DATA SUMMARY REPORT
PREVIOUS REMEDIAL INVESTIGATIONS
DELPHI AUTOMOTIVE SYSTEMS
1000 LEXINGTON AVENUE
ROCHESTER, NEW YORK
Site No. 8-28-064

Volume I - Text

by

Haley & Aldrich of New York
Rochester, New York

for

Delphi Automotive Systems
Rochester, New York

File No. 70014-051
September 1998

HALEY & ALDRICH

DELPHI
Automotive Systems

September 25, 1998

Ms. Mary Jane Peachey, P. E.
Regional Hazardous Waste Remediation Engineer
NYS Department of Environmental Conservation
6274 East Avon-Lima Road
Avon, New York 14414

Re: Summary of Data from Previous Remedial Investigations,
Delphi Energy and Engine Management Systems, Rochester, NY

Dear Ms. Peachey:

Enclosed are three copies of the "Data Summary Report, Previous Remedial Investigations, Delphi Energy and Engine Management Systems, 1000 Lexington Avenue, Rochester, NY." The report was prepared in response to your request for a condensed summary of remedial investigations and actions completed at the site since 1981.

At our first meeting on August 6, 1998 we tentatively picked October 7,1998 to reconvene and continue discussions on a consent order. Delphi is still available to meet with you as scheduled. However, we anticipate you may want to postpone the meeting due to the extension granted for the submission of the enclosed report. I will call you on October 5 to discuss a new date.

Please call me at 647-4766 if you have any questions during your review of the Data Summary Report.

Sincerely,

Richard C. Eisenman

Richard C. Eisenman
Senior Environmental Engineer

c: Maura C. Desmond, Esq., DEC Division of Environmental Enforcement
Mr. Richard Elliott, P. E., Monroe County Department of Health
Dawn E. Hettrick, NYS Department of Health

Energy & Engine Management Systems
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HALEY & ALDRICH

25 September 1998
File No. 70014-051

Delphi Automotive Systems
1000 Lexington Avenue
P.O. Box 92700
Rochester, New York 14692-8800

Attention: Mr. Richard C. Eisenman
Senior Environmental Engineer

Subject: Summary of Data from Previous Remedial Investigations
Delphi Automotive Systems Facility
1000 Lexington Avenue
Rochester, New York

Gentlemen:

This report summarizes results from previous remedial investigations performed at the Delphi Automotive Systems (Delphi) facility located on Lexington Avenue in Rochester, New York. The location of the Delphi facility is shown on Figure 1, Project Locus. This report was prepared to respond to a request made of Delphi by the New York State Department of Environmental Conservation for a report summarizing data from remedial investigations previously documented in separate reports.

Thank you for asking Haley & Aldrich to provide this report. If you have any questions or require additional information, please call us.

Sincerely yours,
HALEY & ALDRICH OF NEW YORK

Thomas D. Wells
Senior Env. Geologist

Jeffrey E. Loney
Vice President

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EXECUTIVE SUMMARY

This report summarizes results from previous remedial investigations performed at the Delphi Automotive Systems (Delphi) facility located at 1000 Lexington Avenue in Rochester, New York. The report was prepared by Haley & Aldrich of New York (Haley & Aldrich) at the request of Delphi.

The report was prepared to address a request by the New York State Department of Environmental Conservation (NYSDEC) for a comprehensive summary of data from previous remedial investigations. The request was made by NYSDEC personnel during a 6 August 1998 meeting of representatives of Delphi, NYSDEC, and the New York State and Monroe County Departments of Health. The meeting was held to discuss NYSDEC's request that Delphi enter into negotiation of an RI/FS Consent Order for the site. The Delphi facility is identified by NYSDEC's Division of Environmental Remediation as Inactive Hazardous Waste Disposal Site No. 8-28-064.

Remedial investigations have been performed voluntarily by Delphi at the site since 1981. The remedial investigations have been performed to determine subsurface environmental conditions and the nature and extent of environmental contamination at the site. Investigations have also been performed in connection with the design and performance-testing of remedial actions which have been implemented at the site.

This report presents a comprehensive summary of remedial investigation data for the site. The majority of the data summarized in this report, with the exception of the data which has been collected during 1998, had previously been submitted to NYSDEC in a series of individual reports documenting the remedial investigation activities performed. The data presented in this report includes:

- logs of soil and bedrock conditions encountered during remedial investigations at the site.
- analysis results for soil and soil-vapor samples collected during remedial investigations at the site.
- groundwater quality data and groundwater elevation data.
- LNAPL-elevation measurements and analysis results for LNAPL samples collected.
- hydrogeologic testing data collected during remedial investigations at the site.

As noted during the meeting on August 6th, it is Delphi's belief that, with two exceptions, a sufficiently-extensive remedial investigation has already been performed to characterize the contamination identified at the site. The areas in which additional investigation of the extent of contamination is warranted are: 1) areas beneath the currently-active manufacturing buildings where cutting-oil-based LNAPL is present; and 2) the area of the east parking lot where contamination of intermediate-bedrock groundwater is present.

- The areas beneath manufacturing buildings in which subsurface LNAPL has been identified are in active use for manufacturing operations, and therefore are not

readily-accessible to invasive investigations. Consequently, future investigations in these areas will be performed at times and in a manner which will not interrupt ongoing production. These areas are located upgradient of a migration-control system which intercepts and treats contaminated groundwater and LNAPL moving downgradient from the manufacturing buildings; the system prevents contamination from these areas from moving off-site.

- In the east parking lot, where additional investigation is necessary to determine the extent of contamination present, additional investigation is planned for the fall of 1998.

The remedial investigations performed at the site indicate that metals concentrations and volatile organic solvent contamination which are present in site groundwater are not related to landfilling which was conducted at the site prior to and during Delphi's ownership. The remedial investigations have identified the on-site source areas, located within the manufacturing building, for the solvent contamination of site groundwater. Contamination of soil and groundwater by heavy metals has been identified in a limited area adjacent to the location of former plating operations within the interior of the manufacturing building.

The remedial work performed at the site has gone beyond investigation of potentially contaminated areas. Ongoing remedial activities include the operation of the migration-control system described above and operation of a separate LNAPL-recovery system in the Tank Farm Area. The Tank-Farm-Area system addresses an LNAPL plume present near the downgradient boundary at the northeast corner of the manufacturing building.

Within the interior of the site a passive LNAPL-recovery system is operating to recover a plume of Stoddard-solvent LNAPL in the Building 22 area, and a soil-vapor extraction system is operating at a former-degreaser location where organic solvent contamination of soil and groundwater is present. Construction and operation of a new, active LNAPL-recovery system in Building 22 is currently pending, and additional testing of remedial methods and systems potentially applicable to subsurface contamination present in other areas of the site is planned. Remedial approaches proven by testing in currently-accessible source areas will be applied to other identified but currently-inaccessible source areas as facility operations permit.

Ongoing investigative activities at the site include regular periodic monitoring of groundwater quality, groundwater elevations, and LNAPL distribution, and related regular monitoring of the progress and effectiveness of the remedial systems currently in operation at the site.

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I. INTRODUCTION

This document presents a summary of the results of previous remedial investigations of hydrogeologic and subsurface environmental conditions at the Delphi Automotive Systems (Delphi) facility located at 1000 Lexington Avenue in Rochester, New York. The site location is shown on Figure 1.

The Delphi site covers approximately 65 acres. It is bounded on the west by Mt. Read Boulevard, on the north by Driving Park Avenue, on the northeast by an adjacent manufacturing property (American Packaging Corporation), and on the east by a railroad embankment. The portion of the site which contains the manufacturing facility is bounded on the south by Lexington Avenue; however, the Delphi site also includes an employee parking lot located on the south side of Lexington Avenue.

1.1 Background Information

This data summary report was prepared to address a request by the Division of Environmental Remediation of the New York State Department of Environmental Conservation (NYSDEC) for a comprehensive summary of data from previous remedial investigations at the Delphi site. The Delphi site has been identified by NYSDEC as Inactive Hazardous Waste Disposal Site No. 8-28-064. The request for a comprehensive data summary was made by NYSDEC personnel during a 6 August 1998 meeting with representatives of Delphi. The meeting was held to discuss NYSDEC's request that Delphi enter into negotiation of an RI/FS Consent Order for the site.

The Delphi site has been owned by General Motors Corporation (GM) since 1937. Various GM divisions, of which Delphi is the most recent, constructed and since 1938 have operated the Delphi facility to manufacture automotive fuel systems and other automotive components. Remedial investigations at the site have been performed voluntarily by Delphi and its predecessor GM divisions since 1981. (Delphi and its predecessor GM divisions are collectively referred to as Delphi in the remainder of this report.)

The report of the site in NYSDEC's Registry of Inactive Hazardous Waste Disposal Sites in New York State describes on-site landfilling conducted by Delphi until approximately 1968 in an area of the site which had been a wide-waters basin on the original Erie Canal. The NYSDEC report describes Delphi's detection of groundwater contamination by chlorinated solvents and heavy metals at wells which had been installed at the site in 1981, describes additional investigation and remediation activities performed at the site by Delphi, and indicates that disposal of hazardous waste containing organic solvents, lead, and heavy metals has been confirmed at the site.

