APPENDIX D

METHOD PROTOCOLS

Appendix D presents protocols followed in the collection and analysis of all samples collected by NUS/FIT during the Remedial Investigation. Information is included as follows:

- Volatile organic analysis using the Foxboro Century Systems Organic Vapor Analyzer (OVA Model 128).
- Volatile organic analysis using the Photovac 10A10 Gas Chromatograph.
- Contract Laboratory analysis for organic Hazardous Substance List compounds.
- Contract Laboratory analysis for inorganic Hazardous Substance List compounds.
- Validation procedures for Contract Laboratory data.
- Groundwater sampling protocols.
- Installation of groundwater monitoring well protocols.

VOLATILE ORGANIC ANALYSIS USING THE FOXBORO ORGANIC VAPOR ANALYZER (OVA-128)

The Foxboro Century Systems Organic Vapor Analyzer (OVA) is a portable unit equipped to detect organic vapors in air. It is fitted with a chromatographic column packed with a material which physically interacts with organic compounds. Since the packing material has a different affinity for each individual compound, the time it takes for each compound to pass through the column (retention time) will be different. The retention time is dependent on several parameters of the column: temperatures, length of column, type of packing, and flow rate or carrier gas (hydrogen). The OVA can be used in the field or laboratory to separate and identify volatile organic compounds. Water and soil samples for analysis on the OVA are collected in 40 to 44 milliliter (ml) septum-fitted vials. Vials are filled to 75% capacity, leaving a "headspace" of air, if analysis is to be conducted at the sampling location. Aqueous samples collected for analysis in the lab are completely filled and kept on ice during transport to preserve sample integrity. A headspace is created in lab by withdrawing 10 ml of liquid with a syringe. Soil samples are always collected with headspace to avoid reopening of the vial.

The OVA runs at ambient temperature, and must therefore be allowed to equilibrate to surrounding conditions. Samples are also Equilibrated to ambient temperature for analysis. The instrument is put in the chromatography mode by depressing the inject valve, which diverts ambient air through an activated charcoal filter to remove interfering volatiles. The backflush valve is left in the up position. A strip chart recorder is plugged into the OVA to receive output from the detector.

A 500 microliter (ul) gas-tight syringe is used to inject sample vapors onto the column. The syringe is initially flushed several times and 500 ul of "clean" ambient air is injected to verify syringe cleanliness. The time of injection is noted on the strip chart and the chromatograph is allowed to run for several minutes. The backflush valve is then depressed, reversing the flow through the column, while the chart is left running to record peaks occurring from heavier compounds that were

still on the column. When this run is through, the backflush valve is returned to the up position. Air may then be withdrawn from the headspace above a soil or water sample and analyzed in the same fashion.

Analysis can be qualitative or quantitative. Standards containing individual volatile organic compounds or mixtures can be prepared. These standards can be at specific concentrations if quantitative analysis is desired. Compound identification is made by comparison of sample and standard peak retention times. Quantitation is accomplished by comparing peak height to a standard peak of that compound at known concentration. Identifications are tentative unless peak retention times match those of the standard on three columns of dissimilar polarity, in which case identification is considered positive. Detection limits for most common volatile organic compounds are in the 0.5-1 part per million range using this method.

VOLATILE ORGANIC ANALYSIS USING THE PHOTOVAC 10A10 CHROMATOGRAPH

The Photovac 10A10 is a portable gas chromatograph used to screen soil and water samples for volatile organic compounds. A 4' by 1/8" SE-30 column is typically used for NUS/FIT screening. This instrument is generally used in the laboratory to allow greater analytical control. Samples are collected in 40 to 44 milliliter (ml) septum-fitted vials and are kept on ice during transporation. Soil samples are collected leaving 25% of the vial empty; this headspace will be sampled for volatile organic vapors. Aqueous sample vials are completely filled to better preserve the sample; a headspace is then created in lab by withdrawing 10 ml of liquid with a syringe.

Samples are allowed to equilibrate to room temperature before analysis. The instrument is also allowed to warm up for several minutes to stabilize analytical conditions. A multi-compound standard of known concentration is prepared daily by dilution of stock solution. Instrument response and technical reproducibility are verified by running the standard two times prior to sample analysis. The standard run takes approximately 12 minutes to complete. A gas-tight 200 microliter (ul) syringe is used to make injections, unless high concentrations require the use of a smaller volume. The syringe is flushed with ambient air between samples, and an injection of "clean" ambient air is run to verify syringe cleanliness. The standard run is repeated every eight samples to confirm ongoing instrument stability.

