HYDROGEOLOGIC CHARACTERIZATION, CONTAMINANT ASSESSMENT, AND COMPUTER MODELING AT AN INDUSTRIAL SITE IN ROGERS COUNTY, OKLAHOMA

BY

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Bachelor of Science

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Dayton, Ohio

1979

Submitted to the Faculty of the
Graduate College of the
Oklahoma State University
in partial fulfillment of
the requirements for
the Degree of
MASTER OF SCIENCE
July, 1992

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ACKNOWLEDGEMENTS

I thank Jim Thomas of Stover and Associates, Incorporated, for suggesting this topic, and providing access to data and support throughout the study. I thank my thesis advisor, Dr. Wayne Pettyjohn, School of Geology, for providing technical guidance, encouragement, and enthusiasm. I thank Drs. Arthur Hounslow, School of Geology, who discussed my chemical data and reviewed the geochemistry chapter, and Brian Carter, School of Agronomy, who reviewed the soil descriptions and instilled a healthy degree of scepticism regarding results emanating from a computer model.

Others in the School of Geology contributed to this project. Dr. Arthur Cleaves provided advice regarding stratigraphy and core descriptions. Kelly Goff provided enthusiastic and abundant computer assistance. Dr. Douglas Kent contributed a few, thoughtful insights into computer modeling. Forrest Hess made the thin sections.

At Stover and Associates, Ray Powers provided expertise in chemistry and chemical analysis. Julie contributed computer drafting expertise to the geologic cross sections. Leslie, Malinda, and Paige furnished frequent and cheerful advice about word processing.

I would also like to thank my fellow geology students, who provided insights into, and diversions from, this project. Frankly, I got more out of the diversions.

Finally, I would like to express my sincere gratitude and appreciation to my wife, Lana, and our son, Evan, who have provided unconditional support and encouragement during my pleasant tenure at Oklahoma State University. Thank you both, and thank you all.

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CHAPTER I

INTRODUCTION

Statement of Confidentiality

While working as an intern hydrogeologist for a local environmental consulting firm, I sought among the firm's clients a suitable topic for a Master's thesis. One particular site was attractive due primarily to the large amount of data that had been collected. The client agreed to provide access to all data on the condition that the client and the location of the site remain confidential.

Nature of the Problem

The area of study of this thesis is within Rogers County, Oklahoma (Figure 1). There, an industrial complex utilized UST's (underground storage tanks) to store waste oils and waste coolant. Spent solvent was stored in the same area. In 1983 a leak was discovered in one UST; the exact volume of wastes released is unknown. The fiberglass UST's were replaced with fiberglass-coated steel tanks.

Objectives

Primary objectives of the study are as follows:

1. To describe the physical features of the rock and

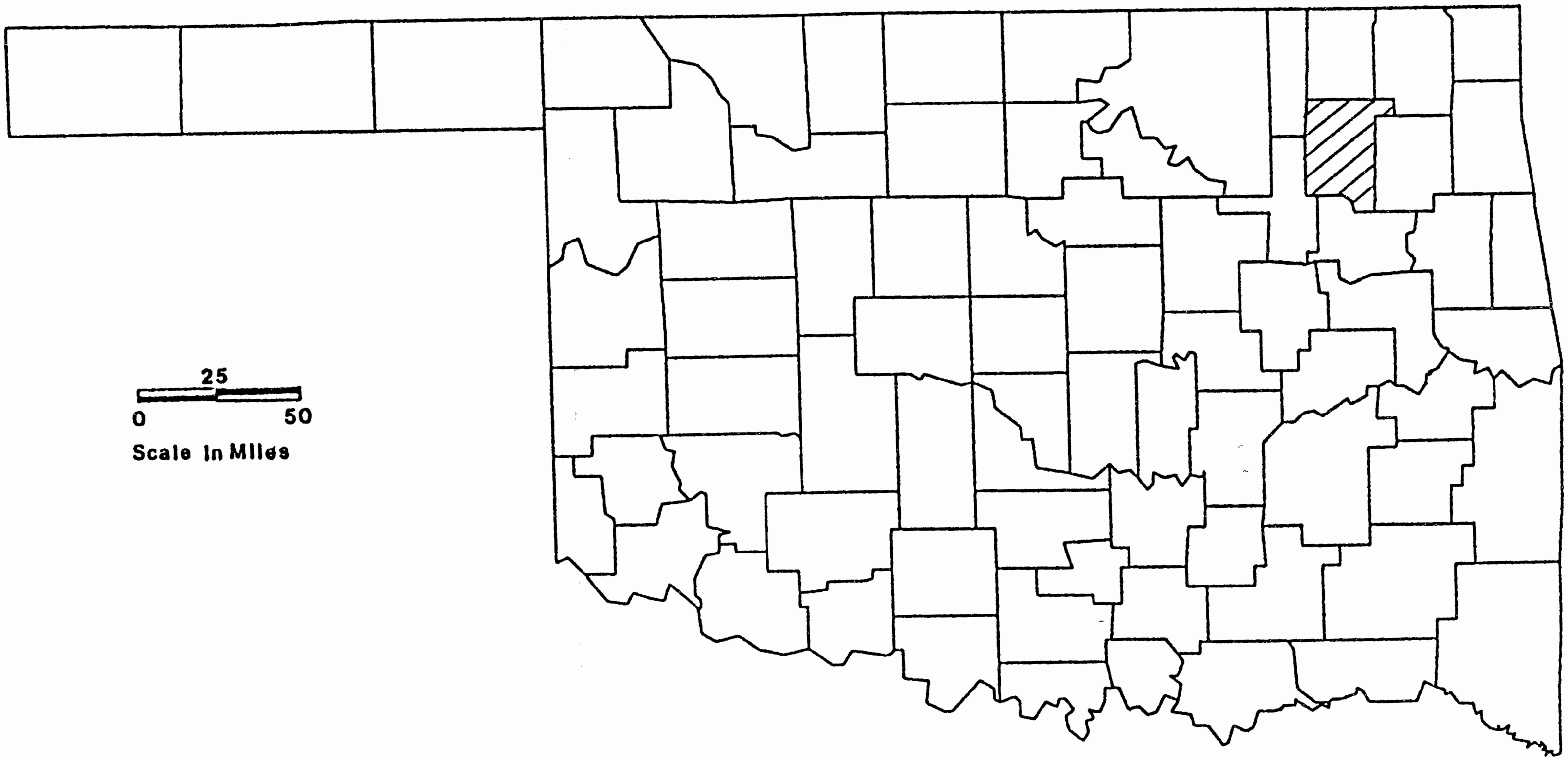

Figure 1. Location of Study Area

soil cores from the study location.

2. To characterize the hydrology and hydrogeology at the site.
3. To establish a hydrogeologic model that represents contaminant migration at the site.
4. To utilize a computer model to predict future migration of the contaminant plume.

Methods of Investigation

1. An extensive review of published literature on the Desmoinesian Series of the Pennsylvanian System, of northeastern Oklahoma, was undertaken.
2. Rock cores from 26 wells at the site were examined and logged in detail.
3. Two geological cross-sections were constructed to show lateral and vertical facies relationships and to identify potential pathways for contaminant migration.
4. Vertical and horizontal flow nets were constructed to identify ground-water flow paths.
5. Chemical analyses of soil and water samples collected at the site were tabulated and trends noted. Isoconcentration maps were drawn to reflect contaminant migration in ground water.
6. An aquifer test provided data for calculation of aquifer coefficients.

7. A computer model was utilized to simulate the contaminant plume and to test the effectiveness of a ground-water withdrawal remediation system.

CHAPTER II

GEOLOGIC SETTING

Stratigraphy

A generalized geologic map of northeastern Oklahoma shows that the Desmoinesian Series (Pennsylvanian) crops out in the Rogers County study area (Figure 2). Marcher and Bingham's (1971) geologic map of the Tulsa quadrangle provides greater detail; their map shows the Senora Formation present in the study area. The Senora Formation was named by Taff (1901), who described a 500-foot thick sequence of shale and sandstone present in southern Okmulgee County. Oakes (1953) traced the Senora northward into Tulsa County.

A stratigraphic problem concerning placement of the contact between the Krebs Group and the Cabaniss Group, Boggy Formation, and Senora Formation, respectively, exists in the Rogers County area.

For purposes of this report and to conform with procedures followed earlier by Hemish (1986), the Boggy-Senora contact is placed at the base of the Weir-Pittsburgh coal bed (Figure 3), and the upper and middle Taft sandstones of Tillman (1952) and Gruman (1954) are included

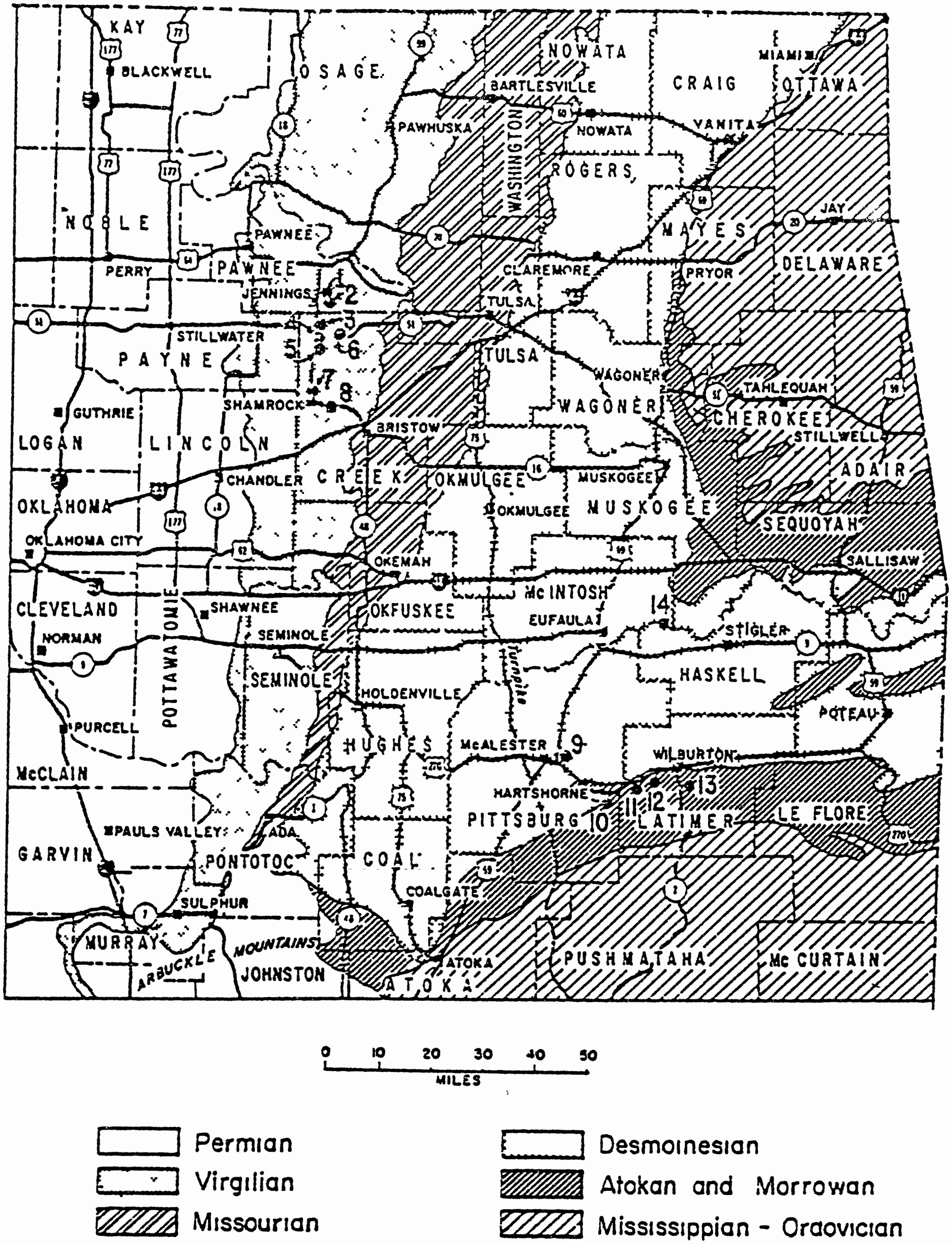

Figure 2. Generalized Geologic Map of Northeastern Oklahoma (after Shelton and Rowland, 1974)

SYSTEM	SERIES	GROUP	FORMATION	MEMBER OR UNIT
PENNSYLVANIAN	DESMOINESIAN	Marmaton	Fort Scott	Higginsville Limestone Little Osage Shale Blackjack Creek Limestone
		Cabaniss	Senora	Excello Shale Breezy Hill Limestone Kinnison Shale Iron Post coal Lagonda Sandstone Verdigris Limestone Oowala Sandstone Croweburg coal Mineral coal Chelsa Sandstone Tiawah Limestone Tebo coal White sandstone upper Taft sandstone RC coal middle Taft sandstone Weir-Pittsburg coal
		Krebs	Boggy	Taft Sandstone Inola Limestone Bluejacket coal Bluejacket Sandstone

Figure 3. Generalized Stratigraphic Nomenclature of Lower Desmoinesian.

in the basal part of the Senora Formation (Hemish, 1989).

Based on published studies of outcrops in the vicinity of the study area, and by using elevation and regional dip, it was determined that those rocks subcroppping beneath the study site probably belong to the lower Senora Formation. Formation members present at the site may be the White sandstone and upper and middle Taft sandstones. The Taft Sandstone of the Boggy Formation may be the massive sandstone that lies at a depth of approximately 40 feet at the study site.

Tectonic Features

The study area is located on the Northeast Oklahoma Platform (Figure 4). The platform is bounded by the Cherokee Basin to the north, the Ozark Uplift to the east, the Arkoma Basin to the south, and the Nemaha Ridge to the west.

The Northeast Oklahoma Platform and Cherokee Basin were relatively stable throughout the Paleozoic Era. Strata on the platform generally strike north-northwest and dip west-southwest. Regional dip has been reported to range from 30 to 80 feet per mile (Bloesch, 1928).

Tectonic History

Pennsylvanian orogenies were classified by Jordan (1967) into two major pulses, the Wichita Orogeny and the Arbuckle Orogenies. The Wichita Orogeny comprises several

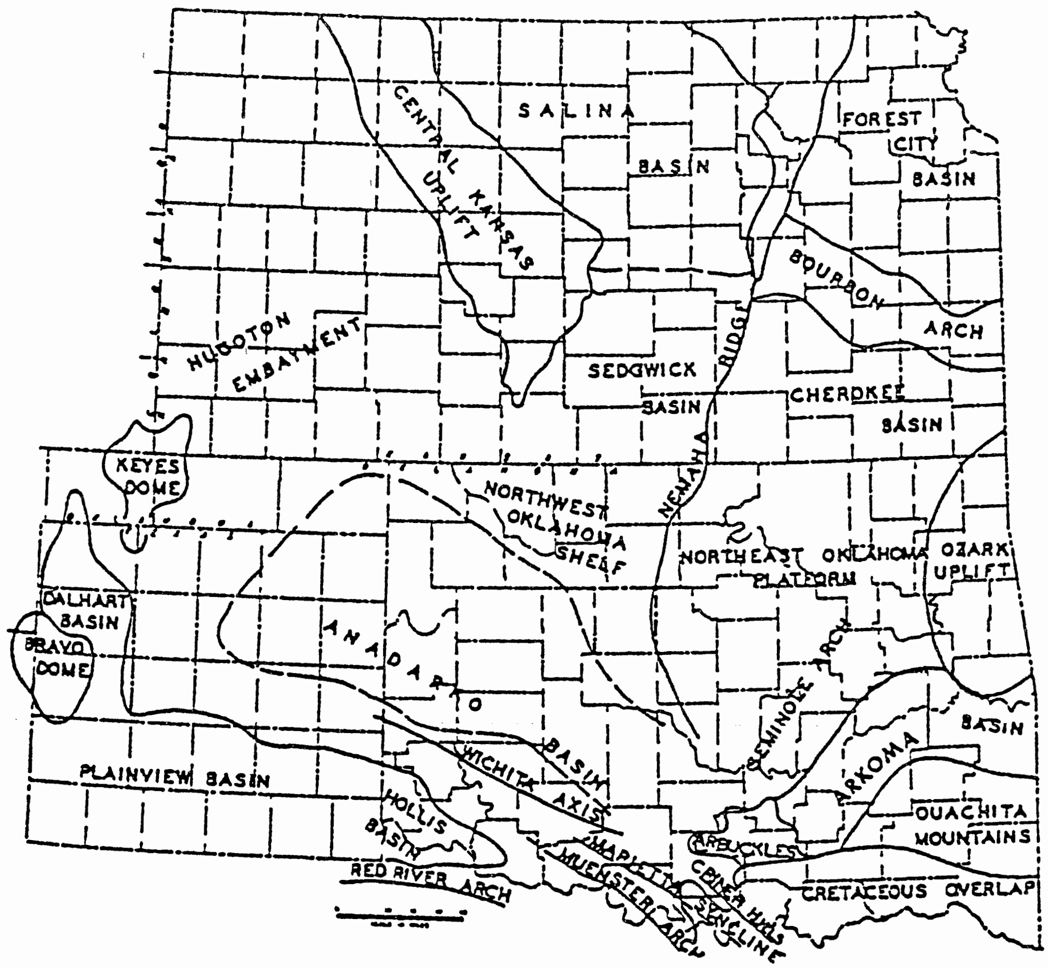

Figure 4. Tectonic Features of the Southern Mid-continent Region (after Huffman, 1960)

tectonic events that resulted from collision of the North and South American plates during late Morrowan and early Desmoinesian time (Rascoe and Adler, 1983). This collision initiated the Wichita and Nemaha Uplifts, and the formation of the Anadarko and Arkoma basins. Folding, faulting and uplifting of the Ouachita foldbelt probably occurred during late Atokan time (Jordan, 1967).

The Arkoma Basin originated during Morrowan and Atokan time as the downwarped North American plate was overridden by the South American plate (Rascoe and Adler, 1983). By early Desmoinesian, transgression of the Cherokee sea caused northerly migration of the Arkoma basinal axis and hingeline (Weirich, 1953).

Depositional History

In northern Oklahoma, Early and Middle Pennsylvanian depositional history is characterized by an overall northward transgression of the Cherokee sea; this was periodically interrupted by minor regressive or delta-progradational episodes. Branson (1954) recorded 25 coal cycles in the Krebs and Cabaniss Groups of northeastern Oklahoma. Bennison (1979) attributed the apparent cyclicity in the Desmoinesian series to sea-level oscillations associated with epeirogenic tilt of the craton toward the eastern Ouachita-Appalachian orogenic systems.

The Northeast Oklahoma Platform was buried by Desmoinesian sediments. The Cabaniss and Krebs Groups were deposited on an eroding, southeasterly-dipping surface of Mississippian rocks. Thickening to the south and east shows that onlapping conditions were prevalent during this time (Figure 5). Each transgression of the Cherokee sea deposited progressively younger sediments northwestward.

Figure 6 shows generalized paleogeography and paleoenvironments of the Cabaniss and Krebs Groups (Moore, 1979). Early Desmoinesian rocks of the Arkoma Basin and Northeast Oklahoma Platform primarily are shales, siltstones and sandstones with minor amounts of limestone and coal (Rascoe and Adler, 1983). These facies characteristically occur in transgressive-regressive couplets. Thin, transgressive limestones are indicative of low sediment influx and stable water depth, whereas dark shales are indicative of shallow, stagnant, nearly anaerobic water with low to moderate influx of sediment (Albano, 1975). Siltstones and sandstones are principally fluvial-deltaic; sands were deposited in distributary channels during regressions and as sheet sands during minor transgressions (Lojek, 1983).

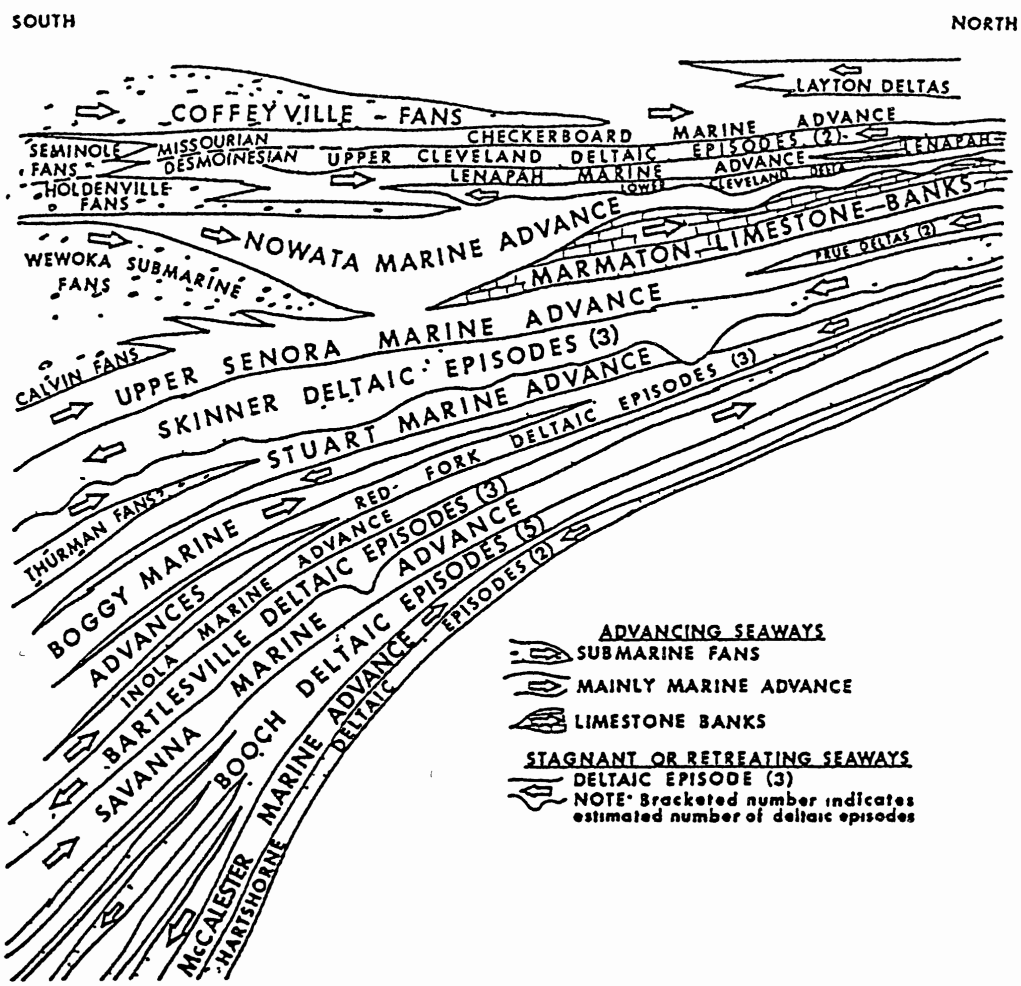

Figure 5. Cross-section Showing Paleoenvironmental Pattern in Northeastern Oklahoma During Desmoinesian Time (after Benninson, 1979)

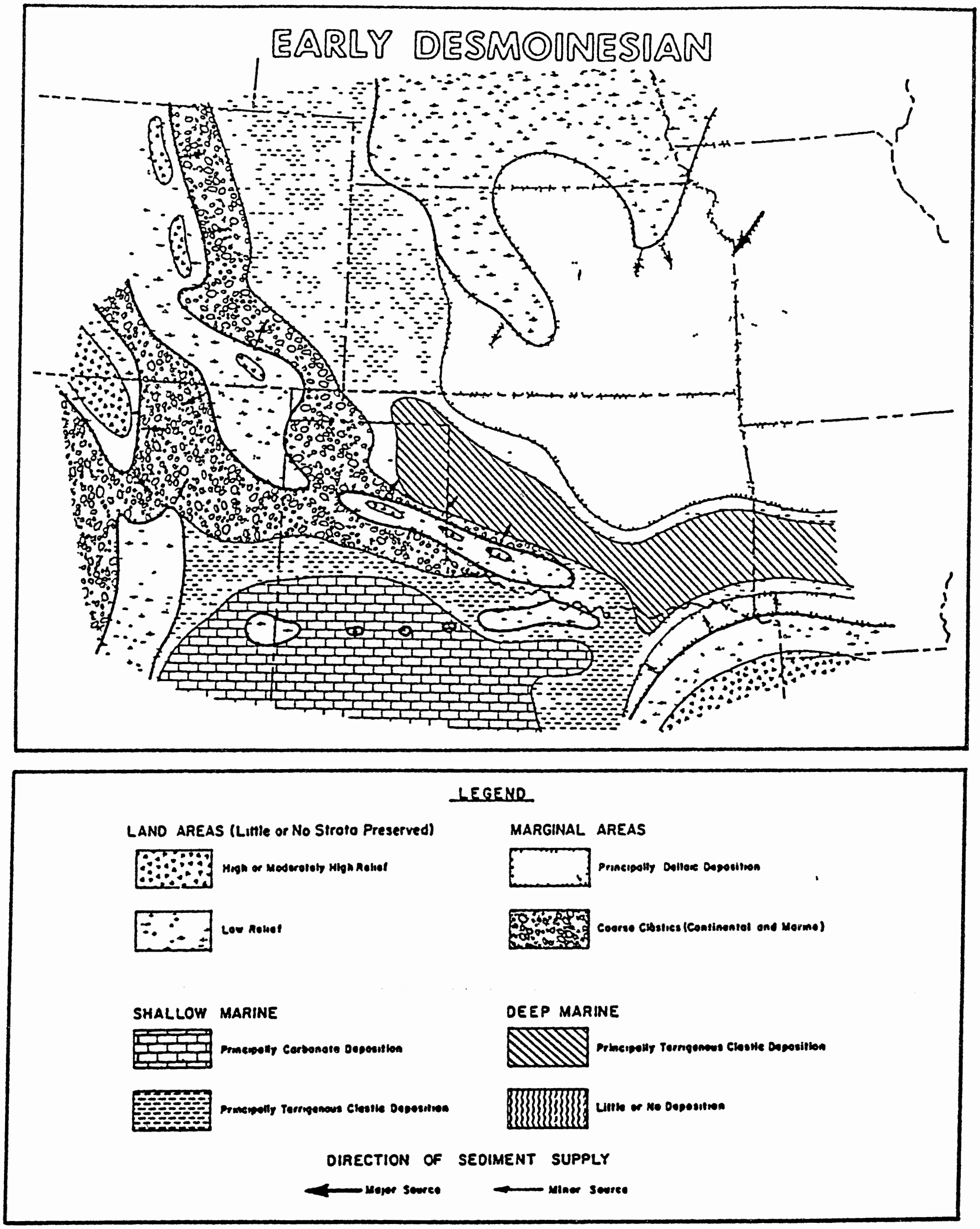

Figure 6. Generalized Paleogeography and Paleoenvironments of the Lower Desmoinesian (after Moore, 1979)

CHAPTER III

HYDROGEOLOGIC SETTING

Climate

Climate in the central United States is continental. Temperature differences between seasons are extreme, however, this diminishes southward. Northeastern Oklahoma benefits from a temperate, subhumid to humid climate. This area receives warm moist air from the Gulf of Mexico. Rapid penetration of cool, dry air from the north can result in significant variations of temperature, precipitation, cloudiness, and wind velocity. (SCS, 1966, from U.S. Weather Bureau, Stanley G. Holbrook, OK. St. Climatologist). In northeastern Oklahoma, daily air temperature for January is approximately 32° F and subfreezing temperatures occur 90-100 days per year. During July mean daily air temperature is 80° F. On average there are 85 days per year when the temperature is 90° F or higher, and 100° F or higher 15 days per year. Record temperatures range from 116° F (8/10/36) to -27° F (1/22/30) (SCS, 1966).

Across Oklahoma average annual precipitation ranges from less than 16 inches in the western Panhandle to more than 54 inches in the southeastern part of the state (Pettyjohn and others, 1983). The Rogers County area typically receives 40 inches of precipitation annually. Precipitation during spring and early summer is more widespread and abundant than during late summer and early fall (Pettyjohn and others, 1983). High intensity convective thunderstorms are possible throughout spring and summer. However, fall and winter are major periods of aquifer recharge. Cyclonic rainstorms occur while evapotranspiration losses are minimal.

Physiography

Northeast Oklahoma has been classified into various physiographic provinces by different authors. Loomis (1938) included much of Oklahoma into the Central Lowlands Province. Hunt (1967) incorporated Oklahoma into the Great Plains Province. Curtis and Ham (1979) divided Oklahoma into 26 geomorphic provinces, which they indentified by the dominant landforms in each (Naff, 1981). Rogers County is characterized by resistant sandstones and limestones forming cuestas that are separated by broad shale plains. Ridges are not evident due to dense vegetation. Some streams have developed broad flood plains that contain thick deposits of alluvium.

Soils

Soils in the general vicinity of the Rogers County study area are classified in the Dennis-Choteau soil association. The Dennis series is present at the actual site; specifically the Dennis silt loam. These soils formed under tall prairie grasses in material that weathered from shale and sandstone (SCS, 1966).

The surface layer generally is a 10-16 inch thick dark brown silt loam with moderate, fine, granular to subangular blocky structure. It is friable when moist and moderately permeable (SCS, 1966). This is underlain by 2 to 9 feet of silty clay and silty clay loam that is light yellowish brown to brownish yellow with reddish to grey mottles. This interval has weak to moderate, fine, subangular blocky structure in the upper portion and weak to strong, fine platy structure in the lower portion. Platy structure in the lower portion is not soil structure but rather a structural remnant of underlying parent material.

Surface Water

The study area lies completely within the Verdigris River basin; major tributaries are the Caney River, Bird Creek, and Dog Creek. During late summer many streams are dry because of uneven distribution of precipitation. As a result, many of the state's watercourses are not dependable sources of supply for municipalities, industry, or agriculture (Pettyjohn and others, 1983). Throughout

Oklahoma a network of man-made reservoirs are utilized for water supply and recreation. Smaller, man-made reservoirs utilized primarily by livestock producers are abundant throughout the region.

Ground Water

Pennsylvanian rocks, exposed in much of northeastern Oklahoma are comprised of mostly thin-bedded shales, sandstones and limestones. Sufficient annual precipitation exists to maintain an underground water supply, but no major aquifers exist in and adjacent to the Rogers County study area. The supply of ground water in Rogers County is insufficient to provide water for industry, municipalities or irrigation (SCS, 1966). Locally, sandstone aquifers provide small to moderate amounts of poor to fair quality water to domestic and stock wells.

CHAPTER IV

SITE CHARACTERIZATION

Facilities Description

The industry has been in operation since 1980. Manufacturing and repair operations are performed in the plant (Figure 7). These include typical machine shop operations such as metal grinding, milling and lathing, degreasing, assembly, and painting.

Hazardous Materials and Wastes

Hazardous waste generated at the plant include: approximately 75 gallons per month of spent 1,1,1-trichloroethane, generated from degreasing of electrical components, parts washing, and epoxy equipment cleanup; and approximately 20 gallons per month of paint thinner (largely xylene), generated in equipment painting and shipping departments.

Additional, non-hazardous waste generated at the plant include: waste oils, hydraulic oils and lapping oils, metal cuttings including nickel, carbon steel and stainless steel, coolants, steam-cleaning water, spent caustic water, and a high-flashpoint, aliphatic solvent used as a parts cleaner.

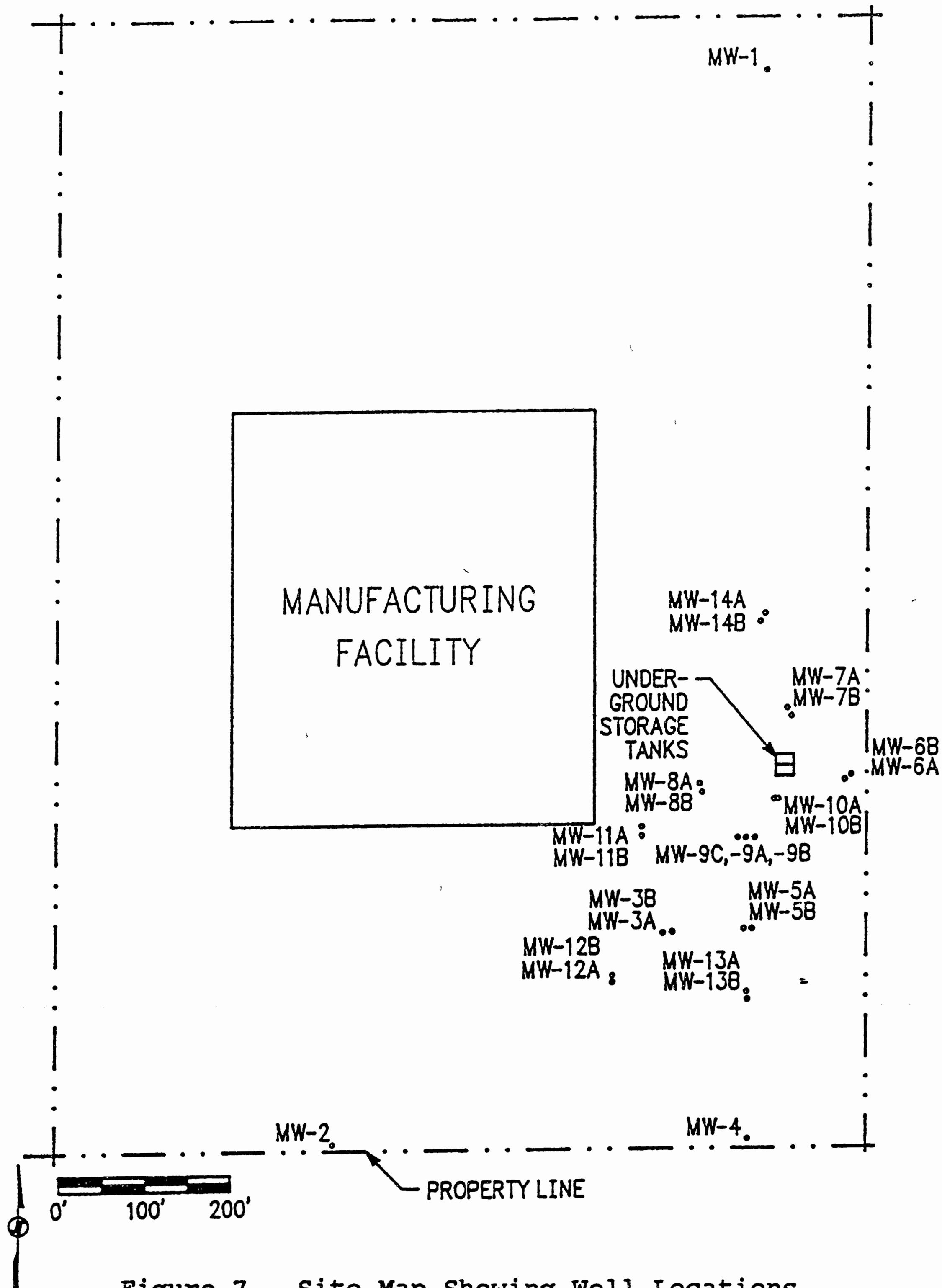

Figure 7. Site Map Showing Well Locations.

Underground Storage Tanks

The plant installed two 2,000 gallon fiberglass UST's in early 1980. A concrete pad was constructed to accommodate bins containing metal chips and cuttings generated from machining operations. The pad was contoured so that coolant and oils from the chip bins would drain into the UST's. An access road was located adjacent to the sloping collection area. Because a curb did not initially exist between the sloping pad and the access road, surface runoff caused premature filling of the UST's. This was corrected in 1982 when a curb was constructed to direct surface water away from the collection area.

Solvent wastes in drums also were stored on the concrete pad between 1980 and 1985. These waste solvents were picked up by vendors for off-site disposal or recycling. Due to spillage and leakage, an indeterminate amount of waste solvent apparently drained into the UST's. Temporary drum storage was moved from the sloping concrete pad to another area in 1985, thus separating the waste coolant and oils from the waste solvents. No solvent wastes or solvent-contaminated wastes were collected in the UST's after 1985.

During late 1983, a leak was discovered in one of the fiberglass UST's. The exact amount of wastes released is unknown. Both fiberglass UST's were removed and replaced with fiberglass-coated steel tanks at that time. A similar, 2,500 gallon UST was installed for waste oils storage. The waste oils tank was removed in 1989. The remaining two tanks continued to be used during most of 1990.

Most of the area surrounding the UST installation is paved with concrete for equipment storage and ease of access. Plant personnel detected a dark-colored, oily liquid seeping up through seams in the concrete in mid-1990. It was discovered that some of the drained coolant from the chip bins was escaping through a crack in the sloping concrete pad rather than collecting in the UST's.

During September 1990, the UST installation was closed and the UST's were removed. Approximately 3300 square feet of concrete surrounding the UST's was removed during closure, including the sloping concrete drip pad, thus exposing the underlying soil. Of this area, approximately 750 square feet occupied the actual tank excavation where soil and backfill material were removed to a depth of approximately 10 feet and piled adjacent to the pit. Approximately 1000 gallons of coolant and water were pumped from the excavation during removal of the UST's. Chemical analyses of samples collected during removal of the UST's, revealed that soil and backfill material were uncontaminated and eventually returned to the excavation. However, a sizeable depression remained at the site of the former UST's. The entire exposed area, particularly the depression, served as a catchment for rain and surface runoff; it often contained standing water. Consequently, the catchment served as a source of ground-water recharge. This is discussed further in a later section.

Monitoring Well Installation

Initially, five wells were drilled in December, 1990 at the site to detect the occurrence of contaminants in the soil, define local geology, and to determine direction of ground-water flow. Drill sites were located in a suspected up-gradient, background area, at the down-gradient property boundary, and near the former UST installation. Monitoring wells were constructed at the five drill sites and designated: MW-1, MW-2, MW-3A, MW-4, and MW-5A (Figure 7).

A second drilling phase took place during March, 1990. This allowed further examination of site geology and hydrogeology, and provided an improved definition of vertical and horizontal extent of contamination. Thirteen monitoring wells were installed. Two-well or three-well monitoring well clusters were installed at seven locations within the suspected contaminated area: MW-3B, MW-5B, MW-6A, MW-6B, MW-7A, MW-7B, MW-8A, MW-8B, MW-9A, MW-9B, MW-9C, MW-10A and MW-10B (Figure 7).

During November, 1991 a third phase of drilling was completed. Four two-well monitoring well clusters were installed: MW-11A, MW-11B, MW-12A, MW-12B, MW-13A, MW-13B, MW-14A and MW-14B (Figure 7). These sites were drilled to allow still greater definition of vertical and horizontal migration of contaminants.

The "B" wells were drilled to depths ranging from 14 to 20 feet. These wells were designed to be screened across the unconfined aquifer (first sandstone) and the underlying second sandstone. Screens are sufficiently long to permit monitoring "sinkers" at the base of the second sandstone as well as "floaters" at the water table (Table I).

Drilled to depths ranging from 30 to 35 feet, the "A" wells are capable of monitoring contaminants within the third sandstone (Table I).

All wells were drilled using a 6-inch diameter air-rotary rock bit. Rock core was collected using a 3-inch diameter core barrel advanced with the drill string. Continuous samples were collected by Shelby tube or rock core barrel to total depth of each well. All drilling equipment and tools were thoroughly steam-cleaned prior to drilling each well to reduce potential for cross-contamination.

Well construction diagrams of representative wells are located in Appendix A.

Local Geology

Interpretation of site geology was determined primarily by examination of continuous soil and rock cores extracted from the study area. The initial task of this investigation was to thoroughly describe the soil and rock cores. Master soil horizons displayed little variation across the site. Identification and recognition of soils was fairly routine.

TABLE I

MONITORING WELL SURVEY DATA

MONITORING WELL NUMBER	LOCATION	DATE CONSTRUCTED	WELL DEPTH	SCREENED INTERVAL	GROUND ELEVATION*	TOP OF CASING*	GROUND-WATER ELEVATION* 12-20-90
MW-01	NE CORNER OF PROPERTY	12/18/90	25.15′	5′-25′	657.20′	657.20′	645.08′
MW-02	SE CENTRAL OF PROPERTY	12/18/90	25.29′	5′-25′	643.10′	642.95′	636.43′
MW-03A	SW OF UST	12/18/90	26.22′	5′-25′	646.00′	648.50′	636.12′
MW-03B	SW OF UST	03/08/91	15.02′	5′-15′	645.66′	647.80′	-
MW-04	SE CORNER OF PROPERTY	12/19/90	24.94′	5′-25′	646.84′	646.63′	639.75′
MW-05A	S OF UST	12/19/90	35.56′	20′-35′	646.99′	648.99′	-
MW-05B	S OF UST	03/08/91	18.85′	4′-19′	646.84′	648.86′	-
MW-06A	E OF UST	03/04/91	32.28′	14′-32′	650.36′	650.31′	-
MW-06B	E OF UST	03/04/91	13.16′	3′-13′	650.79′	650.68′	-
MW-07A	N OF UST	03/04/91	33.05′	15′-33′	649.49′	650.34′	-
MW-07B	N OF UST	03/04/91	14.10′	4′-13′	649.35′	650.34′	-
MW-08A	W OF UST	03/05/91	33.20′	14′-32′	648.37′	648.24′	-

TABLE I (Continued)

MONITORING WELL NUMBER	LOCATION	DATE CONSTRUCTED	WELL DEPTH	SCREENED INTERVAL	GROUND ELEVATION*	TOP OF CASING*	GROUND-WATER ELEVATION* 12/20/90
MW-08B	W OF UST	03/05/91	12.97′	4′-13′	648.43′	648.34′	-
MW-09C	SW OF UST	03/07/91	87.46′	65′-85′	647.33′	649.08′	-
MW-09A	SW OF UST	03/07/91	37.36′	16′-34′	647.54′	649.44′	-
MW-09B	SW OF UST	03/07/91	17.32′	4′-14′	647.57′	649.34′	-
MW-10A	S OF UST	03/11/91	32.93′	14′-32′	649.07′	649.21′	-
MW-10B	S OF UST	03/11/91	13.67′	4′-13′	649.04′	649.25′	-

TABLE I (Continued)

MONITORING WELL NUMBER	GROUND ELEVATION*	TOP OF CASING*	GROUNDWATER ELEVATION* 01/04/91	GROUNDWATER ELEVATION* 01/25/91	GROUNDWATER ELEVATION* 03/11/91	GROUND-WATER ELEVATION* 03/26/91
MW-01	657.20'	657.20'	643.00'	642.88'	-	-
MW-02	643.10'	642.95'	636.15'	637.05'	-	-
MW-03A	646.00'	648.50'	636.51'	636.96'	-	-
MW-03B	645.66'	647.80'	-	-	637.18'	638.16'
MW-04	646.84'	646.63'	638.11'	638.76'	-	-
MW-05A	646.99'	648.99'	636.33'	636.82'	638.03'	638.11'
MW-05B	646.84'	648.86'	-	-	-	638.50'
MW-06A	650.36'	650.31'	-	-	639.10'	638.49'
MW-06B	650.79'	650.68'	-	-	642.17'	641.90'
MW-07A	649.49'	650.34'	-	-	639.46'	638.05'
MW-07B	649.35'	650.34'	-	-	643.82'	644.28'
MW-08A	648.37'	648.24'	-	-	636.85'	636.89'

TABLE I (Continued)

MONITORING WELL NUMBER	GROUND ELEVATION*	TOP OF CASING*	GROUNDWATER ELEVATION* 01/04/91	GROUNDWATER ELEVATION* 01/25/91	GROUNDWATER ELEVATION* 03/11/91	GROUND-WATER ELEVATION* 03/26/91
MW-08B	648.43'	648.34'	-	-	641.33'	641.80'
MW-09C	647.33'	649.08'	-	-	634.59'	634.65'
MW-09A	647.54'	649.44'	-	-	637.21'	637.29'
MW-09B	647.57'	649.34'	-	-	641.55'	641.67'
MW-10A	649.07'	649.21'	-	-	-	638.50'
MW-10B	649.04'	649.25'	-	-	-	644.85'

TABLE I (Continued)

MONITORING WELL NUMBER	GROUND ELEVATION*	TOP OF CASING*	GROUNDWATER ELEVATION* 04/25/91	GROUNDWATER ELEVATION* 05/21/91	GROUND-WATER ELEVATION* 09/19/91
MW-01	657.20′	657.20′	-	641.91′	643.48′
MW-02	643.10′	642.95′	-	638.27′	636.96′
MW-03A	646.00′	648.50′	-	637.76′	637.76′
MW-03B	645.66′	647.80′	-	638.98′	638.52′
MW-04	646.84′	646.63′	-	639.81′	638.70′
MW-05A	646.99′	648.99′	-	638.81′	638.81′
MW-05B	646.84′	648.86′	-	639.75′	639.07′
MW-06A	650.36′	650.31′	638.17′	638.30′	638.63′
MW-06B	650.79′	650.68′	641.37′	643.98′	639.51′
MW-07A	649.49′	650.34′	-	639.47′	637.14′
MW-07B	649.35′	650.34′	-	645.79′	643.84′
MW-08A	648.37′	648.24′	636.57′	637.23′	638.24′

TABLE I (Continued)

MONITORING WELL NUMBER	GROUND ELEVATION*	TOP OF CASING*	GROUNDWATER ELEVATION* 04/25/91	GROUNDWATER ELEVATION* 05/21/91	GROUND-WATER ELEVATION* 09/19/91
MW-08B	648.43′	648.34′	642.74′	643.06′	642.56′
MW-09C	647.33′	649.08′	633.96′	634.54′	643.43′
MW-09A	647.54′	649.44′	636.56′	637.37′	637.39′
MW-09B	647.57′	649.34′	643.52′	643.73′	641.43′
MW-10A	649.07′	649.21′	636.65′	638.58′	638.48′
MW-10B	649.04′	649.25′	646.42′	645.09′	643.72′

* Elevations based upon National Geodetic Vertical Datum of 1929.

Lithologic facies demanded more attention. Grain-size sorting of shales and sandstones ranged from poor to good, making correlation of stratigraphic units across the site difficult at best. Rapid changes in vertical and areal extent of the lithologies present compounded correlation attempts. When individual lithologies were grouped into gross lithologic packages correlations across the site became easier. Figure 8 shows locations of north to south and west to east cross-sections (On Figure 8 and all subsequent site maps, the "MW" designation at monitoring well locations, has been omitted for greater clarity of the data represented on each map). Figures 9 and 10 are north to south and west to east, respectively, generalized geologic cross-section.

Soil horizons display mostly uniform thickness across the site. An exception to this is slight thickening of the silty sandstone, (silty) shale, and (silty) clay interval in MW-9 and MW-5. It is believed that this interval represents a transition between soil and bedrock; it is a zone of weathered bedrock.

A silty sandstone is the dominant lithology in this interval. It is tan to orange, very fine to fine-grained, subangular, micaceous, and displays very poor sorting. The siltstone/sandstone lithology is very friable in part and the core consists largely of rubble in this interval. Scattered throughout the interval is grey to black, platy, micaceous, very poorly-sorted shale. It is interlaminated

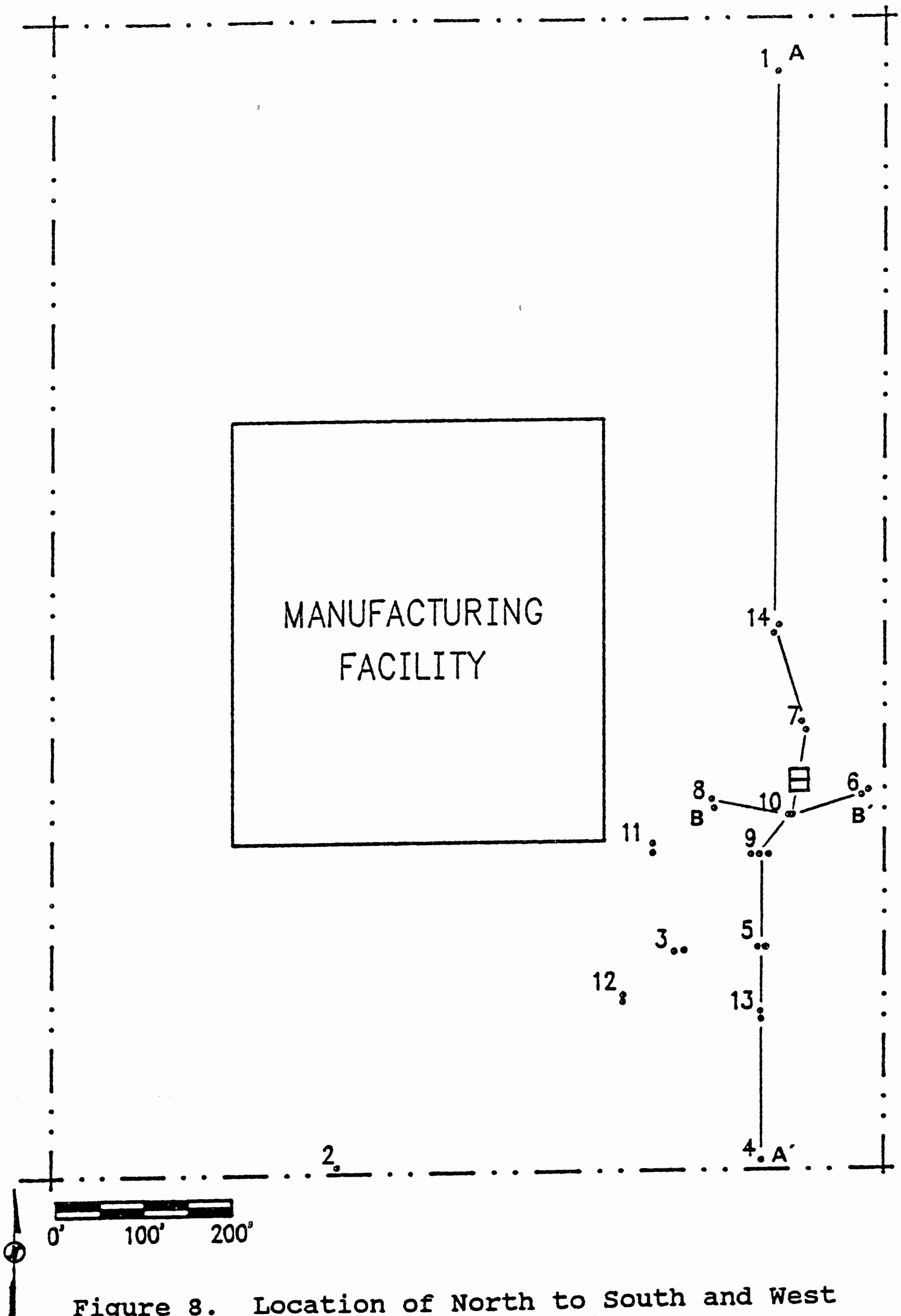

Figure 8. Location of North to South and West to East Cross-sections.

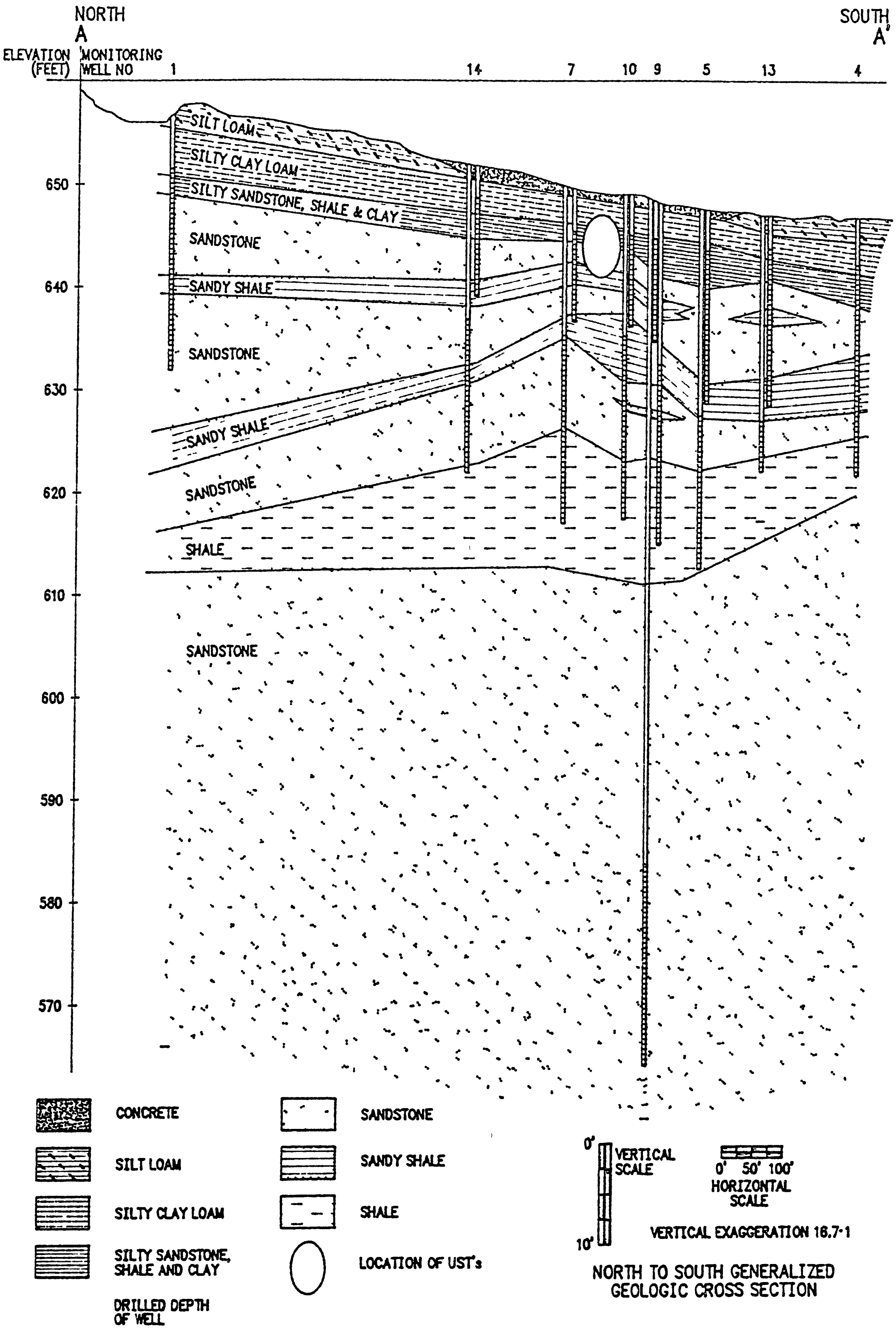

Figure 9. North to South Generalized Geologic Cross-section

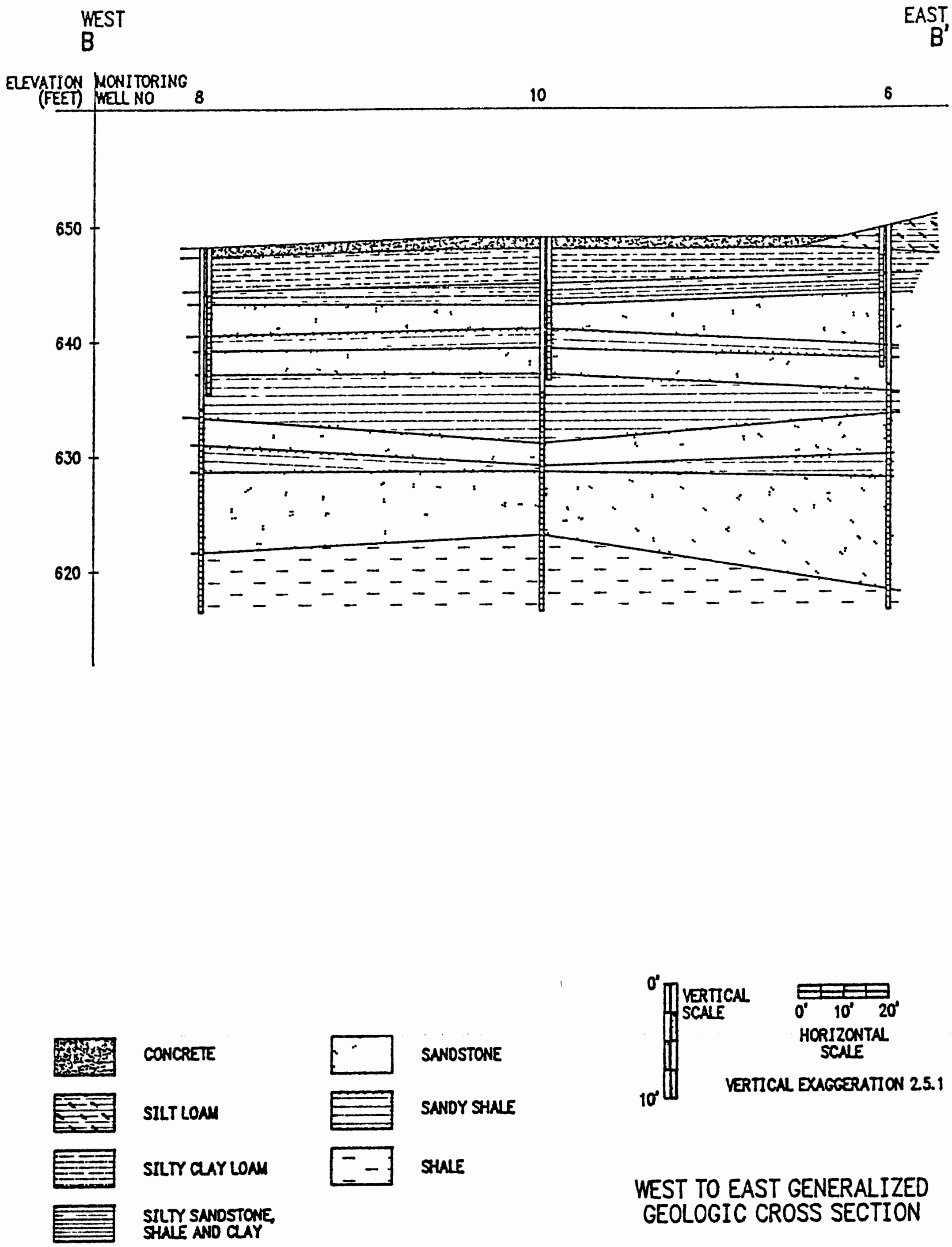

Figure 10. West to East Generalized Geologic Cross-section

with sandstone and siltstone. The overall weathered condition and platy nature of the shale apparently provide a preferred pathway for fluid migration along bedding planes.

The first and second sandstones thin considerably southward. They coalesce into one sandstone south of MW-9, where the upper sandy shale pinches out. The third sandstone also thins in a southerly direction. The second sandy shale and shale intervals thicken slightly southward.

Sandstones across the site possess a very uniform size of quartz grains. All are very fine to fine-grained, subangular, and micaceous. Grains are well-cemented by silica. Color varies between tan, grey, brown, light olive green, and pink. Sorting ranges from very poor to good. Interlaminated shale is generally rust-colored, continuous and discontinuous, horizontal to wavy to small-scale cross-laminated. Locally shale laminations are inclined at approximately 25° to 40°.

The sandy shale intervals are grey to black, micaceous, with mostly poor to fair sorting, interlaminated with thin, grey sandstone. Horizontal, wavy and cross-laminations are readily apparent.

At a depth of approximately 28 to 45 feet a massive shale in encountered. It is grey to black, micaceous, and dense. The shale is generally well-sorted, with occasional sandstone laminations. Detailed core descriptions are located in Appendix B.

Figure 10 is a west to east generalized geologic cross-section. Interval thickness is relatively uniform in an east-west direction, but can change considerably in a north to south direction. This supports the assumption of a northern and/or southern source area.

Hydrogeologic Characterization

Water-Level Measurements

Ground-water levels were measured in the monitoring wells on eight separate occasions. Results of these efforts and monitoring well survey data are presented in Table I. Based on water-table elevations a series of 3-point problems were calculated to determine ground-water flow direction(s) at the site. Additionally, a water-table elevation contour map was prepared. These calculations are located in Appendix C. One observation about the water-table elevation contour map deserves note. Water-table levels in MW-2 and MW-4 are believed to be high relative to the local trend due to recharge from a drainage ditch. This ditch runs parallel to the facility's southern margin and serves to collect and remove surface runoff (Figure 11). Topographic lows within the ditch hold water until removed by infiltration and/or evaporation. This standing water along portions of the drainage ditch provides recharge that would otherwise not occur.

Figure 12 is a water-table elevation map based on water levels measured on September 2, 1991. It clearly shows a

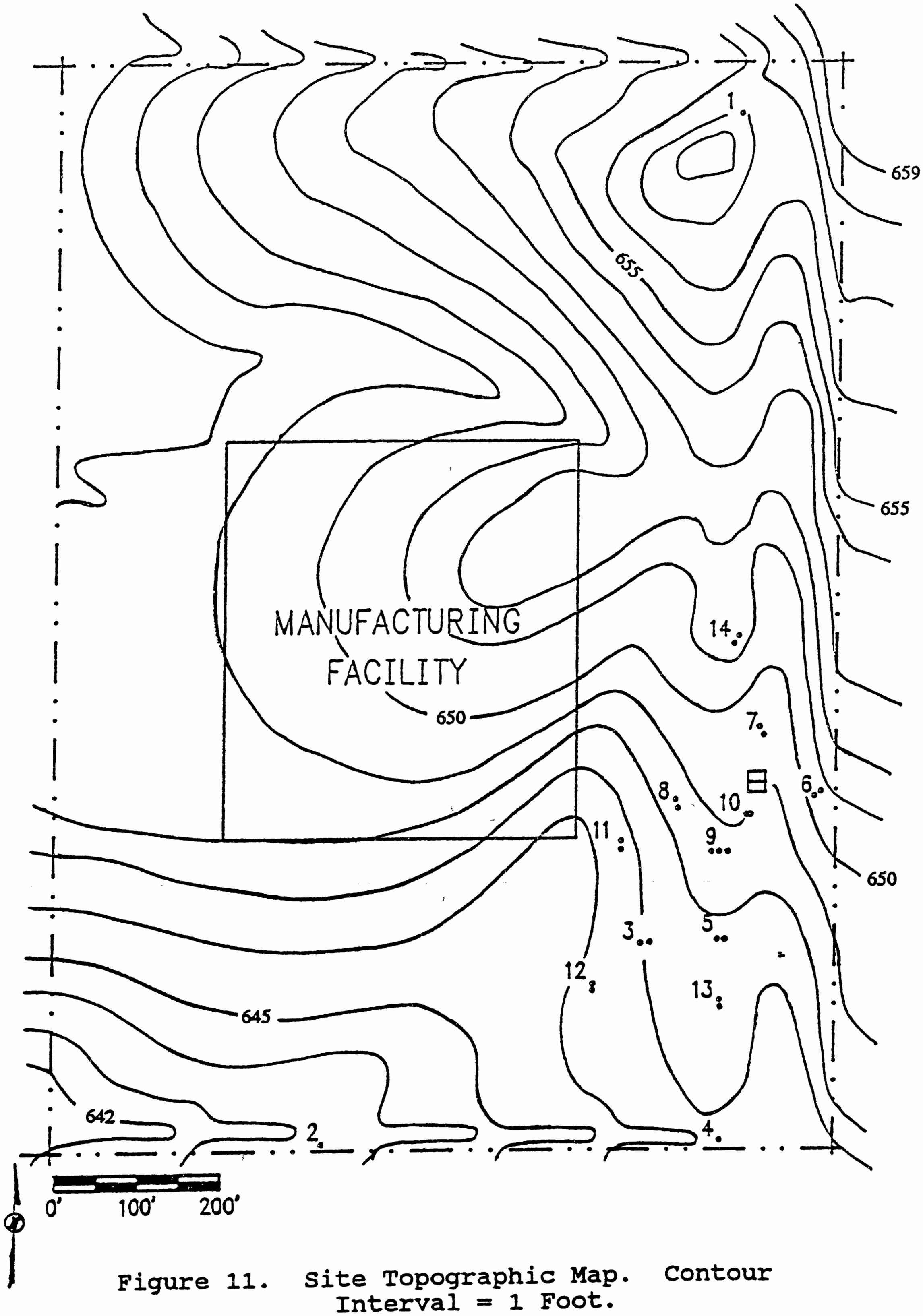

Figure 11. Site Topographic Map. Contour Interval = 1 Foot.

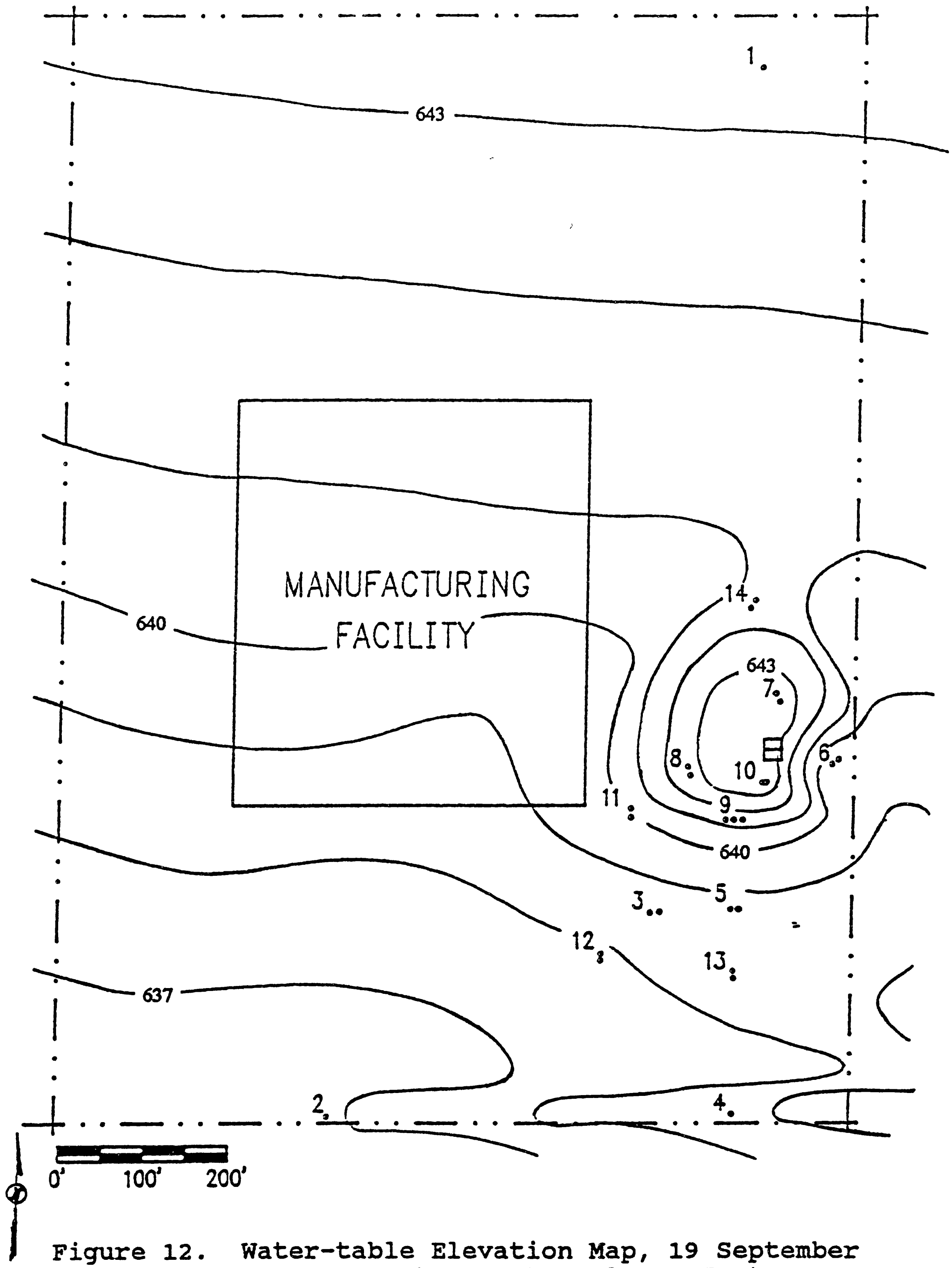

Figure 12. Water-table Elevation Map, 19 September 1991, Contour Interval = 1 Foot.

ground-water mound surrounding the former UST installation. The source of the mound is believed to be recharge by surface runoff that collected in and then infiltrated from the UST excavation pit. Ground-water recharge occurred in this manner from September 1990, when the UST's were removed until October 1991, when the excavation was filled to grade and paved once again with concrete. With the recharge source eliminated the ground-water mound will likely dissipate over time.

