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# INITIAL SITE INVESTIGATION REPORT

## QUARRY HILL QUICK STOP
**Barre, Vermont**

**(VT DEC SITE #98-2388)**

11 February 1999

Prepared for:

**Bradford Oil Co.**
P.O. Box 394
Bradford, Vermont 05033

Contact: Mr. Eugene Pushee
Phone: 802-222-5251

Prepared by:

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11 February 1999

Mr. Gene Pushee
Bradford Oil Company
P.O. Box 394
Bradford, Vermont 05033

Re: *Initial Site Investigation Report*
*Quarry Hill Quick Stop, Barre, VT*

Dear Mr. Pushee:

Enclosed is a final copy of the *Initial Site Investigation Report* for the Quarry Hill Quick Stop, located on Graniteville Road in Barre, Vermont. Per your request, the report has been submitted to Mr. Bob Butler at the VT DEC.

Should you have any questions or concerns regarding this report or any other project matter, please do not hesitate to contact either Ron Miller or myself at (800) 520-6065.

Sincerely,

**Marin Environmental, Inc.**

Eric J. Swiech
Hydrogeologist

enclosure

cc: Mr. Bob Butler, VT DEC

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## EXECUTIVE SUMMARY

Marin Environmental, Inc. (**Marin**) has conducted an initial site investigation (ISI) at the Quarry Hill Quick Stop, located on Quarry Hill Road in Barre, Vermont. The ISI included the installation of four soil borings/monitoring wells, ground water and surface water testing, and an evaluation of potential threats to nearby receptors. **Marin**'s findings related to this work are summarized as follows:

- Subsurface gasoline contamination was discovered at the site in May 1998 during the closure of three gasoline underground storage tanks (USTs) and the installation of a 15,000-gallon replacement UST. Photoionization detector (PID) readings on soils in the former UST excavation were detected up to 200 parts per million (ppm); PID readings on soils from the base of the replacement UST excavation, located immediately downgradient of the former pump island, averaged 1,529 ppm.

- Several potential sources of petroleum contamination have been identified on-site. These include the former UST area, the former pump island, a 275-gallon kerosene aboveground storage tank (AST), and an unknown source of motor-oil contamination, possibly related to former automotive-service operations at the site.

- Analytical results from sampling performed on 4 November 1998 indicate that the shallow aquifer beneath the site, as well as a reach of an unnamed intermittent stream, are contaminated with dissolved-phase gasoline-related VOCs. Total dissolved-phase VOC concentrations in ground water ranged from 24.1 micrograms per liter (µg/L) in monitoring well MW-1 to 1,095 µg/L in monitoring well MW-3. Vermont Groundwater Enforcement Standards (VGESs) were exceeded for one or more gasoline-related VOCs in monitoring wells MW-1, MW-3, and MW-4. Benzene was detected at 2.3 µg/L in the unnamed stream's down-gradient sample (SW-3), exceeding the Vermont Water Quality Criterion (WQC) of 1.2 µg/L for this compound.

- Free-phase product, identified via petroleum fingerprinting as a motor oil/kerosene mixture, is present on the water table in the vicinity of monitoring well MW-2. The lateral extent of dissolved-phase and free-phase contamination has not been adequately defined.

- No petroleum-related VOCs were identified in a sample collected from the bathroom faucet of the convenience store, suggesting that the on-site bedrock supply well is not currently being impacted by petroleum contaminants. However, the hydraulic relationship between the contaminated overburden aquifer and the bedrock supply well is unknown at this time.

## EXECUTIVE SUMMARY

- Underground utilities at the site, namely the sanitary sewer corridor and downgradient manhole, may be at risk for petroleum vapor accumulation based on their proximity to contaminants identified on-site.

- A drain pipe that discharges to the stream appears to be connected to the sinks within the convenience store.

- In general, sandy fill materials are present across the site to approximately seven to twelve feet below ground surface (bgs). The fill materials are underlain by native poorly-sorted silty-sands and very-coarse to very-fine sands. Auger refusal, possibly on bedrock, was encountered in monitoring wells MW-2 and MW-4 at approximately 22 and 17 feet bgs, respectively. No bedrock outcrops were observed on-site. During the boring program, ground water was encountered at the site approximately at depths of seven to 16.5 feet bgs.

- Based on the limited hydrogeologic data collected at the site to date, ground water in the unconfined surficial aquifer at the site appears to flow in a northeasterly direction toward the intermittent stream, with an average horizontal hydraulic gradient of approximately six percent. However, surficial topography and regional surface-water drainage patterns suggest a ground-water divide may be present on the western edge of the property, the axis of which may run parallel with Quarry Hill Road. Shallow ground-water flow beneath the site may also be influenced by the building's perimeter drain, and a reported buried stream channel which is apparently located approximately 40 to 50 feet southwest of the stream's current location. Each of these features might act as a preferential pathway for ground-water migration. The vertical ground-water flow components at the site are currently unknown. Additional data are necessary to adequately characterize hydrogeologic conditions at the site.

Based on all the data collected at the site to date, **Marin** recommends the following:

1. Seven water-table monitoring wells, one deeply-screened monitoring well, and two hand-augered piezometers, should be installed to complement the existing suite of wells and further characterize hydrogeologic and contaminant conditions at the site. The proposed monitoring well locations, including well-placement rationale, are included on Figure 7, Appendix A.

2. Water quality in the on-site bedrock supply well should be monitored quarterly for the possible presence of petroleum compounds. Although this will not provide direct evidence as to the

hydraulic connection between the surficial and bedrock aquifers, periodic water quality monitoring of the well, together with information on vertical hydraulic gradients from the proposed deep overburden monitoring well, avoids the risk of inducing contaminant migration into the bedrock well that is inherent in a pumping test.

3. The newly installed and existing monitoring wells, the three surface water locations, and the on-site supply well should be sampled and analyzed for the possible presence of volatile petroleum compounds by EPA Method 8021B. If free product is encountered in any of the wells at recoverable quantities, it should be removed and containerized on-site in a properly labeled drum.
4. A dye test should be performed to determine whether or not the sinks in the convenience store are connected to the drain pipe that discharges to the stream.
5. The downgradient sanitary-sewer manhole, located along Quarry Hill Road, should be screened for the possible presence of VOCs with a PID. An aqueous sample should also be collected from this location and analyzed by EPA Method 8021B.
6. Upon completion of the additional work, a report should be prepared which includes relevant tables and figures, and identifies an appropriate course of action for the site.

## 1.0 INTRODUCTION

This report details the results of an Initial Site Investigation (ISI) performed by Marin Environmental, Inc. (**Marin**) at the Quarry Hill Quick Stop, located on Quarry Hill Road in Barre, Vermont (Figures 1 and 2, Appendix A). This report has been prepared by **Marin** on behalf of Bradford Oil Company, owner of the former underground storage tanks (UST). The ISI was conducted in accordance with a work plan approved by the Vermont Department of Environmental Conservation (VT DEC) on 28 September 1998.

### 1.1 Site Description and Physical Setting

The site is located on Quarry Hill Road in Barre, Vermont, at the intersection of Beede Road (Figure 1, Appendix A). Two structures are present on the property. The larger of the two buildings is occupied as a convenience store in the front, and a small apartment complex in the rear; the smaller building is a storage shed (Figure 2, Appendix A). The remainder of the property generally consists of asphalt and gravel parking areas. The site is bounded by Quarry Hill Road to the west, Beede Road to the north, private residences to the south, and an intermittent stream to the east. An on-site supply well provides drinking water for the property and the two residences to the south. The store and apartments are reportedly connected to the municipal sanitary sewer.

In general, the ground surface at the site slopes gently to the north-northeast. At the northeast end of the site, a steep embankment slopes down to the northeast toward an intermittent stream, which is approximately 15 feet lower in elevation. A drain pipe, reported to be associated with the building's perimeter drain, discharges into the stream at the base of the embankment near the northeast corner of the site. However, cigarette butts and debris associated with food preparation were observed at the outfall, suggesting the drain pipe may be connected to sinks located within the convenience store. The stream flows to the northwest through a culvert beneath Beede Road, then flows generally northward, paralleling Quarry Hill Road. The terminus of the stream is currently unknown.

According to Mr. Wayne Tucker, current owner of the Quarry Hill Quick Stop, the east-northeast portion of the site has been the subject of extensive earthwork in the past before his ownership. Apparently, the steep embankment and stream were formerly located approximately 40 to 50 feet southwest of their current location. The former stream channel was reportedly buried with fill materials and re-routed to accommodate construction of the attached apartment complex at the rear of the store.

## 1.2 Site History

Subsurface petroleum contamination was discovered at the Quarry Hill Quick Stop on 9 May 1998 during the removal of three gasoline underground storage tanks (USTs). According to a report prepared by Griffin International, Inc. dated 13 May 1998, photoionization detector (PID) readings from soils within the excavation ranged from 0.1 to 200 parts per million (ppm), with the highest reading observed approximately ten feet below ground surface (bgs), in the vicinity of the former fill pipes.

An additional area of petroleum contamination was discovered on-site on 12 May 1998 during the excavation for a 15,000-gallon replacement UST, located approximately 40 feet northwest of the former USTs, immediately north of the pump island. According to a report prepared by Griffin International, Inc. dated 13 May 1998, approximately 160 cubic yards of contaminated soils, with PID readings ranging from 1.8 to 830 ppm, were removed and stockpiled on-site to accommodate the replacement UST. Soil samples collected from the base of the excavation, approximately 12 feet bgs, yielded PID readings averaging 1,529 ppm. These soils were apparently not removed.

The on-site water supply well, located approximately 20 feet northeast of and in the presumed downgradient direction of the former UST area, was sampled by Griffin International, Inc. on 21 May 1998 for laboratory analysis by EPA Method 602. No petroleum compounds were detected in this sample.

On 1 September 1998, based on PID screening and confirmatory laboratory testing by Marin Environmental, Inc., the VT DEC approved the use of the on-site soil stockpile as clean fill at Roland's Mini Mart, in Barre, Vermont. The stockpile was subsequently transported to this facility.

## 1.3 Objectives and Scope of Work

The objectives of this initial site investigation were to:

- evaluate the degree and extent of petroleum contamination in soil and ground water;
- qualitatively assess the risks to environmental and public health via relevant sensitive receptors and potential contaminant migration pathways; and
- identify potentially appropriate monitoring and/or remedial actions based on the site conditions.

To accomplish these objectives, **Marin has**: 4?

- supervised the completion of four soil borings/monitoring wells at the site;

- screened subsurface soils from the soil borings for the possible presence of volatile organic compounds (VOCs) using a PID;
- collected and submitted ground-water samples from three monitoring wells, and the on-site supply well, for laboratory analysis of volatile petroleum compounds by EPA Method 8021B;
- collected and submitted a sample of free-phase product from monitoring well MW-2 for laboratory petroleum fingerprint analysis;
- collected and submitted three surface-water samples from the intermittent stream for laboratory analysis of volatile petroleum compounds by EPA Method 8021B;
- identified sensitive receptors in the area, and assessed the risk posed by the contamination to these potential receptors;
- prepared this summary report, which details the work performed, qualitatively assesses risks, provides conclusions, and offers recommendations for further action.

