aquatec INC. ENVIRONMENTAL SERVICES

75 GREEN MOUNTAIN DRIVE, SOUTH BURLINGTON, VERMONT 05403, TELEPHONE (802) 658-1074

November 8, 1988

Mr. Tony Carins
Champlain Oil Company, Inc.
P.O. Box 2126
South Burlington, VT 05403

Re: Aquatec Project No. 88111
Hydrogeologic Investigation Report

Dear Mr. Cairns:

Enclosed are two copies of the report titled "Hydrogeologic Investigation, Desso's General Store, Jericho Center, Vermont."

If you have any questions regarding this report, feel free to contact me at your convenience.

Sincerely,

Robert J. Ross
Hydrogeologist

RJR/lam

Enclosure

cc: Pat Poundstone (5 copies)

Hydrogeologic Investigation
Desso's General Store
Jericho Center, Vermont

Prepared for:
Champlain Oil Company, Inc.
P.O. Box 2126
South Burlington, Vermont

Prepared by:
Aquatec, Inc.
75 Green Mountain Drive
South Burlington, Vermont

November 1988

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1.0 Introduction

1.1 Objective

The objective of the hydrogeologic investigation of the gasoline contamination incident at Desso's General Store in Jericho Center, Vermont was to define the extent and degree of gasoline contamination, and to recommend appropriate measures for site remediation. The following report summarizes the field investigation methods and procedures as well as the findings and recommendations for site remediation.

1.2 Site History

Desso's General Store is located on Browns Trace Road in Jericho Center, Vermont (Figure 1). The store sells gasoline as part of its operation. On June 6 and 7, 1988, Personnel from the Vermont Agency of Natural Resources (ANR) were present during the excavation and removal of two underground storage tanks (UST's); one 4,000 gallon and one 6,000 gallon capacity tank. During the removal operations, gasoline contaminated soil was observed underlying the 4,000 gallon UST. Later inspection of this tank revealed the presence of a small hole on the underside of the tank. Approximately sixty cubic yards of gasoline contaminated soil was removed from the UST excavation site at this time (VT ANR, 1988 and Aquatec, 1988a).

Subsequent sampling and analysis of the residential supply well located on the adjacent property down gradient of the UST's, identified the presence of gasoline constituents above the Vermont Department of Health (DOH) advisory level for drinking water. The supply well is approximately 150 feet deep and located less than 50 feet from the UST's. The well supplies drinking water to the owner of the store, Mr. Gerry Desso and his neighbor, Mr. Winton Smith (VT ANR, 1988). Prior testing of the integrity of the UST in 1985 did not identify the presence of a leak, however, in December 1986, Mr. Desso noticed a gasoline odor in his drinking water. Subsequently, a carbon filter and water conditioning system was installed to treat the water prior to use (Aquatec, 1988a).

The analytical results of water samples obtained from the residential supply well on June 29, 1988 by Champlain Oil Company personnel indicated the presence of gasoline at 730 micrograms per liter (ug/l); individual compounds were benzene at 50 ug/l, toluene at 6.2 ug/l and xylenes at 110 ug/l (Aquatec, 1988b). A well water sample was also obtained after carbon filtering which indicated the presence of benzene at 2.0 ug/l. The U.S. Environmental Protection Agency (EPA) has established maximum contamination levels (MCLs) for benzene, toluene, xylenes and ethylbenzene of 5 ug/l, 2000 ug/l, 620 ug/l and 1400 ug/l, respectively. The Vermont Department of Health has adopted the EPA MCLs as the State Health Advisory Levels (VT DOH, 1987).

2.0 Environmental Setting

2.1 Topography and Geologic Setting

The local topography slopes toward the west with surrounding elevations ranging between 680 and 765 feet above mean sea level (MSL). Overland run-off would appear to follow this slope, draining into a wetland and pond located approximately a quarter mile to the west. The wetland and pond discharge into an unnamed stream which flows to the north approximately 0.8 miles before discharging into the Lee River (Figure 1). A majority of the area surrounding the site is undeveloped pasture and woodland (USGS, 1948).

According to the Soil Conservation Service Soil Survey Map of Chittenden County, Vermont, the surficial geology of the Jericho Center area consists of glacial till of the Peru series. Soils in the Peru series are typically composed of sandy loam with varying amounts of gravel, silt and clay. During the advancement of soil borings on site, a dense silty sand and gravel was encountered overlying a very dense gray till. The till deposit consisted primarily of coarse to fine sands with varying amounts of gravel and silt. The density of the underlying material generally increased with depth. Bedrock was encountered on site at approximately thirty feet below ground surface

in the vicinity of the bedrock supply well. Review of Vermont geologic publications suggest the overburden formation is underlain by schist of the Underhill formation. The schist formation consists of a mixture of quartz, sericite, albite, chlorite and biotite (Doll, 1961). No bedrock outcrops were observed on site, however several outcrops have been observed in the surrounding area.

2.2 Water Supply and Sewage Disposal

The residents of Jericho Center receive drinking water from individual supply wells which obtain water from either the overburden or the bedrock formation. Information provided by the Vermont Agency of Natural Resources indicates approximately seventeen homes in the immediate vicinity of the study area are supplied with drinking water from the underlying bedrock aquifer. The exact number of homes receiving drinking water from the overburden formation is unknown, however a spring located approximately 500 feet down gradient of the source area provides drinking water to two homes in the area and a shallow dug well provides drinking water to a home located up gradient of the source area. As indicated previously, the Smith's home and the general store are on the same water supply system which receives water from the underlying bedrock formation. The Smith's and Desso's bedrock supply well is approximately 150 feet deep and is located less than 50 feet down gradient of the USTs.

All of the homes in Jericho Center are presently served by individual on site septic systems. Both the Smith's and the Desso's have septic tanks and leach fields on their property which are located down gradient of their bedrock supply well and the USTs.

3.0 Field Investigations

3.1 Soil Boring and Monitoring Well Installation

The subsurface investigation included the advancement of soil borings and the installation of monitoring wells to characterize existing site conditions. The ground water monitoring network was designed to

determine on site ground water quality, the direction of ground water flow in the upper overburden formation and to determine the vertical hydraulic gradient adjacent to the bedrock supply well. Four (4) monitoring wells were constructed in soil borings advanced by the Adams Engineering Company under the supervision of Aquatec personnel (Figure 2). Subsurface soils were inspected to assist in site characterization and screened in the field for the presence of volatile organic compounds (VOCs) using an HNU PID.

Three soil borings were advanced to approximately five feet below the water table. One soil boring was advanced to the top of bedrock which was encountered at approximately thirty feet below ground surface (bgs). Soil samples were obtained from each soil boring at five foot intervals using a two foot long/two inch diameter split-spoon barrel. Screening of the soil samples using a PID did not identify the presence of VOCs; however, soil cuttings from boring MW-1S did indicate the presence of VOCs between three to six parts per million (ppm) in soil from about ten feet bgs.

The monitoring wells were constructed of two inch diameter schedule 40 PVC well material. The well screens consisted of 0.02-inch machine-slotted screens with flush coupled joints. Ten foot sections of screen were installed in monitoring wells MW-1S, MW-2 and MW-3 to intercept the water table. A five foot section of screen was installed in the till formation at the top of bedrock in monitoring well MW-1D. A sand filter pack was installed by flushing clean silica sand around the screen to approximately one foot above the top of the screen. Granular bentonite seals were placed above the annulus of the sand filter pack of wells MW-1S, MW-2 and MW-3 to prevent downward migration of water to the screen. To isolate the screened interval of well MW-1D, a bentonite grout mixture was placed above the sand filter pack which extended to the ground surface. A locking protective well guard was placed over the PVC well at each location and cemented at ground surface to protect the PVC riser. Each well was developed after completion by purging with a bladder pump. Field boring logs and well construction diagrams are included as Attachment A.

