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March 1999

EPA Superfund
Record of Decision Amendment:

Tibbetts Road
Barrington, NH
9/28/1998

DECLARATION FOR THE AMENDED RECORD OF DECISION

Tibbetts Road Superfund Site
Barrington, New Hampshire

STATEMENT OF PURPOSE

This decision document amends the selected remedial action for the Tibbetts Road Superfund Site (Site) located in Barrington, New Hampshire, as outlined in the September 29, 1992 Record of Decision, and is developed in accordance with the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), 42 USC § 9601 et seq., as amended, and to the extent practicable, the National Oil and Hazardous Substances Contingency Plan (NCP), 40 CFR Part 300 et seq., as amended. The Director of the Office of Site Remediation and Restoration has been delegated the authority to approve this Amended Record Of Decision (ROD).

The State of New Hampshire concurs with the selected remedy.

STATEMENT OF BASIS

This decision is based on the Administrative Record which has been developed in accordance with Section 113(k) of CERCLA and which is available for public review at the Barrington Public Library in Barrington, New Hampshire and at the US EPA - Region I Office of Site Remediation and Restoration Records Center in Boston, Massachusetts. The Administrative Record Index (Appendix F to the Amended ROD) identifies each of the items comprising the Administrative Record upon which the selection of the remedial action is based.

ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from this Site, if not addressed by implementing the response action selected in this Amended ROD, may present an imminent and substantial endangerment to the public health or welfare or to the environment.

DESCRIPTION OF THE SELECTED REMEDY

This decision document amends a portion of EPA's 1992 Record of Decision. The 1992 ROD called for the extraction and treatment of contaminated ground water from the overburden and weathered bedrock aquifers beneath the Site using vacuum extraction and pump-and-treat, respectively. The vacuum extraction component of the 1992 ROD remedy was implemented from 1995 through 1997 removing a significant amount of contamination from the subsurface. At the time the vacuum extraction system was shut down in 1997, contaminant removal rates had decreased to the point where there was limited progress being made towards achieving the clean up levels identified in the 1992 ROD. After evaluating the available alternatives, EPA selected natural bioremediation and phytoremediation as the means of treating the remaining contamination found in the overburden and bedrock aquifers. The selected remedy is a comprehensive approach which addresses all current and potential future risks caused by soil and groundwater contamination at the Site and will attain clean up levels within a reasonable time frame.

The selected remedy includes these major components:

1. attainment of clean up levels in the overburden aquifer through the use natural bioremediation and phytoremediation;

2. attainment of clean up levels in the bedrock aquifer through natural bioremediation;

3. the development and implementation of a revised environmental monitoring plan tailored to assess the progress of bioremediation and phytoremediation;

4. the possibility of hot spot remediation using existing vacuum extraction equipment; and

5. a review of site conditions every five years.

In addition, human health and the environment will continue to be protected through the expansion and upgrading of the existing alternate water supply, as needed for new users, and enforcement of a local ordinance restricting ground water use by the Swain's Lake Village Water District.

DECLARATION

The selected remedy is protective of human health and the environment, attains Federal and State requirements that are applicable or relevant and appropriate for this remedial action and is cost-effective. This remedy utilizes permanent solutions and alternative treatment technology, to the maximum extent practicable, and satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element.

As this remedy will result in hazardous substances remaining on-site above health based levels, a review will be conducted within five years after commencement of remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

Patricia L. Meaney (signature) — 9/28/98

Patricia L. Meaney, Director
Office of Site Remediation and Restoration
US EPA - Region 1

Date

AMENDED RECORD OF DECISION

US Environmental Protection Agency
Region I

TIBBETTS ROAD SUPERFUND SITE

CERCLIS No. NHD989090469

BARRINGTON, NEW HAMPSHIRE

September 28, 1998

TIBBETTS ROAD SUPERFUND SITE
AMENDED RECORD OF DECISION

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TIBBETTS ROAD SUPERFUND SITE
AMENDED RECORD OF DECISION SUMMARY
SEPTEMBER 28, 1998

I. SITE NAME, LOCATION, RATIONALE FOR AMENDMENT & SITE DESCRIPTION

SITE NAME: The Tibbetts Road Site (the "Site").

SITE LOCATION: The Site is located in the Town of Barrington, Strafford County, New Hampshire, approximately eight miles west of the City of Dover and two miles northeast of the junction of New Hampshire Route 4 and Hall Road. The Site is located on the US Geological Survey map of the Barrington Quadrangle at longitude 71°2' and latitude 43°11'. Figure 1, which can be found in Appendix A, provides a map showing the location of the Site.

RATIONALE FOR AMENDMENT: Based on the data gathered over the past three years during the testing and full scale operation of the vacuum extraction component of the remedy described in the 1992 Record of Decision (1992 ROD), EPA has determined that further implementation of the 1992 ROD would yield very little benefit to furthering the clean-up of ground water beneath the Site. Three years of operating the full scale vacuum extraction component of the 1992 ROD remedy has removed more than 800 pounds of contaminants from the subsurface. Contaminant removal rates have reached an asymptote, declining from a maximum of 3.5 pounds of contaminants per day to approximately one ounce per day. However, ground water contamination still remains in both the overburden and bedrock aquifers. Following further investigation of the Site and consideration of emerging technologies, EPA believes that phytoremediation and natural bioremediation will restore ground water to cleanup levels in a time frame similar to any active ground water remedy. Phytoremediation, or the use of plants for environmental clean up, will be implemented at the Site through the planting of approximately 1,400 poplar trees. The trees will alter the subsurface environment, thereby slowing and reducing the flow of contaminants away from the Site. Natural bioremediation will use the native microbes, unaided by any manmade inputs, to destroy ground water contaminants. The combined effect will be to reduce contaminant mobility, toxicity and volume and reach cleanup levels set in the 1992 ROD in a reasonable time frame, approximately fourteen years.

SITE DESCRIPTION: The Site is located in a rural residential area. It was the former residence of the late Alexander Johnson. The property, during much of the 1960's through 1995, consisted of two acres that were lightly wooded with white pine and birch, bordered by grasses, and possessing an under story of various shrubs. The surrounding neighborhood, now on a paved road, has six occupied residential homes within 100 feet of the Site boundary. Figure 2 shows an aerial photograph of the Site during the 1985 soil removal operation and also shows the approximate boundaries of the Ground Water Management Zone within which ground water will be restored. A more detailed description of the area and the geology beneath the Site are contained in the 1992 ROD.

II. SITE HISTORY AND ENFORCEMENT ACTIVITIES

Details of the Site History and Enforcement Activities are presented in the 1992 ROD. The most significant enforcement activity since the ROD has been the entry of a Consent Decree. The Consent Decree between EPA, the State, the Potentially Responsible Party at the Site Ford Motor Company (Ford), and the Swain's Lake Village Water District (the Water District) was entered on March 20, 1995. Among other items, Ford agreed under the Consent Decree to conduct the cleanup of the Site as specified in the ROD. The Water District agreed to operate and maintain an alternate water supply for affected residences and pass a local ordinance restricting the use of groundwater in the impacted area.

III. COMMUNITY PARTICIPATION

A history of community participation is contained in the 1992 ROD. Since that time, Ford has kept the neighbors informed of the clean up progress at the Site through annual on-site meetings, including an on-site cookout in June of 1997. During significant construction activities EPA has mailed letters to the neighbors informing them of the status of work.

A Proposed Plan for the changes set forth in this Amended ROD was sent to the public in June of 1998. The EPA and State held a public hearing and informational meeting on June 24, 1998. A document, titled "Responsiveness Summary", attached to this Amended ROD as Appendix E, contains all verbal and written comments regarding the Proposed Plan and EPA's and the State's response to those comments.

IV. DESCRIPTION OF CHANGES TO THE 1992 ROD

In the 1992 ROD EPA determined that the following actions needed to be performed to protect public health and the environment:

① Prevent contaminated ground water from migrating away from the Site with wells or trenches placed to intercept any contaminants.
② Extract contaminated ground water from the overburden and weathered bedrock aquifers with vacuum extraction and pump-and-treat, respectively.
③ Treat the recovered ground water to destroy volatile organic compounds (VOCs) and to remove metal contaminants with Ultraviolet oxidation and precipitation, respectively.
④Return the cleaned ground water to the aquifer. Cleanup levels were to be reached, using the method outlined in ① through ④, within 20 years.

In order to avoid an extended design process and thereby expedite the Site clean up, the EPA, State, and Ford agreed to go straight to the implementation of a pilot-scale vacuum extraction system. Ford's consultant, Arcadis Geraghty & Miller (G&M), began performing the vacuum extraction portion of the 1992 ROD remedy in the summer of 1995. The remedy was expanded to full-scale and operated from 1996 to 1997. Figure 3 provides additional information related to the implementation of the ROD remedy. The vacuum extraction wells were positioned to stop migration and proved to be very successful, removing more than 800 pounds of hydrocarbons from the subsurface. This action resulted in one of the three contaminated areas reaching cleanup levels. However, during the performance of the remedy operational limitations were encountered which made it necessary to change four elements of the 1992 ROD. The changes are discussed further in this section.

The other elements of the 1992 ROD which were performed and/or will be maintained are:

① Ground water cleanup levels will remain the same as listed on Table 16 in the 1992 ROD and Table 3 of this Amended ROD.
② The alternate water supply constructed in 1987 for residences affected by the Site will be upgraded and expanded to include new users, where necessary.
③ Five-Year Reviews will be conducted by EPA.

④ To provide the Institutional controls required by the 1994 Consent Decree, a local ordinance was enacted to prevent the use of ground water at the Site and within the impacted area surrounding the Site. That area is depicted as Attachment B in the 1994 Consent Decree. The Swain's Lake Village Water District enacted the ordinance and complied with the statutory requirements under the State's Groundwater Management Zone regulations Env-Ws 410. The prohibition on ground water use within the area of drinking water supply service of the Swain's Lake Village Water District will be maintained.
⑤ In the event that additional hot spots are discovered at the Site, vacuum extraction may be required at such locations.

The four changes that this Amended ROD makes are:

① Ground water cleanup levels will be attained in the overburden aquifer through the use of natural bioremediation and phytoremediation, not by vacuum extraction.
② Ground water cleanup levels will be attained in the weathered bedrock through the reduction of contaminant flux from the overburden by the methods described in ① above and by natural bioremediation in the weathered bedrock, not by an active pump-and-treat system.
③ Environmental monitoring will be tailored to properly assess natural bioremediation and phytoremediation.
④ The treatment of the ground water recovered during implementation of the vacuum extraction remedy was by carbon filtration rather than ultraviolet oxidation for removal of VOCs and did not require chemical precipitation for metals removal.

The largest apparent physical change at the Site under the Amended ROD will be to its appearance. During the implementation of the vacuum extraction component of the 1992 ROD remedy, the Site was paved to enhance to the performance of the vacuum extraction system. Under the Amended ROD remedy the pavement will be removed, the Site will be re-planted with trees and its appearance will revert to a more natural condition. It is anticipated that phytoremediation and bioremediation will restore the ground water at the Site at the same rate as the remedy described in the 1992 ROD, thereby reducing the risk to public health and the environment. A more detailed description of the four changes from the 1992 ROD to this Amended ROD and the reason for those changes follows.

➊ The greatest difference between the 1992 ROD remedy and the remedy outlined in the Amended ROD is that the 1992 ROD specified that contaminated ground water in the weathered bedrock aquifer would be extracted and treated, whereas the remedy described in the Amended ROD depends on the use of natural bioremediation to achieve the same clean up goals in a similar time frame.

Contamination of the weathered bedrock is due to the migration of contaminated ground water from the overburden aquifer. During the design process it became apparent that removal of ground water from the weathered bedrock aquifer would likely draw more contaminated ground water down from the overburden aquifer into the weathered bedrock. This would make the contamination worse in the weathered bedrock and allow contaminated ground water to escape from the overburden aquifer. Figure 4 depicts the condition of the weathered bedrock and anticipated affects of the remedy.

Dr. John Wilson of EPA's Laboratory in Ada, Oklahoma, also reviewed the situation and recommended that any pumping of the weathered bedrock be held in abeyance to allow ongoing, natural bioremediation to have a chance at treating contaminants. Dr. Wilson was concerned that by pumping the weathered bedrock there would be an increase in the hydraulic gradient which in turn would cause contaminants to flow too quickly through the overburden aquifer. The rapid movement of contaminants through the overburden aquifer would limit the time available for bacteria to adequately treat contaminants. Ultimately, this would allow additional contaminants to enter the weathered bedrock aquifer. To a certain extent this process may have been seen during the recent monitoring of weathered bedrock well 69R. At a pumping rate of less than a gallon-per-minute the preliminary data from April 1998 appears to show an increase from previous sampling rounds in contaminant concentrations, perhaps validating the concerns with regards to pumping this aquifer.

Instead of the remedy outlined in the 1992 ROD, ground water will be monitored to assess the progress of natural bioremediation and phytoremediation in the overburden aquifer. Bioremediation occurring in the overburden aquifer will reduce the amount of contamination that migrates into the weathered bedrock. Phytoremediation will reduce the rate at which ground water and contaminants flow into the weathered bedrock. Lastly, natural bioremediation is also occurring in the weathered bedrock which will help to reduce contaminant concentrations in that aquifer.

❷ The 1992 ROD specified that the method of attaining final cleanup levels in the overburden aquifer would be achieved through vacuum extraction of the contaminants and flushing of the aquifer. The Amended ROD remedy will attain cleanup levels through natural bioremediation and phytoremediation of the overburden aquifer.

The 1992 ROD remedy predicted that it would take approximately twenty years to attain cleanup levels in the overburden aquifer. However, during the three years the vacuum extraction system was operated, a significant reduction in the amount of subsurface contamination was achieved. Approximately eight hundred pounds of hydrocarbon contaminants, of which three hundred pounds were hazardous compounds listed with cleanup levels in Table 16 of the 1992 ROD and in Table 3 of this Amended ROD, were extracted, captured, and destroyed during the systems operation. During peak operation the vacuum extraction system removed 3.5 pounds of contaminants per day. Operation of the vacuum extraction system in the waning months of 1997 removed less than one ounce per day.

The reduction of recovery efficiency led EPA to consider other cleanup alternatives including bioremediation and phytoremediation. Bioremediation uses native microbes to degrade contaminants while phytoremediation uses plants to change the physical properties of the subsurface environment. Modeling of bioremediation indicated that cleanup levels could be attained at the Site in approximately fourteen years at removal rates of approximately one ounce per day or greater, a time frame and removal rate equivalent to that estimated for vacuum extraction. Phytoremediation, using poplar trees, will dewater the Site, thereby minimizing the contaminant flow off-site. The trees also appear to have the ability to breakdown chlorinated compounds such as those found at the Site although the exact mechanism is not clearly understood. In summary, the removal efficiency of bioremediation and phytoremediation compares favorably to the vacuum extraction remedy. The application of bioremediation and phytoremediation at the Site is explained in greater detail later on in this document.

❸ Environmental monitoring will need to be altered to assess the conditions in the aquifer.

Since the 1992 ROD there has been a gradual decrease in the frequency and size of sampling events for ground water and surface water at and/or nearby the Site. This reduction is the result of the accumulation of sufficient data over the years to identify important trends related to the implementation of the 1992 ROD. Since the Amended ROD will involve new approaches (e.g., natural bioremediation and phytoremediation) it is likely that the sampling frequency and parameters of interest will have to be increased again. The installation of additional monitoring wells may also be needed to document the effectiveness of the remedy called for in the Amended ROD.

Although a change in monitoring may appear to be a point of little consequence, bioremediation and phytoremediation are new technologies which will need to be carefully observed. The degradation kinetics of bioremediation are sensitive to the presence of electron acceptors such as iron and oxygen, and other nutrients. The ability of poplar trees to lower the ground water is proven but the contaminant removal abilities of these trees is still under investigation. The sensitivity of either of these processes to other environmental conditions is not well known. Therefore, the monitoring will be tailored to assess function and progress of the phytoremediation and bioremediation remedies.

> **❹ This Amended ROD also documents minor process changes made during the pilot testing and full-scale operation of the vacuum extraction system. The vacuum extraction system was used from 1995 through 1997 to remove contaminated air and ground water from the subsurface. The 1992 ROD specified that volatile organic contaminants (VOCs) in the extracted ground water would be destroyed using ultraviolet oxidation and that inorganic compounds present in the groundwater would be removed using precipitation. Instead, the treatment system used carbon to remove VOCs from the air stream and ground water. Concentrations of inorganic compounds were low enough to not require any treatment with precipitation. No contaminants from the air or ground water were released to the environment at the Site.**

The 1992 ROD chose precipitation to remove inorganic contaminants (e.g., metals) from the extracted ground water, followed by UV-oxidation to destroy VOC contaminants. During the pilot test it was determined that the recovery method, vacuum extraction, caused geochemical changes in the aquifer which removed the metal contaminants while still in the aquifer. Also, the introduction of air into the aquifer and recovery well stripped the VOC contaminants from the ground water. The result was an air stream contaminated with VOCs and a stream of extracted ground water that met EPA's cleanup levels established in the 1992 ROD before any treatment. The vacuum extraction system rarely recovered more than five gallons of water per minute during the remedy and usually recovered three gallons or less.

Therefore, it was only necessary to treat the air stream with vapor-phase granular activated carbon. This change resulted in the construction of a much smaller treatment system. As a precaution, Fords consultant at the Site, G&M filtered the recovered ground water through carbon prior to discharge to the overburden aquifer. Changing the treatment method saved some money but it also allowed the constructed system to fit in better with the surrounding residential neighborhood. The change yielded the same results, the capture of contaminants, and no impacts to the public and the environment.

V. SUMMARY OF SITE CHARACTERISTICS

This summary of Site characteristics, including soils and the surface, air, sediments and surface water, and ground water is derived from the 1990 Remedial Investigation (RI), the 1993 Treatability Study, and investigations performed by G&M. The discussions herein will focus on those elements of each characteristic which is pertinent to this change. A more detailed discussion of each of the media are contained in the above referenced volumes and the 1992 ROD.

Soil:

The soils at the Site consist of a thin (approximately six inches or less), organic-rich top, underlain by a fifteen to twenty-foot thick layer of mineral soil consisting primarily of sand with interlayered gravel. This type of soil is typical of glacial till. Similar to many tills it is extremely variable in its grain size and type. Variable grain size causes ground water to flow slowly and makes contaminant recovery difficult and time-consuming.

The Site is at the top of a ridge. Therefore, the water table fluctuates on a seasonal basis. During the spring, the water table may be as little as one foot below the surface, while in the late summer it may be ten feet below the surface. This oscillation of the water table is an important means of contaminant transport and distribution in ground water and soil, because it continually brings contaminated ground water into contact with different intervals of soil. This causes some of the contaminants, generally VOCs, to sorb to the soil particles and to be caught in the unsaturated zone by capillary forces.

Soil has been the focus of early remedial efforts. Prior to the RI in 1990, 405 cubic yards of VOC and PCB contaminated soil were excavated from two areas and transported off-site for disposal. Also 3.5 yards of dioxin and PCB contaminated soil were excavated, treated and disposed. Following the RI, efforts again focused primarily on removing contamination from the soil. In 1993, a Treatability Study was completed using vacuum extraction. The Study proved to be effective and the full-scale system described in the 1992 ROD remedy was implemented at the Site from 1995 through 1997. More detailed information regarding past soil removals is contained in the 1992 ROD and the 1992 Remedial Investigation.

Currently, following removal of the cap for vacuum extraction, the two-acre Site has been planted with approximately 1,400 four-foot tall poplar trees and a ground cover, and is therefore well vegetated. The Site is a local topographic high; however, winds are abated by surrounding trees. Surface water erosion is also not expected to be a factor in contaminant migration, as no well-defined channels exist on-site, and drainage is limited to minor sheet flow to low lying areas. The overall effect is that little erosion is seen in close proximity to the Site. Therefore, the migration of any Site contaminants adsorbed to soil is unlikely. As a further note, contamination appears to be found primarily in the subsurface environment decreasing the likelihood of off-site transport of contaminated soils.

Air:

Due to the extremely low concentrations of volatile contaminants in soil and surface water, significant concentrations of contaminants in air due to volatilization are not expected, nor were they observed by air monitoring. During all field activities for the RI, air monitoring exhibited fewer than five parts per million (ppm) total organic vapors above background. Therefore, since no source areas are exposed at the surface, and since qualitative sampling detected no contaminants above background, it has been concluded that there are no significant air quality impacts resulting from VOCs on the Tibbetts Road Site.

Surface Water and Sediments:

Surface water and sediment samples collected from Swains Lake in 1991 showed no detectable levels of contaminants from the Site. A summary of surface water and sediment sampling is contained in the 1992 ROD.

Swains Lake is the surface water body of primary concern, due to its proximity to the Site (approximately 900 feet north of the Site) and the fact that it is used as a drinking water supply for residents in the area. Surface water and sediment samples were taken from this lake at a number of locations in 1991. Sampling locations included a point in the lake closest to the Site (the southern end of the lake), at the Swains Lake Village Water District treatment plant, and in the Bellamy River. The sampling results from these locations revealed no detectable contamination. Moreover, the ground water samples from monitoring wells closest to the lake have not shown the presence of Site contaminants, indicating no quantifiable impact on the water quality of the lake from contaminants originating at the Site.

Tributaries of both the Oyster and Bellamy Rivers, both class "A" drinking water bodies, drain the area surrounding the Site and the State of New Hampshire has found them suitable for fishing, swimming and drinking water use. The Bellamy and Oyster Rivers are sources of drinking water for municipalities down gradient from the Site. Sediment/soil transport from the Site to the lake and rivers is not viewed as a significant pathway, because surficial soil contamination is not significant and the Site is a relatively flat topographic high with no developed flow pathways in the areas of contamination.

Ground Water:

The Site sits on a drainage divide as identified in Figure 5. This creates two ground water flow directions. The uppermost aquifer which is very heterogeneous, consists of glacial till, a mix of silt, sand, and gravel otherwise termed "ground moraine". This upper till and the saturated portions thereof is referred to as the "overburden aquifer". The overburden aquifer is approximately twenty to thirty feet thick and is underlain in the general vicinity of the Site by what is called a "lodgment till." The lodgement till is a compacted silt/clay material resembling a dense concrete. The lodgement till is practically impervious to ground water and actually serves to limit the flow of ground water into the underlying bedrock aquifer. The bedrock is fractured and formerly served as a drinking water aquifer, supplying local residents with drinking water prior to the identification of Site contamination.

Ground water in both the overburden and bedrock aquifers on the southwestern portion of the Site flows to the west into the Oyster River watershed, and on the northeastern two-thirds of the Site flows to the east into the Bellamy River watershed.

Ground water contamination at the Site exists in both the overburden and bedrock aquifers. The overburden aquifer, directly beneath the source areas, is the most heavily contaminated of the two. Mass balance calculations performed in the 1992 Remedial Investigation calculated that approximately 570 pounds of VOCs existed in the overburden aquifer in 1990, while only a little more than two pounds of VOCs existed in the weathered bedrock and competent bedrock together. This compares well with the removal of 300 pounds of chlorinated VOCs (800 pounds of total VOCs, including chlorinated and non-chlorinated) during the vacuum extraction pilot-test and full-scale application of the 1992 ROD remedy. Subsequent calculations estimate that approximately 100 pounds of contaminants remain in the aquifer (Appendix D).

Contaminant migration in the overburden aquifer mirrors the flow of ground water from the Site. Those contaminants released from the drum storage areas at the Site entered the uppermost overburden aquifer and migrated horizontally either to the west or to the northeast, depending upon where the release occurred in relation to the drainage divide. The horizontal migration of contaminants is a function of the lodgement till acting as an aquitard, severely restricting vertical flow. Horizontal flow continues to the west and northeast until the underlying aquitard pinches out This aquitard accounts for the low concentrations of contaminants in bedrock wells on-site. In areas where the aquitard thins out, such as northeast of the Site, we see evidence of heavier contamination of the weathered bedrock. With no aquitard, a component of vertical migration of contaminants develops, thereby introducing contaminants to the bedrock. Originally this area was termed the "weathered bedrock"; however, following additional investigation it was determined that what was thought to be a moderate amount of weathered bedrock is actually a localized fracture zone of the bedrock. Three sets of wells convey the flow paths and tenor of the contamination at the Site. Those three sets are shown in Figure 6 and discussed further below.

Flow Path 51S to 50S:

The Western portion of the Site in the vicinity of monitoring well 51S was used as a fuel storage site. Reportedly the Site owner maintained a large aboveground storage tank in this area and only a few drums. However, this was the area into which the owner would mix various solvents with gasoline to fuel his vehicles. Therefore, the spillage here was long-term and consisted mostly of gasoline components such as benzene, toluene, ethyl benzene, and xylene. Neither the EPA nor State removed any soil from this area. Early sampling results indicated the presence of solvents; however, those compounds have not been found since 1990. The contaminated ground water in this area flows in a westerly direction from monitoring well 51S to well 50S.

During vacuum extraction this area was identified as Treatment Cell 3. One vacuum extraction well was operated in Cell 3 beginning in 1996 in the immediate vicinity of well 51S. Because concentrations of fuel component contaminants kept increasing, G&M conducted a drilling program to find a suspected source area. High concentrations of toluene and the other fuel components were found approximately eight feet away and a new vacuum extraction well was positioned. The new well operated over the summer of 1997. The sampling results presented in Table 1 of Appendix A, showed significant concentrations of all fuel components in both 51S and 50S in 1997, and preliminary data for March 1998 show that concentrations are decreasing and approaching cleanup levels.

It is clear that arsenic and manganese remain elevated in concentration; however, this is most likely a product of disequilibrium. As a result of natural degradation processes, the subsurface environment went from aerobic to anaerobic conditions, thereby increasing the solubility and mobility of arsenic and manganese. It is likely that the concentrations of these compounds in the near future will continue to be in a state of flux while degradation processes continue. It is expected that as bioremediation continues to reduce the concentrations of VOCs in this flow path the tendency for the subsurface environment will be to return to its normal aerobic conditions. As this process occurs we believe that the concentrations of arsenic and manganese will also decrease and approach their respective cleanup levels. A goal of the remedial efforts described in this Amended ROD will be to attempt to have this portion of the aquifer become aerobic throughout its thickness as soon as possible.

To help monitor the progress in achieving this goal, ground water monitoring shall be directed at assessing normal ground water parameters as well as special parameters related to the anaerobic/aerobic processes such as measurement of electron acceptors and oxidation potential.

Flow Path 80S to 79S:

The area in the southeast portion of the Site nearby ground water monitoring well 80S was one of the drum storage areas. The EPA and State removed significant quantities of solvent contaminated soil following the initial spill, which was believed to have occurred in 1984. Early ground water sampling results had high concentrations of solvents (trichloroethylene 1,000 parts per billion) and fuel components (toluene 98,000 parts per billion). However, the ground water gradient in this area is not as high as that seen in the vicinity of wells 51S and 50S; therefore, the contaminants did not travel as far. The combined effects of slow ground water velocities, ongoing natural bioremediation, the soil removal, and approximately three years of vacuum extraction treatment have acted to clean this flow path to the cleanup standards set in the 1992 ROD.

During vacuum extraction this area was referred to as Treatment Cell 2. One vacuum extraction well operated in Cell 2 beginning in 1996 in the immediate vicinity of well 80S and was discontinued early in 1997. Sampling results presented in Table 2 in Appendix A of the Amended ROD, did not detect any contaminants in 1996. In 1998 an adjacent well, 84S, was sampled and showed that all contaminants met cleanup levels except for arsenic and manganese.

Although arsenic and manganese still exceed their cleanup levels their concentrations are decreasing over time and appear to be following a trend similar to what is described above in the flow path 51S to 50S section (i.e., as the solvents and fuel components are reduced and the aquifer returns to aerobic conditions we should see a decrease in arsenic and manganese concentrations). Arsenic and manganese levels were measured at this location at 446 and 17,400 parts per billion, respectively, in 1995 prior to vacuum extraction. In 1998, after a couple of years of soil treatment, the concentrations of arsenic and manganese had declined to 160 and 2,200 parts per billion, respectively. Although this relationship needs to be investigated further to establish the properties of the various species and to document trends, it does show a positive trend.

Flow Path 57S to 69R:

The central area of the Site in the vicinity of ground water monitoring well 57S was the largest drum storage area and probably the area of greatest spillage. The EPA and State did remove significant quantities of solvent contaminated soil following the initial spill. Early ground water sampling results had high concentrations of solvents (trichloroethylene 27,000 parts per billion) and fuel components (toluene 140,000 parts per billion). Ground water and contaminants flowed slowly to the northeast in this area.

During vacuum extraction this area was referred to as Treatment Cell 1. Cell 1 had five vacuum extraction wells placed around it based on 1992 ROD information and later information derived from a drilling investigation. The sampling results for this area appear to show limited progress in achieving the cleanup levels identified in the 1992 ROD. Many of the wells (72S, 70S, 52S, 37D, 53S, and 35R) may not be in the same direct groundwater flow path, therefore it is difficult to evaluate what any increases or decreases in contamination in the well means. Probably the most direct connection is between 57S to 69R. There also appears to be a hydraulic connection in this area to 35R which may represent the groundwater flow path into the bedrock aquifer from 69R. Therefore, for brevity in the table the other wells have been omitted. The full table and the data are contained in Appendix D.

Along this flow path it is apparent that there are still some residual pockets of contamination which continue to leach into the aquifer over time. There are obviously a number of questions which still need to be answered including whether the Amended ROD remedy will be able to achieve the mandated cleanup levels throughout this entire area. The ensuing monitoring program will attempt to answer questions such as these and determine whether more active measures such as the continued application of vacuum extraction will be necessary.

