Long-Term Groundwater Monitoring Optimization
Taylor Road Landfill Superfund Site
Seffner, Hillsborough County, Florida

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ABBREVIATIONS

AOC	Area of Concern
AR	Area Ratio
ARARs	Applicable or Relevant and Appropriate Requirements
BGS	Below Ground Surface
CES	Cost Effective Sampling
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
COPC	Constituent of Potential Concern
CUO	Clean-up Objective
CR	Concentration Ratio
11DCE	1,1-Dichloroethene
cDCE	*cis*-1,2-Dichloroethene
EDD	Electronic Data Deliverable
ESD	Explanation of Significant Difference
FDEP	Florida Department of Environmental Protection
FDOT	Florida Department of Transportation
GCTL	Florida Groundwater Cleanup Target Levels
GIS	Geographic Information System
HCSWMD	Hillsborough County Solid Waste Management Department
HSCB	Hypothetical Statistical Compliance Boundary
LFG	Landfill Gas
LTM	Long-Term Monitoring
LTMO	Long-Term Monitoring Optimization
MAROS	Monitoring and Remediation Optimization Software

MCES	Modified Cost Effective Sampling
MCL	Maximum Contaminant Level
Mn	Manganese
MSL	Mean Sea Level
NAPL	Non-Aqueous Phase Liquid
NPL	National Priorities List
O&M	Operation and Maintenance
OU	Operable Unit
PCE	Tetrachloroethene (Perchloroethene)
PDWS	Primary Drinking Water Standard
PLSF	Preliminary Location Sampling Frequency
POC	Point of Compliance
PRG	Preliminary Remediation Goal
PRP	Potentially-Responsible Party
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
ROD	Record of Decision
SF	Slope Factor
SDWA	Safe Drinking Water Act
SDWS	Secondary Drinking Water Standard
TCE	Trichloroethene
TDS	Total Dissolved Solids
TRLF	Taylor Road Landfill Site
USEPA	United States Environmental Protection Agency

VC	Vinyl chloride
VOC	Volatile Organic Compound

GROUNDWATER MONITORING NETWORK OPTIMIZATION
TAYLOR ROAD LANDFILL SUPERFUND SITE

EXECUTIVE SUMMARY

The following report reviews and provides recommendations for improving the groundwater monitoring network for Taylor Road Landfill Superfund Site in Seffner, Hillsborough County, Florida (Taylor Road Site). The Taylor Road Site consists of three, adjacent, closed, solid-waste disposal facilities. Only one of the three landfills (Taylor Road Landfill) is listed on the National Priorities List (NPL). Leachate from the unlined Taylor Road Landfill has affected groundwater in an area with residential, agricultural and industrial land-uses including individual water-supply wells.

The current groundwater monitoring network has been evaluated using a formal qualitative approach as well as using statistical tools found in the Monitoring and Remediation Optimization System software (MAROS). Recommendations are made for groundwater sampling frequency and location based on current hydrogeologic conditions and long-term monitoring (LTM) goals for the system. The recommendations presented below are based on a technical review; balancing both the statistical results with goals of the monitoring system and site management decisions. The recommendations may not reflect the current regulatory requirements. The following report evaluates the monitoring system using analytical and hydrogeologic data from sampling events conducted between January 1995 and April 2007.

Site Groundwater Monitoring Goals and Objectives

The primary groundwater monitoring goal for the Taylor Road Site is to “define and enclose” groundwater exceeding applicable regulatory standards (USEPA, 1995). Currently, the area of affected groundwater is contained within a ring of compliance wells surrounded by a 270 foot setback. All homes or businesses within the setback must be connected to the county water supply. Well construction is restricted within 500 feet of the county property line, so installation of drinking water wells is prohibited in the area of the Taylor Road Site. Additionally, the site Record of Decision (ROD, USEPA, 1995) stipulates that residents in the area of contaminated groundwater must be connected to a public water supply. Monitoring data from the site network are used to support institutional controls by identifying and delineating areas of affected groundwater and areas that must be connected to the public supply. An additional objective of groundwater monitoring is to document natural attenuation of chemical constituents.

Project Goals and Objectives

The goal of long-term monitoring optimization (LTMO) is to review the current groundwater monitoring program and provide recommendations for improving the efficiency and accuracy of the network in supporting site monitoring objectives. Specifically, the LTMO process provides information on the site characterization, stability of the plume, sufficiency and redundancy of monitoring locations and the appropriate frequency of network sampling. Tasks involved in the LTMO process include:

- Evaluate well locations and screened intervals within the context of the hydrogeologic regime to determine if the site is well characterized;
- Evaluate overall plume stability through trend and moment analysis;
- Evaluate individual well concentration trends over time for target chemicals of potential concern (COPCs);
- Develop sampling location recommendations based on an analysis of spatial uncertainty;
- Develop sampling frequency recommendations based on qualitative and quantitative statistical analysis results;
- Evaluate individual well analytical data for statistical sufficiency and identify locations that have achieved clean-up goals.

The end product of the LTMO process at the Taylor Road Site is a recommendation for specific sampling locations and frequencies that best address site monitoring goals and objectives listed above.

Results

Statistical and qualitative evaluations of Taylor Road Site analytical data have been conducted and the following general conclusions have been drawn based on the results of these analyses:

- After a qualitative evaluation of well locations, screened intervals and hydrogeologic characteristics, affected groundwater at the Taylor Road Site is delineated to USEPA MCLs for the compounds investigated. Groundwater areas where concentrations routinely exceed MCLs are bounded by wells where results are below MCLs downgradient. Existing background concentrations for manganese (Mn) may be above the USEPA secondary drinking water standard (SDWS) and the Florida GCTL (50 ug/L).
- Vinyl chloride (VC) was identified as the highest priority constituent among site constituents of potential concern (COPC) based on its prevalence, concentration relative to risk-based screening levels and its mobility. Trichloroethene (TCE) and benzene were also considered in the network recommendations.
- The groundwater plume at the Taylor Road Site is largely stable to decreasing in concentration. The majority of individual well trends for VC and TCE indicate decreasing, probably decreasing or non-detect status. One well, 24-D, shows an increasing trend for VC, while 7 wells indicate increasing trends for TCE (18-D, 24-D, 31-D, 32-D, C-6, F-2, F-15).
- The estimation of moments indicates that total dissolved masses for VC, TCE and manganese are decreasing. Some shift in the center of mass of the plumes may be occurring as the source area concentrations decrease (i.e. TR-4D) and tail wells in the west/northwest of the plume show increases in concentration (i.e. 24-D for VC and 18-D, 31-D, 32-D and F-2 for TCE).
- Sampling frequency analysis indicates that well sampling frequency can be reduced without loss of spatial or temporal information necessary to support site management decisions.
- Spatial redundancy analysis indicates that three wells may provide redundant information in the network: F-4A, C-5 and TR-1D. F-4A has already been plugged

and abandoned. Other wells provided significant information for delineating and monitoring affected groundwater.

- Spatial uncertainty analysis indicates uncertainty between interior locations with higher concentrations and unaffected ring wells nearby. However, no new monitoring locations are recommended for the network.
- 16 of 27 monitoring locations are statistically below the regulatory screening levels for VC. 13 of 14 compliance ring wells have sufficient statistical power to show they have attained the cleanup standard.

Recommendations

The following general recommendations are made based on the findings summarized above and those described in Section 3 below. General recommendations for monitoring are based on a combination of statistical results for VC and TCE and a consideration of qualitative issues such as hydrogeology, potential receptors and monitoring goals. Detailed recommendations are presented in Section 4.

- LTMO is appropriate for the site at this time. No additional fundamental site investigation is recommended for USEPA regulated constituents at this time. Further site characterization may be considered to explain the distribution of inorganic constituents and chemicals with secondary standards in area groundwater.
- Because the groundwater plume at the Taylor Road Site is largely stable to decreasing in concentration and the rate of change of concentrations at individual wells is slow, decreased monitoring effort may be appropriate at this time.
- Reduce monitoring frequency to semi-annual at 18 compliance ring wells and high concentration locations. Reduce monitoring effort to annual sampling at 7 interior locations and biennial monitoring at 2 wells. On average, 44 total analytical samples are recommended each year for the Taylor Road Superfund Site.

    - *Semi-annual Sampling*: 18-D, 24-D, 30-D, 31-D, 32-D, C-1, C-2, C-3, C-4, C-7, C-8, C-9, C-10
    - *Annual Sampling*: 28-D, C-6, F-1A, F-2, NE-23, TR-1D, TR-3D
    - *Biennial Sampling*: F-12, C-5

- All 27 locations within the current monitoring network are recommended for inclusion in the monitoring program, but many are recommended for reduced sampling frequency. Removal of wells F-2 and 28-D has been recommended by the potentially responsible party (PRP); however, based on the results of the analysis, the recommendation is to include these locations in the routine monitoring network at a reduced sampling frequency.
- No new monitoring locations are recommended at this time. However, careful monitoring of VC concentrations at 24-D and TCE concentrations at the seven locations with apparently increasing concentrations (18-D, 24-D, 31-D, 32-D, C-6, F-2, F-15) is highly recommended to determine if the trends represent mobilization of the plume. Particular attention should be paid to the ring wells on the western side of the Taylor Road Superfund Site.

1.0 INTRODUCTION

The Taylor Road Landfill Superfund Site is a National Priorities Listed (NPL) site administered under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA, Superfund). The site is located approximately 7 miles east of Tampa, Florida in Hillsborough County (see Figure 1) in US Environmental Protection Agency (USEPA) Region IV. The Taylor Road Landfill is a 42-acre historic solid waste disposal facility, originally built without a liner or leachate control system and operated between 1976 and 1980. Two additional landfills were constructed adjacent to the Taylor Road Landfill, and fall within a 252 acre "Study Area" that comprises the Taylor Road Site area of concern and is considered as a single operable unit (OU). The site is an enforcement-lead site with Hillsborough County Solid Waste Management Department (HCSWMD) as the lead responsible party.

Groundwater monitoring plays a critical role in long-term restoration of the Taylor Road Site. The purpose of the following LTMO evaluation is to review the current groundwater monitoring network and provide recommendations for improving the efficiency and accuracy of the network for supporting site management decisions.

At the Taylor Road Site, monitoring goals define why data are collected and how data from the site will be used. The primary groundwater monitoring goal for the site is to "define and enclose" groundwater exceeding relevant drinking water standards (USEPA, 1995). Monitoring data from the site network are used to support institutional controls, by identifying areas of affected groundwater and to document natural attenuation of constituents. A ring of monitoring locations has been installed around the landfill area to delineate affected groundwater.

In order to recommend an optimized network that addresses the stated monitoring objective, spatial and analytical data from the site were analyzed using a series of quantitative and qualitative tools. Tasks performed during LTMO analyses include:

- Evaluate well locations and screened intervals within the context of the hydrogeologic regime to determine if the site is well characterized;
- Evaluate overall plume stability through trend and moment analysis;
- Evaluate individual well concentration trends over time for target constituents of concern (COPCs);
- Develop sampling location recommendations based on an analysis of spatial uncertainty;
- Develop sampling frequency recommendations based on both qualitative and quantitative statistical analysis results;
- Evaluate individual well analytical data for statistical sufficiency and identify locations that have achieved clean-up goals.

A discussion of site background and regulatory context for the Taylor Road Site is provided in Section 1 below. Section 2 details the analytical and statistical approach taken during the LTMO evaluation. A detailed discussion of results is provided in Section 3. Summary conclusions and recommendations are presented in Section 4.0.

1.1 Site Background and Regulatory History

The Taylor Road Landfill was permitted as a solid waste landfill in 1975. The landfill operated from 1976 to 1980 as a disposal facility for residential, commercial and industrial waste, receiving an unknown quantity of hazardous as well as medical waste. The landfill was constructed without a liner or leachate collection system. In 1980, the Taylor Road Landfill reached capacity. A second landfill, the Florida Department of Transportation (FDOT) Borrow Pit (10.6 acres) was opened to accept waste diverted from the Taylor Road landfill. The FDOT landfill was constructed with a liner and leachate collection system and operated as a temporary waste disposal site for less than one year. The 64-acre Hillsborough Heights Landfill was constructed north and west of the two smaller landfills and operated between 1980 and 1984 (see Figure 1).

The 42-acre Taylor Road Landfill is the only NPL listed location among the three historic landfills. However, as affected groundwater extends beneath the other locations, a 252-acre region, known as the Study Area, has been identified as the site area of concern. In addition to the three landfills, the Study Area contains five stormwater-retention basins, County maintenance facilities and a recycling collection center. Adjacent land-use is a mixture of residential, commercial and agricultural properties.

During a nationwide program of groundwater sampling during the late 1970's, monitoring and water-supply wells in the vicinity of the Taylor Road site were found to be affected by volatile organic compounds (VOCs) and metals. Groundwater investigations revealed that a plume of affected groundwater with several constituents exceeding standards established under the Safe Drinking Water Act (SDWA) had migrated off-site into residential areas. In 1980, the EPA filed suit against Hillsborough County (the County) under the Resource Conservation and Recovery Act (RCRA) and the SDWA. Because of plume impacts on residential wells, the Taylor Road Landfill was added to the NPL in October 1981.

EPA pursued cleanup of the Site under both RCRA and Superfund. In a Consent Decree signed in September 1983 the USEPA, the state of Florida and the County agreed to a 30-year maintenance and environmental monitoring program for the Taylor Road Study Area. Site maintenance included installation of a cap, cover and drainage ditch and gas control systems for fugitive methane. A water supply system was extended to area residents to replace affected groundwater supply wells. The County was identified as a potentially responsible party (PRP) in 1987, and remains the primary PRP in a group of 19 PRPs.

The Record of Decision (ROD) for the Taylor Road Landfill was issued in September of 1995. The ROD identified a single OU that includes groundwater beneath and contiguous with the Study Area. The remedy chosen for the site includes institutional controls prohibiting installation of water-supply wells in areas of affected groundwater, extension of public water-supply lines to residents and businesses with groundwater wells, and a monitored natural attenuation program. The ROD identifies the point of compliance POC) as a ring of monitoring wells around the Study Area. Compliance monitoring wells have been installed at the site between 1995 and 2001. Well information is listed on Table 1. Quarterly monitoring of point of compliance (POC) wells is specifically described in the ROD as part of the remedy. In the event that concentrations of constituents exceed the regulatory screening levels at the compliance-ring points, a pump and treat contingent remedy will be considered. Groundwater monitoring data are to be evaluated annually by USEPA and Florida Department of Environmental Protection (FDEP) for concentration trends of major regulated constituents. Construction related to the remedial system was completed in 1999.

Operation and maintenance (O & M) of the closed landfills is regulated under the FDEP RCRA program. The closed landfills have low-permeability caps, cover systems and engineered stormwater control systems that contribute to the overall remedial process. An extensive landfill gas (LFG) collection system has been installed in the area to collect and flare landfill-generated methane. The O&M program includes monitoring of groundwater, surface water and landfill gas. Site inspections, facility repair including monitoring wells, landfill cover maintenance, gas monitoring and recovery systems, notification, record keeping and reporting are also included in the O&M program.

USEPA issued an Explanation of Significant Difference (ESD) in August 2000 to set regulatory screening levels to the Florida Primary Drinking Water Standards or Minimum Criteria. The FDEP maintained that federally-enforceable applicable, or relevant and appropriate requirements (ARARs) for the site should include the Florida Secondary Drinking Water Standards. As Secondary Standards address aesthetic issues rather than health threats, the USEPA has determined these standards are not federally-enforceable.

1.2 Geology and Hydrogeology

The Taylor Road Landfill Study Area is located in the Brandon Karst Terrain, an internally drained portion of the Polk Upland karst escarpment characterized by sinkholes and hills formed by marine and coastal sands (USEPA, 2003). Subsurface hydrology is characterized by an ephemeral surficial aquifer underlain by a leaky confining unit consisting of Hawthorn Group clays. The surficial aquifer in the Study Area is largely absent. The Hawthorn group consists of blocky and discontinuous clays and sandy clays, with pipes and limestone pinnacles interconnected with the underlying Floridan aquifer. No intermediate aquifer system is present. Based on water table data, the surficial and intermediate units present in the area surrounding the Site are not considered significant in the Taylor Road Landfill Study Area.

The Floridan aquifer consists of the Tampa Member and underlying limestones. The aquifer in the Study Area is unconfined and characterized by both intergranular and moldic porosity with dominant flow controlled by fractures, caverns, and bedding planes. Flow through the pores is slow with transmissivities for the aquifer in the region of the Study Area reported between 7.4×10^3 and 2.05×10^5 ft^2/d (ERM, 1995). Porosity is estimated at 0.05 and the saturated thickness at approximately 400 ft. Aquifer parameters used in the MAROS analysis are listed in Table 2.

Regional groundwater flow is west/southwest, but there is a recharge mound under the Study Area which results in a range of flow directions across the site. Flow in the vicinity of the Taylor Road and FDOT borrow pit is to the south/southeast, while flows around the Hillsborough Heights Landfill are to the west/southwest. Based on water table data, the aquifer may show some seasonal variation in flow direction.

2.0 ANALYTICAL APPROACH

Evaluation of the groundwater monitoring network in the vicinity of the Taylor Road Landfill Site consisted of both quantitative and qualitative methods. A quantitative statistical evaluation of the site was conducted using tools in the MAROS software. The qualitative evaluation reviewed hydrogeologic conditions, well construction and placement. Both quantitative statistical and qualitative evaluations were combined using a 'lines of evidence' approach to recommend a final groundwater monitoring strategy to support site monitoring objectives.

2.1 MAROS Method

The MAROS 2.2 software was used to evaluate the LTM network at the Taylor Road Landfill Site. MAROS is a collection of tools in one software package that is used in an explanatory, non-linear but linked fashion to statistically evaluate groundwater monitoring programs. The tool includes models, statistics, heuristic rules, and empirical relationships to assist in optimizing a groundwater monitoring network system. Results generated from the software tool can be used to develop lines of evidence, which, in combination with professional judgment, can be used to inform regulatory decisions for safe and economical long-term monitoring of groundwater plumes. A summary description of each tool used in the analysis is provided in Appendix A of this report. For a detailed description of the structure of the software and further utilities, refer to the MAROS 2.2 User Manual (AFCEE, 2003) or Aziz, et al. (2003).

In MAROS 2.2, two levels of analysis are used for optimizing long-term monitoring plans: 1) an overview statistical evaluation with interpretive trend analysis based on temporal trend analysis resulting in plume stability information; and 2) a more detailed statistical optimization based on spatial and temporal redundancy reduction methods (see Appendix A or the MAROS Users Manual (AFCEE, 2003)).

2.1.1 COPC Choice

The karst terrain, varying groundwater flow directions and complex source cause widespread spatial heterogeneity in constituent concentrations at the Taylor Road Site. Because of deviations from diffuse flow, each monitoring location was evaluated individually for priority constituents of potential concern (COPCs). To identify priority COPCs, the average concentration calculated for a constituent at each well between 1999 and 2007 was divided by the Florida Groundwater Cleanup Target Level (GCTLs). COPC concentrations that exceeded the GCTL by the highest ratio were identified as priority COPCs for the individual well. Priority COPCs determined for each monitoring location are listed in Table 1.

The COPC most often identified as a priority was vinyl chloride. Manganese (Mn) frequently exceeds secondary drinking water standards at the Taylor Road Site. As Mn does not have a primary drinking water standard and the secondary standard was exceeded at the background location (F-12), as well, the constituent was not considered to be a risk-driver for the analysis.

MAROS includes a short module that provides recommendations on prioritizing COPCs for the entire plume based on toxicity, prevalence, and mobility of the compound (see Appendix A for details). The module identified vinyl chloride as the only plume-wide priority COPC, with Mn identified as exceeding secondary standards. The MAROS spatial and temporal analyses were performed for vinyl chloride.

2.1.2 Plume Stability

Within MAROS, historical analytical data are analyzed to develop a conclusion about plume stability. If a plume is found to be stable, in many cases, the number of locations and monitoring frequency can be reduced without loss of information. Plume stability results are assessed from time-series concentration data with the application of two types of statistical tools: individual well concentration trend analyses and plume-wide moment analysis.

Individual well concentrations are evaluated using both Mann-Kendall and Linear Regression trend tools. The Mann-Kendall nonparametric evaluation is considered one of the best methods to evaluate concentration trends as it does not assume the data fit a particular distribution (Gilbert, 1987). Individual well concentration trends were calculated for priority COPCs for the time period 1999 to 2007. Individual well Mann-Kendall trends were also used in the sampling frequency analysis, where trends determined for the 2004 to 2007 interval were compared with trends calculated using the entire dataset for each well. During the final 'lines of evidence' evaluation, individual well concentration trends are considered along with summary statistics such as percent detection and historic maximum concentration to recommend sampling frequencies for wells in the network.

Moment analysis algorithms in MAROS are simple approximations of complex calculations and are meant to estimate the total dissolved mass (zeroth moment), center of mass (first moment) and spread of mass (second moment) in the plume and the trend for each of these estimates over time. Trends for the first moment indicate the relative amount of mass upgradient vs. downgradient and the change in the distance of the center of mass from the source over time. Trends in the second moment indicate the relative distribution of mass between the center of the plume and the edge.

2.1.3 Well Redundancy and Sufficiency

Spatial analysis modules in MAROS recommend elimination of sampling locations that have little impact on the historical characterization of a contaminant plume while identifying areas in the plume where additional data are needed. For details on the redundancy and sufficiency analyses, see Appendix A or the MAROS Users Manual (AFCEE, 2003).

Sample locations are evaluated in MAROS for their importance in providing information to define concentrations within the groundwater plume. Wells identified as providing information redundant with surrounding wells are recommended for elimination from the program. (Note: elimination from the program does not necessarily mean plugging and abandoning the well. See Section 2.3 below.)

Well sufficiency is evaluated in MAROS using the same spatial analysis as that for redundancy. Areas identified as having unacceptably high or unexplained levels of concentration uncertainty are recommended for additional monitoring locations.

The well redundancy and sufficiency analysis uses the Delaunay method and is designed to select the minimum number of sampling locations based on the spatial analysis of the relative importance of each sampling location in the monitoring network. The importance of each sampling location is assessed by calculating a slope factor (SF) and concentration and area ratios (CR and AR respectively). Sampling locations with a high SF provide unique information and are retained in the network. Locations with low SF are considered for removal. Areas defined by many wells with high SF may be candidates for new well locations. SF's were calculated for all wells at the Taylor Road Site and the results were used to determine the importance of each well in the network for defining vinyl chloride concentrations.

The results from the Delaunay method and the method for determining new sampling locations are derived solely from the spatial configuration of the monitoring network and the spatial pattern of the contaminant plume based on a two-dimensional assumption. No parameters such as the hydrogeologic conditions are considered in the analysis. Therefore, professional judgment and regulatory considerations must be used to make final decisions.

2.1.4 Sampling Frequency

MAROS uses a Modified Cost Effective Sampling (MCES) method to optimize sampling frequency for each location based on the magnitude, direction, and uncertainty of its concentration trends. The MCES method was developed on the basis of the Cost Effective Sampling (CES) method developed by Ridley et al. (1995). The MCES method estimates a conservative lowest-frequency sampling schedule for a given groundwater monitoring location that still provides needed information for regulatory and remedial decision-making.

MAROS has recommended a preliminary location sampling frequency (PLSF) for each monitoring location at the Taylor Road Study Area based on a combination of recent and long-term trends and the magnitude and rate of concentration change. The PLSF has been reviewed qualitatively and a final optimal sampling frequency has been recommended consistent with monitoring objectives and regulatory requirements.

2.1.5 Data Sufficiency

The MAROS Data Sufficiency module employs simple statistical methods to evaluate whether analytical data are adequate both in quantity and in quality for revealing changes in constituent concentrations. Statistical tests for the MAROS module were taken from the USEPA *Methods for Evaluating the Attainment of Cleanup Standards Volume 2: Groundwater* statistical guidance document (USEPA, 1992).

Two types of statistical analyses have been performed on analytical samples from each individual well. First, hypothesis testing using a sequential T-test has been performed to determine if groundwater concentration is statistically below the screening level for VC (screening levels were set to applicable federal and state Maximum Contaminant Levels (MCLS) including the Florida GCTLs). The sequential T-test indicates if the well has a sufficient number of samples at low enough concentrations to be categorized as "statistically below the MCL". If measured concentrations are high or there are an insufficient number of data points, then the well is recommended for further sampling.

A statistical power analysis was also performed in the Data Sufficiency module to assess the reliability of the hypothesis test and to suggest the number of additional samples that may be required to reach statistical significance. The power analysis uses the number of samples (n), the variance of the samples, the minimum detectible difference and the significance (α) of the test to determine if the well is below the screening level with very high confidence. The power analysis is a more stringent test than the sequential T-test and provides a higher level of certainty that the well is not affected above risk-based levels. Locations that pass the power test are considered "statistically clean".

At the Taylor Road Landfill Site, interior locations that monitor groundwater areas "statistically below MCL" or "statistically clean" may be considered for reduced sampling frequency or elimination from the program. Statistically 'clean' ring locations should be retained in the program to help define the plume, set institutional control boundaries or function as surrogate "point of exposure" locations.

2.2 Data Input, Consolidation and Site Assumptions

Groundwater analytical data from the Taylor Road Landfill Site area were supplied by SCS (SCS, 2006b), supplemented with information from historic site reports. Groundwater monitoring locations included in the evaluation are listed in Table 1, with additional details provided in Table 2.

Chemical analytical data collected between January 1995 and April 2007 and well information data were organized in a database, from which summary statistics were calculated. In all, 28 sample locations were considered in the network evaluation for the Taylor Road Site. Monitoring well F-4A was plugged and abandoned in 2006, due to damage sustained from agricultural activity at the site. The well was included in the analysis to ensure that a replacement well was not needed. Well locations are illustrated on Figures 1.

2.2.1 Time Interval and Data Consolidation

Data prior to 1999 are available for a subset of Taylor Road Site wells, however, the majority of wells in the network have been installed since 1996 with some as recently as 2001. In order to provide reasonable consistency in statistical comparisons, analyses have been limited to certain time-frames. Individual well trend evaluations were performed for data collected between 1999 and 2007. The data represent an 8 year record for many wells, and provide an indication of long-term trends in site constituent concentrations.

For sample locations with more than 40 sample events (n>40), data were consolidated quarterly. That is, for locations with more than one sample result for one calendar quarter (3 month period), the average concentration was used in the statistical analysis. Duplicate samples were also averaged to develop one result for each COPC for each quarter.

To ensure a consistent number and identity of wells for the moment analysis, site data were consolidated annually for this analysis. An average concentration for each well for each year was calculated by the software. Estimates of total dissolved mass, center of mass and spread of mass were calculated for each year 1999 – 2007 based on the average concentration at each monitoring point. Trends for each of the moments are based on the Mann-Kendall evaluation of each moment calculated for each year 1999 – 2007.

2.3 Qualitative Evaluation

Multiple factors should be considered in developing recommendations for monitoring at sites undergoing long-term groundwater restoration. The LTMO process for the Taylor Road Landfill Site includes developing a 'lines of evidence' approach, combining statistical analyses with qualitative review to recommend an improved monitoring network. Results from the statistical analyses in combination with a qualitative review were used to determine continuation or cessation of monitoring at each well location along with a proposed frequency of monitoring for those locations retained in the network.

The primary consideration in developing any monitoring network is to ensure that information collected efficiently supports site management decisions. Site information needs are reflected in the monitoring objectives for the network. For this reason, any proposed changes to the network are reviewed to be consistent with and supportive of the stated monitoring objectives. The qualitative review process starts with evaluating each monitoring location for the role it plays supporting site monitoring objectives. For example, a location may provide vertical or horizontal delineation of the plume or may provide information on decay rates in the source area. Each well in the Taylor Road Site network was evaluated for its contribution to site monitoring objectives. Qualitatively, redundant locations are those where multiple wells address the same monitoring objective in approximately the same location.