Compound identification is by comparison of peak retention time to standards. Comparison of peak height to a standard peak of that compound at a known concentration yields quantitative results for aqueous samples. Soil samples are reported with qualitative results only, as no standard with a soil matrix is run. Compound identification is tentative unless peak retention times match standard peaks on three dissimilar columns, in which case identification is considered positive. A list of compounds analyzed for and typical detection limits are given below.

TABLE 1

COMPOUNDS ANALYZED FOR AND TYPICAL DETECTION LIMITS FOR THE PHOTOVAC 10A10 GC

Compound	detection limit (ppb)
benzene	1
trichloroethylene	1
toluene	3
tetrachloroethylene	3
chlorobenzene	5
ethylbenzene	5
m-xylene	5
o-xylene	10

CONTRACT LABORATORY ANALYSIS
FOR ORGANIC HAZARDOUS SUBSTANCE LIST COMPOUNDS

Full Hazardous Substance List (HSL) analysis by a contract lab includes volatile organic analysis (VOA), semivolatile (base/neutral/acid), pesticide and PCB analysis. A complete list of these compounds and their contract required detection limits is presented in Table 2. Samples are run according to procedures specified in the Contract Lab Program Organics Analysis Statement of Work. This document details analytical and contractual requirements and is based on EPA Methods 624 (purgeables), 625 (base/neutral/acids) and 608 (pesticides and PCBs).

Volatiles (or "purgeables") are analyzed utilizing a purge and trap method. In this method, 5 to 25 ml. of aqueous sample or soil extract is placed in a special enclosed chamber. Finely divided inert gas bubbles are blown through the sample to release volatile compounds into the vapor phase. A sorbent trap collects these vapors for analysis. When purging is completed, the trap is heated and backflushed onto a gas chromatograpic (GC) column. The various chemicals present will interact differently with the column and pass through it with varying retention times. The GC is interfaced with a mass spectroscopy (MS) system which is then used to identify the separated components.

Base/neutral and acid compounds are extracted into methylene chloride and analyzed using fused silica capillary column GC/MS. Base/neutral compounds are extracted at pH 11, acids at pH 2. As with volatiles, compound separation occurs in the column. Qualitative identification is made via GC retention time and relative abundance of three or more characteristics MS ions. Quantitative analysis is accomplished using an internal standard and one characteristic ion.

Screening for pesticides is done using GC equipped with an electron capture detector (ECD) which is particularly sensitive to chlorinated compounds. The sample is extracted with methylene chloride, then the methylene chloride is exchanged for hexane, a GC/ECD compatible solvent. Compounds detected at high enough levels using GC/ECD are confirmed using GC/MS.

Each of the above fractions is subject to contract-required quality control measures. This involves the analysis of method blanks, duplicates, and spiked samples which are used to assess data quality. Data validation is discussed further in a following section.

CONTRACT LABORATORY ANALYSIS FOR INORGANIC HAZRADOUS SUBSTANCE LIST COMPOUNDS

Inorganics analysis by a contract lab includes screening for the 24 metals listed in Table 3. Analysis is conducted according to the Contract Laboratory Program Inorganics Analysis Statement of Work.

Sample preparation involves digestion by nitric acid and hydrogen peroxide. Analysis is conducted using standard atomic absorption (AA) methods. Flame, furnace, or the inductive coupled plasma (ICP) method may be used for each metal, as long as the contract required detection limit for that element is met. These limits are listed in Table 3. Mercury analysis is an exception; it is done by the cold vapor method and requires a persulfate digestion.

All analysis is subject to contract-required quality control measures. This involves analysis of blanks, duplicates and spiked samples to insure valid results. Data quality review is discussed further in the following section.

