BEEKMAN HIGHWAY GARAGE

Town of Beekman, Dutchess County, New York
Site No. 3-14-094

PROPOSED REMEDIAL ACTION PLAN

February 1999

Prepared by:

Division of Environmental Remediation
New York State Department of Environmental Conservation

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Site No. 314094
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SECTION 1: PURPOSE OF THE PROPOSED PLAN

The New York State Department of Environmental Conservation (NYSDEC) in consultation with the New York State Department of Health (NYSDOH) is proposing a remedy to address the significant threat to human health and/or the environment created by the presence of hazardous waste at the Beekman Highway Garage (the Site). The Site is designated as Class 2 on the New York State registry of Inactive Hazardous Waste Disposal Sites. Class 2 sites pose a significant threat to the public and/or the environment and require remedial action. As more fully described in Sections 3 and 4 of this document, the Town Highway Department's past waste management practices and leaking underground storage tanks at the site have resulted in the disposal of a number of hazardous wastes and petroleum related contamination, including perchlorethylene, 1,1,1 trichloroethane, benzene, toluene, xylene, and ethylbenzene. These disposal activities have resulted in a significant threat to human health and/or the environment associated with the contamination of the groundwater and soil at the site, and the potential risk of exposure to the contaminants by inhalation, contact and ingestion.

In order to restore the Beekman Highway Garage inactive hazardous waste disposal site to predisposal conditions to the extent feasible and authorized by law, but at a minimum to eliminate or mitigate the significant threats to the public health that the hazardous and petroleum related waste disposed at the site have caused, the following remedy is proposed:

1. Excavate and remove the contaminated soils at the former underground storage tank (UST) areas to TAGM 4046 guidance objective values. As an alternative to TAGM 4046, cleanup guidance values in the NYSDEC's "Spill Technology and Remediation Series Memo #1" for petroleum related contaminants may be used.

   or

   Install a soil vapor extraction (SVE) system to extract contaminants from the soil in the unsaturated zone at the former UST areas, and operate the system until the NYSDEC determines that its continued use would no longer be productive.

2. Should petroleum related contaminants be encountered on the

groundwater surface, a light non-aqueous phase liquid (LNAPL) recovery system would be installed.

3. Monitor groundwater quality to confirm a decreasing trend in contaminant concentrations. The monitoring program would require that 4 monitoring wells and 5 private wells at residences not supplied with municipal water be sampled annually.

Either proposed remedy, excavation or soil vapor extraction, would be equally protective of the public health and the environment. In the past the NYSDEC has used both technologies to effectively remediate other sites with similar contaminants, and the only distinguishing criteria between these two alternatives is cost. Because the estimated costs included in the PRAP for both alternatives are extremely high, NYSDEC has proposed both alternatives and suggests that the Town of Beekman seek competitive bids for the remedial construction and select the least costly alternative. The proposed remedy, discussed in detail in Section 7 of this document, is intended to attain the remediation goals selected for this site in conformity with applicable standards, criteria, and guidance (SCGs) in Section 6 of this PRAP.

This Proposed Remedial Action Plan (PRAP) identifies the preferred remedy, summarizes the other alternatives considered, and discusses the reasons for this preference. The NYSDEC will select a final remedy for the site only after careful consideration of all comments received during the public comment period.

The NYSDEC has issued this PRAP as a component of the citizen participation plan developed pursuant to the New York State Environmental Conservation Law (ECL) and 6 NYCRR Part 375. This document is a summary of the information that can be found in greater detail in the Focused Remedial Investigation (FRI), Feasibility Study (FS) and other relevant reports and documents, available at the document repositories.

To better understand the site and the investigations conducted, the public is encouraged to review the project documents at the following repositories:

(1)
New York State Department of
Environmental Conservation
21 South Putt Corners Road
New Paltz , NY 12561
Project Manager: Mr. Keith Browne
Tel: (914) 256-3146
Hours: Between 8:30 a.m. & 4:45 p.m.

(2)
Beekman Town Hall
4 Main Street
Poughquag, NY 12570
Town Clerk: Virginia Ward
Tel:(914) 725-5302
Hours: Between 9:00 a.m. & 4:30 p.m.

THE NYSDEC seeks input from the community on all PRAPs. A public comment period has been set from **March 1, 1999 to March 30, 1999** to provide an opportunity for public participation in the remedy selection process for this site. A public meeting is scheduled for **March 15, 1999** at the **Beekman Town Hall** beginning at **7:00 p.m.** In case of inclement weather, the meeting will rescheduled for **March 22, 1999.**

At the meeting, the results of the RI/FS will be presented along with a summary of the proposed remedy. After the presentation, a question and answer period will be held, during which the public can submit verbal or written comments on the PRAP.

The NYSDEC may modify the preferred alternative or select another of the alternatives presented in this PRAP, based on new information or public comments. Therefore, the public is encouraged to review and comment on all of the alternatives identified here.

Comments will be summarized and responses provided in the Responsiveness Summary section of the Record of Decision. The Record of Decision is the NYSDEC's final selection of the remedy for this site. Written comments, postmarked no later than March 30, 1999, may be sent to Mr. Keith Browne at the above address.

SECTION 2: <u>SITE LOCATION AND DESCRIPTION</u>

The Beekman Highway Garage (the Site) is located on theTown of Beekman property at the intersection of County Road 7 (also named Beekman Poughquag Road) and Gardner Hollow Road in the Hamlet of Poughquag in Dutchess County (**Fig. 1**). The site is approximately 0.75 acre in area, and is situated in the north-central part of the 10-acre Town of Beekman Highway Dept. and Town Hall property. The site is in a fairly hilly rural area of central Dutchess County. Approximately 2000 feet to the north-west of the site is a regulated wetland. A stream flowing south from this wetland forms a tributary to the Whaley Creek, 1500 feet to the south of the site. Whaley Creek is a Class C(TS) stream supporting trout propagation and fishing. The area immediately to the west of the site was mined for gravel for the Town Highway Dept.

SECTION 3: <u>SITE HISTORY</u>

In 1991 and 1992, nine residential drinking water wells in the hamlet of Poughquag, Town of Beekman, New York were found to contain elevated concentrations of salt and of these nine, seven had 1,1,1 trichloroethane (TCA) concentrations exceeding NYS drinking water standards. There were also lower concentrations of other volatile organic compounds (VOCs), such as perchloroethylene (PCE) and 1,1 dichloroethylene (DCE) in these seven wells (**Fig. 2**). Well data collected since 1992 show a continuing decrease in the concentrations in all of the impacted wells. For example, one well, which in 1992 had TCA concentration of 200 ppb, had a concentration of 10 ppb in 1996.

In 1994 and 1995, consultants to the NYSDEC, the Town of Beekman and the citizens of Poughquag conducted separate investigations to determine the source of VOCs in the hamlet drinking water. These investigations revealed that TCA, PCE and related compounds are present in soil and groundwater on the Site.

In May 1995, the Site was placed on the Registry of Inactive Hazardous Waste Disposal Sites as a Class 2 site. A Class 2 designation means that hazardous wastes are known to have been disposed on-site, and that the wastes constitute a significant threat to human health and/or the environment.

In May 1996, the NYSDEC collated the data collected by the various consultants in 1994 and 1995 in the form of a PSA report. The report recommended that a focused Remedial Investigation and Feasibility Study (RI/FS) be conducted to: 1) more fully delineate the sources of groundwater contamination at the Highway Garage; 2) determine the extent of subsurface contamination emanating from these sources; and 3) evaluate remedial alternatives.

In July 1997, the Town entered into an Order on Consent with the NYSDEC, under which the Town would voluntarily conduct a focused Remedial Investigation (RI). The RI Field Investigation was completed in March 1998 and included a geophysical survey, a soil-gas survey, and the installation and sampling of groundwater monitoring wells.

3.1: Operational/Disposal History

While the period during which the releases of wastes into the environment occurred is unknown, three operational activities are presumed to have caused the releases.

- Use of PCE in the Block Garage, and its release into the service pit inside the building (**Fig. 3**). .
- Use of TCA in the Pole Barn and its suspected release into the floor drain and injection wells west of the building.
- Disposal of surplus road sealer in the Tar Pit Area at the north-east corner of the Pole Barn.

Two underground storage tanks containing petroleum related products were removed in 1989 and 1993. The soil and groundwater have also been contaminated by releases from these tanks. The cleanup of these releases is included in this PRAP.

3.2: Remedial History

In April 1996, the Town entered into a Memorandum of Understanding (MOU) with the NYSDEC, which obligated the Town to extend an existing potable water supply line on the Dalton Farms located to the north-west of the Site to 19 residences on Beekman Poughquag Road. The extension included all residences impacted by contamination. This extension was constructed and brought on line in February 1997.

The Service Bay Drain in the Block Garage

On June 8, 1994, and June 15, 1994, soil samples were collected from the drain point in the bottom of a service bay in the Block Garage (**Fig. 4**). PCE contamination was detected in the soil with the concentration reaching 39 parts per million (ppm) in one sample.

On November 8, 1994, the floor of the service bay pit was removed to allow access to and removal of the contaminated soils beneath. Soils were removed to a depth of 6 feet below the floor of the pit (11 feet below the garage floor). Contamination was visible during the removal to a depth of 3 feet. At 6 feet below the floor of the service pit, groundwater was encountered and excavation was halted. A composite soil sample was collected from the walls and floor of the excavation, and was analyzed for PCE. The sample had a PCE concentration of 0.17 ppm which is below the NYSDEC cleanup level of 1.4 ppm. After sampling, the excavation was backfilled with 3/4 inch stone to within 6 inches of the garage floor. The crushed stone was then covered with concrete. The contaminated soils removed from beneath the service bay drain were stockpiled and later disposed of at a permitted disposal facility.

The closure of the service bay drain conducted by the Town was coordinated with the EPA and the NYSDEC. The closure has been accepted as a completed interim remedial measure by the NYSDEC.