An additional item of interest for this area is the large declines in trichloroethylene, benzene, and toluene from 1985 to 1995 and a corresponding increase in the 1,2 cis-dichloroethylene concentration. The difference was dramatic enough for EPA to collect samples for other metabolic products, gases, and microcosm studies in 1992 and 1993. These data indicated a significant anaerobic reduction of contaminants to nonhazardous compounds. It is also interesting to note that during the vacuum extraction test, when the aquifer became aerobic in this area, the concentrations of trichloroethylene and other chlorinated solvents remained relatively constant while concentrations of 1,2 cis-dichloroethylene declined. This would support the expectation based on existing literature and studies that under aerobic conditions the degradation of TCE to 1,2 cis dichloroethylene would cease. Again, this confirms that the ensuing monitoring program will have to be tailored to help us better understand the natural processes taking place beneath the Site.

A complete discussion of the geology and hydrogeology at the Site is presented in more detail in Sections 1 and 3 of the 1992 RI. Much of the data and calculations used as the basis for this discussion are found in Appendix D of the Amended ROD.

VI. SUMMARY OF SITE RISKS

The 1992 ROD summarizes the risks at the Site and additional details are provided in Appendix I of the Remedial Investigation. Since that time the contaminants of concern have remained unchanged, although the overall concentrations in ground water have declined. Exposure scenarios have not been changed from the 1992 ROD. The findings of the 1992 ROD were that exposure to Site soils and surface waters in streams surrounding the Site do not incur an unacceptable risk for children or adults. The only unacceptable risk to human health that exists is associated with the consumption of ground water for drinking purposes. However, because drinking water is supplied to the area through a municipal supply system and a local ordinance places further restrictions on ground water use, there is not a current risk. A more detailed accounting of risk at the Site is contained in the 1992 ROD and Remedial Investigation.

The Ecological Risk Assessment conducted during the Remedial Investigation measured the potential ecological impacts of contaminants from the Site on surrounding locations including Swains Lake, the intermittent brook southwest of the Site, and identified wetland areas to the west and northeast of the Site.

The only surface water apparently affected by the Site, as determined by 1990 and 1991 analytical data, was the intermittent stream southwest of the Site. Contaminants of concern were not detected in the same intermittent stream in 1991, thus reinforcing the assessment that the intermittent stream is a limited exposure pathway for environmental receptors. This intermittent stream is the result of ground water in the overburden aquifer discharging to the surface. The intermittent nature of the stream is likely to result in limited bioavailability of contaminants and limited exposure pathways. Thus, the detected surface water and sediment contaminant concentrations are not expected to pose significant risks to aquatic components of this stream.

At this Site, hazardous substances have been released into the environment and response action is necessary to protect public health, welfare and the environment. Actual or threatened releases of hazardous substances from this Site, if not addressed by implementing the response action selected in this Amended ROD, may present an imminent and substantial endangerment to public health, welfare, or the environment. The potential use of contaminated ground water, as well as the migration of groundwater, in both the overburden and bedrock aquifers, from the Site poses a potential threat to public health.

VII. COMPARATIVE ANALYSIS OF THE ORIGINAL REMEDY AND AMENDED REMEDY

Section l2l(b)(1) of CERCLA presents several factors that at a minimum EPA is required to consider in its assessment of potential remedies. Building upon these specific statutory mandates, the National Contingency Plan articulates nine evaluation criteria to be used in assessing the individual remedies. The following is a comparison of the 1992 ROD remedy and the Amended ROD remedy, contrasting each remedy's strength and weakness with respect to the nine evaluation criteria. These criteria are as follows:

Threshold Criteria

The two threshold criteria described below must be met in order for a remedy to be eligible for selection in accordance with the NCP.

1. **Overall protection of human health and the environment** addresses whether or not a remedy provides adequate protection and describes how risks posed through each pathway are eliminated, reduced or controlled through treatment, engineering controls, or institutional controls.

2. **Compliance with applicable or relevant and appropriate requirements (ARARS)** addresses whether or not a remedy will meet all of the ARARs of other Federal and State environmental laws and/or provide grounds for invoking a waiver.

Primary Balancing Criteria

The following five criteria are utilized to compare and evaluate the elements of one alternative to another that meet the threshold criteria.

3. **Long-term effectiveness and permanence** address the criteria that are utilized to assess remedies for the long-term effectiveness and permanence they afford, along with the degree of certainty that they will prove successful.

4. **Reduction of toxicity, mobility, or volume through treatment** addresses the degree to which remedies employ recycling or treatment that reduces toxicity, mobility, or volume, including how treatment is used to address the principal threats posed by the site.

5. **Short term effectiveness** addresses the period of time needed to achieve protection and any adverse impacts on human health and the environment that may be posed during the construction and implementation period, until cleanup goals are achieved.

6. **Implementability** addresses the technical and administrative feasibility of a remedy, including the availability of materials and services needed to implement a particular option.

7. Cost includes estimated capital and Operation Maintenance (O&M) costs, as well as present worth costs.

Modifying Criteria

The modifying criteria are used on the final evaluation of remedial alternatives generally after EPA has received public comment on the RI/FS and Proposed Plan.

8. **State acceptance** addresses the State's position and key concerns related to the Amended ROD remedy and the 1992 ROD remedy, and the State's comments on ARARs or the proposed use of waivers.

9. **Community acceptance** addresses the public's general response to the remedy change described in the Proposed Plan.

An assessment of 1992 Rod and the Amended ROD remedy according to the nine criteria and an assessment of the relative performance of each remedy against the nine criteria follows.

1. Overall Protection of Human Health and the Environment

This criterion considers whether a remedy, as a whole, will protect human health and the environment. This includes an assessment of how public health and environmental risks are properly eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

There are two primary considerations at this Site: the first is that contaminated ground water does not discharge to surface water; and the second is that measures, including the construction of an alternate water supply and enactment of a local ordinance restricting the use of ground water, have been taken to prevent residences near the Site from drinking and using contaminated ground water. Therefore, there is no present exposure, nor anticipated future exposure, to Site contaminants under either remedy. Because the time to attain cleanup levels for both remedies is dependent upon the same physical property of soil (e.g.,desorption rates) the time to attain cleanup levels and comply with all ARARs, is the same for both remedies.

There are currently no exposures to contaminants at the Site to either the public or the environment. Moreover, both remedies would either eliminate or collect residual contamination in the ground water. Therefore, both remedies are equally protective of human health and the environment.

2. Compliance with Applicable and Relevant and Appropriate Regulations

This criterion addresses whether or not a remedy complies with all state and federal environmental and public health laws and requirements that apply or are relevant and appropriate to the conditions and remedy at a specific site. If an Applicable or

Relevant and Appropriate Requirement (ARAR) cannot be met, the analysis of a remedy must provide the grounds for invoking a statutory waiver.

Both of the remedies will meet the requirements of all ARARs within a reasonable time frame. The only ARARs the Site is not in compliance with are the chemical specific ARARs that pertain to drinking water standards.

The period over which either of the two remedial alternatives will achieve compliance with all of the chemical-specific ARARs will be in approximately the same time frame, 14 years. Volatile organic compounds and arsenic concentrations in the ground water violate the drinking water standard, if the ground water were to be used as a drinking water source. Based on the results of ground water modeling, EPA expects that natural bioremediation and phytoremediation will diminish contaminants at the Site within a reasonable time frame, therefore there is no need to invoke an ARAR waiver for ground water cleanup. Pumping and treating or vacuum extraction of contaminated ground water will not hasten the cleanup process because the rate at which contaminants can be leached from the soil by these processes is limited by the same physical properties (e.g., desorption) which limit the rate at which natural biodegradation can take place. A more thorough discussion of cleanup times is contained in Section VIII.A., and Appendix D of this document.

3. Long-term Effectiveness and Permanence

This criterion refers to the ability of an alternative to maintain reliable protection of human health and the environment over time once the remedial action objectives and cleanup levels have been met.

Both remedies, once implemented and maintained over a number of years will be equally effective and permanent. Vacuum extraction would be effective because it would prevent the migration of contaminants from the Site through the extraction and treatment of contaminated soil vapors and ground water. The bioremediation and phytoremediation remedies will be equally effective in preventing the migration of contaminants by using natural processes (e.g., natural biodegradation and phytoremediation) to reduce the concentration, toxicity, and mobility of contaminants. The trees performing the phytoremediation will minimize water infiltration, lessening ground water and contaminant flow, and microorganisms involved with biodegradation will transform the contaminants to nonhazardous materials and permanently reduce the risk posed to human health and the environment.

Vacuum extraction or pumping and treating will reduce contamination. However, there is typically a point reached during treatment where the amount of contamination removed decreases because of physical limitations associated with the soil and contaminants. Contaminants at that point can not diffuse from the soil and/or water at a rate sufficient to keep up with the rate the media around them is being removed. As a result the system is typically shut down and run intermittently to allow contaminants time to equilibrate with their surroundings. This process can continue over long periods and still not necessarily achieve the desired cleanup levels as was seen at the Site during the full-scale application of vacuum extraction. Whereas, if cleanup levels are attained through natural biodegradation, the remedy will be permanent because equilibrium conditions will have been maintained throughout the cleanup process.

4. Reduction of Toxicity, Mobility, and Volume through Treatment

This criterion contains three measures of the overall performance of a remedy. The 1986 amendments to the Superfund statute emphasize that, whenever possible, EPA should select a remedy that uses a treatment process to permanently reduce the level of toxicity of contaminants at the Site, inhibit or eliminate the spread of contaminants away from the source of contamination, and reduce the volume, or amount, of contamination at the Site.

Both remedies reduce contaminant mobility by reducing the mobility of ground water. Vacuum extraction uses a cap and active removal of ground water and air to reduce the water table and ground water flow. The natural bioremediation and phytoremediation remedy will lower the water table through the transpiration of plants and their resultant water uptake. The overall effect of phytoremediation is to have each plant act as a small pump to remove ground water from the subsurface. The transpiration of ground water will be limited primarily to the growing season. However, the density of the trees has been designed to reduce the infiltration of ground water to such a degree that it will likely yield the same effective mass of ground water removed, if not greater than, that removed by the vacuum extraction system over an annual cycle.

Toxicity and volume are diminished by both remedies. Vacuum extraction removes the contaminants, captures them and then treats them off-site. Natural bioremediation will reduce the contaminants, trichloroethylene, benzene, toluene, and others to carbon dioxide and nonhazardous acids and salts on-site.

5. Short-term Effectiveness

This criterion refers to the likelihood of adverse impacts on human health or the environment that may be posed during the construction and implementation of an alternative until remedial action objectives and cleanup levels are achieved.

Short-term effectiveness addresses the risks posed to workers and neighbors during the construction and implementation of the remedy. In this regard, vacuum extraction poses some minor risks such as the on-site storage of carbon filters contaminated with recovered VOCs and truck traffic. Natural bioremediation and phytoremediation would see occasional traffic to conduct environmental monitoring and maintenance of the trees.

6. Implementability

This criterion refers to the technical and administrative feasibility of a remedy, including the availability of materials and services needed to implement the alternative.

Both remedies are implementable with standard technologies that are readily available. As vacuum extraction was used previously at the Site, it is easily implementable because the vacuum unit and extraction wells will be maintained at the Site for treatment of any hot spots that EPA believes may be warranted in the future. Phytoremediation is also easily implementable and has already been implemented with the planting of approximately 1,400 poplar tress to establish a cover over the Site. Natural bioremediation was occurring at the Site as early as 1990 and continues today. Natural bioremediation requires no addition of nutrients or electron acceptors and therefore has already been implemented at the Site.

7. Cost

This criterion includes the capital (up-front) cost of implementing each remedy as well as the cost of operating and maintaining that remedy over the long-term. The costs described below only reflect those costs that would be incurred henceforth and do not include previous costs which are substantial. The cost of the vacuum extraction test and full-scale implementation was greater than $2 million and included clearing the surface of the Site, paving the Site, designing and purchasing the equipment, and operating the equipment for a period of approximately three years. Using the present as time zero for costs, the comparison is surprisingly close. This is because the only practical difference between the two remedies is the $140,000 difference between planting trees and the electrical operating costs for vacuum extraction. The cost of sampling for the bioremediation and phytoremediation remedy will most likely be more than that of vacuum extraction because the technology is still new and less well defined. The potential exists that following additional research in the field and examination of the data, these costs could decrease. Because many of the costs are the same, or in the case of the vacuum extraction system, front loaded, there is no calculation of net present worth of both capital and operation and maintenance costs as it would yield no practical information.

The EPA has developed the costs using reasonable assumptions more fully outlined in the Feasibility Study and adapted to the situation. The length of time has been adjusted to account for the time for cleanup, fourteen years, three years of compliance monitoring and an additional two years as a contingency. The cost for implementing each remedy and monitoring over 20 years is:

Vacuum Extraction Remedy:

Running the vacuum extraction system: Electricity, maintenance, carbon filters ($4,000 per month x 5 months per year x 14 years), adjusting recovery (new wells) $280,000

Technical support: additional investigations to assist recovery, environmental monitoring 2x per year, meetings with State and EPA, evaluation of data and preparation of reports (approximately $30,000 per year x 20 years) $600,000

Site work: cost of samples ($4,000 per round x 2 per year x 20 years), other miscellaneous such as cap maintenance, fence repair, and repair of neighbors property. $200,000

TOTAL: $1,080,000

Natural Bioremediation & Phytoremediation:

Operating and maintaining the trees: Inspections, insect control, culling ($2,000 per year x 20 years) $40,000

Technical support: additional investigations, environmental monitoring 3x per year, meetings with State and EPA, evaluation of data and preparation of reports (approximately $30,000 per year x 20 years) $600,000

Site work: cost of samples ($5,000 per round x 3 per year x 20 years), other miscellaneous such as fence repair and repair of neighbors property. $300,000
TOTAL: $940,000

CONCLUSION AFTER ANALYSIS OF SEVEN OF THE CRITERIA

An analysis of the data gathered over the three years of conducting the vacuum extraction component of the 1992 ROD remedy led EPA to select natural bioremediation and phytoremediation for presentation to the public as EPA's proposed change to the 1992 ROD Remedy during the public participation process. The EPA selected this remedy because under the natural bioremediation and phytoremediation remedy, public health and the environment continue to be protected while doing so in a more cost-effective manner. An alternate public drinking water supply has already been provided to nearby residences, eliminating the greatest potential risk of exposure for the public. In addition, a local ordinance further restricting the use of ground water at and nearby the Site has been enacted by the Swain's Lake Village Water District. Ground water modeling indicates that cleanup levels and ARARs will be met within a reasonable time frame using natural bioremediation and phytoremediation. Due to the physical properties of the soils and chemicals found at the Site there is presently no active remedy which will restore the aquifer in a time frame faster than what can be achieved using natural bioremediation and phytoremediation. Because of these factors, the Amended ROD remedy will have minimal impact on cleanup times, will make the remedy less costly, and have greater public acceptance.

8. State Acceptance

This criterion addresses whether, based on its review of the data derived from the Site and the Proposed Plan, the State concurs with, opposes, or has no comment on the remedy change EPA has selected for the Site.

The State has participated in discussions related to the proposed remedy change and has indicated its support for the use of bioremediation and phytoremediation at the Site. In addition, the State has also had an opportunity to review the technical data supporting this change. The New Hampshire Department of Environmental Services has provided EPA with a letter of concurrence with the remedy change. This letter is attached as Appendix B.

9. Community Acceptance

This criterion addresses whether the public concurs with EPA's proposed remedy change. Community acceptance of this cleanup proposal was evaluated based on comments received at the public hearing.

All of the residents and neighbors nearby the Site appeared to support natural bioremediation and phytoremediation at the public meeting held to discuss the change. The one written and oral comment received during the public comment period, which is included as part of the Responsiveness Summary in Appendix E to this document, had to do with removing the fence at the property. The front fence has since been removed to address the concern of the nearby resident.

VIII. THE SELECTED REMEDY

Natural bioremediation and phytoremediation are selected as the remedy in this Amended ROD based on the following findings:

- Contaminants in the soil and ground water are capable of being effectively remediated by natural bioremediation and phytoremediation.

- Although transformation products will be formed, none are more hazardous than the parent compound.

- The nature and distribution of sources of contamination have been adequately reduced by vacuum extraction over the previous three years and will be controlled by the natural bioremediation and phytoremediation remedies.

- The contaminated ground water plume is stable and does not appear to be migrating.

- Vacuum extraction over the three prior years reduced contamination such that natural bioremediation will be able to maintain and eventually shrink the plume of contaminated ground water.

- The surface water source for the drinking water supply, Swains Lake, will not be affected by the contaminated ground water.

- The natural bioremediation and phytoremediation remedy will attain cleanup levels in approximately the same time frame, fourteen years, as the continued operation of vacuum extraction due to desorption limitations.

- The water supply district is capable of maintaining service to all drinking water users in the area of affected ground water.

- Pursuant to the 1994 Consent Decree, the water district passed an ordinance restricting the use of ground water within its service area. The water district inspects and enforces this ordinance vigorously due to its concerns over cross-connections.

- No current unacceptable risk is posed to public health or the environment.

- The natural bioremediation and phytoremediation remedies will attain cleanup levels and will meet all ARARs within a reasonable time frame.

- The natural bioremediation and phytoremediation remedies will permanently reduce mobility, toxicity and volume.

- Past activities, soil removals and vacuum extraction, have acted to reduce mobility and toxicity of contaminants at the Site, making cleanup through natural bioremediation and phytoremediation more amenable.

- The remedy will pose no short-term risks.

- The cost is less than vacuum extraction, yet cleanup levels will be attained in approximately the same time frame.

Combined with the vacuum extraction remedy performed under the 1992 ROD from 1995 to 1997, natural bioremediation and phytoremediation will provide for a comprehensive remedy. Municipal drinking water is already supplied to the area.

Institutional controls restricting the use of contaminated ground water have been established pursuant to the 1992 ROD through the enactment of a local ordinance by the Swain's Lake Village Water District. The area of the Ground Water Management Zone for which this local ordinance provides usage restrictions is depicted in Figure 2.

A. Interim Cleanup Levels

Interim cleanup levels that were established in the 1992 ROD as the performance standards are retained for this Amended ROD remedy. Those cleanup levels were established for all contaminants of concern identified in the Baseline Risk Assessment found to pose an unacceptable risk to either public health or the environment. These protective levels shall constitute the cleanup levels for this Amended ROD and shall be considered performance standards for any remedial action for the Site.

Periodic assessments of the protection afforded by the Amended ROD remedy will be made as the remedy is being implemented and at the completion of the remedial action. These periodic assessments will be made based on available data and may involve a risk assessment. If, after review of the risk assessment or available data, the remedial action is not determined to be protective by EPA, the remedial action shall continue until either protective levels are achieved, and are not exceeded for a period of three consecutive years, or until the remedy is otherwise deemed protective by EPA. EPA, after its review, may also require further implementation of the vacuum extraction remedy in the event that it is determined that protective levels can not be achieved by the remedy described in the Amended ROD.

Once the interim cleanup levels are attained and all ARARs are complied with over a three-year period a final risk assessment will be performed. Such risk assessment of the residual ground water contamination shall follow EPA procedures and will assess the cumulative carcinogenic and non-carcinogenic risks posed by the ingestion of ground water and surface water used for drinking water purposes. The risk assessment will determine if conditions both on-site and off-site are such that no current or future risk is posed to either the public health or the environment for any exposure pathway. The interim cleanup levels established for ground water are presented in Table 3 of Appendix A. The 1992 ROD also describes how those cleanup levels were selected. This Amended Record of Decision will retain those cleanup levels.

Because the aquifer at and beyond the Site is a Class II aquifer which is a potential source of drinking water, MCLs and non-zero MCLGs where more stringent than MCLs, established under New Hampshire's Water Quality Standards are ARARs.

These interim cleanup levels which are consistent with ARARs or suitable To-Be-Considered (TBC) criteria for ground water, attain EPA's risk management goal for remedial actions and are determined by EPA to be protective. However, the true test of protection cannot be made until residual levels are known. Consequently, at the time that Interim Ground Water Cleanup Levels identified here in the Amended ROD and newly promulgated ARARs and modified ARARs which call into question the protectiveness of the remedy have been achieved, and have not been exceeded for a period of three consecutive years, a risk assessment will be performed on residual ground water contamination to determine whether the remedial action is protective. The EPA has estimated that these levels will be attained in approximately fourteen years.

B. Description of Remedial Components

The selected remedy consists of monitoring the progress of natural bioremediation and operating and maintaining a phytoremediation system to achieve the natural restoration of the ground water and to protect surface water quality. This remedy will meet, through natural processes, cleanup levels in ground water, and act to address any contamination in ground water or surface water which might threaten public health or the environment. The selected remedy consists of the following remedial components:

1. Natural bioremediation and phytoremediation of contaminated ground water in the overburden aquifer.

The natural bioremediation mechanism consists of natural, in-situ degradation processes being performed by anaerobic microorganisms primarily in the overburden aquifer. EPA first came to suspect that bioremediation was occurring in the overburden aquifer in 1992. These suspicions were based on shifts in the concentrations of some species of chlorinated compounds (e.g., trichloroethylene being supplanted by the less chlorinated 1,2 cis-dichloroethylene). To further confirm whether bioremediation was occurring, EPA collected samples and conducted laboratory microcosm studies, the results of which have been presented as a paper (Wilson, et al., *Design and Interpretation of Microcosm Studies for Chlorinated Compounds*). These studies demonstrated that a wide variety of compounds, including benzene and toluene, were being degraded in ground water at the Site by anaerobic microorganisms. During vacuum extraction it appears that anaerobic degradation processes were slowed or halted as portions of the aquifer became aerobic. With the cessation of vacuum extraction treatment the saturated portion of the subsurface environment was able to revert back to anaerobic conditions, thereby allowing the anaerobic microorganisms to continue metabolizing and degrading the contaminants.

Calculations, including analysis with EPA's Bioscreen model, have shown that the cleanup levels for VOCs will be attained in approximately fourteen years. Those same calculations show that the destruction rate by bioremediation is greater than the one ounce per day removal rate of the vacuum extraction system when it was shut down in 1997. The environmental monitoring program will be designed to confirm these calculations and modeling results.

It is believed that the cleanup levels for inorganic contaminants, especially arsenic and manganese, will be achieved shortly after the aquifer becomes aerobic. The aquifer will become aerobic through two mechanisms. The first mechanism is based on the consumption by microbes of a majority of the organic contaminants in the aquifer, after which the oxygen levels should increase and return the aquifer to aerobic conditions. The second mechanism will be through the extension of roots from the trees involved with the phytoremediation. As the root zone moves downward and enters the anaerobic zone it will gradually extend the aerobic zone to this area.

As mentioned previously, the phytoremediation component will consist of the planting of approximately 1,400 poplar trees at the Site. Migration of contaminants from the Site would be slowed if not halted by the uptake and transpiration of water by these poplar trees. The active pumping during the vacuum extraction removed at most 5 gallons per minute or 7200 gallons per day from the aquifer. Research has shown that an individual poplar tree can transpire or use approximately 25 to 50 gallons per day. Considering the number of trees to be used at the Site, it is possible that upwards of 35,000 gallons of ground water per day will removed by the trees, an amount greater than achieved during vacuum extraction.

An additional benefit of the phytoremediation process appears to be the plants ability to withdraw contaminants from the soil. Recent research has shown that poplars grown in media containing 50 parts per million trichloroethylene (the Site maximum is 7 parts per million) were able to consume large amounts of the trichloroethylene, metabolize the majority, and transpire very small amounts of trichloroethylene (Newman, et al., *Uptake and Biotransformation of Trichloroethylene by Hybrid Poplars,* 1997). The environmental monitoring program will attempt to evaluate this process as well, since the mechanism for this activity is not well understood at this time.

There is also a synergistic effect that the poplars and natural bioremediation have. Bioremediation requires that ground water travel times be reduced to metabolize as much of the contaminants as possible. By reducing the hydraulic gradient, the poplar trees will also slow down ground water flow. Also, it has been shown that root growth of poplars into aquifers fosters a rich environment for the production of microbes, molds, and fungi, all of which may help to degrade contaminants.

2. Natural bioremediation of contaminated ground water in the weathered bedrock aquifer.

The remedy in the "weathered bedrock aquifer," henceforth termed the north fracture zone, is dependent upon the success of the overburden aquifer natural bioremediation and phytoremediation remedy. The success of the overburden remedy would reduce the flow of contaminants to the north fracture zone. Reducing the amount of contaminants will enable the microbes and other attenuating processes in the north fracture zone to reduce contamination. Monitoring ground water in the weathered bedrock will allow an assessment of the cleanup progress. EPA will evaluate future monitoring results to determine whether other measures are necessary.

3. Implementation of Long Term Monitoring Plan

A detailed plan for monitoring the performance and effectiveness of the remedial action will be developed and submitted by Ford to the State and EPA for approval or modification. The ground water and surface water monitoring components of the plan will provide the data necessary to monitor the effectiveness of natural bioremediation and phytoremediation. Because bioremediation and phytoremediation are new technologies it is likely that specialized sampling plans, focusing on the contaminants of concern as well as parameters which measure the success of the processes will be necessary. To help fully characterize the Site and these processes it may also be necessary to install additional monitoring wells. The installation of such wells, if needed, and their monitoring will conform with the substantive requirements of the State's Groundwater Protection Rules Env-Ws 410.

Monitoring will focus on the appropriate parameters to determine the progress of natural bioremediation and phytoremediation. Such parameters include the measurement of ground water levels, terminal electron acceptors, degradation products, field parameters (ORP, pH, DO, etc.), and sampling of root zone soils. The ground water levels will be measured on a frequency sufficient to build a data base that shows levels over a year and can be compared from year-to-year to assess the success of phytoremediation in lowering the water table. Terminal electron acceptors shall be measured, either through redox products or through hydrogen concentration or other appropriate methodology. Such measurements will be at a frequency sufficient to determine what is being reduced at the Site and how that affects the mobility of arsenic. Contaminants and their metabolic products will be measured on a basis sufficient to determine the end-products of the natural bioremediation process. Field parameters will be measured during the other sampling events and compared to the terminal electron acceptors to determine the environment of the aquifer and how that affects the degradation of contaminants. Root zone soils shall be sampled periodically to determine the extent and mass of the root zone and to determine the ability of the phytoremediation remedy to assist and augment the bioremediation remedy.

The results of the above monitoring and sampling will be used to provide inputs into models to determine the progress of the natural bioremediation and phytoremediation remedy at the Site. Monitoring shall also be conducted to assess the protectiveness of the remedy and to meet the substantive requirements of New Hampshire's Groundwater Protection Rules, Env-Ws 410. The EPA and State will review all sampling data. The results of sampling and other work will be presented to the public on a periodic basis.

4. Five Year Reviews

The 1986 CERCLA amendments require review of conditions every five years at NPL sites if any hazardous substances, pollutants or contaminants remain to assure that the remedial action continues to protect human health and the environment. All data obtained in the monitoring program will be further evaluated and discussed in the five-year reviews. These reviews will consider all relevant data, any significant trends, and determine if additional remedial actions, adjustment to the monitoring plan, or other actions, are necessary.

IX. STATUTORY DETERMINATIONS

The remedial action selected for implementation at the Tibbetts Road Superfund Site is consistent with CERCLA and, to the extent practicable, the NCP. The selected remedy is protective of human health and the environment, attains ARARs and is cost effective. The selected remedy also satisfies the statutory preference for treatment which permanently and significantly reduces the mobility, toxicity or volume of hazardous substances as a principal element. Additionally, the selected remedy utilizes alternate treatment technologies or resource recovery technologies to the maximum extent practicable.

A. The Selected Remedy is Protective of Human Health and the Environment

The natural bioremediation and phytoremediation remedy at this Site will continue to permanently reduce the risks posed to human health and the environment by eliminating, reducing or controlling exposures to human and environmental receptors through the implementation of the remedy and the use of engineering controls and institutional controls already in place

The *protection of human health and the environment* is the first and most important criterion. This criterion is met because there is no exposure to contaminants from the Site. Exposure to contaminated ground water is prevented by five items:

➢ The provision of an alternate public drinking water supply to affected residences in 1987. The water supply has been operated since then by the Swain's Lake Village Water District.

➢ A prohibition established by the Water District for the Ground Water Management Zone on the use of ground water for drinking water purposes. The prohibition was enacted in compliance with the requirements of State's Groundwater Protection Rules.

➢ Hydraulic containment by the vacuum extraction system stopped contaminants from migrating from the Site and greatly reduced the contaminant mass remaining in the soil.

➢ Phytoremediation will effectively stop contaminants from migrating by lowering the water table and thereby lessening the rate of ground water flow.

➢ Natural bioremediation will continue to destroy contaminants in the ground water at the Site in an time frame estimated to be similar to that of active remediation.

Moreover, the selected remedy will achieve potential human health risk levels that attain the 10^{-4} to 10^{-6} incremental cancer risk range and a level protective of noncarcinogenic endpoints, and will comply with ARARs and to-be-considered criteria. At the time that the Interim Ground Water Cleanup Levels identified in the 1992 ROD, and carried over into this Amended ROD, and newly promulgated ARARs and modified ARARs which call into question the protectiveness of the remedy have been achieved and have not been exceeded for a period of three consecutive years, a risk assessment shall be performed on the residual ground water contamination to determine whether the remedial action is protective. This risk assessment of the residual ground water contamination shall follow EPA procedures and will assess the cumulative carcinogenic and non-carcinogenic risks posed by drinking ground water. If, after review of the risk assessment, the remedial action is not determined to be protective by EPA, the remedial action shall continue until protective levels are achieved and have not been exceeded for a period of three consecutive years, or until the remedy is otherwise deemed protective. These protective levels shall constitute the cleanup levels for this Amended ROD and shall be considered Performance Standards for any remedial action.