The remedial investigations performed at the site, the results of which are summarized in this report, indicate that the metals concentrations and chlorinated solvent contamination detected in site groundwater are not related to the landfilling which was conducted at the site. Contamination of soil and groundwater by heavy metals has been identified in a limited area adjacent to the location of former plating operations within the interior of the manufacturing building. The remedial investigations have also identified former degreaser locations within the manufacturing building as the on-site source areas for chlorinated solvent contamination of

groundwater at the site. Various remedial actions have been implemented to address contamination of site groundwater, and other remedial actions are planned.

Potential pathways for exposure to contamination at the site include contact with contaminated soil or groundwater by site workers during construction activities and inhalation of contaminant vapors from soil or groundwater exposed during construction activities. Delphi employs specific health and safety procedures in its operations to protect site workers from these potential exposure pathways.

Potential pathways for exposure to chlorinated solvent contamination at off-site locations include potential ingestion of contaminated groundwater downgradient of the site and potential contact with or inhalation of vapors from contaminated groundwater infiltrating basements or sumps if they exist at downgradient locations. Groundwater use in the area of the site and elsewhere in the city of Rochester is prohibited by a City of Rochester ordinance, and use of groundwater for drinking water or other purposes in the area downgradient of the site is not known to be occurring. Furthermore, the data collected at the site indicate that the groundwater migration-control system which has been in operation at the site since 1992 is preventing the off-site migration of contaminants at the downgradient northern site boundary. Additional investigation is necessary, however, to determine whether off-site migration of contaminants from the Delphi site may be occurring in the area of the east parking lot along potential pathways which may be related to bedrock sewer tunnels.

Individual reports documenting each of the remedial investigation and remedial action activities performed at the site have been routinely submitted to NYSDEC by Delphi in the past. The majority of the data summarized in this report, with the exception of the data which has been collected during 1998, has previously been submitted to NYSDEC in those reports. A standard, detailed report will be submitted to NYSDEC to document the 1998 investigations which produced the new data summarized herein.

1.2 Report Organization

Section II of the report presents a brief summary of the previous remedial investigations and remedial actions performed at the site. The various types and groups of data presented in this data summary and the various sampling and analytical methods used to collect the data are described in Section III of the report. Conclusions based on the results of the previous remedial investigations and remedial-action monitoring are summarized in Section IV. A bibliography of the previous reports which documented the investigative, remedial, and monitoring activities performed at the site through 1997 is presented in the References section of the report.

Analytical and hydrogeologic data from previous remedial investigations at the site are summarized in tables which are presented following the report text. Well and sampling locations are shown on figures presented following the tables. Figures presenting interpretations of soil conditions and hydrogeologic conditions at the site are also presented.

Soil and bedrock test-boring and test-pit logs and monitoring-well construction reports are presented in Appendix A. Groundwater-level monitoring data are presented in hydrographs and in tabulated form in Appendices B and C, respectively. Chemical time-series plots of groundwater quality at individual site monitoring wells are presented in Appendix D. Copies of petroleum fingerprint scans for samples of oil and other light non-aqueous phase liquid

(LNAPL) contaminants collected from site wells and analyzed by laboratory fingerprinting methods are presented in Appendix E.

II. SUMMARY OF PREVIOUS REMEDIAL INVESTIGATIONS

This section of the report summarizes the history of previous investigations of hydrogeologic and subsurface environmental conditions at the Delphi facility. The remedial investigations have been performed to determine subsurface environmental conditions and the nature and extent of environmental contamination at the site. Investigations have also been performed in connection with the design, testing, and operation of remedial actions which have been implemented at the site.

Initial Investigations

In its 1980 Resource Conservation and Recovery Act (RCRA) Part A permit application, Delphi identified a former waste disposal area in the northern part of the site. The former landfill area is located in the portion of the site which had been a widewaters basin on the former Erie Canal. The canal had been rerouted in approximately 1915, and the section of the canal which crossed the Delphi site was abandoned. Landfilling was reportedly conducted in the abandoned canal basin by others before Delphi began manufacturing operations at the site in 1938. Delphi reportedly continued periodic landfilling of construction and demolition debris and other wastes in this area until 1968. A site plan presented in Figure 2 shows the approximate locations of the former canal dikes and the approximate location of the area in which construction spoil and other wastes were placed by Delphi.

In response to its interpretation of the requirements of RCRA, Delphi commissioned a hydrogeologic investigation of the site which was performed in 1981. The investigation included installation of 13 monitoring wells at locations downgradient of the manufacturing buildings and at the upgradient and downgradient site boundaries. Regular periodic sampling of the 13 original wells for chemical analysis of groundwater was begun in 1981.

In 1984 Delphi responded to a NYSDEC Community-Right-to-Know survey and provided groundwater monitoring data for the site to NYSDEC. The data indicated the presence of groundwater contamination by solvent compounds at wells located hydraulically upgradient and downgradient of the former landfill area. In 1985 the site was listed in New York's registry of inactive waste sites (site code 8-28-504-P, classification 2A). In 1986 NYSDEC requested and received from Delphi additional information on groundwater quality, and in January 1987 NYSDEC reclassified the site (class 2) and assigned the current site code (site no. 8-28-064).

Groundwater quality data from sampling performed from 1981 through 1988 indicated the presence of contamination by chlorinated solvent compounds at both the upgradient and downgradient site boundaries.

Hydrogeologic Investigations

In 1988, Delphi commissioned a review of the previous data and additional investigation of hydrogeologic conditions at the site. The 1988 review and subsequent investigations were performed to address delineation of the groundwater contaminants and identification of source areas. The initial work performed included soil vapor sampling, upgrades of existing wells, additional monitoring well installations with associated soil sampling, and groundwater sampling.

Related investigative activities have continued to the present. Periodic groundwater sampling has been performed each year from 1989 to the present, and all groundwater analysis data for the site have been reported to NYSDEC by Delphi. At present there are 112 monitoring wells, piezometers, and recovery wells located on site, and data from these wells and two abandoned wells are included in this report. The wells are located throughout the site and monitor the overburden, shallow-bedrock, intermediate-bedrock, and deep-bedrock horizons.

Groundwater conditions at three shallow-bedrock wells and one intermediate-bedrock well formerly located on City of Rochester property north and downgradient of the Delphi site were also monitored by Delphi until the wells were abandoned by the City in 1993. Data from these four wells are included in this report. Groundwater quality and elevation data from one sampling event conducted in 1995 at three overburden wells installed on the American Packaging Corporation property located adjacent to the northeast (and downgradient) Delphi site boundary were provided to Delphi by American Packaging Corporation, and these data are also included in this report.

The investigative and remedial activities which have addressed specific areas or conditions of the site are described below.

Tank Farm Area

In May 1988 Delphi had discovered and reported to NYSDEC the presence of a plume of oil-like product (LNAPL) floating on the overburden water table at the northeast corner of the Plant 1 manufacturing building. The floating product was discovered in a tank-removal excavation adjacent to the south end of an above-ground product-storage tank farm. NYSDEC opened spill file #8801732 for this occurrence.

Subsequent investigations in the Tank Farm Area beginning in 1989 identified the product as a mixture of Stoddard solvent, test fuels, and metal-working cutting oil. The downgradient limits of the plume were identified as being located on site, and product-recovery operations were initiated in 1989 which continue at present. The NYSDEC spill file remains open to monitor the progress of the remedial work.

The Tank Farm Area product-recovery system includes three large-diameter recovery wells connected by a 400-foot-long gravel-backfilled trench. Initial product-recovery operations, which consisted of passive skimming of product from the water table at the three recovery wells, collected approximately 38,500 gallons of product between 1989 and November 1994. In November 1994 the passive skimmers were replaced with a total-fluids pumping system. Ongoing groundwater and product-level monitoring in the Tank Farm Area indicates that the pumping system is continuing to capture the product plume.

Degreaser Investigation

In January 1990, Delphi discovered and reported to NYSDEC the presence of soil contamination by degreasing solvents adjacent to the location of one of its decommissioned solvent degreasers. The contamination was discovered during construction activities related to the repair of an adjacent blocked sanitary sewer line.

Delphi initiated an investigation of the 35 locations where degreasers had been located in the manufacturing buildings at the site. A soil vapor survey of former degreaser locations was

completed in 1990. Six areas warranting further study were identified. In January 1991, a soil and groundwater investigation was conducted in Degreaser Investigation Study Area 5, where the largest concentration of degreasers had been located. A soil and groundwater investigation work plan for former degreaser areas was prepared in April 1991 and submitted by Delphi to NYSDEC, and soil and groundwater investigations were subsequently completed in Degreaser Investigation Study Areas 4 and 6. Soil and groundwater investigations in Degreaser Investigation Study Areas 1, 2, and 3 will be performed in the future as facility operations permit.

Implementation of remedial soil-vapor extraction in Degreaser Investigation Study Area 5 is described on page 7.

Design and Implementation of Groundwater Migration Control

In 1991 Delphi commissioned the design and installation of a migration-control, recovery, and treatment system to capture contaminated groundwater moving north from source areas in the plant and prevent offsite migration of contaminated groundwater along its downgradient site boundary. The design process included interaction with NYSDEC personnel concerning the characterization of the vertical extent of contamination at the site. Prior to the installation of the migration-control system, Delphi held a public meeting with its neighbors in which representatives of NYSDEC and the New York State Department of Health participated.

Installation of the groundwater migration-control system involved construction of a 50-foot-deep, 1200-foot-long migration-control trench near the downgradient site boundary in the spring of 1992. The trench was installed using engineered blasting techniques to enhance bedrock aquifer permeability. Two recovery wells were installed in the trench, and groundwater pumping and treatment was initiated in May 1992.