The Road Sealer - Tar Pit Area

The road sealer - tar pit area is located north of the Pole Barn and west of the Block Garage. This location was evidently used to dispose of excess road sealer **(Fig. 5)**. In May, 1994, during excavation work for the footings of the addition to the Pole Barn, a dark tar-like substance was encountered and a soil sample from a depth of four feet below ground had a PCE concentration of 0.93 ppm. A summary of the removal action follows:

- On July 28, 1994, the road sealer was excavated and removed. The material was generally located in a layer approximately 2.5 feet below the ground surface. The depth of the excavation to remove all of the affected soil was 4.5 feet.

- During the excavation, a mobile laboratory was used to analyze the soil. The materials removed from the excavation were staged on plastic sheeting. Once the affected soil was removed, the pit was lined with plastic and backfilled with clean fill. The total volume of affected soil - sealant materials removed was approximately 30 cubic yards. The majority of the staged material was soil.

- Three samples were collected from the pit for laboratory analyses, one from the lower third of the side wall and two from the floor of the excavation, and were analyzed for volatile and semivolatile organic compounds. The results indicated that the contaminants in the soils did not exceed NYSDEC cleanup guidance objectives.

- A sample was collected from the staged material and was analyzed for hazardous waste characteristics. The results of the analyses indicate that the sample did not have the characteristics of a hazardous waste.

- The stockpiled soils were removed for proper disposal offsite.

Section 4: SITE CONTAMINATION

To evaluate the contamination present at the site and to evaluate alternatives to address the significant threat to human health or the environment posed by the presence of hazardous waste, the Town of Beekman has recently conducted an FRI/FS.

4.1: Summary of the Remedial Investigation

The purpose of the FRI was to define the nature and extent of any contamination resulting from previous activities at the site.

The FRI was conducted between August and November of 1997. A report entitled "Focused Remedial Investigation Report" dated March 1998 has been prepared which describes the field activities and findings of the FRI in detail.

The FRI included the following activities:

- Subsurface Geophysics
  - Magnetometry
  - Terrain Conductivity
  - Ground Penetrating Radar
  - Direct-Current Resistivity
  - Seismic Refraction

- Soil Gas Survey

- Groundwater Sampling
  - 9 Existing Monitoring Wells
  - 4 New Monitoring Wells

- Soil Boring Program in Three Suspected VOC Source Areas

To determine which media (soil, groundwater, etc.) contain contamination at levels of concern, the FRI analytical data was compared to environmental Standards, Criteria, and Guidance values (SCGs). Groundwater, drinking water and surface water SCGs identified for the Site are based on NYSDEC Ambient Water Quality Standards and Guidance Values and Part V of NYS Sanitary Code. For soils, NYSDEC TAGM 4046 provides soil cleanup objectives for the protection of groundwater, background conditions, and health-based exposure scenarios.

Based on the Remedial Investigation results, in comparison to the SCGs and potential public health and environmental exposure routes, certain areas and media of the site require remediation. These are summarized below. More complete information can be found in the FRI Report.

Chemical concentrations in groundwater are reported in parts per billion (ppb), and those in soils in parts per million (ppm). For comparison purposes, where applicable, SCGs are provided for each medium.

4.1.1 Nature of Contamination

As described in the FRI Report, many soil, and groundwater soil samples were collected at the Site to characterize the nature and extent of contamination. The main categories of contaminants which exceed their SCGs are volatile organic compounds (VOCs), specifically PCE, toluene, ethylbenzene and xylenes, and a semi-volatile organic compound (SVOC) called napthalene. A brief description of characteristics of these wastes and their impacts to public health is in **Appendix A.**

4.1.2 Extent of Contamination

Table 1 summarizes the extent of contamination for the contaminants of concern in soils and groundwater and compares the data with the SCGs for the Site. The following are the media which were investigated and a summary of the findings of the investigation.

Soil

Soil borings were completed in three areas of concern: west of the Pole Barn, the northeast corner of the Pole Barn, and the former refueling underground storage tank (UST) area northeast of the Salt Shed. Each of these areas had exhibited comparatively high soil gas values for VOCs, and groundwater was known or suspected to be contaminated in all three areas.

Twenty nine soil borings were completed in the three areas of concern from which 32 soil samples were collected and analyzed for VOCs. Soil boring locations for all three areas of concern are depicted on **Fig. 3.** **Table 2** gives the sample number and depth of each sample that contained significant contaminants.

The results of the soil-gas survey conducted during the FRI suggested the possibility of TCA contamination in an area west of the Pole Barn. A soil-gas survey is a screening method that allows efficient measurements of concentrations of contaminants in the form of vapors within the pores of the soil. The measurements are used to locate sources of contamination in the soil Soil samples were collected from the area west of the Pole Barn because the soil-gas survey suggested a possible source of TCA contamination, but there were no detectable concentrations of VOCs (other than trace levels of suspected lab contaminants).

Elevated concentrations of VOCs were detected in soil samples from the former refueling UST area northeast of the Salt Shed. VOC concentrations increased downward in Boring SB-1. Sample SB-1 (14-16 feet) contained toluene (1.5 ppm), ethylbenzene (4.4 ppm), xylenes (30 ppm), and 40 tentatively identified petroleum hydrocarbons with individual concentrations estimated at up to 29 ppm.

In the former refueling UST area, Soil Borings SB-1, SB-8, SB-9, SB-11, and SB-16 contained VOCs at concentrations above the allowable NYSDEC guidance limits for soil. A 4,000 gallon gasoline UST and a 2,000 gallon diesel UST were situated in this area until their removal in 1989 and 1993, respectively. The approximate UST and pump island locations are shown on **Fig. 6**. The limited number of samples analyzed during the FRI indicate that the contamination is localized within the fluctuation range of the groundwater table elevation between 10 to 16 feet below grade. The most common VOCs present in this area are primary constituents of gasoline and diesel fuel, and indicate probable leakage from one or both of the USTs prior to their removal.

Fuel releases from the former refueling UST area probably account for the VOCs present in Monitoring Well MW-5. Because PCE is present in soil samples collected from below the water table in the former refueling UST area, it appears as though petroleum constituents have commingled with the PCE groundwater plume that originates to the north.

Groundwater

The FRI workplan called for sampling of nine existing, on-site groundwater monitoring wells that had been installed in 1994 as part of the PSA (MW-1, MW-2, MW-3, MW-4, MW-5, MW-7, MW-8, MW-16, and MW-17. Two pairs of additional monitoring wells were installed on September 1997 in areas selected on the basis of soil gas mapping. (MW-18S, MW-18D, MW-19S, MW-19D). All 13 on-site monitoring wells were sampled in October 1997 (**Fig. 3**).

Groundwater contours are shown on **Fig. 7,** and indicates a generally southerly flow. Significant results for groundwater samples are summarized in **Table 3**.

A groundwater sample collected from monitoring well MW-18S near the northeast corner of the Pole Barn contained PCE (440 ppb), and TCA (10 ppb). Total VOCs in MW-18S are estimated at a concentration of 710 ppb. Monitoring well MW-18D at this location contained 1,2 dichloroethane (3 ppb) and total VOCs at an estimated concentration of 16 ppb. MW-18S was sampled and analyzed again on December 1, 1998. The concentration of PCE in this sample was found to be 337 ppb.

A groundwater sample collected from monitoring well MW-19D contained toluene at 43 ppb and acetone at 15 ppb and trace levels of TCA (2 ppb). The presence of acetone in samples frequently arises out of its use in the laboratory.

A groundwater sample collected from monitoring well MW-5, approximately 130 feet downgradient (southward) of the refueling area, contains fuel constituents benzene (8 ppb), toluene (6 ppb), ethylbenzene (4 ppb), xylene (5 ppb), naphthalene (26 ppb), as well as 2 butanone (75 ppb), acetone (12 ppb) and other tentatively identified VOCs. The appearance of VOCs and SVOCs in MW-5, which is situated along the down-gradient perimeter of the Town property, in the November 1997 sampling round, is not unexpected given the southerly flow of groundwater and multiple up-gradient source areas.

A comparison of the groundwater quality data collected from two rounds of sampling from the same set of monitoring wells, one in 1994 and the other in 1997, indicates minor differences which may be due to seasonal effects and natural attenuation. Details are contained in the FS report.

4.3 <u>Summary of Human Exposure Pathways</u>:

This section describes the types of human exposures that may present added health risks to persons at or around the site.

An exposure pathway is how an individual may come into contact with a contaminant. The five elements of an exposure pathway are 1) the source of contamination; 2) the environmental media and transport mechanisms; 3) the point of exposure; 4) the route of exposure; and 5) the receptor population. These elements of an exposure pathway may be based on past, present, or future events.

Pathways which are known to or may potentially exist at the site include:

- Ingestion of contaminated groundwater should it be used for potable purposes such as drinking, cooking or bathing.
- Inhalation of VOCs in the form of vapors from contaminated soil or groundwater.
- Direct contact or incidental ingestion of contaminated subsurface soils by construction workers conducting excavation work.

Ingestion of contaminated water has been eliminated by the installation of public water to the residences with private water supplies that were found to contain contamination above drinking water standards.

Analysis of soil, groundwater, and the soil-gas at the perimeter of the site indicate no significant risk of inhalation of contaminant vapors by the nearby residents. The removal of contaminated soils as proposed in this PRAP would further reduce this risk. The Site is mostly paved, thus forming a barrier to the release of contaminant vapor on-site.

The remedy proposed in this PRAP, if selected, would reduce the risk of contact and ingestion of contaminated subsurface soils by construction workers, by requiring cleanup of soils to the NYSDEC cleanup objectives values.

4.4 Summary of Environmental Exposure Pathways:

This section summarizes the types of environmental exposures which may be presented by the site. For the Site, the pathway would be formed by the transport of contaminants by the groundwater into surface water bodies. The groundwater flows generally in a southerly direction. Approximately 2000 feet to the north-west of the site is a regulated wetland. A stream flowing south from this wetland forms a tributary to the Whaley Creek, 1500 feet to the south of the site. Whaley Creek is a Class C(TS) stream supporting trout propagation and fishing. A July 1995 study by NYSDEC of the fish population in these surface water bodies found the fish population conditions to be normal.

SECTION 5: ENFORCEMENT STATUS

Potentially Responsible Parties (PRPs) are those who may be legally liable for contamination at a site. This may include past or present owners and operators, waste generators, and haulers.

