days)		
• Carcinogen Assessment	25550	25550
• Non-Carcinogen Assessment	365	365
Adherence Factor (mg/kg)	0.2	1.0
Matrix Factor (%/100)	0.15	0.15
Absorption Factor - Oral	chemical-specific	
Absorption Factor - Dermal	chemical-specific	
Percent time Factor (%/100)	0.25	0.5
Estimated Cancer Risks	1.26E-07	9.06E-07
Hazard Indices	1.78E-04	3.83E-03

TABLE 8.15

SUMMARY OF EXPOSURE SCENARIOS, ASSUMPTIONS, ESTIMATED CANCER RISKS AND HAZARDS
SURFACE WATER
VACAIR ALLOY DIVISION
FREWSBURG, NEW YORK

	Low-Lying Area North Of the Plant Site	
	Mean	*RME*
1. **Trespasser**		
Exposed Population(s):	older children and adults	
Route(s):	dermal	
Skin Surface Area (cm ^{2})		
• Older child and Adult	3190(1)	3190(1)
Permeability Constant (Water)(cm/hr)	0.0008	0.0008
Conversion Factor (L/hr)	0.001	0.001
Exposure Time (hrs/day)	1	2
Exposure Frequency (days/yr)	10	40
Body Weight (kg)		
• Older Child and Adult	70	70
Exposure Duration (years)		
• Carcinogen Assessment	9	25
• Non-Carcinogen Assessment	1	1
Averaging Time (days)		
• Carcinogen Assessment	25550	25550
• Non-Carcinogen Assessment	365	365
Percent time Factor (%/100)	0.5	0.75
Estimated Cancer Risks	1.87E-07	8.34E-06
Hazard Indices	2.95E-03	4.63E-02

Notes:

(1) Exposed skin area for the lower legs and feet (U.S. EPA Exposure Factors Handbook, March 1990).

TABLE 8.16

SUMMARY OF EXPOSURE SCENARIOS, ASSUMPTIONS, ESTIMATED CANCER RISKS AND HAZARDS GROUNDWATER - WATER TABLE AQUIFER VACAIR ALLOY DIVISION FREWSBURG, NEW YORK

Exposure Scenario:	*On Plant Site*	
	Level 1	*Level 2*
1. Drinking Water (Off-Site)		
Exposed Population(s):	older children and adults	
Route(s):	ingestion	
Ingestion Rate (L/day)		
• Child	1	1
• Older Child and Adult	1.4	2
Exposure Frequency (days/year)	365	365
Exposure Duration (years)		
• Carcinogen Assessment	10	30
• Non-Carcinogen Assessment	1	1
Body Weight (kg)		
• Child	16	16
• Older Child and Adult	70	70
Averaging Time (days)		
• Carcinogen Assessment	25550	25550
• Non-Carcinogen Assessment	365	365
Absorption Factor - Oral (%/100)	1.0	1.0
Percent time Factor (%/100)	1.0	1.0
Estimated Cancer Risks	1.12E-04	5.65E-04
Hazard Indices	0.39	0.63
2. Groundwater Discharge to Conewango Creek		
a. Swimming Exposure		
Exposed Population(s):	children and adults	
Route(s):	ingestion and dermal	
Ingestion Rate (L/hr)		
• Younger Child	0.005	0.005
• Older Child and Adult	0.005	0.005
Skin Surface Area (cm^2)		
• Younger Child	8640 (1)	8640 (1)
• Older child and Adult	19400 (1)	19400 (1)
Permeability Constant (Water) (cm/hr)	0.0008	0.0008
Conversion Factor (L/hr)	0.001	0.001
Exposure Time (hrs/day)	2.6	2.6
Exposure Frequency (days/yr)	7	7
Body Weight (kg)		
• Younger Child	16	16
• Older Child and Adult	70	70
Exposure Duration (years)		
• Carcinogen Assessment	10	30
• Non-Carcinogen Assessment	1	1
Averaging Time (days)		
• Carcinogen Assessment	25550	25550
• Non-Carcinogen Assessment	365	365
Percent time Factor (%/100)	1.0	1.0
Estimated Cancer Risks	1.35E-11	2.88E-11
Hazard Indices	9.28E-08	9.28E-08