## 2.0 INVESTIGATIVE PROCEDURES AND RESULTS

### 2.1 Soil Boring / Monitoring Well Installation

On 22 October 1998, **Marin** supervised the completion of four soil borings/monitoring wells (MW-1, MW-2, MW-3, and MW-4) to initially characterize contaminant and hydrogeolgic conditions at the site (Figure 2, Appendix A). Monitoring well MW-1 was located in the presumed upgradient direction from the former UST area, monitoring wells MW-2 and MW-3 were installed in the presumed downgradient direction of the former USTs and pump island, and MW-4 was located adjacent to the presumed downgradient end of the newly installed 15,000-gallon replacement UST. A monitoring well could not be installed adjacent to the presumed downgradient edge of the former pump island due to the presence of overhead utilities.

In general, sandy fill materials were encountered across the site to approximately seven to twelve feet bgs. The fill materials were found to be underlain by native poorly-sorted silty-sands and very-coarse to very-fine sands. Auger refusal, possibly on bedrock, was encountered in monitoring wells MW-2 and MW-4 at approximately 21.9 and 16.9 feet bgs, respectively. No bedrock outcrops were observed on-site. During the boring program, ground water was encountered at the site at depths of approximately seven to 16.5 feet bgs. Geologic cross-section interpretations, based on soil-boring logs and field observations, are included in Appendix A (Figures 5 and 6).

The soil borings were advanced by M&W Soils Engineering, Inc., of Charlestown, New Hampshire, using the hollow-stem-auger (HSA) drilling method. Soil samples were collected at five-foot intervals from each boring using a standard split-spoon barrel. Sample recovery was poor to excellent, ranging from five to 100 percent. The samples obtained were screened for the possible presence of VOCs with a PID, and logged for lithology by a **Marin** hydrogeologist. All downhole drilling and sampling equipment was decontaminated during use as appropriate.

Monitoring wells were constructed with two-inch-diameter schedule 40 poly-vinyl chloride (PVC) with flush threaded joints. Well screens consisted of 0.010-inch factory-slotted, ten-foot screen sections, and were placed approximately five to nine feet into the water table. Sections of PVC riser were added to extend the tops of the well casings to approximately 0.5 feet bgs. Clean silica #1 filter sand was placed in the borehole annulus around each well screen extending approximately 1.5 to 2.5 feet above the slotted interval. A bentonite chip seal, at least one-foot thick, was set above each well's sand pack. The remainder of the annular space around the PVC riser was backfilled with native material. The completed monitoring wells were protected by flush-mounted steel roadboxes. Each well casing was topped with a water-tight expansion cap. Soil-boring and monitoring-well construction logs are included in Appendix B.

To remove fine-grained sediment, the monitoring wells were developed immediately after installation using a peristaltic pump. None of the monitoring wells contained free-phase product during development, although a heavy sheen was observed at MW-2. Development water was discharged directly to the ground surface in the vicinity of each well. On 4 November 1998, the monitoring wells were surveyed relative to existing site features, with an azimuth accuracy of (±) 1.0 feet, and an elevation accuracy of (±) 0.01 feet.

## 2.2 Soil-Screening Results

During the soil-boring program on 22 October 1998, soil samples were collected from discrete intervals in each boring for subsequent headspace screening with a PID. Elevated PID readings were measured on soil samples collected at each soil boring location.

The highest PID reading (153.2 ppm) was recorded from a soil sample collected approximately two feet bgs in MW-1. Elevated PID readings were observed throughout the soil column at this location, with a PID reading of 2.5 ppm detected at the base of the boring at approximately 16.5 feet bgs. Soil screening results from MW-1 suggest the boring was advanced within the former UST excavation.

In MW-2, PID readings were slightly above or at background levels throughout the vadose zone to approximately 15 feet bgs. PID levels increased to 1.3 ppm in the capillary fringe and 1.7 ppm at the water table, where a heavy sheen was present on the saturated soils. A PID reading of 0.3 ppm was detected at the base of the boring at approximately 22.0 feet bgs.

In MW-3, PID readings were at background levels throughout the vadose zone to approximately 10 feet bgs. PID levels increased to 0.5 ppm in the capillary fringe and 24.9 ppm at the water table. A PID reading of 0.1 ppm was detected at the base of the boring at approximately 16.5 feet bgs.

In MW-4, PID readings were at background levels throughout the vadose zone to approximately 10 feet bgs, where PID levels increased to 1.1 ppm at the water table. A PID reading of 13.2 ppm was detected at the base of the boring at approximately 16.9 feet bgs.

PID screening results are included on the boring logs in Appendix B.

A **Marin** hydrogeologist screened soil samples from each soil boring for the possible presence of volatile organic compounds (VOCs) using a PhotoVac Model 2020 portable photoionization detector (PID). The PID was calibrated in the field with an isobutylene standard gas to a benzene reference.

### 2.3 Ground-Water Elevation Calculations and Flow Direction

Based on the limited hydrogeologic data collected at the site to date, ground water in the unconfined surficial aquifer at the site appears to flow in a northeasterly direction toward the intermittent stream, with an average horizontal hydraulic gradient of approximately six percent. However, surficial topography and regional surface-water drainage patterns suggest a ground-water divide may be present on the western edge of the property, the axis of which may run parallel with Quarry Hill Road. Shallow ground-water flow beneath the site may also be influenced by the building's perimeter drain, and a reported buried stream channel which is apparently located approximately 40 to 50 feet southwest of the stream's current location. Each of these features might act as a preferential pathway for ground-water migration. The vertical ground-water flow components at the site are currently unknown. Additional data are necessary to adequately characterize hydrogeologic conditions at the site.

Fluid levels were measured in the on-site monitoring wells on 4 November 1998. Depths to water ranged from 5.92 feet (MW-1) to 12.23 feet (MW-2) below top-of-casing. Approximately 0.1 feet

of free-phase product was observed in monitoring well MW-2. Static water-table elevations were computed for each monitoring well by subtracting the measured or corrected depth-to-water readings from the surveyed top-of-casing elevations, which are relative to an arbitrary site datum of 100.00 feet. Water-level measurements and elevation calculations for 4 November 1998 are presented in Table 1 (Appendix A); Figure 3 is the water-table contour map prepared using these data (Appendix A).

### 2.4 Sampling and Analysis

Dissolved-phase gasoline constituents were detected in ground-water and surface-water samples collected at the site on 4 November 1998. Free-phase product, identified via petroleum fingerprinting as a motor oil/kerosene mixture, was observed in monitoring well MW-2.

Total dissolved-phase VOC concentrations ranged from 24.1 micrograms per liter (µg/L) in monitoring well MW-1 to 1,095 µg/L in monitoring well MW-3. Vermont Groundwater Enforcement Standards[1] (VGESs) were exceeded for one or more gasoline-related VOCs in monitoring wells MW-1, MW-3, and MW-4. Benzene was detected at 2.3 µg/L in the unnamed stream's down-gradient sample (SW-3), exceeding the Vermont Water Quality Criterion[2] (WQC) of 1.2 µg/L for this compound. No petroleum-related VOCs were identified in a sample collected from the bathroom faucet of the convenience store, suggesting that the on-site bedrock supply well is not currently being impacted by petroleum contaminants. Analytical results are included in Table 2, and on the Contaminant-Distribution Map (Appendix A, Figure 4). Laboratory report forms are included in Appendix C.

Water-quality samples were collected on 4 November 1998 from three monitoring wells (MW-1, MW-3, and MW-4), three surface water locations (SW-1, SW-2, and SW-3), and the on-site supply well. The SW-2 sample was collected directly from the drain pipe effluent that discharges into the stream. The supply-well sample was obtained from the store's bathroom faucet, after allowing the tap to run for approximately five minutes. A sample of free-phase product was also collected from MW-2 for petroleum fingerprinting. Monitoring wells were purged and then

[1] The Vermont DEC has established Groundwater Enforcement Standards (VGESs) for eight petroleum related VOCs, as follows: benzene - 5 ppb; toluene – 1,000 ppb; ethylbenzene - 700 ppb; xylenes – 10,000 ppb.; MTBE, a gasoline additive, - 40 ppb; napthalene – 20 ppb; 1,2,4 trimethylbenzene – 5 ppb; and 1,3,5 trimethylbenzene –4 ppb.

[2]The Vermont DEC has established Water Quality Criteria (WQC) for the protection of human health in Class B waters for three petroleum related VOCs, as follows: benzene - 1.2 ppb; toluene - 6,800 ppb; and ethylbenzene - 3,100 ppb.

sampled using dedicated bailers and dropline. Purge water was discharged directly to the ground in the vicinity of each well. Trip blank and duplicate samples were collected to ensure that adequate quality assurance/quality control (QA/QC) standards were maintained. All field procedures were conducted in accordance with **Marin** standard protocols.

All samples were transported under chain-of-custody in an ice-filled cooler to Endyne, Inc. of Williston, Vermont. All samples, with the exception of the free-phase product sample collected from MW-2, were analyzed for the possible presence of volatile petroleum compounds by EPA Method 8021B. The compounds tested for included: benzene, toluene, ethylbenzene, total xylenes, 1,3,5-trimethylbenzene, 1,2,4-trimethylbenzene, naphthalene, and methyl tertiary butyl-ether (MTBE). Analytical results from the QA/QC samples indicate that adequate QA/QC was maintained during sample collection and analysis. No petroleum compounds were detected in the trip blank. Analytical results for the blind field duplicate sample collected from MW-4 were within approximately three percent of the original sample results. Table 2 also includes a summary of the QA/QC analytical results.

## 3.0 SENSITIVE RECEPTOR SURVEY AND RISK ASSESSMENT

### 3.1 Sensitive Receptor Survey

**Marin** conducted a survey to identify sensitive receptors in the vicinity of the Quarry Hill Quick Stop that could potentially be impacted by contamination associated with the site. The following sensitive receptors were identified in the vicinity of the Quarry Hill Quick Stop:

- an unnamed intermittent stream, located along the eastern edge of the property;
- the on-site bedrock-supply well, located approximately 20 feet downgradient of the former UST area;
- the indoor air-quality of the on-site building, located immediately downgradient of the former UST area; and
- underground utilities present on the site.

### 3.2 Risk Assessment

**Marin** assessed the risks that the residual soil and dissolved-phase subsurface contamination poses to the receptors identified above. In general, human exposure to petroleum related contamination is possible through inhalation, ingestion, or direct contact while impacts to environmental receptors

are due either to a direct release or contaminant migration through one receptor to another or along a preferential pathway.

The results of our risk assessment are as follows:

- Based on the 4 November 1998 analytical results, the unnamed-seasonal stream that traverses the site is impacted by petroleum hydrocarbons. Benzene was detected at 2.3 µg/L in the downgradient sample collected on the north side of Beede Road, exceeding the WQC of 1.2 µg/L for this compound. Iron staining was identified in the stream channel, commencing near the drain pipe outfall on the southern side of Beede Road, and extending in the downgradient direction for an unknown distance. Strong petroleum odors were also observed along the stream on the north side of Beede Road. The terminus of the surface-water contamination, as well as the stream itself, is currently unknown. Therefore, additional risks posed to potential downgradient receptors cannot be ascertained at this time.