The following is the chronological enforcement history of this site.

Orders on Consent

Date :	7/3/97
Index:	W3-0791-9705
Subject:	FRI/FS for the Beekman Highway Garage Site

The NYSDEC and the Town of Beekman entered into a Consent Order on July 3, 1997. The Order obligates the responsible parties to implement an FRI/FS . Upon issuance of the Record of Decision the NYSDEC will approach the PRPs to implement the selected remedy under an Order on Consent.

SECTION 6: SUMMARY OF THE REMEDIATION GOALS

Goals for the remedial program have been established through the remedy selection process stated in 6 NYCRR Part 375-1.10. The overall remedial goal is to restore the site to pre-disposal conditions, to the extent feasible and authorized by law.

At a minimum, the remedy selected should eliminate or mitigate all significant threats to public health and to the environment presented by the hazardous waste disposed at the site through the proper application of scientific and engineering principles.

The goals selected for this site are:

- Eliminate the potential for direct human or animal contact with the contaminated soils on site.
- Mitigate the impacts of contaminated groundwater to the public and the environment.
- Provide for attainment of SCGs for groundwater quality at the limits of the area of concern (AOC), to the extent practicable.

SECTION 7: SUMMARY OF THE EVALUATION OF ALTERNATIVES

The selected remedy should be protective of human health and the environment, be cost effective, comply with other statutory laws and utilize permanent solutions, alternative technologies or resource recovery technologies to the maximum extent practicable. Potential remedial alternatives for the Site were identified, screened and evaluated in the report entitled "*Focused Feasibility Study, Beekman Highway Garage,*" dated December 1998.

A summary of the detailed analysis follows. As presented below, the "Time to Implement" reflects only the time required to implement the remedy, and does not include the time required to design the remedy, procure contracts for design and construction or to negotiate with responsible parties for implementation of the remedy.

7.1: Description of Alternatives

Four remedial alternatives, including "no further action, " were selected for inclusion in the detailed evaluation of alternatives as discussed in the previous chapter. The technical elements included in each of these alternatives are summarized in **Table 4**. This chapter provides a detailed description of each of the three site-wide remedial alternatives.

ALTERNATIVE 1: NO FURTHER ACTION

The no further action alternative would not include any removal or treatment of contaminated soils or groundwater beyond that achieved by past remedial activities. This alternative would implement institutional controls, including deed, development, and groundwater use restrictions to minimize human contact with the contaminated media.

Deed restrictions limit future uses of the site as a whole or for specific areas (i.e., the former UST area) in the event of transfer of the property to other ownership. Deed restrictions are intended to notify prospective owners of the existence of remaining contamination and the limitations such contamination has on site uses prior to transfer of the property. Development restrictions would apply to any new construction initiated by the current owners and might, for example, restrict building construction in the source area of the site. Signs could be posted in contaminated areas to warn construction or utility workers to contact NYSDEC before excavating. Groundwater use restrictions would be intended to prohibit pumping and use of contaminated groundwater in the vicinity of the Site in order to prevent exposure to contaminants.

The pavement in the former UST location acts as a type of cap by diverting storm water away from the contaminated soil area and reducing the amount of storm water that infiltrates into the ground. This pavement should be maintained by the town garage as it serves to reduce the amount of storm water that infiltrates into the ground, which in turn reduces the amount of contaminants that leach into the groundwater. This alternative does not include a long term monitoring program of on-site or off-site wells.

Present Worth:	*$0*
Capital Cost:	*$0*
Annual O&M:	*$0*

ALTERNATIVE 2: LONG-TERM GROUNDWATER MONITORING

Alternative 2 includes the implementation of institutional controls and a long-term groundwater monitoring program. Institutional controls are intended to prevent human contact with the contaminated subsurface soils. Construction workers are potential receptors to the on-site contaminated soils when a future construction project involves excavation in the former UST area. Institutional measures under Alternative 2 would be intended to prevent this exposure through the implementation of deed and development restrictions. Groundwater use restrictions would be included to prevent exposure of the hamlet's residents to contaminated groundwater. This alternative would also implement a long-term groundwater monitoring program to assess the effectiveness of natural attenuation on reducing contaminant concentrations over time.

Institutional measures may be implemented as part of this alternative to minimize human contact with the contaminated media. These institutional measures would include deed, development, and groundwater use restrictions, similar to the ones described in Alternative 1.

Alternative 2 would include periodic sampling of existing monitoring wells, which would constitute a long-term groundwater monitoring program for the hamlet. The purpose of the long-term groundwater monitoring program would be to monitor any migration or natural attenuation (transport and transformation of the contaminants to reduce contaminant concentrations) of the contaminant plume over time.

The monitoring program would require that monitoring wells MW-3, MW-5, MW-16R, and MW-18S and five private wells at residences not supplied with municipal water be sampled annually. NYSDEC and NYSDOH would select the three private wells based on available data. NYSDEC and NYSDOH would terminate the monitoring program when contaminant concentrations in the impacted private wells, currently being monitored separately, show a steadily decreasing trend and the concentrations in the other wells are unlikley to be impacted. It is assumed that groundwater samples would be analyzed for VOCs and methyl tertiary butyl ether (MTBE).

Present Worth:	*$ 35,0000*
Capital Cost:	*$ 00*
Annual O&M:	*$ 8,000*
Time to Implement	*6 months - 1 year*

ALTERNATIVE 3: SOURCE AREA EXCAVATION AND GROUNDWATER MONITORING

Alternative 3 would include the remediation of the source area at the site through excavation of contaminated soils with subsequent off-site disposal. Excavated soils are not anticipated to be hazardous for disposal and, therefore, could be transported to a permitted double-lined landfill. This alternative would also include natural attenuation and long-term monitoring of the contaminated groundwater associated with the site.

Alternative 3 would include excavation of soils contaminated with petroleum-related compounds in the former UST area to prevent continued migration of contaminants to groundwater. The area to be excavated is shown on **Fig. 6**, and is based on removal of readily accessible soils containing VOC concentrations that exceed the New York State soil cleanup objectives. Contaminants of concern in soils include xylenes, ethylbenzene, toluene, PCE, and naphthalene. On December 2, 3 and 4, 1998, a more detailed delineation of the extent of contamination was conducted. The total soil volume to be excavated is estimated to be 410 cubic yards.

The excavation would be conducted using conventional earthmoving equipment, such as backhoes and front end loaders. Shoring or other method would be used in accordance with OSHA requirements for excavations over 5 ft deep. For cost estimating purposes, it is assumed that post-excavation samples would be collected from the bottom of the excavation at the rate of one sample every 200 square feet. The samples would be analyzed for petroleum related compounds such as benzene, toluene, xylene, ethylbenzene and MTBE. Following the excavation to the specified depths and collection of post-excavation samples, the excavations would be immediately backfilled with suitable clean fill material and the top layer would be paved with asphalt to match pre-remediation conditions. The presence of petroleum related contaminants in the form of .light non-aqueous phase liquid (LNAPL) on the groundwater surface would be investigated.

Excavated soils would be placed directly into dump trailers to prevent cross-contamination of clean areas. Waste acceptance approval would be obtained for all soils prior to excavating. For cost estimating purposes, it is assumed that all excavated soils would be disposed off-site. However, excavated soils that contain VOC concentrations less than the soil cleanup objectives could be used as backfill material to fill the excavation.

Groundwater use restrictions must be implemented in order to prevent human exposure to contaminated groundwater. Groundwater use restrictions discussed in Alternative 1 would be implemented.

Alternative 3 would also include the required sampling of monitoring wells as part of a long-term groundwater monitoring program for the hamlet. The purpose of the long-term groundwater monitoring program would be to to monitor any migration or natural attenuation (transport and transformation of the contaminants to reduce concentrations) of the contaminant plume over time.

Similar to Alternative 2, the monitoring program would require that monitoring wells MW-3, MW-5, MW-16R, and MW-18S and five private wells at residences not supplied with municipal water be sampled annually. NYSDEC and NYSDOH would select the five private wells that are presently not impacted by site contamination. NYSDEC and NYSDOH would terminate the monitoring program when contaminant concentrations in the impacted private wells, which are no longer being used as potable water supplies, show a steady decrease in contaminant concentrations and no other wells are likely to be impacted. It is assumed that groundwater samples would be analyzed for VOCs and MTBE.

Present Worth:	*$ 239,000*
Capital Cost:	*$ 204,000*
Annual O&M:	*$ 8,000*
Time to Implement	*6 months - 1 year*

ALTERNATIVE 4: SOIL VAPOR EXTRACTION AND GROUNDWATER MONITORING

Alternative 4 would include remediation of the source area at the site (i.e., former UST location) by implementing an SVE system, an in situ remediation technology. This alternative would also include natural attenuation and long-term monitoring of the groundwater plume associated with the site as described above for Alternative 3.

The objective of SVE is to induce airflow in the unsaturated zone by creating a pressure gradient through the withdrawal of air from perforated tubes driven vertically into the subsurface. The SVE gas flow extracts VOCs from the pores in the unsaturated soil, and enhances volatilization of dissolved contaminants from the groundwater table and desorption of contaminants from the surfaces of soil particles in the unsaturated zone. The effectiveness of SVE on halogenated and non-halogenated VOCs in soils has been demonstrated successfully at many sites. SVE has also been demonstrated to be effective on non-halogenated SVOCs.

The system would include the installation of vapor extraction points, trenches, and piping. Other components would include a blower, moisture separator, vapor recovery system (vapor phase granular activated carbon) if required , and electrical controls. If installed, the vapor recovery system would collect VOCs from the vapor phase by passing the air stream through granular activated carbon (GAC) medium to comply with regulatory limitations on the release of contaminants into the atmosphere. The GAC filter would be replaced before VOCs break through it in exceedence of allowable limits. The presence of LNAPL would be investigated by means of a monitoring well.

Prior to designing this system, a pilot-scale treatability study would be performed to determine the optimal operating pressures and flow rates to remove contaminants from the subsurface and would evaluate the airflow distribution. The results of the pilot test would be used to predict the run time of the SVE system to achieve the remedial action objectives. For cost estimating purposes, the SVE system is estimated to operate for five years.