TABLE 8.16

SUMMARY OF EXPOSURE SCENARIOS, ASSUMPTIONS,
ESTIMATED CANCER RISKS AND HAZARDS
GROUNDWATER - WATER TABLE AQUIFER
VACAIR ALLOY DIVISION
FREWSBURG, NEW YORK

Exposure Scenario:	*On Plant Site* *Level 1*	*Level 2*
b. Fish Consumption		
Exposed Population(s):	children and adults	
Route(s):	ingestion	
Ingestion Rate (g/meal)		
• Younger Child	3.25 (2)	3.25 (2)
• Older Child and Adult	6.5 (3)	6.5 (3)
Conversion Factor (g/kg)	0.001	0.001
Exposure Frequency (days)	365	365
Exposure Duration (years)		
• Carcinogen Assessment	10	30
• Non-Carcinogen Assessment	1	1
Body Weight (kg)		
• Younger Child	16	16
• Older Child and Adult	70	70
Averaging Time (days)		
• Carcinogen Assessment	25550	25550
• Non-Carcinogen Assessment	365	365
Absorption Factor - Oral (%/100)	1.0	1.0
Percent time Factor (%/100)	0.01 (4)	0.05 (4)
Estimated Cancer Risks	2.07E-12	2.33E-11
Hazard Indices	8.22E-09	4.11E-08

Notes:

(1) Total Body Surface (U.S. EPA Dermal Exposure Assessment: Principles and Applications, January 1992, EPA/600/8-91/011B).
(2) Children consume 50% of the quantity by adults.
(3) Average per capita nonmarine fish consumption rate. This value of 6.5 grams per day is the value estimated by setting Ambient Water Quality Criteria (U.S. EPA 1980, PTI 1987).
(4) Local population obtains 1% or 5% of the total annual quantity fish consumed from the Conewango Creek for Levels 1 and 2, respectively.

TABLE 8.17a

SUMMARY OF TOXICOLOGICAL VALUES FOR CHEMICALS OF CONCERN
VACAIR ALLOY DIVISION
FREWSBURG, NEW YORK

Chemical	*Toxicity Class*	*RfD (1) Oral Chronic (mg/kg-day)*	*RfD (1) Oral Subchronic (mg/kg-day)*	*RfD (1) Inhalation Chronic (mg/kg-day)*	*RfD (1) Inhalation Subchronic (mg/kg-day)*	*CSF (2) Oral Chronic [l(mg/kg-day)]*	*CSF (2) Oral Subchronic [l(mg/kg-day)]*	*CSF (2) Inhalation Chronic [l(mg/kg-day)]*	*CSF (2) Inhalation Subchronic [l(mg/kg-day)]*
Barium		0.07		0.00014					
Benz(a)anthracene	B2					1.06			
Benzo(a)pyrene	B2					7.3			
Benzo(b)fluoranthene	B2					1.02			
Beryllium	B2	0.005	0.005			4.3		8,400	
Bis(2-ethylhexyl)phthalate	B2	0.02				0.014			
Cadmium	B1	0.0005 (water)/0.001 (food)						6.3	
Carbon disulphide		0.1		0.0029					
Copper	D	0.037		0.01					
Dibenzo(a,h)anthracene	B2					8.1			
Dichloroethene, 1,1-	C	0.009				0.6		0.175	
Dichloroethene, 1,2-(Total)		0.009	0.009						
Indeno(1,2,3-cd)pyrene	B2					1.7			
Lead	B2	0.10		0.0001					
Manganese	D	0.005 (water)/0.14 (food)		0.000114					
Mercury		0.0003		0.000086					
Nickel	A	0.02						0.84	
Polychlorinated Biphenyls	B2	0.01				7.7			
Thallium		0.00007							
Trichloroethene	B2	under review		under review		0.011		0.006	
Vanadium		0.007							
Vinyl Chloride	A					1.9		0.3	