  The drain pipe, which was reported to be associated with the perimeter drain, does not appear to be discharging petroleum-related VOCs directly to the stream, based on the SW-2 sample results.

  No petroleum-related VOCs were identified in a sample collected from the bathroom faucet of the convenience store, suggesting the on-site bedrock supply well is not currently being impacted by petroleum contaminants. However, the hydraulic relationship between the contaminated overburden aquifer and the bedrock supply well is unknown at this time; therefore, without data to prove otherwise, the on-site water supply may be at risk to future contamination.

- The indoor air of the on-site building does not appear to be at high risk for petroleum vapor contamination. First, PID levels within the store were non-detect during an inspection on 4 November 1998. Secondly, the building does not have a basement, reducing the likelihood of indoor migration of contaminant vapors from the subsurface.

- Underground utilities at the site, namely the sanitary sewer corridor and downgradient manhole, may be at risk for petroleum vapor accumulation based on their proximity to contaminants identified on-site.

## 4.0 CONTAMINANT SOURCE DISCUSSION

Based on all the available data collected to date, several potential sources for petroleum contamination have been identified at the site. These include the former UST area, the former pump island, a 275-gallon kerosene above ground storage tank (AST), and an unknown source of motor-oil contamination, possibly related to former automotive-service operations at the site.

The former UST area represents a source of subsurface gasoline-related contamination on the property. Elevated PID readings, ranging from 0.1 to 200 ppm, were recorded in this area during the UST closure, with the highest reading recorded beneath the water table at approximately 10 feet bgs. These contaminated soils were returned to the excavation. Given this information, ground water has likely been impacted in this area; however, the degree of contamination is currently unknown, as no water-quality data are available.

Significant gasoline-related contamination appears to be present in the vicinity of the former pump island, based on PID results obtained during the replacement tank installation. Approximately 160 cubic yards of contaminated soils, with PID readings ranging from 1.8 to 830 ppm, were removed and subsequently transported offsite to accommodate the 15,000-gallon replacement UST. Soil samples collected from the base of the excavation, approximately 12 feet bgs, yielded PID readings averaging 1,529 ppm. Apparently, these soils were not removed. No monitoring well was installed in the immediate vicinity of the former pump island due to overhead utilities; therefore, no representative water-quality data are available from this source area. The elevated levels of benzene and methyl tertiary butyl-ether (MTBE) in monitoring well MW-4, relative to other VOCs, suggest the well was installed within the clean fill of the replacement UST excavation, and that a residual contaminant source is present upgradient. This scenario may explain the seemingly anomalous contaminant distribution at the site in which MW-3, located downgradient of MW-4, has higher contaminant levels than MW-4.

The 275-gallon kerosene AST, located at the rear of the on-site building, is a potential source for subsurface petroleum contamination at the site. During a site inspection on 22 October 1998, black staining was observed on the ground surface beneath the AST and associated fuel pump. Additional data are necessary to determine if potential surface releases in his area have impacted the subsurface at the site.

On 4 November 1998, approximately 0.1 feet of free-phase petroleum product was detected in monitoring well MW-2. Subsequent laboratory analysis indicated that the product most likely resembled a motor oil/kerosene mixture. The source(s) of this product is currently unknown. According to Mr. Wayne Tucker, the convenience store previously served as an automobile-service station. Used motor oil was

allegedly stored on-site in an AST formerly located within the building. It is possible that the petroleum product identified in MW-2 is related to this former operation.

## 5.0 CONCLUSIONS

Based on the results of the site investigation described above, **Marin** concludes the following:

- Subsurface gasoline contamination was discovered at the site in May 1998 during the closure of three gasoline underground storage tanks (USTs) and the installation of a 15,000-gallon replacement UST. Photoionization detector (PID) readings on soils in the former UST excavation were detected up to 200 parts per million (ppm); PID readings on soils from the base of the replacement UST excavation, located immediately downgradient of the former pump island, averaged 1,529 ppm.

- Several potential sources of petroleum contamination have been identified on-site. These include the former UST area, the former pump island, a 275-gallon kerosene aboveground storage tank (AST), and an unknown source of motor-oil contamination, possibly related to former automotive-service operations at the site.

- Analytical results from sampling performed on 4 November 1998 indicate that the shallow aquifer beneath the site, as well as a reach of an unnamed intermittent stream, are contaminated with dissolved-phase gasoline-related VOCs. Total dissolved-phase VOC concentrations in ground water ranged from 24.1 micrograms per liter (µg/L) in monitoring well MW-1 to 1,095 µg/L in monitoring well MW-3. Vermont Groundwater Enforcement Standards (VGESs) were exceeded for one or more gasoline-related VOCs in monitoring wells MW-1, MW-3, and MW-4. Benzene was detected at 2.3 µg/L in the unnamed stream's down-gradient sample (SW-3), exceeding the Vermont Water Quality Criterion (WQC) of 1.2 µg/L for this compound.

- Free-phase product, identified via petroleum fingerprinting as a motor oil/kerosene mixture, is present on the water table in monitoring well MW-2. The lateral extent of dissolved-phase and free-phase contamination has not been adequately defined.

- No petroleum-related VOCs were identified in a sample collected from the bathroom faucet of the convenience store, suggesting that the on-site bedrock supply well is not currently being impacted by petroleum contaminants. However, the hydraulic relationship between the contaminated overburden aquifer and the bedrock supply well is unknown at this time.

- Underground utilities at the site, namely the sanitary sewer corridor and downgradient manhole, may be at risk for petroleum vapor accumulation based on their proximity to contaminants identified on-site.

- A drain pipe that discharges to the stream appears to be connected to the sinks within the convenience store.

- In general, sandy fill materials are present across the site to approximately seven to twelve feet bgs. The fill materials are underlain by native poorly-sorted silty-sands and very-coarse to very-fine sands. Auger refusal, possibly on bedrock, was encountered in monitoring wells MW-2 and MW-4 at approximately 22 and 17 feet bgs, respectively. No bedrock outcrops were observed on-site. During the boring program, ground water was encountered at the site at depths of approximately seven to 16.5 feet bgs.

- Based on the limited hydrogeologic data collected at the site to date, ground water in the unconfined surficial aquifer at the site appears to flow in a northeasterly direction toward the intermittent stream, with an average horizontal hydraulic gradient of approximately six percent. However, surficial topography and regional surface-water drainage patterns suggest a ground-water divide may be present on the western edge of the property, the axis of which may run parallel with Quarry Hill Road. Shallow ground-water flow beneath the site may also be influenced by the building's perimeter drain, and a reported buried stream channel which is apparently located approximately 40 to 50 feet southwest of the stream's current location. Each of these features might act as a preferential pathway for ground-water migration. The vertical ground-water flow components at the site are currently unknown. Additional data are necessary to adequately characterize hydrogeologic conditions at the site.

## 6.0 RECOMMENDATIONS

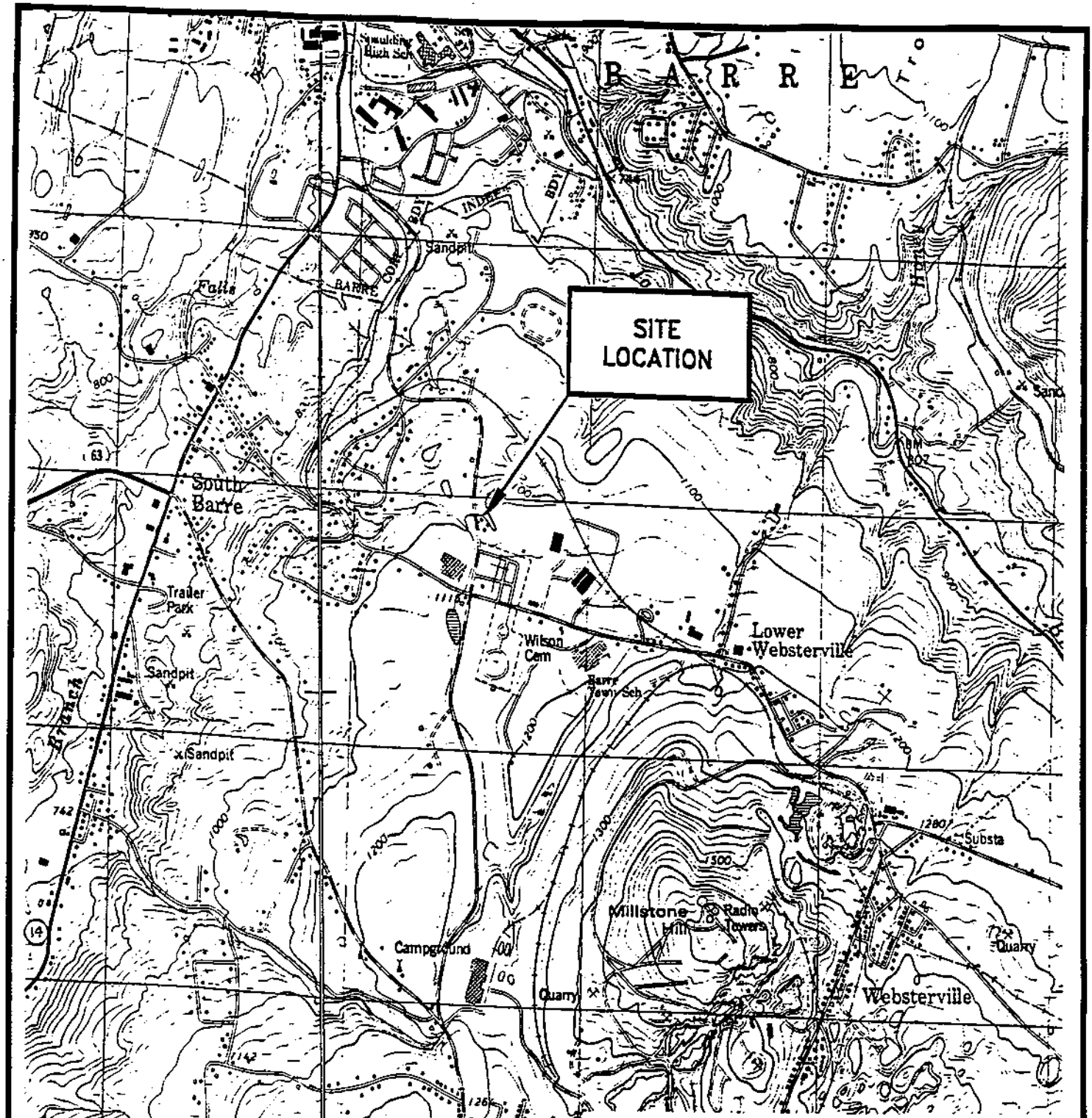
On the basis of the results of this investigation and the conclusions stated above, **Marin** recommends the following:

1. Seven water-table monitoring wells, one deeply-screened monitoring well, and two hand-augered piezometers, should be installed to complement the existing suite of wells and further characterize hydrogeologic and contaminant conditions at the site. The proposed monitoring well locations, including well-placement rationale, are included on Figure 7, Appendix A.