All monitoring wells were surveyed for horizontal location and vertical elevation to a relative bench mark located on site. This relative bench mark can be tied into a U.S.G.S. bench mark if required in the future. Throughout the soil boring program, all drilling equipment (rods, casing, split-spoon barrel, etc.) was steam cleaned between soil boring locations.

3.2 Ground Water Sampling

Sampling procedures implemented by Aquatec during this project were performed in accordance with procedures documented in the U.S. Environmental Protection Agency's RCRA Ground Water Monitoring Technical Enforcement Guidance Document (September, 1986) and Test Methods for Evaluating Solid Waste, Vol. II Field Manual (September, 1986). These documents meet or exceed current Vermont Agency of Natural Resources protocol.

Ground water samples were collected from the four monitoring wells and the bedrock supply well on September 26, 1988. The samples were analyzed for the presence of benzene, toluene, ethylbenzene, xylenes and hydrocarbons. The monitoring wells were sampled approximately one week after construction and development.

Depth to static water level and total depth were measured in each well. These measurements and the inside casing diameter was used to calculate the volume of stagnant water in the well that was required to be purged prior to sampling. A calibrated electronic water level indicator was used to make the measurements. The measurements were recorded to the nearest 0.01 foot from a reference point located on the PVC riser (Table 1). The measuring device was cleaned between each location using a Liquinox detergent and de-ionized water solution.

After the water level measurements were obtained, each well was monitored for the presence of a floating layer of gasoline. This task was performed by lowering a precleaned clear product bailer into the

well to intercept the water table and upper portion of the ground water formation. No floating product was observed in any of the monitoring wells at this time, however a strong gasoline odor was noticed in well MW-1S.

Prior to collecting the samples, each monitoring well was purged to remove the stagnant water. The amount of water evacuated from each well was approximately three times the standing well volume. The water sample obtained from the bedrock supply well was collected directly from the well and was not purged prior to collection. Ground water temperature and conductivity were measured in situ before and after each well was purged. The samples were collected using a Teflon bailer that was cleaned between sampling locations using a Liquinox detergent and de-ionized water wash. An equipment blank sample was also collected at this time, after the teflon bailer was cleaned as indicated above, by filling the bailer with deionized water and pouring the water into the sample containers.

In addition to collecting samples from on site monitoring wells, separate tap water samples were obtained from the Smith's home and Desso's General Store. Both samples were collected after the water had passed through the carbon filtering system. This allowed Aquatec to assess the presence of contamination after the water had been filtered and determine the quality of water being consumed by the Smith's and Desso's. One tap water sample was also collected from the Thompson home which receives drinking water from a spring located approximately 500 feet down gradient of the under ground storage tanks. Prior to collecting each water sample, the water was allowed to run for approximately 10 minutes. This procedure allowed the stagnant water in the pipes of the water system to be purged. Residential water samples were analyzed for the presence of volatile organic compounds using EPA Methods 601 and 602.

All water samples were placed in 40 milliliter (ml) glass vials preserved with hydrochloric acid. Two vials were filled for each sample collected at a designated sample location. Each sample container

was labeled in the field with sample location, date, time and analysis required. Custody seals were placed over the top of each sample container cap immediately following collection. The sealed containers were then placed in a shipping cooler with ice to refrigerate the samples to approximately four degrees centigrade. Proper chain of custody documentation procedures were followed and maintained by the field sampling personnel until relinquished to the laboratory for analysis. Field sampling data for each monitoring well is included as Attachment B.

3.3 Soil Gas Survey

On October 27, 1988, Aquatec personnel visited the site to perform a soil gas survey which would define the extent of the subsurface gasoline contamination plume. However, at this time, Aquatec personnel were unable to drive the soil gas probe greater than three feet below ground surface (bgs). Attempts to penetrate greater than three feet bgs were unsuccessful at eight boring locations in the area down gradient of the bedrock supply well and MW-1S. As a result, the soil gas survey was discontinued.

3.4 Significant Site Observations

- The overburden on site consists of approximately twenty feet of dense silty sand and gravel overlying about ten feet of very dense glacial till.
- Bedrock was encountered at approximately thirty feet bgs at monitoring well location MW-1D.
- A gasoline odor was detected during drilling and ground water sampling at monitoring well location MW-1S.
- No free product was encountered during soil boring or ground water sampling activities.
- PID readings of three to six ppm were detected at approximately ten feet bgs at monitoring well location MW-1S. No other PID readings above background levels were detected during the soil boring program.

4.0 Laboratory Analytical Results

4.1 Ground Water

Ground water samples were obtained from four on site monitoring wells and the bedrock supply well on September 26, 1988. All samples were analyzed for the presence of benzene, toluene, ethylbenzene, xylenes (BTEX) and hydrocarbons. The analytical results of ground water samples obtained from monitoring wells MW-1D, MW-2 and MW-3 did not identify the presence of BTEX or hydrocarbon compounds.

The analytical results of the ground water sample obtained from well MW-1S identified the presence of benzene, toluene, ethylbenzene and xylenes at 50, 440, 2600 and 18000 micrograms per liter (ug/l), respectively and indicated the presence of aromatic hydrocarbons at 12000 ug/l and aliphatic hydrocarbons at 20000 ug/l. Benzene, xylenes, aromatic hydrocarbons and aliphatic hydrocarbons were also identified in the ground water sample obtained from the bedrock supply well at 3.9, 36, 64 and 210 ug/l, respectively (Table 2). The analytical reports are included in Attachment C.

4.2 Residential Tap Water

Tap water samples were obtained from the Smith and Desso residences for volatile organic compound (VOC) analysis on September 26, 1988. In addition, a tap water sample was collected from the Thompson residence on October 14, 1988 for VOC analysis. The three tap water samples were analyzed according to EPA Methods 601 and 602 for the presence of VOCs.

The analytical results for these samples identified the presence of xylenes at 0.7 ug/l in the samples obtained from the Smith's home and Desso's General Store. No other VOCs were identified in these two samples and no VOCs were identified during analysis of the Thompson's tap water (Table 3). The analytical reports are included in Attachment C.

5.0 Findings

Information gathered during the investigation suggests that the ground water contamination is primarily confined to the upper overburden formation and is limited in aerial extent. This information also suggests that an inadequate seal along the supply well casing at the bedrock/overburden interface and the proximity of the supply well (less than 50 feet) to the underground storage tanks are the cause for the gasoline contamination in the supply well.

During the installation of monitoring wells adjacent to the bedrock supply well, approximately ten feet of very dense till was encountered above the bedrock formation. Monitoring well MW-1D was screened within the till formation while MW-1S was installed in the overburden above the till formation. Both wells were installed within ten feet down gradient of the bedrock supply well. Analytical results of ground water samples from MW-1S and the bedrock supply well identified the presence of volatile organic compounds (VOCs) characteristic of gasoline products at total VOC concentrations of 57050 ug/l and 313.9 ug/l, respectively. The analytical results of the ground water sample collected from MW-1D did not identify the presence of VOCs. This finding suggests that the till deposits overlying the bedrock formation is acting as an impermeable boundary. Based on this information, the most likely point for contamination to enter the bedrock supply well would be along the well casing which typically is not sealed at the bedrock/ overburden interface. Pumping of the bedrock supply well could also influence the migration of contamination by drawing in water from the overlying formation had the well casing not been properly sealed at the bedrock surface. Review of available information about construction of the bedrock supply well does not indicate the casing was sealed at the bedrock surface.

