

Appendix M
Spill Volume Calculations
River Terrace Site Remedial Investigation

M RIVER TERRACE PCE SPILL VOLUME ANALYSIS

M.1 INTRODUCTION AND SUMMARY

The spill volume was evaluated to help estimate the rate PCE is attenuating from the site, the length of time remediation will be required, and to assess the likelihood that significant source areas remain on River Terrace Recreation Vehicle Park (RTRVP) property. The techniques used are not capable of discerning between a single spill of a specific volume, several spills of varying volumes, or a continuous leak.

Assumptions necessary to perform the analysis are documented as they apply. The spill volume analysis was performed using the following procedure:

- Media and the physical state of PCE were identified and presented in Section M.2.
- The likely volume of spill was assessed based on expected waste generation rates for a small dry cleaner, field reports, and literature information. Development of the volume estimate from literature sources and reports is contained in Section M.3 Volume Calculation Based on Literature Review.
- The volume of contamination volatilized, migrated off RTRVP property, excavated, and still present (based on site data) was calculated. This volume is termed the "accounted volume" in this evaluation. Development of the volume estimate based on site data is contained in Section M.4 Volume Calculation Based on Site Data. Contaminant migration and attenuation rates were developed for use in Section M.4 from site data and field tests presented in the remedial investigation.
- In Section M.5, Comparison of Volume Estimates with Spill Age, the possible spill volumes assessed in Section M.3 are compared to the "accounted volume" and attenuation rate data developed in Section M.4. A mass balance approach was used to determine what combinations of spill age and volume were credible given site data, attenuation rates, and literature information. Each mass balance calculation resulted in an "unaccounted volume" for each spill age and volume scenario. This "unaccounted volume" was considered potentially still present on site and the probable primary source of continued contamination in groundwater. Only certain combinations of spill volume and age were deemed credible after completion of the mass balances. The mass balance identified several factors that further limited the possible ages and volumes of spills:
 - A range of attenuation rate was calculated from site data. Based on this attenuation rate, a predictable range of contaminant volume migrates off RTRVP property each year. Multiplying the attenuation rate by an assumed number of years results in the minimum spill size necessary for any age of spill. This calculation also indicates the maximum possible spill size for any age of spill.
 - Small dry cleaners generate predictable amounts of waste each year. Multiplying the years of operation by the expected waste generation rate results in a maximum spill volume at any particular time. The more years of operation, the more spill volume possible.
 - To be considered a credible scenario the "accounted volume" needed to be less than the assumed total spill volume.

- Site data strongly suggests that significant (gallons) of PCE and its breakdown products migrate off RTRVP property each year; consequently, scenarios with very small spill volumes or very old spills are unlikely because these scenarios do not contain sufficient volume of PCE to sustain the off RTRVP migration currently ongoing.
- Probable attenuation time frame was estimated in Section M.6. For credible scenarios, the amount of time the site will continue to significantly impact water quality was estimated by computing the difference between the likely spill volume and the "accounted volume" and dividing this sum by the calculated attenuation rate.
- PCE spill volume represents the amount of PCE spilled, other substances (e.g. water) that may have been mixed with the PCE are not included in the volumes used as a basis for the estimate.

The results of the analysis indicated that the likely spill sizes ranged from 500 to 1,000 gallons and most likely spill date was in the 1980's. Consequently, significant concentrations of groundwater contamination are predicted to emanate from the lower area for approximately 15 years. A predicted length of time for contamination to continue to emanate from the upper area could not be assessed; however, the length of time could exceed 15 years because the attenuation rate from the upper area is slower than the lower area.

Important to understanding this analysis is the basic premise that the distribution and degradation of PCE could have been caused by several different spills of differing magnitude over time. The analysis is delineated in the following sections.

M.2 PCE CONTAINING MEDIA IDENTIFICATION

To account for most of the PCE that was originally released at the River Terrace site, the volume of PCE currently detected at the site was evaluated, along with estimates of the PCE degraded and transported off-site. PCE at a release site can be present in several forms: free (or mobile) non-aqueous phase, residual (immobile or trapped) non-aqueous phase, adsorbed to soil organic carbon, vapor phase, and dissolved (in groundwater) phase. At the River Terrace site, no free-phase PCE has been detected, but as will be described later in this section, its presence is suspected. The other four forms of PCE are present. The PCE originally spilled at the site can generally be grouped into one of the following eight scenarios, with respect to its recent physical state.

- PCE contained in excavated soils,
- PCE contained in groundwater,
- PCE transported off site via dissolution into and migration with groundwater,
- PCE degraded to lower concentration levels and other breakdown products,
- PCE contained in soil gas,
- PCE volatilized to the atmosphere,
- PCE contained in and degradation in *in-situ* soils (i.e., remaining in the soil that has not been excavated), and
- Free phase PCE.

M.3 VOLUME CALCULATION BASED ON LITERATURE REVIEW

The EPA has developed standard categories for dry cleaning facilities. Exact details regarding the type of operation at the site are not known; nonetheless, it appears the facility operated a "Small Area Dry Cleaners" using a single "Transfer Machine." This category of facility uses less than 200 gallons of PCE per year (Plain English Guide for Perc Dry Cleaners, EPA 305-B-96-002, August 1996). In older operations, much of the PCE was lost to the atmosphere during transfer of clothing from the washing machine to the dryer and venting of the dryer exhaust.¹ Consequently, the amount of waste PCE generated at the facility was likely much less than 200 gallons per year. A reasonable estimate of 50 gallons per year of waste PCE generated was used as a likely scenario because the EPA estimates that 23% of the PCE used in a dry cleaning machine is generated as waste (EPA, 1991). The facility operated for approximately 20 years (i.e., from about the mid 1960s to about 1988) so the total amount of waste generated, for the purpose of this evaluation, was assumed to total 1,000 gallons. Further basis for the 50 gallon per year estimate is provided below.

A typical dry cleaning machine will clean 30 pounds of clothes per load. Assuming a business cleans 5 loads per day, five days per week, for 52 weeks a total of 39,000 pounds of clothes would be washed in a year. On average, dry cleaners produce 25 pounds of PCE waste (1.85 gallons) for every 1,000 pounds of clothes (EPA 305-B-96-002); consequently, the operation described herein would generate 39 times 1.85 or 72 gallons of waste per year (0.0018 gallons of waste per pound of clothes). Depending upon management practices and the types of equipment used, the amount of waste generated can vary significantly. In particular, if waste is left in open containers, vapors are not contained and collected during drying, or a transfer operation is performed, the amount of waste generated as a liquid can be much lower because of volatilization.

To develop a more site specific estimate of the waste generation rate at the former River Terrace Dry Cleaner, ADEC RCRA Compliance Evaluation Inspection reports for dry cleaning facility files from the late 1980s and early 1990s were reviewed. Information from four facilities was useful for estimating waste generation rates. The results of the review are presented below:

- Norgetown Cleaners: 240 gallons of waste per 100,000 pounds clothes per year or 0.0024 gallons of waste per pound of clothes,
- Diamond Cleaners: 36 to 48 gallons of waste per 36,000 pounds clothes per year (0.0012 gallons of waste per pound of clothes),
- Jewel Lake Cleaners: 990 gallons of waste per 36,000 pounds of clothes per year (0.0275 gallons of waste per pound of clothes), and
- Jade Cleaners: 55 gallons of waste per year based on 30 gallons of fresh PCE per week (0.035 gallons waste PCE per gallon of PCE product used).

The difference in waste generation rates could be associated with discharge of waste into the sanitary sewer, volatilization, poor record keeping, and other factors. The range of waste generation rates is 0.0012 to 0.0275. The assumed rate for the former River Terrace Dry Cleaner, 0.0018, falls within the range documented in the RCRA inspection files at other facilities. A slightly lower value of 50 gallons of waste PCE per year was

¹ The characteristic of dry cleaners to release large amounts of PCE led to development of strict emissions regulations for dry cleaning facilities in the 1990 Clean Air Act Amendments.

used for this analysis because the River Terrace facility likely had minimal vapor collection and container management which tends to maximize volatile loss and it was assumed that not all the waste generated was spilled. The generation rate of 50 gallons of waste PCE per year (0.0013 gallons of waste per pound of clothes) is still greater than the lowest waste generation rate observed (Diamond Cleaners).

The amount of the generated waste actually spilled is not known, but leaking drums were observed in 1992². Given the size of the facility, spills greater than 1,000 gallons are unlikely because virtually all of the waste generated over a 20-year period would have to have been spilled. Likewise, a very small, isolated spill would be unlikely to cause the widespread contamination present over several thousand square feet of site area. Furthermore, a larger spill in the late 1960s or even early 1970s is unlikely because the facility had not been in operation long enough to generate the volume of waste necessary to be consistent with site data. For example, using average values, the maximum predicted spill in 1970 is 300 gallons (50 gallons per year from 1964 to 1970). In the 30-year time period between 1970 and 2000, 714 gallons (23.8 gallons per year flux times 30 years) would be expected to migrate off RTRVP property, 128 gallons were excavated, and 21 gallons remain on site for a total of 863 gallons. This value, 863 gallons, is the minimum 1970 spill volume necessary to account for the contamination observed or calculated to have migrated off of RTRVP property. Under an average scenario, a 1970 spill would need to have amounted to 563 gallons more waste than the facility should have been able to produce since startup. Basis for the volume estimates is summarized later in this document.

M.4 VOLUME CALCULATION BASED ON SITE DATA

Each of the eight scenarios listed in the previous section was evaluated to estimate the PCE volume present currently, migrating off site, and present at various assumed spill dates. In general, sampling results for each scenario were interpreted to represent a sample population (e.g., soil samples from the excavated area represent the PCE contained in excavated soils, etc.). Each sample population was evaluated to determine whether it could be approximated by a normal or log-normal distribution. Where sufficient data were available, all of the data sets could be approximated by lognormal distributions. If the goodness of fit was poor for both a normal and log-normal distribution then log-normal analysis was used. Log-normal was used as the default analysis method because it is more conservative, e.g. a wider confidence interval range is calculated. The 95% upper confidence level (UCL) and 5% lower confidence level (LCL) of the mean were calculated. The 95% UCL and 5% LCL of the mean were interpreted to represent upper and lower bounds on the mean PCE concentration in each scenario. Together, 95% UCL and the 5% LCL constitute the 90% confidence interval. The upper and lower bound concentrations were then converted to the volume of PCE represented by the mean concentration over the applicable soil or groundwater volume. In some situations, sufficient data were not available to perform a meaningful statistical analysis. In these cases, simple averages were used, as indicated in the tables for each media. Statistical analysis spreadsheets and other calculations are provided following this discussion. The 95% UCL, 5% LCL and the average of the two are presented in tabular form in the summary portion of this appendix.

PCE breakdown products were also evaluated. Many samples had elevated laboratory detection levels (because of the high concentrations of PCE present), which resulted in non-detect for breakdown products because the detection level was higher than the

² ADEC letter from Michael Munger to Gary Hinkel dated December 10, 1993.

likely amount of breakdown product present. In some samples, only one constituent was detected at normal detection limits. The other constituents were considered present in these samples, but present below the elevated detection limit. In these cases, soil samples where contaminants were not detected at a specific detection limit were evaluated by assuming any sample with at least one detection of PCE, DCE or TCE also contained the other constituents at 1/2 the detection level. The groundwater detection levels were low enough to warrant interpreting non-detects as zero.

For soils, data from a variety of sources was used. Table 3-1 summarizes the sources of analytical data.

For groundwater, data from the December 1999 sampling event performed by OASIS/Bristol were used to perform the analysis. This data set was used because it contains the highest number of sample points, i.e. data from all of the recently installed wells were available. In addition, the trend analysis charts (Figure 20) show fluctuation but no discernable trend in the wells in the lower plume in the RTRVP property, such as along the river in wells MW-4A and MW-9. Consequently, inclusion of the data from earlier sampling events would not significantly change the outcome of the analysis, but would increase the complexity of the evaluation. Data used to perform each statistical evaluation is contained in the spreadsheets following this discussion. Spreadsheet tables all begin with the letter M and are either referenced in the text or the summary tables in each discussion.

M.4.1 Estimated PCE in Excavated Soils

PCE-contaminated soils were excavated from the River Terrace site in two separate events. In the summer of 1996, approximately 600 cubic yards of soil were excavated from the site during installation of a water line (Dowl Engineers, 1996). In the fall of 1997, a systematic excavation of PCE-contaminated soils was performed. The fall 1997 excavation was based on the results of a soil grid sampling that was performed in spring 1997 by KEC. Further limited excavation was performed in the spring of 1998 that removed about 4 cubic yards of soil (Hart-Crowser letter dated March 2000). Plate 1 illustrates the grid sampling results, the excavation boundaries, and the excavation perimeter sampling results. All of the excavated soil was placed into two treatment cells constructed on the site. The total volume of soil contained in the treatment cells was estimated at 3,300 cubic yards (based on personal citation from Jim Gill of Hart-Crowser to Richard Sundet of ADEC).

To estimate the volume of PCE contained in excavated soils, the grid-sampling scheme was overlaid onto a topographic representation of the excavation area. Grid sample points that fell within the excavated area were used to assess the quantity of PCE in the excavated soils. A total of 51 samples were collected from areas subsequently excavated (KEC 1997). These samples are considered representative of the soils contained within the treatment cells.

The sample set may have some low bias because the 600 yards excavated in 1996 contained PCE detectable using a PID. Follow up sampling indicated PCE at levels between 0.5 mg/kg and 667 mg/kg with an average of 96 mg/kg. TCLP analysis of two samples indicated the soil was a characteristically hazardous waste for PCE (D039) with results of 16.7 and 15.6 mg/L (Dowl Engineers, 1996). Statistical analysis was not performed on these data for this report because it was felt they would bias the analysis high.

As stated above, only samples taken during February and March 1997 and located within the boundaries of the excavation were used. PCE was not detected in one sample. A value of one-half the detection limit of PCE was used to evaluate this sample.

The 95% UCL and 5% LCL of the mean of the PCE concentrations were calculated. The 95% UCL was 252 mg/kg, and the 5% LCL was 19.2 mg/kg. Therefore, it can be stated, at a 90% level of confidence, the true mean concentration of PCE in the volume of soil excavated in 1997 and 1998 falls between these two values. The goodness of fit (D test) spreadsheet and confidence interval calculation is attached as Table M-1.

The likely range of PCE volume (in gallons) removed from the excavation was calculated from these concentrations and the volume of contaminated soil they represent. Using these data, a maximum of 224 gallons of PCE and a minimum of 17 gallons of PCE were excavated from the site. This volume range considers all PCE phases, (non-aqueous, dissolved, adsorbed, and vapor) removed from the excavation. However, it is likely that some of the vapor phase escaped, and contaminated groundwater was removed and disposed separately.

M.4.2 Estimated PCE Contained in Site Groundwater

The volume of PCE contained in site groundwater was evaluated by dividing the site into three areas, estimating the mean or upper and lower confidence level PCE concentrations for each area, and estimating the PCE volume contained in each area.

The site was divided into the following three areas: the upper plume area, the lower plume area, and the former excavation area. The upper plume area was estimated to cover 28,200 square feet with a saturated zone thickness of 4.5 feet. The lower plume area was estimated to cover 26,900 square feet with a saturated zone thickness of 7 feet. The former excavation area was estimated to cover 11,250 square feet with a saturated zone thickness of 15 feet (Figure 5). Figure 16 shows the area of the two plumes. Figures 4 and 5 are cross sections of the site which show the relative elevations of the water table and the glacial till confining layer.

To estimate the mean PCE concentration for each area, the December 1999 PCE concentrations detected in samples collected from site monitoring wells were grouped by area. The upper plume area includes monitoring wells MW-16, MW-21, MW-22, MW-23, and MW-25. The former excavation area was represented by monitoring wells MW-24 and MW-26. Note that both of these monitoring wells are in the upper half of the excavation area, and their PCE concentrations may be biased low for the entire excavation area. The lower plume area was represented by monitoring wells MW-4A, MW-9, MW-10, MW-11, MW-14, MW-19, and the eight monitoring wells adjacent to the Kenai River.

Each group of wells listed above was evaluated statistically by assessing the goodness of fit for the type of distribution assumed and the 90% confidence interval. The average concentration was used for the upper area because the 95% UCL was so large it was meaningless (i.e., above the solubility limit for PCE). Likewise, the average was used for the excavation because only two data points were available, and the small number of data points resulted in a meaningless upper confidence level. Table A presents the PCE groundwater concentration range for each area.

Table A. 95% UCL and 5% LCL of Groundwater PCE Concentration in milligrams per liter (mg/L)

	Average	95% UCL	5% LCL
Upper Area (Table M-2 and M-3)	0.6	Not Used	0.2
Former Excavation (Table M-4)	0.14	Not Used	Not Used
Lower Area (Table M-5)	Not Used	13	0.31

The estimated volume of PCE was calculated from the 95% UCL and 5% LCL PCE concentrations and the volume of groundwater they represent. Table B summarizes the estimated volume of PCE that is present in site groundwater.

Table B. Volume (gallons) of PCE Currently Present in Groundwater

	Average	95% UCL	5% LCL
Upper Area (Table M-2)	0.11	Not Used	0.03
Former Excavation (Table M-4)	0.03	Not Used	Not Used
Lower Area (Table M-5)	Not Used	3.4	0.1

M.4.3 Estimate of PCE Transported Off-RTRVP Property via Dissolution into and Migration with Groundwater

PCE has migrated away from the RTRVP via dissolution in groundwater. There is ample evidence that such migration occurred, because PCE has been detected in adjacent Kenai River sediments and surface water, storm drain system outfall samples, and in samples from off-RTRVP property monitoring wells.

Data regarding the concentration of PCE in the groundwater, flux rate of groundwater, and the length of time the groundwater has been contaminated are all needed to develop a meaningful estimate of dissolved-phase PCE transport volume. Groundwater appears to exit the site in two zones: along the river and under the Sterling Highway to the west of the site (presumably into the storm drain backfill).

The flux rate of groundwater was based on hydraulic conductivity values estimated from slug tests and measured hydraulic gradients. Minimum, maximum, and best estimate flux rates were calculated from these parameters. Seasonal effects that may slow down the groundwater flux, such as icing were not considered. In addition, the calculated groundwater flux upgradient from the river is somewhat lower than near the river, the rates would be expected to be approximately the same, over time. Nonetheless, estimates of hydraulic conductivity using a slug tests are inherently uncertain so the river bank value was used.

M.4.3.1 Upper Area

PCE dissolved in upper plume area groundwater has migrated off-RTRVP property under the Sterling Highway, presumably into the storm drain backfill. Storm water discharging from the Kenai River Bridge Outfall also contains contamination indicating

that contaminated groundwater from RTRVP may be infiltrating the storm sewer (E&E 1997 and 1998). As presented in Section M.4.2, the aerial extent of the upper area groundwater plume was estimated at 28,200 square feet. The volume of contaminated water exiting RTRVP property from the upper plume was estimated between 0.2 and 42 gallons per minute using slug test and gradient data (Table 6-4). The geometric average value of 2.4 gallons per minute was considered representative of site conditions. The range of PCE contamination levels in upper area groundwater varied from an average of 0.6 mg/L to a 5% LCL of 0.2 mg/L. Volume estimates of dissolved-phase PCE transported off-site from the upper plume area are presented in Table C.

Table C. Estimated Volume (gallons) of PCE that Migrated Off-RTRVP Property from the Upper Area

Basis (Table M- 2)	Potential Time Since Spill Occurred					
	6 years (1994)	12 years (1988)	18 years (1982)	24 years (1976)	30 years (1970)	36 years (1964)
5% LCL Concentration (based on 0.2 mg/L and 2.4 gpm)	1	2	3	4	5	6
Average Concentration. (based on 0.6 mg/L and 2.4 gpm) (Table M-2 & M-3)	3	6	9	11	14	17

gpm = gallons per minute

The PCE contaminant flux rate from the upper area was estimated at between 0.2 and 0.5 gallons per year.

M.4.3.2 Lower Plume Evaluation

PCE dissolved in lower plume area groundwater has migrated off RTRVP property into the Kenai River. As presented in Section M.4.2, the aerial extent of the lower area groundwater plume was estimated at 38,150 square feet (including 11,250 square feet in the former excavation area). The volume of contaminated water exiting the site from the lower plume was estimated between 0.6 and 41 gallons per minute using slug test and gradient data (Table 6 - 4). The average value of 7.8 gallons per minute was considered representative of site conditions.

The range of PCE contamination levels leaving the site was estimated by calculating the 95% UCL and 5% LCL of the PCE concentrations in the 6 "sentry wells" along the Kenai River (MW-20, MW-12, MW-6, MW-7, MW-8, and MW-5). The PCE concentrations ranged from a 95% UCL of 5.6 mg/L to a 5% LCL of 0.17 mg/l. Volume estimates of dissolved-phase PCE transported off RTRVP property from the lower plume area are presented in Table D.

Table D. Estimated Volume (gallons) of PCE that Migrated Off- RTRVP Property at the Kenai River Bank

Basis (Table M-6)	Potential Time Since Spill Occurred					
	6 years (1994)	12 years (1988)	18 years (1982)	24 years (1976)	30 years (1970)	36 Years (1964)
5% LCL Concentration (based on 0.17 mg/L and 7.8 gpm). (Table 6-4)	3	5	8	10	13	16
95% UCL Concentration (based on 5.6 mg/L and 7.8 gpm). (Table 6-4)	84	169	253	337	421	505

The PCE contaminant flux rate from the lower area was estimated at between 0.4 and 14 gallons per year.