A recommendation to eliminate chemical analytical monitoring at a particular location based on the data reviewed does not necessarily constitute a recommendation to physically abandon the well. A change in site conditions might warrant resumption of monitoring at some time in the future. In some cases, stakeholders may pursue a comprehensive monitoring event for all historic wells every five to ten years to provide a broad view of plume changes over time.

In general, continuation of water level or hydrogeologic measurements at all site wells is recommended. Data on hydraulic gradients and potentiometric surfaces are often relatively inexpensive to collect and can be used to support model development and resource planning.

Qualitative evaluation for sampling frequency recommendations includes looking at factors such as the rate of change of concentrations, the groundwater flow velocity, and the type and frequency of decisions that must be made about the site. Additionally, consideration is given to the concentration at a particular location relative to the regulatory screening level, the length of the monitoring history and the location relative to potential receptors.

3.0 RESULTS

Data from 28 monitoring wells at various depths were included in the network analysis for the Taylor Road Site. Monitoring locations are listed in Table 1 with the size of the data set for each well, the hydrogeologic unit monitored, major COPC's detected and a brief description of the location and function of the well.

3.1 Plume Stability

3.1.1 Concentration Trends

Individual well concentration trends using the Mann-Kendall method for data collected between 1999 and 2007 are summarized in the table below with detailed results shown in Table 3. Results of the individual well Mann-Kendall trends for VC are also illustrated on Figure 2. Detailed Mann-Kendall reports for major COPCs for each well in the network are located in Appendix B.

COPC	Total Wells	Taylor Road Landfill Mann-Kendall Trend Results by Number of Wells				
		Nondetect	Decreasing or Probably Decreasing	Stable	Increasing or Probably Increasing	No Trend or Insufficient Data
Vinyl chloride	28	13 (46%)	11 (39%)	0	1 (4%)	3 (11%)
TCE	28	10 (35%)	8 (28%)	0	7 (25%)	3 (11%)

For the major organic COPCs, the majority of wells show no detections (ND) or decreasing (D or PD) trends. Because of the design of the monitoring network, including the ring of delineation wells, it is appropriate that a large number of wells have no detections of major COPCs. For wells where constituents have been detected, the majority of wells show decreasing concentration trends. Decreasing trends for VC are found at interior wells with historic high concentrations such as C-2, C-5, C-6 and TR-4D. Source area well TR-4D shows decreasing trends for VC, TCE, 11DCE and benzene. Analytical results for some wells show intermittent detections, varying between around the detection limit, resulting in a No Trend (NT) result. Examples of wells with No Trend for VC resulting from censored data include 28-D and TR-2D.

The only well showing an increasing concentration trend for VC is interior location 24-D. VC is detected at 24-D in 55% of the samples, with the detection rate increasing somewhat since mid-2003. 24-D also shows increasing concentration trends for TCE, PCE, benzene, and Mn with these constituents following roughly the same temporal pattern as that of VC.

TCE concentrations are statistically increasing at seven locations in the network. However, TCE is found at significantly lower concentrations relative to the screening level, and the trends appear to reflect intermittent detections at wells with concentrations near the analytical detection limit. For example, TCE has been detected more frequently at wells 18-D and 24-D since 2002, but average concentrations are below the screening level (3 ug/L). Of the 7 wells with increasing trends 1999-2007, only one location, 31-D has an increasing recent trend (2004-2007). Concentrations at 31-D are still below the screening levels, but, as this location is part of the compliance ring, future results should be carefully monitored for continued increasing trend.

One unusual trend result was found at background well F-12. The statistical trend for Mn is strongly decreasing between 1999 and 2007. F-12 is a background well for the purpose of determining chemical concentrations in an area of the aquifer that is unaffected by the landfills. Concentrations of naturally occurring inorganic constituents are normally stable at background locations, so the trend in Mn is an interesting result.

3.1.2 Moments

Moment analysis was used to estimate the dissolved mass (zeroth moment), center of mass (first moment) and distribution of mass (second moment) for the plume and the trend for these metrics over time. In order to ensure a consistent number and identity of wells for each moment estimate, an annual average concentration for each well was calculated. Trends of moments were evaluated for annually consolidated data 1999-2007. Estimates of the zeroth and first moments for the Taylor Road Site are shown in the table below, and first moments for VC are illustrated on Figure 2.

Moment Type	Moment Analysis Source OU		Comment
	VC Trend	TCE Trend	
Zeroth	Decreasing	Decreasing	The estimate of total dissolved mass of VC and TCE within the Study Area was decreasing between 1999 and 2007.
First	Probably Increasing	Increasing	The distance of the plume center of mass from the source shows a probably increasing trend for VC and an increasing trend for TCE. The center of mass is shifting slightly to the northwest.
Second	Increasing/ No Trend	Increasing	The plume spread about the center of mass is increasing in the direction of groundwater flow for both VC and TCE. VC shows No Trend in the Y direction.

Between 1999 and 2007 the total dissolved mass in the Study Area shows a decreasing trend for both VC and TCE (see Appendix B MAROS reports for Zeroth Moments). A decreasing trend is consistent with the finding that 39% of individual well concentration trends for VC were decreasing with only one well showing an increasing trend. A decreasing trend for TCE indicates that the wells with the highest concentrations are decreasing in concentration while the 7 wells with increasing trends do not contribute significantly to the estimate of total mass in the plume. The total dissolved mass for Mn also shows a decreasing trend.

The center of mass for VC shows a probably increasing trend. First moments are illustrated on Figure 2, and indicate that while the VC center of mass is moving slightly away from the Taylor Road Landfill (TR-4D source well), the increase is not large. Within the size of the Study Area, the movement of the center of mass is not particularly significant in the direction of groundwater flow, but appears to shift to the west/northwest. This shift may be due to the increasing concentrations detected at well 24-D. First moments for TCE are also shifting toward the west, in the direction of 24-D and C-6, which shows increasing trends for TCE.

3.2 Redundancy and Sufficiency

The spatial redundancy analysis was performed for the network using VC as the priority COPC. Data collected between 2004 and 2007 were used in the spatial optimization. Summary results for the redundancy analysis are presented on Table 4 and include average slope factors (the estimate of uncertainty surrounding the well) for each location.

For VC, three locations were identified by the software as candidates for removal based on analytical data: C-5, F-4A and TR-1D. Well F-4A has been plugged and abandoned due to damage sustained from agricultural land use. Redundancy analysis indicates that data from F-4A can be successfully replaced by data from F-15 and C-3. Based on a qualitative review and regulatory requirements, all other wells were recommended for retention in the monitoring network, although at a reduced sampling frequency.

The well sufficiency analysis for vinyl chloride concentrations is illustrated in Figure 3. MAROS uses the Delaunay triangulation and SF calculations to identify areas with high concentration uncertainties. Figure 3 shows the polygons created by the triangulation method and indicates areas of high uncertainty with an “L” or and “E” in the center of the triangle. For the Taylor Road network, areas of high concentration uncertainty exist between interior compliance wells with high concentrations and the unaffected ring wells. Spatial uncertainty within the network is satisfactorily explained by the geology and wells locations, and no new wells are recommended for the network at this time.

3.3 Sampling Frequency

Table 5 summarizes the results of the MAROS preliminary sampling frequency analysis. Recent (2004-2007) and overall trends for VC were determined along with the recent and overall Mann-Kendall trends. The software recommends a preliminary sampling frequency based on the recent and overall trends. Detailed results of the recent and overall trends and concentration rates of change are shown in Table 5. The sampling frequency suggested by the software (MAROS Recommended Frequency) was compared against the current frequency and a final recommended frequency was determined based on both quantitative and qualitative analyses.

Based on the rate of change of concentrations, MAROS recommends an annual to biennial (every two years) sampling frequency for the majority of wells. The current network is sampled quarterly, with this frequency identified as part of the remedy. In order to reconcile the sampling frequency based on rate of change with that of the regulatory requirements a semi-annual sampling frequency is recommended for the ring or delineation wells. Interior monitoring locations with historic high concentrations or increasing trends are also recommended for semi-annual monitoring. Interior locations with low concentrations or decreasing trends are retained at an annual monitoring frequency. Background well F-12 and redundant location C-5 are recommended for sampling every two years.

All 27 wells are recommended for inclusion in the monitoring program, but most are retained at a reduced sampling frequency. The combination of annual and semi-annual frequencies will ensure temporal coverage to "define and enclose" the plume as well as providing a record of attenuation of high concentrations in the interior of the Study Area. The table below summarizes the current monitoring frequency for wells in the network and the sampling frequency recommended after the lines of evidence evaluation.

Monitoring Wells	Recommended Well Sampling Frequency		
	Sampling Frequency	**Current Sampling Frequency**	**Sampling Frequency Recommendation**
	Quarterly	27	0
	Semi-annual	0	18
	Annual	0	7
	Biennial	0	2
Total Samples (average per year)		**108**	**44**
Total Wells		**27**	**27**

The current sampling frequency is estimated from the sample dates in the site analytical database (SCS, 2006). Well F-4A was abandoned prior to the analysis due to issues with placement.

3.4 Data Sufficiency

Among Study Area wells, 16 of 27 wells are statistically below the screening level for VC (0.001 mg/L) assuming a log-normal data distribution. Of these wells, fourteen have data with sufficient statistical power to say that they have reliably 'attained' clean-up goals and are statistically clean. The clean-up status of each well in the network is indicated in the 'lines of evidence' summary Table 6 and illustrated on Figure 4.

All ring wells with the exception of F-1A and TR-2D are statistically clean for VC. Well TR-2D is currently statistically below the screening level for VC and statistically clean for TCE. Well F-1A is currently statistically below the screening level for TCE, but remains above the screening level for VC.

4.0 CONCLUSIONS AND RECOMMENDATIONS

The primary goal of developing an optimized monitoring strategy at the Taylor Road Landfill Study Area is to create a dataset that fully supports site management decisions and risk reduction goals while minimizing time and expense associated with collecting and interpreting analytical data. A summary of the final recommended monitoring network is presented in Table 6 and illustrated on Figure 5. The recommended network reduces monitoring effort and cost by reducing the frequency of groundwater sampling at many locations while meeting the monitoring goal of defining and enclosing the plume.

Tasks identified in the Section 1 were performed for current network. A summary of general results for each task is presented below:

- *Evaluate well locations and screened intervals within the context of the hydrogeologic regime to determine if the site is well characterized.*

  Result: Part of the network optimization process is to identify possible gaps in site characterization that may require additional sampling locations or site investigation. Based on well locations, screened intervals and hydrogeologic characteristics, affected groundwater at the Taylor Road Site is delineated to USEPA MCLs for the compounds investigated. Groundwater areas where concentrations routinely exceed MCLs are bounded by wells where results are below MCLs. The majority of wells in the network have a sufficiently large data set to perform statistical calculations. No major data gaps were identified during the qualitative evaluation.

  One area that may require additional study is the evaluation of inorganic constituents such as Mn and nitrate in both background and affected wells. Elevated concentrations of Mn are seen at interior wells (TR-3D and 18D); however, background well F-12 measures Mn concentrations significantly above the GCTL (50 ug/L).

  Recommendation: LTMO is appropriate for the site at this time. No additional fundamental site investigation is recommended for USEPA regulated constituents at this time. Further statistical or conceptual site characterization may be considered to explain the distribution of inorganic constituents and chemicals with secondary standards in area groundwater.

- *Evaluate overall plume stability through trend and moment analysis. Evaluate individual well concentration trends over time for target chemicals of potential concern (COPCs);*

  Result: The groundwater plume evaluated is largely stable to decreasing. The majority of individual well trends for VC and TCE indicate decreasing, probably decreasing or non-detect status for well concentrations. For 28 wells evaluated at the Taylor Road Site, the majority of locations show stable to decreasing trends or no detections (~86%) for VC. An increasing trend was calculated at only one location for VC and at 7 locations for TCE.

Monitoring locations with the highest VC concentrations, TR-4D, 18-D, F-14, C-5 and C-6, show strongly decreasing trends. Wells with high TCE concentrations, including TR-4D, C-5 and C-2 also show decreasing trends. The moment analysis indicates that total dissolved mass for VC, TCE and Mn is decreasing. Some shift in the center of mass may be occurring as the source area concentrations decrease (TR-4D) and tail wells in the west/northwest of the plume show minor increases in concentration (i.e. 24-D). Changes in the center of mass over time for VC are shown on Figure 2.

Recommendation: Reduced monitoring effort is appropriate for stable or decreasing plumes. Monitoring frequency can be reduced for plumes where groundwater concentrations are not changing rapidly. As a general observation, groundwater concentrations are not changing rapidly at the Taylor Road Site, but there is evidence for steady decrease in concentrations particularly in the source area.

Low concentrations of chemicals may be diffusing to western monitoring locations (24-D for VC and TCE, F-2, 18-D, 31-D and 32-D for TCE). However, concentrations at western monitoring locations are below screening levels at this time. Continued semi-annual monitoring and annual evaluation of concentration trends in the area west of the Hillsborough Heights landfill is highly recommended. Well F-2 is recommended for continued sampling for TCE as concentrations are increasing at this location as well as neighboring wells 31-D, 32-D and 18-D.

- *Develop sampling location recommendations based on an analysis of spatial uncertainty;*

Result: The spatial redundancy analysis indicated that three wells, F-4A, C-5 and TR-1D, could be removed from the routine monitoring program, as they do not provide unique information. One location (F-4A) has already been plugged and abandoned.

The spatial analysis identified areas of high concentrations uncertainty between locations with high concentrations and non-detect ring wells around the perimeter of the site. Some additional uncertainty was identified in the interior of landfill units. Areas of higher spatial uncertainty are illustrated on Figure 3.

Recommendation: Despite the finding of spatial redundancy for wells C-5 and TR-1D, all 27 locations within the current monitoring network are recommended for inclusion in the monitoring program. Well C-5 was retained at a reduced sampling frequency to monitor the area of between higher concentrations at well C-6 and upgradient delineation wells C-8 and F-1A. Well TR-1D was retained at a reduced frequency to monitor higher concentrations southwest of the FDOT and Taylor Road Landfills. Groundwater flow in this area is toward the southwest and there is a relatively short distance between TR-1D and the compliance ring. Both C-5 and TR-1D can contribute data supporting attenuation of priority constituents site-wide.

Hillsborough County has recommended removing wells 28-D, F-2, NE-23 and TR-3D from routine monitoring (SCS, 2006). Based on the above analysis, the recommendation is to include these locations in the routine monitoring network at an annual sampling frequency.

Well 28-D is located upgradient of the source areas, but shows intermittent detections (18% for VC) of site COPCs, with historic exceedances of VC detected as recently as 2004. Spatial uncertainty analysis calculates a high average slope factor (0.83) for 28-D, indicating that concentrations at 28-D cannot be estimated from the surrounding network (see Figure 3). Including 28-D in the network at an annual frequency will provide information on overall attenuation of mass at the site and will provide early warning of any shift in mass toward the compliance ring to the east. Future monitoring frequency may be reduced should decreasing to non-detect trends develop.

Groundwater at location F-2 shows historic exceedances for both VC and TCE, and currently indicates an increasing trend for TCE. As this location is immediately upgradient of the compliance ring near residential development, the well should be maintained in the network.

Location NE-23 monitors the region immediately upgradient of the Taylor Road Landfill and areas of highest concentrations site-wide. Data at NE-23 indicate historic exceedance of MCLs for VC and TCE, but show largely decreasing trends for both compounds. The proximity of NE-23 to the compliance ring provides information for the delineation of the plume in addition to confirming attenuation of site constituents.

While TR-3D has a relatively low average slope factor (0.32), the location monitors groundwater that currently exceeds the screening level for VC. If current trends continue, the concentration at TR-3D will drop below MCLs. Continued monitoring at a reduced frequency will provide a statistically significant dataset to demonstrate successful attenuation in this area. Should decreasing concentration trends continue, consider reducing the monitoring frequency for TR-3D to biennial.

No new monitoring locations are recommended.

- *Develop sampling frequency recommendations based on both qualitative and quantitative statistical analysis results;*

  Result: The sampling frequency analysis recommended a reduced sampling frequency for the majority of wells. Largely annual to biennial sampling frequencies were recommended by the algorithm based on the rate of change and trend of well concentrations.

  Recommendation: Reduce the frequency of monitoring. Compliance ring locations and interior wells in historic high concentration areas are recommended for semi-annual monitoring. 18 of 27 wells are recommended for semi-annual monitoring; 7 are recommended for annual sampling, and 2 for biennial sampling. A total of 44 groundwater samples are recommended annually to support site management decisions.

Upgradient well F-1A is recommended for annual sampling. Groundwater at F-1A shows exceedances of VC and historic exceedance of arsenic standards, but is bounded both up and downgradient by non-detect wells C-8 and C-10. Detected concentrations at F-1A show high variability and may result from its proximity to the Hillsborough Heights landfill leachate collection system.

Interior locations in low concentration areas or areas with higher well density are recommended for a combination of annual and biennial sampling. Background well F-12 is recommended for biennial monitoring. Specific sampling frequency recommendations are listed in Table 6 and illustrated on Figure 5.

- *Evaluate individual well analytical data for statistical sufficiency and identify locations that have achieved clean-up goals.*

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Result: 16 of 27 wells are statistically below the screening level for VC (0.001 mg/L), and 14 of 27 have data with sufficient statistical power to say that they have reliably 'attained' clean-up goals and are statistically clean. Compliance ring well F-1A is not statistically below the GCTL for VC, while ring well C-2 has insufficient data to confirm attainment of the cleanup standard. Data for well F-12 indicate that background concentrations of Mn in area groundwater exceed the GCTL. The clean-up status of each well in the network is indicated in the 'lines of evidence' summary Table 6 and illustrated on Figure 4.

Recommendation: The majority of the compliance ring wells are statistically clean, and, therefore, are suited to delineate the extent of affected groundwater. Continue sampling interior wells to confirm attenuation of site COPCs.

Additional Recommendations

- Groundwater monitoring data as well as well construction and location information should be managed in a site-wide relational database available to all stakeholders. Analytical data are available in electronic format for most laboratories and can be appended to the database after every monitoring event. Management of analytical data in a database will streamline the statistical and trend analysis.

- The list of analytes analyzed during each monitoring event can be reduced. The recommended reduction in analytes described in *Taylor Road Landfill Superfund Site Groundwater Quality Statistical Evaluation* (SCS, 2006) is appropriate.

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GROUNDWATER MONITORING NETWORK OPTIMIZATION
TAYLOR ROAD LANDFILL SUPERFUND SITE

Hillsborough County, Florida

TABLES

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Table 2 Aquifer Input Parameters: Taylor Road Landfill Site

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TABLE 1
TAYLOR ROAD LANDFILL SUPERFUND SITE MONITORING LOCATIONS

LONG-TERM MONITORING OPTIMIZATION
TAYLOR ROAD LANDFILL SUPERFUND SITE
HILLSBOROUGH COUNTY, FLORIDA

Well Name	Hydrologic Unit	Well Type	Source or Tail (for MAROS)	Minimum Sample Date	Maximum Sample Date	Number of Samples (1995-2007)	Current Sampling Frequency	Priority COPC at Well	Well Function and Rationale
18-D	Floridian	Interior	S	1/17/1995	4/9/2007	50	Quarterly	Vinyl Chloride, TCE, Benzene	Monitors interior of site, south of the Hillsborough Heights Landfill and west of the Taylor Road site.
24-D	Floridian	Interior	S	4/14/1999	4/9/2007	33	Quarterly	Vinyl Chloride, TCE, Benzene	Monitors area west of HH landfill interior to compliance ring.
28-D	Floridian	Interior	S	1/18/1995	4/9/2007	50	Quarterly	Vinyl Chloride	Proposed for abandonment GWMP (May, 2006). Monitors interior of compliance ring east of HH landfill.
30-D	Floridian	Ring	T	1/17/1995	4/9/2007	50	Quarterly	None	Compliance ring location, low to non-detect results.
31-D	Floridian	Ring	T	1/17/1995	4/9/2007	51	Quarterly	Vinyl Chloride	Compliance ring location, intermittent detections of COCs.
32-D	Floridian	Ring	T	1/17/1995	4/9/2007	50	Quarterly	Mercury	Compliance ring location, low to non-detect results, historic mercury detections.
C-1	Floridian	Ring	T	4/14/1999	4/9/2007	32	Quarterly	Manganese*	Compliance ring location, west of landfill, low detections of inorganic constituents.
C-2	Floridian	Interior	S	4/12/1999	4/9/2007	34	Quarterly	Vinyl Chloride	Interior location south of Hillsborough Heights Landfill, immediately southwest of FDOT and Taylor Road landfills.
C-3	Floridian	Ring	T	4/13/1999	4/9/2007	33	Quarterly	Vanadium	Compliance ring location south and downgradient of landfills, southernmost point in current network.
C-4	Floridian	Ring	T	4/13/1999	4/9/2007	33	Quarterly	None	Eastern compliance ring location, no exceedances of COCs.
C-5	Floridian	Interior	S	4/14/1999	4/9/2007	34	Quarterly	Vinyl Chloride, TCE and Benzene	Interior location north of Hillsborough Heights Landfill.
C-6	Floridian	Interior	S	10/20/1999	4/9/2007	31	Quarterly	Vinyl Chloride, TCE, PCE, Benzene, Mercury	Interior well monitors area north of Hillsborough Heights Landfill. Historic concentrations exceed screening levels for several COCs.
C-7	Floridian	Ring	T	10/20/1999	4/9/2007	32	Quarterly	None	Compliance ring location south and downgradient of landfills. Largely unaffected.
C-8	Floridian	Ring	T	4/17/2000	4/9/2007	29	Quarterly	None	Compliance ring location north of Hillsborough Heights Landifll, northernmost compliance monitoring point. Largely unaffected.
C-9	Floridian	Ring	T	4/18/2000	4/9/2007	29	Quarterly	None	Compliance ring location, one oulying detection of Vanadium, other COCs non-detect.
C-10	Floridian	Ring	T	4/23/2001	4/9/2007	25	Quarterly	None	Compliance ring location, west of landfill. No detections of VOCs.
F-1A	Floridian	Interior	T	4/14/1999	4/9/2007	36	Quarterly	Vinyl Chloride, Arsenic	Compliance ring location northeast of Hillsborough Heights landfill. Historic exceedances for vinyl chloride and arsenic.
F-2	Deep Floridian	Interior	S	1/17/1995	4/9/2007	49	Quarterly	Vinyl Chloride	Interior location southeast of Hillsborough Heights landfill. Proposed for abandonment GWMP (May, 2006)
F-3	Deep Floridian	Ring	T	4/13/1999	4/9/2007	33	Quarterly	None	Compliance ring location south of FDOT landfill. Some historic exceedances for metals, not repeated.
F-4A	Floridian	Ring	T	4/13/1999	10/25/2005	27	Quarterly	Nitrate	Proposed for abandonment GWMP (May, 2006), and abandoned 2006.
F-12	Floridian	Background	T	4/11/1995	4/9/2007	41	Quarterly	Manganese*	Background well location; exceeds screening level for Manganese.
F-14	Floridian	Interior	T	1/18/1995	4/12/2007	50	Quarterly	Vinyl Chloride, TCE	Interior well south of Taylor Road Landfill, monitors source area.
F-15	Deep Floridian	Ring	T	1/18/1995	4/9/2007	51	Quarterly	None	Eastern compliance ring location, no exceedances of COCs 1999-2007.
NE-23	Floridian	Interior	S	1/17/1995	4/9/2007	50	Quarterly	Vinyl Chloride	Interior compliance location east of Taylor Road landfill.
TR-1D	Floridian	Interior	S	1/17/1995	4/9/2007	49	Quarterly	Vinyl Chloride, Manganese*	Interior well southwest of FDOT Landfill, between landfill and well C-2.
TR-2D	Floridian	Ring	T	1/17/1995	4/9/2007	50	Quarterly	Vinyl Chloride	Compliance ring location southwest of FDOT landfill. Intermittent detections of site COCs.
TR-3D	Floridian	Interior	S	1/17/1995	4/9/2007	49	Quarterly	Vinyl Chloride, Manganese*	Interior compliance location due west of FDOT landfill.
TR-4D	Floridian	Interior	S	1/17/1995	4/9/2007	50	Quarterly	Vinyl Chloride, 11DCE, TCE	Interior well between FDOT and Taylor Road Landfill. Monitors source area, historic high concentrations for many COCs.

Notes:
1) Wells listed are in current monitoring program.
2) Data from TRLF database received July, 2007.
3) * = Manganese does not have a primary USEPA MCL, and is considered a secondary contaminant. Background concentrations of inorganics should be confirmed.
4) Chemicals of Potential Concern (COPC) at each well is the constituent/s detected at the highest amount above the GCTL or USEPA MCLs.
5) Interior and ring wells described in GWMP (SCS, 2006a) and GW statistical evaluation (SCS, 2006b).
6) TCE = Trichloroethene, PCE = tetrachloroethene, 11DCE = 1,1-Dichloroethene.

TABLE 2
AQUIFER INPUT PARAMETERS: TAYLOR ROAD LANDFILL SITE

LONG-TERM MONITORING OPTIMIZATION
TAYLOR ROAD LANDFILL SUPERFUND SITE
HILLSBOROUGH COUNTY, FLORIDA

Parameter	Value	Units
Current Plume Length	3500	ft
Maximum Plume Length	3500	ft
PlumeWidth	3500	ft
SeepageVelocity (ft/yr)*	68*	ft/yr
Distance to Receptors (TR-4D to F-3)	300	ft
GWFluctuations	No	--
SourceTreatment	Natural Attenuation/Landfill gas collection, cap and cover	--
PlumeType	Metals	--
NAPLPresent	No	--
Priority Constituents	**Cleanup Goals**	
Vinyl Chloride	1	ug/L
Benzene	1	ug/L
Trichloroethene (TCE)	3	ug/L
Manganese (secondary standard)	50	ug/L
Parameter	**Value**	
Groundwater flow direction	S/SW and S/SE	200-270 degrees
Porosity	0.05	--
Source Location near Well	TR-4D	--
Source X-Coordinate	561225	ft
Source Y-Coordinate	1336686	ft
Coordinate System	NAD 83 SP Florida West	
Saturated Thickness Floridian Zone	400	ft

Notes:
1. Aquifer data from Final Remedial Investigation Report (ERM, 1995) and TRLF (2006).
2. Priority COCs defined by prevalence, toxicty and mobility.
3. Saturated thickness represents the span of the clay to the Floridan limestone
4. * = a wide range of transmissivites are present in the aquifer, and groundwater velocity calculations result in a wide range,, with 68 being the best estimate.
5. Cleanup objectives are GCTL = Florida Groundwater Cleanup Target Levels promulgated by the Florida Department of Environmental Protection.