Inspection of subsurface soil samples collected during the soil boring and monitoring well installation program indicate that the overburden formation underlying the study area is composed of a dense silty sand and gravel deposit overlying a very dense glacial till.

These overburden deposits characteristically have low permeability values as compared to clean sand and gravel. The horizontal hydraulic gradient between MW-1S and MW-3 is estimated to be approximately 0.09 ft/ft. This information combined with published values for characteristics of the underlying soil, suggest that the horizontal ground water flow velocity is in the range of 95 feet/year (Attachment D). Assuming ground water flow velocity is the dominant mechanism acting on contaminant migration and also assuming that in December 1986 the bedrock supply well was first impacted by gasoline contamination, the leading edge of the contamination plume would be approximately 170 feet down gradient of the bedrock supply well. However, analytical results of the ground water sample obtained from MW-3 located approximately 80 feet down gradient of MW-1S and the bedrock supply well did not identify the presence of VOCs. This finding suggests that the contamination may be localized and has not yet migrated far from the initial source area. However, additional ground water sampling and analysis should be performed to verify this finding.

The following findings are based on information gathered during the investigation of the gasoline contamination incident at Desso's General Store in Jericho Center, Vermont.

- The bedrock supply well is approximately 150 feet deep and situated less than 50 feet from the underground storage tanks.
- A gasoline odor was first detected in the water from the bedrock supply well in December 1986, after which a carbon filtering system was installed.
- Analytical results of water obtained from the bedrock supply well in June 1988 identified the presence of benzene, toluene, xylenes and gasoline at 50, 6.2, 110 and 730 ug/l, respectively and the analytical results of water obtained from the bedrock supply well in September 1988 identified the presence of benzene, xylenes, aromatic hydrocarbons and aliphatic hydrocarbons at 3.9, 36, 64 and 210 ug/l, respectively.

- Analysis of ground water from monitoring well MW-1S, installed approximately ten feet down gradient of the bedrock supply well identified the presence of benzene, toluene, ethylbenzene, xylenes (BTEX), aromatic hydrocarbons and aliphatic hydrocarbons at 50, 4400, 2600, 18000, 12000 and 20000 ug/l, respectively. However, analysis of ground water from monitoring well MW-1D, installed in the lower portion of the overburden aquifer, adjacent to MW-1S, did not identify the presence of BTEX or hydrocarbon compounds.

- The overburden on site is composed of a very dense till overlain by a poorly sorted silty, sand and gravel. Bedrock was encountered at approximately thirty feet below ground surface at well MW-1D.

- The general direction of ground water flow across the site in the overburden formation is to the northwest (Figure 3).

- A downward vertical gradient was observed in the vicinity of monitoring wells MW-1S and MW-1D (Attachment D).

- The estimated ground water flow velocity for the overburden formation is approximately 95 feet/year (Attachment D). Note: this estimate is based on several assumptions and is intended to estimate ground water flow velocity to within an order of magnitude ($\pm$).

6.0 Recommendations

Based on the findings of the hydrogeologic investigation, Aquatec recommends the following measures be implemented at Desso's General Store in Jericho, Center, Vermont:

- Install two additional monitoring wells down gradient of the bedrock supply well to define the extent of the contamination plume and to provide a warning mechanism to safe guard down gradient water supplies.

- Obtain additional ground water samples from the existing monitoring wells. This information will be useful for verifying previous results and for providing additional information on the extent of ground water contamination.

- Provide the Smith's and Desso's with a new permanent source of drinking water unaffected by the gasoline contamination. Note: arrangements are presently being made to retain the services of a water well contractor to install a new supply well.

- Obtain ground water samples from the new water supply; directly from the well and at the kitchen faucet in the Smith and Desso homes. Arrangements should also be made to flush and clean the plumbing system of each home. This task will provide information on the water quality in the new well and will indicate if any residual contamination remains in the home plumbing systems.

- Abandon the existing contaminated bedrock supply well by pulling out the pump, grouting the entire open bore hole and removing the well casing.

Aquatec is currently reviewing available remedial options that may be appropriate for site remediation. Aquatec has made arrangements to install soil vapor monitoring points along the basement foundations of the Smith's home and Desso's General Store which will provide data necessary to evaluate possible soil gas migration into the basements of these homes. This information as well as additional ground water sampling results, will be used to assess alternatives for ground water treatment and site remediation.

88111D8NOV88

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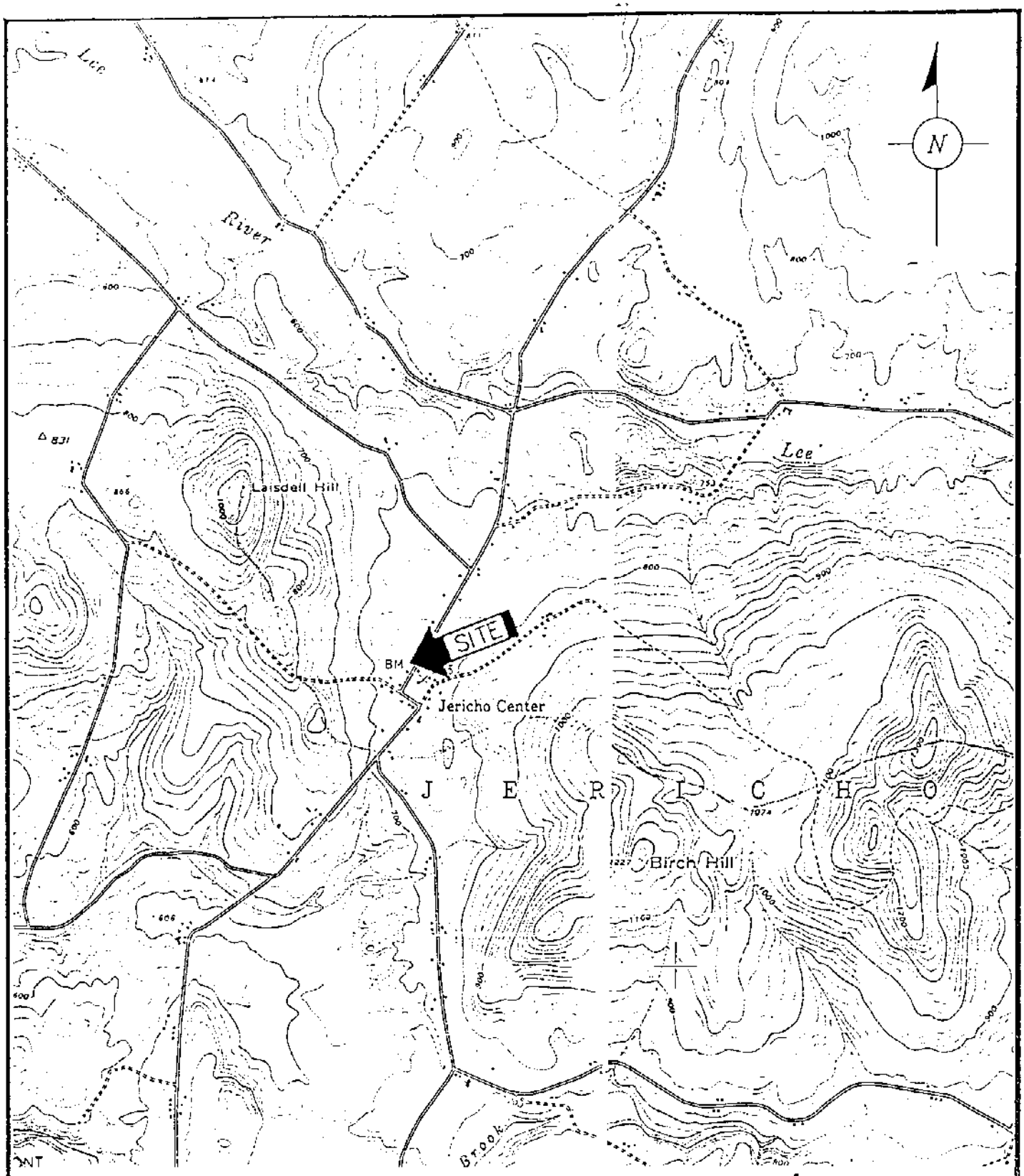