2. Water quality in the on-site bedrock supply well should be monitored quarterly for the possible presence of petroleum compounds. Although this will not provide direct evidence as to the hydraulic connection between the surficial and bedrock aquifers, periodic water quality monitoring of the well, together with information on vertical hydraulic gradients from the proposed deep overburden monitoring well, avoids the risk of inducing contaminant migration into the bedrock well that is inherent in a pumping test.
3. The newly installed and existing monitoring wells, the three surface water locations, and the on-site supply well should be sampled and analyzed for the possible presence of volatile petroleum compounds by EPA Method 8021B. If free product is encountered in any of the wells at recoverable quantities, it should be removed and containerized on-site in a properly labeled drum.
4. A dye test should be performed to determine whether or not the sinks in the convenience store are connected to the drain pipe that discharges to the stream.
5. The downgradient sanitary-sewer manhole, located along Quarry Hill Road, should be screened for the possible presence of VOCs with a PID. An aqueous sample should also be collected from this location and analyzed by EPA Method 8021B.
6. Upon completion of the additional work, a report should be prepared which includes relevant tables and figures, and identifies an appropriate course of action for the site.

# APPENDIX A

## Figures and Tables




**MARIN**
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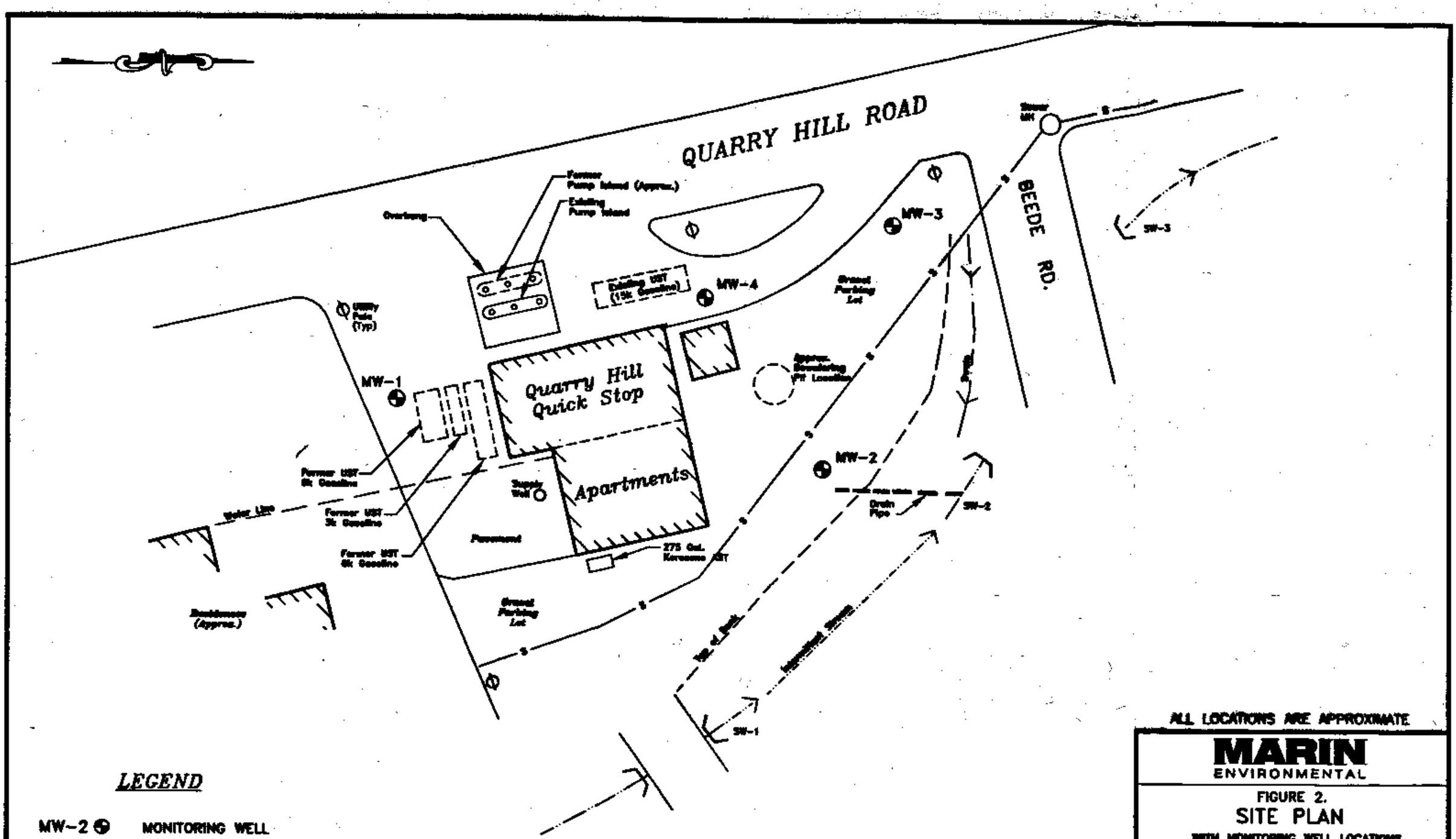
TITLE: FIGURE 1. Site Location Map

Source: U.S.G.S. Topographic Map
Barre West Quadrangle, 7.5' Series, 1979, Photorevised 1988.

SITE: QUARRY HILL QUICK STOP

QUADRANGLE LOCATION

| | | |
|---|---|---|
| DRAWN BY: M.IB | DATE: 11/12/98 | SCALE: 1"= 2000' |
| APPROVED BY: ES | | FILE No.: 980073sloc |




*LEGEND*

MW-2 ⊕ MONITORING WELL

—S— SANITARY SEWER LINE (approximate)

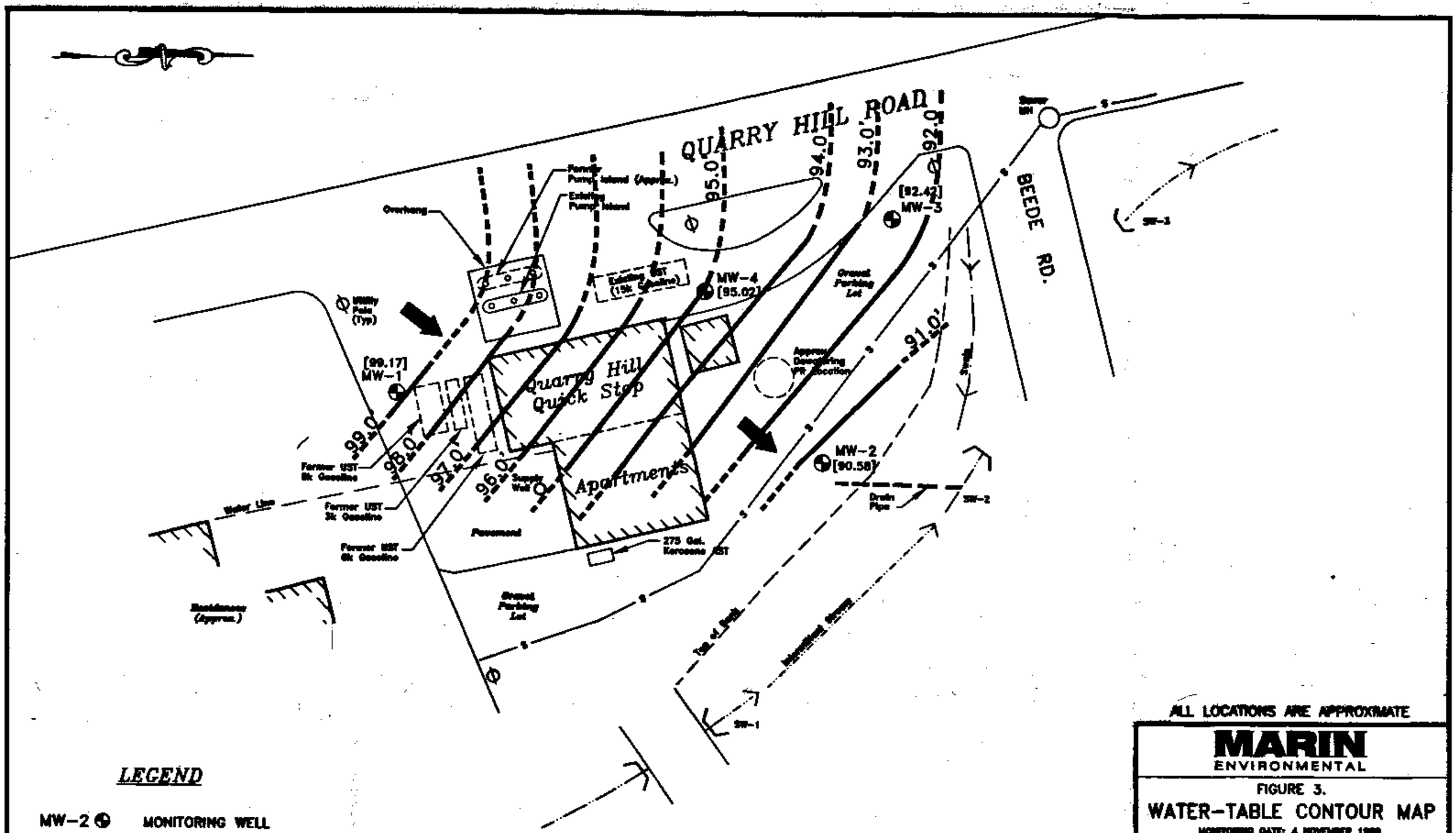
ALL LOCATIONS ARE APPROXIMATE

**MARIN**
ENVIRONMENTAL

FIGURE 2.
SITE PLAN
WITH MONITORING WELL LOCATIONS

QUARRY HILL QUICK STOP
BARRE, VT

| | | |
|---|---|---|
| DRAWN BY: MJB | DATE: 1/19/99 | SCALE: 1"= 30' |
| APPROVED BY: ES | FILE No.: 980073sp | |




*LEGEND*

- MW-2 ⊕ MONITORING WELL
- —s— SANITARY SEWER LINE (approximate)
- 96.0' WATER-TABLE CONTOUR (FT)
- ⬅ APPARENT GROUND-WATER FLOW DIRECTION