TABLE 3
WELL TREND SUMMARY RESULTS: 1999-2007

LONG-TERM MONITORING OPTIMIZATION
TAYLOR ROAD LANDFILL SUPERFUND SITE
HILLSBOROUGH COUNTY, FLORIDA

WellName	Number of Samples	Number of Detects	Percent Detection	Maximum Result [ug/L]	Max Result Above Standard?	Average Result [ug/L]	Average Result Above Standard?	Mann-Kendall Trend	Linear Regression Trend	Overall Trend Result
Vinyl Chloride										
18-D	34	32	94%	100	Yes	20.0	Yes	D	D	D
24-D	33	18	55%	25	Yes	2.5	Yes	I	I	I
28-D	34	6	18%	33	Yes	0.4	No	NT	D	S
30-D	34	0	0%	ND	No	0.1	No	ND	ND	ND
31-D	34	4	12%	2	Yes	0.3	No	PD	D	D
32-D	33	0	0%	ND	No	0.1	No	ND	ND	ND
C-1	31	0	0%	ND	No	0.1	No	ND	ND	ND
C-2	33	33	100%	9	Yes	4.3	Yes	D	D	D
C-3	33	0	0%	ND	No	0.1	No	ND	ND	ND
C-4	33	0	0%	ND	No	0.1	No	ND	ND	ND
C-5	33	32	97%	33	Yes	11.4	Yes	D	D	D
C-6	30	30	100%	27	Yes	16.5	Yes	D	D	D
C-7	31	0	0%	ND	No	0.1	No	ND	ND	ND
C-8	29	0	0%	ND	No	0.1	No	ND	ND	ND
C-9	29	0	0%	ND	No	0.1	No	ND	ND	ND
C-10	25	0	0%	ND	No	0.1	No	ND	ND	ND
F-1A	33	23	70%	6.6	Yes	1.1	Yes	NT	NT	NT
F-2	32	25	78%	6	Yes	1.1	Yes	D	S	PD
F-3	33	0	0%	ND	No	0.1	No	ND	ND	ND
F-4A	27	0	0%	ND	No	ND	No	ND	ND	ND
F-12	33	0	0%	ND	No	ND	No	ND	ND	ND
F-14	34	33	97%	33	Yes	14.1	Yes	D	PD	D
F-15	34	0	0%	7	Yes	0.1	No	ND	ND	ND
NE-23	34	22	65%	7	Yes	0.8	No	D	D	D
TR-1D	33	32	97%	38	Yes	4.1	Yes	D	D	D
TR-2D	33	2	6%	13	Yes	0.5	No	NT	NT	NT
TR-3D	33	22	67%	6	Yes	1.5	Yes	D	PD	D
TR-4D	34	33	97%	97	Yes	35.0	Yes	D	NT	S
Trichloroethene										
18-D	34	18	53%	10	Yes	0.87	No	PI	I	PI
24-D	33	16	48%	4.2	Yes	0.83	No	I	I	I
28-D	34	1	3%	1.2	No	0.18	No	NT	NT	NT
30-D	34	0	0%	ND	No	0.15	No	ND	ND	ND
31-D	34	18	53%	1.2	No	0.44	No	I	I	I
32-D	33	7	21%	1	No	0.21	No	PI	I	PI
C-1	31	0	0%	ND	No	0.15	No	ND	ND	ND
C-2	33	33	100%	6	Yes	3	No	D	D	D
C-3	33	0	0%	ND	No	0.15	No	ND	ND	ND
C-4	33	0	0%	ND	No	0.15	No	ND	ND	ND
C-5	33	31	94%	8	Yes	2.8	No	D	S	PD
C-6	30	28	93%	8.5	Yes	6.1	Yes	I	I	I
C-7	31	0	0%	ND	No	0.15	No	ND	ND	ND
C-8	29	2	7%	0.48	No	0.17	No	NT	NT	NT
C-9	29	0	0%	ND	No	0.15	No	ND	ND	ND
C-10	25	0	0%	ND	No	0.15	No	ND	ND	ND
F-1A	33	17	52%	1.1	No	0.39	No	PD	PD	PD
F-2	32	13	41%	27	Yes	0.36	No	I	I	I
F-3	32	0	0%	ND	No	0.15	No	ND	ND	ND
F-4A	27	0	0%	ND	No	0.15	No	ND	ND	ND
F-12	33	0	0%	ND	No	ND	No	ND	ND	ND
F-14	34	31	91%	6	Yes	1.9	No	D	D	D
F-15	34	8	24%	5	Yes	0.21	No	PI	I	PI
NE-23	34	31	91%	4	Yes	1.3	No	D	NT	S
TR-1D	33	33	100%	5	Yes	1.8	No	D	D	D
TR-2D	33	3	9%	2	No	0.16	No	NT	NT	NT
TR-3D	33	23	70%	3	Yes	0.8	No	D	D	D
TR-4D	34	33	97%	75	Yes	21	Yes	D	D	D

Notes

1. Trends were evaluated for data collected between 1/1/1999 and 4/10/2007.
2. Number of Samples is the number of samples for the compound at this location.
   Number of Detects is the number of times the compound has been detected for data at this location.
3. Maximum Result is the maximum concentration for the COC analyzed between 1999 and 2007.
4. Screening level from Florida Department of Environmental Protection. Vinyl chloride = 1 ug/L; TCE = 3 ug/L
6. D = Decreasing; PD = Probably Decreasing; S = Stable; PI = Probably Increasing; I = Increasing; N/A = Insufficient Data to determine trend;
   NT = No Trend; ND = well has all non-detect results for COC; ND* = Non-detect except for one trace value.
7. Mann-Kendall trend results are illustrated on Figure 2.

TABLE 4
WELL REDUNDANCY ANALYSIS SUMMARY RESULTS

TAYLOR ROAD SUPERFUND SITE
LONG-TERM MONITORING OPTIMIZATION
HILLSBOROUGH COUNTY, FLORIDA

WellName	VC Average Slope Factor	VC Minimum Slope Factor	VC Maximum Slope Factor	Preliminary Statistical Result	Recommendation After Qualitative Review
18-D	0.62	0.51	0.88	Retain	Retain
24-D	0.62	0.47	0.81	Retain	Retain
28-D	0.83	0.19	0.89	Retain	Retain
30-D	0.75	0.61	0.78	Retain	Retain
31-D	0.68	0.47	0.78	Retain	Retain
32-D	0.55	0.00	0.76	Retain	Retain
C-1	0.70	0.00	0.89	Retain	Retain
C-2	0.45	0.31	0.53	Retain	Retain
C-3	0.72	0.00	0.83	Retain	Retain
C-4	0.33	0.00	0.81	Retain	
C-5	0.13	0.04	0.27	**Exclude**	Retain as an attenuation monitoring point for concentrations between HH Landfill and compliance wells.
C-6	0.51	0.44	0.61	Retain	Retain
C-7	0.77	0.71	0.87	Retain	Retain
C-8	0.88	0.85	0.90	Retain	Retain
C-9	0.45	0.00	0.77	Retain	Retain
C-10	0.76	0.58	0.89	Retain	Retain
F-1A	0.32	0.08	0.84	Retain	Retain
F-2	0.49	0.29	0.75	Retain	Retain
F-3	0.87	0.73	0.89	Retain	Retain
F-4A	0.00	0.00	0.00	**Exclude**	**Abandoned**
F-12	0.05	0.00	0.07	Retain	**Background**
F-14	0.66	0.63	0.80	Retain	Retain
F-15	0.85	0.77	0.88	Retain	Retain
NE-23	0.51	0.07	0.78	Retain	Retain
TR-1D	0.07	0.00	0.23	**Exclude**	Retain as an attenuation monitoring point for higher concentrations between FDOT Landfill and compliance well.
TR-2D	0.78	0.61	0.86	Retain	Retain
TR-3D	0.32	0.02	0.87	Retain	Retain
TR-4D	0.56	0.45	0.73	Retain	Retain

Notes:

1. Slope Factor is the difference between the actual concentration and the concentration estimated from nearest neighbors normalized by the actual concentration. Slope factors close to 1 show the concentrations cannot be estimated from the nearest neighbors, and the well is important in the network.
2. Slope factors were calculated using data between January 2004 and May 2007.
3. Locations with slope factors below 0.3 and area ratios below 0.8 were considered for elimination.

TABLE 5
SAMPLING FREQUENCY ANALYSIS RESULTS VINYL CHLORIDE

TAYLOR ROAD SUPERFUND SITE
LONG-TERM MONITORING OPTIMIZATION
HILLSBOROUGH COUNTY, FLORIDA

Well Name	Recent Concentration Rate of Change [mg/yr]	Recent MK Trend (2004-2006)	Frequency Based on Recent Data (2004-2006)	Overall Concentration Rate of Change [mg/yr]	Overall MK Trend (1995 - 2007)	Frequency Based on Overall Data (1995 - 2007)	MAROS Recommended Frequency	Current Sampling Frequency	Final Recommended Frequency
Vinyl Chloride									
18-D	2.13E-06	S	Annual	-6.07E-06	D	Annual	Annual	Quarterly	Semi-annual
24-D	-8.96E-06	NT	Annual	1.48E-06	I	Annual	Annual	Quarterly	Semi-annual
28-D	-5.55E-07	NT	Annual	-2.20E-07	NT	Annual	Annual	Quarterly	Annual
30-D	0.00E+00	S	Annual	1.99E-38	S	Annual	Biennial	Quarterly	Semi-annual
31-D	0.00E+00	S	Annual	-1.86E-07	PD	Annual	Biennial	Quarterly	Semi-annual
32-D	0.00E+00	S	Annual	-7.24E-39	S	Annual	Biennial	Quarterly	Semi-annual
C-1	0.00E+00	S	Annual	-4.77E-38	S	Annual	Biennial	Quarterly	Semi-annual
C-2	-1.05E-06	PD	Annual	-1.35E-06	D	Annual	Annual	Quarterly	Semi-annual
C-3	0.00E+00	S	Annual	-4.55E-38	S	Annual	Biennial	Quarterly	Semi-annual
C-4	0.00E+00	S	Annual	-4.55E-38	S	Annual	Biennial	Quarterly	Semi-annual
C-5	4.17E-07	S	Annual	-6.36E-06	D	Annual	Annual	Quarterly	Biennial
C-6	-2.26E-06	PD	Annual	-4.10E-06	D	Annual	Annual	Quarterly	Annual
C-7	0.00E+00	S	Annual	-7.17E-39	S	Annual	Biennial	Quarterly	Semi-annual
C-8	0.00E+00	S	Annual	-4.38E-38	S	Annual	Biennial	Quarterly	Semi-annual
C-9	0.00E+00	S	Annual	-4.38E-38	S	Annual	Biennial	Quarterly	Semi-annual
C-10	0.00E+00	S	Annual	-3.25E-38	S	Annual	Biennial	Quarterly	Semi-annual
F-1A	-2.02E-06	D	Annual	-6.43E-08	NT	Annual	Annual	Quarterly	Annual
F-2	5.04E-08	NT	Annual	-3.16E-07	D	Annual	Annual	Quarterly	Annual
F-3	0.00E+00	S	Annual	-4.55E-38	S	Annual	Biennial	Quarterly	Semi-annual
F-4A	0.00E+00	S	Annual	3.59E-38	S	Annual	Biennial	Quarterly	***Abandoned***
F-12	0.00E+00	S	Annual	0.00E+00	S	Annual	Biennial	Quarterly	Biennial
F-14	-3.67E-06	D	Annual	-1.07E-06	D	Annual	Annual	Quarterly	Semi-annual
F-15	0.00E+00	S	Annual	1.99E-38	S	Annual	Biennial	Quarterly	Semi-annual
NE-23	-8.13E-07	D	Annual	-4.09E-07	D	Annual	Annual	Quarterly	Annual
TR-1D	-7.99E-07	PD	Annual	-1.85E-06	D	Annual	Annual	Quarterly	Annual
TR-2D	-2.81E-06	NT	Annual	2.41E-07	NT	Annual	Annual	Quarterly	Semi-annual
TR-3D	-5.85E-07	S	Annual	-6.75E-07	D	Annual	Annual	Quarterly	Annual
TR-4D	5.22E-06	NT	SemiAnnual	-3.25E-06	D	Annual	SemiAnnual	Quarterly	Semi-annual

Notes:
1. 'Recent' concentration rate of change and MK trends are calculated from data collected 2004 - 2007.
2. D = Decreasing, PD = Probably Decreasing, S = Stable, NT = No Trend, PI = Probably Increasing, I = Increasing, ND = Non-detect, N/A = insufficient data.
3. Recent data frequency is the estimated sample frequency based on the recent trend.
4. Overall rate of change and MK trend are for the full data set (1995-2007) for each well. The overall result is the estimated sample frequncy based on the full data record.
6. Final Result Frequency is the recommended frequency from MAROS based on both recent and overall trends.
7. Current frequency is the approximate sample frequency currently implemented.
8. The final recommended sampling frequency is based on a combination of qualitative and statistical evaluations.

TABLE 6
FINAL RECOMMENDED MONITORING NETWORK TAYLOR ROAD LANDFILL

TAYLOR ROAD SUPERFUND SITE
LONG-TERM MONITORING OPTIMIZATION
HILLSBOROUGH COUNTY, FLORIDA

	Vinyl Chloride					Manganese		All COCs
WellName	**Percent Detection**	**Statistically Below Standard?**	**Statistically Attained Cleanup Goal?**	**Mann Kendall Trend**	**MAROS Redundancy Determination Vinyl Chloride**	**Average Manganese Concentration Above GCTL?**	**Mann Kendall Trend**	**Final Recommended Frequency**
18-D	94%	NO	No	D	Retain	NO	NT	Semi-annual
24-D	55%	NO	Continue Sampling	I	Retain	NO	I	Semi-annual
28-D	18%	YES	Continue Sampling	NT	Retain	NO	D	Annual
30-D	0%	YES	Attained	ND	Retain	YES	I	Semi-annual
31-D	12%	YES	Attained	PD	Retain	YES	I	Semi-annual
32-D	0%	YES	Attained	ND	Retain	YES	D	Semi-annual
C-1	0%	YES	Attained	ND	Retain	YES	D	Semi-annual
C-2	100%	NO	No	D	Retain	NO	D	Semi-annual
C-3	0%	YES	Attained	ND	Retain	YES	D	Semi-annual
C-4	0%	YES	Attained	ND	Retain	YES	NT	Semi-annual
C-5	97%	NO	No	D	**Exclude**	NO	D	Biennial
C-6	100%	NO	No	D	Retain	YES	I	Annual
C-7	0%	YES	Attained	ND	Retain	YES	NT	Semi-annual
C-8	0%	YES	Attained	ND	Retain	YES	D	Semi-annual
C-9	0%	YES	Attained	ND	Retain	YES	S	Semi-annual
C-10	0%	YES	Attained	ND	Retain	YES	NT	Semi-annual
F-1A	70%	NO	Continue Sampling	NT	Retain	NO	S	Annual
F-2	78%	NO	Continue Sampling	D	Retain	NO	D	Annual
F-3	0%	YES	Attained	ND	Retain	YES	NT	Semi-annual
F-4A	0%	YES	Attained	ND	**Exclude**	YES	NT	**Abandoned**
F-12	0%	YES	Attained	ND	Retain	NO	D	Biennial
F-14	97%	NO	No	D	Retain	YES	I	Semi-annual
F-15	0%	YES	Attained	ND	Retain	YES	NT	Semi-annual
NE-23	65%	NO	Continue Sampling	D	Retain	YES	D	Annual
TR-1D	97%	NO	Not Attained	D	**Exclude**	NO	D	Annual
TR-2D	6%	YES	Continue Sampling	NT	Retain	YES	NT	Semi-annual
TR-3D	67%	NO	Continue Sampling	D	Retain	NO	D	Annual
TR-4D	97%	NO	Not Attained	D	Retain	NO	D	Semi-annual

Notes:
1. Cleanup status of wells illustrated on Figure 5.
2. D = Decreasing; PD = Probably Decreasing; S = Stable; PI = Probably Increasing; I = Increasing; N/A = Insufficient Data to determine trend; NT = No Trend; ND = well has all non-detect results for COC; ND* = Non-detect except for one trace value.
3. Mann-Kendall trends 1999 - 2007 are shown.
4. Statistically below standard based on sequential t-test; statistically attained cleanup goal determined at statistical power =0.8 for GCTL cleanup standard.

GROUNDWATER MONITORING NETWORK OPTIMIZATION
TAYLOR ROAD LANDFILL SUPERFUND SITE

Hillsborough County, Florida

FIGURES

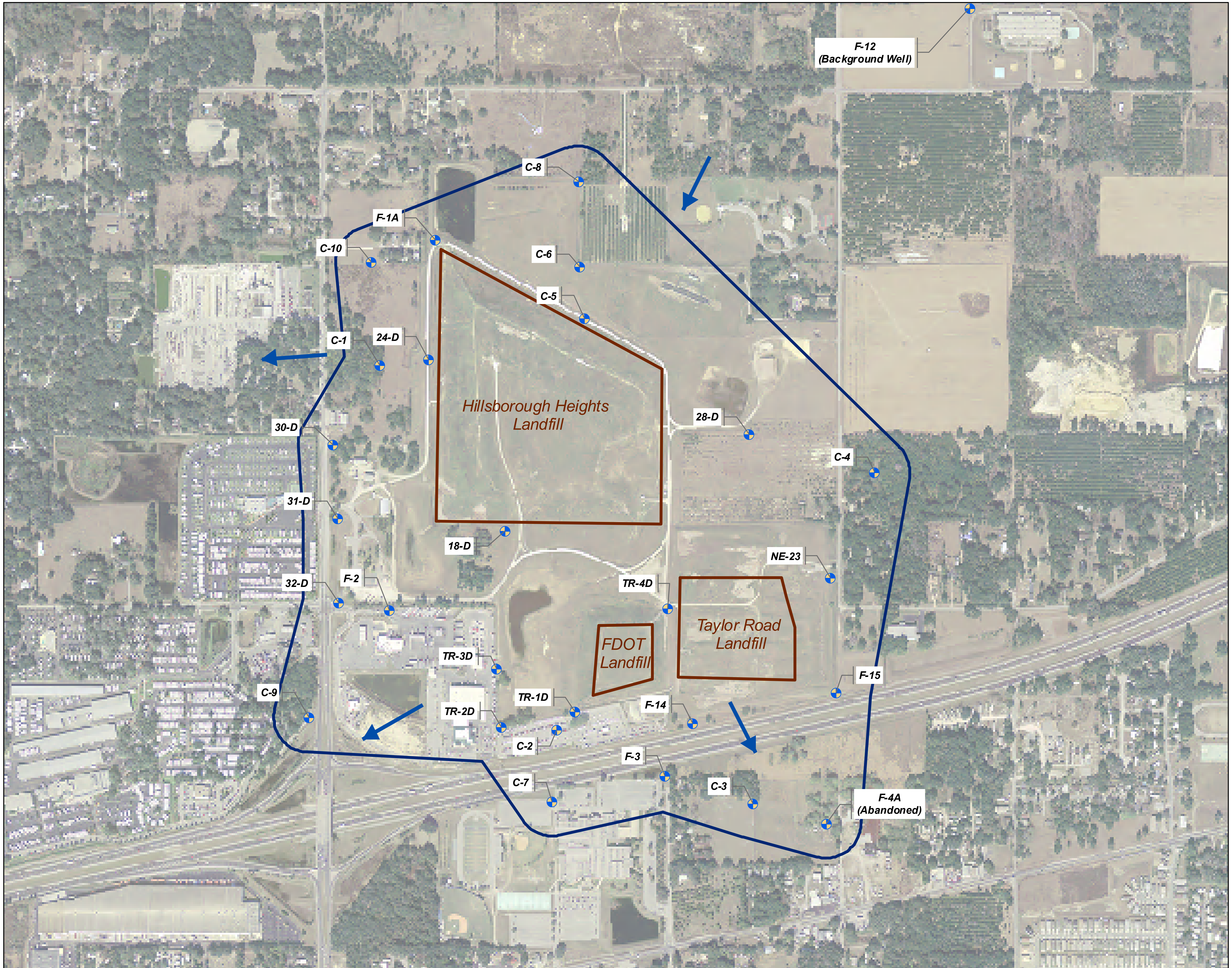
Figure 1 Taylor Road Superfund Site Monitoring Locations

Figure 2 Taylor Road Landfill Mann-Kendall Trends and First Moments Vinyl Chloride

Figure 3 Taylor Road Landfill Spatial Uncertainty Analysis

Figure 4 Taylor Road Landfill Well Clean-up Status Vinyl Chloride

Figure 5 Taylor Road Landfill Recommended Monitoring Network



N

LEGEND

- Monitoring Locations
- Landfill Boundaries
- Compliance Ring Setback (270 ft)
- Approximate Groundwater Flow Direction

Notes:
1. Well locations from SCS database, 2006. Map in NAD 83 State Plane Florida West, ft.
2. Well F-12 is the background well, F-4A has been abandoned.
3. Landfill boundaries are approximate.

Scale (ft)
0 370 740

TAYLOR ROAD SUPERFUND SITE
MONITORING LOCATIONS

Taylor Road Landfill Site
Hillsborough County, Florida

Coord.	NAD 83 SP Fla. W. FT.	Issued:	15-AUG-07
Drawn By:	CDM	Revised:	----
Chk'd By:	MV	Map ID:	----
Appv'd By:			**FIGURE 1**

LEGEND

First Moments Vinyl Chloride 1999 - 2007 (Center of mass estimate)

Mann-Kendall Trends for Vinyl Chloride

- Decreasing
- Probably Decreasing
- Stable
- Probably Increasing
- Increasing
- No Trend
- Non-Detect

Landfill Boundaries (Approximate)

Area of Concern

Notes:
1. Well locations from site database, 2006. Map in NAD 83 State Plane Florida West, ft.
2. Trends determined from data 1999-2007.
3. First moments (plume center of mass) were calcualted using average annual concentrations for each monitoring location 1999 - 2007.

Scale (ft)
0 300 600

TAYLOR ROAD LANDFILL MANN-KENDALL TRENDS AND FIRST MOMENTS VINYL CHLORIDE

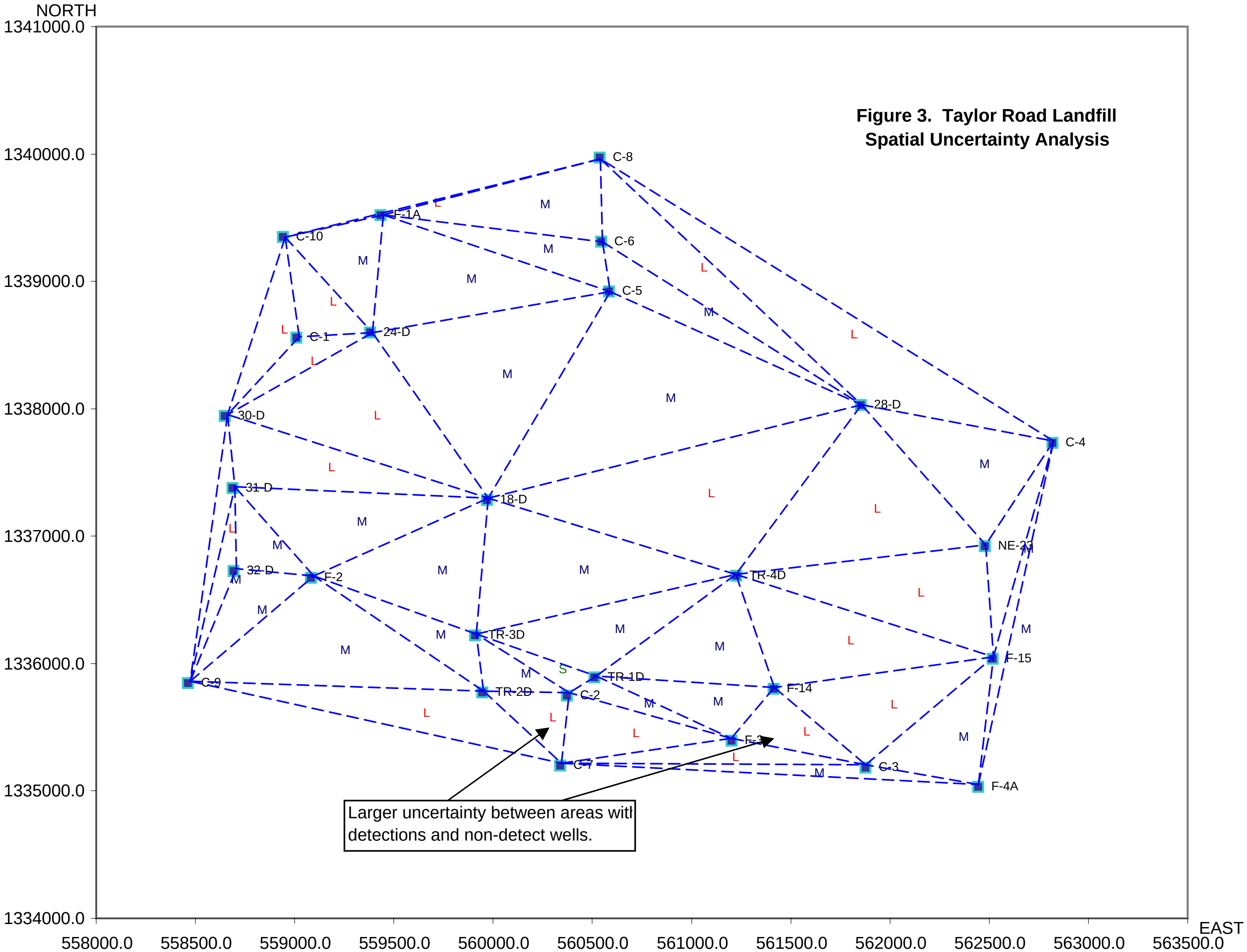
Taylor Road Landfill Site
Hillsborough County, Florida

Coord.	NAD 83 SP Fla. W. FT.	Issued:	15-AUG-07
Drawn By:	CDM	Revised:	----
Chk'd By:	MV	Map ID:	----
Appv'd By:	MV		FIGURE 2

New Location Analysis for

VINYL CHLORIDE

Figure 3. Taylor Road Landfill Spatial Uncertainty Analysis



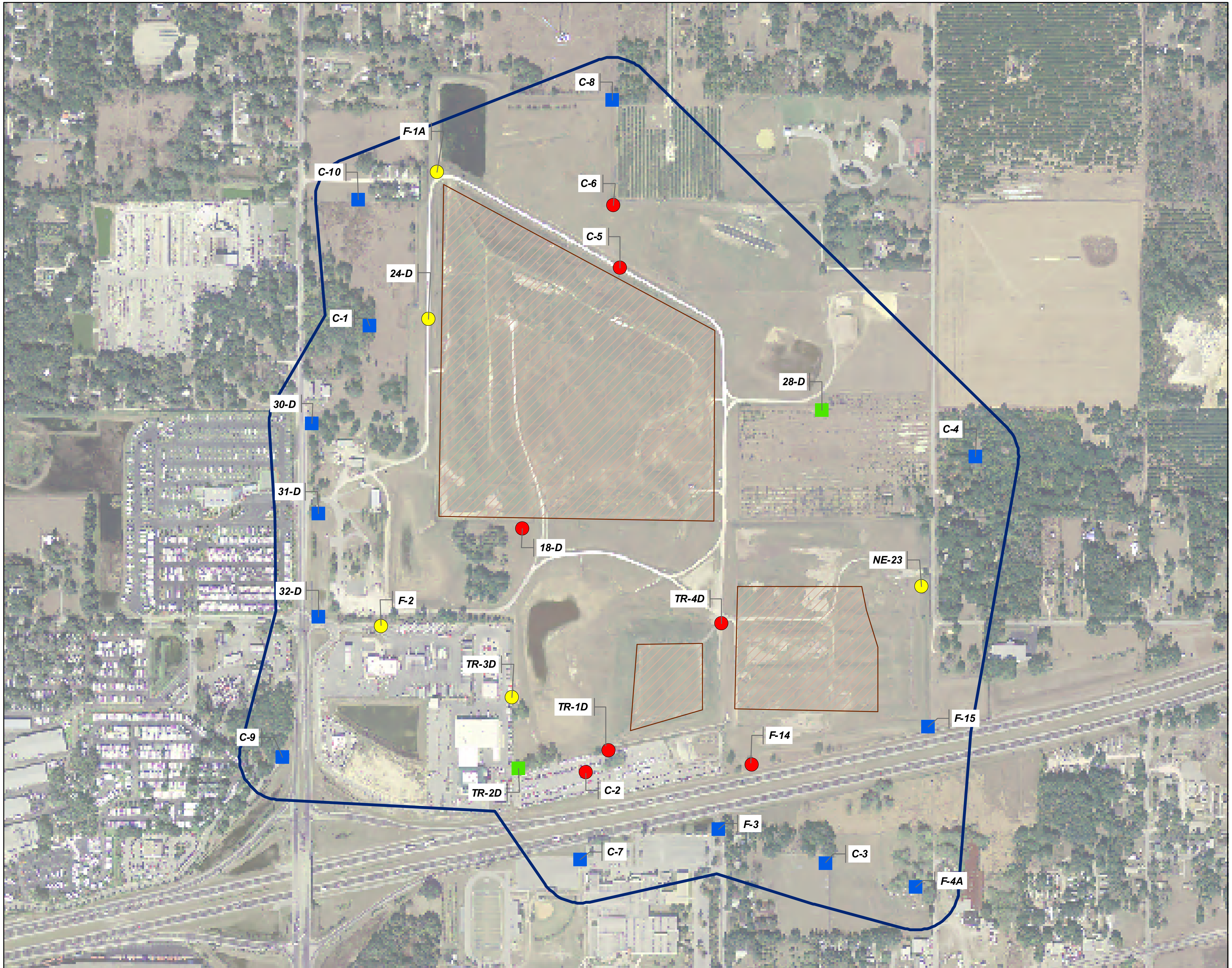
Existing Locations

Potential areas for new locations are indicated by triangles with a high SF level.