Notes:

Reference: USEPA Integrated Risk and Information System Database (IRIS), January 1993.
USEPA Superfund Health Evaluation Manual (SPHEM) EPA/540-1-86/060 October 1986.
- Values from this document are only included where no IRIS value has been confirmed.
Health Effects Assessment Tables (HEAST), OSWER (OS-230), OERR 9200.6-303-(89-4), July 1992.

(1) RfD - Reference Dose
(2) CSF - Cancer Slope Factor
Tox. Class - Toxicological Classification
EPA Weight of Evidence Ranking:
- A Known human carcinogen
- B1 Probable human carcinogen (limited evidence in humans)
- B2 Probable human carcinogen (sufficient evidence in animal studies)
- C Probable human carcinogen (limited evidence in animal studies)
- D Not classified (inadequate evidence of carcinogenicity in animal studies)

TABLE 8.17b

SUMMARY OF PHYSICOCHEMICAL PROPERTIES OF CHEMICALS OF CONCERN
VACAIR ALLOY DIVISION
FREWSBURG, NEW YORK

Chemical	*Melting Point** *(degrees Celcius)*	*Boiling Point** *(degress Celcius)*	*Vapour Pressure**^* *(mm Hg)*	*Water Solubility**^* *(mg/L)*	*Specific Density**	*Henry's Law**^* *(atm-m3/mol)*	*Koc*** *(mL/g)*	*Kow***	*BCF*** *(L/kg)*
Barium	--	--	--	--	--	NA	--	--	--
Benz(a)anthracene	--	--	2.20E-08	5.70E-03	--	1.60E-06	1.38E+06	3.98E+05	--
Benzo(a)pyrene	179	311 (at 10 mm)	5.60E-09	1.20E-03	--	1.55E-06	5.50E+06	1.15E+06	--
Benzo(b)fluoranthene	--	--	7.50E-07	1.40E-02	--	1.19E-05	5.50E+05	1.15E+06	--
Beryllium	--	--	0.00E+00	--	--	NA	--	--	19
Bis(2-ethylhexyl)phthalate	--	--	--	--	--	--	--	--	--
Cadmium	--	--	0.00E+00	--	--	NA	--	--	81
Carbon disulphide	-108.6/-116.6	46.3	3.60E+02	2.94E+03	1.263	1.23E-02	5.40E+01	1.00E+02	0
Copper	--	--	0.00E+00	--	--	NA	--	--	200
Dibenzo(a,h)anthracene	266-267	524	1.00E-10	5.00E-04	--	7.33E-08	3.30E+06	6.31E+06	--
Dichloroethene, 1,1-	-122.5	31.9	2.25E+03	6.00E+02	1.218	3.40E-02	6.50E+01	6.92E+01	5.6
Dichloroethene, 1,2-(cis)	-81	60	2.08E+02	3.50E+03	1.28	7.58E-03	4.90E+01	5.01E+00	1.6
Dichloroethene, 1,2-(trans)	-50	48	3.24E+02	6.30E+03	1.26	6.56E-03	5.90E+01	3.02E+00	1.6
Indeno(1,2,3-cd)pyrene	160-163	536	1.00E-10	5.30E-03	--	6.86E-08	1.60E+06	3.16E+06	--
Lead	--	--	0.00E+00	--	--	NA	--	--	49
Manganese	--	--	--	--	--	NA	--	--	--
Mercury	--	--	2.00E-03	--	--	NA	--	--	5500
Nickel	--	--	0.00E+00	--	--	NA	--	--	47
Polychlorinated Biphenyls	--	--	7.70E-05	3.10E-02	--	1.07E-03	5.30E+05	1.10E+06	100000
Thallium	--	--	0.00E+00	--	--	--	--	--	--
Trichloroethene	-87	86.7	5.79E+01	1.10E+03	1.46	9.10E-03	1.26E+02	2.40E+02	10.6
Vanadium	--	--	--	--	--	--	--	--	--
Vinyl Chloride	-153/-160	-13.9	2.66E+03	2.67E+03	0.9121	8.19E-02	5.70E+01	2.40E+01	1.17