ALL LOCATIONS ARE APPROXIMATE

**MARIN ENVIRONMENTAL**

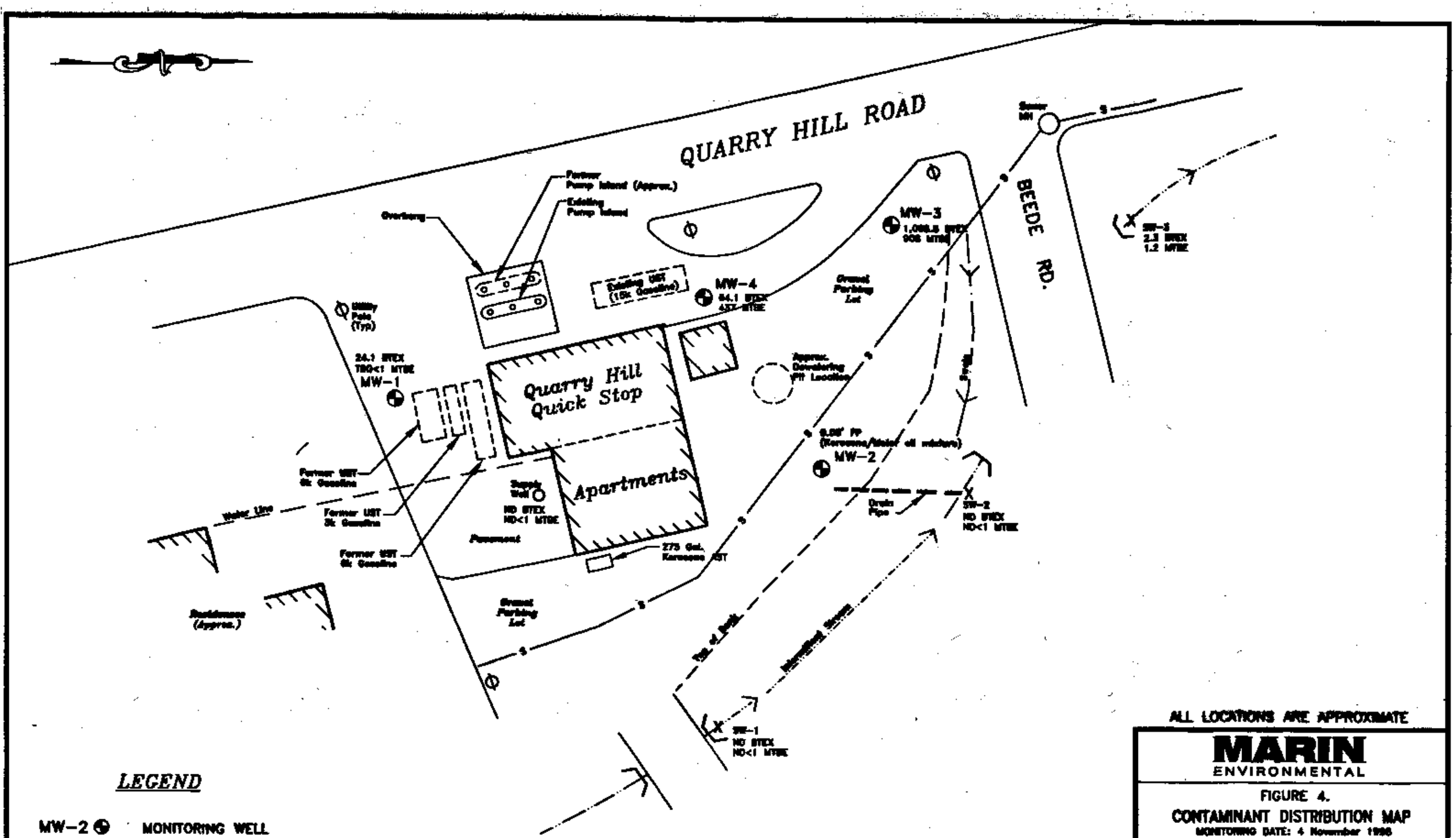
FIGURE 3.

## WATER-TABLE CONTOUR MAP

MONITORING DATE: 4 NOVEMBER 1998

QUARRY HILL QUICK STOP
BARRE, VT

| DRAWN BY: MJB | DATE: 1/19/99 | SCALE: 1"= 30' |
|---|---|---|
| APPROVED BY: ES | FILE No.: 980073ep | |




ALL LOCATIONS ARE APPROXIMATE

## *LEGEND*

| | |
|---|---|
| MW-2 ⊕ | MONITORING WELL |
| —s— | SANITARY SEWER LINE (approximate) |
| ND | NONE DETECTED |
| FP | FREE PRODUCT |

Note: All concentrations reported in µg/L.

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ENVIRONMENTAL

FIGURE 4.
CONTAMINANT DISTRIBUTION MAP
MONITORING DATE: 4 November 1998

QUARRY HILL QUICK STOP
BARRE, VT

| | | |
|---|---|---|
| DRAWN BY: MJB | DATE: 1/19/99 | SCALE: 1"= 30' |
| APPROVED BY: ES | FILE No.: 980073ep | |

FIGURE 5

Marin Environmental, Inc.