B. The Selected Remedy Attains ARARs

This remedy will attain all applicable or relevant and appropriate federal and state requirements that apply to the Site. All ARARs for the Site are listed in tabular form in Appendix C, Tables 1 through 3 of this document. Environmental laws from which ARARs for the selected remedial action are derived include:

- New Hampshire *Drinking Water Quality Standards*
- New Hampshire *Surface Water Quality Rules*
- New Hampshire *Groundwater Protection Rules*
- Federal Fish and Wildlife Coordination Act, 40 CFR 6.0302(g)
- Executive Order 11990 (Protection of Wetlands)

Because natural bioremediation and phytoremediation are of a more passive nature, with the exception of monitoring, the impacts of ARARs are few. New Hampshire's Hazardous Waste Rules (RCRA Authorized), Executive Order 11988 (Floodplain Management), and New Hampshire's Wetlands Program do not apply. The only air emission that may occur is the venting of air from a small vacuum extraction system if it is turned on for any hot spot mitigation. Such gases will be treated with activated carbon to remove all contaminants. The RCRA Land Ban requirements do not apply to the selected remedy as no excavation, placement, or disposal of Land Ban waste will occur as a result of the remedial action. The Federal Safe Drinking Water Act and the Clean Water Act are supplanted by the delegated State programs.

The following policies, criteria, and guidance will also be considered (TBCs) during the implementation of the remedial action:

- EPA Health Advisories
- EPA Guidance to Management of Investigation-derived Wastes
- EPA Policy for low-stress sampling

A brief narrative summary of the ARARs and TBCs follows.

CHEMICAL SPECIFIC

New Hampshire *Drinking Water Quality Standards* Maximum Contaminant Levels (MCLs). These are standards for metals, pesticides, VOCs, radionuclides, and other classes of contaminants. The state drinking water program is authorized and these regulations have been adopted as enforceable standards for public drinking water systems identical to the Safe Drinking Water Act (SDWA). MCLs for non-carcinogens are based in part on the allowable lifetime exposure to the contaminant for a seventy kilogram (154 pound) adult who is presumed to consume two liters of water per day. The basic jurisdictional prerequisite for MCLs and non-zero Maximum Contaminant Level Goals (MCLGs), where more stringent than MCLs, is that they apply to "public water systems," defined as systems for the provision of piped water for human consumption with at least fifteen service connections. Although not directly applicable to activities at the Site, the potential exists for residential drinking water use of ground water at the Site. Therefore, these standards are considered to be relevant and appropriate.

To attain this requirement, ground water at and beyond the Site will attain MCLs and non-zero MCLGs at the completion of the remedy. These levels will be attained by natural bioremediation and phytoremediation. In the overburden and bedrock aquifers MCLs and non-zero MCLGs are expected to be attained off-site in approximately fourteen years.

New Hampshire *Surface Water Quality Rules* Water Quality Criteria Water quality criteria relating to surface water are developed under the State's *Surface Water Quality Rules*. They are used by the State of New Hampshire, in conjunction with a designated use for a stream segment, to establish water quality standards. The appropriateness of the WQC guidelines are dependent on site-specific circumstances. These regulations apply to point and non-point sources and include sediments. Ground water discharges to surface water at Swains Lake and surrounding small streams, therefore AWQC are applicable.

To date, there has not been any evidence of Site-related impacts on the surface water and sediments. Monitoring will continue under the Amended ROD to ensure that contaminants do not affect surface water bodies and sediments.

New Hampshire *Groundwater Protection Rules* The substantive rules provide quantitative limits on contaminants in ground water and the use of that ground water, regardless of whether it is used as a drinking water source or not. Therefore, these standards are considered to be applicable.

Ground water within and beyond the Site will attain State standards at the completion of the remedy. These levels will be obtained by natural bioremediation and phytoremediation. The time to achieve these standards is expected to be fourteen years.

LOCATION SPECIFIC

There are few location-specific ARARs because there will be no action at the site other than sampling. Therefore the only ARARs are:

Federal Protection of Wetlands Executive Order 11990 - 40 CFR Part 6 Appendix A is an ARAR for any undertaking or new construction located in a wetland. Although the activities occurring at the Site (e.g., natural bioremediation and phytoremediation) will not occur in or have an impact on any nearby wetland there is the potential for discharges of ground water from the Site to enter into Swain Lake, a nearby surface water. In this case the potential for discharge of contaminated ground water to surface waters will require monitoring to ensure that there are no impacts to any nearby wetland. Compliance with the Executive Order will be ensured by ground water, surface water, and sediment monitoring.

Federal Fish and Wildlife Coordination Act - 40 CFR 6.0302(g) which is also an ARAR for any pollutants discharged to surface water from ground water. In this case the potential for discharge of contaminated ground water to surface waters will require monitoring to ensure that there are no impacts to fish or wildlife.

New Hampshire *Groundwater Protection Rules* - Env-Ws 410.26 (a - g) is an applicable ARAR which establishes a state ambient ground water quality standards (AGQSs) which shall not be exceeded and requires that all ground waters be suitable for use as drinking water without treatment. For Sites at which the AGQSs are exceeded there is the requirement to establish a Groundwater Management Zone (GMZ), provide an alternate water supply for impacted residences, and/or restrict further use of the groundwater. All property owners within the impacted area have been connected to an alternate water supply. The Swain's Lake Village Water District has also enacted a local ordinance further restricting the use of ground water in the GMZ. Ground water within and beyond the Site will attain State standards at the completion of the remedy and migration of contaminants will not be allowed to occur.

ACTION SPECIFIC

There are also few action-specific ARARs because of the passive nature of the remedy selected in the Amended ROD. Therefore the only ARARs are:

Federal Guidance to *Management of Investigation-Derived Wastes* provides guidelines in the handling of contaminated media and equipment. Because this is a guideline, it is to-be-considered.

September 23, 1996 Memorandum from Linda Murphy, Director, Office of Site Remediation and Restoration *New Procedure for collecting Ground water samples for the determination of organic and Inorganic contamination* establishes the low-stress method of sampling as the only method to collect valid samples. All ground water samples, with noted exceptions, will be collected using this technique. Because this is a guideline, it is to-be-considered.

C. The Selected Remedial Action is Cost-Effective

In the Agency's judgment, the selected remedy is cost effective, i.e., the remedy affords overall effectiveness proportional to its costs. In selecting this remedy, once EPA identified remedies that are protective of human health and the environment and that attains ARARs, EPA evaluated the overall effectiveness of each remedy by assessing the relevant three criteria in combination:

- long term effectiveness and permanence;

- reduction in toxicity, mobility, and volume through treatment; and
- short term effectiveness,

The relationship of the overall effectiveness of this remedy change was determined to be proportional to its costs. The costs of this remedy change is approximately $140,000 less than the 1992 ROD remedy over a twenty-year period. Although the remedy performed at the Site, vacuum extraction, is cost effective as well, it was determined that it would not clean up ground water any faster than the remedy selected in this Amended ROD.

D. The Selected Remedy Utilizes Permanent Solutions and Alternative Treatment or Resource Recovery Technologies to the Maximum Extent Practicable

Once the Agency determined the remedy change will attain ARARs and will be protective of human health and the environment, EPA examined the remedy change to determine if it utilizes permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. This determination was made by deciding whether the 1992 ROD remedy or the Amended ROD remedy provides the better balance of trade-offs in terms of:

1) long-term effectiveness and permanence;
2) reduction of toxicity, mobility or volume through treatment;
3) short-term effectiveness;
4) Implementability; and
5) cost.

The balancing test emphasized:
long-term effectiveness and permanence; and
the reduction of toxicity, mobility and volume through treatment.

The balancing test considered as principal elements:
the preference for treatment;
the bias against off-site land disposal of untreated waste; and community and state acceptance.

The selected remedy for this Amended ROD provides the better balance of trade-offs as compared to the 1992 ROD.

Although a preference for treatment exists, the EPA and State believe that no treatment system will achieve cleanup levels in the ground water any faster than natural bioremediation and phytoremediation can. The cleanup time at the Site is dependent upon and limited by desorption processes that will not be influenced greatly by the application of engineered recovery systems such as vacuum extraction. The EPA and the State also believe that any active treatment system may also generate hazardous residues that will require management and off-site disposal. Therefore the only remaining criteria to evaluate was cost. The Amended ROD remedy will cost slightly less and better address neighborhood concerns. The neighboring community believes that natural bioremediation will provide a better remedy than pump and treat because it will preclude intensified traffic and the generation and storage of potentially hazardous materials. The local residents also maintain that they wish the Site to fit into the neighborhood rather than contrast, as it has for the past fourteen years.

E. The Selected Remedy Satisfies the Preference for Treatment Which Permanently and Significantly reduces the Toxicity, Mobility or Volume of the Hazardous Substances as a Principal Element

Continuation of the vacuum extraction system may arrest migration; however, it is believed that phytoremediation may be equally as successful in controlling the migration of contaminants from the Site. It is even possible based on the estimated volume of water that the plants will take up that phytoremediation will exceed the performance of vacuum extraction system. The volume of hazardous substances would be reduced under both the 1992 ROD remedy and the Amended ROD remedy. However, both remedies are limited by the desorption of contaminants from the soil and will therefore both achieve cleanup levels in approximately the same time, fourteen years. The 1992 ROD remedy relies on collecting contaminants from the subsurface so that they may be taken off-site and destroyed. The natural bioremediation and phytoremediation remedy will permanently destroy contaminants in-situ by transforming them to nonhazardous products.

X. DOCUMENTATION OF NO SIGNIFICANT CHANGES

EPA presented a proposed plan with a preferred remedy change for the Site on June 24, 1998. The change included:

Rely on natural biodegradation of contaminants, assisted by phytoremediation, rather than vacuum extraction and pumping and treating, to restore ground water quality in the overburden aquifer and halt migration of contaminated ground water.

Rely on natural biodegradation, assisted by the reduction of contaminants flowing from the overburden aquifer, to restore ground water quality in the weathered bedrock aquifer and not perform an active, engineered remedy to restore ground water quality.

Ensure the functioning of the biodegradation and phytoremediation remedies through a modified program of sampling of ground water and surface water.

This amended Record of Decision contains all of those components and remains substantially unchanged from the presentation given in the Proposed Plan.

XI. STATE ROLE

The New Hampshire Department of Environmental Services has reviewed the remedy change and has indicated its support. The State has also reviewed the technical data generated to determine if the selected remedy is in compliance with applicable or relevant and appropriate State Environmental laws and regulations. The State of New Hampshire concurs with the selected remedy for the Tibbetts Road Site. A copy of the declaration of concurrence is attached as Appendix B .

APPENDIX A

FIGURES AND TABLES

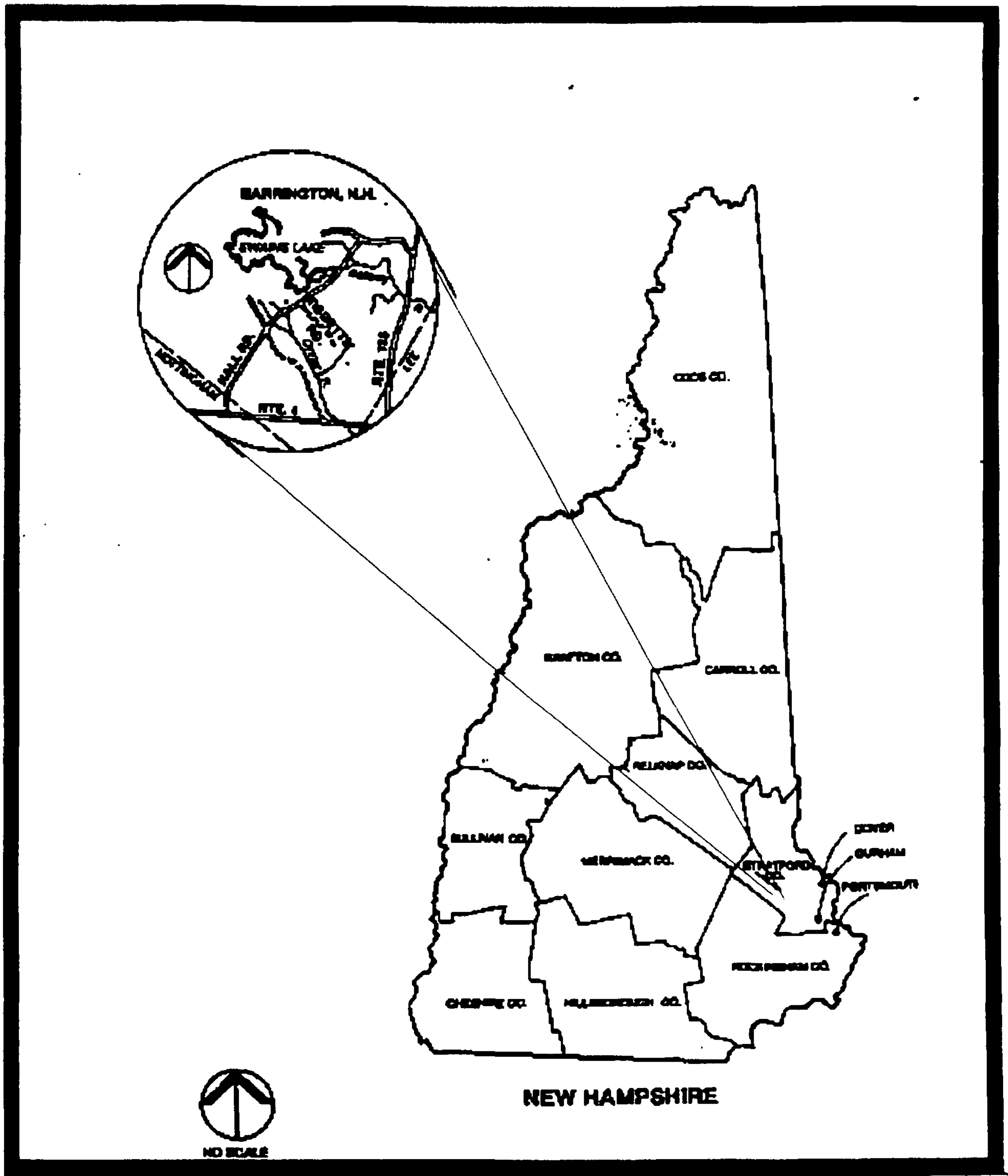


Figure 1. Location of the Site in Barrington, New Hampshire. The Site lies on Tibbetts Road which is off Hall Road, north and west of the Lee Circle (the intersection of New Hampshire Routes 4 and 125).

Figure 2. General details of the Site. The aerial photo is of the Site in 1985. The center of the photo is the house where the former Site owner lived. The source areas, where drums were stored and their contents used, are circled in yellow. A fence is seen as a faint outline around the Site. Houses surround the Site, and the trailer-like figure to the right of the house is an incinerator EPA brought on the Site to destroy dioxins in soil. Figure 5 shows the geology, each of the aquifers, ground water flow and rough contaminant locations. Below the aerial photo is a diagram of the Site and the Ground Water Management Zone. A water supply service provides drinking water to all the residents in the photo and an additional 70 residences that lie within the area of influence and may be contaminated if ground water were pumped from the bedrock aquifer. A municipal ordinance prevents the use of ground water within its service area. That area is shown in the 1994 Consent Decree between the EPA, State of New Hampshire, Ford, and the Swains Lake Village Water District.

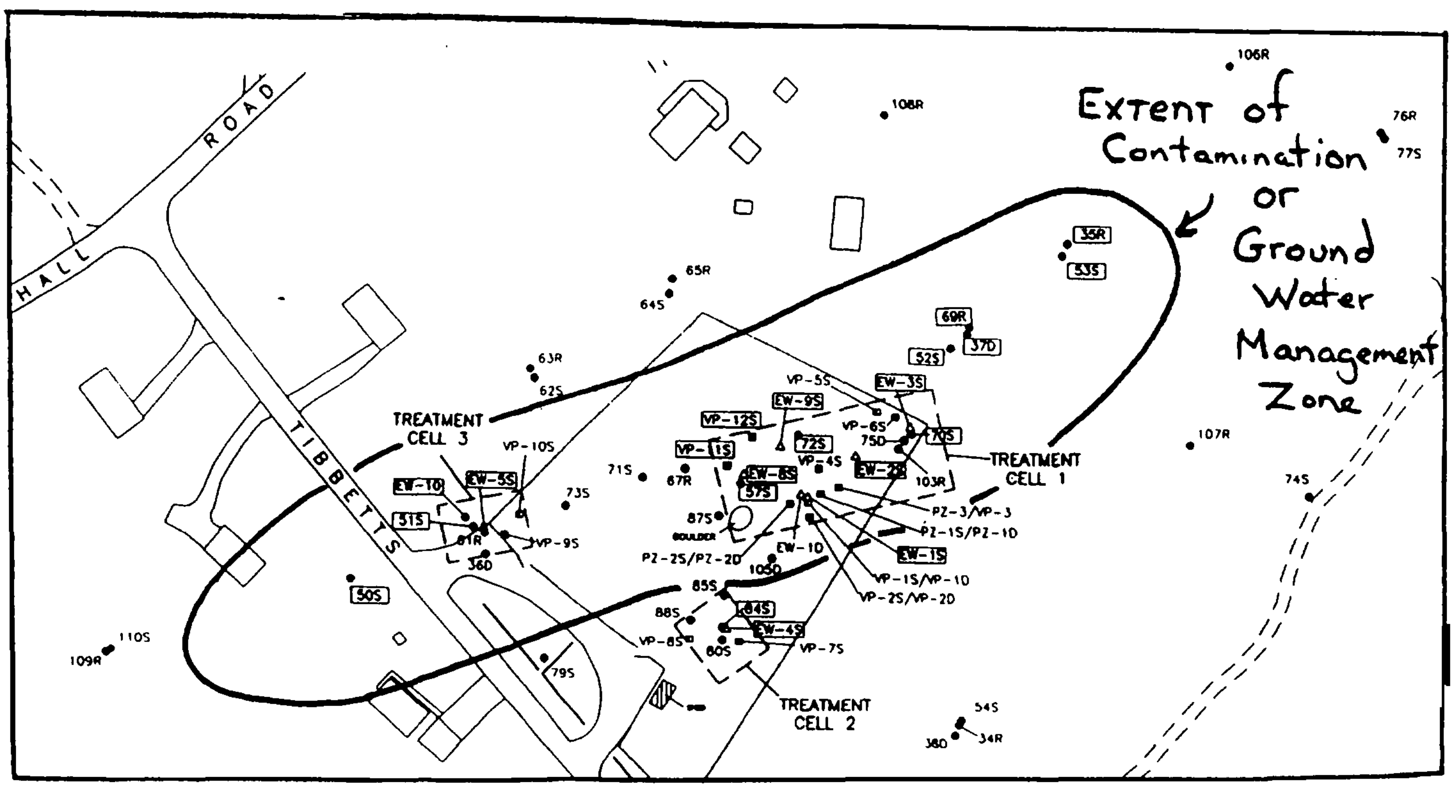


Figure 3a. **The pre-remedial stage.** The photo shows one of the three drum storage areas behind the Site owner's house during Site discovery. The three areas in which 337 drums were stored prior to EPA removing them are outlined in yellow in Figure 2.

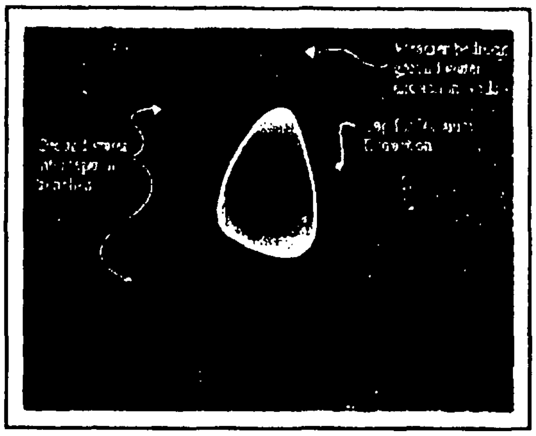


Figure 3b. **The remedy as outlined in the 1992 ROD.** The house is to be removed, the Site is capped to minimize infiltration (dark blue), vacuum extraction wells operate to recover contaminants in the subsurface (light blue), contaminated ground water migrating from the Site is intercepted and collected with either wells or two trenches (red lines). Contaminants in the weathered bedrock are pumped from the aquifer (red dots) and treated.

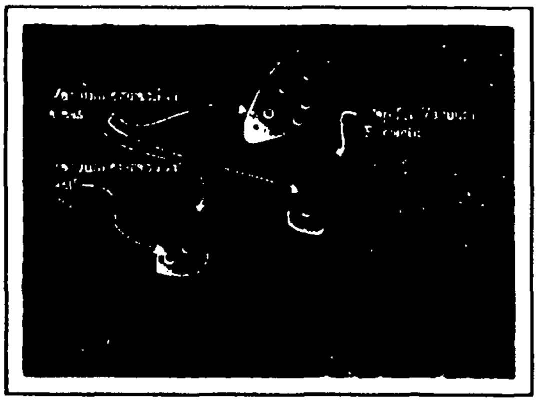


Figure 3c. **The remedy performed by G&M from 1995 to 1997.** The house is gone, the Site is paved, vacuum extraction is used more widely over the Site to maximize recovery. The requirement for intercepting contaminants migrating in the aquifer is met by positioning the vacuum extraction wells in an appropriate manner and paving the entire site. A small amount of pumping in the weathered bedrock did occur in 1997.

A photo of the Site taken in May 1996, during the 1992 ROD remedial Action. The view is from the Tibbetts Road end of the Site looking roughly northward at the vacuum extraction pump and treatment area.

Figure 4

A cross-section through the Site prior to vacuum extraction (1948 - 1995)

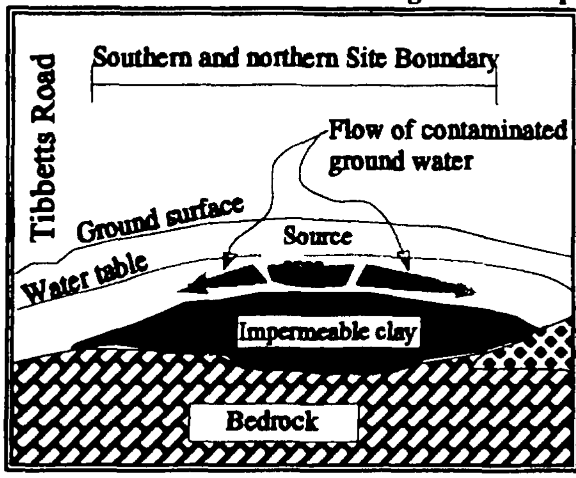


Figure 4a. This shows a north-south cross-section of the Site (looking westward), before remediation began in 1995. Although contaminated soil was removed, significant ground water contamination existed in the water table and served as a source of more wide-spread ground water contamination. In 1992 EPA found that naturally occurring microbes were active in the ground water; however, because there was too much contamination and ground water flow was too fast, the microbes were unable to degrade all of the compounds and contaminated ground water continued to flow off-site.

A cross-section through the Site during vacuum extraction (1995 - 1997)

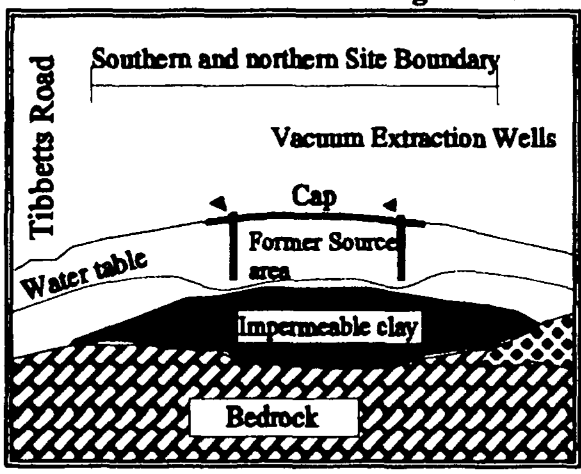


Figure 4b. This shows the same cross-section (again looking westward); however, this is after remediation began in 1995. Up to ten vacuum extraction wells operated, removing both ground water and air, to reverse the flow of contaminated ground water so that it flowed back to, rather than away from, the Site. Vacuum extraction removed the majority of the contaminants in the source area.

Cross-section during proposed Phytoremediation and Natural Attenuation (1998 and on)

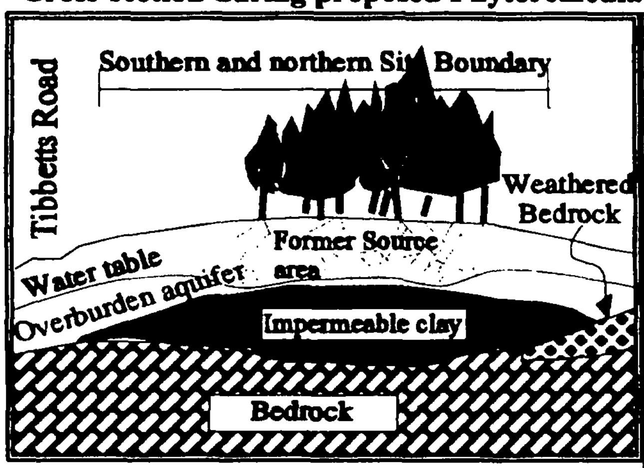


Figure 4c. The cap and vacuum extraction system are gone and the poplar trees are planted. The fence remains to protect the trees from deer damage. Although small at first, the poplars will grow very quickly. In the second year of growth the trees are expected to begin depressing the water table, ultimately acting in the same fashion as the cap and vacuum extraction system. During this phase and until the Site is taken off the Superfund list, ground water will be monitored to determine the success of phytoremediation and natural attenuation.

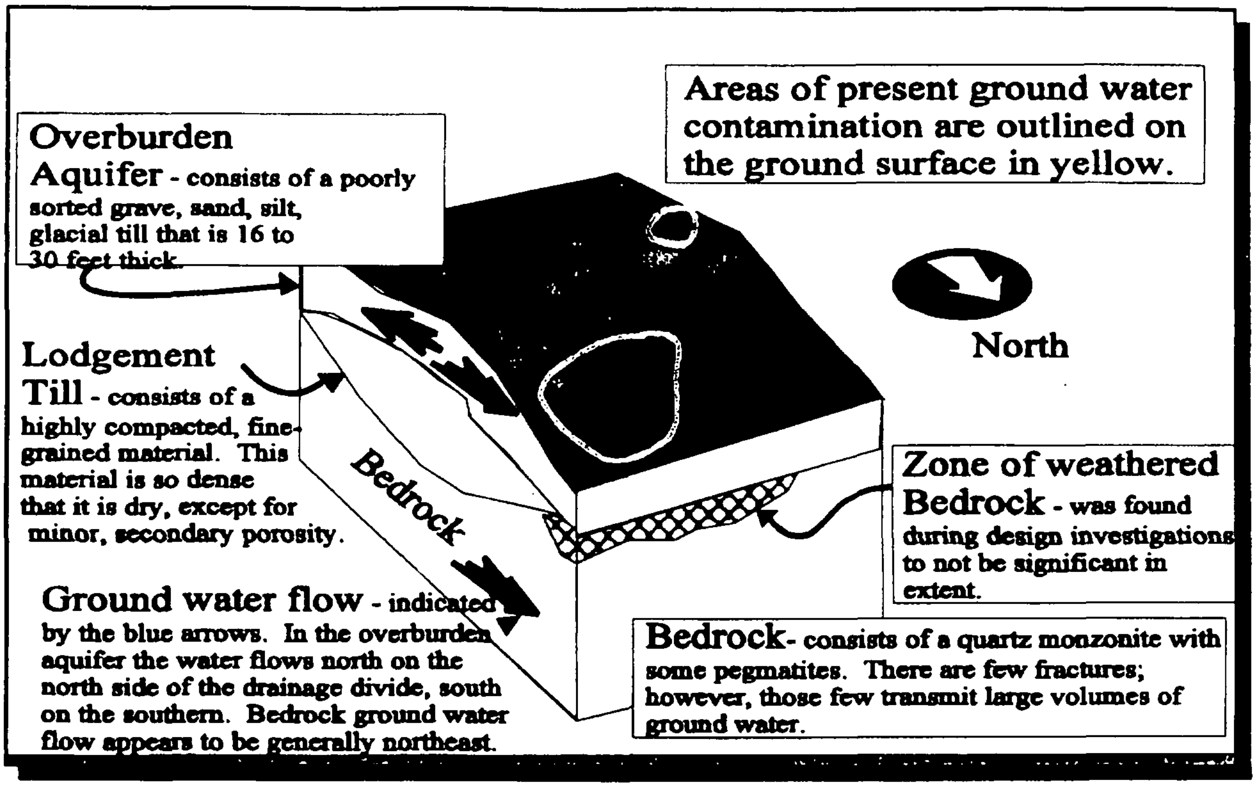
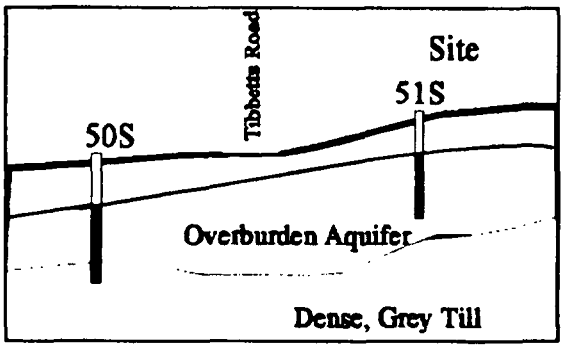


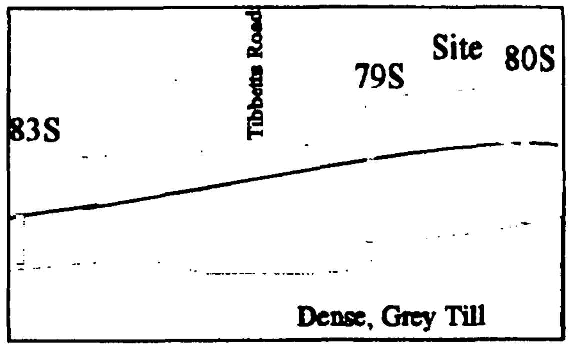
Figure 5. Geology and Hydrogeology at the Site. The house at the Site is visible. Tibbetts Road lies just to the south of the house. The two remaining areas of contamination are outlined in yellow. The ground water and contaminant flow in the smaller, southernmost area of contamination is to the south and well 50S. The flow in the larger, northernmost area of remaining contamination is to the north in the overburden aquifer. Flow is also into the bedrock. The flow of ground water in the bedrock is generally to the north; however, is very susceptible to pumping. Contaminated ground water will migrate to the area of any pumping along fractures which are very transmissive.