Based on the geological information presented in the FRI, it is estimated that four vapor extraction points and one blower would likely be necessary. Piping is assumed to be aboveground. Emissions from the vapor extraction system would be discharged to the atmosphere after necessary treatment. The SVE system would be operated until the remedial action objectives for unsaturated soils are satisfied.

Operations and maintenance costs would include electricity to operate the blower and vapor recovery system and periodic sampling to determine the effectiveness of the system. GAC filters would be provided if required to meet air emission limitations. The cost of operations and maintenance would then include the replacements of the GAC filters.

Groundwater use restrictions must be implemented in order to prevent human exposure to contaminated groundwater. Groundwater use restrictions, as discussed in Alternative 1, would be implemented.

Long-term monitoring of the contaminant plume in the groundwater would be performed under Alternative 4. The frequency and type of groundwater monitoring would be similar to the program described in Alternatives 2 and 3.

Present Worth:	*$ 455,000*
Capital Cost:	*$ 234,000*
Annual O&M:	*$ 51,000*
Time to Implement	*6 months - 1 year*

7.2 Evaluation of Remedial Alternatives

The criteria used to compare the potential remedial alternatives are defined in the regulation that directs the remediation of inactive hazardous waste sites in New York State (6NYCRR Part 375). For each of the criteria, a brief description is provided, followed by an evaluation of the alternatives against that criterion. A detailed discussion of the evaluation criteria and comparative analysis is included in the Feasibility Study.

The first two evaluation criteria are termed threshold criteria and must be satisfied in order for an alternative to be considered for selection.

1. Compliance with New York State Standards, Criteria, and Guidance (SCGs).

Compliance with SCGs addresses whether or not a remedy would meet applicable environmental laws, regulations, standards, and guidance.

An extended time frame would be required to achieve chemical-specific SCGs for the site, including the New York State soil cleanup objectives and the fresh groundwater (Class GA) standards by Alternatives 1 and 2, because they would rely principally on the natural attenuation processes. Alternative 2, however, would contain a long-term monitoring program that would enable assessment of any natural attenuation process. Alternatives 3 and 4 are expected to achieve compliance with site SCGs, including the achievement of remedial action objectives, in a shorter period of time when compared to Alternatives 1 and 2 because of the more aggressive removal of the contaminants in the soils.

2. Protection of Human Health and the Environment.

This criterion is an overall evaluation of each alternative's ability to protect public health and the environment.

In comparing the four remedial alternatives, Alternative 1 would provide the least protection of human health as workers that excavate soil in the former UST location in the future may be exposed to VOC contaminants. Under Alternative 1, remaining contaminants in the groundwater may be inhaled or directly contacted by person or persons that use the groundwater. Institutional measures would be implemented to prevent human exposure to contaminants. Alternative 1 does not include monitoring of the contaminant plume. In comparison, Alternative 2 would provide an early warning, and thus more protection, to the community by instituting a long-term groundwater monitoring program to assess the reduction in groundwater contaminant concentrations achieved by natural attenuation over time, and thus allow implementation of an appropriate corrective measure.

Because they both include active removal of contaminants from site soils, Alternatives 3 and 4 would provide greater protection of human health and the environment than Alternatives 1 and 2. Alternative 3 would remove the soil contaminants from the site in less time than Alternative 4. The success of SVE in Alternative 4 depends on site-specific geological conditions that must be evaluated through a pilot test. If SVE cannot achieve the remedial action objectives, Alternative 4 would not be protective of human health or the environment.

The next five "primary balancing criteria" are used to compare the positive and negative aspects of each of the remedial strategies.

3. Short-term Effectiveness.

The potential short-term adverse impacts of the remedial action upon the community, the workers, and the environment during the construction and/or implementation are evaluated. The length of time needed to achieve the remedial objectives is also estimated and compared against the other alternatives.

No short-term impacts would result from the implementation of Alternatives 1 and 2 as these alternatives do not include any active remediation of contaminated soils and groundwater. Alternatives 3 and 4 would have similar short-term impacts; however soil remediation in Alternative 3 would be achieved in a shorter amount of time. Because Alternative 4 would require no trucking of contaminated soil, it would generate less dust than Alternative 3 which would require excavation and transportation of contaminated soils.

4. Long-term Effectiveness and Permanence.

This criterion evaluates the long-term effectiveness of the remedial alternatives after implementation. If wastes or treated residuals remain on site after the selected remedy has been implemented, the following items are evaluated: 1) the magnitude of the remaining risks, 2) the adequacy of the controls intended to limit the risk, and 3) the reliability of these controls.

Alternatives 1 and 2 would provide the least long-term effectiveness and permanence as contaminated soils would remain on site. Alternatives 3 and 4 would both include the removal of contaminants from site soils and long-term groundwater monitoring and therefore provide comparable long-term effectiveness for site cleanup. The time to effect soil remediation using SVE in Alternative 4 is unknown at this point, but would be determined following a pilot test.

5. Reduction of Toxicity, Mobility or Volume.

Preference is given to alternatives that permanently and significantly reduce the toxicity, mobility or volume of the wastes at the site.

Alternatives 1 and 2 would not achieve a substantial reduction in the toxicity or volume of contamination present as contaminated soils would remain on site. Alternative 3 would result in the greatest reduction in toxicity, mobility, and volume of contaminants as the majority of source soils would be removed from the site. With Alternative 4, soil contaminant concentrations would be reduced over a longer period of time.

6. Implementability.

The technical and administrative feasibility of implementing each alternative are evaluated. Technical feasibility includes the difficulties associated with the construction and the ability to monitor the effectiveness of the remedy. Consideration of administrative feasibility includes the availability of the necessary personnel and material, potential difficulties in obtaining specific operating approvals, access for construction, and other related factors.

Alternative 1 would be easiest alternative to implement as it would maintain the current conditions at the site and would add institutional measures. Alternative 2 would be the next easiest alternative to implement as it involves techniques (well sampling) that have already been implemented at the Site and would add institutional measures. Alternatives 3 and 4 would be equally straightforward to implement..

7. Cost.

Capital and operation and maintenance costs are estimated for each alternative and compared on a present worth basis. Although cost is the last balancing criterion evaluated, where two or more alternatives have met the requirements of the remaining criteria, cost effectiveness can be used as the basis for the final decision. The costs for each alternative are presented in **Table 5.**

Alternative 1, the no further action alternative, would have the lowest estimated present worth cost since only administrative actions would be required. Alternative 2, the long-term groundwater monitoring of natural attenuation alternative, would have the next lowest estimated present worth cost ($35,000) since it would include periodic well sampling and implementation of institutional controls. Alternative 3, the source excavation and groundwater monitoring alternative ($239,000). has the next lowest, although significantly higher than Alternatives 1 and 2. Alternative 4, the SVE and groundwater alternative, with estimated present worth cost of $455,000, would have the highest cost.

The most economical alternative that achieves the site's remedial action objectives and complies with the ARARs is Alternative 2, but would require a protracted period to achieve SCGs. Alternatives 3 and 4, would both meet the SCGs in a shorter time period than would Alternatives 1 and 2. Alternative 3 would cost half as much as Alternative 4. The cost of Alternative 4 assumes that the SVE system would be operational at the site for 5 years. A better estimate of remediation time would be obtained after reviewing the results of a pilot test.

This final criterion is considered a modifying criterion and is taken into account after evaluating those above. It is evaluated after public comments on the Proposed Remedial Action Plan have been received.

8. Community Acceptance

Concerns of the community regarding the FRI/FS reports and the Proposed Remedial Action Plan are evaluated. A "Responsiveness Summary" would be prepared that describes public comments received and how the Department would address the concerns raised. If the selected remedy differs significantly from the proposed remedy, notices to the public would be issued describing the differences and reasons for the changes.

SECTION 8: SUMMARY OF THE PROPOSED REMEDY

Based upon the results of the FRI/FS, and the evaluation presented in Section 7, the NYSDEC is proposing either Alternative 3 **or** Alternative 4 to address the soil contamination, recovery of any LNAPL, and groundwater monitoring as the proposed remedy for the Site. Either of these alternatives would be equally protective of the public health and the environment. In the past the NYSDEC has used both types of technologies to remediate other sites with similar contaminants, and cost is really the only distinguishing criteria between these two alternatives. Alternative 3 would consist of removal of soils containing petroleum related contaminants to NYSDEC SCG levels, backfilling the excavation with clean fill or site soil that meet the SCGs. Alternative 4 would consist of the installation of vapor extraction points, trenches, and piping. Other components would include a blower, moisture separator, vapor recovery system (vapor phase granular activated carbon) if required, and electrical controls. The vapor recovery system would collect VOCs from the vapor phase by passing the air stream through granular activated carbon (GAC) medium. The GAC filter would be replaced before VOCs break through it in exceedence of allowable limits.

This selection is based upon the community's expressed desire to cleanup the site expeditiously, successful demonstrations of the effectiveness of Alternatives 3 and 4 at many sites, and the results of periodic groundwater analysis that have exhibited continuing decreases in the concentration of contaminants in the impacted private wells that have been abandoned. While the excavation and removal of contaminated soils in Alternative 3 would be accomplished within a few months, it would take several years to achieve the same level of cleanup in Alternative 4. The other two alternatives, Alternatives 1 and 2 would rely on institutional controls and would require a considerably greater duration to achieve the same level of reduction in contaminant concentrations.

The estimated present worth costs to implement Alternatives 3 and 4 has been estimated in the Feasibility Study to be $239,000 and $455,000. For Alternative 3, the cost to construct the proposed remedy is estimated to be $204,000 and the estimated average annual operation and maintenance cost for 5 years is $8,000. For Alternative 4, the cost to construct is estimated to $234,000 and the annual operation and maintenance cost for 5 years is $51,000. The NYSDEC's experience with similar remedial alternatives at other sites leads it to conclude that the estimated costs for both of these alternatives are extremely high. The NYSDEC suggests that the Town of Beekman seek competitive bidding for the remedial construction work of both alternatives so that the Town could select the least costly alternative.

The elements of the proposed remedy are as follows:

1. A remedial design program to verify the components of the conceptual design and provide the details necessary for the construction, operation and maintenance, and monitoring of the remedial program. Any uncertainties identified during the FRI/FS would be resolved.