7 Island Dock Road
Haddam, CT 06438

| PREPARED BY | DATE | CHECKED BY | DATE | PROJECT NO. |
|---|---|---|---|---|
| EJS | 11/13/98 | | | 98-0073 |

**SUBJECT:** QUARRY HILL QUICK STOP – GEOLOGIC X-SECTION A-A'

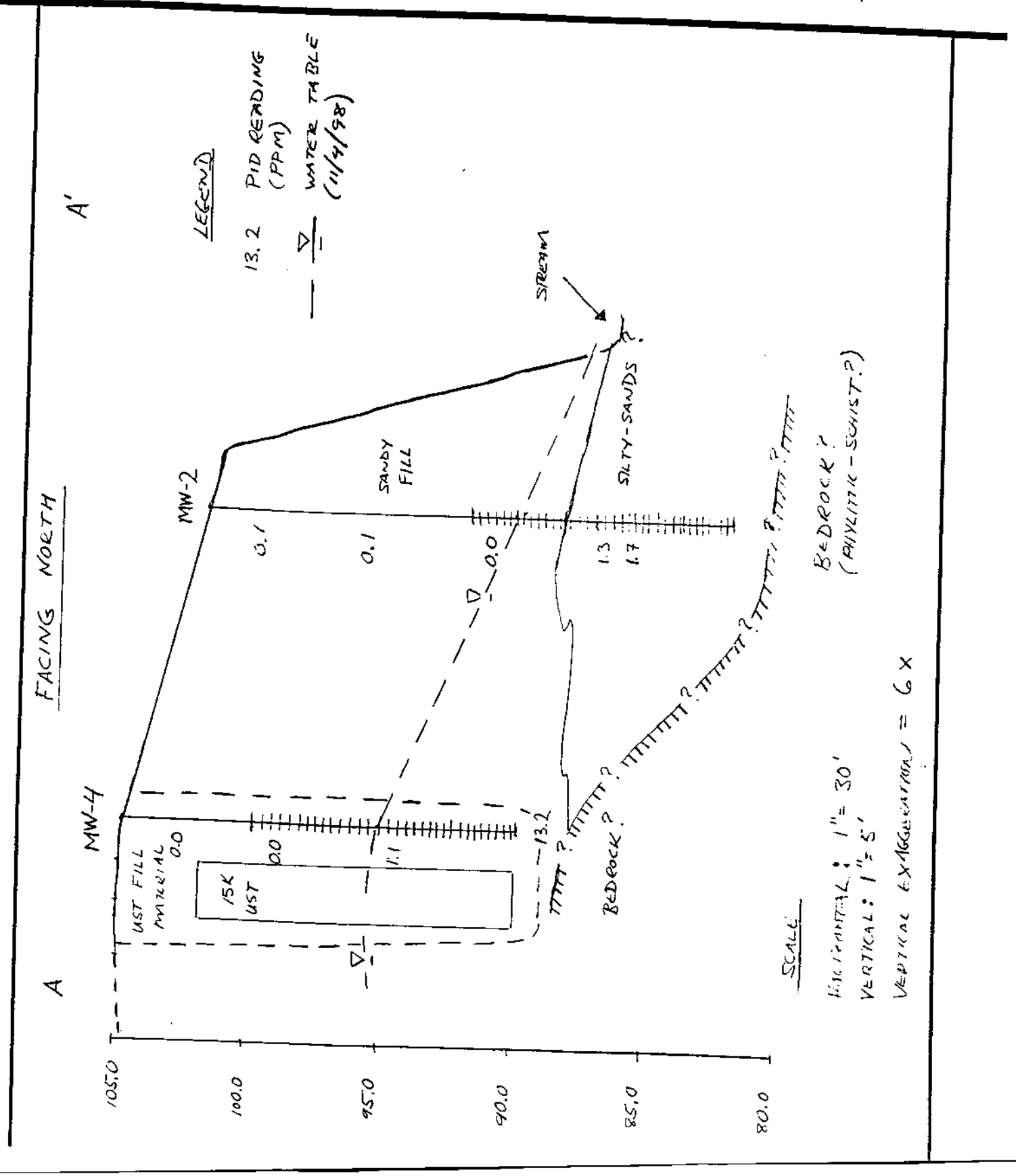


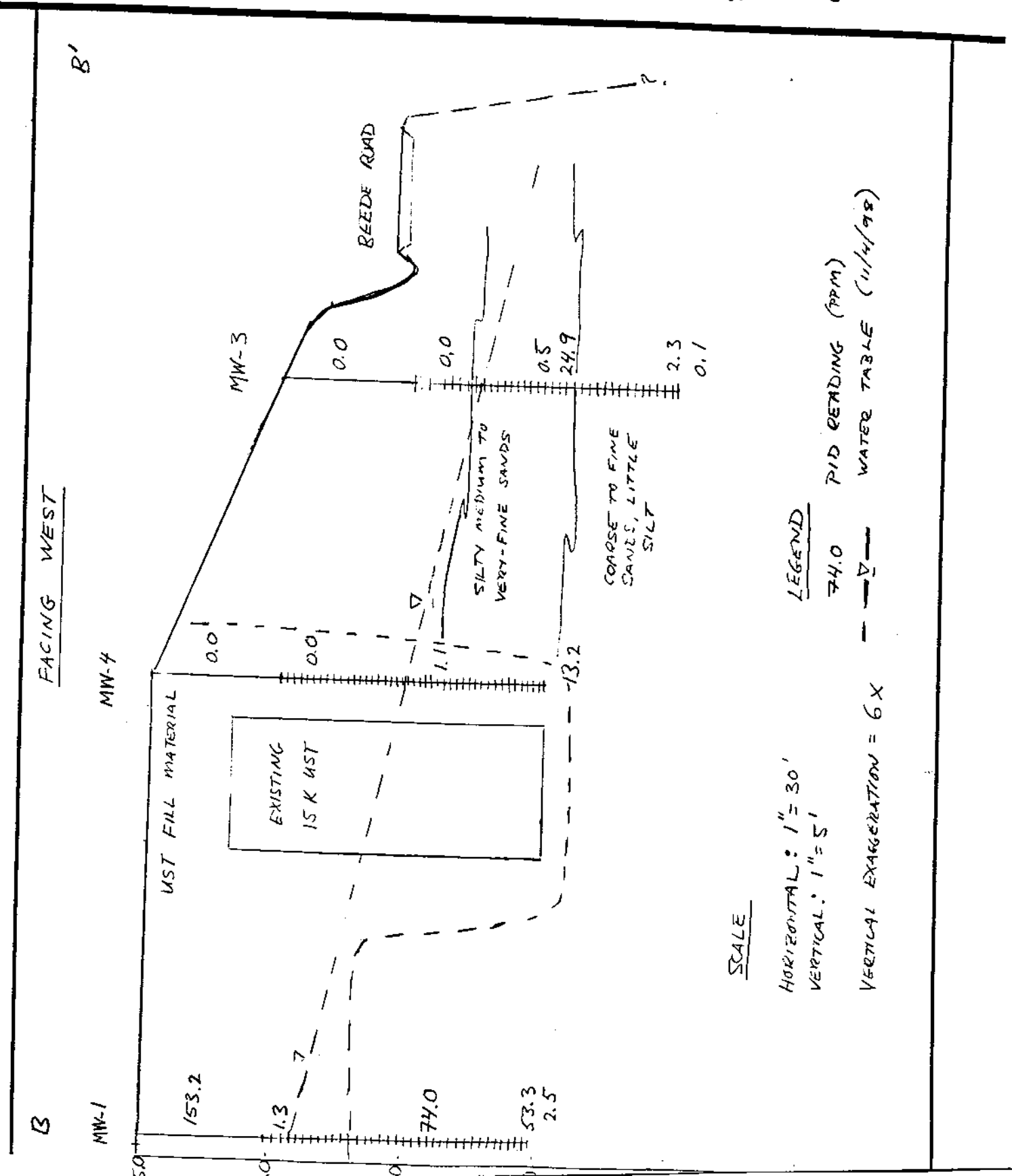
FIGURE 6

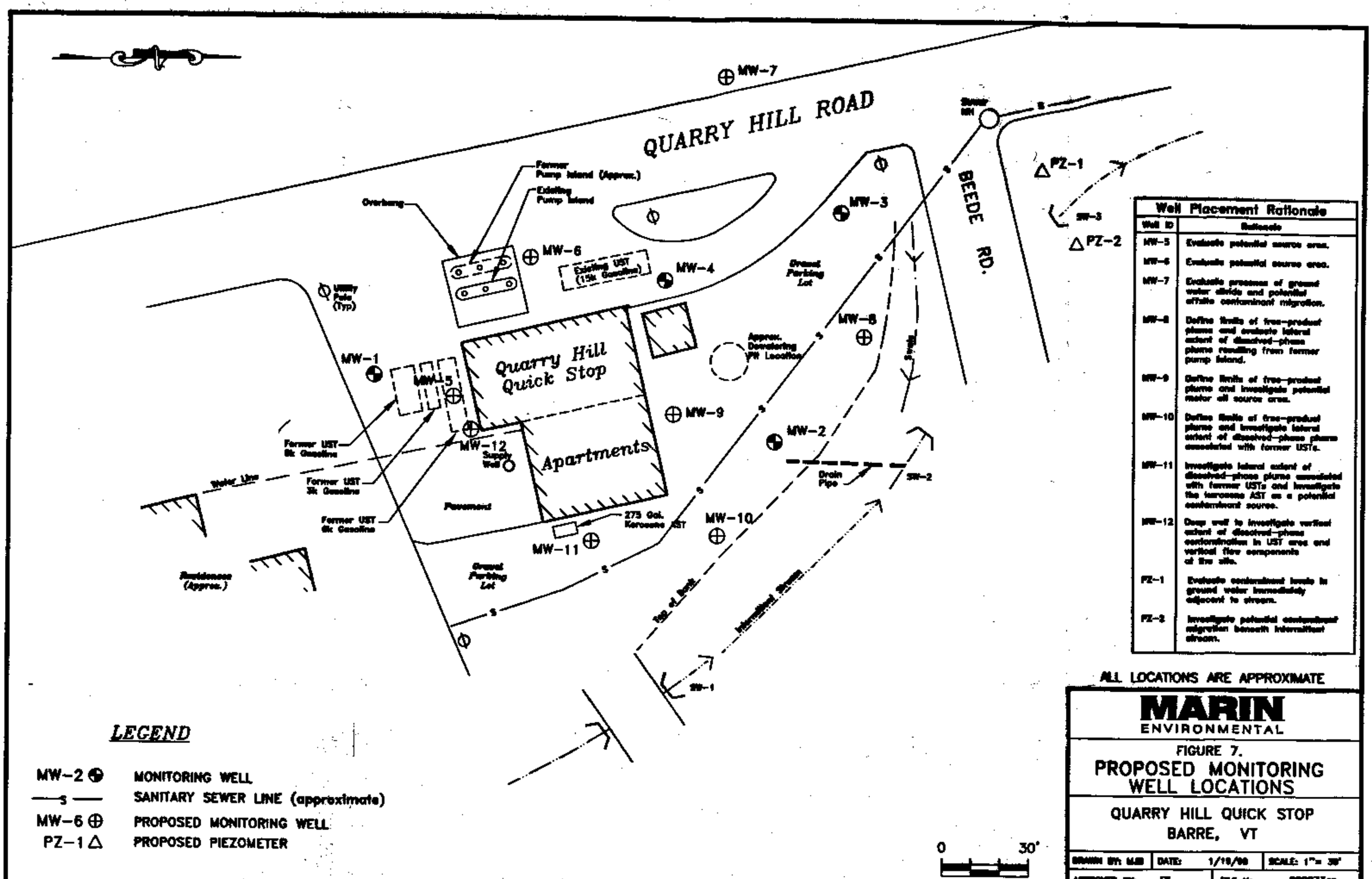
Marin Environmental, Inc.

7 Island Dock Road
Haddam, CT 06438

| PREPARED BY | DATE | CHECKED BY | DATE | PROJECT NO. |
|---|---|---|---|---|
| EJS | 1/19/99 | | | VT 98-0073 |

**SUBJECT:** QUARRY HILL QUICK STOP - GEOLOGIC X-SECTION B-B'






| Well Placement Rationale | |
|---|---|
| Well ID | Rationale |
| MW-5 | Evaluate potential source area. |
| MW-6 | Evaluate potential source area. |
| MW-7 | Evaluate presence of ground water divide and potential offsite contaminant migration. |
| MW-8 | Define limits of free-product plume and evaluate lateral extent of dissolved-phase plume resulting from former pump island. |
| MW-9 | Define limits of free-product plume and investigate potential motor oil source area. |
| MW-10 | Define limits of free-product plume and investigate lateral extent of dissolved-phase plume associated with former USTs. |
| MW-11 | Investigate lateral extent of dissolved-phase plume associated with former USTs and investigate the kerosene AST as a potential contaminant source. |
| MW-12 | Deep well to investigate vertical extent of dissolved-phase contamination in UST area and vertical flow components at the site. |
| PZ-1 | Evaluate contaminant levels in ground water immediately adjacent to stream. |
| PZ-2 | Investigate potential contaminant migration beneath intermittent stream. |

ALL LOCATIONS ARE APPROXIMATE

*LEGEND*

- MW-2 ⊕ MONITORING WELL
- —s— SANITARY SEWER LINE (approximate)
- MW-6 ⊕ PROPOSED MONITORING WELL
- PZ-1 △ PROPOSED PIEZOMETER

**MARIN ENVIRONMENTAL**

FIGURE 7.
PROPOSED MONITORING WELL LOCATIONS

QUARRY HILL QUICK STOP
BARRE, VT

| | | |
|---|---|---|
| DRAWN BY: MJB | DATE: 1/19/99 | SCALE: 1"= 30' |
| APPROVED BY: ES | FILE No.: 980073ep | |

# TABLE 1
# GROUND-WATER ELEVATION CALCULATIONS

## Quarry Hill Quick Stop
## Barre, Vermont

### Monitoring Date: 4 November 1998

| Well I.D. | Top of Casing Elevation | Depth to Product | Depth to Water | Product Thickness | Corrected Depth to water | Water Table Elevation |
|---|---|---|---|---|---|---|
| MW-1 | 105.09 | - | 5.92 | - | - | 99.17 |
| MW-2 | 102.73 | 12.13 | 12.23 | 0.10 | 12.15 | 90.58 |
| MW-3 | 100.00 | - | 7.58 | - | - | 92.42 |
| MW-4 | 104.93 | - | 9.91 | - | - | 95.02 |

All values reported in feet relative to arbitrary site datum of 100.00 feet.

**TABLE 2**
**LABORATORY ANALYTICAL RESULTS**
(EPA Method 8021B)

Quarry Hill Quick Stop
Barre, VT

Monitoring Date: 4 November 1998

| Sample Location | MTBE | Benzene | Toluene | Ethylbenzene | Total Xylenes | 1,3,5 TMB | 1,2,4 TMB | Napthalene | Total VOCs |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Ground Water | | | | | |
| MW-1 | TBQ<1 | ND<1 | 2.7 | 8.0 | 13.4 | 22.3 | 44.1 | 13.2 | 103.7 |
| MW-3 | 908 | 548 | 31.4 | 447 | 69.4 | 68.9 | TBQ<10 | 176 | 2248.7 |
| MW-4 | 437 | 56.2 | TBQ<5 | ND<5 | 7.9 | ND <5 | TBQ<5 | 12.0 | 513.1 |
| Supply Well | ND<1 | ND<1 | ND<1 | ND<1 | ND<1 | ND<1 | ND<1 | ND <1 | ND |
| *VGES* | *40* | *5* | *1,000* | *700* | *10,000* | *4* | *5* | *20* | -- |
| | | | | Surface Water | | | | | |
| SW-1 | ND<1 | ND<1 | ND<1 | ND<1 | ND<1 | ND<1 | ND<1 | ND <1 | ND |
| SW-2 | ND<1 | ND<1 | ND<1 | ND<1 | ND<1 | ND<1 | ND<1 | ND <1 | ND |
| SW-3 | 1.2 | 2.3 | ND<1 | TBQ<1 | ND<1 | ND<1 | ND<1 | ND <1 | 3.5 |
| *WQC* | -- | *1.2* | *6,800* | *3,100* | -- | -- | -- | -- | -- |
| | | | | QA/QC | | | | | |
| MW-4 | 437 | 56.2 | TBQ<5 | ND<5 | 7.9 | ND <5 | TBQ<5 | 12.0 | 513.1 |
| Duplicate(MW4) | 424 | 57.6 | TBQ<5 | ND<5 | 7.4 | ND <5 | ND<5 | 12.4 | 501.3 |
| Trip Blank | ND <1 | ND <1 | ND <1 | ND <1 | ND <1 | ND <1 | ND <1 | ND <1 | ND |
| *VGES* | *40* | *5* | *1,000* | *700* | *10,000* | *4* | *5* | *20* | -- |

Notes: All concentrations reported in ug/L.
Shaded values exceed either the VGES or WQC.
Approximately 0.1 feet of free product detected in MW-2. Petroleum fingerprinting indicates that the propduct most closely resembles a mixture of motor oil and kerosene.
TBQ = trace below quantitation limit.
ND = None Detected above quantitation limit
*VGES* = Vermont Ground water Enforcement Standard
*WQC* = Water Quality Criteria for the protection of human health in class B waters

# APPENDIX B

## Boring Logs /Monitoring Well Construction Diagrams

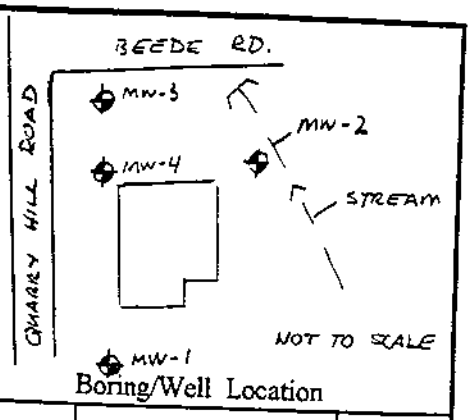
# Marin Environmental, Inc.