TABLE 2
COMPOUNDS INCLUDED IN CLP ORGANICS ANALYSIS
AND CONTRACT REQUIRED DETECTION LIMITS (CRDL)

Volatile Organics		Pesticides/PCBs	
Compound	CRDL (ug/l)	Compound	CRDL (ug/l)
Chloromethane	10	Alpha-BHC	0.05
Bromomethane	10	Beta-BHC	0.05
Vinyl Chloride	10	Delta-BHC	0.05
Chloroethane	10	Gamma-BHC (Lindane)	0.05
Methylene Chloride	5	Heptachlor	0.05
Acetone	10	Aldrin	0.05
Carbon Disulfide	5	Heptachlor epoxide	0.05
1,1-Dichloroethene	5	Endosulfan I	0.05
1,1-Dichloroethane	5	Dieldrin	0.10
Trans-1,2-Dichloroethene	5	4,4'-DDE	0.10
Chloroform	5	Endrin	0.10
1,2-Dichloroethane	5	Endosulfan II	0.10
2-Butanone	10	4,4'-DDD	0.10
1,1,1-Tetrachloroethene	5	Endrin Aldehyde	0.10
Carbon Tetrachloride	5	Endosulfan Sulfate	0.10
Vinyl Acetate	10	4,4'-DDT	0.10
Bromodichloromethane	5	Methoxychlor	0.50
1,2-Dichloropropane	5	Endrin ketone	0.10
Trans-1,3-Dichloropropene	5	Chlordane	0.50
Trichloroethene	5	Toxaphene	1
Dibromochloromethane	5	Aroclor-1016	0.50
1,1,2-Trichloroethane	5	Aroclor-1221	0.50
Benzene	5	Aroclor-1242	0.50
cis-1,3-Dichloropropene	5	Aroclor-1248	0.50
2-Chloroethylvinylether	10	Aroclor-1254	1
Bromoform	5	Aroclor-1260	1
4-Methyl-2-Pentanone	10		
2-Hexanone	10		
Tetrachloroethene	5		
1,1,2,2-Tetrachloroethane	5		
Toluene	5		
Chlorobenzene	5		
Ethylbenzene	5		
Styrene	5		
Total Xylenes	5		

TABLE 2
COMPOUNDS INCLUDED IN CLP ORGANICS ANALYSIS AND CONTRACT REQUIRED DETECTION LIMITS (CRDL)

Semivolatile (Base/Neutral/Acid) Organics

Compound	CRDL (ug/l)	Compound	CRDL (ug/l)
Phenol	20	Acenaphthene	20
bis(2-Chloroethyl)Ether	20	2,4-Dinitrophenol	100
2-Chlorophenol	20	4-Nitrophenol	100
1,3-Dichlorobenzene	20	Dibenzofuron	20
1,4-Dichlorobenzene	20	2,4-Dinitrotoluene	20
Benyl Alchohol	20	2,6-Dinitrotoluene	20
1,2-Dichlorobenzene	20	Diethylphthalate	20
2-Methylphenol	20	4-Chlorophenyl-phenylether	20
bis(2-chloroisopropyl)Ether	20	Fluorene	20
4-Methylphenol	20	4-Nitroaniline	100
N-Nitroso-Di-n-Propylamine	20	4,6-Dinitro-2-Methylphenol	100
Hexachloroethane	20	N-Nitrosodiphenylamine (1)	20
Nitrobenzene	20	4-Bromophenyl-phenylether	20
Isophorone	20	Hexachlorobenzene	20
2-Nitrophenol	20	Pentachlorophenol	100
2,4-Dimethylphenol	20	Phenanthrene	20
Benzoic Acid	20	Anthracene	20
bis(2-Chloroethnoxy)Methane	20	Di-n-Butylphthalate	20
2,4-Dichlorophenol	20	Fluoranthene	20
1,2,4-Trichlorobenzene	20	Pyrene	20
Naphthalene	20	Butylbenzylphthalate	20
4-Chloroaniline	20	3,3-Dichlorobenzidine	40
Hexachlorobutadiene	20	Benzo (a) Anthracene	20
4-Chloro-3-Methylphenol	20	bis(2-Ethylhexyl)Phthalate	20
2-Methylnaphthalene	20	Chrysene	20
Hexachlorocyclopentadiene	20	Di-n-Octyl Phthalate	20
2,4,6-Trichlorophenol	20	Benzo (b) Fluoranthene	20
2,4,5-Trichlorophenol	100	Benzo (k) Fluoranthene	20
2-Chloronaphthalene	20	Benzo (a) Pyrene	20
2-Nitroaniline	100	Indeno(1,2,3-cd)Pyrene	20
Dimethyl Phthalate	20	Dibenzo(a,h)Anthracene	20
Acenaphthylene	20	Benzo(g,h,i)Perylene	20
		3-Nitroaniline	100