Source:
USGS 1948. Richmond Quadrangle Vermont
U.S. Geological Survey, 7.5 min. series
(topographic), 1948.

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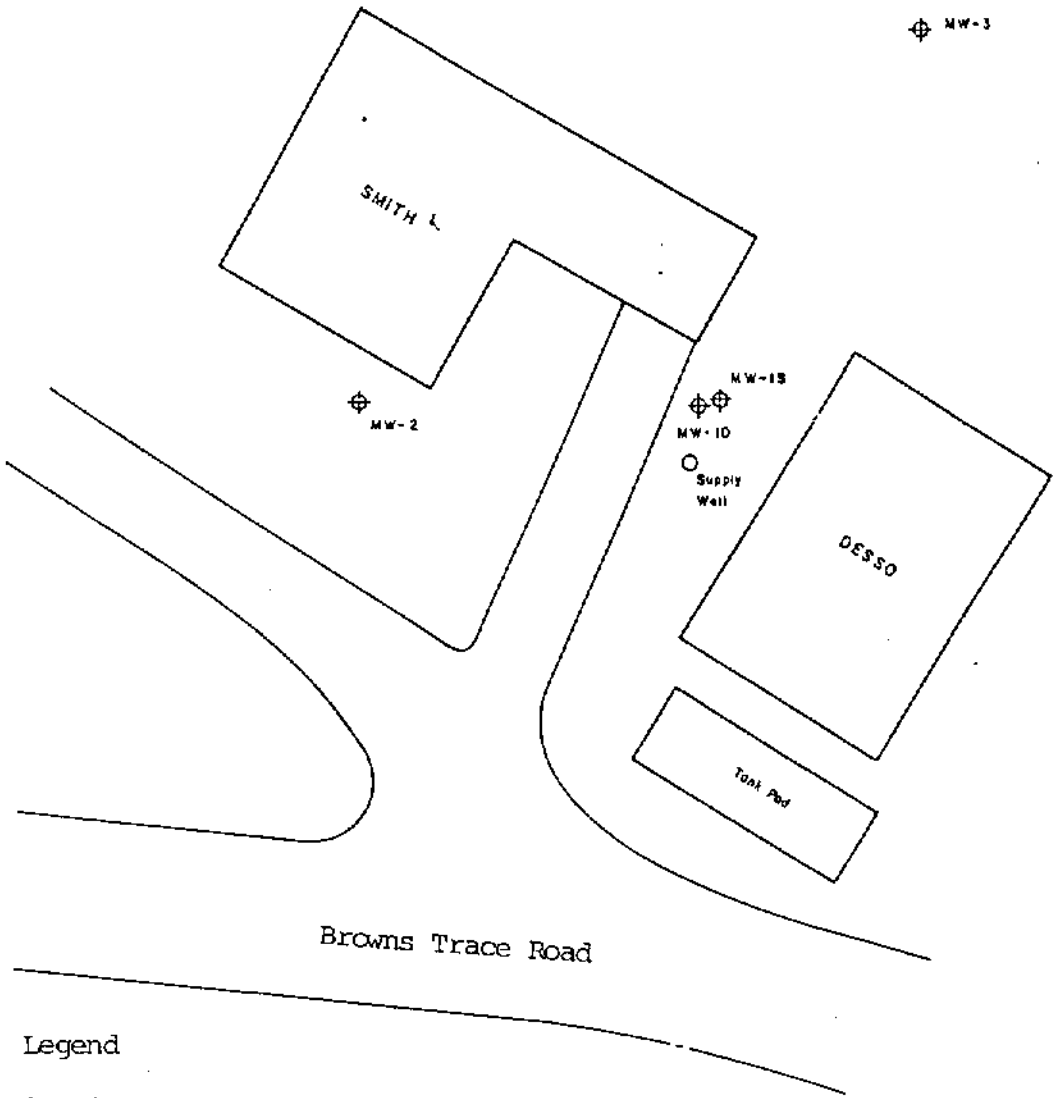
Figure 1
Site Locus Plan
Desso's General Store
Jericho Center, Vermont
Aquatec Project No. 88111



Legend

MW-2 - monitoring well

Supply Well - bedrock supply well

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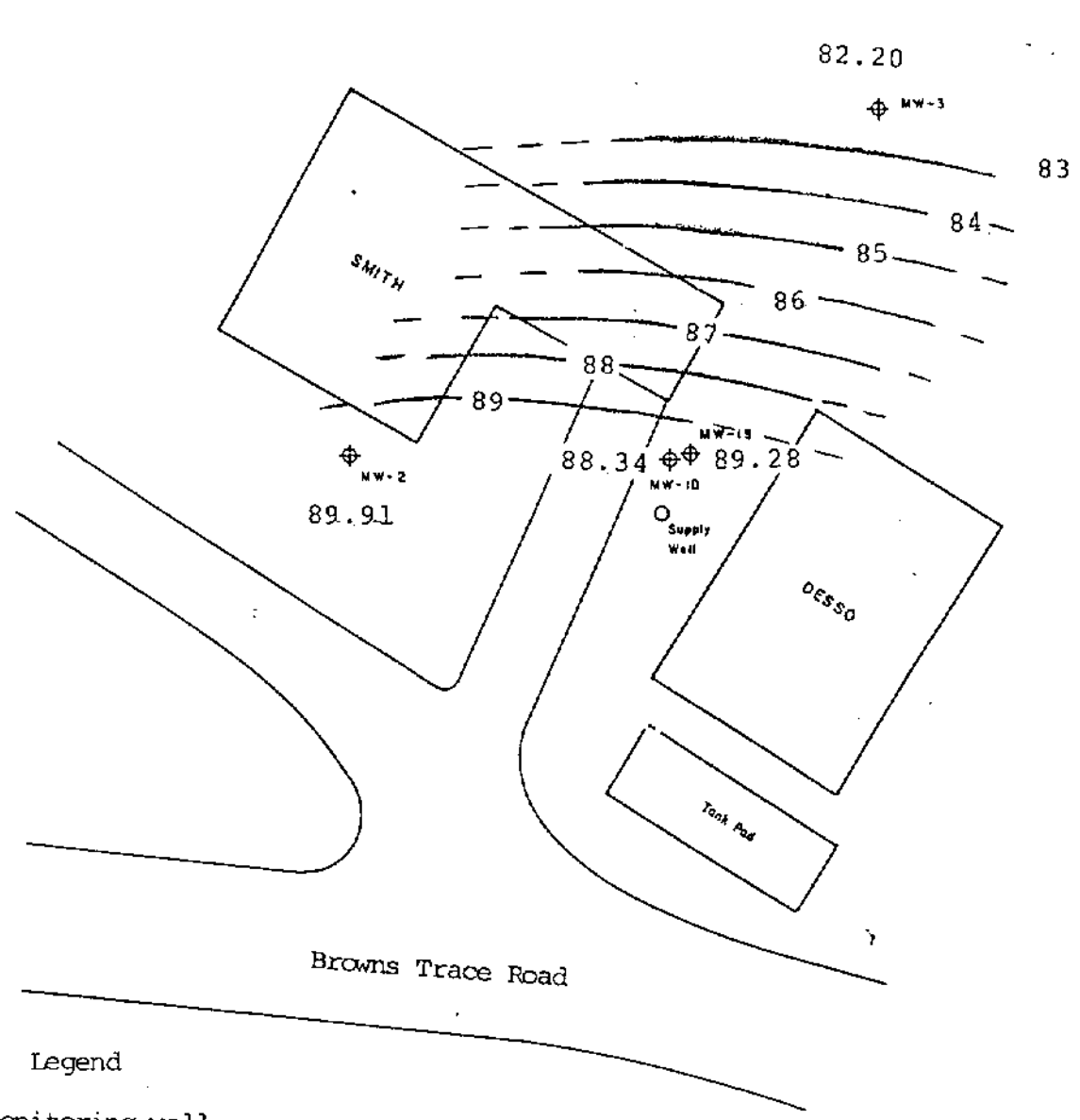
Figure 2
Site Sketch
Desso's General Store
Jericho Center, Vermont
Aquatec Project No. 88111