Estimated SF Level:
- S - Small
- M - Moderate
- L - Large
- E - Extremely large

High SF -> high estimation error -> possible need for new locations

Low SF -> low estimation error -> no need for new locations



N

LEGEND

- Statistically Clean
- Statistically below GCTL
- Approaching GCTL
- Not Attained Clean-up Standard
- Landfill boundaries
- 270' Setback from Compliance Ring

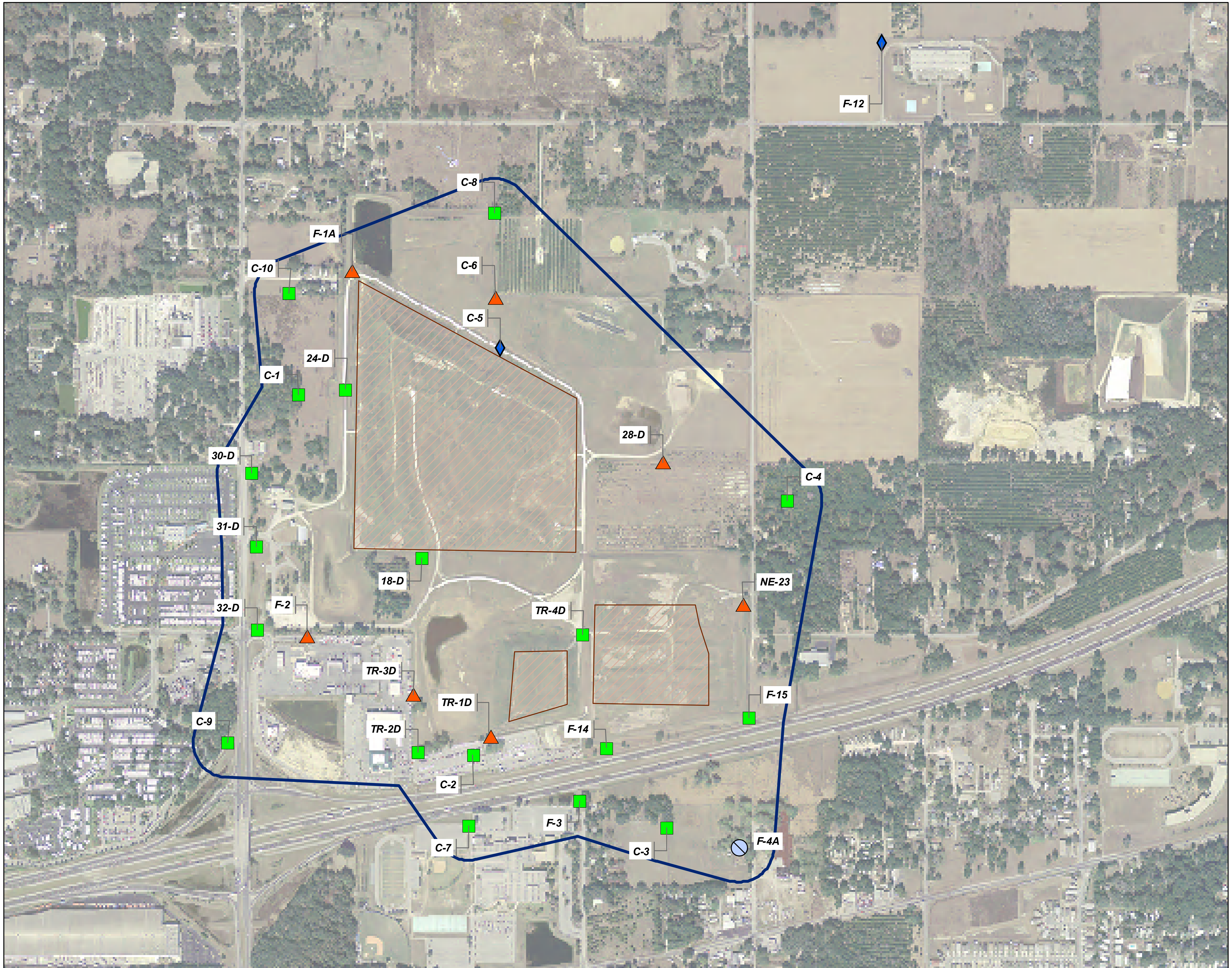
Notes:
1. GCTL = Florida Groundwater Cleanup Target Level (VC = 1 ug/L).
2. Wells statistically clean at 80% Power, and statistically below the GCTL.
3. Wells statistically below GCTL based on sequential T-test.
4. Wells approaching GCTL may be close to compliance but require a larger dataset.

Scale (ft)
0 280 560

TAYLOR ROAD LANDFILL
WELL CLEAN-UP STATUS
VINYL CHLORIDE

Taylor Road Landfill Site
Hillsborough County, Florida

Coord.	NAD 83 SP Fla. W. FT.	Issued:	15-AUG-07
Drawn By:	CDM	Revised:	----
Chk'd By:	MV	Map ID:	----
Appv'd By:			**FIGURE 4**



LEGEND

Recommended Well Sample Frequency

- Semi-annual
- Annual
- Biennial
- Abandoned
- Landfill boundaries
- 270' Setback from Compliance Ring

Notes:
1. Wells statistically attain clean up at 80% Power, below the GCTL standard for vinyl chloride.
2. Wells statistically below GCTL after sequential T-test.
3. Wells approaching GCTL may be close to compliance but require a larger dataset.

Scale (ft)
0 340 680

TAYLOR ROAD LANDFILL RECOMMENDED GROUNDWATER MONITORING NETWORK

Taylor Road Landfill Site
Hillsborough County, Florida

Coord.	NAD 83 SP Fla. W. FT.	Issued:	15-AUG-07
Drawn By:	CDM	Revised:	----
Chk'd By:	MV	Map ID:	----
Appv'd By:	MV		FIGURE 5

GROUNDWATER MONITORING NETWORK OPTIMIZATION
TAYLOR ROAD LANDFILL SUPERFUND SITE

Hillsborough County, Florida

APPENDIX A:

MAROS 2.2 Methodology

APPENDIX A
MAROS 2.2 METHODOLOGY

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Figure 3 Decision Matrix for Determining Provisional Frequency

MAROS METHODOLOGY

MAROS is a collection of tools in one software package that is used in an explanatory, non-linear but linked fashion. The tool includes models, statistics, heuristic rules, and empirical relationships to assist the user in optimizing a groundwater monitoring network system. The final optimized network maintains adequate delineation while providing information on plume dynamics over time. Results generated from the software tool can be used to develop lines of evidence, which, in combination with expert opinion, can be used to inform regulatory decisions for safe and economical long-term monitoring of groundwater plumes. For a detailed description of the structure of the software and further utilities, refer to the MAROS 2.2 Manual (AFCEE, 2003; http://www.gsi-net.com/software/MAROS_V2_1Manual.pdf) and Aziz et al., 2003.

1.0 MAROS Conceptual Model

In MAROS 2.2, two levels of analysis are used for optimizing long-term monitoring plans: 1) an overview statistical evaluation with interpretive trend analysis based on temporal trend analysis and plume stability information; and 2) a more detailed statistical optimization based on spatial and temporal redundancy reduction methods (see Figures A.1 and A.2 for further details). In general, the MAROS method applies to 2-D aquifers that have relatively simple site hydrogeology. However, for a multi-aquifer (3-D) system, the user has the option to apply the statistical analysis layer-by-layer.

The overview statistics or interpretive trend analysis assesses the general monitoring system category by considering individual well concentration trends, overall plume stability, hydrogeologic factors (e.g., seepage velocity, and current plume length), and the location of potential receptors (e.g., property boundaries or drinking water wells). The method relies on temporal trend analysis to assess plume stability, which is then used to determine the general monitoring system category. Since the monitoring system category is evaluated for both source and tail regions of the plume, the site wells are divided into two different zones: the source zone and the tail zone.

Source zone monitoring wells could include areas with non-aqueous phase liquids (NAPLs), contaminated vadose zone soils, and areas where aqueous-phase releases have been introduced into ground water. The source zone generally contains locations with historical high ground water concentrations of the COCs. The tail zone is usually the area downgradient of the contaminant source zone. Although this classification is a simplification of the plume conceptual model, this broadness makes the user aware on an individual well basis that the concentration trend results can have a different interpretation depending on the well location in and around the plume. The location and type of the individual wells allows further interpretation of the trend results, depending on what type of well is being analyzed (e.g., remediation well, leading plume edge well, or monitoring well). General recommendations for the monitoring network frequency and density are suggested based on heuristic rules applied to the source and tail trend results.

The detailed statistics level of analysis or sampling optimization consists of well redundancy and well sufficiency analyses using the Delaunay method, a sampling frequency analysis using the Modified Cost Effective Sampling (MCES) method and a data sufficiency analysis including statistical power analysis. The well redundancy analysis is designed to minimize monitoring locations and the Modified CES method is designed to minimize the frequency of sampling. The data sufficiency analysis uses simple statistical methods to assess the sampling record to determine if groundwater concentrations are statistically below target levels and if the current monitoring network and record is sufficient in terms of evaluating concentrations at downgradient locations.

2.0 Data Management

In MAROS, ground water monitoring data can be imported from simple database-format Microsoft® Excel spreadsheets, Microsoft Access tables, previously created MAROS database archive files, or entered manually. Monitoring data interpretation in MAROS is based on historical analytical data from a consistent set of wells over a series of sampling events. The analytical data is composed of the well name, coordinate location, constituent, result, detection limit and associated data qualifiers. Statistical validity of the concentration trend analysis requires constraints on the minimum data input of at least four wells (ASTM 1998) in which COCs have been detected. Individual sampling locations need to include data from at least six most-recent sampling events. To ensure a meaningful comparison of COC concentrations over time and space, both data quality and data quantity need to be considered. Prior to statistical analysis, the user can consolidate irregularly sampled data or smooth data that might result from seasonal fluctuations or a change in site conditions. Because MAROS is a terminal analytical tool designed for long-term planning, impacts of seasonal variation in the water unit are treated on a broad scale, as they relate to multi-year trends.

Imported ground water monitoring data and the site-specific information entered in Site Details can be archived and exported as MAROS archive files. These archive files can be appended as new monitoring data becomes available, resulting in a dynamic long-term monitoring database that reflects the changing conditions at the site (i.e. biodegradation, compliance attainment, completion of remediation phase, etc.). For wells with a limited monitoring history, addition of information as it becomes available can change the frequency or identity of wells in the network.

3.0 Site Details

Information needed for the MAROS analysis includes site-specific parameters such as seepage velocity and current plume length and width. Information on the location of potential receptors relative to the source and tail regions of the plume is entered at this point. Part of the trend analysis methodology applied in MAROS focuses on where the monitoring well is located, therefore the user needs to divide site wells into two different zones: the source zone or the tail zone. Although this classification is a simplification of the well function, this broadness makes the user aware on an individual well basis that the concentration trend results can have a different interpretation depending on the well location in and around the plume. It is up to the user to make further interpretation of the trend results, depending on what type of well is being analyzed (e.g., remediation well, leading plume edge well, or monitoring well). The Site Details section of MAROS contains a preliminary map of well locations to confirm well coordinates.

4.0 Constituent Selection

A database with multiple COCs can be entered into the MAROS software. MAROS allows the analysis of up to 5 COCs concurrently and users can pick COCs from a list of compounds existing in the monitoring data. MAROS runs separate optimizations for each compound. For sites with a single source, the suggested strategy is to choose one to three priority COCs for the optimization. If, for example, the site contains multiple chlorinated volatile organic compounds (VOCs), the standard sample chemical analysis will evaluate all VOCs, so the sample locations and frequency should based on the concentration trends of the most prevalent, toxic or mobile compounds. If different chemical classes are present, such as metals and chlorinated VOCs, choose and evaluate the priority constituent in each chemical class.

MAROS includes a short module that provides recommendations on prioritizing COCs based on toxicity, prevalence, and mobility of the compound. The toxicity ranking is determined by examining a representative concentration for each compound for the entire site. The representative concentration is then compared to the screening level (PRG or MCL) for that compound and the COCs are ranked according to the representative concentrations percent exceedence of the screening level. The evaluation of prevalence is performed by determining a representative concentration for each well location and evaluating the total exceedences (values above screening levels) compared to the total number of wells. Compounds found over screening levels are ranked for mobility based on Kd (sorption partition coefficient). The MAROS COC assessment provides the relative ranking of each COC, but the user must choose which COCs are included in the analysis.

5.0 Data Consolidation

Typically, raw data from long-term monitoring have been measured irregularly in time or contain many non-detects, trace level results, and duplicates. Therefore, before the data can be further analyzed, raw data are filtered, consolidated, transformed, and possibly smoothed to allow for a consistent dataset meeting the minimum data requirements for statistical analysis mentioned previously.

MAROS allows users to specify the period of interest in which data will be consolidated (i.e., monthly, bi-monthly, quarterly, semi-annual, yearly, or a biennial basis). In computing the representative value when consolidating, one of four statistics can be used: median, geometric mean, mean, and maximum. Non-detects can be transformed to one half the reporting or method detection limit (DL), the DL, or a fraction of the DL. Trace level results can be represented by their actual values, one half of the DL, the DL, or a fraction of their actual values. Duplicates are reduced in MAROS by one of three ways: assigning the average, maximum, or first value. The reduced data for each COC and each well can be viewed as a time series in a graphical form on a linear or semi-log plot generated by the software.

6.0 Overview Statistics: Plume Trend Analysis

Within the MAROS software there are historical data analyses that support a conclusion about plume stability (e.g., increasing plume, etc.) through statistical trend analysis of historical monitoring data. Plume stability results are assessed from time-series concentration data with the application of three statistical tools: Mann-Kendall Trend analysis, linear regression trend analysis and moment analysis. The two trend methods are used to estimate the concentration trend for each well and each COC based on a statistical trend analysis of concentrations versus time at each well. These trend analyses are then consolidated to give the user a general plume stability estimate and general monitoring frequency and density recommendations (see Figures A.1 through A.3 for further step-by-step details). Both qualitative and quantitative plume information can be gained by these evaluations of monitoring network historical data trends both spatially and temporally. The MAROS Overview Statistics are the foundation the user needs to make informed optimization decisions at the site. The Overview Statistics are designed to allow site personnel to develop a better understanding of the plume behavior over time and understand how the individual well concentration trends are spatially distributed within the plume. This step allows the user to gain information that will support a more informed decision to be made in the next level or detailed statistics optimization analysis.

6.1 Mann-Kendall Analysis

The Mann-Kendall test is a statistical procedure that is well suited for analyzing trends in data over time. The Mann-Kendall test can be viewed as a non-parametric test for zero slope of the first-order regression of time-ordered concentration data versus time. One advantage of the Mann-Kendall test is that it does not require any assumptions as to the statistical distribution of the data (e.g. normal, lognormal, etc.) and can be used with data sets which include irregular sampling intervals and missing data. The Mann-Kendall test is designed for analyzing a single groundwater constituent, multiple constituents are analyzed separately. The Mann-Kendall S statistic measures the trend in the data: positive values indicate an increase in concentrations over time and negative values indicate a decrease in concentrations over time. The strength of the trend is proportional to the magnitude of the Mann-Kendall statistic (i.e., a large value indicates a strong trend). The confidence in the trend is determined by consulting the S statistic and the sample size, n, in a Kendall probability table such as the one reported in Hollander and Wolfe (1973).

The concentration trend is determined for each well and each COC based on results of the S statistic, the confidence in the trend, and the Coefficient of Variation (COV). The decision matrix for this evaluation is shown in Table 3. A Mann-Kendall statistic that is greater than 0 combined with a confidence of greater than 95% is categorized as an Increasing trend while a Mann-Kendall statistic of less than 0 with a confidence between 90% and 95% is defined as a probably Increasing trend, and so on.

Depending on statistical indicators, the concentration trend is classified into six categories:

- Decreasing (D),
- Probably Decreasing (PD),
- Stable (S),
- No Trend (NT),
- Probably Increasing (PI)
- Increasing (I).

These trend estimates are then analyzed to identify the source and tail region overall stability category (see Figure 2 for further details).

6.2 Linear Regression Analysis

Linear Regression is a parametric statistical procedure that is typically used for analyzing trends in data over time. Using this type of analysis, a higher degree of scatter simply corresponds to a wider confidence interval about the average log-slope. Assuming the sign (i.e., positive or negative) of the estimated log-slope is correct, a level of confidence that the slope is not zero can be easily determined. Thus, despite a poor goodness of fit, the overall trend in the data may still be ascertained, where low levels of confidence correspond to "Stable" or "No Trend" conditions (depending on the degree of scatter) and higher levels of confidence indicate the stronger likelihood of a trend. The linear regression analysis is based on the first-order linear regression of the log-transformed concentration data versus time. The slope obtained from this log-transformed regression, the confidence level for this log-slope, and the COV of the untransformed data are used to determine the concentration trend. The decision matrix for this evaluation is shown in Table 4.

To estimate the confidence in the log-slope, the standard error of the log-slope is calculated. The coefficient of variation, defined as the standard deviation divided by the average, is used as a secondary measure of scatter to distinguish between "Stable" or "No Trend" conditions for negative slopes. The Linear Regression Analysis is designed for analyzing a single groundwater constituent; multiple constituents are analyzed separately, (up to five COCs simultaneously). For this evaluation, a decision matrix developed by Groundwater Services, Inc. is also used to determine the "Concentration Trend" category (plume stability) for each well.

Depending on statistical indicators, the concentration trend is classified into six categories:

- Decreasing (D),
- Probably Decreasing (PD),
- Stable (S),
- No Trend (NT),
- Probably Increasing (PI)
- Increasing (I).

The resulting confidence in the trend, together with the log-slope and the COV of the untransformed data, are used in the linear regression analysis decision matrix to determine the concentration trend. For example, a positive log-slope with a confidence of less than 90% is categorized as having No Trend whereas a negative log-slope is considered Stable if the COV is less than 1 and categorized as No Trend if the COV is greater than 1.

6.3 Overall Plume Analysis

General recommendations for the monitoring network frequency and density are suggested based on heuristic rules applied to the source and tail trend results.

Individual well trend results are consolidated and weighted by the MAROS according to user input, and the direction and strength of contaminant concentration trends in the source zone and tail zone for each COC are determined. Based on

i) the consolidated trend analysis,

ii) hydrogeologic factors (e.g., seepage velocity), and

iii) location of potential receptors (e.g., wells, discharge points, or property boundaries),

the software suggests a general optimization plan for the current monitoring system in order to efficiently but effectively monitor groundwater in the future. A flow chart utilizing the trend analysis results and other site-specific parameters to form a general sampling frequency and well density recommendation is outlined in Figure 2. For example, a generic plan for a shrinking petroleum hydrocarbon plume (BTEX) in a slow hydrogeologic environment (silt) with no nearby receptors would entail minimal, low frequency sampling of just a few indicators. On the other hand, the generic plan for a chlorinated solvent plume in a fast hydrogeologic environment that is expanding but has very erratic concentrations over time would entail more extensive, higher frequency sampling. The generic plan is based on a heuristically derived algorithm for assessing future sampling duration, location and density that takes into consideration plume stability. For a detailed description of the heuristic rules used in the MAROS software, refer to the MAROS 2.2Manual (AFCEE, 2003).

6.4 Moment Analysis

An analysis of moments can help resolve plume trends, where the zeroth moment shows change in dissolved mass vs. time, the first moment shows the center of mass location vs. time, and the second moment shows the spread of the plume vs. time. Moment calculations can predict how the plume will change in the future if further statistical analysis is applied to the moments to identify a trend (in this case, Mann Kendall Trend Analysis is applied). The trend analysis of moments can be summarized as:

- Zeroth Moment: An estimate of the total mass of the constituent for each sample event
- First Moment: An estimate of the center of mass for each sample event
- Second Moment: An estimate of the spread of the plume around the center of mass

The role of moment analysis in MAROS is to provide a relative estimate of plume stability and condition within the context of results from other MAROS modules. The Moment analysis algorithms in MAROS are simple approximations of complex calculations and are meant to estimate changes in total mass, center of mass and spread of mass for complex well networks. The Moment Analysis module is sensitive to the number and arrangement of wells in each sampling event, so, changes in the number and identity of wells during monitoring events, and the parameters chosen for data consolidation can cause changes in the estimated moments.

Plume stability may vary by constituent, therefore the MAROS Moment analysis can be used to evaluate multiple COCs simultaneously which can be used to provide a quick way of comparing individual plume parameters to determine the size and movement of constituents relative to one another. Moment analysis in the MAROS software can also be used to assist the user in evaluating the impact on plume delineation in future sampling events by removing identified “redundant” wells from a long-term monitoring program (this analysis was not performed as part of this study, for more details on this application of moment analysis refer to the MAROS Users Manual (AFCEE, 2003)).

The **zeroth moment** is the sum of concentrations for all monitoring wells and is a mass estimate. The zeroth moment calculation can show high variability over time, largely due to the fluctuating concentrations at the most contaminated wells as well as varying monitoring well network. Plume analysis and delineation based exclusively on concentration can exhibit fluctuating temporal and spatial values. The mass estimate is also sensitive to the extent of the site monitoring well network over time. The zeroth moment trend over time is determined by using the Mann-Kendall Trend Methodology. The zeroth Moment trend test allows the user to understand how the plume mass has changed over time. Results for the trend include: Increasing, probably Increasing, no trend, stable, probably decreasing, decreasing or not applicable (N/A) (Insufficient Data). When considering the results of the zeroth moment trend, the following factors should be considered which could effect the calculation and interpretation of the plume mass over time: 1) Change in the spatial distribution of the wells sampled historically 2) Different wells sampled within the well network over time (addition and subtraction of well within the network). 3) Adequate versus inadequate delineation of the plume over time

The **first moment** estimates the center of mass, coordinates (Xc and Yc) for each sample event and COC. The changing center of mass locations indicate the movement of the center of mass over time. Whereas, the distance from the original source location to the center of mass locations indicate the movement of the center of mass over time relative to the original source. Calculation of the first moment normalizes the spread by the concentration indicating the center of mass. The first moment trend of the distance to the center of mass over time shows movement of the plume in relation to the original source location over time. Analysis of the movement of mass should be viewed as it relates to 1) the original source location of contamination 2) the direction of groundwater flow and/or 3) source removal or remediation. Spatial and temporal trends in the center of mass can indicate spreading or shrinking or transient movement based on season variation in rainfall or other hydraulic considerations. No appreciable movement or a neutral trend in the center of mass would indicate plume stability. However, changes in the first moment over time do not necessarily completely characterize the changes in the concentration distribution (and the mass) over time. Therefore, in order to fully characterize the plume the First Moment trend should be compared to the zeroth moment trend (mass change over time).

The **second moment** indicates the spread of the contaminant about the center of mass (Sxx and Syy), or the distance of contamination from the center of mass for a particular COC and sample event. The Second Moment represents the spread of the plume over time in both the x and y directions. The Second Moment trend indicates the spread of the plume about the center of mass. Analysis of the spread of the plume should be viewed as it relates to the direction of groundwater flow. An Increasing trend in the second moment indicates an expanding plume, whereas a declining trend in the second moment indicates a shrinking plume. No appreciable movement or a neutral trend in the center of mass would indicate plume stability. The second moment provides a measure of the spread of the concentration distribution about the plume’s center of mass.

However, changes in the second moment over time do not necessarily completely characterize the changes in the concentration distribution (and the mass) over time. Therefore, in order to fully characterize the plume the Second Moment trend should be compared to the zeroth moment trend (mass change over time).

7.0 Detailed Statistics: Optimization Analysis

Although the overall plume analysis shows a general recommendation regarding sampling frequency reduction and a general sampling density, a more detailed analysis is also available with the MAROS 2.2 software in order to allow for further reductions on a well-by-well basis for frequency, well redundancy, well sufficiency and sampling sufficiency. The MAROS Detailed Statistics allows for a quantitative analysis for spatial and temporal optimization of the well network on a well-by-well basis. The results from the Overview Statistics should be considered along with the MAROS optimization recommendations gained from the Detailed Statistical Analysis described previously. The MAROS Detailed Statistics results should be reassessed in view of site knowledge and regulatory requirements as well as in consideration of the Overview Statistics (Figure 2).

The Detailed Statistics or Sampling Optimization MAROS modules can be used to determine the minimal number of sampling locations and the lowest frequency of sampling that can still meet the requirements of sampling spatially and temporally for an existing monitoring program. It also provides an analysis of the sufficiency of data for the monitoring program.

Sampling optimization in MAROS consists of four parts:

- Well redundancy analysis using the Delaunay method
- Well sufficiency analysis using the Delaunay method
- Sampling frequency determination using the Modified CES method
- Data sufficiency analysis using statistical power analysis.

The well redundancy analysis using the Delaunay method identifies and eliminates redundant locations from the monitoring network. The well sufficiency analysis can determine the areas where new sampling locations might be needed. The Modified CES method determines the optimal sampling frequency for a sampling location based on the direction, magnitude, and uncertainty in its concentration trend. The data sufficiency analysis examines the risk-based site cleanup status and power and expected sample size associated with the cleanup status evaluation.

<u>7.1 Well Redundancy Analysis – Delaunay Method</u>

The well redundancy analysis using the Delaunay method is designed to select the minimum number of sampling locations based on the spatial analysis of the relative importance of each sampling location in the monitoring network. The approach allows elimination of sampling locations that have little impact on the historical characterization of a contaminant plume. An extended method or wells sufficiency analysis, based on the Delaunay method, can also be used for recommending new sampling locations.

Details about the Delaunay method can be found in Appendix A.2 of the MAROS Manual (AFCEE, 2003).

Sampling Location determination uses the Delaunay triangulation method to determine the significance of the current sampling locations relative to the overall monitoring network. The Delaunay method calculates the network Area and Average concentration of the plume using data from multiple monitoring wells. A slope factor (SF) is calculated for each well to indicate the significance of this well in the system (i.e. how removing a well changes the average concentration.)

The Sampling Location optimization process is performed in a stepwise fashion. Step one involves assessing the significance of the well in the system, if a well has a small SF (little significance to the network), the well may be removed from the monitoring network. Step two involves evaluating the information loss of removing a well from the network. If one well has a small SF, it may or may not be eliminated depending on whether the information loss is significant. If the information loss is not significant, the well can be eliminated from the monitoring network and the process of optimization continues with fewer wells. However if the well information loss is significant then the optimization terminates. This sampling optimization process allows the user to assess “redundant” wells that will not incur significant information loss on a constituent-by-constituent basis for individual sampling events.

7.2 Well Sufficiency Analysis – Delaunay Method

The well sufficiency analysis, using the Delaunay method, is designed to recommend new sampling locations in areas *within* the existing monitoring network where there is a high level of uncertainty in contaminant concentration. Details about the well sufficiency analysis can be found in Appendix A.2 of the MAROS Manual (AFCEE, 2003).