TABLE 3

ELEMENTS INCLUDED IN CLP INORGANICS ANALYSIS AND CONTRACT REQUIRED DETECTION LIMITS (CRDL)

Element	CRDL	Element	CRDL
1. Aluminum	200	13. Magnesium	5000
2. Antimony	60	14. Manganese	15
3. Arsenic	10	15. Mercury	0.2
4. Barium	200	16. Nickel	40
5. Beryllium	5	17. Potassium	5000
6. Cadmium	5	18. Selenium	5
7. Calcium	5000	19. Silver	10
8. Chromium	10	20. Sodium	5000
9. Cobalt	50	21. Thallium	10
10. Copper	25	22. Tin	40
11. Iron	100	23. Vanadium	50
12. Lead	5	24. Zinc	20

VALIDATION OF
CONTRACT LABORATORY DATA

Contract Laboratory analysis is conducted according to EPA Methods 624 (Purgeables) and 625 (Base/Neutrals and Acids). Results are released to the public only after data validation has been completed by NUS/FIT and approved by EPA. This data review insures that the laboratory followed appropriate quality control procedures and met all contractual requirements. Data may be considered unuseable (rejected) or approximate as a result of the review. Parameters assessed in the NUS/FIT Level I data validation are as follows:

- Instrument tuning and calibration. The laboratory is required to verify proper and stable instrument response prior to sample analysis. Poor or fluctuating response may result in misidentification or invalid quantitation.

- Sample holding times. Samples must be analyzed within contract specified holding times to minimize sample degradation and contamination. Data will frequently be approximated for samples held beyond the specified limits.

- Surrogate spike recoveries. All samples are spiked with a known quantity of solution containing compounds not likely to occur in the samples. The laboratory determines their percent recoveries from analysis results. Poor recoveries, either high or low, result in entire fractions of data being approximated. Results may be rejected entirely if recoveries are so low that analysis is considered unuseable.

- Matrix spike recoveries. The laboratory spikes one in ten samples with a known concentration of several of the compounds that are being analyzed for. Percent recoveries of these compounds may be low if laboratory technique is poor or if the sample matrix prevents successful analysis. Recoveries outside of contract-required limits may result in approximating or rejecting data.

- Laboratory duplicate. The laboratory divides each matrix-spiked sample into two portions for the purpose of duplicate analysis. Comparison of the two sets of data gives an indication of the reliability of results. Values that vary greatly generally result in the approximation of data for certain compounds.

- Field ("blind") duplicates. The sample collection team collects duplicate samples that are submitted to the laboratory unidentified in order to get an unbiased duplicate comparison. Data qualifiers due to poor agreement are the same as for laboratory duplicates.

- Laboratory blanks. The laboratory is required to store, prepare, and analyze "blank" water samples with each group of samples submitted. These blanks frequently contain common laboratory solvents that have contaminated samples as well. Data for compounds present in blanks is generally rejected.

- Field ("blind") blanks. Blank water is carried to the sampling location, stored with other samples and shipped to the laboratory unidentified. This gives unbiased blank data as well as indications of cross-contamination that may have occurred in the field. Data for compounds found in these blanks is generally rejected.

Inorganics data validation also includes assessment of the following:

- Interference Check. The laboratory is required to run a sample that has been spiked with high levels of certain elements to determine if inter-element interferences exist. Poor recoveries of elements present at known, lower concentrations may result in approximation of data for these elements in certain samples.

- Standard additions. Certain sample matrices may interfere with the analysis of inorganic constituents. A poor matrix spike recovery indicates such an interference, and requires the laboratory to quantitate that element using the method of standard additions. This method sets a new standard curve using the sample matrix in question. Data for a given element may be approximated or rejected if the spike recovery was poor and standard additions were not used.

Groundwater Sampling

The method NUS/FIT utilized for groundwater sample collection followed a measure, purge, and sample sequence. Initially, static water levels and total depth measurements were collected. From these data, the volume of standing water in the column was calculated according to the following formula:

$$r^2h$$

r = radius of the well

h = height of water column

Purging of the wells was accomplished by mecahnical pumps or by hand bailing. For those wells having a fairly rapid recharge, NUS/FIT was able to use a gasoline powered pump. In order to ensure proper evacuation of the standing water, the pump was started with the intake hose at the bottom of the well, after which the hose was drawn upwards. The purged water was measured by filling and emptying a calibrated ten gallon wash tub.