Legend

MW-2 - monitoring well

Supply Well - bedrock supply well

87- groundwater contour

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Figure 3
Potentiometric Map
Desso's General Store
Jericho Center, Vermont
Aquatec Project No. 88111

Table 1
Ground Water Elevation Data
Desso's General Store
Jericho, Center, Vermont
Aquatec Project No. 88111

Well ID	Well Elevation (ft.)	Depth to Water (ft.)			Ground Water Elevation (ft.)		
		9/30/88	10/26/88	10/27/88	9/30/88	10/26/88	10/27/88
MW-1S	100.18	10.90	10.87	10.87	89.28	89.31	89.31
MW-1D	100.31	11.97	11.90	11.86	88.34	88.41	88.45
MW-2	100.00	10.09	9.82	9.85	89.91	90.18	90.15
MW-3	94.09	11.89	11.85	11.84	82.20	82.24	82.25

Note: All measurements were measured to a reference point marked on the PVC riser. The well elevation data is based on a level survey performed by Aquatec, assuming an arbitrary elevation of 100.00 feet for monitoring well MW-2.

Table 2
Analytical Results - Monitoring Wells
September 26, 1988
Desso's General Store
Jericho Center, Vermont
Aquatec Project No. 88111

Compound	MW-1S 89718	MW-1D 89724/89725	MW-2 89719	MW-3 89720	Bedrock Supply Well 89721	Trip Blank 89716	Equipment Blank 89717
Benzene	50	<1/<1	<1	<1	3.9	<1	<1
Toluene	4400	<1/<1	<1	<1	<1	<1	<1
Ethylbenzene	2600	<1/<1	<1	<1	<1	<1	<1
Xylenes	18000	<1/<1	<1	<1	36	<1	<1
Other Aromatic Hydrocarbons as o-Xylene	12000	<10/<10	<10	<10	64	<10	<10
Aliphatic Hydrocarbons as Hexane	20000	<10/<10	<10	<10	210	<10	<10

Note: All results are reported as micrograms per liter (ug/l). A field replicate sample was collected at monitoring well MW-1D. All samples were analyzed according to Aquatec Method OR209.

Table 3
Analytical Results - Residential Tap Water
Desso's General Store
Jericho Center, Vermont
Aquatec Project No. 88111

Compound	Lab # 89723 Smith 9/26/88	Lab # 89722 Desso 9/26/88	Lab # 90737 Thompson 10/14/88
benzene	<0.5	<0.5	<0.5
bromodichloroemethane	<0.5	<0.5	<0.5
bromoform	<0.5	<0.5	<0.5
bromomethane	<0.5	<0.5	<0.5
carbon tetrachloride	<0.5	<0.5	<0.5
chlorobenzene	<0.5	<0.5	<0.5
chloroethane	<0.5	<0.5	<0.5
chloroform	<0.5	<0.5	<0.5
chloromethane	<0.5	<0.5	<0.5
dibromochloromethane	<0.5	<0.5	<0.5
1,2-dichlorobenzene	<0.5	<0.5	<0.5
1,3-dichlorobenzene	<0.5	<0.5	<0.5
1,4-dichlorobenzene	<0.5	<0.5	<0.5
1,1-dichloroethane	<0.5	<0.5	<0.5
1,2-dichloroethane	<0.5	<0.5	<0.5
1,1-dichloroethene	<0.5	<0.5	<0.5
cis-1,2-dichloroethene	<0.5	<0.5	<0.5
trans-1,2-dichloroethene	<0.5	<0.5	<0.5
1,2-dichloropropane	<0.5	<0.5	<0.5
cis-1,3-dichloropropene	<0.5	<0.5	<0.5
trans-1,3-dichloropropene	<0.5	<0.5	<0.5
ethylbenzene	<0.5	<0.5	<0.5
methylene chloride	<0.5	<0.5	<0.5
1,1,2,2-tetrachloroethane	<0.5	<0.5	<0.5
tetrachloroethene	<0.5	<0.5	<0.5
toluene	<0.5	<0.5	<0.5
1,1,1-trichloroethane	<0.5	<0.5	<0.5
1,1,2-trichloroethane	<0.5	<0.5	<0.5
trichloroethene	<0.5	<0.5	<0.5
trichlorofluoromethane	<0.5	<0.5	<0.5
vinyl chloride	<0.5	<0.5	<0.5
xylenes	0.7	0.7	<0.5
Freon 113	<0.5	<0.5	NA
dichlorodifluoromethane	<0.5	<0.5	NA

Note: All results are reported as micrograms per liter (ug/l).
NA = not analyzed. All samples were analyzed according to EPA Methods 601 and 602.

Attachment A

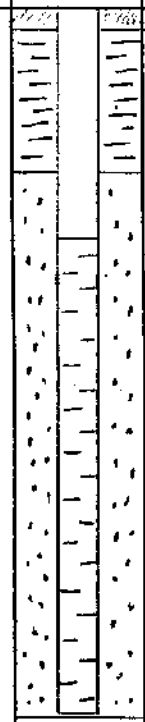
FIELD BORING LOG

Aquatec, Inc.
75 Green Mountain Drive
South Burlington, VT 05403

Project: COC - Desso
Project No: 88111
Location: Jericho Center, VT

Boring No: MW-1S
Sheet 1 **of** 1
Dates: 9/13/88

Elev. T.O.W: 100.18 **Elev. B.O.W:** 85.10 **Well Dia:** 2" **Boring Dia:** 4"
Screen Inter: 5.0' to 15.0' **Screen Matl:** 0.20 inch PVC **Casing Matl:** Sch 40 PVC
Packing Matl: Silica Sand **Seal Matl:** Bentonite Pellets **Backfill Matl:** Bentonite Pellets
Contractor: Adams Engineering **Driller:** G. Adams **Method:** Drive & Wash **Logged By:** RJR