Since 1992 over 100 million gallons of groundwater have been pumped from migration-control wells and treated with UV-oxidation in the on-site treatment system. VOC concentrations detected in recent samples from wells located along the downgradient site boundary are one order of magnitude or more below the concentrations which were detected in samples from those wells collected before the installation and start-up of the migration-control system. Ongoing monitoring indicates that the continued operation of the groundwater migration-control system has been and remains an effective means of controlling the groundwater flow regime hydraulically downgradient of the Lexington Avenue facility. The data collected at the site indicate that the system has functioned as intended and acts as a barrier to further off-site migration of contaminants. The data also indicate that the system is capturing groundwater with relatively low levels of contamination from off-site areas along Driving Park Avenue.

Building 22 Area

In 1992 a floating product layer composed of Stoddard solvent developed at the water table in two existing wells near the former location of carburetor testing operations in Building 22. Stoddard solvent had been used as a carburetor-flow test material in Building 22, and subgrade piping had been used to handle the solvent.

Delphi commissioned an investigation of the source and extent of the product in 1993. A soil-vapor survey was performed to determine the extent of contamination, a recovery well

and piezometers were installed, and a passive LNAPL-recovery operation using a product-skimming system was implemented.

PCBs were subsequently detected in LNAPL samples from the Building 22 plume at concentrations which varied significantly between locations and over time. PCBs had not been a component of the Stoddard solvent used in carburetor testing, and no source for the PCBs was known. A soil investigation was performed in 1995 to attempt to identify possible source(s) of the PCBs in the subsurface. No apparent source areas were identified by the soil sampling.

The product-skimming system continues in operation in Building 22 at present, and approximately 700 gallons of product have been recovered to date. A new LNAPL-recovery system has been designed to replace the skimmer. The new system, which is intended to enhance the rate of product recovery, will work using vacuum-enhanced total-fluids pumping. The vacuum-enhanced system components have been purchased by Delphi for installation in the near future.

East Parking Lot Area LNAPL

In 1993 during routine groundwater monitoring activities, a floating product layer composed of mineral oil contaminated with PCBs was encountered in intermediate-bedrock well R-2. R-2 is located near the upgradient site boundary at the southeast corner of the facility. LNAPL had not previously been present in the well, and LNAPL has not been detected before or since in the adjacent shallow-bedrock well SR-2. Delphi began additional on-site investigations of the source and extent of the product occurrence in this part of the site in 1993, and investigation and monitoring activities are currently ongoing. A work plan describing additional investigations to be performed in this area will be submitted to NYSDEC.

Former Plating Area

In 1995, plating operations were relocated from an area in Plant 2 to a different part of the facility, and plating equipment was removed from the area. Soil and groundwater sampling was performed in the former plating area in conjunction with the removal of the floor slab and containment structures for the former plating equipment.

Metals contamination was detected in soil in a limited area beneath one former plating line. Levels detected were below health-based industrial-use criteria. Groundwater monitoring wells located adjacent to and downgradient of the former plating area were sampled. Metals were detected at concentrations above NYSDEC GA standards (which are standards for groundwater used as a source of drinking water) in half of the overburden groundwater samples, but were below the NYSDEC GA standards in the remaining overburden samples and in the shallow-bedrock groundwater sample collected. Groundwater in the former plating area is within the capture zone of the groundwater migration-control system. Results of the sampling in the former plating area were reported to NYSDEC in December 1995.

Degreaser Investigation Study Area 5 - Implementation of Soil-vapor Extraction

Soil-vapor extraction (SVE) for remedial purposes was initiated by Delphi in Degreaser Investigation Study Area 5 in June 1996. The Study Area 5 SVE system uses 16 overburden

monitoring wells installed during the subsurface investigations performed in Study Area 5 in 1990 and 1991. Monitoring data indicate that approximately 3,500 pounds of solvent mass were removed during the initial 18 months of operation of the SVE system. Results of initial SVE operations were reported to NYSDEC by Delphi in April 1998.

Summary

The investigations performed to date have, with two exceptions, characterized the extent of contamination identified at the site. The extent of cutting-oil-based LNAPL in areas beneath currently-active manufacturing operations upgradient of the migration-control trench is not known. Additional investigation is also necessary to determine the extent of contamination of intermediate-bedrock groundwater in the area of the east facility parking lot, and additional investigation of the contamination in this area of the site is planned for the fall of 1998.

Ongoing remedial investigation activities at the site include regular periodic monitoring of groundwater quality, groundwater elevations, and LNAPL distribution at the site. Ongoing remedial actions at the site include the operation and regular monitoring of the progress and effectiveness of the groundwater migration-control system, the LNAPL-recovery systems in the Tank Farm Area and Building 22, and the Study Area 5 SVE system. Additional testing of remedial methods potentially applicable to subsurface contamination at the site is planned. Remedial approaches proven by testing in currently-accessible source areas will be applied to other identified but currently-inaccessible source areas located inside the facility as operations permit.

III. DATA SUMMARY

This section of the report describes the various types and groups of data collected at the site during previous remedial investigations and describes the various sampling and analytical methods used to collect and interpret the data. The data presented in this report includes:

- logs of soil and bedrock conditions encountered during remedial investigations at the site.
- analysis results for soil and soil-vapor samples collected during remedial investigations at the site.
- groundwater quality data and groundwater elevation data collected during remedial investigations at the site.
- LNAPL-elevation measurements and analysis results for LNAPL samples collected during remedial investigations at the site.
- hydrogeologic testing data collected during remedial investigations at the site.

These data are described below.

3.1 Overburden and Bedrock Geology

Soil sampling and bedrock coring have been performed during installation of monitoring wells at each monitoring well or well-cluster location. Soil sampling in test borings, test pits, and other excavations has also been performed in the Tank Farm Area, the former plating area, selected Degreaser Investigation locations, and in the courtyard areas around Building 22. Detailed logs of soil and bedrock conditions encountered in each subsurface exploration are presented in Appendix A. A summary of soil and bedrock conditions at the site is presented below.

The site is underlain by variable overburden materials and bedrock of the Upper Silurian-aged Rochester Shale, which dips gently to the south at 40 to 60 feet per mile. The fill and native soil overburden deposits vary from 5 to approximately 25 feet in thickness. The overburden is thickest in the area at the north end of the plant and thinnest near Lexington Avenue. The presence or absence of specific soil deposits or fill components is variable across the site. Deep bedrock wells on the north side of the site penetrate the Rochester shale and intersect the underlying Irondequoit Limestone.

On the following page the soil and bedrock types observed during on-site investigations are listed in order of increasing depth.

Overburden Deposits

Type	Description
Fill	Silt, sand, gravel, and miscellaneous materials including construction and demolition debris, riprap, asphalt, flyash, cinders, and railroad ties, etc.
Swamp Deposits	Soft, dark brown to black clayey SILT to loose sandy SILT with organic matter and shell fragments. The swamp sediments were encountered at locations within the footprint of the former canal widewaters basin.
Lacustrine sediments	Soft gray to brown silty CLAY to loose to medium dense silty SAND, little gravel, bedded.
Glacio-lacustrine Sediments	Same as lacustrine, except often red-brown, often underlying glacial till.
Glacial Till	Medium dense brown to red-brown silty SAND, with trace to little gravel, trace clay.
Residual Soil	Loose to medium dense brown sandy SILT to silty SAND with organics and root fibers (formed from weathered shale bedrock material).
Completely Weathered Bedrock	Medium dense to very dense gray-brown SILT, little to some fine sand, with the visible pattern of the structural fabric of the parent bedrock material that has been completely altered to soil.

Bedrock

Formation	Description
Rochester Shale	Moderately hard, fresh, fine grained, gray to brown-gray dolomitic MUDSTONE, with horizontal closely-spaced bedding, occasional pits and vugs, occasional fossils, and secondary gypsum mineralization in fractures, vugs, joint openings, and as fossil replacement.
Irondequoit Limestone	Hard, fresh, gray to green-gray, fine to medium grained fossiliferous LIMESTONE, with horizontal moderately-spaced bedding and occasional vugs.

3.2 Hydrogeologic Data

Hydrogeologic conditions at the site have been evaluated from data obtained from 113 existing and abandoned groundwater monitoring wells, recovery wells, and piezometers located on-site and 7 downgradient monitoring wells located off-site. Well and piezometer locations are shown on Figure 2. Cross sections showing vertical profiles of interpreted hydrogeologic conditions at the site are presented in Figures 3a, b, and c. Well construction information, including casing, monitoring-interval, and top-of-bedrock elevation data are summarized in Table I. Monitoring well completion reports for site wells are presented in Appendix A.

Four horizons have been identified as the uppermost hydrogeologic units at the site, and the on-site and off-site wells have been installed to monitor hydrogeologic conditions in these units:

- Overburden Unit - saturated overburden deposits. Wells labeled with the OW prefix monitor this unit, as do piezometers PZ-1, PZ-111 through 114, -116 through 128, and -132, Tank Farm Area recovery wells RW-101, RW-2, and RW-3, and Degreaser Investigation vapor-monitoring wells VM-209 through -232.

- Shallow-Bedrock Unit - the overburden-bedrock interface and underlying upper 7 feet of bedrock. Wells labeled with the SR prefix monitor this unit, as do piezometers PZ-115, -129, -130, -133 through 144, and Building 22 LNAPL recovery well RW-4. Well Z, which was an unscreened shallow to deep bedrock well installed as a water-supply well but never used, was modified for monitoring purposes by plugging the bottom section of the original well interval. The Well Z monitoring interval currently spans the shallow-bedrock and underlying-intermediate bedrock units. It has exhibited static water levels consistent with those in surrounding shallow bedrock wells.