Following the removal of each well volume, measurements of pH, conductivity and temperature were taken in order to ensure collection of samples representative of the aquifer. Two consecutive measurements within + 0.03 pH units +10% relative conductance represented stabilization of the groundwater conditions. A maximum of five well volumes were purged from any one well.

Collection occurred after allowing the wells to recharge to a minimum of 75% of their initial static water levels. The samples were obtained from each well utilizing a stainless steel bailer with a teflon check valve which was lowered to the middle of known well screens and allowed to fill. The retrieved groundwater was then poured into two 44 ml septum sealed vials to which a 7,000 part per million (ppm) mecuric chloride ($HgCl_2$) solution had been added as a preservative to a final concentration in the sample of 16 ppm $HgCl_2$. Replicate samples were obtained by

filling two additional vials from the same bailer volume. Field blanks consisted of deionized water obtained from the EPA's New England Regional Laboratory in Lexington, Massachusetts. All samples were labelled in the field and placed on ice. Custody of the samples was then relinguished by the field personnel to an NUS chemist for analysis at EPA's New England Regional Laboratory in Lexington, Massachusetts or for shipment to a CLP laboratory.

All sampling equpiment was decontaminted bewteen wells utilizing a deionized water, methanol, deionized water final rinse sequence.

Installation of Groundwater Monitoring Wells Protocols

Installation of groundwater monitoring wells was subcontracted by NUS to M & M Enterprises, Inc., of Arlington, Virginia. M & M Enterprises subcontracted the actual field work to Buffalo Drilling Co., Inc. (BDC) of Buffalo, New York and New England Boring Contractors, Inc. (NEBC) of Glastonbury, Connecticut.

There were two primary overburden drilling methods employed during the investigation; hollow stem auger (BDC), and drive and wash (NEBC). The five foot auger flights used by BDC had an eight inch outside diameter with a nominal 3 and 3/8 inch inside diameter. Initially, the augers were plugged with a removable plug that was retracted for soil sampling. The plugged auger method was eventually abandoned in favor of open ended augering which requires the removal of soils that enter the augers by the pumping of clean water into the flights. The washing action forces soil particles into suspension. The wash flows up and out the top of the flights, carrying with it the suspended particles. In locations where the augers could not penetrate, BDC would advance the borehole by roller bitting and subsequent introduction of a smaller diameter casing through the auger flights, a method referred to as telescoping. The flights were then retracted and the method became essentially drive and wash.

The drive and wash method (NEBC) utilized five or ten foot lengths of steel casing that are driven into the overburden by a 300 pound hammer. The hammer is winch raised then allowed to free fall the length of the drive stem (approximately 3 ft) which is threaded into the steel casing. The casing was then cleansed of soil with clean water as described previously. In several well locations, very difficult

drilling was encountered. When confronted with refusal using the drive and wash method, NEBC utilizing telescoping, as did BDC. The spin method was used in nested boulder and cobble zones and utilized a diamond-impregnated shoe. The shoe is placed at the bottom of the casing and the entire assembly is spun, allowing the casing to be advanced by cutting its way through blockages.

All water used during the drilling procedures came from the current Woburn water supply as accessed through a variety of hydrants throughout the study area. Samples were drawn from the water supply and screened on the Foxboro Century Systems Organic Analyzer (OVA) Model 128 for volatile organics before use. Samples were also collected periodically from the drillers' storage tanks and analyzed to ensure absence of volatile organics prior to their use in the drilling procedures.

All drilling tools used down the borehole (i.e., casing, chuch rods, auger flights) were decontaminated by a steam cleaning, methanol rinse, and a final steaming before use and between boreholes. Any part of the drilling rigs that extended over the borehole was also steam cleaned prior to its use and between locations. Hydraulic equipment (i.e., hoses, valve banks, etc.) was inspected for leaskage by NUS/FIT to confirm that no fluids were leaking before allowing the drill rig to be on-site. Lengths of PVC riser and screen were steam cleaned and cold water rinsed before being introduced to the subsurface. There were no petroleum based lubricants used during the study. In most situations, the drillers used no lubricants at all. Occasionally, however, a vegetable based lubricant (ie., Crisco) was used on casing and rod joints. Soil samples were collected with a 24 inch, 2 inch outside diameter split spoon sampler at 5 foot intervals. The split spoon sampler was driven by a 140 pound hammer with a 30 foot freefall (standard penetration test). The driving resistance was gauged by blow counts (the number of hammer falls needed) for each six inch interval of the total penetration of 24 inches. Retrieved soil samples were placed into at least one eight ounce jar for geologic characterization. These jars were labelled and retained by NUS/FIT for future reference. In addition, one septum sealed 44 ml VOA (volatile organic analysis) vial wsa partially filled with soil for OVA headspace analysis which was performed by the NUS/FIT on-site chemist.