Notes:

Reference: * Handbook of Environmental Data on Organic Chemistry, 2nd Edition, 1983
** USEPA Superfund Public Health Evaluation Manual, October 1986

^ for temperature range of 20-30 degrees Celcius
-- not available
NA - not applicable

TABLE 8.17c

SUMMARY OF HALF-LIVES OF CHEMICALS OF CONCERN
VACAIR ALLOY DIVISION
FREWSBURG, NEW YORK

Chemical	*Air (hours)*		*Surface Water (hours)*		*Ground Water (hours)*		*Soil (hours)*	
	low	*high*	*low*	*high*	*low*	*high*	*low*	*high*
Barium	--	--	--	--	--	--	--	--
Benz(a)anthracene	1	3	1	3	4896	32640	2448	16320
Benzo(a)pyrene	0.37	1.1	0.37	1.1	2736	25440	1368	12720
Benzo(b)fluoranthene	1.43	14.3	8.7	720	17280	29280	8640	14640
Beryllium	--	--	--	--	--	--	--	--
Bis(2-ethylhexyl)phthalate	2.9	29	120	550	240	9336	120	550
Cadmium	--	--	--	--	--	--	--	--
Carbon disulphide	--	--	--	--	--	--	--	--
Copper	--	--	--	--	--	--	--	--
Dibenzo(a,h)anthracene	0.428	4.28	6	782	17328	45120	8664	22560
Dichloroethene, 1,1-	9.9	98.7	672	4320	1344	3168	672	4320
Dichloroethene, 1,2-(Total)	25.2	286	672	4320	1344	69000	672	4320
Indeno(1,2,3-cd)pyrene	0.629	6.29	3000	6000	28800	35040	14400	17520
Lead	--	--	--	--	--	--	--	--
Manganese	--	--	--	--	--	--	--	--
Mercury	--	--	--	--	--	--	--	--
Nickel	--	--	--	--	--	--	--	--
Polychlorinated Biphenyls	--	--	--	--	--	--	--	--
Thallium	--	--	--	--	--	--	--	--
Trichloroethene	27	272	4320	8640	7704	39672	4320	8640
Vanadium	--	--	--	--	--	--	--	--
Vinyl Chloride	9.7	97	672	4320	1344	69000	672	4320

Notes:

Reference: Handbook of Environmental Degradation Rates, 1991

-- not available

TABLE 8.18

SUMMARY OF ESTIMATED PRESENT AND FUTURE CANCER RISKS AND HAZARDS VAC AIR ALLOYS DIVISION FREWSBURG, NEW YORK

Exposure Scenario	*Estimated Excess Cancer Risks*		*Hazard Indices*	
	Level 1 (Average)	*Level 2 (RME)*	*Level 1 (Average)*	*Level 2 (RME)*
ON SITE PLANT SITE - PRESENT/FUTURE				
Surface Soil				
• Trespasser Exposure	1.67E-09	9.36E-08	4.30E-05	4.66E-04
• On-Site Worker Exposure	8.89E-07	1.91E-05	2.21E-02	9.18E-02
General Soil				
• Construction Worker Exposure	5.39E-09	2.56E-07	1.41E-03	4.28E-02
OUTSIDE THE PLANT FENCE - PRESENT/FUTURE				
Surface Soil				
• Trespasser/Hiker Exposure	1.99E-09	6.77E-08	9.82E-05	1.15E-03
Sediments (Lowlying Area)				
• Trespasser/Hiker Exposure	1.26E-07	9.06E-07	1.78E-04	3.83E-03
Surface Water (Lowlying Area)				
• Trespasser/Hiker Exposure	1.87E-07	8.34E-06	2.95E-03	4.63E-02