Figure 6. Three sets of wells depict the flow of ground water and contamination at the Site. Each of these sets of wells will be discussed separately in the context of what contaminants are present and the characteristics of the flowpath.

Flowpath 51S to 50S



Flowpath 80S to 79S



Flowpath 57S to 69R

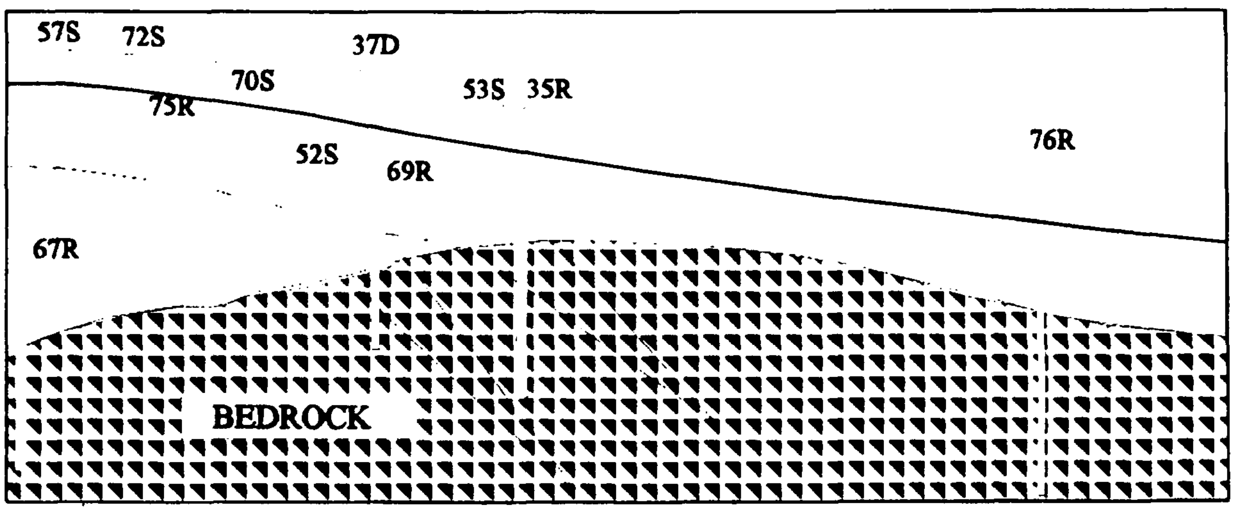


Table 1 - Contaminant Concentrations along flow path 51S to 50S (Flow is from 51S to 50S)			
Well	Concentration (in parts per billion) of Benzene / Toluene Ethyl benzene / Xylene Arsenic / Manganese		Cleanup Level
	1997	1998	
51S	<2500 / 12000 1600 / 10000 110 / 5000	<100 / 1200 780 / 4700 210 / 6600	5 / 1000 700 / 10000 50 / 3650
50S	44 / 34 620 / 1200 not analyzed	<25 / 590 310 / 590 370 / 7100	

Table 2 - Contaminant Concentrations along flow path 57S to 69R to 35R
(Flow is postulated to be from 57S to 72S to 70S to 52S to 37D to 53S and 69R, lastly 35R)

Well	Concentration (in parts per billion) of Trichloroethylene / Toluene Benzene / Ethyl benzene 4-methyl-2-pentanone Arsenic / Manganese		Cleanup Level
	1995	1998	
57S	7200 / 250 100 / 760 no data 113 / 14000	6500 / 28000 <1000 / 2400 <1000 170 / 19000	5 / 1000 5 / 700 1825 50 / 3650
69R	<1000 / 7300 2700 / <4000 51000 135 / 5300	<1000 / 12000 3600 / <700 26000 120 / 4600	
35R	25 / not detected 290 / not detected 790 31 / no data	<50 / not detected 130 / not detected 1000 30 / 870	

TABLE 3
CLEANUP LEVELS FOR THE TIBBETTS ROAD SUPERFUND SITE
NON-CARCINOGENIC COMPOUNDS

Non-carcinogenic Contaminants of Concern (class)	Interim Cleanup Level (µg/l)	Basis	Target Endpoint of Toxicity	Hazard Quotient
1,2 Dichloroethene - (cis) (D) - (trans) (D)	70 100	MCLG	Blood	0.19 0.14
Ethylbenzene (D)	700	MCL	Kidney & Liver	0.19
4-Methyl-2-Pentanone (D)	1825	Risk	Kidney & Liver	1
Styrene (C)	100	MCL	Blood & Liver	0.014
Toluene (D)	1000	MCLG	Kidney & Liver	0.14
1,1,1 Trichloroethane (D)	200	MCLG	Liver	0.06
Xylene (D)	10000	MCLG	CNS-DBW	0.14
Naphthalene (D)	1460	Risk	DBW	1
Chromium (D)	100	MCLG	No effect	0.55
Manganese (D)	3650	Risk	CNS	1
Nickel (D)	100	MCLG	DBW	0.14
Vanadium (D)	256	Risk	No effect	1

HAZARD QUOTIENT SUMS

TOXIC ENDPOINT	TOTAL
Blood	0.344
Kidney	1.33
Liver	1.404
Decreased Body Weight (DBW)	1.28
Central Nervous System (CNS)	1.14

TABLE 3, continued
CLEANUP LEVELS FOR THE TIBBETTS ROAD SITE
CARCINOGENIC COMPOUNDS

Carcinogenic Contaminants of Concern (class)	Interim Cleanup Level (µg/l)	Basis	Level of Risk
Benzene (A)	5	MCL	1.7×10^{-6}
Tetrachloroethylene (B_2)	5	MCL	3.1×10^{-6}
Trichloroethylene (B_2)	5	MCL	6.4×10^{-7}
Styrene (C)	100	MCL	3.5×10^{-5}
Bis(2-ethylhexyl)phthalate (B_2)	4	MCL	6.6×10^{-7}
Arsenic (A)	50	MCL	8.8×10^{-4}
	Sum:		**9.2×10^{-4}**

[1]

[2]

[1] Standard exposure parameters from OSWER Directive 9285.6-03 for residential ingestion of potable water (i.e., adult of seventy kilogram body weight drinks two liters of water per day for 350 days for a thirty year duration) are the basis for calculation of risk-based cleanup level, hazard quotient, and level of risk.

[2] Toxicity values (i.e., RfD or CPF) used for calculation of risk-based cleanup level, hazard quotient, and level of risk are from either the on-line IRIS or FY 1997 HEAST.

APPENDIX B

STATE OF NEW HAMPSHIRE
LETTER OF CONCURRENCE

State of New Hampshire
DEPARTMENT OF ENVIRONMENTAL SERVICES
6 Hazen Drive, P.O. Box 95, Concord, NH 03302-0095
(603) 271-2900 FAX (603) 271-2456

September 23, 1998

Patricia L. Meaney, Director
Office of Site Remediation and Restoration
US EPA - Region I
John F. Kennedy Federal Building (HBO)
1 Congress Street
Boston MA 02203-2211

SUBJECT: BARRINGTON, NEW HAMPSHIRE - Tibbetts Road Superfund Site, Amended Record of Decision Declaration of Concurrence

Dear Ms. Meaney:

The New Hampshire Department of Environmental Services (Department) has reviewed and concurs with the "Amended Record of Decision" (Amended ROD) for the Tibbetts Road Superfund Site in Barrington, New Hampshire. The Amended ROD addresses the remedial action necessary to address potential threats to human health, welfare and the environment at Tibbetts Road which resulted from releases of hazardous substances. The Amended ROD documents the changes in the cleanup plan and in the 1992 ROD to protect human health and the environment.

The primary difference between the 1992 ROD versus the remedy performed and the remedy outlined in the Amended ROD is that the 1992 ROD specified that contaminated groundwater in the weathered bedrock aquifer would be extracted and treated. During the performance of the remedy from 1995 to 1997, and as outlined in the Amended ROD, the weathered bedrock will instead be monitored. The 1992 ROD specified that the method of attaining final cleanup levels would be from vacuum extraction and flushing of the aquifer. The Amended ROD directs that cleanup levels will be attained through natural phytoremediation and bioremediation.

EPA prepared the Tibbetts Road Amended ROD in accordance with the provisions of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) as amended by the Superfund Amendment and Reauthorization Act of 1986 (SARA). The Department has participated in the oversight of EPA's Remedial Investigation, Risk Assessment, Feasibility Study and in the implementation of the remedial actions performed in the 1992 ROD. The Department has reviewed the proposed changes in the Amended ROD and has indicated its support to finish the groundwater cleanup using natural processes. The elements of the proposal are:

- Discontinue recovery of contaminants from the weathered bedrock
- Establish a tree and vegetative cover on the site
- Continue monitoring groundwater quality to determine if contamination continues to decrease

Vacuum extraction in the overburden aquifer greatly reduced the amount of contamination flowing into the bedrock. The weathered bedrock below the site is an area of intensely fractured bedrock where contaminants have collected over time. The bedrock yields little groundwater. In addition, EPA determined that even minimal pumping of the weathered bedrock would increase flow from the overburden aquifer and cause additional contaminants to flow into the weathered bedrock zone. Phytoremediation will be employed to cost-effectively remove the remaining contaminants in the overburden aquifer. EPA and the Department anticipate that concentrations in the weathered bedrock will decline through natural attenuation processes.

Phytoremediation is a newly recognized technology that uses vegetation to remove or concentrate contaminants from the soil and groundwater. The installation of the Phytoremediation system at the Tibbetts Road Site began in the spring of 1998. The Phytoremediation system uses a hybrid poplar tree in a planting area approximately 1.1 acres of a 2-acre site. The system also incorporates understory crops which consist of clover and perennial rye grass. The understory offers quick erosion control and water uptake.

The trees are primarily used to lower the water table, minimizing the groundwater flow away from the site. The active pumping during the vacuum extraction, removed at most 5 gallons per minute or 7,200 gallons per day from the aquifer. A mature poplar tree has been shown to transpire, or use, 25 to 50 gallons per day. Considering that more than 1,500 trees are planted at the site, it is possible that they may pump a minimum of 37,000 gallons of groundwater from the subsurface per day. A secondary purpose is to actively treat the organic contaminants in the groundwater. As the trees (root system) lower the water table and contain the off-site flow of contaminants, the native microbes have greater time to destroy contaminants.

An irrigation system was installed at the site to ensure a reliable source of water throughout all weather conditions and facilitate optimum tree health during the first three growing seasons. Removal of the irrigation system is anticipated after the first three-year establishment period. An on-site bedrock well is being used for irrigation.

The Phytoremediation system is being maintained and monitored by the Potentially Responsible Party (PRP). They will perform periodic visits to the site to monitor and review tree growth. As these hybrid poplar trees reach the end of their life expectancy of 30 or more years, natural colonization of slower growing and longer-lived trees will occur which is the beneficial end use sought by the PRP, the regulatory agencies and the neighborhood.

New Hampshire's Groundwater Protection Rules

The Department has been actively involved in the oversight of EPA's environmental response activities at the Tibbetts Road site and has worked with EPA to ensure that all actions that are taken comply with state regulations and policies. EPA has designated the State's groundwater quality criteria and ambient groundwater quality standard's Env-Ws 410.03 and 410.05 as applicable to the groundwater response action. These provisions establish numeric criteria for groundwater restoration. EPA also designated the Groundwater Management Zone (GMZ) provisions (Env-Ws 410.26) as an applicable ARAR. Under Env-Ws 410, a GMZ is established to manage the use of contaminated groundwater until the groundwater quality standards are met. The relevant requirements of Env-Ws 410 applicable to the Tibbetts Road remedy are as follows:

- GMZ Establishment: The Amended ROD includes Env-Ws 410.26 as an ARAR; this provides for the establishment of a GMZ and containment of groundwater contamination within the GMZ.

- Eventual Achievement of Groundwater Quality Standards: The Amended ROD includes Env-Ws 410's numerical groundwater quality standards as an ARAR and the NCP requires that these standards be met within a reasonable time frame (March 8, 1990 Federal Register, P. 8732). The requirement that groundwater quality will be restored within the reasonable time frame of the NCP is functionally equivalent to Env-Ws 410's expectation that groundwater quality will eventually be restored.

- Groundwater Restoration: The remedial action must restore groundwater quality to meet the groundwater quality criteria contained in Env-Ws 410.03. A high priority is given to source control, high value groundwater or groundwater that will be used as a water supply.

- Institutional Controls: The Description of Changes to the 1992 ROD section in the Amended ROD requires establishment of institutional controls to restrict the use of groundwater for consumptive purposes within the GMZ. The 1994 Consent Decree mandated that an ordinance be enacted to prevent the use of groundwater within the impacted area surrounding the Tibbetts Road site. The Swain's Lake Village Water District enacted the ordinance and complied with the statutory requirements under the State's Groundwater Management Zone regulations Env-Ws 410.

- Long-Term Monitoring of the GMZ and Remedy Performance: The description of the Environmental Monitoring Program in the Amended ROD provides for monitoring of the performance and effectiveness of the remedial actions as well as the groundwater quality at the GMZ boundary.

The remedy as discussed in the text of the Amended ROD is consistent with the State's "Draft Guidelines for Selection of Natural Attenuation for Groundwater Restoration under Env-Ws 410" in that it meets the guidance for implementation of natural attenuation at contaminated sites and for monitoring of the natural attenuation process. The Amended ROD, consistent with the guidance, includes a contingency remedial method that could be implemented if it fails to achieve remedial goals and cleanup levels. In the event that these cleanup levels cannot be achieved through the use of bioremediation and Phytoremediation, or the time frame to achieve these cleanup levels is significantly greater than estimated in the Amended ROD, EPA and the Department may direct that active remedies again be implemented. The active remedy may include pumping contaminated groundwater from the weathered bedrock or localized vacuum extraction to reduce groundwater contaminants to acceptable levels. Under such circumstances, the ARARs as described in the 1992 ROD would apply.

After the remedy is implemented, the long-term monitoring plan will ensure future consistency with Env-Ws 410's substantive requirements and other key ARARs. A comprehensive, detailed review of all environmental monitoring data will be conducted on a periodic basis by EPA and the Department in order to ensure that the remedial action provides adequate protection of human health and the environment and complies with applicable regulations.

The Department reviewed all information in the Tibbetts Road Administrative Record, evaluated the cumulative risks associated with current and future potential exposures to the contaminants whose presence is associated with a CERCLA release and determined the actions set forth in the Amended ROD are consistent with State applicable or relevant and appropriate requirements. Acting as agent for the State of New Hampshire, the Department concurs with the remedial decision selected under CERCLA for Tibbetts Road.

In striving to achieve the maximum benefit with limited public (and private) resources, the Department continues to seek reasonable and practical solutions to the often costly and complex environmental challenges associated with contaminated site cleanups. Through the partnership and dedication exhibited by all parties, the rapid implementation of the actions necessary to protect human health and the environment will serve to expedite the achievement of our mutual environmental goals and facilitate efforts to restore the local economy in order to protect the welfare of those in communities surrounding the Tibbetts Road site. As always, the Department stands ready to provide the guidance and assistance EPA may require in order to take the actions necessary to protect human health and the environment in a complete and cost-effective manner.

Sincerely,

Philip J. O'Brien, Ph.D.
Director

A:\TIBBETS2.WPD

cc: Carl W. Baxter, P.E., DES-WMD
Richard H. Pease, P.E., DES-WMD
John Regan, DES-WMD
Michael Walls, Esq., NHDOJ
Richard Boynton, P.E., EPA-New England
Neil Handler, EPA-New England

APPENDIX C

APPLICABLE AND RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs) ANALYSIS

ARARs DETERMINATION

The purpose of this section is to identify the ARARs which may apply to the remedy described in the Amended ROD and where appropriate, briefly describe how the remedy will achieve these ARARs. The remedy as discussed further in the text of the Amended ROD consists of the use of natural bioremediation and phytoremediation to achieve the clean-up levels identified in the 1992 ROD. In the event that these clean-up levels can not be achieved through the use of bioremediation and phytoremediation, or the time frame to achieve these clean-up levels is significantly greater than estimated in the Amended ROD, or additional hot spots are discovered at the Site, then EPA may require that vacuum extraction as described in the 1992 ROD be further implemented. Under such circumstances the ARARs as described in the 1992 ROD would apply.

AMENDED ROD REMEDY
TABLE 1 - NATURAL BIOREMEDIATION AND PHYTOREMEDIATION
CHEMICAL-SPECIFIC ARARs

AUTHORITY	REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENTS	STATUS
Federal	SDWA-Maximum Contaminant Levels (MCLs) and Maximum Contaminant Level Goals (MCLGs) (40 CFR 141.11-141.16)	MCLs and MCLGs have been promulgated for a number of common organic and inorganic contaminants to regulate the concentration of contaminants in public drinking water supply systems.	MCLs and non-zero MCLGs were used in determining the clean-up levels for contaminants found in the aquifer beneath the Site as it is a potential drinking water source. A number of compounds still exceed these standards but it is anticipated that the remedy will attain them in approximately fourteen years.	Relevant and Appropriate
State	State of New Hampshire Safe Drinking Water Act, Env-Ws 316 and 317 of the Water Quality Standards.	Establishes MCLs and MCLGs to regulate the concentration of contaminants allowed in public water supplies in the State of New Hampshire . These regulations are generally equivalent to SDWA MCLs and MCLGs.	New Hampshire MCLs and non-zero MCLGs were used in determining acceptable clean-up levels for contaminants found in the aquifer beneath the Site where they were more stringent than federal MCLs and non-zero MCLGs The remedy is projected to attain these standards in approximately fourteen years.	Relevant and Appropriate
State	State of New Hampshire Safe Drinking Water Act - Env-Ws 319.01 of the Water Quality Standards	These are secondary standards established for public water supplies which are based on aesthetic criteria.	A number of compounds still exceed their respective SMCLs in the aquifer beneath the Site but it is anticipated that the remedy will return these compounds to compliance within approximately fourteen years.	To-Be-Considered
State	State of New Hampshire Groundwater Protection Rules, Env-Ws 410.03 (a),(b) and Env-Ws 410.05	These regulations establish state ambient ground water quality standards. Section 410.03 requires that all ground waters shall be suitable for use as drinking water without treatment and shall not contain any contaminant that exceeds the standards set forth in Ws 410.05.	Ground water beneath the Site continues to exceed the groundwater quality standards for arsenic, vinyl chloride, trichloroethylene, tetrachloroethylene, and benzene . The remedy is projected to attain these standards in approximately fourteen years.	Applicable

AMENDED ROD REMEDY
TABLE 1 - NATURAL BIOREMEDIATION AND PHYTOREMEDIATION CHEMICAL-SPECIFIC ARARs

AUTHORITY	REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENTS	STATUS
State	State of New Hampshire Groundwater Protection Rules, Env-Ws 410.03 (c)	Ground water shall not contain any contaminants that will cause an exceedence of the surface water quality standards.	Although no surface water standards are currently being violated, continued surface water monitoring will occur as part of the remedy.	Applicable
State	State of New Hampshire Surface Water Quality Standards, Env-Ws 430-437	Establishes water quality criteria for toxic substances and rules for determining acceptable point- and non point- source discharges to the State's surface waters.	Although no surface water standards are currently being violated, continued surface monitoring will occur as part of the remedy.	Applicable

AMENDED ROD REMEDY
TABLE 2 - NATURAL BIOREMEDIATION AND PHYTOREMEDIATION
LOCATION SPECIFIC ARARs

AUTHORITY	REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENTS	STATUS
Federal	Federal Fish and Wildlife Coordination Act - 16 USC 661 - 666, 40 CFR 6.0302(g)	Requires the protection of fish or wildlife resources related to actions that control or modify water bodies.	Although it does not appear that groundwater beneath the Site is impacting any nearby surface water bodies, monitoring of water quality will continue as part of the remedy.	Relevant and Appropriate
State	State of New Hampshire Groundwater Protection Rules, Env-Ws 410.26 (a - g) and RSA 485-C:6 - a	Requires the establishment of a Groundwater Management Zone (GMZ) at sites with contaminated groundwater exceeding ambient ground water quality standards (AGQSs). It also requires that an alternative water supply service be provided to the affected area and certain restrictions be placed on the use of ground water.	Ground water usage within the GMZ has been restricted by the provision of an alternative drinking water supply to residences within the impacted area and the passage of an ordinance by the Swain's Lake Village Water District.	Applicable
Federal	Protection of Wetlands Executive Order 11990 (40 CFR 6, Appendix A)	Requires Federal Agencies to avoid impacts associated with the destruction or loss of wetlands and to avoid support of new construction in wetlands if a practical alternative exists.	Although there is no evidence of any Site-related impact to nearby wetland areas, monitoring of the surface water will continue as part of the remedy.	Relevant and Appropriate

AMENDED ROD REMEDY
TABLE 3 - NATURAL BIOREMEDIATION AND PHYTOREMEDIATION ACTION SPECIFIC ARARs

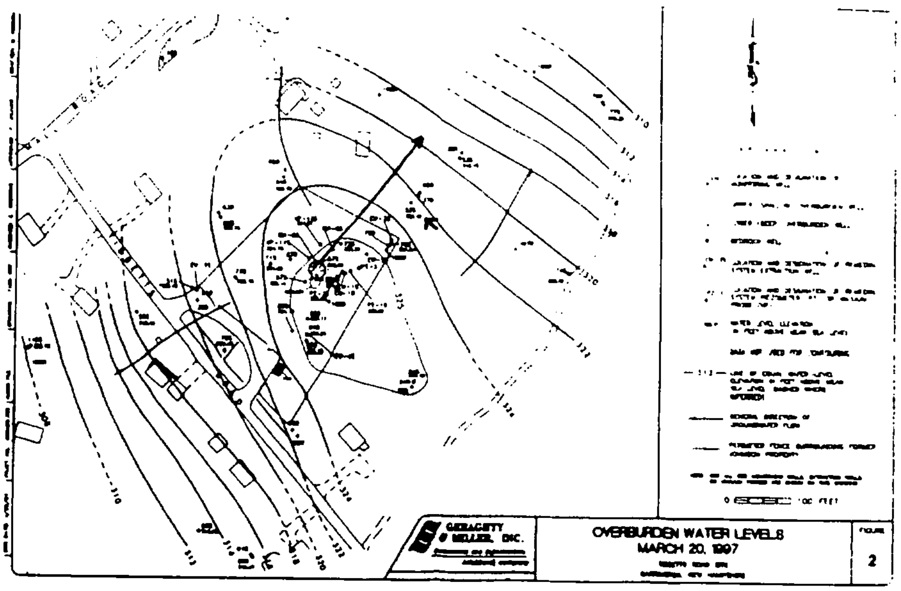
AUTHORITY	REQUIREMENT	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENTS	STATUS
State	State of New Hampshire Groundwater Protection Rules, Env-Ws 410.30 (a - i)	Defines where ground water and surface water will be sampled and for what parameters.	Monitoring of the ground water and surface water will comply with the substantive requirements of these regulations .	Applicable
Federal Guidance	September 23, 1996 Memorandum from Linda Murphy, Director, Office of Site Remediation and Restoration, New Procedure for Collecting Ground Water Samples for the Determination of Organic and Inorganic Contamination	Establishes a standard ground water sampling methodology using the low stress method.	Ground water sampling will be performed using the low-stress methodology.	To-be-considered
State	State of New Hampshire Groundwater Protection Rules, Env-Ws 410.31 (a), (b)	Defines how ground water wells will be installed and who may install them.	Additional ground water wells, if required, will be installed in compliance with the substantive portions of these regulations.	Applicable
Federal Guidance	Federal Guidance to Management of Investigation-derived Wastes	Establishes guidelines for the handling of contaminated media (sediment, ground water) and contaminated equipment.	All monitoring activities will dispose of purge water and disposable sampling equipment in an appropriate manner.	To-be-considered
Federal Guidance	Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites, Directive 9200.4-17, December 1, 1997.	Sets criteria for the selection, application, and monitoring of natural attenuation remedies.	Components of this remedy are implemented, monitored, and managed in a manner similar to natural attenuation remedies.	To-be-considered

APPENDIX D

CALCULATION OF BIODEGRADATION CLEANUP RATES, AND OTHER TECHNICAL DATA

Attachment A
Mass Balance and Clean Up Time Calculations

Biodegradation Rate on Flow path 57S to 52S ①



Conditions:

1. K for:
   - 70S K = 0.012'/day
   - 72S K = 0.21'/day
   - (from RI)

2. Degradation rates determined by Dr. John Wilson, Ada Labs. He determined through microcosm studies and field data.

Contaminant	max conc @ 57S now	1st Order kinetics microcosm	field
TCE	6500 ppb	6.31	0.5
Benzene	1,000 ppb	3.87	0.5
Toluene	28,000 ppb	5.49	0.83

(from: Design & Interpretation of Microcosm Studies ... attached)

1st Order kinetics

$$\text{rate} = k_1 C;\quad C_t = C_o \exp(-kt) \rightarrow t = \ln\left(\frac{C_t}{C_o}\right)\left(\frac{1}{-k}\right)$$

When will TCE, Benzene & Toluene meet MCLs?

TCE $\ln\left(\frac{5\text{ ppb}}{6500\text{ ppb}}\right)\left(\frac{1}{-6.31 \text{ to } -0.5}\right) = 1.13$ to 14.3 yrs

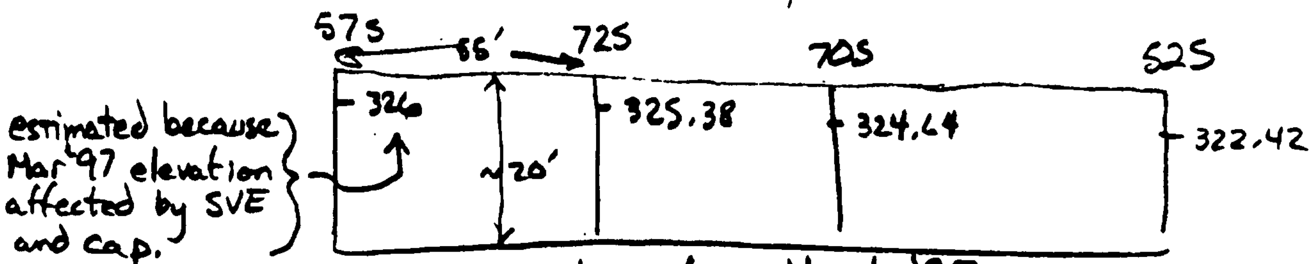
Benzene $\ln\left(\frac{5\text{ ppb}}{1000\text{ ppb}}\right)\left(\frac{1}{-3.87 \text{ to } -0.5}\right) = 1.37$ to 10.6 yrs

Toluene $\ln\left(\frac{1000\text{ ppb}}{28000\text{ ppb}}\right)\left(\frac{1}{-5.49 \text{ to } -0.83}\right) = 0.6$ to 4 yrs

→

Biodegradation Rates

The problem now is how long will the contaminants be in the "Treatment zone" (generally assumed to be an area between 57S and 52S). Using the K's found in the RI (Condition 1) yields:



Values from March '97

I'll go with seepage velocity since its more conservative (faster)

$$V_s = -\frac{K\,dh}{n_e\,dl} \qquad n_e \approx 0.2 \text{ (porosity)}$$

57S To 72S $\quad V_s = \frac{-(.21\ ft/day)}{.2}\frac{(326 - 325.38)}{65'} = 0.012\ ft/day$ or 4.?

57S To 52S $\quad V_s = \frac{-(.21\ ft/day)}{.2}\frac{(326 - 322.42)}{185'} = 0.02\ ft/day$ or 7.4 ft/

However, these travel time figures do not agree with what is seen in the field:

1. Major part of spill occurred in 1984. Evidence is anecdotal backed by occurrence of heavily mineralized area in tree rings corresponding to that time.
2. Yet, contaminants (MIBK) reached and were close to their peak within 1.5 yrs at well 52S
3. K is an estimate over the entire well and averages out any preferential pathways.

Therefore, if I back-calculate a K using a travel time of 90'/yr (based on field evidence and admittedly a very rough estimate and ignoring retardation of TCE, Benzene and Toluene in the aquifer matrix) gives:

$$V_{s\,(575\ \mathrm{to}\ 525)} \geq 90'/yr = K \frac{(0.019)}{n_e}$$

assume high n_e for preferential pathway say $n_e \approx 0.35$

$$K = \frac{(90\ ft/yr)(0.35)}{0.019} = 1658\ ft/yr \cong 4.5\ ft/day$$

K is now adjusted for results seen in the field (conservatively = fast.

under present conditions TCE (the limiting contaminant) would migrate (assuming no retardation or abiotic processes, and assuming biodegradation would operate at its minimal state over the entire flow path):

14.3 yrs @ 90'/yr ≈ 1,300 ft.

Swain's Lake lies ≈ 800 ft to the northeast ∴ contam. H_2O would discharge (above MCLs) to the lake under the worst-case (no-action) alternative.

<u>However</u>: now consider that the poplar trees reduce the hydraulic gradient (dh) and assume they have no other effect on any other aspect (rhizosphere activity, direct uptake, addition of enzymes). →

Biodegradation Rates

now assume with the trees present there is a net zero infiltration (G&M speculates that the water table may be depressed below the surrounding area; however, that remains to be seen). If zero infiltration water table at 57S should decline to ≈ 323' MSL which translates into:

$$575 \text{ to } 525 \quad \frac{dh}{dl} = \frac{(323 - 322.42)}{185} \approx 0.003$$

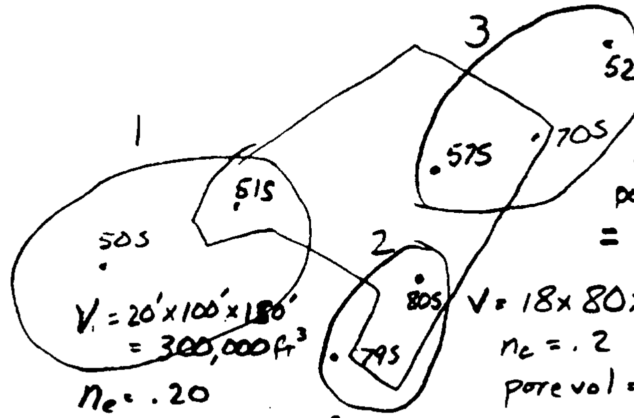
and yields a potential travel time of...

$$V_{s\,(575 \text{ to } 525)} = 1658 \text{ ft/yr} \, (0.003)\left(\frac{1}{0.35}\right) \approx 14.2 \text{ ft/yr}$$

∴ the flowpath and travel time from 57S to 52S ≈ 185'/14.2 ft/yr ≈ 13 yrs travel time

This may be just outside the value estimated using the slowest degradation rate; however, based on concentrations seen at well 52S and considering retardation forces, this "Treatment zone" is most likely adequate. This does point out the need for additional monitoring and perhaps additional wells along the flowpath.