M.4.4 Estimate of PCE Degraded

Both soil and groundwater sampling results indicate that PCE degradation has occurred across part of the River Terrace site. The presence of PCE degradation products in both soil and groundwater samples is interpreted as evidence that degradation has occurred in the area between the former dry cleaning building and the Kenai River (also known as the lower, or southern, portion of the site). In addition, the groundwater geochemistry of this area is conducive to PCE degradation. A stringent study of actual field degradation rates determined a range of half lives from 877 to 1,019 days (Ellis et al, 1996).

In the northern portion of the site (adjacent to and north of the former dry cleaning building), there are few indications of degradation in groundwater. Consequently, an infinite half-life was assumed for groundwater in the upper area resulting in an assumption that no measurable loss of PCE through degradation occurred in this area. Breakdown products have been identified in soils from this area so breakdown in soil is probably occurring.

M.4.4.1 PCE Degraded in Area of Soil Excavation

The volume of PCE degraded in the area of the 1997 soil excavation was estimated by evaluating the breakdown products present in samples used to characterize the site. The same procedure used to estimate the volume of PCE concentration was used. Note that this procedure does not account for any PCE that completely degraded to ethene. Some of the PCE completely degraded is accounted for in the other media evaluations; however, this evaluation is based only on the breakdown products present at the time of the excavation.

The 95% UCL and 5% LCL of the mean of the PCE concentrations were calculated. The 95% UCL was 13.2 mg/kg, and the 5% LCL was 2.2 mg/kg (Table M- 7). Therefore, it can be stated, at a 90% level of confidence that the true mean concentration of PCE breakdown products (in PCE equivalent) in the volume of soil removed in September-October 1997 falls between these two values.

PCE equivalence is the mass of PCE represented by the breakdown products. The PCE equivalence was calculated by converting mass concentrations to molar concentrations. As a PCE molecule degrades it loses mass because heavy chlorine atoms are replaced by light hydrogen atoms. However, the summation of the moles of compounds

remains constant, e.g. if 10 moles of PCE were spilled and half of the PCE degraded there would be 5 moles of PCE and 5 moles of TCE remaining. The mass of TCE would be less than the mass of PCE even though 5 moles of each was present. Using molar equivalence concentrations allows direct addition of all the breakdown products to calculate the total amount of PCE represented. Consequently, if 5 moles of PCE, 1 mole of TCE and 0.5 moles of DCE were present the total equivalent PCE concentrations would be $5 + 1 + 0.5$ or 6.5 moles of PCE represented.

The likely range of breakdown products volume (in gallons) removed from the excavation was calculated from these concentrations and the volume of contaminated soil they represent. Using these data, a maximum of 12 gallons of PCE equivalent and a minimum of 2 gallons of PCE equivalent were removed during the excavation activities (Table M-16).

M.4.4.2 Degradation from Groundwater

The volume of PCE degraded in the lower groundwater plume (between the former dry cleaning building and the Kenai River) was estimated using the same general approach used to estimate the volume of PCE that migrated off of RTRVP property. The concentration of breakdown products present in groundwater at the sentry wells is known, and it is reasonable to assume that breakdown products began migrating off the property shortly after the spill reached the river. The concentrations of breakdown products were converted to PCE equivalents, and then the 95% UCL and the 5% LCL of the PCE equivalent concentration was calculated. Data for the six sentry wells adjacent to the river (from MW-12 east to MW-5) were used. The PCE equivalent concentrations ranged from a 5% LCL of 0.9 mg/L to a 95% UCL of 11.7 mg/L. Volume estimates of dissolved-phase PCE equivalent degraded from the lower plume area are presented in Table G.

Table G. Estimated Volume (gallons) of Breakdown Products (in PCE equivalents) that Migrated Off-RTRVP Property from the Kenai River Bank

Basis (Table M-8)	Potential Time Since Spill Occurred					
	6 years (1994)	12 years (1988)	18 years (1982)	24 years (1976)	30 years (1970)	36 Years (1964)
5% LCL Concentration (based on 0.9 mg/L and 7.8 gpm). (Table 6-4)	13	27	40	54	67	80
95% UCL Concentration (based on 11.7mg/L and 7.8 gpm). (Table 6- 4)	178	355	533	710	888	1066

The breakdown product flux rate was estimated at between 2.2 and 29.6 gallons per year.

M.4.4.3 Complete PCE Degradation to Ethene

The amount of PCE, throughout the site, that has degraded completely to ethene was not evaluated because a site specific degradation rate has not been determined. In general, the rate limiting steps in the degradation process are breakdown of cis - 1,2, DCE to vinyl chloride and of vinyl chloride to ethene. Consequently, in areas where complete breakdown has occurred, higher concentrations of DCE or vinyl chloride would be expected. In the lower area groundwater, more than 60% of the contaminants

present are breakdown products with most of the products represented by DCE. However, very little vinyl chloride was detected, indicating that complete degradation to vinyl chloride may not be occurring.

The most credible literature based half-life identified for PCE was 2.4 to 2.8 years (877 to 1,019 days). The rate is field based and was developed from data for a site in Delaware (Ellis et al, 1996). This rate is the time required for PCE to degrade to TCE. Some degradation has occurred as evidenced by the widespread presence of breakdown products. Given this half life most of the PCE would be expected to degrade to TCE within a few years. Significant amounts of PCE still present on site indicate that a more recent release is likely.

In practice, several years of data would be needed to accurately determine the site specific degradation rate. Furthermore, the rate probably changes with season, time since release, localized conditions within soil strata and many other factors. Regardless, assuming that some degradation is and has occurred in site soils throughout the site (degradation products have been detected in soils in both the upper and lower area), a total spill volume of 500 to 1,000 gallons sometime in the 1980s is credible. Multiple smaller spills in the same time frame are also credible. Spill scenarios in the 1970s would need to have been much larger to result in the contamination levels documented in 1999. Smaller, more recent spill scenarios are also possible.

M.4.5 Estimate of PCE Contained in Soil Gas

The 95% UCL and 5% LCL of the soil gas data were used to estimate concentration of PCE in soil gas in the general area between the former dry cleaning building and the storm sewer and vicinity. The 95% UCL soil gas concentration was 46,123 ug/m³ and the 5% LCL soil gas concentration was 23,510 ug/m³. Pore volume was estimated by multiplying the aerial extent by the vadose zone thickness and the assumed porosity of 0.3 (Table 6-4).

Soil gas data are not available for the portion of the site between the former dry cleaning facility and the river. This area generally has less vadose zone than the upper area, is slightly larger areally, and the maximum current PCE concentration is slightly lower. Based on the above considerations, the volume of PCE in soil gas in the lower area was qualitatively estimated at less than 0.1 gallons. The concentration of PCE contained in soil gas is presented in Table H.

Table H. PCE Contained in Soil Gas

(Table M-9)	Upper Area	Lower Area
High Estimate	0.4 gallons	<0.1 gallons
Low Estimate	0.2 gallons	

M.4.6 Estimate of PCE Volatilized

With respect to other chlorinated solvents, PCE has a relatively low vapor pressure. At 10 degrees C, which is a reasonable average subsurface temperature for the site, the maximum vapor concentration in air is 64 mg/L (Pankow and Cherry, 1996). In addition, PCE tends to volatilize relatively slowly.

PCE will volatilize from soil and groundwater and then either condense again or migrate to the surface. The areal extent of groundwater contamination and the soil gas 5% LCL and 95% UCL based on the upper area soil gas data were again used to estimate the volatile loss over time. This estimate is considered very applicable to the upper area but somewhat uncertain for the lower area, because the upper area soil gas data are probably a poor representation of the entire site. Soil gas levels are dependent on groundwater contamination levels, soil contamination levels, and distance from a contaminant source, soil conditions and temperature. In addition, the rate of volatilization will change with concentrations and is different for the various breakdown products. Nonetheless, the estimate does provide an indication of the amount of PCE that may have left the site through volatilization over time.

A simple flux calculation using boundary conditions, the soil gas concentrations and the dispersivity of PCE were used to develop the estimate. Table I summarizes the calculations.

Table I. Estimated Volume (gallons) of PCE that Volatilized from the Site

Basis (Table M-9)	Potential Time Since Spill Occurred					
	6 years (1994)	12 years (1988)	18 years (1982)	24 years (1976)	30 years (1970)	36 years (1964)
Lowest Flux Rate	1.4	2.8	4.2	11	13.8	16.5
Highest Flux Rate	2.8	5.5	8.3	5.6	7	8.4

The vapor phase PCE flux rate, for the entire site, was estimated at between 0.2 and 0.4 gallons per year. Breakdown product vapor flux rate was not estimated.

M.4.7 Estimated PCE contained in *in-situ* soils

The amount of PCE remaining in in-situ soils was evaluated by inferring the mass of contaminated soil present based on grid sample data outside the excavation area and boring data.

Figures M-1 through M-5 were used to perform the evaluation. First the contaminated site was separated into five areas: along the river (between grid lines FF, E, 13 & 9), beneath and around the former excavation (between grid lines AA, G, 0 & 9), north of the building and west into the Sterling Highway right-of-way (ROW) (between grid lines DD, F, 0 & -4), ROW west of the excavation (between grid lines DD, AA, 4 & 0), and west of the excavation (between grid lines AA, CC, 6 & 9). These areas were selected because they are similar in terms of depth to groundwater. The grid used to guide RTRVP 1997 site excavation was expanded and used to define each area as shown on the figures. Sample results from each boring in each area were plotted at their approximate depth below ground surface. The resulting plots are two-dimensional representations of three-dimensional space. Crosses indicate that PCE or its breakdown product were detected, "o"s indicate no detection. Borings/samples at the boundaries between areas or at the excavation limits were used. Borings with no detections were used as the basis to consider a 20x20 foot area uncontaminated. In instances where two consecutive samples contained no detections, the second sample was eliminated from the data set. Finally, areas excavated were shaded and not considered a part of the remaining volume.

From the plots, the minimum amount of contaminated soil at each boring was interpolated. Where contamination was encountered at the termination of a boring an

additional 2.5 feet of contamination was assumed or the thickness of the contaminated zone was inferred from adjacent boring data. Note that in areas of the B and C lines and portions of the D line most of the deep samples contained detections. In this area, no credible estimate of the depth of contamination can be made and the volume estimate is biased low for this area.

The estimated contamination thickness values for each boring were then summed and the average computed. The resulting average was multiplied by the area represented. For each clean boring, 400 square feet of area were subtracted from the area. Volume estimates for each area are shown in Table M-10. Contaminant data for each area were evaluated statistically to develop concentration confidence intervals.

The 95% UCL and 5% LCL of the mean of the PCE concentrations and breakdown product concentrations were calculated for each area. It can be stated, at a 90% level of confidence, that the true mean concentrations in the volumes of soil represented fall between these two values. Results of the analysis are presented in Tables J and K.

Table J. Concentration of PCE and Breakdown Products Remaining in In-situ Soils (mg/kg)

	95% UCL PCE	5% LCL PCE	95% UCL Breakdown	5% LCL Breakdown
Around/beneath Excavated Area (Table M-11)	1.02	0.44	0.28	0.18
West of Excavation (Table M-12)	16.20	0.62	2.10	0.23
R of W West of Excavation (Table M-13)	1.72	0.05	2.35	0.08
R of W NW and North of Building * (Table M-14)	0.07	0.03	2.49	0.01
Along River (Table M-15)	1.13	0.31	0.79	0.34
* Average PCE value used instead of 95% UCL because 95% UCL value was extremely high R of W = Right of Way				

Table K. Volume (gallons) of PCE and Breakdown Products Remaining in In-situ Soils (mg/kg)

(Table M-16)	High PCE (gallons)	Low PCE (gallons)	High Breakdown (gallons)	Low Breakdown (gallons)
Around/beneath Excavated Area	2.59	1.11	0.70	0.44
West of Excavation	3.23	0.12	0.42	0.05
R of W West of Excavation	0.68	0.02	0.93	0.03
R of W NW and North of Building	0.10	0.04	3.58	0.02
Along River	2.50	0.69	1.73	0.76
Total	9.09	1.99	19.13	3.27

M.4.8 Free Phase PCE

The presence of free phase PCE is evaluated in the Total Estimated Spill Volume section because all of the data need to be considered to perform the evaluation.

In addition to the PCE detected in the site investigations, it is possible that the investigation missed one or more layers of soil contaminated with PCE above the clean-up level. The fingering-type distribution of free-phase PCE makes this possibility quite realistic. In addition, the absence of any discernable decrease in the groundwater contamination levels is evidence that another source area does exist. A method described by Gilbert (Gilbert, 1987) was used to estimate the probability that a hot spot was missed by the KEC grid sampling. To use this method, the aerial extent of the hypothetical hot spot was estimated. It was assumed that an elliptically shaped hot spot 12.5 feet by 6.25 feet would be a reasonable size and shape for a drum release. The probability that such a hot spot would be missed using a 20-foot square sampling grid is approximately 61%. The probability of not detecting a hot spot is the same at each depth sampled if the sampling grid is maintained. As the sample density decreases, because borings were terminated, the probability of missing subsurface lateral spread of the hot spot increases. Consequently, there is a high probability that if a hot spot of the size described were present, it could be missed.

The potential for unidentified contaminant sources is important, because groundwater contamination levels remain high in certain areas. Groundwater contamination levels at 1% to 10 % of the solubility limit are indicative of free phase product. The solubility limit of PCE is approximately 150 mg/L, and contamination levels in MW-16 and MW-4a have consistently ranged between 1 mg/L and 5.5 mg/L and 1.2 mg/L and 3.5 mg/L, respectively. At these concentrations free phase PCE is possible. In addition, if all the source area had been removed the PCE concentration in the monitoring wells would be expected to decrease. No discernable trends are yet evident in the monitoring wells. Consequently, any estimate of remediation time frame needs to consider the presence of free phase product and unidentified source areas.

M.4.9 Summary of Estimated PCE Spill Volume in Site Media

The total estimated PCE spill volume is the summation of the spill volumes evaluated statistically in the previous subsections presented in L. The amount of PCE completely degraded from site soils was only evaluated qualitatively because of a lack of site specific degradation data; however, the volume completely degraded could be very high, in the thousands of gallons, depending upon the actual spill age. There is also the potential for a highly contaminated hot spot to still be present and/or free phase PCE product. Note that upper 95% confidence levels, lower 5% confidence levels, and the average of the upper and lower confidence interval levels are presented.

Table L. Estimated PCE Volume (gallons) Contained in Site Media for Various Spill Dates

Estimated Spill Date	1994			1988			1982			1976			1970			1964		
	High Est.	Ave. Est.	Low Est.	High Est.	Ave. Est.	Low Est.	High Est.	Ave. Est.	Low Est.	High Est.	Ave. Est.	Low Est.	High Est.	Ave. Est.	Low Est.	High Est.	Ave. Est.	Low Est.
PCE Contained in Excavated Soils	224	121	17	224	121	17	224	121	17	224	121	17	224	121	17	224	121	17
PCE Degradation Products in Excavated Soils	12	7	2	12	7	2	12	7	2	12	7	2	12	7	2	12	7	2
PCE Remaining in Site Soils	9.1	5.6	2.0	9.1	5.6	2.0	9.1	5.6	2.0	9.1	5.6	2.0	9.1	5.6	2.0	9.1	5.6	2.0
PCE Degradation Products in Soils	19	13	7	19	13	7	19	13	7	19	13	7	19	13	7	19	13	7
PCE Completely Degraded	Only evaluated qualitatively.																	
PCE Degraded in Groundwater	178	96	13	355	191	27	533	286	40	710	382	54	888	478	67	1,066	573	80
Dissolved PCE Transported off-site from the Upper Area	3	2	1	6	4	2	9	6	3	11	8	4	14	9	5	17	12	6
Dissolved PCE Transported off-site from the Lower Area	84	44	3	169	87	5	253	130	8	337	174	10	421	217	13	505	260	16
PCE Contained in Groundwater	3.5	1.9	0.2	3.5	1.9	0.2	3.5	1.9	0.2	3.5	1.9	0.2	3.5	1.9	0.2	3.5	1.9	0.2
PCE Contained in Soil Gas	0.5	0.4	0.3	0.5	0.4	0.3	0.5	0.4	0.3	0.5	0.4	0.3	0.5	0.4	0.3	0.5	0.4	0.3
PCE Volatilized	2.8	2.1	1.4	5.5	4.2	2.8	8.3	6.3	4.2	11.0	8.3	5.6	13.8	10.4	7.0	16.6	12.5	8.4
Total	536	293	47	804	434	66	1072	578	91	1338	721	103	1605	864	121	1873	1008	140

M.5 COMPARISON OF VOLUME ESTIMATES WITH SPILL AGE

The extreme possible range for spill date was estimated between 1964 and 1994. This time frame is based on the following information: reports that the dry cleaners operated between the mid to late sixties and 1988, an ADEC report placing leaky drum(s) at the site in 1992, and PCE contamination in soil documented in a 1996 report (Dowl, 1996).

Refinement of the estimated spill age was necessary to develop a more precise volume estimate. Defining the age of the spill as close as possible is useful because site data indicate that the contamination in some parts of the site is degrading and contamination continually migrates off RTRVP property with groundwater flow. As the age of the spill increases the cumulative amount of contaminant lost through degradation and migration becomes more significant. Based on the dissolved phase transport analysis between 0.9 and 15 gallons of PCE will continue to migrate off site each year with the groundwater, 0.2 to 0.5 gallons of PCE would be expected to volatilize, and 2.2 to 29.6 gallons of breakdown products (PCE equivalent) will migrate off RTRVP property each year. Spill date was refined, as explained below, by performing a mass balance for various ages of spills.

This discussion considers a range of assumed spill sizes for spill ages spanning most of the operating period for the RTRVP dry cleaning facility based on analysis of site data. The combination of maximum concentration and maximum groundwater flux or minimum concentration and minimum groundwater flux are unlikely to occur and represent extremes of the potential range of values. Arguments could also be made that the groundwater flux rate is slower or faster than estimated. In addition, the amount of PCE completely degraded is unknown, but likely a large number. The values used in the estimate are reasonable given site data and information provided in the literature.

Using the average of the high and low volume estimates and relying on a base assumption that a spill in the 500 gallon range is most credible, the most likely spill date is in the 1980s. Note that other spills could easily have occurred before and after the assumed date. The basis for this age estimate is explained below.

- 1964 and 1970 scenarios are not credible with the average value, even without accounting for degradation. Even a small amount of degradation would necessitate a spill of more than 1,000 gallons to account for existing levels of contamination. Some degradation is known to have occurred because significant amounts of degradation products have been observed. The presence of the degradation products also makes the 1960's and 1970's low volume spill estimates of low probability because a small spill would be largely attenuated today. In addition, the dry cleaner reportedly commenced operation in the mid-to late- 1960s and by the early 1970s there would have been only a limited amount of waste generated.
- A mid-1990s spill in the 300 gallon range is credible from a data analysis standpoint; however, the site has received a significant amount of attention since the early 1990s. A smaller spill, perhaps one drum, could have occurred but it is unlikely the widespread contamination present could be attributed to one such spill event. In addition, the observed flux rate of contamination off RTRVP property is much too high over too large an area to be attributed to a small release.
- The widespread nature of the contamination indicates that several spills probably occurred over time. Regardless, both empirical data and historical reports indicate that a release(s) could have occurred in the 1980s. Specifically, the average of the extreme estimates, without degradation, puts a 500-gallon spill in the 1982 to 1988 time frame.

Current data can account for only about 20 gallons of product remaining in the unexcavated soils at RTRVP, yet the average contaminant flux rate is approximately 24 gallons per year. Clearly all the remaining contamination has not been accounted for. Indeed, the groundwater contamination levels indicate that free phase product could still be present near MW-4A and MW-16.

Considering the probable age of the spill, i.e. the 1980s, and the upper limit on the size of the spill, i.e. 1,000 gallons, the total amount of unaccounted for volume can be estimated by subtracting the amount of contamination accounted for in this evaluation from the upper credible limit on spill size. This unaccounted for volume could be free phase and/or unidentified areas of contamination. Some of the unaccounted for volume could also be contained in uncertainty associated with this analysis. However, site data strongly suggest that free phase product remains on RTRVP property, i.e. based on concentrations in groundwater at or above the solubility limit and stable groundwater contamination levels.

The mass balance was developed by assuming spill volumes of 250, 500, 750, and 1,000 gallons at various dates from 1964 to 1994. The mass balance involved adding the amount of PCE migrating off site (by year) plus the amount remediated plus the amount currently identified on site and subtracting this sum from the assumed spill volumes. The resulting volume indicates the volume of PCE that is unaccounted. The unaccounted volume is either present on site as free phase product or in additional areas of contaminated soil or the volume estimate is too high. Note that a large old spill is unlikely because the facility had not been in operation long enough to generate significant amounts of waste. Likewise, a small (less than 100 gallons) spill is unlikely because contaminant flux off site is too high for a small spill to maintain. Table M presents the results of the mass balance. Interpretation of Table M is discussed in the following section. In general, dark shaded areas indicate scenarios that are virtually impossible, light shaded areas indicate possible but unlikely scenarios, no shading indicates a reasonable scenario.