Ground-Water Velocity

Uncertainties in understanding the geologic framework of the ground-water system at the study site make it impractical to attempt a calculation of the amount of water flowing through the system. It is however, possible to calculate the linear velocity of the moving ground water.

Linear, ground water velocity through a granular medium can be expressed as follows:

$$v = KI/7.48n \tag{4.1}$$

where v = average linear velocity through pore openings, in feet per day (ft/d);

K = hydraulic conductivity of the aquifer material, in gallons per day per square foot of aquifer (gpd/ft^2);

I = hydraulic gradient, in feet per foot (ft/ft); and

n = effective porosity of the aquifer.

This equation does not take into account dispersion or retardation of contaminants in flowing ground water, nor can it accurately predict the arrival of a contaminant plume; contaminants do not necessarily flow at the same velocity of ground water.

Based on aquifer test data, hydraulic conductivity of the third sandstone is approximately 4 gpd/ft^2. Increased shale laminations in the uppermost unconfined aquifer however, may reduce hydraulic conductivity. The hydraulic gradient between MW-1 at the northern end of the site and MW-2 on the southern property line is 0.007 ft/ft. Due to the ground-water mound beneath the former UST installation the hydraulic gradient increases slightly near there; between MW-7B and MW-2 the hydraulic gradient is 0.011 ft/ft. However, before removal of the UST system the ground-water mound probably did not exist. Ground-water velocity was probably slightly lower prior to tank removal, due to the lower hydraulic gradient. Effective porosity was estimated to be 0.10 based on thin-section analysis of two sandstone samples.

Inserting these values into equation 4.1 yields:

$$v = \frac{4 \text{ gpd/ft}^2 * 0.011 \text{ ft/ft}}{7.48 * 0.10} = 0.06 \text{ ft/d} \tag{4.2}$$

This value can be checked by relating the distance from the UST's to the leading edge of the plume, with the amount of time since contamination began. Based on the isoconcentration maps presented in Chapter VII, the leading edge of contamination may lie as much as 300 feet downgradient from the former UST system. Moving at 0.06 feet/day over a 10-year period (the maximum period of contamination), the ground water would have advanced only 220 feet. However, dispersion is ignored in equation (4.2); based on this velocity a calculated front would be less, perhaps by 25 percent (Pettyjohn, 1992). Using the aquifer coefficients determined thus far will apparently result in conservative estimates of contaminant migration.

Flow Net Construction

A flow path was selected from the water-table contour map (Figure 12), and a flow net was constructed (Figure 13). The cross-section represents generalized geologic and hydrogeologic conditions along the ground-water flowpath (Figure 14).

Three hydrologic units are apparent on the cross-section. The first hydrologic unit extends from land surface to the top of the shale lithology, an interval of approximately 25 to 40 feet. This unit contains an unconfined aquifer directly below the water table, mostly within the uppermost sandstone interval. The second sandstone is probably a semi-confined aquifer, although no monitoring wells at the site are screened exclusively across this zone. The third sandstone is a semi-confined aquifer. Three monitoring wells along the cross-section are screened across this sandstone: MW-7A, MW-9A and MW-10A (a fourth

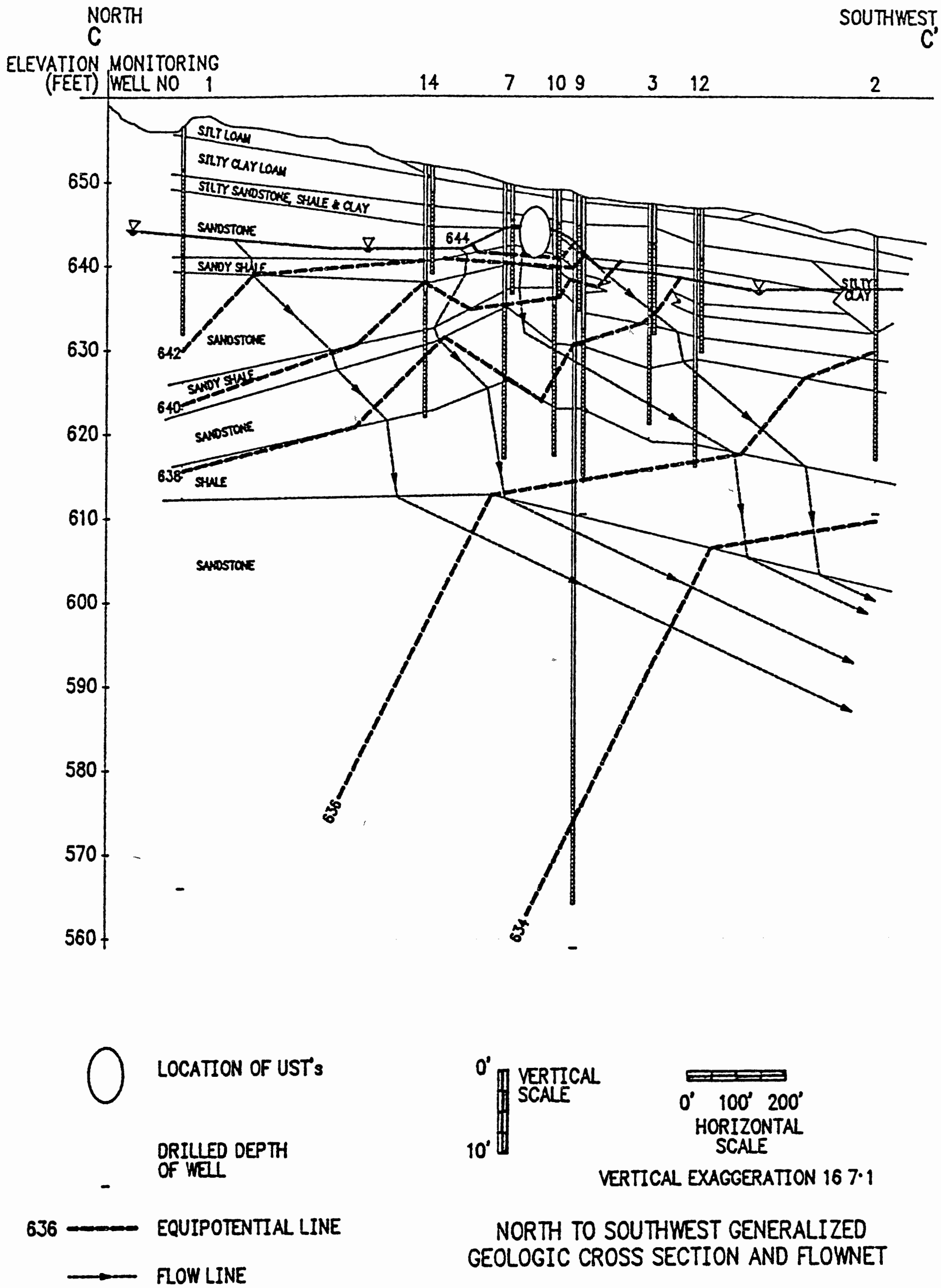

Figure 13. Flow Net Along North to Southwest Cross-section.

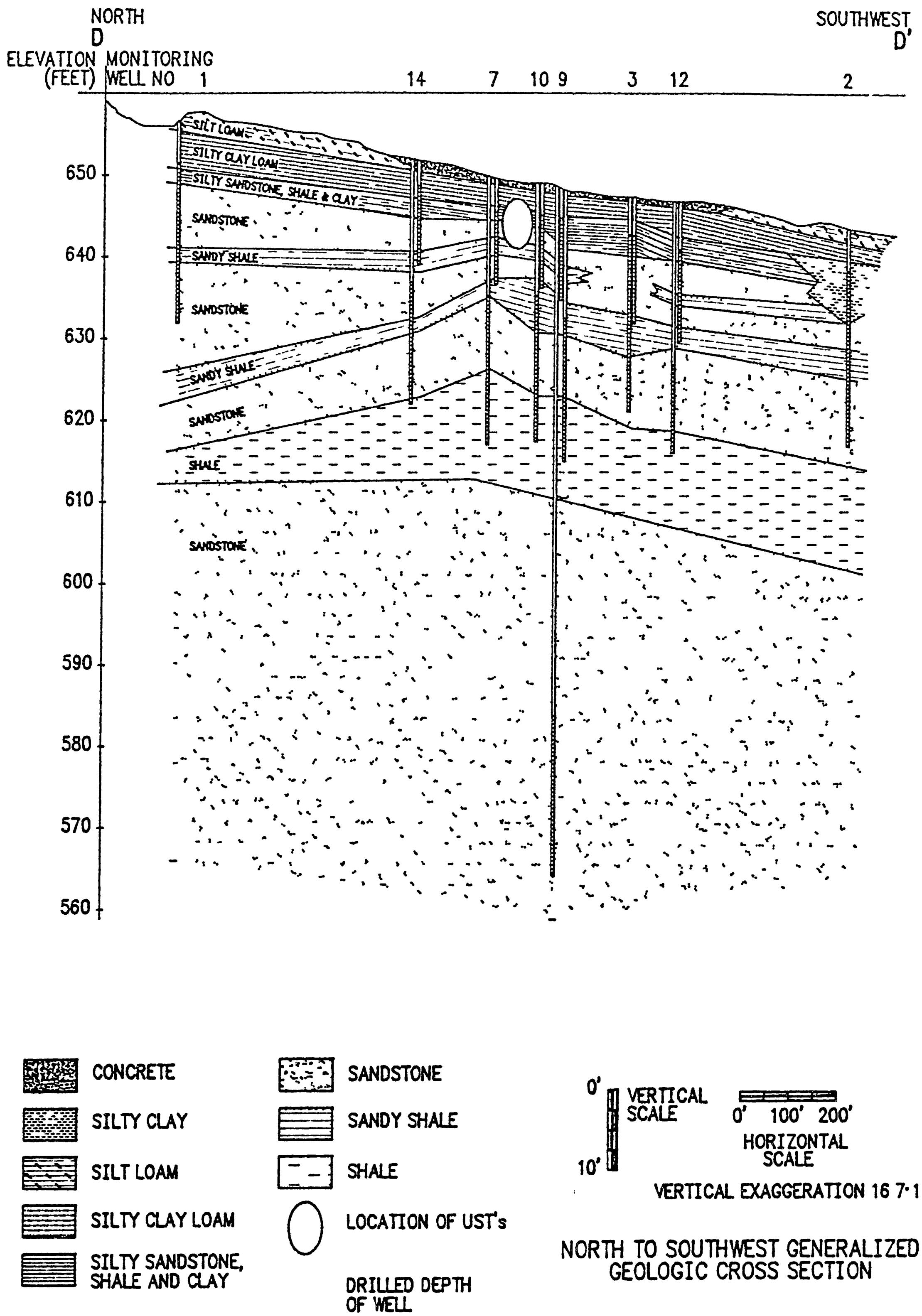

Figure 14 North to Southwest Generalized Geologic Cross-section.

well, MW-12A, installed during the final phase of drilling, also is screened across the third sandstone, but no water level data are available for it). Equipotential lines indicate a decreased potential head in these three wells relative to shallower wells. This fact, coupled with the overlying sandy shale, seem to imply the third sandstone is a confined or semi-confined aquifer.

On a local scale, the upper hydrologic unit most likely contains confining and semi-confining beds. However, because of rapid, vertical and lateral changes of lithologies characteristic of fluvial-deltaic deposits, in a broad, regional sense the upper hydrologic unit may behave more like an unconfined aquifer.

A grey to black, massive shale comprises the second hydrologic unit. It ranges from approximately 4 to 14 feet in thickness. This shale is a confining bed between the first and third hydrologic units.

The third hydrologic unit is a massive sandstone at least 40 feet thick, with shale laminations scattered throughout the zone. This sandstone is a confined aquifer. An equipotential line intersecting the screened interval in MW-9C provides further evidence of decreasing potential head with depth.

CHAPTER V

AQUIFER PERFORMANCE

Aquifer Testing Methods

An aquifer test was conducted to determine transmissivity, storativity, and hydraulic conductivity. The test involved pumping water from one well and measuring the change in water level in observation wells. All aquifer test data are located in Appendix D.

Monitoring well MW-9A was selected as the pumping well for two reasons: its central location relative to other monitoring wells at the site would provide multiple observation points, and the "A" wells are screened only in one confined or semi-confined sandstone (the third sandstone), while the "B" wells are screened through multiple zones.

Approximately one week prior to the aquifer test MW-9A was pumped at various rates to determine a discharge appropriate for a 24-hour aquifer test.

In late October 1991, MW-9A was pumped with a slim-hole submersible pump at an average rate of 0.0625 gpm (gallons per minute), approximately 0.5 pint/minute, for 570 minutes (9 hours, 30 minutes). Water was discharged into barrels located adjacent to the well head. Three electric sounding devices were utilized for drawdown measurements. One device was used exclusively in the pumped well, while the remaining two were used in observation wells. The instruments were decontaminated prior to use in each well. Despite attempts to reduce discharge MW-9A was pumped dry at approximately 11:30 pm. Thus the pumping period ended and recovery measurements commenced. Recovery was measured for 750 minutes (12 hours, 30 minutes).

Pitfalls of Data Collection

A variable discharge rate during an aquifer test can be a source of error. Slight fluctuations in discharge will immediately affect the water level in the pumped well. Water levels in observation wells are less sensitive, if at all, to variations in discharge. Table II summarizes discharge during the pumping period of the aquifer test at the study site.

TABLE II

DISCHARGE VARIABILITY DURING AQUIFER TEST

Q (gpm)	TIME INTERVAL (minutes)	TOTAL TIME (minutes)
0.125	0 - 60	60
0.094	60 - 120	60
0.094 - 0.063	120 - 260	140
0.063	260 - 570	310

During more than 80 percent of the pumping period, discharge was 0.063 gpm (0.5 pint/minute), or varied between 0.063-0.094 gpm (0.5 - 0.75 pint/minute).

All wells at the study site are constructed of 2 inch I.D. (inner diameter) casing, including the pumping well used during the aquifer test. During the initial portion of an aquifer test, drawdown of the water level proceeds rapidly, especially in small diameter wells. During the first 15 minutes of pumping, water level in the pumped well dropped approximately 0.10 foot (1.2 inches) every 3 seconds. Measurement of the water level at a precise time can be difficult at best, and subject to error even with electronic sounding devices.

Data Interpretation Methods

Aquifer transmissivity and storativity were calculated using two techniques. Theis (1935) and Jacob (1946) devised methods to analyze confined aquifers. The Theis equation is used to analyze confined aquifers under non-equilibrium conditions (Theis, 1935). The equations for transmissivity and storativity are based on two dimensionless parameters, u and W(u). To solve the Theis equation graphically, time is plotted against drawdown on a log-log scale, a type curve matched to the data, and a match point is chosen. Transmissivity, in gpd/ft, and storativity are calculated by the following equations:

$$T = \frac{114.6 * Q * W(u)}{s} \quad (5.1)$$

$$S = \frac{T * u * t}{2693 * r^2} \quad (5.2)$$

where Q is the pumping rate in gpm, s and t are the drawdown (feet) and time (minutes) coordinates of the match point on the graphed curve, r is the distance (feet) between the pumping and observation well, and W(u) and u are the coordinates of the match point on the type curve.

The Jacob straight-line method is based on the Theis' equation and may be applied to that part of the cone of depression in which steady-shape conditions have been reached (Jacob, 1946; Cooper and Jacob, 1946). This condition is met when the value of u is less than 0.05, which occurs when distance from the pumping well is small or length of pumping time is large. To interpret the data, time is plotted against drawdown on a log-linear scale, a straight line fit to the data, and the following equations are solved:

$$T = \frac{264 * Q}{\text{delta } s} \quad (5.3)$$

$$S = \frac{T * t_0}{4790 * r^2} \quad (5.4)$$

where Q and r are as above, delta s is the drawdown over one log cycle, and t_o is the time when the extended straight line intersects the zero drawdown axis.

Aquifer test data were also analyzed assuming leaky artesian conditions. This method utilizes Theis's non-equilibrium type curve in conjunction with an equation derived by Hantush and Jacob (1955) and a set of leaky artesian type curves developed by Walton (1960). Transmissivity, storativity, and leakance into the aquifer are calculated as follows:

$$T = \frac{114.6 * Q * W(u, r/B)}{\text{delta } s} \qquad (5.5)$$

$$S = \frac{T * u * t}{2693 * r^2} \qquad (5.6)$$

$$K = \frac{T * m' * (r/B)^2}{r^2} \qquad (5.7)$$

$$K'/m' = \text{leakance, gpd/ft}^3 \qquad (5.8)$$

where Q, S, T, t, r, and s are as above, W(u,r/B) and u are type curve match points, K' is the vertical hydraulic conductivity of the confining bed, in gpd/ft^2, and m' is thickness of the confining bed, in feet.

In addition to measuring drawdowns during pumping, water levels were measured during the recovery period. Recovery data were interpreted using techniques outlined in Driscoll (1986). One method involved plotting time against recovery data. Calculated recovery is the difference between extended-time drawdown and residual drawdown (Figure 15). Calculated recovery is plotted on a linear

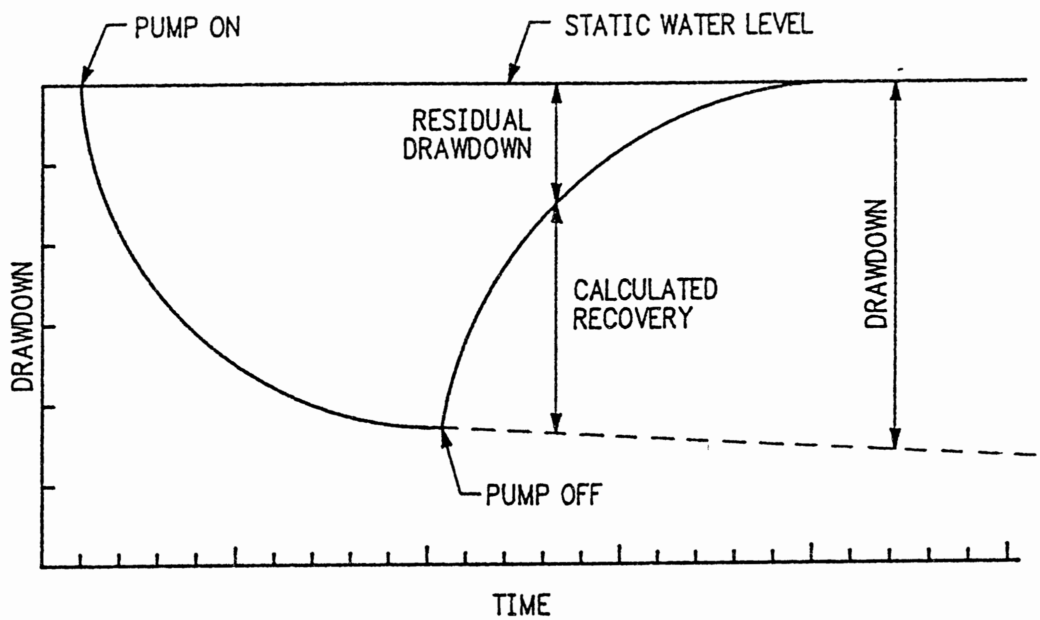

Figure 15. Water Levels During Pumping and Recovery, (modified from Driscoll, 1986)

scale against time (since pumping stopped) on a logarithmic scale. Transmissivity and storativity are calculated using the Jacob straight-line method. A second method uses residual drawdown calculated as the difference between the static water level (without pumping) and the measured water level during recovery. Residual drawdown is plotted against the ratio of time-since-pumping-started to time-since-pumping-stopped on a linear-log scale. Transmissivity is calculated using the Jacob, straight-line method. Storativity cannot be obtained from this plot: the horizontal scale represents a ratio without units.

Pitfalls of Data Interpretation

Theis developed his equation based on the following assumptions (Theis, 1935):

1. The water-bearing formation is uniform in character and the hydraulic conductivity is the same in all directions.
2. The formation is uniform in thickness and infinite in areal extent.
3. The formation receives no recharge from any source.
4. The pumped well penetrates, and receives water from, the full thickness of the water-bearing formation.
5. The water removed from storage is discharged instantaneously when the head is lowered.
6. The pumping well is 100-percent efficient.

7. All water removed from the well comes from aquifer storage.
8. Laminar flow exists throughout the well and aquifer.
9. The water table or potentiometric surface has no slope.

These assumptions are necessary to simplify derivation of the Theis equation, however, several of these assumptions are probably never met even under the most ideal conditions. When hydrogeologic conditions deviate from Theis's assumptions it is to be expected that the interpretation will be equally subject to error.

The geologic assumptions especially are not valid at the study site. Lithologies present there are neither homogeneous nor uniform in thickness, and the aquifers are not infinite in areal extent. The formation probably does receive some recharge; the shallow "B" and some of the "A" wells showed rising water levels during all or a portion of the pumping period. Precipitation data from two recording stations in the vicinity of the study area are located in Appendix E. Both indicate approximately four inches of rainfall during late October. When hydrogeologic conditions deviate from Theis' assumptions it is to be expected that data interpretation will be equally subject to error.

Water levels depicted on the flow net (Figure 13) indicate confined or semi-confined conditions in the aquifer penetrated by the "A" wells. Available head was consumed in the pumping well approximately 16 minutes after pumping began. After this time, dewatering of the aquifer and gravity drainage began, and the aquifer behaved as an unconfined aquifer. After approximately 116 minutes of pumping, drawdown exceeded aquifer thickness (the screen continues into the underlying shale, where the pump was set). This implies that there was considerable well loss, due, most likely, to turbulent flow. The aquifer was not totally dewatered but rather the discharge rate exceeded the capacity of the aquifer to deliver water to the well. Drawdown for the remainder of the pumping period, 75 percent of total pumping time, was from a level below the base of the stressed aquifer.

Departure from Ideal Drawdown Curves

The time-drawdown plot for observation well MW-10A is nearly straight, with virtually no indication of recharge or slow drainage. There appears to be very slight indication of low specific leakage. During pumping, reduction in head within the cone of depression may cause leakage from both above and below the aquifer (Driscoll, 1986).

On the residual drawdown - t/t′ plot, a residual drawdown of 14 inches is apparent as t/t′ approaches 1. This indicates incomplete recovery of the water level due to an aquifer of limited extent.

Time-drawdown data from observation well MW-10A displays a plot that is quite conformable with Theis's type curve. Under ideal conditions, points falling above the type curve indicate a negative boundary, while data points plotting below the type curve indicate recharge.

For pumping well MW-9A, the time-drawdown plot is very irregular. This may be primarily due to fluctuating discharge. If other factors, such as leakage or a limited aquifer, are affecting the plot its extreme irregularity masks those possibilities. Sudden increases in drawdown occur when available head is consumed and again when drawdown exceeds aquifer thickness (Figure 16).

Plotted valves of residual drawdown - t/t′ for the pumping well indicate a small t/t′ intercept at zero drawdown resulting from a variation in storativity. In theory, storativity is assumed constant during pumping and recovery periods. In practice, however, storativity probably varies and is apt to be greater during the pumping period than during subsequent recovery (Jacob, 1963). During pumping from an unconfined aquifer air occupies voids created during dewatering. During recovery the rising water level may trap some air bubbles in void spaces of the sandstone. Thus, a slightly smaller volume of water will refill the dewatered portion of the formation resulting in a correspondingly lower value of storativity during recovery (Driscoll, 1986).

Table III summarizes results of various techniques utilized to interpret the aquifer test data. In addition to

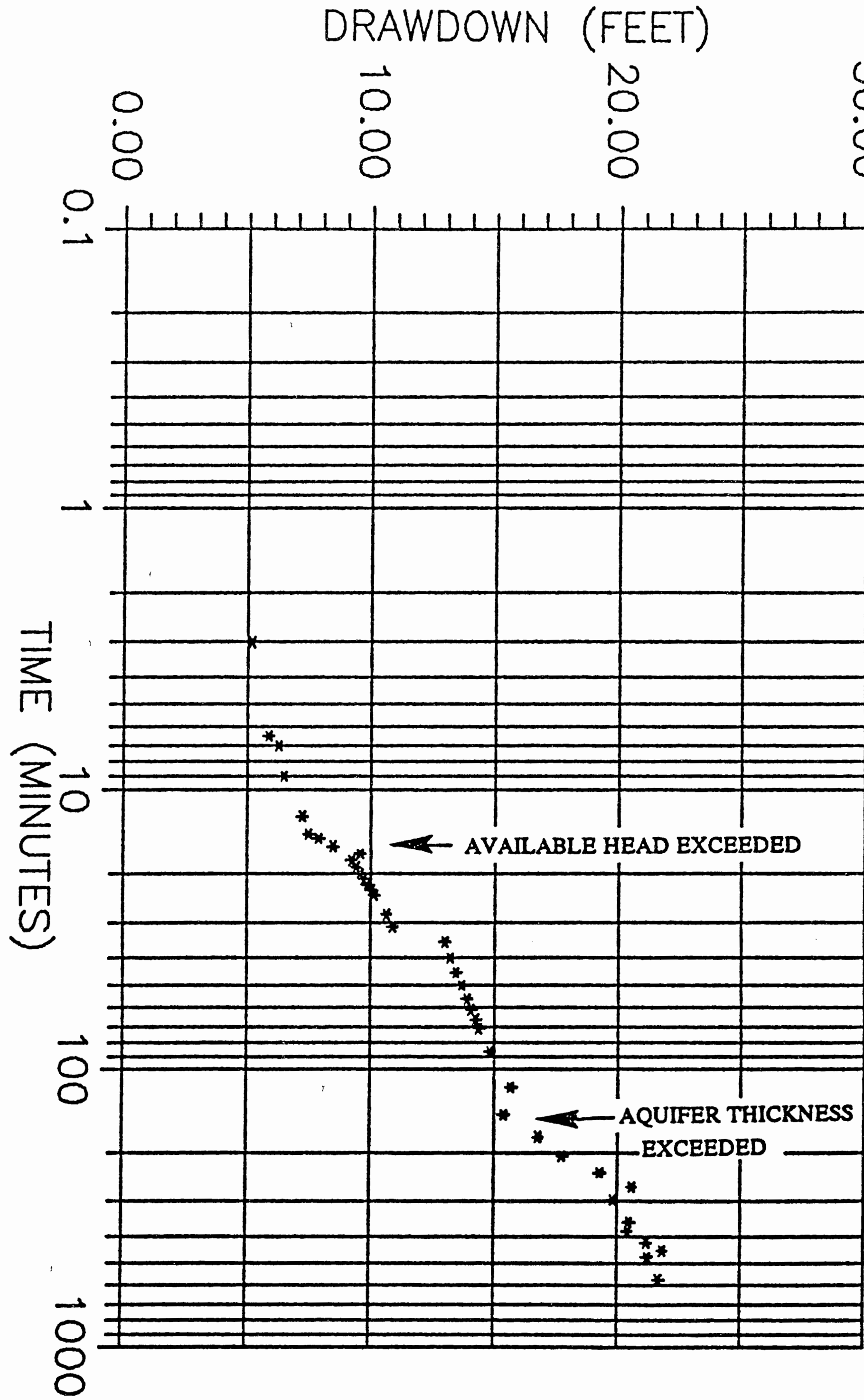

Figure 16. Time vs. Drawdown in Pumping Well 9-A.

the pumping well, MW-9A, sufficient drawdown was measured in only one observation well, MW-10A.

TABLE III

RESULTS OF AQUIFER TEST

OBSERVATION WELL MW-10A Average Q = 0.0625 gpm	T gpd/ft	S
JACOB METHOD		
Time - Drawdown	33.00	9.13×10^{-7}
Distance - Drawdown	6.11	7.46×10^{-5}
Time - Calculated Recovery	15.26	2.19×10^{-4}
T/T′ - Residual Drawdown	22.30	N.A.
THEIS METHOD		
Type-Curve Matching	37.69	3.23×10^{-6}
THEISFIT Program	35.18	6.15×10^{-6}
Leaky Artesian	37.69	3.23×10^{-6}

PUMPING WELL MW-9A Q = 0.0625 gpm	T gpd/ft	S
JACOB METHOD		
Time - Drawdown	4.46	N.A.
Time - Calculated Recovery	1.13	N.A.
T/T′ - Residual Drawdown	0.90	N.A.
THEIS METHOD		
Type-Curve Matching	2.59	1.65×10^{-2}
Type-Curve Matching, early data	8.95	9.77×10^{-3}
THEISFIT Program	2.02	1.31×10^{-2}
THEISFIT Program, early data	7.80	1.39×10^{-2}

Values of transmissivity calculated from the aquifer test range from 0.90 to 37.69 gpd/ft, and storativity ranges from 9.13×10^{-7} to 1.31×10^{-2}. Deviation from Theis's assumptions is at least partly responsible for this range of values. However, calculated values of transmissivity and storativity show relatively small variation when each well is considered individually.

Calculated values of transmissivity based on measurements from the pumping well are extremely low; 0.90 to 8.95 gpd/ft. If a confined or semi-confined aquifer is considered, then total discharge for the test exceeded what the aquifer was capable of producing under tested conditions; available head and saturated aquifer thickness were consumed by the test. No longer a confined system, using confined aquifer techniques to evaluate data the risks introducing error. Likewise, using unconfined techniques produce suspect results. For instance, what is the saturated thickness of the 'unconfined aquifer?' If the drawdown correction equation,

$$s' = s - (s^2/2m) \tag{5.9}$$

where s is drawdown and m is saturated thickness, is used, corrected drawdown values become invalid when S > m. Trying to compensate for this by introducing a 'corrected thickness' would require the use of data evaluation techniques not utilized in this study, such as described by Moench and Prickett, (1972).

Storativity values calculated from pumping well data are noteworthy. Regardless of how appropriate or inappropriate calculated transmissivity may seem, calculated storativity values are within the range of accepted values for an unconfined aquifer. In unconfined aquifers storativity is roughly equivalent to specific yield. Average values range from 0.01 to 0.30 (Freeze and Cherry, 1979).

Transmissivity and storativity values calculated from drawdown measurements in observation well MW-10A show relatively little range; 33.00 to 37.69 gpd/ft and 9.13 X 10^{-7} to 3.23 X 10^{-6} respectively. Recovery period measurements yield calculated transmissivity and storativity values of 15.26 to 22.30 gpd/ft and 2.19 X 10^{-4} respectively.

Aquifer Coefficients

While the range of calculated transmissivity values may seem great, in truth they are not. All transmissivity values indicate that well yield at the study site is extremely low. Because of the variable discharge rate and drawdown exceeding available head, as well as exceeding aquifer thickness, results for the production well MW-9A are questionable at best.

Time-drawdown plotting methods used with data collected from observation well MW-10A apparently have produced the most consistent values of transmissivity and storativity. From these values, mean transmissivity is calculated to be 36 gpd/ft and mean storativity is 2.00 X 10^{-6} (Table IV). This storativity value is 1 to 2 orders of magnitude too small.

TABLE IV

ACCEPTED VALUES OF AQUIFER TEST

OBSERVATION WELL MW-10A m = 8 feet	T gpd/ft	S	K gpd/ft^2
Jacob Method	33.00	9.13×10^{-7}	4.17
Type-Curve Matching	37.69	3.23×10^{-6}	4.71
THEISFIT Program	35.18	6.15×10^{-7}	4.40
Leaky Artesian	37.69	3.23×10^{-6}	4.71
MEAN	36	2.00×10^{-6}	4.50

For confined conditions, a storativity of 10^{-5} is assumed for fine-grained sandstone/siltstone formations (Driscoll, 1986). A generalized approach to estimate storativity is to multiply saturated thickness, in feet, times 10^{-6} (Pettyjohn, 1990). Leakage could reduce this value by at least one order of magnitude to 10^{-5}. The discrepancy between estimated and calculated storativity values is a reflection of the violation of Theis's assumptions; the aquifer is not homogeneous or uniform in thickness, water is not released instantly, and the aquifer is not infinite in areal extent.

Hydraulic conductivity (Table IV) was calculated by the equation:

$$K = T/m \tag{5.10}$$

where T is transmissivity derived from the aquifer test and m is saturated thickness in the pumping well.

CHAPTER VI

CONTAMINANT ASSESSMENT

Chemical Analyses of Soil and Groundwater Samples

Soil Samples

Soil and rock were collected during drilling and tested on-site for volatile hydrocarbons by means of a photoionization detector (PID). Select samples were collected for chemical analyses. Soil samples were analyzed for the following constituents:

		EPA Method
1.	Benzene	8010
2.	Toluene	8010
3.	Ethylbenzene	8010
4.	Xylene	8010
5.	Purgeable Halogenated Hydrocarbons	8010

Results of chemical analyses of soil/rock samples collected during drilling operations are presented in Table V. Concentrations are presented in units of ug/Kg (micrograms per kilograms), approximately equivalent to ppb (parts per billion). Generally, the highest degree of soil/rock contamination detected in the samples was found in

TABLE V

RESULTS OF CHEMICAL ANALYSIS OF SOIL/ROCK SAMPLES

SAMPLE LOCATION	DEPTH (FEET BLS)	SAMPLE DATE	*BENZENE* (μg/kg)	*TOLUENE* (μg/kg)	*ETHYLBENZENE* (μg/kg)	*XYLENE* (μg/kg)	*1,1,1-TCE* (μg/kg)	*TETRACHLO* (μg/kg)	*TRICHLORETH* (μg/kg)	*METH CHL* (μg/kg)	*1,1-DCA* (μg/kg)
MW-3B	3	03-08-91	ND	ND	ND	ND	ND	ND	ND	ND	ND
	7		ND	ND	ND	ND	ND	ND	ND	ND	ND
	13		ND	ND	ND	ND	511	ND	ND	ND	ND
	17		ND	ND	ND	ND	212	ND	ND	ND	ND
MW-5B	6	03-08-91	ND	4,697	ND	22,533	51,704	13,401	1,291	230	ND
	8		ND	ND	ND	ND	ND	ND	ND	ND	ND
	17		ND	ND	ND	ND	148	ND	ND	ND	ND
	20		ND	ND	ND	ND	112	ND	ND	ND	ND
MW-6A	12	03-04-91	ND	ND	ND	ND	ND	ND	ND	ND	ND
	14		ND	ND	ND	ND	312	ND	ND	ND	ND
	18		ND	ND	ND	ND	262	ND	ND	ND	ND
	23		ND	ND	ND	ND	ND	ND	ND	ND	ND
	33		60	900	1,300	6,900	ND	ND	ND	ND	ND
MW-7A	2	03-04-91	ND	ND	ND	ND	ND	ND	ND	ND	ND
	6		ND	212	318	1,268	569	ND	ND	ND	ND
	12		83	860	26	290	217	72	ND	ND	ND
	10		ND	ND	ND	ND	188	ND	ND	ND	ND
	17		ND	ND	ND	ND	766	ND	ND	ND	ND
	26		ND	ND	ND	ND	166	ND	ND	ND	ND
MW-8A	2	03-05-91	ND	ND	ND	ND	ND	ND	ND	ND	ND
	6		ND	ND	ND	ND	ND	ND	ND	ND	ND
	13		ND	ND	ND	ND	645	ND	ND	ND	ND
	20		ND	ND	ND	ND	223	ND	985	ND	ND
	27		ND	ND	ND	ND	289	ND	ND	ND	ND
	33		ND	ND	ND	ND	ND	ND	ND	ND	ND
MW-8B	1 5	03-05-91	ND	236	515	5,533	2,859	397	ND	ND	1,009
MW-9C	2	03-05-91	ND	ND	ND	ND	ND	ND	ND	ND	ND
	6		ND	ND	ND	ND	ND	ND	ND	ND	ND
	8		ND	ND	ND	116	246	196	769	ND	ND
	10		ND	ND	2,394	9,280	6,578	2,498	17,094	ND	ND
	14		ND	ND	ND	ND	343	ND	ND	ND	ND
	18		ND	ND	ND	ND	1,268	ND	ND	ND	ND
	25		ND	ND	ND	ND	180	ND	ND	ND	ND
	37		ND	ND	ND	ND	454	ND	ND	ND	ND
	56		ND	ND	ND	ND	836	ND	ND	ND	ND
	59		ND	ND	ND	ND	ND	ND	ND	ND	ND

those wells nearest the former UST system at a depth of approximately 6 feet. Chemical data for all analyses are located in Appendix F.

The lithology present at a depth of 6 feet in the vicinity of the former UST installation is the 'silty sandstone, shale and clay' interval depicted on the cross-sections. It consists of silty, fine-grained sandstone, thin, platy, grey to black shale interlaminated with fine-grained sandstone, and occasionally, silty clay. When this interval was observed in the core barrel it was generally badly crumbled and in pieces. It is believed that this interval represents a weathered, transition zone between bedrock and soil. Evidence would suggest the sandstone and/or platy shale provides one pathway for contaminant migration. To verify this, a small excavation was made with a jackhammer and a backhoe north of MW-5. At a depth of approximately 7 feet, moisture was observed seeping from bedding planes in a shale at that depth. Also, a strong "solvent" odor was reported emanating from the shale. A rock sample was collected from the base of the shale. Chemical analyses of that sample detected 2,000 ppb of 1,1,1-trichloroethane, as well as high concentrations of other chlorinated and aromatic hydrocarbons.

Analyses of soil/rock samples collected from MW-5B also showed the presence of extremely high concentrations of aromatic and chlorinated hydrocarbons in the sample collected at a depth of 6 feet (Table V). Samples collected at deeper depths suggest significantly lower concentrations of contaminants.

In addition to soil/rock samples collected at the drilling sites, eight shallow soil samples were collected manually at depths of 4 to 5 feet (Figure 17). A stainless steel auger was used to drill a pilot hole through which a soil probe was inserted to collect the sample. The purpose of these samples was to provide a broader investigation of possible shallow soil contamination should soil removal prove to be a viable option for site remediation. Low concentrations of benzene were detected in 7 of the 8 shallow soil samples. Results are summarized in Table VI.

Due to the level of benzene detected in the shallow soil samples, 9 additional locations were sampled at depths of 2 and 5 feet (Figure 18). Toxicity Characteristic Leachate Procedure (TCLP) for volatiles only, analyses were run on the 18 samples. All TCLP parameters, including benzene, were below detection limits. Results are presented in Appendix F.

A plausible explanation for the apparent detection of benzene in the first set of shallow soil samples is that it is simply a laboratory error. This was apparently verified by analysis of the second set of shallow soil samples.

Based on analyses of all soil sampling done, the soil horizons were determined to be relatively clean.

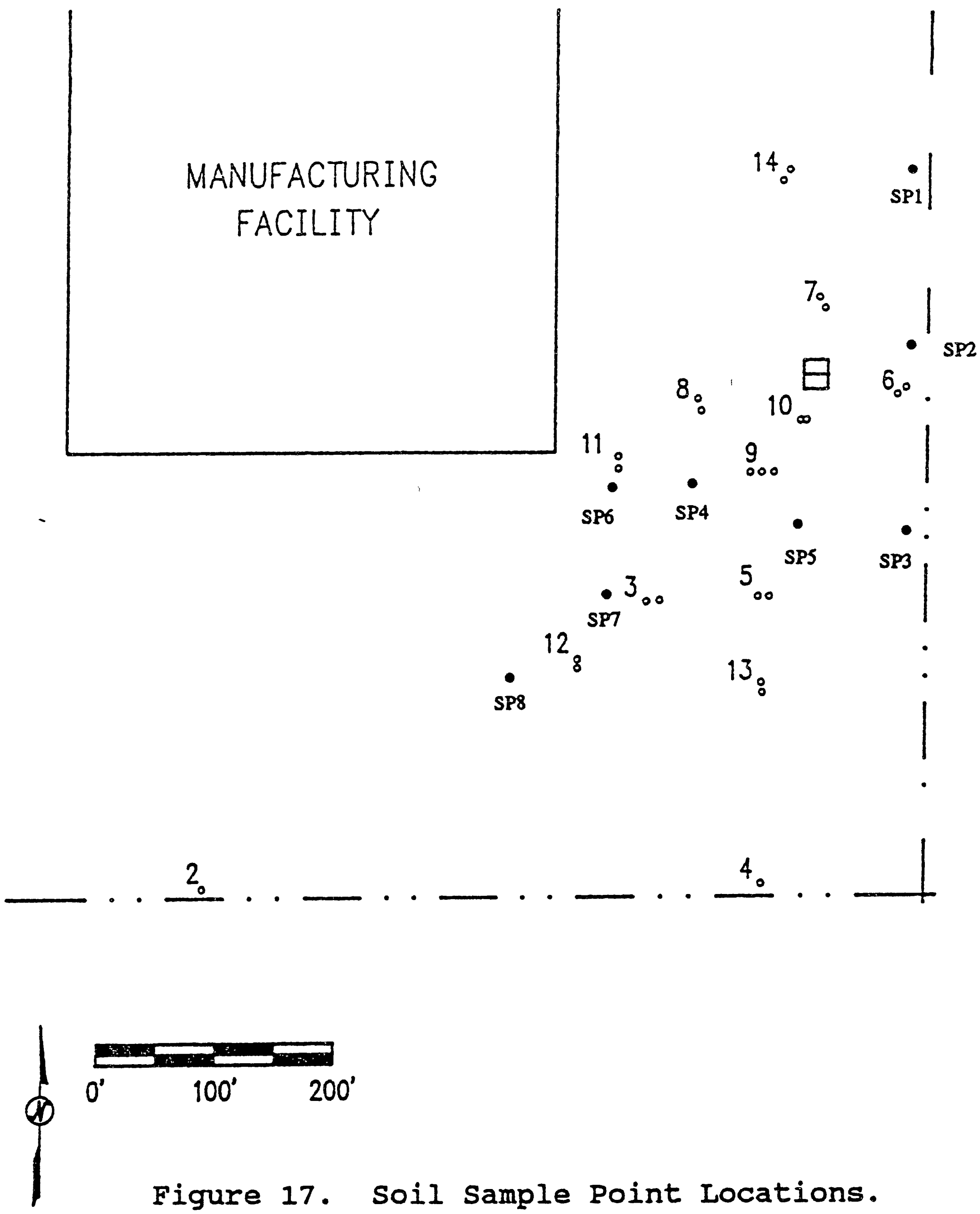

Figure 17. Soil Sample Point Locations.

TABLE VI

SHALLOW SOIL SAMPLE ANALYTICAL RESULTS

SAMPLE DATE: 1-25-91

SAMPLE LOCATION	DEPTH (FEET BLS)	SAMPLE NUMBER	BENZENE (µg/kg)	TOLUENE (µg/kg)	ETHYLBENZENE (µg/kq)	XYLENE (µg/kq)	1,1,1-TCA (µg/kg)	TETRACHLO (µg/kg)	TRICHLORETH (µg/kg)	METH CHL. (µg/kg)	1,1-DCA (µg/kg)
SP-1	5	045	ND	ND	ND	ND	ND	ND	ND	ND	ND
SP-2	4-5	046	614	ND	ND	ND	ND	ND	ND	ND	ND
SP-3	5	047	615	ND	ND	ND	ND	ND	ND	ND	ND
SP-4	4-5	048	539	ND	70	ND	ND	ND	ND	ND	ND
SP-5	4-5	049	664	ND	103	ND	ND	ND	ND	ND	ND
SP-6	4	050	448	ND	ND	ND	ND	ND	ND	ND	ND
SP-7	4	051	390	ND	ND	ND	ND	ND	ND	ND	ND
SP-8	4	052	521	ND	ND	ND	ND	ND	ND	ND	ND

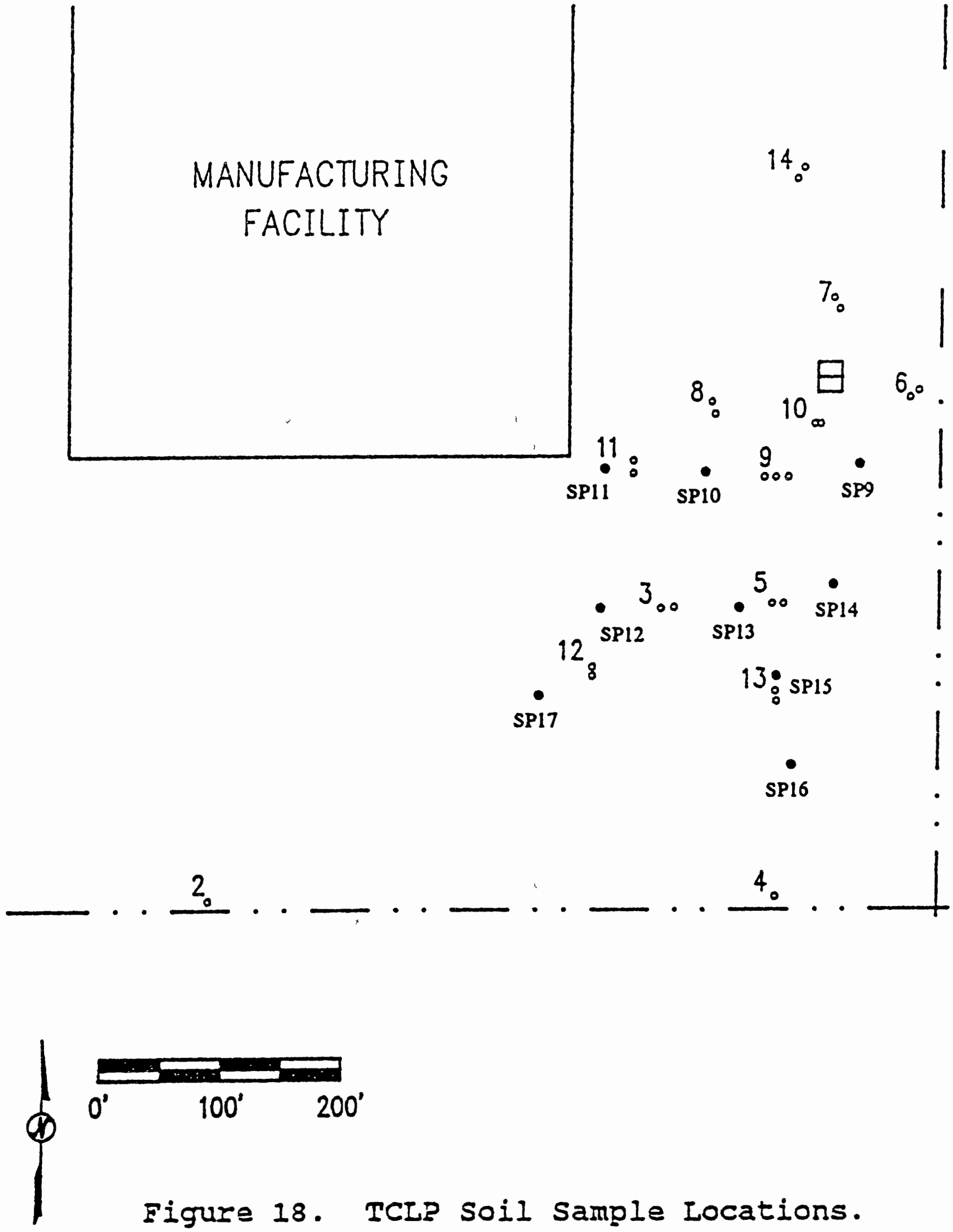

Figure 18. TCLP Soil Sample Locations.

Ground-water Samples

Ground-water samples were collected from all monitoring wells at the site. Samples were analyzed for the following constituents:

		EPA Method
1.	Benzene	8010 or 8240
2.	Toluene	"
3.	Ethylbenzene	"
4.	Xylene	"
5.	Purgeable Halogenated Hydrocarbons	"
6.	Lead	239.1
7.	Iron	236.1
8.	Manganese	243.1
9.	Total Dissolved Solids	160.2
10.	Total Hardness	130.2
11.	Calcium Hardness	130.1
12.	Chloride	325.3
13.	Sulfate	375.4
14.	Specific Conductance	120.1
15.	pH	150.1

All of the samples were not analyzed for all constituents listed above, but, all ground-water samples were analyzed for aromatic hydrocarbons and chlorinated hydrocarbons. Results of these analyses are summarized in Table VII, but only those constituents found in detectable concentrations are listed. Concentrations are listed in

TABLE VII

GROUND WATER SAMPLES, ANALYTICAL RESULTS SUMMARY

PARAMETER	WELL LOCATION NUMBER / SAMPLE DATE							
	MW-1		MW-2		MW-4			
	(05-08-91)	(12-20-90)	(03-28-91)	(05-02-91)	(12-20-90)	(03-28-90)	(05-08-91)	
Benzene	ND	ND	ND	ND	ND	ND	ND	ND
Toluene	ND	ND	ND	ND	ND	ND	ND	ND
Ethylbenzene	ND	ND	ND	ND	ND	ND	ND	ND
Xylenes	ND	ND	ND	ND	ND	ND	ND	ND
Tetrachloroethane	ND	ND	ND	ND	ND	ND	ND	ND
Trichloroethene	ND	ND	ND	5.3	ND	ND	9.4	ND
Methylene Chloride	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethane	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethene	ND	ND	ND	ND	ND	ND	10	ND
Chloroform	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dichloroethane	ND	ND	ND	ND	ND	ND	ND	ND
1,1,1-Trichloroethane	ND	ND	ND	100	ND	ND	184	ND
4-Methyl, 2-Pentanone	ND	ND	ND	ND	ND	ND	ND	-
Acetone	ND	ND	ND	ND	ND	ND	ND	-
2-Butanone	ND	ND	ND	ND	ND	ND	ND	-
1,2-Dichloropropane	ND	ND	ND	ND	ND	ND	ND	ND
1,1,2-Trichloroethane	ND	ND	ND	ND	ND	ND	ND	ND
Bromodichloromethane	ND	ND	ND	ND	ND	ND	ND	ND

TABLE VII (continued)

PARAMETER	WELL LOCATION NUMBER / SAMPLE DATE							
	MW-3A			MW-3B		MW-5A		
	(12-20-90)	(03-28-91)	(05-08-91)	(03-27-91)	(05-02-91)	(12-20-90)	(03-28-90)	(05-02-91)
Benzene	ND	ND	ND	ND	5 5	ND	ND	ND
Toluene	ND	22	ND	17	12	ND	10	ND
Ethylbenzene	ND	8.7	ND	ND	ND	ND	ND	ND
Xylenes	2.7	39	ND	ND	ND	ND	14	ND
Tetrachloroethane	ND	15	8 8	290	190	ND	5 2	ND
Trichloroethene	ND	66	260	3800	3900	ND	210	ND
Methylene Chloride	ND	ND	ND	400	ND	ND	ND	ND
1,1-Dichloroethane	ND	27	46	70	59	ND	ND	ND
1,1-Dichloroethene	ND	1600	3600	780	9700	ND	21	ND
Chloroform	ND	ND	ND	11	ND	ND	ND	ND
1,2-Dichloroethane	ND	3.8	11	17	19	ND	ND	ND
1,1,1-Trichloroethane	ND	1600	3000	7700	11000	ND	150	ND
4-Methyl, 2-Pentanone	ND	84	-	720	NA	ND	1400	NA
Acetone	ND	ND	-	ND	NA	ND	ND	NA
2-Butanone	ND	ND	-	ND	NA	ND	ND	NA
1,2-Dichloropropane	ND	ND	ND	ND	ND	ND	ND	ND
1,1,2-Trichloroethane	ND	ND	ND	ND	ND	ND	ND	ND
Bromodichloromethane	ND	ND	ND	ND	NA	ND	ND	NA

TABLE VII (continued)

PARAMETER	WELL LOCATION NUMBER / SAMPLE DATE					
	MW-5B		MW-6A		MW-6B	
	(03-27-91)	(05-02-91)	(03-26-91)	(04-25-91)	(03-26-91)	(04-25-91)
Benzene	ND	21	ND	ND	ND	ND
Toluene	4100	4 1	ND	ND	ND	ND
Ethylbenzene	1800	2300	ND	ND	ND	ND
Xylenes	3800	3700	ND	ND	ND	ND
Tetrachloroethane	4300	4000	ND	ND	ND	ND
Trichloroethene	5400	6900	ND	59	8 3	ND
Methylene Chloride	670	1500	ND	ND	ND	ND
1,1-Dichloroethane	2300	3300	ND	ND	ND	ND
1,1-Dichloroethene	2400	12000	ND	160	ND	ND
Chloroform	18	19	ND	ND	ND	ND
1,2-Dichloroethane	110	190	ND	ND	ND	ND
1,1,1-Trichloroethane	9400	11000	64	17	43	ND
4-Methyl, 2-Pentanone	6500	NA	ND	NA	ND	NA
Acetone	ND	NA	ND	NA	ND	NA
2-Butanone	ND	NA	ND	NA	ND	NA
1,2-Dichloropropane	32	47	ND	ND	ND	ND
1,1,2-Trichloroethane	21	36	ND	ND	ND	ND
Bromodichloromethane	ND	NA	ND	ND	ND	ND

TABLE VII (continued)

PARAMETER	MW-7A		MW-7B		MW-8A		SAMW-08B	
	(03-27-91)	(05-02-91)	(03-27-91)	(05-02-91)	(03-27-91)	(04-25-91)	(03-27-91)	(04-25-91)
Benzene	ND	ND	ND	ND	ND	ND	ND	ND
Toluene	ND	10	35	250	ND	ND	ND	ND
Ethylbenzene	ND	ND	18	34	ND	ND	ND	ND
Xylenes	ND	11	ND	120	ND	ND	ND	ND
Tetrachloroethane	ND	15	610	580	ND	ND	9 4	4 5
Trichloroethene	ND	35	2900	2100	ND	ND	52	42
Methylene Chloride	ND	ND	520	950	ND	ND	ND	ND
1,1-Dichloroethane	ND	42	1600	2700	ND	ND	310	350
1,1-Dichloroethene	ND	62	260	5300	ND	ND	5 9	ND
Chloroform	ND	ND	14	13	ND	ND	ND	ND
1,2-Dichloroethane	ND	ND	18	24	ND	ND	ND	ND
1,1,1-Trichloroethane	46	720	10200	15000	54	ND	130	44
4-Methyl, 2-Pentanone	ND	NA	ND	NA	ND	NA	ND	NA
Acetone	ND	NA	ND	NA	ND	NA	ND	NA
2-Butanone	ND	NA	ND	NA	ND	NA	ND	NA
1,2-Dichloropropane	ND	ND	ND	ND	ND	ND	ND	ND
1,1,2-Trichloroethane	ND	ND	ND	17	ND	ND	ND	ND
Bromodichloromethane	ND	NA	ND	NA	ND	NA	ND	NA

TABLE VII (continued)

PARAMETER	WELL LOCATION NUMBER / SAMPLE DATE						
	MW-9C		MW-9A			MW-9B	
	(03-28-91)	(05-02-91)	(05-29-91)	(03-28-91)	(04-25-91)	(03-28-91)	(04-25-91)
Benzene	ND	ND	ND	ND	ND	13	13
Toluene	ND	160	ND	ND	ND	630	3100
Ethylbenzene	ND	97	ND	ND	ND	750	690
Xylenes	ND	300	ND	ND	ND	2000	1800
Tetrachloroethane	ND	140	ND	ND	ND	1900	1600
Trichloroethene	6.4	151	ND	23	ND	4300	14000
Methylene Chloride	ND	ND	ND	ND	ND	8600	17000
1,1-Dichloroethane	ND	30	ND	ND	ND	1800	2100
1,1-Dichloroethene	14	630	ND	32	ND	1500	5500
Chloroform	ND	ND	ND	ND	ND	27	38
1,2-Dichloroethane	ND	4 2	ND	ND	ND	520	550
1,1,1-Trichloroethane	30	6400	5.2	54	ND	12000	21000
4-Methyl, 2-Pentanone	ND	NA	ND	ND	NA	ND	NA
Acetone	ND	NA	ND	ND	NA	5400	NA
2-Butanone	ND	NA	ND	ND	NA	220	NA
1,2-Dichloropropane	ND	ND	ND	ND	ND	21	21
1,1,2-Trichloroethane	ND	ND	ND	ND	ND	120	140
Bromodichloromethane	ND	NA	ND	ND	NA	9.8	5 7

TABLE VII (continued)

PARAMETER	WELL LOCATION NUMBER / SAMPLE DATE			
	MW-10A		MW-10B	
	(03-27-91)	(04-25-91)	(03-27-91)	(04-25-91)
Benzene	ND	ND	11	11
Toluene	39	140	2400	3100
Ethylbenzene	13	24	610	680
Xylenes	11	67	1500	1600
Tetrachloroethane	660	330	1600	1500
Trichloroethene	5800	6300	11000	13000
Methylene Chloride	1260	2700	6600	13000
1,1-Dichloroethane	350	450	2800	3600
1,1-Dichloroethene	350	3900	820	4400
Chloroform	13	11	26	16
1,2-Dichloroethane	22	24	350	260
1,1,1-Trichloroethane	9560	13000	17000	23000
4-Methyl, 2-Pentanone	53	NA	21000	NA
Acetone	ND	NA	6800	NA
2-Butanone	ND	NA	330	NA
1,2-Dichloropropane	ND	ND	20	23
1,1,2-Trichloroethane	ND	5 9	84	56
Bromodichloromethane	ND	ND	ND	ND

NOTE: All units in ug/l

units of ug/l (micrograms per liter), approximately equivalent to ppb (parts per billion).

Laboratory results indicate that ground water in the vicinity of the former UST installation is contaminated with aromatic and chlorinated hydrocarbons. Dense, nonaqueous phase, free product was detected only in MW-5B. Free product migrated south from the former UST installation, perhaps along bedding planes, through the interlaminated silty sandstone-shale facies at a depth of 6 to 8 feet. The heavier-than-water free product is migrating downgradient as a 'slug'. No free product has been detected in MW-9B or MW-10B.

Ground-water contaminated with aromatic and chlorinated hydrocarbons surrounds the former site of the UST's. The ground-water mound beneath the UST excavation has apparently created a localized ground-water gradient sufficiently steep to allow contaminants to migrate northward against the regional ground-water gradient.

Figure 19 shows the distribution of 1,1,1-trichloroethane measured on March 27, 1991 in the shallow, "B" wells. Concentration is presented in units of ppm (parts per million, ppm = ppb/1000) on the map(s) for the sake of clarity. Since 1,1,1-trichloroethane occurred consistently in the highest concentrations, and was the most widely distributed organic compound, it was chosen to define the extent of contamination at the study site. The "B" wells are screened at a depth ranging from approximately 4

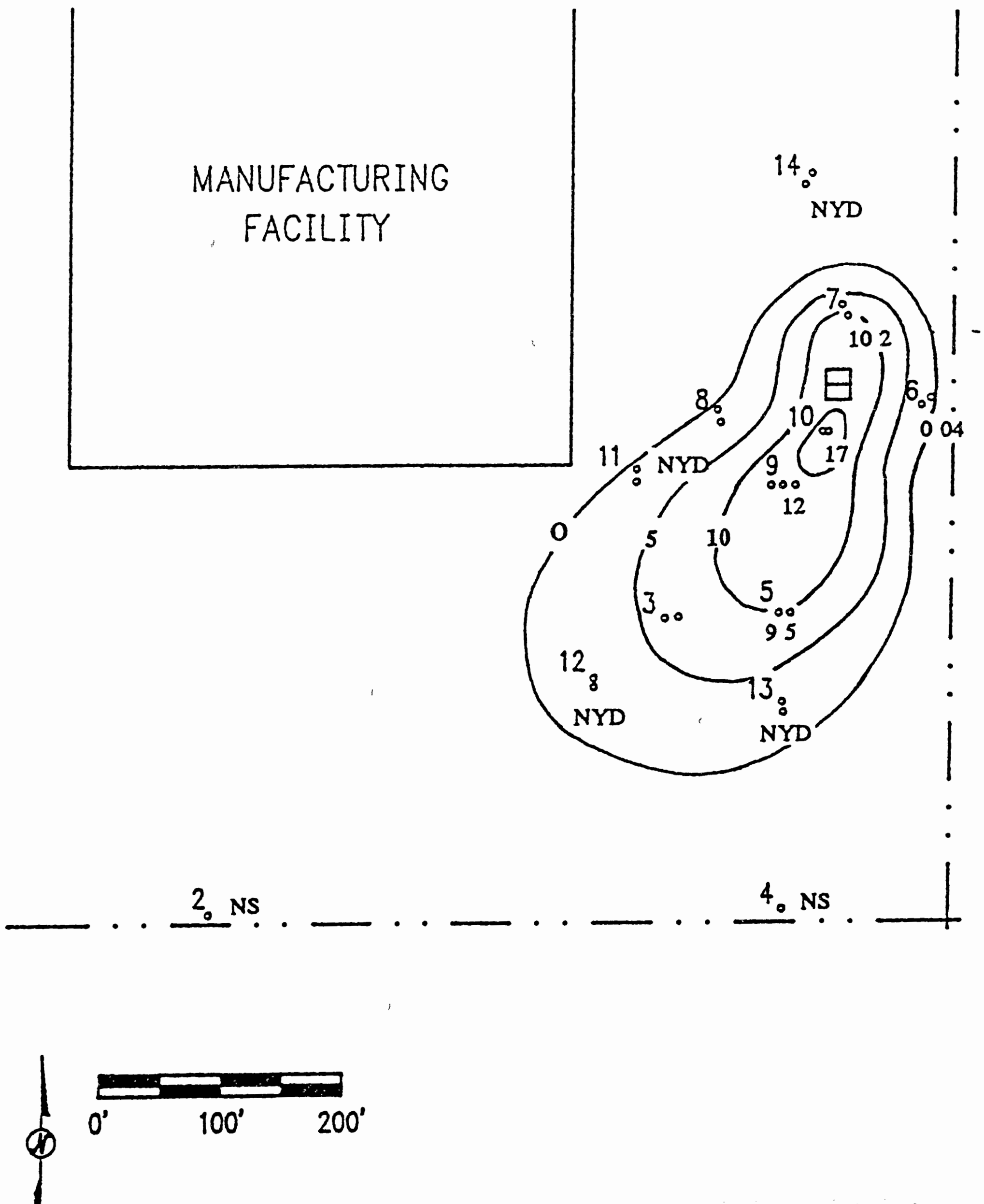

Figure 19. 1,1,1-Trichloroethane Concentration (ppm) in the 15 feet Deep "B" Wells, Sample Date 27 March 1991, Contour Interval = 5 ppm, NS = Not Sampled, NYD = Not Yet Drilled as of Sample Date.

to 15 feet. The map indicates a contaminant plume migrating to the south and southwest along the direction of regional flow, and lesser migration of contaminants east, west and north. Concentrations of 10 ppm have been detected approximately 200 feet downgradient from the UST site.

Figures 20 and 21 also are isoconcentration maps of 1,1,1-trichloroethane levels in the "B" wells, that represent later sampling dates. Figure 20 depicts the plume approximately one month later at the end of April 1991. Concentration of 1,1,1-trichloroethane has increased in all but two wells, extending the leading edge of contamination farther south-southwest and surprisingly, farther north as well. Concentrations as high as 11 ppm have been detected more than 250 feet downgradient and concentration increased 50% to 15 ppm 50 feet north of the UST's. Contaminant levels decreased east and west of the former UST system.

There is an apparent preference for a nearly north-south migration of contaminants. Figure 21 reflects 1,1,1-trichloroethane concentrations in ground-water samples collected on December 18, 1991; only wells installed during the final phase of drilling were sampled. This map suggests that the eastern, southern, and western boundaries of the plume have moved little, if any, since May 1991. However, low levels of contaminant were detected in MW-14B, extending the northern leading edge of the plume approximately 100 feet north of the former UST installation. The increase in 1,1,1-trichloroethane concentration from April to May in

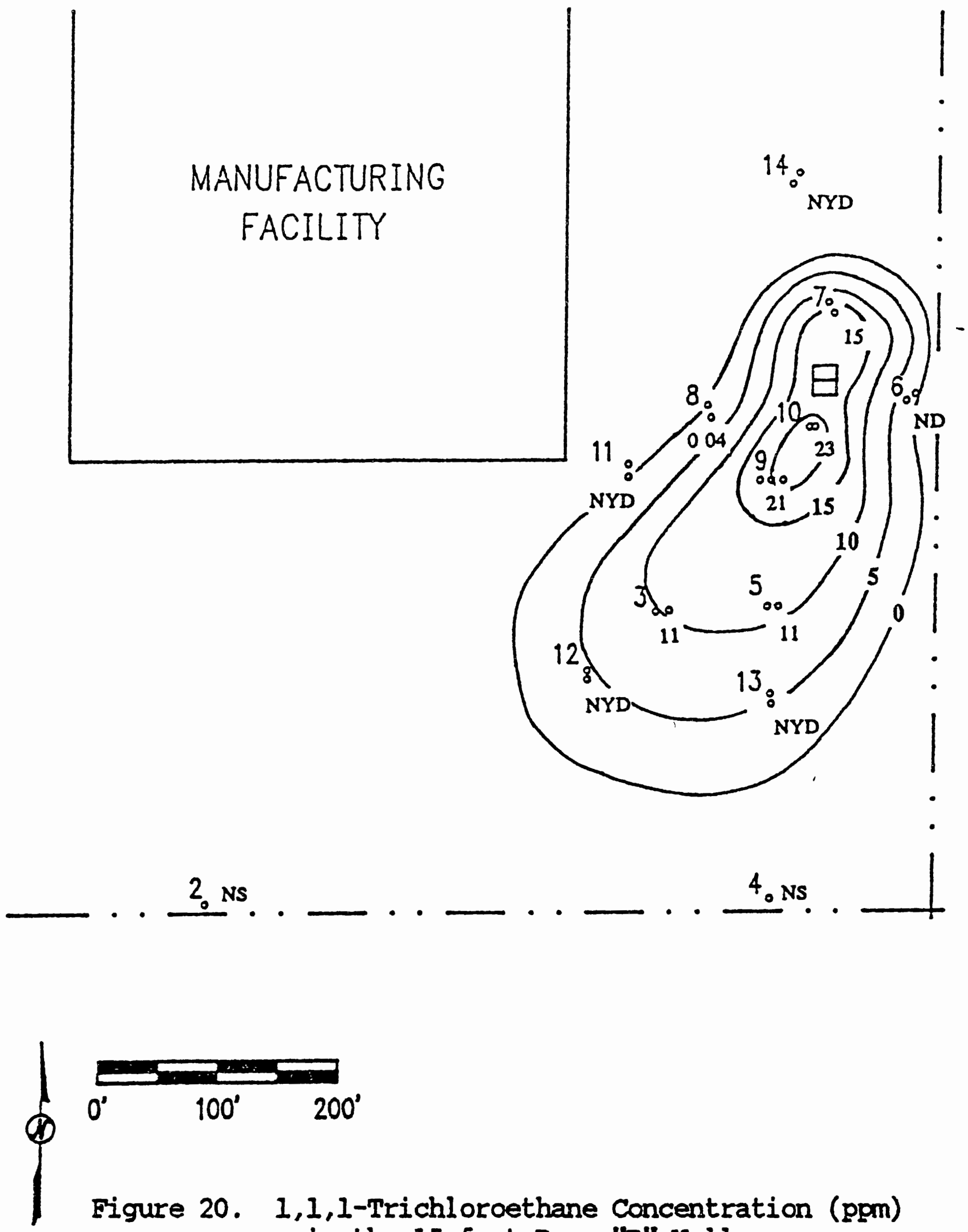

Figure 20. 1,1,1-Trichloroethane Concentration (ppm) in the 15 feet Deep "B" Wells, Sample Date 25 April - 2 May 1991, Contour Interval = 5 ppm, ND = None Detected, NS = Not Sampled, NYD = Not Yet Drilled as of Sample Date.