Mass Balance calcs



Area 1: $V = 20' \times 100' \times 150'$ = 300,000 ft^3
n_e = .20
pore vol. = 60,000 ft^3
= 448,800 gallons
≈ 2,000,000 liters of water

Area 2: $V = 18 \times 80 \times 100$ = 144000 [cut off]
n_e = .2
pore vol = 28,800 ft^3
= 900,000 liters

Area 3: $V = 20 \times 100 \times 2$[cut off]
= 400,000 ft^3
n_e = .2
pore vol = 80,000
= 2,500,000 lite[cut off]

	in GW	90-91	98	
1	51S	15178	6680	
	50S	12680	1000	
2	80S	26,900	0 '96	
	79S	265	0	
3	57S	26,770	20,800	(not incl. 28,000 MIBK)
	70S	122	0	
	72S	9030	530	(nc 23,000 MIBK)
	52S	16620	0	
	69R	10070 nc 4k MIBK	19520	12K is due to Toluene (nc 26,000 MIBK)

90-98 Ben remains sam[cut off]
DCE declines (SVE stopp[cut off]
methanogenic red.?)
MIBK declines (aerobic co[cut off]
Toluene takes off
effects of moderate
pumping ?
this may be a very
imp. well !

1000 ppb = 8.34 lbs / million gallons

Area 1 Total VOCs
90-91 (15178 + 12680/2) ≈ 14000 ppb ≈ 58 lbs
98 (6680 + 1000/2) ≈ 4000 ppb ≈ 17 lbs

Area 2
90-91 (26900 + 265) → ≈ 12000 ≈ 22 lbs 96-98 - 0 lbs

Area 3
90-91 (≈ 20,000 ppb) → 100 lbs
98 (≈ 17,000 ppb) → 85 lbs

This estimates a total of
~180 lbs of VOCs in ground water in 1990
~102 lbs of VOCs " " " 1998

What amount is sorbed to the soil?

$f_{oc} \approx 0.13\%$ (RI) $K_{oc} = K_d / f_{oc}$ ∴ $K_d = K_{oc} \times f_{oc}$

Log K_{oc} of TCE = 2.10, Ben = 1.81; 12 DCE = 1.5; PCE 2.82
est. ≈ Log $K_{oc} \approx 2 \longrightarrow K_{oc} \approx 100$
$K_d \approx 100 \times .13 = 13$
and $K_d = C_{soil} / C_{water}$ ∴ $C_{soil} = K_d \times C$

Area 1: 1990: 13 × 14 ppm = 182 ppm
1998: 13 × 4 ppm = 52 ppm
Area 2 1990: 13 × 12 ppm = 156 ppm
1998: = 0 ppm
Area 3 1990: 13 × 20 = 260 ppm
1998 13 × 17 = 221 ppm

1.3%
~1% / wk
1% of 6500
65 ppb ≈ 0.065 ppm
.065 × 8.34 × 0.625 mil gal
= 0.338 ≈ .3 lbs / wk Ben
.68 / .7 oz/day
~ 15 kg

volume of soil Area 1 = 20 × 30 × 16 = 9600 ft
Area 2 = 20 × 10 × 16 = 3200 ft³ ~
Area 3 = 20 × 30 × 16 = 9600 ft³ ~ 132 lbs or 60 kg

again 1 ppm = 8.34 lb/gal million gals
X ~~P/mil~~ × 8.34 lb/gal × (X ~~mil~~ gal) = lbs

Attachment B
Application of Bioscreen, a R.S. Kerr Laboratory Hydrocarbon Degradation Screening Tool

Tibbetts Road
TCE

115

150.0

300
75
20

20

10

13.0
2.0
1.0

10	0.5	1
10	2	2
20	7	3
10	2	4
10	0.5	5

1.8

3 | 3

10

7.0		1.0								
0	*30*	*60*	*90*	*120*	*150*	*180*	*210*	*240*	*270*	*300*

5.4E-1

0
0
0
0
0

RUN CENTERLINE

View Output

RUN ARRAY

View Output

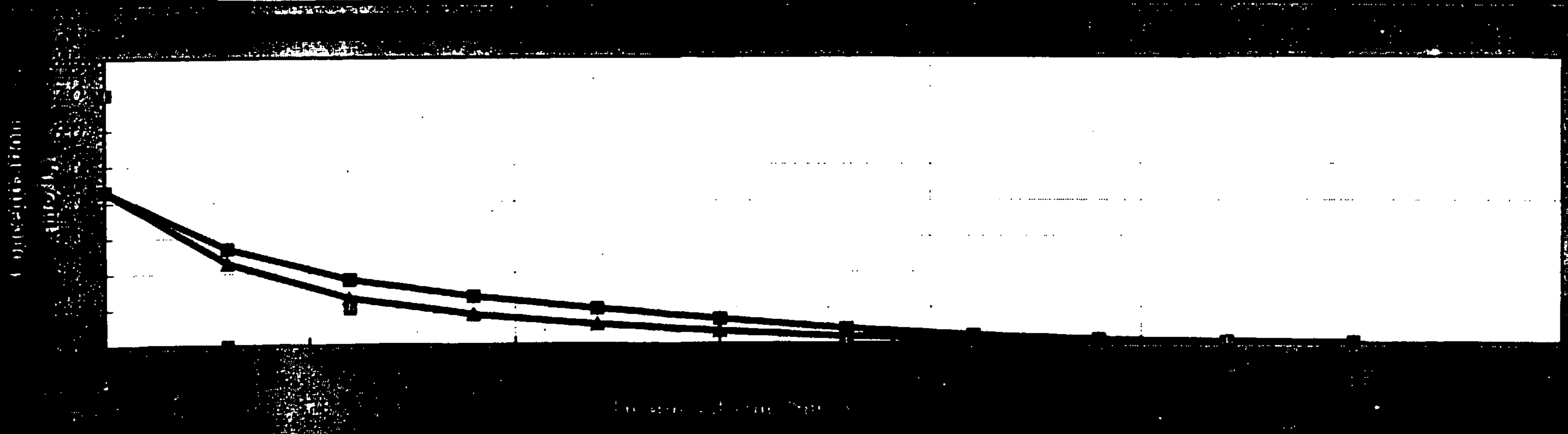
Help

Recalculate This Sheet

Paste Example Dataset

Restore Formulas for Vs, Dispersivities, R, lambda, other

4.314	2.698	1.813	1.338	0.990	0.694	0.421	0.217	0.097	0.037	0.012
4.314	2.274	1.298	0.829	0.544	0.346	0.195	0.095	0.041	0.015	0.005
4.314	2.698	1.813	1.338	0.990	0.694	0.421	0.217	0.097	0.037	0.012
7.000		1.000								



Replay Animation

Next Timestep

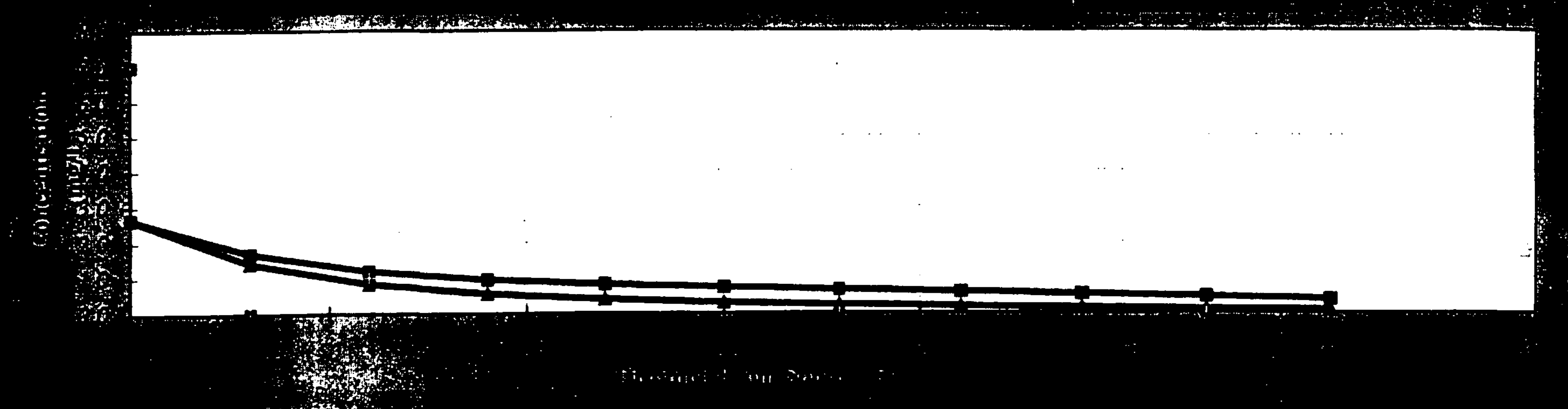
Prev Timestep

2 Years

Return to Input

Recalculate This Sheet

2.659	1.696	1.182	0.944	0.808	0.717	0.648	0.586	0.522	0.452	0.376
2.659	1.412	0.820	0.546	0.391	0.292	0.224	0.174	0.135	0.104	0.078
2.659	1.696	1.182	0.944	0.808	0.717	0.648	0.586	0.522	0.452	0.376
7.000		1.000								



Replay Animation

Next Timestep

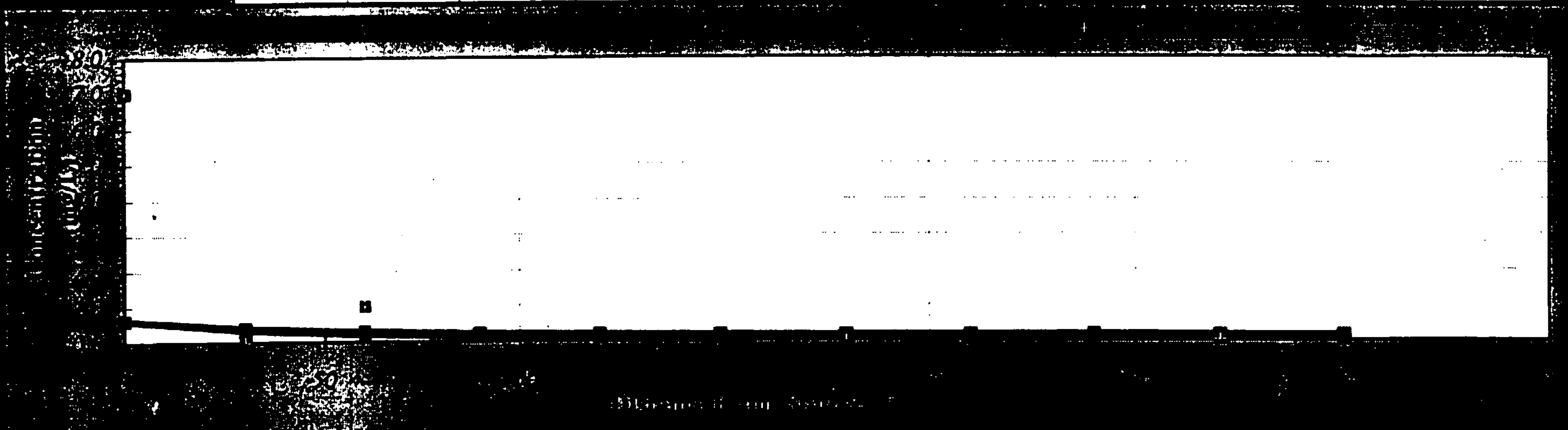
Prev Timestep

4 Years

Return to Input

Recalculate This Sheet

0.623	0.397	0.277	0.222	0.192	0.173	0.161	0.153	0.148	0.145	0.144
0.623	0.331	0.192	0.128	0.092	0.069	0.053	0.042	0.034	0.028	0.023
0.623	0.397	0.277	0.222	0.192	0.173	0.161	0.153	0.148	0.145	0.144
7.000		1.000								



Replay Animation

Next Timestep

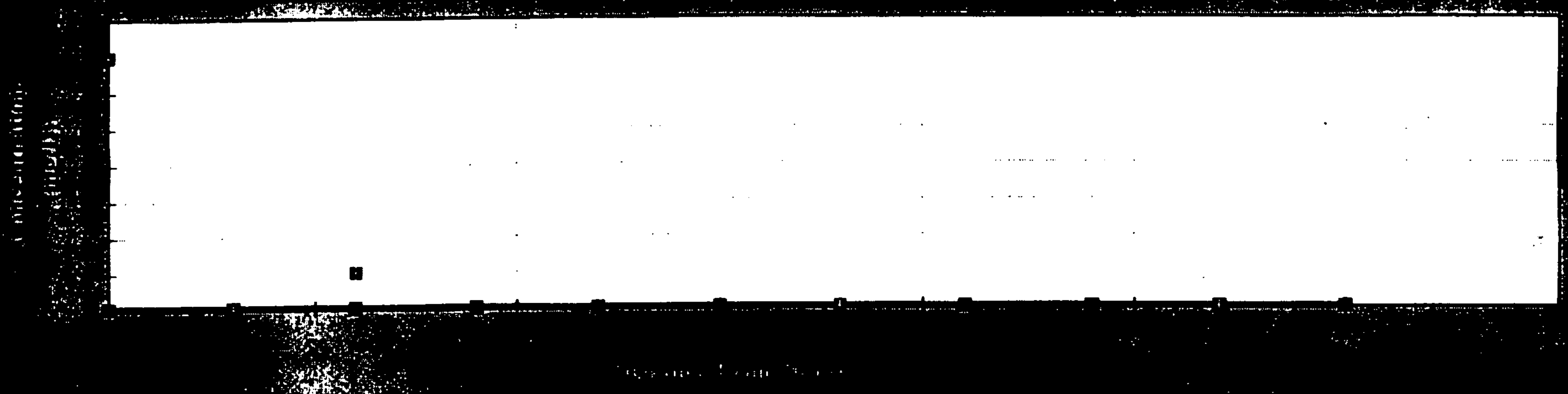
Prev Timestep

10 Years

Return to Input

Recalculate This Sheet

0.055	0.035	0.025	0.020	0.017	0.015	0.014	0.014	0.013	0.013	0.013
0.055	0.029	0.017	0.011	0.008	0.006	0.005	0.004	0.003	0.002	0.002
0.055	0.035	0.025	0.020	0.017	0.015	0.014	0.014	0.013	0.013	0.013
7.000		1.000								



Replay Animation

Next Timestep

Prev Timestep

20 Years

Return to Input

Recalculate This Sheet

Tibbetts Road
benzene

115

150.0

300
75
20

20

10

13.0
2.0
1.0

10	0.5	1
10	0.8	2
20	1	3
10	0.8	4
10	0.5	5

1.4

10 | 3

10

1.0		.5								
0	*30*	*60*	*90*	*120*	*150*	*180*	*210*	*240*	*270*	*300*

6.2E+0

0
0
0
0
0

RUN CENTERLINE

View Output

RUN ARRAY

View Output

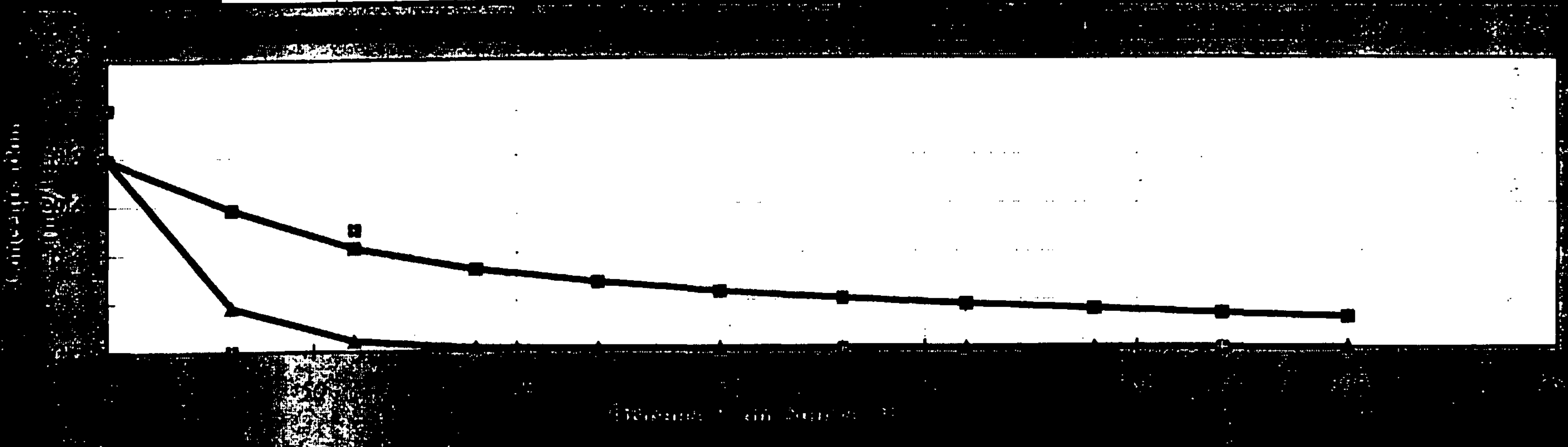
Help

Recalculate This Sheet

Paste Example Dataset

Restore Formulas for Vs, Dispersivities, R, lambda, other

0.791	0.584	0.424	0.333	0.275	0.235	0.205	0.181	0.161	0.143	0.125
0.791	0.180	0.040	0.010	0.002	0.001	0.000	0.000	0.000	0.000	0.000
0.791	0.584	0.424	0.333	0.275	0.235	0.205	0.181	0.161	0.143	0.125
1.000		0.500								



Replay Animation

Next Timestep

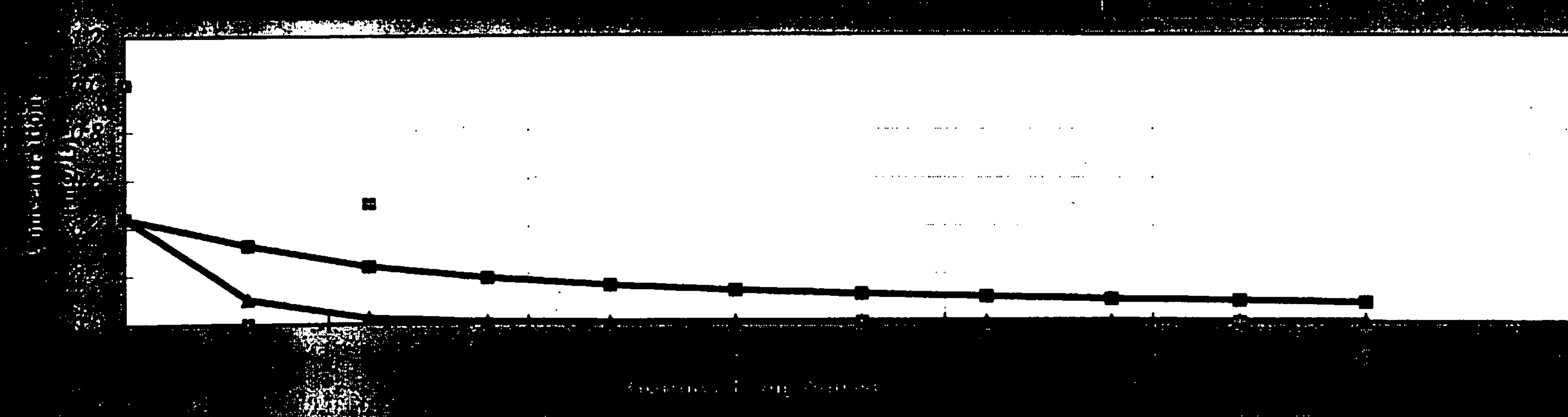
Prev Timestep

4 Years

Return to Input

Recalculate This Sheet

0.440	0.325	0.236	0.185	0.153	0.131	0.115	0.103	0.094	0.086	0.080
0.440	0.100	0.022	0.005	0.001	0.000	0.000	0.000	0.000	0.000	0.000
0.440	0.325	0.236	0.185	0.153	0.131	0.115	0.103	0.094	0.086	0.080
1.000		0.500								



Replay Animation

Next Timestep

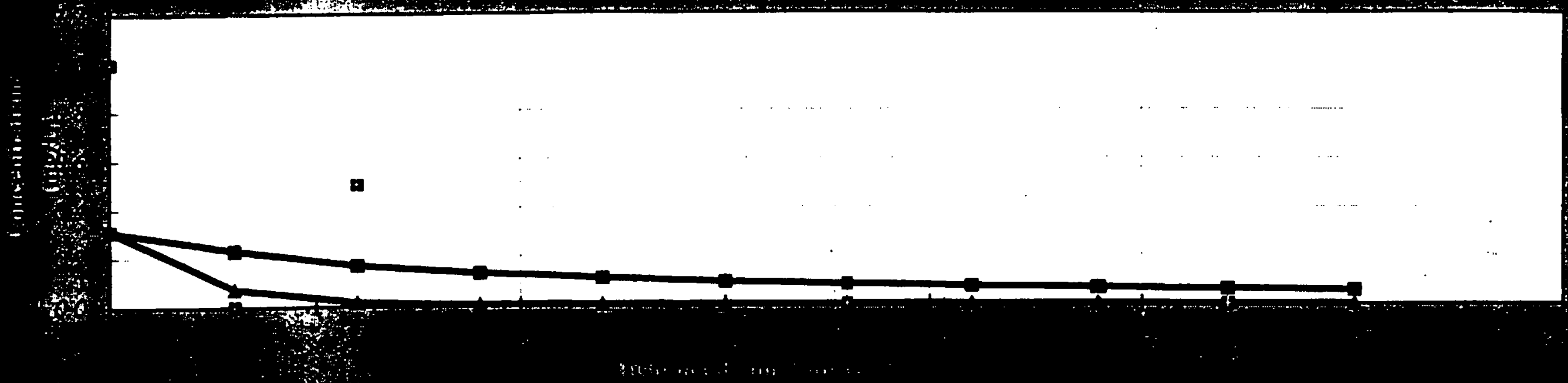
Prev Timestep

14 Years

Return to Input

Recalculate This Sheet

0.310	0.229	0.166	0.130	0.108	0.092	0.081	0.073	0.066	0.061	0.056
0.310	0.071	0.016	0.004	0.001	0.000	0.000	0.000	0.000	0.000	0.000
0.310	0.229	0.166	0.130	0.108	0.092	0.081	0.073	0.066	0.061	0.056
1.000		0.500								



Replay Animation

Next Timestep

Prev Timestep

20 Years

Return to Input

Recalculate This Sheet

Tibbetts Road

toluene

115

150.0

300

75

20

20

10

13.0

2.0

1.0

10	0.5	1
10	6	2
20	28	3
10	6	4
10	0.5	5

2.7

3	3

30

28.0		.5								
0	*30*	*60*	*90*	*120*	*150*	*180*	*210*	*240*	*270*	*300*

8.5E-1

0

0

0

0

0

RUN CENTERLINE

View Output

RUN ARRAY

View Output

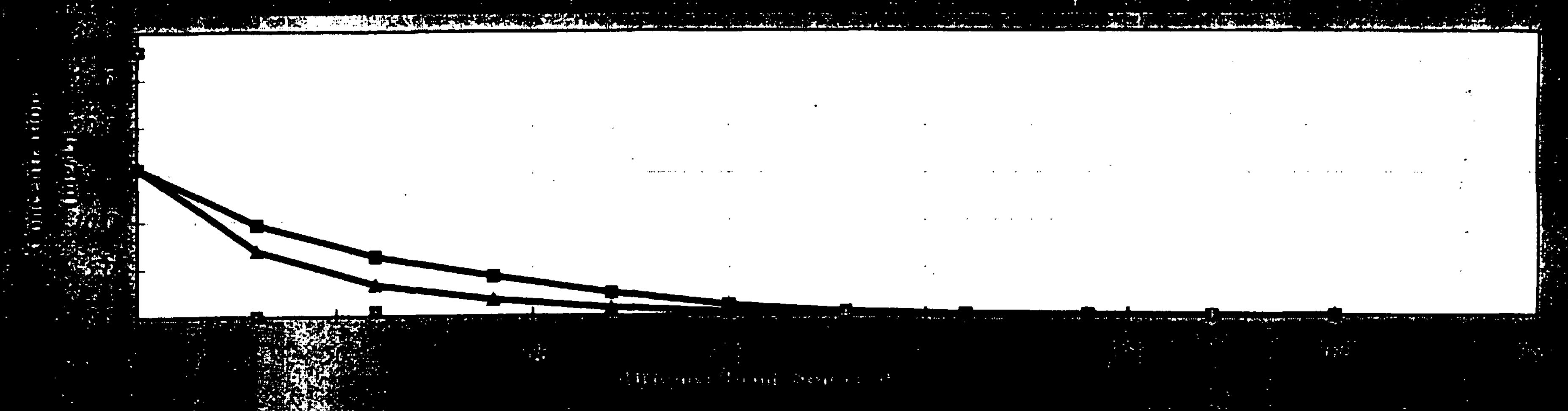
Help

Recalculate This Sheet

Paste Example Dataset

Restore Formulas for Vs, Dispersivities, R, lambda, other

15.586	9.628	6.257	4.174	2.417	1.067	0.383	0.108	0.024	0.004	0.001
15.586	6.860	3.269	1.699	0.815	0.314	0.102	0.027	0.006	0.001	0.000
15.586	9.628	6.257	4.174	2.417	1.067	0.383	0.108	0.024	0.004	0.001
28.000		0.500								



Replay Animation

Next Timestep

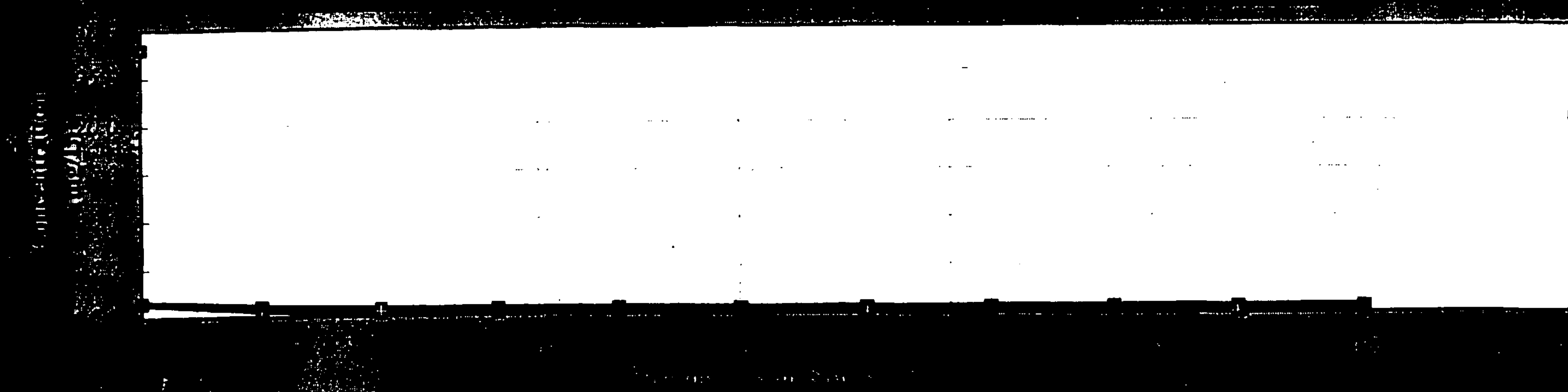
Prev Timestep

2 Years

Return to Input

Recalculate This Sheet

1.497	0.990	0.726	0.617	0.567	0.546	0.543	0.552	0.571	0.597	0.628
1.497	0.668	0.330	0.189	0.117	0.076	0.051	0.035	0.025	0.017	0.012
1.497	0.990	0.726	0.617	0.567	0.546	0.543	0.552	0.571	0.597	0.628
28.000		0.500								



Replay Animation

Next Timestep

Prev Timestep

10 Years

Return to Input

Recalculate This Sheet

Attachment B
Application of Bioscreen, a R.S. Kerr Laboratory Hydrocarbon Degradation Screening Tool