- Intermediate-Bedrock Unit - from 10 feet to approximately 25 feet below the top of bedrock. Wells labeled with the R prefix monitor this unit.

- Deep-Bedrock Unit - from 30 feet to 65 feet below the top of rock. Wells labeled with the DR prefix monitor the deep-bedrock horizon from approximately 50 to approximately 65 feet below the top of rock.

The results of hydrogeologic testing at the site indicate that site conditions are characteristic of a groundwater flow regime controlled by bedrock fractures. The extent of the dissolved VOC contaminant plume associated with operations and activities at the Delphi site has been found to be restricted to the overburden and the upper 25 feet of bedrock. The limitation on the vertical extent of VOC contamination is interpreted to be the result of the decrease in permeability and an absence of transmissive fractures in deep bedrock. Permeability in the shallow- and intermediate-bedrock units is variable and ranges from $2x10^{-2}$ centimeters per second (cm/sec) to less than $1x10^{-6}$ cm/sec. Permeability in the deep-bedrock unit is very low, ranging from $2x10^{-6}$ cm/sec to less than $1x10^{-8}$ cm/sec. The rates of recharge observed after purging and sampling at most of the five deep-bedrock wells have been extremely slow.

Groundwater migration-control system recovery wells GR-1 and -2 span the shallow and intermediate bedrock units, as does the blasted-bedrock zone along the migration-control

trench. The permeability of the shallow- and intermediate-bedrock units has been enhanced continuously along the migration-control trench by the engineered blasting performed during trench construction in 1992.

Under static conditions prior to the start-up of the migration-control system in 1992, groundwater flow at the site generally tended to exhibit a downward vertical component from the overburden to the intermediate-bedrock unit. Lateral flow in the overburden, shallow-bedrock, and intermediate-bedrock units tended to be to the north or northeast. These conditions appear to prevail at present in areas on the south and west sides of the site.

Since the start-up of groundwater migration-control pumping in May 1992, lateral flow in the shallow- and intermediate-bedrock units in the area north of the migration-control trench has reversed, and groundwater in these units along Driving Park Avenue now flows from Driving Park Avenue south towards the trench.

Total-fluids pumping for LNAPL recovery was initiated in the Tank Farm Area in November 1994, and during operation of the total-fluids system, overburden groundwater flow in the Tank Farm Area has been towards the LNAPL-recovery trench.

In the southeast corner of the site, localized components of lateral flow towards the City Lexington Avenue combined wastewater sewer tunnel are apparent in the shallow- and intermediate-bedrock units at monitoring-well locations near the sewer line along both sides of Lexington Avenue. An apparent depression in the overburden/shallow-bedrock water table above the sewer line and an apparent gradient in the intermediate-bedrock unit from R-235 south towards Lexington Avenue have been observed during recent monitoring events, and these observations indicate possible discharge of groundwater from the shallow- and intermediate-bedrock units to the Lexington Avenue tunnel or to a zone of increased permeability which may surround the tunnel lining. The tunnel, a permeable zone around it, or the water-table depression which is evident along and above it may each provide a pathway for migration of groundwater contamination and LNAPL on to and off of the Delphi site.

A depression in the water table along the Lexington Avenue sewer tunnel may have functioned or be functioning as an accumulation zone for LNAPL. Manholes or other vertical features associated with the tunnel may be conduits for LNAPL to have been introduced below the water table in the intermediate-bedrock unit in the area of monitoring wells R-2 and R-235. R-2 and R-235 are located close to the north side of Lexington Avenue in the southeast and southwest corners, respectively, of Delphi's east parking lot, and LNAPL is not present in the overlying shallow-bedrock unit at adjacent shallow-bedrock wells SR-2 and SR-235.

Wipe sampling was performed inside the tunnel in 1995 in the area north of the electrical-utility transformer substation located across Lexington Avenue from Delphi's east parking lot. The substation is owned by Rochester Gas & Electric. The sampling detected PCBs at oil seeps located on the south wall of the tunnel. The detection of PCBs in the tunnel seeps indicates that PCB-contaminated LNAPL may be present in bedrock around the tunnel and that the RG&E substation is a potential source of the PCBs which have been detected in LNAPL from R-2. However, other unidentified off-site locations may be the source of the PCB-contaminated LNAPL encountered in R-2.

(Water and wipe samples from the interior of the Lexington Avenue Sewer tunnel were collected for Delphi on 24 April 1995 by Monroe County Pure Waters personnel. Samples were submitted by Delphi for laboratory analysis of PCBs by method 8080. The water samples were collected approximately 225 ft. upstream (west) and immediately downstream (east) from a manhole located due south of the Delphi plant entrance at the southeast corner of the manufacturing building. PCBs were not detected in the sewer water samples. The wipe sampling results and locations were as follows: PCBs were not detected in wipes collected on the south wall of the tunnel 150 ft. upstream from the manhole, on the north wall 100 ft. downstream from the manhole, or on the south wall 300 ft. downstream and 375 ft. downstream from the manhole; Arochlor-1248 was detected at concentrations of 0.044 and 0.051 milligrams per wipe in wipes collected on the south wall of the tunnel 50 ft. and 75 ft., respectively, downstream of the manhole.)

Indications of possible discharge of overburden, shallow- and intermediate-bedrock groundwater to the Driving Park Avenue leg of the city sewer tunnel which runs beneath Delphi's north parking lot were also evident prior to the start-up of the migration-control system in May 1992. Vertical components of flow upward from the intermediate- to the shallow-bedrock zone were apparent at some monitoring-well locations along Driving Park Avenue, and hydraulic heads in the shallow- and intermediate-bedrock units at other locations along Driving Park Avenue were observed to be nearly equal. The sewer invert is above the routine pumping level of the migration-control trench, and data collected since migration-control operations began in 1992 indicate that discharge of groundwater to the sewer in the north parking lot is not occurring.

A. Groundwater and LNAPL Level Measurements

Groundwater- and LNAPL-level measurements have been performed during each groundwater sampling event and during numerous other events performed to monitor groundwater elevations and LNAPL thicknesses. Groundwater and LNAPL elevation hydrographs for most site wells are presented in Appendix B. The database of historic and recent groundwater- and LNAPL-level measurements at all site wells and the seven off-site wells which have been monitored at times during the previous remedial investigations is presented in Appendix C. The Appendix C database table also presents LNAPL thicknesses recorded at site wells and presents an adjusted potentiometric level at each well which accounts for the measured thickness of any LNAPL layer present.

The hydrographs document the broad hydraulic influence which is exerted by the groundwater migration-control system on groundwater conditions in the shallow- and intermediate-bedrock units. Influence in the North parking lot, where the migration control trench is installed, is evident in the sustained decrease in water levels observed at well clusters located along the Driving Park Avenue property boundary; this influence appears to extend northwest to PZ-141 but not as far northwest as the former location of SR-1. (Contamination had never been detected in groundwater from SR-1, which was abandoned in 1997 after it was destroyed by vehicle impacts.) Southeast of the southeast end of the migration control trench, water levels in Tank-Farm-Area overburden piezometer PZ-112 have exhibited a sustained decrease since the beginning of migration-control pumping, but this influence is not evident at most other Tank-Farm-Area overburden wells or at the property boundary wells located southeast of PZ-112 (overburden piezometers PZ-111 and -113 and shallow-bedrock piezometer PZ-115).

Upgradient of the migration-control trench a sustained decrease in water levels of a few to several feet has been evident at shallow-bedrock wells as far south as PZ-130, SR-102, SR-131, and SR-132. These wells are located along the north side of Plants 1 and 2. No obvious influence has been seen in the shallow-bedrock water levels in wells SR-208, -216, and -230 located inside Plant 2 in Degreaser Investigation Study Areas 4 and 5. In the intermediate-bedrock unit a sustained decrease in water levels of approximately 10 feet has been evident at R-102, R-131, and R-132; no obvious influence has been seen in upgradient wells R-3 and R-101 which are located on the south and west sides of Plant 2.

The hydrographs for Tank-Farm-Area wells and piezometers indicate that the hydraulic influence on the overburden water table of total fluids pumping at recovery well RW-2 extends from PZ-112 on the north to PZ-126 on the south and PZ-127 on the east, extending beyond the apparent downgradient limits of the Tank Farm Area LNAPL plume. The rise in water levels apparent in the Tank-Farm-Area hydrographs during the winter and spring of 1998 reflect the period from February to July 1998 during which the RW-2 pump not operating. (The pump had been shut off when the discharge line had frozen in winter. A malfunction of a wastewater treatment system into which the pump effluent discharged necessitated keeping the pump off for a period after the freeze-up had cleared. Once the wastewater treatment system was again available, the pump was left off for a short additional period to permit monitoring of hydrogeologic conditions in the Tank Farm Area at the beginning of a trial reduction in the pumping rate of the migration-control system).

The adjusted water levels presented in the Appendix C database were used in contouring potentiometric levels for Figures 9 through 12. The adjusted potentiometric level was calculated by applying to the measured LNAPL thickness a factor equal to the specific gravity of the LNAPL present in the well, if known. Because most specific gravity analyses performed on samples of LNAPL collected at the site have indicated specific gravities of approximately 0.9, an adjustment factor of 0.9 was used for wells in which the specific gravity of the LNAPL has not been determined by analysis.