SITE NAME: Quarry Hill Quick Stop
LOCATION: Barre, Vermont
JOB NO. VT98-0073
DATE: 10/22/98

BORING NO: MW-1
TOTAL DEPTH: 16.5 FT.
DEPTH TO WATER: 5.92 FT (11/4/98)

DRILLING METHOD: H.S.A
BORING DIAMETER:

FIELD SUPERVISOR: Eric Swiech
CONTRACTOR: M&W Soils Engineering
DRILLERS:



Boring/Well Location

| Depth (ft) | Sample No. | BLOW COUNTS PER 6" (0-6 / 6-12 / 12-18 / 18-24) | Rec. (ft) | SAMPLE DESCRIPTION | STRATA | WELL DETAIL | PID (ppm) |
|---|---|---|---|---|---|---|---|
| 1'-3' | | 12 / 11 | | GREY M-F SAND, LITTLE SILT + GRAVEL, MOIST. PETRO ODOR. (FILL) | SANDY FILL | EXPANSION CAP; 2" PVC CASING; 2.5 BENTONITE | 153.2 |
| | | 11 / 9 | 1.5 | | | | |
| 5'-7' | | 2 / 1 | | BRN M-F SAND, AND SILT, TRACE GRAVEL. MOIST. PETRO ODOR. (FILL) | | 4.0; 5.0 | 1.3 |
| | | 1 / 1 | 0.1 | | | | |
| 10'-12' | | 8 / 10 | | BRN-GREY M-VF SAND, TRACE SILT. WET. | SAND | #1 SAND | 74 |
| | | 20 / 26 | 1.5 | | | | |
| 15'-16.5 | | 17 / 28 | | BRN-GREY VC-F SAND, TRACE SILT AND GRAVEL. WET. | | 0.010" SCREEN; 15.0 | 53.3 |
| | | 32 | 1.5 | | | BACKFILL | 2.5 |
| | | | | END OF BORING @ 16.5' SET WELL @ 15' | | | |
| 20' | | | | | | | |
| 25' | | | | | | | |

| | |
|---|---|
| ND | 33-50% |
| OME | 20-33% |
| LITTLE | 10-20% |
| RACE | 0-10% |

| BLOW COUNT | |
|---|---|
| 0 - 4 | VERY LOSE |
| 4 - 10 | LOOSE |
| 10 - 30 | MEDIUM |
| 30 - 50 | DENSE |
| > 50 | VERY DENSE |

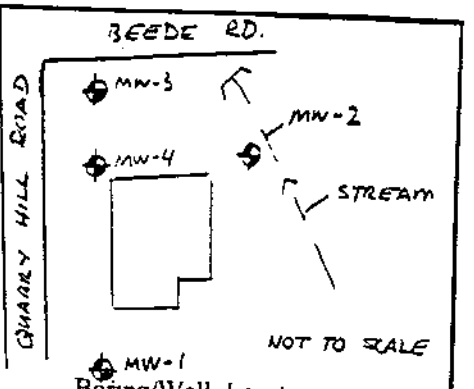
| MATERIALS USED | SIZE/TYPE | QUANTITY |
|---|---|---|
| WELL SCREEN | | |
| SLOT SIZE | | |
| RISER | | |
| GRADED SAND | | |
| BENTONITE PELLETS | | |
| BENTONITE GROUT | | |

# Marin Environmental, Inc.

SITE NAME: Quarry Hill Quick Stop
LOCATION: Barre, Vermont
JOB NO. VT98-0073
DATE: 10/22/98

BORING NO: MW-2
TOTAL DEPTH: 22.0'
DEPTH TO WATER: 12.23' (11/4/98)

DRILLING METHOD: H.S.A
BORING DIAMETER:
FIELD SUPERVISOR: Eric Swiech
CONTRACTOR: M&W Soils Engineering
DRILLERS:



Boring/Well Location

| Depth (ft) | Sample No. | BLOW COUNTS PER 6" (0-6 / 6-12 / 12-18 / 18-24) | Rec. (ft) | SAMPLE DESCRIPTION | STRATA | WELL DETAIL | PID (ppm) |
|---|---|---|---|---|---|---|---|
| 1'-3' | | 8 / 8 | | TOP 0.5' = BRN VC SAND, AND GRAVEL. NEXT 1.5' = BRN M-VF SAND, AND SILT, TRACE GRAVEL. MOIST. (FILL). | SANDY FILL | EXPANSION CAP; NATIVE BACKFILL | 0.1 |
| | | 7 / 9 | 2.0 | | | | |
| 5'-7' | | 17 / 18 | | SAME AS ABOVE. | | 2" PVC RISER | 0.1 |
| | | 8 / 5 | 0.4 | | | 6.5 BENTONITE 7.5 | |
| 10'-12' | | 5 / 4 | | BRN - BLACK VC-F SAND, SOME SILT & LITHIC FRAGS & FIL MATERIALS (TIRE SCRAP). MOIST. (FILL) | | 10.0' | 0.0 |
| | | 7 / 4 | 0.8 | | | | |
| 15'-17' | | 17 / 14 | | TOP 0.75' = BRN F-VF SAND, AND SILT. MOIST. BOTTOM 0.75' = GREY-BLACK VF SAND, AND SILT. WET@ 16.5', STRONG ODOR. SHEEN ON COILS IN SHOE. | SILTY-SAND | 0.010" SCREEN | 1.3 |
| | | 14 / 12 | 1.5 | | | #1 SAND | 1.7 |
| 20'-22' | | 30 / 17 | | TOP 0.5' = BRN C-VF SAND, SOME SILT, SOUPY (WET). BET 1.0' = WEATHERED PHYLLITIC-SCHIST FRAGS. (REFUSAL @ ~ 21.9' - BEDROCK?) | | 20.0' | 2.3 |
| | | 16 / 25 for 5" | 1.5 | | | BACKFILL | 0.3 |
| 25' | | | | END OF BORING @ 21.9' SET WELL @ 20.0' | WEATHERED BEDROCK? BEDROCK? | | |

| | |
|---|---|
| AND | 33-50% |
| SOME | 20-33% |
| LITTLE | 10-20% |
| TRACE | 0-10% |

| BLOW COUNT | |
|---|---|
| 0 - 4 | VERY LOSE |
| 4 - 10 | LOOSE |
| 10 - 30 | MEDIUM |
| 30 - 50 | DENSE |
| > 50 | VERY DENSE |

| MATERIALS USED | SIZE/TYPE | QUANTITY |
|---|---|---|
| WELL SCREEN | | |
| SLOT SIZE | | |
| RISER | | |
| GRADED SAND | | |
| BENTONITE PELLETS | | |
| BENTONITE GROUT | | |

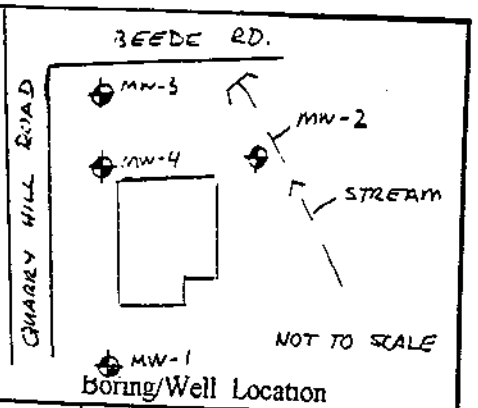
# Marin Environmental, Inc.

SITE NAME: Quarry Hill Quick Stop
LOCATION: Barre, Vermont
JOB NO. VT98-0073
DATE: 10/22/98

BORING NO: MW-3
TOTAL DEPTH: 16.5'
DEPTH TO WATER: 7.58' (11/4/98)

DRILLING METHOD: H.S.A
BORING DIAMETER:

FIELD SUPERVISOR: Eric Swiech
CONTRACTOR: M&W Soils Engineering
DRILLERS:



Boring/Well Location

| Depth (ft) | Sample No. | BLOW COUNTS PER 6" (0-6 / 6-12 / 12-18 / 18-24) | Rec. (ft) | SAMPLE DESCRIPTION | STRATA | WELL DETAIL | PID (ppm) |
|---|---|---|---|---|---|---|---|
| 1'-3' | | 10 / 7 | | BRN F-VF SAND, AND SILT, TRACE GRAVEL. MOIST. (FILL) | SILTY-SAND (FILL) | EXPANSION CAP; 2.0 BENTONITE 3.0; 2" PVC RISER SCH | |
| | | 5 / 5 | 0.7 | | | | 0.0 |
| 5'-7' | | 4 / 5 | | BRN VC-VF SAND, SOME SILT + GRAVEL (WEATHERED) SCHIST FRAGS, MOIST. (FILL) NATIVE IN SHOE? | SANDY FILL | | |
| | | 5 / 8 | 1.5 | | | | 0.0 |
| 10'-12' | | 6 / 6 | | TOP 0.5' = BRN M(-)-VF(+) SAND, AND SILT. MOIST. NEXT 1.0' = GREY C-F SAND, LITTLE SILT. WET. ODOR. NATIVE. | SILTY-SAND | #1 SAND | |
| | | 6 / 7 | 1.5 | | | | 0.5 |
| | | | | | | | 24.9 |
| | | | | | SAND | 0.010" SLOT SCREEN | |
| 15'-16.5' | | 28 / 34 | | SAME AS ABOVE, EXCEPT NO ODOR/STAINING. | | | |
| | | 40 | 1.5 | | | | 2.3 |
| | | | | END OF BORING @ 16.5' SET WELL @ 15.0' | | 15.0 BACKFILL | 0.1 |
| 20' | | | | | | | |
| 25' | | | | | | | |

| | |
|---|---|
| ND | 33-50% |
| ME | 20-33% |
| LITTLE | 10-20% |
| CE | 0-10% |

| BLOW COUNT | |
|---|---|
| 0 - 4 | VERY LOSE |
| 4 - 10 | LOOSE |
| 10 - 30 | MEDIUM |
| 30 - 50 | DENSE |
| > 50 | VERY DENSE |

| MATERIALS USED | SIZE/TYPE | QUANTITY |
|---|---|---|
| WELL SCREEN | | |
| SLOT SIZE | | |
| RISER | | |
| GRADED SAND | | |
| BENTONITE PELLETS | | |
| BENTONITE GROUT | | |

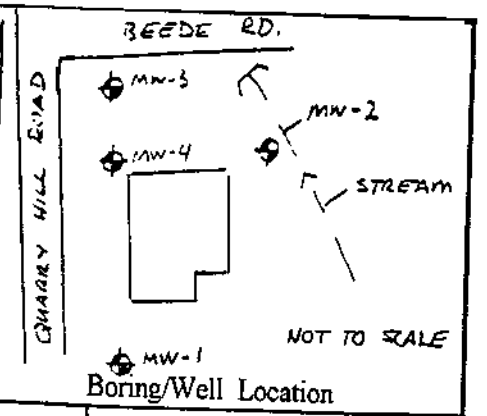
# Marin Environmental, Inc.