Table M. Potential Unaccounted Volume (gallons) and Years to Attenuate

Spill Age	1994			1988			1982			1976			1970			1964		
	UCL	Ave.	LCL	UCL	Ave.	LCL	UCL	Ave.	LCL	UCL	Ave.	LCL	UCL	Ave.	LCL	UCL	Ave.	LCL
Assumed Spill Size of 1,000 Gallons																		
Volume Accounted	536	292	47	804	435	65	1072	578	84	1338	721	102	1606	865	122	1874	1007	140
Unaccounted Volume	464	708	953	196	565	935	-72	422	916	-338	279	898	-606	135	879	-874	-7	860
Years to Attenuate	10	30	307	4	24	302	-2	18	296	-8	12	290	-14	6	283	-20	0	277
Assumed Spill Size of 750 Gallons																		
Volume Accounted	536	292	47	804	435	65	1072	578	84	1338	721	102	1606	865	122	1874	1007	140
Unaccounted Volume	214	458	703	-54	315	685	-322	172	666	-588	29	648	-856	-115	629	-1124	-257	610
Years to Attenuate	5	19	227	-1	13	221	-7	7	215	-13	1	209	-19	-5	203	-25	-11	197
Assumed Spill Size of 500 Gallons																		
Volume Accounted	536	292	47	804	435	65	1072	578	84	1338	721	102	1606	865	122	1874	1007	140
Unaccounted Volume	-36	208	453	-304	65	435	-572	-78	416	-838	-221	398	-1106	-365	379	-1374	-507	360
Years to Attenuate	-1	9	146	-7	3	140	-13	-3	134	-19	-9	128	-25	-15	122	-31	-21	116
Assumed Spill Size 250 Gallons																		
Volume Accounted	536	292	47	804	435	65	1072	578	84	1338	721	102	1606	865	122	1874	1007	140
Unaccounted Volume	-286	-42	203	-554	-185	185	-822	-328	166	-1088	-471	148	-1356	-615	129	-1624	-757	110
Years to Attenuate	-6	-2	66	-12	-8	60	-18	-14	54	-24	-20	48	-30	-26	41	-36	-32	36

UCL = 95% Upper Confidence Level; LCL = 5% Lower Confidence Level

M.6 ATTENUATION TIME FRAME CALCULATION

The purpose of this section is to present a semi-qualitative estimate of the remaining remediation time frame, assuming no source area treatment. The remediation time frame presented herein can be used for cost estimating purposes in the feasibility study. The ranges of spill size possible for various ages of the spill are presented in Table M. Each combination of date (age), attenuation rate, and spill volume constitute a scenario. Negative year values indicate that no further contamination would remain if the spill occurred at the time indicated and negative unaccounted volume values indicate there is no unaccounted volume, but there is excess volume in the scenario. In general, any negative value indicates the scenario is inconsistent with the combination of spill size, age, and attenuation rate and not considered credible. Scenarios that are not credible are shaded dark.

Scenarios shaded medium are considered possible, but unlikely. The basis for classification of each scenario are discussed below.

Arguments could be made that a slower or higher degradation rate applies or that the groundwater flux rate is slower or higher than estimated. In reality, both of these parameters, and others, will vary over time. Nonetheless, the values used in the estimate are likely extreme ranges.

This analysis is essentially a mass balance for the entire site. Most of the attenuation is associated with migration into the river because the groundwater flux is much higher near the river than in the upper area. The upper area flux rate is quite small by comparison and if most of the unaccounted PCE volume is in the upper area then more remediation time will be needed for the upper area.

The unaccounted volume was added to the estimated volume calculated to remain on site. This sum was divided by the calculated contamination flux off RTRVP property to estimate the number of years necessary for all the contamination to migrate off-site. This assumption assumes that flux will remain steady state, no other factors contribute to contaminant loss, and no significant contamination will remain on RTRVP property. In a real system, the flux would be expected to vary with season, precipitation rate, and the physical state of the contamination in the subsurface. In addition, many other factors will affect contaminant fate. Detail regarding the Volume Accounted values are also presented in Table L. The total Volume Accounted values in the table are summations of the volumes calculated in for each physical state.

The 5% LCL scenarios indicate more than one hundred years will be needed to attenuate in all 5% LCL scenarios except for the 250 gallon scenario. However, if the 5% LCL scenarios were valid then it can be qualitatively stated that it is unlikely significant degradation products would be present or high levels of contamination would be found in the Kenai River or its sediments because the flux rates would be too low to support significant cross media contamination, i.e. a significant flux rate is necessary to result in any detection in flowing surface water.

The shortest 5% LCL remediation time frame for a 250 gallon spill event is 41 years for the 1970 scenario. Spills of 250 gallons prior to 1970 are considered unlikely because the facility would not have been capable of generating that volume of waste.

The 95% UCL scenarios are based on maximum attenuation rate. All of these maximum attenuation rate scenarios result in negative volumes by 1982 and only the 1,000 gallon scenario is positive for 1988, i.e. a spill of less than 1,000 gallons that occurred before 1982 would be expected to have attenuated. The negative values imply that the

presumed spill volume would be attenuated from the site if the attenuation rate were accurate. Consequently, the 95% UCL values are considered unlikely because the attenuation is too rapid for the upper limit on spill size. An attenuation rate somewhat lower than the value in the 95% UCL scenarios probably applies to the site.

As previously discussed, contamination probably occurred prior to 1994. The average values are considered credible for 500 to 1,000 gallon 1994 and 1988 scenarios and for the 750 and 1,000 gallon 1982 scenarios. The flux rates in these scenarios are probably capable of resulting in the surface water contamination levels observed and the remediation time frames are reasonable from a qualitative perspective, i.e. in the 10 to 20 year time frame rather than many decades. The average remaining attenuation time (all three spill sizes) for these three scenarios is 15 years:

$$(30+24+19+13+7+9+3)/7 = 15 \text{ years}$$

Based on the above analysis a remediation time frame of 15 is a reasonable estimate of the amount of time needed for the site to attenuate assuming the majority of PCE was spilled in the 1980s. A significant pre-1980s spill is very unlikely unless some dramatic change occurred in site conditions that recently (early 1990s) stimulated degradation.

The loss of contaminants in this analysis is primarily associated with migration into the river by groundwater movement, i.e. media transfer. The upper area flux rate is quite small by comparison to the lower area and if most of the unaccounted PCE volume is in the upper area then more remediation time will be needed for the upper area. In addition, complete degradation of PCE was not quantitatively evaluated; however, hundreds or even thousands of gallons of PCE could have degraded from very old spills using literature based degradation rates.

Figure M-1

✓

Arc2 (Along River)

FF-13 - FF9

¹ ¹ = 40 20x26 =
E13 - E9

0					0	0	0	0	mw13
10						+	+	0	mw12
0					0				mw8
0				0					mw10
12.5				0	+		+		BE10A
15					+		+		mw74
15					+	+			mw19
7.5	0	0	0	0	0		+		MA10A
10						+		+	mw6
7.5				0	0		+		A10A
25			+	+	+				mw9
25	+		+	+	0		+		A4
25			+	+	+		+		B9
25				+	+		+		B10A
10						+			mw7
7.5					0		+		C10A
25			+	+	+		+		C9
10								+	mw5
0					0		0		0010A

-15

-20

-25

-30

-35

-40

-45

Figure M-2

Area (Main Excavation)

AA9 - AA0

G9 - G0 = 63 20 x 20

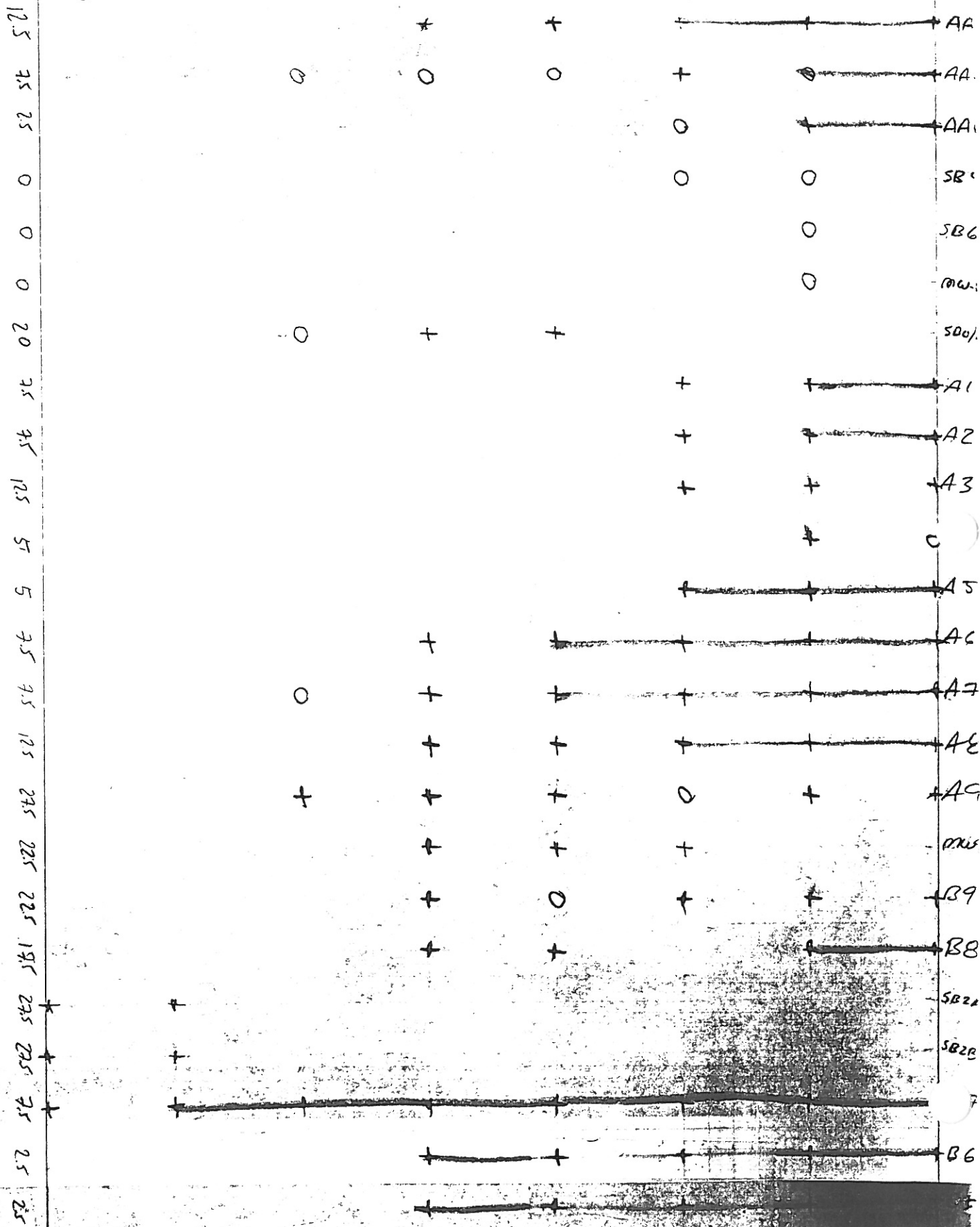


Figure M-3

Area (R. + W West of Building)

DD(0) — DD(-4)

1 1 = 36 20x20 blocks =

EO — E(-4)

10
10
10
10

+

+

+

+

AW21

-mw25

-mw16

-mw29

30

21

20

15

10

5

0

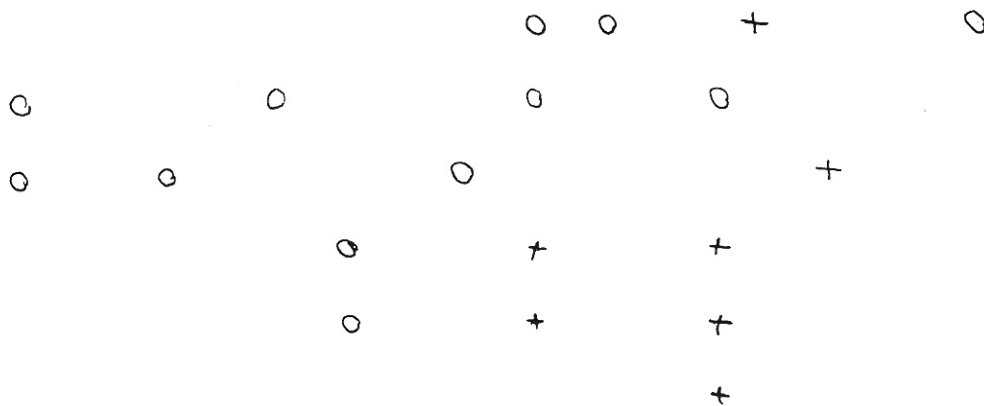
Figure M-4

V

Area (R.F.W. West of Excavation)

$\begin{matrix} \text{DO 4} \\ \text{AA 4} \end{matrix} \quad \text{---} \quad \begin{matrix} \text{DO(0)} \\ \text{AA(0)} \end{matrix} = 12 \quad 20 \times 20 \text{ blocks} =$

5
0
10
10
10
10
10



MW 14
 MW 17
 MW 15
 SB 182
 SB 181
 MW 21

-30
 -21
 -20
 -15
 -10
 -5
 0

Figure M-5 (1 of 3)

Area (west of Excavation)

CC9 — CC6

1

1

6

20 x 20

AA9 — AAC

15
25
35
10
7.5
25

+

+

MW19

+

← AA8 →

← MW4 →

+

+

MW9a

0

0

+

← AA7 →

0

← AA6 →

25

20

15

10

5

0

Figure M-5 (2 of 3)

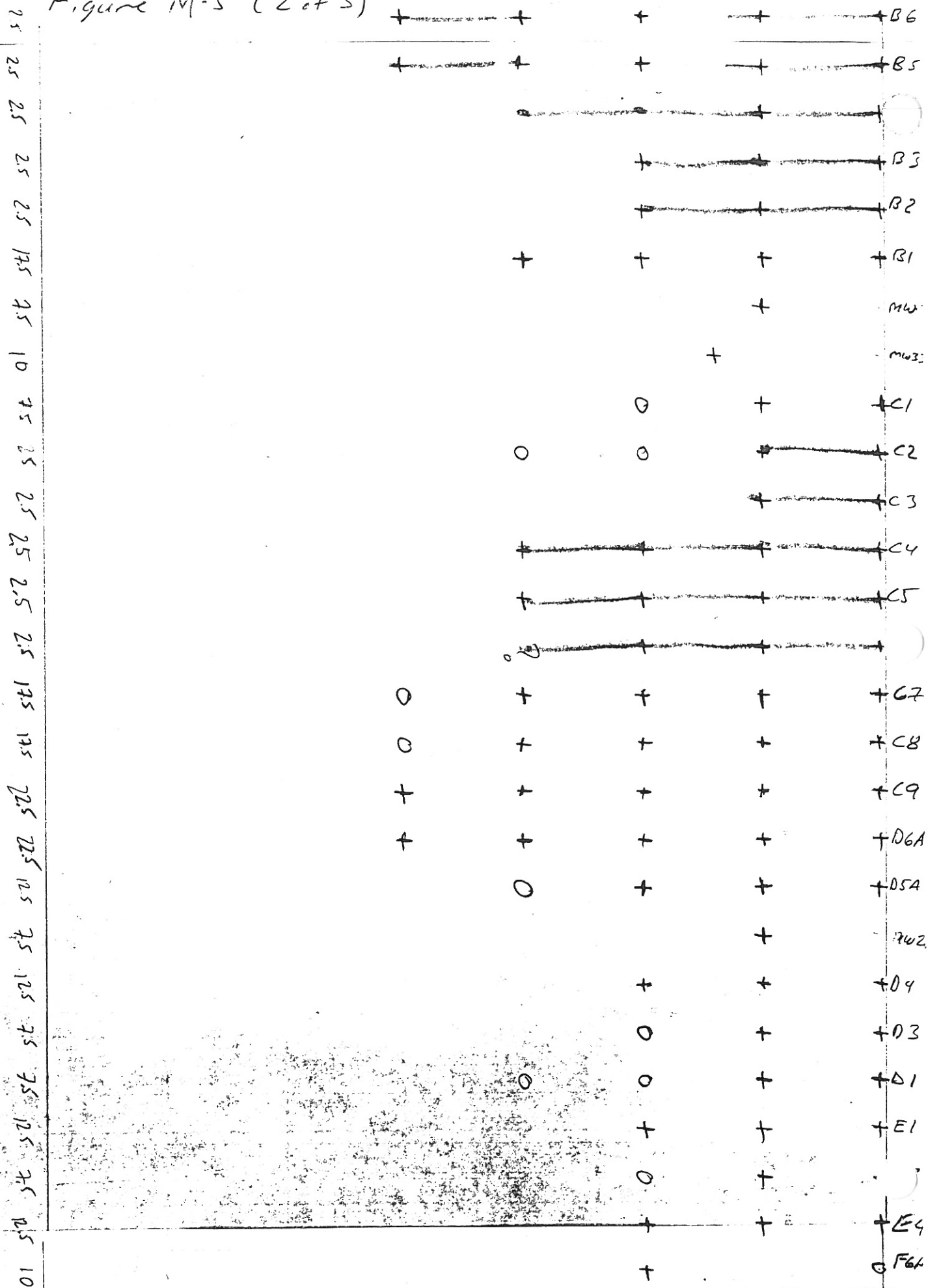


Figure M-5 (3 + 3)

10 17.5 2.5 7.5 7.5 7.5 7.5 0 5 12.5 2.5 12.5 17.5

0

+

+

+

+

0

0

+

0

0

+

+

+

+

+

+

+

+

0

+

G F6

+ F5

+ F4

+ F3

0 F1

+ G1

0 G2

0 G3

- m43

+ G4

+ G5

m43

+ G6

+

0

0

+

m43

TOPS

Table M-1. Long Normal Statistical Analysis of PCE Contained in Excavated Soils

Assumptions

Evaluation of PCE Only

PCE Density 1623 kg/m3

Soil Density 135 lb/ft3

Soil Density 2155 7244 kg/m3

Designation	Depth	Corresponding Interval	Thickness	Concentration (mg/kg)	Natural Log Concentration	Ordered log conc	Order	$i-1/2(n+1)x_i$	$(x_i - \text{mean})^2$
A1	0	0-2.5	2.5	0.124	-2.087473713	-4.605170186	1	138.155106	24.563397
A1	5	2.5-7.5	5	0.177	5.176149733	-3.575550789	2	103.690972	15.417622
A1	10	7.5-12.5	5	0.063	-2.764620553	-3.381394754	3	94.6790531	13.930601
A2	0	0-2.5	2.5	3.05	1.115141591	-3.194183212	4	86.2429467	12.568162
A2	5	2.5-7.5	5	0.087	-2.44184716	-3.101092789	5	80.6284125	11.916787
A2	10	7.5-12.5	5	0.028	-3.575550769	-2.764620553	6	69.1155138	9.7069495
A5	0	0-2.5	2.5	0.298	-1.210661792	-2.659260037	7	63.8222409	9.0615283
A5	5	2.5-7.5	5	1.75	0.559615788	-2.551046452	8	58.6740684	8.4217414
A5	10	7.5-12.5	5	0.078	-2.551046452	-2.453407983	9	53.9749756	7.8645764
A6	0	0-2.5	2.5	0.663	-0.410980289	-2.44184716	10	51.2787904	7.799868
A6	5	2.5-7.5	5	1.36	0.3074847	-2.353878387	11	47.0775677	7.3162439
A6	10	7.5-12.5	5	70	4.248495242	-2.162823151	12	41.0936399	6.3191923
A6	15	12.5-17.5	5	2.56	0.940007258	-2.103734234	13	37.8672162	6.0256083
A6	20	17.5-22.5	5	0.382	-0.96233467	-2.087473713	14	35.4870531	5.946043
A8	0	0-2.5	2.5	19.2	2.954910279	-1.857899272	15	29.7263883	4.8791354
A8	5	2.5-7.5	5	8.83	2.178155015	-1.731605546	16	25.9740832	4.337151
A8	10	7.5-12.5	5	0.177	-1.731605546	-1.410587054	17	19.7482188	3.1031087
AA8	0	0-2.5	2.5	21	3.044522438	-1.331806176	18	17.3134803	2.83176
AA8	5	2.5-7.5	5	21.4	3.063390922	-1.255266099	19	15.0631932	2.5800176
B2	0	0-2.5	2.5	0.07	-2.659260037	-1.224175512	20	13.4659306	2.4811061
B2	5	2.5-7.5	5	0.115	-2.162823151	-1.210661792	21	12.1068179	2.4387164
B2	10	7.5-12.5	5	0.095	-2.353878387	-1.127011763	22	10.1431059	2.1844514
B3	0	0-2.5	2.5	114	4.736198448	-0.96233467	23	7.69867736	1.7247881
B3	5	2.5-7.5	5	16	2.772588722	-0.84397007	24	5.90779049	1.427899
B3	10	7.5-12.5	5	0.244	-1.410587054	-0.534435489	25	3.20661294	0.7839557
B5	0	0-2.5	2.5	4700	8.455317788	-0.458865885	26	2.29432942	0.6558459
B5	5	2.5-7.5	5	182	5.204006687	-0.447850825	27	1.7914033	0.6381262
B5	10	7.5-12.5	5	40.1	3.691376334	-0.418550348	28	1.25565104	0.5921727
B5	15	12.5-17.5	5	32.9	3.493472658	-0.410980289	29	0.82196058	0.5805792
B5	20	17.5-22.5	5	0.586	-0.534435489	-0.407968238	30	0.40796824	0.5759982
B6	0	0-2.5	2.5	0.639	-0.447850825	-0.265268478	31	0	0.3797588
B6	5	2.5-7.5	5	0.294	-1.224175512	-0.094310679	32	-0.0943107	0.1982813
B6	10	7.5-12.5	5	1.24	0.21511138	0.198850859	33	0.39770172	0.0231424
B6	15	12.5-17.5	5	28.6	3.353406718	0.21511138	34	0.64533414	0.0184595
B6	20	17.5-22.5	5	0.632	-0.458865885	0.3074847	35	1.2299388	0.0018916
B7	0	0-2.5	2.5	0.767	-0.265268478	0.559615788	36	2.79807894	0.0435301
B7	5	2.5-7.5	5	0.285	-1.255266099	0.58221562	37	3.49329372	0.0534712
B7	10	7.5-12.5	5	0.43	-0.84397007	0.662687973	38	4.63881581	0.0971636
B7	15	12.5-17.5	5	3.27	1.184789985	0.693147181	39	5.64517744	0.1170803
B7	20	17.5-22.5	5	14.3	2.660259537	0.940007258	40	8.46006533	0.3469564
B7	25	22.5-27.5	5	48.2	3.875359021	1.115141591	41	11.1514159	0.5839472
B7	30	27.5-32.5	5	96.6	4.570578741	1.184789985	42	13.0326898	0.6952437
B7	35	32.5-37.5	5	0.91	-0.094310679	2.063058062	43	24.7566967	2.9312208
B8	0	0-2.5	2.5	10.7	2.370243741	2.178155015	44	28.3160152	3.3385787
B8	5	2.5-7.5	5	7.87	2.063058062	2.370243741	45	33.1834124	4.0774373
C2	0	0-2.5	2.5	0.086	-2.453407983	2.468099531	46	37.021493	4.4822069
C2	5	2.5-7.5	5	0.264	-1.331806176	2.660259537	47	42.5641526	5.3327848
C3	0	0-2.5	2.5	0.041	-3.194183212	2.772588722	48	47.1340083	5.8642023
C3	5	2.5-7.5	5	0.01	-4.605170186	2.954910279	49	53.188385	6.7804674
C4	0	0-2.5	2.5	0.658	-0.418550348	3.044522438	50	57.8459263	7.2551858
C4	5	2.5-7.5	5	11.8	2.468099531	3.063390922	51	61.2678184	7.3571881
C4	10	7.5-12.5	5	1.79	0.58221562	3.353406718	52	70.4215411	9.0145829
C4	15	12.5-17.5	5	0.045	-3.101092789	3.493472658	53	76.8563985	9.8752776
C5	0	0-2.5	2.5	0.156	-1.857899272	3.691376334	54	84.9016557	11.158266
C5	5	2.5-7.5	5	0.665	-0.407968238	3.875359021	55	93.0086165	12.421267
C5	10	7.5-12.5	5	1.94	0.662687973	4.248495242	56	106.212381	15.190647
C5	15	12.5-17.5	5	0.034	-3.381394754	4.570578741	57	118.835047	17.805037
C6	0	0-2.5	2.5	1.22	0.198850859	4.736198448	58	127.877358	19.230165
C6	5	2.5-7.5	5	0.324	-1.127011763	5.176149733	59	144.932193	23.28229
C6	10	7.5-12.5	5	0.122	-2.103734234	5.204006687	60	150.916194	23.551895
C6	15	12.5-17.5	5	2	0.693147181	8.455317788	61	253.659534	65.680336
H interpolation - UCL									
				n	61	sum	2792.91	435.8611	
				mean	0.350977219	D	0.2785		
				st dev	2.695246105				
				H (from Gilbert)	4.441697008				
				exp	5.528662689	Y	-0.940713	Y is close to zero, therefore the null hypothesis that the distribution is log normal can not be rejected @ the 0.05 and 0.95 level of significance	
				95% UCL	251.8069414				
H interpolation - LCL									
				n	61				
				mean	-2.78				
				st dev	-2.8082				
				H (from Gilbert)	-2.96260062				
				exp	-3.0854				
				5% LCL	-3.342				
Mass of Soil									
				volume	3,300 cu yd.	Density	135	lb/ft3	Mass
									12028500
								lb	or
									5460939
Mass of PCE									
				95% UCL	1375102	Density	1.623	g/cm3	Volume
				5% LCL	104577				847259.61
								g/cm3	64434.3214
									cm3
									223.8
									gallons