Groundwater elevation plans for the site in April 1992 are shown in Figures 9a, b, and c. The April 1992 data are representative of site conditions prior to the initiation of migration-control pumping at the site on 20 May 1992. Figures 10a, b, and c, 11a, b, and c, and 12a, b, and c present groundwater elevation plans for the site on 29 May 1992, August 1997, and August 1998. These figures represent groundwater elevation conditions at the site during early and recent operation of the migration-control system.

LNAPL distribution plans showing the extent and thickness of LNAPL encountered in site wells during site-wide monitoring events in April 1992 and June 1998 are presented in Figures 14a and 14b.

B. Hydraulic Conductivity and Aquifer-testing Data

Hydraulic-conductivity and aquifer testing activities conducted at the site have included slug testing on a number of groundwater monitoring wells and packer-testing of deep bedrock monitoring wells. Groundwater pumping tests were also conducted at the Tank Farm Area recovery well RW-2, at bedrock Well Z, and on the migration-control wells GR-1 and GR-2.

Permeability (or hydraulic conductivity) testing was conducted on many of the site monitoring wells immediately following well installation activities or during well upgrade programs

designed to improve efficiency and durability of existing wells. Hydraulic conductivity values were determined by conducting rising (or falling, if appropriate) head tests and evaluating the data using Hvorslev's method. The tests consisted of removing (or adding) a slug of water from a well and monitoring the water level response in the well over time. Hydraulic conductivity in deep bedrock wells DR-103, DR-105, and DR-109 was investigated using packer testing procedures during the installation of the wells. A list of hydraulic conductivity values calculated for the wells tested is presented in Table II.

Groundwater pumping tests were also performed. Pumping tests were conducted at various levels of sophistication which were dictated by the data requirements for each test. A brief summary of the results of each of these pump tests follows.

- Tank Farm Area LNAPL recovery well RW-2, which is installed in the center of a gravel-backfilled LNAPL-collection trench excavated in overburden, was utilized as a pumping well during a three-day pumping test performed in October 1992 to determine whether continuous pumping of groundwater and oil at RW-2 would be likely to be an effective means of enhancing oil recovery in the Tank Farm area. The testing included monitoring the extent of drawdown and changes in LNAPL thicknesses in Tank-Farm-Area wells and piezometers during pumping. No aquifer coefficients were calculated; however, the test results indicated that an elongated cone of depression, which was centered on RW-2 and aligned along the recovery trench, developed during the test. Drawdown approaching 2 feet was observed at several monitoring locations near the trench, and the rate of oil recovery during the pump test increased significantly compared to pre-test conditions. Conditions observed since 1996 start-up of the permanent total-fluids pumping system in RW-2 indicate that the operation of the permanent system has an influence broader than that seen during the October 1993 pump test.

- A groundwater pumping test was conducted on Well Z over a span of 11 days in June and July 1991. The well was pumped at 4 gallons-per-minute (gpm), and water levels in groundwater observation wells SR-105, R-105, and DR-105 were monitored during the test. Immediate and significant head response in well SR-105 was observed from the data. Little to no response from pumping was evident at wells R-105 or DR-105. The pumping test data yielded an aquifer transmissivity value of 340 ft^2/day. Test results and observed hydraulic response to pumping were interpreted to be indicative of a fractured shallow bedrock zone. Results of the pump test at Well Z are summarized on Table III.

- Additional pumping test events were conducted at migration-control system pumping wells GR-1 and GR-2, which were installed in the blasted bedrock zone (BBZ) of the migration-control trench, during 1992 and 1993. The first test was conducted in May to June 1992. GR-1 was pumped at a rate of approximately 50 gpm during the first 9 days of the test, was allowed to recover for approximately 6 days, and was then pumped at 44 gpm for an additional 6 days. Aquifer transmissivity values from the pump test, calculated for a number of area monitoring wells, are shown in Table III. The data are indicative of a groundwater flow regime controlled by bedrock fractures.

- Additional pumping activities were conducted at the migration-control trench in June 1993 to evaluate the production and efficiency of GR-2 and the eastern portion of the recovery trench. Recovery well GR-2 was operated at the start of the test, and

approximately five days into the test GR-1 was started. The GR-2 pump failed several hours later and only GR-1 pumped thereafter for an additional two days. The pumping test data analysis yielded aquifer transmissivity values fairly similar to the May 1992 test at GR-1, as shown in Table III. Results for GR-2 indicated that transmissivity there had decreased since 1992, and the well was subsequently redeveloped to restore its initial performance. Periodic redevelopment to remove material accumulated on the wellscreens of GR-1 and GR-2 has been performed since 1993 as necessary.

3.3 Soil-vapor Sampling Data

The following information concerning soil-vapor sampling procedures used at the site is generally applicable to all the phases of soil-vapor sampling conducted at the Delphi site. Variations in procedures used in individual soil-vapor survey areas are noted below where necessary. Soil-vapor sampling and analysis procedures used in each area investigated were described in detail in previous soil-vapor survey reports. Refer to the References section of this report text for a listing of these reports.

The soil-vapor sampling protocol involved withdrawing pore-space air from soils beneath the surface and analyzing the air for volatile organic compounds (VOCs). Soil-vapor sampling was most often performed in areas covered with asphalt pavement or concrete floor slab. Samples were typically obtained from a depth of 40 inches below grade. Depth profiling by collection of samples at several depths down to approximately 10 feet below grade was performed at a few locations.

The air samples were collected for analysis using an air pump after evacuating several hole volumes of soil-gas from the sample hole. Soil-vapor samples were analyzed in the field by direct-injection of the samples into a Photovac Model 10S50, 10S55, or 10S70 portable gas chromatograph (GC). In most cases soil-vapor sample concentrations were calculated based on GC response to headspace air withdrawn from vials containing aqueous standards of known concentrations of VOCs. The exception was the 1993 survey in Building 22, for which a vapor-phase Stoddard solvent calibrant standard was used.

Soil-vapor samples were typically analyzed for one or more of the following compounds: chlorinated solvent-related compounds, such as vinyl chloride, methylene chloride, cis- and trans-1,2-dichloroethylene, 1,1-dichloroethylene, 1,1,1-trichloroethane, trichloroethylene, tetrachloroethylene; BTEX compounds, such as benzene, toluene, xylenes, ethylbenzene; various petroleum products such as Stoddard Solvent (mineral spirits), gasoline, test fuels (Indolene); and other related compounds such as chlorobenzene. Refer to Table IV for specific lists of the soil-vapor analytes targeted in each soil-vapor survey area.

Soil-vapor sampling locations and survey areas are shown on Figure 4. Soil-vapor survey results are summarized in Table IV. Details of soil-vapor survey procedures and results from individual investigation areas are described below.

A. North Parking Lot Area

A soil-vapor survey was performed on 5 and 6 August 1988 in North Parking Lot No. 2 to attempt to determine the extent of groundwater contamination previously detected near the north property boundary. The survey was also designed to

investigate the parking lot subgrade for areas which may have received various fill materials during past landfilling at the site. The past landfilling was thought at the time to be a possible source of the VOCs which had been detected in groundwater at Driving Park Avenue well SR-9.

The soil-vapor survey was conducted in the area shown on Figure 4. Soil-vapor samples were collected from 14 locations, designated RP-01 through RP-14, as shown on Figure 4. Sampling results are presented in Table IV, Part 1. Concentrations of up to 1.55 parts per million (ppm) of chlorinated solvents and petroleum-related compounds were detected across the survey area. The results were interpreted as indicating that VOC source areas were not present in the survey area

B. Areas Around the Die Cast Building

Additional soil-vapor surveying was conducted north of the Building 16 Die-Cast and Plant 2 areas. This survey occurred between 22 May and 1 June 1989. Sampling was attempted at 33 points, but highly-compacted soils in areas of truck traffic prevented advancement of the sampling tube to an appropriate depth in the subsurface at nine of the locations attempted. Sample locations are shown on Figure 4. Soil-vapor sampling points were identified as RP2-01 through RP2-24, with multiple samples at some locations where sampling at more than one depth was possible or duplicate sampling was performed. The samples were analyzed for chlorinated solvent-related compounds. The results from these sampling locations are presented in Table IV, Part 2. Concentrations of up to 0.286 ppm of chlorinated VOCs and other unidentified volatile compounds (unknowns) were detected in soil gas; the results were interpreted as indicating that VOC source areas were not present in the survey area.

C. Tank Farm Area

Soil-vapor investigation activities in the Tank Farm Area were conducted during the period of 15 August to 16 September 1989. The soil-vapor survey consisted of 68 sampling locations in the area of the tank farm just north and east of the northeast corner of Plant 1. The investigation focused on delineating the extent of the floating-oil layer which had been encountered in the 1988 tank-removal excavation in this area. The survey also focused on determining the presence of chemicals of concern in the oil layer.

Soil-vapor samples were analyzed for the compound list previously mentioned. Sample points were identified as AC-1 through AC-68, located as shown on Figure 4. The results of the soil-vapor survey are presented as data in Table IV, Part 3. The results of the survey indicated the presence of petroleum-product vapors in an area approximately 650 feet wide located adjacent to the northeast corner of the plant.