Tibbetts Road
TCE

115

150.0

300
75
20

20

10

13.0
2.0
1.0

10	0.5	1
10	2	2
20	7	3
10	2	4
10	0.5	5

1.8

3 | 3

10

7.0		1.0								
0	*30*	*60*	*90*	*120*	*150*	*180*	*210*	*240*	*270*	*300*

5.4E-1

0
0
0
0
0

RUN CENTERLINE

View Output

RUN ARRAY

View Output

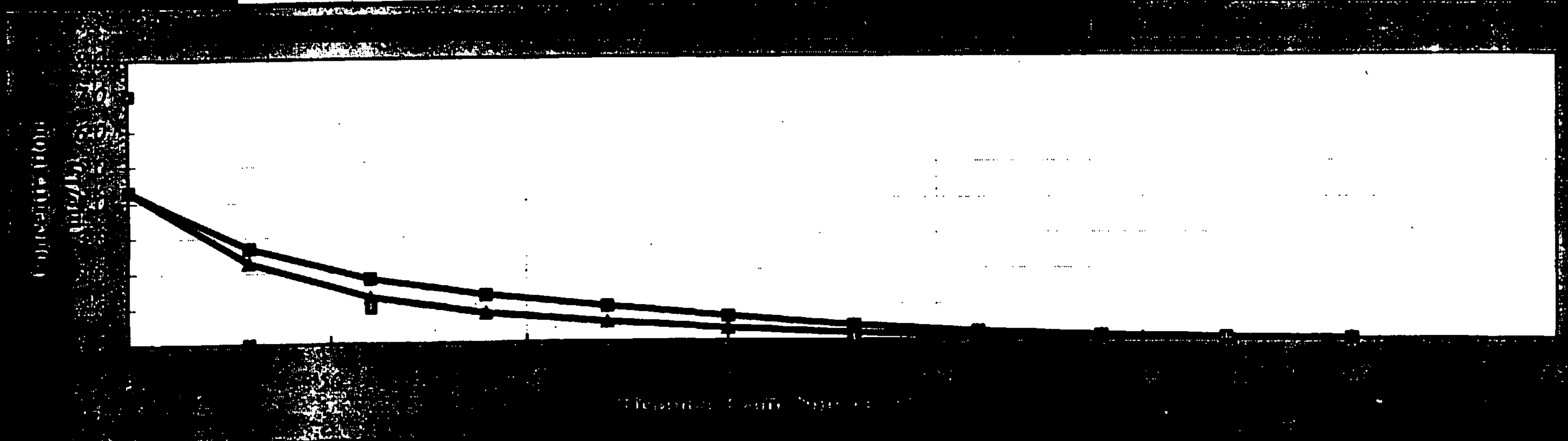
Help

Recalculate This Sheet

Paste Example Dataset

Restore Formulas for Vs, Dispersivities, R, lambda, other

4.314	2.698	1.813	1.338	0.990	0.694	0.421	0.217	0.097	0.037	0.012
4.314	2.274	1.298	0.829	0.544	0.346	0.195	0.095	0.041	0.015	0.005
4.314	2.698	1.813	1.338	0.990	0.694	0.421	0.217	0.097	0.037	0.012
7.000		1.000								



Replay Animation

Next Timestep

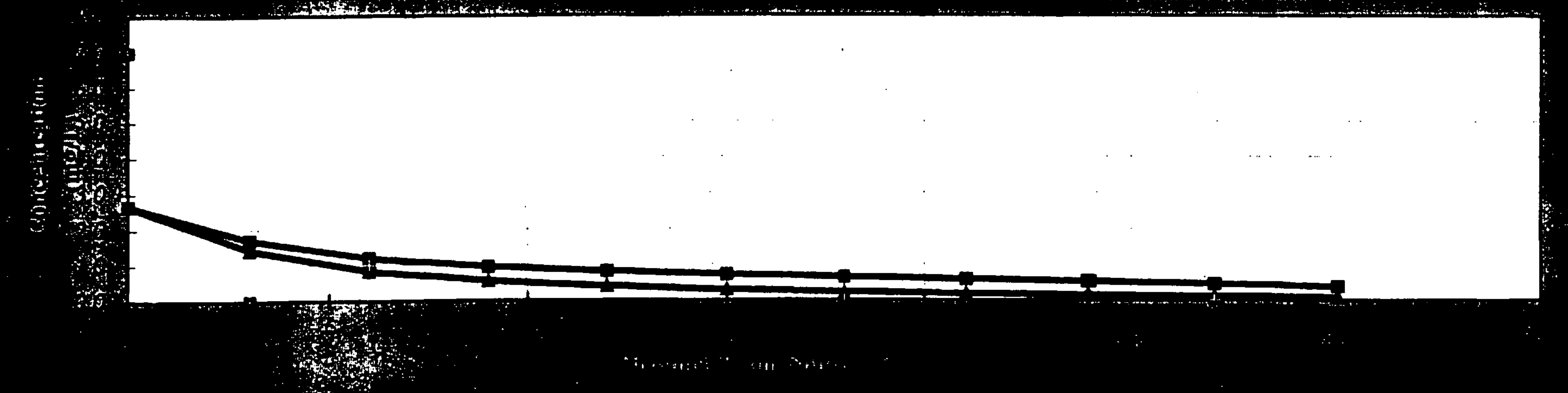
Prev Timestep

2 Years

Return to Input

Recalculate This Sheet

2.659	1.696	1.182	0.944	0.808	0.717	0.648	0.586	0.522	0.452	0.376
2.659	1.412	0.820	0.546	0.391	0.292	0.224	0.174	0.135	0.104	0.078
2.659	1.696	1.182	0.944	0.808	0.717	0.648	0.586	0.522	0.452	0.376
7.000		1.000								



Replay Animation

Next Timestep

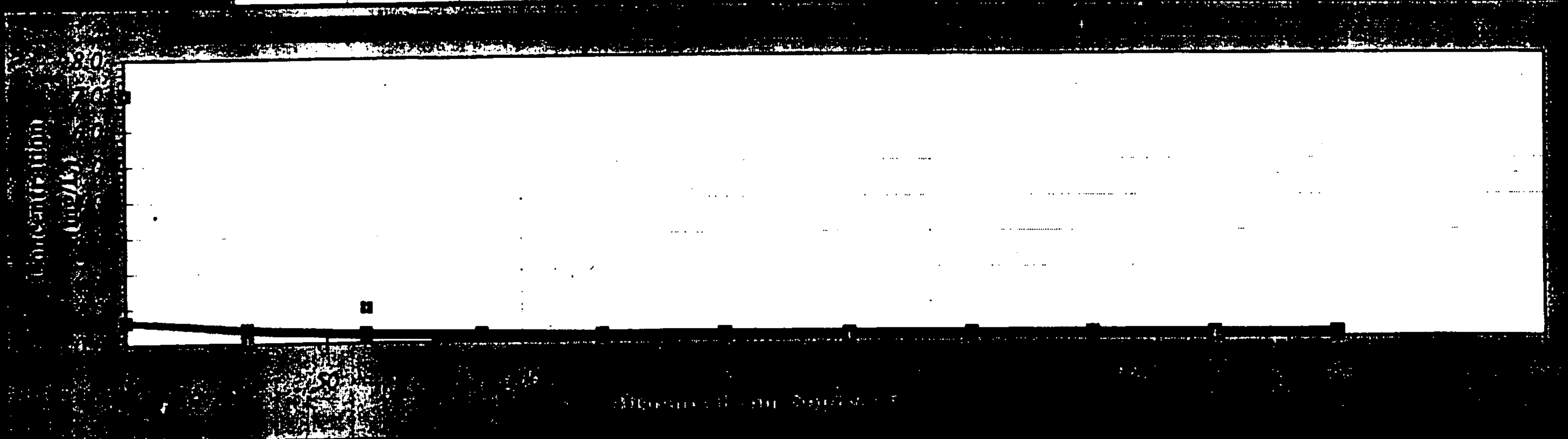
Prev Timestep

4 Years

Return to Input

Recalculate This Sheet

0.623	0.397	0.277	0.222	0.192	0.173	0.161	0.153	0.148	0.145	0.144
0.623	0.331	0.192	0.128	0.092	0.069	0.053	0.042	0.034	0.028	0.023
0.623	0.397	0.277	0.222	0.192	0.173	0.161	0.153	0.148	0.145	0.144
7.000		1.000								



Replay Animation

Next Timestep

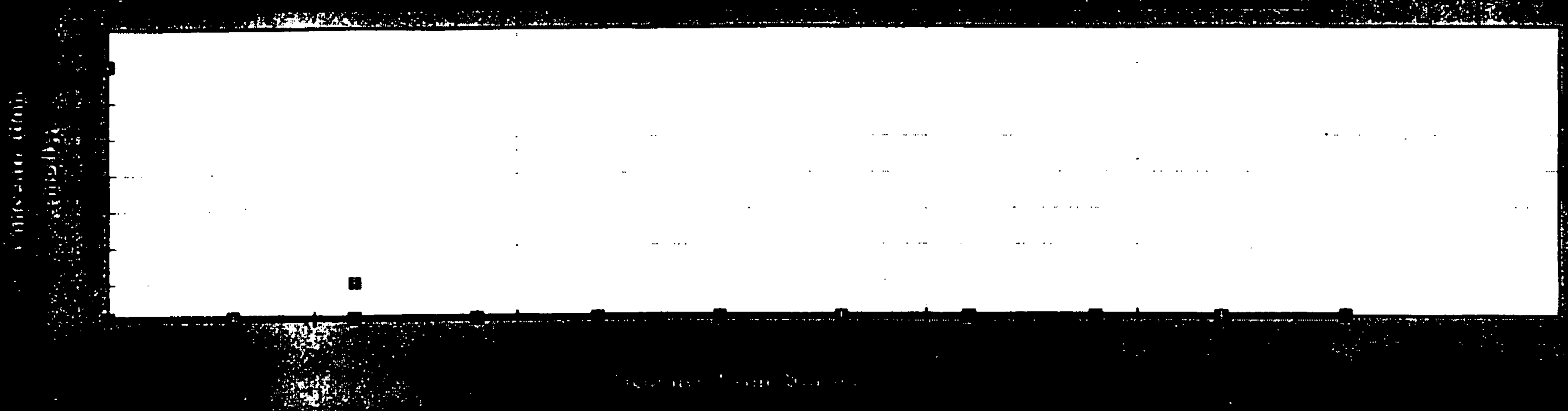
Prev Timestep

10 Years

Return to Input

Recalculate This Sheet

0.055	0.035	0.025	0.020	0.017	0.015	0.014	0.014	0.013	0.013	0.013
0.055	0.029	0.017	0.011	0.008	0.006	0.005	0.004	0.003	0.002	0.002
0.055	0.035	0.025	0.020	0.017	0.015	0.014	0.014	0.013	0.013	0.013
7.000		1.000								



Replay Animation

Next Timestep

Prev Timestep

20 Years

Return to Input

Recalculate This Sheet

Tibbetts Road
benzene

115

150.0

300
75
20

20

10

13.0
2.0
1.0

10	0.5	1
10	0.8	2
20	1	3
10	0.8	4
10	0.5	5

1.4

10 | 3

10

1.0		.5								
0	30	60	90	120	150	180	210	240	270	300

6.2E+0

0
0
0
0
0

RUN CENTERLINE

View Output

RUN ARRAY

View Output

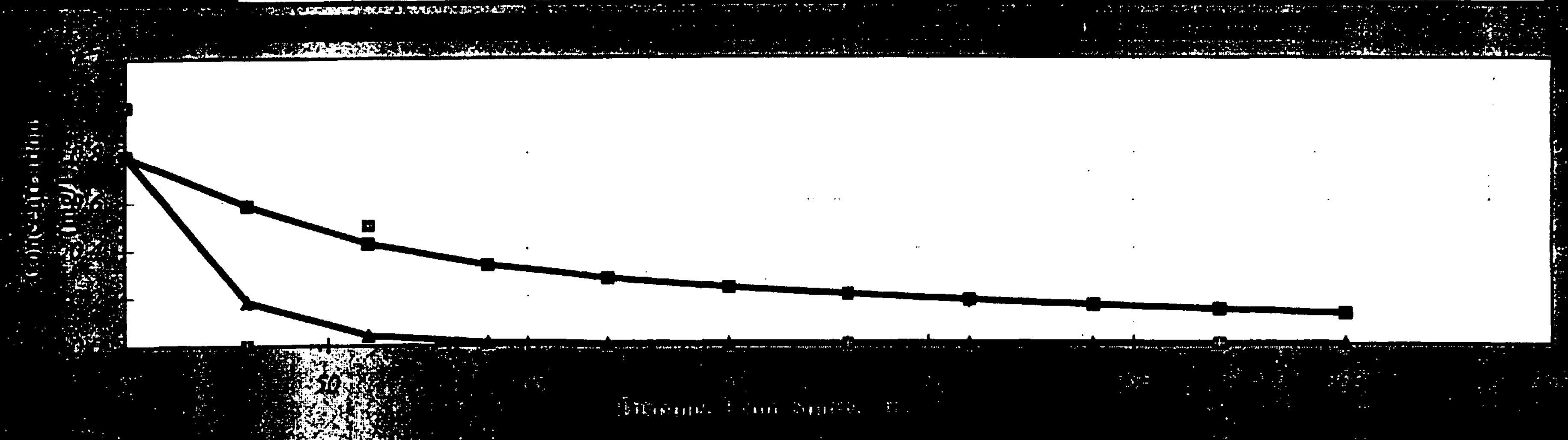
Help

Recalculate This Sheet

Paste Example Dataset

Restore Formulas for Vs, Dispersivities, R, lambda, other

0.791	0.584	0.424	0.333	0.275	0.235	0.205	0.181	0.161	0.143	0.125
0.791	0.180	0.040	0.010	0.002	0.001	0.000	0.000	0.000	0.000	0.000
0.791	0.584	0.424	0.333	0.275	0.235	0.205	0.181	0.161	0.143	0.125
1.000		0.500								



Replay Animation

Next Timestep

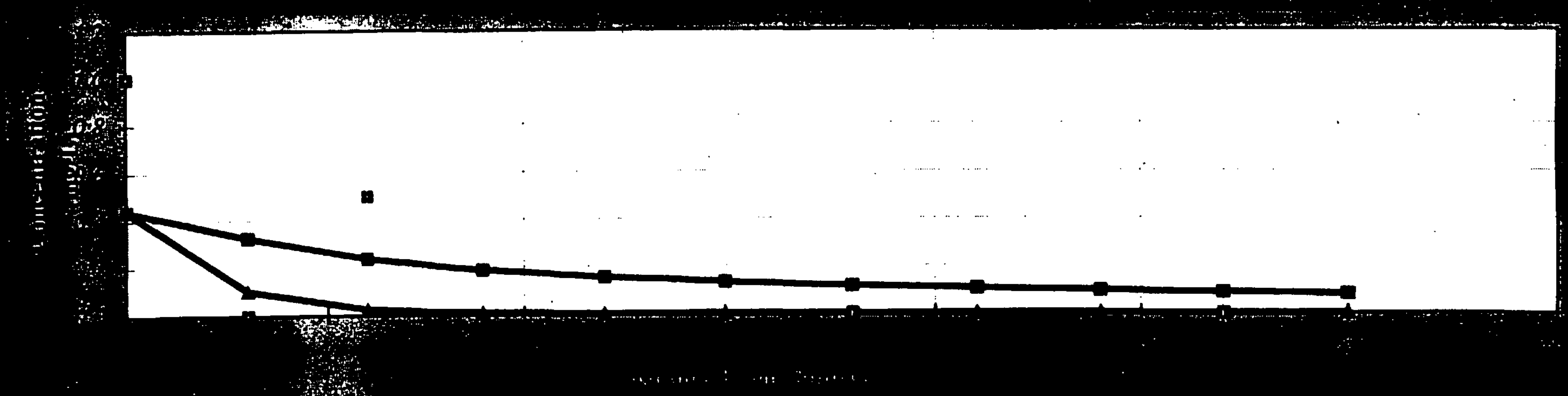
Prev Timestep

4 Years

Return to Input

Recalculate This Sheet

0.440	0.325	0.236	0.185	0.153	0.131	0.115	0.103	0.094	0.086	0.080
0.440	0.100	0.022	0.005	0.001	0.000	0.000	0.000	0.000	0.000	0.000
0.440	0.325	0.236	0.185	0.153	0.131	0.115	0.103	0.094	0.086	0.080
1.000		0.500								



Replay Animation

Next Timestep

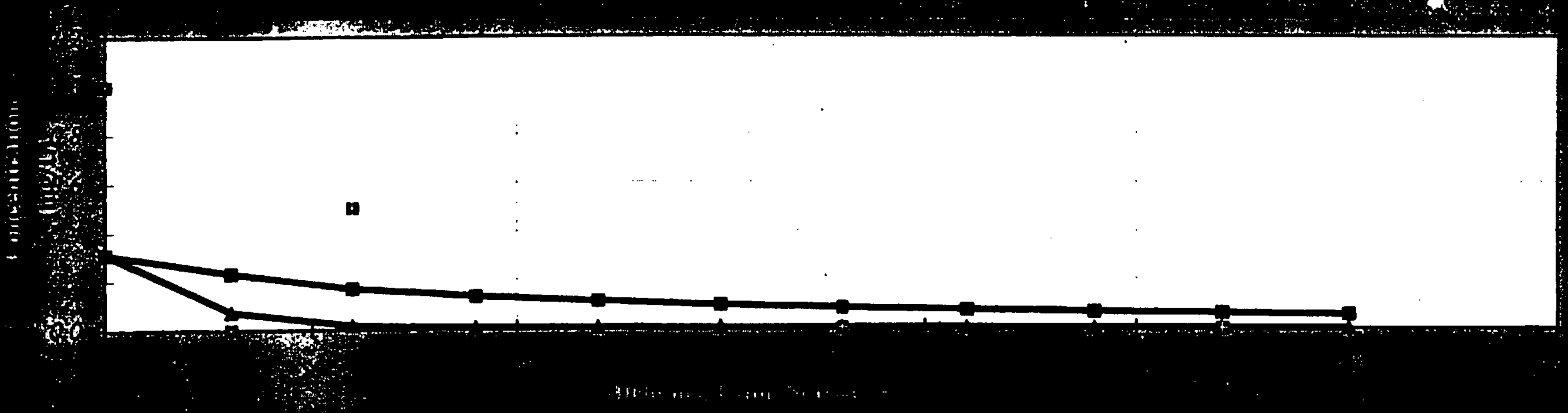
Prev Timestep

14 Years

Return to Input

Recalculate This Sheet

0.310	0.229	0.166	0.130	0.108	0.092	0.081	0.073	0.066	0.061	0.056
0.310	0.071	0.016	0.004	0.001	0.000	0.000	0.000	0.000	0.000	0.000
0.310	0.229	0.166	0.130	0.108	0.092	0.081	0.073	0.066	0.061	0.056
1.000		0.500								



Replay Animation

Next Timestep

Prev Timestep

20 Years

Return to Input

Recalculate This Sheet

Tibbetts Road

toluene

115

150.0

300

75

20

20

10

13.0

2.0

1.0

10	0.5	1
10	6	2
20	28	3
10	6	4
10	0.5	5

2.7

3 | 3

30

28.0		.5								
0	*30*	*60*	*90*	*120*	*150*	*180*	*210*	*240*	*270*	*300*

8.5E-1

0

0

0

0

0

RUN CENTERLINE

View Output

RUN ARRAY

View Output

Help

Recalculate This Sheet

Paste Example Dataset

Restore Formulas for Vs, Dispersivities, R, lambda, other

15.586	9.628	6.257	4.174	2.417	1.067	0.383	0.108	0.024	0.004	0.001
15.586	6.860	3.269	1.699	0.815	0.314	0.102	0.027	0.006	0.001	0.000
15.586	9.628	6.257	4.174	2.417	1.067	0.383	0.108	0.024	0.004	0.001
28.000		0.500								

Replay Animation

Next Timestep

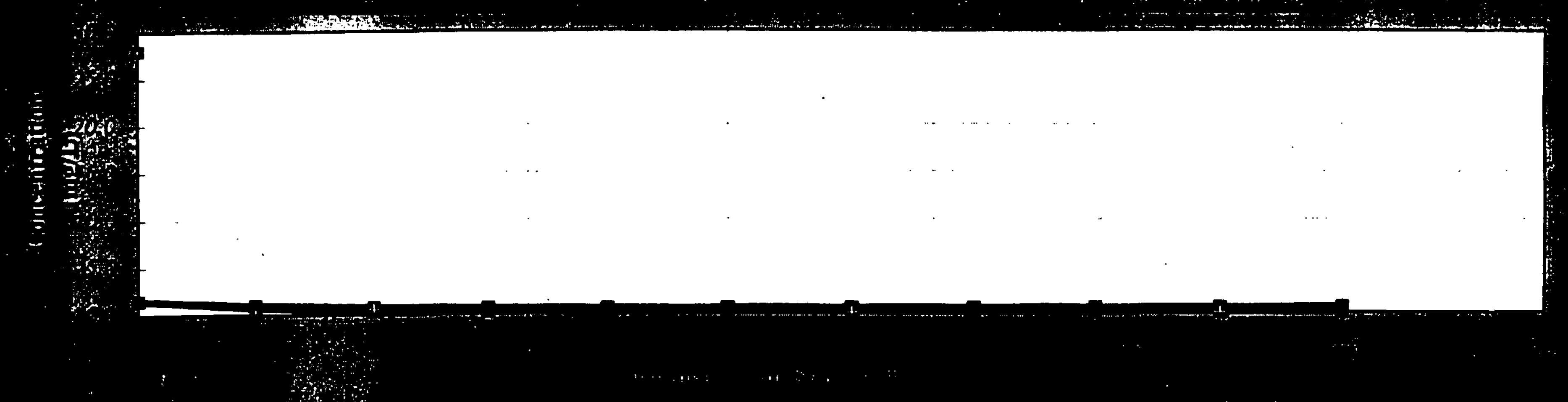
Prev Timestep

2 Years

Return to Input

Recalculate This Sheet

1.497	0.990	0.726	0.617	0.567	0.546	0.543	0.552	0.571	0.597	0.628
1.497	0.668	0.330	0.189	0.117	0.076	0.051	0.035	0.025	0.017	0.012
1.497	0.990	0.726	0.617	0.567	0.546	0.543	0.552	0.571	0.597	0.628
28.000		0.500								



Replay Animation

Next Timestep

Prev Timestep

10 Years

Return to Input

Recalculate This Sheet

Attachment C
Preliminary Monitoring Data from the Site

ARCADIS GERAGHTY & MILLER

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Environmental

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Date: 6/22/98

From: Pete Jalajas

Total pages: 14

Extension: x315

Our ref.: MA000402.0003

Subject: Draft Tables/Data

If you do not receive all pages, please call to let us know as soon as possible.

Please call if you need more.

Table __. Summary of Groundwater Data Collected in April 1998, Tibbetts Road, Barrington, New Hampshire

Well Designation	184SD	35R	37D	50S	51S	51S	51S	52S	53S	57S
Sample ID	184SD-0498	35R-0498	37D-0498	50S-0498	51SL-0498	51SM-0498	51SV-0498	52S-0498	53S-0498	57S-0498
Sample Date	16-Apr-98	21-Apr-98	20-Apr-98	21-Apr-98	17-Apr-98	17-Apr-98	17-Apr-98	21-Apr-98	21-Apr-98	20-Apr-98
Metals (mg/L)										
Arsenic	NA	0.03	0.36	0.37	0.21	0.15	<0.002	0.0027	<0.02	0.17
Chromium	NA	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Iron	NA	1.2	40	66	29	35	<0.02	0.42	0.081	21
Manganese	NA	0.87	3.1	7.1	5.8	6.6	<0.005	0.097	0.037	19
Nickel	NA	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Vanadium	NA	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
VOCs (ug/L)										
4-Methyl-2-pentanone (MIBK)	---	1000	---	---	---	---	---	---	---	<1000
Acetone	---	---	---	---	---	---	---	---	---	---
Benzene	---	**130**	---	<25	<100	<100	<100	---	---	<1000
cis-1,2-Dichloroethene	5.3	---	7.8	---	<100	<100	<100	---	---	**1400**
Ethylbenzene	---	---	---	310	**780**	370	580	---	---	**2400**
Methylene chloride	---	---	---	---	---	---	---	---	---	1200KB
Tetrachloroethene	---	<25	**7.6**	<25	<100	<100	<100	---	---	<1000
Toluene	---	---	---	---	**1200**	440	210	---	---	**28000**
Trichloroethene	---	<50	**14**	<50	<100	<100	<100	---	---	**6500**
Xylene (total)	9.3	---	---	590	4300	2100	4700	---	---	6300

Bold indicates value exceeds cleanup levels.
< indicates that reporting limit exceeds cleanup levels.
NA - Not analyzed.
-- = Not detected and detected unit is less than cleanup limit.
mg/L - Micrograms per liter.
ug/L - Kilograms per liter.

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Table __. Summary of Groundwater Data Collected in April 1998, Tibbetts Road, Barrington, New Hampshire

	69R 69R-0498 21-Apr-98	70SL 70SL-0498 15-Apr-98	70SM 70SM-0498 15-Apr-98	70SV 70SV-0498 15-Apr-98	72S 72S-0498 20-Apr-98	73S 73S-0498 20-Apr-98	79S 79SL-0498 17-Apr-98	79S 79SM-0498 17-Apr-98	79S 79SV-0498 17-Apr-98	84S 84SL- 16-A
<u>Metals</u> (mg/L)										
Arsenic	0.12	<0.02	<0.02	<0.02	0.034	<0.02	<0.002	<0.002	<0.002	0
Chromium	<0.02	<0.02	0.028	<0.005	<0.02	<0.02	<0.02	<0.02	<0.02	<0
Iron	25	0.6	0.083	0.025	3.3	0.9	0.039	0.21	<0.02	6
Manganese	4.6	0.22	0.23	<0.02	2.9	0.081	2.5	2.5	<0.005	2.
Nickel	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0
Vanadium	<0.002	<0.02	<0.002	<0.002	<0.02	<10	<0.02	<0.02	<0.02	<0.
<u>VOCs</u> (ug/L)										
4-Methyl-2-pentanone (MIBK)	26000	---	---	---	23000	---	---	---	---	-
Acetone	---	---	---	---	---	---	---	---	---	-
Benzene	3600	---	---	---	530	---	---	---	---	-
cis-1,2-Dichloroethene	720	---	---	---	<500	57	---	---	---	-
Ethylbenzene	---	---	---	---	---	---	---	---	---	-
Methylene chloride	---	---	---	---	---	---	---	---	---	-
Tetrachloroethene	<500	---	---	---	<500	---	---	---	---	-
Toluene	12000	---	---	---	---	---	---	---	---	-
Trichloroethene	<1000	---	---	---	<1000	170	---	---	---	-
Xylene (total)	1700	---	---	---	---	---	---	---	---	7

Bold indicates value exceeds cleanup levels.
< indicates that reporting limit exceeds cleanup levels.
NA - Not analyzed.
-- = Not detected and detected unit is less than cleanup limit.
mg/L - Micrograms per liter.
ug/L - Kilograms per liter.

Table __. Summary of Groundwater Data Collected in April 1998,Tibbetts Road, Barrington, New Hampshire

84SL 84SL-0498 16-Apr-98		84SM 84SM-0498 16-Apr-98	84SV 84SV-0498 16-Apr-98	EW-01 W1DM-049 17-Apr-98	EW-01 EW1DV-049 17-Apr-98	EW-01D EW1DL-0498 17-Apr-98	EW-01S EW1S-0498 21-Apr-98	EW-02S EW2S-0498 20-Apr-98	EW-03S EW3S-049 20-Apr-9!
	Metals (mg/L)								
0.16	Arsenic	0.16	<0.005	0.0037	<0.002	<0.002	28	0.086	0.027
<0.02	Chromium	0.06	0.067	<0.02	<0.02	<0.02	0.042	<0.02	<0.02
68	Iron	74	0.029	0.03	0.033	0.033	3200	27	6.5
2.2	Manganese	2.3	<0.02	<0.005	<0.005	<0.005	16	2.8	1.6
<0.02	Nickel	<0.02	<0.02	<0.02	<0.02	<0.02	0.063	<0.02	<0.02
<0.002	Vanadium	<0.002	<0.002	<0.02	<0.02	<0.02	<0.2M	<0.02	<0.002
	VOCs (ug/L)								
---	4-Methyl-2-pentanone (MIBK)	---	---	980	390	1000	---	---	---
---	Acetone	---	---	---	---	110	---	---	---
---	Benzene	---	---	<100	<100	<50	---	---	---
---	cis-1,2-Dichloroethene	---	5.4	**140**	**130**	**120**	22	---	---
---	Ethylbenzene	---	---	600	620	530	42	---	---
---	Methylene chloride	---	---	---	---	---	---	---	---
---	Tetrachloroethene	---	---	<100	<100	<50	**140**	---	5
---	Toluene	---	---	**2500**	**2500**	1900	---	---	---
---	Trichloroethene	---	---	<100	<100	<50	5.8	---	---
7.7	Xylene (total)	7.8	10	3100	3300	2500	150	---	---

Bold indicates value exceeds cleanup levels.
< indicates that reporting limit exceeds cleanup levels.
NA - Not analyzed.
-- = Not detected and detected unit is less than cleanup limit.
mg/L - Micrograms per liter.
ug/L - Kilograms per liter.

W-03S 3S-0498 Apr-98	EW-04S EW4S-0498 20-Apr-98
).027	0.52
<0.02	<0.02
6.5	250
1.6	3
<0.02	<0.02
:0.002	<0.02
---	---
---	16
---	---
---	12
---	---
---	---
5	---
---	---
---	---
---	---

FB B-0498 -Apr-98	Trip Blank TB-041698 16-Apr-98	Trip Blank TB-0498 20-Apr-98
<0.02	NA	NA
<0.02	NA	NA
<0.005	NA	NA
<0.02	NA	NA
<0.02	NA	NA
<0.02	NA	NA
---	---	---
---	---	---
---	---	---
---	---	---
---	---	---
---	---	---
---	---	---
---	---	---
---	---	---
---	---	---

Table __. Summary of Groundwater Data Collected in April 1998

	Trip Blank Trip Blank (4/17/98) 17-Apr-98
Metals (mg/L)	
Arsenic	NA
Chromium	NA
Iron	NA
Manganese	NA
Nickel	NA
Vanadium	NA
VOCs (ug/L)	
4-Methyl-2-pentanone (MIBK)	---
Acetone	---
Benzene	---
cis-1,2-Dichloroethene	---
Ethylbenzene	---
Methylene chloride	---
Tetrachloroethene	---
Toluene	---
Trichloroethene	---
Xylene (total)	---

Bold indicates value exceeds cleanup levels.
< indicates that reporting limit exceeds cleanup levels.
NA - Not analyzed.
-- = Not detected and detected unit is less than cleanup
mg/L - Micrograms per liter.
ug/L - Kilograms per liter.

Table 5. Historical Summary of Selected Compounds Detected in Groundwater Samples Collected from Monitoring Wells, 1985 through 1997, Tibbetts Road Site, Barrington, New Hampshire.