TABLE 8.18

SUMMARY OF ESTIMATED PRESENT AND FUTURE
CANCER RISKS AND HAZARDS
VAC AIR ALLOYS DIVISION
FREWSBURG, NEW YORK

Exposure Scenario	*Estimated Excess Cancer Risks*		*Hazard Indices*	
	Level 1 (Average)	*Level 2 (RME)*	*Level 1 (Average)*	*Level 2 (RME)*
OUTSIDE THE PLANT FENCE - FUTURE				
Groundwater - Water Table Aquifer				
• Off-Site Residents Drinking Water Exposure	1.12E-04	5.65E-04	0.39	0.63
Groundwater Discharge from the Water Table Aquifer to Conewango Creek				
• Trespasser/Hiker Swimming Exposure	1.35E-11	2.88E-11	9.28E-08	9.28E-08
• Local Residents Consumption of Fish Exposure	2.07E-12	2.33E-11	8.22E-09	4.11E-08

TABLE 9.1

COMPARISON OF COCs IN SURFACE WATER OF CONEWANGO CREEK TO NYS AND FEDERAL AMBIENT WATER QUALITY CRITERIA POTENTIAL IMPACT ON AQUATIC LIFE IN CONEWANGO CREEK
VACAIR ALLOY DIVISION
FREWSBURG, NEW YORK

	Reported Concentration in Conewango Creek (ug/L)					**New York AWQC to Protect Aquatic Life Water Class C*	***Federal AWQC to Protect Aquatic Life*	
	Upstream Background (1)		*Midstream by Plant*	*Downstream of Plant*				
Chemicals of Concern	*SW-4*	*SW-M/SW-N (2)*	*SW-L*	*SW-3*	*SW-K*	*(μg/L)*	*Acute (μg/L)*	*Chronic (μg/L)*
VOCs								
1,1-Dichloroethene	ND	ND	ND	ND	–	--	11,600	--
1,2-Dichloroethene (total)	ND	ND	ND	3.0	7.2	--	11,600	--
Vinyl Chloride	ND	ND	ND	ND	ND	--	--	--
Trichloroethene	4.0	ND	ND	3.0	7.2	11	45,000	21,900
Metals								
Cadmium	ND	ND	ND	ND	ND	(3) 1.2	3.9	1.1
Manganese	164	125.1	152.0	176.0	90.9	--	82	3.2
Nickel	ND	ND	ND	ND	ND	(4) 97	1400	--

Notes:

ND - Not Detected
-- - Not Available
(1) Taken from background sample locations: SW-4, SW-M, SW-N (dup of SW-M).
(2) Concentrations listed are the average concentrations for sampling locations SW-M and SW-N
(3) exp (0.7852 [Ln (ppm hardness)] - 3.490), hardness is 102.433 ppm
(4) exp (0.76 [Ln (ppm hardness)] + 1.06), hardness is 102.433 ppm

Reference:

* "Ambient Water Quality Criteria" and "Guidance Values" NYSDEC Division of Water TOGS 1.1.1., dated November 5, 1991.
** IRIS-EPA Integrated Risk Information System Database, January 1993.