In many cases, new sampling locations need to be added to the existing network to enhance the spatial plume characterization. If the MAROS algorithm calculates a high level of uncertainty in predicting the constituent concentration for a particular area, a new sampling location is recommended. The Slope Factor (SF) values obtained from the redundancy evaluation described above are used to calculate the concentration estimation error for each triangle area formed in the Delaunay triangulation. The estimated SF value for each area is then classified into four levels: Small, Moderate, Large, or Extremely large (S, M, L, E) because the larger the estimated SF value, the higher the estimation error at this area. Therefore, the triangular areas with the estimated SF value at the Extremely large or Large level can be candidate regions for new sampling locations.

The results from the Delaunay method and the method for determining new sampling locations are derived solely from the spatial configuration of the monitoring network and the spatial pattern of the contaminant plume. No parameters such as the hydrogeologic conditions are considered in the analysis. Therefore, professional judgment and regulatory considerations must be used to make final decisions.

7.3 Sampling Frequency Determination - Modified CES Method

The Modified CES method optimizes sampling frequency for each sampling location based on the magnitude, direction, and uncertainty of its concentration trend derived from its recent and historical monitoring records. The Modified Cost Effective Sampling (MCES) estimates a conservative lowest-frequency sampling schedule for a given groundwater monitoring location that still provides needed information for regulatory and remedial decision-making. The MCES method was developed on the basis of the Cost Effective Sampling (CES) method developed by Ridley et al (1995). Details about the MCES method can be found in Appendix A.9 of the MAROS Manual (AFCEE, 2003).

In order to estimate the least frequent sampling schedule for a monitoring location that still provides enough information for regulatory and remedial decision-making, MCES employs three steps to determine the sampling frequency. The first step involves analyzing frequency based on recent trends. A preliminary location sampling frequency (PLSF) is developed based on the rate of change of well concentrations calculated by linear regression along with the Mann-Kendall trend analysis of the most recent monitoring data (see Figure 3). The variability within the sequential sampling data is accounted for by the Mann-Kendall analysis. The rate of change vs. trend result matrix categorizes wells as requiring annual, semi-annual or quarterly sampling. The PLSF is then reevaluated and adjusted based on overall trends. If the long-term history of change is significantly greater than the recent trend, the frequency may be reduced by one level.

The final step in the analysis involves reducing frequency based on risk, site-specific conditions, regulatory requirements or other external issues. Since not all compounds in the target being assessed are equally harmful, frequency is reduced by one level if recent maximum concentration for a compound of high risk is less than 1/2 of the Maximum Concentration Limit (MCL). The result of applying this method is a suggested sampling frequency based on recent sampling data trends and overall sampling data trends and expert judgment.

The final sampling frequency determined from the MCES method can be Quarterly, Semiannual, Annual, or Biennial. Users can further reduce the sampling frequency to, for example, once every three years, if the trend estimated from Biennial data (i.e., data drawn once every two years from the original data) is the same as that estimated from the original data.

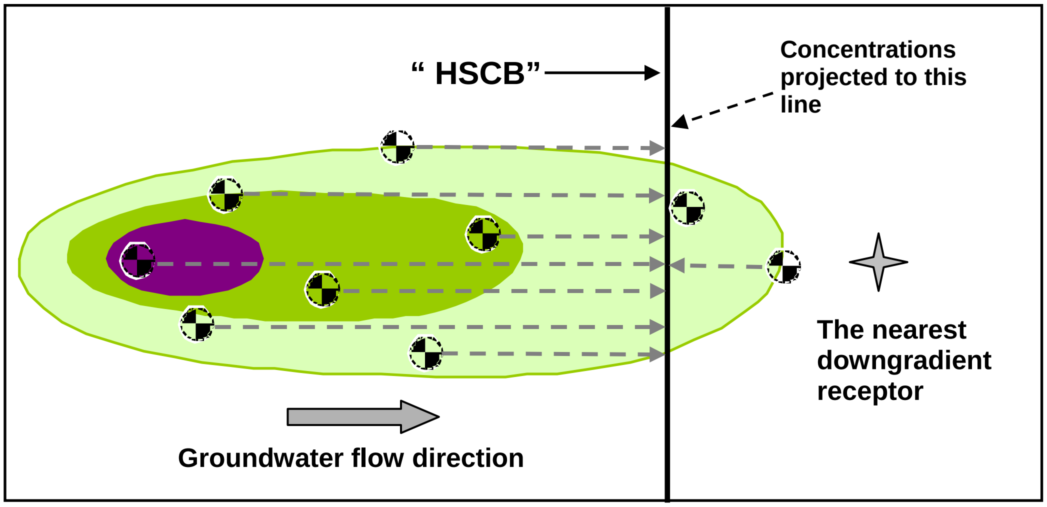
7.4 Data Sufficiency Analysis – Power Analysis

The MAROS Data Sufficiency module employs simple statistical methods to evaluate whether the collected data are adequate both in quantity and in quality for revealing changes in constituent concentrations. The first section of the module evaluates individual well concentrations to determine if they are statistically below a target screening level. The second section includes a simple calculation for estimating projected groundwater concentrations at a specified point downgradient of the plume. A statistical Power analysis is then applied to the projected concentrations to determine if the downgradient concentrations are statistically below the cleanup standard. If the number of projected concentrations is below the level to provide statistical significance, then the number of sample events required to statistically confirm concentrations below standards is estimated from the Power analysis.

Before testing the cleanup status for individual wells, the stability or trend of the contaminant plume should be evaluated. Only after the plume has reached stability or is reliably diminishing can we conduct a test to examine the cleanup status of wells. Applying the analysis to wells in an expanding plume may cause incorrect conclusions and is less meaningful.

Statistical power analysis is a technique for interpreting the results of statistical tests. The Power of a statistical test is a measure of the ability of the test to detect an effect given that the effect actually exists. The method provides additional information about a statistical test: 1) the power of the statistical test, i.e., the probability of finding a difference in the variable of interest when a difference truly exists; and 2) the expected sample size of a future sampling plan given the minimum detectable difference it is supposed to detect. For example, if the mean concentration is lower than the cleanup goal but a statistical test cannot prove this, the power and expected sample size can tell the reason and how many more samples are needed to result in a significant test. The additional samples can be obtained by a longer period of sampling or an increased sampling frequency. Details about the data sufficiency analysis can be found in Appendix A.6 of the MAROS Manual (AFCEE, 2003).

When applying the MAROS power analysis method, a hypothetical statistical compliance boundary (HSCB) is assigned to be a line perpendicular to the groundwater flow direction (see figure below). Monitoring well concentrations are projected onto the HSCB using the distance from each well to the compliance boundary along with a decay coefficient. The projected concentrations from each well and each sampling event are then used in the risk-based power analysis. Since there may be more than one sampling event selected by the user, the risk-based power analysis results are given on an event-by-event basis. This power analysis can then indicate if target are statistically achieved at the HSCB. For instance, at a site where the historical monitoring record is short with few wells, the HSCB would be distant; whereas, at a site with longer duration of sampling with many wells, the HSCB would be close. Ultimately, at a site the goal would be to have the HSCB coincide with or be within the actual compliance boundary (typically the site property line).



In order to perform a risk-based cleanup status evaluation for the whole site, a strategy was developed as follows.

- Estimate concentration versus distance decay coefficient from plume centerline wells.
- Extrapolate concentration versus distance for each well using this decay coefficient.
- Comparing the extrapolated concentrations with the compliance concentration using power analysis.

Results from this analysis can be *Attained* or *Not Attained*, providing a statistical interpretation of whether the cleanup goal has been met on the site-scale from the risk-based point of view. The results as a function of time can be used to evaluate if the monitoring system has enough power at each step in the sampling record to indicate certainty of compliance by the plume location and condition relative to the compliance boundary. For example, if results are *Not Attained* at early sampling events but are *Attained* in recent sampling events, it indicates that the recent sampling record provides a powerful enough result to indicate compliance of the plume relative to the location of the receptor or compliance boundary.

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TABLE 1
Mann-Kendall Analysis Decision Matrix (Aziz, et. al., 2003)

Mann-Kendall Statistic	Confidence in the Trend	Concentration Trend
S > 0	> 95%	Increasing
S > 0	90 - 95%	Probably Increasing
S > 0	< 90%	No Trend
$S \leq 0$	< 90% and COV $\geq$ 1	No Trend
$S \leq 0$	< 90% and COV < 1	Stable
S < 0	90 - 95%	Probably Decreasing
S < 0	> 95%	Decreasing

TABLE 2
Linear Regression Analysis Decision Matrix (Aziz, et. al., 2003)

Confidence in the Trend	Log-slope	
	Positive	**Negative**
< 90%	No Trend	COV < 1 Stable COV > 1 No Trend
90 - 95%	Probably Increasing	Probably Decreasing
> 95%	Increasing	Decreasing

MAROS: Decision Support Tool

MAROS is a collection of tools in one software package that is used in an explanatory, non-linear fashion. The tool includes models, geostatistics, heuristic rules, and empirical relationships to assist the user in optimizing a groundwater monitoring network system while maintaining adequate delineation of the plume as well as knowledge of the plume state over time. Different users utilize the tool in different ways and interpret the results from a different viewpoint.

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Overview Statistics

What it is: Simple, qualitative and quantitative plume information can be gained through evaluation of monitoring network historical data trends both spatially and temporally. The MAROS Overview Statistics are the foundation the user needs to make informed optimization decisions at the site.

What it does: The Overview Statistics are designed to allow site personnel to develop a better understanding of the plume behavior over time and understand how the individual well concentration trends are spatially distributed within the plume. This step allows the user to gain information that will support a more informed decision to be made in the next level of optimization analysis.

What are the tools: Overview Statistics includes two analytical tools:

1) **Trend Analysis:** includes Mann-Kendall and Linear Regression statistics for individual wells and results in general heuristically-derived monitoring categories with a suggested sampling density and monitoring frequency.

2) **Moment Analysis:** includes dissolved mass estimation (0^{th} Moment), center of mass (1^{st} Moment), and plume spread (2^{nd} Moment) over time. Trends of these moments show the user another piece of information about the plume stability over time.

What is the product: A first-cut blueprint for a future long-term monitoring program that is intended to be a foundation for more detailed statistical analysis.

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Detailed Statistics

What it is: The MAROS Detailed Statistics allows for a quantitative analysis for spatial and temporal optimization of the well network on a well-by-well basis.

What it does: The results from the Overview Statistics should be considered along side the MAROS optimization recommendations gained from the Detailed Statistical Analysis. The MAROS Detailed Statistics results should be reassessed in view of site knowledge and regulatory requirements as well as the Overview Statistics.

What are the tools: Detailed Statistics includes four analytical tools:

1) **Sampling Frequency Optimization:** uses the Modified CES method to establish a recommended future sampling frequency.

2) **Well Redundancy Analysis:** uses the Delaunay Method to evaluate if any wells within the monitoring network are redundant and can be eliminated without any significant loss of plume information.

3) **Well Sufficiency Analysis:** uses the Delaunay Method to evaluate areas where new wells are recommended within the monitoring network due to high levels of concentration uncertainty.

4) **Data Sufficiency Analysis:** uses Power Analysis to assess if the historical monitoring data record has sufficient power to accurately reflect the location of the plume relative to the nearest receptor or compliance point.

What is the product: List of wells to remove from the monitoring program, locations where monitoring wells may need to be added, recommended frequency of sampling for each well, analysis if the overall system is statistically powerful to monitor the plume.

Figure 1. MAROS Decision Support Tool Flow Chart

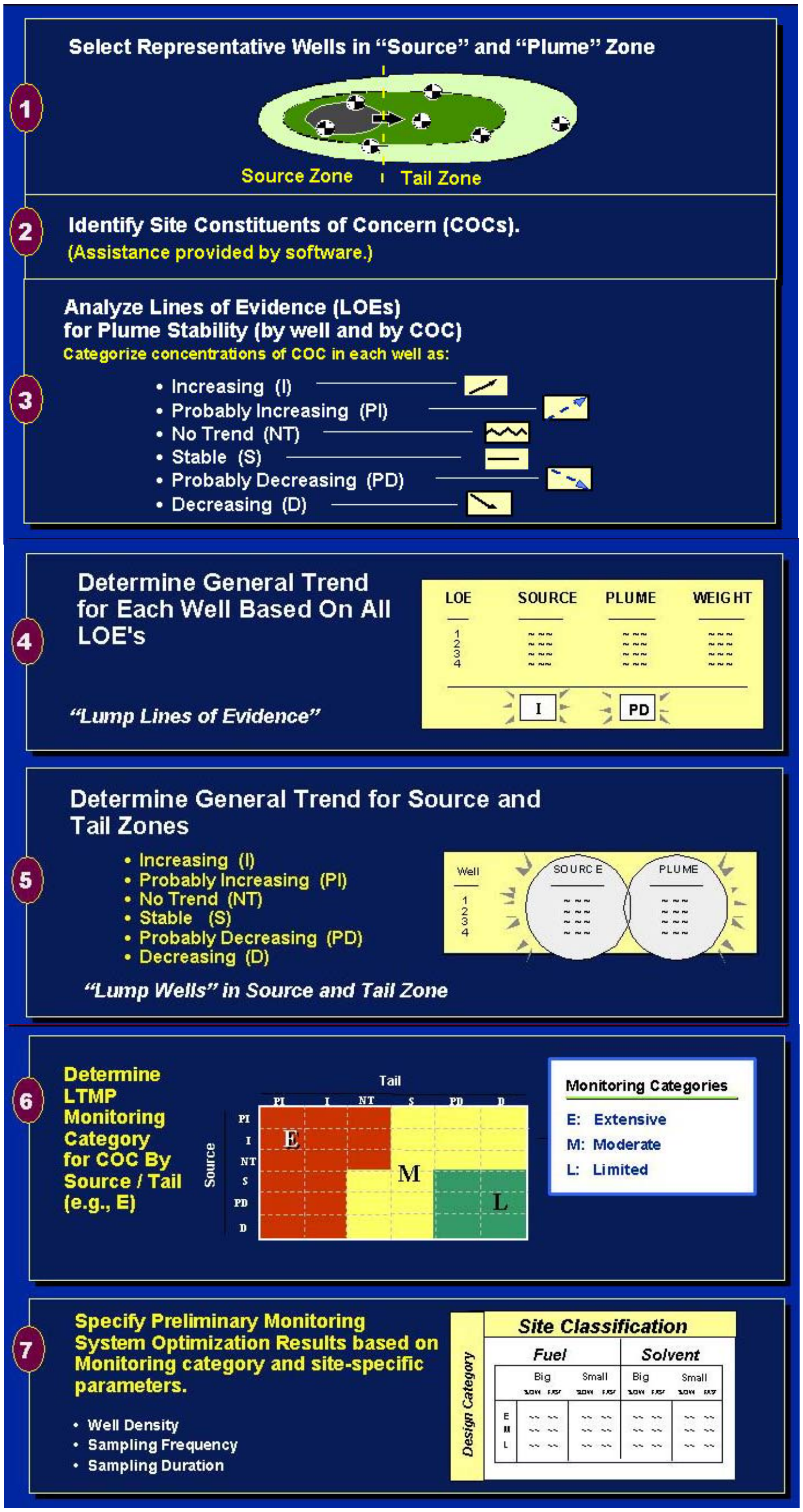


Figure 2:
MAROS Overview Statistics Trend Analysis Methodology

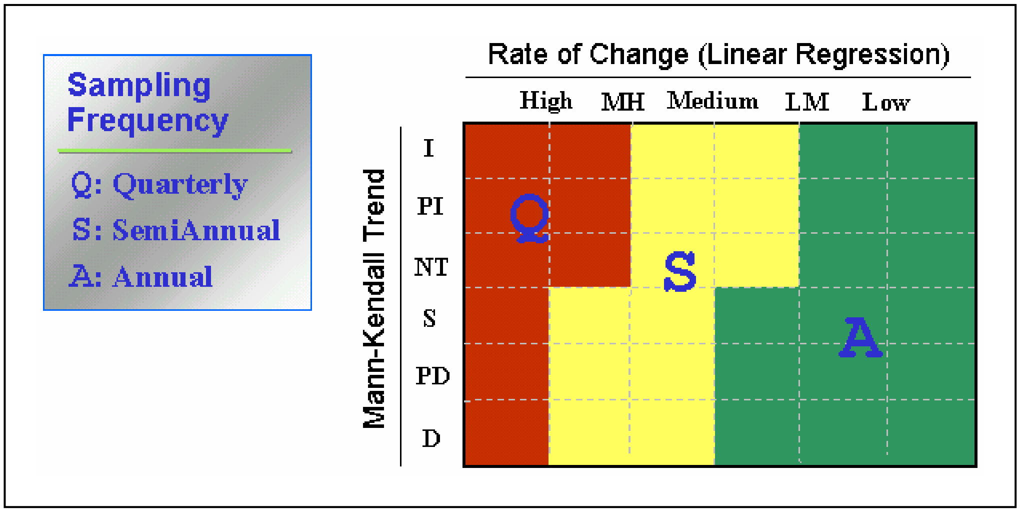


Figure 3. Decision Matrix for Determining Provisional Frequency (*Figure A.3.1 of the MAROS Manual (AFCEE 2003*)

GROUNDWATER MONITORING NETWORK OPTIMIZATION
TAYLOR ROAD LANDFILL SUPERFUND SITE

Hillsborough County, Florida

APPENDIX B:

MAROS Reports

COC Assessment Report
Mann-Kendall Reports
Zeroth Moment Reports

MAROS COC Assessment

Project: Taylor Road

User Name: MV

Location: Hillsborough County

State: Florida

Toxicity:

Contaminant of Concern	Representative Concentration (mg/L)	PRG (mg/L)	Percent Above PRG
MANGANESE	3.3E-01	5.0E-02	557.1%
VINYL CHLORIDE	4.5E-03	1.0E-03	345.6%

Note: Top COCs by toxicity were determined by examining a representative concentration for each compound over the entire site. The compound representative concentrations are then compared with the chosen PRG for that compound, with the percentage excedence from the PRG determining the compound's toxicity. All compounds above exceed the PRG.

Prevalence:

Contaminant of Concern	Class	Total Wells	Total Excedences	Percent Excedences	Total detects
VINYL CHLORIDE	ORG	27	12	44.4%	15
MANGANESE	MET	27	10	37.0%	27

Note: Top COCs by prevalence were determined by examining a representative concentration for each well location at the site. The total excedences (values above the chosen PRGs) are compared to the total number of wells to determine the prevalence of the compound.

Mobility:

Contaminant of Concern	Kd
VINYL CHLORIDE	0.042
MANGANESE	50.1

Note: Top COCs by mobility were determined by examining each detected compound in the dataset and comparing their mobilities (Koc's for organics, assume foc = 0.001, and Kd's for metals).

Contaminants of Concern (COC's)

1,1-DICHLOROETHENE

VINYL CHLORIDE

MANGANESE

TRICHLOROETHYLENE (TCE)

MAROS Mann-Kendall Statistics Summary

Project: Taylor Road Landfill

User Name: MV

Location: Hillsborough County

State: Florida

Time Period: 1/1/1999 **to** 4/10/2007

Consolidation Period: No Time Consolidation

Consolidation Type: Median

Duplicate Consolidation: Average

ND Values: Specified Detection Limit

J Flag Values : Actual Value

Well	Source/ Tail	Number of Samples	Number of Detects	Coefficient of Variation	Mann-Kendall Statistic	Confidence in Trend	All Samples "ND" ?	Concentration Trend
BENZENE								
NE-23	S	34	2	1.17	21	61.6%	No	NT
F-2	S	32	0	0.00	0	49.4%	Yes	S
18-D	S	34	31	0.43	-54	78.3%	No	S
C-6	S	30	29	0.47	-217	100.0%	No	D
C-5	S	33	19	1.08	-19	60.9%	No	NT
C-2	S	33	4	0.43	29	66.7%	No	NT
TR-1D	S	32	2	0.35	21	62.6%	No	NT
TR-3D	S	33	1	0.64	10	55.5%	No	NT
24-D	S	33	7	1.10	111	95.6%	No	I
TR-4D	S	34	33	0.35	-222	100.0%	No	D
28-D	S	34	0	0.00	0	49.4%	Yes	S
C-3	T	33	0	0.00	0	49.4%	Yes	S
F-1A	T	33	11	1.11	79	88.6%	No	NT
C-9	T	29	0	0.00	0	49.3%	Yes	S
C-8	T	29	0	0.00	0	49.3%	Yes	S
F-3	T	33	0	0.00	0	49.4%	Yes	S
C-4	T	33	0	0.00	0	49.4%	Yes	S
F-4A	T	27	0	0.00	0	49.2%	Yes	S
F-15	T	34	0	0.00	0	49.4%	Yes	S
C-7	T	31	0	0.00	0	49.4%	Yes	S
C-10	T	25	0	0.00	0	49.1%	Yes	S
30-D	T	34	0	0.00	0	49.4%	Yes	S
C-1	T	31	0	0.00	0	49.4%	Yes	S
31-D	T	34	0	0.00	0	49.4%	Yes	S
32-D	T	33	0	0.00	0	49.4%	Yes	S
TR-2D	T	33	1	1.80	10	55.5%	No	NT
MANGANESE								
C-5	S	33	32	0.69	-115	96.2%	No	D
28-D	S	33	32	1.12	-156	99.2%	No	D
18-D	S	33	31	0.31	40	72.6%	No	NT
F-2	S	31	31	0.59	-139	99.1%	No	D
C-6	S	30	30	0.70	274	100.0%	No	I
TR-4D	S	33	32	0.21	-132	97.9%	No	D
24-D	S	33	33	0.82	306	100.0%	No	I
NE-23	S	33	33	0.38	-429	100.0%	No	D
TR-3D	S	32	31	0.97	-289	100.0%	No	D
C-2	S	33	33	0.33	-179	99.8%	No	D

Project: Taylor Road Landfill **User Name:** MV

Location: Hillsborough County **State:** Florida

Well	Source/ Tail	Number of Samples	Number of Detects	Coefficient of Variation	Mann-Kendall Statistic	Confidence in Trend	All Samples "ND" ?	Concentration Trend
MANGANESE								
TR-1D	S	32	32	0.34	-236	100.0%	No	D
F-14	T	33	33	0.13	192	99.9%	No	I
C-9	T	29	29	0.18	-41	77.2%	No	S
C-10	T	25	5	3.56	-22	68.6%	No	NT
C-8	T	29	27	0.66	-139	99.6%	No	D
31-D	T	33	11	1.13	143	98.7%	No	I
C-7	T	31	9	2.66	10	56.1%	No	NT
C-4	T	33	12	1.67	-20	61.5%	No	NT
32-D	T	32	31	0.41	-266	100.0%	No	D
C-3	T	33	23	2.32	-268	100.0%	No	D
C-1	T	31	30	1.09	-246	100.0%	No	D
30-D	T	33	11	1.31	151	99.1%	No	I
TR-2D	T	33	6	1.43	34	69.4%	No	NT
F-15	T	33	9	2.20	78	88.3%	No	NT
F-3	T	33	19	1.97	-59	81.4%	No	NT
F-4A	T	27	16	1.24	43	80.8%	No	NT
F-1A	T	33	33	0.21	-5	52.5%	No	S
NITRATE								
NE-23	S	30	28	0.39	288	100.0%	No	I
C-5	S	29	10	3.81	-10	56.6%	No	NT
TR-1D	S	29	7	3.00	52	82.9%	No	NT
C-6	S	26	26	0.80	95	98.1%	No	I
F-2	S	27	27	0.35	40	79.0%	No	NT
C-2	S	29	10	1.97	16	61.0%	No	NT
28-D	S	30	20	1.00	172	99.9%	No	I
TR-4D	S	29	2	5.00	25	67.3%	No	NT
TR-3D	S	28	18	2.38	103	97.8%	No	I
18-D	S	30	3	0.85	20	63.2%	No	NT
24-D	S	29	26	0.63	-164	99.9%	No	D
C-3	T	29	29	0.28	1	50.0%	No	NT
F-4A	T	27	27	0.40	221	100.0%	No	I
F-15	T	30	30	0.29	133	99.1%	No	I
C-7	T	27	27	0.19	194	100.0%	No	I
C-4	T	29	29	0.16	2	50.7%	No	NT
C-10	T	21	20	0.24	70	98.2%	No	I
F-3	T	29	29	0.15	-38	75.4%	No	S
31-D	T	30	29	0.24	89	94.1%	No	PI
C-1	T	27	27	0.16	25	69.0%	No	NT
C-8	T	25	25	0.17	-6	54.6%	No	S
32-D	T	29	29	0.08	121	98.9%	No	I
C-9	T	25	1	4.70	10	58.2%	No	NT
TR-2D	T	29	29	0.30	-112	98.2%	No	D
30-D	T	30	30	0.11	133	99.1%	No	I
F-1A	T	29	22	1.71	-110	98.0%	No	D
TRICHLOROETHYLENE (TCE)								
18-D	S	34	18	1.05	91	90.8%	No	PI
TR-1D	S	33	33	0.48	-326	100.0%	No	D
TR-4D	S	34	33	1.05	-375	100.0%	No	D

Project: Taylor Road Landfill **User Name:** MV

Location: Hillsborough County **State:** Florida

Well	Source/ Tail	Number of Samples	Number of Detects	Coefficient of Variation	Mann-Kendall Statistic	Confidence in Trend	All Samples "ND" ?	Concentration Trend
TRICHLOROETHYLENE (TCE)								
24-D	S	33	16	1.26	216	100.0%	No	I
TR-3D	S	33	23	0.81	-178	99.7%	No	D
C-2	S	33	33	0.43	-323	100.0%	No	D
28-D	S	34	1	1.00	9	54.7%	No	NT
NE-23	S	34	31	0.37	-212	99.9%	No	D
C-6	S	30	28	0.31	96	95.5%	No	I
F-2	S	32	13	0.73	239	100.0%	No	I
C-5	S	33	31	0.53	-216	100.0%	No	D
C-8	T	29	2	0.39	9	55.9%	No	NT
C-3	T	33	0	0.00	0	49.4%	Yes	S
30-D	T	34	0	0.00	0	49.4%	Yes	S
32-D	T	33	7	0.74	91	91.8%	No	PI
C-7	T	31	0	0.00	0	49.4%	Yes	S
TR-2D	T	33	3	0.26	28	66.1%	No	NT
F-4A	T	27	0	0.00	0	49.2%	Yes	S
C-1	T	31	0	0.00	0	49.4%	Yes	S
31-D	T	34	18	0.73	129	97.1%	No	I
C-4	T	33	0	0.00	0	49.4%	Yes	S
C-10	T	25	0	0.00	0	49.1%	Yes	S
C-9	T	29	0	0.00	0	49.3%	Yes	S
F-3	T	32	0	0.00	0	49.4%	Yes	S
F-15	T	34	8	0.61	92	91.1%	No	PI
F-14	T	34	31	0.44	-356	100.0%	No	D
F-1A	T	33	17	0.79	-92	92.0%	No	PD
VINYL CHLORIDE								
24-D	S	33	18	2.13	181	99.8%	No	I
28-D	S	34	6	1.51	-85	89.3%	No	NT
TR-3D	S	33	22	1.00	-115	96.2%	No	D
18-D	S	34	32	0.49	-244	100.0%	No	D
TR-4D	S	34	33	0.35	-169	99.4%	No	D
C-2	S	33	33	0.33	-345	100.0%	No	D
TR-1D	S	33	32	0.59	-292	100.0%	No	D
F-2	S	32	25	0.71	-120	97.3%	No	D
NE-23	S	34	22	0.83	-246	100.0%	No	D
C-5	S	33	32	0.61	-330	100.0%	No	D
C-6	S	30	30	0.28	-246	100.0%	No	D
C-1	T	31	0	0.00	0	49.4%	Yes	S
F-14	T	34	33	0.34	-115	95.4%	No	D
C-3	T	33	0	0.00	0	49.4%	Yes	S
F-3	T	33	0	0.00	0	49.4%	Yes	S
C-9	T	29	0	0.00	0	49.3%	Yes	S
F-4A	T	27	0	0.00	0	49.2%	Yes	S
C-10	T	25	0	0.00	0	49.1%	Yes	S
F-15	T	34	0	0.00	0	49.4%	Yes	S
F-1A	T	33	23	1.09	-82	89.4%	No	NT
C-8	T	29	0	0.00	0	49.3%	Yes	S
C-7	T	31	0	0.00	0	49.4%	Yes	S
TR-2D	T	33	2	4.20	19	60.9%	No	NT
32-D	T	33	0	0.00	0	49.4%	Yes	S

Project: Taylor Road Landfill

User Name: MV

Location: Hillsborough County

State: Florida

Well	Source/ Tail	Number of Samples	Number of Detects	Coefficient of Variation	Mann-Kendall Statistic	Confidence in Trend	All Samples "ND" ?	Concentration Trend
VINYL CHLORIDE								
30-D	T	34	0	0.00	0	49.4%	Yes	S
31-D	T	34	4	1.46	-96	92.0%	No	PD
C-4	T	33	0	0.00	0	49.4%	Yes	S

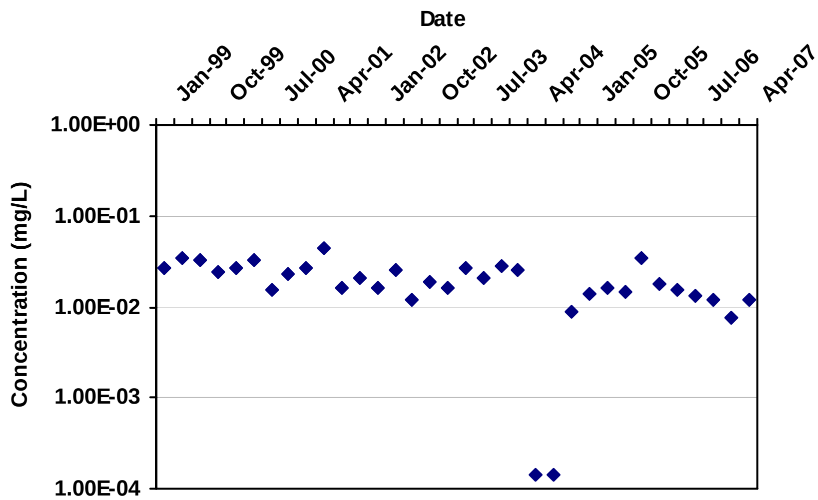
Note: Increasing (I); Probably Increasing (PI); Stable (S); Probably Decreasing (PD); Decreasing (D); No Trend (NT); Not Applicable (N/A)- Due to insufficient Data (< 4 sampling events); Source/Tail (S/T)

The Number of Samples and Number of Detects shown above are post-consolidation values.