Well Designation	Sample Date	Benzene	cis-1,2-Dichloroethene	Ethylbenzene	4-Methyl-2-pentanone	Toluene	Tetrachloroethane	1,1,1-Trichloroethane	Trichloroethene	total Xylenes	As	Mn
		Volatile Organic Compounds (µg/L)									Metals (µg/L)	
32R	01-Jan-85	—	**	**	—	—	—	—	—	—	**	**
32R	01-Jun-90	—	**	**	—	—	—	—	—	—	**	**
33R	01-Jan-85	—	**	**	—	—	—	—	2J	—	**	**
33R	01-Jun-90	—	**	**	—	—	—	—	—	—	**	**
34R	01-Jan-85	—	—	**	—	—	—	—	—	—	**	**
34R	01-Jun-90	—	—	**	—	—	—	—	—	—	**	**
35R	01-Jan-85	13	—	**	—	—	—	—	110	4J	**	**
35R	01-Jun-90	19	—	**	140	—	—	—	4J	—	**	**
35R	01-Jun-91	53	—	**	320D	—	—	—	12J	—	**	**
35R	24-May-94	290	26	—	790	—	—	—	25	—	31	**
35R	08-Jan-97	17	4J	—	120	—	—	—	1J	—	NA	NA
35R	21-Mar-97	—	3J	5	23	3J	—	—	5	6	NA	NA
	4/98	170			1000						30	870
36D	01-Jan-85	—	**	—	—	—	—	—	2J	—	**	**
36D	15-Jun-90	—	**	—	—	—	—	—	—	—	**	**
36D	01-Oct-90	—	**	—	—	—	—	—	4J	—	31	44J
36D	01-Jun-95	—	—	—	—	12	—	—	1J	3J	20.6	—
36D	03-Apr-96	—	—	—	—	—	—	—	—	—	5.7	—
37D	01-Jan-85	620	**	58.0	87,000	430	6J	—	200	270	**	**
37D	19-Jun-90	1,000J	**	—	2,300	—	—	—	150J	—	53.53	9,610
37D	10-Oct-90	3,100J	270	1,500	3,800	2,600	210	—	630	3,100	44	6,010J
37D	01-May-91	2,300	950	1,100	750	840	383	—	160	2,200	26.8	6,590
37D	24-May-94	290	26	—	790	—	—	—	25	—	31	**
37D	25-May-95	98	—	190	28	41	130	—	330	6J	31.1	4,900
37D	23-Aug-95	28	100	68	—	—	91	—	320	—	NA	NA
37D	03-Apr-96	—	89	33	—	—	47	—	—	—	26	4,000
37D	12-Aug-96	—	52	—	—	—	35	—	120	—	NA	NA
37D	08-Jan-97	21	39	10	7J	—	38	—	87	—	NA	NA
37D	21-Mar-97	—	43	14J	—	—	36	—	97	—	NA	NA
	4/98		7.6				7.6		19		766	310
38D	01-Jan-85	2J	**	7J	—	17	—	—	—	58	**	**
38D	15-Jun-90	—	**	—	—	—	—	—	—	—	**	**
38D	01-Oct-90	—	**	—	—	—	—	—	—	—	26	446J

See notes on page 8

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Table 5. Historical Summary of Selected Compounds Detected in Groundwater Samples Collected from Monitoring Wells, 1985 through 1997, Tibbetts Road Site, Barrington, New Hampshire.

		Volatile Organic Compounds (µg/L)									Metals (µg/L)	
Well Designation	Sample Date	Benzene	cis-1,2-Dichloroethene	Ethylbenzene	4-Methyl-2-pentanone	Toluene	Tetrachloroethene	1,1,1-Trichloroethane	Trichloroethene	total Xylenes	As	Mn
49S	01-Jan-85	2J	**	5J	---	20.0	---	—	—	52.0	**	**
49S	15-Jun-90	—	**	---	---	—	—	—	—	—	**	**
49S	10-Oct-90	—	**	—	—	—	---	—	—	—	25	1,090
50S	01-Jan-85	6J	**	---	—	22.0	---	—	—	52.0	**	**
50S	15-Jun-90	41J	2J	360EJ	—	330EJ	---	—	---	760EJ	**	**
50S	10-Oct-90	2,200	**	**	940	**	3,200	**	**	**	**	**
50S	10-Oct-90	140J	**	940	---	2,200	---	—	—	3,200	185	12,400J
50S	08-Feb-94	22	—	490	—	62	[illegible]	—	[illegible]	>1,400	41	**
50S	03-Jun-95	21J	—	370	---	7J	[illegible]	—	[illegible]	720	300	6,130
50S	28-Nov-95	32	---	670	---	240	[illegible]	—	[illegible]	1,700	NA	NA
50S	02-Apr-96	[illegible]	[illegible]	780	---	---	[illegible]	—	[illegible]	2,200	320	7,900
50S	07-Aug-96	[illegible]	—	300	---	---	[illegible]	---	[illegible]	680	NA	NA
50S	08-Jan-97	16	---	230	4J	3J	—	—	—	360	NA	NA
50S	21-Mar-97	44J	[illegible]	620	---	34J	[illegible]	—	[illegible]	1,200	NA	NA
	4/98	<25	ND	310		ND	<25		<50	590	370	7100
51S	01-Jan-85	120	**	---	210	1,000	—	—	—	4,800	**	**
51S	19-Jun-90	---	**	—	10,000J	---	---	—	—	—	50.8J	6,680
51S	10-Oct-90	28J	**	450	---	2,500	---	---	—	2,200	165	3,710J
51S	30-May-95	[illegible]	[illegible]	3,400	850J	18,000	[illegible]	[illegible]	[illegible]	12,000	139	7,410
51S	28-Nov-95	[illegible]	—	270	---	580	[illegible]	—	[illegible]	2,000	NA	NA
51S	10-Apr-96	[illegible]	[illegible]	4,000	---	7,800	[illegible]	[illegible]	[illegible]	23,000	140	8,700
51S	14-Aug-96	[illegible]	[illegible]	2,300	---	17,000	[illegible]	[illegible]	[illegible]	11,000	NA	NA
51S	08-Jan-97	[illegible]	[illegible]	1,300	---	15,000	[illegible]	[illegible]	[illegible]	11,000	NA	NA
51S	20-Mar-97	[illegible]	[illegible]	1,600J	[illegible]	12,000	[illegible]	[illegible]	[illegible]	10,000	110	8,000
	4/98	<100	<100	780	ND	[illegible]	<100		<100	[illegible]	[illegible]	[illegible]
52S	01-Jan-85	1,700	**	—	47,000	5,200	18J	—	84J	750	**	**
52S	01-Jan-85	1,700	**	—	96,000	8,100	—	—	—	1,500	**	**
52S	15-Jun-90	960J	**	---	---	12,000J	—	—	310J	—	30.1J	12,600
52S	10-Oct-90	1,100	200J	880	—	4,600	130J	—	300	2,000	150	18,600J
52S	01-May-91	200	180	110	---	880	---	—	19J	290	63.6	8,910
52S	24-May-94	3.8	1.6	4.3	---	---	3.2	—	4.2	3.9	—	**
52S	30-May-95	2J	8J	2J	---	---	10	—	20	—	—	1,430
52S	28-Nov-95	—	---	—	---	---	---	—	---	---	NA	NA
52S	03-Apr-96	—	---	—	---	---	---	—	—	---	---	150
52S	13-Aug-96	---	—	---	---	---	---	—	---	---	NA	NA
52S	08-Jan-97	---	---	---	---	---	---	—	---	—	NA	NA
52S	21-Mar-97	---	---	—	---	2J	---	—	—	—	NA	NA
	4/98	ND									217	97

See notes on page 8.

Table 5. Historical Summary of Selected Compounds Detected in Groundwater Samples Collected from Monitoring Wells, 1985 through 1997, Tibbetts Road Site, Barrington, New Hampshire.

Well Designation	Sample Date	Volatile Organic Compounds (µg/L) Benzene	cis-1,2-Dichloroethene	Ethylbenzene	4-Methyl-2-pentanone	Toluene	Tetrachloroethane	1,1,1-Trichloroethane	Trichloroethene	total Xylenes	Metals (µg/L) As	Mn
53S	01-Jan-85	23	**	--	19	83	--	--	--	36	**	**
53S	15-Jun-90	--	**	--	--	--	--	--	--	--	**	**
53S	01-Oct-90	--	**	--	--	--	8	--	10	--	17	336J
53S	01-May-91	--	**	--	--	--	--	--	--	--	3.6	48
53S	24-May-94	--	--	--	--	--	3.3	--	1.4	--	--	**
53S	08-Apr-96	--	--	--	--	--	--	--	--	--	--	33
53S	13-Aug-96	--	--	--	--	--	--	--	--	--	NA	NA
53S	08-Jan-97	--	--	--	--	--	--	--	--	--	NA	NA
53S	21-Mar-97	--	--	--	--	--	--	--	7	--	NA	NA
	4/97	all ND									ND	37
54S	01-Jan-85	--	**	--	--	13	--	--	--	--	**	**
54S	15-Jun-90	--	**	--	--	--	--	--	--	--	**	**
54S	01-Oct-90	--	**	--	--	--	--	--	--	--	18	760J
54S	28-Nov-95	--	--	--	--	--	--	--	--	--	NA	NA
54S	10-Apr-96	--	--	--	--	--	--	--	--	--	--	67
54S	08-Aug-96	--	--	--	--	7	--	--	--	7	NA	NA
57S	01-Jan-84	344	**	1,319	250	18,655	--	--	10,361	10,790	**	**
57S	01-Jan-84	--	**	1,989	NA	37,322	--	--	13,091	11,287	**	**
57S	01-Jan-85	1,900	**	4,700	21,000	140,000	810J	--	27,000	28,000	**	**
57S	19-Jun-90	170J	**	--	--	--	--	--	--	--	85.0J	19,900
57S	01-Oct-90	160	4,000	1,700	--	7,700	--	--	7,800	5,400	97	16,800J
57S	14-Feb-92	**	**	**	**	**	**	**	**	**	0.086	**
57S	14-Feb-92	**	**	**	**	**	**	**	**	**	--	**
57S	08-Feb-94	[illegible]	18,000	1,800	--	28,000	[illegible]	[illegible]	3,200	8,400	120	**
57S	28-May-95	100J	15,000	760	--	250J	[illegible]	[illegible]	7,200	220J	113	14,000
57S	29-Nov-95	[illegible]	9,400	--	--	--	[illegible]	[illegible]	3,800	--	NA	NA
57S	08-Apr-96	[illegible]	6,900	350	--	1,200	[illegible]	[illegible]	2,700	290	1,300	16,000
57S	07-Aug-96	[illegible]	1,900	--	--	--	[illegible]	[illegible]	[illegible]	--	190	13,000
57S	08-Jan-97	21J	1,300	200	--	--	[illegible]	--	2,000	770	NA	NA
57S	20-Mar-97	[illegible]	[illegible]	2,200J	[illegible]	37,000	[illegible]	[illegible]	8,700	12,000	160	18,000
	4/97		1400	3400		26,000			6,300	6,300	170	19000
58S	01-Jan-84	--	**	--	--	--	--	--	--	--	**	**
58S	01-Jan-84	--	**	--	--	--	--	--	--	--	**	**
58S	01-Jan-85	--	**	--	--	--	--	--	--	--	**	**
58S	15-Jun-90	--	**	--	--	--	--	--	--	--	--	2,200
58S	10-Oct-90	--	**	--	--	--	--	--	--	--	20	836J
58S	06-Jun-93	[illegible]	--	--	--	--	[illegible]	--	[illegible]	--	--	8.0B

See notes on page 8.

Table 5. Historical Summary of Selected Compounds Detected in Groundwater Samples Collected from Monitoring Wells, 1985 through 1997, Tibbetts Road Site, Barrington, New Hampshire.

Well Designation	Sample Date	Volatile Organic Compounds (µg/L): Benzene	cis-1,2-Dichloroethene	Ethylbenzene	4-Methyl-2-pentanone	Toluene	Tetrachloroethane	1,1,1-Trichloroethane	Trichloroethene	total Xylenes	Metals (µg/L): As	Mn
59R	01-Jan-84	—	—	••	—	—	—	—	—	—	••	••
59R	01-Jan-84	—	—	••	—	—	—	—	—	—	••	••
59R	01-Jan-85	—	—	••	—	—	—	—	—	—	••	••
59R	01-Jun-90	—	—	••	—	—	—	—	—	—	••	••
60S	01-Jan-84	702.5	••	1,500	3,440	6,500	—	—	26.4	4,000	••	••
60S	01-Jan-84	741	••	3,346	NA	49,169	—	—	636	15,556	••	••
61R	01-Jan-84	—	••	••	20.5	5.3	—	—	—	—	••	••
61R	01-Jan-84	—	••	••	—	29.1	—	—	—	—	••	••
61R	01-Jan-85	—	••	••	—	—	—	—	16	—	••	••
61R	01-Jun-90	2J	••	••	—	—	—	—	5.0	—	••	••
61R	02-Jun-95	2J	2J	—	—	—	—	—	28	2J	26	134
61R	01-Apr-96	—	—	—	—	—	—	—	17	—	26	170
62S	01-Jan-84	—	••	—	5.4	—	—	27.8	—	—	••	••
62S	01-Jan-84	—	••	—	—	—	—	18.5	—	—	••	••
62S	01-Jan-85	4J	••	—	—	—	—	—	33	—	••	••
62S	15-Jun-90	—	••	—	—	—	—	—	21J	—	24.7J	7,800
62S	10-Oct-90	—	••	—	—	—	—	—	—	—	—	254J
63R	01-Jan-84	11.8	—	••	—	5	—	—	23.1	—	••	••
63R	01-Jan-84	33.5	—	••	—	—	—	—	77.5	—	••	••
63R	01-Jan-85	14	—	••	2J	2J	—	—	310	—	••	••
63R	01-Jun-90	14	—	••	—	—	—	—	45	—	••	••
64S	01-Jan-84	—	••	—	—	—	—	—	—	—	••	••
64S	01-Jan-84	—	••	—	—	—	—	—	—	—	••	••
64S	01-Jan-85	—	••	—	—	—	—	—	—	—	••	••
64S	01-Jun-90	••	••	••	••	••	••	••	••	••	—	1,890
64S	01-Jun-90	—	••	—	—	—	—	—	—	—	••	••
64S	10-Oct-90	—	••	—	—	—	—	—	—	—	—	441J
65R	01-Jan-84	122.6	7.2	••	130	24.8	—	14.1	327.2	—	••	••
65R	01-Jan-84	236	—	••	NA	—	—	—	629	—	••	••
65R	01-Jan-85	200	—	••	210	2J	2J	—	650	—	••	••
65R	01-Jun-90	39	—	••	43	4J	—	—	110	—	••	••
65R	13-Aug-96	140	95	—	130	—	—	—	72	6	17	1,300
		5	70						5		50	3650

See notes on page 8.

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Table 5. Historical Summary of Selected Compounds Detected in Groundwater Samples Collected from Monitoring Wells, 1985 through 1997, Tibbetts Road Site, Barrington, New Hampshire.

Well Designation	Sample Date	Volatile Organic Compounds (µg/L): Benzene	cis-1,2-Dichloroethene	Ethylbenzene	4-Methyl-2-pentanone	Toluene	Tetrachloroethene	1,1,1-Trichloroethane	Trichloroethene	Total Xylenes	Metals (µg/L): As	Mn
67R	01-Jan-84	—	—	**	---	—	—	—	6.4	—	**	**
67R	01-Jan-84	6	—	**	---	—	—	—	5	—	**	**
67R	01-Jan-85	27	—	**	33	—	—	—	26	—	**	**
67R	01-Jun-90	33	—	**	---	—	—	—	9	—	**	**
67R	14-Feb-92	**	**	**	**	**	**	**	**	**	18	**
67R	14-Feb-92	**	**	**	**	**	**	**	**	**	13	**
67R	29-May-95	33	—	---	14	61	<10	—	57	27	—	53
67R	05-Apr-96	—	—	---	---	---	---	—	---	—	—	26
68S	01-Jan-84	575.2	**	130	19,000	2,370	---	—	771.6	1,046	**	**
68S	01-Jan-84	2,573	**	---	NA	11,938	—	---	—	---	**	**
69R	01-Jan-84	500	**	**	18,800	3,300	10.6	---	3,000	500	**	**
69R	01-Jan-84	473	**	**	NA	893	---	—	1,415	—	**	**
69R	19-Jun-90	4901	**	**	5,500	---	—	—	---	—	31.6J	3,880
69R	01-Oct-90	2,800	1,000J	**	41,000J	5,400	—	220J	650J	—	80	2,880J
69R	01-Jun-91	4,000	1,700J	**	53,000B	9,100	—	---	—	2,900	**	**
69R	24-May-94	3,500	1,100	310	>10,000	4,600	<10	—	<10	1,300	114	**
69R	31-May-95	2700J	<10	<10	51,000	7,300	<10	<10	<10	—	135	5,330
69R	05-Apr-96	2,100	1,100	--	—	1,900	<10	—	<10	230	960	6,600
69R	14-Aug-96	4,100	1,300	360	---	690	<10	—	<10	1,800	160	7,500
69R	08-Jan-97	5100	1,100	290	---	400	<10	—	<10	1,400	NA	NA
69R	21-May-97	6300	1,800	790	---	740	<10	<10	170J	3,500	NA	NA
	4/98	3600	720		26000	12000				1700	120	4[illegible]
70S	01-May-91	**	**	7	**	87	33	**	41	23	17.6J	6,890
70S	08-Feb-94	610	410	660	---	3,700	180	—	430	1,300	14	**
70S	27-May-95	260	460	700	—	320	310	—	500	900	79.4	14,300
70S	23-Aug-95	---	7	13	---	---	10	—	15	23	NA	NA
70S	29-Nov-95	---	—	---	---	---	---	—	—	—	NA	NA
70S	04-Apr-96	---	—	---	---	---	---	—	—	—	—	700
70S	07-Aug-96	---	—	—	---	---	---	—	---	—	NA	NA
70S	08-Jan-97	---	—	—	---	—	---	—	—	—	NA	NA
70S	21-May-97	—	---	---	---	—	—	—	—	—	NA	NA
	4/98	ND									ND	220-270
71S	01-May-91	—	**	—	---	28J	---	—	138	---	17.5	1,470
71S	14-Feb-92	**	**	**	**	**	**	**	**	**	0.006	**
71S	14-Feb-92	**	**	**	**	**	**	**	**	**	---	**
71S	29-Nov-95	---	---	---	---	---	—	—	—	—	NA	NA

50 3650

See notes on page 8.

Table 5. Historical Summary of Selected Compounds Detected in Groundwater Samples Collected from Monitoring Wells, 1985 through 1997, Tibbetts Road Site, Barrington, New Hampshire.

		Volatile Organic Compounds (µg/L)										Metals (µg/L)	
Well Designation	Sample Date	Benzene	cis-1,2-Dichloroethene	Ethylbenzene	4-Methyl-2-pentanone	Toluene	Tetrachloroethane	1,1,1-Trichloroethane	Trichloroethene	total Xylenes	As	Mn
72S	01-May-91	—	**	980	—	5,100	150J	—	—	2,800	84.9	15,600
72S	14-Feb-92	**	**	**	**	**	**	**	**	**	0.21	**
72S	03-Feb-94	[illegible]	520	1,200	—	760	310	—	[illegible]	2,300	64	**
72S	28-May-95	80J	1,600	3,200	—	2,300	52J	—	[illegible]	6,200	92.2	29,600
72S	29-Nov-95	[illegible]	820	1,500	—	6,300	[illegible]	—	[illegible]	3,500	NA	NA
72S	01-Apr-96	[illegible]	590	660	290	870	[illegible]	—	[illegible]	730	250	26,000
72S	07-Aug-96	[illegible]	130	140	—	—	[illegible]	—	[illegible]	72	NA	NA
72S	08-Jan-97	—	6	—	—	1J	4J	—	—	2J	NA	NA
72S	21-Mar-97	—	5	—	—	—	3J	—	—	9	NA	NA
	4/98	570			(23000)						34	2900
73S	01-May-91	—	**	1J	—	7	—	—	14	7	5	1,320
73S	14-Feb-92	**	**	**	**	**	**	**	**	**	—	**
73S	14-Feb-92	**	**	**	**	**	**	**	**	**	6	**
73S	14-Feb-92	**	**	**	**	**	**	**	**	**	9	**
73S	08-Feb-94	—	10	—	—	—	—	—	90	—	11	**
73S	08-Jan-97	—	—	—	—	—	—	—	—	—	NA	NA
	4/98		57						1700		ND	81
74S	01-May-91	—	**	—	—	—	—	22	—	—	10.2	474
75D	01-May-91	**	**	**	**	**	**	**	**	**	26.1	2,220
75D	01-Jun-91	2,900	**	**	74,000D	3,300	—	—	—	2,100J	**	**
75D	24-May-95	5J	—	3J	—	4J	89	—	69	—	20.9	1,210
75D	23-Aug-95	4J	61	3J	—	2J	79	—	62	2J	NA	NA
75D	29-Nov-95	45	150	—	—	—	120	—	100	7	NA	NA
75D	09-Apr-96	—	34	—	—	—	110	—	110	—	12	1,500
76R	01-May-91	—	**	**	—	3J	—	—	21	—	3.8J	97.7
77S	01-May-91	**	**	**	**	**	**	**	**	**	19.3	509
77S	01-May-91	—	**	—	—	—	—	—	—	—	**	**
77S	24-May-94	—	—	—	—	—	—	—	—	—	—	**
78R	01-May-91	—	**	**	—	3J	—	—	—	—	18.4	106
79S	01-May-91	15	**	1J	—	3J	53	—	53	140	5.8J	3,880
79S	08-Feb-94	—	—	—	—	—	—	—	—	—	5	**
	4/98	all ND									ND	2500

See notes on page 8.

Table 3. Historical Summary of Selected Compounds Detected in Groundwater Samples Collected from Monitoring Wells, 1985 through 1997, Tibbetts Road Site, Barrington, New Hampshire.

Well Designation	Sample Date	Volatile Organic Compounds (µg/L) Benzene	cis-1,2-Dichloroethene	Ethylbenzene	4-Methyl-2-pentanone	Toluene	Tetrachloroethene	1,1,1-Trichloroethane	Trichloroethene	total Xylenes	Metals (µg/L) As	Mn
80S	01-Jan-84	980	**	1,827	1,135	10,732	135	---	214	8,218	**	**
80S	01-Jan-84	1,468	**	1,945	NA	31,703	---	---	---	18,841	**	**
80S	01-Jan-85	4,100	**	3,700	39,000	98,000	343	---	1,100	29,000	**	**
80S	01-May-91	890	**	1,400	---	18,000	---	---	210J	6,700	21.9	6,370
80S	13-Feb-92	**	**	**	**	**	**	**	**	**	88	**
80S	13-Feb-92	**	**	**	**	**	**	**	**	**	9	**
80S	08-Feb-94	78	260	>330	---	27	34	---	35	>700	114	**
80S	07-Aug-96	---	---	---	---	---	---	---	---	---	NA	NA
81R	01-May-91	---	**	**	---	22	---	---	---	---	11.2	148
82S	01-May-91	11	**	---	---	---	---	---	---	---	22.1	297
83S	01-May-91	---	**	---	---	---	---	---	---	---	32.7	3,290
84S	27-May-95	150J	390J	810J	760J	12,000	[illegible]	[illegible]	[illegible]	2,400	446	17,400
84S	23-Aug-95	130J	800	1,100	---	7,100	[illegible]	[illegible]	[illegible]	---	NA	NA
84S	29-Nov-95	---	67	47	---	16	6	---	6	47	NA	NA
84S	02-Apr-96	[illegible]	---	200	---	33	[illegible]	---	[illegible]	470	160	3,600
84S	07-Aug-96	---	26	---	---	---	---	---	---	---	NA	NA
84S	08-Jan-97	---	---	---	---	---	---	---	---	---	NA	NA
84S	20-Mar-97	---	---	33	---	13	---	---	---	31	170	1,800
	4/98		ND-5.4?							9.9?-10	160	2200-23?
87S	08-Feb-94	---	---	---	---	---	---	---	---	---	10	**
88S	07-Aug-96	---	---	---	---	---	---	---	---	---	NA	NA
103R	27-May-95	750J	[illegible]	[illegible]	32,000	900J	[illegible]	[illegible]	[illegible]	---	19.3	1,450
103R	01-Apr-96	[illegible]	[illegible]	[illegible]	36,000	[illegible]	[illegible]	[illegible]	[illegible]	---	42	2,600
105D	28-May-95	[illegible]	---	---	---	---	[illegible]	---	[illegible]	---	---	13.0B
105D	03-Apr-96	---	---	---	---	---	---	---	---	---	---	---
106R	08-Jun-95	13	---	---	---	---	[illegible]	---	12	---	8.1B	13.0B
106R	23-Aug-95	10	---	---	---	---	---	---	21	---	NA	NA
106R	28-Nov-95	13	8	---	---	---	---	---	7	---	NA	NA
106R	02-Apr-96	---	---	---	---	---	---	---	---	---	---	21

See notes on page 8.

Table 5. Historical Summary of Selected Compounds Detected in Groundwater Samples Collected from Monitoring Wells, 1983 through 1997, Tibbetts Road Site, Barrington, New Hampshire

Well Designation	Sample Date	Volatile Organic Compounds (µg/L): Benzene	cis-1,2-Dichloroethene	Ethylbenzene	4-Methyl-2-pentanone	Toluene	Tetrachloroethene	1,1,1-Trichloroethane	Trichloroethene	total Xylenes	Metals (µg/L): As	Mn
107R	06-Jun-95	<10	—	—	—	—		—	<10	—	NA	NA
107R	23-Aug-95	—	—	—	—	—		—	—	—	NA	NA
107R	09-Apr-96	—	—	—	—	—		—	—	—	14	360
108R	07-Jun-95	<10	—	—	—	—		—	<10	—	59.9	22
108R	09-Apr-96	—	—	—	—	—		—	—	—	15	120
109R	05-Jun-95	<10	—	—	—	—	<10	—	<10	—	35	48
109R	09-Apr-96	—	—	—	—	—	—	—	—	—	24	18
110S	07-Jul-95	<10	—	—	—	—	<10	—	<10	—	—	79
110S	25-Aug-95	—	—	—	—	—	—	—	—	—	NA	NA
110S	16-Apr-96	—	—	—	—	—	—	—	—	28	—	20
110S	17-Aug-96	—	—	—	—	—	—	—	—	—	NA	NA

— Below reporting limit. Reporting limit is less than the Interim Groundwater Cleanup Level (ICL) established by the USEPA (1992).
a Data not available.
115 Boldface value is greater than the ICL.
J Estimated concentration.
B Constituent was detected in the associated method blank.
<10 Value is below reporting limit. Reporting limit is greater than the ICL.
NA Not analyzed.
µg/L Micrograms per liter.

Contaminant Concentrations along flowpath 57S to 35R (Flow is from 57S to 72S to 70S to 52S to 37D to 53S and 69R, lastly 35R)			
Well	Concentration (in parts per billion) of Trichloroethylene / Toluene Benzene / Ethylbenzene 4-methyl-2-pentanone Arsenic / Manganese		Cleanup Level
	1995	1998	
57S	7200 / 250 100 / 760 no data 113 / 14000	6500 / 28000 <1000 / 2400 <1000 170 / 19000	5 / 1000 5 / 700 1825 50 / 3650
72S	<200 / 6300 80 / 3200 not detected 92 / 29600	<1000 / not detected 530 / not detected 23000 34 / 2900	
70S	500 / 320 260 / 700 not detected 79 / 14200	all below detection limits and cleanup levels <20 / 220	
52S	20 / not detected 2 / 2 not detected not detected / 1430	all below detection limits and cleanup levels 2.7 / 97	
37D	330 / 41 98 / 190 28 31 / 4500	14 / not detected <25 / not detected not detected 36 / 3100	
53S	1.4 / not detected not detected / not det. not detected not detected	all below detection limits and cleanup levels <20 / 37	

Contaminant Concentrations along flowpath 57S to 35R (Flow is from 57S to 72S to 70S to 52S to 37D to 53S and 69R, lastly 35R)			
Well	Concentration (in parts per billion) of Trichloroethylene / Toluene Benzene / Ethylbenzene 4-methyl-2-pentanone Arsenic / Manganese		Cleanup Level
	1995	1998	
69R	<1000 / 7300 2700 / <4000 51000 135 / 5300	<1000 / 12000 3600 / <700 26000 120 / 4600	
35R	25 / not detected 290 / not detected 790 31 / no data	<50 / not detected 130 / not detected 1000 30 / 870	

APPENDIX E

RESPONSIVENESS SUMMARY

RESPONSIVENESS SUMMARY

Tibbetts Road Site
Barrington, New Hampshire

Prepared by

U.S. ENVIRONMENTAL PROTECTION AGENCY NEW ENGLAND
Office of Site Remediation and Restoration
Boston, MA

August 31, 1998

The Amended ROD changes the remedy from active, remedial measures to passive natural processes. Since the completion of a water treatment plant and distribution system in 1987, the public's main concern has been the physical appearance of the Site.

Following Site discovery (1985) until active cleanup by Ford (1995) the Site consisted of two overgrown acres, a boarded up, partially burned out, dilapidated house, piles of debris and tires, all surrounded by an eight-foot chain-linked fence topped with three strands of barbed wire. The Site contrasted quite starkly with the surrounding residential neighborhood. Meetings with the public were attended primarily by neighbors abutting the Site, who stressed that their primary concern was the appearance of the Site as well as its potential as an attractive nuisance for children.

During Ford's remedial activities the debris, house, and vegetation were removed from the Site. The portion of the fence facing the neighborhood was replaced by a less obtrusive six-foot horse fence. Ford paved the Site to enhance the vacuum extraction remedy and landscaped the perimeter. Landscaping efforts by Ford included the hiring of an arborist to prune a large sugar maple, to improve the appearance of the Site. During the Site remediation, EPA held meetings or sent letters at appropriate junctures to let the public know what was occurring. In June of 1997, Ford hosted a picnic at the Site to discuss their future remediation plans with nearby residents. At the June 1997 meeting, Ford stated that they hoped to finish the ground water remedy using a combination of natural processes (e.g., bioremediation and phytoremediation). All of the neighbors concurred with this proposal, including one neighbor who expressed a desire for Ford to clear some brush so that she might better see the Site from her house once the phytoremediation remedy was in-place.