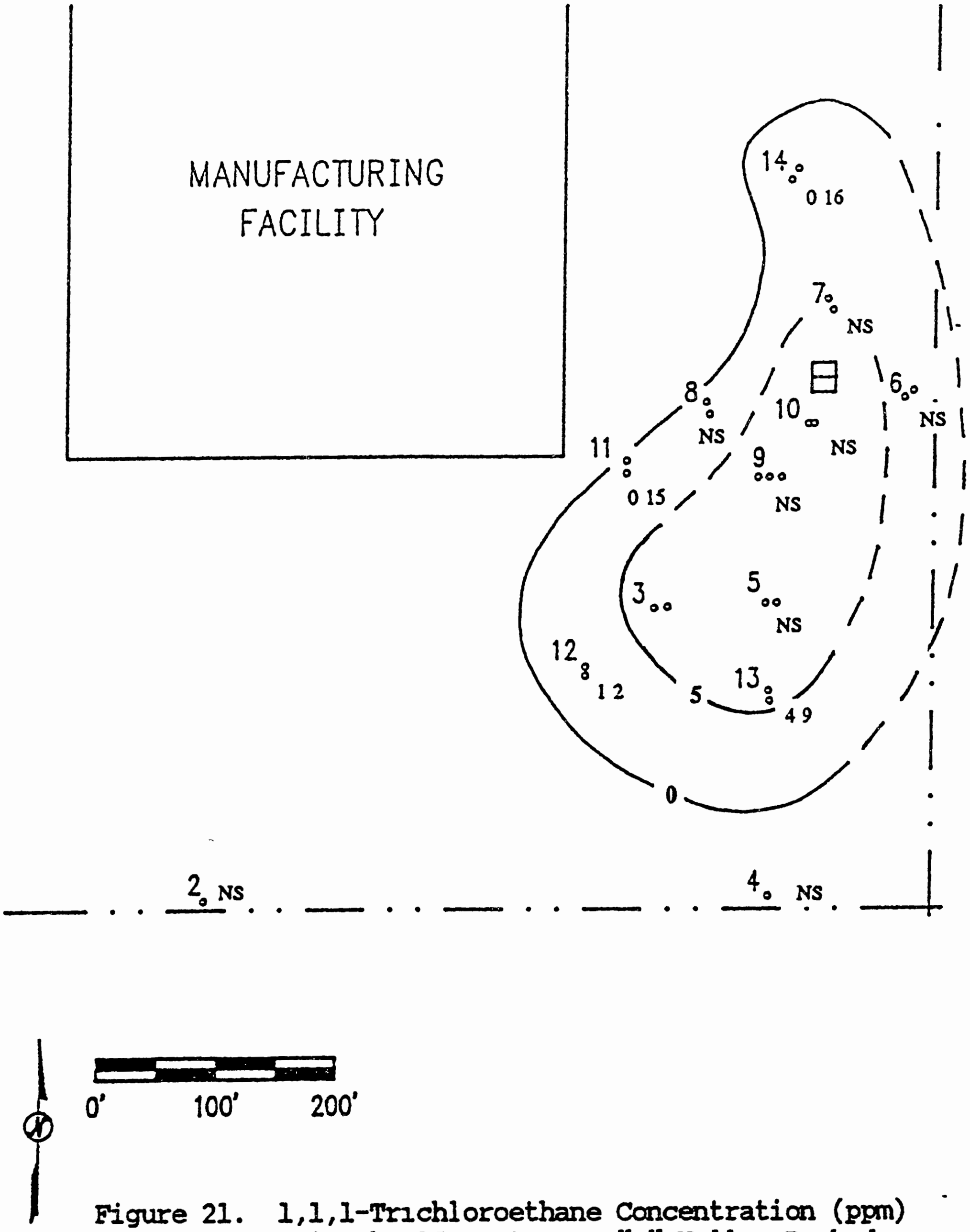

Figure 21. 1,1,1-Trichloroethane Concentration (ppm) in the 15 Feet Deep "B" Wells, Dashed Where Inferred, Contour Interval = 5 ppm, Sample Date 18 December 1991, NS = Not Sampled, NYD = Not Yet Drilled as of Sample Date.

MW-9B and MW-10B, indicates the slow migration rate of the contaminant plume. Dispersion and diffusion have apparently carried the leading edge of the plume over 250 feet downgradient while the main body of contamination has migrated only approximately 75 feet. This suggests an extremely low ground water velocity.

Results of chemical analyses of ground water samples collected from the deeper, "A" wells, suggests a relatively limited areal extent of contamination. Five wells were sampled on December 19, 1990: MW-1, MW-2, MW-3A, MW-4, and MW-5A. No aromatic or chlorinated hydrocarbons were detected. Figure 22 and Figure 23 reflect 1,1,1-trichloroethane concentrations in ground-water samples collected from "A" wells on March 26-28, and on April 25 - May 8, 1991, respectively. The contours indicate contamination in the immediate vicinity of the former UST installation only.

No contamination has been detected in the upgradient background well, MW-1. Although one set of ground-water samples collected from downgradient wells MW-2 and MW-4 were reported as containing very low levels of chlorinated hydrocarbons, other sets of samples from these wells indicate no contamination. Based on results of ground water analyses, contamination from releases from the former UST installation has not migrated beyond property boundaries.

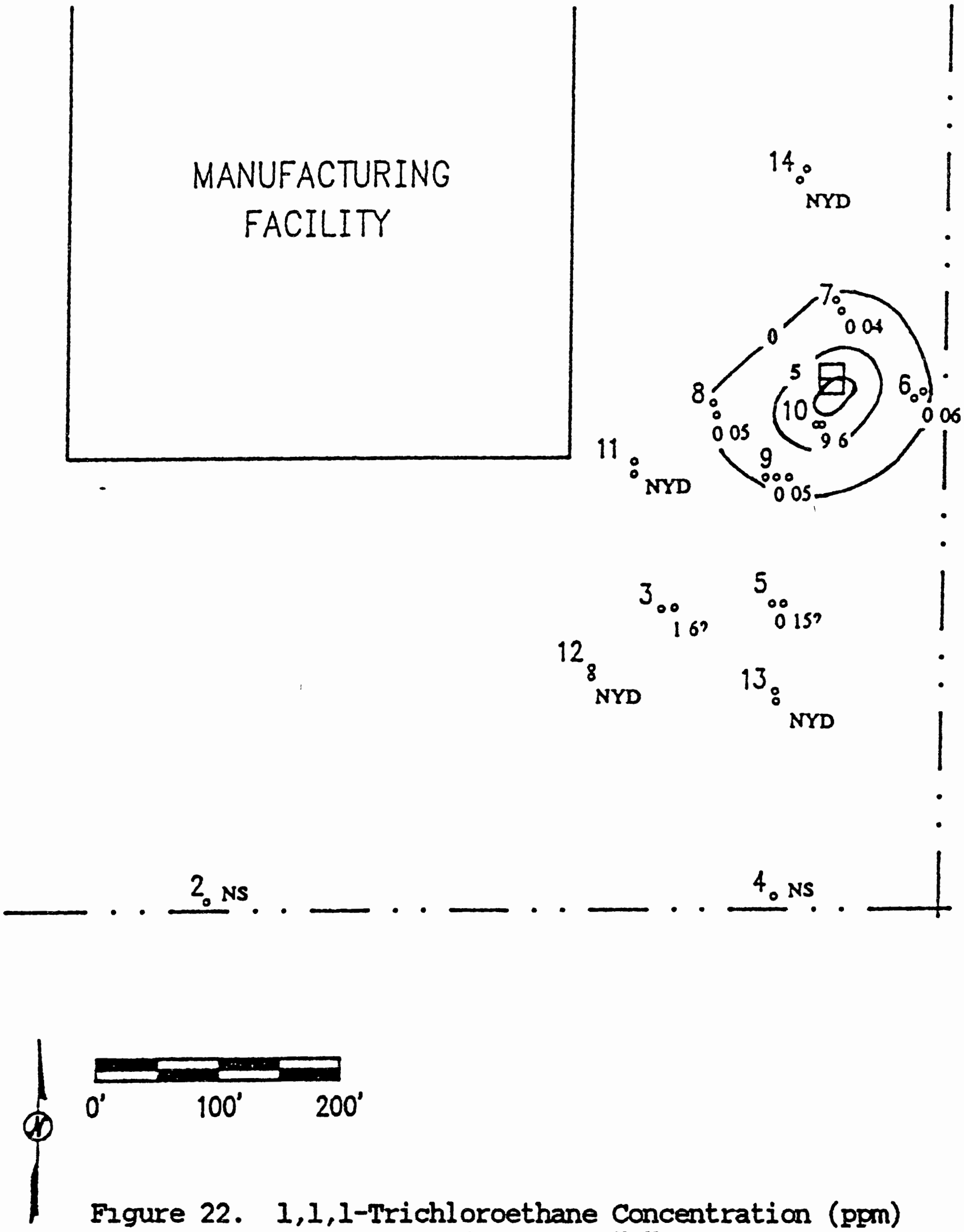

Figure 22. 1,1,1-Trichloroethane Concentration (ppm) in the 30 feet Deep "A" Wells, Sample Date 26-28 March 1991, Contour Interval = 5 ppm, NS = Not Sampled, NYD = Not Yet Drilled as of Sample Date.

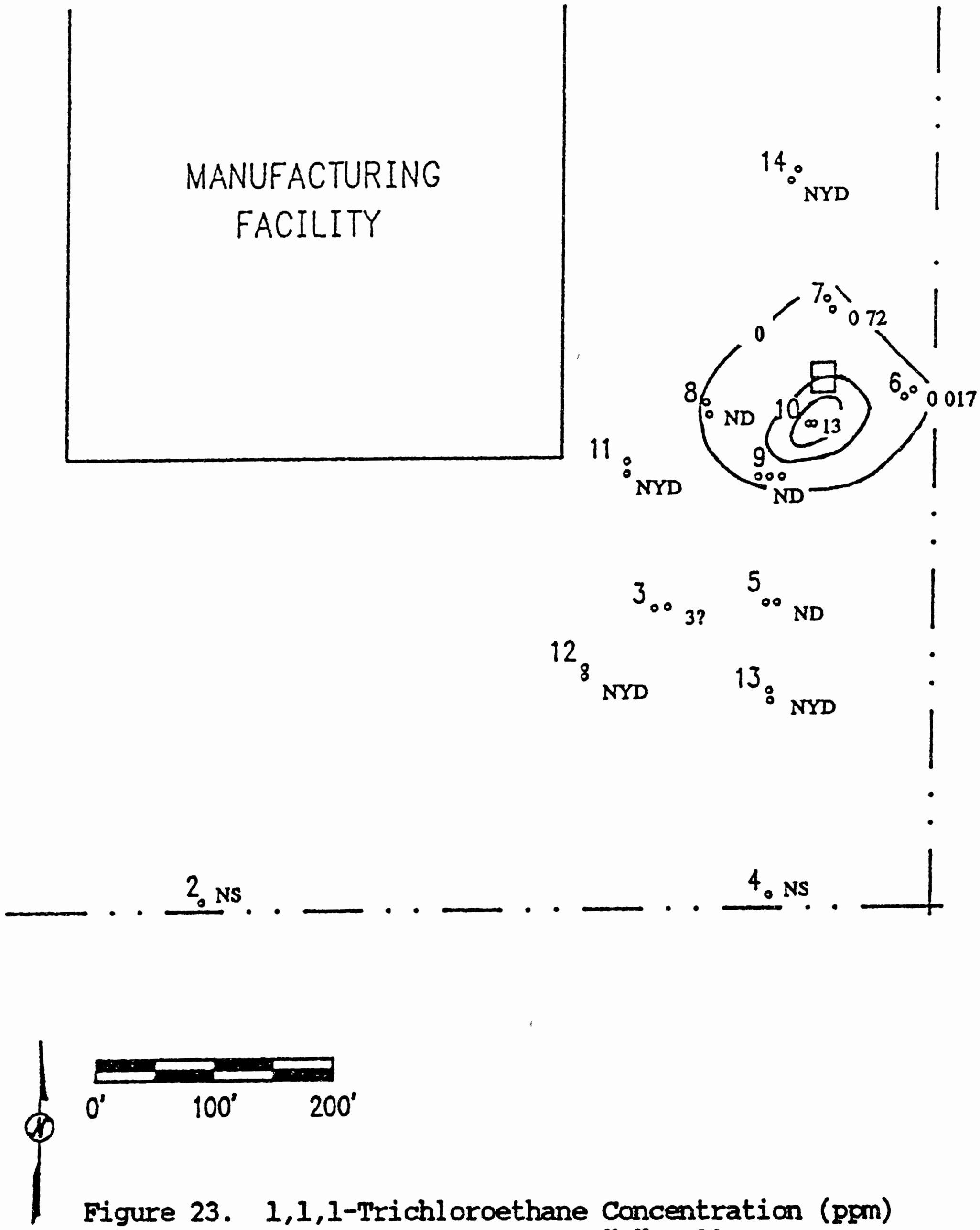

Figure 23. 1,1,1-Trichloroethane Concentration (ppm) in the 30 feet Deep "A" Wells, Sample Date 25 April - 8 May 1991, Contour Interval = 5 ppm, ND = None Detected, NS = Not Sampled, NYD = Not Yet Drilled as of Sample Date.

Sampling Data Anomalies

Two anomalies on Figure 22 are noteworthy. Levels of contaminant detected in MW-3A are considered non-representative. Well screen in MW-3A extends from a depth of 5 to 25 feet, and the screen is set across the deeper "A" zones, as well as the shallow "B" zones. It is suspected that contaminants enter MW-3A from the shallow silty sandstone, shale and clay interval; MW-3A may be a conduit for contaminant migration from the shallow to a deeper aquifer. For this reason, during the third phase of drilling in November 1991, MW-3A was drilled out, grouted to surface and abandoned.

A second anomaly on Figure 22 is the apparent level of 1,1,1-trichloroethane (0.15 ppm), measured on March 28, 1991 in MW-5A. Analysis of a sample collected December 20, 1990 from MW-5A indicated no hydrocarbon contamination, nor did a sample collected on May 5, 1991. The anomalous sample of March 28, 1991 is most likely a result of bailer cross-contamination, as dedicated bailers were not in place for all wells at that time.

It is also suspected that bailer cross-contamination is responsible for contaminants detected in MW-9C on May 2, 1991. The field log indicates MW-9C was sampled immediately following sample collection from MW-5B, the well containing dense phase non-aqueous free product. Although bailers are decontaminated between each sampling, the introduction of contaminants to a borehole via bailer contamination does occasionally occur.

There is reason to suspect laboratory analytical errors occurred as well. This may explain some analytical results that do not correlate with other analyses or what would be expected from other data gathered at the site. For example, a soil sample collected at a depth of 33 feet from MW-6A was reported to contain 6400 ug/Kg xylenes and 1300 ug/Kg ethylbenzene. However, no detectable concentrations of these compounds were present in ground-water samples from MW-6A. Also, xylene and ethylbenzene are lighter-than-water aromatic compounds. No heavier-than-water chlorinated hydrocarbons were detected.

Other examples of questionable analytical analyses are from MW-2 and MW-4. Analytical results for these wells reported detectable concentrations of hydrocarbon contaminants from one sampling date (3/28/91), while an earlier and later sample from each well (12/20/90 & 5/2/91) were clean. It is suspected that the apparent contamination was a result of bailer cross-contamination or an analytical error in the laboratory.

CHAPTER VII

SITE GEOCHEMISTRY

Introduction

The most commonly detected contaminant present at the study site is 1,1,1-trichloroethane. It is used within the manufacturing facility as a solvent. Chemical analyses of ground-water samples from the site have shown that, in addition to 1,1,1-trichloroethane, other chlorinated and aromatic hydrocarbons also are present. The question arises as to their origin.

When a solvent is used as a degreaser the dissolved grease is incorporated into the solvent. Degreasing produces additional hydrocarbons. When a solvent is recycled it undergoes a distillation process. Distillation of 1,1,1-trichloroethane can produce other chlorinated hydrocarbons including 1,1-dichloroethane, 1,1-dichloroethene, 1,2-dichlorethane, and trichloroethene (Thom, 1992). Recycled 1,1,1-trichloroethane was used periodically in the plant.

Degreasing internal combustion engines might introduce benzene, toluene, ethylbenzene, and xylenes into the spent solvent. Cold cleaning and vapor degreasing can introduce dichloromethane, trichloromethane, and tetrachloroethene

(Thom, 1992). Some cutting oils contain high concentrations of trichloroethylene and toluene (Althoff and others, 1981). Recycled solvent is a virtual chemical gene pool of all solvent, oil, grease, tar, and other chemicals introduced to the spent solvent stock by industrial processes.

Ground-water Chemistry

Ground-water chemistry is affected by the composition and concentration of contaminants and chemical processes occurring in the ground-water reservoir. These processes include sorption/desorption, volatilization, ion exchange, dissolution/precipitation, and oxidation-reduction reactions.

Five wells at the study site were sampled for water quality and inorganic constituents in late March 1991: MW-5A, MW-5B, MW-9A, MW-9B and MW-9C. Parameters consisted of pH, total dissolved solids (TDS), total hardness, calcium hardness, chloride, sulfate, iron, manganese, and specific conductivity (Table VIII). Complete analyses are listed in Appendix F.

Elevated levels of sulfate are present in two wells, MW-5B and MW-9B. While the mean sulfate concentrations is 140 mg/l in the other three wells (155 mg/l in MW-5A, 77.5 mg/l in MW-9A, and 190 mg/l in MW-9C), sulfate concentration is 2280 mg/l and 895 mg/l in MW-5B and MW-9B, respectively. Concentrations of total dissolved solids and hardness are

TABLE VIII

WATER QUALITY ANALYSES

	Analysis Result				
Analysis	MW-9C	MW-9A	MW-9B	MW-5A	MW-5B
pH	7.0	6.9	5.8	6.6	6.0
TDS	688	440	2710	564	4310
Hardness Total	280	156	2600	96	1220
Hardness (Ca)	136	90	576	60	612
Cl	5.0	11.5	128	7.0	24.0
SO_4	190	77.5	895	155	2280
Fe	<0.1	<0.1	<0.1	<0.1	0.1
Mn	<0.5	<0.5	20.4	<0.5	2.2
Spec.Cond.	414	231	1860	293	2650

Date Sampled: 3/28/91
All units in mg/l except pH (standard units) and Specific Conductivity (umhos/cm^2) unless otherwise noted.

elevated as well, indicating that additional inorganic ions may be present.

It is possible that the elevated level of sulfate detected in the water-table aquifer ("B" wells) is due to the presence of coal-bearing formations in northern Rogers County. As with sulfate, concentration of manganese is highest in MW-5B and MW-9B where it is 2.2 mg/l and 20.4 mg/l, respectively. Manganese concentrations are below detection level (0.5 mg/l) in the deeper wells sampled. Reducing conditions in ground water, often associated with coal mining, can increase the solubility and mobility of many ions, such as manganese. It is also possible that the former UST system is a source of both organic and inorganic contaminants.

The acidic pH measured in MW-5B and MW-9B which was 6.0 and 5.8 respectively, could be a result of coal-associated, acid drainage, or it may be due to the contaminant itself. 1,1,1-trichloroethane was tested for pH using litmus paper. It was found to have a pH of approximately 5.0 (Powers, 1992). The oxidation-reduction potential (ORP) of 1,1,1-trichloroethane was measured as 0.182 volts using an ORP electrode (Powers, 1992). This would indicate reducing conditions within the contaminant itself.

Water quality analyses from off-site were examined, in an attempt to identify a particular water quality, characteristic to particular aquifers present at the site. Sources of ground-water analyses were publications of the

United States Geological Survey, the Oklahoma Geological Survey, and the National Water Data Exchange (NAWDEX).

More than 100 water-quality analyses from Rogers County were examined. Most analyses did not have well depth or depth-to-water information available. Depth data that was available was not sufficiently detailed to be applicable to the site's aquifers. However, several conclusions are apparent concerning water quality in Rogers County. A summary of chemical analyses of water from Pennsylvanian shale, siltstone, and sandstone reveal that approximately 23 percent contained more than 250 mg/l sulfate, and 62 percent contained more than 500 mg/l total dissolved solids. Water from sandstone is least mineralized, whereas that from shale, particularly shale containing coal beds, is most mineralized (Marcher and Bingham, 1971). Only 5 percent of Rogers County water analyses from the NAWDEX data base contained more than 1000 mg/l of sulfate. Drainage from abandoned lead-zinc and coal mines has caused water-quality changes. Water in the mine shafts contain large concentrations of iron, manganese, zinc, and other trace elements and large concentrations of dissolved solids, principally sulfate (Moody and others, 1986).

Whether the elevated concentrations of these compounds, together with a lower pH, is indigenous to the shallow, "B" aquifer, or, is a result of or a part of the contaminant plume, could be determined through more wide-spread sampling and analysis of ground water at the site.

The areal distribution of sulfate may be similar to that of 1,1,1-trichloroethane. It is also possible that the elevated levels of inorganic ions detected are due to biological activity or ion exchange.

Nature and Mobility of Chlorinated Hydrocarbons

The principle contaminants detected at the site, in general order of decreasing concentration, were 1,1,1-trichloroethane, 1,1-dichloroethene and trichloroethene. These compounds are technically considered halogenated aliphatic hydrocarbons, containing chlorine atoms of the halogen group.

Overall, these compounds are only slightly soluble in water (Table IX). An exception is 1,1,1-trichloroethane, whose solubility in water reportedly ranges from 480 mg/l to 4400 mg/l (Montgomery and Welkom, 1990). These compounds are "sinkers", having a specific gravity greater than water. When present in concentrations in excess of aqueous solubilities, sinkers commonly migrate to the bottom of an aquifer or to a layer of lower permeability (Pettyjohn and Hounslow, 1983) as an immiscible organic liquid phase (Dion, 1987).

A dense, non-aqueous, free product phase is present in only one monitoring well, however, a dissolved solute phase plume exists as evidenced by the contaminant concentrations measured in other monitoring wells.

TABLE IX

PHYSICAL AND CHEMICAL CHARACTERISTICS OF ORGANIC CONTAMINANTS AND WATER

	Water	Halogenated aliphatic hydrocarbon		
		Tetrachloroethene	Trichloroethene	1,1,1-trichloroethane
Chemical formula	H_2O	$Cl_2C:C\ Cl_2$	$CH\ Cl:C\ Cl_2$	$CH_3\ C\ Cl_3$
Molecular weight	18	166	131	133
Specific gravity	1.00	1.62	1.46	1.32
Melting point (°C)	0	-23	-73	-30
Boiling point (°C)	100	121	87	74
Vapor pressure at 20°C (torr)	18	14	58	96
Solubility in water at 20°C (mg/L)	--	150-200	1100	480-4400
Log octanol/water partition coefficient	--	2.88	2.29	2.17

Modified from Dion, 1987

The fate of dissolved organic solutes in ground water is affected by the processes of advection, dispersion, sorption, volatilization, and chemical and biological transformation.

Advection

Advection is the process by which solutes are transported by the motion of flowing ground water (Driscoll, 1986). In the absence of other influences, ground-water contaminants would be expected to travel at the same velocity as the ground water in which they are dissolved (Dion, 1987). Ground-water velocity determined previously for the site is approximately 0.11 ft/dy.

Dispersion

Dissolved contaminants spread both longitudinally and transversely through the flowing ground water. Called dispersion, the microscopic variations of ground-water velocity within the aquifer, it results in the formation of a contaminant plume. Dispersion may result in the arrival of detectable contaminant concentrations at a given location before (or after) an arrival time based on ground-water velocity. Based on the isoconcentration maps (Figures 19-21), longitudinal dispersion appears to be approximately 2 times as great at transverse dispersion.

Sorption

Adsorption of a contaminant onto aquifer materials tends to retard its movement through the aquifer. The solvent contaminants present in the site plume are hydrophobic with low water solubility. Pettyjohn and Hounslow (1983) state that these low molecular weight chlorinated hydrocarbons, such as 1,1,1-trichloroethane and trichloroethene, are sorbed only by aquifer materials that contain appreciable concentrations of organic matter.

It has been further established that the distribution of these hydrophobic organics between water and solid organic matter can be approximated by their distribution between water and the organic solvent octanol. This distribution coefficient also correlates reasonably well with their solubility in water (Pettyjohn and Hounslow, 1983). The partition coefficients shown in Table IX are considered low (Dion, 1987), suggesting that movement of the solvents through an aquifer would not be retarded substantially regardless if organic matter was present or not.

Volatilization

The solvents present in the plume have relatively low molecular weight, high vapor pressure, and low boiling point (Table IX), suggesting evaporation to the atmosphere can be rapid. However, because most of the study area is paved with concrete and the contamination is found at depths greater than 5 feet, it is doubtful that volatilization diminished the contamination at the site.

Chemical and Biological Transformations

1,1,1-Trichloroethane has been shown to be susceptible to both abiotic and biological transformations (Klecka and others, 1990). Abiotic degradation has been shown to yield 1,1-dichloroethene by elimination of HCl and acetic acid by a hydrolysis substitution reaction (Figure 24). Parsons and others (1985) have demonstrated biological dehalogenation of chlorinated ethanes and ethenes in natural sediments under anaerobic conditions. Dehalogenation refers to an oxidation-reduction reaction in which electrons are transferred from a donor (e.g., reduced organic substrate) to the chlorinated hydrocarbon acceptor, resulting in the replacement of a chlorine constituent on the molecule by hydrogen (Klecka and other, 1990).

1,1,1-Trichloroethane was shown to biodegrade under anaerobic conditions to 1,1-dichloroethane and chloroethane by Wood (1985). Further reductive dehalogenation of 1,1-dichloroethene yields chloroethane, 1,1-dichloroethene, and vinyl chloride (Vogel and McCarty, 1987). These products of transformation of 1,1,1-trichloroethane are more mobile in ground water than the parent compound, and vinyl chloride exhibits greater carcinogenicity (Wilson, 1987).

Concentrations of organic contaminants within the ground water may be greatly decreased by volatilization and

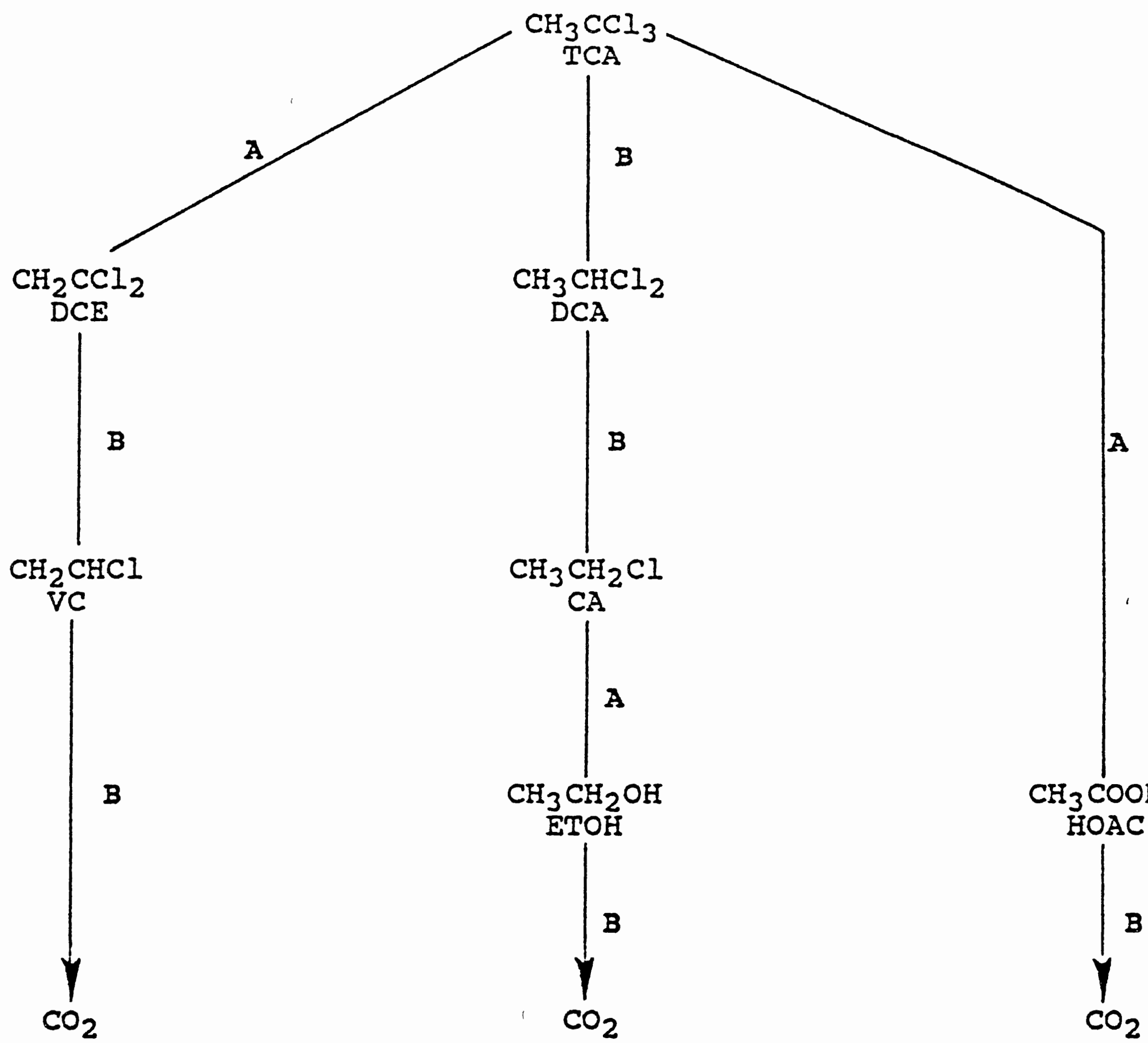

Figure 24. Pathway Proposed for the Degradation of 1,1,1-Trichloroethane. Reaction mechanisms are designated as (A) abiotic or (B) biological. TCA = 1,1,1-trichloroethane; DCE = 1,1-dichloroethene; DCA = 1,1-dichloroethane; VC = vinyl chloride; CA = chloroethane; ETOH = ethanol; HOAC = acetic acid. Modified from Vogel and McMarty (1987).

microbial degradation under anaerobic conditions. However, most of the study area is paved with concrete, limiting volatilization. Daughter compounds from microbial degradation of 1,1,1-trichloroethane are present at the site, but further geochemical analysis is required to determine their source.

CHAPTER VIII

COMPUTER MODELING

Introduction

Analyses of ground-water samples taken from monitoring wells at the study site have confirmed that a contaminant plume exists. A computer model was utilized to predict future movement of the plume, and to test the effectiveness of a ground-water withdrawal remediation system.

According to Walton (1988), "Modeling is approached as the science and art of simulation." Simulation of a ground-water system refers to the construction and operation of a model whose behavior assumes the appearance of the actual aquifer behavior (Mercer and Faust, 1981).

For more information about computer models, such as types, uses, and limitations, the above two references are recommended.

Model Selection

Because a contaminant plume is present in the ground water at the site, a solute transport model is appropriate to simulate aquifer behavior. An educational version of "Random-Walk" (Prickett, Naymik, and Lonnquist, 1981), written in BASIC, was chosen because of its ease-of-use and availability. Random-Walk is a contaminant transport model that uses the Theis equation. All aquifer coefficients are assumed constant over the entire aquifer. Random-Walk is a porous media model, and can not accurately depict contaminant migration that may occur due to fractures or other preferred pathways. However, the model is useful for generalized conceptions. The random-walk technique is based on the concept that in a porous aquifer, dispersion is a random process. The effects of convection, dispersion, and chemical reactions are included in the program. The solute transport portion of the code is based on a particle-in-a-cell technique for the convective mechanisms, and a random walk technique for the dispersion effects (Prickett, Naymik, and Lonnquist, 1981). The program also allows time-varying pumping or injection by wells. For a more complete description of the program, the reference cited above is suggested.

Computer Model Input

The Random-Walk computer program prompts the user to input values for the following coefficients: transmissivity, storage coefficient, hydraulic conductivity, porosity, retardation, regional x-direction and y-direction flow, particle mass, and longitudinal and transverse dispersivity. Input parameters that are the most sensitive to changes are retardation and porosity, followed by source strength and dispersivity.

Transmissivity, storage coefficient, and hydraulic conductivity values were based on results of the aquifer test. Porosity was estimated by examination of cores and thin-sections. An estimate of retardation was based on the distribution coefficient between water and octanol for the primary contaminants in the plume. Regional x-and y-velocities were calculated based on ground-water velocity of the contaminated area. Particle mass refers to initial concentration of the contaminant at the plume origin. Each particle is moved by ground-water flow and is assigned a mass that represents a fraction of the total mass of chemical constituent(s) involved (Prickett, Naymik, and Lonnquist, 1981). The term dispersion is often confused with dispersivity. Selection of dispersion coefficients that adequately reflect aquifer conditions is a problem that cannot be solved readily (Kent, Pettyjohn, and Prickett, 1985). Dispersion is equal to the product of dispersivity and velocity, calculated for both x and y directions. Dispersivity can be measured in the laboratory using cylindrical samples of aquifer materials, and then related to field conditions. Values of longitudinal dispersivity as large as 300 feet and transverse dispersivity values as large as 150 feet have been used in mathematical models of large contaminant plumes in sandy aquifers (Freeze and

Cherry, 1979). If dispersivity is large, contaminants can migrate much farther than by advection alone.

The values of dispersivity used for the study site were obtained by relating the size of the plume to ground-water velocity, and by comparisons with existing data.

Model Calibration

Aquifer coefficients as previously determined were input into Random-Walk. Particle mass was determined by equating specific gravity of 1,1,1-trichloroethane to a daily, gallon amount that leaked from the UST's. The number of particles input to the model to represent solute transport was determined by multiplying the daily amount by a five year time span. Three years is the length of time between installation and leakage from the first set of UST's, but solvent drums were stored on the sloping concrete pad for five years.

Model One, No Retardation

The manufacturing facility uses approximately 75 gallons per month of 1,1,1-trichloroethane, or 2.5 gallons daily. As an arbitrary starting point, 0.5 gallons was chosen as the daily amount that leaked from the UST's, during a five year period. Then a time step of an additional five years, with the source being shut off, was implemented. Ten years is the time frame utilized for approximating when leakage started until ground-water sampling began in 1991. This produced a contaminant plume much larger and with higher concentration levels than is present at the site.

The amount of contaminant entering the ground water was reduced to 0.10 gallons/day, then to 0.01 gallons/day, and finally to 0.005 gallons/day, each time producing a contaminant plume that exceeded in size and concentration the actual plume present. Also, shutting the source off after five years and moving the existing particles another five years would produce a plume moving as a slug, with the highest levels of contaminant concentration down gradient from the source. The isoconcentration maps (Figures 19 and 20) indicate that the highest levels of contaminant are still adjacent to the former UST system.

A free-product phase of contaminant is present in MW-5B. It is suspected that a mass of free product exists in the subsurface, between the former UST system and MW-5B. The free product continues to be a source, contributing to the dissolved-phase contaminant plume.

Considering this additional source, the model was adjusted. Particles were introduced in each time step over the 10-year period. Aquifer coefficients were adjusted as well; porosity was increased slightly, to lengthen the plume. Transverse dispersivity was increased, to broaden the plume to realistic dimensions. A total of 325 particles, with particle mass equal to 0.25 pounds per particle, were introduced to the ground-water system in two time steps spanning a 10-year period. This is equivalent to approximately 0.002 gallons/day of 1,1,1-trichloroethane entering the ground water at the source. The resultant contaminant plume is represented in Figure 25. Figure 26 is an isoconcentration map of the sum total of compounds detected in ground water, sampled on March 27, 1991.

Since the model-generated plume reasonably simulates actual conditions, pumping wells were added to the model to test the effectiveness of a ground-water withdrawal remediation system.

Three pumping wells were installed in the model at the approximate locations of MW-3B, MW-5B, and MW-9B, pumping 50 gallons per day (gpd) each. Time steps of one year intervals were run until all particles were withdrawn by the pumping wells or had passed the last pumping well.

After six years (5840 days) of pumping the plume is considerably smaller (Figure 27). The model indicated that relatively high levels of contamination remain; 7-58 ppm. The model also indicated several particles had escaped past the pumping wells.

Ten years after pumping began, the contaminant plume has been substantially reduced in size (Figure 28). The simulation indicated that contamination levels as high as 43 ppm have migrated beyond the ground-water withdrawal system.

Eighteen years after pumping began, all particles passed the remaining pumping well, MW-5B (Figure 29). The model indicated particles had migrated beyond pumping well

//////////////PRESENT MASS TRANSPORT COEFFICIENTS\\\\\\\\\\\\\\\\\\\\\\\\\\\\

TRANSMISSIVITY = 37 GPD/FT
STORAGE COEFFICIENT = .0001
HYDRAULIC CONDUCTIVITY = 4 GPD/SQ.FT.
POROSITY = .15
RETARDATION COEFFICIENT = 1
REGIONAL X FLOW = .04 FT/DAY
REGIONAL Y FLOW = .04 FT/DAY
PARTICLE MASS = .25 LBS
DISPERSIVITY MODEL IS CONSTANT
LONGITUDINAL DISPERSIVITY = 10 FT
TRANSVERSE DISPERSIVITY = 7 FT

ACCUMULATED TIME = 3650 DAYS PARTICLES= 325
CONCENTRATION MAP IN PPM (P SIGNIFIES PUMPAGE, I SIGNIFIES INJECTION)

Y \ X	0	20	40	60	80	100	120	140	160	180	200
200	▪	▪	7	7	7	▪	14	14	7	22	▪
180	▪	▪	▪	14	7	14	14	▪	22	▪	14
160	▪	▪	▪	7	22	▪	43	14	7	14	▪
140	▪	7	7	7	29	22	29	43	14	7	▪
120	▪	7	14	14	7	29	14	22	29	14	7
100	14	14	14	22	29	79	29	14	22	22	14
80	▪	43	29	43	58	36	51	29	29	14	7
60	22	▪	36	36	65	51	22	14	7	▪	▪
40	22	43	58	36	22	22	14	7	▪	▪	▪
20	51	94	72	22	36	22	14	7	7	▪	▪
0	79	51	29	36	7	7	▪	▪	7	7	▪

Measured concentrations (circled): (73) at (40, 40); (40) at (80, 60); (41) at (140, 140); (14) at (200, 100)

X AND Y COORDINATES SHOWN ARE IN FEET FROM ORIGIN

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Figure 25. Model-generated Plume, Time = 10 Years. (41) = Measured Concentration in Monitoring Wells.

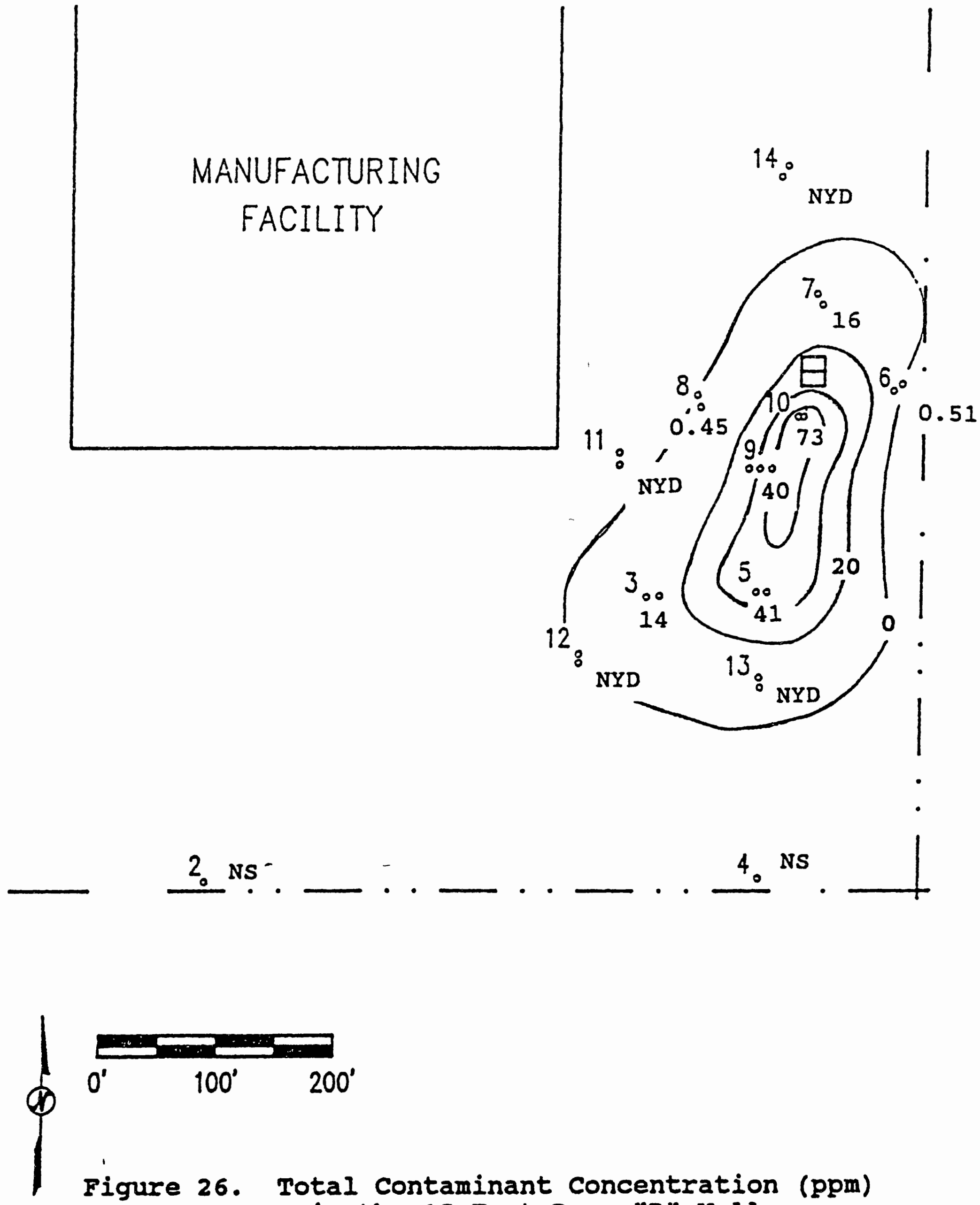

Figure 26. Total Contaminant Concentration (ppm) in the 15 Feet Deep "B" Wells, Sample Date 27 March 1991, Contour Interval = 20 ppm, NS = Not Sampled, NYD = Not Yet Drilled as of Sample Date.

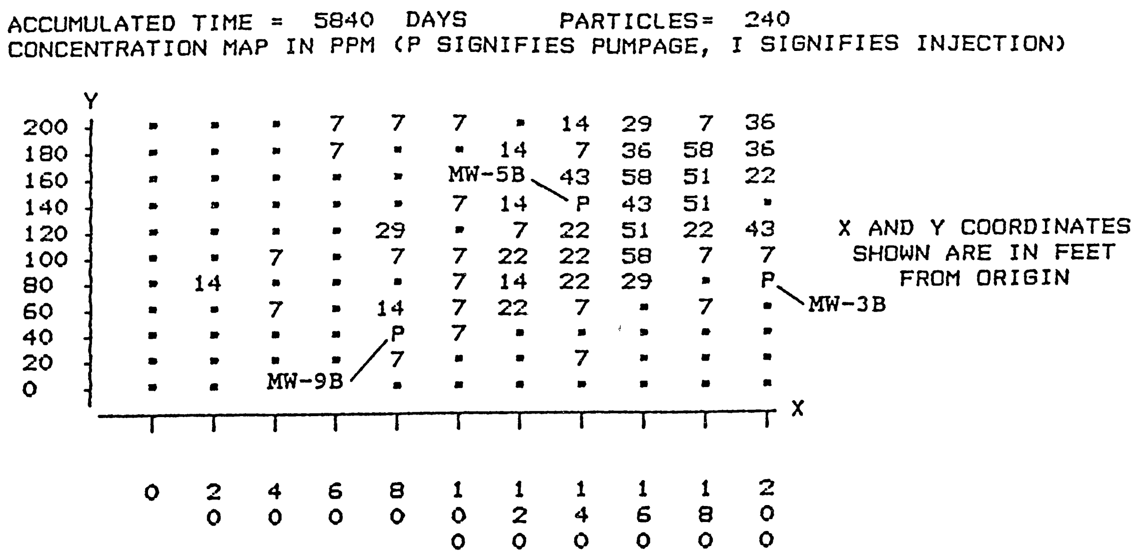

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Figure 27. Model-generated Plume, Remediation Time = 6 Years.

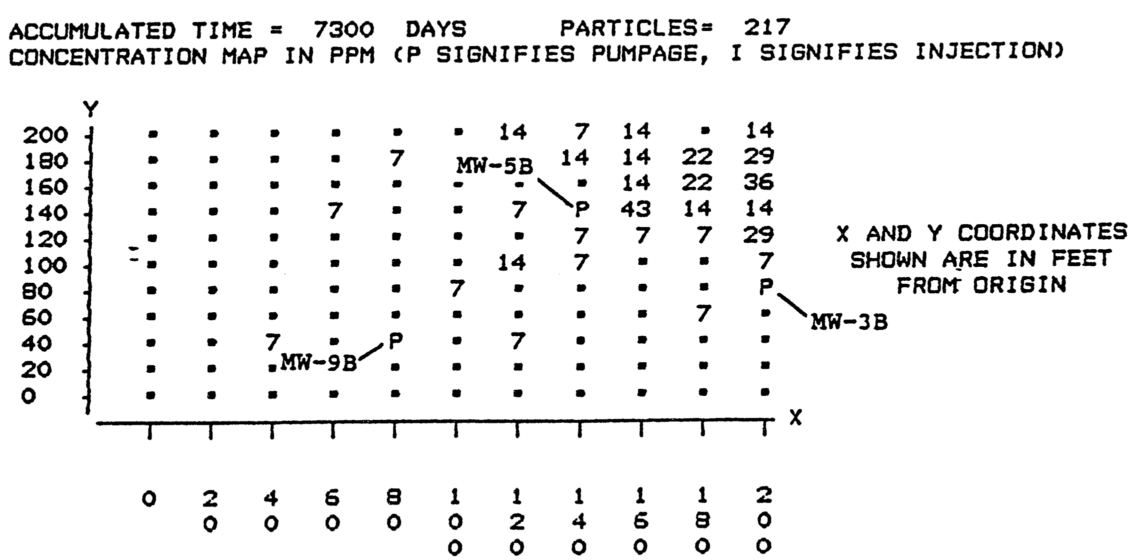

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Figure 28. Model-generated Plume, Remediation Time = 10 Years.

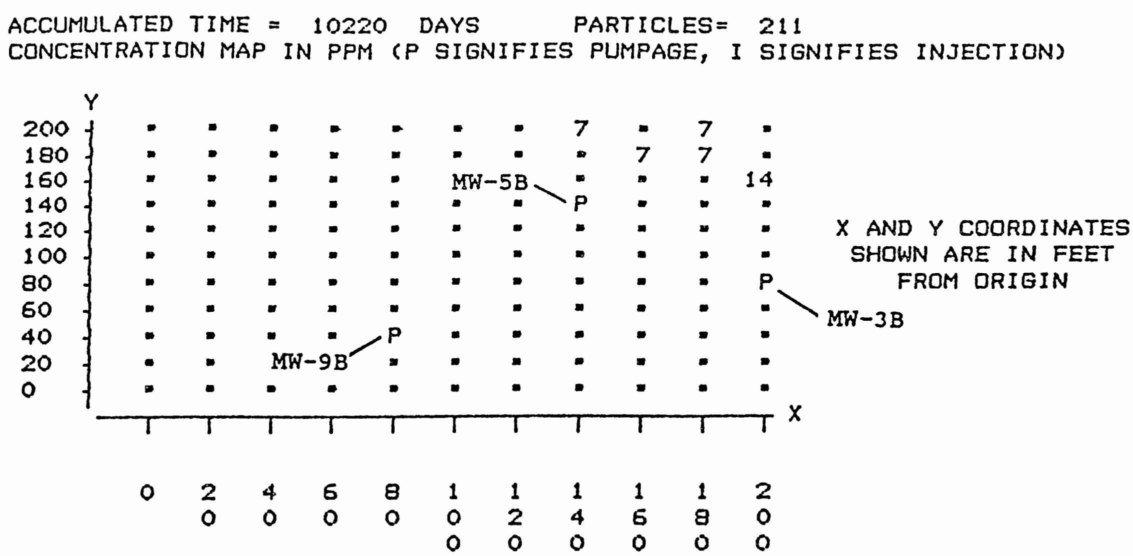

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Figure 29. Model-generated Plume, Remediation Time = 18 Years.

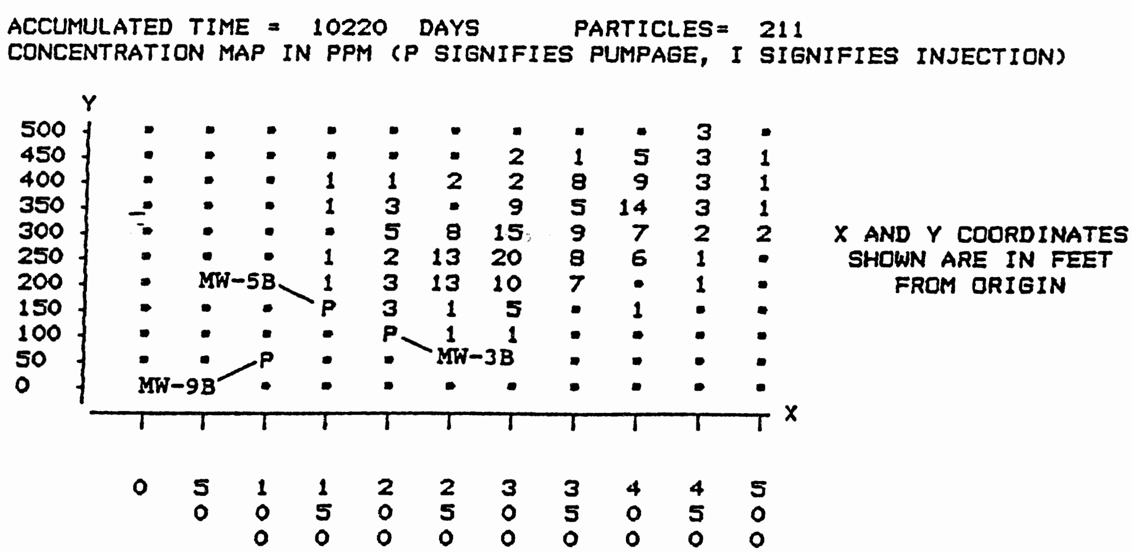

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Figure 30. Model-generated Plume, Remediation Time = 18 Years.

MW-5B, however, most contamination had been removed from the site.

Figure 30 represents the model simulation 18 years after pumping began (28 years since the release of contaminants). A small plume exists beyond the ground-water withdrawal system. Under the conditions present in this simulation, the spacing and number of pumping wells, was not sufficient to prevent a small, contaminant plume from migrating off-site. Of the 325 particles input into the simulation, only 35% were captured by the pumping wells. Contamination appears diluted in Figure 30 because cell size has been increased to 50 feet X 50 feet.

Another simulation was run, exactly the same, except a fourth pumping well was added at the approximate location of MW-13B. After 10 years of pumping, the plume had been substantially reduced in size (Figure 31).

Fourteen years after pumping began, all particles have passed pumping wells MW-5B and MW-3B, so they are turned off. This is accomplished with the model, by adding a new well injecting 50 gpd at the same location.

The simulated, four-well, ground-water withdrawal system still allowed some particles to migrate beyond the pumping wells. Figure 32 represents the simulation 18 years after pumping of the 4-well ground-water withdrawal system began. Compared with Figure 30, it depicts a smaller plume with lower concentrations. Of the 325 particles input into this simulation, 61% were captured by the pumping wells.

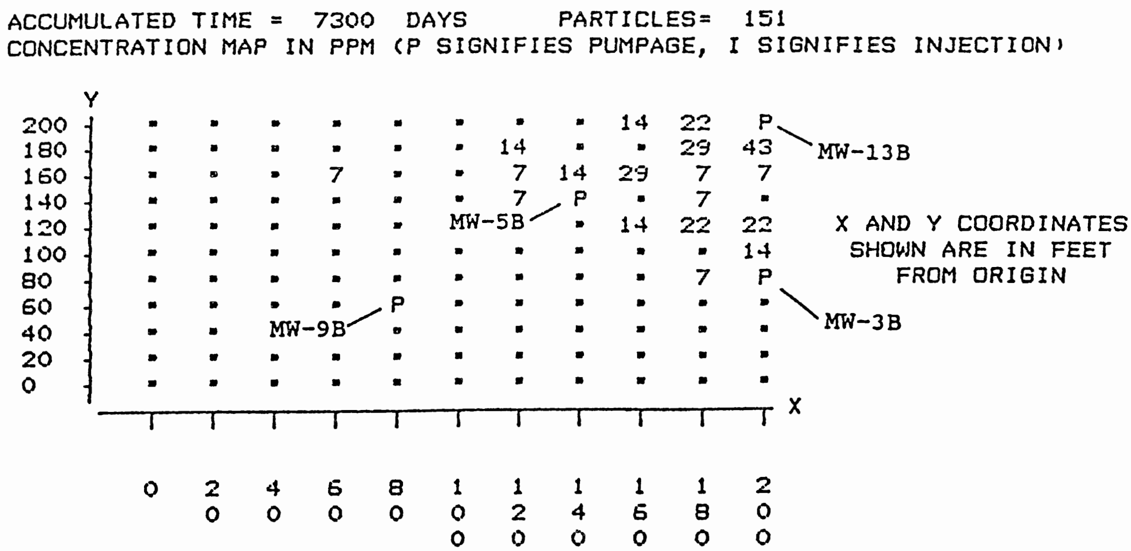

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Figure 31. Model-generated Plume, Remediation Time = 9 Years, Four Well Ground-water Withdrawal System.

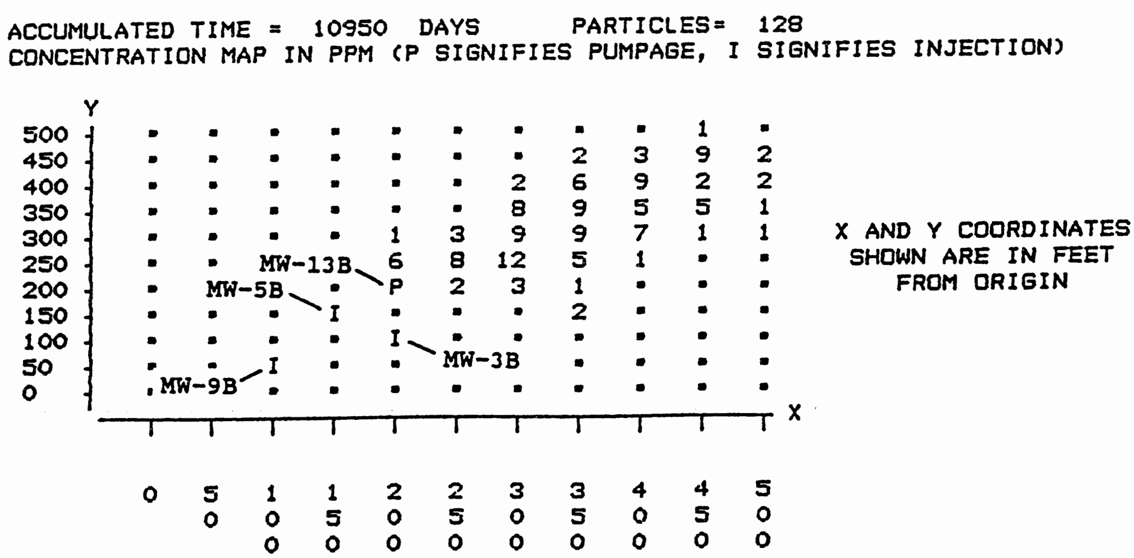

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Figure 32. Model-generated Plume, Remediation Time = 20 Years, Four Well Ground-water Withdrawal System.

Adding a fourth pumping well made the ground-water withdrawal system almost twice as effective.

No contaminant particles were added to the model once pumping began. It is suspected that the pumping gradient may withdraw the free product relatively quickly. Pumping MW-5B will certainly reduce the amount of free product present near that borehole. If a free-product phase exists in spite of pumping, then remediation may take longer than 18 years as the current model indicates.

Computer Model Pitfalls

The first difficulty in using this model, or any model, is determining the concentration of the contaminant at the source. If it has not been measured directly, it must be estimated.

In the case of this study, the concentration of the contaminant as it leaves the UST is unknown. Because the waste solvent was mixed with waste oils, waste coolant, and, until 1982, surface runoff, it would be extremely difficult to estimate the concentration at the source. The waste solvent apparently consisted of many compounds. A reasonable approach to estimate the concentration of a multi-compound solution is unavailable. In addition, because an indeterminate amount of contaminant was released, contaminant concentration in initial modeling runs was only crudely estimated.

A mass of free-product apparently exists in the subsurface in the vicinity of MW-5B, and is serving as a source to the dissolved phase plume. It may be trapped or semi-trapped by permeability barriers. The free-product may be trapped within pore spaces or fractures by the higher viscosity waste oil, or it may be trapped in a perched fashion. Possibilities for how and where a free-product phase of hydrocarbons might exist are as limitless as the detailed stratigraphy is complex. Regardless of where the free product may be located, evidence supports its existence.

The Random Walk program assumes homogeneous and infinite aquifer conditions just as the Theis equation does. Deviation from these ideal conditions at the site is in part responsible for the variation between the actual plume and the model plume. Careful selection of aquifer parameters matched with variable cell or grid sizes can be used to accommodate inhomogeneous conditions, but this can be very tedious.

Model Two, Slight Retardation

Computer model one generated a plume that was slightly larger and with slightly higher overall concentrations than the actual plume. A second model was generated, using a small retardation coefficient. Aquifer coefficients were based on the aquifer test results. Ground-water velocity was increased to a rate determined by the location of the actual plume front. Particle mass was identical, but the number of particles was decreased, to provide a more realistic simulation. A retardation coefficient was calculated using ECOPLUS, (Hounslow and Goff, 1990), a computer program that estimates environmental partitioning coefficients of organic chemicals. Assuming an organic carbon content of 0.028 percent, for 1,1,1-trichloroethane the estimated retardation coefficient is 2.

Figure 33 represents a simulation after 10 years of contaminant input. It is reasonably comparable to Figure 26. However, this simulation utilized a lower transverse dispersivity. The resulting, simulated plume has an unrealistically narrow width.

Pumping wells were installed at MW-3B, MW-5B, and MW-9B. The pumping rate was lowered to 30 gpd from each well. After five years of pumping all contamination has passed MW-9B, so it is subsequently shut off (Figure 34). Some contamination has migrated downgradient beyond the capture radius of the two remaining pumping wells.