MAROS Mann-Kendall Statistics Summary

Well: 18-D
Well Type: S
COC: VINYL CHLORIDE

Time Period: 1/1/1999 **to** 4/15/2007
Consolidation Period: No Time Consolidation
Consolidation Type: Geometric Mean
Duplicate Consolidation: Average
ND Values: Specified Detection Limit
J Flag Values : Actual Value



Mann Kendall S Statistic: -244

Confidence in Trend: 100.0%

Coefficient of Variation: 0.49

Mann Kendall Concentration Trend: (See Note) D

Data Table:

Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
18-D	S	1/19/1999	VINYL CHLORIDE	2.7E-02		1	1
18-D	S	4/12/1999	VINYL CHLORIDE	3.5E-02		1	1
18-D	S	7/12/1999	VINYL CHLORIDE	3.2E-02		1	1
18-D	S	10/18/1999	VINYL CHLORIDE	2.4E-02		1	1
18-D	S	1/10/2000	VINYL CHLORIDE	2.7E-02		1	1
18-D	S	4/17/2000	VINYL CHLORIDE	3.3E-02		1	1
18-D	S	7/17/2000	VINYL CHLORIDE	1.5E-02		1	1
18-D	S	10/16/2000	VINYL CHLORIDE	2.3E-02		1	1
18-D	S	1/16/2001	VINYL CHLORIDE	2.7E-02		1	1
18-D	S	4/23/2001	VINYL CHLORIDE	4.4E-02		1	1
18-D	S	7/16/2001	VINYL CHLORIDE	1.6E-02		1	1
18-D	S	10/23/2001	VINYL CHLORIDE	2.1E-02		1	1
18-D	S	1/16/2002	VINYL CHLORIDE	1.6E-02		1	1
18-D	S	4/8/2002	VINYL CHLORIDE	2.6E-02		1	1
18-D	S	7/15/2002	VINYL CHLORIDE	1.2E-02		1	1
18-D	S	10/14/2002	VINYL CHLORIDE	1.9E-02		1	1
18-D	S	1/13/2003	VINYL CHLORIDE	1.6E-02		1	1
18-D	S	4/14/2003	VINYL CHLORIDE	2.7E-02		1	1
18-D	S	7/14/2003	VINYL CHLORIDE	2.1E-02		1	1
18-D	S	10/15/2003	VINYL CHLORIDE	2.8E-02		1	1
18-D	S	1/26/2004	VINYL CHLORIDE	2.5E-02		1	1
18-D	S	4/19/2004	VINYL CHLORIDE	1.4E-04	ND	1	0

MAROS Mann-Kendall Statistics Summary

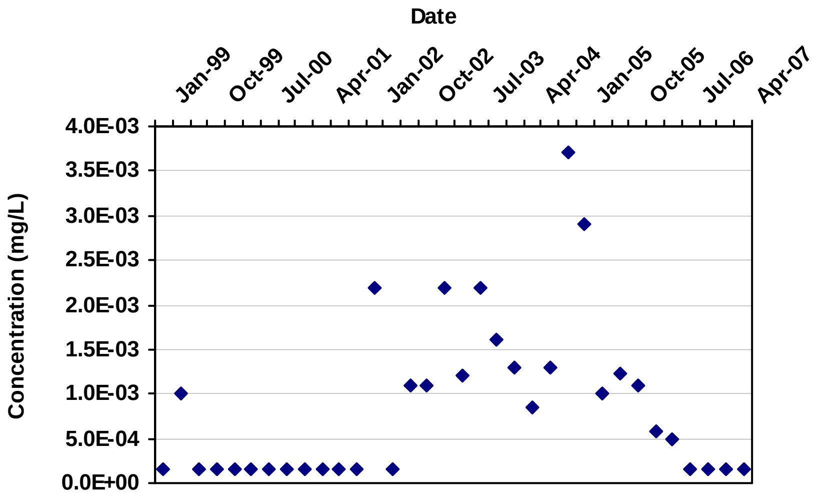
Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
18-D	S	7/26/2004	VINYL CHLORIDE	1.4E-04	ND	1	0
18-D	S	10/11/2004	VINYL CHLORIDE	8.6E-03		1	1
18-D	S	1/10/2005	VINYL CHLORIDE	1.4E-02		1	1
18-D	S	4/18/2005	VINYL CHLORIDE	1.6E-02		1	1
18-D	S	7/26/2005	VINYL CHLORIDE	1.4E-02		1	1
18-D	S	10/25/2005	VINYL CHLORIDE	3.5E-02		1	1
18-D	S	1/9/2006	VINYL CHLORIDE	1.8E-02		1	1
18-D	S	4/17/2006	VINYL CHLORIDE	1.5E-02		1	1
18-D	S	7/10/2006	VINYL CHLORIDE	1.3E-02		1	1
18-D	S	10/10/2006	VINYL CHLORIDE	1.2E-02		1	1
18-D	S	1/10/2007	VINYL CHLORIDE	7.6E-03		1	1
18-D	S	4/10/2007	VINYL CHLORIDE	1.2E-02		1	1

Note: Increasing (I); Probably Increasing (PI); Stable (S); Probably Decreasing (PD); Decreasing (D); No Trend (NT); Not Applicable (N/A) - Due to insufficient Data (< 4 sampling events); ND = Non-detect

MAROS Mann-Kendall Statistics Summary

Well: 18-D
Well Type: S
COC: TRICHLOROETHYLENE (TCE)

Time Period: 1/1/1999 **to** 4/10/2007
Consolidation Period: No Time Consolidation
Consolidation Type: Median
Duplicate Consolidation: Average
ND Values: Specified Detection Limit
J Flag Values : Actual Value



Mann Kendall S Statistic: 91

Confidence in Trend: 90.8%

Coefficient of Variation: 1.05

Mann Kendall Concentration Trend: (See Note) PI

Data Table:

Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
18-D	S	1/19/1999	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
18-D	S	4/12/1999	TRICHLOROETHYLENE (TCE)	1.0E-03		1	1
18-D	S	7/12/1999	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
18-D	S	10/18/1999	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
18-D	S	1/10/2000	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
18-D	S	4/17/2000	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
18-D	S	7/17/2000	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
18-D	S	10/16/2000	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
18-D	S	1/16/2001	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
18-D	S	4/23/2001	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
18-D	S	7/16/2001	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
18-D	S	10/23/2001	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
18-D	S	1/16/2002	TRICHLOROETHYLENE (TCE)	2.2E-03		1	1
18-D	S	4/8/2002	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
18-D	S	7/15/2002	TRICHLOROETHYLENE (TCE)	1.1E-03		1	1
18-D	S	10/14/2002	TRICHLOROETHYLENE (TCE)	1.1E-03		1	1
18-D	S	1/13/2003	TRICHLOROETHYLENE (TCE)	2.2E-03		1	1
18-D	S	4/14/2003	TRICHLOROETHYLENE (TCE)	1.2E-03		1	1
18-D	S	7/14/2003	TRICHLOROETHYLENE (TCE)	2.2E-03		1	1
18-D	S	10/15/2003	TRICHLOROETHYLENE (TCE)	1.6E-03		1	1
18-D	S	1/26/2004	TRICHLOROETHYLENE (TCE)	1.3E-03		1	1
18-D	S	4/19/2004	TRICHLOROETHYLENE (TCE)	8.4E-04		1	1

MAROS Mann-Kendall Statistics Summary

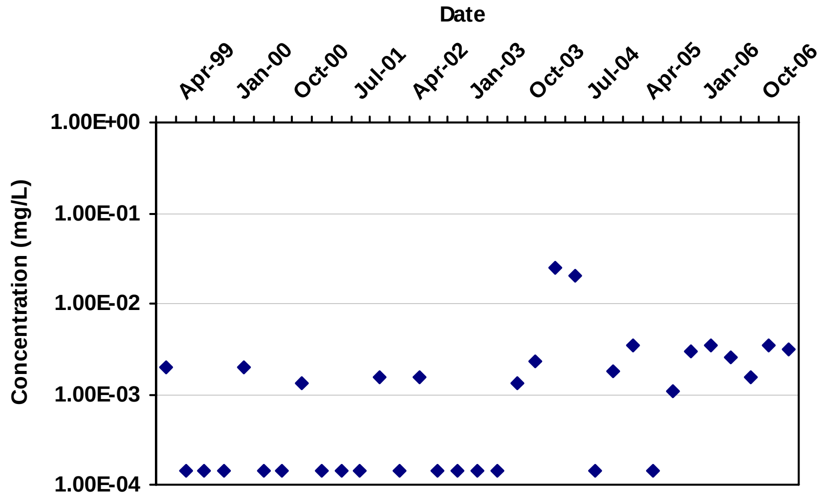
Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
18-D	S	7/26/2004	TRICHLOROETHYLENE (TCE)	1.3E-03		1	1
18-D	S	10/11/2004	TRICHLOROETHYLENE (TCE)	3.7E-03		1	1
18-D	S	1/10/2005	TRICHLOROETHYLENE (TCE)	2.9E-03		1	1
18-D	S	4/18/2005	TRICHLOROETHYLENE (TCE)	1.0E-03		1	1
18-D	S	7/26/2005	TRICHLOROETHYLENE (TCE)	1.2E-03		1	1
18-D	S	10/25/2005	TRICHLOROETHYLENE (TCE)	1.1E-03		1	1
18-D	S	1/9/2006	TRICHLOROETHYLENE (TCE)	5.7E-04		1	1
18-D	S	4/17/2006	TRICHLOROETHYLENE (TCE)	5.0E-04		1	1
18-D	S	7/10/2006	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
18-D	S	10/10/2006	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
18-D	S	1/10/2007	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
18-D	S	4/10/2007	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0

Note: Increasing (I); Probably Increasing (PI); Stable (S); Probably Decreasing (PD); Decreasing (D); No Trend (NT); Not Applicable (N/A) - Due to insufficient Data (< 4 sampling events); ND = Non-detect

MAROS Mann-Kendall Statistics Summary

Well: 24-D
Well Type: S
COC: VINYL CHLORIDE

Time Period: 1/1/1999 **to** 4/15/2007
Consolidation Period: No Time Consolidation
Consolidation Type: Geometric Mean
Duplicate Consolidation: Average
ND Values: Specified Detection Limit
J Flag Values : Actual Value



Mann Kendall S Statistic: 181

Confidence in Trend: 99.8%

Coefficient of Variation: 2.13

Mann Kendall Concentration Trend: (See Note) I

Data Table:

Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
24-D	S	4/12/1999	VINYL CHLORIDE	2.0E-03		1	1
24-D	S	7/12/1999	VINYL CHLORIDE	1.4E-04	ND	1	0
24-D	S	10/18/1999	VINYL CHLORIDE	1.4E-04	ND	1	0
24-D	S	1/10/2000	VINYL CHLORIDE	1.4E-04	ND	1	0
24-D	S	4/17/2000	VINYL CHLORIDE	2.0E-03		1	1
24-D	S	7/17/2000	VINYL CHLORIDE	1.4E-04	ND	1	0
24-D	S	10/16/2000	VINYL CHLORIDE	1.4E-04	ND	1	0
24-D	S	1/16/2001	VINYL CHLORIDE	1.3E-03		1	1
24-D	S	4/23/2001	VINYL CHLORIDE	1.4E-04	ND	1	0
24-D	S	7/16/2001	VINYL CHLORIDE	1.4E-04	ND	1	0
24-D	S	10/23/2001	VINYL CHLORIDE	1.4E-04	ND	1	0
24-D	S	1/16/2002	VINYL CHLORIDE	1.5E-03		1	1
24-D	S	4/8/2002	VINYL CHLORIDE	1.4E-04	ND	1	0
24-D	S	7/15/2002	VINYL CHLORIDE	1.5E-03		1	1
24-D	S	10/14/2002	VINYL CHLORIDE	1.4E-04	ND	1	0
24-D	S	1/13/2003	VINYL CHLORIDE	1.4E-04	ND	1	0
24-D	S	4/14/2003	VINYL CHLORIDE	1.4E-04	ND	1	0
24-D	S	7/14/2003	VINYL CHLORIDE	1.4E-04	ND	1	0
24-D	S	10/15/2003	VINYL CHLORIDE	1.3E-03		1	1
24-D	S	1/26/2004	VINYL CHLORIDE	2.3E-03		1	1
24-D	S	4/19/2004	VINYL CHLORIDE	2.5E-02		1	1
24-D	S	7/26/2004	VINYL CHLORIDE	2.0E-02		1	1

MAROS Mann-Kendall Statistics Summary

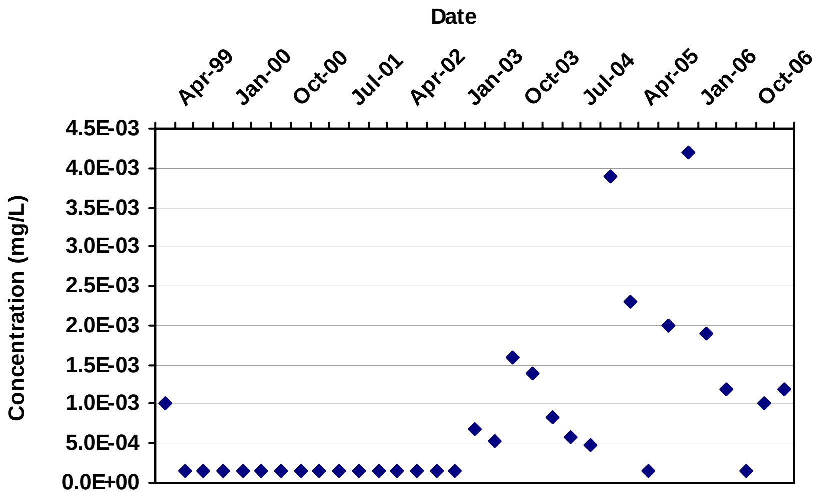
Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
24-D	S	10/11/2004	VINYL CHLORIDE	1.4E-04	ND	1	0
24-D	S	1/10/2005	VINYL CHLORIDE	1.8E-03		1	1
24-D	S	4/18/2005	VINYL CHLORIDE	3.5E-03		1	1
24-D	S	7/26/2005	VINYL CHLORIDE	1.4E-04	ND	1	0
24-D	S	10/25/2005	VINYL CHLORIDE	1.1E-03		1	1
24-D	S	1/9/2006	VINYL CHLORIDE	3.0E-03		1	1
24-D	S	4/17/2006	VINYL CHLORIDE	3.4E-03		1	1
24-D	S	7/10/2006	VINYL CHLORIDE	2.5E-03		1	1
24-D	S	10/10/2006	VINYL CHLORIDE	1.5E-03		1	1
24-D	S	1/10/2007	VINYL CHLORIDE	3.4E-03		1	1
24-D	S	4/10/2007	VINYL CHLORIDE	3.2E-03		1	1

Note: Increasing (I); Probably Increasing (PI); Stable (S); Probably Decreasing (PD); Decreasing (D); No Trend (NT); Not Applicable (N/A) - Due to insufficient Data (< 4 sampling events); ND = Non-detect

MAROS Mann-Kendall Statistics Summary

Well: 24-D
Well Type: S
COC: TRICHLOROETHYLENE (TCE)

Time Period: 1/1/1999 **to** 4/10/2007
Consolidation Period: No Time Consolidation
Consolidation Type: Median
Duplicate Consolidation: Average
ND Values: Specified Detection Limit
J Flag Values : Actual Value



Mann Kendall S Statistic: 216

Confidence in Trend: 100.0%

Coefficient of Variation: 1.26

Mann Kendall Concentration Trend: (See Note) I

Data Table:

Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
24-D	S	4/12/1999	TRICHLOROETHYLENE (TCE)	1.0E-03		1	1
24-D	S	7/12/1999	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
24-D	S	10/18/1999	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
24-D	S	1/10/2000	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
24-D	S	4/17/2000	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
24-D	S	7/17/2000	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
24-D	S	10/16/2000	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
24-D	S	1/16/2001	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
24-D	S	4/23/2001	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
24-D	S	7/16/2001	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
24-D	S	10/23/2001	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
24-D	S	1/16/2002	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
24-D	S	4/8/2002	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
24-D	S	7/15/2002	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
24-D	S	10/14/2002	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
24-D	S	1/13/2003	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
24-D	S	4/14/2003	TRICHLOROETHYLENE (TCE)	6.9E-04		1	1
24-D	S	7/14/2003	TRICHLOROETHYLENE (TCE)	5.2E-04		1	1
24-D	S	10/15/2003	TRICHLOROETHYLENE (TCE)	1.6E-03		1	1
24-D	S	1/26/2004	TRICHLOROETHYLENE (TCE)	1.4E-03		1	1
24-D	S	4/19/2004	TRICHLOROETHYLENE (TCE)	8.4E-04		1	1
24-D	S	7/26/2004	TRICHLOROETHYLENE (TCE)	5.7E-04		1	1

MAROS Mann-Kendall Statistics Summary

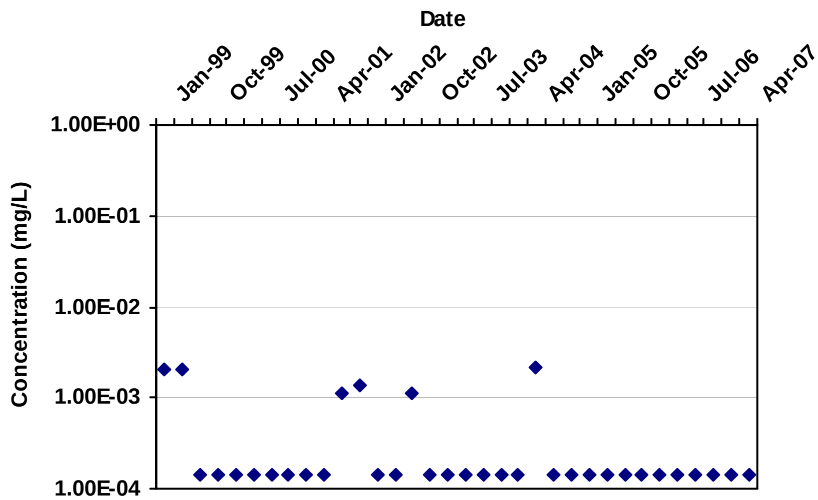
Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
24-D	S	10/11/2004	TRICHLOROETHYLENE (TCE)	4.7E-04		1	1
24-D	S	1/10/2005	TRICHLOROETHYLENE (TCE)	3.9E-03		1	1
24-D	S	4/18/2005	TRICHLOROETHYLENE (TCE)	2.3E-03		1	1
24-D	S	7/26/2005	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
24-D	S	10/25/2005	TRICHLOROETHYLENE (TCE)	2.0E-03		1	1
24-D	S	1/9/2006	TRICHLOROETHYLENE (TCE)	4.2E-03		1	1
24-D	S	4/17/2006	TRICHLOROETHYLENE (TCE)	1.9E-03		1	1
24-D	S	7/10/2006	TRICHLOROETHYLENE (TCE)	1.2E-03		1	1
24-D	S	10/10/2006	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
24-D	S	1/10/2007	TRICHLOROETHYLENE (TCE)	1.0E-03		1	1
24-D	S	4/10/2007	TRICHLOROETHYLENE (TCE)	1.2E-03		1	1

Note: Increasing (I); Probably Increasing (PI); Stable (S); Probably Decreasing (PD); Decreasing (D); No Trend (NT); Not Applicable (N/A) - Due to insufficient Data (< 4 sampling events); ND = Non-detect

MAROS Mann-Kendall Statistics Summary

Well: 28-D
Well Type: S
COC: VINYL CHLORIDE

Time Period: 1/1/1999 **to** 4/15/2007
Consolidation Period: No Time Consolidation
Consolidation Type: Geometric Mean
Duplicate Consolidation: Average
ND Values: Specified Detection Limit
J Flag Values : Actual Value



Mann Kendall S Statistic: -85

Confidence in Trend: 89.3%

Coefficient of Variation: 1.51

Mann Kendall Concentration Trend: (See Note) NT

Data Table:

Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
28-D	S	1/19/1999	VINYL CHLORIDE	2.0E-03		1	1
28-D	S	4/12/1999	VINYL CHLORIDE	2.0E-03		1	1
28-D	S	7/12/1999	VINYL CHLORIDE	1.4E-04	ND	1	0
28-D	S	10/18/1999	VINYL CHLORIDE	1.4E-04	ND	1	0
28-D	S	1/10/2000	VINYL CHLORIDE	1.4E-04	ND	1	0
28-D	S	4/17/2000	VINYL CHLORIDE	1.4E-04	ND	1	0
28-D	S	7/17/2000	VINYL CHLORIDE	1.4E-04	ND	1	0
28-D	S	10/16/2000	VINYL CHLORIDE	1.4E-04	ND	1	0
28-D	S	1/16/2001	VINYL CHLORIDE	1.4E-04	ND	1	0
28-D	S	4/23/2001	VINYL CHLORIDE	1.4E-04	ND	1	0
28-D	S	7/16/2001	VINYL CHLORIDE	1.1E-03		1	1
28-D	S	10/23/2001	VINYL CHLORIDE	1.4E-03		1	1
28-D	S	1/16/2002	VINYL CHLORIDE	1.4E-04	ND	1	0
28-D	S	4/8/2002	VINYL CHLORIDE	1.4E-04	ND	1	0
28-D	S	7/15/2002	VINYL CHLORIDE	1.1E-03		1	1
28-D	S	10/14/2002	VINYL CHLORIDE	1.4E-04	ND	1	0
28-D	S	1/13/2003	VINYL CHLORIDE	1.4E-04	ND	1	0
28-D	S	4/14/2003	VINYL CHLORIDE	1.4E-04	ND	1	0
28-D	S	7/14/2003	VINYL CHLORIDE	1.4E-04	ND	1	0
28-D	S	10/15/2003	VINYL CHLORIDE	1.4E-04	ND	1	0
28-D	S	1/26/2004	VINYL CHLORIDE	1.4E-04	ND	1	0
28-D	S	4/19/2004	VINYL CHLORIDE	2.2E-03		1	1

MAROS Mann-Kendall Statistics Summary

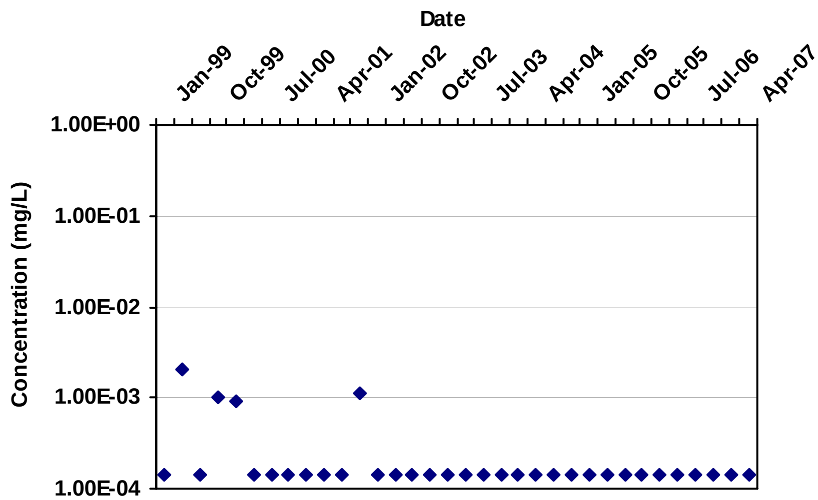
Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
28-D	S	7/26/2004	VINYL CHLORIDE	1.4E-04	ND	1	0
28-D	S	10/11/2004	VINYL CHLORIDE	1.4E-04	ND	1	0
28-D	S	1/10/2005	VINYL CHLORIDE	1.4E-04	ND	1	0
28-D	S	4/18/2005	VINYL CHLORIDE	1.4E-04	ND	1	0
28-D	S	7/26/2005	VINYL CHLORIDE	1.4E-04	ND	1	0
28-D	S	10/25/2005	VINYL CHLORIDE	1.4E-04	ND	1	0
28-D	S	1/9/2006	VINYL CHLORIDE	1.4E-04	ND	1	0
28-D	S	4/17/2006	VINYL CHLORIDE	1.4E-04	ND	1	0
28-D	S	7/10/2006	VINYL CHLORIDE	1.4E-04	ND	1	0
28-D	S	10/10/2006	VINYL CHLORIDE	1.4E-04	ND	1	0
28-D	S	1/10/2007	VINYL CHLORIDE	1.4E-04	ND	1	0
28-D	S	4/10/2007	VINYL CHLORIDE	1.4E-04	ND	1	0

Note: Increasing (I); Probably Increasing (PI); Stable (S); Probably Decreasing (PD); Decreasing (D); No Trend (NT); Not Applicable (N/A) - Due to insufficient Data (< 4 sampling events); ND = Non-detect

MAROS Mann-Kendall Statistics Summary

Well: 31-D
Well Type: T
COC: VINYL CHLORIDE

Time Period: 1/1/1999 **to** 4/15/2007
Consolidation Period: No Time Consolidation
Consolidation Type: Geometric Mean
Duplicate Consolidation: Average
ND Values: Specified Detection Limit
J Flag Values : Actual Value