The split spoons were decontaminated prior to use and between uses by the NUS on-site geologist utilizing a water bath with brushing to remove residual soils, followed by an Alconox and water scrub to ensure removal of contaminants, and finally a clean water rinse.

Whenever possible, the deepest well in a nested set was drilled first. During the drilling, data was compiled throughout the volatile organic screening and through visual examination of the split spoon samples. The collected data formed the basis for screen placement decisions according to the following criteria. In boreholes where OVA analysis of the soil samples indicated the presence of volatile organics, the screened interval was placed to intercept the zone of contamination. Where contamination was not clearly indicated, the screened interval was placed in the most permeable stratum, as directed by the NUS on-site geologist, based on visual inspection of the soil samples. Upon reaching the desired depth, well installation was conducted. The wells were constructed using shedule 80 1.5 inch inside diameter threaded flush jointed polyvinyl chloride (PVC). The screen slot size for all wells installed was 0.010 inch. The overburden wells are screened entirely in the overburden. The screen length varied (5-50 feet) according to the intended purpose of the well. Longer screen lengths were used where past groundwater quality has not been documented and current contamination was not indicated by field chemical screening. The shorter lengths were used where groundwater gradient information was important and/or information on vertical distribution of contaminants was known or desired. After establishing the most advantageous screen length, the five foot sections of screen were threaded together and the bottom was capped. No solvents or glues were used for jointing. A small amount of Ottawa sand (4") was poured into the cased borehole and the bottom was sounded. This small amount of sand acted to seat the bottom of the PVC riser. Next, the screen and riser were lowered into the borehole and seated. Filter sands were then placed around the screen. A 60/40 grade Ottawa sand was used as filter sand. The sand level was periodically measured until enough had been added to reach a level two feet above the top of the screened interval. Clean water was used to wash the filter sand off the steel casing and PVC riser and down to the screened interval. Time was allowed for the sands to settle before measuring took

place. The two feet of sand above the top of the screen was placed to act as a separation between the slurry grout and the screened interval.

In order to seal the screen in the interval of choice, a cement/bentonite slurry grout was injected into the borehole above the filter sand. A tremie pipe was lowered to a level approximately one foot from the top of sand, and grout (10:1 ratio by weight cement to bentonite) was slowly pumped into the borehole. This technique minimized disturbance of the filter sand. The casing still remaining in the borehole was then pumped full of grout. The standing water was displaced out the top of casing. This process was continued until the grout was observed to be flowing out of the top of the casing. The remaining casing was then retracted. If the grout level dropped substantially during the casing retraction, more grout was pumped into the borehole. In cases where the top of the screen was less than 15 feet from ground surface, bentonite pellets were used to seal the well instead of the slurry grout.

One well from each nested location penetrated 20 feet into the bedrock. The bedrock was cored using a NWX size diamond core bit according to standard ASTM method for diamond core drilling. All rock cores were boxed, labelled and retained by NUS/FIT for future reference. Rock quality designations (RQDs) were calculated for each five foot run. The NWX bit cuts a 2.155 inch diameter core and leaves a 2.930 inch diameter borehole. This diameter afforded a 2.93 inch annulus around the screen for the placement of filter sand. Fifteen feet of 0.010 slotted PVC screen was then lowered into the rock borehole with PVC riser to a point above ground surface. Filter sand was added to a level one foot above the top of screen. Cement/bentonite slurry was then emplaced via a tremie pipe with the grout being brought to ground surface. In this manner, a four foot grout plug was emplaced into the bedrock limiting or precluding communication between the bedrock well and the overburden aquifer.

The PVC risers were brought to a level approximately 2 1/2 feet above ground surface (except on Unifirst, Corp. property where limited space demanded subsurface installation). A five foot steel security casing was placed around the

riser. The security casing was grouted into the ground to a depth of 2 1/2 feet leaving 2 1/2 above the ground surface. Each casing has a lockable lid. Padlocks were used to secure each lid. Serial numbers located on each lock were removed by filing.