Within this area, distinct smaller areas of soil vapor with higher petroleum concentrations were identified. Two small areas of soil vapor with a premium-gasoline chromatographic profile were identified; one was centered on the location of PZ-120, and the second was located adjacent to and south of the PZ-126 location. One small area of soil vapor with a Stoddard-solvent chromatographic profile was identified centered on the location of PZ-118. A third area extending from the

location of PZ-117 southeast to the RW-3 location was identified as having soil vapor with a chromatographic VOC profile like that of a mixture of high-octane test fuels and Stoddard solvent. Low levels of TCE were detected in soil vapor from sampling locations surrounding the PZ-132 location west of the Tank Farm.

D. Degreaser Investigation

Soil-vapor investigations were conducted at 35 former solvent degreaser locations in Plants 1 and 2, and along a process waste line located adjacent to the Plant 2 survey areas. The Degreaser Investigation soil-vapor sampling was conducted during the period from 20 March through 27 July 1990 to investigate the presence and extent in the subsurface of chlorinated compounds related to past solvent-degreasing operations at the facility. Soil-vapor samples were analyzed for the following compounds: vinyl chloride, methylene chloride, cis- and trans-1,2-dichloroethylene (cis- and trans-1,2-DCE), 1,1-DCE, 1,1,1-trichloroethane, trichloroethylene, tetrachloroethylene, and toluene.

The soil-vapor sampling locations in Plant 1 are shown in Figures 5 and 5a. As shown on the figures, the Degreaser Investigation soil-vapor sample names were based on Delphi's building-column grid system. Soil-vapor sampling results for the Plant 1 investigation are presented in Table IV, Part 4.

Soil-vapor sampling results for the Plant 1 investigation indicated elevated solvent concentrations at a number of the former degreaser locations in Plant 1. Areas in which total VOC concentrations in soil vapor of 100 parts per million or greater were detected (as determined on the basis of reference to the project's aqueous standard) were identified as Study Areas 1, 2, and 3A-3C. The locations of the Study Areas are shown in Figure 5. The 100 ppm soil-vapor VOC concentration was used as a threshold for defining study area limits based on an understanding of Henry's Law which predicts that volatile compounds tend to the vapor phase. General experience from this site and others has indicated that at low levels of VOC contamination in soil, related soil-vapor VOC concentrations tend to be higher by factors of one or two orders of magnitude.

The soil-vapor sampling locations in Plant 2 are shown in Figure 6 and 6A. Soil-vapor sampling results for the Plant 2 investigation are presented in Table IV, Parts 5 and 6. Soil-vapor sampling results for the Plant 2 investigation indicated elevated solvent concentrations at several of the former degreaser locations in Plant 2. These areas were identified as Study Areas 4, 5A-5C, and 6, as shown in Figure 6. No significant levels of VOCs were found along the process waste lines, as shown in Figure 6A.

E. Building 22 Area

A soil-vapor survey was conducted inside Building 22 and in areas around the outside of the building to determine the areal extent and possible sources of a Stoddard-solvent LNAPL layer which had developed in PZ-129 and Well Z.

The program was conducted from 3 August to 15 October 1993. Sample locations are shown on Figure 7. Soil-vapor samples were screened for Stoddard solvent

(refined mineral spirits) only. Soil-vapor samples were collected in Tedlar bags and analyzed off-site on a Hewlett-Packard 5890 Series II gas chromatograph calibrated using a vapor-phase Stoddard-solvent standard. All samples were analyzed within 24 hours of collection. Soil-vapor sample results are presented in Table IV, Part 7, and on Figure 7.

The highest concentrations of Stoddard solvent were detected near two former test-fuel collection sumps and the associated piping network. Readings were higher and more widespread in the southern of the two former carburetor test rooms.

3.4 Soil Sample Analysis Data

Soil sampling for laboratory analysis has been performed during the installation of monitoring wells at the site to determine whether contaminants were present in areas of possible past landfilling or in other areas where soil horizons appeared from field-screening results or visual observations to be potentially contaminated. Soil sampling for laboratory analysis has also been performed during investigations of soil conditions in the Tank Farm Area, Degreaser Investigation Study Areas 4, 5, and 6, the former metal-plating area, and the area surrounding Building 22.

In general, soil sampling has been performed using split-spoon or direct-push samplers in test borings advanced using standard auger-drilling methods. Soil samples from test-pit and LNAPL-recovery-trench excavations in the Tank Farm Area were collected by hand from the excavation sidewalls where safety conditions allowed; samples were collected from the excavator bucket where the sample depth or excavation conditions did not permit safe entry in the excavation.

Test boring and test pit logs which describe soil types and conditions observed and which present the results of VOC field-screening performed at each exploration are presented in Appendix A.

A. Monitoring Well Borings

Monitoring well locations at which soil sampling for laboratory VOC analysis was performed are shown on Figure 8, and depths and analysis results for the soil samples are shown on Table V, Part 1. Where contaminants were detected in the samples analyzed, concentrations were generally low, ranging up to 24.5 ppm total VOCs.

B. Tank Farm Area

Soil sampling was performed in the Tank Farm Area at locations which are shown on Figure 8. Sample locations included the 1989 excavation for LNAPL-recovery well RW-101, four test pits (TP-1 through TP-4), in Tank Farm Area piezometer-installation borings, at locations along the product-recovery trench between recovery wells RW-2 and RW-3 (RT samples), and at six test borings along the subsequently-completed section of the recovery trench between RW-2 and RW-101 (B-142 through B-148).

Laboratory analysis for total petroleum hydrocarbons (TPH) and VOCs was performed on samples from test pits TP-1 and TP-3, the PZ-121 through -128 test borings, and the recovery trench samples. Up to 331 ppm of the aromatic VOCs benzene, toluene, ethyl benzene, and xylene (BTEX) and up to 69,900 ppm TPH were detected in test-pit and recovery-trench samples. Sample depths and analytical results are presented in Table V, Part 2.

C. Degreaser Investigation

Study Area 5

Soil sampling was conducted in Study Area 5 during the period from 28 August through 23 September 1990 prior to the construction of a new manufacturing line in the area. Samples were collected from each of the test borings for the 20 overburden vapor-extraction/monitoring wells (VM-209 to -229) and 2 shallow-bedrock monitoring wells (SR-216 and -230) installed in Study Area 5. The test-boring and well locations were chosen to coincide with the areas of highest soil-vapor VOCs detected in the area. The VM wells were later connected to the SVE system which began operation in June 1996. Soil sample locations are shown on Figure 8.

Soil sample analysis results are presented in Table V, Part 3A. Analyses indicated that chlorinated VOC concentrations of up to 5,904 ppm were present in soil.

Study Area 4

Soil sampling was conducted in Study Area 4 during the period from 27 August through 26 September 1991 prior to the installation of new manufacturing equipment in the area. Soil sampling was done in Study Area 4 and at the column EE-27 area at soil boring locations B-231(SA-4), B-232(SA-4), HA-233, and HA-234. Soil sampling was also done in the soil boring for shallow-bedrock monitoring well SR-208, which was installed during the same period to provide information on groundwater quality in Study Area 4.

Soil sample depths and analytical results are shown in Table V, Part 3B. B-231 and B-232 samples were analyzed for VOCs, and TCLP metals analysis was performed on composite samples from the B-231 and B-232 locations. Soil sample analyses indicated relatively low levels of VOCs (primarily TCE and 1,2-DCE, with total VOC concentrations of up to 12 ppm) and metals concentrations which were below hazardous-waste levels.

Study Area 6

Soil sampling was conducted in Plant 2 in Study Area 6 during the period 8-9 May 1995 after manufacturing activities and equipment were removed from this area of the facility. Soil samples were taken from soil borings B-231(SA-6), B-232(SA-6), and B-304, located as shown on Figure 8. These borings were installed to determine the nature of contamination associated with degreaser No.3 in Study Area 6. Shallow-bedrock monitoring well SR-231 was installed in the B-231(SA-6) boring and vapor monitoring well VM-232 was installed in the B-232(SA-6) boring.

Soil samples were analyzed for VOCs. (Samples from test boring B-304, which was located at the south end of the adjacent Former Plating Area, were also analyzed for metals, as described below under Section 3.4D.) Results indicated low levels of VOCs in all samples except the B-231 sample from 6-8 feet, in which 480 ppm total VOCs were detected (mostly TCE and 1,2-DCE). Sample analysis results are presented in Table V, Part 3C.

D. Former Plating Area

Soil sampling was conducted in the former plating area located in Plant 2 between Degreaser Investigation Study Areas 5 and 6. The sampling in the former plating area was conducted in connection with Delphi's anticipated replacement of the concrete floor in the former plating area, and the sampling focused on identifying whether releases of inorganic contaminants had occurred to underlying soils. Locations were selected to investigate past positions of plating equipment and waste-water sumps and areas where the apparent integrity of concrete containment features was degraded. The sample locations included test borings B-301 through B-304 and hand borings PA-1 through PA-18. Sample locations in the former plating area are shown on Figures 8 and 8a.

Twenty-one soil samples from the four test borings and 18 hand boring samples were analyzed for metals using EPA SW-846 methods. Sample results are presented in Table V, Part 4. Results indicated that release(s) to shallow soil of several metals at low to moderate concentrations (up to 5,950 ppm zinc, up to 1,150 ppm total chromium) had occurred where degraded concrete was observed beneath the former Ionic III Plating line. Levels detected were below generic health-based cleanup criteria for industrial sites which had been established by the Michigan Department of Natural Resources.