TABLE 9.2

COMPARISON OF COCs IN SURFACE WATER OF LOW LYING AREA NORTH OF THE PLANT FENCE TO NYS AND FEDERAL AWQCs
VACAIR ALLOY DIVISION
FREWSBURG, NEW YORK

	Reported Concentration (µg/L)											*Background Concentration (1) (µg/L)*	**NYS AWQC Class D (µg/L)*	***Federal AWQC (µg/L)*	
	Upstream from Culvert		*Seeps*		*Discharge from Culvert*	*Discharge from Concrete Pads*		*Swale through Wetland*			*Wetland*				
Chemicals of Concern	*SW-C*	*SW-8*	*SW1*	*SW2*	*SW-6/SW-7 (2)*	*SW-D*	*SW-E*	*SW-H*	*SW-G*	*SW-F*	*SW-J*	*SW-B*		*Acute*	*Chronic*
VOCs															
1,1-Dichloroethene	ND	ND	ND	10	ND	ND	ND	ND	ND	ND	ND	ND	–	11,600	–
1,2-Dichloroethene (total)	ND	ND	130,000	13,000	250	ND	9	615	540	170	11	ND	–	11,600	–
Trichloroethene	ND	3	62,000	4	870	ND	ND	655	600	160	ND	ND	11	45,000	21,900
Vinyl Chloride	ND	ND	5,300	1,500	12	ND	140	130	48	ND	ND	ND	–	–	–
Metals															
Cadmium	ND	ND	3.10	ND	ND	24.7	166	ND	ND	ND	5.1	ND	17.8 (3)	3.9	1.1
Manganese	17.9	6.10	9,780	29,900	240	11,000	6,770	267	140	356	713	24.4	–	82	3.2
Nickel	ND	ND	540	262	8	892	5,670	71.9	17.9	13.4	49.8	ND	5,115.3 (4)	1,400	–

Notes:

– Not available
ND - Not Detected
(1) Taken from background sample location: SW-B.
(2) Concentrations listed are the average concentrations for sampling locations SW-6 and SW-7.
(3) exp (1.128 [Ln (ppm hardness)] - 3.828), hardness is 382.875 ppm
(4) exp (0.76 [Ln (ppm hardness)] + 4.02), hardness is 382.875 ppm

Reference:

* "Ambient Water Quality Criteria" and "Guidance Values" NYSDEC Division of Water TOGS 1.1.1., dated November 5, 1991.
** IRIS-EPA Integrated Risk Information System Database, January 1993.

TABLE 9.3

COMPARISON OF COCs IN SEDIMENT OF CONEWANGO CREEK TO NYS SEDIMENT CRITERIA*
POTENTIAL IMPACT ON BENTHIC ORGANISMS
VACAIR ALLOY DIVISION
FREWSBURG, NEW YORK

	Reported concentrations in Conewango Creek (ug/kg)						
	Upstream Background	*Midstream by Plant*	*Downstream of Plant*	*Log Kow*	*Protection of Aquatic Life*		*Protection of Wildlife from Toxic Effects of Bioaccumulation*
Chemicals of Concern	*SED-M/SED-N (2)*	*SED-L*	*SED-K*		*Acute Sediment Criteria (µg/g OC)*	*Chronic Sediment Critera (µg/g OC)*	*Sediment Criteria (µg/g OC)*
VOCs							
1,1-Dichloroethene	ND	ND	ND	1.84	--	–	--
1,2-Dichloroethene (total)	ND	ND	ND	0.70/0.48 (1)	--	--	--
Vinyl Chloride	ND	ND	ND	1.38	--	--	--
BNAs							
Benzo(a)pyrene	–	–	–	6.04	--	--	--
Benzo(b)fluoranthene	–	–	–	6.04	--	--	--
Benz(a)anthracene	–	–	–	5.6	--	--	--
Bis(2-ethylhexyl)phthalate	–	–	–	5.3	--	199.5	--
PCBs (Total)	ND	ND	ND	6.04	2761	19.3	1.4

Notes:

AWQS/GV proposed by Division of Fish and Wildlife.
++ Current NYS AWQS or GV in TOGS 1.1.1.
* Sediment criteria are normalized to organic carbon (OC) content as µg/gOC; to obtain criteria for bulk sediments in µg/kg multiply criteria by fraction OC; i.e. for 1% multiply by 10.
** AWQS/GV/C = Ambient water quality standard or guidance value in TOGS 1.1.1 or other water quality criterion.
ND Not detected.
– Not available
(1) Criteria for cis-1,2-dichloroethene/trans-1,2-dichloroethene.
(2) Concentrations listed are the average concentrations for sampling locations SED-M and SED-N
Reference: NYS Department of Fish & Wildlife. Technical Guidance for Screening Contaminated Sediments. November 1993.