On June 24, 1998 EPA held a public meeting and hearing where EPA identified to the public that it was considering changing the remedy for the groundwater from vacuum extraction and pump-and-treat to bioremediation and phytoremediation, to complete the cleanup process. One oral and written comment was received at the hearing. Both of the comments were from the same person, a resident located across the street from the Site. The comments were about the fence at the Site and requested that "the fence must come down." EPA had originally proposed that the fence be retained to protect the phytoremediation remedy, young poplar trees, from marauding deer. After conferring with Ford a compromise was reached, and EPA asked that the fence closest to the street be taken down. Based on subsequent conversations with the individual who had the comment his concerns appear to have been addressed.

In trying to keep with the concerns of surrounding neighbors the pavement over the Site was removed. As of August 31, 1998 approximately 1,400 poplar trees, four to six feet in height, were planted at the Site. A thin ground cover has also been planted and the trees and ground cover are being watered through an irrigation system. The Site is surrounded on three sides by a fence. The fence on the south side which immediately faces a residence has been removed. Ford will continue to monitor the trees and if deer predation becomes a problem Ford has agreed to install a three-rail wooden fence which would fit in better with the surrounding neighborhood.

The transcript of the public meeting and hearing is attached as Attachment A. The single comment letter has been attached as Attachment B.

ATTACHMENT A

ORIGINAL

TIBBETTS ROAD SUPERFUND SITE

Barrington, New Hampshire

Public Meeting/Hearing

June 24, 1998

Darryl Luce, U.S. Environmental Protection Agency
Thomas Andrews, N.H. Department of Environmental Services
Peter Jalajas, Arcadis, Geraghty & Miller, Inc.

PROCEEDINGS

MR. LUCE: Good evening. My name is Darryl and I'm with the EPA, and what we're here for tonight is to discuss site progress at the Tibbetts Road site and where we hope to go in the future.

This isn't a project that's just been EPA'd, as you're probably well aware. Also been involved is Tom Andrews of the Department of Environmental Services. The State's been involved with us in site discovery. Also along with him tonight is Carl Baxter on the right side and Paul Lincoln on the left, more as an observer.

Okay, let's see. There is going to be the person doing most of the work there, Geraghty & Miller, Peter Jalajas. I know several of you have dealt with him on many occasions. They've done the site work since approximately 1994. Let's see.

In 1992 we had a similar public meeting, I think in this building, but not in this part, where we outlined what we were going to do in terms of a remedy, or what we hoped to do at that time for a remedy. I hope this can all be seen, but essentially, this is Hall Road right here, Tibbetts Road. I'm sure you're well familiar with how the site is laid out. North is at the top of the map. The fence I've sort of done in pencil around here.

And the remedy, as we proposed it at that time, was going to be a set of interception trenches because this is a hilltop right here with groundwater flowing to either crest, off of either crest, so we were going to put interception trenches on either side or wells sufficient to keep groundwater from migrating off the site.

At the same time, we were going to put in a vacuum extraction system which would pump water and air, cleaning up both groundwater and the air in the soil, taking the contaminants out of it. And I've put these three, A, B, C, here. These were, as I'm sure again you're all very familiar with, the three main drum storage areas. B was perhaps the one that was the most active and the most contaminated where most of the contaminants were stored and then eventually spilled.

In cross-section, I've drawn a little cross-section, here's the hilltop, and I should have put Tibbetts Road over on one side or the other, but the trenches were going to be going, like I said, on the flanks of the hill, the vacuum extraction in the center, the idea being to lower the water table so that we wouldn't have off-site migration contaminants and then we'd also have recovery in the center.

This water table was bounded at the bottom by this what I've labeled as dense till. And, actually, I've brought some of it because at the time I was very taken with it. When we drilled down about twenty feet through the water table, we got into that dense till and this stuff was like concrete. I mean this was essentially underneath the water table and very resilient material like concrete and in dropping a three hundred pound hammer on it, we were only going about one inch for every hundred blows of the hammer. I remember it was very tough. I talked to a couple of people in terms of what this was because I'm from the mid-west and I'd never seen anything like that. It's a lodging till, so that the glacier could literally ground into a pocket of the bedrock. So that's what was the bounding layer underneath to keep the contamination from going deeper down into the bedrock at that point.

And then in 1994 EPA settled with Ford Motor Company and Ford Motor Company, through their contractor, Geraghty & Miller, began doing work at the site. And what they did, again, as I'm sure you're familiar with, is removed a lot of the surface material, two hundred and thirteen tons of non-hazardous debris, rubble, that was at the site, four hundred tires, a number of drums that contained things like ash that was from the incineration, the PCB contaminated soil that was located in that area, just miscellaneous waste; for instance, some of the activated carbon filters that were going to be used, I guess, for the alternative to the water treatment plan before that was the final remedy there. So they took all those materials off site.

Eventually, we also got the house off site, I imagine much to many of your pleasure, and the lead contaminated wood from there, the lead-painted wood, was taken to a separate facility for disposal there.

Tom and I at that time, when we were doing the oversight, we were going up there on a monthly basis and also reviewing the reports that they had submitted regarding the progress at the site.

In 1995 they started the vacuum extraction pilot test. And what that was to do, what that did, was not only right here, but also in Area A and C there were wells installed that pumped both air and water in as fast a rate as we could at that site because it doesn't yield much water. Five gallons a minute was pretty much all we were getting for the whole area. And what that did was it approximated pretty much what these trenches would have done; namely it de-watered, kept contaminants from migrating from the site.

And the vacuum extraction that they were doing, as we saw, the site was capped, it was paved, essentially, with asphalt, the one point nine acres, and it turned out to be a very efficient system, so we let them run it at full speed to test this system and see what it would do and it operated real well. It took out eight hundred pounds of contaminants from the subsurface, as you've seen in the write-up of the proposed plan. And at its peak operation, which I think was in late '95, it was taking out about three and a half pounds of contaminants a day.

Now, towards the end we were only recovering about an ounce per day and that was with the best positioning that had been done. Geraghty & Miller had gone in there and positioned these wells based on hydropunch and geoprobes; mainly, they've gone in there and dug some temporary holes or drilled very small temporary holes to measure the contaminants and see where things were lying. And so that way they optimized the system and really got just about all that could be got.

So with the vacuum extraction system having been so successful, the surface debris removed from the site, you're saying why are we here tonight. And what it comes down to is there is still contamination at the site and in the groundwater and the vacuum extraction is really not any more efficient in collecting it. Like I said, an ounce a day, that's not something that you can easily justify keeping the site paved, running a fifty horse motor in there, and even driving up there, you almost would cause as much pollution as what we'd be recovering out of the groundwater.

So what we're looking to do and what you've seen out there is using phytoremediation and bioremediation at the site. Now, I know you see out there there's already the trees planted and you're saying well, it looks like they've already really made up their minds, but that's not the case there; because what we can do is if there's any localized concentrations, regardless of whether we say yes, we have to do something active or if we say eventually we'd say yes, we'll do the phytoremediation, then if there is a localized concentration that we find to be hazardous, a threat to health, then we'll go in and do a spot removal, mainly put down a temporary cap, sort of like what we did in 1992 when we did the first pilot test of the vacuum extraction system, put down plastic with gravel on top of it, a well in the center that would be withdrawing the contaminants, and in that way reduce the contamination in that very local area.

Now, what the trees do, and this is something that's relatively new. In fact, when it was first brought up, it wasn't brought up so much for any reduction in contaminants, rather the idea of planting all these trees was to reduce the elevation of the water table. Now, you see on this diagram right here, again it's a cross-section, I've shown the root zone going down through these very schematically what I've labeled as Water Table One and Water Table Two.

Water Table One is the usual water table and can fluctuate through the column. As many of you know up there, in spring time usually the water table is just a part of the surface and then in the winter time there can be as much as -- or early fall there can be as much as eight feet down. So it's a fluctuating water table, but with the trees growing into this zone now, the idea is that they will reduce the amount of water in there and take the water table down to this zone. Now, when the leaves are not on the trees during the winter time, it can be expected that the water table will recover in part, maybe even as high as here. But during the summer time, again, it will de-water probably more efficiently, as you saw in the proposed plan, de-water more efficiently than the vacuum extraction.

Now, since this was first counted as something to be done just to reduce the water table, and when you reduce the water table, as I said before, then the migration of the contaminants is less, simply because there's not as much driving force to push them off. Now, when there's not as much driving force to push them off, that gives the bacteria, the microbes that are in there, longer times to work on the contaminants. I don't want to jump too far ahead.

Now, to stay with the phytoremediation for a minute, there's a couple of processes. You might ask well, if these trees pumping the water are contaminated, what happens to those contaminants in the water. Well, there's several papers I've read on the use of poplars, or, actually, I believe those species are cottonwood trees, and they've shown that the respiration that occurs, the transpiration, is simply nothing more than the oxygen and water; that the contaminants aren't seen at the leaf because they're metabolized by the tree itself when it takes it up. It's, I guess, a useable product. So they've never seen accumulation or transpiration from leaves and they haven't seen any accumulation of any contaminants in wood, other than possible low concentrations of iron and manganese. I've tried to approximate the color of poplar, but I think I've failed there.

The next zone, the next element of remedy, is not only phytoremediation, but bioremediation. In '92 when Tom and I first started working on the site, it was noticeable that there were some contaminants that were disappearing and other contaminants being produced. Those disappearing included the more heavily chlorinated ones like trichloroethylene and those being produced included the less chlorinated, like dichloroethane, 1, 2 dichloroethane. And at the time I had no idea what that meant and I had contacted some people in EPA's risk reduction laboratory out in Ada, Oklahoma. They had me collect samples in '92 back when we did that one vacuum extraction test and I took core samples down in this zone right here near the dense till. Those cores were taken into the laboratory there in Oklahoma and put through a microcausing test where they were kept in little viles. First of all, they were left for six months, I believe, just to let them equilibrate again.

And after that time, Doctor Wilson down there, he would drip in a certain amount of tagged trichloroethylene and other contaminants, too, from the site, benzene and the like, to see what would happen mixing with that material and, indeed, he saw percentage reductions of the contaminants per week. So that necessarily can't be extrapolated back to this situation entirely because travel times are much slower through here than they are in a laboratory setting because they want to see the results in a hurry. But they did see those results.

And so we knew we had phytoremediation going on here, probably sometime in '94. The thing is, at the time, though, the contamination was so plentiful that it was able to overwhelm, there were just too many Indians for the cowboys and they were able to run past the boundaries of the site. Hopefully, with the vacuum extraction at the time, we thought that we would be able to reduce that contaminate mass and that's indeed what happened; eight hundred pounds of contaminants were removed. So that will give the microbes there a little bit more of a foothold to reduce what remains. But now with the trees coming in here and reducing the water table, that will slow down the rate of groundwater flow off the site and give the microbes even more time to work.

There will be the aerodegradation that occurs up here above the water table where oxygen can get to it and where the trees can -- they'll have a root -- in the root zone, there's called a rhizosphere and a number of bacteria in there will be able to degrade some of the contaminants.

Down here, out of reach of the roots, what will happen is the bioremediation that was occurring naturally before we started any of this. Like I said, it'll just be more efficient now, and what that will be doing is it will be taking apart some of the contaminants like the toluene, gasoline components. And when it does that, there will be an enzyme produced and that's what destroys the trichloroethylene and the other chlorinated solvents and reduces that.

Just to give you an idea where things lie right now, the area of contamination, I couldn't think of really a good way to present this, but the area of contamination, as you all were aware of back in '85 through '90, really was flowing off of the top of the hill in each direction. The concentrations were very high, especially on this side where you saw concentrations as high as a hundred thousand parts per billion of trichloroethylene in 1986 and lower, but still plentiful concentrations on this side.

After the vacuum extraction, many of these areas were greatly reduced in concentration, but like I said, there are still some contaminants there. This area over here, on the second diagram I believe we'll see, this area now meets the cleanup levels, the drinking water standards. And I've just put in a few wells right here just more or less to orient, but 84S is the tip of the well right in the center and was the most contaminated and that well and the wells downgradient of it, 79S, probably should be more over in this direction, but I arted it in badly.

Those wells, like I said, meet the drinking water standards. These areas don't. However, the ideas with the planting of the trees, the contaminants will then be, like I said, degraded further and hopefully the concentrations there will be returned to the drinking water standards approximately within the time frame that we had talked about back in 1992. In 1992 we had said that the cleanup levels would be reached in twenty years and I use that as an upper sealing now. I know I put in the proposed plan there the seven to eight year figure, but that could be viewed as maybe an optimistic figure.

Now, Pete Jalajas of Geraghty & Miller just came in a few minutes ago and if you have any questions, we'll be happy to entertain those. Yes?

AUDIENCE: What do the little wet yellow flags indicate?

MR. LUCE: Pete, could you come up here?

MR. JALAJAS: The question was, what are the little wet yellow flags on part of the property there. Those represent locations where we hammered in six inch pieces of the poplar trees, which are then hand drilled. Other than plant the four foot width, which would be inside of the fence in a nice little grove, that was kind of an irregular area and those just mark it.

MR. LUCE: Yes?

AUDIENCE: I notice you have a proposed plan that talks about a prohibitation established by the district on the use of the groundwater for drinking purposes. How was that implemented, was that deed restrictions or just a zoning ordinance of some sort?

MR. LUCE: Just an ordinance to the --

AUDIENCE: Just a local ordinance?

MR. LUCE: Correct.

AUDIENCE: How is that monitored, verified, ensured it's not violated?

MR. LUCE: In terms of drinking water, the district itself, they do inspections, they now have meters, I believe, on all the houses. It's something that they're made aware of under the State's Groundwater Management Zone Rules. There's notification required so those people will know that they're not supposed to use it for drinking water purposes. I mean, it would be difficult to go out there and inspect, and I wouldn't want to do it, inspect people's yards to make sure there are no wells, but I know the water district would be very interested in possible cross-connections if there were something like that.

AUDIENCE: And on developing the natural accumulation process that you're going to use, did you follow the guidelines put forth in the latest EPA guidance on monitor natural accumulations and all those protocols?

MR. LUCE: Yes. Those are still draft and I know they may not be marked entirely. The last copy out is draft. And the guidelines involved in there are very -- they're suggestive.

There are no definitive guidelines proposed in there. Now, in this situation right here, there will be monitoring very specifically tailored to that, and in particular looking at water levels because phytoremediation is a key component of it, lowering the water table.

There's a lot of things that that draft guidance doesn't talk about. For instance, I had talked some about just very generally, and I'm no biologist and I know most biologists would probably scream, but anaerobic degradation in this zone is important. If that zone were to be aerobic, turned aerobic for some reason, then there wouldn't be any degradation or it certainly wouldn't be a quick degradation of contaminants and so some may migrate off site there. What turns in our favor there is the fact that usually down at those sort of depths, eighteen to twenty feet below the ground, the situation is anaerobic.

AUDIENCE: On the vapor extraction system, I noticed in the paper and you mentioned that efficiency had dropped off so it would be unique for a flat slope line or efficiency of operation, although maybe the clean-up goals or objectives weren't reached.

MR. LUCE: In the three areas they positioned a number of wells and repositioned wells based on geoprobe surveys to make sure that they were in the proper area, that namely you didn't have to drag the contaminants over a whole lot of the aquifer to withdraw them. So they were continually out there. I can think of two occasions of drilling just to find the better places to put them.

And, like I said, three and a half pounds per day was pretty much the maximum that they reached, that's a good recovery, and at the tail end of it about an ounce per day is what they were recovering in the flow rates and I can't remember exactly what the flow rate was at that point, but it reached an optimum point that several -- there were other EPA experts that I had consulted with before Geraghty & Miller was involved with this in terms of drawing up the scope of work with Ford Motor Company where what we did was look at where is really the pit of efficiency, where will you no longer be efficient. And what they had given me at that time was a figure of around a half a pound per day per hundred standard cubic foot removed and we were well underneath that for, actually, a year before we turned it off. It's just that Geraghty & Miller went out there and optimized it one more time, I believe, in terms of putting in some additional wells and operating others, such that they would draw out the most amount of contaminants.

AUDIENCE: The approach you're taking, I do concur with that, it's a rational evolution that you go ahead and try to remove the mass of the contaminants using the best means available, but once that becomes an inefficient operation, the next step in the process is monitoring, so it's a natural and I think it's a good evolution for clean-up, so don't get me wrong there, I think that's a positive approach.

MR. LUCE: Geraghty & Miller had first posed that to Tom and I in terms of saying we'll get out the mass and although I like snakes, they said we're going to cut off the head of the snake and then essentially the phytoremediation will be the polishing effort. Yes?

AUDIENCE: The water you're using for your irrigation system, that's the contaminated water that you're bringing back up?

MR. LUCE: That well is right over in this location and what that well represents is that well is drilled down two hundred and ten feet and the water down there is slightly contaminated, just barely above drinking water limits; however, the reason why it's contaminated isn't because of the bedrock down there, and this was seen when we did a geophysical test, is that there's a leak on one of the casings where it goes down through the sandy interval up above, before it gets in the bedrock there's a leak, so that that small trickle is what we've been sampling, that's what we believe. And so yes, it was slightly contaminated when it's brought out on the surface like that and put through the sprinklers. I mean there's really nothing much left of it.

AUDIENCE: So, I mean, could people open up their wells and use it to wash cars and water lawns and stuff with?

MR. LUCE: That's something that I think the district would be concerned with in terms of, again, potential cross-connections, and under the Groundwater Management Zone Rules, I'm not sure how that applies, either. I mean that's the operational regulation there is the State's Groundwater Management Zone and I mean, you know, in terms of operating a well like that, at any point you have to ask yourself, you know, what am I doing, will I hit a lucky fracture and draw the contaminants from the site in some fashion. I mean, you're right, watering, washing a car, it's not likely to be a big draw on the system, but it's the fact that you don't know what you're doing to the system right now.

Most of the contaminants are all in this area and the bedrock really doesn't hold much right now, but it's still something that I'd question, what am I pulling over and what's the value of that versus just using water that's supplied anyway.

AUDIENCE: But as long as you're using it on site, you don't think that it's being drawn into any other areas, then.

AUDIENCE: How long is the fence going to be up?

MR. LUCE: We had hoped to drop the fence and then the tree guy, Lou, who I guess you met last June, he said the deer will eat the trees up and so that's one of the reasons why we want to leave part of it up. I got Mr. Runde's comment regarding the fence and what I've talked to Pete Jalajas about is in terms of leaving up the three sides, the back, the two sides, and putting in something that's more aesthetically pleasing, a three railed fence or something up front so that it looks like a nursery, which is what it looks like now, and then a wooded lot in a couple years from now. And I don't know if that's something that would be possible, acceptable to you and acceptable to Ford. That's something we have to work out. I know when I went up there, there were a couple of other things that I talked to Pete about in terms of just more or less hiding things and he has no problem with that in terms of neating up the site a little bit.

MR. JALAJAS: All those things that Darryl mentioned here, our field people are doing their quarterly ground monitoring through the end of June here in the second quarter, so they're all really close. So come July we should see all these things happening.

MR. LUCE: Yes?

AUDIENCE: How far from the site do you have monitoring wells? I'm wondering if they've shown any changes with the incredibly hard rain that we've had which has caused a lot more groundwater. That's one question. I have a second, a different question.

MR. LUCE: Well, the first part is I know we've had some hard rains and I wouldn't expect to see anything right now. We have wells that are almost a half mile from the site. Whether they're effective wells, that I'm not certain of. I mean they've shown no contamination or very light contamination from what I believe may have been other sources. There's a well way down here that had benzene a long time ago that was not above the drinking water standards, but still benzene can come from a lot of other things, the main component of gasoline.

And then I know there was the Vances' house down here that was contaminated because principally there was a fracture that lies -- I believe it dips down this way and then runs along almost Hall Road and the campground down there at the time was pumping for all the residents and I think that was pulling in a lot of contaminants and so they had low contamination. They did have some that was over the drinking water standard and we haven't sampled that in some time. That's something that we will look to do in the future because we saw no reason to sample right now with no one drinking it and we wanted to concentrate our sampling efforts in here while we were doing the vacuum extraction to make sure that we were, again, optimizing the recovery there; again, removing the mass here so hopefully we don't see anything in the future.

Now, with the hard rain I wouldn't expect it to immediately affect this particular zone right here, simply because the rate of groundwater movement, approximately twenty feet per day at its very highest in this material right here. So that wouldn't have a big effect there. In the bedrock, in areas where it may outcrop, you would see a more immediate effect there, yes, and in terms of what that may do to the contaminants; because there's not much in the way of bedrock contamination, I don't think it would be, again, a lot. If there were to be any effect, I would think there would be a lag time after -- maybe a couple months after landing up here and having to get through this material and then out.

And the second part?

AUDIENCE: How long does it take the trees to get big enough to have the desired effect of decreasing the groundwater?

MR. LUCE: Well, I have a vague idea, but Pete, would you say two years?

MR. JALAJAS: More like three years to get big enough roots (inaudible).

MR. LUCE: They'll be water this year, so right, they won't be lowering the water table this year. I don't think anything could lower the water table this year. But in the future as the trees do start competing and moving down, that's what Lou Litka talked about, two to three years before we start seeing effective removal. Are there any other questions?

The next segment of this is what's going to be the public hearing portion. Typically, what we've done in the past for these sort of things is we have a public meeting and then a couple weeks after that a public hearing where we take comments. As described in the proposed plan there, with the comments what we're doing is just soliciting your ideas and input.

You not only have this opportunity to just comment out loud, but also you can send in your comments. Mr. Runde has already sent me one on the portion of the proposed plan that can just be mailed in to either Tom or I, but it would be nice to have it just come to me so that we've got just the one central area. Again, too, you can call us at any time. I know Mr. Boucher and Mr. Swier and Ms. Judwell have my phone number and Tom's, as well, so if there are any comments that anyone would like to make, though, we now formally open the public hearing; please step forward and state your name and what your comment is.

MR. RUNDE: I have a couple comments. Mr. Runde from Tibbetts Road. I'd like to know if the road that was damaged between my property and Stan's is going to be repaired. It was damaged this spring by the trucks coming in and out of the site.

I don't believe that there are going to be enough deer in that area to warrant leaving that fence up. That is a populated area and you don't have that many deer running through there. I think that's just a bunch of baloney. I think it's a ploy to keep the fence up and keep it as a test site. I'd just like to make that comment. I think it's a ploy for the EPA and these people to keep the fence up, to keep it as a test site longer than it should be. I don't believe it. I can't believe it. I don't see that many deer out there.

And those poplars, because I've worked with the forest service and I've planted many of those trees, even if they did eat a few of those leaves and branches, they will bounce right back the next year and actually help them to grow; because every place where you cut one of those branches, it will just branch off and make it better.

MR. LUCE: I should also state, too, that with the commentary we don't -- EPA and the State don't engage in -- it's not a question and answer. We'll take these comments and we will -- I should have stated this earlier -- and we'll put those in as an official response. So those comments that Mr. Runde made will be officially recorded in the record decision and we'll respond to it in writing in that same document. And once that document is done, it will be put in the Barrington Town Library. Thanks. Any other comments? Well, again, thank you for coming this evening and, again, if you have any questions, please give me a call or Tom a call. We're usually around to take any questions.

CERTIFICATE

I, Linda M. Lynn, do hereby certify that the foregoing instrument, numbered 1 through 20, contain a true and correct transcript, to the best of my knowledge, of tape recorded proceedings at the Barrington Elementary School, Barrington, New Hampshire, hereinbefore set forth, transcribed by me, from tapes identified as follows:

TAPE NO. 98-027

Dated at Wolfeboro, New Hampshire, this 26th day of June, 1998.

Linda M. Lynn, RPR
Notary Public
My commission expires: 10/18/2000

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ATTACHMENT B

Use This Space to Write Your Comments

EPA wants your written comments on the options under consideration for dealing with the contamination at the Tibbetts Road Superfund Site. You can use the form below to send written comments. If you have questions about how to comment, please call EPA Community Involvement Coordinator Sarah White at 617/ 565-9260. Send this form, or any other written comments, postmarked no later than July 24, 1998 to:

Darryl Luce
Remedial Project Manager
U.S. Environmental Protection Agency
Region I, (HBO)
JFK Federal Building
Boston, MA 02203

THE FENCE MUST GO WILL SETTLE FOR NOTHING LESS!

Comment Submitted

by: GEORGE R. RUNDLE

Address: 199 TIBBETTS RD BARRINGTON

APPENDIX F

ADMINISTRATIVE RECORD INDEX

Tibbetts Road
NPL Site

Administrative Record
for the
Amended Record of Decision

Index

Compiled: September 28, 1998

Prepared by
EPA-New England
Office of Site Remediation and Restoration

INTRODUCTION

This document is the Index to the Administrative Record for the remedial action at the Tibbetts Road Superfund Site. The citations in the Index are for those documents that EPA relied upon in selecting a response action at the Site. Site-specific documents are cited in Section I of the Index, and EPA guidance documents are cited in Section II. Documents cited in Section I of the Index are ordered by the Document Number that appears at the end of each citation.

The Administrative Record is available for public review at the EPA Region I Office of Site Remediation and Restoration (OSRR) Records Center in Boston, Massachusetts [(617) 573-5729], and the Barrington Public Library, Star Route, Barrington, NH 03285. This Administrative Record includes documents in the September 29, 1992 Administrative Record for this Site. EPA guidance documents cited in Section II are available for review only at the OSRR Records Center. The Staff of the OSRR Records Center recommends that you set up an appointment prior to your visit.

Questions concerning the Administrative Record should be addressed to the Project Manager for the Tibbetts Road Superfund Site.

An Administrative Record is required by the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA).

Section I

04.09 FEASIBILITY STUDY - PROPOSED PLANS FOR SELECTED REMEDIAL ACTION

Title: Proposed Plan to Amend the Cleanup Plan at the Tibbetts Road Superfund Site.
Authors: ENVIRONMENTAL PROTECTION AGENCY REGION 1
Date: June 1998
Format: FACT SHEET, PRESS RELEASE No. Pgs: 12
AR No. 04.09.1 Document No. 000007

05.04 RECORDS OF DECISION - RECORD OF DECISION

Title: Amended Record of Decision.
Authors: ENVIRONMENTAL PROTECTION AGENCY REGION 1
Date: September 28, 1998
Format: REPORT, STUDY
AR No. 05.04.1 Document No. 000008

06.04 REMEDIAL DESIGN - REMEDIAL DESIGN REPORTS

Title: Overburden Aquifer Pilot Testing Program Results.
Addressee: ENVIRONMENTAL PROTECTION AGENCY REGION 1
Authors: GERAGHTY & MILLER, INC.
Date: April 1996
Format: REPORT, STUDY No. Pgs: 393
AR No. 06.04.1 Document No. 000001

Title: Results of Pulsed Operation Phase.
Addressee: ENVIRONMENTAL PROTECTION AGENCY REGION 1
Authors: GERAGHTY & MILLER, INC.
Date: December 1996
Format: REPORT, STUDY No. Pgs: 48
AR No. 06.04.2 Document No. 000002

Title: Final Remedial Action Construction Report for Overburden Remedial System.
Addressee: ENVIRONMENTAL PROTECTION AGENCY REGION 1
Authors: GERAGHTY & MILLER, INC.
Date: June 1997
Format: REPORT, STUDY No. Pgs: 75
AR No. 06.04.3 Document No. 000003

Title:	Phytoremediation Design Report.		
Addressee:	DARRYL LUCE - ENVIRONMENTAL PROTECTION AGENCY REGION 1		
Authors:	ARCADIS GERAGHTY & MILLER		
Date:	April 1998		
Format:	REPORT, STUDY	No. Pgs:	187
AR No.	06.04.4	Document No.	000004

17.07 SITE MANAGEMENT RECORDS - REFERENCE DOCUMENTS

Title:	Design and Interpretation of Microcosm Studies for Chlorinated Compounds.		
Authors:	BARBARA H. WILSON, JOHN T. WILSON, DARRYL LUCE - ENVIRONMENTAL PROTECTION AGENCY		
Format:	REPORT, STUDY	No. Pgs:	8
AR No.	17.07.1	Document No.	000006

Title:	Uptake and Biotransformation of Trichloroethylene by Hybrid Poplars.		
Authors:	LEE A. NEWMAN, STUART E. STRAND, NAMI CHOE, JAMES DUFFY		
Date:	1997		
Format:	REPORT, STUDY	No. Pgs:	6
AR No.	17.07.2	Document No.	000005

Section II

GUIDANCE DOCUMENTS

The EPA guidance documents listed below were considered during the process of selecting the response action for the Tibbetts Road Superfund Site. These EPA guidance documents may be reviewed at the EPA Region I Office of Site Remediation and Restoration Records Center, 90 Canal Street, Boston, MA 02114.

1. CERCLA Compliance with Other Environmental Statutes, Porter, J.W. OSWER #9234.0-2. October 2, 1985. [3001]

2. CERCLA Compliance with Other Laws (Draft), Office of Emergency and Remedial Response. OSWER #9234.1-01. August 8, 1988. [3002]

3. Considerations in Ground Water Remediation at Superfund Sites. OSWER # 9355.4-03. October 18, 1989. [2410]

4. Ground-Water Protection Strategy, Office of Ground-Water Protection. (EPA/440/6-84-002). August 1, 1984. [2403]

5. Guidance on Remedial Actions for Contaminated Ground Water at Superfund Sites. OSWER #9283.1-2. December 1, 1988. [2413]

6. Suggested ROD Language for Various Ground Water Remediation Options, Longest II, Henry, Office of Emergency and Remedial Response. OSWER # 9283.1-03. October 10, 1990. [C206]

7. Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites. OSWER # 9200.4-17. December 1, 1997. [C473]