E. Building 22 Area

Soil sampling activities were conducted during 18-20 September 1995 in areas around the exterior of Building 22 to determine the source of PCBs detected in LNAPL samples from nearby wells. As shown on Figure 8, test borings C-101 through C-123 were located in the Plant 2/Building 22 courtyard north of Building 22 and south of Building 22 in the area north of the AWTA building. Soil samples were collected from the borings using direct-push drilling methods.

Samples were field-screened for VOCs and PCBs using, respectively, a Photovac Microtip photoionization detector and Ensys immunoassay PCB screening kits. Ten split samples were also submitted for laboratory analysis of PCBs. Sample depths, field-screening results, and laboratory analysis results are summarized in Table V, Part 5. Soil sample analysis results indicated relatively low levels of PCBs were present in soils north and south of Building 22. The highest PCB concentrations of 9 and 30 ppm were detected in two samples collected from depths at or near the water table in an area where LNAPL was apparently present. PCB concentrations of less than 10 ppm were detected in six other samples from fill intervals containing ash and cinders.

3.5 Groundwater Analysis Data

Groundwater quality sampling has been performed at the site since the early 1980s. Periodic groundwater sampling at all then-existing site wells for laboratory analysis of VOCs and various inorganic compounds, principally metals, was performed through 1991. Routine semi-annual or annual sampling of selected site wells for VOC analysis has continued from 1991 to the present. Since 1992, groundwater quality sampling has focused on monitoring groundwater quality conditions along the downgradient site boundary, in the area of the east parking lot, and at the upgradient site boundary. Sampling of wells located within the interior of the site has been performed infrequently. Analysis of PCBs in groundwater and LNAPL from wells located in the east parking lot and in the Building 22 area was added to the periodic sampling program since 1992.

Groundwater analysis data for VOCs and inorganics from 1981 to the present are summarized in Table VI, Parts 1 and 2, respectively. Groundwater analysis data for PCBs are summarized in Table VI, Part 3.

In 1990, groundwater from the 103 and 110 well clusters, located on the north side of the facility within or downgradient of the area thought to have been used by Delphi for landfilling in the past, were sampled for analysis of the complete list of the U.S. EPA's Appendix IX parameters. Only those VOCs, cyanide, and several metals previously detected at the site were detected in the samples analyzed; concentrations detected were equivalent to those previously detected. Appendix IX semi-volatile organic compounds, dioxins, furans, pesticides, herbicides, PCBs, and sulfide were not detected in the samples analyzed, as shown in Part 4 of Table VI. Part 4 also summarizes results of laboratory analyses of groundwater samples from the site for other parameters not listed in Parts 1, 2, and 3.

Part 5 of Table VI lists the results of onsite analyses of groundwater field parameters (pH, temperature, and specific conductance) performed during groundwater sampling events.

Metals in Groundwater

Routine sampling of site groundwater for metals analysis has not been performed since 1991. The results of the metals analyses performed through 1991 were interpreted as indicating that metals concentrations detected in site groundwater were due to site background conditions. Sampling results had indicated that metals concentrations detected in site groundwater were highest at the upgradient 11 well cluster. Where detections of metals at concentrations above NYSDEC standards were noted at other locations, the highest concentrations of the transgressing metals were generally detected in initial samples from the wells in question, and the concentrations detected in subsequent sampling events tended to decrease, often to below NYSDEC standards.

Metals analysis of Study Area 5 wells located downgradient of the former plating area in Plant 2 was performed in 1995 in conjunction with the soil sampling investigation of the former plating area. Groundwater from half of the Study Area 5 overburden (VM-series) wells sampled for metals analysis in 1995 contained chromium, copper, lead, mercury, zinc, or cyanide at levels above NYSDEC GA standards. Groundwater from the Study Area 5 shallow-bedrock well SR-216 did not contain metals or cyanide at levels above NYSDEC's GA standards. The soil and groundwater-analysis results from the 1995 investigation in the former plating area appear to indicate that a release of plating chemicals from the former

plating area may have impacted overburden groundwater in the area of the southwest corner of Study Area 5.

VOCs in Groundwater

Groundwater contamination by VOCs, including the chlorinated solvents trichloroethylene (TCE) and tetrachloroethylene (PERC), and associated break-down products is present in the overburden, shallow-bedrock, and intermediate-bedrock units at the Delphi site. Degreasing operations formerly conducted within the interior of the Lexington Avenue Facility are the apparent on-site sources of chlorinated VOC contamination. However, the chlorinated solvent compound 1,1,1-trichloroethane (1,1,1-TCA) and its break-down products have also been detected with TCE and related compounds in groundwater at the SR/R-11 well cluster which is located at the upgradient site boundary. Site investigations have identified groundwater contamination by TCE, PERC, 1,2-dichloroethylene (1,2-DCE), vinyl chloride, 1,1-dichloroethane (1,1-DCA), 1,1-DCE and 1,1,1-trichloroethane (1,1,1-TCA). Benzene, toluene, ethyl benzene, and xylene (BTEX) have also been detected in shallow-groundwater in localized areas of the site at lower concentrations.

Total chlorinated VOC concentrations of over 600 ppm have been detected in shallow groundwater from beneath the facility in Degreaser Investigation Study Area 5. Concentrations of chlorinated VOCs of up to 80 ppm have been detected in shallow-bedrock and intermediate-bedrock groundwater downgradient of the source areas at locations between the plant buildings and the migration control trench. Up to 22 ppm of chlorinated VOCs, primarily TCE breakdown products, had been detected in groundwater at the downgradient site boundary along Driving Park Avenue prior to the start-up of the groundwater migration-control system in 1992. Concentrations of VOCs in groundwater along the Driving Park Avenue boundary have decreased by factors of 10 or more since the direction of groundwater flow in the shallow- and intermediate-bedrock units along this boundary was reversed by the migration-control system beginning in May 1992. The distribution of VOC contamination detected in groundwater at the site during recent sampling events is shown on Figures 13a, b, and c.

BTEX VOCs are present at relatively low concentrations in deep-bedrock groundwater at the site. The BTEX in deep-bedrock groundwater is believed to be a naturally-occurring feature which results from well-documented petroliferous characteristics of the Rochester Shale. Acetone and methyl ethyl ketone (MEK) have also been detected and reported by the laboratory in deep-bedrock groundwater samples from most locations on site. The source of the ketones is unknown, and may be related to an unidentified off-site source or to natural conditions. Acetone and MEK have not typically been detected in groundwater from shallower units at the site, and both compounds have been detected in groundwater from deep-bedrock wells screened in the Rochester Shale at another site located in Rochester south of the Delphi site.

Groundwater quality data indicate that the groundwater contaminant plume associated with former degreasing operations is restricted to the shallow-bedrock and intermediate-bedrock zones. The isolation of shallow groundwater at the site from the underlying deep-bedrock unit is evidenced by the following: the absence of chlorinated VOCs in deep-bedrock groundwater, the presence in deep-bedrock groundwater of BTEX and ketones not typically observed in the shallower units, the uniformly-high specific conductance recorded for deep-bedrock groundwater during field-parameter measurements at the site, the relatively low

permeability and slow rates of well recharge measured in deep-bedrock wells, and the absence of an apparent effect on water levels or VOC concentrations in the deep-bedrock unit from groundwater pumping at the migration-control trench.

Time-series plots showing historic trends of VOC contamination in groundwater are presented in Appendix D. A plot was made for each well for which enough data exists to produce a meaningful plot; plots were not made for wells at which VOCs have been not been detected or which have not been sampled more than once or twice.

The plots show the significant decline which has occurred in VOC concentrations in shallow groundwater along the downgradient site boundary as a result of migration-control activities. Plots for Study Area 5 VM- and SR-well groundwater and LNAPL samples show the variable effect that the operation of the Study Area 5 SVE system has had on groundwater quality in this area since SVE operation was begun in June 1996. The plot for east-parking-lot intermediate-bedrock well R-2 shows that chlorinated VOCs concentrations in groundwater from R-2 increased from less than 1 ppm in December 1994 to 11 ppm in October 1995. Groundwater at R-2 has not been sampled since then because of the possibility that the LNAPL layer which occurs in this well prevents collection of groundwater samples which are representative of actual dissolved-phase contamination.

PCBs in Groundwater

With two exceptions, PCBs have not been detected in site groundwater. PCBs were detected in two groundwater samples collected from monitoring well R-2 and in two water samples collected from the sump which collects groundwater from foundation drains which circle the Additional Waste Treatment Area building. (The AWTA building is located north of Building 22. R-2 is located in the east parking lot at the southeast corner of the site.) In all four cases, the water samples were collected when LNAPL containing PCBs was present in the well or sump, and the PCBs detected in the water samples may therefore not have been representative of actual dissolved-phase contamination.

Other Groundwater Quality Data

Data from an 18 May 1995 groundwater sampling event at the American Packaging site located adjacent to the northeast corner of the Delphi facility was reported to Delphi by American Packaging. The groundwater quality data included analysis of groundwater from three wells (APMW-1, -2, and -3) south, west, and north of ethanol- and fuel-oil bulk storage tanks located at the west end of the American Packaging facility. The well locations are shown on Figure 2. Samples were analyzed for TCL VOCs by EPA method 8260 and site-specific alcohols (n-butanol, ethanol, methanol, and 2-propanol) by method 8015.