TABLE 9.3

COMPARISON OF COCs IN SEDIMENT OF CONEWANGO CREEK TO NYS SEDIMENT CRITERIA FOR METALS

POTENTIAL IMPACT ON BENTHIC ORGANISMS

VACAIR ALLOY DIVISION
FREWSBURG, NEW YORK

	Reported concentrations in Conewango Creek (mg/kg)			*Sediment Criteria for Metals (mg/kg)*		*Literature Background Reference (2) (mg/kg)*
	Upstream Background (1)	*Midstream by Plant*	*Downstream of Plant*	*Lowest Effect*	*Severe Effect*	
Chemical of Concern	*SED-M/SED-N (3)*	*SED-L*	*SED-K*	*Level (4)(5)*	*Level (6)(5)*	*Range*
Metals						
Arsenic	–	–	–	6	33	10
Barium	–	–	–	--	--	500
Beryllium	–	–	–	--	--	--
Cadmium	3.8	3.20	3.60	0.6	9	--
Copper	40.15	22.30	25.70	16	110	50-700
Lead	24.50	15.20	35.50	31	110	50-700
Manganese	554	426	580	460	1100	2-150
Mercury	ND	ND	ND	0.15	1.3	0.082-0.13
Nickel	25.7	19.8	48.4	16	50	20

Notes:

– Not available
(1) Taken from sediment background locations: SED-M, SED-N (dup of SED-M).
(2) Hansford T. Shacklette and Josephine G. Boerngen. Element Concentrations in Soils and other Surficial Materials of the Conterminous United States. U.S. G.S. professional paper 1270. 1984
(3) Concentrations listed are the average concentations for sampling locations SED-M and SED-N
(4) Values are the "lowest-effect" levels, from Persaud (1989).
(5) NYS Department of Fish & Wildlife. Technical Guidance for Screening Contaminated Sediments. November 1993.
(6) Concentration which would be detrimental to the majority of species, potentially eliminating most (Persaud 1989).

TABLE 9.4

COMPARISON OF SEDIMENT CONCENTRATIONS IN LOW LYING AREA NORTH OF THE PLANT FENCE TO NYS SEDIMENT CRITERIA
VACAIR ALLOY DIVISION
FREWSBURG, NEW YORK

	Reported Concentration (µg/kg)												*NYS Sediment Criteria (µg/g OC)**		
	Upstream from Culvert		*Seeps*		*Discharge from Culvert*	*Discharge from Concrete Pads*		*Swale through Wetland*			*Wetland*		*Protection of Aquatic Life*		
Chemicals of Concern	*SED-C*	*SED-5*	*SED 1*	*SED 2/SED 3 (1)*	*SED-4*	*SED-D*	*SED-E*	*SED-H*	*SED-G*	*SED-F*	*SED-J*	*Background Sediment Concentration*** (µg/kg)*	*Acute*	*Chronic*	*Protection of Wildlife from Toxic Effects of Bioaccumulation*
VOCs															
1,1-Dichloroethene	ND	ND	830	ND	1,300	ND	ND	46	ND	ND	ND	ND	–	–	–
1,2-Dichloroethene (total)	ND	330	110,000	98	230,000	ND	ND	6,650	470	270	ND	ND	–	–	–
Vinyl Chloride	ND	ND	31,000	28	7,600	ND	ND	1,100	310	300	ND	ND	–	–	–
BNAs															
Benzo(a)pyrene	–	ND	ND	ND	400	–	–	–	–	–	–	–	–	–	–
Benzo(b)fluoranthene	–	ND	ND	ND	520	–	–	–	–	–	–	–	–	–	–
Benz(a)anthracene	–	ND	ND	ND	550	–	–	–	–	–	–	–	–	–	–
Bis(2-ethylhexyl)phthalate	–	ND	2000	1200	34000	–	–	–	–	–	–	–	–	199.5	–
PCBs (Total)	–	ND	ND	123	ND	–	–	ND	ND	ND	ND	–	2761	19.3	1.4