2. Excavate and remove the contaminated soils at the former UST areas to TAGM 4046 guidance objective values. As an alternative to TAGM 4046, cleanup guidance values in the NYSDEC's "Spill Technology and Remediation Series Memo #1" for petroleum related contaminants may be used.

   or

   Install a SVE system to extract contaminants from the soil in the unsaturated zone at the former USTs areas, and operate the system until the NYSDEC determines that its continued use would no longer be productive.

3. Should petroleum related contaminants be encountered on the groundwater surface, an LNAPL recovery system would be installed.

4. Monitor groundwater quality to confirm a decreasing trend in contaminant concentrations. The monitoring program would require that monitoring wells MW-3, MW-5, MW-16R and MW-18S, and five private wells at residences not supplied with municipal water be sampled annually. NYSDEC and NYSDOH would select the three private wells based on available data. NYSDEC and NYSDOH would terminate the monitoring program when contaminant concentrations in the impacted private wells, currently being monitored separately, show a steadily decreasing trend and the concentrations in the other wells are unlikley to be impacted. It is assumed that groundwater samples would be analyzed for VOCs and MTBE.

Table 1
Nature and Extent of Contamination

MEDIA	CLASS	CONTAMINANT OF CONCERN	CONCENTRATION RANGE	FREQUENCY of EXCEEDING SCGs	SCG
Groundwater (Conc. in ppb)	VOCs	Perchloroethylene	ND to 440	4 of 13	5
		Trichloroethane	ND to 10	1 of 13	5
		Benzene	ND to 8	2 of 13	0.7
		Toluene	ND to 43	3 of 13	5
		Total Xylenes	ND to 5	1 of 13	5
	SVOCs+	Napthalene	26 to 130	2 of 2	10
Soils (Conc. in ppm)	VOCs	Perchloroethylene	ND to 3.8	1 of 32	1.4
		Toluene	ND to 26	2 of 32	1.5
		Ethylbenzene	ND to 58	2 of 32	5.5
		Total Xylenes	ND to 400	6 of 32	1.2
	SVOC	Napthalene	9.9 to 110	1 of 2	13

Note:

VOCs: Volatile Organic Compounds
SVOCs: Semi-Volatile Organic Compounds

Table 2

Beekman Highway Garage
Site ID No. 314094
Salient Soils Results
Extracted from March 1998 Focused Remedial Investigation Report

Sample Locations Boring No. & Depth Range in Feet	Chemical Constituents (ppm)					
	PCE	TCA	Toluene	Ethylbenzene	Total Xylenes	Napthalene
SB1 (14-16)	-	-	1.5	4.4	30.0	na
SB8 (10-12)	0.4	-	26.0	58.0	400.0	110*
SB8 (13-16)	0.3	-	3.9	5.6	37.0	9.9
SB9 (13-15)	0.3	1.2	-	-	1.5	na
SB11 (12-14)	3.8	-	0.6	2.1	5.1	na
SB16 (18-20)	-	-	0.7	2.7	13.0	na
NYSDEC Limits	1.4	0.8	1.5	5.5	1.2	13.0

Note:

*	Estimated in duplicate. Not detected in primary sample.
-	Not detected
na	Not analyzed

Table 3

Beekman Highway Garage
Site ID No. 314094
Salient Groundwater Results
Extracted from March 1998 Focused RI Report

Monitoring Well	Chemical Constituents (ppb)						
	PCE	TCA	Toluene	Ethylbenzene	Total Xylenes	Benzene	Napthalene
MW-4	91	-	-	-	-	-	na
MW-5	-	-	6	4	5	8	26
MW-8	68	-	-	-	-	-	na
MW-16R	-	-	9	-	-	-	na
MW-17	19	-	-	-	-	-	na
MW-18S	440	10	-	-	-	-	na
MW-19D	-	2	43	-	-	-	130
NYSDEC Limits	5	5	5	5	5	0.7	10

Note:

na Not analyzed

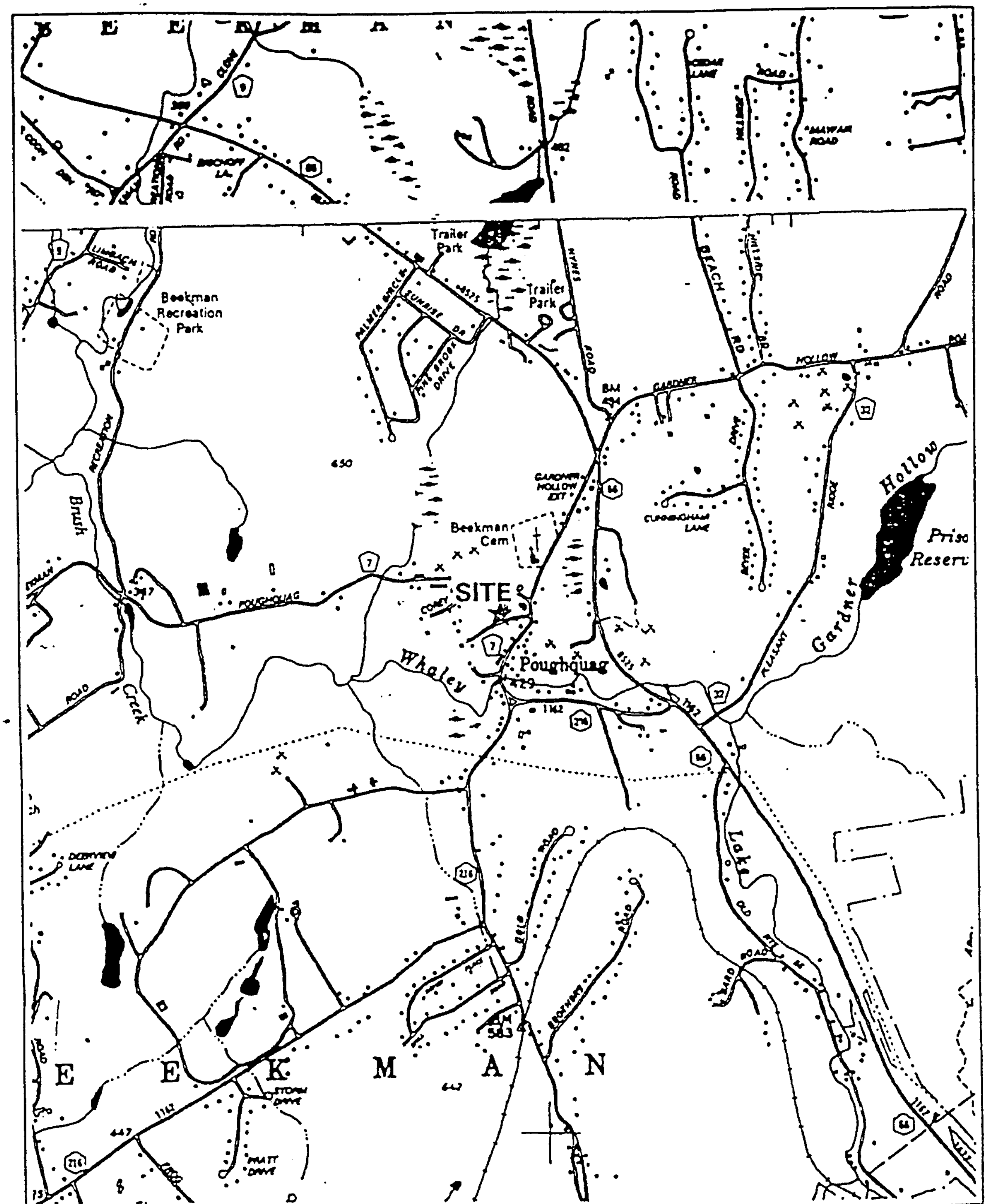
Table 4

Elements of Remedial Alternatives

Alternative	Elements of the Alternative
Alternative 1: No Further Action	• Institutional controls
Alternative 2: Long Term Groundwater Monitoring	• Monitor groundwater quality • Institutional controls
Alternative 3: Source Excavation and Groundwater Monitoring	• Excavate contaminated soils in former UST area • Transport and dispose waste soils off-site • Monitor groundwater quality • Institutional controls
Alternative 4: Soil Vapor Extraction (SVE) and Groundwater Monitoring	• Reduce soil contaminant concentrations using SVE • Monitor effectiveness of SVE system • Monitor groundwater quality • Institutional controls

Table 5
Remedial Alternative Costs

Remedial Alternative	Capital Cost	Annual O&M	Total Present Worth
Alternative 1: No Action	$0	$0	$0
Alternative 2: Groundwater Monitoring	$0	$8,000	$35,000
Alternative 3: Source Excavation & Groundwater Monitoring	$204,000	$8,000	$239,000
Alternative 4: Soil Vapor Extraction and Groundwater Monitoring	$234,000	$51,000	$455,000