Mann Kendall S Statistic: -96

Confidence in Trend: 92.0%

Coefficient of Variation: 1.46

Mann Kendall Concentration Trend: (See Note) PD

Data Table:

Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
31-D	T	1/19/1999	VINYL CHLORIDE	1.4E-04	ND	1	0
31-D	T	4/12/1999	VINYL CHLORIDE	2.0E-03		1	1
31-D	T	7/12/1999	VINYL CHLORIDE	1.4E-04	ND	1	0
31-D	T	10/18/1999	VINYL CHLORIDE	1.0E-03		1	1
31-D	T	1/10/2000	VINYL CHLORIDE	9.2E-04		2	1
31-D	T	4/17/2000	VINYL CHLORIDE	1.4E-04	ND	1	0
31-D	T	7/17/2000	VINYL CHLORIDE	1.4E-04	ND	1	0
31-D	T	10/16/2000	VINYL CHLORIDE	1.4E-04	ND	1	0
31-D	T	1/16/2001	VINYL CHLORIDE	1.4E-04	ND	1	0
31-D	T	4/23/2001	VINYL CHLORIDE	1.4E-04	ND	1	0
31-D	T	7/16/2001	VINYL CHLORIDE	1.4E-04	ND	1	0
31-D	T	10/23/2001	VINYL CHLORIDE	1.1E-03		1	1
31-D	T	1/16/2002	VINYL CHLORIDE	1.4E-04	ND	1	0
31-D	T	4/8/2002	VINYL CHLORIDE	1.4E-04	ND	1	0
31-D	T	7/15/2002	VINYL CHLORIDE	1.4E-04	ND	1	0
31-D	T	10/14/2002	VINYL CHLORIDE	1.4E-04	ND	1	0
31-D	T	1/13/2003	VINYL CHLORIDE	1.4E-04	ND	1	0
31-D	T	4/14/2003	VINYL CHLORIDE	1.4E-04	ND	1	0
31-D	T	7/14/2003	VINYL CHLORIDE	1.4E-04	ND	1	0
31-D	T	10/15/2003	VINYL CHLORIDE	1.4E-04	ND	1	0
31-D	T	1/26/2004	VINYL CHLORIDE	1.4E-04	ND	1	0
31-D	T	4/19/2004	VINYL CHLORIDE	1.4E-04	ND	1	0

MAROS Mann-Kendall Statistics Summary

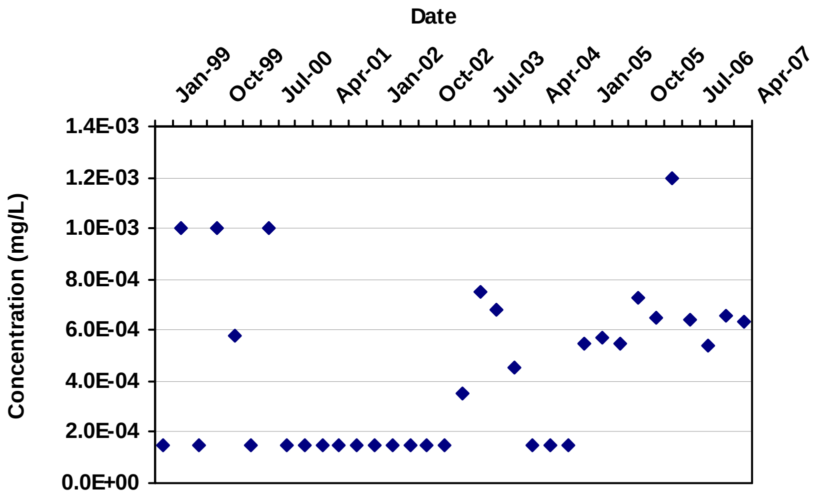
Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
31-D	T	7/26/2004	VINYL CHLORIDE	1.4E-04	ND	1	0
31-D	T	10/11/2004	VINYL CHLORIDE	1.4E-04	ND	1	0
31-D	T	1/10/2005	VINYL CHLORIDE	1.4E-04	ND	1	0
31-D	T	4/18/2005	VINYL CHLORIDE	1.4E-04	ND	1	0
31-D	T	7/26/2005	VINYL CHLORIDE	1.4E-04	ND	1	0
31-D	T	10/25/2005	VINYL CHLORIDE	1.4E-04	ND	1	0
31-D	T	1/9/2006	VINYL CHLORIDE	1.4E-04	ND	1	0
31-D	T	4/17/2006	VINYL CHLORIDE	1.4E-04	ND	1	0
31-D	T	7/10/2006	VINYL CHLORIDE	1.4E-04	ND	1	0
31-D	T	10/10/2006	VINYL CHLORIDE	1.4E-04	ND	1	0
31-D	T	1/10/2007	VINYL CHLORIDE	1.4E-04	ND	1	0
31-D	T	4/10/2007	VINYL CHLORIDE	1.4E-04	ND	1	0

Note: Increasing (I); Probably Increasing (PI); Stable (S); Probably Decreasing (PD); Decreasing (D); No Trend (NT); Not Applicable (N/A) - Due to insufficient Data (< 4 sampling events); ND = Non-detect

MAROS Mann-Kendall Statistics Summary

Well: 31-D
Well Type: T
COC: TRICHLOROETHYLENE (TCE)

Time Period: 1/1/1999 **to** 4/10/2007
Consolidation Period: No Time Consolidation
Consolidation Type: Median
Duplicate Consolidation: Average
ND Values: Specified Detection Limit
J Flag Values : Actual Value



Mann Kendall S Statistic: 129

Confidence in Trend: 97.1%

Coefficient of Variation: 0.73

Mann Kendall Concentration Trend: (See Note) I

Data Table:

Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
31-D	T	1/19/1999	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
31-D	T	4/12/1999	TRICHLOROETHYLENE (TCE)	1.0E-03		1	1
31-D	T	7/12/1999	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
31-D	T	10/18/1999	TRICHLOROETHYLENE (TCE)	1.0E-03		1	1
31-D	T	1/10/2000	TRICHLOROETHYLENE (TCE)	5.8E-04		2	1
31-D	T	4/17/2000	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
31-D	T	7/17/2000	TRICHLOROETHYLENE (TCE)	1.0E-03		1	1
31-D	T	10/16/2000	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
31-D	T	1/16/2001	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
31-D	T	4/23/2001	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
31-D	T	7/16/2001	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
31-D	T	10/23/2001	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
31-D	T	1/16/2002	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
31-D	T	4/8/2002	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
31-D	T	7/15/2002	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
31-D	T	10/14/2002	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
31-D	T	1/13/2003	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
31-D	T	4/14/2003	TRICHLOROETHYLENE (TCE)	3.5E-04		1	1
31-D	T	7/14/2003	TRICHLOROETHYLENE (TCE)	7.5E-04		1	1
31-D	T	10/15/2003	TRICHLOROETHYLENE (TCE)	6.8E-04		1	1
31-D	T	1/26/2004	TRICHLOROETHYLENE (TCE)	4.5E-04		1	1
31-D	T	4/19/2004	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0

MAROS Mann-Kendall Statistics Summary

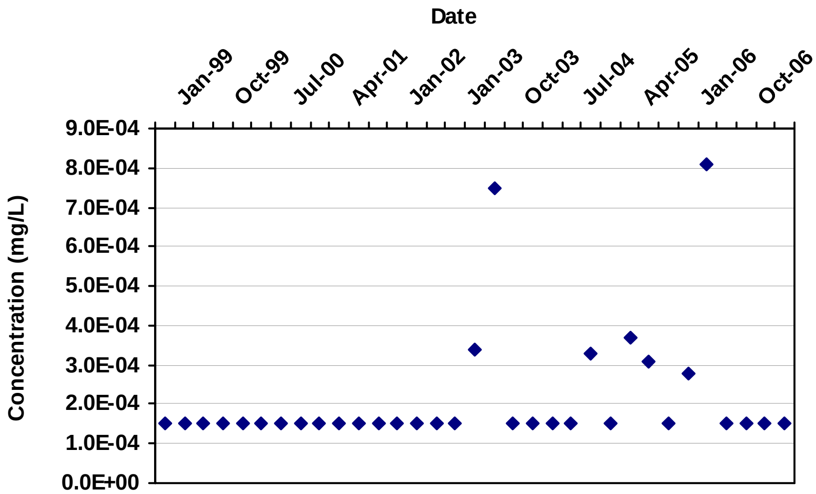
Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
31-D	T	7/26/2004	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
31-D	T	10/11/2004	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
31-D	T	1/10/2005	TRICHLOROETHYLENE (TCE)	5.5E-04		1	1
31-D	T	4/18/2005	TRICHLOROETHYLENE (TCE)	5.7E-04		1	1
31-D	T	7/26/2005	TRICHLOROETHYLENE (TCE)	5.5E-04		1	1
31-D	T	10/25/2005	TRICHLOROETHYLENE (TCE)	7.3E-04		1	1
31-D	T	1/9/2006	TRICHLOROETHYLENE (TCE)	6.5E-04		1	1
31-D	T	4/17/2006	TRICHLOROETHYLENE (TCE)	1.2E-03		1	1
31-D	T	7/10/2006	TRICHLOROETHYLENE (TCE)	6.4E-04		1	1
31-D	T	10/10/2006	TRICHLOROETHYLENE (TCE)	5.4E-04		1	1
31-D	T	1/10/2007	TRICHLOROETHYLENE (TCE)	6.6E-04		1	1
31-D	T	4/10/2007	TRICHLOROETHYLENE (TCE)	6.3E-04		1	1

Note: Increasing (I); Probably Increasing (PI); Stable (S); Probably Decreasing (PD); Decreasing (D); No Trend (NT); Not Applicable (N/A) - Due to insufficient Data (< 4 sampling events); ND = Non-detect

MAROS Mann-Kendall Statistics Summary

Well: 32-D
Well Type: T
COC: TRICHLOROETHYLENE (TCE)

Time Period: 1/1/1999 **to** 4/10/2007
Consolidation Period: No Time Consolidation
Consolidation Type: Median
Duplicate Consolidation: Average
ND Values: Specified Detection Limit
J Flag Values : Actual Value



Mann Kendall S Statistic: 91

Confidence in Trend: 91.8%

Coefficient of Variation: 0.74

Mann Kendall Concentration Trend: (See Note) PI

Data Table:

Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
32-D	T	1/19/1999	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
32-D	T	4/12/1999	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
32-D	T	7/12/1999	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
32-D	T	10/18/1999	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
32-D	T	1/10/2000	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
32-D	T	4/17/2000	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
32-D	T	7/17/2000	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
32-D	T	10/16/2000	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
32-D	T	1/16/2001	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
32-D	T	4/23/2001	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
32-D	T	7/16/2001	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
32-D	T	10/23/2001	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
32-D	T	1/16/2002	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
32-D	T	4/8/2002	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
32-D	T	7/15/2002	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
32-D	T	1/13/2003	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
32-D	T	4/14/2003	TRICHLOROETHYLENE (TCE)	3.4E-04		1	1
32-D	T	7/14/2003	TRICHLOROETHYLENE (TCE)	7.5E-04		1	1
32-D	T	10/15/2003	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	2	0
32-D	T	1/26/2004	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
32-D	T	4/19/2004	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
32-D	T	7/26/2004	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0

MAROS Mann-Kendall Statistics Summary

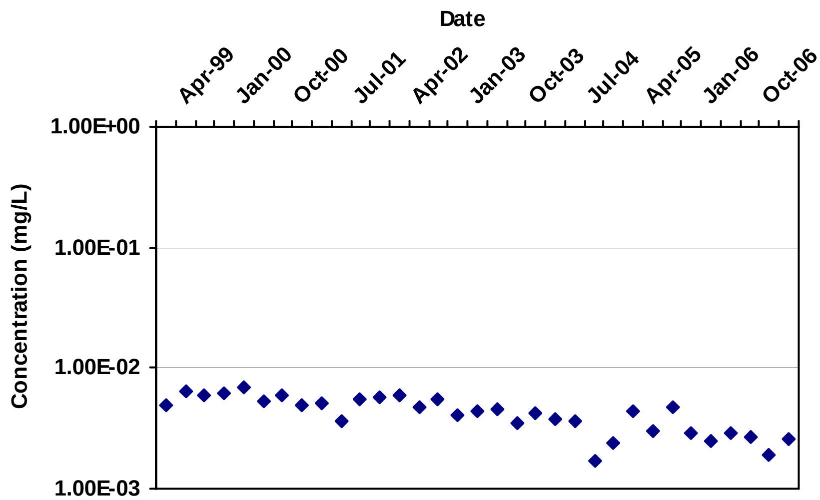
Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
32-D	T	10/11/2004	TRICHLOROETHYLENE (TCE)	3.3E-04		1	1
32-D	T	1/10/2005	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
32-D	T	4/18/2005	TRICHLOROETHYLENE (TCE)	3.7E-04		1	1
32-D	T	7/26/2005	TRICHLOROETHYLENE (TCE)	3.1E-04		1	1
32-D	T	10/25/2005	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
32-D	T	1/9/2006	TRICHLOROETHYLENE (TCE)	2.8E-04		1	1
32-D	T	4/17/2006	TRICHLOROETHYLENE (TCE)	8.1E-04		1	1
32-D	T	7/10/2006	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
32-D	T	10/10/2006	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
32-D	T	1/10/2007	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
32-D	T	4/10/2007	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0

Note: Increasing (I); Probably Increasing (PI); Stable (S); Probably Decreasing (PD); Decreasing (D); No Trend (NT); Not Applicable (N/A) - Due to insufficient Data (< 4 sampling events); ND = Non-detect

MAROS Mann-Kendall Statistics Summary

Well: C-2
Well Type: S
COC: VINYL CHLORIDE

Time Period: 1/1/1999 **to** 4/15/2007
Consolidation Period: No Time Consolidation
Consolidation Type: Geometric Mean
Duplicate Consolidation: Average
ND Values: Specified Detection Limit
J Flag Values : Actual Value



Mann Kendall S Statistic: -345

Confidence in Trend: 100.0%

Coefficient of Variation: 0.33

Mann Kendall Concentration Trend: (See Note) D

Data Table:

Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
C-2	S	4/12/1999	VINYL CHLORIDE	5.0E-03		1	1
C-2	S	7/12/1999	VINYL CHLORIDE	6.5E-03		2	2
C-2	S	10/18/1999	VINYL CHLORIDE	6.0E-03		1	1
C-2	S	1/10/2000	VINYL CHLORIDE	6.3E-03		1	1
C-2	S	4/17/2000	VINYL CHLORIDE	7.0E-03		1	1
C-2	S	7/17/2000	VINYL CHLORIDE	5.4E-03		1	1
C-2	S	10/16/2000	VINYL CHLORIDE	5.9E-03		1	1
C-2	S	1/16/2001	VINYL CHLORIDE	4.9E-03		1	1
C-2	S	4/23/2001	VINYL CHLORIDE	5.1E-03		1	1
C-2	S	7/16/2001	VINYL CHLORIDE	3.6E-03		1	1
C-2	S	10/23/2001	VINYL CHLORIDE	5.6E-03		1	1
C-2	S	1/16/2002	VINYL CHLORIDE	5.7E-03		1	1
C-2	S	4/8/2002	VINYL CHLORIDE	6.0E-03		1	1
C-2	S	7/15/2002	VINYL CHLORIDE	4.7E-03		1	1
C-2	S	10/14/2002	VINYL CHLORIDE	5.5E-03		1	1
C-2	S	1/13/2003	VINYL CHLORIDE	4.1E-03		1	1
C-2	S	4/14/2003	VINYL CHLORIDE	4.4E-03		1	1
C-2	S	7/14/2003	VINYL CHLORIDE	4.6E-03		1	1
C-2	S	10/15/2003	VINYL CHLORIDE	3.5E-03		1	1
C-2	S	1/26/2004	VINYL CHLORIDE	4.2E-03		1	1
C-2	S	4/19/2004	VINYL CHLORIDE	3.8E-03		1	1
C-2	S	7/26/2004	VINYL CHLORIDE	3.6E-03		1	1

MAROS Mann-Kendall Statistics Summary

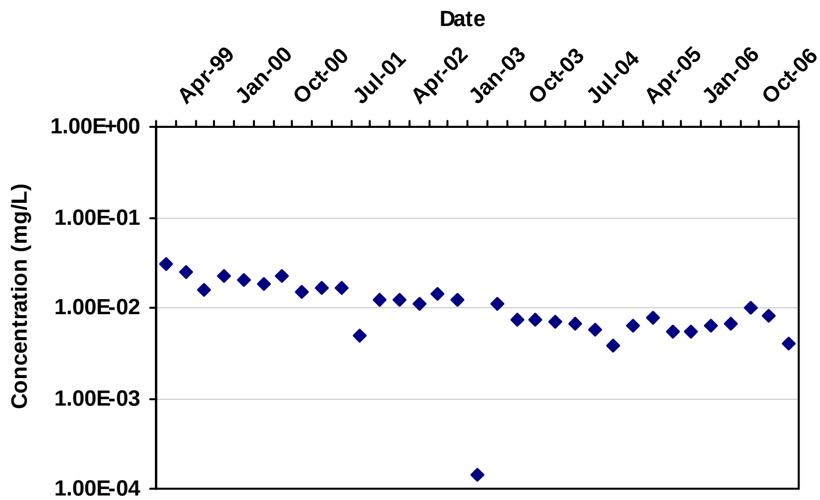
Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
C-2	S	10/11/2004	VINYL CHLORIDE	1.7E-03		1	1
C-2	S	1/10/2005	VINYL CHLORIDE	2.4E-03		1	1
C-2	S	4/18/2005	VINYL CHLORIDE	4.4E-03		1	1
C-2	S	7/26/2005	VINYL CHLORIDE	3.1E-03		1	1
C-2	S	10/25/2005	VINYL CHLORIDE	4.7E-03		1	1
C-2	S	1/9/2006	VINYL CHLORIDE	2.9E-03		1	1
C-2	S	4/17/2006	VINYL CHLORIDE	2.5E-03		1	1
C-2	S	7/10/2006	VINYL CHLORIDE	2.9E-03		1	1
C-2	S	10/10/2006	VINYL CHLORIDE	2.7E-03		1	1
C-2	S	1/10/2007	VINYL CHLORIDE	1.9E-03		1	1
C-2	S	4/10/2007	VINYL CHLORIDE	2.6E-03		1	1

Note: Increasing (I); Probably Increasing (PI); Stable (S); Probably Decreasing (PD); Decreasing (D); No Trend (NT); Not Applicable (N/A) - Due to insufficient Data (< 4 sampling events); ND = Non-detect

MAROS Mann-Kendall Statistics Summary

Well: C-5
Well Type: S
COC: VINYL CHLORIDE

Time Period: 1/1/1999 **to** 4/15/2007
Consolidation Period: No Time Consolidation
Consolidation Type: Geometric Mean
Duplicate Consolidation: Average
ND Values: Specified Detection Limit
J Flag Values : Actual Value



Mann Kendall S Statistic:
-330

Confidence in Trend:
100.0%

Coefficient of Variation:
0.61

Mann Kendall Concentration Trend: (See Note)
D

Data Table:

Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
C-5	S	4/12/1999	VINYL CHLORIDE	3.0E-02		1	1
C-5	S	7/12/1999	VINYL CHLORIDE	2.5E-02		2	2
C-5	S	10/18/1999	VINYL CHLORIDE	1.6E-02		1	1
C-5	S	1/10/2000	VINYL CHLORIDE	2.3E-02		1	1
C-5	S	4/17/2000	VINYL CHLORIDE	2.0E-02		1	1
C-5	S	7/17/2000	VINYL CHLORIDE	1.8E-02		1	1
C-5	S	10/16/2000	VINYL CHLORIDE	2.2E-02		1	1
C-5	S	1/16/2001	VINYL CHLORIDE	1.5E-02		1	1
C-5	S	4/23/2001	VINYL CHLORIDE	1.7E-02		1	1
C-5	S	7/16/2001	VINYL CHLORIDE	1.7E-02		1	1
C-5	S	10/23/2001	VINYL CHLORIDE	5.0E-03		1	1
C-5	S	1/16/2002	VINYL CHLORIDE	1.2E-02		1	1
C-5	S	4/8/2002	VINYL CHLORIDE	1.2E-02		1	1
C-5	S	7/15/2002	VINYL CHLORIDE	1.1E-02		1	1
C-5	S	10/14/2002	VINYL CHLORIDE	1.4E-02		1	1
C-5	S	1/13/2003	VINYL CHLORIDE	1.2E-02		1	1
C-5	S	4/14/2003	VINYL CHLORIDE	1.4E-04	ND	1	0
C-5	S	7/14/2003	VINYL CHLORIDE	1.1E-02		1	1
C-5	S	10/15/2003	VINYL CHLORIDE	7.5E-03		1	1
C-5	S	1/26/2004	VINYL CHLORIDE	7.3E-03		1	1
C-5	S	4/19/2004	VINYL CHLORIDE	6.9E-03		1	1
C-5	S	7/26/2004	VINYL CHLORIDE	6.6E-03		1	1

MAROS Mann-Kendall Statistics Summary

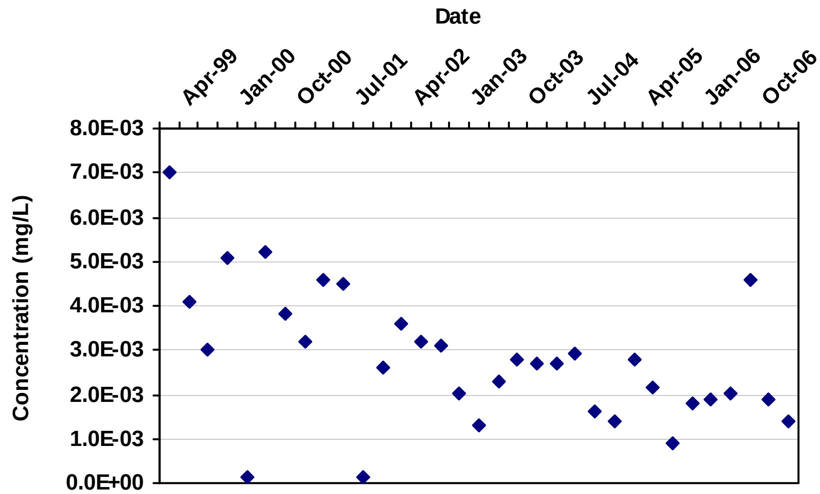
Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
C-5	S	10/11/2004	VINYL CHLORIDE	5.6E-03		1	1
C-5	S	1/10/2005	VINYL CHLORIDE	3.9E-03		1	1
C-5	S	4/18/2005	VINYL CHLORIDE	6.5E-03		1	1
C-5	S	7/26/2005	VINYL CHLORIDE	7.7E-03		1	1
C-5	S	10/25/2005	VINYL CHLORIDE	5.4E-03		1	1
C-5	S	1/9/2006	VINYL CHLORIDE	5.4E-03		1	1
C-5	S	4/17/2006	VINYL CHLORIDE	6.2E-03		1	1
C-5	S	7/10/2006	VINYL CHLORIDE	6.8E-03		1	1
C-5	S	10/10/2006	VINYL CHLORIDE	1.0E-02		1	1
C-5	S	1/10/2007	VINYL CHLORIDE	8.1E-03		1	1
C-5	S	4/10/2007	VINYL CHLORIDE	4.1E-03		1	1

Note: Increasing (I); Probably Increasing (PI); Stable (S); Probably Decreasing (PD); Decreasing (D); No Trend (NT); Not Applicable (N/A) - Due to insufficient Data (< 4 sampling events); ND = Non-detect

MAROS Mann-Kendall Statistics Summary

Well: C-5
Well Type: S
COC: TRICHLOROETHYLENE (TCE)

Time Period: 1/1/1999 **to** 4/10/2007
Consolidation Period: No Time Consolidation
Consolidation Type: Median
Duplicate Consolidation: Average
ND Values: Specified Detection Limit
J Flag Values : Actual Value



Mann Kendall S Statistic: -216

Confidence in Trend: 100.0%

Coefficient of Variation: 0.53

Mann Kendall Concentration Trend: (See Note) D

Data Table:

Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
C-5	S	4/12/1999	TRICHLOROETHYLENE (TCE)	7.0E-03		1	1
C-5	S	7/12/1999	TRICHLOROETHYLENE (TCE)	4.1E-03		2	1
C-5	S	10/18/1999	TRICHLOROETHYLENE (TCE)	3.0E-03		1	1
C-5	S	1/10/2000	TRICHLOROETHYLENE (TCE)	5.1E-03		1	1
C-5	S	4/17/2000	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
C-5	S	7/17/2000	TRICHLOROETHYLENE (TCE)	5.2E-03		1	1
C-5	S	10/16/2000	TRICHLOROETHYLENE (TCE)	3.8E-03		1	1
C-5	S	1/16/2001	TRICHLOROETHYLENE (TCE)	3.2E-03		1	1
C-5	S	4/23/2001	TRICHLOROETHYLENE (TCE)	4.6E-03		1	1
C-5	S	7/16/2001	TRICHLOROETHYLENE (TCE)	4.5E-03		1	1
C-5	S	10/23/2001	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
C-5	S	1/16/2002	TRICHLOROETHYLENE (TCE)	2.6E-03		1	1
C-5	S	4/8/2002	TRICHLOROETHYLENE (TCE)	3.6E-03		1	1
C-5	S	7/15/2002	TRICHLOROETHYLENE (TCE)	3.2E-03		1	1
C-5	S	10/14/2002	TRICHLOROETHYLENE (TCE)	3.1E-03		1	1
C-5	S	1/13/2003	TRICHLOROETHYLENE (TCE)	2.0E-03		1	1
C-5	S	4/14/2003	TRICHLOROETHYLENE (TCE)	1.3E-03		1	1
C-5	S	7/14/2003	TRICHLOROETHYLENE (TCE)	2.3E-03		1	1
C-5	S	10/15/2003	TRICHLOROETHYLENE (TCE)	2.8E-03		1	1
C-5	S	1/26/2004	TRICHLOROETHYLENE (TCE)	2.7E-03		1	1
C-5	S	4/19/2004	TRICHLOROETHYLENE (TCE)	2.7E-03		1	1
C-5	S	7/26/2004	TRICHLOROETHYLENE (TCE)	2.9E-03		1	1

MAROS Mann-Kendall Statistics Summary

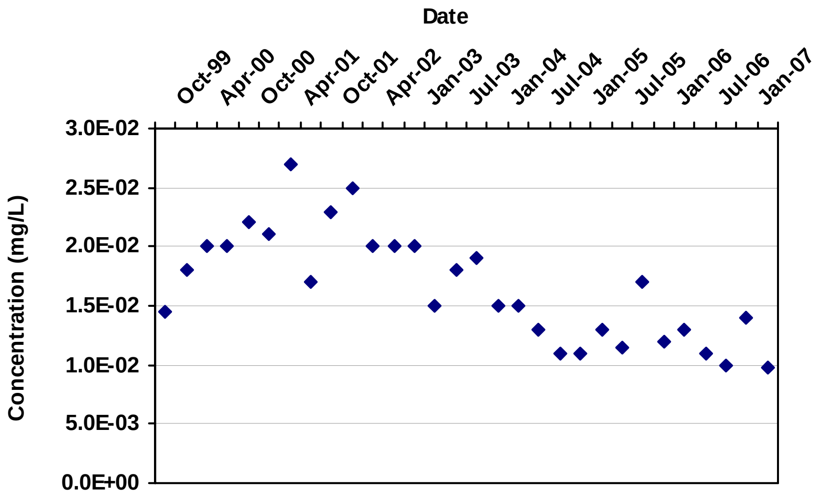
Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
C-5	S	10/11/2004	TRICHLOROETHYLENE (TCE)	1.6E-03		1	1
C-5	S	1/10/2005	TRICHLOROETHYLENE (TCE)	1.4E-03		1	1
C-5	S	4/18/2005	TRICHLOROETHYLENE (TCE)	2.8E-03		1	1
C-5	S	7/26/2005	TRICHLOROETHYLENE (TCE)	2.2E-03		1	1
C-5	S	10/25/2005	TRICHLOROETHYLENE (TCE)	8.9E-04		1	1
C-5	S	1/9/2006	TRICHLOROETHYLENE (TCE)	1.8E-03		1	1
C-5	S	4/17/2006	TRICHLOROETHYLENE (TCE)	1.9E-03		1	1
C-5	S	7/10/2006	TRICHLOROETHYLENE (TCE)	2.0E-03		1	1
C-5	S	10/10/2006	TRICHLOROETHYLENE (TCE)	4.6E-03		1	1
C-5	S	1/10/2007	TRICHLOROETHYLENE (TCE)	1.9E-03		1	1
C-5	S	4/10/2007	TRICHLOROETHYLENE (TCE)	1.4E-03		1	1