Table M-2. Log Normal Statistical Analysis of Upper Area Groundwater

Lower Area Log Normal Analysis									
	Ln(Concen)	mean	x-mean	(x-mean)^2					
0.0064	-5.051457289	-2.251619	-2.799838	7.839091959	a1	1	0.6872	5	3.4714
0.012	-4.422848629	-2.251619	-2.171229	4.714236177	a2	2	0.1677	4	0.7417
0.14	-1.966112856	-2.251619	0.285507	0.081514011	a3	3		12	0
0.5	-0.693147181	-2.251619	1.558472	2.428835794	a4	4		11	0
2.4	0.875468737	-2.251619	3.127088	9.778680491	a5	5		10	0
					a6	6		9	0
					a7	7		8	0
							Sum	4.2131	
							sq. Sum	17.75	
d=							24.84235843		
k=							2.5		
W=							0.714504846		
sum	-11.2581	24.84235843			Reject null hypothesis at level of significance if				
N=	5				calculated W is less than W at desired quantile				
					W.01	0.686			
					W.02	0.715			
Mean	-2.251619				W.05	0.762			
Standard Deviat	2.492105				W.10	0.806			
					W.50	0.927			
W of 0.714505 indicates that the null hypothesis is not rejected but the correlation is weak									
H interpolation - UCL									
	n				n	5			
Sy	3	5	7		mean	-2.251619			
					st dev	2.492105			
2.492105		11.67			H (from Gilbert)	11.67			
					exp	15.39511			
					UCL is meaningless, average was used for volume estimate				
					95% UCL	4853015	mg/L		
H interpolation - LCL									
	n				H (from Gilbert)	-1.986			
Sy	3	5	7		exp	-1.620985			
2.492105		-1.986			5% LCL	0.197704			
						mg/L			
Area Represented =		28190	ft2						
Assumed Porosity =		0.3							
Average Sat. Zone =		4.5	ft						
Sat. Pore Volume =		38056.5	ft3						
Volume Water		1077640	L						
Density PCE		1623	g/L						
Average =		0.61168	mg/L						
LCL=		0.197704	mg/L						
Mass PCE AVE =		659170.9	mg	659.17	g				
Mas PCE LCL =		213053.5	mg	213.05	g				
Volume PCE AVE =		0.406143	L	0.11	gal				
Volume PCE LCL =		0.131271	L	0.03	gal				
GW Flux									
Rate	Time (years)	Time (minutes)	Volume Water (gallons)	Volume Water (liters)	Contaminant Concentration (mg/L)	Mass Contaminant (mg)	Volume Cont. (liters)	Volume Cont. (gallons)	
2.4	1	525600	1261440	4774937.03	0.20	954987	0.59	0.16	
2.4	6	3153600	7568640	28649622.19	0.20	5729924	3.53	0.93	
2.4	12	6307200	15137280	57299244.38	0.20	11459849	7.06	1.87	
2.4	24	12614400	30274560	114598488.75	0.20	22919698	14.12	3.73	
2.4	30	15768000	37843200	143248110.94	0.20	28649622	17.65	4.66	
2.4	36	18921600	45411840	171897733.13	0.20	34379547	21.18	5.60	
GW Flux									
Rate	Time (years)	Time (minutes)	Volume Water (gallons)	Volume Water (liters)	Contaminant Concentration (mg/L)	Mass Contaminant (mg)	Volume Cont. (liters)	Volume Contaminant (gallons)	
2.4	1	525600	1261440	4774937.03	0.61	2912712	1.79	0.47	
2.4	6	3153600	7568640	28649622.19	0.61	17476270	10.77	2.84	
2.4	12	6307200	15137280	57299244.38	0.61	34952539	21.54	5.69	
2.4	24	12614400	30274560	114598488.75	0.61	69905078	43.07	11.38	
2.4	30	15768000	37843200	143248110.94	0.61	87381348	53.84	14.22	
2.4	36	18921600	45411840	171897733.13	0.61	104857617	64.61	17.07	

Page 1 of 1

Table M-3. Normal Statistical Analysis of Upper Area Groundwater

Lower Area Normal Analysis								
Conc	mean	x-mean	(x-mean)^2		i	n-i+1	ai*(xn-i+1 - xi)^2	
0.0064	6.4	611.68	-605.28	366363.8784	a1	1	0.6872	5 -4.398
0.012	12	611.68	-599.68	359616.1024	a2	2	0.1677	4 -2.012
0.14	140	611.68	-471.68	222482.0224	a3	3		12 0
0.5	500	611.68	-111.68	12472.4224	a4	4		11 0
2.4	2400	611.68	1788.32	3198088.422	a5	5		10 0
					a6	6		9 0
					a7	7		8 0
							Sum	-6.41
							sq Sum	41.094
					d=	4159023		
					k=	2		
					W=	9.88E-06		
sum	3058.4		4159022.848		Reject null hypothesis at level of significance if			
N=	5				calculated W is less than W at desired quantile			
					W.01	0.686		
					W.02	0.715		
					W.05	0.762		
					W.10	0.806		
					W.50	0.927		
Mean	611.68				W of 9.88E-06 indicates that the null hypothesis			
Standard Deviation	1019.684				is rejected, the population is not normally distributed			

Table M-4. Analysis of PCE Contained in Former Excavation Groundwater

Excavation Groundwater

Average PCE Concentration	0.14	mg/L		
Area Represented =	11250	ft ²		
Assumed Porosity =	0.3			
Average Sat. Zone =	15	ft	Average Assumed Based on Excavation	
Sat. Pore Volume =	50625	ft ³		
Mass Water =	1433540	L		
Density PCE	1623	g/L		
Mass PCE =	200695.7	mg	200.70	g
Volume PCE =	0.123657	L	0.03	gal

Table M-5. Log Normal Statistical Analysis of PCE in Lower Area Groundwater

Lower Area Log Normal Analysis									
	Ln(Concen.)	mean	x-mean	(x-mean)^2		i	n-i+1	ai*(xn-l+	
0.0011	-6.812445099	-1.939279	-4.873167	23.74775204	a1	1	0.5251	14	3.8859
0.028	-3.575550769	-1.939279	-1.636272	2.677386715	a2	2	0.3318	13	1.2469
0.029	-3.540459449	-1.939279	-1.601181	2.563780214	a3	3	0.246	12	0.8635
0.034	-3.381394754	-1.939279	-1.442116	2.079699095	a4	4	0.1802	11	0.5345
0.09	-2.407945609	-1.939279	-0.468667	0.219648795	a5	5	0.124	10	0.2267
0.098	-2.3227878	-1.939279	-0.383509	0.147079331	a6	6	0.0727	9	0.0709
0.12	-2.120263536	-1.939279	-0.180985	0.032755559	a7	7	0.024	8	0.0176
0.25	-1.386294361	-1.939279	0.552984	0.305791533					
0.26	-1.347073648	-1.939279	0.592205	0.350706667					
0.56	-0.579818495	-1.939279	1.35946	1.848131689				Sum	6.8459
0.66	-0.415515444	-1.939279	1.523763	2.321854058	d=		50.82542	sq. Sum	46.866
0.97	-0.030459207	-1.939279	1.908819	3.643591351	k=		7		
1.2	0.182321557	-1.939279	2.1216	4.501187089					
1.8	0.587786665	-1.939279	2.527065	6.386058691	W=		0.922097		
sum		-27.1499		50.82542283					
N=		14							
Mean		-1.939279							
Standard Deviation		1.977283							

Reject null hypothesis at level of significance if
calculated W is less than W at desired quantile

W.01	0.825
W.02	0.846
W.05	0.874
W.10	0.895
W.50	0.947

W of 0.922097 indicates that the null hypothesis
is not rejected

H interpolation - UCL

	n		
Sy	12	14	15
1.75	4.422	4.152667	4.018
1.977283	4.912931197	4.647234	4.514386
2	4.962	4.696667	4.564

n	14
mean	-1.939279
st dev	1.977283
H (from Gilbert)	4.647234
exp	2.564087
95% UCL	12.98879 mg/L

H interpolation - LCL

	n		
Sy	12	14	15
1.75	-1.962	-1.997333	-2.015
1.977283	-2.072004953	-2.112187	-2.132278
2	-2.083	-2.123667	-2.144

H (from Gilbert)	-2.112187
exp	-1.142777
5% LCL	0.318932 mg/L

Area Represented = 26910 ft²
Assumed Porosity = 0.3
Average Sat. Zone = 7 ft

Sat. Pore Volume = 56511 ft³
Volume Water 1600213 L
Density PCE 1623 g/L

UCL= 12.98879 mg/L
LCL= 0.318932 mg/L

Mass PCE UCL = 20784841 mg 20784.84 g
Mas PCE LCL = 510359.3 mg 510.36 g

Volume PCE UCL =	12.80643	L	3.38	gal
Volume PCE LCL =	0.314454	L	0.08	gal

Table M-6. Log Normal Statistical Analysis of PCE Migrating Off-site from the Lower Area Groundwater

Lower Area Log Normal Analysis									
	Ln(Concen)	mean	x-mean	(x-mean)^2		i	n-i+1	ai*(xn-l+1 - xi)^2	
0.028	-3.575550769	-1.60451	-1.97104	3.885014513	a1	1	0.6431	6	2.0322
0.098	-2.3227878	-1.60451	-0.71828	0.515927663	a2	2	0.2806	5	0.4891
0.25	-1.386294361	-1.60451	0.218212	0.047616648	a3	3	0.0875	4	0.0034
0.26	-1.347073648	-1.60451	0.257433	0.066271804					
0.56	-0.579818495	-1.60451	1.024688	1.049986025					
0.66	-0.415515444	-1.60451	1.188991	1.413700333					
								Sum	2.5247
								sq. Sum	6.3743
								d=	6.97851699
								k=	3
								W=	0.913
sum	-9.62704	6.978516985			Reject null hypothesis at level of significance if				
N=	6				calculated W is less than W at desired quantile				
					W.01	0.825			
					W.02	0.846			
					W.05	0.874			
					W.10	0.895			
					W.50	0.947			
								W of	0.913 indicates that the null hypothesis is not rejected
H interpolation - UCL									
	n				n	6			
Sy	5	6	7		mean	-1.60451			
1	4.905	4.3015	3.698		st dev	1.181399			
1.181399	5.700252845	4.963243	4.226234		H (from Gilbert)	4.963243			
1.25	6.001	5.2135	4.426		exp	1.715613			
					95% UCL	5.560084	mg/L		
H interpolation - LCL									
	n				H (from Gilbert)	-1.6172			
Sy	5	6	7		exp	-1.76108			
1	-1.562	-1.586	-1.61		5% LCL	0.171859	mg/L		
1.181399	-1.586670252	-1.6172	-1.64773						
1.25	-1.596	-1.629	-1.662						
Area Represented =		26910	ft2						
Assumed Porosity =		0.3							
Average Sat. Zone =		7	ft						
Sat. Pore Volume =		56511	ft3						
Volume Water		1600213	L						
Density PCE		1623	g/L						
UCL=		5.560084	mg/L						
LCL=		0.171859	mg/L						
Mass PCE UCL =		8897321	mg	8897.32	g				
Mas PCE LCL =		275010.5	mg	275.01	g				
Volume PCE UCL =		5.482021	L	1.45	gal	Not used, see analysis of all lower groundwater data			
Volume PCE LCL =		0.169446	L	0.04	gal				
Contaminant									
GW Flux Rate (GPM)	Time (years)	Time (minutes)	Volume Water (gallons)	Volume Water (liters)	Concentration (mg/L)	Mass Contaminant (mg)	Volume Cont. (liters)	Volume Cont. (gallons)	
7.8	1	525600	4099680	15518545.35	0.17	2666996	1.64	0.43	
7.8	6	3153600	24598080	93111272.11	0.17	16001976	9.86	2.60	
7.8	12	6307200	49196160	186222544.23	0.17	32003952	19.72	5.21	
7.8	24	12614400	98392320	372445088.45	0.17	64007904	39.44	10.42	
7.8	30	15768000	1.23E+08	465556360.56	0.17	80009880	49.30	13.02	
7.8	36	18921600	1.48E+08	558667632.68	0.17	96011856	59.16	15.63	
Contaminant									
GW Flux Rate (GPM)	Time (years)	Time (minutes)	Volume Water (gallons)	Volume Water (liters)	Concentration (mg/L)	Mass Contaminant (mg)	Volume Cont. (liters)	Volume Cont. (gallons)	
7.8	1	525600	4099680	15518545.35	5.56	86284419	53.16	14.04	
7.8	6	3153600	24598080	93111272.11	5.56	517706512	318.98	84.27	
7.8	12	6307200	49196160	186222544.23	5.56	1035413024	637.96	168.54	
7.8	24	12614400	98392320	372445088.45	5.56	2070826047	1275.92	337.07	
7.8	30	15768000	1.23E+08	465556360.56	5.56	2588532559	1594.91	421.34	
7.8	36	18921600	1.48E+08	558667632.68	5.56	3106239071	1913.89	505.61	

Table M-7. Statistical Evaluation of PCE Breakdown Products in Excavated Soils

Designation	Samp ID	Depth	Total DCE ug/kg	TCE ug/kg	DCE g-moles/kg	TCE g- moles/kg	DCE+TCE g- moles/kg	PCE Equivalent DCE+TCE ug/kg
AA8	125-1439	0	2585	2585	0.026665979	0.019674	0.046340231	7684.60
AA8	126-1444	5	2445	2445	0.025221787	0.018609	0.043830509	7268.41
A1	148-0947	0	261	64.3	0.002692387	0.000489	0.00318177	527.63
A1	149-1003	5	2705	2705	0.027903858	0.020588	0.048491422	8041.33
A1	150-1023	10	95	27.5	0.000979988	0.000209	0.001189288	197.22
A2	151-1114	0	26.9	26.9	0.000277491	0.000205	0.000482225	79.97
A2	152-1209	5	253	25.6	0.002609862	0.000195	0.002804702	465.10
A2	153-1236	10	25.3	25.3	0.000260986	0.000193	0.000453543	75.21
A5	159-0843	0	26.55	26.55	0.000273881	0.000202	0.000475951	78.93
A5	160-0903	5	24.55	24.55	0.000253249	0.000187	0.000440098	72.98
A5	161-0937	10	28.15	28.15	0.000290386	0.000214	0.000504633	83.68
A6	052-1432	0	25.55	25.55	0.000263565	0.000194	0.000458024	75.95
A6	053-1504	5	25.95	25.95	0.000267691	0.000198	0.000465195	77.14
A6	054-1704	10	27.15	27.15	0.00028007	0.000207	0.000486707	80.71
A6	055-1731	15	26.75	26.75	0.000275944	0.000204	0.000479536	79.52
A6	056-1754	20	25.55	25.55	0.000263565	0.000194	0.000458024	75.95
A8	063-1127	0	263.5	263.5	0.002718176	0.002005	0.004723656	783.32
A8	064-1137	5	118	118	0.001217248	0.000898	0.002115337	350.79
A8	065-1200	10	245	27.4	0.002527336	0.000209	0.002735876	453.69
B8	082-0824	0	1320	1320	0.01361667	0.010046	0.023663097	3924.05
B8	083-0848	5	1285	1285	0.013255622	0.00978	0.023035666	3820.00
B7	074-1022	0	24.65	24.65	0.000254281	0.000188	0.00044189	73.28
B7	075-1033	5	880	27.45	0.00907778	0.000209	0.0092867	1540.01
B7	076-1058	10	448	26.4	0.004621415	0.000201	0.004822344	799.69
B7	077-1130	15	28.4	28.4	0.000292965	0.000216	0.000509115	84.43
B7	078-1154	20	2690	2690	0.027749123	0.020473	0.048222523	7996.74
B7	079-1317	25	2685	2685	0.027697545	0.020435	0.04813289	7981.88
B7	080-1348	30	25700	25700	0.265112441	0.195601	0.460713324	76400.09
B7	081-1429	35	24.6	24.6	0.000253765	0.000187	0.000440994	73.13
B6	047-1013	0	26.9	26.9	0.000277491	0.000205	0.000482225	79.97
B6	048-1024	5	24.1	24.1	0.000248607	0.000183	0.000432031	71.64
B6	049-1039	10	30.4	30.4	0.000313596	0.000231	0.000544968	90.37
B6	050-1131	15	2750	2750	0.028368063	0.02093	0.049298118	8175.11
B6	051-1216	20	26.95	26.95	0.000278007	0.000205	0.000483122	80.12
B5	167-1340	0	140000	140000	1.444192284	1.06553	2.509722385	416187.26
B5	168-1456	5	2680	2680	0.027645967	0.020397	0.048043257	7967.01
B5	169-1546	10	2610	2610	0.02692387	0.019865	0.046788396	7758.92
B5	170-1630	15	2600	2600	0.026820714	0.019788	0.04660913	7729.19
B5	171-1721	20	25.1	25.1	0.000258923	0.000191	0.000449957	74.62
B3	162-1023	0	2700	2700	0.02785228	0.02055	0.048401789	8026.47
B3	163-1030	5	2755	2755	0.028419641	0.020968	0.049387751	8189.97
B3	164-1051	10	27.6	27.6	0.000284712	0.00021	0.000494774	82.05
B2	145-1132	0	25.2	25.2	0.000259955	0.000192	0.00045175	74.91
B2	146-0837	5	752	27.45	0.007757376	0.000209	0.007966296	1321.05
B2	147-0908	10	137	27	0.001413245	0.000205	0.00161874	268.44
C2	199-0936	0	25.95	25.95	0.000267691	0.000198	0.000465195	77.14
C2	200-0954	5	26	26	0.000268207	0.000198	0.000466091	77.29
C3	180-1445	0	21.6	21.6	0.000222818	0.000164	0.000387214	64.21
C3	181-1526	5	26.45	26.45	0.000272849	0.000201	0.000474158	78.63
C4	176-1057	0	26.15	26.15	0.000269754	0.000199	0.00046878	77.74
C4	177-1205	5	2285	2285	0.023571281	0.017391	0.040962255	6792.77
C4	178-1231	10	22.75	22.75	0.000234681	0.000173	0.00040783	67.63
C4	179-1358	15	25.45	25.45	0.000262534	0.000194	0.000456232	75.66
C5	172-0836	0	26.6	26.6	0.000274397	0.000202	0.000476847	79.08
C5	173-0855	5	24.05	49.1	0.000248092	0.000374	0.000621788	103.11
C5	174-0919	10	381	77.5	0.003930266	0.00059	0.004520113	749.57
C5	175-1003	15	22.7	22.7	0.000234165	0.000173	0.000406934	67.48
C6	038-1659	0	27.05	27.05	0.000279039	0.000206	0.000484914	80.41
C6	039-1706	5	128	28.8	0.001320404	0.000219	0.001539599	255.31
C6	040-1734	10	25.95	25.95	0.000267691	0.000198	0.000465195	77.14
C6	041-1817	15	261	261	0.002692387	0.001986	0.00467884	775.89