Twelve years after pumping began all particles were captured by the pumping wells or have migrated beyond them. Figure 35 shows the location of the plume after 12 years of pumping. Particle concentration is reduced because of the expanded cell size.

```
////////////PRESENT MASS TRANSPORT COEFFICIENTS\\\\\\\\\\\\

TRANSMISSIVITY =  37  GPD/FT
STORAGE COEFFICIENT    =   001
HYDRAULIC CONDUCTIVITY =  4 6  GPD/SQ.FT
POROSITY =  .1
RETARDATION COEFFICIENT =  2
REGIONAL X FLOW =  .075  FT/DAY
REGIONAL Y FLOW =  .075  FT/DAY
PARTICLE MASS =  .25  LBS
DISPERSIVITY MODEL IS CONSTANT
LONGITUDINAL DISPERSIVITY =  9  FT
TRANSVERSE DISPERSIVITY =  3  FT

ACCUMULATED TIME =  3650  DAYS      PARTICLES=  200
CONCENTRATION MAP IN PPM (P SIGNIFIES PUMPAGE, I SIGNIFIES INJECTION)
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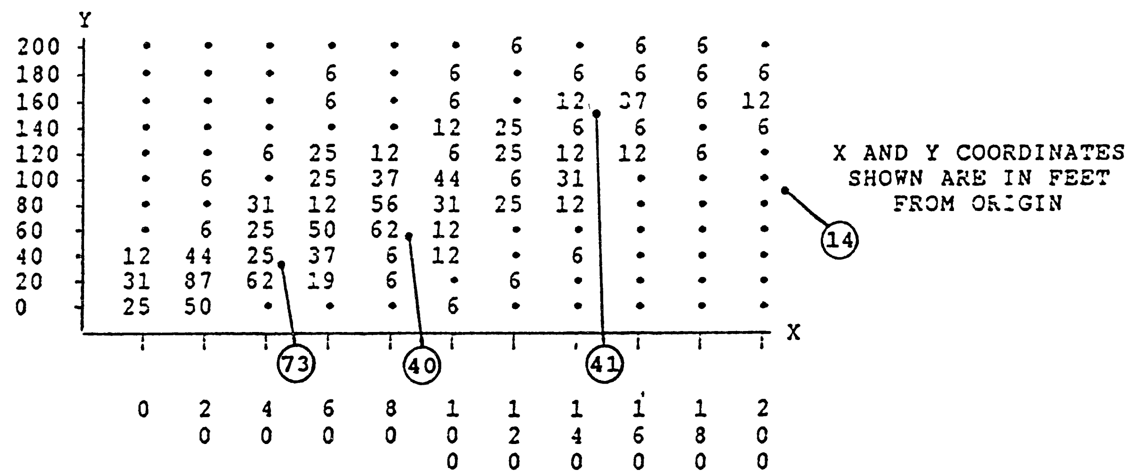

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Figure 33. Model-generated Plume, Time = 10 Years, (73) = Measured Concentration in Monitoring Wells.

ACCUMULATED TIME = 5475 DAYS PARTICLES= 119
CONCENTRATION MAP IN PPM (P SIGNIFIES PUMPAGE, I SIGNIFIES INJECTION)

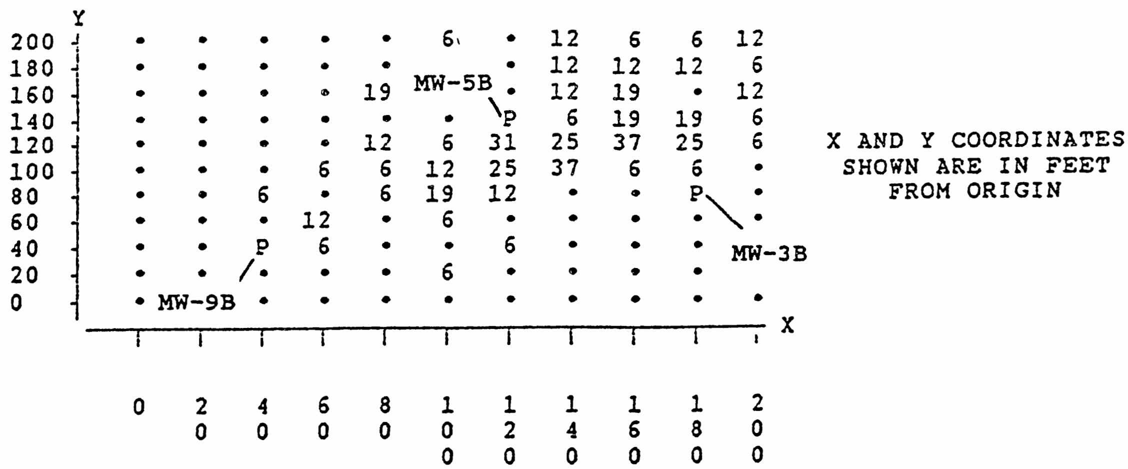

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Figure 34. Model-generated Plume, Remediation Time = 5 Years.

ACCUMULATED TIME = 8395 DAYS PARTICLES= 101
CONCENTRATION MAP IN PPM (P SIGNIFIES PUMPAGE, I SIGNIFIES INJECTION)

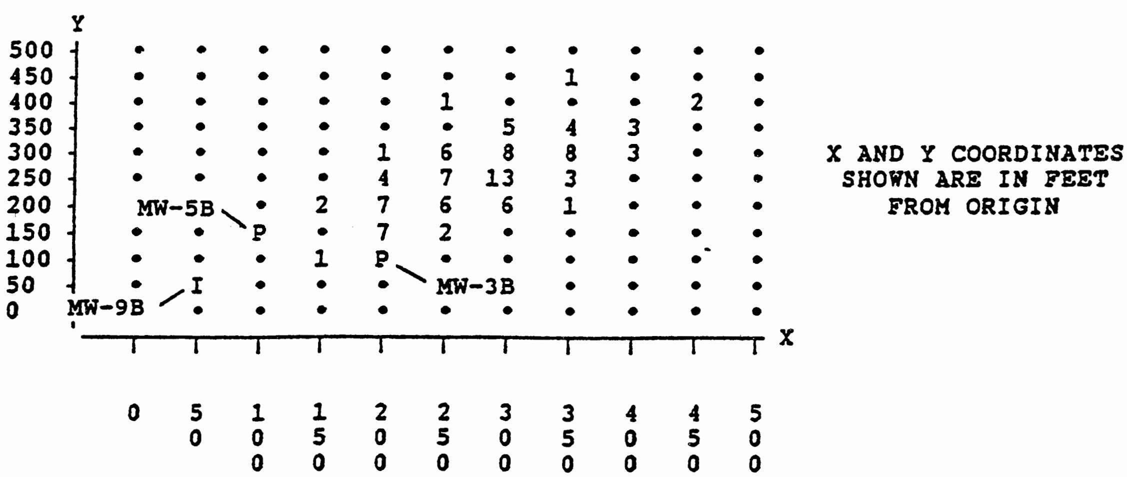

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Figure 35. Model-generated Plume, Remediation Time = 12 Years.

Computer Modeling Summary

The computer simulations generated for this study are by no means accurate representations of the contaminant plume at the site, however, they are reasonable. The simulations were successful in demonstrating that a ground-water withdrawal remediation system can be effective. The simulations also demonstrate that discharge and location of the pumping wells is critical. These two factors must be considered together so that overlapping cones of depression can be created to effectively remediate the site to meet state and federal standards. Monitoring wells located downgradient from the pumping wells should be sampled regularly to monitor the advance of the plume and to test the effectiveness of the ground-water contaminant withdrawal system.

CHAPTER IX

SUMMARY AND CONCLUSIONS

The goals of this research were to characterize the geology and hydrogeology at a contaminated site, to define the extent of contamination, and to use a computer model to predict future migration of the contaminant, as well as to test the effectiveness of a ground-water withdrawal remediation system. Geologic data, water-level measurements, aquifer test data, and chemical analyses were collected and interpreted to characterize the geology, the aquifers, and the extent of contamination.

Local geology exhibits rapid lateral and vertical stratigraphic changes. Zones of localized, interlaminated shale and sandstone within the sandstone aquifers can reduce transmissivity and impede ground-water and contaminant migration.

A hydraulic flow net was constructed. It indicates decreasing hydraulic head with depth. Regional ground-water flow is in a southern to southwestern direction. Calculated hydraulic parameters are reasonable for the aquifer material.

Chemical analyses of soil and ground-water samples confirm that a release of hydrocarbons occurred from the UST system at the study site. Two contaminant plumes exist at the site; in the upper, water-table aquifer and in a deeper, confined or semi-confined interval. The upper plume is migrating in a south to southwestern direction, while the deeper plume remains adjacent to the former UST system. All intervals within the upper hydrologic unit apparently are hydraulically connected.

Dense, non-aqueous phase hydrocarbons exists in MW-5B. A mass of free product apparently exists in the subsurface, and continues to serve as a source to the dissolved phase contaminant plume.

Computer modeling of site conditions indicate that a ground-water withdrawal remediation system can be effective for the study area, provided it is designed with overlapping cones of depression. Remediation is estimated to be accomplished in a minimum of 10 years after beginning, but could require a much longer period of time.

REFERENCES CITED

Albano, M.A., 1975, Subsurface Stratigraphic Analysis "Cherokee" Group (Pennsylvanian), Northeast Cleveland County, Oklahoma: Shale Shaker, Vol. 25, Nos. 5,6,7, pp. 94-103; 114-124; 134-143.

Althoff, W.F., Cleary, R.W. and Roux, P.H., 1981, Aquifer Decontamination for Volatile Organics: A Case History, Groundwater, Vol. 19, No. 5, pp. 495-504.

Bennison, A.P., 1979, Mobile Basin and Shelf Border Area in Northeastern Oklahoma During Desmoinesian Cyclic Sedimentation: Tulsa Geological Soc. Spec. Publication No. 1, pp. 283-294.

Bloesch, E., 1928, Geology of Nowata and Craig Counties, Oklahoma: Geol. Surv., Bull. 40 EE, 27 p.

Branson, C.C., 1954, Field Conference on Desmoinesian Rocks of Northeastern Oklahom: Oklahoma Geological Survey Guidebook 11, 41 p.

Cooper, H.H., Jr. and C.E. Jacob, 1946, A Generalized Graphical Method for Evaluating Formation Constants and Summarizing Well-Field History, Transactions: American Geophysical Union, Vol. 27, pp. 526-534.

Curtis, N.M. and Ham, W.E., 1979, Geology and Earth Resources of Oklahoma: Oklahoma Geological Survey, University of Oklahoma, 8 p.

Dion, N.P., 1987, Geohydrologic Reconnaissance of a Ground-Water Contamination Problem in the Argonne Road Area near Spokane, Washington: U.S. Geological Survey Water-Resources Investigations Report 86-4173, 37 p.

Driscoll, F.G., 1986, Groundwater and Wells: 2nd Edition, Johnson Division, St. Paul, Minnesota, 1089 p.

Ferree, D.M., 1985, Ground-Water Quality Data For Oklahoma 1982-84, U.S. Geological Survey, Open-File Report 85-417, 39 p.

Freeze, R. A. and Cherry, J.A., 1979, Groundwater: Prentice-Hall, Inc., Englewood Cliffs, N.J., 604 p.

Fusillo, T.V., Ehlke, T.A., Martin, M. and Sargent, B.P., 1987, Movement and Fate of Chlorinated Solvents in Ground Water: Preliminary Results and Future Research Plans: U.S. Geological Survey Program on Toxis Waste-Ground Water Contamination: Proceedings of the Third

Technical Meeting, pp. D5-D12.

Gruman, W.P., 1954, Geology of the Foyil area, Rogers and Mayes Counties, Oklahoma: University of Oklahoma unpublished M.S. thesis, 99 p.

Hantush, M.S. and Jacob, C.E., 1955, Non-steady radial flow in an infinite leaky aquifer and non-steady Green's functions for an infinite strip of leaky aquifer: Transactions, American Geophysical Union, Vol. 36, No. 1, pp. 95-112.

Havens, J.S. and Bergman, D.L., 1976, Ground-Water Records For Northeastern Oklahoma, Part 1 - Records of Wells, Test-Holes, and Springs, U.S. Geological Survey, Open-File Report, 100 p.

____, 1978, Ground-Water Records for Eastern Oklahoma, Part 2 - Water-Quality Records for Wells, Test-Holes, and Springs, U.S. Geological Survey, Open-File Report 78-357, 139 p.

Hemish, L.A., 1986, Coal geology of Craig County and eastern Nowata County, Oklahoma: Oklahoma Geological Survey Bulletin 140, 131 p.

Hounslow, A.W. and Goff, K.D., 1990, ECOPLUS, Environmental Partitioning of and Organic Chemical, A BASIC computer program.

Howard, P.H., Editor, 1990, Handbook of Environmental Fate and Exposure Data for Organic Chemicals, Volume II, Solvents, 375 p.

Hunt, C.B., 1967, Physiography of the United States: W.H. Freeman and Company, San Francisco and London, 480 p.

Jacob, C.E., 1963, Recovery method for determining the coefficient of transmissibility: U.S. Geological Survey Water Supply Paper 1536-I, Washington, D.C., pp.

____, 1946, Radial Flow in a Leaky Artesian Aquifer: Transactions, American Geophysical Union, Vol. 27, pp. 198-205.

Jordan, L., 1967, Geology of Oklahoma - A Summary: Oklahoma Geology Notes, Vol. 27, No. 12, pp. 215-228.

Kent, D.C., Pettyjohn, W.A. and Prickett, T.A., 1985, Analytical Methods for the Prediction of Leachate Plume Migration: Ground Water Monitoring Review, Vol. 5, No. 2, pp. 46-59.

Klecka, G.M., Gonsior, S.J. and Markham, D.A., 1990, Biological Transformations of 1,1,1-Trichloroethane in Subsurface Soils and Ground Water: Environmental Toxicology and Chemistry, Vol. 9, pp. 1437-1451.

Lojek, C.A., 1983, Petrology, Diagenesis and Depositional Environment of the Skinner Sandstones, Desmoinesian, Northeast Oklhoma Platform, Shale Shaker, Vol. 34, Nos. 7 and 8, pp. 82-92 and 95-103.

Loomis, F.B., 1938, Physiography of the United States: Doubleday, Doran & Company, Inc., New York, 350 p.

Marcher, M.V. and Bingham, R.H., 1971, Reconnaissance of the Water Resources of the Tulsa Quadrangle, Northeastern Oklahoma, Oklahoma Geological Survey, Hydrologic Atlas 2.

Martin, M., 1988, Preliminary Results of a Study to Simulate Trichloroethylene Movement in Ground Water at Picatinry Arsenal, New Jersey: U.S. Geological Survey Water-Resources Investigations Report 88-4220, pp. 377-384.

Mercer, J.W. and Faust, C.R., 1981, Ground-Water Modeling: National Water Well Association, Worthington, Ohio, 112 p.

Moench, A.F. and Prickett, T.A., 1972, Radial flow in an infinite aquifer undergoing conversion from artesian to water table conditions: Water Resources Research, Vol. 8, No. 2, pp. 494-499.

Montgomery, J.H. and Welkom, L.M., 1990, Groundwater Chemicals Desk Reference, Lewis Publishers, Inc., Chelsea, Michigan, 392 p.

Moody, D.W., Carr, J., Chase, E.B., Paulson, R.W., 1986, National Water Summary, Hydrologic Events and Ground-Water Quality, United States Geological Survey - Supply Paper 2325, 560 p.

Moore, G.E., 1979, Pennsylvanian Paleogeography of the Southern Mid-Continent: Tulsa Geological Soc. Spec. Publication No. 1, pp. 2-9.

Naff, John D., 1981, Guidebook for Geologic Field Trips in North-Central Oklahoma: Oklahoma Geological Survey, University of Oklahoma, 42 p.

Oakes, M.C., 1953, Krebs and Cabaniss Groups of Pennsylvanian Age in Oklahoma: Amer. Assoc. Petrol. Bull., Vol. 37, No. 6, pp. 1523-1526.

Parsons, F., G.B. Lage and R. Rice, 1985, Biotransformation of chlorinated organic solvents in static microcosms: Environ. Toxicol. Chem., Vol. 4, pp 739-742.

Pettyjohn, W.A., 1990, Practical Approaches to Aquifer Testing, 77 p.

Pettyjohn, W.A. and Hounslow, A.K., 1983, Organic compounds and ground-water pollution: Ground Water Monitoring Review, Vol. 3, No. 4, pp. 41-47.

Pettyjohn, W.A., White, H., Dunn, S., 1983, Water Atlas of Oklahoma: University Center for Water Research, Oklahoma State University, 72 p.

Powers, R., 1992, Personnel Communication, Chemist, Stillwater, Oklahoma.

Prickett, T.A., Naymik, T.G. and Lonnquist, C.G., 1981, A "Random-Walk" Solute Transport Model for Selected Groundwater Quality Evaluations, Illinois State Water Survey, Champaign, Bulletin 65.

_____, 1965, Type-curve Solution to Aquifer Tests Under Water-table Conditions: Groundwater, Vol. 3, pp. 5-14.

Rascoe, B.R., Jr. and Adler, F.J., 1983, Permo-Carboniferous Hydrocarbon Accumulations, Mid-Continent, U.S.A., Amer. Assoc. Pet. Geol. Bull., Vol. 67, No. 6, pp. 979-1001.

Shelton, J.W. and Rowland, T.L., 1974, Guidebook to the Depositional Environments of Selected Pennsylvanian Sandstones and Carbonats of Oklahoma: Oklahoma Geological Survey Spec. Publication 74-1, 75 p.

Soil Conservation Service, 1966, Soil Survey of Rogers County, Oklahoma: U.S. Department of Agriculture, 65 p.

Taff, J.A., 1901, Description of the Coalgate Quadrangle (Indian Territory): U.S. Geological Survey, Geological Atlas, Folia 74.

Theis, C.V., 1935, The Relation Between the Lowering of the Piezometric Surface and the Rate and Duration of Discharge of a Well Using Groundwater Storage: Transactions, American Geophysical Union, Vol. 2, pp. 519-524.

Thom, R., 1992, Personal Communication. Senior Chemist, Vulcan Materials Co., Chemicals Division, Wichita, Kansas.

Tillman, J.L., 1952, Geology of the Tiawah area, Rogers and Mayes Counties, Oklahoma: University of Oklahoma unpublished M.S. thesis, 65 p.

Vogel, T.M. and McCarty, P.L., 1987, Abiotic and biotic transformations of 1,1,1-trichloroethane under methanogenic conditions: Environmental Science and Technology, Vol. 21, pp. 1208-1213.

____, 1987, Rate of abiotic formation of 1,1-dichloroethylene from 1,1,1-trichloroethane in ground-water: J. Contam. Hydrol., Vol. 1, pp. 299-308.

Walton, W.C., 1988, Practical Aspects of Ground Water Modeling: National Water Well Association, Worthington, Ohio, 588 p.

Walton, W.C., 1960, Application and Limitation of Methods Used to Analyze Pumping Test Data: Water Well Journal, Feb.-March, p.

Ware, H.E. Jr., 1955, Surface and Shallow Investigation of the Senora Formation of Northeastern Oklahoma, Shale Shaker, Vol. 5, No. 7, pp. 5-24.

Weirich, T.E., 1953, Shelf Principal of Oil Origin, Migration and Accumulation: Amer. Assoc. Petrol. Geol. Bull., Vol., 37, pp. 2027-2045.

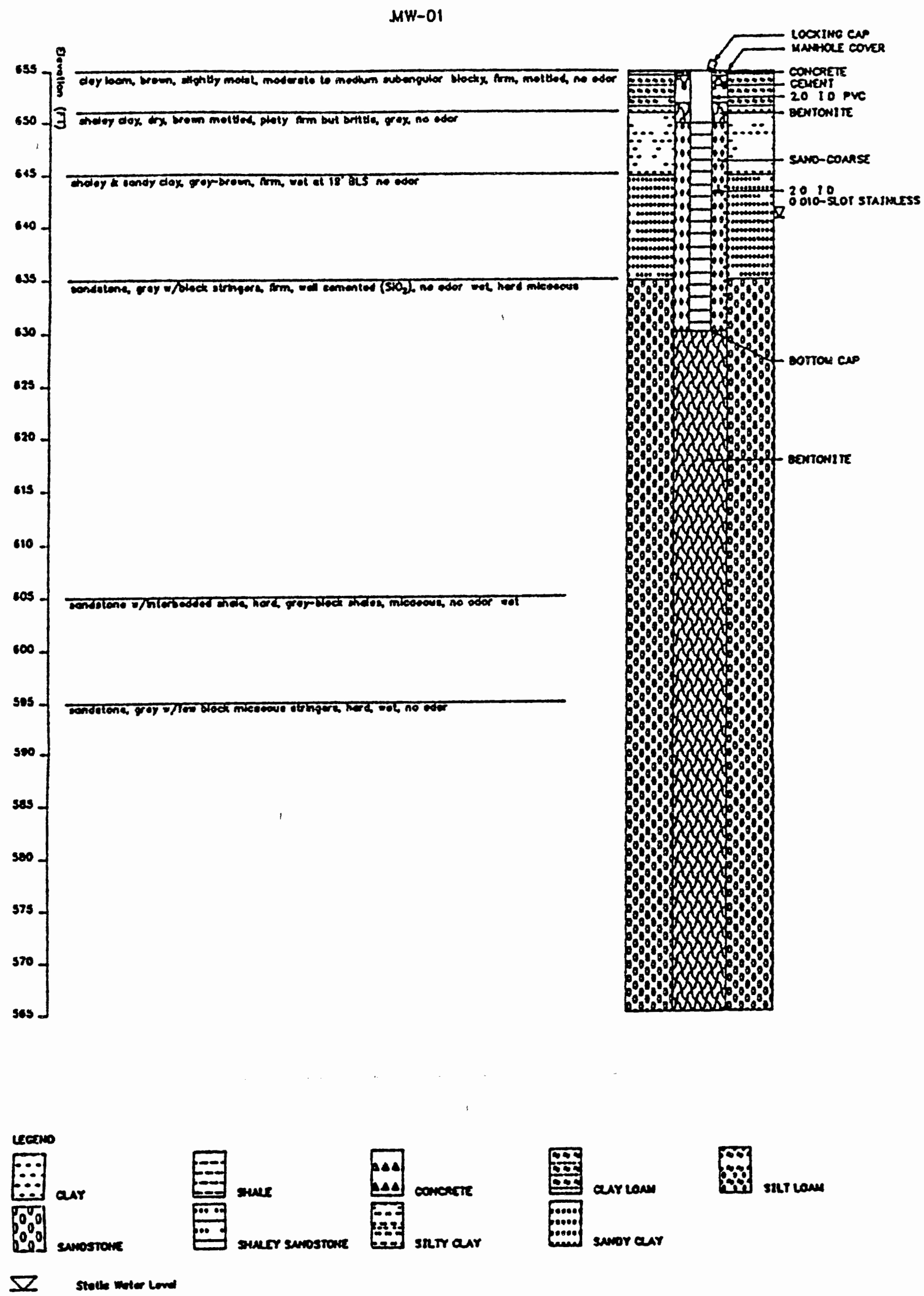
Wilson, B.H., 1987, Biotransformation of Chlorinated Hydrocarbons and Alkylbenzenes in Aquifer Material from the Picatinny Arsenal, New Jersey: U.S. Geological Survey Wateer-Resource Investigations Report 88-4200, pp. 389-394.

Wood, P.R. R.F. Lang and I.L. Payan, 1985, Anearobic transformation, transport, and removal of volatile chlorinated organics in ground water: In C.H. Ward, W. Giger and P.L. McCarty, eds., Ground Water Quality, John Wiley and Sons, New York, NY, pp. 493-511.

APPENDIXES

APPENDIX A

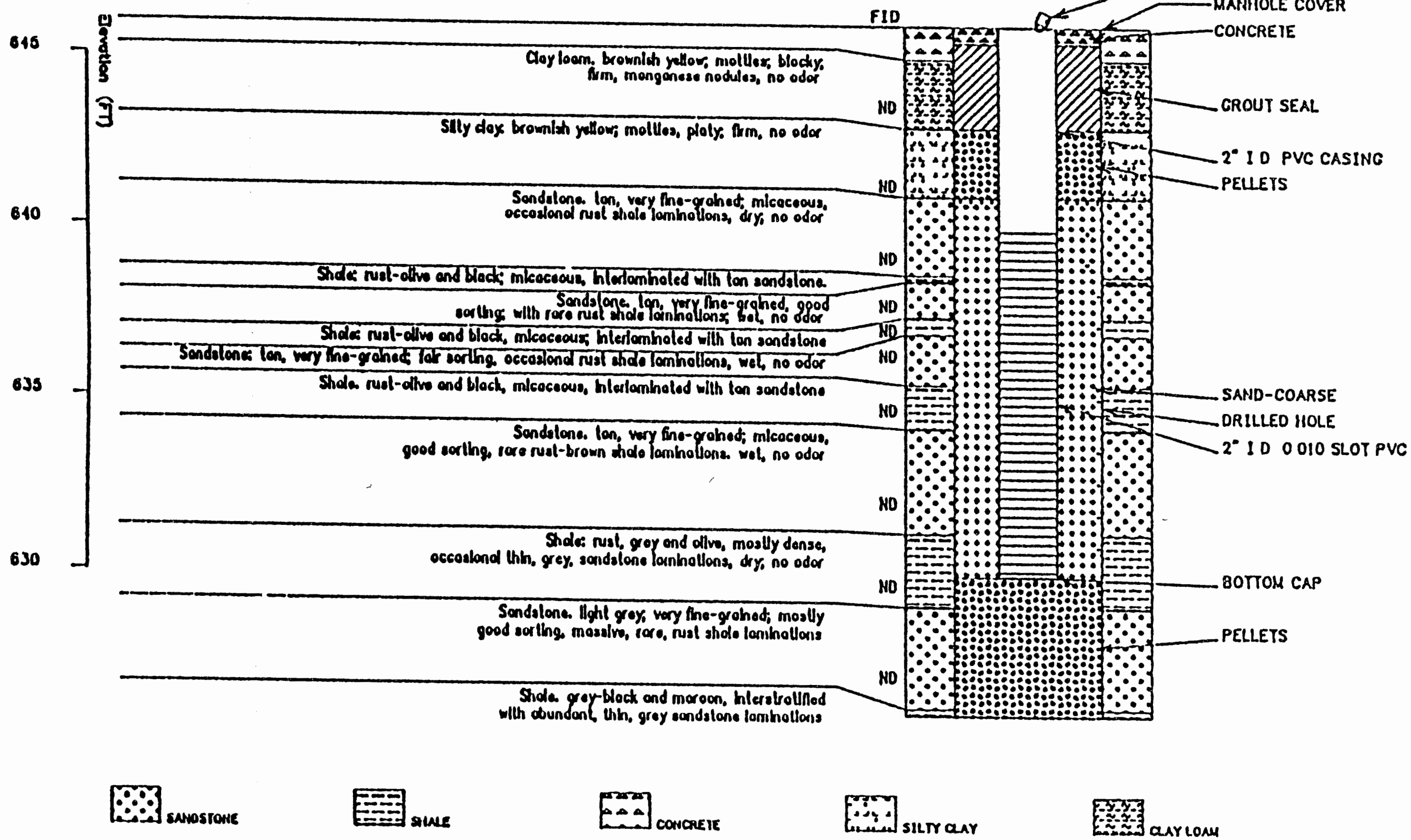
WELL CONSTRUCTION DIAGRAMS



Elevation (ground): 657 20'
Top of casing 657 20'
Drilled by: A.W. Peal, Inc.
Drilling method: Air Rotary Core
PVC casing diameter 2.0"

LITHOLOGIC LOG AND MONITORING WELL CONSTRUCTION DIAGRAM

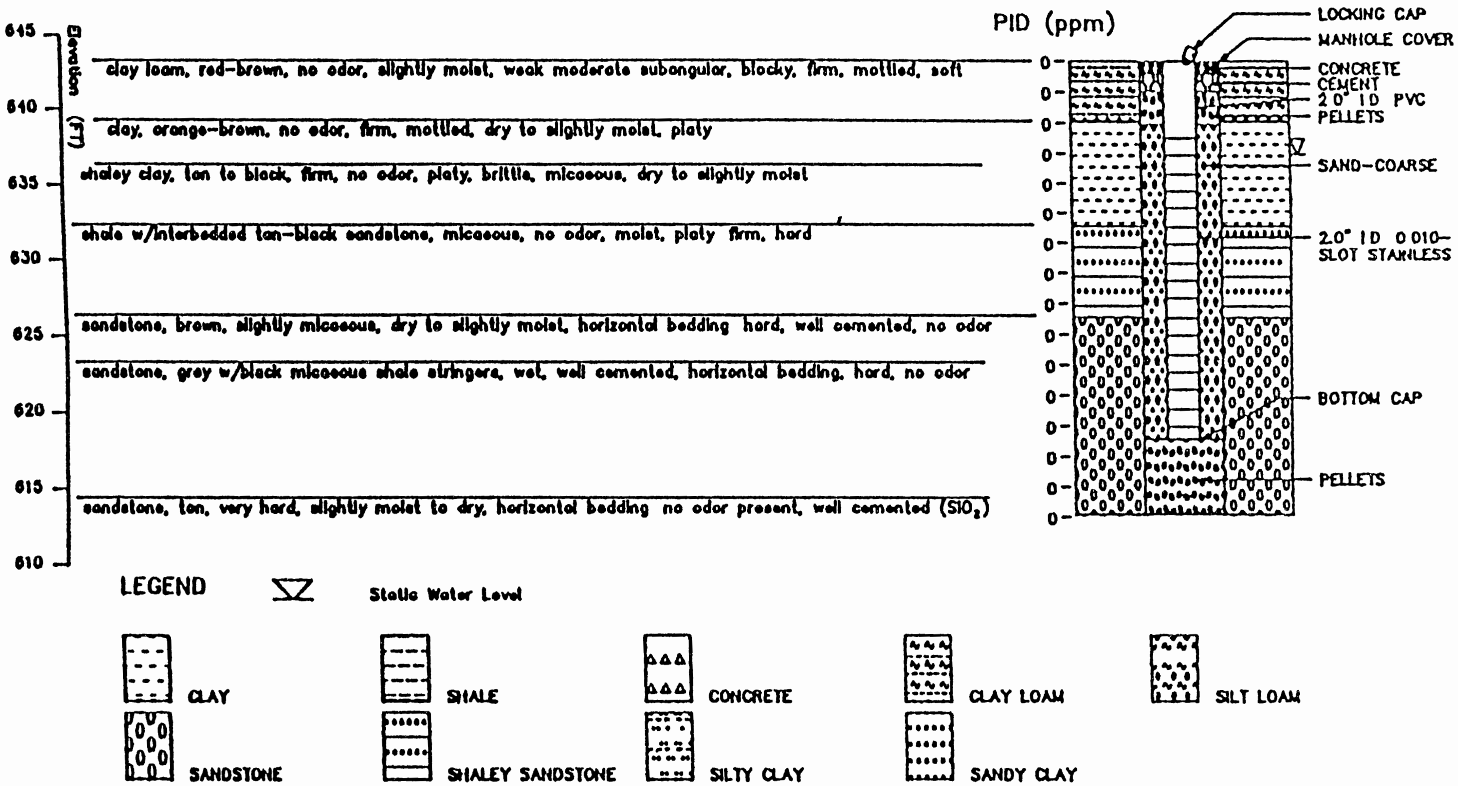
SAMW-12B



Elevation (ground).	647.16'
Top of casing	646 83'
Drilled by:	A.W. Pool, Inc.
Drilling method.	Air Rotary Core
PVC casing diameter:	2.0"

LITHOLOGIC LOG AND MONITORING WELL CONSTRUCTION DIAGRAM

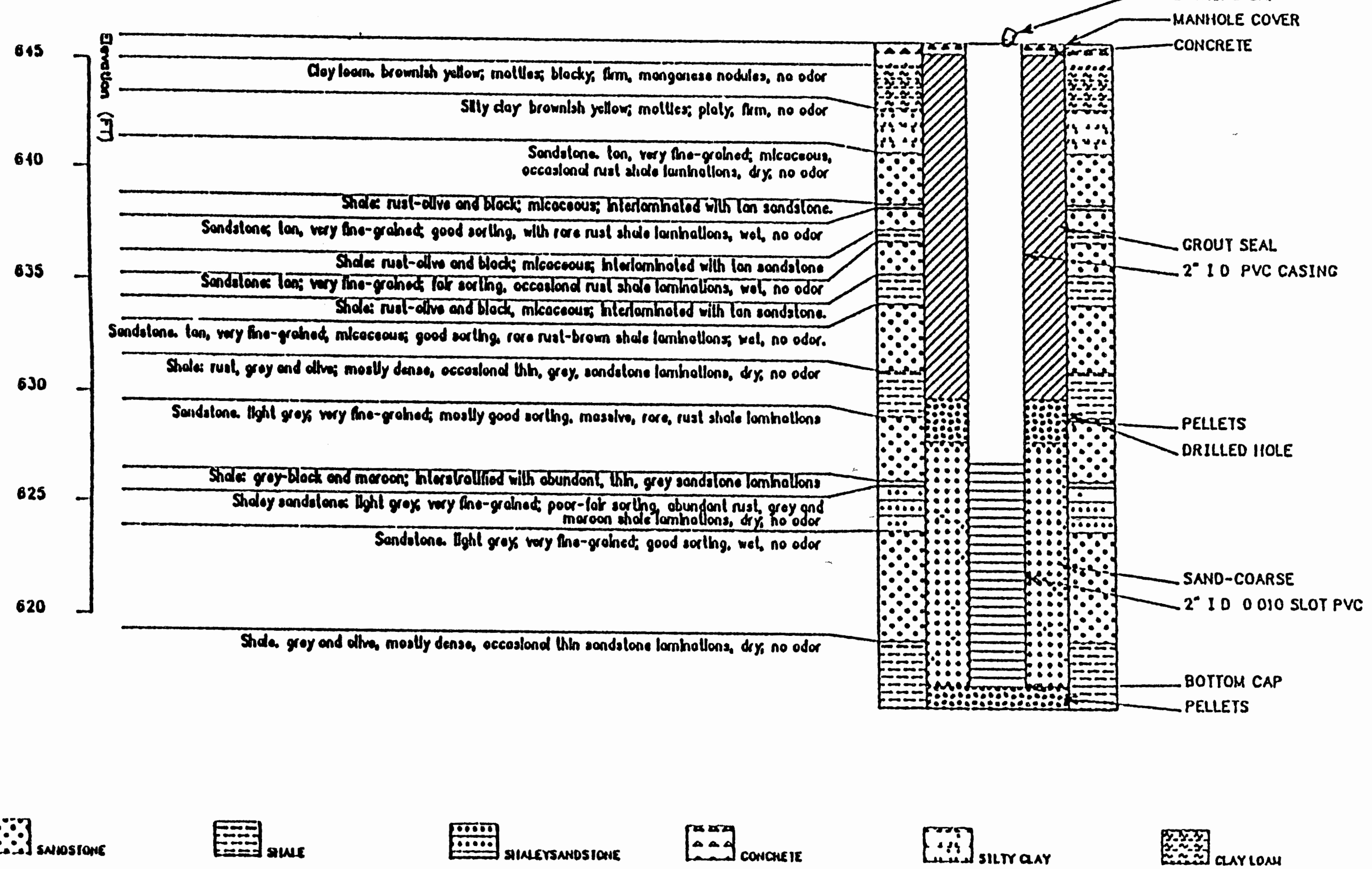
MW-02



Elevation (ground). 643.10'
Top of casing. 642.95'
Drilled by: A.W. Pool, Inc.
Drilling method: Air Rotary Core
PVC casing diameter: 2.0"

LITHOLOGIC LOG AND MONITORING WELL CONSTRUCTION DIAGRAM

MW-12A



Elevation (ground). 647 01'
Top of casing 647.16'
Drilled by: A W Pool, Inc
Drilling method. Air Rotary Core
PVC casing diameter: 2 0"

LITHOLOGIC LOG AND MONITORING WELL CONSTRUCTION DIAGRAM

APPENDIX B

CORE DESCRIPTIONS

MW-01

Depth	
0-1	Silt loam: A; dark brown (10YR 3/3); moderate, fine, subangular blocky structure; hard; 5-15% clay.
1-4	Silty clay loam: Bt; brownish yellow (10YR 6/6); common, medium, distinct mottles, yellowish red (5YR 4/6) to light grey (5YR 7/1); moderate, fine, subangular blocky structure; hard; manganese nodules; occasional subrounded pebbles, 4-10 mm.
4-6	Silty clay: C1; brownish yellow (10YR 6/8); common, medium, distinct mottles, brownish yellow (10YR 6/8) to light grey (5YR 7/1); platy; hard.
6-8	Silty clay: C2; light yellowish brown (10YR 6/4); few, medium, faint mottles, reddish yellow (7.5YR 6/6) to light grey (5YR 7/1); platy; hard; micaceous.
8-9.5	Sandstone: grey to slightly olive; very fine to fine-grained; subangular; argillaceous; fair to good sorting; well-cemented with silica; small scale trough cross bedding; with thin, discontinuous, wavy mud-shale laminations; minor muscovite in mudstone.
9.5-12.5	Sandstone: as above but interlaminated with continuous and discontinuous silty clay, light to dark orange; platy; poor sorting; clay decreases toward base.
12.5-15.5	Sandstone: grey to light olive; fine-grained; subangular to subrounded; argillaceous; well-cemented; with clay laminations as above.
15.5-15.8	Silty clay: orange to maroon to black; mottled.
15.8-16.1	Sandstone: tan to grey; very fine to fine-grained; subangular; argillaceous; small scale cross laminations with black, thin, discontinuous, irregular wavy mud-shale laminations; minor muscovite in mudstone.
16.1-17.2	Shale: black, micaceous; very thinly laminated, with interlaminated very thin sandstone as above; horizontal bedding (where the shale is thicker, greater than 2 mm, it appears unlithified, it is easily smeared with water).

17.2-17.4	Sandstone: tan; fine-grained; subangular; argillaceous; small scale cross laminations with grey-black shale.
17.4-17.6	Shale; orange to black; silty; micaceous.
17.6-22.5	Sandstone: tan to light grey; very fine-grained; subangular; argillaceous; with occasional discontinuous, light orange mudstone laminations and occasional black, micaceous, shale laminations.
22.5-40	Sandstone: light grey; very fine-grained; subangular; argillaceous; well-cemented; mostly massive; occasional zones of small scale cross lamination with thin, grey-black micaceous shale. Sandstone is very silty at 30-34 feet.
40-44	Sandstone: same as above but with increased shale laminations.
44-57.5	Sandstone: very fine to fine-grained; subangular; argillaceous; well-cemented; massive.
57.5-60	Sandstone: as above, with abundant angular, black shale rip-up clasts; bottom foot mostly massive with very few clasts.
60-61.3	Sandstone: light grey; very fine-grained; subangular to subrounded; argillaceous; well-cemented; interlaminated with abundant, thin, small scale cross laminations of black, micaceous shale.
61.3-90	Sandstone: light grey; very fine-grained; subangular; argillaceous; well-cemented; with rare black, micaceous shale laminations.

MW-02

Depth (feet)

0-1.1	Silt loam: A; dark brown (10YR 3/3); weak, fine, subangular blocky structure and medium, fine, platy structure; hard; 5% clay.
1.1-4	Silty clay loam: Bt; brownish yellow (7.5YR 6/8); common, medium, distinct mottles, reddish yellow (7.5YR 6/6) to light grey (5YR 7/1); weak, fine, subangular blocky structure and medium, fine, platy structure; manganese nodules; hard.
4-7	Silty clay: C1; reddish yellow (7.5YR 6/8); common, medium, distinct mottles, yellowish red (5YR 5/8) to light grey (5YR 7/1); platy; scattered small subrounded pebbles; manganese nodules.
7-11	Silty clay: C2; yellowish brown (10YR 5/4); common, medium, distinct mottles, reddish yellow (7.5YR 6/8) to light grey (7.5YR 7/1); hard; with occasional very thin black laminations; platy.
11-14.2	Sandstone: cream to tan; very fine-grained; well-cemented; argillaceous; poor to fair sorting; with small scale cross laminations of continuous and discontinuous olive and black, micaceous shale.
14.2-17.7	Shale: dark grey to black; micaceous; thin, horizontal laminations, with thin, very fine grained, tan sandstone laminations.
17.7-19.3	Sandstone: cream to tan; very fine grained; subangular; well-cemented; argillaceous; massive.
19.3-20	Shale: grey to black as above.
20-22	Sandstone: tan to grey; very fine grained; subangular; well-cemented; argillaceous; horizontal to small scale cross laminations with grey to black shale.
22-24.4	Shale: dark grey to black; micaceous; with occasional thin sand laminations.
24.4-31	Sandstone: tan; very fine grained; well-cemented; agillaceous; with thin, cross laminations of black, micaceous shale.

MW-03A

Depth (feet)

1-3	Silty clay loam: Bt; brownish yellow (10YR 6/6); common, medium, distinct mottles, reddish brown (2.5YR 4/4) to light grey (5YR 7/1) moderate, fine, subangular blocky structure; hard; manganese nodules and streaks of black organic matter.
3-7	Silty clay: C1; light brownish yellow (10YR 6/4); common, medium, distinct mottles, reddish yellow (7.5YR 6/6) to light grey (5YR 7/1); platy; slightly hard.
7-10	Sandstone: white to tan; very fine to fine grained; argillaceous; subangular; poor to fair sorting; interstratified with thin, wavy and cross laminated, continuous and discontinuous, black, micaceous shale.
10-14	Shale: olive to black; micaceous; very poor sorting; with continuous, thin, horizontal and wavy laminations of very fine to fine grained light grey sandstone.
14-19	Shale: as above, with thin, maroon mud-shale laminations at base.
19-21	Sandstone: tan to light olive; very fine to fine grained; argillaceous; subangular to subrounded; mostly horizontal laminations; wavy and small scale cross laminations in part; with thin, discontinuous red to maroon mud-shale laminations.
21-27	Sandstone: as above, with horizontal, red to maroon mud-shale laminations.
27-30	Shale: grey to black; micaceous; poor sorting; with continuous, thin, horizontal and wavy laminations of very fine-grained light grey sandstone.

MW-03B

Depth (feet)

1-3	Silty clay loam: Bt; brownish yellow (10YR 6/4); common, medium; distinct mottles, yellowish red (5YR 5/8) to light grey (5YR 7/1); moderate, fine, subangular structure; manganese nodules; hard; streaks of organic matter.
3-5	Sandstone: tan; very fine to fine grained; argillaceous; subangular, fair sorting; interstratified with abundant very thin, discontinuous, wavy, rust-colored mud-shale laminations; slightly friable.
5-6.5	Shale: tan; silty; friable; platy; micaceous; very poor sorting; interlaminated with thin, very fine grained sandstone (this unit is not well-lithified).
6.5-7	Sandstone: tan; very fine to fine grained; argillaceous; subangular to subrounded; good sorting; massive.
7-13	Sandstone: as above; fair sorting; interstratified with very thin, discontinuous and continuous, wavy and small scale cross laminated, grey to black shale laminations.
13-17.5	Shale: black; micaceous; moderately platy; thinly laminated with tan sandstone; horizontal laminations; several very thin maroon mud-shale laminations at base.
17.5-18	Sandstone: tan; very fine to fine grained; argillaceous; subangular; small scale cross laminations; with thin, discontinuous, wavy, maroon and black shale laminations.
18-19	Sandstone: tan to mostly light grey; very fine grained; argillaceous; subangular; slight cross bedding in part; mostly massive.

MW-04

Depth (feet)

Depth (feet)	Description
0-2.7	Silt loam: A; dark brown (10YR 3/3); moderate, fine, subangular blocky structure; scattered, small subrounded pebbles; hard; 5-15% clay.
2.7-6	Silty clay loam: Bt; brownish yellow (10YR 6/6); common, medium, distinct mottles, reddish yellow (7.5YR 6/6) to light grey (5YR 7/1); weak, fine, subangular blocky structure; manganese nodules; hard.
6-9	Sandstone: tan to orange; very fine to fine-grained; very friable; very poor sorting; very silty in part; micaceous; with thin, horizontal and wavy, shale and siltstone laminations; core is mostly rubble.
9-10	Sandstone: tan; very fine grained; very poor sorting; micaceous; very friable, poorly cemented; very abundant thin, horizontal siltstone laminations.
10-13.5	Sandstone: tan to rust; very fine grained; argillaceous; subangular; platy in part; interlaminated with very thin, discontinuous dark grey to black, micaceous shale.
13.5-18.5	Shale: grey; micaceous; interlaminated with dark brown and black shale and sandstone; horizontal, wavy and small scale cross bedding; flute and load casts?; mostly shale in upper and lower portions and mostly sand in middle.
18.5-21	Sandstone: grey to orange; very fine grained; argillaceous; with very thin wavy and discontinuous rust and black shale laminations.
21-27	Shale: grey to black; horizontal bedding; sand laminations in upper foot.
27-30	Sandstone: grey; very fine to fine grained; argillaceous; well sorted; subangular; well-cemented, rust to grey subangular to subrounded shale rip-up clasts scattered in lower 2 feet, mostly lensoid to elongate, most are 0.5 mm to 6 cm.

MW-05A

Depth (feet)	
0-1	Concrete and asphalt.
1-4	Silty clay loam: Bt; brownish yellow (10YR 6/6); common, medium, distinct mottles, red (2.5YR 4/6) to light grey (5YR 7/1); moderate, fine, subangular, blocky structure; hard; scattered, manganese nodules, small, subrounded pebbles in lower foot.
4-6	Sandstone: tan to orange; very poor sorting; very fine to fine grained; subangular to subrounded; micaceous; with abundant, thin, interlaminated siltstone.
6-7	Shale: dark grey to black; platy; micaceous; with thin, mostly horizontal, continuous, grey sandstone laminations.
7-8	Sandstone: tan to orange; very poor sorting; very fine grained; subangular; very friable; poorly cemented; micaceous; with abundant, thin, horizontal?, interlaminated siltstone.
8-23.3	Sandstone: light brown to light olive; fine grained; argillaceous; mostly good sorting; subangular; micaceous; well-cemented; mostly massive, with rare rust-colored mud-shale laminations, showing small scale cross laminations and wavy laminations; sandstone becomes slightly pink below 21 feet.
23.3-25.3	Shale: grey to black; micaceous; with abundant, thin, wavy, horizontal and small scale cross laminations of very fine grained grey sandstone; scattered beds are 1-3 cm.
25.3-27.8	Shale: grey to black as above; with scattered sand lenses and laminations as above.
27.8-28.5	Shale: as above with sandstone 50% or greater; wavy and small scale cross laminations.
28.5-35	Shale: grey to black; micaceous; with scattered sand lenses and laminations.

MW-05B

Depth (feet)	
0-1	Concrete and asphalt.
1-3	Silty clay loam: Bt; brownish yellow (10YR 6/6); common, medium, distinct mottles, red (2.5YR 4/6) to light grey (5YR 7/1); moderate, fine, subangular, blocky structure; manganese nodules; hard.
3-5	Sandstone: tan to orange; very fine to fine grained; very poor sorting, subangular to subrounded; micaceous; with abundant, thin, horizontal, continuous, siltstone laminations; some black organic matter.
5-7	Shale: grey to black; platy; micaceous; with abundant, thin, horizontal, continuous, grey sandstone laminations; 1.5 inch maroon shale bed at 5.5 feet.
7-7.5	Sandstone: tan to brown; very fine grained; poor sorting; subangular to subrounded; with thin, small scale cross laminations of maroon and black shale.
7.5-9	Sandstone: light brown to light olive; fine grained; argillaceous; fair sorting; well-cemented; micaceous; mostly massive; occasional discontinuous and continuous, wavy and small scale cross laminations of rust-colored, shale.
9-17	Sandstone: light brown to light pink; fine grained; argillaceous; poor to fair sorting; increased shale laminations as above; horizontal and wavy laminations.
17-19	Shale: grey to black; micaceous; thinly laminated, with very fine grained grey sandstone.
19-20	Shale: grey; not well lithified; slakes readily in water.

MW-06A

Depth (feet)

0-2	Silt loam: A; dark brown (10YR 3/3); many fine roots; moderate, fine, subangular, blocky structure; slightly hard.
2-4	Silty clay loam: Bt; brownish yellow (10 YR 6/6); common, medium, distinct mottles, yellowish red (5YR 4/6) to light grey (5YR 7/1); moderate, fine, subangular, blocky structure; manganese nodules, trace of very small rounded pebbles.
4-12	Sandstone: light brown to light olive; fine grained; argillaceous; mostly good sorting, subangular; well-cemented; mostly massive; occasional thin, small scale cross laminations of rust to maroon and black shale, especially at base.
12-14.5	Siltstone: tan to orange; very friable; poorly cemented; poor sorting; with thin, horizontal, grey, very fine grained sandstone laminations; 1.0 inch grey shale bed at 14 feet.
14.5-15	Sandstone: tan to brown; very fine grained; argillaceous; poor sorting; subangular to subrounded; with abundant, thin, wavy and horizontal, maroon and black micaceous shale laminations.
15-20	Sandstone: light brown to light olive; fine grained; argillaceous; poor sorting in upper 1.5 feet, fair sorting below; subangular; micaceous; well-cemented; mostly massive; occasional continuous and discontinuous, wavy and small scale cross laminations of rust, black and brown shale; 4.0 inch shaley bed at 19 feet, thinly laminated with sand, silt and clay; platy; friable.
20-21	Shale: grey to black; with rust and tan silty laminations; platy; horizontal bedding, friable.
21-22	Sandstone: as 14.5-15.
22-32	Sandstone: light brown to light olive; very fine grained; argillaceous; subangular; micaceous; well-cemented; mostly massive; occasional rust-colored mud-shale showing small scale cross laminations in upper 1 foot.
32-34	Shale: grey to black; micaceous; interlaminated with thin, grey sandstone; horizontal bedding.

MW-07A

Depth (feet)

0-1	Concrete and asphalt.
1-4	Silty clay loam: Bt; brownish yellow (10YR 6/6); common, medium, distinct mottles, yellowish red (5YR 4/6) to light grey (5YR 7/1); mostly moderate, fine, platy structure in upper half, and moderate, fine, subangular blocky in lower half; slightly hard; manganese nodules.
4-6	Sandstone: light grey to tan; very fine to fine grained; silty; very poor sorting; subangular; friable; micaceous; with abundant, horizontal, thin, silty clay and micaceous mud-shale laminations; core is mostly rubble.
6-7.5	Sandstone: light brown to light olive; fine grained; argillaceous; good sorting; subangular; well-cemented; micaceous; mostly massive; occasional thin, rust and black mud-shale showing horizontal and small scale cross laminations; silty and shaley bottom 6 inches.
7.5-10	Shale: grey to black; poor sorting; with abundant, horizontal, continuous, very thin, light grey sandstone laminations and occasional thin, silty rust-colored mud-shale laminations.
10-12.5	Sandstone: as at 6-7.5; grades into a ...
12.5-13.2	Siltstone: tan to orange; thinly interlaminated with grey sandstone and occasional maroon and black mud-shale; 2 inch grey shale near base.
13.2-14.4	Shale: grey, dense, firm, interlaminated with abundant rust siltstone bottom 5 inches.
14.4-23.3	Sandstone: tan to light grey and tan to pink below 19.5 feet; very fine grained; argillaceous; subangular to subrounded; well-cemented; mostly massive; occasional rust and black mud-shale showing small scale cross laminations; abundant shale laminations 15-15.7 feet.
23.3-25	Shale: grey to black; interlaminated with sandstone as above; very thin laminations in upper portion with increasing sand and sand thickness

near base; mostly wavy laminations with some horizontal and small scale cross laminations in upper portion; 1.5 inch grey shale bed at base.

25-25.5	Sandstone: light grey to pink; very fine grained; argillaceous; subangular; micaceous; with very thin rust and black mud-shale showing wavy and small scale cross laminations.
25.5-34	Shale: grey; dense; firm; slightly platy; occasional thin light grey sandstone laminations.

MW-08A

Depth (feet)	
0-1	Concrete and asphalt
1-4	Silty clay loam: Bt; brownish yellow (10YR 6/6); common, medium, distinct mottles, reddish yellow (2.5YR 4/4) to light grey (5YR 7/1); weak, fine, subangular, blocky structure; slightly hard; manganese nodules; black organic matter.
4-5	Sandstone: tan to very light olive; very fine grained; subangular; very poor sorting;, micaceous; friable; interlaminated with thin, discontinuous, rust-colored shale showing small scale trough cross laminations.
5-8	Sandstone: tan to very light olive; very fine grained; argillaceous; fair sorting; subangular; well-cemented; occasional thin, discontinuous, rust-colored shale showing small scale cross laminations.
8-9.5	Siltstone: tan to orange and rust; very friable; platy; with thin, mostly horizontal, very fine grained tan sandstone and mud-shale laminations; 2 inch grey shale bed near base.
9.5-11.3	Sandstone: as above @ 5-8; very poor sorting 10.2-11.1.
11.3-15.5	Shale: grey to black and occasional green and maroon; platy; very thin to thin laminations of sandstone, as above; mostly horizontal and some wavy and small scale cross laminations.
15.5-17.7	Sandstone: light grey to tan and pink in lower half; very fine to fine grained; argillaceous; micaceous; subangular to subrounded; well-cemented; mostly massive; occasional rust and maroon thin mud-shale laminations; approximate 20° inclined laminations at 16.3 feet with small scale cross laminations superimposed; small discontinuous laminations of dark red to rust mud-shale scattered throughout 16-16.5.
17.7-19.1	Sandstone: as above but poor sorting; with thin, mostly horizontal, maroon and brown mud-shale showing some small scale cross laminations; very shaley in middle portion.

19.1-19.8	Sandstone; light grey to tan and pink; very fine grained; argillaceous; well-cemented; with occasional thin, mostly horizontal pink to maroon mud-shale showing some small scale cross laminations; 1/4 inch black and maroon shale at base.
19.8-20	Clayey silt; grey green to maroon; platy; dense; this does not appear to be a lithified unit.
20-27.3	Sandstone: light grey, very fine to fine grained; argillaceous; well-cemented; mostly massive; occasional thin, micaceous, pink to maroon mud-shale laminations 23.5-24.5; and 26.6-27; wavy and small scale cross bedding; bedding inclined at approximately 20° near base.
27.3-29.8	Shale: grey to black; dense; micaceous; platy; very thin to thin laminations; interlaminated with sandstone as above; 7 inch sandstone as per 20-27.3 at 27.7. Bottom 1 foot is 50% sand with bed width ranging from 1/8 to 3/4 inch.
29.8-33	Shale; grey, dense; micaceous; firm; platy; occasional thin sandstone laminations at 32 feet.

MW-09A

Depth (feet)

0-4	Silty clay loam: Bt; brownish yellow (10YR 6/6); common, medium, faint mottles; yellowish red (5YR 4/6) to light grey (5YR 7/1); weak, fine, subangular, blocky structure; hard; friable in part; manganese nodules; scattered small, subrounded pebbles and streaks of black organic matter.
4-6.5	Sandstone: tan to orangish brown; very fine to fine grained; very poorly sorted; subangular; friable; micaceous; with thin, rust-colored mud-shale showing wavy and small scale cross laminations; abundant shale laminations in middle 4 inches; decreasing shale towards base.
6.5-8	Siltstone: tan to orange; poor sorting; friable; poorly cemented; with occasional, thin, mostly horizontal sand laminations or small lenses; platy; some small scale cross laminations.
8-10	Sandstone: tan to light olive; very fine grained; argillaceous; well sorted; subangular; well-cemented; mostly massive; occasional thin, mostly discontinuous, horizontal, wavy and small scale cross laminations of rust-colored mud-shale.
10-12	Shale; mostly grey with some black and occasional silty, rust-colored laminations; micaceous; interlaminated with very thin horizontal sandstone; some wavy and small scale cross laminations; increasing sandstone towards base; grades into a....
12-14	Sandstone: as above; large (> 1 inch) shale rip-up clasts and shale balls at 12.7 feet.
14-18	Shale: black and occasional grey, maroon and green; very thin to thin laminations; platy; mostly horizontal bedding; interlaminated with sandstone as above; some wavy and small scale cross laminations.
18-20.5	Sandstone: as above; mostly massive; occasional thin rust-colored shale laminations; inclined at approx. 35°- 40° in part; nearly horizontal at base.
20.5-21	Sandstone: grey to olive; very fine grained; argillaceous; subangular to subrounded; interlaminated with thin, wavy, shale laminations.

21-25 Sandstone: as above, mostly massive; some very thin rust and black mud-shale laminations inclined at approx. 30 ; upper 5 inches displays 2 inches of mostly dark green shale with thin sandstone laminations, underlain by 3 inches of grey, rust and maroon mud-shale rip-up clasts, showing slight inclination; most clasts are 3/8 X 1 inch and flattened; some are lensoid to near-circular; largest clast is 1 X 2 inches; bedding becomes more near horizontal below 23.6; 2 inch black shale interlaminated with thin sandstone laminations @ 24'.

25-36.5 Shale: grey to black; dense; shale varies from <0.5 mm to 6 in; mostly horizontal and wavy bedding, some cross bedding; sandstone is as above; very thin to 3 inches thick; at approximately 31' are very steep inclined beds.

36.5-41.3 Sandstone; medium grey to medium green, very fine to fine grained; argillaceous; subangular; well-cemented; wavy and cross laminated with very thin green mud-shale.