Depth (Feet)	Sample Type and No.	Sample Depth Range (Feet)	Sample Recovery or RQD	Sample Blows	Well Const.	Soil and Rock Descriptions/Comments (Unified soil class system, Rock description, Depth to water, Loss of drill water, discoloration, PID, etc.)
	No Samples Collected					see boring log for MW-1D - COC - Desso (Project Number 88111)
5.0						
10.0						▼ @ 10' ATD
15.0						bottom of boring at 15 feet

Sample Type: A-Auger SS-Split Spoon RC-Rock Core C-Chips

Summary: Overburden Depth: - Bedrock Depth: - Total Depth: 15.0'

FIELD BORING LOG

Aquatec, Inc.
75 Green Mountain Drive
South Burlington, VT 05403

Project: COC - Desso
Project No: 88111
Location: Jericho Center, VT

Boring No: MW-1D
Sheet 1 **of** 2
Dates: 9/12/88-9/13/88

Elev. T.O.W: 100.31 **Elev. B.O.W:** 71.49 **Well Dia:** 2" **Boring Dia:** 4"
Screen Inter: 24' - 29' **Screen Matl:** 0.20 inch PVC **Casing Matl:** Sch 40 PVC
Packing Matl: Silica Sand **Seal Matl:** Bentonite Grout **Backfill Matl:** Bentonite Grout
Contractor: Adams Engineering **Driller:** G. Adams **Method:** Drive & Wash **Logged By:** RJR

Depth (Feet)	Sample Type and No	Sample Depth Range (Feet)	Sample Recovery or RQD	Sample Blows	Well Const.	Soil and Rock Descriptions/Comments (Unified soil class system, Rock description, Depth to water, Loss of drill water, discoloration, PID, etc.)
5	SS-1	5.1 to 7.1	50%	13/20 22/18		brown fine to coarse SAND, some coarse gravel, trace silt
						gray fine SAND, some silt, trace gravel
10	SS-2	9.0 to 11.0	50%	3/8 9/9		light brown fine to coarse SAND, some gravel grading to fine sand ▼@10' ATD
15	SS-3	14.7 to 16.7	75%	19/48 47/58		brown fine to coarse SAND, trace gravel, trace silt (brown till)
20	SS-4	20.0 to 20.3	100%	76/4"		gray fine SAND and SILT, some fine gravel, trace medium to coarse sand (gray till)
25	SS-5	24.7 to 26.3	100%	29/55 70		gray fine SAND and SILT, some coarse sand, trace gravel (gray till)

Sample Type: A-Auger SS-Split Spoon RC-Rock Core C-Chips

Summary: Overburden Depth: 30.0' Bedrock Depth: - Total Depth: 35.0'

FIELD BORING LOG

Aquatec, Inc.
75 Green Mountain Drive
South Burlington, VT 05403

Project: COC - Desso
Project No: 88111
Location: Jericho Center, VT

Boring No: MW-1D
Sheet 2 **of** 2
Dates: 9/12/88-9/13/88

Elev. T.O.W: 100.31 **Elev. B.O.W:** 71.49 **Well Dia:** 2" **Boring Dia:** 4"
Screen Inter: 24' to 29' **Screen Matl:** 0.20 inch PVC **Casing Matl:** Sch 40 PVC
Packing Matl: Silica Sand **Seal Matl:** Bentonite Grout **Backfill Matl:** Bentonite Grout
Contractor: Adams Engineering **Driller:** G. Adams **Method:** Drive & Wash **Logged By:** RJR

Depth (Feet)	Sample Type and No	Sample Depth Range (Feet)	Sample Recovery or RQD	Sample Blows	Well Const.	Soil and Rock Descriptions/Comments (Unified soil class system, Rock description, Depth to water, Loss of drill water, discoloration, PID, etc.)
						gray till
30						bedrock encountered at 30 feet
35	SS-6	35	0%	20/0"		bottom of boring at 35 feet
40						
45						

Sample Type: A-Auger SS-Split Spoon RC-Rock Core C-Chips

Summary: Overburden Depth: 30.0' Bedrock Depth: - Total Depth: 35.0'

FIELD BORING LOG

Aquatec, Inc.
75 Green Mountain Drive
South Burlington, VT 05403

Project: COC - Desso
Project No: 88111
Location: Jericho Center, VT

Boring No: MW-2
Sheet 1 **of** 1
Dates: 9/14/88

Elev. T.O.W: 100.00 **Elev. B.O.W:** 85.75 **Well Dia:** 2" **Boring Dia:** 4"
Screen Inter: 4.0' to 14.0' **Screen Matl:** 0.20 inch PVC **Casing Matl:** Sch 40 PVC
Packing Matl: Silica Sand **Seal Matl:** Bentonite Pellets **Backfill Matl:** Natural
Contractor: Adams Engineering **Driller:** G. Adams **Method:** Drive & Wash **Logged By:** RJR

Depth (Feet)	Sample Type and No	Sample Depth Range (Feet)	Sample Recovery or RQD	Sample Blows	Well Const.	Soil and Rock Descriptions/Comments (Unified soil class system, Rock description, Depth to water, Loss of drill water, discoloration, PID, etc.)
5.0	SS-1	5.3 to 7.3	30%	9/9 12/16		brown fine to coarse SAND, some fine gravel, trace silt
10.0						▼ @ 10' ATD
	SS-2	10.7 to 12.7	25%	5/5 6/8		brown fine to medium SAND, some coarse sand, trace gravel (brown till) boulder at approximately 13 feet
15.0	SS-3	14.5 to 16.5	25%	11/10 11/11		brown fine SAND, some medium to coarse sand, trace gravel (brown till) bottom of boring at 16.5 feet
20.0						

Sample Type: A-Auger SS-Split Spoon RC-Rock Core C-Chips

Summary: Overburden Depth: - Bedrock Depth: - Total Depth: 16.5

FIELD BORING LOG

Aquatec, Inc.
75 Green Mountain Drive
South Burlington, VT 05403

Project: COC - Desso
Project No: 88111
Location: Jericho Center, VT

Boring No: MW-3
Sheet 1 **of** 1
Dates: 9/14/88-9/15/88

Elev. T.O.W: 94.09 **Elev. B.O.W:** 77.56 **Well Dia:** 2" **Boring Dia:** 4"
Screen Inter: 3.6' to 13.6' **Screen Matl:** 0.20 inch PVC **Casing Matl:** Sch 40 PVC
Packing Matl: Silica Sand **Seal Matl:** Bentonite Pellets **Backfill Matl:** Natural
Contractor: Adams Engineering **Driller:** G. Adams **Method:** Drive & Wash **Logged By:** RJR

Depth (Feet)	Sample Type and No.	Sample Depth Range (Feet)	Sample Recovery or RQD	Sample Blows	Well Const.	Soil and Rock Descriptions/Comments (Unified soil class system, Rock description, Depth to water, Loss of drill water, discoloration, PID, etc.)
5.0	SS-1	5.8 to 7.3	20%	6/15 19		brown fine to medium SAND, some coarse sand (mottling)
10.0	SS-2	10.2 to 11.5	100%	13/38 70/3"		gray brown fine SAND, little gravel, trace medium to coarse sand (mottling) (gray-brown till)
15.0	SS-3	15.9 to 16.8	100%	6/71/5"		gray fine SAND, some medium to coarse sand, little gravel, trace silt (gray till) bottom of boring at 16.8 feet
20.0						

Sample Type: A-Auger SS-Split Spoon RC-Rock Core C-Chips

Summary: Overburden Depth: - Bedrock Depth: - Total Depth: 16.8'

Attachment B

FIELD DATA
Desso's General Store
Jericho Center, Vermont
Aquatec Project No. 88111

Well ID: MW-1S

Time: 1158

Date: 9/26/88

Well Elevation (assumed) (ft.): 100.18

Depth from Top of Casing (ft.): 10.90

Water Elevation (ft.): 89.28

Well Bottom Elevation (ft.): 85.10

Height of Water Column (ft.): 4.18

Volume of Water (gal.): .66

Temperature 13.1°C at 1020 hours

Temperature 13.9°C at 1150 hours

Conductivity 1960 mS/cm at 1020 hours

Conductivity 1952 mS/cm at 1158 hours

Purging Description: Purged well by hand using Teflon bailer. Hand bailed approximately 2.5 gallons.