Area Not Excavated

		Natural Log			
PCE Equivalent DCE+TCE ug/kg	Concentration	Ordered log conc	Order	$i-1/2(n+1) \times (x-\text{mean})^2$	
64.21	4.162186	4.162186203	1	-124.866	3.58634
67.48	4.211858	4.211857813	2	-122.144	3.400675
67.63	4.214058	4.214058033	3	-117.994	3.392565
71.64	4.271705	4.271704729	4	-115.336	3.18353
72.98	4.290205	4.290204742	5	-111.545	3.117855
73.13	4.292239	4.292239331	6	-107.306	3.110674
73.28	4.29427	4.294269789	7	-103.062	3.103516
74.62	4.312361	4.312360734	8	-99.1843	3.040103
74.91	4.316337	4.316336883	9	-94.9594	3.026253
75.21	4.320297	4.320297284	10	-90.7262	3.01249
75.66	4.326209	4.326208631	11	-86.5242	2.992004

Table M-7. Statistical Evaluation of PCE Breakdown Products in Excavated Soils

75.95	4.33013	4.330130205	12	-82.2725	2.978453
75.95	4.33013	4.330130205	13	-77.9423	2.978453
77.14	4.345664	4.345664498	14	-73.8763	2.925076
77.14	4.345664	4.345664498	15	-69.5306	2.925076
77.14	4.345664	4.345664498	16	-65.185	2.925076
77.29	4.347589	4.347589426	17	-60.8663	2.918495
77.74	4.353342	4.353342079	18	-56.5934	2.898873
78.63	4.364749	4.364749046	19	-52.377	2.86016
78.93	4.368523	4.368522636	20	-48.0537	2.84741
79.08	4.370404	4.370404104	21	-43.704	2.841064
79.52	4.376027	4.376027361	22	-39.3842	2.822139
79.97	4.381619	4.381619175	23	-35.053	2.803383
79.97	4.381619	4.381619175	24	-30.6713	2.803383
80.12	4.383476	4.383476185	25	-26.3009	2.797168
80.41	4.38718	4.387179893	26	-21.9359	2.784793
80.71	4.39087	4.390869934	27	-17.5635	2.772491
82.05	4.407309	4.407308661	28	-13.2219	2.718017
83.68	4.42704	4.427040243	29	-8.85408	2.653346
84.43	4.435882	4.435882033	30	-4.43588	2.624619
90.37	4.503935	4.503935497	31	0	2.408748
103.11	4.635807	4.635807459	32	4.635807	2.016804
197.22	5.284318	5.284318125	33	10.56864	0.595415
255.31	5.542485	5.542485249	34	16.62746	0.263646
268.44	5.592611	5.592611482	35	22.37045	0.214682
350.79	5.860178	5.860177513	36	29.30089	0.038327
453.69	6.117415	6.11741483	37	36.70449	0.003778
465.10	6.14226	6.142260305	38	42.99582	0.00745
527.63	6.268401	6.268400749	39	50.14721	0.045135
749.57	6.6195	6.619500197	40	59.5755	0.317589
775.89	6.654013	6.654013295	41	66.54013	0.35768
783.32	6.663546	6.663546256	42	73.29901	0.369174
799.69	6.684223	6.684223251	43	80.21068	0.394728
1321.05	7.186183	7.186182772	44	93.42038	1.277427
1540.01	7.339546	7.339546445	45	102.7537	1.64762
3820.00	8.248007	8.248006885	46	123.7201	4.805114
3924.05	8.27488	8.274879904	47	132.3981	4.923651
6792.77	8.823614	8.823614191	48	150.0014	7.659966
7268.41	8.891293	8.89129329	49	160.0433	8.039173
7684.60	8.946974	8.946973675	50	169.9925	8.358019
7729.19	8.95276	8.952759612	51	179.0552	8.391507
7758.92	8.956598	8.956598388	52	188.0886	8.413762
7967.01	8.983065	8.983064962	53	197.6274	8.568003
7981.88	8.984929	8.984928895	54	206.6534	8.578919
7996.74	8.986789	8.986789361	55	215.6829	8.589821
8026.47	8.9905	8.99049994	56	224.7625	8.611585
8041.33	8.99235	8.992350079	57	233.8011	8.622447
8175.11	9.008849	9.008849079	58	243.2389	8.719614
8189.97	9.010666	9.01066561	59	252.2986	8.730346
76400.09	11.24374	11.24373916	60	326.0684	26.91316
416187.26	12.93889	12.93889059	61	388.1667	47.37487

n	61	sum	2079.28	284.1016
ln mean	6.05595	D	0.2568	
st dev	2.176012			
mean	9916.75			

Y -6.58881 Y is not close to zero, therefore the null hypothesis that the distribution is log normal is rejected. Normal analysis also rejected; therefore, long normal assumed because it is a conservative assumption

H interpolation - UCL			
	n	61	101
Sy	51		
2	3.533	3.4854	3.295
2.176012	3.798778	3.742025	3.515015
2.5	4.288	4.2144	3.92

	n	61
	mean	6.055949755
	st dev	2.176011822
H (from Gilbe		3.798777851
exp		9.49062344
95% UCL		13235.04401

ug/kg 13 2350 mg/kg

H interpolation - LCL			
	n	61	101
Sy	51		
2	-2.416	-2.438	-2.526
2.176012	-2.54414	-2.56832	-2.66505
2.5	-2.78	-2.8082	-2.921

H (from Gilbe	-2.544136606
exp	7.708759743
5% LCL	2227.777528

ug/kg 2 2278 mg/kg

PCE Equivalent		ordered		
DCE+TCE ug/kg		Concentration	Order	$i-1/2(n+1) \times (x-\text{mean})^2$
64.21	4.162186	64.21	1	-1926.35 3382.097
67.48	4.211858	67.48	2	-1956.97 3773.134

Table M-7. Statistical Evaluation of PCE Breakdown Products in Excavated Soils

67.63	4.214058	67.63	3	-1893.65	3791.417
71.64	4.271705	71.64	4	-1934.38	4301.748
72.98	4.290205	72.98	5	-1897.52	4479.017
73.13	4.292239	73.13	6	-1828.25	4498.935
73.28	4.29427	73.28	7	-1758.69	4518.896
74.62	4.312361	74.62	8	-1716.18	4700.54
74.91	4.316337	74.91	9	-1648.1	4741.391
75.21	4.320297	75.21	10	-1579.43	4782.419
75.66	4.326209	75.66	11	-1513.14	4844.292
75.95	4.33013	75.95	12	-1443.13	4885.762
75.95	4.33013	75.95	13	-1367.18	4885.762
77.14	4.345664	77.14	14	-1311.44	5053.409
77.14	4.345664	77.14	15	-1234.29	5053.409
77.14	4.345664	77.14	16	-1157.15	5053.409
77.29	4.347589	77.29	17	-1082.09	5074.563
77.74	4.353342	77.74	18	-1010.59	5138.293
78.63	4.364749	78.63	19	-943.556	5266.944
78.93	4.368523	78.93	20	-868.196	5310.181
79.08	4.370404	79.08	21	-790.756	5331.866
79.52	4.376027	79.52	22	-715.693	5397.186
79.97	4.381619	79.97	23	-639.739	5462.904
79.97	4.381619	79.97	24	-559.772	5462.904
80.12	4.383476	80.12	25	-480.696	5484.898
80.41	4.38718	80.41	26	-402.067	5529.019
80.71	4.39087	80.71	27	-322.842	5573.317
82.05	4.407309	82.05	28	-246.145	5774.844
83.68	4.42704	83.68	29	-167.367	6026.016
84.43	4.435882	84.43	30	-84.4266	6141.952
90.37	4.503935	90.37	31	0	7109.212
103.11	4.635807	103.11	32	103.1111	9419.71
197.22	5.284318	197.22	33	394.4393	36543.56
255.31	5.542485	255.31	34	765.9352	62128.44
268.44	5.592611	268.44	35	1073.743	68843.14
350.79	5.860178	350.79	36	1753.932	118839.1
453.69	6.117415	453.69	37	2722.142	200376.5
465.10	6.14226	465.10	38	3255.726	210724.8
527.63	6.268401	527.63	39	4221.063	272042.5
749.57	6.6195	749.57	40	6746.133	552813.7
775.89	6.654013	775.89	41	7758.92	592647.5
783.32	6.663546	783.32	42	8616.563	604145.4
799.69	6.684223	799.69	43	9596.271	629853.9
1321.05	7.186183	1321.05	44	17173.66	1729212
1540.01	7.339546	1540.01	45	21560.19	2353026
3820.00	8.248007	3820.00	46	57300.07	14546204
3924.05	8.27488	3924.05	47	62784.82	15350688
6792.77	8.823614	6792.77	48	115477.1	46059497
7268.41	8.891293	7268.41	49	130831.4	52741834
7684.60	8.946974	7684.60	50	146007.4	58960047
7729.19	8.95276	7729.19	51	154583.8	59646831
7758.92	8.956598	7758.92	52	162937.3	60106896
7967.01	8.983065	7967.01	53	175274.3	63376842
7981.88	8.984929	7981.88	54	183583.2	63613724
7996.74	8.986789	7996.74	55	191921.8	63851047
8026.47	8.9905	8026.47	56	200661.7	64327020
8041.33	8.99235	8041.33	57	209074.6	64565669
8175.11	9.008849	8175.11	58	220727.9	66733394
8189.97	9.010666	8189.97	59	229319.2	66976462
76400.09	11.24374	76400.09	60	2215603	5.84E+09
416187.26	12.93889	416187.26	61	12485618	1.73E+11
n	61	sum	16992967	1.8E+11	
mean	9916.75	D	0.0848		
st dev	53823.75	Y	-51.3759	Y is not close to zero, therefore the null hypothesis that the distribution is normal is rejected.	

Table M-8. Log Normal Statistical Analysis of PCE Migrating Off-site from the Lower Area Groundwater

Lower Area Log Normal Analysis								
	Ln(Concen.)	mean	x-mean	(x-mean)^2		i	n-i+1	ai*(xn-l+1 - xi)^2
0.205209	-1.583724615	0.08685	-1.67057	2.790820662	a1	1	0.6431	6 1.9063
0.892633	-0.11357941	0.08685	-0.20043	0.040172083	a2	2	0.2806	5 0.2101
0.901368	-0.103841778	0.08685	-0.19069	0.036363482	a3	3	0.0875	4 0.0359
1.358786	0.306591948	0.08685	0.219742	0.048286376				
1.887224	0.635107144	0.08685	0.548257	0.300585528				
3.977083	1.38054872	0.08685	1.293698	1.673655512				
							Sum	2.1523
							sq. Sum	4.6325
					d=		4.88988364	
					k=		3	
					W=		0.947	
sum	0.521102			4.889883643	Reject null hypothesis at level of significance if			
N=	6				calculated W is less than W at desired quantile			
					W.01		0.825	
					W.02		0.846	
					W.05		0.874	
					W.10		0.895	
					W.50		0.947	
Mean	0.08685				W of	0.947	indicates that the null hypothesis	
Standard Deviation	0.988927						is not rejected	
H interpolation - UCL					n	6		
Sy	5	6	7		mean	0.08685		
0.9	4.478	3.949	3.42		st dev	0.988927		
0.988927	4.857718543	4.262468	3.667217		H (from Gilbert)	4.262468		
1	4.905	4.3015	3.698		exp	2.460965		
					95% UCL	11.71611	mg/L	
H interpolation - LCL					H (from Gilbert)	-1.58484		
Sy	5	6	7		exp	-0.12507		
0.9	-1.556	-1.5755	-1.595		5% LCL	0.882432	mg/L	
0.988927	-1.561335624	-1.58484	-1.60834					
1	-1.562	-1.586	-1.61					
Area Represented =	26910	ft2						
Assumed Porosity =	0.3							
Average Sat. Zone =	7	ft						
Sat. Pore Volume =	56511	ft3						
Volume Water	1600213	L						
Density PCE	1623	g/L						
UCL=	11.71611	mg/L						
LCL=	0.882432	mg/L						
Mass PCE UCL =	18748273	mg	18748.27	g				
Mass PCE LCL =	1412079	mg	1412.08	g				
Volume PCE UCL =	11.55162	L	3.05	gal	Not used, see analysis using all lower area data			
Volume PCE LCL =	0.870042	L	0.23	gal				

						Contaminant			
GW Flux Rate (GPM)	Time (years)	Time (minutes)	Volume Water (gallons)	Volume Water (liters)	Concentration (mg/L)	Mass Contaminant (mg)	Volume Cont. (liters)	Volume Cont. (gallons)	
7.8	1	525600	4099680	15518545.35	0.88	13694054	8.44	2.23	
7.8	6	3153600	24598080	93111272.11	0.88	82164326	50.62	13.37	
7.8	12	6307200	49196160	186222544.23	0.88	164328651	101.25	26.75	
7.8	24	12614400	98392320	372445088.45	0.88	328657302	202.50	53.50	
7.8	30	15768000	1.23E+08	465556360.56	0.88	410821628	253.12	66.87	
7.8	36	18921600	1.48E+08	558667632.68	0.88	492985953	303.75	80.24	
						Contaminant			
GW Flux Rate (GPM)	Time (years)	Time (minutes)	Volume Water (gallons)	Volume Water (liters)	Concentration (mg/L)	Mass Contaminant (mg)	Volume Cont. (liters)	Volume Cont. (gallons)	
7.8	1	525600	4099680	15518545.35	11.72	181816959	112.03	29.59	
7.8	6	3153600	24598080	93111272.11	11.72	1090901751	672.15	177.57	
7.8	12	6307200	49196160	186222544.23	11.72	2181803502	1344.30	355.14	
7.8	24	12614400	98392320	372445088.45	11.72	4363607004	2688.61	710.27	
7.8	30	15768000	1.23E+08	465556360.56	11.72	5454508755	3360.76	887.84	
7.8	36	18921600	1.48E+08	558667632.68	11.72	6545410506	4032.91	1065.41	

Table M-9. Log Normal Statistical Analysis of PCE in Upper Area Soil Gas

Lower Area Log Normal Analysis									
	Ln(Concen.)	mean	x-mean	(x-mean)^2	i		n-i+1	ai*(xn-l+1 - xi)^2	
5700	8.648221454	10.08476	-1.436539065	2.063644484	a1	1	0.4808	19	1.3103925
8600	9.059517482	10.08476	-1.025243036	1.051123283	a2	2	0.3232	18	0.6055441
9700	9.179881164	10.08476	-0.904879354	0.818806645	a3	3	0.2561	17	0.4300221
10000	9.210340372	10.08476	-0.874420146	0.764610592	a4	4	0.2059	16	0.3394588
16000	9.680344001	10.08476	-0.404416517	0.163552719	a5	5	0.1641	15	0.1622311
17000	9.740968623	10.08476	-0.343791895	0.118192867	a6	6	0.1271	14	0.1149564
18000	9.798127037	10.08476	-0.286633482	0.082158753	a7	7	0.0932	13	0.0671549
21000	9.952277717	10.08476	-0.132482802	0.017551693		8	0.0612	12	0.0424206
22000	9.998797732	10.08476	-0.085962786	0.007389601		9	0.0303	11	0.0203058
23000	10.04324949	10.08476	-0.041511023	0.001723165		10	0	10	
26000	10.16585182	10.08476	0.081091299	0.006575799		11		9	
29000	10.27505111	10.08476	0.190290591	0.036210509		12		8	
37000	10.51867319	10.08476	0.433912673	0.188280208		13		7	
42000	10.6454249	10.08476	0.560664379	0.314344546		14		6	
43000	10.66895539	10.08476	0.584194876	0.341283653		15		5	
52000	10.858999	10.08476	0.774238479	0.599445223		16		4	
52000	10.858999	10.08476	0.774238479	0.599445223		17		3	
56000	10.93310697	10.08476	0.848346451	0.719691701		18		2	
87000	11.37366534	10.08476	1.288902879	1.661270632		19		1	
					d=	9.5553013	Sum		3.0924863
sum	191.6104			9.555301296	k=	9.5	sq. Sum		9.5634715
N=	19				W=	1.000855			

W.01	0.863
W.02	0.879
W.05	0.901
W.10	0.917
W.50	0.957

W of 1.000855 indicates that the null hypothesis is not rejected

H interpolation - UCL

	n		
Sy	15	19	21
0.7	2.306	2.229333	2.191
0.728594587	2.345174584	2.264505	2.224169721
0.8	2.443	2.352333	2.307

n	19
mean	10.08476
st dev	0.728595
H (from Gilbert	2.264505
exp	10.73907
95% UCL	46123.23 ug/L

H interpolation - LCL

	n		
Sy	15	19	21
0.7	-1.638	-1.653333	-1.661
0.728594587	-1.643147026	-1.659624	-1.667862701
0.8	-1.656	-1.675333	-1.685

H (from Gilbert	-1.659624	
exp	10.06518	
5% LCL	23509.88	ug/L

Area Represented =	28188	ft ²
Assumed Porosity =	0.3	
Average Vadose Zone =	15	ft

Pore Volume =	126846	ft3
	3591879	L
	3591.879	m3

UCL=	46123.23	ug/m3
LCL=	23509.88	ug/m3

Mass PCE

	Conc.	ug/m3	Pore Volume (m3)	Mass (ug)	Mass (g)	Volume (liters)	Volume (gallons)
UCL		46123	3592	165669065		166	0.102075826
LCL		23510	3592	84444635		84	0.052029966

Upper Area

Dx (cm2/sec)	Pa	Dv (cm2/sec)	Dv (m2/sec)	L (m)	Cgas (ug/m3)	J (ug/m2/s)	Area (m2)	Q (ug/sec)	Q (kg/year)
0.072	0.3	0.01446	1.44598E-06	4.6	46123	0.014498489	2618.751	37.967932	1.197356703
0.072	0.3	0.01446	1.44598E-06	4.6	23510	0.007390152	2618.751	19.352968	0.610315208

Entire Site

J (ug/m2/s)	Area (ft2)	Area (m2)	Q (ug/sec)	Q (g/year)	Q (liters/year)	Q (gal/year)	6 year Total	12 Year Total	18 Year Total	24 Year Total	30 Year Total	36 Year Total
0.014498489	66350	6164	89.37038058	2818.38	1.74	0.46	2.75	5.51	8.26	11.01	13.76	16.52
0.007390152	66350	6164	45.55376211	1436.58	0.89	0.23	1.40	2.81	4.21	5.61	7.02	8.42

Table M-10 Existing Soil Volume Estimates

	Main Excavation	RofW West of Exca	West of Excavation	Excavation Edge to River	RofW West of Building	Total
Average	10 75	9 00	8 33	15 33	10 00	
Total Area (sq. ft.)	25200	4800	2400	16000	14400	
Excluded Area	1600	400	0	1600	0	
Effective Area	23600	4400	2400	14400	14400	
Volume (cu. ft.)	253596 5	39600	20000	220800	144000	
Volume (cu. Yd.)	9392 463	1466 667	740 7407	8177 778	5333 333	25110 98
2 5	5	15	10	10		
2 5	10	7 5	12 5	10		
2 5	10	7 5	15	10		
2 5	10	10	15	10		
2 5	10	7 5	7 5			
2 5		2 5	10			
2 5			7 5			
2 5			25			
2 5			25			
2 5			25			
2 5			25			
5			10			
5			7 5			
5			25			
7 5			10			
7 5						
7 5						
7 5						
7 5						
7 5						
7 5						
7 5						
7 5						
7 5						
7 5						
7 5						
7 5						
7 5						
10						
10						
12 5						
12 5						
12 5						
12 5						
12 5						
12 5						
12 5						
12 5						
12 5						
12 5						
12 5						
17 5						
17 5						
17 5						
17 5						
17 5						
17 5						
17 5						
20						
22 5						
22 5						
22 5						
22 5						
27 5						
27 5						
27 5						