41.3-41.6 Shale: grey to black; dense; massive.

41.6-43 Shale: grey to black; thin horizontal, wavy and cross laminations; with thin sandstone laminations.

43-57 Sandstone: light grey to very light green; very fine grained; argillaceous; subangular; well-cemented; mostly massive; very scattered thin shale laminations.

57-59 Shale: grey and black; sand as above with thin black shale laminations.

59-89 Sandstone: light grey to very light green; very fine grained; argillaceous; subangular to subrounded; well-cemented; mostly massive; very rare thin black shale laminations, some discontinuous; flake-like, micaceous from 62 feet to base. Rust-colored, almond-sized, silty ? shale rip-up clasts at 65.5 and 69; between 78.5 and 80' are scattered, silty, shale rip-up clasts, mostly lensoid-shaped. Rust-colored shale rip-up clast 6 mm X 6 cm at approximately 83 feet. 84.2 to 85.5; small to very large (2 mm to 13 cm) rust-colored rip-up clasts; most are elongate/lensoid; very few display any angularity.

MW-10A

Depth (feet)	
0-1	Concrete and asphalt.
1-4	Silty clay loam: Bt; light brownish yellow (10YR 6/4); common, medium, distinct mottles, reddish yellow (7.5YR 6/6) to light grey (5YR 7/1); moderate, fine, subangular, blocky structure; slightly hard; manganese nodules.
4-6	Siltstone: tan to light grey; poor sorting; subangular; very friable; micaceous; upper half is very silty; unconsolidated; contains some clay; increasing clay in middle with thin sandstone laminations; lower portion is primarily sandstone with abundant interlaminated siltstone and mud-shale.
6-8	Sandstone: tan to light olive; very fine grained; argillaceous; fair sorting; subangular; well-cemented; with mostly horizontal and discontinuous, rust-colored shale laminations; especially at 6.5-7 feet.
8-10	Shale: orange, rust and light to dark grey; very poor sorting; very friable in part; micaceous; platy; continuous and discontinuous wavy and horizontal laminations interlaminated with sandstone.
10-10.8	Sandstone: tan; very fine grained; subangular; moderately friable; micaceous; with rust-colored shale showing wavy and small scale cross laminations.
10.8-11.3	Shale: rust, grey and black; micaceous; mostly thin horizontal bedding; interlaminated with rust siltstone and light grey sandstone as above.
11.3-12	Sandstone: tan to light olive; very fine grained; argillaceous; subangular; well-cemented; occasional thin rust-colored shale showing small scale cross laminations.
12-15.5	Shale: tan, orange and grey to black; micaceous; very silty in upper 2-1/2 feet; thinly laminated; with very thin sandstone laminations as above showing small scale cross laminations.
15.5-16	Sandstone: as above silty and shaley at base.

16-17	Shale: grey to green and black; micaceous; very silty; mostly thinly laminated, with very thin sandstone showing small scale cross laminations; organic matter in black shale.
17-17.8	Sandstone: as above; silty and shaley at base.
17.8-18.3	Shale: as above; tan and grey to black.
18.3-24.6	Sandstone: tan to light olive; very fine grained; argillaceous; subangular; well-cemented; mostly good sorting; mostly massive; with occasional small scale cross laminations of rust shale; 25° inclined laminations at 20.7 feet; rare shale laminations below this; 3/4 inch rust-colored shale rip-up clasts coated with brown shale at 21.9 and 22.7 feet; 4 inch shaley sand at base.
24.6-27	Sandstone: light to light grey; very fine grained; subangular; micaceous; interlaminated with very thin grey shale; horizontal and small scale cross-laminations.
27-33.6	Shale: dark grey to black; dense; organic matter; mostly massive; occasional thin sandstone laminations; abundant sand laminations 29.5 to 31 feet and 32.5 to 33.6 feet.
33.6-33.8	Sandstone: light olive; very fine grained; subrounded; argillaceous; interlaminated with very thin rust and black shale showing small scale cross laminations.
33.8-35	Sandstone: tan to light olive; very fine grained; subangular; argillaceous; well-cemented; very thin rust to black shale laminations showing 20° inclined laminations and small scale cross laminations; increased shale laminations at base; grey shale rip-up clasts at 34.7 feet.

MW-11A

0-1.7	Gravel fill.
1.7-5.5	Silty clay loam; Bt; brownish yellow (10YR 6/6); common, medium, distinct mottles, light grey (5YR 7/1) to reddish yellow (7.5YR 6/6); no structure apparent; moist; manganese nodules; core recovery poor.
5.5-10	Sandstone: tan; very fine-grained; subangular; poor sorting, occasional fair sorting; rust and maroon shale; discontinuous and continuous, wavy and small-scale cross-laminations. Shale laminations every 1-6 inches are probably continuous and greater than 1/8 inch thick; these layers are generally poorly represented in the cores. Preferential breaks at these intervals results in poor recovery of these shale laminations. Very silty interval at approximately 9 feet with grey shale zone below. Core is badly crumbled.
10-11	Sandstone: tan; very fine-grained; subangular; well-sorted; with rare, discontinuous, wavy, rust shale laminations.
11-11.8	Sandstone: tan; very fine-grained; subangular; poor sorting; with abundant, dark olive, rust and micaceous black shale laminations; continuous and discontinuous, horizontal, wavy and small-scale cross-laminations.
11.8-15.1	Sandstone: light grey; very fine-grained; subangular; very poor-poor sorting; abundant, mostly continuous dark olive, grey and black shale laminations; mostly wavy and horizontal and small-scale cross-laminations; up to 50% shale in part; 1 inch grey shale at 12.7 feet; 1/2 inch maroon shale at 14.7 feet; abundant, black, continuous, organic shale laminations 14.9-15.1 feet.
15.1-21	Sandstone: tan; very fine grained; subangular; mostly good sorting, fair sorting 15.5-15.7 and 16.1-16.8 feet; mostly discontinuous, maroon, rust, grey-black shale; wavy and small-scale cross-laminations; 1.5 X 3 inch maroon shale rip-up clast at 17 feet; additional, smaller clasts at 18.9 feet; poor to fair sorting below 18 feet with continuous laminations more common.
21-23	Shale: grey; dense; massive with rare thin, grey sandstone laminations.

23.5-24	Shale: same as above with thin, horizontal laminations with 40-50% very thin grey sand laminations.
24-26.5	Sandstone: tan; very fine-grained; subangular; poor to fair sorting; with maroon, olive-rust and black shale laminations; shale rip-up clasts 25.7-26 feet.
26.5-27	Shale: grey-black; mostly dense, with approximately 20% thin, grey sandstone laminations.
27-28.6	Sandstone: light grey; very fine-grained; subangular; poor to fair sorting; with very thin, dark olive, rust and black shale; discontinuous small-scale cross-laminations; occasional continuous shale laminations; poor sorting at base.
28.6-30	Shale: grey to dark olive and black; with up to 50% grey sand laminations; shale is micaceous and platy.

MW-12A

0-1	Concrete.
1-3	Silty clay loam: Bt; brownish yellow (10YR 6/6); common, medium, distinct mottles, yellowish red (5YR 4/6) to light grey (5YR 7/1); moderate, fine, subangular blocky structure; hard; manganese nodules; occasional subrounded pebbles, 4-10 mm.
3-5	Silty clay: C; brownish yellow (10YR 6/8); common, medium, distinct mottles, brownish yellow (10YR 6/8) to light grey (5YR 7/1); platy; hard.
5-7.3	Sandstone: tan, very fine-grained; subangular; fair sorting, very silty at top; with occasional rust shale; horizontal and wavy, continuous and discontinuous, and small-scale cross-laminations; micaceous.
7.3-7.5	Shale: rust-olive and black, micaceous; thinly-interlaminated with tan sandstone; not well lithified.
7.5-8.5	Sandstone: tan; very fine-grained; subangular; good sorting; very silty at top; with occasional rust shale; horizontal and wavy, continuous and discontinuous, and small-scale cross-laminations; micaceous.
8.5-9	Shale: rust-olive and black; micaceous; thinly interlaminated with tan sandstone.
9-10.5	Sandstone: tan; very fine-grained; subangular; fair sorting; silty; with occasional rust shale; horizontal and wavy, continuous and discontinuous, and small-scale cross-laminations; micaceous.
10.5-11.8	Shale: rust-olive and black; micaceous; thinly interlaminated with tan sandstone.
11.8-14.8	Sandstone: tan; very fine-grained; subangular; good sorting; with rare rust shale; horizontal and wavy, continuous and discontinuous, and small-scale cross-laminations; micaceous.
14.8-16.9	Shale: rust, grey and olive; mostly dense; occasional thin, grey, sandstone laminations, some inclined at approximately 25 degrees.
16.9-19.8	Sandstone: light grey, very fine-grained; subangular, mostly good sorting; massive; micaceous; scattered rust mud-shale laminations.

19.8-20	Shale: grey-black and maroon; interstratified with abundant, thin, grey sandstone laminations.
20-27	Sandstone: light grey; very fine-grained; subangular; poor to fair sorting; with abundant rust, grey and maroon shale; continuous and discontinuous, wavy and small-scale cross-laminations.
22-27	Sandstone: light grey; very fine-grained; subangular; mostly good sorting; grades into a...
27-30	Shale: grey and olive; mostly dense; scattered thin sandstone laminations.

MW-13A

0-2.3	Silt loam: A; dark brown (10YR 3/3); moderate, fine, granular structure; small plant roots; small, subrounded pebbles; moist; 5-15% clay.
2.3-5	Silty clay loam: Bt; brownish yellow (10YR 6/6); common, fine, distinct mottles, reddish yellow (7.5YR 6/6) to light grey (5YR 7/1); manganese nodules; moist; micaceous; trace of fine sand at 5 feet.
5-6.3	Loamy silt (C) to siltstone: tan to orange; very friable; with very thin, horizontal and wavy, grey very fine sandstone and grey-black shale. Several 1/4 inch mud-shale continuous laminations; micaceous; manganese nodules. Core is rubble.
6.3-7	Sandstone: tan; very fine-grained; subangular; good sorting; mostly massive with rare discontinuous rust, mud-shale laminations showing small-scale cross-laminations.
7-8.4	Sandstone: same as above with increased shale laminations; sand is still relatively well sorted but there are more separate, continuous, mud shale laminations.
8.4-8.7	Sandstone: tan to rust; very poor sorting; thinly-interlaminated with abundant, grey-black micaceous shale; organic matter.
8.7-9-3	Shale: grey; micaceous; interlaminated with grey sandstone; horizontal, wavy, and small-scale and cross-laminations.
9.3-10.2	Shale: same as above; and interlaminated with abundant rust mud-shale laminations.
10.2-18.5	Sandstone: tan to rust; very fine-grained; subangular; fair-good sorting; mostly massive with rare rust and grey shale; discontinuous and small-scale cross-laminations; with zones of increased number of discontinuous and continuous shale laminations at 10.5, 13.0-13.4, 13.8-14 feet; 1/8-1/4 inch rust shale at 15.1 feet; moderately sorted to 16 feet; 16.0-16.5 feet is poorly sorted with abundant rust and black, very thin, continuous and discontinuous, wavy and small scale laminations; moderately sorted as above below 16.5 feet with scattered 1/8 inch continuous, rust and black shale laminations; all micaceous.

18.5-20	Shale: grey; dense; with rare thin, wavy, grey sandstone laminations.
20-23.7	Sandstone: tan to rust; very fine grained; subangular; very poor sorting upper 6 inches; abundant rust and grey mud-shale laminations; mostly horizontal, continuous laminations; several shales 1/8-1/4 inch thick; very thin, black, discontinuous laminations at base; 20.5-21.2 is well sorted with rare rust mud shale laminations; 21.2-21.9 is very poorly-sorted; very thin, interstratified, horizontal, continuous, rust and mostly black shale laminations in the sandstone; 21.9-22.8 is well-sorted sandstone as above; 22.8-23.7 is very poorly-sorted sandstone as above; several 1/8-1/4 inch thick grey and rust laminations.
23.7-30	Shale: grey and black; dense; interstratified with occasional sandstone laminations; abundant soft-sediment deformation present; sand is continuous and discontinuous up to 1/4 inch thick; bottom 6 inches is mostly sand with interlaminated grey-black, thin, continuous shale.

MW-13B

0-2 Silt loam: A; dark brown (10YR 3/3); moist; firm; no structure apparent due to sample trauma; manganese nodules; trace of small pebbles.

2-4.8 Silty clay loam: Bt; brownish yellow (10YR 6/6); common, medium, distinct mottles; yellowish red (5YR 5/8) to light grey (5YR 7/1); manganese nodules; moist; firm; micaceous.

4.8-5.5 Silty clay: C1; brownish yellow (10 YR 6/8); with thin, wavy, grey sandstone laminations; micaceous; moist; siltstone at base.

5.5-6.5 Silty loam: C2; light yellowish brown (10YR 6/4); few, faint mottles, reddish yellow (7.5YR 6/6) to light grey (5YR 7/1); purple-black organic matter; few apparent horizontal laminations; firm but friable; clay < 10%; few, fine, distinct mottles. reddish yellow (7.5YR 6/6) to light grey (5YR 7/1); silt and laminations increase near base.

6.5-8.5 Sandstone: tan-light grey; very fine-grained; subangular; mostly good sorting; rare rust mud-shale laminations showing low angle, small scale cross-laminations; good sorting in upper foot, fair sorting below with several 1/8-1/4 inch continuous and wavy, discontinuous laminations.

8.5-10 Shale: grey-black; micaceous; thinly laminated; with abundant thin grey sandstone laminations, especially last .5 foot.

10-15.5 Sandstone: tan to rust; very fine-grained; subangular; micaceous; mostly good sorting; with occasional, wavy, continuous and discontinuous shale showing low-angle cross-lamination; fair sorting 10.2-10.8, 13.4-13.6 and at 14.8; overall poor-fair sorting below 14 feet.

15.5-16.3 Shale: grey; micaceous; interlaminated with dark brown and black shale and grey sandstone; wavy and small scale cross laminations; black organic matter.

16.3-17 Sandstone: tan-light grey; very fine-grained; subangular; poor sorti subangular; poor s abundant grey-black, discontinuous and continuous, horizontal and wavy shale showing small scale-cross laminations.

17-17.3 Shale: grey, with very thin, horizontal, grey sandstone laminations.

17.3-17.7 Sandstone: tan-light grey; very fine-grained; subangular; good sorting; with rare, rust shale showing small-scale cross-laminations.

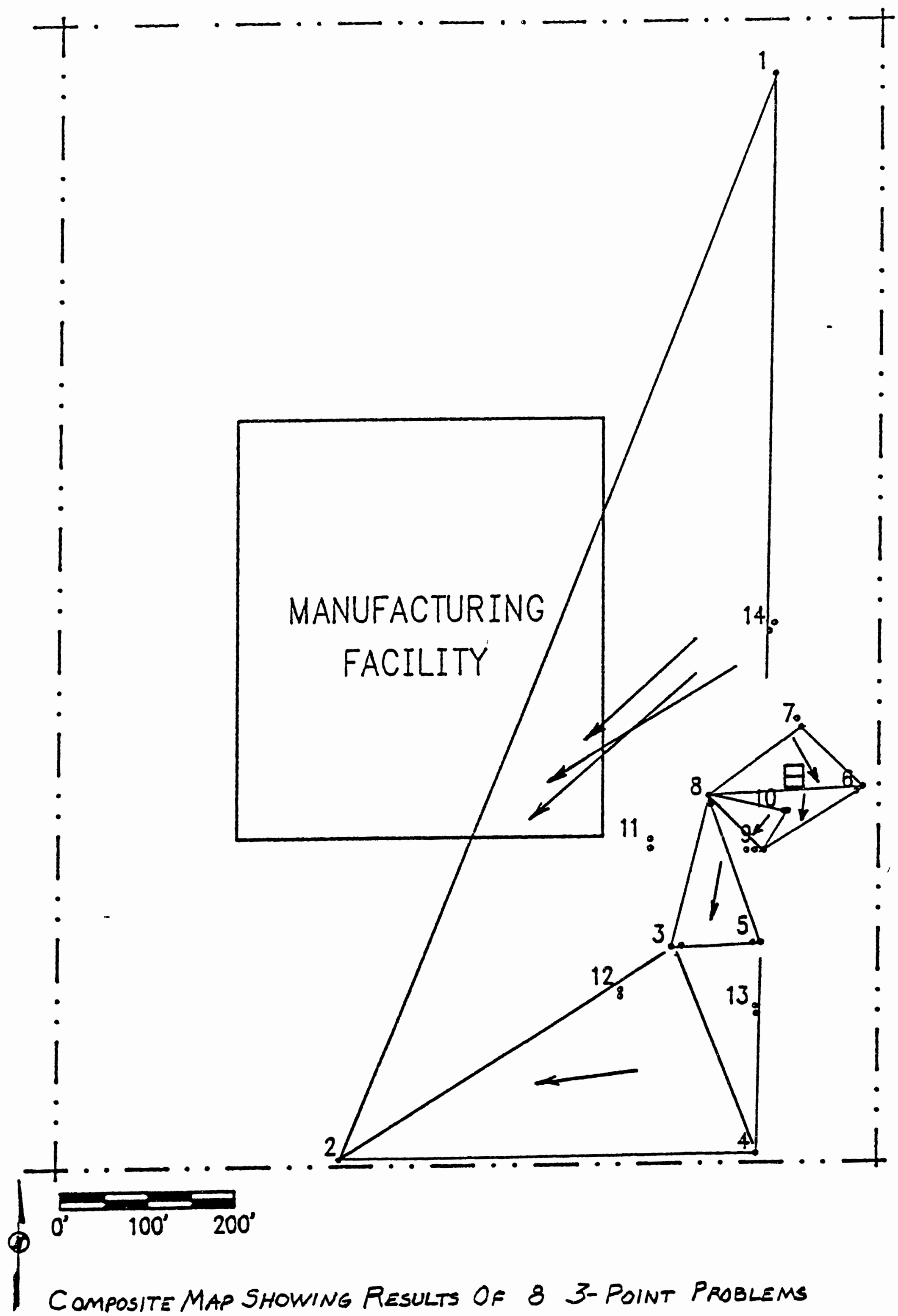
17.7-18.5 Shale: grey; dense; massive.

MW-14A

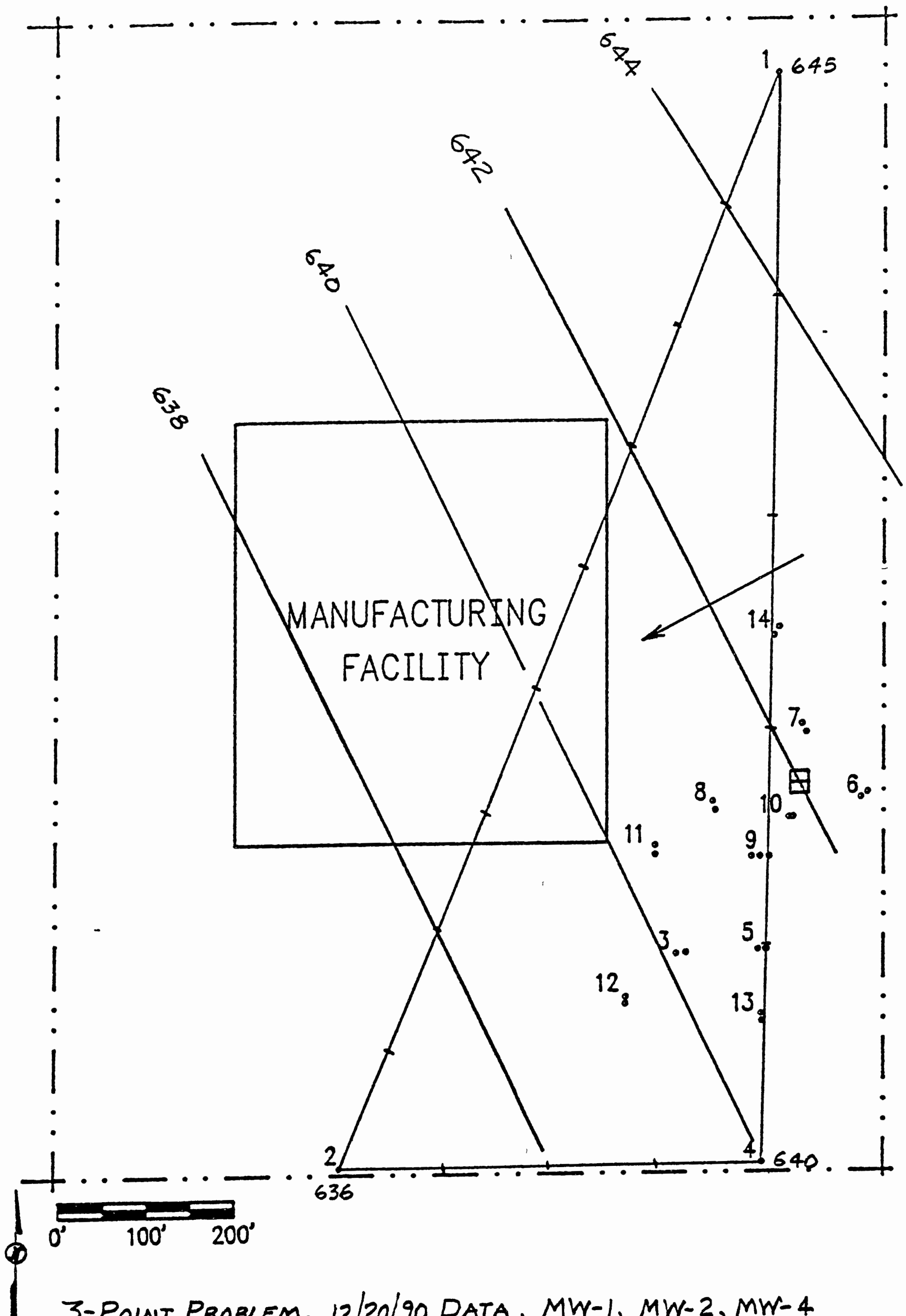
0-1	Concrete.
1-3	Silty clay loam: Bt; brownish yellow (10YR 6/6); common, medium, distinct mottles, yellowish red (5YR 4/6) to light grey (5YR 7/1); moderate, fine, subangular blocky structure; hard; manganese nodules; occasional subrounded pebbles, 4-10 mm.
3-5	Silty clay; C; brownish yellow (10YR 6/8); common, medium, distinct mottles, brownish yellow (10YR 6/8) to light grey (5YR 7/1); platy; hard.
5-7.5	Sandstone; tan; very fine-grained; subangular; very silty; fair sorting; with rust mud-shale; wavy, discontinuous, and small-scale cross-laminations; micaceous.
7.5-9	Shale: mostly tan and light olive; not well lithified; with trace of grey sandstone laminations.
9-11	Sandstone: tan, very fine-grained; subangular; mostly good sorting; massive; micaceous.
11-12	Sandstone: tan; very fine-grained; subangular; fair sorting; with interlaminated grey and rust shale towards base; grades into a....
12-14	Shale: mostly grey-black with rust towards base; mostly dense; fair sorting, with thin, horizontal, grey sandstone laminations.
14-19.7	Sandstone: tan; very fine-grained; subangular; good sorting; mostly massive, with occasional rust and black mud-shale; wavy, discontinuous, small-scale cross-laminations; micaceous; increased shale bottom foot.
19.7-20	Shale: black, thinly laminated; with abundant thin grey sandstone laminations.
20-21	No Recovery
21-28.6	Sandstone: tan-light grey; very fine-grained; subangular; good sorting; mostly massive; sandstone is light pink below 24'; 3" pink-maroon shale bed at 24 feet.
28.6-30	Shale: grey-black; dense; 1-1/2 inch sandstone bed at 28.7 feet.

APPENDIX C

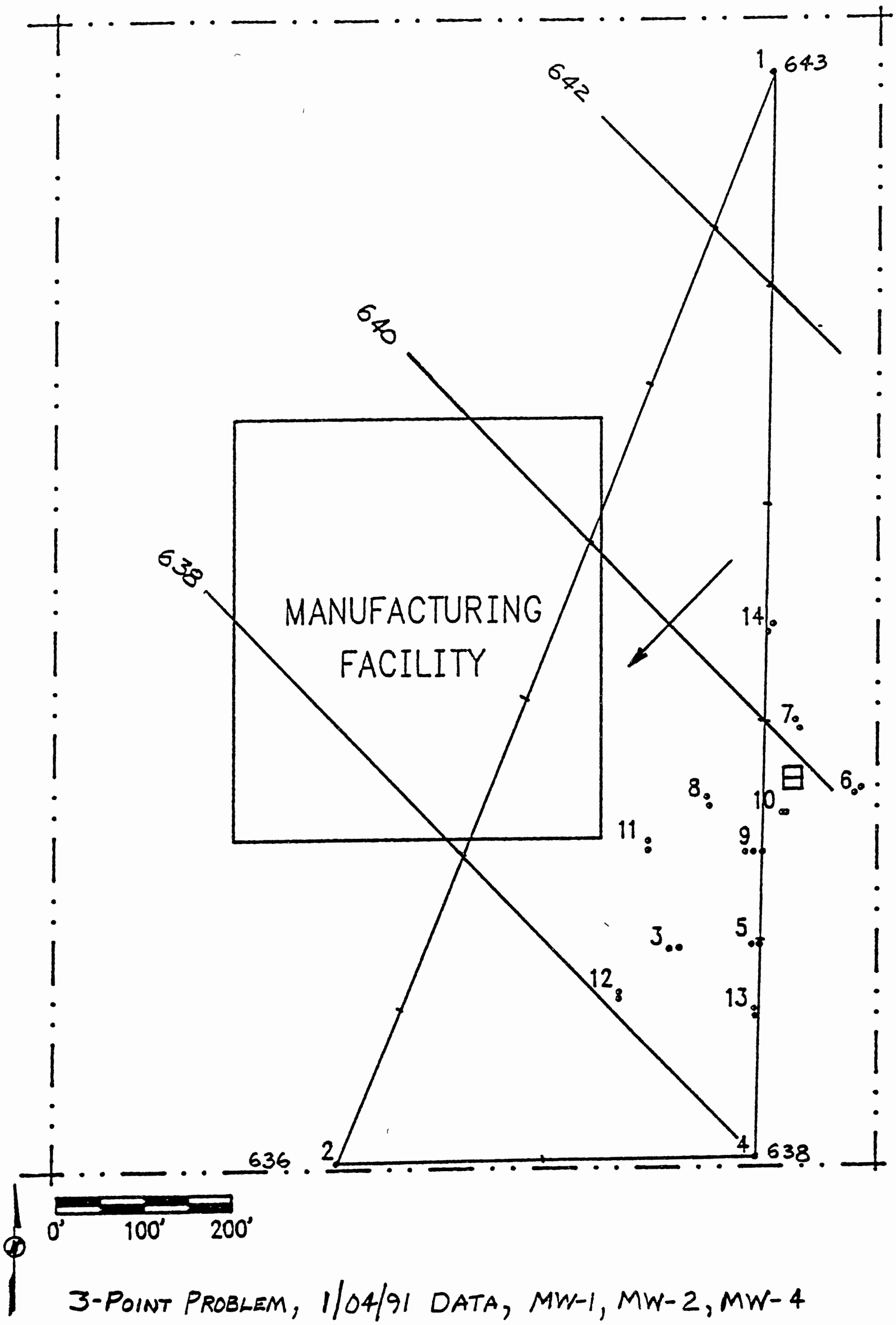
THREE-POINT PROBLEMS



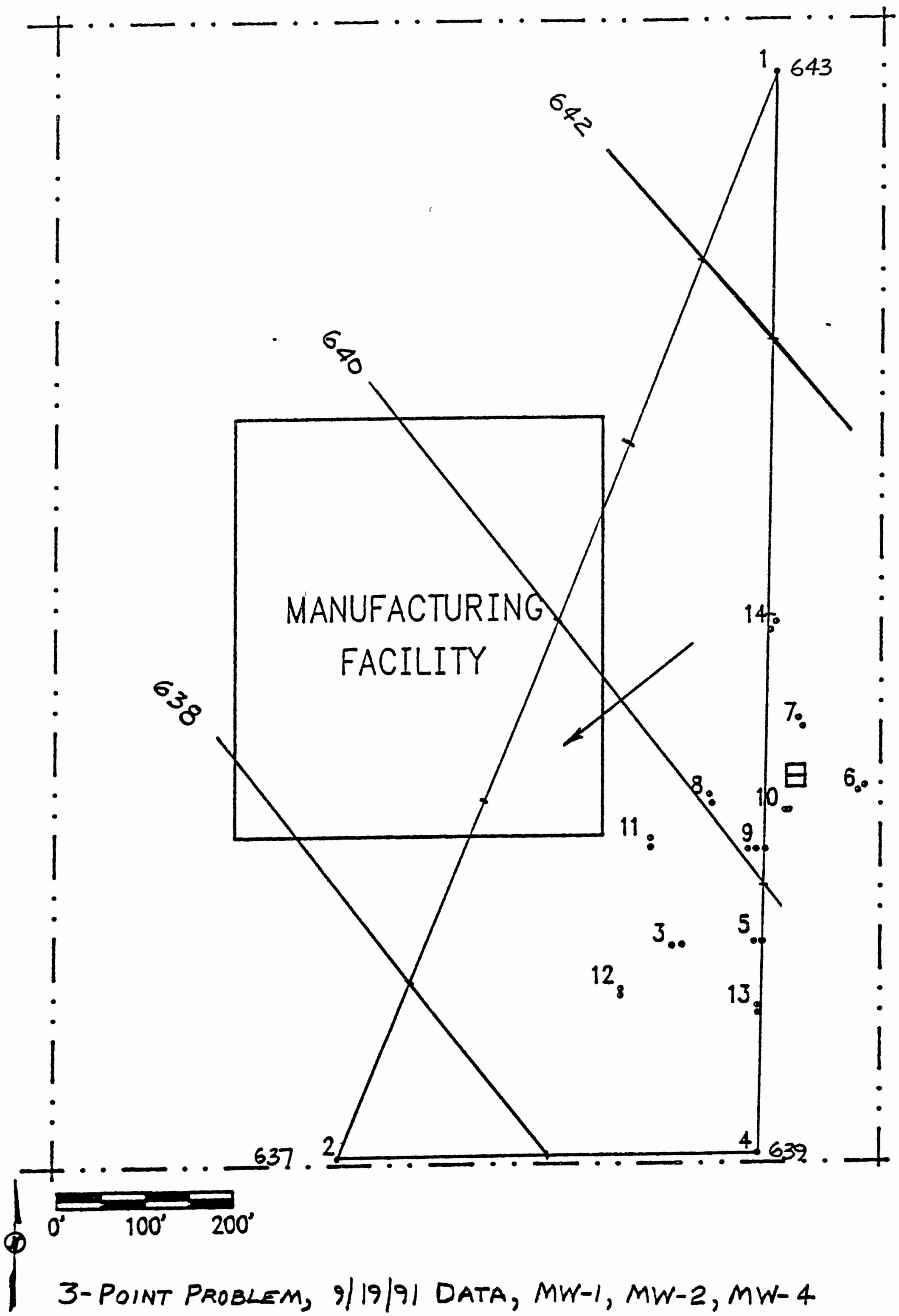
COMPOSITE MAP SHOWING RESULTS OF 8 3-POINT PROBLEMS



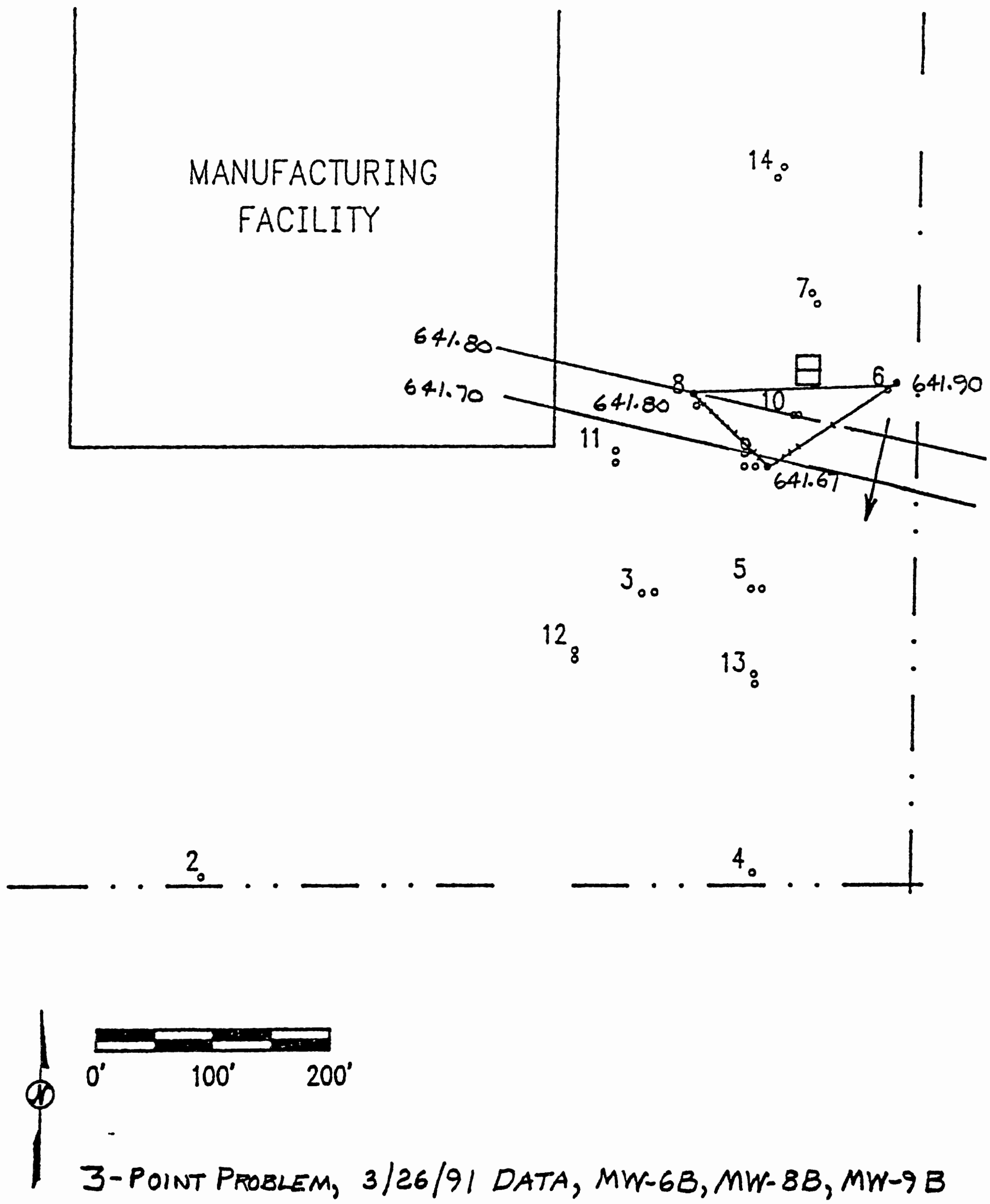
3-POINT PROBLEM, 12/20/90 DATA, MW-1, MW-2, MW-4



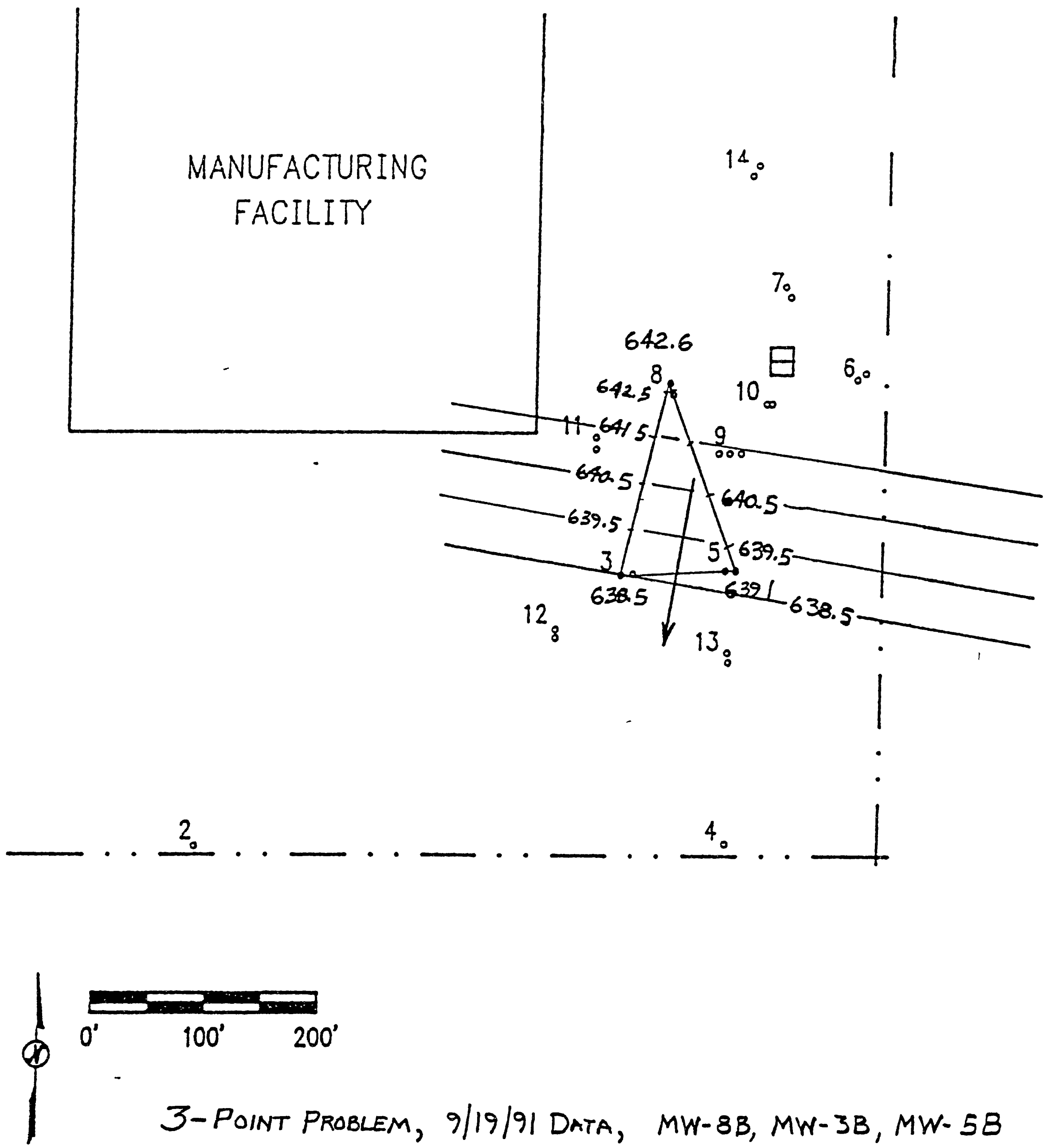
3-POINT PROBLEM, 1/04/91 DATA, MW-1, MW-2, MW-4



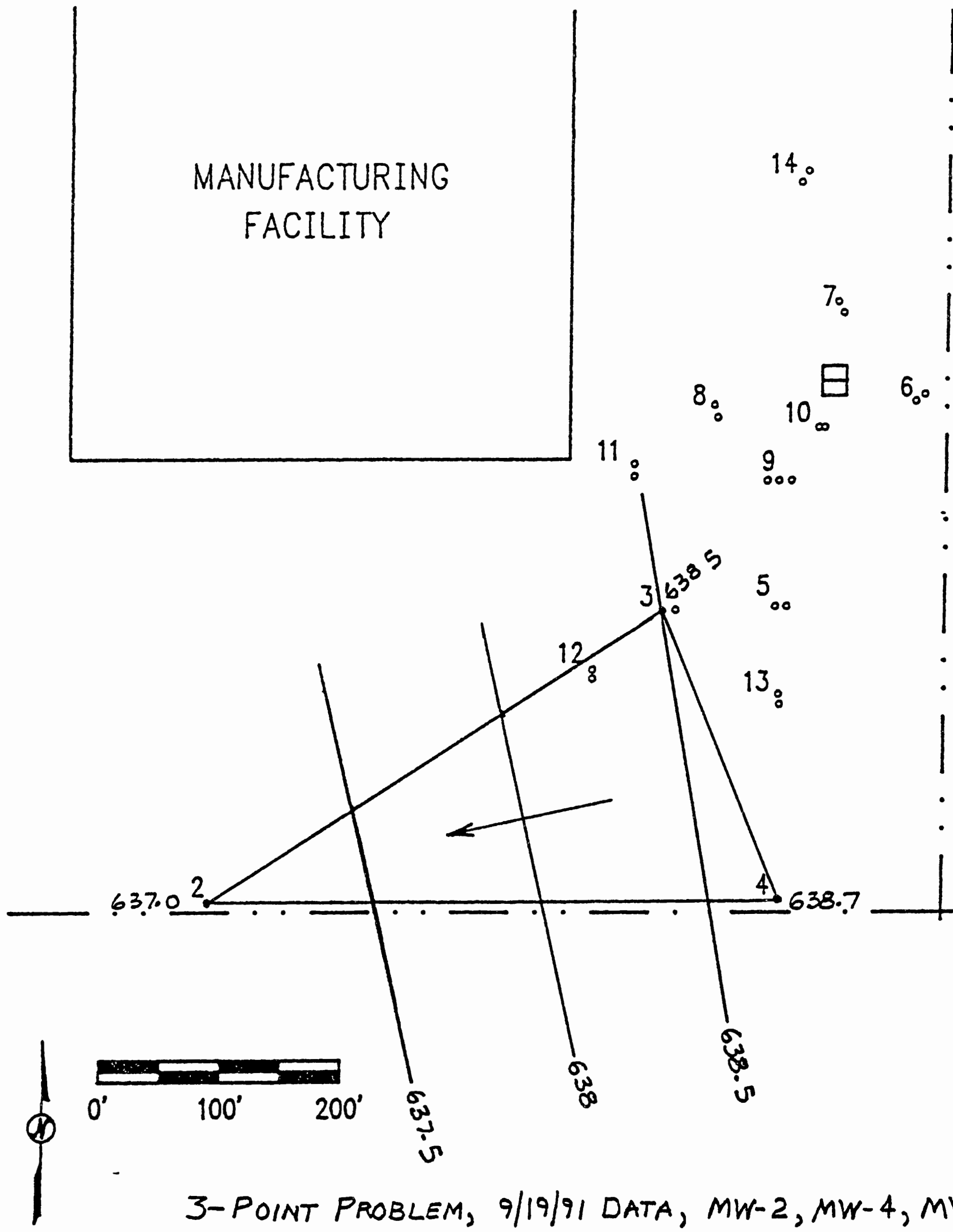
3-POINT PROBLEM, 9/19/91 DATA, MW-1, MW-2, MW-4



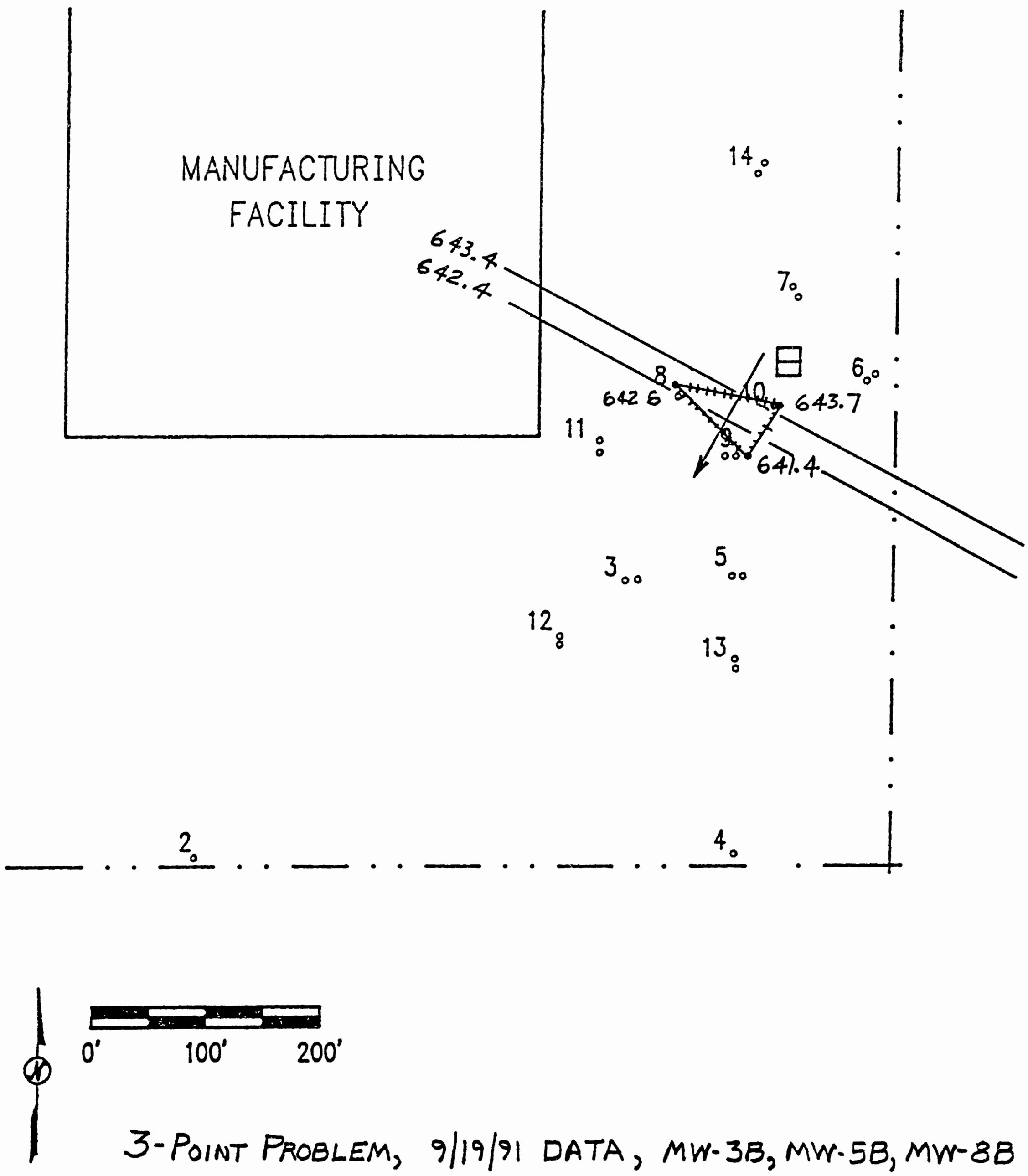
3-POINT PROBLEM, 3/26/91 DATA, MW-6B, MW-8B, MW-9B



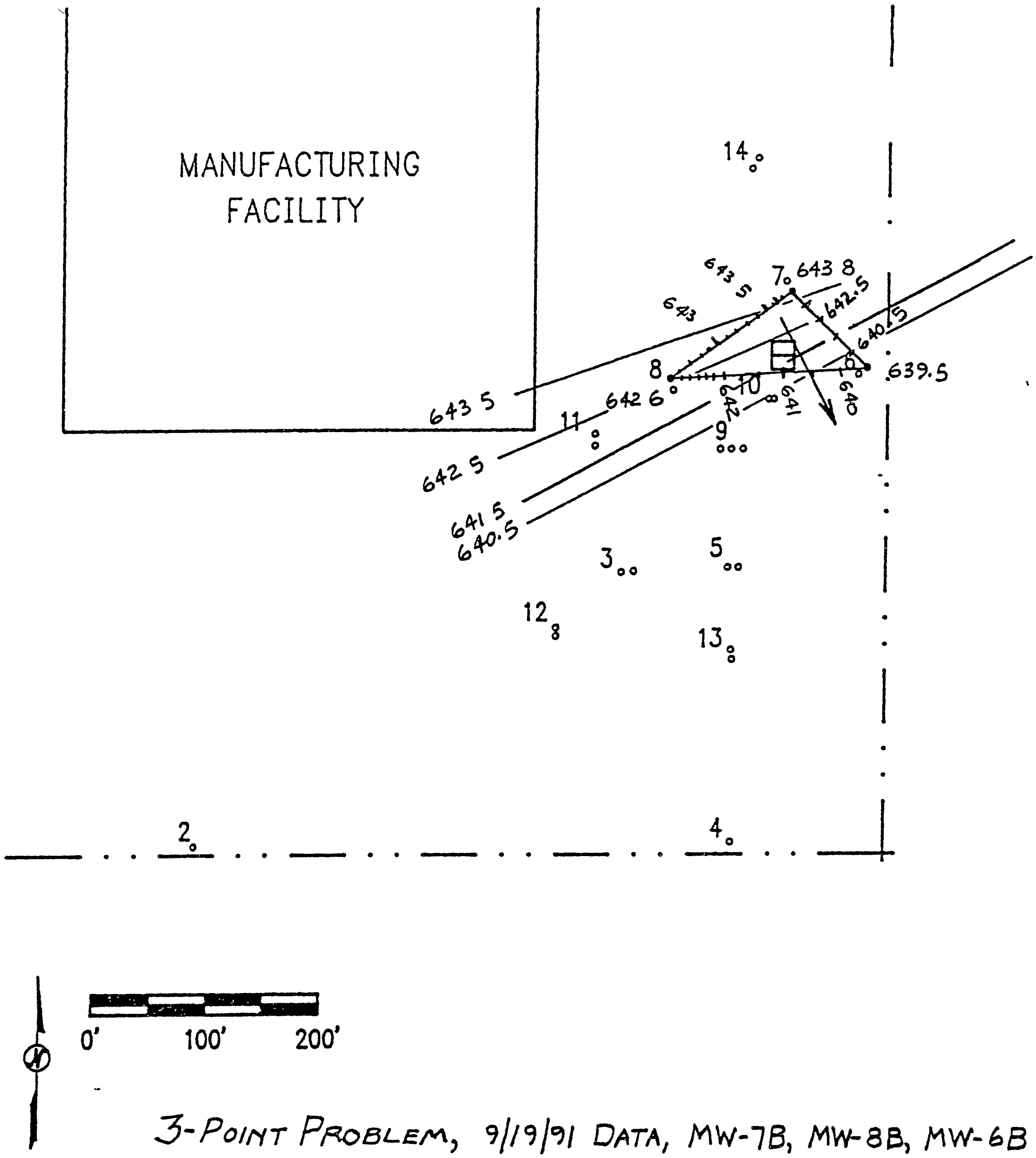
3-POINT PROBLEM, 9/19/91 DATA, MW-8B, MW-3B, MW-5B



3-POINT PROBLEM, 9/19/91 DATA, MW-2, MW-4, MW-3B



3-POINT PROBLEM, 9/19/91 DATA, MW-3B, MW-5B, MW-8B



3-Point Problem, 9/19/91 Data, MW-7B, MW-8B, MW-6B

APPENDIX D

AQUIFER TEST DATA

AQUIFER TEST DRAWDOWN DATA

Well 5A (SWL=10.68)
5B (SWL= 9.79)
6A (SWL=11.68)
6B (SWL=11.17)
7A (SWL=13.20)
7B (SWL= 6.50)

Well 8A (SWL=10.00)
8B (SWL= 5.78)

WELL	TIME (Min.)	DRAWDOWN (Feet)	WELL	TIME (Min.)	DRAWDOWN (Feet)
5A	94	-0.04	8A	31	0.61
	125	-0.04		39	0.61
	360	-0.02		70	0.61
	533	0.02		123	0.61
				164	0.60
				175	0.60
5B	103	0.08		205	0.60
	156	0.07		235	0.60
	377	0.11		266	0.60
	539	0.14		295	0.60
				353	0.61
				390	0.62
6A	72	-0.05		415	0.62
	125	-0.06		475	0.64
	238	-0.07		505	0.64
6B	21	-0.25	8B	12	-0.14
	84	-0.33		27	-0.14
	148	-0.42		76	-0.18
	369	-0.64		130	-0.22
	514	-0.77		1365	-0.29
				500	-0.29
7A	82	-0.03			
	133	-0.04			
	368	-0.03			
	529	0.02			
7B	85	0.05			
	144	-0.13			
	376	-0.24			
	530	-0.27			

AQUIFER TEST DRAWDOWN DATA

Well 9A (SWL (w/pump) =11.14) Q = 0.0625 to 0.125 gpm
9B (SWL= 7.91)
9C (SWL=14.65)

WELL	TIME (Min.)	DRAWDOWN (Feet)	WELL	TIME (Min.)	DRAWDOWN (Feet)
9A	3	5.19	9B	23	-0.14
	6.5	5.86		26	-0.06
	7	6.26		32	-0.04
	9	6.50		34	-0.03
	13	7.24		35	-0.03
	15	7.50		40	-0.03
	15.5	7.91		45	-0.03
	16	8.48		50	-0.03
	17	9.58		55	-0.04
	18	9.23		60	-0.05
	19	9.43		65	-0.05
	20	9.58		70	-0.05
	21	9.73		85	-0.07
	22	9.87		115	-0.08
	23	10.01		145	-0.08
	24	10.14		175	-0.09
	28	10.65		205	-0.10
	31	10.89		235	-0.11
	35	12.98		265	-0.11
	40	13.21		295	-0.11
	45	15.45		355	-0.13
	50	13.68		285	-0.13
	56	13.89		415	-0.13
	61	14.07		445	-0.13
	66	14.26		535	-0.13
	71	14.38			
	86	14.83			
	116	15.69	9C	108	-0.05
	146	15.39		199	-0.08
	176	16.81		420	-0.06
	206	17.78		545	-0.03
	236	19.30			
	266	20.59			
	296	19.83			
	355	20.48			
	385	20.44			
	420	21.17			
	450	21.81			
	475	21.21			
	571	21.66			

AQUIFER TEST DRAWDOWN DATA

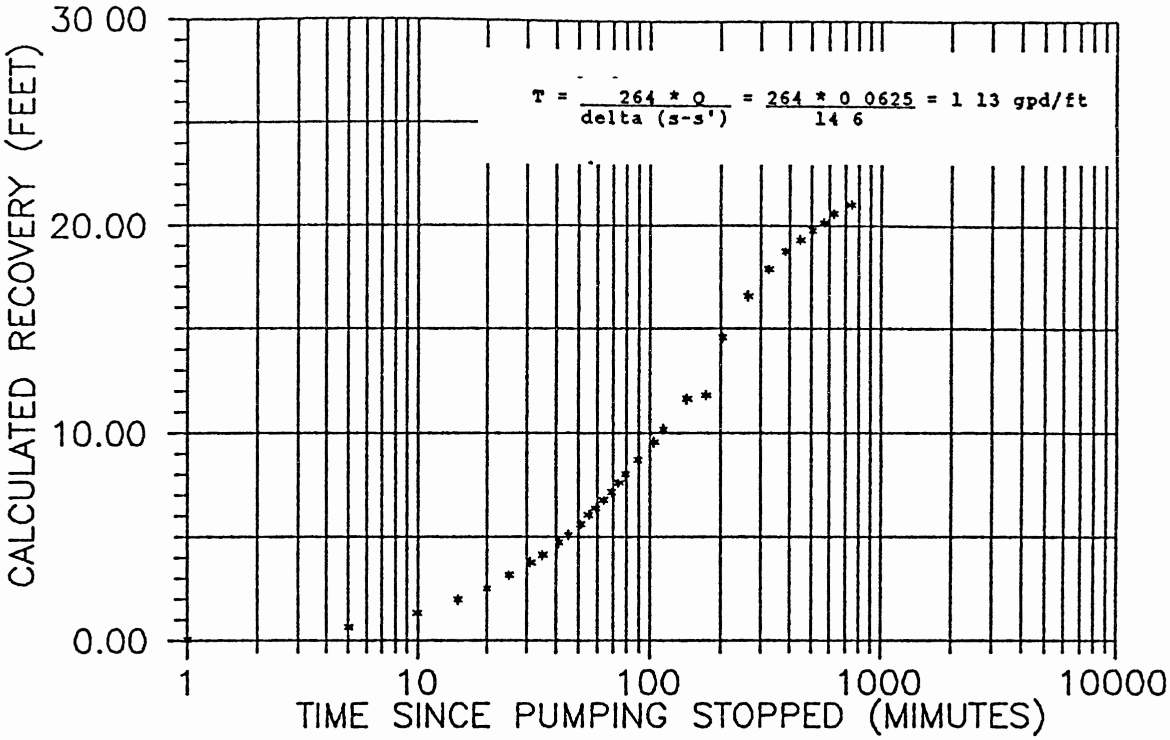
Well 10A (SWL=10.73) Well 10B (SWL=5.53)

WELL	TIME (Min.)	DRAWDOWN (Feet)	WELL	TIME (Min.)	DRAWDOWN (Feet)
10A	35	1.04	10B	31	-.07
	40	1.06		42	-.10
	44	1.08		47	-.11
	51	1.11		53	-.12
	55	1.13		57	-.12
	61	1.15		63	-.13
	65	1.16		306	-.39
	90	1.25		439	-.45
	120	1.33			
	162	1.39			
	175	1.40			
	205	1.44			
	240	1.46			
	269	1.49			
	298	1.51			
	358	1.54			
	393	1.56			
	418	1.57			
	478	1.60			
	508	1.61			

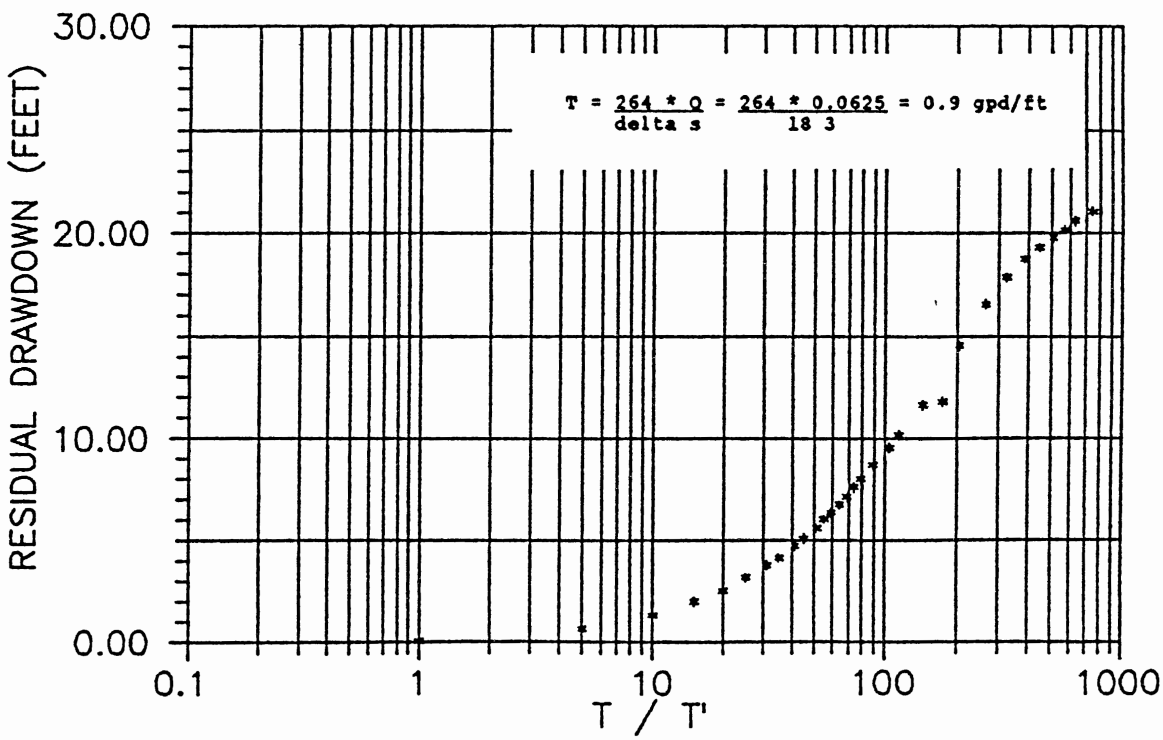
PUMPED WELL MW-9A
RECOVERY DATA
SWL (w/ pump) = 11.14'

TIME SINCE PUMP STARTED	TIME SINCE PUMP STOPPED	DRAWDOWN (FEET)	TIME SINCE PUMP STARTED	TIME SINCE PUMP STOPPED	DRAWDOWN (FEET)
571	0	21.66	635	64	15.33
572	1	21.60	640	69	14.96
573	2	21.43	645	74	14.59
574	3	21.28	650	79	14.18
575	4	21.17	660	89	13.49
576	5	21.05	675	104	12.63
577	6	20.93	685	114	12.01
578	7	20.82	715	144	10.56
579	8	20.70	745	174	10.38
580	9	20.59	775	204	7.72
581	10	20.48	835	264	5.83
582	11	20.36	895	324	4.53
583	12	20.25	955	384	3.76
584	13	20.13	1015	444	3.29
585	14	20.03	1075	504	2.92
586	15	19.92	1135	564	2.63
587	16	19.82	1195	624	2.29
588	17	19.71	1315	744	2.13
589	18	19.60			
590	19	19.50			
591	20	19.37			
592	21	19.26			
593	22	19.17			
594	23	19.04			
595	24	18.93			
596	25	18.82			
598	27	18.62			
600	29	18.41			
602	31	18.22			
604	33	18.03			
606	35	17.85			
608	37	17.65			
610	39	17.46			
612	41	17.27			
614	43	17.08			
616	45	16.90			
618	47	16.71			
620	49	16.54			
622	51	16.38			
624	53	16.22			
626	55	16.04			
628	57	15.88			
630	59	15.72			

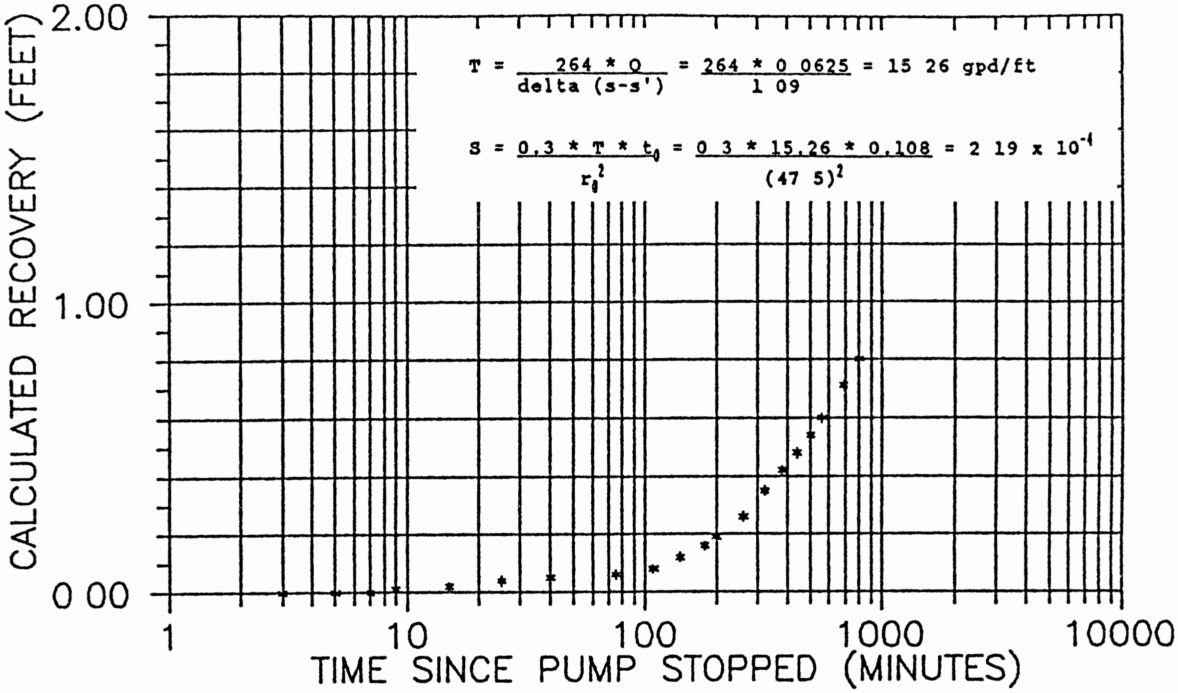
TIME-CALCULATED RECOVERY, JACOB METHOD, MW-9A



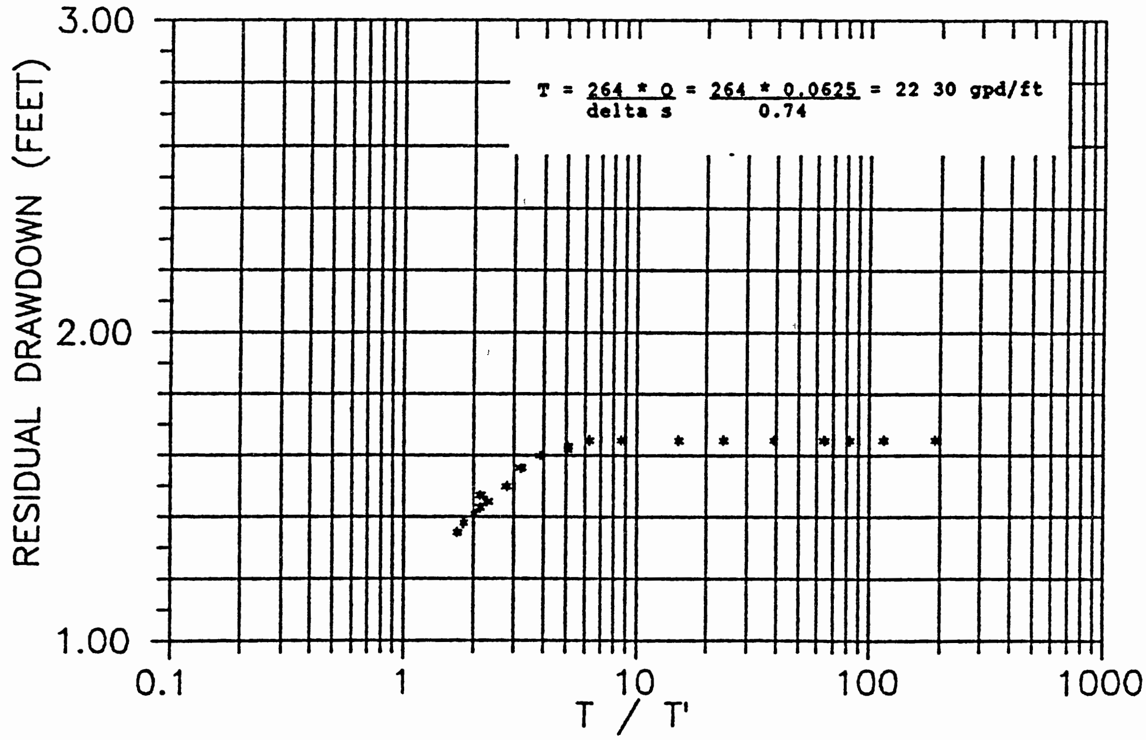
RESIDUAL DRAWDOWN-t/t', JACOB METHOD, MW-9A



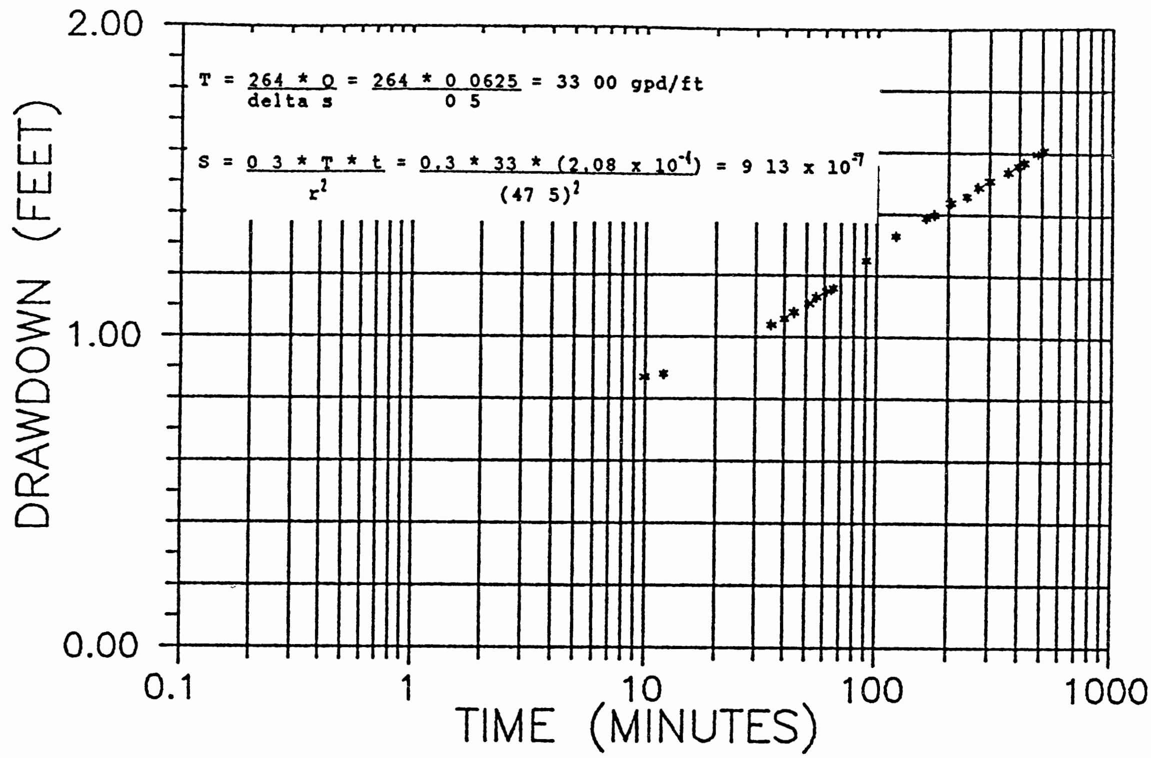
TIME-CALCULATED RECOVERY, JACOB METHOD, MW-10A



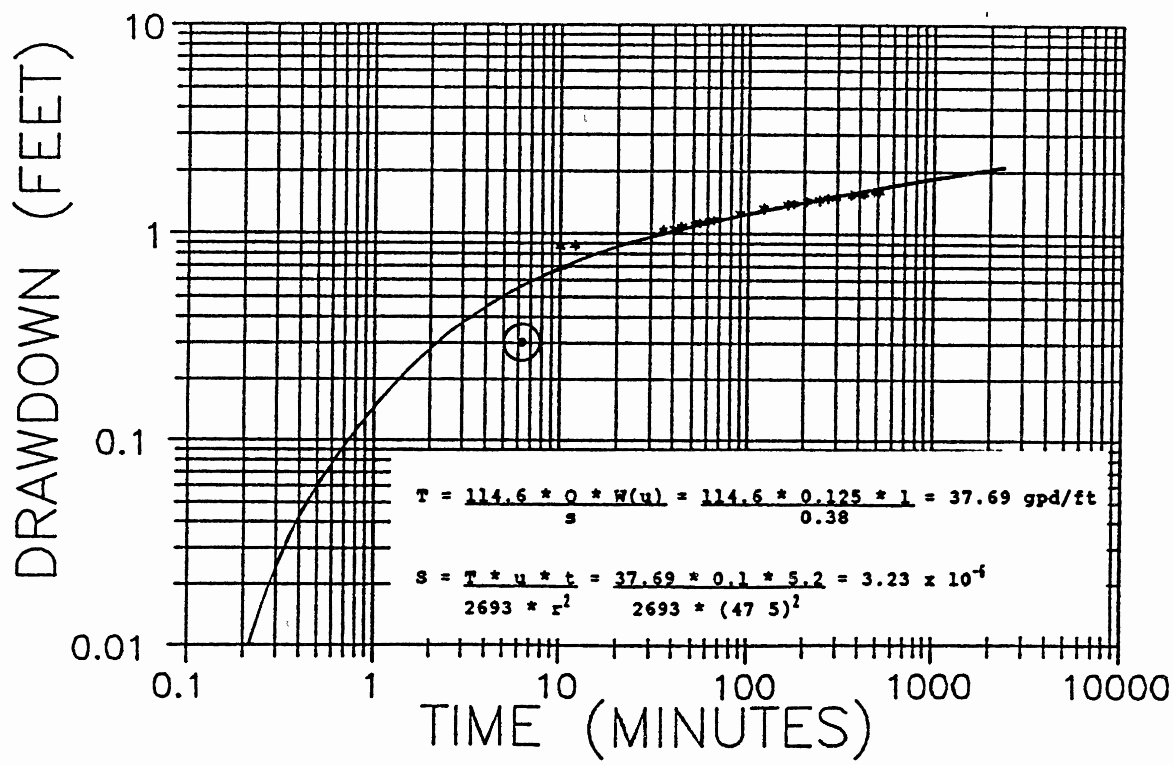
RESIDUAL DRAWDOWN-t/t', JACOB METHOD, MW-10A



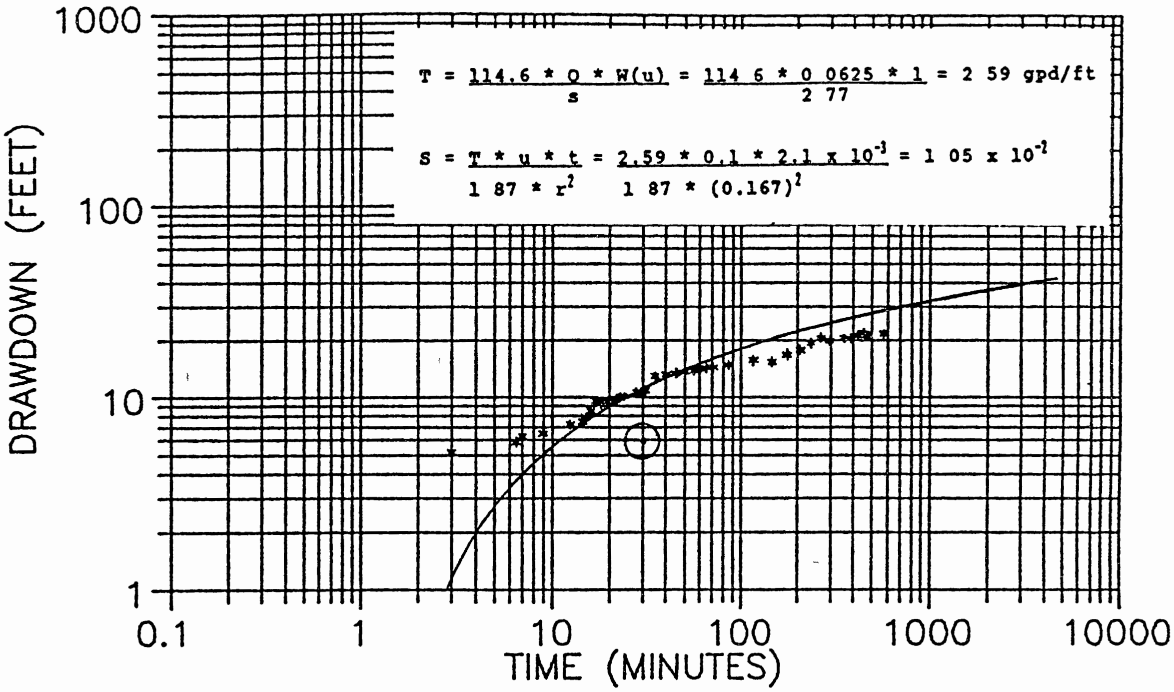
TIME-DRAWDOWN, JACOB METHOD, MW-10A



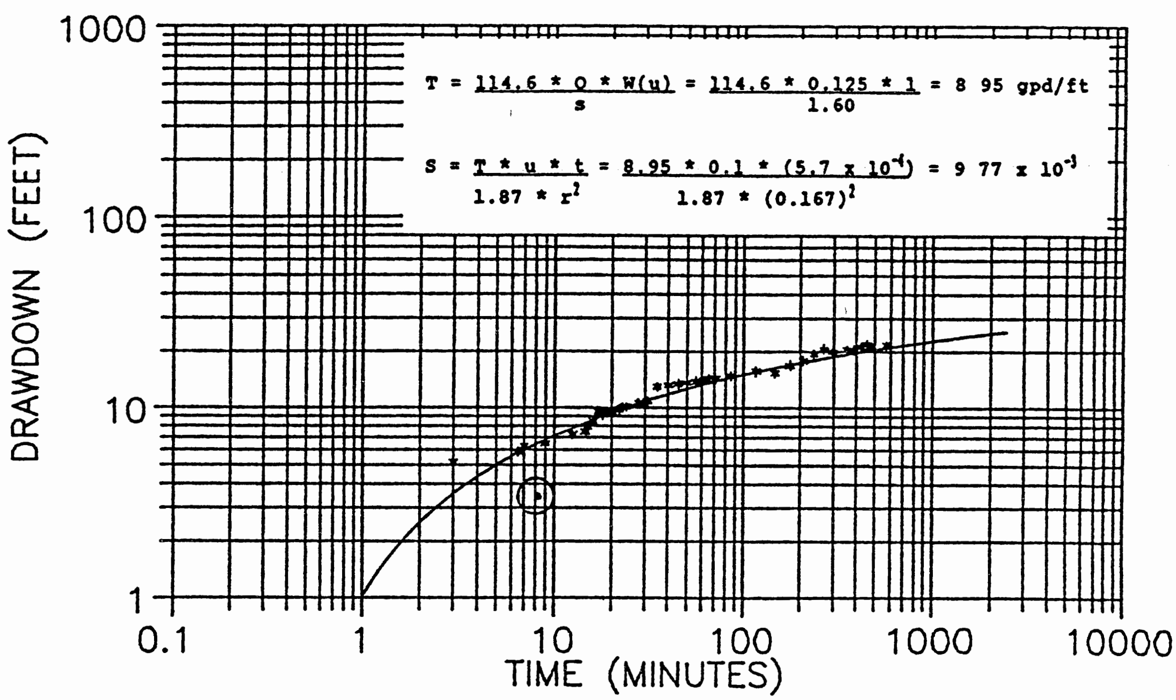
TIME-DRAWDOWN, THEIS METHOD, MW-10A



TIME-DRAWDOWN, THEIS METHOD, MW-9A

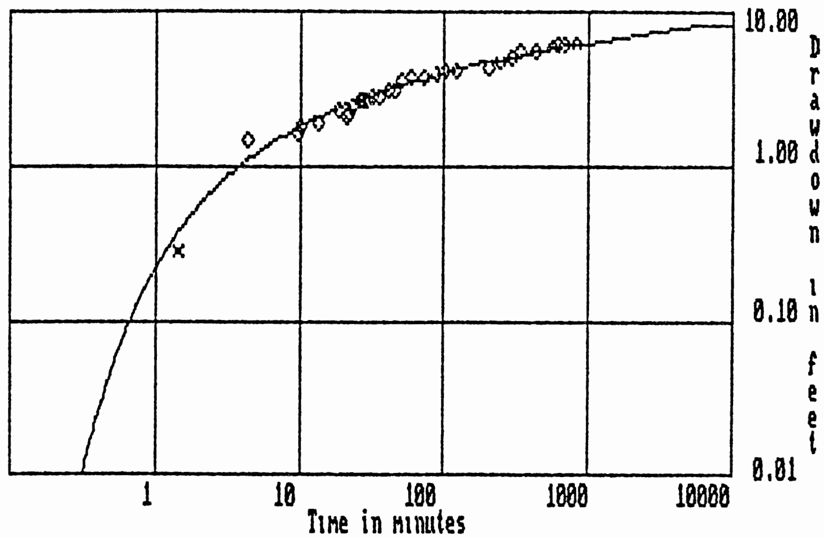


TIME-DRAWDOWN, THEIS METHOD, EARLY DATA, MW-9A



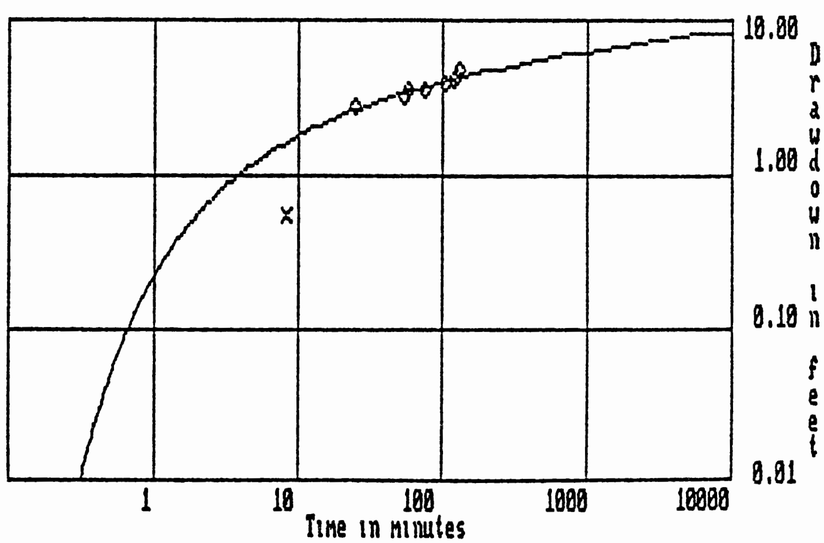
TIME-DRAWDOWN, THEIS METHOD, MW-9A

TRANSMISSIVITY = .2028E+01 GALLONS PER DAY PER FOOT
STORAGE COEFFICIENT = .1313E-01 LOG MEAN SQUARED ERROR = 3.63
MATCH POINT AT W(U) = U = 1, TIME = 0.694 MINUTES DRAWDOWN = 3.511 FEET



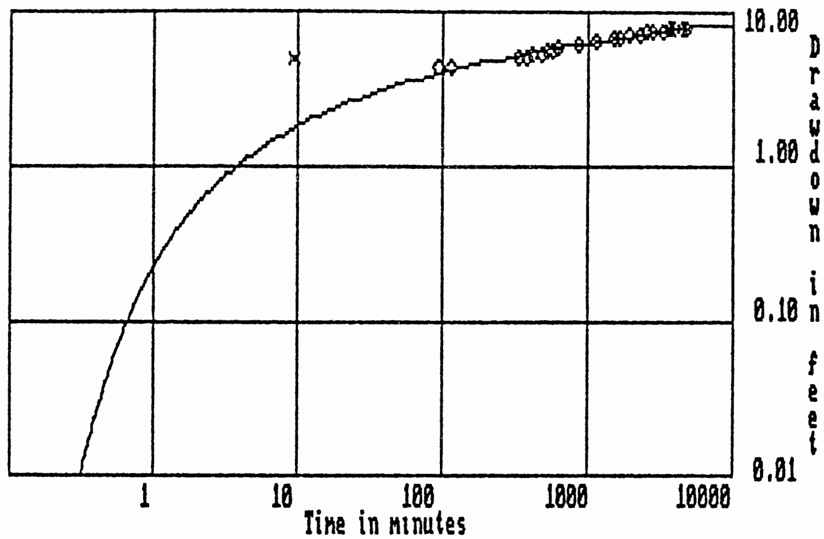
TIME-DRAWDOWN, THEIS METHOD, EARLY DATA, MW-9A

TRANSMISSIVITY = .7822E+01 GALLONS PER DAY PER FOOT
STORAGE COEFFICIENT = .1386E-01 LOG MEAN SQUARED ERROR = 1.38
MATCH POINT AT W(U) = U = 1, TIME = 0.121 MINUTES DRAWDOWN = 1.797 FEET

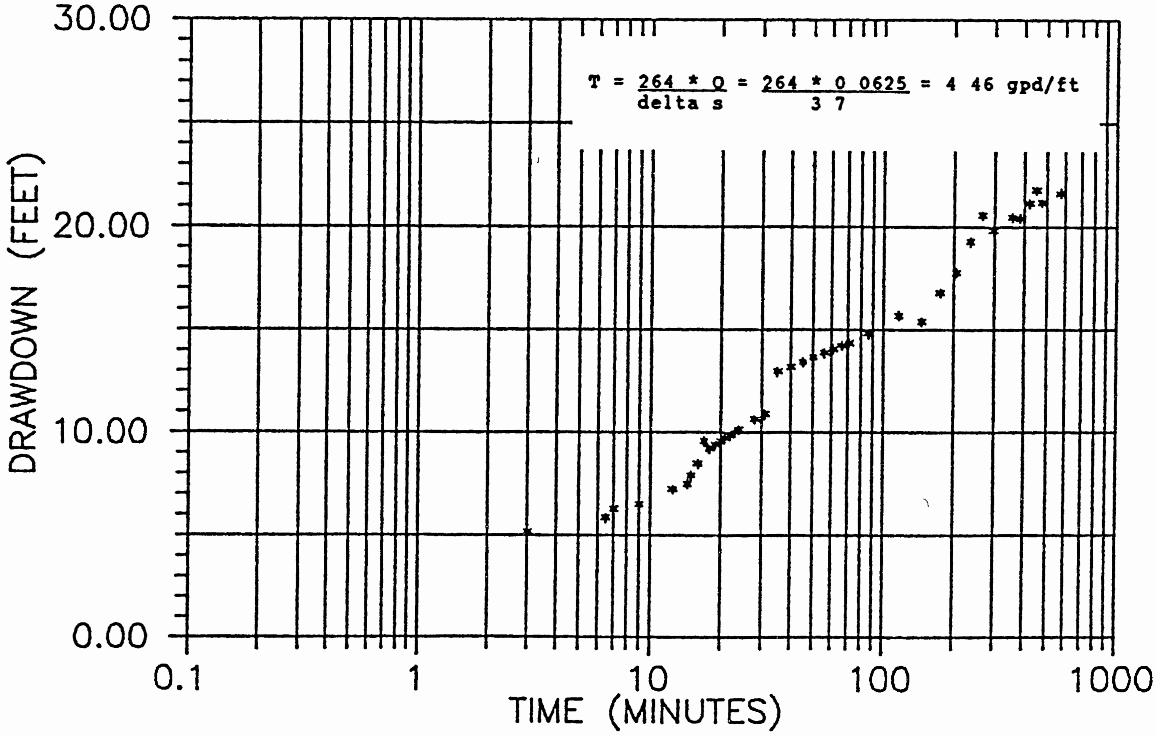


TIME-DRAWDOWN, THEIS METHOD, MW-10A

TRANSMISSIVITY = .3518E+02 GALLONS PER DAY PER FOOT
STORAGE COEFFICIENT = .6147E-06 LOG MEAN SQUARED ERROR = 0.50
MATCH POINT AT W(U) = U = 1, TIME = 0.106 MINUTES DRAWDOWN = 0.204 FEET



TIME-DRAWDOWN, JACOB METHOD, MW-9A



APPENDIX E

PRECIPITATION DATA

PRECIPITATION DATA 1991*

Claremore Water Plant, 1.8 Miles ENE of Post Office
N. Latitude 36° 19', W. Longitude 95° 35'

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1			.11		.02				.01		1.49	.02
2			.26			.47	.01		.30			.68
3			Tr	1.38	.80	.01			.69		.01	
4	Tr	.02		.07			.35		1.28			
5	.10	.29			1.88					.01		
6	.15					1.44						.07
7	.09											
8	.15				.29	.71			.06		.01	
9	.05							.03				
10	.47											
11				.01								
12			Tr								.01	.77
13		.01		.01			1.19					
14			Tr	.04				.66			.11	
15	.37				.01				.14		.09	
16	.23		.12		.06	.10			2.55		1.10	
17		Tr	.50		.98				.11		.78	
18				1.23				.14	.70		.02	
19	.07								.29			.03
20			Tr		.34						.40	1.82
21	Tr				.77			.14	.01			1.19
22			.87	.20	.13	.07			.05			.03
23					.10				.75			.21
24					.21				.12	.20		
25		.10		.63	.43		.09	.42	.08	.38		
26	.07									1.74		
27			.12	.31			.01					
28							.37			1.38		.35
29	.09		.31				.47			.08		
30	.06				.09			.65		.04	.40	
31					.34			.01		.06		
Total (Inches)	1.90	0.42	2.29	3.88	6.45	2.80	2.49	2.05	7.14	3.89	4.42	5.17

* Record of River & Climatological Observations, National Weather Service

PRECIPITATION DATA 1991*

Chelsa (Farmhouse) 3.8 Miles S of Post Office
N. Latitude 36° 29', W. Longitude 95° 25'

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1			.15									
2												.59
3				1.02	.72		.10		.54			
4		.04							.02			
5	.08	.03			1.14							
6	.21					1.40						
7	.52											
8				.05	.16	1.75			.22			.11
9					.26			.25				
10												
11		.04										
12												1.24
13		.11					.88					
14				.18			.04	1.23			.05	
15	.41				.10				.25		.13	
16	.31		.03		.05				2.57		1.31	
17			.42		.85						.92	
18		.12		1.71	.12			.20	.17		.03	
19	.11								.14			
20											.33	2.00
21					.22			.16				1.13
22			.24	.12	.07				.05			
23					.16				.22			.17
24										1.17		
25		.18		.83	.82					.69		
26										1.19		
27			.24	.59						.09		
28							.38			1.32		.26
29	.12		.12	.10						.05		
30	.05				.10					.04	.19	
31					.05			.07				
Total (Inches)	2.72	0.52	1.20	4.60	4.82	3.15	1.40	1.91	4.18	4.55	2.96	5.50

* Record of River & Climatological Observations, National Weather Service

APPENDIX F

CHEMICAL ANALYSIS DATA

Sample Location: MW-5, 7 Feet BLS

Sample Type: Soil

Date Sampled: 12/19/90

PURGEABLE HALOCARBONS
BTEX:

BENZENE	ND
TOLUENE	186
ETHYLBENZENE	ND
XYLENES (TOTAL)	84

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	5.0
BROMOFORM	ND	5.0
BROMOMETHANE	ND	5.0
CARBON TETRACHLORIDE	ND	5.0
CHLOROBENZENE	ND	5.0
CHLOROETHANE	ND	5.0
2-CHLOROETHYLVINYL ETHER	ND	5.0
CHLOROFORM	ND	5.0
CHLOROMETHANE	ND	5.0
DIBROMOCHLOROMETHANE	ND	5.0
1,2-DICHLOROBENZENE	ND	5.0
1,3-DICHLOROBENZENE	ND	5.0
1,4-DICHLOROBENZENE	ND	5.0
DICHLORODIFLUOROMETHANE	ND	5.0
1,1-DICHLOROETHANE	ND	5.0
1,2-DICHLOROETHANE	ND	5.0
1,1-DICHLOROETHENE	ND	5.0
trans-1,2-DICHLOROETHENE	ND	5.0
1,2-DICHLOROPROPANE	ND	5.0
cis-1,3-DICHLOROPROPENE	ND	5.0
trans-1,3-DICHLOROPROPENE	ND	5.0
METHYLENE CHLORIDE	ND	5.0
1,1,2,2-TETRACHLOROETHANE	ND	5.0
TETRACHLOROETHENE	ND	5.0
1,1,1-TRICHLOROETHANE	ND	5.0
1,1,2-TRICHLOROETHANE	ND	5.0
TRICHLOROETHENE	ND	5.0
TRICHLOROFLUOROMETHANE	ND	5.0
VINYL CHLORIDE	ND	5.0

ND = NONE DETECTED
All analyses reported in ug/Kg (micrograms per kilogram), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8010, 8020

Sample Location: MW-5, 12 Feet BLS

Sample Type: Soil

Date Sampled: 12/19/90

PURGEABLE HALOCARBONS
BTEX:

BENZENE	ND
TOLUENE	239
ETHYLBENZENE	ND
XYLENES (TOTAL)	ND

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	5.0
BROMOFORM	ND	5.0
BROMOMETHANE	ND	5.0
CARBON TETRACHLORIDE	ND	5.0
CHLOROBENZENE	ND	5.0
CHLOROETHANE	ND	5.0
2-CHLOROETHYLVINYL ETHER	ND	5.0
CHLOROFORM	ND	5.0
CHLOROMETHANE	ND	5.0
DIBROMOCHLOROMETHANE	ND	5.0
1,2-DICHLOROBENZENE	ND	5.0
1,3-DICHLOROBENZENE	ND	5.0
1,4-DICHLOROBENZENE	ND	5.0
DICHLORODIFLUOROMETHANE	ND	5.0
1,1-DICHLOROETHANE	ND	5.0
1,2-DICHLOROETHANE	ND	5.0
1,1-DICHLOROETHENE	ND	5.0
trans-1,2-DICHLOROETHENE	ND	5 0
1,2-DICHLOROPROPANE	ND	5.0
cis-1,3-DICHLOROPROPENE	ND	5.0
trans-1,3-DICHLOROPROPENE	ND	5.0
METHYLENE CHLORIDE	ND	5.0
1,1,2,2-TETRACHLOROETHANE	ND	5.0
TETRACHLOROETHENE	ND	5.0
1,1,1-TRICHLOROETHANE	ND	5.0
1,1,2-TRICHLOROETHANE	ND	5.0
TRICHLOROETHENE	ND	5.0
TRICHLOROFLUOROMETHANE	ND	5.0
VINYL CHLORIDE	ND	5.0

ND = NONE DETECTED
All analyses reported in ug/Kg (micrograms per kilogram), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8010, 8020

Sample Location: MW-5, 20 Feet BLS

Sample Type: Soil

Date Sampled: 12/19/90

PURGEABLE HALOCARBONS
BTEX:

BENZENE	ND
TOLUENE	ND
ETHYLBENZENE	ND
XYLENES (TOTAL)	ND

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	5.0
BROMOFORM	ND	5.0
BROMOMETHANE	ND	5.0
CARBON TETRACHLORIDE	ND	5.0
CHLOROBENZENE	ND	5.0
CHLOROETHANE	ND	5.0
2-CHLOROETHYLVINYL ETHER	ND	5.0
CHLOROFORM	ND	5.0
CHLOROMETHANE	ND	5.0
DIBROMOCHLOROMETHANE	ND	5.0
1,2-DICHLOROBENZENE	ND	5.0
1,3-DICHLOROBENZENE	ND	5.0
1,4-DICHLOROBENZENE	ND	5.0
DICHLORODIFLUOROMETHANE	ND	5.0
1,1-DICHLOROETHANE	ND	5.0
1,2-DICHLOROETHANE	ND	5.0
1,1-DICHLOROETHENE	ND	5.0
trans-1,2-DICHLOROETHENE	ND	5.0
1,2-DICHLOROPROPANE	ND	5.0
cis-1,3-DICHLOROPROPENE	ND	5.0
trans-1,3-DICHLOROPROPENE	ND	5.0
METHYLENE CHLORIDE	ND	5.0
1,1,2,2-TETRACHLOROETHANE	ND	5.0
TETRACHLOROETHENE	ND	5.0
1,1,1-TRICHLOROETHANE	ND	5.0
1,1,2-TRICHLOROETHANE	ND	5.0
TRICHLOROETHENE	ND	5.0
TRICHLOROFLUOROMETHANE	ND	5.0
VINYL CHLORIDE	ND	5.0

ND = NONE DETECTED
All analyses reported in ug/Kg (micrograms per kilogram), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8010, 8020

Sample Location: MW-1

Sample Type: Water

Date Sampled: 12/20/90

PURGEABLE HALOCARBONS
BTEX.

BENZENE	ND
TOLUENE	ND
ETHYLBENZENE	ND
XYLENES (TOTAL)	3.4

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	0.2
BROMOFORM	ND	0.2
BROMOMETHANE	ND	0.2
CARBON TETRACHLORIDE	ND	0.2
CHLOROBENZENE	ND	0.2
CHLOROETHANE	ND	0.2
2-CHLOROETHYLVINYL ETHER	ND	0.2
CHLOROFORM	ND	0.2
CHLOROMETHANE	ND	0 2
DIBROMOCHLOROMETHANE	ND	0.2
1,2-DICHLOROBENZENE	ND	0 2
1,3-DICHLOROBENZENE	ND	0 2
1,4-DICHLOROBENZENE	ND	0.2
DICHLORODIFLUOROMETHANE	ND	0.2
1,1-DICHLOROETHANE	ND	0.2
1,2-DICHLOROETHANE	ND	0.2
1,1-DICHLOROETHENE	ND	0.2
trans-1,2-DICHLOROETHENE	ND	0.2
1,2-DICHLOROPROPANE	ND	0.2
cis-1,3-DICHLOROPROPENE	ND	0.2
trans-1,3-DICHLOROPROPENE	ND	0.2
METHYLENE CHLORIDE	ND	0.2
1,1,2,2-TETRACHLOROETHANE	ND	0.2
TETRACHLOROETHENE	ND	0.2
1,1,1-TRICHLOROETHANE	ND	0.2
1,1,2-TRICHLOROETHANE	ND	0.2
TRICHLOROETHENE	ND	0.2
TRICHLOROFLUOROMETHANE	ND	0.2
VINYL CHLORIDE	ND	0.2

ND = NONE DETECTED
All analyses reported in ug/L (micrograms per Liter), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 601, 602

Sample Location: MW-1

Sample Type: Water

Date Sampled: 12/20/90

PURGEABLE HALOCARBONS
BTEX.

BENZENE	ND
TOLUENE	ND
ETHYLBENZENE	ND
XYLENES (TOTAL)	ND

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	0.2
BROMOFORM	ND	0.2
BROMOMETHANE	ND	0.2
CARBON TETRACHLORIDE	ND	0.2
CHLOROBENZENE	ND	0.2
CHLOROETHANE	ND	0.2
2-CHLOROETHYLVINYL ETHER	ND	0.2
CHLOROFORM	ND	0.2
CHLOROMETHANE	ND	0.2
DIBROMOCHLOROMETHANE	ND	0.2
1,2-DICHLOROBENZENE	ND	0.2
1,3-DICHLOROBENZENE	ND	0.2
1,4-DICHLOROBENZENE	ND	0.2
DICHLORODIFLUOROMETHANE	ND	0.2
1,1-DICHLOROETHANE	ND	0.2
1,2-DICHLOROETHANE	ND	0.2
1,1-DICHLOROETHENE	ND	0.2
trans-1,2-DICHLOROETHENE	ND	0.2
1,2-DICHLOROPROPANE	ND	0.2
cis-1,3-DICHLOROPROPENE	ND	0.2
trans-1,3-DICHLOROPROPENE	ND	0.2
METHYLENE CHLORIDE	ND	0.2
1,1,2,2-TETRACHLOROETHANE	ND	0.2
TETRACHLOROETHENE	ND	0.2
1,1,1-TRICHLOROETHANE	ND	0.2
1,1,2-TRICHLOROETHANE	ND	0.2
TRICHLOROETHENE	ND	0.2
TRICHLOPOFLUOROMETHANE	ND	0.2
VINYL CHLORIDE	ND	0.2

ND = NONE DETECTED
All analyses reported in ug/L (micrograms per Liter), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 601, 602

Sample Location: MW-2

Sample Type: Water

Date Sampled: 12/20/90

PURGEABLE HALOCARBONS
BTEX:

BENZENE	ND
TOLUENE	ND
ETHYLBENZENE	ND
XYLENES (TOTAL)	ND

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	0.2
BROMOFORM	ND	0.2
BROMOMETHANE	ND	0.2
CARBON TETRACHLORIDE	ND	0 2
CHLOROBENZENE	ND	0.2
CHLOROETHANE	ND	0.2
2-CHLOROETHYLVINYL ETHER	ND	0.2
CHLOROFORM	ND	0.2
CHLOROMETHANE	ND	0.2
DIBROMOCHLOROMETHANE	ND	0.2
1,2-DICHLOROBENZENE	ND	0.2
1,3-DICHLOROBENZENE	ND	0.2
1,4-DICHLOROBENZENE	ND	0.2
DICHLORODIFLUOROMETHANE	ND	0.2
1,1-DICHLOROETHANE	ND	0.2
1,2-DICHLOROETHANE	ND	0.2
1,1-DICHLOROETHENE	ND	0.2
trans-1,2-DICHLOROETHENE	ND	0.2
1,2-DICHLOROPROPANE	ND	0.2
cis-1,3-DICHLOROPROPENE	ND	0.2
trans-1,3-DICHLOROPROPENE	ND	0.2
METHYLENE CHLORIDE	ND	0.2
1,1,2,2-TETRACHLOROETHANE	ND	0.2
TETRACHLOROETHENE	ND	0.2
1,1,1-TRICHLOROETHANE	ND	0.2
1,1,2-TRICHLOROETHANE	ND	0.2
TRICHLOROETHENE	ND	0.2
TRICHLOROFLUOROMETHANE	ND	0.2
VINYL CHLORIDE	ND	0.2

ND = NONE DETECTED
All analyses reported in ug/L (micrograms per Liter), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 601, 602

Sample Location· MW-2

Sample Type· Water

Date Sampled. 12/20/90

PURGEABLE HALOCARBONS
BTEX:

BENZENE	ND
TOLUENE	ND
ETHYLBENZENE	ND
XYLENES (TOTAL)	ND

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	0.2
BROMOFORM	ND	0.2
BROMOMETHANE	ND	0.2
CARBON TETRACHLORIDE	ND	0.2
CHLOROBENZENE	ND	0.2
CHLOROETHANE	ND	0.2
2-CHLOROETHYLVINYL ETHER	ND	0.2
CHLOROFORM	ND	0.2
CHLOROMETHANE	ND	0.2
DIBROMOCHLOROMETHANE	ND	0 2
1,2-DICHLOROBENZENE	ND	0.2
1,3-DICHLOROBENZENE	ND	0.2
1,4-DICHLOROBENZENE	ND	0.2
DICHLORODIFLUOROMETHANE	ND	0.2
1,1-DICHLOROETHANE	ND	0 2
1,2-DICHLOROETHANE	ND	0.2
1,1-DICHLOROETHENE	ND	0 2
trans-1,2-DICHLOROETHENE	ND	0.2
1,2-DICHLOROPROPANE	ND	0.2
cis-1,3-DICHLOROPROPENE	ND	0.2
trans-1,3-DICHLOROPROPENE	ND	0.2
METHYLENE CHLORIDE	ND	0.2
1,1,2,2-TETRACHLOROETHANE	ND	0.2
TETRACHLOROETHENE	ND	0.2
1,1,1-TRICHLOROETHANE	ND	0.2
1,1,2-TRICHLOROETHANE	ND	0.2
TRICHLOROETHENE	ND	0.2
TRICHLOROFLUOROMETHANE	ND	0.2
VINYL CHLORIDE	ND	0.2

ND = NONE DETECTED
All analyses reported in ug/L (micrograms per Liter), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 601, 602

Sample Location: MW-3

Sample Type: Water

Date Sampled: 12/20/90

PURGEABLE HALOCARBONS
BTEX:

BENZENE	ND
TOLUENE	ND
ETHYLBENZENE	ND
XYLENES (TOTAL)	2.7

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	0.2
BROMOFORM	ND	0.2
BROMOMETHANE	ND	0.2
CARBON TETRACHLORIDE	ND	0.2
CHLOROBENZENE	ND	0.2
CHLOROETHANE	ND	0.2
2-CHLOROETHYLVINYL ETHER	ND	0 2
CHLOROFORM	ND	0.2
CHLOROMETHANE	ND	0.2
DIBROMOCHLOROMETHANE	ND	0.2
1,2-DICHLOROBENZENE	ND	0.2
1,3-DICHLOROBENZENE	ND	0.2
1,4-DICHLOROBENZENE	ND	0.2
DICHLORODIFLUOROMETHANE	ND	0.2
1,1-DICHLOROETHANE	ND	0.2
1,2-DICHLOROETHANE	ND	0.2
1,1-DICHLOROETHENE	ND	0.2
trans-1,2-DICHLOROETHENE	ND	0.2
1,2-DICHLOROPROPANE	ND	0.2
cis-1,3-DICHLOROPROPENE	ND	0.2
trans-1,3-DICHLOROPROPENE	ND	0.2
METHYLENE CHLORIDE	ND	0.2
1,1,2,2-TETRACHLOROETHANE	ND	0.2
TETRACHLOROETHENE	ND	0.2
1,1,1-TRICHLOROETHANE	ND	0.2
1,1,2-TRICHLOROETHANE	ND	0.2
TRICHLOROETHENE	ND	0.2
TRICHLOROFLUOROMETHANE	ND	0.2
VINYL CHLORIDE	ND	0.2

ND = NONE DETECTED
All analyses reported in ug/L (micrograms per Liter), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 601, 602

Sample Location: MW-3

Sample Type: Water

Date Sampled: 12/20/90

PURGEABLE HALOCARBONS
BTEX:

BENZENE	ND
TOLUENE	ND
ETHYLBENZENE	ND
XYLENES (TOTAL)	ND

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	0.2
BROMOFORM	ND	0.2
BROMOMETHANE	ND	0.2
CARBON TETRACHLORIDE	ND	0.2
CHLOROBENZENE	ND	0.2
CHLOROETHANE	ND	0.2
2-CHLOROETHYLVINYL ETHER	ND	0.2
CHLOROFORM	ND	0.2
CHLOROMETHANE	ND	0.2
DIBROMOCHLOROMETHANE	ND	0.2
1,2-DICHLOROBENZENE	ND	0.2
1,3-DICHLOROBENZENE	ND	0.2
1,4-DICHLOROBENZENE	ND	0.2
DICHLORODIFLUOROMETHANE	ND	0.2
1,1-DICHLOROETHANE	ND	0.2
1,2-DICHLOROETHANE	ND	0.2
1,1-DICHLOROETHENE	ND	0.2
trans-1,2-DICHLOROETHENE	ND	0.2
1,2-DICHLOROPROPANE	ND	0.2
cis-1,3-DICHLOROPROPENE	ND	0.2
trans-1,3-DICHLOROPROPENE	ND	0.2
METHYLENE CHLORIDE	ND	0.2
1,1,2,2-TETRACHLOROETHANE	ND	0.2
TETRACHLOROETHENE	ND	0.2
1,1,1-TRICHLOROETHANE	ND	0.2
1,1,2-TRICHLOROETHANE	ND	0.2
TRICHLOROETHENE	ND	0.2
TRICHLOROFLUOROMETHANE	ND	0.2
VINYL CHLORIDE	ND	0.2

ND = NONE DETECTED
All analyses reported in ug/L (micrograms per Liter), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 601, 602

Sample Location: MW-4

Sample Type: Water

Date Sampled: 12/20/90

PURGEABLE HALOCARBONS
BTEX:

BENZENE	ND
TOLUENE	ND
ETHYLBENZENE	ND
XYLENES (TOTAL)	ND

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	0.2
BROMOFORM	ND	0.2
BROMOMETHANE	ND	0.2
CARBON TETRACHLORIDE	ND	0.2
CHLOROBENZENE	ND	0.2
CHLOROETHANE	ND	0.2
2-CHLOROETHYLVINYL ETHER	ND	0.2
CHLOROFORM	ND	0.2
CHLOROMETHANE	ND	0.2
DIBROMOCHLOROMETHANE	ND	0.2
1,2-DICHLOROBENZENE	ND	0.2
1,3-DICHLOROBENZENE	ND	0.2
1,4-DICHLOROBENZENE	ND	0.2
DICHLORODIFLUOROMETHANE	ND	0.2
1,1-DICHLOROETHANE	ND	0.2
1,2-DICHLOROETHANE	ND	0.2
1,1-DICHLOROETHENE	ND	0.2
trans-1,2-DICHLOROETHENE	ND	0.2
1,2-DICHLOROPROPANE	ND	0.2
cis-1,3-DICHLOROPROPENE	ND	0.2
trans-1,3-DICHLOROPROPENE	ND	0.2
METHYLENE CHLORIDE	ND	0.2
1,1,2,2-TETRACHLOROETHANE	ND	0.2
TETRACHLOROETHENE	ND	0.2
1,1,1-TRICHLOROETHANE	ND	0.2
1,1,2-TRICHLOROETHANE	ND	0.2
TRICHLOROETHENE	ND	0.2
TRICHLOROFLUOROMETHANE	ND	0.2
VINYL CHLORIDE	ND	0.2

ND = NONE DETECTED
All analyses reported in ug/L (micrograms per Liter), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 601, 602

Sample Location: MW-4

Sample Type: Water

Date Sampled: 12/20/90

PURGEABLE HALOCARBONS
BTEX:

BENZENE	ND
TOLUENE	ND
ETHYLBENZENE	ND
XYLENES (TOTAL)	ND

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	0.2
BROMOFORM	ND	0 2
BROMOMETHANE	ND	0.2
CARBON TETRACHLORIDE	ND	0.2
CHLOROBENZENE	ND	0.2
CHLOROETHANE	ND	0.2
2-CHLOROETHYLVINYL ETHER	ND	0.2
CHLOROFORM	ND	0.2
CHLOROMETHANE	ND	0.2
DIBROMOCHLOROMETHANE	ND	0.2
1,2-DICHLOROBENZENE	ND	0.2
1,3-DICHLOROBENZENE	ND	0.2
1,4-DICHLOROBENZENE	ND	0.2
DICHLORODIFLUOROMETHANE	ND	0.2
1,1-DICHLOROETHANE	ND	0.2
1,2-DICHLOROETHANE	ND	0.2
1,1-DICHLOROETHENE	ND	0.2
trans-1,2-DICHLOROETHENE	ND	0.2
1,2-DICHLOROPROPANE	ND	0.2
cis-1,3-DICHLOROPROPENE	ND	0.2
trans-1,3-DICHLOROPROPENE	ND	0.2
METHYLENE CHLORIDE	ND	0.2
1,1,2,2-TETRACHLOROETHANE	ND	0.2
TETRACHLOROETHENE	ND	0.2
1,1,1-TRICHLOROETHANE	ND	0.2
1,1,2-TRICHLOROETHANE	ND	0.2
TRICHLOROETHENE	ND	0.2
TRICHLOROFLUOROMETHANE	ND	0.2
VINYL CHLORIDE	ND	0.2

ND = NONE DETECTED
All analyses reported in ug/L (micrograms per Liter), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 601, 602

Sample Location. MW-5

Sample Type' Water