Sample Collection: Sample collected using Teflon bailer by filling two 40 ml vials preserved with hydrochloric acid (HCl). Sample analyzed for BTEX and hydrocarbons using Method OR209.

Comments: Strong gasoline odor in water during well purging and sample collection.

FIELD DATA
Desso's General Store
Jericho Center, Vermont
Aquatec Project No. 88111

Well ID: MW-1D

Time: 1125

Date: 9/26/88

Well Elevation (assumed) (ft.): 100.31

Depth from Top of Casing (ft.): 11.97

Water Elevation (ft.): 88.34

Well Bottom Elevation (ft.): 71.49

Height of Water Column (ft.): 16.85

Volume of Water (gal.): 2.64

Temperature 11.8°C at 1020 hours

Temperature 11.2°C at 1125 hours

Conductivity 450 mS/cm at 1020 hours

Conductivity 597 mS/cm at 1125 hours

Purging Description: Purged well by hand using Teflon bailer. Hand bailed approximately 5 gallons.

Sample Collection: Sample collected using Teflon bailer by filling two 40 ml vials preserved with hydrochloric acid (HCl). Sample analyzed for BTEX and hydrocarbons using Method OR209.

Comments: Collected replicate sample.

FIELD DATA
Desso's General Store
Jericho Center, Vermont
Aquatec Project No. 88111

Well ID: MW-2

Time: 1106

Date: 9/26/88

Well Elevation (assumed) (ft.): 100.00

Depth from Top of Casing (ft.): 10.09

Water Elevation (ft.): 89.91

Well Bottom Elevation (ft.): 85.75

Height of Water Column (ft.): 4.16

Volume of Water (gal.): 0.66

Temperature 12.9°C at 1015 hours

Temperature 13.1°C at 1106 hours

Conductivity 838 mS/cm at 1015 hours

Conductivity 765 mS/cm at 1106 hours

Purging Description: Purged well by hand using Teflon bailer. Hand bailed approximately 3 gallons.

Sample Collection: Sample collected using Teflon bailer by filling two 40 ml vials preserved with hydrochloric acid (HCl). Sample analyzed for BTEX and hydrocarbons using Method OR209.

Comments:

FIELD DATA
Desso's General Store
Jericho Center, Vermont
Aquatec Project No. 88111

Well ID: MW-3

Time: 1100

Date: 9/26/88

Well Elevation (assumed) (ft.): 94.09

Depth from Top of Casing (ft.): 11.99

Water Elevation (ft.): 82.20

Well Bottom Elevation (ft.): 77.56

Height of Water Column (ft.): 4.64

Volume of Water (gal.): 0.75

Temperature 11.7°C at 1015 hours

Temperature 11.7°C at 1100 hours

Conductivity 1782 mS/cm at 1015 hours

Conductivity 1932 mS/cm at 1100 hours

Purging Description: Purged well by hand using Teflon bailer. Hand bailed approximately 3 gallons.

Sample Collection: Sample collected using Teflon bailer by filling two 40 ml vials preserved with hydrochloric acid (HCl). Sample analyzed for BTEX and hydrocarbons using Method OR209.

Comments:

FIELD DATA
Desso's General Store
Jericho Center, Vermont
Aquatec Project No. 88111

Well ID: Bedrock Supply Well

Time: 1207

Date: 9/26/88

Well Elevation (assumed) (ft.): 102.05

Depth from Top of Casing (ft.): 39.40

Water Elevation (ft.): 62.65

Well Bottom Elevation (ft.): -

Height of Water Column (ft.): 105.8

Volume of Water (gal.): -

Temperature 9.6°C at 1025 hours

Temperature 10.1°C at 1207 hours

Conductivity 555 mS/cm at 1025 hours

Conductivity 511 mS/cm at 1207 hours

Purging Description: Bedrock well not purged prior to sampling. However, tap water at Smith's and Desso's was left running for approximately 20 minutes before collecting sample from well.

Sample Collection: Sample collected using Teflon bailer by filling two 40 ml vials preserved with hydrochloric acid (HCl). Sample analyzed for BTEX and hydrocarbons using Method OR209.

Comments: Slight gasoline odor in water during sampling. Well is currently being used by the Smith's and Desso's.

Attachment C

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ENVIRONMENTAL SERVICES
75 Green Mountain Drive, So. Burlington, VT 05403
TEL. 802/658-1074

ANALYTICAL REPORT

COC - Desso

Date: 10/25/88
Project No: 88111
ETR No: 15111
Sample(s) Received On: 9/26/88
Page 1 of 1

Standard analyses were performed in accordance with Methods for Analysis of Water and Wastes, EPA-600/4/79-020, Test Methods for Evaluating Solid Waste, SW-846, or Standard Methods for the Examination of Water and Wastewater. All results are in mg/l unless otherwise noted.

Parameter	89716	89717	89718	89719	89720	89721		
Following Results are in µg/l								
Benzene	<1	<1	50	<1	<1	3.9		
Toluene	<1	<1	4400	<1	<1	<1		
Ethylbenzene	<1	<1	2600	<1	<1	<1		
Xylenes	<1	<1	18000	<1	<1	36		
Other Aromatic Hydrocarbons as o-Xylene	<10	<10	12000	<10	<10	64		
Aliphatic Hydrocarbons as Hexane	<10	<10	20000	<10	<10	210		

Lab No.	Sample Description
89716.	Water sample labeled trip blank, collected 9/26/88 at 0900 hours.
89717.	Water sample labeled equip. blank, collected 9/26/88 at 1110 hours.
89718.	Water sample labeled MW-1S, collected 9/26/88 at 1158 hours.
89719.	Water sample labeled MW-2, collected 9/26/88 at 1106 hours.
89720.	Water sample labeled MW-3, collected 9/26/88 at 1100 hours.
89721.	Water sample labeled supply well, collected 9/26/88 at 1207 hours.

Submitted By: R. Mann McBee Aquatec Inc.

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ANALYTICAL REPORT

COC - Desso

Date: 10/25/88
Project No: 88111
ETR No: 15112
Sample(s) Received On: 9/26/88
Page 1 of 1

Standard analyses were performed in accordance with Methods for Analysis of Water and Wastes, EPA-600/4/79-020, Test Methods for Evaluating Solid Waste, SW-846, or Standard Methods for the Examination of Water and Wastewater. All results are in mg/l unless otherwise noted.