Site Location Map

314094 Beekman Town Garage

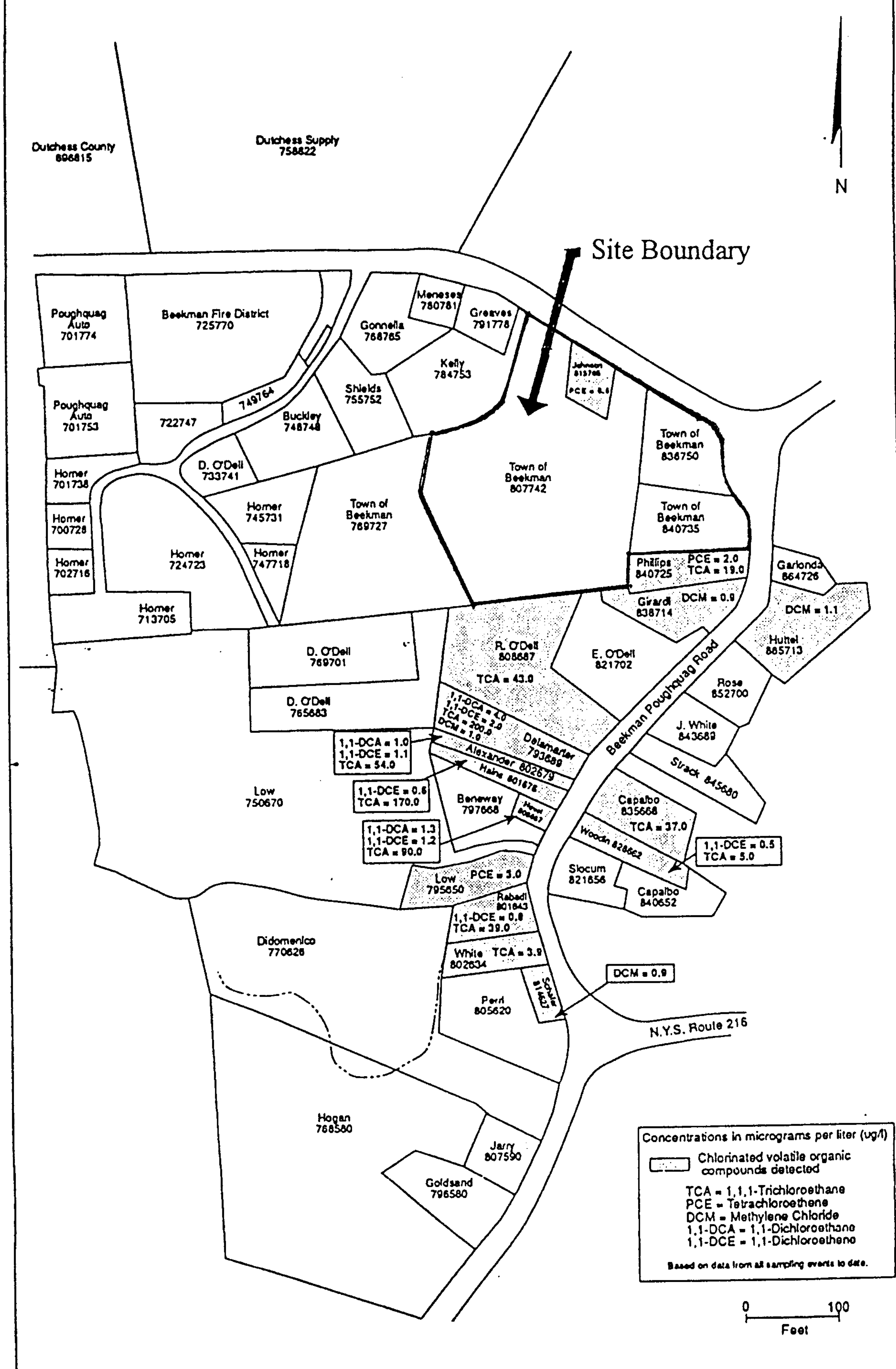
NYSDOT Planimetric Quadrangle(s):
VERBANK, POUGHQUAG

0 500 1000 1500 2000
FEET

Scale 1:24,000

April 18, 1996

FIGURE 1



Distribution of Chlorinated Volatile Organic Compounds in Groundwater Poughquag, NY	DATE:	7/94
	SCALE:	As Shown
	JOB NO.:	BP00390

U.S. HYDROGEOLOGIC, INC.

Figure 2

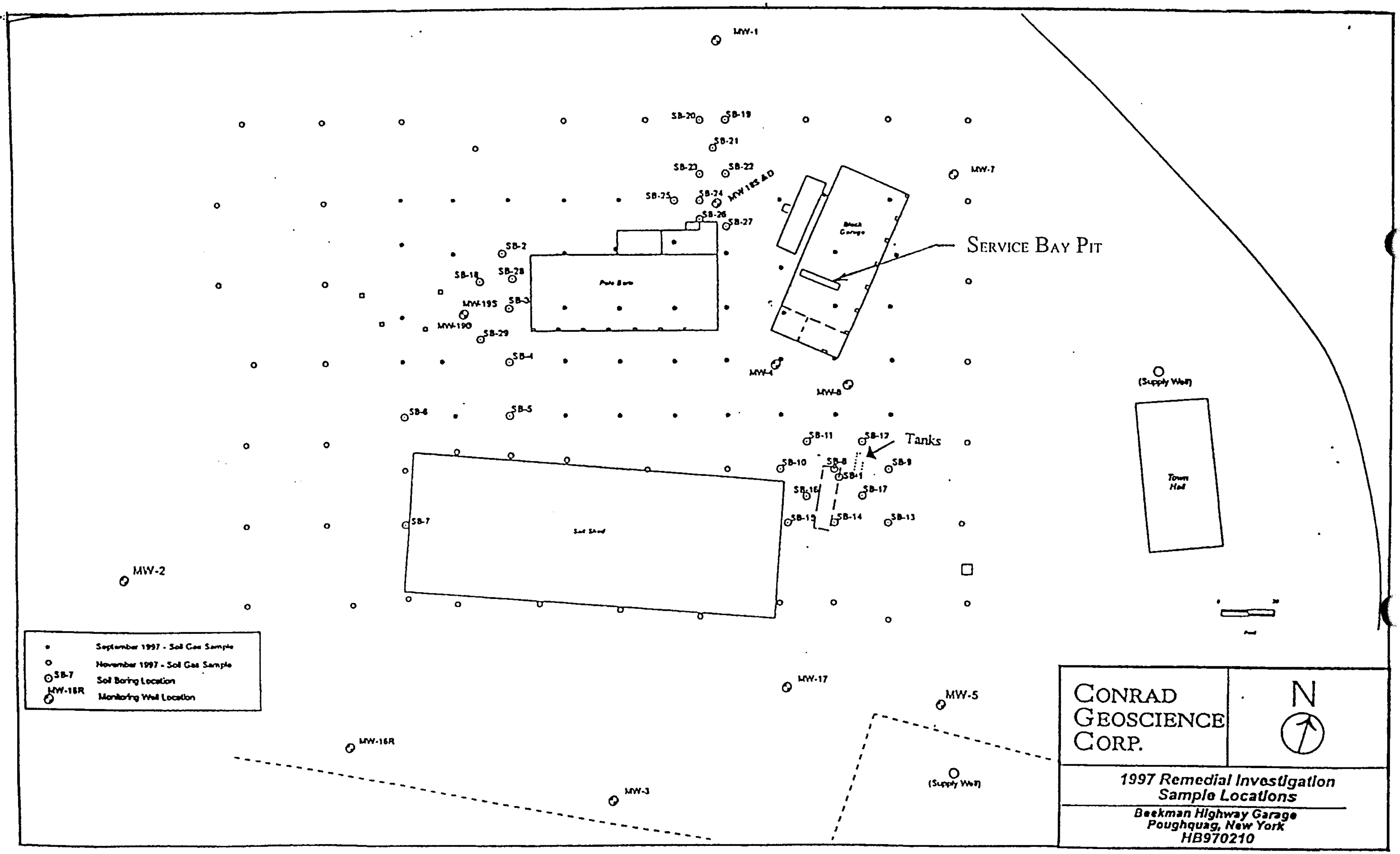

MW-1
SB-20
SB-19
SB-21
SB-23
SB-22
MW-7
SB-25
SB-24
MW 185 &D
SB-26
SB-27
SB-2
SB-18
SB-28
MW-195
SB-3
MW-190
SB-29
SB-4
MW-4
MW-8
SB-6
SB-5
SB-11
SB-12
Tanks
SB-10
SB-8
SB-9
SB-1
SB-16
SB-17
SB-7
SB-15
SB-14
SB-13
Service Bay Pit
(Supply Well)
Town Hall
MW-2
September 1997 - Soil Gas Sample
November 1997 - Soil Gas Sample
SB-7 Soil Boring Location
MW-18R Monitoring Well Location
MW-17
MW-5
MW-18R
(Supply Well)
MW-3
Conrad Geoscience Corp.
N
1997 Remedial Investigation
Sample Locations
Beekman Highway Garage
Poughquag, New York
HB970210