Table M-11 Statistical Analysis of Area Beneath and Around Excavated Area

Designation	Depth	Total DCE	DCE g- mole/kg	TCE g- mole/kg	PCE g- mole/kg	DCE+TCE g- mole/kg	PCE g- mole/kg	Total PCE Equivalent DCE+TCE g- mole/kg
n	Samp ID	Depth	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
A1	150-1023	10	95	27.5	63.6	0.00096	0.000209	0.001169
A2	152-1209	5	253	25.6	87.6	0.00261	0.000195	0.002805
A3	153-1236	10	25.3	25.3	15.15	0.000261	0.000193	0.000454
A3	154-1408	0	25.35	25.35	126	0.000262	0.000192	0.000454
A3	155-1435	5	25.1	25.1	2090	0.000259	0.000191	0.000450
A3	156-1508	10	27.05	27.05	140	0.000279	0.000206	0.000484
A4	157-1548	0	26.05	26.05	15.6	0.000269	0.000198	0.000467
A4	158-1601	5	26.15	26.15	1800	0.00027	0.000199	0.000469
A5	161-0937	10	28.15	28.15	78.1	0.00029	0.000214	0.000505
A6	055-1731	15	26.75	26.75	2560	0.000276	0.000204	0.000480
A6	056-1754	20	25.55	25.55	382	0.000264	0.000194	0.000458
A7	060-0933	15	26.85	26.85	1580	0.000277	0.000204	0.000481
A7	061-0954	20	26.5	24.75	411	0.0002734	0.000188	0.000461
A7	062-1039	25	24.75	24.75	14.85	0.000255	0.000188	0.000443
A8	065-1202	10	24.5	27.4	177	0.000257	0.000209	0.000466
A8	066-1214	15	27.15	27.15	1030	0.000258	0.000207	0.000465
A8	067-1347	20	24.3	24.3	185	0.000251	0.000185	0.000436
A9	068-1454	0	25.85	25.85	2250	0.000267	0.000197	0.000464
A9	069-1503	5	24.1	24.1	559	0.000249	0.000183	0.000432
A9	070-1526	10	26.5	26.5	15.9	0.000273	0.000202	0.000475
A9	071-1543	15	23.8	23.9	633	0.001424	0.000182	0.001606
A9	072-1611	20	153	28	591	0.001578	0.000213	0.001791
A9	073-1636	25	28.55	28.55	83.1	0.000295	0.000217	0.000512
AA8	127-1519	15	148	27.25	2720	0.001527	0.000207	0.001734
AA8	128-1533	20	26.4	26.4	32.3	0.000272	0.000201	0.000473
B1	141-0906	0	26.85	26.85	187	0.000275	0.000203	0.000478
B1	142-0930	5	24.75	24.75	45.4	0.000285	0.000188	0.000473
B1	143-1010	10	225	274	551	0.002321	0.000205	0.002526
B1	144-1103	15	26.55	26.55	194	0.000274	0.000202	0.000476
B2	147-0908	10	137	27	95.3	0.001413	0.000205	0.001618
B3	154-1051	10	27.6	27.6	244	0.000285	0.00021	0.000495
B5	171-1721	20	25.1	25.1	586	0.000259	0.000191	0.000450
B6	051-1216	20	26.95	26.95	532	0.000278	0.000205	0.000483
B7	081-1429	35	24.6	24.6	811	0.000254	0.000187	0.000441
B8	083-0848	5	1285	1285	7870	0.013256	0.00978	0.023036
B8	084-0938	15	428	96.9	317	0.004415	0.000737	0.005152
B8	085-0957	20	27.85	27.85	167	0.000287	0.000212	0.000499
B9	086-1106	0	24.85	24.85	1180	0.000256	0.000189	0.000445
B9	087-1114	5	264	264	2190	0.002723	0.000209	0.002932
B9	088-1132	10	268.5	268.5	4420	0.002777	0.000204	0.002981
B9	089-1143	15	259	29.6	17.75	0.002672	0.000225	0.002897
B9	090-1157	20	204	59.1	725	0.002104	0.00045	0.002554
C1	188-1305	0	25.2	25.2	59.2	0.00026	0.000192	0.000452
C1	190-1319	5	23.95	23.95	972	0.000247	0.000182	0.000429
C1	191-1336	10	25.55	25.55	15.3	0.000264	0.000194	0.000458
C2	200-0954	5	26	26	264	0.000268	0.000196	0.000464
C2	201-1015	10	24.9	24.9	14.95	0.000257	0.00019	0.000446
C3	181-1526	5	26.45	26.45	15.85	0.000273	0.000201	0.000474
C4	179-1358	15	25.45	25.45	45.4	0.000263	0.000194	0.000457
C5	175-1003	15	22.7	22.7	34.6	0.000234	0.000173	0.000407
C7	091-1354	0	25.85	25.85	104	0.000267	0.000197	0.000464
C7	092-1403	5	323	28.85	17.3	0.003332	0.00022	0.003552
C7	094-1434	15	161	27.65	1980	0.001867	0.00021	0.002078
C7	095-1458	20	25.7	25.7	15.4	0.000265	0.000196	0.000461
C7	093-1413	10	1130	31.8	19.05	0.010557	0.000242	0.010799
C8	096-1607	0	25.6	25.6	0.772	0.000264	0.000195	0.000459
C8	097-1617	5	25.9	25.9	681	0.000267	0.000197	0.000464
C8	098-1655	10	179	26.6	42.3	0.001847	0.000202	0.002049
C8	099-1701	15	111	27.85	45.3	0.001145	0.000212	0.001357
C8	100-1719	20	26.25	26.25	15.75	0.000271	0.0002	0.000471
C9	101-0831	0	24.85	24.85	85.7	0.000256	0.000189	0.000445
C9	102-0840	5	25.7	25.7	1470	0.000265	0.000196	0.000461
C9	103-0907	10	486	29.9	211	0.000259	0.000228	0.000487
C9	104-0924	15	165	30.45	171	0.001702	0.000232	0.001934
C9	105-0942	20	351	71.5	89.5	0.000261	0.000244	0.000505
D1	192-1423	0	24.75	24.75	371	0.000255	0.000194	0.000449
D1	193-1450	5	26.7	26.7	84.7	0.000275	0.000203	0.000478
D1	194-1510	10	23.65	23.65	14.2	0.000244	0.00018	0.000424
D1	195-1541	15	23.3	23.3	14	0.00024	0.000177	0.000417
D3	203-1135	0	25.7	25.7	1120	0.000265	0.000196	0.000461
D3	204-1210	5	25.7	25.7	1250	0.000265	0.000196	0.000461
D3	205-1235	10	25.5	25.5	15.3	0.000263	0.000194	0.000457
D4	182-1610	0	27.7	27.7	1170	0.000296	0.000211	0.000507
D4	183-1631	5	118	118	5500	0.001217	0.000898	0.002115
D4	184-1712	10	23.55	23.55	413	0.000243	0.000179	0.000422
D5A	185-0833	0	27.2	27.2	155	0.000281	0.000207	0.000488
D5A	186-0849	5	164	57.2	52.2	0.001692	0.000435	0.002127
D5A	187-1026	10	144	26.05	545	0.001485	0.000198	0.001683
D5A	188-1131	20	26.1	26.1	15.65	0.000269	0.000199	0.000468
D6A	042-1858	0	23.95	23.95	56.3	0.000247	0.000182	0.000429
D6A	043-0829	5	177	39.6	305	0.001826	0.000301	0.002127
D6A	044-0837	10	24.55	24.55	128	0.000253	0.000187	0.000440
D6A	045-0848	15	25.05	25.05	162	0.000258	0.000191	0.000449
D6A	046-0908	20	28.1	28.1	530	0.00029	0.000214	0.000504
E1	196-1645	0	25.15	25.15	217	0.000259	0.000191	0.000450
E1	197-1658	5	25.5	25.5	143	0.000263	0.000194	0.000457
E1	198-1720	10	26.6	26.6	153	0.000274	0.000202	0.000476
E2	206-1426	0	26.8	26.8	54.1	0.000275	0.000204	0.000479
E3	207-1437	5	24.6	24.6	2370	0.000254	0.000187	0.000441
E3	208-1457	10	26.1	26.1	15.65	0.000269	0.000199	0.000468
E4	209-1548	0	25.05	25.05	647	0.000258	0.000191	0.000449
E4	210-1600	5	26.55	26.55	1190	0.000274	0.000202	0.000476
F1	017-1310	0	26.65	26.65	296	0.000242	0.000179	0.000421
F1	019-1413	10	27.7	27.7	16	0.000275	0.000203	0.000478
F3A	023-1637	0	27.65	27.65	294	0.000296	0.000211	0.000507
F3A	024-1659	5	25.95	25.95	47	0.000285	0.00021	0.000496
F3A	025-1721	10	26.35	26.35	35.1	0.000268	0.000198	0.000466
F4	026-0824	0	25.6	25.6	15.8	0.000272	0.000201	0.000473
F4	027-0841	5	25.9	25.9	64	0.000264	0.000195	0.000459
F4	028-0906	10	26.45	26.45	58.6	0.000267	0.000197	0.000464
F5A	029-0957	0	57	57	2620	0.000588	0.000434	0.010022
F5A	030-1001	5	198	31.55	111	0.002043	0.00024	0.002283
F5A	031-1035	10	25.45	25.45	58.9	0.000263	0.000194	0.000457
F5A	032-1056	15	24.5	24.5	1070	0.000262	0.000193	0.000455
F6A	034-1436	0	24.3	24.3	15.55	0.000268	0.000198	0.000465
F6A	037-1605	10	197	26.65	14.6	0.000251	0.000185	0.000436
G1	013-1015	0	25	25	16	0.000232	0.000203	0.000435
G1	013-1015	5	25	25	15	0.000258	0.00019	0.000448
G1	016-1144	10	26.7	26.7	15	0.000275	0.000203	0.000478
G2A	020-1504	0	28.55	28.55	17.15	0.000295	0.000217	0.000512
G2A	022-1543	10	26.95	26.95	67.6	0.000278	0.000205	0.000483
G4	007-1525	0	28.1	28.1	141	0.00029	0.000214	0.000504
G4	008-1544	5	25.9	25.9	34	0.000267	0.000197	0.000464
G4	009-1558	10	26.05	26.05	54	0.000269	0.000198	0.000466
G5	001-1309	0	28.25	28.25	1160	0.000291	0.000215	0.000506
G5	002-1328	5	27.6	27.6	16.55	0.000285	0.00021	0.000495
G6	003-1404	0	27.35	27.35	267	0.000282	0.000208	0.000490
G6	004-1421	5	24.75	24.75	54.8	0.000255	0.000188	0.000443
G6	005-1431	10	325	37.75	22.65	0.000353	0.000287	0.000640
G6	006-1448	15	25.9	25.9	40.6	0.000267	0.000197	0.000464
MW-24	99-RT-036	5	100	39	100	0.001032	0.000297	0.001329
MW-26	99-RT-038	5	17	6	31	0.000175	4.57E-05	0.000180
MW-3	97-RTGW	10	290	125	460	0.002992	0.000951	0.003943
MW-3	97-RTGW	15	800	310	310	0.008253	0.002359	0.010612
MW-33	99-RT-053							

Table M-11 Statistical Analysis of Area Beneath and Around Excluded Area

MW-3A	MW-3A 15	15 1	1	1	1.03E-05	7.61E-06	6.03E-06	1.79E-05	2.97	3.97
MW-3A	MW-3A 25	25 1	1	3	1.03E-05	7.61E-06	1.81E-05	1.79E-05	2.97	5.97
MW-9	MW-9 10-1	10 37	7	170	0.000382	5.33E-05	0.001025	0.000435	72.13	242.13
MW-9	MW-9 15-1	15 69	15	11	0.000712	1.14E-05	6.63E-05	0.000723	119.93	130.93
MW-9	MW-9 20-2	20 1	1	4	1.03E-05	7.61E-06	2.41E-05	1.79E-05	2.97	6.97
SB-01	99-RT-002	15 6	66	10	5.19E-05	0.000502	6.03E-05	0.000564	93.56	103.56
SB-01	99-RT-003	20 170	850	360	0.001754	0.006698	0.002171	0.000851	1401.48	1761.48
SB-01	99-RT-004	25 2.5	2.5	2.5	2.58E-05	1.9E-05	1.51E-05	4.48E-05	7.43	9.93
SB-2A	SB-2A 30-	30 7	2	100	7.22E-05	1.52E-05	0.000603	8.74E-05	14.50	114.50
SB-2A	SB-2A 35-	35 14	3	120	0.000144	2.28E-05	0.000724	0.000167	27.74	147.74
SB-2A	SB-2A 35-36D	13 1	110	110	0.000134	7.61E-06	0.000663	0.000142	23.50	133.50
SB-2B	SB-2B 30-	30 1	1	560	1.03E-05	7.61E-06	0.003377	1.79E-05	2.97	562.97
SB-2B	SB-2B 35-	35 1	1	410	1.03E-05	7.61E-06	0.002472	1.79E-05	2.97	412.97
SB-2B	SB-2B 35-36 5D	1 1	1	720	1.03E-05	7.61E-06	0.004342	1.79E-05	2.97	722.97

Natural Log		Ordered									
PCE Equivalent	DCE+ICE ug/kg	Concentration	log conc	Order	+1/2(n+1)(x-mean)^2	Order	+1/2(n+1)(x-mean)^2	Order	+1/2(n+1)(x-mean)^2	Order	+1/2(n+1)(x-mean)^2
2.97	1.089493	1.089493		1	-76.2645	12.4774					
2.97	1.089493	1.089493		2	-75.17501	12.4774					
2.97	1.089493	1.089493		3	-74.08552	12.4774					
2.97	1.089493	1.089493		4	-72.99602	12.4774					
2.97	1.089493	1.089493		5	-71.90653	12.4774					
2.97	1.089493	1.089493		6	-70.81704	12.4774					
7.43	2.005784	2.005784		7	-128.3702	6.843697					
7.43	2.005784	2.005784		8	-126.3644	6.843697					
14.50	2.674063	2.674063		9	-165.7919	3.793794					
23.50	3.157022	3.157022		10	-192.5734	2.14566					
27.74	3.32271	3.32271		11	-199.3626	1.687713					
36.65	3.601514	3.601514		12	-212.4893	1.041043					
67.48	4.211858	4.211858		13	-244.2878	0.168077					
69.27	4.237946	4.237946		14	-241.5629	0.147366					
69.86	4.246493	4.246493		15	-237.8036	0.146877					
70.01	4.246619	4.246619		16	-233.674	0.139286					
70.31	4.252856	4.252856		17	-229.6542	0.136142					
71.20	4.265461	4.265461		18	-226.0694	0.126998					
71.20	4.265461	4.265461		19	-221.804	0.126996					
71.64	4.271705	4.271705		20	-217.8568	0.122567					
72.13	4.278453	4.278453		21	-213.5226	0.117808					
72.24	4.279969	4.279969		22	-209.7185	0.116869					
72.24	4.279969	4.279969		23	-205.4385	0.116869					
72.96	4.290205	4.290205		24	-201.6396	0.109975					
73.13	4.292239	4.292239		25	-197.443	0.10863					
73.13	4.292239	4.292239		26	-193.1508	0.10863					
73.58	4.298318	4.298318		27	-189.126	0.10466					
73.58	4.298318	4.298318		28	-184.8277	0.10466					
73.58	4.298318	4.298318		29	-180.5294	0.10466					
73.58	4.298318	4.298318		30	-176.2311	0.10466					
73.87	4.302351	4.302351		31	-172.094	0.102067					
73.87	4.302351	4.302351		32	-167.7917	0.102067					
74.02	4.304361	4.304361		33	-163.5657	0.100787					
74.32	4.308369	4.308369		34	-159.4096	0.098258					
74.32	4.308369	4.308369		35	-155.1013	0.098258					
74.47	4.310367	4.310367		36	-150.8628	0.097009					
74.47	4.310367	4.310367		37	-146.5625	0.097009					
74.62	4.312361	4.312361		38	-142.3079	0.095771					
74.62	4.312361	4.312361		39	-137.9955	0.095771					
74.77	4.314351	4.314351		40	-133.7449	0.094543					
74.91	4.316337	4.316337		41	-129.4901	0.093326					
75.21	4.320297	4.320297		42	-125.2886	0.092122					
75.36	4.322272	4.322272		43	-121.0236	0.089735					
75.66	4.326209	4.326209		44	-116.8078	0.087392					
75.66	4.326209	4.326209		45	-112.4814	0.087392					
75.81	4.328171	4.328171		46	-108.2043	0.086235					
75.81	4.328171	4.328171		47	-103.8761	0.086235					
75.95	4.33013	4.33013		48	-99.59299	0.085089					
75.95	4.33013	4.33013		49	-95.26286	0.085089					
76.10	4.332085	4.332085		50	-90.97379	0.083952					
76.10	4.332085	4.332085		51	-86.6417	0.083952					
76.40	4.335984	4.335984		52	-82.38369	0.081708					
76.40	4.335984	4.335984		53	-78.04771	0.081708					
76.40	4.335984	4.335984		54	-73.71172	0.081708					
76.40	4.335984	4.335984		55	-69.37574	0.081708					
76.85	4.341803	4.341803		56	-65.12705	0.078415					
76.85	4.341803	4.341803		57	-60.78525	0.078415					
76.99	4.343736	4.343736		58	-56.46857	0.077336					
76.99	4.343736	4.343736		59	-52.12483	0.077336					
76.99	4.343736	4.343736		60	-47.78109	0.077336					
76.99	4.343736	4.343736		61	-43.43736	0.077336					
77.14	4.345664	4.345664		62	-39.11098	0.076267					
77.14	4.345664	4.345664		63	-34.76532	0.076267					
77.29	4.347589	4.347589		64	-30.43313	0.075208					
77.44	4.349511	4.349511		65	-26.09706	0.074158					
77.44	4.349511	4.349511		66	-21.74755	0.074158					
77.59	4.351428	4.351428		67	-17.40571	0.073117					
77.59	4.351428	4.351428		68	-13.05428	0.073117					
77.74	4.353342	4.353342		69	-8.706684	0.072066					
78.04	4.357159	4.357159		70	-4.357159	0.070051					
78.33	4.360961	4.360961		71	0	0.068052					
78.48	4.362857	4.362857		72	4.362857	0.067067					
78.63	4.364749	4.364749		73	8.729498	0.06609					
78.63	4.364749	4.364749		74	13.09425	0.06609					
78.78	4.366638	4.366638		75	17.46655	0.065123					
78.93	4.368523	4.368523		76	21.84261	0.064164					
78.93	4.368523	4.368523		77	26.21114	0.064164					
79.08	4.370404	4.370404		78	30.59283	0.063215					
79.22	4.372282	4.372282		79	34.97826	0.062274					
79.22	4.372282	4.372282		80	39.35954	0.062274					
79.37	4.374156	4.374156		81	43.74156	0.061342					
79.37	4.374156	4.374156		82	48.11572	0.061342					
79.52	4.376027	4.376027		83	52.51233	0.060419					
79.67	4.377895	4.377895		84	56.91263	0.059504					
79.82	4.379759	4.379759		85	61.31662	0.058598					
80.12	4.383476	4.383476		86	65.75214	0.058612					
80.12	4.383476	4.383476		87	70.13562	0.058612					
80.41	4.38718	4.38718		88	74.58206	0.05506					
80.86	4.39271	4.39271		89	79.06878	0.052496					
81.31	4.398209	4.398209		90	83.56598	0.050005					
82.05	4.407309	4.407309		91	88.14617	0.046019					
82.05	4.407309	4.407309		92	92.58348	0.046019					
82.20	4.409119	4.409119		93	97.00081	0.045246					
82.35	4.410925	4.410925		94	101.4513	0.044481					
82.35	4.410925	4.410925		95	105.8622	0.044481					
82.79	4.416326	4.416326		96	110.4081	0.042232					
83.53	4.425262	4.425262		97	115.0568	0.038639					
83.53	4.425262	4.425262		98	119.4521	0.038639					
83.68	4.42704	4.42704		99	123.9571	0.037943					
83.96	4.430586	4.430586		100	128.487	0.036574					
84.87	4.44115	4.44115		101	133.2345	0.032645					
84.87	4.44115	4.44115		102	137.6756	0.032645					
93.96	4.538644	4.538644		103	145.2396	0.00592					
119.93	4.786889	4.786889		104	157.9673	0.027245					
162.02	5.087694	5.087694		105	172.9816	0.217029					
169.45	5.132544	5.132544		106	188.0069	0.260199					
192.27	5.284318	5.284318		107	200.2355	0.418368					
220.29	5.394932	5.394932		108	196.6125	0.976888					
225.03	5.416241	5.416241		109	205.8172	0.63169					
266.23	5.584375	5.584375		110	217.7906	0.926493					
266.23	5.582811	5.582811		111	222.9451	0.926493					
266.23	5.531969	5.531969		112	230.9102	1.028043					