Chloroethane, MEK, methyl-isobutyl ketone (MIBK), and isopropyl alcohol (IPA) were the only analytes detected in the samples from the American Packaging wells. Chloroethane was detected only in the sample from the well located upgradient of the tanks (APMW-1, located 80 feet north of Delphi monitoring well PZ-113); the concentration detected was 0.012 ppm. MEK and MIBK were detected at concentrations of 0.005 and 0.007 ppm, respectively, in the sample from the well adjacent to the tanks (APMW-2) and at concentrations of 0.008 and 0.210 ppm, respectively, in the sample from the well downgradient of the tanks. IPA was detected at a concentration of 0.250 ppm in the sample from the well downgradient of the tanks.

Five Delphi wells were sampled for ethene and ethane analysis by method 8015 during the June 1996 groundwater sampling event. The analysis was performed to determine whether ethene or ethane, potential products of the natural degradation of vinyl chloride, were present in groundwater at the site. Ethene was detected at concentrations of 0.07 and 0.08 ppm in samples from SR-231 and R-103, the only two of the five samples which contained detectable vinyl chloride. Results are summarized in Table VI, Part 4.

3.6 LNAPL Analysis Data

LNAPL samples have been collected for laboratory analysis from selected wells during most of the annual and semi-annual groundwater sampling events performed at the site since 1990. Additional LNAPL samples have been collected for analysis from one or more wells on numerous other occasions. Analytical parameters have included VOCs for most of the samples analyzed, and PCBs have been analyzed frequently since PCBs were first detected in the LNAPL at monitoring well R-2 in 1993. Flashpoint and specific gravity analysis and GC fingerprinting have been performed on a number of LNAPL samples. Viscosity, total chlorine, total halogenated organics, semi-volatile organics, leachable metals, and leachable organics have been analyzed in a few samples.

Quantitative LNAPL analysis results are summarized in Table VII. Part 1 of the table presents VOC analysis results, and Part 2 presents PCB analysis results. Part 3 of the table summarizes total BTEX VOCs, total chlorinated VOCs, and total PCBs results from parts 1 and 2 and presents analytical results for flash point, specific gravity, and all other parameters for which LNAPL samples have been analyzed. GC fingerprint scans are presented in Appendix E.

East Parking Lot Area

PCBs at concentrations of from 54 to 295 ppm have been detected in LNAPL from intermediate-bedrock zone well R-2 during the period since LNAPL first appeared in the well in 1993. R-2 is located at the southeast corner of the east parking lot at a point across Lexington Avenue from an electrical utility transformer substation. Samples collected from R-2 in 1993 and 1994 contained Arochlors 1242/1248 and 1254/1260, however since 1995 only the 1248 Arochlor mix has been identified.

PCBs (23 ppm Arochlor 1248) were detected in LNAPL from intermediate-bedrock well R-235, which is located at the southwest corner of the east parking lot, only in one sample collected in November 1997. PCBs have not been detected in LNAPL from R-235 before or since, and have not been detected in LNAPL from R-236 or R-238, the only other two east-parking-lot wells in which LNAPL has been encountered.

Chlorinated VOCs at total concentrations of up to 3,000 ppm and lower concentrations of BTEX VOCs have been detected in the LNAPL samples from R-235, -236, and -238. BTEX VOCs were detected in R-2 LNAPL at decreasing concentrations through 1996, but have not been detected since. Chlorinated VOCs have not been detected in R-2 LNAPL.

Fingerprinting of the east parking lot LNAPL samples has indicated that the LNAPL layers present in these wells contain in varying relative amounts petroleum hydrocarbons from three boiling ranges (three ranges of elution time). All samples have contained significant or

dominant components of medium-boiling hydrocarbons. Low-boiling (late eluting) and high-boiling (early eluting) hydrocarbons were present in R-2 LNAPL but were not significant components of the R-235 or R-238 LNAPL. R-2 samples have also had the lowest flash point (150 to 170 degrees Fahrenheit (°F)) of the east-parking-lot LNAPL samples. It is apparent from the VOC, PCB, and other analytical data that the R-2 LNAPL contains oils and contaminants from a source or sources other than the sources of the LNAPL present at R-235, R-236, and R-238.

Tank Farm Area

PCBs have not been detected in LNAPL samples collected from Tank-Farm-Area wells. BTEX VOCs have been detected at concentrations of up to 566 ppm in samples from several locations. Chlorinated VOCs have been detected only in samples from PZ-116 and PZ-132. Both low- and high-boiling hydrocarbon fractions have been detected by fingerprinting of Tank-Farm-Area LNAPL samples. Flash-points have ranged from 76 to greater than 200° F, and specific gravity has ranged from 0.8 to 0.9. The recent analytical data appear to corroborate the conclusions from the 1990 soil-vapor survey that the Tank-Farm-Area LNAPL plume is comprised of a mixture of test fuels, mineral spirits or Stoddard solvent, and cutting oil.

Degreaser Investigation Study Areas 4 and 5

LNAPL containing up to 11% VOCs has been observed in Study Area 5 overburden/vapor extraction wells; up to 13% VOCs have been detected in LNAPL from Study Area 5 shallow-bedrock wells. In both units the VOCs are primarily the chlorinated solvents TCE and PERC and related breakdown products; BTEX VOCs are also present at lower concentrations. Time-series plots showing concentrations of VOCs detected in Study Area 5 LNAPL samples are presented in Appendix D. The plots indicate that operation of the Study Area 5 SVE system has not had an obvious consistent effect on VOC levels in LNAPL in this area.

Chlorinated VOCs and lower concentrations of BTEX VOCs have been detected in LNAPL from Study Area 4 shallow-bedrock well SR-208 at a total concentration of 1,274 ppm (0.13%).

Courtyard North of Plant 2

Up to 1037 ppm chlorinated and BTEX VOCs have been detected in LNAPL from shallow-bedrock wells SR-102 and PZ-130 located in the courtyard between Plant 2 and Building 22. Flash points for this LNAPL have been greater than 200° F, and the specific gravity has been measured at 0.89. PCBs have not been detected in LNAPL from these wells.

Building 22 Area

Up to 830 ppm PCBs (Arochlor 1242 or 1248) and up to 583 ppm BTEX have been detected in samples of the Stoddard-solvent LNAPL from Building 22 Area shallow-bedrock wells PZ-129, PZ-142, RW-4, and Well Z and the sump for the AWTA building foundation-drain system. Flash points for this LNAPL have ranged from 115 to 120° F, and the specific gravity has been measured at 0.95.

North Parking Lot Wells

Chlorinated VOCs were detected in LNAPL from migration-control well GR-2 at a concentration of 95 ppm. Up to 14 ppm chlorinated VOCs have been detected in LNAPL from shallow-bedrock well PZ-139, which is located at the southwest end of the migration control trench.

IV. CONCLUSIONS

The nature and extent of soil and groundwater contamination at the Delphi site have been determined by the remedial investigations performed to date, with two exceptions. Further investigation of the extent of contamination of intermediate-bedrock groundwater is necessary in the east parking lot at the eastern site boundary, and Delphi plans to perform additional investigation in this area in the fall of 1998. Future investigation of the extent of LNAPL beneath the manufacturing buildings will be performed in a manner which will not disrupt ongoing operations.

Ongoing remedial actions have been implemented at the Delphi site, and the available data indicate that these actions have been effective in preventing the offsite migration of groundwater contamination along the northern and northeastern downgradient site boundaries. These actions also serve to intercept contamination migrating downgradient towards the site boundaries from source areas located within the manufacturing facility.

Within the interior of the site a passive LNAPL-recovery system is operating to recover a plume of Stoddard-solvent LNAPL in the Building 22 area, and construction and operation of a new, active system designed to enhance LNAPL-recovery in Building 22 is currently pending. A soil-vapor extraction system is operating at a former-degreaser location where organic solvent contamination of soil and groundwater is present. Additional testing of remedial methods and systems potentially applicable to subsurface contamination present in other areas of contamination at the site is planned. Remedial approaches proven by testing in currently-accessible source areas will be applied to other identified but currently-inaccessible source areas as facility operations permit.

Ongoing monitoring activities at the site include regular periodic monitoring of groundwater quality, groundwater elevations, and LNAPL distribution, and related regular monitoring of the progress and effectiveness of the remedial systems currently in operation at the site.

Potential pathways for exposure to chlorinated solvent compound contamination at the site include contact with contaminated soil or groundwater by site workers during construction activities and inhalation of contaminant vapors from soil or groundwater exposed during construction activities. Delphi employs specific health and safety procedures in its operations to protect site workers from these potential exposure pathways.

Potential pathways for exposure to chlorinated solvent contamination at off-site locations include potential ingestion of contaminated groundwater downgradient of the site and potential contact with or inhalation of vapors from contaminated groundwater infiltrating basements or sumps at downgradient locations. Groundwater use in the area of the site and elsewhere in the city of Rochester is prohibited by a City of Rochester ordinance. Use of groundwater for drinking water or other purposes in the area of the site is therefore not likely, and groundwater use is not known to be occurring.

As indicated above, the data summarized in this report indicate that the migration-control system which has been in operation at the site since 1992 is preventing the off-site migration of contaminants along the downgradient northern site boundary. In the east parking lot area of the site, potential pathways for off-site migration of contaminants to the east include the bedrock sewer tunnel present beneath Lexington Avenue and the bedrock tunnel for the

Driving-Park leg of the sewer located along the property line between the Delphi site and American Packaging Corporation. The additional investigation planned in the east parking lot will investigate whether off-site migration of contaminants from the Delphi site may be occurring in that area.

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