Figure 3

Removal of Contaminated Soil in the Service Bay Pit

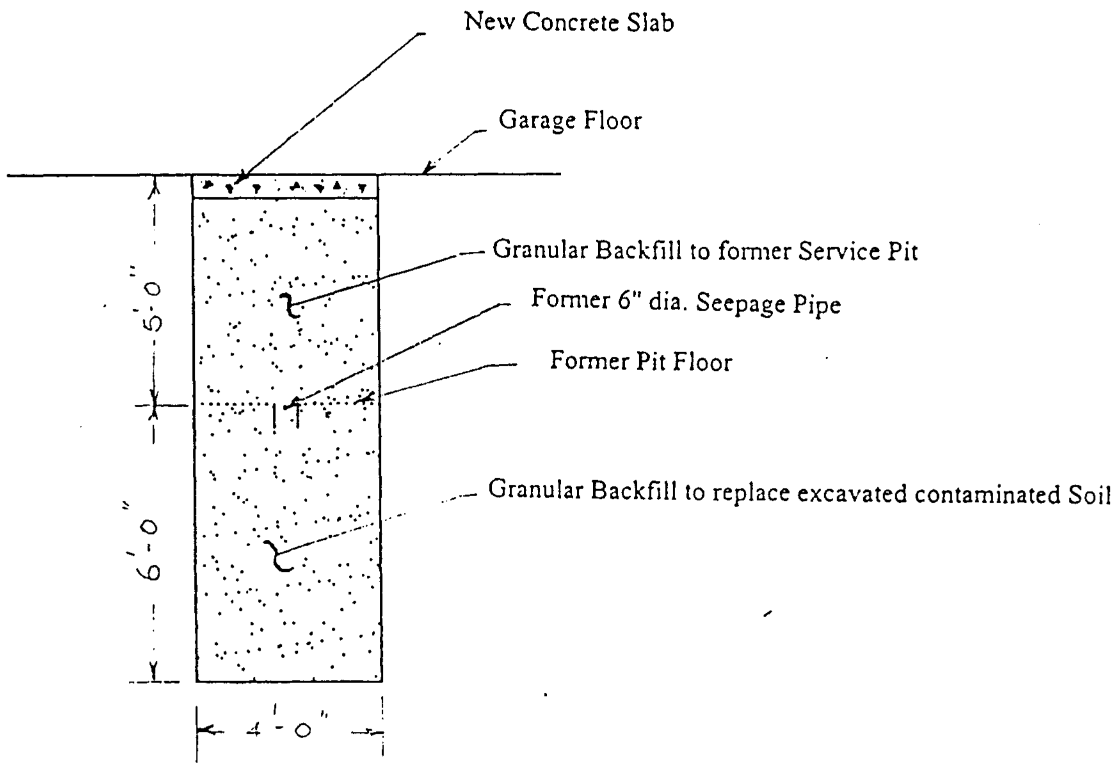


Figure 4

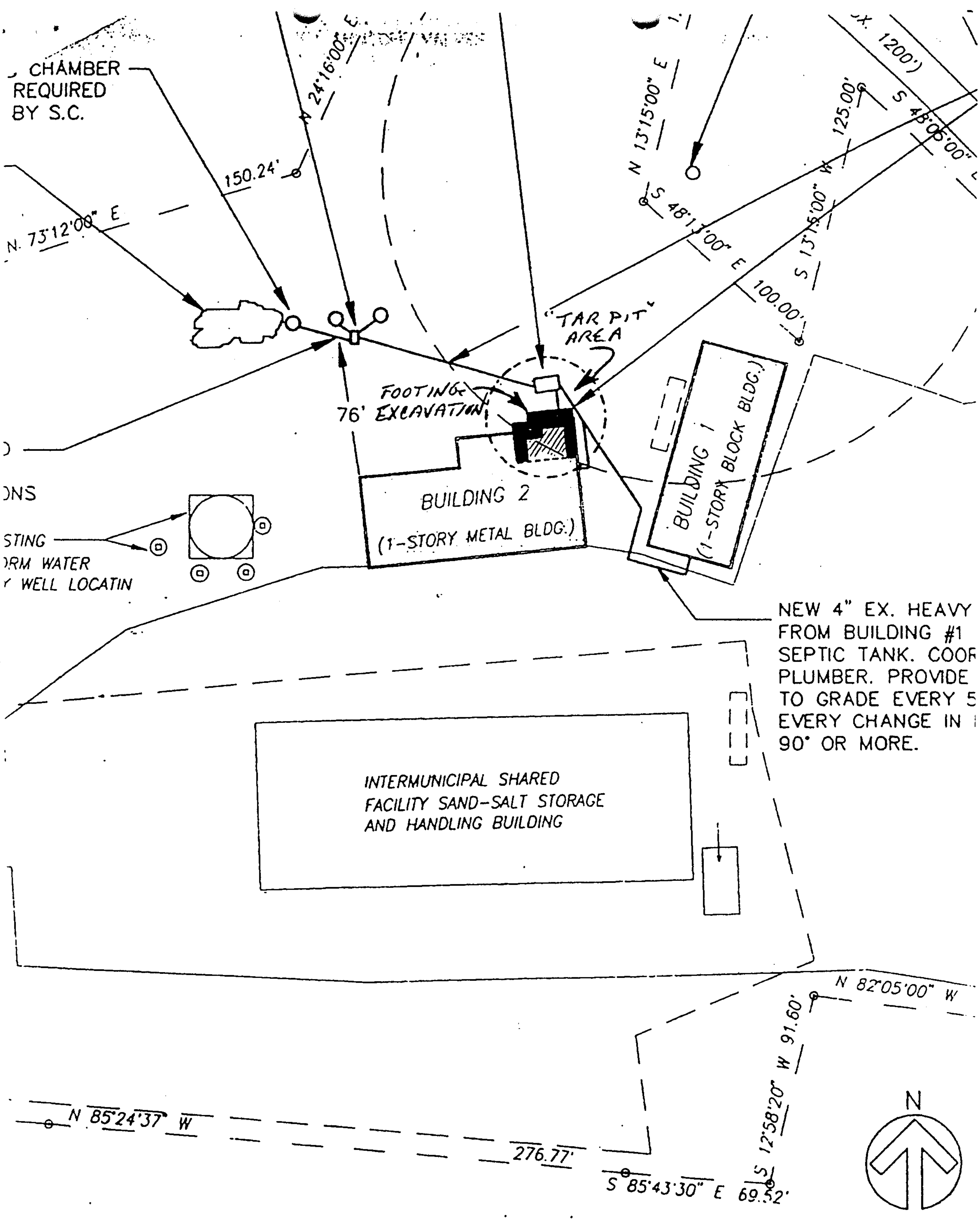

CHAMBER
REQUIRED
BY S.C.
150.24'
N. 73°12'00" E
N 24°16'00" E
N 13°15'00" E
125.00'
S 48°05'00"
S 48°13'00" E
S 13°15'00" W
100.00'
"TAR PIT" AREA
FOOTING EXCAVATION
76'
BUILDING 2
(1-STORY METAL BLDG.)
BUILDING 1
(1-STORY BLOCK BLDG.)
ONS
STING
ORM WATER
WELL LOCATIN
NEW 4" EX. HEAVY
FROM BUILDING #1
SEPTIC TANK. COOR
PLUMBER. PROVIDE
TO GRADE EVERY 5
EVERY CHANGE IN
90° OR MORE.
INTERMUNICIPAL SHARED
FACILITY SAND-SALT STORAGE
AND HANDLING BUILDING
N 82°05'00" W
S 12°58'20" W 91.60'
N 85°24'37" W
276.77'
S 85°43'30" E 69.52'
N

Figure 5

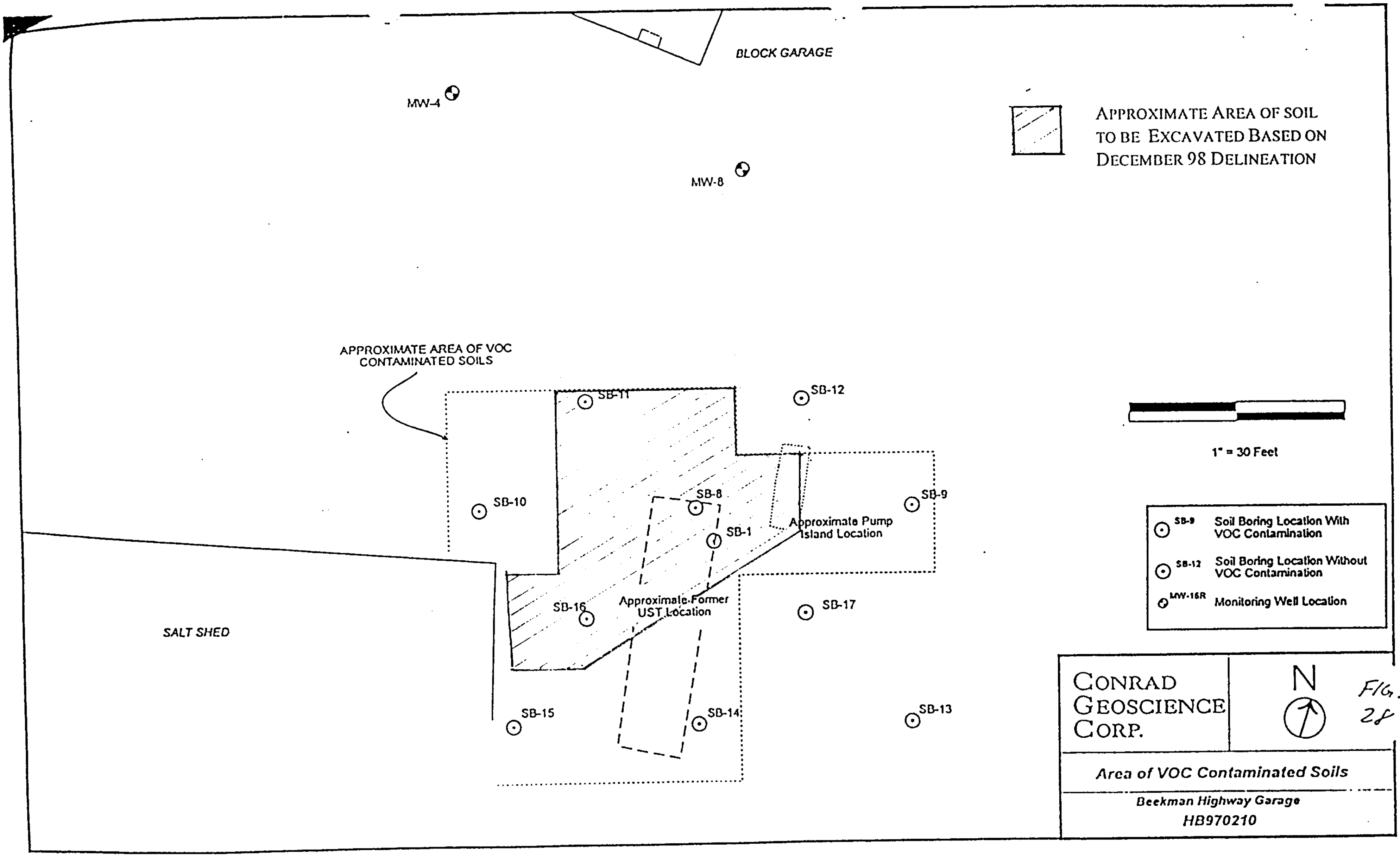

BLOCK GARAGE
MW-4
MW-8
APPROXIMATE AREA OF SOIL TO BE EXCAVATED BASED ON DECEMBER 98 DELINEATION
APPROXIMATE AREA OF VOC CONTAMINATED SOILS
SB-11
SB-12
1" = 30 Feet
SB-10
SB-8
SB-1
SB-9
Approximate Pump Island Location
SB-9 Soil Boring Location With VOC Contamination
SB-12 Soil Boring Location Without VOC Contamination
MW-16R Monitoring Well Location
SALT SHED
SB-16
Approximate Former UST Location
SB-17
SB-15
SB-14
SB-13
CONRAD GEOSCIENCE CORP.
N
FIG. 28
Area of VOC Contaminated Soils
Beekman Highway Garage
HB970210