Table M-11 Statistical Analysis of Area Beneath and Around Excavated Area

287.57	5.661461	5.661461	113	237.7813	1.080833
297.07	5.693962	5.693962	114	244.8404	1.149467
326.69	5.770469	5.770469	115	253.9006	1.319373
339.78	5.828292	5.828292	116	262.2732	1.455553
344.52	5.842165	5.842165	117	268.7396	1.489219
350.79	5.860178	5.860178	118	275.4283	1.533506
352.74	5.865729	5.865729	119	281.555	1.547286
352.76	5.8658	5.8658	120	287.4242	1.547462
370.63	5.915212	5.915212	121	295.7606	1.672837
378.53	5.936289	5.936289	122	302.7568	1.727805
423.56	6.048702	6.048702	123	314.5325	2.035966
453.69	6.117415	6.117415	124	324.223	2.236775
465.10	6.14226	6.14226	125	331.6821	2.31171
480.42	6.174652	6.174652	126	339.6059	2.411259
484.56	6.183238	6.183238	127	346.2613	2.437997
588.95	6.378343	6.378343	128	363.5655	3.085338
603.60	6.40292	6.40292	129	371.3694	3.172283
653.85	6.482882	6.482882	130	382.49	3.463514
674.05	6.513301	6.513301	131	390.7981	3.577666
690.68	6.537674	6.537674	132	398.7981	3.67048
730.72	6.594025	6.594025	133	408.8296	3.889556
784.81	6.665442	6.665442	134	419.9228	4.176352
798.19	6.682344	6.682344	135	427.67	4.245719
854.46	6.750465	6.750465	136	438.7802	4.531088
869.11	6.767471	6.767471	137	446.6531	4.603778
1401.48	7.245281	7.245281	138	485.4338	8.882498
1759.77	7.472941	7.472941	139	508.16	8.128834
1973.17	7.587394	7.587394	140	523.5302	8.794573
3820.00	8.248007	8.248007	141	577.3605	13.14916
n	141		sum	5804.731	210.9275
ln mean	4.62183		D	0.2379	
st dev	1.227446		Y	-17.5125	Y is not close to zero, therefore the hypothesis that the distribution is log normal is rejected. Normal and rejected, therefore log normal as because it is a conservative assum
mean	219.58				
H interpolation - UCL					
n	141				
Sv	>101				
1	2.205				
1.227446	2.425158				
1.25	2.447				
H interpolation - LCL					
n	141				
Sv	>101				
1	-1.874				
1.227446	-1.99955				
1.25	-2.012				
Excavated Soils					
Natural Log					
Concentra	Ordered				
DCE + TCE ug/kg	log conc	Order	i-1/2(n+1)x	(x-mean)^2	
0.772	-0.258771	1	18.11395	23.82026	
1	0	2	0	21.36131	
2.5	0.916291	3	-62.30777	13.73102	
3	1.098612	4	-73.80702	12.41306	
4	1.386294	5	-91.49543	10.46669	
10	2.302585	6	-149.668	5.378895	
11	2.397895	7	-153.4653	4.945884	
14	2.639057	8	-168.2606	3.331389	
14.2	2.653242	9	-164.501	3.875337	
14.6	2.681022	10	-163.5423	3.766736	
14.85	2.698	11	-161.88	3.701121	
14.95	2.704711	12	-159.578	3.675343	
15	2.70805	13	-157.0669	3.662552	
15	2.70805	14	-154.3588	3.662552	
15.15	2.718001	15	-152.208	3.624565	
15.3	2.727853	16	-150.0319	3.587148	
15.3	2.727853	17	-147.3041	3.587148	
15.4	2.734368	18	-144.9215	3.562513	
15.55	2.744061	19	-142.6912	3.528016	
15.6	2.747271	20	-140.1108	3.51397	
15.65	2.750471	21	-137.5235	3.501983	
15.65	2.750471	22	-134.7731	3.501983	
15.75	2.75684	23	-132.3283	3.478185	
15.8	2.76001	24	-129.7205	3.466372	
15.85	2.76317	25	-127.1058	3.454617	
15.9	2.766319	26	-124.4844	3.442919	
16	2.772589	27	-121.9939	3.419692	
16	2.772589	28	-119.2213	3.419692	
16	2.772589	29	-116.4487	3.419692	
16.55	2.806386	30	-115.0618	3.295835	
16.7	2.815409	31	-112.6163	3.263156	
17.15	2.841998	32	-110.8379	3.1678	
17.3	2.850707	33	-108.3268	3.136877	
17.75	2.876386	34	-106.4263	3.046575	
18.75	2.931194	35	-105.523	2.88825	
19.05	2.947067	36	-103.1473	2.804829	
22.65	3.12016	37	-106.0854	2.255012	
31	3.433987	38	-113.3216	1.41097	
32.3	3.475067	39	-111.2022	1.315064	
34	3.526361	40	-109.3172	1.200953	
34.6	3.543854	41	-106.3156	1.182032	
35.1	3.558201	42	-103.1878	1.131306	
37	3.610918	43	-101.1057	1.021942	
40.6	3.703768	44	-100.0017	0.842837	
42.3	3.744787	45	-97.36446	0.769204	
45.3	3.813307	46	-95.33268	0.653709	
45.4	3.815512	47	-91.57229	0.650148	
47	3.850148	48	-88.55339	0.595493	
54	3.988984	49	-87.75765	0.400493	
54.8	4.00369	50	-84.07749	0.382096	
56.3	4.030695	51	-80.61389	0.349441	
58.6	4.070735	52	-77.34396	0.303706	
58.9	4.075841	53	-73.36514	0.298103	
59.2	4.080922	54	-69.37567	0.292582	
63.6	4.152613	55	-66.44182	0.220164	
64	4.158883	56	-62.38325	0.214319	
67.6	4.213608	57	-58.99051	0.166645	
78.1	4.35799	58	-56.65387	0.069611	
83.1	4.420045	59	-53.04054	0.040717	
84.7	4.439116	60	-48.83027	0.033384	
87.6	4.472781	61	-44.72781	0.022215	
89.5	4.494239	62	-40.4815	0.016279	
95.3	4.55703	63	-36.45624	0.004199	
100	4.60517	64	-32.23619	0.000278	
100	4.60517	65	-27.63102	0.000278	
104	4.644391	66	-23.22195	0.000509	
110	4.70048	67	-18.80192	0.006186	
111	4.70953	68	-14.12659	0.007691	
120	4.787492	69	-9.574983	0.027444	
126	4.836282	70	-4.836282	0.04599	
128	4.85203	71	0	0.052992	
140	4.941642	72	4.941642	0.10228	
141	4.94876	73	9.89752	0.106883	

Table M-11 Statistical Analysis of Area Beneath and Around Excavated Area

143	4 962845	4 962845	74	14 88853	0 116291
153	5 030438	5 030438	75	20 12175	0 166961
155	5 043425	5 043425	76	25 21713	0 177743
161	5 081404	5 081404	77	30 48843	0 211209
170	5 135798	5 135798	78	35 95059	0 264164
171	5 141664	5 141664	79	41 13331	0 270227
185	5 220356	5 220356	80	46 96332	0 358234
187	5 231109	5 231109	81	52 31109	0 371223
192	5 257495	5 257495	82	57 83245	0 404071
194	5 267858	5 267858	83	63 2143	0 417353
211	5 351858	5 351858	84	69 57416	0 532942
217	5 379897	5 379897	85	75 31856	0 574667
244	5 497168	5 497168	86	82 45752	0 786218
254	5 575949	5 575949	87	89 21519	0 910344
267	5 587249	5 587249	88	94 96323	0 932034
294	5 68358	5 68358	89	102 3044	1 127313
296	5 690359	5 690359	90	108 1168	1 141756
305	5 720312	5 720312	91	114 4062	1 206663
310	5 736572	5 736572	92	120 468	1 242651
317	5 758902	5 758902	93	126 6958	1 292033
360	5 886104	5 886104	94	135 3804	1 598339
371	5 916202	5 916202	95	141 9888	1 6754
382	5 945421	5 945421	96	148 6355	1 751893
382	5 945421	5 945421	97	154 5009	1 751893
410	6 016157	6 016157	98	162 4362	1 944149
411	6 018593	6 018593	99	168 5206	1 950949
413	6 023448	6 023448	100	174 68	1 964533
460	6 131226	6 131226	101	183 9368	2 278279
504	6 222576	6 222576	102	192 8999	2 56239
530	6 272877	6 272877	103	200 7321	2 725958
541	6 292419	6 292419	104	207 6828	2 794212
545	6 300786	6 300786	105	214 2267	2 818894
551	6 311735	6 311735	106	220 9107	2 85578
559	6 326149	6 326149	107	227 7414	2 904706
560	6 327937	6 327937	108	234 1337	2 910802
586	6 37332	6 37332	109	242 1862	3 067718
591	6 381816	6 381816	110	248 8908	3 097552
632	6 448889	6 448889	111	257 9556	3 338147
633	6 45047	6 45047	112	264 4693	3 343927
647	6 472346	6 472346	113	271 8385	3 424412
681	6 523562	6 523562	114	280 5132	3 616587
720	6 578251	6 578251	115	289 4371	3 831499
725	6 586172	6 586172	116	296 3777	3 85864
811	6 698268	6 698268	117	308 1203	4 311597
852	6 747587	6 747587	118	317 1366	4 518842
972	6 879356	6 879356	119	330 2091	5 096425
1030	6 937314	6 937314	120	339 9284	5 361468
1070	6 975414	6 975414	121	348 7707	5 539359
1120	7 021084	7 021084	122	358 0753	5 756421
1160	7 056175	7 056175	123	366 9211	5 926039
1170	7 064759	7 064759	124	374 4322	5 967904
1180	7 07327	7 07327	125	381 9566	6 099559
1190	7 081709	7 081709	126	389 494	6 051005
1250	7 130899	7 130899	127	399 3303	6 295428
1360	7 21524	7 21524	128	411 2687	6 725777
1470	7 293018	7 293018	129	422 995	7 135246
1580	7 36518	7 36518	130	434 5456	7 525972
1600	7 495542	7 495542	131	441 9108	7 525972
1800	7 528332	7 528332	132	457 2281	8 258223
2080	7 640123	7 640123	133	466 7566	8 447755
2180	7 68708	7 68708	134	481 3278	9 110096
2240	7 714231	7 714231	135	491 9731	9 395761
2250	7 716885	7 716885	136	501 425	9 562947
2370	7 770645	7 770645	137	509 4332	9 590516
2560	7 847763	7 847763	138	520 6332	9 91504
2560	7 847763	7 847763	139	533 6479	10 40664
2620	7 87093	7 87093	140	541 4956	10 40664
			141	550 9651	10 55665

n	141	sum	10269 98	458 5952
In mean	4 797493	D	0 2837	
st dev	1 820997	Y	0 626071	Y is close to zero, therefore the null hypothesis can not be rejected and the distribution is assumed log-normal
mean	426 387			

H interpolation - UCL

n	141
mean	4 797493
st dev	1 820997
H (from Gilbe	3 081629
exp	6 929778
95% UCL	1022 267
uq/kq	1 0223 mq/kq

H interpolation - LCL

n	141
mean	4 797493
st dev	1 820997
H (from Gilbe	-2 393538
exp	6 087137
5% LCL	440 1594
uq/kq	0 4402 mq/kq

Table M-12 Statistical Analysis of Area West of Excavation

Designation	n	Samp ID	Depth	Total DCE ug/kg	TCE ug/kg	PCE ug/kg	DCE g- moles/kg	TCE g- moles/kg	PCE g- moles/kg	DCE+TCE g- moles/kg	PCE Equivalent DCE+TCE ug/kg	Total PCE Equivalent ug/kg
MW-19	99	RT-023-SL	8	25	120	2000	0.000258	0.000913	0.012061	0.001171	194.22	2194.22
MW-19	99	RT-026-SL	12	507	98	890	0.00523	0.000746	0.005367	0.005976	990.99	1880.99
MW-19	99	RT-027-SL	12	480	130	660	0.004952	0.000989	0.00398	0.005941	985.19	1645.19
MW-19	99	RT-028-SL	12	193.8	52	200	0.001999	0.000396	0.001206	0.002395	397.15	597.15
AA8	127	1519	15	148	27.25	2720	0.001527	0.000207	0.016402	0.001734	287.57	3007.57
AA8	128	1533	20	26.4	26.4	32.3	0.000272	0.000201	0.000195	0.000473	78.48	110.78
MW-4	97	RTGW-077-SL	10	94	56	1600	0.000272	0.000226	0.000948	0.001386	231.48	1831.48
MW-4A	MW-4A	10-11.5	10	5	1	25	5.16E-05	7.61E-06	0.000151	5.92E-05	9.82	34.82
MW-4A	MW-4A	15-16.5	15	1	1	12	1.03E-05	7.61E-06	7.24E-05	1.79E-05	2.97	14.97
AA7	118	0855	5	26.4	26.4	15.85	0.000272	0.000201	9.56E-05	0.000473	78.48	94.33
AA7	119	0918	10	25.15	25.15	234	0.000259	0.000191	0.001411	0.000451	74.77	308.77
AA7	120	0959	15	25.55	25.55	15.35	0.000264	0.000194	9.26E-05	0.000458	75.95	91.30
AA8	123	1202	5	26.95	26.95	119	0.000278	0.000205	0.000718	0.000483	80.12	199.12
AA8	124	1227	10	25.25	25.25	15.15	0.00026	0.000192	9.14E-05	0.000453	75.06	90.21

PCE Equivalent DCE+TCE ug/kg	In	In mean	s-mean	(s-mean) ²	s1	i	n-i+1	s1*(n-i+1-x)/2	
2.97	1.089493	4.69	-3.60	12.93087		1	0.5475	14	3.18
9.82	2.283947	4.69	-2.40	5.76719		2	0.3325	13	1.53
74.77	4.314351	4.69	-0.37	0.137711		3	0.2347	12	0.39
75.06	4.318319	4.69	-0.37	0.134781		4	0.1586	11	0.21
75.95	4.33013	4.69	-0.36	0.126249		5	0.1586	10	0.18
78.48	4.362857	4.69	-0.32	0.104063		6	0.1586	9	0.14
78.48	4.362857	4.69	-0.32	0.104063		7	0.1586	8	0.00
80.12	4.383476	4.69	-0.30	0.091185					
194.22	5.268995	4.69	0.58	0.34053					
231.48	5.444491	4.69	0.76	0.576151					
287.57	5.661461	4.69	0.98	0.962607					
397.15	5.984323	4.69	1.30	1.687083					
985.19	6.89283	4.69	2.21	4.872549					
990.99	6.8987	4.69	2.21	4.898496					
	65.59623	4.69	60.91	32.72353					
							Sum	5.64	
							sum squared	31.83	
							d=	32.72353	
							k=	7	
							w=	0.97265	
254.4457446	4.685445								
	1.586567								

Reject null hypothesis at level of significance if
calculated W is less than W at desired quantile

W 01 0.687
W 02 0.707
W 05 0.748
W 10 0.792
W 50 0.935

W of 0.97265 indicates that the null hypothesis
is not rejected

H interpolation - UCL	n	mean	st dev	H (from Gilbe)	exp	95% UCL	ug/kg	mg/kg
Sy	12	14	15	4.685445	1.586567			
1.5	3.896	3.706667	3.612	3.875645	3.7744			
1.586567	4.078136813	3.875645	3.7744	7.64946				
1.75	4.422	4.194967	4.081	2099.511			2.0995	mg/kg

H interpolation - LCL	n	mean	st dev	H (from Gilbe)	exp	5% LCL	ug/kg	mg/kg
Sy	12	14	15	-1.881667	-1.896			
1.5	-1.853	-1.881667	-1.896	-1.187667	-1.182			
0	-1.199	-1.187667	-1.182	5.421428				
1.75	-1.962	-1.997333	-2.015	226.2019			0.2262	mg/kg

PCE ug/kg	ln	ln mean	s-mean	(s-mean) ²	s1	i	n-i+1	s1*(n-i+1-x)/2	
12.00	2.484907	4.69	-2.20	4.842369		1	0.5475	14	2.97
15.15	2.718001	4.69	-1.97	3.870837		2	0.3325	13	1.62
15.35	2.731115	4.69	-1.95	3.819404		3	0.2347	12	1.05
15.85	2.76317	4.69	-1.92	3.695143		4	0.1586	11	0.64
25.00	3.218876	4.69	-1.47	2.150825		5	0.1586	10	0.52
32.30	3.475067	4.69	-1.21	1.485014		6	0.1586	9	0.31
119.00	4.779123	4.69	0.09	0.008776		7	0.1586	8	0.08
200.00	5.298317	4.69	0.61	0.375613					
234.00	5.455321	4.69	0.77	0.592709					
660.00	6.49224	4.69	1.81	3.264508					
890.00	6.791221	4.69	2.11	4.434295					
1600.00	7.377759	4.69	2.69	7.248555					
2000.00	7.600902	4.69	2.92	8.499893					
2720.00	7.908387	4.69	3.22	10.38736					
sum	69.09441	4.69	64.41	54.6553					
							Sum	7.24	
							sum squared	52.39	
							d=	54.6553	
							k=	7	
							w=	0.958503	
Mean	609.9035714	4.935515							
std dev		2.033966							

Reject null hypothesis at level of significance if
calculated W is less than W at desired quantile

W 01 0.687
W 02 0.707
W 05 0.748
W 10 0.792
W 50 0.935

W of 0.958503 indicates that the null hypothesis
is not rejected

H interpolation - UCL	n	mean	st dev	H (from Gilbe)	exp	95% UCL	ug/kg	mg/kg
Sy	12	14	15	4.935315	2.033966			
2	4.962	4.696667	4.564	4.766658	4.631456			
2.033966	5.037083882	4.766658	4.631456	9.892793				
2.5	6.067	5.727	5.557	16200.42			16.2004	mg/kg

H interpolation - LCL	n	mean	st dev	H (from Gilbe)	exp	5% LCL	ug/kg	mg/kg
Sy	12	14	15	-1.003667	-1.003667			
2	-2.083	-2.123667	-2.144	6.437634				
0	-1.011	-1.003667	-1.003667	6.437634				
2.5	-2.351	-2.403667	-2.43	624.9263			0.6249	mg/kg

Table M-13 Statistical Analysis of Area R of W West of Excavation

Designation	Sample ID	Depth	Total DCE ug/kg	TCE ug/kg	PCE ug/kg	DCE g- moles/kg	TCE g- moles/kg	PCE g- moles/kg	DCE+TCE g- moles/kg	PCE Equivalent DCE+TCE ug/kg	Total PCE Equivalent (ug/kg)
MW-14	98DOTROW-001-SL	8	70	140	140	0.000722	0.001066	0.000844	0.001788	296.44	436.44
MW-14	98DOTROW-002-SL	14	36.5	75	160	0.000377	0.000571	0.000965	0.000947	157.10	317.10
MW-14	98DOTROW-003-SL	18	48	95	95	0.000495	0.000723	0.000573	0.001218	202.01	297.01
MW-15	99-RT-010-SL	12	28	25	100	0.000289	0.00019	0.000603	0.000479	79.45	179.45
MW-15	99-RT-011-SL	22	2.5	2.5	2.5	2.58E-05	1.9E-05	1.51E-05	4.48E-05	7.43	9.93
SB-02	99-RT-005-SL	15	2.5	2.5	39	2.58E-05	1.9E-05	0.000235	4.48E-05	7.43	46.43
SB-02	99-RT-006-SL	20	9	6	39	9.28E-05	4.57E-05	0.000235	0.000139	22.97	61.97
SB-02	99-RT-007-SL	25	2.5	2.5	2.5	2.58E-05	1.9E-05	1.51E-05	4.48E-05	7.43	9.93
SB-01	99-RT-002-SL	15	6	66	10	6.19E-05	0.000502	6.03E-05	0.000564	93.56	103.56
SB-01	99-RT-003-SL	20	170	880	360	0.001754	0.006698	0.002171	0.008451	1401.48	1761.48
SB-01	99-RT-004-SL	25	2.5	2.5	2.5	2.58E-05	1.9E-05	1.51E-05	4.48E-05	7.43	9.93
MW-21	99-RT-035-SL	15	18	17	72	0.000186	0.000129	0.000434	0.000315	52.25	124.25

PCE Equivalent DCE+TCE ug/kg	ln	ln mean	z-mean	(z-mean) ²	z	i	n+1	z ² (n+1) - z ²
7.43	2.005784	3.94	-1.94	3.757125	1	0.5475	12	2.87
7.43	2.005784	3.94	-1.94	3.757125	2	0.3325	11	1.23
7.43	2.005784	3.94	-1.94	3.757125	3	0.2347	10	0.78
7.43	2.005784	3.94	-1.94	3.757125	4	0.1586	9	0.48
22.97	3.134125	3.94	-0.81	0.656082	5	0.0922	8	0.13
52.25	3.955995	3.94	0.01	0.000141	6	0.0303	7	0.01
79.45	4.375142	3.94	0.43	0.185785				
93.56	4.538644	3.94	0.59	0.353465				
157.10	5.056867	3.94	1.11	1.23822				
202.01	5.308329	3.94	1.36	1.861083				
296.44	5.691852	3.94	1.75	3.054587				
1401.48	7.245281	3.94	3.30	10.8977				
sum	47.32937	3.94	43.39	33.27557				
Mean	194.5822175	3.944114						
st dev	1.739268							
n	12							

Reject null hypothesis at level of significance if
calculated W is less than W at desired quantile

W 01	0.687
W 02	0.707
W 05	0.748
W 10	0.792
W 50	0.935

W of 0.907571 indicates that the null hypothesis
is not rejected

H interpolation - UCL				n	12
Sy	12	12	12	mean	3.944114
1.5	3.896	3.896	3.896	st dev	1.739268
1.739268	4.399418862	4.399419	4.399419	H (from Gilbe)	4.399419
1.75	4.422	4.422	4.422	exp	7.763734
				95% UCL	2353.677 ug/kg
					2.3537 mg/kg

H interpolation - LCL				n	12
Sy	12	12	12		
1.5	-1.853	-1.853	-1.853	H (from Gilbe)	-1.957321
1.739268	-1.957320639	-1.957321	-1.957321	exp	4.430204
1.75	-1.962	-1.962	-1.962	5% LCL	83.9485 ug/kg
					0.0839 mg/kg

PCE ug/kg	ln	ln mean	z-mean	(z-mean) ²	z	i	n+1	z ² (n+1) - z ²
3	0.916291	3.94	-3.03	9.167715	1	0.5475	12	2.72
3	0.916291	3.94	-3.03	9.167715	2	0.3325	11	1.38
3	0.916291	3.94	-3.03	9.167715	3	0.2347	10	0.94
10	2.302585	3.94	-1.64	2.694618	4	0.1586	9	0.37
39	3.663562	3.94	-0.28	0.07871	5	0.0922	8	0.08
39	3.663562	3.94	-0.28	0.07871	6	0.0303	7	0.02
72	4.276666	3.94	0.33	0.110591				
95	4.553877	3.94	0.61	0.371811				
100	4.60517	3.94	0.66	0.436995				
140	4.941642	3.94	1.00	0.995063				
160	5.075174	3.94	1.13	1.279296				
360	5.886104	3.94	1.94	3.771325				
sum	41.71721	3.94	37.77	37.32026				
Mean	85.20833333	3.476435						
st dev	1.775991							
n	12							

Reject null hypothesis at level of significance if
calculated W is less than W at desired quantile

W 01	0.687
W 02	0.707
W 05	0.748
W 10	0.792
W 50	0.935

W of 0.814803 indicates that the null hypothesis
is not rejected

H interpolation - UCL				n	12
Sy	12	12	12	mean	3.476435
1.75	4.422	4.422	4.422	st dev	1.775991
1.775991	4.478139756	4.47814	4.47814	H (from Gilbe)	4.47814
2	4.962	4.962	4.962	exp	7.451466
				95% UCL	1722.386 ug/kg
					1.7224 mg/kg

H interpolation - LCL				n	12
Sy	12	12	12		
1.75	-1.962	-1.962	-1.962	H (from Gilbe)	-1.974579
1.775991	-1.974579464	-1.974579	-1.974579	exp	3.996155
2	-2.083	-2.083	-2.083	5% LCL	54.38865 ug/kg
					0.0544 mg/kg