SITE NAME: Quarry Hill Quick Stop
LOCATION: Barre, Vermont
JOB NO. VT98-0073
DATE: 10/22/98

BORING NO: MW-4
TOTAL DEPTH: 17.0'
DEPTH TO WATER: 9.91' (11/4/98)

DRILLING METHOD: H.S.A
BORING DIAMETER:

FIELD SUPERVISOR: Eric Swiech
CONTRACTOR: M&W Soils Engineering
DRILLERS:



Boring/Well Location

| Depth (ft) | Sample No. | BLOW COUNTS PER 6" (0-6 / 6-12 / 12-18 / 18-24) | Rec. (ft) | SAMPLE DESCRIPTION | STRATA | WELL DETAIL | PID (ppm) |
|---|---|---|---|---|---|---|---|
| 1'-3' | | 6 / 5 | 1.5 | BRN VC-VF SAND, AND SILT W/ SOME GRAVEL (SCHIST FRAGS) MOIST. | | EXPANSION CAP | 0.0 |
| 5'-7' | | 20 / 20 | 1.5 | BRN-GREY WEATHERED SCHIST FRAGS (FRIABLE). DRY. | | 2.5 BENTONITE 3.5 2" PVC 5.0 | 0.0 |
| 10'-12' | | 20 / 18 | 1.5 | TOP 0.5' = SAME AS ABOVE. DRY. NEXT 1.0' = BRN VC-VF SAND, TRACE SILT. WET. | SAND | 0.010" SCREEN | 1.1 |
| 15'-17' | | 17 / 28 | 1.8 | GREY C-VF SAND, TRACE SILT. WET. REFUSAL @ ~16.9' SET WELL @ 15.0' | | #1 SAND 15.0 BACKFILL | 13.2 |
| 20' | | | | | | | |
| 25' | | | | | | | |

| | |
|---|---|
| ND | 33-50% |
| ME | 20-33% |
| LITTLE | 10-20% |
| ACE | 0-10% |

| BLOW COUNT | |
|---|---|
| 0 - 4 | VERY LOSE |
| 4 - 10 | LOOSE |
| 10 - 30 | MEDIUM |
| 30 - 50 | DENSE |
| > 50 | VERY DENSE |

| MATERIALS USED | SIZE/TYPE | QUANTITY |
|---|---|---|
| WELL SCREEN | | |
| SLOT SIZE | | |
| RISER | | |
| GRADED SAND | | |
| BENTONITE PELLETS | | |
| BENTONITE GROUT | | |

# APPENDIX C

## Laboratory Report Forms

ENDYNE, INC.

Laboratory Services

32 James Brown Drive
Williston, Vermont 05495
(802) 879-4333
FAX 879-7103

# REPORT OF LABORATORY ANALYSIS

CLIENT: Marin Environmental
PROJECT NAME: Quarry Hill Quick Stop
REPORT DATE: November 12, 1998
DATE SAMPLED: November 4, 1998

PROJECT CODE: GWVT1617
REF.#: 130,642 - 130,650

Enclosed please find the results of the analyses performed for the samples referenced on the attached chain of custody. Chain of custody indicated sample preservation with HCl.

All samples were prepared and analyzed by requirements outlined in the referenced method and within the specified holding times. All instrumentation was calibrated with the appropriate frequency and verified by the requirements outlined in the referenced method. Blank contamination was not observed at levels affecting the analytical results.

Analytical method precision and accuracy was monitored by laboratory control standards which included matrix spike, duplicate and quality control analyses. These standards were determined to be within established laboratory method acceptance limits.

Individual sample performance was monitored by the addition of surrogate analytes to each sample. All surrogate recovery data was determined to be within laboratory QA/QC guidelines unless otherwise noted.

Reviewed by,

Harry B. Locker, Ph.D.
Laboratory Director



enclosures

ENDYNE, Inc.

32 James Brown Drive
Williston, Vermont 05495
(802) 879-4333

31389

# CHAIN-OF-CUSTODY RECORD

| | | |
|---|---|---|
| Project Name: QUARRY HILL QUICK STOP<br>Site Location: BARRE, VT | Reporting Address: MARIN ENVIRONMENTAL | Billing Address: MARIN |
| Endyne Project Number: 6402VT1617 | Company: MARIN<br>Contact Name/Phone #: [illegible] | Sampler Name: [illegible]<br>Phone #: [illegible] |

| Lab # | Sample Location | Matrix | GRAB | COMP | Date/Time 11/4/98 | Sample Containers No. | Sample Containers Type/Size | Field Results/Remarks | Analysis Required | Sample Preservation | Rush |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 130642 | MW-1 | $H_2O$ | X | | 1105 | 2 | 40 ml vials | | 8021B | HCL | |
| 130643 | MW-2 | Free Product | | | 1125 | 1 | 40 ml vials | Free Product | Phase II | — | |
| 130644 | MW-3 | $H_2O$ | | | 1100 | 2 | | | 8021B | HCL | |
| 130645 | MW-4 | | | | 1130 | 2 | | | | | |
| 130646 | SW-1 | | | | 1150 | 1 | | | | | |
| 130647 | SW-2 | | | | 1155 | 1 | | | | | |
| 130648 | SW-3 | | | | 1210 | 1 | | | | | |
| 130649 | DUP | | | | | 1 | | | | | |
| 130649 | TRIP BLANK | | | | 1030 | 1 | | | | | |
| 130650 | SUPPLY WELL | | | | 1129 | 1 | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

| | | |
|---|---|---|
| Relinquished by: Signature [signature] | Received by: Signature [signature] | Date/Time 11/4/98 1 33 pm COC. |
| Relinquished by: Signature | Received by: Signature | Date/Time |

New York State Project: Yes ____ No ____

## Requested Analyses

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | pH | 6 | TKN | 11 | Total Solids | 16 | Metals (Specify) | 21 | EPA 624 | 26 | EPA 8270 B/N or Acid |
| 2 | Chloride | 7 | Total P | 12 | TSS | 17 | Coliform (Specify) | 22 | EPA 625 B/N or A | 27 | EPA 8010/8020 |
| 3 | Ammonia N | 8 | Total Diss. P | 13 | TDS | 18 | COD | 23 | EPA 418.1 | 28 | EPA 8080 Pest/PCB |
| 4 | Nitrite N | 9 | $BOD_5$ | 14 | Turbidity | 19 | BTEX | 24 | EPA 608 Pest/PCB | | |
| 5 | Nitrate N | 10 | Alkalinity | 15 | Conductivity | 20 | EPA 601/602 | 25 | EPA 8240 | | |
| 29 | TCLP (Specify: volatiles, semi-volatiles, metals, pesticides, herbicides) | | | | | | | | | | |
| 30 | Other (Specify): | | | | | | | | | | |

ENDYNE, INC.

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# REPORT OF LABORATORY ANALYSIS

CLIENT: Marin Environmental
PROJECT NAME: Quarry Hill Quick Stop
DATE REPORTED: November 20, 1998
DATE SAMPLED: November 4, 1998

PROJECT CODE: GWVT1618
REF. #: 130,651

Enclosed please find the results of the analyses performed for the samples referenced on the attached chain of custody record.

Chain of custody indicated no sample preservation.

All samples were prepared and analyzed by requirements outlined in the referenced methods and within the specified holding times.

All instrumentation was calibrated with the appropriate frequency and verified by the requirements outlined in the referenced methods.

Blank contamination was not observed at levels affecting the analytical results.

Analytical method precision and accuracy was monitored by laboratory control standards which included matrix spike, duplicate and quality control analyses. These standards were determined to be within established laboratory method acceptance limits.

Reviewed by,

Harry B. Locker, Ph.D.
Laboratory Director



enclosures

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# LABORATORY REPORT

## GC/FID PETROLEUM FINGERPRINT

CLIENT: Marin Environmental
PROJECT NAME: Quarry Hill Quick Stop
REPORT DATE: November 20, 1998
SAMPLER: Eric Swiech
DATE SAMPLED: November 4, 1998
DATE RECEIVED: November 4, 1998

PROJECT CODE: GWVT1618
ANALYSIS DATE: November 20, 1998
STATION: MW-2 (Free Product)
REF.#: 130,651
TIME SAMPLED: 11:53

Petroleum identification is determined by comparison of the chromatographic fingerprint of the sample with a laboratory generated library of chromatographic fingerprints of assorted petroleum standards. The fingerprint of this sample most closely resembles that of Kerosene and Motor Oil.

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Williston, Vermont 05495
(802) 879-4333

01384

# CHAIN-OF-CUSTODY RECORD

| | | |
|---|---|---|
| Project Name: QUARRY HILL QUICK STOP<br>Site Location: BARRE, VT | Reporting Address: MACIN ENVIRONMENTAL | Billing Address: MACIN |
| Endyne Project Number: GWVT1618 | Company: MACIN<br>Contact Name/Phone #: ERIC SWANSON / 655-0031 | Sampler Name: ERIC SWANSON<br>Phone #: 655-0031 |

| Lab # | Sample Location | Matrix | GRAB | COMP | Date/Time | Sample Containers No. | Sample Containers Type/Size | Field Results/Remarks | Analysis Required | Sample Preservation | Rush |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ~~130642~~ | MW-1 | $H_2O$ | X | | 11/4/98 1145 | 2 | 64/40ml | | 8021B | HCL | |
| 130651 ~~130643~~ | MW-2 | FREE PRODUCT | | | 1153 | 1 | 64/40ml | FREE PRODUCT | FUEL ID | — | |
| ~~130644~~ | MW-3 | $H_2O$ | | | 1100 | 2 | | | 8021B | HCL | |
| ~~130645~~ | MW-4 | | | | 1130 | 2 | | | | | |
| ~~130646~~ | SW-1 | | | | 1150 | | | | | | |
| ~~130647~~ | SW-2 | | | | 1155 | | | | | | |
| ~~130648~~ | SW-3 | | | | 1200 | | | | | | |
| ~~130649~~ | DUP | | | | | | | | | | |
| | TRIP BLANK | | | | 1030 | | | | | | |
| | SUPPLY WELL | ↓ | ↓ | | 1134 | ↓ | ↓ | | ↓ | ↓ | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

| | | |
|---|---|---|
| Relinquished by: Signature ERIC SWANSON | Received by: Signature [illegible] | Date/Time 11/4/98 1:33 pm COOL |
| Relinquished by: Signature | Received by: Signature | Date/Time |

New York State Project: Yes ____ No ____

**Requested Analyses**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | pH | 6 | TKN | 11 | Total Solids | 16 | Metals (Specify) | 21 | EPA 624 | 26 | EPA 8270 B/N or Acid |
| 2 | Chloride | 7 | Total P | 12 | TSS | 17 | Coliform (Specify) | 22 | EPA 625 B/N or A | 27 | EPA 8010/8020 |
| 3 | Ammonia N | 8 | Total Diss. P | 13 | TDS | 18 | COD | 23 | EPA 418.1 | 28 | EPA 8080 Pest/PCB |
| 4 | Nitrite N | 9 | $BOD_5$ | 14 | Turbidity | 19 | BTEX | 24 | EPA 608 Pest/PCB | | |
| 5 | Nitrate N | 10 | Alkalinity | 15 | Conductivity | 20 | EPA 601/602 | 25 | EPA 8240 | | |
| 29 | TCLP (Specify: volatiles, semi-volatiles, metals, pesticides, herbicides) | | | | | | | | | | |
| 30 | Other (Specify): | | | | | | | | | | |