Date Sampled: 12/20/90

PURGEABLE HALOCARBONS
BTEX

BENZENE	ND
TOLUENE	ND
ETHYLBENZENE	ND
XYLENES (TOTAL)	ND

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	0.2
BROMOFORM	ND	0.2
BROMOMETHANE	ND	0.2
CARBON TETRACHLORIDE	ND	0.2
CHLOROBENZENE	ND	0.2
CHLOROETHANE	ND	0.2
2-CHLOROETHYLVINYL ETHER	ND	0.2
CHLOROFORM	ND	0.2
CHLOROMETHANE	ND	0.2
DIBROMOCHLOROMETHANE	ND	0.2
1,2-DICHLOROBENZENE	ND	0 2
1,3-DICHLOROBENZENE	ND	0.2
1,4-DICHLOROBENZENE	ND	0.2
DICHLORODIFLUOROMETHANE	ND	0.2
1,1-DICHLOROETHANE	ND	0.2
1,2-DICHLOROETHANE	ND	0.2
1,1-DICHLOROETHENE	ND	0.2
trans-1,2-DICHLOROETHENE	ND	0.2
1,2-DICHLOROPROPANE	ND	0.2
cis-1,3-DICHLOROPROPENE	ND	0.2
trans-1,3-DICHLOROPROPENE	ND	0.2
METHYLENE CHLORIDE	ND	0.2
1,1,2,2-TETRACHLOROETHANE	ND	0.2
TETRACHLOROETHENE	ND	0.2
1,1,1-TRICHLOROETHANE	ND	0.2
1,1,2-TRICHLOROETHANE	ND	0.2
TRICHLOROETHENE	ND	0.2
TRICHLOPOFLUOROMETHANE	ND	0.2
VINYL CHLORIDE	ND	0.2

ND = NONE DETECTED
All analyses reported in ug/L (micrograms per Liter), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 601, 602

Sample Location: MW-5

Sample Type: Water

Date Sampled: 12/20/90

PURGEABLE HALOCARBONS
BTEX:

BENZENE	ND
TOLUENE	ND
ETHYLBENZENE	ND
XYLENES (TOTAL)	ND

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	0.2
BROMOFORM	ND	0.2
BROMOMETHANE	ND	0.2
CARBON TETRACHLORIDE	ND	0.2
CHLOROBENZENE	ND	0.2
CHLOROETHANE	ND	0.2
2-CHLOROETHYLVINYL ETHER	ND	0.2
CHLOROFORM	ND	0.2
CHLOROMETHANE	ND	0.2
DIBROMOCHLOROMETHANE	ND	0.2
1,2-DICHLOROBENZENE	ND	0.2
1,3-DICHLOROBENZENE	ND	0.2
1,4-DICHLOROBENZENE	ND	0.2
DICHLORODIFLUOROMETHANE	ND	0.2
1,1-DICHLOROETHANE	ND	0.2
1,2-DICHLOROETHANE	ND	0.2
1,1-DICHLOROETHENE	ND	0.2
trans-1,2-DICHLOROETHENE	ND	0.2
1,2-DICHLOROPROPANE	ND	0.2
cis-1,3-DICHLOROPROPENE	ND	0.2
trans-1,3-DICHLOROPROPENE	ND	0.2
METHYLENE CHLORIDE	ND	0.2
1,1,2,2-TETRACHLOROETHANE	ND	0.2
TETRACHLOROETHENE	ND	0.2
1,1,1-TRICHLOROETHANE	ND	0.2
1,1,2-TRICHLOROETHANE	ND	0.2
TRICHLOROETHENE	ND	0.2
TRICHLOROFLUOROMETHANE	ND	0.2
VINYL CHLORIDE	ND	0.2

ND = NONE DETECTED
All analyses reported in ug/L (micrograms per Liter), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 601, 602

Sample Location: SP-1

Sample Type: Soil

Date Sampled: 1/28/91

PURGEABLE HALOCARBONS
BTEX:

BENZENE	ND
TOLUENE	ND
ETHYLBENZENE	ND
XYLENES (TOTAL)	ND

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	5.0
BROMOFORM	ND	5.0
BROMOMETHANE	ND	5.0
CARBON TETRACHLORIDE	ND	5.0
CHLOROBENZENE	ND	5.0
CHLOROETHANE	ND	5.0
2-CHLOROETHYLVINYL ETHER	ND	5.0
CHLOROFORM	ND	5.0
CHLOROMETHANE	ND	5.0
DIBROMOCHLOROMETHANE	ND	5.0
1,2-DICHLOROBENZENE	ND	5.0
1,3-DICHLOROBENZENE	ND	5.0
1,4-DICHLOROBENZENE	ND	5.0
DICHLORODIFLUOROMETHANE	ND	5.0
1,1-DICHLOROETHANE	ND	5.0
1,2-DICHLOROETHANE	ND	5.0
1,1-DICHLOROETHENE	ND	5.0
trans-1,2-DICHLOROETHENE	ND	5.0
1,2-DICHLOROPROPANE	ND	5.0
cis-1,3-DICHLOROPROPENE	ND	5.0
trans-1,3-DICHLOROPROPENE	ND	5.0
METHYLENE CHLORIDE	ND	5.0
1,1,2,2-TETRACHLOROETHANE	ND	5.0
TETRACHLOROETHENE	ND	5.0
1,1,1-TRICHLOROETHANE	ND	5.0
1,1,2-TRICHLOROETHANE	ND	5.0
TRICHLOROETHENE	ND	5.0
TRICHLOROFLUOROMETHANE	ND	5.0
VINYL CHLORIDE	ND	5.0

ND = NONE DETECTED
All analyses reported in ug/Kg (micrograms per kilogram), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8010

Sample Location: SP-2

Sample Type: Soil

Date Sampled: 1/28/91

PURGEABLE HALOCARBONS
BTEX:

BENZENE	614
TOLUENE	ND
ETHYLBENZENE	ND
XYLENES (TOTAL)	ND

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	5.0
BROMOFORM	ND	5.0
BROMOMETHANE	ND	5.0
CARBON TETRACHLORIDE	ND	5.0
CHLOROBENZENE	ND	5.0
CHLOROETHANE	ND	5.0
2-CHLOROETHYLVINYL ETHER	ND	5.0
CHLOROFORM	ND	5.0
CHLOROMETHANE	ND	5.0
DIBROMOCHLOROMETHANE	ND	5.0
1,2-DICHLOROBENZENE	ND	5.0
1,3-DICHLOROBENZENE	ND	5.0
1,4-DICHLOROBENZENE	ND	5.0
DICHLORODIFLUOROMETHANE	ND	5.0
1,1-DICHLOROETHANE	ND	5.0
1,2-DICHLOROETHANE	ND	5.0
1,1-DICHLOROETHENE	ND	5.0
trans-1,2-DICHLOROETHENE	ND	5.0
1,2-DICHLOROPROPANE	ND	5.0
cis-1,3-DICHLOROPROPENE	ND	5.0
trans-1,3-DICHLOROPROPENE	ND	5.0
METHYLENE CHLORIDE	ND	5.0
1,1,2,2-TETRACHLOROETHANE	ND	5.0
TETRACHLOROETHENE	ND	5.0
1,1,1-TRICHLOROETHANE	ND	5.0
1,1,2-TRICHLOROETHANE	ND	5.0
TRICHLOROETHENE	ND	5.0
TRICHLOROFLUOROMETHANE	ND	5.0
VINYL CHLORIDE	ND	5.0

ND = NONE DETECTED
All analyses reported in ug/Kg (micrograms per kilogram), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8010

Sample Location: SP-3

Sample Type: Soil

Date Sampled: 1/28/91

PURGEABLE HALOCARBONS
BTEX:

BENZENE	615
TOLUENE	ND
ETHYLBENZENE	ND
XYLENES (TOTAL)	ND

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	5.0
BROMOFORM	ND	5.0
BROMOMETHANE	ND	5.0
CARBON TETRACHLORIDE	ND	5.0
CHLOROBENZENE	ND	5.0
CHLOROETHANE	ND	5.0
2-CHLOROETHYLVINYL ETHER	ND	5.0
CHLOROFORM	ND	5.0
CHLOROMETHANE	ND	5.0
DIBROMOCHLOROMETHANE	ND	5.0
1,2-DICHLOROBENZENE	ND	5.0
1,3-DICHLOROBENZENE	ND	5.0
1,4-DICHLOROBENZENE	ND	5.0
DICHLORODIFLUOROMETHANE	ND	5.0
1,1-DICHLOROETHANE	ND	5.0
1,2-DICHLOROETHANE	ND	5.0
1,1-DICHLOROETHENE	ND	5.0
trans-1,2-DICHLOROETHENE	ND	5.0
1,2-DICHLOROPROPANE	ND	5.0
cis-1,3-DICHLOROPROPENE	ND	5.0
trans-1,3-DICHLOROPROPENE	ND	5.0
METHYLENE CHLORIDE	ND	5.0
1,1,2,2-TETRACHLOROETHANE	ND	5.0
TETRACHLOROETHENE	ND	5.0
1,1,1-TRICHLOROETHANE	ND	5.0
1,1,2-TRICHLOROETHANE	ND	5.0
TRICHLOROETHENE	ND	5.0
TRICHLOROFLUOROMETHANE	ND	5.0
VINYL CHLORIDE	ND	5.0

ND = NONE DETECTED
All analyses reported in ug/Kg (micrograms per kilogram), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8010

Sample Location: SP-4

Sample Type: Soil

Date Sampled. 1/28/91

PURGEABLE HALOCARBONS
BTEX:

BENZENE	539
TOLUENE	ND
ETHYLBENZENE	ND
XYLENES (TOTAL)	ND

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	5.0
BROMOFORM	ND	5.0
BROMOMETHANE	ND	5.0
CARBON TETRACHLORIDE	ND	5.0
CHLOROBENZENE	ND	5.0
CHLOROETHANE	ND	5.0
2-CHLOROETHYLVINYL ETHER	ND	5.0
CHLOROFORM	ND	5.0
CHLOROMETHANE	ND	5.0
DIBROMOCHLOROMETHANE	ND	5.0
1,2-DICHLOROBENZENE	ND	5.0
1,3-DICHLOROBENZENE	ND	5.0
1,4-DICHLOROBENZENE	ND	5.0
DICHLORODIFLUOROMETHANE	ND	5.0
1,1-DICHLOROETHANE	ND	5.0
1,2-DICHLOROETHANE	ND	5.0
1,1-DICHLOROETHENE	ND	5.0
trans-1,2-DICHLOROETHENE	ND	5.0
1,2-DICHLOROPROPANE	ND	5.0
cis-1,3-DICHLOROPROPENE	ND	5.0
trans-1,3-DICHLOROPROPENE	ND	5.0
METHYLENE CHLORIDE	ND	5.0
1,1,2,2-TETRACHLOROETHANE	ND	5.0
TETRACHLOROETHENE	ND	5.0
1,1,1-TRICHLOROETHANE	ND	5.0
1,1,2-TRICHLOROETHANE	ND	5.0
TRICHLOROETHENE	ND	5.0
TRICHLOROFLUOROMETHANE	ND	5.0
VINYL CHLORIDE	ND	5.0

ND = NONE DETECTED
All analyses reported in ug/Kg (micrograms per kilogram), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8010

Sample Location: SP-5

Sample Type: Soil

Date Sampled. 1/28/91

PURGEABLE HALOCARBONS
BTEX:

BENZENE	644
TOLUENE	ND
ETHYLBENZENE	103
XYLENES (TOTAL)	ND

PURGEABLE HALOGENATED HYDROCARBONS.

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	5.0
BROMOFORM	ND	5.0
BROMOMETHANE	ND	5.0
CARBON TETRACHLORIDE	ND	5.0
CHLOROBENZENE	ND	5.0
CHLOROETHANE	ND	5.0
2-CHLOROETHYLVINYL ETHER	ND	5 0
CHLOROFORM	ND	5.0
CHLOROMETHANE	ND	5.0
DIBROMOCHLOROMETHANE	ND	5 0
1,2-DICHLOROBENZENE	ND	5.0
1,3-DICHLOROBENZENE	ND	5.0
1,4-DICHLOROBENZENE	ND	5.0
DICHLORODIFLUOROMETHANE	ND	5.0
1,1-DICHLOROETHANE	ND	5.0
1,2-DICHLOROETHANE	ND	5.0
1,1-DICHLOROETHENE	ND	5.0
trans-1,2-DICHLOROETHENE	ND	5.0
1,2-DICHLOROPROPANE	ND	5.0
cis-1,3-DICHLOROPROPENE	ND	5.0
trans-1,3-DICHLOROPROPENE	ND	5.0
METHYLENE CHLORIDE	ND	5.0
1,1,2,2-TETRACHLOROETHANE	ND	5.0
TETRACHLOROETHENE	ND	5.0
1,1,1-TRICHLOROETHANE	ND	5.0
1,1,2-TRICHLOROETHANE	ND	5.0
TRICHLOROETHENE	ND	5.0
TRICHLOROFLUOROMETHANE	ND	5.0
VINYL CHLORIDE	ND	5.0

ND = NONE DETECTED
All analyses reported in ug/Kg (micrograms per kilogram), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8010

Sample Location: SP-6

Sample Type: Soil

Date Sampled: 1/28/91

PURGEABLE HALOCARBONS
BTEX:

BENZENE	448
TOLUENE	ND
ETHYLBENZENE	ND
XYLENES (TOTAL)	ND

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	5 0
BROMOFORM	ND	5.0
BROMOMETHANE	ND	5.0
CARBON TETRACHLORIDE	ND	5.0
CHLOROBENZENE	ND	5.0
CHLOROETHANE	ND	5.0
2-CHLOROETHYLVINYL ETHER	ND	5.0
CHLOROFORM	ND	5.0
CHLOROMETHANE	ND	5.0
DIBROMOCHLOROMETHANE	ND	5.0
1,2-DICHLOROBENZENE	ND	5.0
1,3-DICHLOROBENZENE	ND	5.0
1,4-DICHLOROBENZENE	ND	5.0
DICHLORODIFLUOROMETHANE	ND	5.0
1,1-DICHLOROETHANE	ND	5.0
1,2-DICHLOROETHANE	ND	5.0
1,1-DICHLOROETHENE	ND	5.0
trans-1,2-DICHLOROETHENE	ND	5.0
1,2-DICHLOROPROPANE	ND	5.0
cis-1,3-DICHLOROPROPENE	ND	5.0
trans-1,3-DICHLOROPROPENE	ND	5.0
METHYLENE CHLORIDE	ND	5.0
1,1,2,2-TETRACHLOROETHANE	ND	5.0
TETRACHLOROETHENE	ND	5.0
1,1,1-TRICHLOROETHANE	ND	5.0
1,1,2-TRICHLOROETHANE	ND	5.0
TRICHLOROETHENE	ND	5.0
TRICHLOROFLUOROMETHANE	ND	5.0
VINYL CHLORIDE	ND	5.0

ND = NONE DETECTED
All analyses reported in ug/Kg (micrograms per kilogram), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8010

Sample Location: SP-7

Sample Type: Soil

Date Sampled: 1/28/91

PURGEABLE HALOCARBONS
BTEX

BENZENE	390
TOLUENE	ND
ETHYLBENZENE	ND
XYLENES (TOTAL)	ND

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	5.0
BROMOFORM	ND	5.0
BROMOMETHANE	ND	5.0
CARBON TETRACHLORIDE	ND	5.0
CHLOROBENZENE	ND	5.0
CHLOROETHANE	ND	5.0
2-CHLOROETHYLVINYL ETHER	ND	5.0
CHLOROFORM	ND	5.0
CHLOROMETHANE	ND	5.0
DIBROMOCHLOROMETHANE	ND	5.0
1,2-DICHLOROBENZENE	ND	5 0
1,3-DICHLOROBENZENE	ND	5 0
1,4-DICHLOROBENZENE	ND	5.0
DICHLORODIFLUOROMETHANE	ND	5.0
1,1-DICHLOROETHANE	ND	5.0
1,2-DICHLOROETHANE	ND	5.0
1,1-DICHLOROETHENE	ND	5.0
trans-1,2-DICHLOROETHENE	ND	5.0
1,2-DICHLOROPROPANE	ND	5.0
cis-1,3-DICHLOROPROPENE	ND	5.0
trans-1,3-DICHLOROPROPENE	ND	5.0
METHYLENE CHLORIDE	ND	5.0
1,1,2,2-TETRACHLOROETHANE	ND	5.0
TETRACHLOROETHENE	ND	5.0
1,1,1-TRICHLOROETHANE	ND	5.0
1,1,2-TRICHLOROETHANE	ND	5.0
TRICHLOROETHENE	ND	5.0
TRICHLOROFLUOROMETHANE	ND	5.0
VINYL CHLORIDE	ND	5.0

ND - NONE DETECTED
All analyses reported in ug/Kg (micrograms per kilogram), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8010

Sample Location SP-8

Sample Type. Soil

Date Sampled: 1/28/91

PURGEABLE HALOCARBONS
BTEX:

BENZENE	521
TOLUENE	ND
ETHYLBENZENE	ND
XYLENES (TOTAL)	ND

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	5.0
BROMOFORM	ND	5.0
BROMOMETHANE	ND	5.0
CARBON TETRACHLORIDE	ND	5 0
CHLOROBENZENE	ND	5.0
CHLOROETHANE	ND	5.0
2-CHLOROETHYLVINYL ETHER	ND	5.0
CHLOROFORM	ND	5.0
CHLOROMETHANE	ND	5.0
DIBROMOCHLOROMETHANE	ND	5.0
1,2-DICHLOROBENZENE	ND	5.0
1,3-DICHLOROBENZENE	ND	5.0
1,4-DICHLOROBENZENE	ND	5.0
DICHLORODIFLUOROMETHANE	ND	5.0
1,1-DICHLOROETHANE	ND	5.0
1,2-DICHLOROETHANE	ND	5.0
1,1-DICHLOROETHENE	ND	5.0
trans-1,2-DICHLOROETHENE	ND	5.0
1,2-DICHLOROPROPANE	ND	5.0
cis-1,3-DICHLOROPROPENE	ND	5.0
trans-1,3-DICHLOROPROPENE	ND	5.0
METHYLENE CHLORIDE	ND	5.0
1,1,2,2-TETRACHLOROETHANE	ND	5.0
TETRACHLOROETHENE	ND	5.0
1,1,1-TRICHLOROETHANE	ND	5.0
1,1,2-TRICHLOROETHANE	ND	5 0
TRICHLOROETHENE	ND	5.0
TRICHLOROFLUOROMETHANE	ND	5.0
VINYL CHLORIDE	ND	5.0

ND = NONE DETECTED
All analyses reported in ug/Kg (micrograms per kilogram), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8010

Sample Location MW-6A, 12 Feet BLS

Sample Type: Soil

Date Sampled: 3/4/91

PURGEABLE HALOCARBONS

BTEX.

BENZENE	ND
TOLUENE	ND
ETHYLBENZENE	ND
XYLENES (TOTAL)	ND

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	5.0
BROMOFORM	ND	5.0
BROMOMETHANE	ND	5.0
CARBON TETRACHLORIDE	ND	5.0
CHLOROBENZENE	ND	5.0
CHLOROETHANE	ND	5.0
2-CHLOROETHYLVINYL ETHER	ND	5.0
CHLOROFORM	ND	5.0
CHLOROMETHANE	ND	5.0
DIBROMOCHLOROMETHANE	ND	5.0
1,2-DICHLOROBENZENE	ND	5.0
1,3-DICHLOROBENZENE	ND	5.0
1,4-DICHLOROBENZENE	ND	5.0
DICHLORODIFLUOROMETHANE	ND	5.0
1,1-DICHLOROETHANE	ND	5.0
1,2-DICHLOROETHANE	ND	5.0
1,1-DICHLOROETHENE	ND	5.0
trans-1,2-DICHLOROETHENE	ND	5.0
1,2-DICHLOROPROPANE	ND	5.0
cis-1,3-DICHLOROPROPENE	ND	5.0
trans-1,3-DICHLOROPROPENE	ND	5.0
METHYLENE CHLORIDE	ND	5.0
1,1,2,2-TETRACHLOROETHANE	ND	5.0
TETRACHLOROETHENE	ND	5.0
1,1,1-TRICHLOROETHANE	ND	5.0
1,1,2-TRICHLOROETHANE	ND	5.0
TRICHLOROETHENE	ND	5.0
TRICHLOROFLUOROMETHANE	ND	5.0
VINYL CHLORIDE	ND	5.0

ND = NONE DETECTED
All analyses reported in ug/Kg (micrograms per kilogram), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8010

Sample Location MW-6A, 14 Feet BLS

Sample Type: Soil

Date Sampled: 3/4/91

PURGEABLE HALOCARBONS
BTEX:

BENZENE	ND
TOLUENE	ND
ETHYLBENZENE	ND
XYLENES (TOTAL)	ND

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	5.0
BROMOFORM	ND	5.0
BROMOMETHANE	ND	5.0
CARBON TETRACHLORIDE	ND	5.0
CHLOROBENZENE	ND	5.0
CHLOROETHANE	ND	5.0
2-CHLOROETHYLVINYL ETHER	ND	5.0
CHLOROFORM	ND	5.0
CHLOROMETHANE	ND	5.0
DIBROMOCHLOROMETHANE	ND	5.0
1,2-DICHLOROBENZENE	ND	5.0
1,3-DICHLOROBENZENE	ND	5.0
1,4-DICHLOROBENZENE	ND	5.0
DICHLORODIFLUOROMETHANE	ND	5.0
1,1-DICHLOROETHANE	ND	5.0
1,2-DICHLOROETHANE	ND	5.0
1,1-DICHLOROETHENE	ND	5.0
trans-1,2-DICHLOROETHENE	ND	5.0
1,2-DICHLOROPROPANE	ND	5.0
cis-1,3-DICHLOROPROPENE	ND	5.0
trans-1,3-DICHLOROPROPENE	ND	5.0
METHYLENE CHLORIDE	ND	5.0
1,1,2,2-TETRACHLOROETHANE	ND	5.0
TETRACHLOROETHENE	ND	5.0
1,1,1-TRICHLOROETHANE	ND	5.0
1,1,2-TRICHLOROETHANE	312	5.0
TRICHLOROETHENE	ND	5.0
TRICHLOROFLUOROMETHANE	ND	5.0
VINYL CHLORIDE	ND	5.0

ND = NONE DETECTED
All analyses reported in ug/Kg (micrograms per kilogram), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8010

Sample Location: MW-6A, 18 Feet BLS

Sample Type: Soil

Date Sampled: 3/4/91

PURGEABLE HALOCARBONS
BTEX:

BENZENE	ND
TOLUENE	ND
ETHYLBENZENE	ND
XYLENES (TOTAL)	ND

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	5.0
BROMOFORM	ND	5.0
BROMOMETHANE	ND	5.0
CARBON TETRACHLORIDE	ND	5.0
CHLOROBENZENE	ND	5.0
CHLOROETHANE	ND	5.0
2-CHLOROETHYLVINYL ETHER	ND	5.0
CHLOROFORM	ND	5.0
CHLOROMETHANE	ND	5.0
DIBROMOCHLOROMETHANE	ND	5.0
1,2-DICHLOROBENZENE	ND	5.0
1,3-DICHLOROBENZENE	ND	5.0
1,4-DICHLOROBENZENE	ND	5.0
DICHLORODIFLUOROMETHANE	ND	5.0
1,1-DICHLOROETHANE	ND	5.0
1,2-DICHLOROETHANE	ND	5.0
1,1-DICHLOROETHENE	ND	5.0
trans-1,2-DICHLOROETHENE	ND	5.0
1,2-DICHLOROPROPANE	ND	5.0
cis-1,3-DICHLOROPROPENE	ND	5.0
trans-1,3-DICHLOROPROPENE	ND	5.0
METHYLENE CHLORIDE	ND	5.0
1,1,2,2-TETRACHLOROETHANE	ND	5.0
TETRACHLOROETHENE	ND	5.0
1,1,1-TRICHLOROETHANE	262	5.0
1,1,2-TRICHLOROETHANE	ND	5.0
TRICHLOROETHENE	ND	5.0
TRICHLOROFLUOROMETHANE	ND	5.0
VINYL CHLORIDE	ND	5.0

ND = NONE DETECTED
All analyses reported in ug/Kg (micrograms per kilogram), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8010

Sample Location: MW-6A, 23 Feet BLS

Sample Type: Soil

Date Sampled: 3/4/91

PURGEABLE HALOCARBONS
BTEX:

BENZENE	ND
TOLUENE	ND
ETHYLBENZENE	ND
XYLENES (TOTAL)	ND

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	5.0
BROMOFORM	ND	5.0
BROMOMETHANE	ND	5.0
CARBON TETRACHLORIDE	ND	5.0
CHLOROBENZENE	ND	5.0
CHLOROETHANE	ND	5.0
2-CHLOROETHYLVINYL ETHER	ND	5.0
CHLOROFORM	ND	5.0
CHLOROMETHANE	ND	5.0
DIBROMOCHLOROMETHANE	ND	5.0
1,2-DICHLOROBENZENE	ND	5.0
1,3-DICHLOROBENZENE	ND	5.0
1,4-DICHLOROBENZENE	ND	5.0
DICHLORODIFLUOROMETHANE	ND	5.0
1,1-DICHLOROETHANE	ND	5.0
1,2-DICHLOROETHANE	ND	5.0
1,1-DICHLOROETHENE	ND	5.0
trans-1,2-DICHLOROETHENE	ND	5.0
1,2-DICHLOROPROPANE	ND	5.0
cis-1,3-DICHLOROPROPENE	ND	5.0
trans-1,3-DICHLOROPROPENE	ND	5.0
METHYLENE CHLORIDE	ND	5.0
1,1,2,2-TETRACHLOROETHANE	ND	5.0
TETRACHLOROETHENE	ND	5.0
1,1,1-TRICHLOROETHANE	ND	5.0
1,1,2-TRICHLOROETHANE	ND	5.0
TRICHLOROETHENE	ND	5.0
TRICHLOROFLUOROMETHANE	ND	5.0
VINYL CHLORIDE	ND	5.0

ND = NONE DETECTED
All analyses reported in ug/Kg (micrograms per kilogram), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8010

Sample Location: MW-6A, 33 Feet BLS

Sample Type: Soil

Date Sampled: 3/4/91

PURGEABLE HALOCARBONS
BTEX:

BENZENE	60
TOLUENE	900
ETHYLBENZENE	1300
XYLENES (TOTAL)	6900

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	5.0
BROMOFORM	ND	5.0
BROMOMETHANE	ND	5.0
CARBON TETRACHLORIDE	ND	5.0
CHLOROBENZENE	ND	5.0
CHLOROETHANE	ND	5.0
2-CHLOROETHYLVINYL ETHER	ND	5.0
CHLOROFORM	ND	5.0
CHLOROMETHANE	ND	5.0
DIBROMOCHLOROMETHANE	ND	5.0
1,2-DICHLOROBENZENE	ND	5.0
1,3-DICHLOROBENZENE	ND	5.0
1,4-DICHLOROBENZENE	ND	5.0
DICHLORODIFLUOROMETHANE	ND	5.0
1,1-DICHLOROETHANE	ND	5.0
1,2-DICHLOROETHANE	ND	5.0
1,1-DICHLOROETHENE	ND	5.0
trans-1,2-DICHLOROETHENE	ND	5.0
1,2-DICHLOROPROPANE	ND	5.0
cis-1,3-DICHLOROPROPENE	ND	5.0
trans-1,3-DICHLOROPROPENE	ND	5.0
METHYLENE CHLORIDE	ND	5.0
1,1,2,2-TETRACHLOROETHANE	ND	5.0
TETRACHLOROETHENE	ND	5.0
1,1,1-TRICHLOROETHANE	ND	5.0
1,1,2-TRICHLOROETHANE	ND	5.0
TRICHLOROETHENE	ND	5.0
TRICHLOROFLUOROMETHANE	ND	5.0
VINYL CHLORIDE	ND	5.0

ND = NONE DETECTED
All analyses reported in ug/Kg (micrograms per kilogram), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8010

Sample Location: MW-7A, 2 Feet BLS

Sample Type: Soil

Date Sampled: 3/4/91

PURGEABLE HALOCARBONS
BTEX:

BENZENE	ND
TOLUENE	ND
ETHYLBENZENE	ND
XYLENES (TOTAL)	ND

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	5.0
BROMOFORM	ND	5.0
BROMOMETHANE	ND	5.0
CARBON TETRACHLORIDE	ND	5.0
CHLOROBENZENE	ND	5.0
CHLOROETHANE	ND	5.0
2-CHLOROETHYLVINYL ETHER	ND	5.0
CHLOROFORM	ND	5.0
CHLOROMETHANE	ND	5.0
DIBROMOCHLOROMETHANE	ND	5.0
1,2-DICHLOROBENZENE	ND	5.0
1,3-DICHLOROBENZENE	ND	5.0
1,4-DICHLOROBENZENE	ND	5.0
DICHLORODIFLUOROMETHANE	ND	5.0
1,1-DICHLOROETHANE	ND	5.0
1,2-DICHLOROETHANE	ND	5.0
1,1-DICHLOROETHENE	ND	5.0
trans-1,2-DICHLOROETHENE	ND	5.0
1,2-DICHLOROPROPANE	ND	5.0
cis-1,3-DICHLOROPROPENE	ND	5.0
trans-1,3-DICHLOROPROPENE	ND	5.0
METHYLENE CHLORIDE	ND	5.0
1,1,2,2-TETRACHLOROETHANE	ND	5.0
TETRACHLOROETHENE	ND	5.0
1,1,1-TRICHLOROETHANE	ND	5.0
1,1,2-TRICHLOROETHANE	ND	5.0
TRICHLOROETHENE	ND	5.0
TRICHLOROFLUOROMETHANE	ND	5.0
VINYL CHLORIDE	ND	5.0

ND = NONE DETECTED
All analyses reported in ug/Kg (micrograms per kilogram), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8010

Sample Location: MW-7A, 6 Feet BLS

Sample Type: Soil

Date Sampled: 3/4/91

PURGEABLE HALOCARBONS
BTEX:

BENZENE	ND
TOLUENE	212
ETHYLBENZENE	318
XYLENES (TOTAL)	1268

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	5.0
BROMOFORM	ND	5.0
BROMOMETHANE	ND	5.0
CARBON TETRACHLORIDE	ND	5.0
CHLOROBENZENE	ND	5.0
CHLOROETHANE	ND	5.0
2-CHLOROETHYLVINYL ETHER	ND	5.0
CHLOROFORM	ND	5.0
CHLOROMETHANE	ND	5.0
DIBROMOCHLOROMETHANE	ND	5.0
1,2-DICHLOROBENZENE	ND	5.0
1,3-DICHLOROBENZENE	ND	5.0
1,4-DICHLOROBENZENE	ND	5.0
DICHLORODIFLUOROMETHANE	ND	5.0
1,1-DICHLOROETHANE	ND	5.0
1,2-DICHLOROETHANE	ND	5.0
1,1-DICHLOROETHENE	ND	5.0
trans-1,2-DICHLOROETHENE	ND	5.0
1,2-DICHLOROPROPANE	ND	5.0
cis-1,3-DICHLOROPROPENE	ND	5.0
trans-1,3-DICHLOROPROPENE	ND	5.0
METHYLENE CHLORIDE	ND	5.0
1,1,2,2-TETRACHLOROETHANE	ND	5.0
TETRACHLOROETHENE	ND	5.0
1,1,1-TRICHLOROETHANE	569	5.0
1,1,2-TRICHLOROETHANE	ND	5.0
TRICHLOROETHENE	ND	5.0
TRICHLOROFLUOROMETHANE	ND	5.0
VINYL CHLORIDE	ND	5.0

ND = NONE DETECTED
All analyses reported in ug/Kg (micrograms per kilogram), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8010

Sample Location: MW-7A, 12 Feet BLS

Sample Type: Soil

Date Sampled: 3/4/91

PURGEABLE HALOCARBONS
BTEX:

BENZENE	83
TOLUENE	860
ETHYLBENZENE	26
XYLENES (TOTAL)	290

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	5.0
BROMOFORM	ND	5.0
BROMOMETHANE	ND	5.0
CARBON TETRACHLORIDE	ND	5.0
CHLOROBENZENE	ND	5.0
CHLOROETHANE	ND	5.0
2-CHLOROETHYLVINYL ETHER	ND	5.0
CHLOROFORM	ND	5.0
CHLOROMETHANE	ND	5.0
DIBROMOCHLOROMETHANE	ND	5.0
1,2-DICHLOROBENZENE	ND	5.0
1,3-DICHLOROBENZENE	ND	5.0
1,4-DICHLOROBENZENE	ND	5.0
DICHLORODIFLUOROMETHANE	ND	5.0
1,1-DICHLOROETHANE	ND	5.0
1,2-DICHLOROETHANE	ND	5.0
1,1-DICHLOROETHENE	ND	5.0
trans-1,2-DICHLOROETHENE	ND	5.0
1,2-DICHLOROPROPANE	ND	5.0
cis-1,3-DICHLOROPROPENE	ND	5.0
trans-1,3-DICHLOROPROPENE	ND	5.0
METHYLENE CHLORIDE	ND	5.0
1,1,2,2-TETRACHLOROETHANE	ND	5.0
TETRACHLOROETHENE	72	5.0
1,1,1-TRICHLOROETHANE	217	5.0
1,1,2-TRICHLOROETHANE	ND	5.0
TRICHLOROETHENE	ND	5.0
TRICHLOROFLUOROMETHANE	ND	5.0
VINYL CHLORIDE	ND	5.0

ND = NONE DETECTED
All analyses reported in ug/Kg (micrograms per kilogram), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8010

Sample Location: MW-7A, 10 Feet BLS

Sample Type: Soil

Date Sampled: 3/4/91

PURGEABLE HALOCARBONS
BTEX:

BENZENE	ND
TOLUENE	ND
ETHYLBENZENE	ND
XYLENES (TOTAL)	ND

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	5.0
BROMOFORM	ND	5.0
BROMOMETHANE	ND	5.0
CARBON TETRACHLORIDE	ND	5.0
CHLOROBENZENE	ND	5.0
CHLOROETHANE	ND	5.0
2-CHLOROETHYLVINYL ETHER	ND	5.0
CHLOROFORM	ND	5.0
CHLOROMETHANE	ND	5.0
DIBROMOCHLOROMETHANE	ND	5.0
1,2-DICHLOROBENZENE	ND	5.0
1,3-DICHLOROBENZENE	ND	5.0
1,4-DICHLOROBENZENE	ND	5.0
DICHLORODIFLUOROMETHANE	ND	5.0
1,1-DICHLOROETHANE	ND	5.0
1,2-DICHLOROETHANE	ND	5.0
1,1-DICHLOROETHENE	ND	5.0
trans-1,2-DICHLOROETHENE	ND	5.0
1,2-DICHLOROPROPANE	ND	5.0
cis-1,3-DICHLOROPROPENE	ND	5.0
trans-1,3-DICHLOROPROPENE	ND	5.0
METHYLENE CHLORIDE	ND	5.0
1,1,2,2-TETRACHLOROETHANE	ND	5.0
TETRACHLOROETHENE	ND	5.0
1,1,1-TRICHLOROETHANE	188	5.0
1,1,2-TRICHLOROETHANE	ND	5.0
TRICHLOROETHENE	ND	5.0
TRICHLOROFLUOROMETHANE	ND	5.0
VINYL CHLORIDE	ND	5.0

ND = NONE DETECTED
All analyses reported in ug/Kg (micrograms per kilogram), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8010

Sample Location: MW-7A, 17 Feet BLS

Sample Type: Soil

Date Sampled: 3/4/91

PURGEABLE HALOCARBONS
BTEX:

BENZENE	ND
TOLUENE	ND
ETHYLBENZENE	ND
XYLENES (TOTAL)	ND

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	5.0
BROMOFORM	ND	5.0
BROMOMETHANE	ND	5.0
CARBON TETRACHLORIDE	ND	5.0
CHLOROBENZENE	ND	5.0
CHLOROETHANE	ND	5.0
2-CHLOROETHYLVINYL ETHER	ND	5.0
CHLOROFORM	ND	5.0
CHLOROMETHANE	ND	5.0
DIBROMOCHLOROMETHANE	ND	5.0
1,2-DICHLOROBENZENE	ND	5.0
1,3-DICHLOROBENZENE	ND	5.0
1,4-DICHLOROBENZENE	ND	5.0
DICHLORODIFLUOROMETHANE	ND	5.0
1,1-DICHLOROETHANE	ND	5.0
1,2-DICHLOROETHANE	ND	5.0
1,1-DICHLOROETHENE	ND	5.0
trans-1,2-DICHLOROETHENE	ND	5.0
1,2-DICHLOROPROPANE	ND	5.0
cis-1,3-DICHLOROPROPENE	ND	5.0
trans-1,3-DICHLOROPROPENE	ND	5.0
METHYLENE CHLORIDE	ND	5.0
1,1,2,2-TETRACHLOROETHANE	ND	5.0
TETRACHLOROETHENE	ND	5.0
1,1,1-TRICHLOROETHANE	766	5.0
1,1,2-TRICHLOROETHANE	ND	5.0
TRICHLOROETHENE	ND	5.0
TRICHLOROFLUOROMETHANE	ND	5.0
VINYL CHLORIDE	ND	5.0

ND = NONE DETECTED
All analyses reported in ug/Kg (micrograms per kilogram), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8010

Sample Location: MW-7A, 26 Feet BLS

Sample Type: Soil

Date Sampled: 3/4/91

PURGEABLE HALOCARBONS
BTEX:

BENZENE	ND
TOLUENE	ND
ETHYLBENZENE	ND
XYLENES (TOTAL)	ND

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	5.0
BROMOFORM	ND	5.0
BROMOMETHANE	ND	5.0
CARBON TETRACHLORIDE	ND	5.0
CHLOROBENZENE	ND	5.0
CHLOROETHANE	ND	5.0
2-CHLOROETHYLVINYL ETHER	ND	5.0
CHLOROFORM	ND	5.0
CHLOROMETHANE	ND	5.0
DIBROMOCHLOROMETHANE	ND	5.0
1,2-DICHLOROBENZENE	ND	5.0
1,3-DICHLOROBENZENE	ND	5.0
1,4-DICHLOROBENZENE	ND	5.0
DICHLORODIFLUOROMETHANE	ND	5.0
1,1-DICHLOROETHANE	ND	5.0
1,2-DICHLOROETHANE	ND	5.0
1,1-DICHLOROETHENE	ND	5.0
trans-1,2-DICHLOROETHENE	ND	5.0
1,2-DICHLOROPROPANE	ND	5.0
cis-1,3-DICHLOROPROPENE	ND	5.0
trans-1,3-DICHLOROPROPENE	ND	5.0
METHYLENE CHLORIDE	ND	5.0
1,1,2,2-TETRACHLOROETHANE	ND	5.0
TETRACHLOROETHENE	ND	5.0
1,1,1-TRICHLOROETHANE	166	5.0
1,1,2-TRICHLOROETHANE	ND	5.0
TRICHLOROETHENE	ND	5.0
TRICHLOROFLUOROMETHANE	ND	5.0
VINYL CHLORIDE	ND	5.0

ND = NONE DETECTED
All analyses reported in ug/Kg (micrograms per kilogram), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8010

Sample Location: MW-8A, 2 Feet BLS

Sample Type: Soil

Date Sampled: 3/4/91

PURGEABLE HALOCARBONS
BTEX:

BENZENE	ND
TOLUENE	ND
ETHYLBENZENE	ND
XYLENES (TOTAL)	ND

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	5.0
BROMOFORM	ND	5.0
BROMOMETHANE	ND	5.0
CARBON TETRACHLORIDE	ND	5.0
CHLOROBENZENE	ND	5.0
CHLOROETHANE	ND	5.0
2-CHLOROETHYLVINYL ETHER	ND	5.0
CHLOROFORM	ND	5.0
CHLOROMETHANE	ND	5.0
DIBROMOCHLOROMETHANE	ND	5.0
1,2-DICHLOROBENZENE	ND	5.0
1,3-DICHLOROBENZENE	ND	5.0
1,4-DICHLOROBENZENE	ND	5.0
DICHLORODIFLUOROMETHANE	ND	5.0
1,1-DICHLOROETHANE	ND	5.0
1,2-DICHLOROETHANE	ND	5.0
1,1-DICHLOROETHENE	ND	5.0
trans-1,2-DICHLOROETHENE	ND	5.0
1,2-DICHLOROPROPANE	ND	5.0
cis-1,3-DICHLOROPROPENE	ND	5.0
trans-1,3-DICHLOROPROPENE	ND	5.0
METHYLENE CHLORIDE	ND	5.0
1,1,2,2-TETRACHLOROETHANE	ND	5.0
TETRACHLOROETHENE	ND	5.0
1,1,1-TRICHLOROETHANE	ND	5.0
1,1,2-TRICHLOROETHANE	ND	5.0
TRICHLOROETHENE	ND	5.0
TRICHLOROFLUOROMETHANE	ND	5.0
VINYL CHLORIDE	ND	5.0

ND = NONE DETECTED
All analyses reported in ug/Kg (micrograms per kilogram), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8010

Sample Location: MW-8A, 6 Feet BLS

Sample Type: Soil

Date Sampled: 3/4/91

PURGEABLE HALOCARBONS
BTEX:

BENZENE	ND
TOLUENE	ND
ETHYLBENZENE	ND
XYLENES (TOTAL)	ND

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	5.0
BROMOFORM	ND	5.0
BROMOMETHANE	ND	5.0
CARBON TETRACHLORIDE	ND	5.0
CHLOROBENZENE	ND	5.0
CHLOROETHANE	ND	5.0
2-CHLOROETHYLVINYL ETHER	ND	5.0
CHLOROFORM	ND	5.0
CHLOROMETHANE	ND	5.0
DIBROMOCHLOROMETHANE	ND	5.0
1,2-DICHLOROBENZENE	ND	5.0
1,3-DICHLOROBENZENE	ND	5.0
1,4-DICHLOROBENZENE	ND	5.0
DICHLORODIFLUOROMETHANE	ND	5.0
1,1-DICHLOROETHANE	ND	5.0
1,2-DICHLOROETHANE	ND	5.0
1,1-DICHLOROETHENE	ND	5.0
trans-1,2-DICHLOROETHENE	ND	5.0
1,2-DICHLOROPROPANE	ND	5.0
cis-1,3-DICHLOROPROPENE	ND	5.0
trans-1,3-DICHLOROPROPENE	ND	5.0
METHYLENE CHLORIDE	ND	5.0
1,1,2,2-TETRACHLOROETHANE	ND	5.0
TETRACHLOROETHENE	ND	5.0
1,1,1-TRICHLOROETHANE	ND	5.0
1,1,2-TRICHLOROETHANE	ND	5.0
TRICHLOROETHENE	ND	5.0
TRICHLOROFLUOROMETHANE	ND	5.0
VINYL CHLORIDE	ND	5.0

ND = NONE DETECTED
All analyses reported in ug/Kg (micrograms per kilogram), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8010

Sample Location: MW-8A, 13 Feet BLS

Sample Type: Soil

Date Sampled: 3/4/91

PURGEABLE HALOCARBONS
BTEX:

BENZENE	ND
TOLUENE	ND
ETHYLBENZENE	ND
XYLENES (TOTAL)	ND

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	5.0
BROMOFORM	ND	5.0
BROMOMETHANE	ND	5.0
CARBON TETRACHLORIDE	ND	5.0
CHLOROBENZENE	ND	5.0
CHLOROETHANE	ND	5.0
2-CHLOROETHYLVINYL ETHER	ND	5.0
CHLOROFORM	ND	5.0
CHLOROMETHANE	ND	5.0
DIBROMOCHLOROMETHANE	ND	5.0
1,2-DICHLOROBENZENE	ND	5.0
1,3-DICHLOROBENZENE	ND	5.0
1,4-DICHLOROBENZENE	ND	5.0
DICHLORODIFLUOROMETHANE	ND	5.0
1,1-DICHLOROETHANE	ND	5.0
1,2-DICHLOROETHANE	ND	5.0
1,1-DICHLOROETHENE	ND	5.0
trans-1,2-DICHLOROETHENE	ND	5.0
1,2-DICHLOROPROPANE	ND	5.0
cis-1,3-DICHLOROPROPENE	ND	5.0
trans-1,3-DICHLOROPROPENE	ND	5.0
METHYLENE CHLORIDE	ND	5.0
1,1,2,2-TETRACHLOROETHANE	ND	5.0
TETRACHLOROETHENE	ND	5.0
1,1,1-TRICHLOROETHANE	645	5.0
1,1,2-TRICHLOROETHANE	ND	5.0
TRICHLOROETHENE	ND	5.0
TRICHLOROFLUOROMETHANE	ND	5.0
VINYL CHLORIDE	ND	5.0

ND = NONE DETECTED
All analyses reported in ug/Kg (micrograms per kilogram), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8010

Sample Location: MW-8A, 20 Feet BLS

Sample Type: Soil

Date Sampled: 3/4/91

PURGEABLE HALOCARBONS
BTEX:

BENZENE	ND
TOLUENE	ND
ETHYLBENZENE	ND
XYLENES (TOTAL)	ND

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	5.0
BROMOFORM	ND	5.0
BROMOMETHANE	ND	5.0
CARBON TETRACHLORIDE	ND	5.0
CHLOROBENZENE	ND	5.0
CHLOROETHANE	ND	5.0
2-CHLOROETHYLVINYL ETHER	ND	5.0
CHLOROFORM	ND	5.0
CHLOROMETHANE	ND	5.0
DIBROMOCHLOROMETHANE	ND	5.0
1,2-DICHLOROBENZENE	ND	5.0
1,3-DICHLOROBENZENE	ND	5.0
1,4-DICHLOROBENZENE	ND	5.0
DICHLORODIFLUOROMETHANE	ND	5.0
1,1-DICHLOROETHANE	ND	5.0
1,2-DICHLOROETHANE	ND	5.0
1,1-DICHLOROETHENE	ND	5.0
trans-1,2-DICHLOROETHENE	ND	5.0
1,2-DICHLOROPROPANE	ND	5.0
cis-1,3-DICHLOROPROPENE	ND	5.0
trans-1,3-DICHLOROPROPENE	ND	5.0
METHYLENE CHLORIDE	ND	5.0
1,1,2,2-TETRACHLOROETHANE	ND	5.0
TETRACHLOROETHENE	ND	5.0
1,1,1-TRICHLOROETHANE	223	5.0
1,1,2-TRICHLOROETHANE	ND	5.0
TRICHLOROETHENE	ND	5.0
TRICHLOROFLUOROMETHANE	ND	5.0
VINYL CHLORIDE	ND	5.0

ND = NONE DETECTED
All analyses reported in ug/Kg (micrograms per kilogram), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8010

Sample Location: MW-8A, 27 Feet BLS

Sample Type: Soil

Date Sampled: 3/4/91

PURGEABLE HALOCARBONS
BTEX:

BENZENE	ND
TOLUENE	ND
ETHYLBENZENE	ND
XYLENES (TOTAL)	ND

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	5.0
BROMOFORM	ND	5.0
BROMOMETHANE	ND	5.0
CARBON TETRACHLORIDE	ND	5.0
CHLOROBENZENE	ND	5.0
CHLOROETHANE	ND	5.0
2-CHLOROETHYLVINYL ETHER	ND	5.0
CHLOROFORM	ND	5.0
CHLOROMETHANE	ND	5.0
DIBROMOCHLOROMETHANE	ND	5.0
1,2-DICHLOROBENZENE	ND	5.0
1,3-DICHLOROBENZENE	ND	5.0
1,4-DICHLOROBENZENE	ND	5.0
DICHLORODIFLUOROMETHANE	ND	5.0
1,1-DICHLOROETHANE	ND	5.0
1,2-DICHLOROETHANE	ND	5.0
1,1-DICHLOROETHENE	ND	5.0
trans-1,2-DICHLOROETHENE	ND	5.0
1,2-DICHLOROPROPANE	ND	5.0
cis-1,3-DICHLOROPROPENE	ND	5.0
trans-1,3-DICHLOROPROPENE	ND	5.0
METHYLENE CHLORIDE	ND	5.0
1,1,2,2-TETRACHLOROETHANE	ND	5.0
TETRACHLOROETHENE	ND	5.0
1,1,1-TRICHLOROETHANE	289	5.0
1,1,2-TRICHLOROETHANE	ND	5.0
TRICHLOROETHENE	985	5.0
TRICHLOROFLUOROMETHANE	ND	5.0
VINYL CHLORIDE	ND	5.0

ND = NONE DETECTED
All analyses reported in ug/Kg (micrograms per kilogram), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8010

Sample Location: MW-8A, 33 Feet BLS

Sample Type: Soil

Date Sampled: 3/4/91

PURGEABLE HALOCARBONS
BTEX:

BENZENE	ND
TOLUENE	ND
ETHYLBENZENE	ND
XYLENES (TOTAL)	ND

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	5.0
BROMOFORM	ND	5.0
BROMOMETHANE	ND	5.0
CARBON TETRACHLORIDE	ND	5.0
CHLOROBENZENE	ND	5.0
CHLOROETHANE	ND	5.0
2-CHLOROETHYLVINYL ETHER	ND	5.0
CHLOROFORM	ND	5.0
CHLOROMETHANE	ND	5.0
DIBROMOCHLOROMETHANE	ND	5.0
1,2-DICHLOROBENZENE	ND	5.0
1,3-DICHLOROBENZENE	ND	5.0
1,4-DICHLOROBENZENE	ND	5.0
DICHLORODIFLUOROMETHANE	ND	5.0
1,1-DICHLOROETHANE	ND	5.0
1,2-DICHLOROETHANE	ND	5.0
1,1-DICHLOROETHENE	ND	5.0
trans-1,2-DICHLOROETHENE	ND	5.0
1,2-DICHLOROPROPANE	ND	5.0
cis-1,3-DICHLOROPROPENE	ND	5.0
trans-1,3-DICHLOROPROPENE	ND	5.0
METHYLENE CHLORIDE	ND	5.0
1,1,2,2-TETRACHLOROETHANE	ND	5.0
TETRACHLOROETHENE	ND	5.0
1,1,1-TRICHLOROETHANE	ND	5.0
1,1,2-TRICHLOROETHANE	ND	5.0
TRICHLOROETHENE	ND	5.0
TRICHLOROFLUOROMETHANE	ND	5.0
VINYL CHLORIDE	ND	5.0

ND = NONE DETECTED
All analyses reported in ug/Kg (micrograms per kilogram), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8010

Sample Location: MW-8B 1.5 Feet BLS

Sample Type: Soil

Date Sampled: 3/5/91

PURGEABLE HALOCARBONS
BTEX:

BENZENE	ND
TOLUENE	236
ETHYLBENZENE	515
XYLENES (TOTAL)	5533

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	5.0
BROMOFORM	ND	5.0
BROMOMETHANE	ND	5.0
CARBON TETRACHLORIDE	ND	5.0
CHLOROBENZENE	ND	5.0
CHLOROETHANE	ND	5.0
2-CHLOROETHYLVINYL ETHER	ND	5.0
CHLOROFORM	ND	5.0
CHLOROMETHANE	ND	5.0
DIBROMOCHLOROMETHANE	ND	5.0
1,2-DICHLOROBENZENE	ND	5.0
1,3-DICHLOROBENZENE	ND	5.0
1,4-DICHLOROBENZENE	ND	5.0
DICHLORODIFLUOROMETHANE	ND	5.0
1,1-DICHLOROETHANE	1009	5.0
1,2-DICHLOROETHANE	ND	5.0
1,1-DICHLOROETHENE	ND	5.0
trans-1,2-DICHLOROETHENE	ND	5.0
1,2-DICHLOROPROPANE	ND	5.0
cis-1,3-DICHLOROPROPENE	ND	5.0
trans-1,3-DICHLOROPROPENE	ND	5.0
METHYLENE CHLORIDE	ND	5.0
1,1,2,2-TETRACHLOROETHANE	ND	5.0
TETRACHLOROETHENE	397	5.0
1,1,1-TRICHLOROETHANE	2859	5.0
1,1,2-TRICHLOROETHANE	ND	5.0
TRICHLOROETHENE	ND	5.0
TRICHLOROFLUOROMETHANE	ND	5.0
VINYL CHLORIDE	ND	5.0

ND = NONE DETECTED
All analyses reported in ug/Kg (micrograms per kilogram), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8010

Sample Location: MW-9C, 2 Feet BLS

Sample Type: Soil

Date Sampled: 3/5/91

PURGEABLE HALOCARBONS
BTEX:

BENZENE	ND
TOLUENE	ND
ETHYLBENZENE	ND
XYLENES (TOTAL)	ND

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	5.0
BROMOFORM	ND	5.0
BROMOMETHANE	ND	5.0
CARBON TETRACHLORIDE	ND	5.0
CHLOROBENZENE	ND	5.0
CHLOROETHANE	ND	5.0
2-CHLOROETHYLVINYL ETHER	ND	5.0
CHLOROFORM	ND	5.0
CHLOROMETHANE	ND	5.0
DIBROMOCHLOROMETHANE	ND	5.0
1,2-DICHLOROBENZENE	ND	5.0
1,3-DICHLOROBENZENE	ND	5.0
1,4-DICHLOROBENZENE	ND	5.0
DICHLORODIFLUOROMETHANE	ND	5.0
1,1-DICHLOROETHANE	ND	5.0
1,2-DICHLOROETHANE	ND	5.0
1,1-DICHLOROETHENE	ND	5.0
trans-1,2-DICHLOROETHENE	ND	5.0
1,2-DICHLOROPROPANE	ND	5.0
cis-1,3-DICHLOROPROPENE	ND	5.0
trans-1,3-DICHLOROPROPENE	ND	5.0
METHYLENE CHLORIDE	ND	5.0
1,1,2,2-TETRACHLOROETHANE	ND	5.0
TETRACHLOROETHENE	ND	5.0
1,1,1-TRICHLOROETHANE	ND	5.0
1,1,2-TRICHLOROETHANE	ND	5.0
TRICHLOROETHENE	ND	5.0
TRICHLOROFLUOROMETHANE	ND	5.0
VINYL CHLORIDE	ND	5.0

ND = NONE DETECTED
All analyses reported in ug/Kg (micrograms per kilogram), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8010

Sample Location: MW-9C, 6 Feet BLS

Sample Type: Soil

Date Sampled: 3/5/91

PURGEABLE HALOCARBONS
BTEX:

BENZENE	ND
TOLUENE	ND
ETHYLBENZENE	ND
XYLENES (TOTAL)	ND

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	5.0
BROMOFORM	ND	5.0
BROMOMETHANE	ND	5.0
CARBON TETRACHLORIDE	ND	5.0
CHLOROBENZENE	ND	5.0
CHLOROETHANE	ND	5.0
2-CHLOROETHYLVINYL ETHER	ND	5.0
CHLOROFORM	ND	5.0
CHLOROMETHANE	ND	5.0
DIBROMOCHLOROMETHANE	ND	5.0
1,2-DICHLOROBENZENE	ND	5.0
1,3-DICHLOROBENZENE	ND	5.0
1,4-DICHLOROBENZENE	ND	5.0
DICHLORODIFLUOROMETHANE	ND	5.0
1,1-DICHLOROETHANE	ND	5.0
1,2-DICHLOROETHANE	ND	5.0
1,1-DICHLOROETHENE	ND	5.0
trans-1,2-DICHLOROETHENE	ND	5.0
1,2-DICHLOROPROPANE	ND	5.0
cis-1,3-DICHLOROPROPENE	ND	5.0
trans-1,3-DICHLOROPROPENE	ND	5.0
METHYLENE CHLORIDE	ND	5.0
1,1,2,2-TETRACHLOROETHANE	ND	5.0
TETRACHLOROETHENE	ND	5.0
1,1,1-TRICHLOROETHANE	ND	5.0
1,1,2-TRICHLOROETHANE	ND	5.0
TRICHLOROETHENE	ND	5.0
TRICHLOROFLUOROMETHANE	ND	5.0
VINYL CHLORIDE	ND	5.0

ND = NONE DETECTED
All analyses reported in ug/Kg (micrograms per kilogram), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8010

Sample Location: MW-9C, 8 Feet BLS

Sample Type: Soil

Date Sampled: 3/5/91

PURGEABLE HALOCARBONS
BTEX:

BENZENE	ND
TOLUENE	ND
ETHYLBENZENE	ND
XYLENES (TOTAL)	116

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	5.0
BROMOFORM	ND	5.0
BROMOMETHANE	ND	5.0
CARBON TETRACHLORIDE	ND	5.0
CHLOROBENZENE	ND	5.0
CHLOROETHANE	ND	5.0
2-CHLOROETHYLVINYL ETHER	ND	5.0
CHLOROFORM	ND	5.0
CHLOROMETHANE	ND	5.0
DIBROMOCHLOROMETHANE	ND	5.0
1,2-DICHLOROBENZENE	ND	5.0
1,3-DICHLOROBENZENE	ND	5.0
1,4-DICHLOROBENZENE	ND	5.0
DICHLORODIFLUOROMETHANE	ND	5.0
1,1-DICHLOROETHANE	ND	5.0
1,2-DICHLOROETHANE	ND	5.0
1,1-DICHLOROETHENE	ND	5.0
trans-1,2-DICHLOROETHENE	ND	5.0
1,2-DICHLOROPROPANE	ND	5.0
cis-1,3-DICHLOROPROPENE	ND	5.0
trans-1,3-DICHLOROPROPENE	ND	5.0
METHYLENE CHLORIDE	ND	5.0
1,1,2,2-TETRACHLOROETHANE	ND	5.0
TETRACHLOROETHENE	196	5.0
1,1,1-TRICHLOROETHANE	246	5.0
1,1,2-TRICHLOROETHANE	ND	5.0
TRICHLOROETHENE	769	5.0
TRICHLOROFLUOROMETHANE	ND	5.0
VINYL CHLORIDE	ND	5.0

ND = NONE DETECTED
All analyses reported in ug/Kg (micrograms per kilogram), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8010

Sample Location: MW-9C, 10 Feet BLS

Sample Type: Soil

Date Sampled: 3/5/91

PURGEABLE HALOCARBONS
BTEX:

BENZENE	ND
TOLUENE	ND
ETHYLBENZENE	2394
XYLENES (TOTAL)	9230

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	5.0
BROMOFORM	ND	5.0
BROMOMETHANE	ND	5.0
CARBON TETRACHLORIDE	ND	5.0
CHLOROBENZENE	ND	5.0
CHLOROETHANE	ND	5.0
2-CHLOROETHYLVINYL ETHER	ND	5.0
CHLOROFORM	ND	5.0
CHLOROMETHANE	ND	5.0
DIBROMOCHLOROMETHANE	ND	5.0
1,2-DICHLOROBENZENE	ND	5.0
1,3-DICHLOROBENZENE	ND	5.0
1,4-DICHLOROBENZENE	ND	5.0
DICHLORODIFLUOROMETHANE	ND	5.0
1,1-DICHLOROETHANE	ND	5.0
1,2-DICHLOROETHANE	ND	5.0
1,1-DICHLOROETHENE	ND	5.0
trans-1,2-DICHLOROETHENE	ND	5.0
1,2-DICHLOROPROPANE	ND	5.0
cis-1,3-DICHLOROPROPENE	ND	5.0
trans-1,3-DICHLOROPROPENE	ND	5.0
METHYLENE CHLORIDE	ND	5.0
1,1,2,2-TETRACHLOROETHANE	ND	5.0
TETRACHLOROETHENE	2498	5.0
1,1,1-TRICHLOROETHANE	6578	5.0
1,1,2-TRICHLOROETHANE	ND	5.0
TRICHLOROETHENE	17,094	5.0
TRICHLOROFLUOROMETHANE	ND	5.0
VINYL CHLORIDE	ND	5.0

ND = NONE DETECTED
All analyses reported in ug/Kg (micrograms per kilogram), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8010

Sample Location: MW-9C, 14 Feet BLS

Sample Type: Soil

Date Sampled: 3/5/91

PURGEABLE HALOCARBONS
BTEX:

BENZENE	ND
TOLUENE	ND
ETHYLBENZENE	ND
XYLENES (TOTAL)	ND

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	5.0
BROMOFORM	ND	5.0
BROMOMETHANE	ND	5.0
CARBON TETRACHLORIDE	ND	5.0
CHLOROBENZENE	ND	5.0
CHLOROETHANE	ND	5.0
2-CHLOROETHYLVINYL ETHER	ND	5.0
CHLOROFORM	ND	5.0
CHLOROMETHANE	ND	5.0
DIBROMOCHLOROMETHANE	ND	5.0
1,2-DICHLOROBENZENE	ND	5.0
1,3-DICHLOROBENZENE	ND	5.0
1,4-DICHLOROBENZENE	ND	5.0
DICHLORODIFLUOROMETHANE	ND	5.0
1,1-DICHLOROETHANE	ND	5.0
1,2-DICHLOROETHANE	ND	5.0
1,1-DICHLOROETHENE	ND	5.0
trans-1,2-DICHLOROETHENE	ND	5.0
1,2-DICHLOROPROPANE	ND	5.0
cis-1,3-DICHLOROPROPENE	ND	5.0
trans-1,3-DICHLOROPROPENE	ND	5.0
METHYLENE CHLORIDE	ND	5.0
1,1,2,2-TETRACHLOROETHANE	ND	5.0
TETRACHLOROETHENE	ND	5.0
1,1,1-TRICHLOROETHANE	343	5.0
1,1,2-TRICHLOROETHANE	ND	5.0
TRICHLOROETHENE	ND	5.0