Notes:

(1) Concentrations listed are the average concentrations for sampling locations SED 2 and SED 3.
ND - Not Detected
– Not available
* Sediment criteria are normalized to organic carbon (OC) content as µg/gOC; to obtain criteria for bulk sediments in µg/kg multiply criteria by fraction OC; i.e. for 1% multiply by 10.
** Taken from sediment background location SED-B

Reference:

NYS Department of Fish & Wildlife. Technical Guidance for Screening Contaminated Sediments. November 1993.

TABLE 9.4

COMPARISON OF SEDIMENT CONCENTRATIONS IN LOW LYING AREA NORTH OF THE PLANT FENCE TO NYS SEDIMENT CRITERIA
VACAIR ALLOY DIVISION
FREWSBURG, NEW YORK

	Reported Concentration (mg/kg)												*NYS Sediment Criteria for Metals (µg/g OC)*		*Literature Background Reference (2)*
	Upstream from Culvert		*Seeps*		*Discharge from Culvert*	*Discharge from Concrete Pads*		*Swale through Wetland*			*Wetland*	*Background (1) Concentration*			
Chemicals of Concern	*SED-C*	*SED-S*	*SED 1*	*SED 2/SED 3 (5)*	*SED-4*	*SED-D*	*SED-E*	*SED-H*	*SED-G*	*SED-F*	*SED-J*	*(mg/kg)*	*Lowest Effect Level (3)(6)*	*Severe Effect Level (4)(6)*	*(mg/kg)*
Metals															
Arsenic	–	11.1	15.9	17.7	9	–	–	–	–	–	–	–	6	33	10
Barium	–	197	682	248	138	–	–	–	–	–	–	–	–	–	500
Beryllium	–	–	0.71	0.64	1.1	–	–	–	–	–	–	–	–	–	–
Cadmium	4.7	–	4.6	2.8	4.9	49.3	43	27	13	15	19.9	1.8	0.6	9	–
Copper	27.7	2.80	90	91.7	323	774	492	488	282	310	489	8.8	16	110	50-700
Lead	28.6	24.7	38	73.9	129	800	433	184	80.0	64	106	15.2	31	110	50-700
Manganese	267	498	1,230	2,620	992	2,060	1,100	3,605	1,020	2,540	297	569	460.0	1100	2-150
Mercury	ND	–	ND	0.44	1.8	6.4	8	3.5	3	1	2.8	ND	0.15	1.3	0.082-0.13
Nickel	30.1	44.1	481	362	1,320	1,660	1,720	1,365	349	958	259	11.5	16	50	20

Notes:

ND - Not Detected
– Not available
(1) Taken from background sample locations: SED-B
(2) Handsford T. Shacklette and Josephine G. Boerngen, Element Concentrations in Soils and other Surficial Materials of the Conterminous United States. U.S. G.S. professional paper 1270. 1984.
(3) Values are the "no-effect" and "lowest-effect" levels from Persaud (1989).
(4) Concentration which would be detrimental to the majority of species, potentially eliminating most (Persaud 1989).
(5) Concentrations listed are the average concentrations for sampling locations SED 2 and SED 3.
(6) NYS Department of Fish & Wildlife. Technical Guidance for Screening Contaminated Sediments. November 1993.

Reference:

* "Ambient Water Quality Criteria" and "Guidance Values" NYSDEC Division of Water TOGS 1.1.1., dated November 5, 1991.
** IRIS-EPA Integrated Risk Information System Database, January 1993.