Figure 6

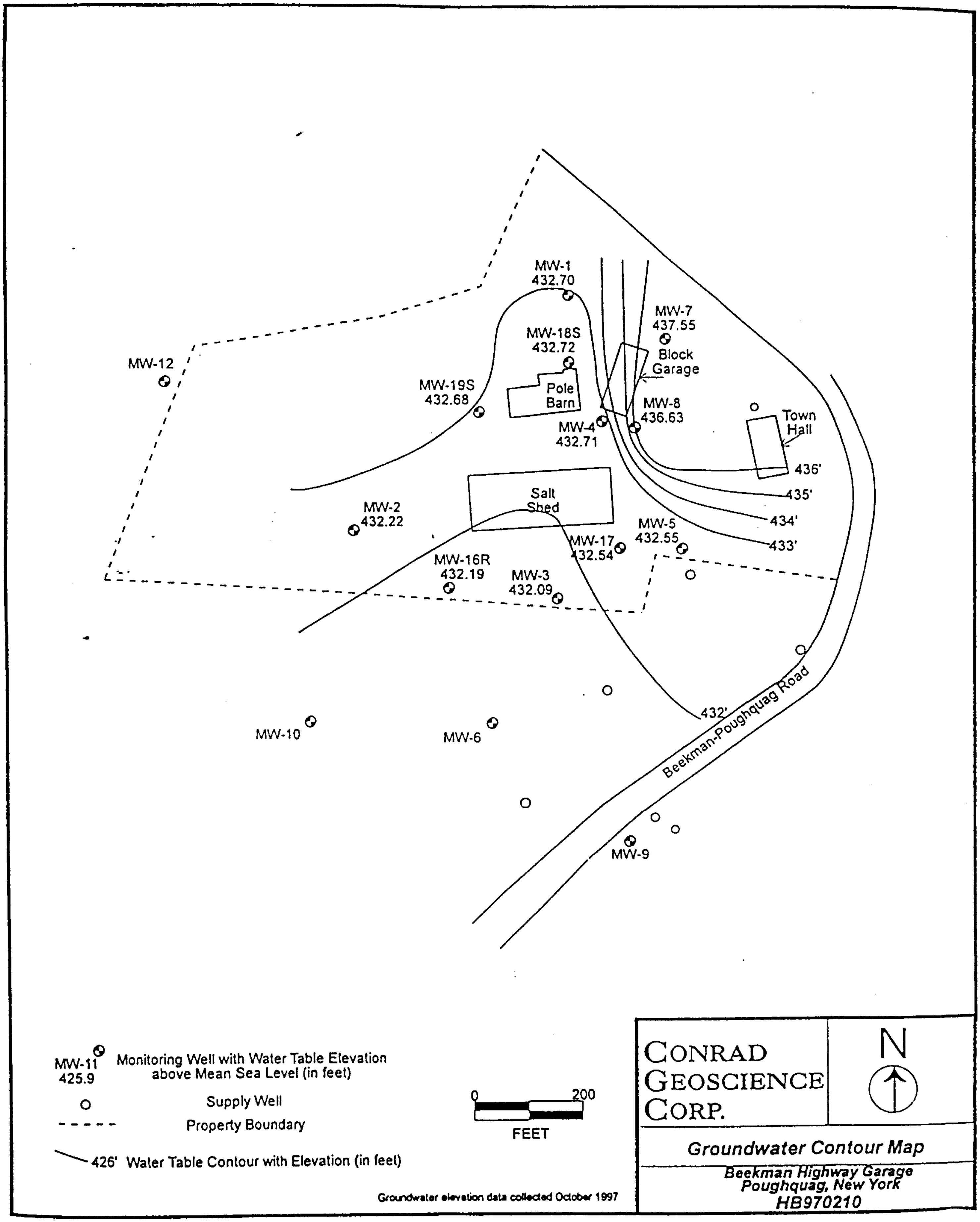

MW-1
432.70
MW-7
437.55
Block
Garage
MW-18S
432.72
MW-12
MW-19S
432.68
Pole
Barn
MW-8
436.63
MW-4
432.71
Town
Hall
436'
435'
434'
433'
Salt
Shed
MW-2
432.22
MW-5
432.55
MW-17
432.54
MW-16R
432.19
MW-3
432.09
432'
Beekman-Poughquag Road
MW-10
MW-6
MW-9
MW-11
425.9
Monitoring Well with Water Table Elevation above Mean Sea Level (in feet)
Supply Well
Property Boundary
426' Water Table Contour with Elevation (in feet)
0
200
FEET
Groundwater elevation data collected October 1997
CONRAD
GEOSCIENCE
CORP.
N
Groundwater Contour Map
Beekman Highway Garage
Poughquag, New York
HB970210

Figure 7

APPENDIX A

CHARACTERISTICS OF PRINCIPAL CONTAMINANTS
AT THE TOWN OF BEEKMAN HIGHWAY GARAGE - SITE ID # 314 094

BENZENE

Benzene is a naturally occurring substance and a major industrial chemical made from coal and oil. As a pure chemical, benzene is a colorless liquid. It is used as a solvent and in the manufacture of other chemicals. Benzene is also found in petroleum products such as gasoline. It generally gets into drinking water from gasoline or fuel oil spills, leaking storage tanks or by improper waste disposal.

Benzene has been associated with an increased risk of leukemia in industrial workers who breathed large amounts of the chemical over a long time in workplace air. Benzene has also caused cancer in laboratory animals exposed at high levels over their lifetimes. Chemicals that cause cancer among exposed industrial workers and laboratory animals are believed to increase the risk of cancer in humans exposed to lower levels over long periods of time. Benzene has also been associated with damage to the blood-cell-forming tissues and the immune and nervous system of industrial workers and laboratory animals.

TOLUENE

Toluene is a colorless liquid that is used to make other chemicals and is found in many consumer products such as paints, lacquers, adhesives, rubber, dyes and gasoline. Toluene generally gets into drinking water from improper waste disposal or leaking gasoline storage tanks.

Exposure to large amounts of toluene can damage the nervous system, liver and kidneys. High levels of toluene damage the unborn offspring of laboratory animals exposed during pregnancy. Chemicals that cause adverse health effects in humans and laboratory animals after high levels of exposure may also pose a risk of adverse health effects in humans who are exposed to lower levels over long periods of time.

ETHYLBENZENE

Ethylbenzene is a colorless liquid used as a solvent in the printing and paint industries. It is also used to make other chemicals and is found in gasoline. Ethylbenzene generally gets into drinking water from improper waste disposal or gasoline spills.

People exposed to large amounts of ethylbenzene had nervous system damage. High levels of ethylbenzene damage the nervous system, livers and kidneys of laboratory animals and the unborn offspring of laboratory animals exposed during pregnancy. Chemicals that cause adverse health effects in humans and laboratory animals after high levels of exposure may also pose a risk of adverse health effects in humans who are exposed to lower levels over long periods of time.

XYLENE

Xylene is a colorless liquid used as a solvent in the printing, rubber, leather, paint and insecticide industries. It is also used to make other chemicals and is found in gasoline. Xylene occurs in three forms: meta-xylene, ortho-xylene, and para - xylene. The three forms have similar properties and are frequently grouped together and called total xylenes or just xylene. Xylene generally gets into drinking water from improper waste disposal or leaking gasoline storage tanks.

People exposed to large amounts of xylene had nervous systems, liver and kidney damage. High levels of xylene damage the nervous systems, liver, kidneys, and heart of laboratory animals, and the unborn offspring of laboratory animals exposed during pregnanacy. Chemicals that cause adverse health effects in humans and laboratory animals after high levels of exposure may also pose a risk of adverse health effects in human who are exposed to lower levels over long periods of time.

TETRACHLOROETHENE

Tetrachloroethene (also called tetracholoroethylene or perchloroethylene) is a colorless man-made liquid used as a solvent for dry cleaning fabrics, for removing grease from metal, and as an intermediate (building block) in the manufacture of other chemicals. It is found in some consumer products such as paint and spot removers, water repellents, silicone lubricants, adhesives and wood cleaners. Contamination of drinking water may occur if tetrachloroethene leaches into the groundwater from leaking storage sites or after improper waste disposal.

An association exists between people in the workplace being exposed to high levels of tetrachloroethene in air and certain forms of cancer, although the association does not prove that the cancers were caused by tetrachlorethene. Tetrachloroethene causes cancer in laboratory animals exposed to high levels over their lifetimes. Chemicals that cause cancer in laboratory animals also may increase the risk of cancer in people who are exposed to lower levels over long periods of time. People exposed to high levels of tetrachloroethene in air show nervous system effects and slight changes to their liver and kidneys. Exposure to high levels of tetrachloroethene has caused liver an d kidney damage in laboratory animals and has changed their behavior.

1,1,1- TRICHLOROETHANE

1,1,1- trichloroethane (also called methyl chloroform) is a colorless man-made liquid which is used primarily as a solvent for removing grease from metal. It has a variety of other solvent uses and is also used as a chemical intermediate (building block) in the production of other chemicals. 1,1,1- Trichloroethane generally gets into drinking water from improper waste disposal.

Some industrial workers exposed to large amounts of 1,1,1- trichloroethane have had nervous system, liver and cardiovascular system damage. Exposure to high concentration of this chemical causes nervous system, liver and cardiovascular system damage in laboratory animals. Chemicals which cause adverse health effects in exposed industrial workers and laboratory animals may also pose a risk of adverse health effects in humans who are exposed at lower levels over long periods of time.

NAPTHALENE

Napthalene is a white solid substance that is used to make moth repellents (mothballs, moth flakes), toilet deodorant blocks, dyes, resins, leather tanning agents, and other chemicals. It occurs naturally in fossil fuels such as petroleum and coal and as a combustion product of burning tobacco or wood. Exposure to a large amount of naphthalene can damage or destroy red blood cells causing hemolytic anemia. People, particularly children, have developed this problem after eating naphthalene-containing mothballs or deodorant blocks. Some of the symptoms of hemolytic anemia are fatigue, lack of appetite, restlessness, and pale skin. Exposure to large amounts of naphthalene can also cause eye, nose, and skin irritation, nausea, vomiting, and diarrhea.

Reference:

1) "*Handbook of Toxic and Hazardous Chemicals*" by Marshall Sittig, 1981. Noyes Publication

2) "*New York State Department of Health Chemical Information Summary*", March 1991