TRICHLOROFLUOROMETHANE	ND	5.0
VINYL CHLORIDE	ND	5.0

ND = NONE DETECTED
All analyses reported in ug/Kg (micrograms per kilogram), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8010

Sample Location: MW-9C, 18 Feet BLS

Sample Type: Soil

Date Sampled: 3/5/91

PURGEABLE HALOCARBONS
BTEX:

BENZENE	ND
TOLUENE	ND
ETHYLBENZENE	ND
XYLENES (TOTAL)	ND

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	5.0
BROMOFORM	ND	5.0
BROMOMETHANE	ND	5.0
CARBON TETRACHLORIDE	ND	5.0
CHLOROBENZENE	ND	5.0
CHLOROETHANE	ND	5.0
2-CHLOROETHYLVINYL ETHER	ND	5.0
CHLOROFORM	ND	5.0
CHLOROMETHANE	ND	5.0
DIBROMOCHLOROMETHANE	ND	5.0
1,2-DICHLOROBENZENE	ND	5.0
1,3-DICHLOROBENZENE	ND	5.0
1,4-DICHLOROBENZENE	ND	5.0
DICHLORODIFLUOROMETHANE	ND	5.0
1,1-DICHLOROETHANE	ND	5.0
1,2-DICHLOROETHANE	ND	5.0
1,1-DICHLOROETHENE	ND	5.0
trans-1,2-DICHLOROETHENE	ND	5.0
1,2-DICHLOROPROPANE	ND	5.0
cis-1,3-DICHLOROPROPENE	ND	5.0
trans-1,3-DICHLOROPROPENE	ND	5.0
METHYLENE CHLORIDE	ND	5.0
1,1,2,2-TETRACHLOROETHANE	ND	5.0
TETRACHLOROETHENE	ND	5.0
1,1,1-TRICHLOROETHANE	1268	5.0
1,1,2-TRICHLOROETHANE	ND	5.0
TRICHLOROETHENE	ND	5.0
TRICHLOROFLUOROMETHANE	ND	5.0
VINYL CHLORIDE	ND	5.0

ND = NONE DETECTED
All analyses reported in ug/Kg (micrograms per kilogram), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8010

Sample Location: MW-9C, 25 Feet BLS

Sample Type: Soil

Date Sampled: 3/6/91

PURGEABLE HALOCARBONS
BTEX:

BENZENE	ND
TOLUENE	ND
ETHYLBENZENE	ND
XYLENES (TOTAL)	ND

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	5.0
BROMOFORM	ND	5.0
BROMOMETHANE	ND	5.0
CARBON TETRACHLORIDE	ND	5.0
CHLOROBENZENE	ND	5 0
CHLOROETHANE	ND	5.0
2-CHLOROETHYLVINYL ETHER	ND	5.0
CHLOROFORM	ND	5.0
CHLOROMETHANE	ND	5.0
DIBROMOCHLOROMETHANE	ND	5.0
1,2-DICHLOROBENZENE	ND	5.0
1,3-DICHLOROBENZENE	ND	5.0
1,4-DICHLOROBENZENE	ND	5.0
DICHLORODIFLUOROMETHANE	ND	5.0
1,1-DICHLOROETHANE	ND	5.0
1,2-DICHLOROETHANE	ND	5.0
1,1-DICHLOROETHENE	ND	5.0
trans-1,2-DICHLOROETHENE	ND	5.0
1,2-DICHLOROPROPANE	ND	5.0
cis-1,3-DICHLOROPROPENE	ND	5.0
trans-1,3-DICHLOROPROPENE	ND	5.0
METHYLENE CHLORIDE	ND	5.0
1,1,2,2-TETRACHLOROETHANE	ND	5.0
TETRACHLOROETHENE	ND	5.0
1,1,1-TRICHLOROETHANE	180	5.0
1,1,2-TRICHLOROETHANE	ND	5.0
TRICHLOROETHENE	ND	5.0
TRICHLOROFLUOROMETHANE	ND	5.0
VINYL CHLORIDE	ND	5.0

ND = NONE DETECTED
All analyses reported in ug/Kg (micrograms per kilogram), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8010

Sample Location: MW-9C, 37 Feet BLS

Sample Type: Soil

Date Sampled: 3/6/91

PURGEABLE HALOCARBONS
BTEX:

BENZENE	ND
TOLUENE	ND
ETHYLBENZENE	ND
XYLENES (TOTAL)	ND

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	5.0
BROMOFORM	ND	5.0
BROMOMETHANE	ND	5.0
CARBON TETRACHLORIDE	ND	5.0
CHLOROBENZENE	ND	5.0
CHLOROETHANE	ND	5.0
2-CHLOROETHYLVINYL ETHER	ND	5 0
CHLOROFORM	ND	5.0
CHLOROMETHANE	ND	5.0
DIBROMOCHLOROMETHANE	ND	5.0
1,2-DICHLOROBENZENE	ND	5.0
1,3-DICHLOROBENZENE	ND	5.0
1,4-DICHLOROBENZENE	ND	5.0
DICHLORODIFLUOROMETHANE	ND	5.0
1,1-DICHLOROETHANE	ND	5.0
1,2-DICHLOROETHANE	ND	5.0
1,1-DICHLOROETHENE	ND	5.0
trans-1,2-DICHLOROETHENE	ND	5.0
1,2-DICHLOROPROPANE	ND	5.0
cis-1,3-DICHLOROPROPENE	ND	5.0
trans-1,3-DICHLOROPROPENE	ND	5.0
METHYLENE CHLORIDE	ND	5.0
1,1,2,2-TETRACHLOROETHANE	ND	5.0
TETRACHLOROETHENE	ND	5.0
1,1,1-TRICHLOROETHANE	454	5.0
1,1,2-TRICHLOROETHANE	ND	5.0
TRICHLOROETHENE	ND	5.0
TRICHLOROFLUOROMETHANE	ND	5.0
VINYL CHLORIDE	ND	5.0

ND = NONE DETECTED
All analyses reported in ug/Kg (micrograms per kilogram), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8010

Sample Location: MW-9C, 56 Feet BLS

Sample Type: Soil

Date Sampled: 3/6/91

PURGEABLE HALOCARBONS
BTEX:

BENZENE	ND
TOLUENE	ND
ETHYLBENZENE	ND
XYLENES (TOTAL)	ND

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	5.0
BROMOFORM	ND	5.0
BROMOMETHANE	ND	5.0
CARBON TETRACHLORIDE	ND	5.0
CHLOROBENZENE	ND	5.0
CHLOROETHANE	ND	5.0
2-CHLOROETHYLVINYL ETHER	ND	5.0
CHLOROFORM	ND	5.0
CHLOROMETHANE	ND	5.0
DIBROMOCHLOROMETHANE	ND	5.0
1,2-DICHLOROBENZENE	ND	5.0
1,3-DICHLOROBENZENE	ND	5.0
1,4-DICHLOROBENZENE	ND	5.0
DICHLORODIFLUOROMETHANE	ND	5.0
1,1-DICHLOROETHANE	ND	5.0
1,2-DICHLOROETHANE	ND	5.0
1,1-DICHLOROETHENE	ND	5.0
trans-1,2-DICHLOROETHENE	ND	5.0
1,2-DICHLOROPROPANE	ND	5.0
cis-1,3-DICHLOROPROPENE	ND	5.0
trans-1,3-DICHLOROPROPENE	ND	5.0
METHYLENE CHLORIDE	ND	5.0
1,1,2,2-TETRACHLOROETHANE	ND	5.0
TETRACHLOROETHENE	ND	5.0
1,1,1-TRICHLOROETHANE	836	5.0
1,1,2-TRICHLOROETHANE	ND	5.0
TRICHLOROETHENE	ND	5.0
TRICHLOROFLUOROMETHANE	ND	5.0
VINYL CHLORIDE	ND	5.0

ND = NONE DETECTED
All analyses reported in ug/Kg (micrograms per kilogram), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8010

Sample Location: MW-9C, 59 Feet BLS

Sample Type: Soil

Date Sampled: 3/6/91

PURGEABLE HALOCARBONS
BTEX:

BENZENE	ND
TOLUENE	ND
ETHYLBENZENE	ND
XYLENES (TOTAL)	ND

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	5.0
BROMOFORM	ND	5.0
BROMOMETHANE	ND	5.0
CARBON TETRACHLORIDE	ND	5.0
CHLOROBENZENE	ND	5.0
CHLOROETHANE	ND	5.0
2-CHLOROETHYLVINYL ETHER	ND	5.0
CHLOROFORM	ND	5.0
CHLOROMETHANE	ND	5.0
DIBROMOCHLOROMETHANE	ND	5.0
1,2-DICHLOROBENZENE	ND	5.0
1,3-DICHLOROBENZENE	ND	5.0
1,4-DICHLOROBENZENE	ND	5.0
DICHLORODIFLUOROMETHANE	ND	5.0
1,1-DICHLOROETHANE	ND	5.0
1,2-DICHLOROETHANE	ND	5.0
1,1-DICHLOROETHENE	ND	5.0
trans-1,2-DICHLOROETHENE	ND	5.0
1,2-DICHLOROPROPANE	ND	5.0
cis-1,3-DICHLOROPROPENE	ND	5.0
trans-1,3-DICHLOROPROPENE	ND	5.0
METHYLENE CHLORIDE	ND	5.0
1,1,2,2-TETRACHLOROETHANE	ND	5.0
TETRACHLOROETHENE	ND	5.0
1,1,1-TRICHLOROETHANE	ND	5.0
1,1,2-TRICHLOROETHANE	ND	5.0
TRICHLOROETHENE	ND	5.0
TRICHLOROFLUOROMETHANE	ND	5.0
VINYL CHLORIDE	ND	5.0

ND = NONE DETECTED
All analyses reported in ug/Kg (micrograms per kilogram), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8010

Sample Location: MW-3B, 3 Feet BLS

Sample Type: Soil

Date Sampled: 3/8/91

PURGEABLE HALOCARBONS
BTEX:

BENZENE	ND
TOLUENE	ND
ETHYLBENZENE	ND
XYLENES (TOTAL)	ND

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	5.0
BROMOFORM	ND	5.0
BROMOMETHANE	ND	5.0
CARBON TETRACHLORIDE	ND	5.0
CHLOROBENZENE	ND	5.0
CHLOROETHANE	ND	5.0
2-CHLOROETHYLVINYL ETHER	ND	5.0
CHLOROFORM	ND	5.0
CHLOROMETHANE	ND	5.0
DIBROMOCHLOROMETHANE	ND	5.0
1,2-DICHLOROBENZENE	ND	5.0
1,3-DICHLOROBENZENE	ND	5.0
1,4-DICHLOROBENZENE	ND	5.0
DICHLORODIFLUOROMETHANE	ND	5.0
1,1-DICHLOROETHANE	ND	5.0
1,2-DICHLOROETHANE	ND	5.0
1,1-DICHLOROETHENE	ND	5.0
trans-1,2-DICHLOROETHENE	ND	5.0
1,2-DICHLOROPROPANE	ND	5.0
cis-1,3-DICHLOROPROPENE	ND	5.0
trans-1,3-DICHLOROPROPENE	ND	5.0
METHYLENE CHLORIDE	ND	5.0
1,1,2,2-TETRACHLOROETHANE	ND	5.0
TETRACHLOROETHENE	ND	5.0
1,1,1-TRICHLOROETHANE	ND	5.0
1,1,2-TRICHLOROETHANE	ND	5.0
TRICHLOROETHENE	ND	5.0
TRICHLOROFLUOROMETHANE	ND	5.0
VINYL CHLORIDE	ND	5.0

ND = NONE DETECTED
All analyses reported in ug/Kg (micrograms per kilogram), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8010

Sample Location: MW-3B, 7 Feet BLS

Sample Type: Soil

Date Sampled: 3/8/91

PURGEABLE HALOCARBONS
BTEX:

BENZENE	ND
TOLUENE	ND
ETHYLBENZENE	ND
XYLENES (TOTAL)	ND

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	5.0
BROMOFORM	ND	5.0
BROMOMETHANE	ND	5.0
CARBON TETRACHLORIDE	ND	5.0
CHLOROBENZENE	ND	5.0
CHLOROETHANE	ND	5.0
2-CHLOROETHYLVINYL ETHER	ND	5.0
CHLOROFORM	ND	5.0
CHLOROMETHANE	ND	5.0
DIBROMOCHLOROMETHANE	ND	5.0
1,2-DICHLOROBENZENE	ND	5.0
1,3-DICHLOROBENZENE	ND	5.0
1,4-DICHLOROBENZENE	ND	5.0
DICHLORODIFLUOROMETHANE	ND	5.0
1,1-DICHLOROETHANE	ND	5.0
1,2-DICHLOROETHANE	ND	5.0
1,1-DICHLOROETHENE	ND	5.0
trans-1,2-DICHLOROETHENE	ND	5.0
1,2-DICHLOROPROPANE	ND	5.0
cis-1,3-DICHLOROPROPENE	ND	5.0
trans-1,3-DICHLOROPROPENE	ND	5.0
METHYLENE CHLORIDE	ND	5.0
1,1,2,2-TETRACHLOROETHANE	ND	5.0
TETRACHLOROETHENE	ND	5.0
1,1,1-TRICHLOROETHANE	ND	5.0
1,1,2-TRICHLOROETHANE	ND	5.0
TRICHLOROETHENE	ND	5.0
TRICHLOROFLUOROMETHANE	ND	5.0
VINYL CHLORIDE	ND	5.0

ND = NONE DETECTED
All analyses reported in ug/Kg (micrograms per kilogram), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8010

Sample Location: MW-3B, 13 Feet BLS

Sample Type: Soil

Date Sampled: 3/8/91

PURGEABLE HALOCARBONS
BTEX:

BENZENE	ND
TOLUENE	ND
ETHYLBENZENE	ND
XYLENES (TOTAL)	ND

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	5.0
BROMOFORM	ND	5.0
BROMOMETHANE	ND	5.0
CARBON TETRACHLORIDE	ND	5.0
CHLOROBENZENE	ND	5.0
CHLOROETHANE	ND	5.0
2-CHLOROETHYLVINYL ETHER	ND	5.0
CHLOROFORM	ND	5.0
CHLOROMETHANE	ND	5.0
DIBROMOCHLOROMETHANE	ND	5.0
1,2-DICHLOROBENZENE	ND	5.0
1,3-DICHLOROBENZENE	ND	5.0
1,4-DICHLOROBENZENE	ND	5.0
DICHLORODIFLUOROMETHANE	ND	5.0
1,1-DICHLOROETHANE	ND	5.0
1,2-DICHLOROETHANE	ND	5.0
1,1-DICHLOROETHENE	ND	5.0
trans-1,2-DICHLOROETHENE	ND	5.0
1,2-DICHLOROPROPANE	ND	5.0
cis-1,3-DICHLOROPROPENE	ND	5.0
trans-1,3-DICHLOROPROPENE	ND	5.0
METHYLENE CHLORIDE	ND	5.0
1,1,2,2-TETRACHLOROETHANE	ND	5.0
TETRACHLOROETHENE	ND	5.0
1,1,1-TRICHLOROETHANE	511	5.0
1,1,2-TRICHLOROETHANE	ND	5.0
TRICHLOROETHENE	ND	5.0
TRICHLOROFLUOROMETHANE	ND	5.0
VINYL CHLORIDE	ND	5.0

ND = NONE DETECTED
All analyses reported in ug/Kg (micrograms per kilogram), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8010

Sample Location: MW-3B, 17 Feet BLS

Sample Type: Soil

Date Sampled: 3/8/91

PURGEABLE HALOCARBONS
BTEX:

BENZENE	ND
TOLUENE	ND
ETHYLBENZENE	ND
XYLENES (TOTAL)	ND

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	5.0
BROMOFORM	ND	5.0
BROMOMETHANE	ND	5.0
CARBON TETRACHLORIDE	ND	5.0
CHLOROBENZENE	ND	5.0
CHLOROETHANE	ND	5.0
2-CHLOROETHYLVINYL ETHER	ND	5.0
CHLOROFORM	ND	5.0
CHLOROMETHANE	ND	5.0
DIBROMOCHLOROMETHANE	ND	5.0
1,2-DICHLOROBENZENE	ND	5.0
1,3-DICHLOROBENZENE	ND	5.0
1,4-DICHLOROBENZENE	ND	5.0
DICHLORODIFLUOROMETHANE	ND	5.0
1,1-DICHLOROETHANE	ND	5.0
1,2-DICHLOROETHANE	ND	5.0
1,1-DICHLOROETHENE	ND	5.0
trans-1,2-DICHLOROETHENE	ND	5.0
1,2-DICHLOROPROPANE	ND	5.0
cis-1,3-DICHLOROPROPENE	ND	5.0
trans-1,3-DICHLOROPROPENE	ND	5.0
METHYLENE CHLORIDE	ND	5.0
1,1,2,2-TETRACHLOROETHANE	ND	5.0
TETRACHLOROETHENE	ND	5.0
1,1,1-TRICHLOROETHANE	212	5.0
1,1,2-TRICHLOROETHANE	ND	5.0
TRICHLOROETHENE	ND	5.0
TRICHLOROFLUOROMETHANE	ND	5.0
VINYL CHLORIDE	ND	5.0

ND = NONE DETECTED
All analyses reported in ug/Kg (micrograms per kilogram), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8010

Sample Location: MW-5B, 6 Feet BLS

Sample Type: Soil

Date Sampled: 3/8/91

PURGEABLE HALOCARBONS
BTEX:

BENZENE	ND
TOLUENE	4697
ETHYLBENZENE	ND
XYLENES (TOTAL)	22,533

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	5.0
BROMOFORM	ND	5.0
BROMOMETHANE	ND	5.0
CARBON TETRACHLORIDE	ND	5.0
CHLOROBENZENE	ND	5.0
CHLOROETHANE	ND	5.0
2-CHLOROETHYLVINYL ETHER	ND	5.0
CHLOROFORM	ND	5.0
CHLOROMETHANE	ND	5.0
DIBROMOCHLOROMETHANE	ND	5.0
1,2-DICHLOROBENZENE	ND	5.0
1,3-DICHLOROBENZENE	ND	5.0
1,4-DICHLOROBENZENE	ND	5.0
DICHLORODIFLUOROMETHANE	ND	5.0
1,1-DICHLOROETHANE	ND	5.0
1,2-DICHLOROETHANE	ND	5.0
1,1-DICHLOROETHENE	ND	5.0
trans-1,2-DICHLOROETHENE	ND	5.0
1,2-DICHLOROPROPANE	ND	5.0
cis-1,3-DICHLOROPROPENE	ND	5.0
trans-1,3-DICHLOROPROPENE	ND	5.0
METHYLENE CHLORIDE	230	5.0
1,1,2,2-TETRACHLOROETHANE	ND	5.0
TETRACHLOROETHENE	13,401	5.0
1,1,1-TRICHLOROETHANE	51,704	5.0
1,1,2-TRICHLOROETHANE	ND	5.0
TRICHLOROETHENE	1291	5.0
TRICHLOROFLUOROMETHANE	ND	5.0
VINYL CHLORIDE	ND	5.0

ND = NONE DETECTED
All analyses reported in ug/Kg (micrograms per kilogram), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8010

Sample Location: MW-5B, 8 Feet BLS

Sample Type: Soil

Date Sampled: 3/8/91

PURGEABLE HALOCARBONS
BTEX:

BENZENE	ND
TOLUENE	ND
ETHYLBENZENE	ND
XYLENES (TOTAL)	ND

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	5.0
BROMOFORM	ND	5.0
BROMOMETHANE	ND	5.0
CARBON TETRACHLORIDE	ND	5.0
CHLOROBENZENE	ND	5.0
CHLOROETHANE	ND	5.0
2-CHLOROETHYLVINYL ETHER	ND	5.0
CHLOROFORM	ND	5.0
CHLOROMETHANE	ND	5.0
DIBROMOCHLOROMETHANE	ND	5.0
1,2-DICHLOROBENZENE	ND	5.0
1,3-DICHLOROBENZENE	ND	5.0
1,4-DICHLOROBENZENE	ND	5.0
DICHLORODIFLUOROMETHANE	ND	5.0
1,1-DICHLOROETHANE	ND	5.0
1,2-DICHLOROETHANE	ND	5.0
1,1-DICHLOROETHENE	ND	5.0
trans-1,2-DICHLOROETHENE	ND	5.0
1,2-DICHLOROPROPANE	ND	5.0
cis-1,3-DICHLOROPROPENE	ND	5.0
trans-1,3-DICHLOROPROPENE	ND	5.0
METHYLENE CHLORIDE	ND	5.0
1,1,2,2-TETRACHLOROETHANE	ND	5.0
TETRACHLOROETHENE	ND	5.0
1,1,1-TRICHLOROETHANE	ND	5.0
1,1,2-TRICHLOROETHANE	ND	5.0
TRICHLOROETHENE	ND	5.0
TRICHLOROFLUOROMETHANE	ND	5.0
VINYL CHLORIDE	ND	5.0

ND = NONE DETECTED
All analyses reported in ug/Kg (micrograms per kilogram), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8010

Sample Location: MW-5B, 17 Feet BLS

Sample Type: Soil

Date Sampled: 3/8/91

PURGEABLE HALOCARBONS
BTEX:

BENZENE	ND
TOLUENE	ND
ETHYLBENZENE	ND
XYLENES (TOTAL)	ND

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	5.0
BROMOFORM	ND	5.0
BROMOMETHANE	ND	5.0
CARBON TETRACHLORIDE	ND	5.0
CHLOROBENZENE	ND	5.0
CHLOROETHANE	ND	5.0
2-CHLOROETHYLVINYL ETHER	ND	5.0
CHLOROFORM	ND	5.0
CHLOROMETHANE	ND	5.0
DIBROMOCHLOROMETHANE	ND	5.0
1,2-DICHLOROBENZENE	ND	5.0
1,3-DICHLOROBENZENE	ND	5.0
1,4-DICHLOROBENZENE	ND	5.0
DICHLORODIFLUOROMETHANE	ND	5.0
1,1-DICHLOROETHANE	ND	5.0
1,2-DICHLOROETHANE	ND	5.0
1,1-DICHLOROETHENE	ND	5.0
trans-1,2-DICHLOROETHENE	ND	5.0
1,2-DICHLOROPROPANE	ND	5.0
cis-1,3-DICHLOROPROPENE	ND	5.0
trans-1,3-DICHLOROPROPENE	ND	5.0
METHYLENE CHLORIDE	ND	5.0
1,1,2,2-TETRACHLOROETHANE	ND	5.0
TETRACHLOROETHENE	ND	5.0
1,1,1-TRICHLOROETHANE	148	5.0
1,1,2-TRICHLOROETHANE	ND	5.0
TRICHLOROETHENE	ND	5.0
TRICHLOROFLUOROMETHANE	ND	5.0
VINYL CHLORIDE	ND	5.0

ND = NONE DETECTED
All analyses reported in ug/Kg (micrograms per kilogram), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8010

Sample Location: MW-5B, 20 Feet BLS

Sample Type: Soil

Date Sampled: 3/8/91

PURGEABLE HALOCARBONS
BTEX:

BENZENE	ND
TOLUENE	ND
ETHYLBENZENE	ND
XYLENES (TOTAL)	ND

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	5.0
BROMOFORM	ND	5.0
BROMOMETHANE	ND	5.0
CARBON TETRACHLORIDE	ND	5.0
CHLOROBENZENE	ND	5.0
CHLOROETHANE	ND	5.0
2-CHLOROETHYLVINYL ETHER	ND	5.0
CHLOROFORM	ND	5.0
CHLOROMETHANE	ND	5 0
DIBROMOCHLOROMETHANE	ND	5.0
1,2-DICHLOROBENZENE	ND	5.0
1,3-DICHLOROBENZENE	ND	5.0
1,4-DICHLOROBENZENE	ND	5.0
DICHLORODIFLUOROMETHANE	ND	5.0
1,1-DICHLOROETHANE	ND	5.0
1,2-DICHLOROETHANE	ND	5.0
1,1-DICHLOROETHENE	ND	5.0
trans-1,2-DICHLOROETHENE	ND	5.0
1,2-DICHLOROPROPANE	ND	5.0
cis-1,3-DICHLOROPROPENE	ND	5.0
trans-1,3-DICHLOROPROPENE	ND	5.0
METHYLENE CHLORIDE	ND	5.0
1,1,2,2-TETRACHLOROETHANE	ND	5.0
TETRACHLOROETHENE	ND	5.0
1,1,1-TRICHLOROETHANE	112	5.0
1,1,2-TRICHLOROETHANE	ND	5.0
TRICHLOROETHENE	ND	5.0
TRICHLOROFLUOROMETHANE	ND	5.0
VINYL CHLORIDE	ND	5.0

ND = NONE DETECTED
All analyses reported in ug/Kg (micrograms per kilogram), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8010

Sample Location MW-10, 5 Feet BLS

Sample Type: Soil

Date Sampled: 3/11/91

PURGEABLE HALOCARBONS
BTEX·

BENZENE	ND
TOLUENE	ND
ETHYLBENZENE	ND
XYLENES (TOTAL)	ND

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	5.0
BROMOFORM	ND	5.0
BROMOMETHANE	ND	5.0
CARBON TETRACHLORIDE	ND	5.0
CHLOROBENZENE	ND	5.0
CHLOROETHANE	ND	5.0
2-CHLOROETHYLVINYL ETHER	ND	5.0
CHLOROFORM	ND	5.0
CHLOROMETHANE	ND	5.0
DIBROMOCHLOROMETHANE	ND	5.0
1,2-DICHLOROBENZENE	ND	5.0
1,3-DICHLOROBENZENE	ND	5.0
1,4-DICHLOROBENZENE	ND	5.0
DICHLORODIFLUOROMETHANE	ND	5.0
1,1-DICHLOROETHANE	ND	5.0
1,2-DICHLOROETHANE	ND	5.0
1,1-DICHLOROETHENE	ND	5.0
trans-1,2-DICHLOROETHENE	ND	5.0
1,2-DICHLOROPROPANE	ND	5.0
cis-1,3-DICHLOROPROPENE	ND	5.0
trans-1,3-DICHLOROPROPENE	ND	5.0
METHYLENE CHLORIDE	ND	5.0
1,1,2,2-TETRACHLOROETHANE	ND	5.0
TETRACHLOROETHENE	ND	5.0
1,1,1-TRICHLOROETHANE	82	5.0
1,1,2-TRICHLOROETHANE	ND	5.0
TRICHLOROETHENE	ND	5.0
TRICHLOROFLUOROMETHANE	ND	5.0
VINYL CHLORIDE	ND	5.0

ND = NONE DETECTED
All analyses reported in ug/Kg (micrograms per kilogram), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8010

Sample Location: MW-10A, 6 Feet BLS

Sample Type: Soil

Date Sampled: 3/11/91

PURGEABLE HALOCARBONS
BTEX:

BENZENE	ND
TOLUENE	98,882
ETHYLBENZENE	ND
XYLENES (TOTAL)	82,078

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	5.0
BROMOFORM	ND	5.0
BROMOMETHANE	ND	5.0
CARBON TETRACHLORIDE	ND	5.0
CHLOROBENZENE	ND	5.0
CHLOROETHANE	ND	5.0
2-CHLOROETHYLVINYL ETHER	ND	5.0
CHLOROFORM	ND	5.0
CHLOROMETHANE	ND	5.0
DIBROMOCHLOROMETHANE	ND	5.0
1,2-DICHLOROBENZENE	ND	5.0
1,3-DICHLOROBENZENE	ND	5.0
1,4-DICHLOROBENZENE	ND	5.0
DICHLORODIFLUOROMETHANE	ND	5.0
1,1-DICHLOROETHANE	948	5.0
1,2-DICHLOROETHANE	1291	5.0
1,1-DICHLOROETHENE	ND	5.0
trans-1,2-DICHLOROETHENE	ND	5.0
1,2-DICHLOROPROPANE	ND	5.0
cis-1,3-DICHLOROPROPENE	ND	5 0
trans-1,3-DICHLOROPROPENE	ND	5.0
METHYLENE CHLORIDE	389	5.0
1,1,2,2-TETRACHLOROETHANE	ND	5.0
TETRACHLOROETHENE	229,714	5.0
1,1,1-TRICHLOROETHANE	516,700	5.0
1,1,2-TRICHLOROETHANE	ND	5.0
TRICHLOROETHENE	420,353	5.0
TRICHLOROFLUOROMETHANE	ND	5.0
VINYL CHLORIDE	ND	5.0

ND = NONE DETECTED
All analyses reported in ug/Kg (micrograms per kilogram), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8010

Sample Location: MW-10A, 15 Feet BLS

Sample Type: Soil

Date Sampled: 3/11/91

PURGEABLE HALOCARBONS
BTEX:

BENZENE	ND
TOLUENE	ND
ETHYLBENZENE	ND
XYLENES (TOTAL)	ND

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	5.0
BROMOFORM	ND	5.0
BROMOMETHANE	ND	5.0
CARBON TETRACHLORIDE	ND	5.0
CHLOROBENZENE	ND	5.0
CHLOROETHANE	ND	5.0
2-CHLOROETHYLVINYL ETHER	ND	5.0
CHLOROFORM	ND	5.0
CHLOROMETHANE	ND	5.0
DIBROMOCHLOROMETHANE	ND	5.0
1,2-DICHLOROBENZENE	ND	5.0
1,3-DICHLOROBENZENE	ND	5.0
1,4-DICHLOROBENZENE	ND	5.0
DICHLORODIFLUOROMETHANE	ND	5.0
1,1-DICHLOROETHANE	ND	5.0
1,2-DICHLOROETHANE	ND	5.0
1,1-DICHLOROETHENE	ND	5.0
trans-1,2-DICHLOROETHENE	ND	5.0
1,2-DICHLOROPROPANE	ND	5.0
cis-1,3-DICHLOROPROPENE	ND	5.0
trans-1,3-DICHLOROPROPENE	ND	5.0
METHYLENE CHLORIDE	113	5.0
1,1,2,2-TETRACHLOROETHANE	ND	5.0
TETRACHLOROETHENE	ND	5.0
1,1,1-TRICHLOROETHANE	1746	5.0
1,1,2-TRICHLOROETHANE	ND	5.0
TRICHLOROETHENE	318	5.0
TRICHLOROFLUOROMETHANE	ND	5.0
VINYL CHLORIDE	ND	5.0

ND = NONE DETECTED
All analyses reported in ug/Kg (micrograms per kilogram), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8010

Sample Location: MW-10A, 18 Feet BLS

Sample Type: Soil

Date Sampled: 3/11/91

PURGEABLE HALOCARBONS
BTEX:

BENZENE	ND
TOLUENE	ND
ETHYLBENZENE	ND
XYLENES (TOTAL)	ND

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	5.0
BROMOFORM	ND	5.0
BROMOMETHANE	ND	5.0
CARBON TETRACHLORIDE	ND	5.0
CHLOROBENZENE	ND	5.0
CHLOROETHANE	ND	5.0
2-CHLOROETHYLVINYL ETHER	ND	5.0
CHLOROFORM	ND	5.0
CHLOROMETHANE	ND	5.0
DIBROMOCHLOROMETHANE	ND	5.0
1,2-DICHLOROBENZENE	ND	5.0
1,3-DICHLOROBENZENE	ND	5.0
1,4-DICHLOROBENZENE	ND	5.0
DICHLORODIFLUOROMETHANE	ND	5.0
1,1-DICHLOROETHANE	ND	5.0
1,2-DICHLOROETHANE	ND	5.0
1,1-DICHLOROETHENE	ND	5.0
trans-1,2-DICHLOROETHENE	ND	5.0
1,2-DICHLOROPROPANE	ND	5.0
cis-1,3-DICHLOROPROPENE	ND	5.0
trans-1,3-DICHLOROPROPENE	ND	5.0
METHYLENE CHLORIDE	ND	5.0
1,1,2,2-TETRACHLOROETHANE	ND	5.0
TETRACHLOROETHENE	ND	5.0
1,1,1-TRICHLOROETHANE	103	5.0
1,1,2-TRICHLOROETHANE	ND	5.0
TRICHLOROETHENE	109	5.0
TRICHLOROFLUOROMETHANE	ND	5.0
VINYL CHLORIDE	ND	5.0

ND = NONE DETECTED
All analyses reported in ug/Kg (micrograms per kilogram), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8010

Sample Location: MW-10A, 30 Feet BLS

Sample Type: Soil

Date Sampled: 3/11/91

PURGEABLE HALOCARBONS
BTEX:

BENZENE	ND
TOLUENE	ND
ETHYLBENZENE	ND
XYLENES (TOTAL)	ND

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	5.0
BROMOFORM	ND	5.0
BROMOMETHANE	ND	5.0
CARBON TETRACHLORIDE	ND	5.0
CHLOROBENZENE	ND	5.0
CHLOROETHANE	ND	5.0
2-CHLOROETHYLVINYL ETHER	ND	5.0
CHLOROFORM	ND	5.0
CHLOROMETHANE	ND	5.0
DIBROMOCHLOROMETHANE	ND	5.0
1,2-DICHLOROBENZENE	ND	5 0
1,3-DICHLOROBENZENE	ND	5.0
1,4-DICHLOROBENZENE	ND	5.0
DICHLORODIFLUOROMETHANE	ND	5.0
1,1-DICHLOROETHANE	ND	5.0
1,2-DICHLOROETHANE	ND	5.0
1,1-DICHLOROETHENE	ND	5.0
trans-1,2-DICHLOROETHENE	ND	5.0
1,2-DICHLOROPROPANE	ND	5.0
cis-1,3-DICHLOROPROPENE	ND	5.0
trans-1,3-DICHLOROPROPENE	ND	5.0
METHYLENE CHLORIDE	ND	5.0
1,1,2,2-TETRACHLOROETHANE	ND	5.0
TETRACHLOROETHENE	ND	5.0
1,1,1-TRICHLOROETHANE	75	5.0
1,1,2-TRICHLOROETHANE	ND	5.0
TRICHLOROETHENE	29	5.0
TRICHLOROFLUOROMETHANE	ND	5.0
VINYL CHLORIDE	ND	5.0

ND = NONE DETECTED
All analyses reported in ug/Kg (micrograms per kilogram), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8010

Sample Location: MW-10A, 35 Feet BLS

Sample Type: Soil

Date Sampled: 3/11/91

PURGEABLE HALOCARBONS
BTEX:

BENZENE	ND
TOLUENE	ND
ETHYLBENZENE	ND
XYLENES (TOTAL)	ND

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	5.0
BROMOFORM	ND	5 0
BROMOMETHANE	ND	5.0
CARBON TETRACHLORIDE	ND	5.0
CHLOROBENZENE	ND	5.0
CHLOROETHANE	ND	5.0
2-CHLOROETHYLVINYL ETHER	ND	5 0
CHLOROFORM	ND	5.0
CHLOROMETHANE	ND	5.0
DIBROMOCHLOROMETHANE	ND	5.0
1,2-DICHLOROBENZENE	ND	5.0
1,3-DICHLOROBENZENE	ND	5.0
1,4-DICHLOROBENZENE	ND	5.0
DICHLORODIFLUOROMETHANE	ND	5.0
1,1-DICHLOROETHANE	ND	5.0
1,2-DICHLOROETHANE	ND	5.0
1,1-DICHLOROETHENE	ND	5.0
trans-1,2-DICHLOROETHENE	ND	5.0
1,2-DICHLOROPROPANE	ND	5.0
cis-1,3-DICHLOROPROPENE	ND	5.0
trans-1,3-DICHLOROPROPENE	ND	5.0
METHYLENE CHLORIDE	ND	5.0
1,1,2,2-TETRACHLOROETHANE	ND	5.0
TETRACHLOROETHENE	ND	5.0
1,1,1-TRICHLOROETHANE	953	5.0
1,1,2-TRICHLOROETHANE	ND	5.0
TRICHLOROETHENE	216	5.0
TRICHLOROFLUOROMETHANE	ND	5.0
VINYL CHLORIDE	ND	5.0

ND = NONE DETECTED
All analyses reported in ug/Kg (micrograms per kilogram), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8010

Sample Location: MW-9B

Sample Type: Water

Date Sampled: 3/12/91

PURGEABLE HALOCARBONS
BTEX:

BENZENE	ND
TOLUENE	500
ETHYLBENZENE	ND
XYLENES (TOTAL)	403

PURGEABLE HALOGENATED HYDROCARBONS:

	AMOUNT DETECTED	DETECTION LIMIT
BROMODICHLOROMETHANE	ND	0.2
BROMOFORM	ND	0.2
BROMOMETHANE	ND	0.2
CARBON TETRACHLORIDE	ND	0.2
CHLOROBENZENE	ND	0.2
CHLOROETHANE	ND	0.2
2-CHLOROETHYLVINYL ETHER	ND	0.2
CHLOROFORM	ND	0.2
CHLOROMETHANE	ND	0.2
DIBROMOCHLOROMETHANE	ND	0.2
1,2-DICHLOROBENZENE	ND	0.2
1,3-DICHLOROBENZENE	ND	0.2
1,4-DICHLOROBENZENE	ND	0.2
DICHLORODIFLUOROMETHANE	ND	0.2
1,1-DICHLOROETHANE	167	0.2
1,2-DICHLOROETHANE	58	0.2
1,1-DICHLOROETHENE	1376	0.2
trans-1,2-DICHLOROETHENE	ND	0.2
1,2-DICHLOROPROPANE	ND	0.2
cis-1,3-DICHLOROPROPENE	ND	0.2
trans-1,3-DICHLOROPROPENE	ND	0.2
METHYLENE CHLORIDE	10,780	0.2
1,1,2,2-TETRACHLOROETHANE	ND	0.2
TETRACHLOROETHENE	204	0.2
1,1,1-TRICHLOROETHANE	19,120	0.2
1,1,2-TRICHLOROETHANE	ND	0.2
TRICHLOROETHENE	12,910	0.2
TRICHLOROFLUOROMETHANE	ND	0.2
VINYL CHLORIDE	ND	0.2

ND = NONE DETECTED
All analyses reported in ug/L (micrograms per Liter), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 601, 602

TCLP, VOLATILES ONLY

Sample Type: Soil   Date Sampled: 3/13/91

	SP 9-2'	SP 9-5'	Detection Limits
Benzene	ND	ND	5.0
Carbon tetrachloride	ND	ND	5.0
Chlorobenzene	ND	ND	5.0
Chloroform	ND	ND	5.0
1,2-Dichloroethane	ND	ND	5.0
1,1-Dichloroethene	ND	ND	5.0
Methyl ethyl ketone	ND	ND	100.0
Pyridine	ND	ND	100.0
Tetrachloroethene	ND	ND	5.0
Trichloroethene	ND	ND	5.0
Vinyl chloride	ND	ND	10.0
Ethylbenzene	10.0	ND	5.0
Methylene chloride	303.0	230.0	5.0
1,1,1 Trichloroethane	ND	ND	5.0

	SP 10-2'	SP 10-4'	Detection Limits
Benzene	ND	ND	5.0
Carbon tetrachloride	ND	ND	5.0
Chlorobenzene	ND	ND	5.0
Chloroform	ND	ND	5.0
1,2-Dichloroethane	ND	ND	5.0
1,1-Dichloroethene	ND	ND	5.0
Methyl ethyl ketone	ND	ND	5.0
Pyridine	ND	ND	100.0
Tetrachloroethene	ND	ND	5.0
Trichloroethene	ND	ND	5.0
Vinyl chloride	ND	ND	10.0
Ethylbenzene	ND	ND	5.0
Methylene chloride	ND	ND	5.0
1,1,1 Trichloroethane	ND	ND	5.0

	SP 11-2'	SP 11-5'	Detection Limits
Benzene	ND	ND	5.0
Carbon tetrachloride	ND	ND	5.0
Chlorobenzene	ND	ND	5.0
Chloroform	ND	ND	5.0
1,2-Dichloroethane	ND	ND	5.0
1,1-Dichloroethene	ND	ND	5.0
Methyl ethyl ketone	ND	ND	5.0
Pyridine	ND	ND	100.0
Tetrachloroethene	ND	ND	5.0
Trichloroethene	ND	ND	5.0
Vinyl chloride	ND	ND	10.0
Ethylbenzene	10.0	ND	5.0
Methylene chloride	28.0	ND	5.0
1,1,1 Trichloroethane	ND	ND	5.0

ND = NONE DETECTED

All analyses reported in ug/L (micrograms per Liter), equivalent to parts-per-billion, unless otherwise noted.

EPA Method: 8260

TCLP, VOLATILES ONLY
Sample Type Soil Date Sampled: 3/13/91

	SP-12 2'	SP-12 4'	Detection Limits
Benzene	ND	ND	5.0
Carbon tetrachloride	ND	ND	5.0
Chlorobenzene	ND	ND	5 0
Chloroform	ND	ND	5.0
1,2-Dichloroethane	ND	ND	5.0
1,1-Dichloroethene	ND	ND	5.0
Methyl ethyl ketone	ND	ND	5.0
Pyridine	ND	ND	100.0
Tetrachloroethene	ND	ND	5.0
Trichloroethene	ND	ND	5.0
Vinyl chloride	ND	ND	10.0
Ethylbenzene	ND	ND	5.0
Methylene chloride	173.0	37.0	5.0
1,1,1 Trichloroethane	ND	ND	5.0

	SP-13 2'	SP-13 5'	Detection Limits
Benzene	ND	ND	5.0
Carbon tetrachloride	ND	ND	5.0
Chlorobenzene	ND	ND	5.0
Chloroform	ND	ND	5.0
1,2-Dichloroethane	ND	ND	5.0
1,1-Dichloroethene	ND	ND	5.0
Methyl ethyl ketone	ND	ND	5.0
Pyridine	ND	ND	100.0
Tetrachloroethene	ND	ND	5.0
Trichloroethene	ND	ND	5.0
Vinyl chloride	ND	ND	10.0
Ethylbenzene	ND	ND	5.0
Methylene chloride	ND	2010.0	5.0
1,1,1 Trichloroethane	15.0	ND	5.0

	SP-14 2'	SP-14 4'	Detection Limits
Benzene	ND	ND	5.0
Carbon tetrachloride	ND	ND	5.0
Chlorobenzene	ND	ND	5.0
Chloroform	ND	ND	5.0
1,2-Dichloroethane	ND	ND	5.0
1,1-Dichloroethene	ND	ND	5.0
Methyl ethyl ketone	ND	ND	5.0
Pyridine	ND	ND	100.0
Tetrachloroethene	ND	ND	5.0
Trichloroethene	ND	ND	5.0
Vinyl chloride	ND	ND	10.0
Ethylbenzene	ND	ND	5.0
Methylene chloride	20.0	ND	5.0
1,1,1 Trichloroethane	ND	ND	5.0

ND = NONE DETECTED
All analyses reported in ug/L (micrograms per Liter), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8260

TCLP, VOLATILES ONLY

Sample Type: Soil   Date Sampled: 3/13/91

	SP-15 2'	SP-15 5'	Detection Limits
Benzene	ND	ND	5.0
Carbon tetrachloride	ND	ND	5.0
Chlorobenzene	ND	ND	5.0
Chloroform	ND	ND	5.0
1,2-Dichloroethane	ND	ND	5.0
1,1-Dichloroethene	ND	ND	5.0
Methyl ethyl ketone	ND	ND	5.0
Pyridine	ND	ND	100.0
Tetrachloroethene	ND	ND	5.0
Trichloroethene	ND	ND	5.0
Vinyl chloride	ND	ND	10.0
Ethylbenzene	ND	ND	5.0
Methylene chloride	ND	ND	5.0
1,1,1 Trichloroethane	ND	ND	5.0

	SP-16 2'	SP-16 5'	Detection Limits
Benzene	ND	ND	5.0
Carbon tetrachloride	ND	ND	5.0
Chlorobenzene	ND	ND	5.0
Chloroform	ND	ND	5.0
1,2-Dichloroethane	ND	ND	5.0
1,1-Dichloroethene	ND	ND	5.0
Methyl ethyl ketone	ND	ND	5.0
Pyridine	ND	ND	100.0
Tetrachloroethene	ND	ND	5.0
Trichloroethene	ND	ND	5.0
Vinyl chloride	ND	ND	10.0
Ethylbenzene	ND	ND	5.0
Methylene chloride	36.0	ND	5.0
1,1,1 Trichloroethane	15.0	ND	5.0

	SP-17 2'	SP-17 5'	Detection Limits
Benzene	ND	ND	5.0
Carbon tetrachloride	ND	ND	5.0
Chlorobenzene	ND	ND	5.0
Chloroform	ND	ND	5.0
1,2-Dichloroethane	ND	ND	5.0
1,1-Dichloroethene	ND	ND	5.0
Methyl ethyl ketone	ND	ND	5.0
Pyridine	ND	ND	100.0
Tetrachloroethene	ND	ND	5.0
Trichloroethene	ND	ND	5.0
Vinyl chloride	ND	ND	10.0
Ethylbenzene	ND	ND	5.0
Methylene chloride	ND	ND	5.0
1,1,1 Trichloroethane	ND	ND	5.0

ND = NONE DETECTED

All analyses reported in ug/L (micrograms per Liter), equivalent to parts-per-billion, unless otherwise noted.

EPA Method: 8260

Sample Location: MW-3B

Sample Type: Water

Date Sampled: 3/26/91

PURGEABLE HALOGENATED HYDROCARBONS AND BTEX:

	AMOUNT DETECTED	DETECTION LIMIT
CHLOROMETHANE	ND	10
BROMOMETHANE	ND	10
VINYL CHLORIDE	ND	3
CHLOROETHANE	ND	5
METHYLENE CHLORIDE	400	3
ACETONE	ND	10
CARBON DISULFIDE	ND	10
1,1-DICHLOROETHENE	780	3
1,1-DICHLOROETHANE	70	5
1,2-DICHLOROETHENE (TOTAL)	ND	3
CHLOROFORM	11	3
1,2-DICHLOROETHANE	17	3
2-BUTANONE	ND	10
1,1,1-TRICHLOROETHANE	7700	3
CARBON TETRACHLORIDE	ND	3
VINYL ACETATE	ND	5
BROMODICHLOROMETHANE	ND	3
1,2-DICHLOROPROPANE	ND	6
cis-1,3-DICHLOROPROPENE	ND	5
TRICHLOROETHENE	3800	3
DIBROMOCHLOROMETHANE	ND	3
1,1,2-TRICHLOROETHANE	ND	3
BENZENE	ND	3
trans-1,3-DICHLOROPROPENE	ND	3
BROMOFORM	ND	5
4-METHYL-2-PENTANONE	720	10
2-HEXANONE	ND	10
TETRACHLOROETHENE	290	3
1,1,2,2-TETRACHLOROETHANE	ND	3
TOLUENE	17	3
CHLOROBENZENE	ND	5
ETHYLBENZENE	ND	8
STYRENE	ND	10
XYLENES (TOTAL)	ND	10

ND = NONE DETECTED
All analyses reported in ug/L (micrograms per Liter), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8240

Sample Location: MW-6A

Sample Type: Water

Date Sampled: 3/26/91

PURGEABLE HALOGENATED HYDROCARBONS AND BTEX:

	AMOUNT DETECTED	DETECTION LIMIT
CHLOROMETHANE	ND	10
BROMOMETHANE	ND	10
VINYL CHLORIDE	ND	3
CHLOROETHANE	ND	5
METHYLENE CHLORIDE	ND	3
ACETONE	ND	10
CARBON DISULFIDE	ND	10
1,1-DICHLOROETHENE	ND	3
1,1-DICHLOROETHANE	ND	5
1,2-DICHLOROETHENE (TOTAL)	ND	3
CHLOROFORM	ND	3
1,2-DICHLOROETHANE	ND	3
2-BUTANONE	ND	10
1,1,1-TRICHLOROETHANE	64	3
CARBON TETRACHLORIDE	ND	3
VINYL ACETATE	ND	5
BROMODICHLOROMETHANE	ND	3
1,2-DICHLOROPROPANE	ND	6
cis-1,3-DICHLOROPROPENE	ND	5
TRICHLOROETHENE	ND	3
DIBROMOCHLOROMETHANE	ND	3
1,1,2-TRICHLOROETHANE	ND	3
BENZENE	ND	3
trans-1,3-DICHLOROPROPENE	ND	3
BROMOFORM	ND	5
4-METHYL-2-PENTANONE	ND	10
2-HEXANONE	ND	10
TETRACHLOROETHENE	ND	3
1,1,2,2-TETRACHLOROETHANE	ND	3
TOLUENE	ND	3
CHLOROBENZENE	ND	5
ETHYLBENZENE	ND	8
STYRENE	ND	10
XYLENES (TOTAL)	ND	10

ND = NONE DETECTED
All analyses reported in ug/L (micrograms per Liter), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8240

Sample Location: MW-6B

Sample Type: Water

Date Sampled: 3/26/91

PURGEABLE HALOGENATED HYDROCARBONS AND BTEX:

	AMOUNT DETECTED	DETECTION LIMIT
CHLOROMETHANE	ND	10
BROMOMETHANE	ND	10
VINYL CHLORIDE	ND	3
CHLOROETHANE	ND	5
METHYLENE CHLORIDE	ND	3
ACETONE	ND	10
CARBON DISULFIDE	ND	10
1,1-DICHLOROETHENE	ND	3
1,1-DICHLOROETHANE	ND	5
1,2-DICHLOROETHENE (TOTAL)	ND	3
CHLOROFORM	ND	3
1,2-DICHLOROETHANE	ND	3
2-BUTANONE	ND	10
1,1,1-TRICHLOROETHANE	43	3
CARBON TETRACHLORIDE	ND	3
VINYL ACETATE	ND	5
BROMODICHLOROMETHANE	ND	3
1,2-DICHLOROPROPANE	ND	6
cis-1,3-DICHLOROPROPENE	ND	5
TRICHLOROETHENE	8.3	3
DIBROMOCHLOROMETHANE	ND	3
1,1,2-TRICHLOROETHANE	ND	3
BENZENE	ND	3
trans-1,3-DICHLOROPROPENE	ND	3
BROMOFORM	ND	5
4-METHYL-2-PENTANONE	ND	10
2-HEXANONE	ND	10
TETRACHLOROETHENE	ND	3
1,1,2,2-TETRACHLOROETHANE	ND	3
TOLUENE	ND	3
CHLOROBENZENE	ND	5
ETHYLBENZENE	ND	8
STYRENE	ND	10
XYLENES (TOTAL)	ND	10

ND = NONE DETECTED
All analyses reported in ug/L (micrograms per Liter), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8240

Sample Location: MW-7A

Sample Type: Water

Date Sampled: 3/26/91

PURGEABLE HALOGENATED HYDROCARBONS AND BTEX:

	AMOUNT DETECTED	DETECTION LIMIT
CHLOROMETHANE	ND	10
BROMOMETHANE	ND	10
VINYL CHLORIDE	ND	3
CHLOROETHANE	ND	5
METHYLENE CHLORIDE	ND	3
ACETONE	ND	10
CARBON DISULFIDE	ND	10
1,1-DICHLOROETHENE	ND	3
1,1-DICHLOROETHANE	ND	5
1,2-DICHLOROETHENE (TOTAL)	ND	3
CHLOROFORM	ND	3
1,2-DICHLOROETHANE	ND	3
2-BUTANONE	ND	10
1,1,1-TRICHLOROETHANE	46	3
CARBON TETRACHLORIDE	ND	3
VINYL ACETATE	ND	5
BROMODICHLOROMETHANE	ND	3
1,2-DICHLOROPROPANE	ND	6
cis-1,3-DICHLOROPROPENE	ND	5
TRICHLOROETHENE	ND	3
DIBROMOCHLOROMETHANE	ND	3
1,1,2-TRICHLOROETHANE	ND	3
BENZENE	ND	3
trans-1,3-DICHLOROPROPENE	ND	3
BROMOFORM	ND	5
4-METHYL-2-PENTANONE	ND	10
2-HEXANONE	ND	10
TETRACHLOROETHENE	ND	3
1,1,2,2-TETRACHLOROETHANE	ND	3
TOLUENE	ND	3
CHLOROBENZENE	ND	5
ETHYLBENZENE	ND	8
STYRENE	ND	10
XYLENES (TOTAL)	ND	10

ND = NONE DETECTED
All analyses reported in ug/L (micrograms per Liter), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8240

Sample Location: MW-7B

Sample Type: Water

Date Sampled: 3/26/91

PURGEABLE HALOGENATED HYDROCARBONS AND BTEX:

	AMOUNT DETECTED	DETECTION LIMIT
CHLOROMETHANE	ND	10
BROMOMETHANE	ND	10
VINYL CHLORIDE	ND	3
CHLOROETHANE	ND	5
METHYLENE CHLORIDE	520	3
ACETONE	ND	10
CARBON DISULFIDE	ND	10
1,1-DICHLOROETHENE	260	3
1,1-DICHLOROETHANE	1600	5
1,2-DICHLOROETHENE (TOTAL)	ND	3
CHLOROFORM	14	3
1,2-DICHLOROETHANE	18	3
2-BUTANONE	ND	10
1,1,1-TRICHLOROETHANE	10,200	3
CARBON TETRACHLORIDE	ND	3
VINYL ACETATE	ND	5
BROMODICHLOROMETHANE	ND	3
1,2-DICHLOROPROPANE	ND	6
cis-1,3-DICHLOROPROPENE	ND	5
TRICHLOROETHENE	2900	3
DIBROMOCHLOROMETHANE	ND	3
1,1,2-TRICHLOROETHANE	ND	3
BENZENE	ND	3
trans-1,3-DICHLOROPROPENE	ND	3
BROMOFORM	ND	5
4-METHYL-2-PENTANONE	ND	10
2-HEXANONE	ND	10
TETRACHLOROETHENE	610	3
1,1,2,2-TETRACHLOROETHANE	ND	3
TOLUENE	35	3
CHLOROBENZENE	ND	5
ETHYLBENZENE	18	8
STYRENE	ND	10
XYLENES (TOTAL)	ND	10

ND = NONE DETECTED
All analyses reported in ug/L (micrograms per Liter), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8240

Sample Location: MW-8A

Sample Type: Water

Date Sampled: 3/26/91

PURGEABLE HALOGENATED HYDROCARBONS AND BTEX:

	AMOUNT DETECTED	DETECTION LIMIT
CHLOROMETHANE	ND	10
BROMOMETHANE	ND	10
VINYL CHLORIDE	ND	3
CHLOROETHANE	ND	5
METHYLENE CHLORIDE	ND	3
ACETONE	ND	10
CARBON DISULFIDE	ND	10
1,1-DICHLOROETHENE	ND	3
1,1-DICHLOROETHANE	ND	5
1,2-DICHLOROETHENE (TOTAL)	ND	3
CHLOROFORM	ND	3
1,2-DICHLOROETHANE	ND	3
2-BUTANONE	ND	10
1,1,1-TRICHLOROETHANE	54	3
CARBON TETRACHLORIDE	ND	3
VINYL ACETATE	ND	5
BROMODICHLOROMETHANE	ND	3
1,2-DICHLOROPROPANE	ND	6
cis-1,3-DICHLOROPROPENE	ND	5
TRICHLOROETHENE	ND	3
DIBROMOCHLOROMETHANE	ND	3
1,1,2-TRICHLOROETHANE	ND	3
BENZENE	ND	3
trans-1,3-DICHLOROPROPENE	ND	3
BROMOFORM	ND	5
4-METHYL-2-PENTANONE	ND	10
2-HEXANONE	ND	10
TETRACHLOROETHENE	ND	3
1,1,2,2-TETRACHLOROETHANE	ND	3
TOLUENE	ND	3
CHLOROBENZENE	ND	5
ETHYLBENZENE	18	8
STYRENE	ND	10
XYLENES (TOTAL)	ND	10

ND = NONE DETECTED
All analyses reported in ug/L (micrograms per Liter), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8240

Sample Location: MW-8B

Sample Type: Water

Date Sampled: 3/26/91

PURGEABLE HALOGENATED HYDROCARBONS AND BTEX:

	AMOUNT DETECTED	DETECTION LIMIT
CHLOROMETHANE	ND	10
BROMOMETHANE	ND	10
VINYL CHLORIDE	ND	3
CHLOROETHANE	ND	5
METHYLENE CHLORIDE	ND	3
ACETONE	ND	10
CARBON DISULFIDE	ND	10
1,1-DICHLOROETHENE	5.9	3
1,1-DICHLOROETHANE	310	5
1,2-DICHLOROETHENE (TOTAL)	ND	3
CHLOROFORM	14	3
1,2-DICHLOROETHANE	18	3
2-BUTANONE	ND	10
1,1,1-TRICHLOROETHANE	130	3
CARBON TETRACHLORIDE	ND	3
VINYL ACETATE	ND	5
BROMODICHLOROMETHANE	ND	3
1,2-DICHLOROPROPANE	ND	6
cis-1,3-DICHLOROPROPENE	ND	5
TRICHLOROETHENE	52	3
DIBROMOCHLOROMETHANE	ND	3
1,1,2-TRICHLOROETHANE	ND	3
BENZENE	ND	3
trans-1,3-DICHLOROPROPENE	ND	3
BROMOFORM	ND	5
4-METHYL-2-PENTANONE	ND	10
2-HEXANONE	ND	10
TETRACHLOROETHENE	9.4	3
1,1,2,2-TETRACHLOROETHANE	ND	3
TOLUENE	ND	3
CHLOROBENZENE	ND	5
ETHYLBENZENE	ND	8
STYRENE	ND	10
XYLENES (TOTAL)	ND	10

ND = NONE DETECTED
All analyses reported in ug/L (micrograms per Liter), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8240

Sample Location: MW-10A

Sample Type: Water

Date Sampled: 3/26/91

PURGEABLE HALOGENATED HYDROCARBONS AND BTEX:

	AMOUNT DETECTED	DETECTION LIMIT
CHLOROMETHANE	ND	10
BROMOMETHANE	ND	10
VINYL CHLORIDE	ND	3
CHLOROETHANE	ND	5
METHYLENE CHLORIDE	1260	3
ACETONE	ND	10
CARBON DISULFIDE	11	10
1,1-DICHLOROETHENE	350	3
1,1-DICHLOROETHANE	350	5
1,2-DICHLOROETHENE (TOTAL)	ND	3
CHLOROFORM	13	3
1,2-DICHLOROETHANE	22	3
2-BUTANONE	ND	10
1,1,1-TRICHLOROETHANE	9560	3
CARBON TETRACHLORIDE	ND	3
VINYL ACETATE	ND	5
BROMODICHLOROMETHANE	ND	3
1,2-DICHLOROPROPANE	ND	6
cis-1,3-DICHLOROPROPENE	ND	5
TRICHLOROETHENE	5800	3
DIBROMOCHLOROMETHANE	ND	3
1,1,2-TRICHLOROETHANE	ND	3
BENZENE	ND	3
trans-1,3-DICHLOROPROPENE	ND	3
BROMOFORM	ND	5
4-METHYL-2-PENTANONE	53	10
2-HEXANONE	ND	10
TETRACHLOROETHENE	660	3
1,1,2,2-TETRACHLOROETHANE	ND	3
TOLUENE	39	3
CHLOROBENZENE	ND	5
ETHYLBENZENE	13	8
STYRENE	ND	10
XYLENES (TOTAL)	11	10

ND = NONE DETECTED
All analyses reported in ug/L (micrograms per Liter), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8240

Sample Location: MW-10B

Sample Type: Water

Date Sampled: 3/26/91

PURGEABLE HALOGENATED HYDROCARBONS AND BTEX:

	AMOUNT DETECTED	DETECTION LIMIT
CHLOROMETHANE	ND	10
BROMOMETHANE	ND	10
VINYL CHLORIDE	ND	3
CHLOROETHANE	ND	5
METHYLENE CHLORIDE	6600	3
ACETONE	6800	10
CARBON DISULFIDE	ND	10
1,1-DICHLOROETHENE	820	3
1,1-DICHLOROETHANE	2800	5
1,2-DICHLOROETHENE (TOTAL)	ND	3
CHLOROFORM	26	3
1,2-DICHLOROETHANE	350	3
2-BUTANONE	330	10
1,1,1-TRICHLOROETHANE	17,000	3
CARBON TETRACHLORIDE	ND	3
VINYL ACETATE	ND	5
BROMODICHLOROMETHANE	ND	3
1,2-DICHLOROPROPANE	20	6
cis-1,3-DICHLOROPROPENE	ND	5
TRICHLOROETHENE	11,000	3
DIBROMOCHLOROMETHANE	ND	3
1,1,2-TRICHLOROETHANE	84	3
BENZENE	11	3
trans-1,3-DICHLOROPROPENE	ND	3
BROMOFORM	ND	5
4-METHYL-2-PENTANONE	21,000	10
2-HEXANONE	ND	10
TETRACHLOROETHENE	1600	3
1,1,2,2-TETRACHLOROETHANE	ND	3
TOLUENE	2400	3
CHLOROBENZENE	ND	5
ETHYLBENZENE	610	8
STYRENE	ND	10
XYLENES (TOTAL)	1500	10

ND = NONE DETECTED
All analyses reported in ug/L (micrograms per Liter), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8240

Sample Location: MW-2

Sample Type: Water

Date Sampled: 3/28/91

PURGEABLE HALOGENATED HYDROCARBONS AND BTEX:

	AMOUNT DETECTED	DETECTION LIMIT
CHLOROMETHANE	ND	10
BROMOMETHANE	ND	10
VINYL CHLORIDE	ND	3
CHLOROETHANE	ND	5
METHYLENE CHLORIDE	ND	3
ACETONE	ND	10
CARBON DISULFIDE	ND	10
1,1-DICHLOROETHENE	ND	3
1,1-DICHLOROETHANE	ND	5
1,2-DICHLOROETHENE (TOTAL)	ND	3
CHLOROFORM	ND	3
1,2-DICHLOROETHANE	ND	3
2-BUTANONE	ND	10
1,1,1-TRICHLOROETHANE	100	3
CARBON TETRACHLORIDE	ND	3
VINYL ACETATE	ND	5
BROMODICHLOROMETHANE	ND	3
1,2-DICHLOROPROPANE	ND	6
cis-1,3-DICHLOROPROPENE	ND	5
TRICHLOROETHENE	5.3	3
DIBROMOCHLOROMETHANE	ND	3
1,1,2-TRICHLOROETHANE	ND	3
BENZENE	ND	3
trans-1,3-DICHLOROPROPENE	ND	3
BROMOFORM	ND	5
4-METHYL-2-PENTANONE	ND	10
2-HEXANONE	ND	10
TETRACHLOROETHENE	ND	3
1,1,2,2-TETRACHLOROETHANE	ND	3
TOLUENE	ND	3
CHLOROBENZENE	ND	5
ETHYLBENZENE	ND	8
STYRENE	ND	10
XYLENES (TOTAL)	ND	10

ND = NONE DETECTED
All analyses reported in ug/L (micrograms per Liter), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8240

Sample Location: MW-3A

Sample Type: Water

Date Sampled: 3/28/91

PURGEABLE HALOGENATED HYDROCARBONS AND BTEX:

	AMOUNT DETECTED	DETECTION LIMIT
CHLOROMETHANE	ND	10
BROMOMETHANE	ND	10
VINYL CHLORIDE	ND	3
CHLOROETHANE	ND	5
METHYLENE CHLORIDE	ND	3
ACETONE	ND	10
CARBON DISULFIDE	ND	10
1,1-DICHLOROETHENE	1600	3
1,1-DICHLOROETHANE	27	5
1,2-DICHLOROETHENE (TOTAL)	ND	3
CHLOROFORM	ND	3
1,2-DICHLOROETHANE	3.8	3
2-BUTANONE	ND	10
1,1,1-TRICHLOROETHANE	1600	3
CARBON TETRACHLORIDE	ND	3
VINYL ACETATE	ND	5
BROMODICHLOROMETHANE	ND	3
1,2-DICHLOROPROPANE	ND	6
cis-1,3-DICHLOROPROPENE	ND	5
TRICHLOROETHENE	66	3
DIBROMOCHLOROMETHANE	ND	3
1,1,2-TRICHLOROETHANE	ND	3
BENZENE	ND	3
trans-1,3-DICHLOROPROPENE	ND	3
BROMOFORM	ND	5
4-METHYL-2-PENTANONE	84	10
2-HEXANONE	ND	10
TETRACHLOROETHENE	15	3
1,1,2,2-TETRACHLOROETHANE	ND	3
TOLUENE	22	3
CHLOROBENZENE	ND	5
ETHYLBENZENE	8.7	8
STYRENE	ND	10
XYLENES (TOTAL)	39	10

ND = NONE DETECTED
All analyses reported in ug/L (micrograms per Liter), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8240

Sample Location: MW-4

Sample Type: Water

Date Sampled: 3/28/91

PURGEABLE HALOGENATED HYDROCARBONS AND BTEX:

	AMOUNT DETECTED	DETECTION LIMIT
CHLOROMETHANE	ND	10
BROMOMETHANE	ND	10
VINYL CHLORIDE	ND	3
CHLOROETHANE	ND	5
METHYLENE CHLORIDE	ND	3
ACETONE	ND	10
CARBON DISULFIDE	ND	10
1,1-DICHLOROETHENE	10	3
1,1-DICHLOROETHANE	ND	5
1,2-DICHLOROETHENE (TOTAL)	ND	3
CHLOROFORM	ND	3
1,2-DICHLOROETHANE	ND	3
2-BUTANONE	ND	10
1,1,1-TRICHLOROETHANE	184	3
CARBON TETRACHLORIDE	ND	3
VINYL ACETATE	ND	5
BROMODICHLOROMETHANE	ND	3
1,2-DICHLOROPROPANE	ND	6
cis-1,3-DICHLOROPROPENE	ND	5
TRICHLOROETHENE	9.4	3
DIBROMOCHLOROMETHANE	ND	3
1,1,2-TRICHLOROETHANE	ND	3
BENZENE	ND	3
trans-1,3-DICHLOROPROPENE	ND	3
BROMOFORM	ND	5
4-METHYL-2-PENTANONE	ND	10
2-HEXANONE	ND	10
TETRACHLOROETHENE	ND	3
1,1,2,2-TETRACHLOROETHANE	ND	3
TOLUENE	ND	3
CHLOROBENZENE	ND	5
ETHYLBENZENE	ND	8
STYRENE	ND	10
XYLENES (TOTAL)	ND	10

ND = NONE DETECTED
All analyses reported in ug/L (micrograms per Liter), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8240

Sample Location: MW-5A

Sample Type: Water

Date Sampled: 3/28/91

PURGEABLE HALOGENATED HYDROCARBONS AND BTEX:

	AMOUNT DETECTED	DETECTION LIMIT
CHLOROMETHANE	ND	10
BROMOMETHANE	ND	10
VINYL CHLORIDE	ND	3
CHLOROETHANE	ND	5
METHYLENE CHLORIDE	ND	3
ACETONE	ND	10
CARBON DISULFIDE	ND	10
1,1-DICHLOROETHENE	21	3
1,1-DICHLOROETHANE	ND	5
1,2-DICHLOROETHENE (TOTAL)	ND	3
CHLOROFORM	ND	3
1,2-DICHLOROETHANE	ND	3
2-BUTANONE	ND	10
1,1,1-TRICHLOROETHANE	150	3
CARBON TETRACHLORIDE	ND	3
VINYL ACETATE	ND	5
BROMODICHLOROMETHANE	ND	3
1,2-DICHLOROPROPANE	ND	6
cis-1,3-DICHLOROPROPENE	ND	5
TRICHLOROETHENE	210	3
DIBROMOCHLOROMETHANE	ND	3
1,1,2-TRICHLOROETHANE	ND	3
BENZENE	13	3
trans-1,3-DICHLOROPROPENE	ND	3
BROMOFORM	ND	5
4-METHYL-2-PENTANONE	1400	10
2-HEXANONE	ND	10
TETRACHLOROETHENE	5.2	3
1,1,2,2-TETRACHLOROETHANE	ND	3
TOLUENE	10	3
CHLOROBENZENE	ND	5
ETHYLBENZENE	ND	8
STYRENE	ND	10
XYLENES (TOTAL)	14	10

ND = NONE DETECTED
All analyses reported in ug/L (micrograms per Liter), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8240

Sample Location: MW-5B

Sample Type: Water

Date Sampled: 3/28/91

PURGEABLE HALOGENATED HYDROCARBONS AND BTEX:

	AMOUNT DETECTED	DETECTION LIMIT
CHLOROMETHANE	ND	10
BROMOMETHANE	ND	10
VINYL CHLORIDE	ND	3
CHLOROETHANE	ND	5
METHYLENE CHLORIDE	670	3
ACETONE	ND	10
CARBON DISULFIDE	ND	10
1,1-DICHLOROETHENE	2400	3
1,1-DICHLOROETHANE	2300	5
1,2-DICHLOROETHENE (TOTAL)	ND	3
CHLOROFORM	18	3
1,2-DICHLOROETHANE	110	3
2-BUTANONE	ND	10
1,1,1-TRICHLOROETHANE	9400	3
CARBON TETRACHLORIDE	ND	3
VINYL ACETATE	ND	5
BROMODICHLOROMETHANE	ND	3
1,2-DICHLOROPROPANE	32	6
cis-1,3-DICHLOROPROPENE	ND	5
TRICHLOROETHENE	5400	3
DIBROMOCHLOROMETHANE	ND	3
1,1,2-TRICHLOROETHANE	21	3
BENZENE	19	3
trans-1,3-DICHLOROPROPENE	ND	3
BROMOFORM	ND	5
4-METHYL-2-PENTANONE	6500	10
2-HEXANONE	ND	10
TETRACHLOROETHENE	4300	3
1,1,2,2-TETRACHLOROETHANE	ND	3
TOLUENE	4100	3
CHLOROBENZENE	ND	5
ETHYLBENZENE	1800	8
STYRENE	ND	10
XYLENES (TOTAL)	3800	10

ND = NONE DETECTED
All analyses reported in ug/L (micrograms per Liter), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8240

Sample Location: MW-9A

Sample Type: Water

Date Sampled: 3/28/91

PURGEABLE HALOGENATED HYDROCARBONS AND BTEX:

	AMOUNT DETECTED	DETECTION LIMIT
CHLOROMETHANE	ND	10
BROMOMETHANE	ND	10
VINYL CHLORIDE	ND	3
CHLOROETHANE	ND	5
METHYLENE CHLORIDE	ND	3
ACETONE	ND	10
CARBON DISULFIDE	ND	10
1,1-DICHLOROETHENE	32	3
1,1-DICHLOROETHANE	ND	5
1,2-DICHLOROETHENE (TOTAL)	ND	3
CHLOROFORM	ND	3
1,2-DICHLOROETHANE	ND	3
2-BUTANONE	ND	10
1,1,1-TRICHLOROETHANE	54	3
CARBON TETRACHLORIDE	ND	3
VINYL ACETATE	ND	5
BROMODICHLOROMETHANE	ND	3
1,2-DICHLOROPROPANE	ND	6
cis-1,3-DICHLOROPROPENE	ND	5
TRICHLOROETHENE	23	3
DIBROMOCHLOROMETHANE	ND	3
1,1,2-TRICHLOROETHANE	ND	3
BENZENE	ND	3
trans-1,3-DICHLOROPROPENE	ND	3
BROMOFORM	ND	5
4-METHYL-2-PENTANONE	ND	10
2-HEXANONE	ND	10
TETRACHLOROETHENE	ND	3
1,1,2,2-TETRACHLOROETHANE	ND	3
TOLUENE	ND	3
CHLOROBENZENE	ND	5
ETHYLBENZENE	ND	8
STYRENE	ND	10
XYLENES (TOTAL)	ND	10

ND = NONE DETECTED
All analyses reported in ug/L (micrograms per Liter), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8240

Sample Location: MW-9B

Sample Type: Water

Date Sampled: 3/28/91

PURGEABLE HALOGENATED HYDROCARBONS AND BTEX:

	AMOUNT DETECTED	DETECTION LIMIT
CHLOROMETHANE	ND	10
BROMOMETHANE	ND	10
VINYL CHLORIDE	ND	3
CHLOROETHANE	ND	5
METHYLENE CHLORIDE	8600	3
ACETONE	5400	10
CARBON DISULFIDE	ND	10
1,1-DICHLOROETHENE	1500	3
1,1-DICHLOROETHANE	1800	5
1,2-DICHLOROETHENE (TOTAL)	ND	3
CHLOROFORM	27	3
1,2-DICHLOROETHANE	520	3
2-BUTANONE	220	10
1,1,1-TRICHLOROETHANE	12,000	3
CARBON TETRACHLORIDE	ND	3
VINYL ACETATE	ND	5
BROMODICHLOROMETHANE	9.8	3
1,2-DICHLOROPROPANE	21	6
cis-1,3-DICHLOROPROPENE	ND	5
TRICHLOROETHENE	4300	3
DIBROMOCHLOROMETHANE	ND	3
1,1,2-TRICHLOROETHANE	120	3
BENZENE	13	3
trans-1,3-DICHLOROPROPENE	ND	3
BROMOFORM	ND	5
4-METHYL-2-PENTANONE	ND	10
2-HEXANONE	ND	10
TETRACHLOROETHENE	1900	3
1,1,2,2-TETRACHLOROETHANE	ND	3
TOLUENE	630	3
CHLOROBENZENE	ND	5
ETHYLBENZENE	750	8
STYRENE	ND	10
XYLENES (TOTAL)	2000	10

ND = NONE DETECTED
All analyses reported in ug/L (micrograms per Liter), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8240

Sample Location: MW-9C

Sample Type: Water

Date Sampled: 3/28/91

PURGEABLE HALOGENATED HYDROCARBONS AND BTEX:

	AMOUNT DETECTED	DETECTION LIMIT
CHLOROMETHANE	ND	10
BROMOMETHANE	ND	10
VINYL CHLORIDE	ND	3
CHLOROETHANE	ND	5
METHYLENE CHLORIDE	ND	3
ACETONE	ND	10
CARBON DISULFIDE	ND	10
1,1-DICHLOROETHENE	14	3
1,1-DICHLOROETHANE	ND	5
1,2-DICHLOROETHENE (TOTAL)	ND	3
CHLOROFORM	ND	3
1,2-DICHLOROETHANE	ND	3
2-BUTANONE	ND	10
1,1,1-TRICHLOROETHANE	30	3
CARBON TETRACHLORIDE	ND	3
VINYL ACETATE	ND	5
BROMODICHLOROMETHANE	ND	3
1,2-DICHLOROPROPANE	ND	6
cis-1,3-DICHLOROPROPENE	ND	5
TRICHLOROETHENE	6.4	3
DIBROMOCHLOROMETHANE	ND	3
1,1,2-TRICHLOROETHANE	ND	3
BENZENE	ND	3
trans-1,3-DICHLOROPROPENE	ND	3
BROMOFORM	ND	5
4-METHYL-2-PENTANONE	ND	10
2-HEXANONE	ND	10
TETRACHLOROETHENE	ND	3
1,1,2,2-TETRACHLOROETHANE	ND	3
TOLUENE	ND	3
CHLOROBENZENE	ND	5
ETHYLBENZENE	ND	8
STYRENE	ND	10
XYLENES (TOTAL)	ND	10

ND = NONE DETECTED
All analyses reported in ug/L (micrograms per Liter), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8240

Sample Location: Backhoe Pit, 7.5 Feet

Sample Type: Soil

Date Sampled: 4/17/91

PURGEABLE HALOGENATED HYDROCARBONS AND BTEX:

	AMOUNT DETECTED	DETECTION LIMIT
CHLOROMETHANE	ND	10
BROMOMETHANE	ND	10
VINYL CHLORIDE	ND	3
CHLOROETHANE	ND	5
METHYLENE CHLORIDE	ND	3
ACETONE	ND	10
CARBON DISULFIDE	ND	10
1,1-DICHLOROETHENE	1600	3
1,1-DICHLOROETHANE	240	5
1,2-DICHLOROETHENE (TOTAL)	ND	3
CHLOROFORM	ND	3
1,2-DICHLOROETHANE	17	3
2-BUTANONE	ND	10
1,1,1-TRICHLOROETHANE	21,000	3
CARBON TETRACHLORIDE	ND	3
VINYL ACETATE	ND	5
BROMODICHLOROMETHANE	ND	3
1,2-DICHLOROPROPANE	9.8	6
cis-1,3-DICHLOROPROPENE	ND	5
TRICHLOROETHENE	7100	3
DIBROMOCHLOROMETHANE	ND	3
1,1,2-TRICHLOROETHANE	ND	3
BENZENE	4.5	3
trans-1,3-DICHLOROPROPENE	ND	3
BROMOFORM	ND	5
4-METHYL-2-PENTANONE	2700	10
2-HEXANONE	ND	10
TETRACHLOROETHENE	9600	3
1,1,2,2-TETRACHLOROETHANE	ND	3
TOLUENE	6800	3
CHLOROBENZENE	ND	5
ETHYLBENZENE	5200	8
STYRENE	ND	10
XYLENES (TOTAL)	9500	10

ND = NONE DETECTED
All analyses reported in ug/Kg (micrograms per kilogram), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8240

Sample Location: Backhoe Pit

Sample Type: Water

Date Sampled: 4/17/91

PURGEABLE HALOGENATED HYDROCARBONS AND BTEX·

	AMOUNT DETECTED	DETECTION LIMIT
CHLOROMETHANE	ND	10
BROMOMETHANE	ND	10
VINYL CHLORIDE	ND	3
CHLOROETHANE	ND	5
METHYLENE CHLORIDE	ND	3
ACETONE	ND	10
CARBON DISULFIDE	ND	10
1,1-DICHLOROETHENE	ND	3
1,1-DICHLOROETHANE	ND	5
1,2-DICHLOROETHENE (TOTAL)	ND	3
CHLOROFORM	ND	3
1,2-DICHLOROETHANE	ND	3
2-BUTANONE	ND	10
1,1,1-TRICHLOROETHANE	ND	3
CARBON TETRACHLORIDE	ND	3
VINYL ACETATE	ND	5
BROMODICHLOROMETHANE	ND	3
1,2-DICHLOROPROPANE	ND	6
cis-1,3-DICHLOROPROPENE	ND	5
TRICHLOROETHENE	ND	3
DIBROMOCHLOROMETHANE	ND	3
1,1,2-TRICHLOROETHANE	ND	3
BENZENE	ND	3
trans-1,3-DICHLOROPROPENE	ND	3
BROMOFORM	ND	5
4-METHYL-2-PENTANONE	ND	10
2-HEXANONE	ND	10
TETRACHLOROETHENE	ND	3
1,1,2,2-TETRACHLOROETHANE	ND	3
TOLUENE	ND	3
CHLOROBENZENE	ND	5
ETHYLBENZENE	ND	8
STYRENE	ND	10
XYLENES (TOTAL)	ND	10

ND = NONE DETECTED
All analyses reported in ug/L (micrograms per Liter), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8240

Sample Location: MW-6A

Sample Type: Water

Date Sampled: 4/25/91

PURGEABLE HALOGENATED HYDROCARBONS AND BTEX:

	AMOUNT DETECTED	DETECTION LIMIT
CHLOROMETHANE	ND	10
BROMOMETHANE	ND	10
VINYL CHLORIDE	ND	3
CHLOROETHANE	ND	5
METHYLENE CHLORIDE	ND	3
1,1-DICHLOROETHENE	160	3
1,1-DICHLOROETHANE	ND	5
1,2-DICHLOROETHENE (TOTAL)	ND	3
CHLOROFORM	ND	3
1,2-DICHLOROETHANE	ND	3
1,1,1-TRICHLOROETHANE	17	3
CARBON TETRACHLORIDE	ND	3
BROMODICHLOROMETHANE	ND	3
1,2-DICHLOROPROPANE	ND	6
cis-1,3-DICHLOROPROPENE	ND	5
TRICHLOROETHENE	59	3
DIBROMOCHLOROMETHANE	ND	3
1,1,2-TRICHLOROETHANE	ND	3
BENZENE	ND	3
trans-1,3-DICHLOROPROPENE	ND	3
BROMOFORM	ND	5
TETRACHLOROETHENE	ND	3
1,1,2,2-TETRACHLOROETHANE	ND	3
TOLUENE	ND	3
CHLOROBENZENE	ND	5
ETHYLBENZENE	ND	8
XYLENES (TOTAL)	ND	10

ND = NONE DETECTED
All analyses reported in ug/L (micrograms per Liter), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8240

Sample Location: MW-6B

Sample Type: Water

Date Sampled: 4/25/91

PURGEABLE HALOGENATED HYDROCARBONS AND BTEX:

	AMOUNT DETECTED	DETECTION LIMIT
CHLOROMETHANE	ND	10
BROMOMETHANE	ND	10
VINYL CHLORIDE	ND	3
CHLOROETHANE	ND	5
METHYLENE CHLORIDE	ND	3
1,1-DICHLOROETHENE	ND	3
1,1-DICHLOROETHANE	ND	5
1,2-DICHLOROETHENE (TOTAL)	ND	3
CHLOROFORM	ND	3
1,2-DICHLOROETHANE	ND	3
1,1,1-TRICHLOROETHANE	ND	3
CARBON TETRACHLORIDE	ND	3
BROMODICHLOROMETHANE	ND	3
1,2-DICHLOROPROPANE	ND	6
cis-1,3-DICHLOROPROPENE	ND	5
TRICHLOROETHENE	ND	3
DIBROMOCHLOROMETHANE	ND	3
1,1,2-TRICHLOROETHANE	ND	3
BENZENE	ND	3
trans-1,3-DICHLOROPROPENE	ND	3
BROMOFORM	ND	5
TETRACHLOROETHENE	ND	3
1,1,2,2-TETRACHLOROETHANE	ND	3
TOLUENE	ND	3
CHLOROBENZENE	ND	5
ETHYLBENZENE	ND	8
XYLENES (TOTAL)	ND	10

ND = NONE DETECTED
All analyses reported in ug/L (micrograms per Liter), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8240

Sample Location: MW-8A

Sample Type: Water

Date Sampled: 4/25/91

PURGEABLE HALOGENATED HYDROCARBONS AND BTEX:

	AMOUNT DETECTED	DETECTION LIMIT
CHLOROMETHANE	ND	10
BROMOMETHANE	ND	10
VINYL CHLORIDE	ND	3
CHLOROETHANE	ND	5
METHYLENE CHLORIDE	ND	3
1,1-DICHLOROETHENE	ND	3
1,1-DICHLOROETHANE	ND	5
1,2-DICHLOROETHENE (TOTAL)	ND	3
CHLOROFORM	ND	3
1,2-DICHLOROETHANE	ND	3
1,1,1-TRICHLOROETHANE	ND	3
CARBON TETRACHLORIDE	ND	3
BROMODICHLOROMETHANE	ND	3
1,2-DICHLOROPROPANE	ND	6
cis-1,3-DICHLOROPROPENE	ND	5
TRICHLOROETHENE	ND	3
DIBROMOCHLOROMETHANE	ND	3
1,1,2-TRICHLOROETHANE	ND	3
BENZENE	ND	3
trans-1,3-DICHLOROPROPENE	ND	3
BROMOFORM	ND	5
TETRACHLOROETHENE	ND	3
1,1,2,2-TETRACHLOROETHANE	ND	3
TOLUENE	ND	3
CHLOROBENZENE	ND	5
ETHYLBENZENE	ND	8
XYLENES (TOTAL)	ND	10

ND = NONE DETECTED
All analyses reported in ug/L (micrograms per Liter), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8240

Sample Location: MW-8B

Sample Type: Water

Date Sampled: 4/25/91

PURGEABLE HALOGENATED HYDROCARBONS AND BTEX:

	AMOUNT DETECTED	DETECTION LIMIT
CHLOROMETHANE	ND	10
BROMOMETHANE	ND	10
VINYL CHLORIDE	ND	3
CHLOROETHANE	ND	5
METHYLENE CHLORIDE	ND	3
1,1-DICHLOROETHENE	ND	3
1,1-DICHLOROETHANE	350	5
1,2-DICHLOROETHENE (TOTAL)	ND	3
CHLOROFORM	ND	3
1,2-DICHLOROETHANE	ND	3
1,1,1-TRICHLOROETHANE	44	3
CARBON TETRACHLORIDE	ND	3
BROMODICHLOROMETHANE	ND	3
1,2-DICHLOROPROPANE	ND	6
cis-1,3-DICHLOROPROPENE	ND	5
TRICHLOROETHENE	42	3
DIBROMOCHLOROMETHANE	ND	3
1,1,2-TRICHLOROETHANE	ND	3
BENZENE	ND	3
trans-1,3-DICHLOROPROPENE	ND	3
BROMOFORM	ND	5
TETRACHLOROETHENE	4.5	3
1,1,2,2-TETRACHLOROETHANE	ND	3
TOLUENE	ND	3
CHLOROBENZENE	ND	5
ETHYLBENZENE	ND	8
XYLENES (TOTAL)	ND	10

ND = NONE DETECTED
All analyses reported in ug/L (micrograms per Liter), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8240

Sample Location: MW-9A

Sample Type: Water

Date Sampled: 4/25/91

PURGEABLE HALOGENATED HYDROCARBONS AND BTEX:

	AMOUNT DETECTED	DETECTION LIMIT
CHLOROMETHANE	ND	10
BROMOMETHANE	ND	10
VINYL CHLORIDE	ND	3
CHLOROETHANE	ND	5
METHYLENE CHLORIDE	ND	3
1,1-DICHLOROETHENE	ND	3
1,1-DICHLOROETHANE	ND	5
1,2-DICHLOROETHENE (TOTAL)	ND	3
CHLOROFORM	ND	3
1,2-DICHLOROETHANE	ND	3
1,1,1-TRICHLOROETHANE	ND	3
CARBON TETRACHLORIDE	ND	3
BROMODICHLOROMETHANE	ND	3
1,2-DICHLOROPROPANE	ND	6
cis-1,3-DICHLOROPROPENE	ND	5
TRICHLOROETHENE	ND	3
DIBROMOCHLOROMETHANE	ND	3
1,1,2-TRICHLOROETHANE	ND	3
BENZENE	ND	3
trans-1,3-DICHLOROPROPENE	ND	3
BROMOFORM	ND	5
TETRACHLOROETHENE	ND	3
1,1,2,2-TETRACHLOROETHANE	ND	3
TOLUENE	ND	3
CHLOROBENZENE	ND	5
ETHYLBENZENE	ND	8
XYLENES (TOTAL)	ND	10

ND = NONE DETECTED
All analyses reported in ug/L (micrograms per Liter), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8240

Sample Location: MW-9B

Sample Type: Water

Date Sampled: 4/25/91

PURGEABLE HALOGENATED HYDROCARBONS AND BTEX:

	AMOUNT DETECTED	DETECTION LIMIT
CHLOROMETHANE	ND	10
BROMOMETHANE	ND	10
VINYL CHLORIDE	ND	3
CHLOROETHANE	ND	5
METHYLENE CHLORIDE	17,000	3
1,1-DICHLOROETHENE	5500	3
1,1-DICHLOROETHANE	2100	5
1,2-DICHLOROETHENE (TOTAL)	7.6	3
CHLOROFORM	38	3
1,2-DICHLOROETHANE	550	3
1,1,1-TRICHLOROETHANE	21,000	3
CARBON TETRACHLORIDE	ND	3
BROMODICHLOROMETHANE	5.7	3
1,2-DICHLOROPROPANE	21	6
cis-1,3-DICHLOROPROPENE	ND	5
TRICHLOROETHENE	14,000	3
DIBROMOCHLOROMETHANE	ND	3
1,1,2-TRICHLOROETHANE	140	3
BENZENE	13	3
trans-1,3-DICHLOROPROPENE	ND	3
BROMOFORM	ND	5
TETRACHLOROETHENE	1600	3
1,1,2,2-TETRACHLOROETHANE	ND	3
TOLUENE	3100	3
CHLOROBENZENE	ND	5
ETHYLBENZENE	690	8
XYLENES (TOTAL)	1800	10

ND = NONE DETECTED
All analyses reported in ug/L (micrograms per Liter), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8240

Sample Location: MW-10A

Sample Type: Water

Date Sampled: 4/25/91

PURGEABLE HALOGENATED HYDROCARBONS AND BTEX:

	AMOUNT DETECTED	DETECTION LIMIT
CHLOROMETHANE	ND	10
BROMOMETHANE	ND	10
VINYL CHLORIDE	ND	3
CHLOROETHANE	ND	5
METHYLENE CHLORIDE	2700	3
1,1-DICHLOROETHENE	3900	3
1,1-DICHLOROETHANE	450	5
1,2-DICHLOROETHENE (TOTAL)	ND	3
CHLOROFORM	11	3
1,2-DICHLOROETHANE	24	3
1,1,1-TRICHLOROETHANE	13,000	3
CARBON TETRACHLORIDE	ND	3
BROMODICHLOROMETHANE	ND	3
1,2-DICHLOROPROPANE	ND	6
cis-1,3-DICHLOROPROPENE	ND	5
TRICHLOROETHENE	6300	3
DIBROMOCHLOROMETHANE	ND	3
1,1,2-TRICHLOROETHANE	5.9	3
BENZENE	11	3
trans-1,3-DICHLOROPROPENE	ND	3
BROMOFORM	ND	5
TETRACHLOROETHENE	330	3
1,1,2,2-TETRACHLOROETHANE	ND	3
TOLUENE	140	3
CHLOROBENZENE	ND	5
ETHYLBENZENE	24	8
XYLENES (TOTAL)	67	10

ND = NONE DETECTED
All analyses reported in ug/L (micrograms per Liter), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8240

Sample Location: MW-10B

Sample Type: Water

Date Sampled: 4/25/91

PURGEABLE HALOGENATED HYDROCARBONS AND BTEX:

	AMOUNT DETECTED	DETECTION LIMIT
CHLOROMETHANE	ND	10
BROMOMETHANE	ND	10
VINYL CHLORIDE	ND	3
CHLOROETHANE	ND	5
METHYLENE CHLORIDE	13,000	3
1,1-DICHLOROETHENE	4400	3
1,1-DICHLOROETHANE	3600	5
1,2-DICHLOROETHENE (TOTAL)	ND	3
CHLOROFORM	16	3
1,2-DICHLOROETHANE	260	3
1,1,1-TRICHLOROETHANE	23,000	3
CARBON TETRACHLORIDE	ND	3
BROMODICHLOROMETHANE	ND	3
1,2-DICHLOROPROPANE	23	6
cis-1,3-DICHLOROPROPENE	ND	5
TRICHLOROETHENE	13,000	3
DIBROMOCHLOROMETHANE	ND	3
1,1,2-TRICHLOROETHANE	56	3
BENZENE	11	3
trans-1,3-DICHLOROPROPENE	ND	3
BROMOFORM	ND	5
TETRACHLOROETHENE	1500	3
1,1,2,2-TETRACHLOROETHANE	ND	3
TOLUENE	3100	3
CHLOROBENZENE	ND	5
ETHYLBENZENE	680	8
XYLENES (TOTAL)	1600	10

ND = NONE DETECTED
All analyses reported in ug/L (micrograms per Liter), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8240

Sample Location: MW-2

Sample Type: Water

Date Sampled: 5/2/91

PURGEABLE HALOGENATED HYDROCARBONS AND BTEX:

	AMOUNT DETECTED	DETECTION LIMIT
ACROLEIN	ND	10
ACRYLONITRILE	ND	10
BENZENE	ND	3
BROMOFORM	ND	5
CARBON TETRACHLORIDE	ND	3
CHLOROBENZENE	ND	5
DIBROMOCHLOROMETHANE	ND	3
CHLOROETHANE	ND	5
2-CHLOROETHYLVINYL ETHER	ND	5
CHLOROFORM	ND	3
BROMODICHLOROMETHANE	ND	3
1,1-DICHLOROETHANE	ND	5
1,2-DICHLOROETHANE	ND	3
1,1-DICHLOROETHENE	ND	3
1,2-DICHLOROPROPANE	ND	6
1,3-DICHLOROPROPYLENE	ND	5
ETHYLBENZENE	ND	8
BROMOMETHANE	ND	10
CHLOROMETHANE	ND	10
METHYLENE CHLORIDE	ND	3
1,1,2,2-TETRACHLORETHANE	ND	3
TETRACHLOROETHENE	ND	3
TOLUENE	ND	3
1,2-TRANS-DICHLOROETHYLENE	ND	10
1,1,1-TRICHLOROETHANE	ND	3
1,1,2-TRICHLOROETHANE	ND	3
TRICHLOROETHENE	ND	3
VINYL CHLORIDE	ND	5
XYLENES (TOTAL)	ND	10

ND = NONE DETECTED
All analyses reported in ug/L (micrograms per Liter), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 624

[redacted]

Sample Location: MW-3B

Sample Type: Water

Date Sampled: 5/2/91

PURGEABLE HALOGENATED HYDROCARBONS AND BTEX:

	AMOUNT DETECTED	DETECTION LIMIT
ACROLEIN	ND	10
ACRYLONITRILE	ND	10
BENZENE	5.5	3
BROMOFORM	ND	5
CARBON TETRACHLORIDE	ND	3
CHLOROBENZENE	ND	5
DIBROMOCHLOROMETHANE	ND	3
CHLOROETHANE	ND	5
2-CHLOROETHYLVINYL ETHER	ND	5
CHLOROFORM	ND	3
BROMODICHLOROMETHANE	ND	3
1,1-DICHLOROETHANE	59	5
1,2-DICHLOROETHANE	19	3
1,1-DICHLOROETHENE	9700	3
1,2-DICHLOROPROPANE	ND	6
1,3-DICHLOROPROPYLENE	ND	5
ETHYLBENZENE	ND	8
BROMOMETHANE	ND	10
CHLOROMETHANE	ND	10
METHYLENE CHLORIDE	ND	3
1,1,2,2-TETRACHLORETHANE	ND	3
TETRACHLOROETHENE	190	3
TOLUENE	12	3
1,2-TRANS-DICHLOROETHYLENE	ND	10
1,1,1-TRICHLOROETHANE	11,000	3
1,1,2-TRICHLOROETHANE	ND	3
TRICHLOROETHENE	3900	3
VINYL CHLORIDE	ND	5
XYLENES (TOTAL)	ND	10

ND = NONE DETECTED
All analyses reported in ug/L (micrograms per Liter), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 624

Sample Location: MW-5A

Sample Type: Water

Date Sampled: 5/2/91

PURGEABLE HALOGENATED HYDROCARBONS AND BTEX:

	AMOUNT DETECTED	DETECTION LIMIT
ACROLEIN	ND	10
ACRYLONITRILE	ND	10
BENZENE	ND	3
BROMOFORM	ND	5
CARBON TETRACHLORIDE	ND	3
CHLOROBENZENE	ND	5
DIBROMOCHLOROMETHANE	ND	3
CHLOROETHANE	ND	5
2-CHLOROETHYLVINYL ETHER	ND	5
CHLOROFORM	ND	3
BROMODICHLOROMETHANE	ND	3
1,1-DICHLOROETHANE	ND	5
1,2-DICHLOROETHANE	ND	3
1,1-DICHLOROETHENE	ND	3
1,2-DICHLOROPROPANE	ND	6
1,3-DICHLOROPROPYLENE	ND	5
ETHYLBENZENE	ND	8
BROMOMETHANE	ND	10
CHLOROMETHANE	ND	10
METHYLENE CHLORIDE	ND	3
1,1,2,2-TETRACHLORETHANE	ND	3
TETRACHLOROETHENE	ND	3
TOLUENE	ND	3
1,2-TRANS-DICHLOROETHYLENE	ND	10
1,1,1-TRICHLOROETHANE	ND	3
1,1,2-TRICHLOROETHANE	ND	3
TRICHLOROETHENE	ND	3
VINYL CHLORIDE	ND	5
XYLENES (TOTAL)	ND	10

ND = NONE DETECTED
All analyses reported in ug/L (micrograms per Liter), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 624

Sample Location: MW-5B

Sample Type. Water

Date Sampled: 5/2/91

PURGEABLE HALOGENATED HYDROCARBONS AND BTEX:

	AMOUNT DETECTED	DETECTION LIMIT
ACROLEIN	ND	10
ACRYLONITRILE	ND	10
BENZENE	20	3
BROMOFORM	ND	5
CARBON TETRACHLORIDE	ND	3
CHLOROBENZENE	ND	5
DIBROMOCHLOROMETHANE	ND	3
CHLOROETHANE	ND	5
2-CHLOROETHYLVINYL ETHER	ND	5
CHLOROFORM	19	3
BROMODICHLOROMETHANE	ND	3
1,1-DICHLOROETHANE	3300	5
1,2-DICHLOROETHANE	190	3
1,1-DICHLOROETHENE	12,000	3
1,2-DICHLOROPROPANE	47	6
1,3-DICHLOROPROPYLENE	ND	5
ETHYLBENZENE	2300	8
BROMOMETHANE	ND	10
CHLOROMETHANE	ND	10
METHYLENE CHLORIDE	1500	3
1,1,2,2-TETRACHLORETHANE	ND	3
TETRACHLOROETHENE	4000	3
TOLUENE	4.1	3
1,2-TRANS-DICHLOROETHYLENE	ND	10
1,1,1-TRICHLOROETHANE	11,000	3
1,1,2-TRICHLOROETHANE	36	3
TRICHLOROETHENE	6900	3
VINYL CHLORIDE	ND	5
XYLENES (TOTAL)	3700	10

ND = NONE DETECTED
All analyses reported in ug/L (micrograms per Liter), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 624

Sample Location: MW-7A

Sample Type: Water

Date Sampled: 5/2/91

PURGEABLE HALOGENATED HYDROCARBONS AND BTEX:

	AMOUNT DETECTED	DETECTION LIMIT
ACROLEIN	ND	10
ACRYLONITRILE	ND	10
BENZENE	ND	3
BROMOFORM	ND	5
CARBON TETRACHLORIDE	ND	3
CHLOROBENZENE	ND	5
DIBROMOCHLOROMETHANE	ND	3
CHLOROETHANE	ND	5
2-CHLOROETHYLVINYL ETHER	ND	5
CHLOROFORM	ND	3
BROMODICHLOROMETHANE	ND	3
1,1-DICHLOROETHANE	42	5
1,2-DICHLOROETHANE	ND	3
1,1-DICHLOROETHENE	62	3
1,2-DICHLOROPROPANE	ND	6
1,3-DICHLOROPROPYLENE	ND	5
ETHYLBENZENE	ND	8
BROMOMETHANE	ND	10
CHLOROMETHANE	ND	10
METHYLENE CHLORIDE	ND	3
1,1,2,2-TETRACHLORETHANE	ND	3
TETRACHLOROETHENE	15	3
TOLUENE	10	3
1,2-TRANS-DICHLOROETHYLENE	ND	10
1,1,1-TRICHLOROETHANE	720	3
1,1,2-TRICHLOROETHANE	ND	3
TRICHLOROETHENE	35	3
VINYL CHLORIDE	ND	5
XYLENES (TOTAL)	11	10

ND = NONE DETECTED
All analyses reported in ug/L (micrograms per Liter), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 624

Sample Location: MW-7B

Sample Type: Water

Date Sampled: 5/2/91

PURGEABLE HALOGENATED HYDROCARBONS AND BTEX:

	AMOUNT DETECTED	DETECTION LIMIT
ACROLEIN	ND	10
ACRYLONITRILE	ND	10
BENZENE	ND	3
BROMOFORM	ND	5
CARBON TETRACHLORIDE	ND	3
CHLOROBENZENE	ND	5
DIBROMOCHLOROMETHANE	ND	3
CHLOROETHANE	ND	5
2-CHLOROETHYLVINYL ETHER	ND	5
CHLOROFORM	13	3
BROMODICHLOROMETHANE	ND	3
1,1-DICHLOROETHANE	2700	5
1,2-DICHLOROETHANE	24	3
1,1-DICHLOROETHENE	5300	3
1,2-DICHLOROPROPANE	ND	6
1,3-DICHLOROPROPYLENE	ND	5
ETHYLBENZENE	34	8
BROMOMETHANE	ND	10
CHLOROMETHANE	ND	10
METHYLENE CHLORIDE	950	3
1,1,2,2-TETRACHLORETHANE	ND	3
TETRACHLOROETHENE	580	3
TOLUENE	250	3
1,2-TRANS-DICHLOROETHYLENE	ND	10
1,1,1-TRICHLOROETHANE	15,000	3
1,1,2-TRICHLOROETHANE	17	3
TRICHLOROETHENE	2100	3
VINYL CHLORIDE	ND	5
XYLENES (TOTAL)	120	10

ND = NONE DETECTED
All analyses reported in ug/L (micrograms per Liter), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 624

Sample Location: MW-9C

Sample Type: Water

Date Sampled: 5/2/91

PURGEABLE HALOGENATED HYDROCARBONS AND BTEX·

	AMOUNT DETECTED	DETECTION LIMIT
ACROLEIN	ND	10
ACRYLONITRILE	ND	10
BENZENE	ND	3
BROMOFORM	ND	5
CARBON TETRACHLORIDE	ND	3
CHLOROBENZENE	ND	5
DIBROMOCHLOROMETHANE	ND	3
CHLOROETHANE	ND	5
2-CHLOROETHYLVINYL ETHER	ND	5
CHLOROFORM	ND	3
BROMODICHLOROMETHANE	ND	3
1,1-DICHLOROETHANE	30	5
1,2-DICHLOROETHANE	4.2	3
1,1-DICHLOROETHENE	630	3
1,2-DICHLOROPROPANE	ND	6
1,3-DICHLOROPROPYLENE	ND	5
ETHYLBENZENE	97	8
BROMOMETHANE	ND	10
CHLOROMETHANE	ND	10
METHYLENE CHLORIDE	ND	3
1,1,2,2-TETRACHLORETHANE	ND	3
TETRACHLOROETHENE	140	3
TOLUENE	160	3
1,2-TRANS-DICHLOROETHYLENE	ND	10
1,1,1-TRICHLOROETHANE	6400	3
1,1,2-TRICHLOROETHANE	ND	3
TRICHLOROETHENE	151	3
VINYL CHLORIDE	ND	5
XYLENES (TOTAL)	300	10

ND = NONE DETECTED
All analyses reported in ug/L (micrograms per Liter), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 624

Sample Location: MW-1

Sample Type: Water

Date Sampled: 5/8/91

PURGEABLE HALOGENATED HYDROCARBONS AND BTEX:

	AMOUNT DETECTED	DETECTION LIMIT
ACROLEIN	ND	10
ACRYLONITRILE	ND	10
BENZENE	ND	3
BROMOFORM	ND	5
CARBON TETRACHLORIDE	ND	3
CHLOROBENZENE	ND	5
DIBROMOCHLOROMETHANE	ND	3
CHLOROETHANE	ND	5
2-CHLOROETHYLVINYL ETHER	ND	5
CHLOROFORM	ND	3
BROMODICHLOROMETHANE	ND	3
1,1-DICHLOROETHANE	ND	5
1,2-DICHLOROETHANE	ND	3
1,1-DICHLOROETHENE	ND	3
1,2-DICHLOROPROPANE	ND	6
1,3-DICHLOROPROPYLENE	ND	5
ETHYLBENZENE	ND	8
BROMOMETHANE	ND	10
CHLOROMETHANE	ND	10
METHYLENE CHLORIDE	ND	3
1,1,2,2-TETRACHLORETHANE	ND	3
TETRACHLOROETHENE	ND	3
TOLUENE	ND	3
1,2-TRANS-DICHLOROETHYLENE	ND	10
1,1,1-TRICHLOROETHANE	ND	3
1,1,2-TRICHLOROETHANE	ND	3
TRICHLOROETHENE	ND	3
VINYL CHLORIDE	ND	5
XYLENES (TOTAL)	ND	10

ND = NONE DETECTED
All analyses reported in ug/L (micrograms per Liter), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 624

Sample Location: MW-3A

Sample Type: Water

Date Sampled: 5/8/91

PURGEABLE HALOGENATED HYDROCARBONS AND BTEX:

	AMOUNT DETECTED	DETECTION LIMIT
ACROLEIN	ND	10
ACRYLONITRILE	ND	10
BENZENE	ND	3
BROMOFORM	ND	5
CARBON TETRACHLORIDE	ND	3
CHLOROBENZENE	ND	5
DIBROMOCHLOROMETHANE	ND	3
CHLOROETHANE	ND	5
2-CHLOROETHYLVINYL ETHER	ND	5
CHLOROFORM	ND	3
BROMODICHLOROMETHANE	ND	3
1,1-DICHLOROETHANE	46	5
1,2-DICHLOROETHANE	11	3
1,1-DICHLOROETHENE	3600	3
1,2-DICHLOROPROPANE	ND	6
1,3-DICHLOROPROPYLENE	ND	5
ETHYLBENZENE	ND	8
BROMOMETHANE	ND	10
CHLOROMETHANE	ND	10
METHYLENE CHLORIDE	ND	3
1,1,2,2-TETRACHLORETHANE	ND	3
TETRACHLOROETHENE	8.8	3
TOLUENE	ND	3
1,2-TRANS-DICHLOROETHYLENE	ND	10
1,1,1-TRICHLOROETHANE	3000	3
1,1,2-TRICHLOROETHANE	ND	3
TRICHLOROETHENE	260	3
VINYL CHLORIDE	ND	5
XYLENES (TOTAL)	ND	10

ND = NONE DETECTED
All analyses reported in ug/L (micrograms per Liter), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 624

Sample Location: MW-4

Sample Type: Water

Date Sampled: 5/8/91

PURGEABLE HALOGENATED HYDROCARBONS AND BTEX:

	AMOUNT DETECTED	DETECTION LIMIT
ACROLEIN	ND	10
ACRYLONITRILE	ND	10
BENZENE	ND	3
BROMOFORM	ND	5
CARBON TETRACHLORIDE	ND	3
CHLOROBENZENE	ND	5
DIBROMOCHLOROMETHANE	ND	3
CHLOROETHANE	ND	5
2-CHLOROETHYLVINYL ETHER	ND	5
CHLOROFORM	ND	3
BROMODICHLOROMETHANE	ND	3
1,1-DICHLOROETHANE	ND	5
1,2-DICHLOROETHANE	ND	3
1,1-DICHLOROETHENE	ND	3
1,2-DICHLOROPROPANE	ND	6
1,3-DICHLOROPROPYLENE	ND	5
ETHYLBENZENE	ND	8
BROMOMETHANE	ND	10
CHLOROMETHANE	ND	10
METHYLENE CHLORIDE	ND	3
1,1,2,2-TETRACHLORETHANE	ND	3
TETRACHLOROETHENE	ND	3
TOLUENE	ND	3
1,2-TRANS-DICHLOROETHYLENE	ND	10
1,1,1-TRICHLOROETHANE	ND	3
1,1,2-TRICHLOROETHANE	ND	3
TRICHLOROETHENE	ND	3
VINYL CHLORIDE	ND	5
XYLENES (TOTAL)	ND	10

ND = NONE DETECTED
All analyses reported in ug/L (micrograms per Liter), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 624

Sample Location: MW-9C

Sample Type: Water

Date Sampled: 5/29/91

PURGEABLE HALOGENATED HYDROCARBONS AND BTEX:

	AMOUNT DETECTED	DETECTION LIMIT
CHLOROMETHANE	ND	10
BROMOMETHANE	ND	10
VINYL CHLORIDE	ND	3
CHLOROETHANE	ND	5
METHYLENE CHLORIDE	ND	3
ACETONE	ND	10
CARBON DISULFIDE	ND	10
1,1-DICHLOROETHENE	ND	3
1,1-DICHLOROETHANE	ND	5
1,2-DICHLOROETHENE (TOTAL)	ND	3
CHLOROFORM	ND	3
1,2-DICHLOROETHANE	ND	3
2-BUTANONE	ND	10
1,1,1-TRICHLOROETHANE	5.2	3
CARBON TETRACHLORIDE	ND	3
VINYL ACETATE	ND	5
BROMODICHLOROMETHANE	ND	3
1,2-DICHLOROPROPANE	ND	6
cis-1,3-DICHLOROPROPENE	ND	5
TRICHLOROETHENE	ND	3
DIBROMOCHLOROMETHANE	ND	3
1,1,2-TRICHLOROETHANE	ND	3
BENZENE	ND	3
trans-1,3-DICHLOROPROPENE	ND	3
BROMOFORM	ND	5
4-METHYL-2-PENTANONE	ND	10
2-HEXANONE	ND	10
TETRACHLOROETHENE	ND	3
1,1,2,2-TETRACHLOROETHANE	ND	3
TOLUENE	ND	3
CHLOROBENZENE	ND	5
ETHYLBENZENE	ND	8
STYRENE	ND	10
XYLENES (TOTAL)	ND	10

ND = NONE DETECTED
All analyses reported in ug/L (micrograms per Liter), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8240

Sample Location: MW-11A

Sample Type: Water

Date Sampled: 12/18/91

PURGEABLE HALOGENATED HYDROCARBONS AND BTEX:

	AMOUNT DETECTED	DETECTION LIMIT
CHLOROMETHANE	ND	10
BROMOMETHANE	ND	10
VINYL CHLORIDE	ND	3
CHLOROETHANE	ND	5
METHYLENE CHLORIDE	ND	3
1,1-DICHLOROETHENE	ND	3
1,1-DICHLOROETHANE	ND	5
1,2-DICHLOROETHENE (TOTAL)	ND	3
CHLOROFORM	ND	3
1,2-DICHLOROETHANE	ND	3
1,1,1-TRICHLOROETHANE	ND	3
CARBON TETRACHLORIDE	ND	3
BROMODICHLOROMETHANE	ND	3
1,2-DICHLOROPROPANE	ND	6
cis-1,3-DICHLOROPROPENE	ND	5
TRICHLOROETHENE	ND	3
DIBROMOCHLOROMETHANE	ND	3
1,1,2-TRICHLOROETHANE	ND	3
BENZENE	ND	3
trans-1,3-DICHLOROPROPENE	ND	3
BROMOFORM	ND	5
TETRACHLOROETHENE	ND	3
1,1,2,2-TETRACHLOROETHANE	ND	3
TOLUENE	ND	3
CHLOROBENZENE	ND	5
ETHYLBENZENE	ND	8
XYLENES (TOTAL)	ND	10

ND = NONE DETECTED
All analyses reported in ug/L (micrograms per Liter), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8260

Sample Location: MW-11B

Sample Type: Water

Date Sampled: 12/18/91

PURGEABLE HALOGENATED HYDROCARBONS AND BTEX:

	AMOUNT DETECTED	DETECTION LIMIT
CHLOROMETHANE	ND	10
BROMOMETHANE	ND	10
VINYL CHLORIDE	ND	3
CHLOROETHANE	ND	5
METHYLENE CHLORIDE	ND	3
1,1-DICHLOROETHENE	ND	3
1,1-DICHLOROETHANE	25	5
1,2-DICHLOROETHENE (TOTAL)	ND	3
CHLOROFORM	ND	3
1,2-DICHLOROETHANE	ND	3
1,1,1-TRICHLOROETHANE	150	3
CARBON TETRACHLORIDE	ND	3
BROMODICHLOROMETHANE	ND	3
1,2-DICHLOROPROPANE	ND	6
cis-1,3-DICHLOROPROPENE	ND	5
TRICHLOROETHENE	ND	3
DIBROMOCHLOROMETHANE	ND	3
1,1,2-TRICHLOROETHANE	ND	3
BENZENE	ND	3
trans-1,3-DICHLOROPROPENE	ND	3
BROMOFORM	ND	5
TETRACHLOROETHENE	ND	3
1,1,2,2-TETRACHLOROETHANE	ND	3
TOLUENE	ND	3
CHLOROBENZENE	ND	5
ETHYLBENZENE	ND	8
XYLENES (TOTAL)	ND	10

ND = NONE DETECTED
All analyses reported in ug/L (micrograms per Liter), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8260

Sample Location: MW-12A

Sample Type: Water

Date Sampled: 12/18/91

PURGEABLE HALOGENATED HYDROCARBONS AND BTEX:

	AMOUNT DETECTED	DETECTION LIMIT
CHLOROMETHANE	ND	10
BROMOMETHANE	ND	10
VINYL CHLORIDE	ND	3
CHLOROETHANE	ND	5
METHYLENE CHLORIDE	ND	3
1,1-DICHLOROETHENE	ND	3
1,1-DICHLOROETHANE	ND	5
1,2-DICHLOROETHENE (TOTAL)	ND	3
CHLOROFORM	ND	3
1,2-DICHLOROETHANE	ND	3
1,1,1-TRICHLOROETHANE	ND	3
CARBON TETRACHLORIDE	ND	3
BROMODICHLOROMETHANE	ND	3
1,2-DICHLOROPROPANE	ND	6
cis-1,3-DICHLOROPROPENE	ND	5
TRICHLOROETHENE	ND	3
DIBROMOCHLOROMETHANE	ND	3
1,1,2-TRICHLOROETHANE	ND	3
BENZENE	ND	3
trans-1,3-DICHLOROPROPENE	ND	3
BROMOFORM	ND	5
TETRACHLOROETHENE	ND	3
1,1,2,2-TETRACHLOROETHANE	ND	3
TOLUENE	ND	3
CHLOROBENZENE	ND	5
ETHYLBENZENE	ND	8
XYLENES (TOTAL)	ND	10

ND = NONE DETECTED
All analyses reported in ug/L (micrograms per Liter), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8260

Sample Location: MW-12B

Sample Type: Water

Date Sampled: 12/18/91

PURGEABLE HALOGENATED HYDROCARBONS AND BTEX:

	AMOUNT DETECTED	DETECTION LIMIT
CHLOROMETHANE	ND	10
BROMOMETHANE	ND	10
VINYL CHLORIDE	ND	3
CHLOROETHANE	ND	5
METHYLENE CHLORIDE	ND	3
1,1-DICHLOROETHENE	ND	3
1,1-DICHLOROETHANE	7.2	5
1,2-DICHLOROETHENE (TOTAL)	ND	3
CHLOROFORM	ND	3
1,2-DICHLOROETHANE	ND	3
1,1,1-TRICHLOROETHANE	1200	3
CARBON TETRACHLORIDE	ND	3
BROMODICHLOROMETHANE	ND	3
1,2-DICHLOROPROPANE	ND	6
cis-1,3-DICHLOROPROPENE	ND	5
TRICHLOROETHENE	920	3
DIBROMOCHLOROMETHANE	ND	3
1,1,2-TRICHLOROETHANE	ND	3
BENZENE	ND	3
trans-1,3-DICHLOROPROPENE	ND	3
BROMOFORM	ND	5
TETRACHLOROETHENE	92	3
1,1,2,2-TETRACHLOROETHANE	ND	3
TOLUENE	ND	3
CHLOROBENZENE	ND	5
ETHYLBENZENE	ND	8
XYLENES (TOTAL)	ND	10

ND = NONE DETECTED
All analyses reported in ug/L (micrograms per Liter), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8260

Sample Location: MW-13A

Sample Type: Water

Date Sampled: 12/18/91

PURGEABLE HALOGENATED HYDROCARBONS AND BTEX:

	AMOUNT DETECTED	DETECTION LIMIT
CHLOROMETHANE	ND	10
BROMOMETHANE	ND	10
VINYL CHLORIDE	ND	3
CHLOROETHANE	ND	5
METHYLENE CHLORIDE	ND	3
1,1-DICHLOROETHENE	ND	3
1,1-DICHLOROETHANE	ND	5
1,2-DICHLOROETHENE (TOTAL)	ND	3
CHLOROFORM	ND	3
1,2-DICHLOROETHANE	ND	3
1,1,1-TRICHLOROETHANE	590	3
CARBON TETRACHLORIDE	ND	3
BROMODICHLOROMETHANE	ND	3
1,2-DICHLOROPROPANE	ND	6
cis-1,3-DICHLOROPROPENE	ND	5
TRICHLOROETHENE	ND	3
DIBROMOCHLOROMETHANE	ND	3
1,1,2-TRICHLOROETHANE	ND	3
BENZENE	ND	3
trans-1,3-DICHLOROPROPENE	ND	3
BROMOFORM	ND	5
TETRACHLOROETHENE	ND	3
1,1,2,2-TETRACHLOROETHANE	ND	3
TOLUENE	ND	3
CHLOROBENZENE	ND	5
ETHYLBENZENE	ND	8
XYLENES (TOTAL)	ND	10

ND = NONE DETECTED
All analyses reported in ug/L (micrograms per Liter), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8260

Sample Location: MW-13B

Sample Type: Water

Date Sampled: 12/18/91

PURGEABLE HALOGENATED HYDROCARBONS AND BTEX:

	AMOUNT DETECTED	DETECTION LIMIT
CHLOROMETHANE	ND	10
BROMOMETHANE	ND	10
VINYL CHLORIDE	ND	3
CHLOROETHANE	ND	5
METHYLENE CHLORIDE	6300	3
1,1-DICHLOROETHENE	ND	3
1,1-DICHLOROETHANE	1700	5
1,2-DICHLOROETHENE (TOTAL)	ND	3
CHLOROFORM	26	3
1,2-DICHLOROETHANE	1900	3
1,1,1-TRICHLOROETHANE	4900	3
CARBON TETRACHLORIDE	ND	3
BROMODICHLOROMETHANE	ND	3
1,2-DICHLOROPROPANE	ND	6
cis-1,3-DICHLOROPROPENE	ND	5
TRICHLOROETHENE	740	3
DIBROMOCHLOROMETHANE	ND	3
1,1,2-TRICHLOROETHANE	19	3
BENZENE	ND	3
trans-1,3-DICHLOROPROPENE	ND	3
BROMOFORM	ND	5
TETRACHLOROETHENE	170	3
1,1,2,2-TETRACHLOROETHANE	ND	3
TOLUENE	ND	3
CHLOROBENZENE	ND	5
ETHYLBENZENE	ND	8
XYLENES (TOTAL)	ND	10

ND = NONE DETECTED
All analyses reported in ug/L (micrograms per Liter), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8260

Sample Location: MW-14B

Sample Type: Water

Date Sampled: 12/18/91

PURGEABLE HALOGENATED HYDROCARBONS AND BTEX:

	AMOUNT DETECTED	DETECTION LIMIT
CHLOROMETHANE	ND	10
BROMOMETHANE	ND	10
VINYL CHLORIDE	ND	3
CHLOROETHANE	ND	5
METHYLENE CHLORIDE	52	3
1,1-DICHLOROETHENE	ND	3
1,1-DICHLOROETHANE	23	5
1,2-DICHLOROETHENE (TOTAL)	ND	3
CHLOROFORM	ND	3
1,2-DICHLOROETHANE	ND	3
1,1,1-TRICHLOROETHANE	160	3
CARBON TETRACHLORIDE	ND	3
BROMODICHLOROMETHANE	ND	3
1,2-DICHLOROPROPANE	ND	6
cis-1,3-DICHLOROPROPENE	ND	5
TRICHLOROETHENE	38	3
DIBROMOCHLOROMETHANE	ND	3
1,1,2-TRICHLOROETHANE	ND	3
BENZENE	ND	3
trans-1,3-DICHLOROPROPENE	ND	3
BROMOFORM	ND	5
TETRACHLOROETHENE	43	3
1,1,2,2-TETRACHLOROETHANE	ND	3
TOLUENE	ND	3
CHLOROBENZENE	ND	5
ETHYLBENZENE	ND	8
XYLENES (TOTAL)	ND	10

ND = NONE DETECTED
All analyses reported in ug/L (micrograms per Liter), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8260

Sample Location: MW-14A

Sample Type: Water

Date Sampled: 12/18/91

PURGEABLE HALOGENATED HYDROCARBONS AND BTEX:

	AMOUNT DETECTED	DETECTION LIMIT
CHLOROMETHANE	ND	10
BROMOMETHANE	ND	10
VINYL CHLORIDE	ND	3
CHLOROETHANE	ND	5
METHYLENE CHLORIDE	ND	3
1,1-DICHLOROETHENE	ND	3
1,1-DICHLOROETHANE	ND	5
1,2-DICHLOROETHENE (TOTAL)	ND	3
CHLOROFORM	ND	3
1,2-DICHLOROETHANE	ND	3
1,1,1-TRICHLOROETHANE	ND	3
CARBON TETRACHLORIDE	ND	3
BROMODICHLOROMETHANE	ND	3
1,2-DICHLOROPROPANE	ND	6
cis-1,3-DICHLOROPROPENE	ND	5
TRICHLOROETHENE	ND	3
DIBROMOCHLOROMETHANE	ND	3
1,1,2-TRICHLOROETHANE	ND	3
BENZENE	ND	3
trans-1,3-DICHLOROPROPENE	ND	3
BROMOFORM	ND	5
TETRACHLOROETHENE	ND	3
1,1,2,2-TETRACHLOROETHANE	ND	3
TOLUENE	ND	3
CHLOROBENZENE	ND	5
ETHYLBENZENE	ND	8
XYLENES (TOTAL)	ND	10

ND = NONE DETECTED
All analyses reported in ug/L (micrograms per Liter), equivalent to parts-per-billion, unless otherwise noted.
EPA Method: 8260

VITA

James Carl Bruggeman

Candidate for the Degree of

Master of Science

Thesis: HYDROGEOLOGIC CHARACTERIZATION, CONTAMINANT ASSESSMENT, AND COMPUTER MODELING AT AN INDUSTRIAL SITE IN ROGERS COUNTY, OKLAHOMA

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Biographical:

Personal Data: Born in Dayton, Ohio, December 25, 1954, the son of James A. and Emma M. Bruggeman.

Education: Graduated from Chaminade High School, Dayton, Ohio, in June 1973; received Bachelor of Science Degree in Geology from Wright State University in June, 1979; completed requirements for the Master of Science degree at Oklahoma State University in July, 1992.

Professional Experience: Geologist, Cities Service Oil and Gas Corporation, Wichita, Kansas, June 1981 to July 1983; Geologist, OXY USA, Incorporated, Oklahoma City, Oklahoma, July 1983 to December 1989.

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