Table M-14. Statistical Analysis of Area R of W NW and North of Building

Designation	Samp ID	Depth	Total DCE ug/kg	TCE ug/kg	PCE ug/kg	DCE g- moles/kg	TCE g- moles/kg	PCE g- moles/kg	DCE+TCE g- moles/kg	PCE Equivalent DCE+TCE ug/kg	Total PCE Equivalent (ug/kg)
MW-21	99-RT-03E	15	18	17	72	0.000186	0.000129	0.000434	0.000315	52.25	124.25
MW-25	99-RT-037	20	6	9	190	6.19E-05	6.85E-05	0.001146	0.00013	21.62	211.62
MW-16	99-RT-001	10	2.5	2.5	8	2.58E-05	1.9E-05	4.82E-05	4.48E-05	7.43	15.43
MW-29	99-RT-052	13	2.5	2.5	9	2.58E-05	1.9E-05	5.43E-05	4.48E-05	7.43	16.43

PCE Equivalent DCE+TCE ug/kg	ln(PCE)	ln mean	x-mean	(x-mean)*2	a1	i		n-i+1	all*(x _{n-i+1} - x _i)*2
7.43	2.005784	2.76	-0.75	0.56934		1	0.6872	4	1.34
7.43	2.005784	2.76	-0.75	0.56934		2	0.1677	3	0.18
21.62	3.073756	2.76	0.31	0.098236		3		2	0.00
52.25	3.955995	2.76	1.20	1.429617		4		1	0.00
sum	11.04132			2.666532					1.52
								sum squared	2.31
Mean	22.18361	2.76033						d=	2.666532
st dev		0.942785						k=	2
								w=	0.865628

Reject null hypothesis at level of significance if
calculated W is less than W at desired quantile

W.01	0.687
W.02	0.707
W.05	0.748
W.10	0.792
W.50	0.935

W of 0.865628 indicates that the null hypothesis
is not rejected

H interpolation - UCL

Sy	n	3	4	5	n	4	mean	2.76033
0.9	11.74	8.109	4.478		mean	2.76033		
0.942785	12.30049	8.480589	4.660693		st dev	0.942785		
1	13.05	8.9775	4.905		H (from Gilbe	8.480589		
					exp	7.820883		
					95% UCL	2492.104	ug/kg	2.4921 mg/kg

H interpolation - LCL

Sy	n	3	4	5	n	4	mean	2.76033
0.9	-1.502	-1.529	-1.556		mean	2.76033		
0	-1.61	-1.556	-1.502		st dev	0.942785		
1	-1.49	-1.526	-1.562		H (from Gilbe	-1.556		
					exp	2.357794		
					5% LCL	10.56761	ug/kg	0.0106 mg/kg

PCE ug/kg	ln(PCE)	ln mean	x-mean	(x-mean)^2	a1	i		n-i+1	a1^2*(x-n+1-x)^2
8.00	2.079442	2.76	-0.68	0.463608		1	0.6872	4	2.18
9.00	2.197225	2.76	-0.56	0.317087		2	0.1677	3	0.35
72.00	4.276666	2.76	1.52	2.299277		3		2	0.00
190.00	5.247024	2.76	2.49	6.18365		4		1	0.00
sum	13.80036			9.263622					2.53
								sum squared	6.38
Mean	69.75	3.450089						d=	9.263622
st dev		1.56637						k=	2
n	4							w=	0.688508

Reject null hypothesis at level of significance if
calculated W is less than W at desired quantile

W.01	0.687
W.02	0.707
W.05	0.748
W.10	0.792
W.50	0.935

W of 0.688508 indicates that the null hypothesis
is not rejected, but goodness of fit is weak

H interpolation - UCL

Sy	n	3	4	5	n	4	mean	3.450089
1.5	19.6	13.36	7.12		mean	3.450089		
1.56637	16.58678	11.69941	6.812041		st dev	1.56637		
1.75	8.25	7.105	5.96		H (from Gilbe	11.69941		
					exp	15.25714		
					95% UCL	4227598	ug/kg	4228 mg/kg

H interpolation - LCL

Sy	n	3	4	5	n	4	mean	3.450089
1.5	-1.508	-1.579	-1.65		mean	3.450089		
1.56637	-1.51835	-1.59334	-1.66832		st dev	1.56637		
1.75	-1.547	-1.633	-1.719		H (from Gilbe	-1.59334		
					exp	3.235923		
					95% LCL	25.42983	ug/kg	0.0254 mg/kg

Table M-15 Statistical Analysis of Area Along River

Designation	Sample ID	Depth	Total DCE ug/kg	TCE ug/kg	PCE ug/kg	DCE g- moles/kg	TCE g- moles/kg	PCE g- moles/kg	DCE+TCE g- moles/kg	PCE Equivalent DCE+TCE ug/kg	Total PCE Equivalent ug/kg
MW-12	98DOTROW-016	2	70	145	145	0.000722	0.001104	0.000874	0.001826	302.75	447.75
MW-12	98DOTROW-017	4	380	175	175	0.00392	0.001332	0.001055	0.005252	870.92	1045.92
MW-12	98DOTROW-018	6	330	145	145	0.003404	0.001104	0.000874	0.004508	747.52	892.52
BB10A	138-1555	0	30	30	54.1	0.000309	0.000228	0.000326	0.000538	89.18	143.28
BB10A	139-1604	5	480	106	71.6	0.004952	0.000807	0.000432	0.005758	954.89	1026.49
BB10A	140-1624	10	27.7	27.7	16.6	0.000286	0.000211	0.0001	0.000497	82.35	98.95
MW-20	99-RT-029-SL	5	626	130	190	0.006458	0.000989	0.001145	0.007447	1234.94	1424.94
MW-20	99-RT-030-SL	5	386	140	140	0.003982	0.001066	0.000844	0.005047	837.01	977.01
MW-20	99-RT-031-SL	5	435.2	100	120	0.004489	0.000761	0.000724	0.00525	870.69	990.69
MW-20	99-RT-032-SL	10	15	2.5	6	0.000155	1.9E-05	3.62E-05	0.000174	28.81	34.81
MW-19	99-RT-023-SL	8	25	120	2000	0.000258	0.000913	0.012061	0.001171	194.22	2194.22
MW-19	99-RT-026-SL	12	507	98	890	0.00523	0.000746	0.005367	0.005976	990.99	1880.99
MW-19	99-RT-027-SL	12	480	130	660	0.004952	0.000989	0.00398	0.005941	985.19	1645.19
MW-19	99-RT-028-SL	12	193.8	52	200	0.001999	0.000396	0.001206	0.002395	397.15	597.15
AA10A	132-1044	0	29.35	29.35	50.8	0.000303	0.000223	0.000306	0.000526	87.25	138.05
AA10A	133-1056	5	29.65	29.65	256	0.000306	0.000226	0.001544	0.000532	88.14	344.14
AA10A	134-1125	10	27.55	27.55	16.55	0.000284	0.00021	9.98E-05	0.000494	81.90	98.45
MW-6	97-RTGW-058-SI	4	420	160	220	0.004333	0.001218	0.001327	0.005555	920.41	1140.41
MW-6	97-RTGW-059-SI	4	410	160	220	0.004229	0.001218	0.001327	0.005447	903.30	1123.30
MW-6	97-RTGW-062-SI	9	30	12.5	12.5	0.000309	9.51E-05	7.54E-05	0.000405	67.10	79.60
A10A	116-1642	0	25.3	25.3	42.3	0.000261	0.000193	0.000255	0.000454	75.21	117.51
A10A	129-0843	5	261	64.3	147	0.002692	0.000489	0.000886	0.003182	527.63	674.63
A10A	130-0902	10	25.6	25.6	15.35	0.000264	0.000195	9.26E-05	0.000459	76.10	91.45
MW-9	MW-9 10-11.5	10	37	7	170	0.000382	5.33E-05	0.001025	0.000435	72.13	242.13
MW-9	MW-9 15-16.5	15	69	1.5	11	0.000712	1.14E-05	6.63E-05	0.000723	119.93	130.93
MW-9	MW-9 20-21.5	20	1	1	4	1.03E-05	7.61E-06	2.41E-05	1.79E-05	2.97	6.97
A9	068-1454	0	25.85	25.85	2250	0.000267	0.000197	0.013568	0.000463	76.85	2326.85
A9	069-1503	5	24.1	24.1	559	0.000249	0.000183	0.003371	0.000432	71.64	630.64
A9	070-1526	10	26.5	26.5	15.9	0.000273	0.000202	9.59E-05	0.000475	78.78	94.68
A9	071-1543	15	138	23.9	633	0.001424	0.000182	0.003817	0.001605	266.23	899.23
A9	072-1611	20	153	28	591	0.001578	0.000213	0.003564	0.001791	297.07	888.07
A9	073-1636	25	28.55	28.55	83.1	0.000295	0.000217	0.000501	0.000512	84.87	167.97
B9	086-1106	0	24.85	24.85	1180	0.000256	0.000189	0.007116	0.000445	73.87	1253.87
B9	087-1114	5	264	264	2180	0.002723	0.002009	0.013146	0.004733	784.81	2964.81
B9	088-1132	10	268.5	268.5	4420	0.00277	0.002044	0.026654	0.004813	798.19	5218.19
B9	089-1143	15	259	29.6	17.75	0.002672	0.000225	0.000107	0.002897	480.42	498.17
B9	090-1157	20	204	59.1	725	0.002104	0.00045	0.004372	0.002554	423.56	1148.56
BB10A	138-1555	0	30	30	54.1	0.000309	0.000228	0.000326	0.000538	89.18	143.28
BB10A	139-1604	5	480	106	71.6	0.004952	0.000807	0.000432	0.005758	954.89	1026.49
BB10A	140-1624	10	27.7	27.7	16.6	0.000286	0.000211	0.0001	0.000497	82.35	98.95
MW-7	97-RTGW-067-SI	8	490	210	350	0.005055	0.001598	0.002111	0.006653	1103.26	1453.26
C10A	109-1317	0	27.25	27.25	59.8	0.000281	0.000207	0.000361	0.000488	81.01	140.81
C10A	110-1331	5	170	27.7	106	0.001754	0.000211	0.000639	0.001964	325.77	431.77
C10A	111-1343	10	25.7	25.7	15.45	0.000265	0.000196	9.32E-05	0.000461	76.40	91.85
C9	101-0831	0	24.85	24.85	852	0.000256	0.000189	0.005138	0.000445	73.87	925.87
C9	102-0840	5	25.7	25.7	1470	0.000285	0.000196	0.008864	0.000461	76.40	1546.40
C9	103-0907	10	486	29.9	211	0.005013	0.000228	0.001272	0.005241	869.11	1080.11
C9	104-0924	15	165	30.45	171	0.001702	0.000232	0.001031	0.001934	320.69	491.69
C9	105-0942	20	351	71.5	89.5	0.003621	0.000544	0.00054	0.004165	690.68	780.18
MW-5	97-RTGW-053-SI	4	160	12.5	56	0.001651	9.51E-05	0.000338	0.001746	289.48	345.48

PCE Equivalent DCE+TCE ug/kg	Natural Log Concentra tion	Ordered log conc	Order	$i-1/2(n+1)x$	$(x-\text{mean})^2$
2.972766	1.089493	1.089493	1	-26.69258	18.47597
28.81499	3.360896	3.360896	2	-78.98105	4.108589
67.09588	4.206123	4.206123	3	-94.63776	1.396506
71.64366	4.271705	4.271705	4	-91.84165	1.245805
72.12874	4.278453	4.278453	5	-87.70828	1.230787
73.87324	4.302351	4.302351	6	-83.89584	1.178333
73.87324	4.302351	4.302351	7	-79.59349	1.178333
75.21098	4.320297	4.320297	8	-75.6052	1.139692
76.10281	4.332085	4.332085	9	-71.47941	1.114663
76.40009	4.335984	4.335984	10	-67.20775	1.106446
76.40009	4.335984	4.335984	11	-62.87177	1.106446
76.84601	4.341803	4.341803	12	-58.61435	1.094236
78.7783	4.366638	4.366638	13	-54.58297	1.042897
81.00788	4.394546	4.394546	14	-50.53728	0.986674
81.89971	4.405495	4.405495	15	-46.2577	0.965042
82.34562	4.410925	4.410925	16	-41.90379	0.954403
82.34562	4.410925	4.410925	17	-37.49287	0.954403
84.87247	4.44115	4.44115	18	-33.30862	0.896262
87.25069	4.468785	4.468785	19	-29.04711	0.8447
88.14252	4.478955	4.478955	20	-24.63425	0.82611
89.18298	4.49069	4.49069	21	-20.20811	0.804915
89.18298	4.49069	4.49069	22	-15.71742	0.804915
119.9277	4.786889	4.786889	23	-11.96722	0.361167
194.2206	5.268995	5.268995	24	-7.903492	0.014129
266.2338	5.584375	5.584375	25	-2.792187	0.003618
289.4798	5.668086	5.668086	26	2.834043	0.078526
297.0682	5.693962	5.693962	27	8.540942	0.093698
302.7527	5.712916	5.712916	28	14.28229	0.105661
320.6881	5.770469	5.770469	29	20.19664	0.146389
325.7705	5.786193	5.786193	30	26.03787	0.158668
397.1534	5.984323	5.984323	31	32.91377	0.355766
423.5631	6.048702	6.048702	32	39.31657	0.436711
480.416	6.174652	6.174652	33	46.30989	0.619041
527.6329	6.268401	6.268401	34	53.28141	0.77535
690.6783	6.537674	6.537674	35	62.1079	1.32207
747.5206	6.616762	6.616762	36	69.476	1.510197
784.8103	6.665442	6.665442	37	76.65258	1.632213
798.1877	6.682344	6.682344	38	83.5293	1.675886
837.0061	6.729831	6.729831	39	90.85272	1.800884
869.1112	6.767471	6.767471	40	98.12833	1.903324
870.6851	6.76928	6.76928	41	104.9238	1.908319
870.9165	6.769546	6.769546	42	111.6975	1.909053
903.304	6.806059	6.806059	43	119.106	2.011286
920.4105	6.82482	6.82482	44	126.2592	2.06485
954.8947	6.861601	6.861601	45	133.8012	2.17191
954.8947	6.861601	6.861601	46	140.6628	2.17191
965.1856	6.89283	6.89283	47	148.1958	2.264932
990.9852	6.8987	6.8987	48	155.2207	2.282633
1103.262	7.006026	7.006026	49	164.6416	2.618459
1234.94	7.118778	7.118778	50	174.4101	2.996072

Table M-15 Statistical Analysis of Area Along River

				n	50	sum	847.897	78.88365				
				mean	5.387861							
				st dev	1.268807	D	0.2673					
						Y	-3.487537	Y is not rejected but the goodness of fit is weak				
H interpolation - UCL												
				n	50							
				mean	5.387861							
				st dev	1.268807							
				H (from Gilbe		exp	6.665996					
				95% UCL		785.2451	ug/kg	0.7852	mg/kg			
H interpolation - LCL												
				n	50							
				mean	5.387861							
				st dev	1.268807							
				H (from Gilbe		exp	5.838106					
				5% LCL		343.1287	ug/kg	0.3431	mg/kg			
Natural Log												
PCE	Concentra	Ordered	Order			$i-1/2(n+1)x(x-mean)^2$						
ug/kg	tion	log conc										
4	1.386294	1.386294	1	-33.96421 16.01254								
6	1.791759	1.791759	2	-42.10635 12.93195								
11	2.397895	2.397895	3	-53.95264 8.939895								
12.5	2.525729	2.525729	4	-54.30317 8.191802								
15.35	2.731115	2.731115	5	-55.98787 7.058297								
15.45	2.737609	2.737609	6	-53.38338 7.023836								
15.9	2.766319	2.766319	7	-51.1769 6.872482								
16.55	2.806386	2.806386	8	-49.11176 6.664013								
16.6	2.809403	2.809403	9	-46.35514 6.648447								
16.6	2.809403	2.809403	10	-43.54574 6.648447								
17.75	2.876386	2.876386	11	-41.70759 6.307509								
42.3	3.744787	3.744787	12	-50.55463 2.699692								
50.8	3.927896	3.927896	13	-49.0987 2.131497								
54.1	3.990834	3.990834	14	-45.89459 1.951684								
54.1	3.990834	3.990834	15	-41.90376 1.951684								
56	4.025352	4.025352	16	-38.24084 1.856432								
59.8	4.091006	4.091006	17	-34.77355 1.681834								
71.6	4.271095	4.271095	18	-32.03321 1.247166								
71.6	4.271095	4.271095	19	-27.76212 1.247166								
83.1	4.420045	4.420045	20	-24.31025 0.936668								
89.5	4.494239	4.494239	21	-20.22407 0.798561								
106	4.663439	4.663439	22	-16.32204 0.524787								
120	4.787492	4.787492	23	-11.96873 0.360443								
140	4.941642	4.941642	24	-7.412464 0.199111								
145	4.976734	4.976734	25	-2.488367 0.169026								
145	4.976734	4.976734	26	2.488367 0.169026								
147	4.990433	4.990433	27	7.485649 0.157949								
170	5.135798	5.135798	28	12.8395 0.063536								
171	5.141664	5.141664	29	17.99582 0.060613								
175	5.164786	5.164786	30	23.24154 0.049762								
190	5.247024	5.247024	31	28.85863 0.019835								
200	5.298317	5.298317	32	34.43906 0.008018								
211	5.351858	5.351858	33	40.13894 0.001296								
220	5.393628	5.393628	34	45.84583 3.33E-05								
220	5.393628	5.393628	35	51.23946 3.33E-05								
256	5.545177	5.545177	36	58.22436 0.024748								
350	5.857933	5.857933	37	67.36623 0.220968								
559	6.326149	6.326149	38	79.07687 0.880385								
591	6.381816	6.381816	39	86.15452 0.987946								
633	6.45047	6.45047	40	93.53182 1.129139								
660	6.49224	6.49224	41	100.6297 1.219653								
725	6.586172	6.586172	42	108.6718 1.435948								
852	6.747587	6.747587	43	118.0828 1.848853								
890	6.791221	6.791221	44	125.6376 1.96942								
1180	7.07327	7.07327	45	137.9288 2.840602								
1470	7.293018	7.293018	46	149.5069 3.629622								
2000	7.600902	7.600902	47	163.4194 4.897552								
2180	7.68708	7.68708	48	172.9593 5.286409								
2250	7.718685	7.718685	49	181.3891 5.432743								
4420	8.393895	8.393895	50	205.6504 9.03624								
				n	50	sum	1184.22	152.4253				
				mean	4.865485							
				st dev	1.682936	D	0.2815					
						Y	-0.148455	Y is close to zero, therefore the null hypothesis that the distribution is log normal not rejected. Normal analysis also rejected				
H interpolation - UCL												
				n	50							
				mean	4.865485							
				st dev	1.682936							
				H (from Gilbe		exp	3.125727					
				95% UCL		1133.549	ug/kg	1.1335	mg/kg			
H interpolation - LCL												
				n	50							
				mean	4.865485							
				st dev	1.682936							
				H (from Gilbe		exp	5.75242					
				5% LCL		314.9521	ug/kg	0.3150	mg/kg			

Table M-16. Summary of in Place Soil Statistical Analysis

	UCL PCE mg/kg	LCL PCE mg/kg	UCL Breakdown mg/kg	LCL Breakdown mg/kg	Volume (cu. ft.)	Density lb/ft3	Mass soil (lb)	Mass soil (kg)
Around/beneath Excavated Area	1.02	0.44	0.28	0.18	253596	135	34235526	15542929
West of Excavation	16.20	0.62	2.10	0.23	20000	135	2700000	1225800
R of W West of Excavation	1.72	0.05	2.35	0.08	39600	135	5346000	2427084
R of W NW and North of Building *	0.07	0.03	2.49	0.01	144000	135	19440000	8825760
Along River	1.13	0.31	0.79	0.34	220800	135	29808000	13532832
Breakdown w/in excavation			13.24	2.23	89100	135	12028500	5460939
* Average PCE value used instead of UCL because UCL value was extremely high								

	UCL Mass PCE (mg)	LCL Mass PCE (mg)	UCL Mass Breakdown (mg)	LCL Mass Breakdown (mg)	Density mg/cm3	UCL PCE Volume cm3	LCL PCE Volume cm3	UCL Breakdown Volume cm3	LCL Breakdown Volume cm3
Around/beneath Excavated Area	15889024	6841367	4317061.8	2727983.9	1623	9789.9101	4215.26	2659.927155	1680.828065
West of Excavation	19858479	766034.67	2573580.8	277278.28	1623	12235.662	471.98686	1585.693679	170.843055
R of W West of Excavation	4180376.5	132005.81	5712572.9	203750.07	1623	2575.7095	81.334452	3519.761477	125.5391684
R of W NW and North of Building	608977.44	224437.55	21994713	93267.203	1623	375.21715	138.28561	13551.88719	57.46592926
Along River	15340129	4262193.5	10626590	4643503.7	1623	9451.7123	2626.1204	6547.4983	2861.062022
Breakdown w/in excavation			72275768	12165757	1623			44532.20455	7495.845464

	High PCE (gallons)	Low PCE (gallons)	High Breakdown (gallons)	Low Breakdown (gallons)
Around/beneath Excavated Area	2.59	1.11	0.70	0.44
West of Excavation	3.23	0.12	0.42	0.05
R of W West of Excavation	0.68	0.02	0.93	0.03
R of W NW and North of Building	0.10	0.04	3.58	0.02
Along River	2.50	0.69	1.73	0.76
Breakdown w/in excavation			11.76	1.98
Total	9.09	1.99	19.13	3.27