Parameter	89724	89725						
Following Results are in µg/l								
Benzene	<1	<1						
Toluene	<1	<1						
Ethylbenzene	<1	<1						
Xylenes	<1	<1						
Other Aromatic Hydrocarbons as o-Xylene	<10	<10						
Aliphatic Hydrocarbons as Hexane	<10	<10						

Lab No.	Sample Description
89724.	Water sample labeled MW-1D, collected 9/26/88 at 1125 hours.
89725.	Water sample labeled MW-1DR, collected 9/26/88 at 1125 hours.

Submitted By: R. Mason Nichols Aquatec Inc.

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ANALYTICAL REPORT

Date: 17 September 1988
Aquatec Lab No.: 89722
ETR No.: 15111
Sample Received On: 26 September 1988
Sample Identification: Water sample labeled Desso, collected 9/26/88 at 1218 hours.

Volatile Organic Compounds in ug/l

benzene	<0.5
bromodichloromethane	<0.5
bromoform	<0.5
bromomethane	<0.5
carbon tetrachloride	<0.5
chlorobenzene	<0.5
chloroethane	<0.5
chloroform	<0.5
chloromethane	<0.5
dibromochloromethane	<0.5
1,2-dichlorobenzene	<0.5
1,3-dichlorobenzene	<0.5
1,4-dichlorobenzene	<0.5
1,1-dichloroethane	<0.5
1,2-dichloroethane	<0.5
1,1-dichloroethene	<0.5
cis-1,2-dichloroethene	<0.5
trans-1,2-dichloroethene	<0.5
1,2-dichloropropane	<0.5
cis-1,3-dichloropropene	<0.5
trans-1,3-dichloropropene	<0.5
ethylbenzene	<0.5
methylene chloride	<0.5
1,1,2,2-tetrachloroethane	<0.5
tetrachloroethene	<0.5
toluene	<0.5
1,1,1-trichloroethane	<0.5
1,1,2-trichloroethane	<0.5
trichloroethene	<0.5
trichlorofluoromethane	<0.5
vinyl chloride	<0.5
xylenes	0.7
Freon 113	<0.5
dichlorodifluoromethane	<0.5

Percent Surrogate Standard Recoveries

Method 601 101%
Method 602 96%

Sample was analyzed by EPA Methods 601-602.

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ANALYTICAL REPORT

Date: 17 September 1988
Aquatec Lab No.: 89723
ETR No.: 15111
Sample Received On: 26 September 1988
Sample Identification: Water sample labeled Smith, collected 9/26/88 at 1150 hours.

Volatile Organic Compounds in ug/l

benzene	<0.5
bromodichloromethane	<0.5
bromoform	<0.5
bromomethane	<0.5
carbon tetrachloride	<0.5
chlorobenzene	<0.5
chloroethane	<0.5
chloroform	<0.5
chloromethane	<0.5
dibromochloromethane	<0.5
1,2-dichlorobenzene	<0.5
1,3-dichlorobenzene	<0.5
1,4-dichlorobenzene	<0.5
1,1-dichloroethane	<0.5
1,2-dichloroethane	<0.5
1,1-dichloroethene	<0.5
cis-1,2-dichloroethene	<0.5
trans-1,2-dichloroethene	<0.5
1,2-dichloropropane	<0.5
cis-1,3-dichloropropene	<0.5
trans-1,3-dichloropropene	<0.5
ethylbenzene	<0.5
methylene chloride	<0.5
1,1,2,2-tetrachloroethane	<0.5
tetrachloroethene	<0.5
toluene	<0.5
1,1,1-trichloroethane	<0.5
1,1,2-trichloroethane	<0.5
trichloroethene	<0.5
trichlorofluoromethane	<0.5
vinyl chloride	<0.5
xylenes	0.7
Freon 113	<0.5
dichlorodifluoromethane	<0.5

Percent Surrogate Standard Recoveries

Method 601	102%
Method 602	98%

Sample was analyzed by EPA Methods 601-602.

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ANALYTICAL REPORT

Date: 19 October 1988
Aquatec Lab No.: 90737
ETR No.: 15328; Project # 88111
Sample Received On: 14 October 1988
Sample Identification: Champlain Oil Co., Desso, water sample labeled Thompson, collected 10/14/88 at 1130 hours.

Volatile Organic Compounds in ug/l

benzene	<0.5
bromodichloromethane	<0.5
bromoform	<0.5
bromomethane	<0.5
carbon tetrachloride	<0.5
chlorobenzene	<0.5
chloroethane	<0.5
chloroform	<0.5
chloromethane	<0.5
dibromochloromethane	<0.5
1,2-dichlorobenzene	<0.5
1,3-dichlorobenzene	<0.5
1,4-dichlorobenzene	<0.5
1,1-dichloroethane	<0.5
1,2-dichloroethane	<0.5
1,1-dichloroethene	<0.5
cis-1,2-dichloroethene	<0.5
trans-1,2-dichloroethene	<0.5
1,2-dichloropropane	<0.5
cis-1,3-dichloropropene	<0.5
trans-1,3-dichloropropene	<0.5
ethylbenzene	<0.5
methylene chloride	<0.5
1,1,2,2-tetrachloroethane	<0.5
tetrachloroethene	<0.5
toluene	<0.5
1,1,1-trichloroethane	<0.5
1,1,2-trichloroethane	<0.5
trichloroethene	<0.5
trichlorofluoromethane	<0.5
vinyl chloride	<0.5
xylenes	<0.5

Surrogate Recovery	% Rec
Method 601	104%
Method 602	110%

Sample was analyzed by EPA Methods 601 and 602

Attachment D

Attachment D
Hydraulic Gradient and Ground Water
Flow Velocity Calculations
Desso's General Store
Jericho Center, Vermont
Aquatec Project No. 88111

I. Hydraulic gradient (Hg)

$$Hg = \frac{h_1 - h_2}{L}$$

where,

h_1 = water level at point 1 (ft.)
h_2 = water level at point 2 (ft.)
L = distance between point 1 and point 2 (ft.)

a. Vertical hydraulic gradient between MW-1S and MW-1D

hMW-1S = 89.28 ft.
hMW-1D = 88.34 ft.
L = 3 ft.

$$Hg = \frac{89.28 - 88.34}{3}$$

$$Hg = 0.31$$

downward vertical gradient of 0.31 between MW-1S and MW-1D

b. Horizontal hydraulic gradient between MW-1S and MW-3

hMW-1S = 89.28 ft.
hMW-3 = 82.20 ft.
L = 78 ft.

$$Hg = \frac{89.28 - 82.20}{L}$$

$$Hg = 0.09$$

horizontal gradient of 0.09 between MW-1S and MW-3

c. Horizontal hydraulic gradient between MW-2 and MW-3

hMW-2 = 89.91 ft.
hMW-3 = 82.20 ft.
L = 127 ft.

$$Hg = \frac{89.91 - 82.20}{127}$$

$$Hg = 0.06$$

horizontal gradient of 0.06 between MW-2 and MW-3

II. Ground water flow velocity (Va)

$$Va = \frac{K}{n} \frac{(h_1 - h_2)}{L}$$

where,

K = hydraulic conductivity (ft/s)

$\frac{(h1 - h2)}{L}$ = hydraulic gradient (ft/ft)

n = average soil porosity

a. ground water flow velocity

$$Va = \frac{10^{-5} \text{ ft/s } (0.09)}{0.30} \text{ ft/ft}$$

Va = 3 x 10-6 ft/s
= 94.6 ft/year

Assuming a uniform geologic material with a published value of K = 10^{-5} ft/sec and an average porosity value of n = 0.30. Freeze and Cherry, 1979. Groundwater. Prentice Hall, Inc. Englewood Cliffs, NJ.