Note: Increasing (I); Probably Increasing (PI); Stable (S); Probably Decreasing (PD); Decreasing (D); No Trend (NT); Not Applicable (N/A) - Due to insufficient Data (< 4 sampling events); ND = Non-detect

MAROS Mann-Kendall Statistics Summary

Well: C-6
Well Type: S
COC: VINYL CHLORIDE

Time Period: 1/1/1999 **to** 4/15/2007
Consolidation Period: No Time Consolidation
Consolidation Type: Geometric Mean
Duplicate Consolidation: Average
ND Values: Specified Detection Limit
J Flag Values : Actual Value



Mann Kendall S Statistic: -246

Confidence in Trend: 100.0%

Coefficient of Variation: 0.28

Mann Kendall Concentration Trend: (See Note) D

Data Table:

Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
C-6	S	10/18/1999	VINYL CHLORIDE	1.5E-02		2	2
C-6	S	1/10/2000	VINYL CHLORIDE	1.8E-02		1	1
C-6	S	4/17/2000	VINYL CHLORIDE	2.0E-02		1	1
C-6	S	7/17/2000	VINYL CHLORIDE	2.0E-02		1	1
C-6	S	10/16/2000	VINYL CHLORIDE	2.2E-02		1	1
C-6	S	1/16/2001	VINYL CHLORIDE	2.1E-02		1	1
C-6	S	4/23/2001	VINYL CHLORIDE	2.7E-02		1	1
C-6	S	7/16/2001	VINYL CHLORIDE	1.7E-02		1	1
C-6	S	10/23/2001	VINYL CHLORIDE	2.3E-02		1	1
C-6	S	1/16/2002	VINYL CHLORIDE	2.5E-02		1	1
C-6	S	4/8/2002	VINYL CHLORIDE	2.0E-02		1	1
C-6	S	10/14/2002	VINYL CHLORIDE	2.0E-02		1	1
C-6	S	1/13/2003	VINYL CHLORIDE	2.0E-02		1	1
C-6	S	4/14/2003	VINYL CHLORIDE	1.5E-02		1	1
C-6	S	7/14/2003	VINYL CHLORIDE	1.8E-02		1	1
C-6	S	10/15/2003	VINYL CHLORIDE	1.9E-02		1	1
C-6	S	1/26/2004	VINYL CHLORIDE	1.5E-02		1	1
C-6	S	4/19/2004	VINYL CHLORIDE	1.5E-02		1	1
C-6	S	7/26/2004	VINYL CHLORIDE	1.3E-02		1	1
C-6	S	10/11/2004	VINYL CHLORIDE	1.1E-02		1	1
C-6	S	1/10/2005	VINYL CHLORIDE	1.1E-02		1	1
C-6	S	4/18/2005	VINYL CHLORIDE	1.3E-02		1	1

MAROS Mann-Kendall Statistics Summary

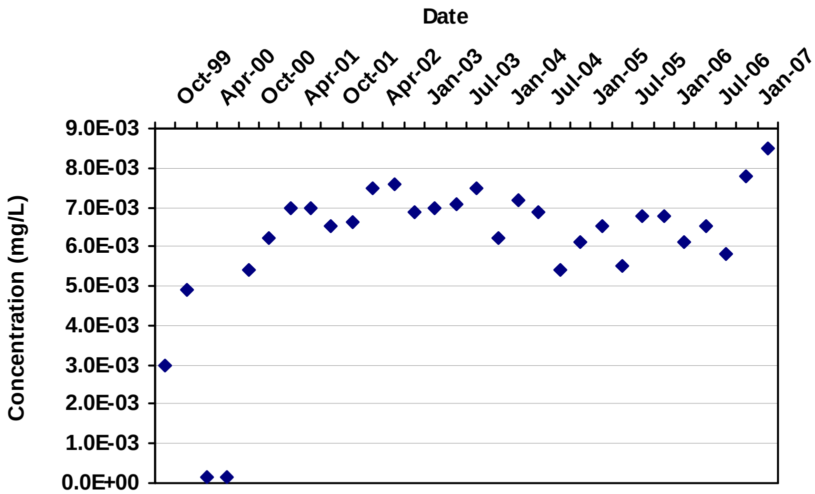
Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
C-6	S	7/26/2005	VINYL CHLORIDE	1.2E-02		1	1
C-6	S	10/25/2005	VINYL CHLORIDE	1.7E-02		1	1
C-6	S	1/9/2006	VINYL CHLORIDE	1.2E-02		1	1
C-6	S	4/17/2006	VINYL CHLORIDE	1.3E-02		1	1
C-6	S	7/10/2006	VINYL CHLORIDE	1.1E-02		1	1
C-6	S	10/10/2006	VINYL CHLORIDE	1.0E-02		1	1
C-6	S	1/10/2007	VINYL CHLORIDE	1.4E-02		1	1
C-6	S	4/10/2007	VINYL CHLORIDE	9.7E-03		1	1

Note: Increasing (I); Probably Increasing (PI); Stable (S); Probably Decreasing (PD); Decreasing (D); No Trend (NT); Not Applicable (N/A) - Due to insufficient Data (< 4 sampling events); ND = Non-detect

MAROS Mann-Kendall Statistics Summary

Well: C-6
Well Type: S
COC: TRICHLOROETHYLENE (TCE)

Time Period: 1/1/1999 **to** 4/10/2007
Consolidation Period: No Time Consolidation
Consolidation Type: Geometric Mean
Duplicate Consolidation: Average
ND Values: Specified Detection Limit
J Flag Values : Actual Value



Mann Kendall S Statistic: 96

Confidence in Trend: 95.5%

Coefficient of Variation: 0.31

Mann Kendall Concentration Trend: (See Note) I

Data Table:

Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
C-6	S	10/18/1999	TRICHLOROETHYLENE (TCE)	3.0E-03		2	2
C-6	S	1/10/2000	TRICHLOROETHYLENE (TCE)	4.9E-03		1	1
C-6	S	4/17/2000	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
C-6	S	7/17/2000	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
C-6	S	10/16/2000	TRICHLOROETHYLENE (TCE)	5.4E-03		1	1
C-6	S	1/16/2001	TRICHLOROETHYLENE (TCE)	6.2E-03		1	1
C-6	S	4/23/2001	TRICHLOROETHYLENE (TCE)	7.0E-03		1	1
C-6	S	7/16/2001	TRICHLOROETHYLENE (TCE)	7.0E-03		1	1
C-6	S	10/23/2001	TRICHLOROETHYLENE (TCE)	6.5E-03		1	1
C-6	S	1/16/2002	TRICHLOROETHYLENE (TCE)	6.6E-03		1	1
C-6	S	4/8/2002	TRICHLOROETHYLENE (TCE)	7.5E-03		1	1
C-6	S	10/14/2002	TRICHLOROETHYLENE (TCE)	7.6E-03		1	1
C-6	S	1/13/2003	TRICHLOROETHYLENE (TCE)	6.9E-03		1	1
C-6	S	4/14/2003	TRICHLOROETHYLENE (TCE)	7.0E-03		1	1
C-6	S	7/14/2003	TRICHLOROETHYLENE (TCE)	7.1E-03		1	1
C-6	S	10/15/2003	TRICHLOROETHYLENE (TCE)	7.5E-03		1	1
C-6	S	1/26/2004	TRICHLOROETHYLENE (TCE)	6.2E-03		1	1
C-6	S	4/19/2004	TRICHLOROETHYLENE (TCE)	7.2E-03		1	1
C-6	S	7/26/2004	TRICHLOROETHYLENE (TCE)	6.9E-03		1	1
C-6	S	10/11/2004	TRICHLOROETHYLENE (TCE)	5.4E-03		1	1
C-6	S	1/10/2005	TRICHLOROETHYLENE (TCE)	6.1E-03		1	1
C-6	S	4/18/2005	TRICHLOROETHYLENE (TCE)	6.5E-03		1	1

MAROS Mann-Kendall Statistics Summary

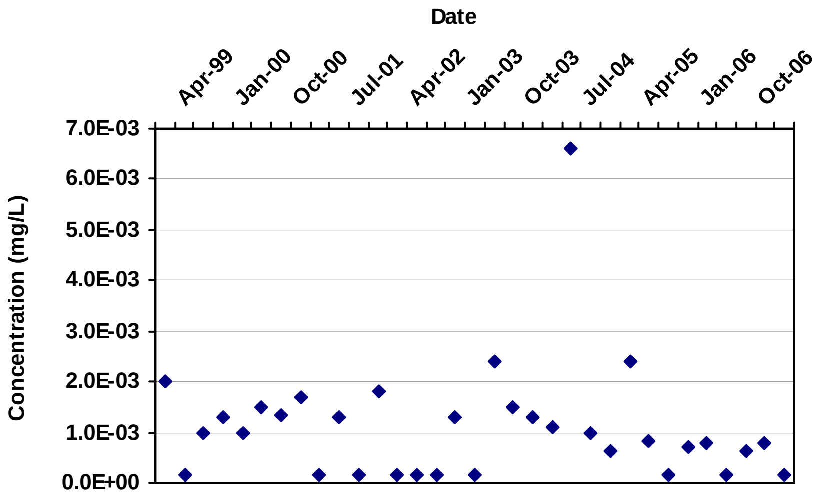
Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
C-6	S	7/26/2005	TRICHLOROETHYLENE (TCE)	5.5E-03		1	1
C-6	S	10/25/2005	TRICHLOROETHYLENE (TCE)	6.8E-03		1	1
C-6	S	1/9/2006	TRICHLOROETHYLENE (TCE)	6.8E-03		1	1
C-6	S	4/17/2006	TRICHLOROETHYLENE (TCE)	6.1E-03		1	1
C-6	S	7/10/2006	TRICHLOROETHYLENE (TCE)	6.5E-03		1	1
C-6	S	10/10/2006	TRICHLOROETHYLENE (TCE)	5.8E-03		1	1
C-6	S	1/10/2007	TRICHLOROETHYLENE (TCE)	7.8E-03		1	1
C-6	S	4/10/2007	TRICHLOROETHYLENE (TCE)	8.5E-03		1	1

Note: Increasing (I); Probably Increasing (PI); Stable (S); Probably Decreasing (PD); Decreasing (D); No Trend (NT); Not Applicable (N/A) - Due to insufficient Data (< 4 sampling events); ND = Non-detect

MAROS Mann-Kendall Statistics Summary

Well: F-1A
Well Type: T
COC: VINYL CHLORIDE

Time Period: 1/1/1999 **to** 4/15/2007
Consolidation Period: No Time Consolidation
Consolidation Type: Geometric Mean
Duplicate Consolidation: Average
ND Values: Specified Detection Limit
J Flag Values : Actual Value



Mann Kendall S Statistic: -82

Confidence in Trend: 89.4%

Coefficient of Variation: 1.09

Mann Kendall Concentration Trend: (See Note) NT

Data Table:

Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
F-1A	T	4/12/1999	VINYL CHLORIDE	2.0E-03		1	1
F-1A	T	7/12/1999	VINYL CHLORIDE	1.4E-04	ND	1	0
F-1A	T	10/18/1999	VINYL CHLORIDE	1.0E-03		1	1
F-1A	T	1/10/2000	VINYL CHLORIDE	1.3E-03		2	2
F-1A	T	4/17/2000	VINYL CHLORIDE	1.0E-03		1	1
F-1A	T	7/17/2000	VINYL CHLORIDE	1.5E-03		2	2
F-1A	T	10/16/2000	VINYL CHLORIDE	1.4E-03		2	2
F-1A	T	1/16/2001	VINYL CHLORIDE	1.7E-03		1	1
F-1A	T	4/23/2001	VINYL CHLORIDE	1.4E-04	ND	1	0
F-1A	T	7/16/2001	VINYL CHLORIDE	1.3E-03		1	1
F-1A	T	10/23/2001	VINYL CHLORIDE	1.4E-04	ND	1	0
F-1A	T	1/16/2002	VINYL CHLORIDE	1.8E-03		1	1
F-1A	T	4/8/2002	VINYL CHLORIDE	1.4E-04	ND	1	0
F-1A	T	7/15/2002	VINYL CHLORIDE	1.4E-04	ND	1	0
F-1A	T	10/14/2002	VINYL CHLORIDE	1.4E-04	ND	1	0
F-1A	T	1/13/2003	VINYL CHLORIDE	1.3E-03		1	1
F-1A	T	4/14/2003	VINYL CHLORIDE	1.4E-04	ND	1	0
F-1A	T	7/14/2003	VINYL CHLORIDE	2.4E-03		1	1
F-1A	T	10/15/2003	VINYL CHLORIDE	1.5E-03		1	1
F-1A	T	1/26/2004	VINYL CHLORIDE	1.3E-03		1	1
F-1A	T	4/19/2004	VINYL CHLORIDE	1.1E-03		1	1
F-1A	T	7/26/2004	VINYL CHLORIDE	6.6E-03		1	1

MAROS Mann-Kendall Statistics Summary

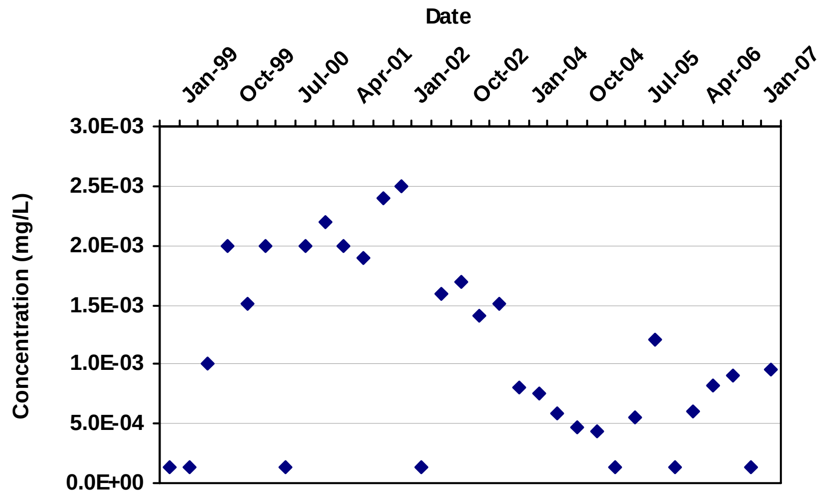
Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
F-1A	T	10/11/2004	VINYL CHLORIDE	9.9E-04		1	1
F-1A	T	1/10/2005	VINYL CHLORIDE	6.4E-04		1	1
F-1A	T	4/18/2005	VINYL CHLORIDE	2.4E-03		1	1
F-1A	T	7/26/2005	VINYL CHLORIDE	8.2E-04		1	1
F-1A	T	10/25/2005	VINYL CHLORIDE	1.4E-04	ND	1	0
F-1A	T	1/9/2006	VINYL CHLORIDE	7.0E-04		1	1
F-1A	T	4/17/2006	VINYL CHLORIDE	7.7E-04		1	1
F-1A	T	7/10/2006	VINYL CHLORIDE	1.4E-04	ND	1	0
F-1A	T	10/10/2006	VINYL CHLORIDE	6.1E-04		1	1
F-1A	T	1/10/2007	VINYL CHLORIDE	8.0E-04		1	1
F-1A	T	4/10/2007	VINYL CHLORIDE	1.4E-04	ND	1	0

Note: Increasing (I); Probably Increasing (PI); Stable (S); Probably Decreasing (PD); Decreasing (D); No Trend (NT); Not Applicable (N/A) - Due to insufficient Data (< 4 sampling events); ND = Non-detect

MAROS Mann-Kendall Statistics Summary

Well: F-2
Well Type: S
COC: VINYL CHLORIDE

Time Period: 1/1/1999 **to** 4/15/2007
Consolidation Period: No Time Consolidation
Consolidation Type: Geometric Mean
Duplicate Consolidation: Average
ND Values: Specified Detection Limit
J Flag Values : Actual Value



Mann Kendall S Statistic: -120

Confidence in Trend: 97.3%

Coefficient of Variation: 0.71

Mann Kendall Concentration Trend: (See Note) D

Data Table:

Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
F-2	S	1/19/1999	VINYL CHLORIDE	1.4E-04	ND	1	0
F-2	S	4/12/1999	VINYL CHLORIDE	1.4E-04	ND	1	0
F-2	S	7/12/1999	VINYL CHLORIDE	1.0E-03		1	1
F-2	S	10/18/1999	VINYL CHLORIDE	2.0E-03		1	1
F-2	S	1/10/2000	VINYL CHLORIDE	1.5E-03		2	2
F-2	S	4/17/2000	VINYL CHLORIDE	2.0E-03		1	1
F-2	S	7/17/2000	VINYL CHLORIDE	1.4E-04	ND	1	0
F-2	S	10/16/2000	VINYL CHLORIDE	2.0E-03		1	1
F-2	S	1/16/2001	VINYL CHLORIDE	2.2E-03		1	1
F-2	S	4/23/2001	VINYL CHLORIDE	2.0E-03		1	1
F-2	S	7/16/2001	VINYL CHLORIDE	1.9E-03		1	1
F-2	S	10/23/2001	VINYL CHLORIDE	2.4E-03		1	1
F-2	S	1/16/2002	VINYL CHLORIDE	2.5E-03		1	1
F-2	S	4/8/2002	VINYL CHLORIDE	1.4E-04	ND	1	0
F-2	S	7/15/2002	VINYL CHLORIDE	1.6E-03		1	1
F-2	S	10/14/2002	VINYL CHLORIDE	1.7E-03		1	1
F-2	S	1/13/2003	VINYL CHLORIDE	1.4E-03		1	1
F-2	S	10/15/2003	VINYL CHLORIDE	1.5E-03		1	1
F-2	S	1/26/2004	VINYL CHLORIDE	8.1E-04		1	1
F-2	S	4/19/2004	VINYL CHLORIDE	7.6E-04		1	1
F-2	S	7/26/2004	VINYL CHLORIDE	5.8E-04		1	1
F-2	S	10/11/2004	VINYL CHLORIDE	4.7E-04		1	1

MAROS Mann-Kendall Statistics Summary

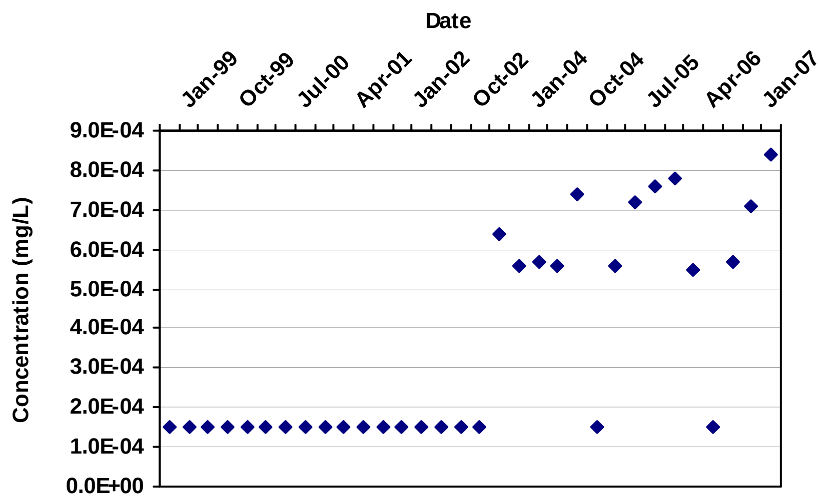
Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
F-2	S	1/10/2005	VINYL CHLORIDE	4.3E-04		1	1
F-2	S	4/18/2005	VINYL CHLORIDE	1.4E-04	ND	1	0
F-2	S	7/26/2005	VINYL CHLORIDE	5.5E-04		1	1
F-2	S	10/25/2005	VINYL CHLORIDE	1.2E-03		1	1
F-2	S	1/9/2006	VINYL CHLORIDE	1.4E-04	ND	1	0
F-2	S	4/17/2006	VINYL CHLORIDE	6.1E-04		1	1
F-2	S	7/10/2006	VINYL CHLORIDE	8.2E-04		1	1
F-2	S	10/10/2006	VINYL CHLORIDE	9.0E-04		1	1
F-2	S	1/10/2007	VINYL CHLORIDE	1.4E-04	ND	1	0
F-2	S	4/10/2007	VINYL CHLORIDE	9.5E-04		1	1

Note: Increasing (I); Probably Increasing (PI); Stable (S); Probably Decreasing (PD); Decreasing (D); No Trend (NT); Not Applicable (N/A) - Due to insufficient Data (< 4 sampling events); ND = Non-detect

MAROS Mann-Kendall Statistics Summary

Well: F-2
Well Type: S
COC: TRICHLOROETHYLENE (TCE)

Time Period: 1/1/1999 **to** 4/10/2007
Consolidation Period: No Time Consolidation
Consolidation Type: Median
Duplicate Consolidation: Average
ND Values: Specified Detection Limit
J Flag Values : Actual Value



Mann Kendall S Statistic: 239

Confidence in Trend: 100.0%

Coefficient of Variation: 0.73

Mann Kendall Concentration Trend: (See Note) I

Data Table:

Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
F-2	S	1/19/1999	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
F-2	S	4/12/1999	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
F-2	S	7/12/1999	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
F-2	S	10/18/1999	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
F-2	S	1/10/2000	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	2	0
F-2	S	4/17/2000	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
F-2	S	7/17/2000	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
F-2	S	10/16/2000	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
F-2	S	1/16/2001	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
F-2	S	4/23/2001	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
F-2	S	7/16/2001	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
F-2	S	10/23/2001	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
F-2	S	1/16/2002	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
F-2	S	4/8/2002	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
F-2	S	7/15/2002	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
F-2	S	10/14/2002	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
F-2	S	1/13/2003	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
F-2	S	10/15/2003	TRICHLOROETHYLENE (TCE)	6.4E-04		1	1
F-2	S	1/26/2004	TRICHLOROETHYLENE (TCE)	5.6E-04		1	1
F-2	S	4/19/2004	TRICHLOROETHYLENE (TCE)	5.7E-04		1	1
F-2	S	7/26/2004	TRICHLOROETHYLENE (TCE)	5.6E-04		1	1
F-2	S	10/11/2004	TRICHLOROETHYLENE (TCE)	7.4E-04		1	1

MAROS Mann-Kendall Statistics Summary

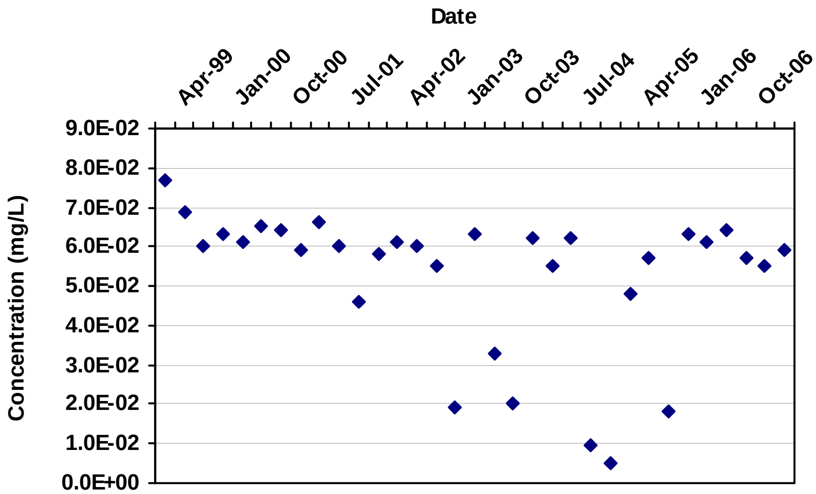
Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
F-2	S	1/10/2005	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
F-2	S	4/18/2005	TRICHLOROETHYLENE (TCE)	5.6E-04		1	1
F-2	S	7/26/2005	TRICHLOROETHYLENE (TCE)	7.2E-04		1	1
F-2	S	10/25/2005	TRICHLOROETHYLENE (TCE)	7.6E-04		1	1
F-2	S	1/9/2006	TRICHLOROETHYLENE (TCE)	7.8E-04		1	1
F-2	S	4/17/2006	TRICHLOROETHYLENE (TCE)	5.5E-04		1	1
F-2	S	7/10/2006	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
F-2	S	10/10/2006	TRICHLOROETHYLENE (TCE)	5.7E-04		1	1
F-2	S	1/10/2007	TRICHLOROETHYLENE (TCE)	7.1E-04		1	1
F-2	S	4/10/2007	TRICHLOROETHYLENE (TCE)	8.4E-04		1	1

Note: Increasing (I); Probably Increasing (PI); Stable (S); Probably Decreasing (PD); Decreasing (D); No Trend (NT); Not Applicable (N/A) - Due to insufficient Data (< 4 sampling events); ND = Non-detect

MAROS Mann-Kendall Statistics Summary

Well: F-12
Well Type: T
COC: MANGANESE

Time Period: 1/1/1999 **to** 4/10/2007
Consolidation Period: No Time Consolidation
Consolidation Type: Median
Duplicate Consolidation: Average
ND Values: Specified Detection Limit
J Flag Values : Actual Value



Mann Kendall S Statistic: -165

Confidence in Trend: 99.5%

Coefficient of Variation: 0.34

Mann Kendall Concentration Trend: (See Note) D

Data Table:

Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
F-12	T	4/12/1999	MANGANESE	7.7E-02		1	1
F-12	T	7/12/1999	MANGANESE	6.9E-02		1	1
F-12	T	10/18/1999	MANGANESE	6.0E-02		1	1
F-12	T	1/10/2000	MANGANESE	6.3E-02		1	1
F-12	T	4/17/2000	MANGANESE	6.1E-02		1	1
F-12	T	7/17/2000	MANGANESE	6.5E-02		1	1
F-12	T	10/16/2000	MANGANESE	6.4E-02		1	1
F-12	T	1/16/2001	MANGANESE	5.9E-02		1	1
F-12	T	4/23/2001	MANGANESE	6.6E-02		1	1
F-12	T	7/16/2001	MANGANESE	6.0E-02		1	1
F-12	T	10/23/2001	MANGANESE	4.6E-02		1	1
F-12	T	1/16/2002	MANGANESE	5.8E-02		1	1
F-12	T	4/8/2002	MANGANESE	6.1E-02		1	1
F-12	T	7/15/2002	MANGANESE	6.0E-02		1	1
F-12	T	10/14/2002	MANGANESE	5.5E-02		1	1
F-12	T	1/13/2003	MANGANESE	1.9E-02		1	1
F-12	T	4/14/2003	MANGANESE	6.3E-02		1	1
F-12	T	7/14/2003	MANGANESE	3.3E-02		1	1
F-12	T	10/15/2003	MANGANESE	2.0E-02		1	1
F-12	T	1/26/2004	MANGANESE	6.2E-02		1	1
F-12	T	4/19/2004	MANGANESE	5.5E-02		1	1
F-12	T	7/26/2004	MANGANESE	6.2E-02		1	1

MAROS Mann-Kendall Statistics Summary

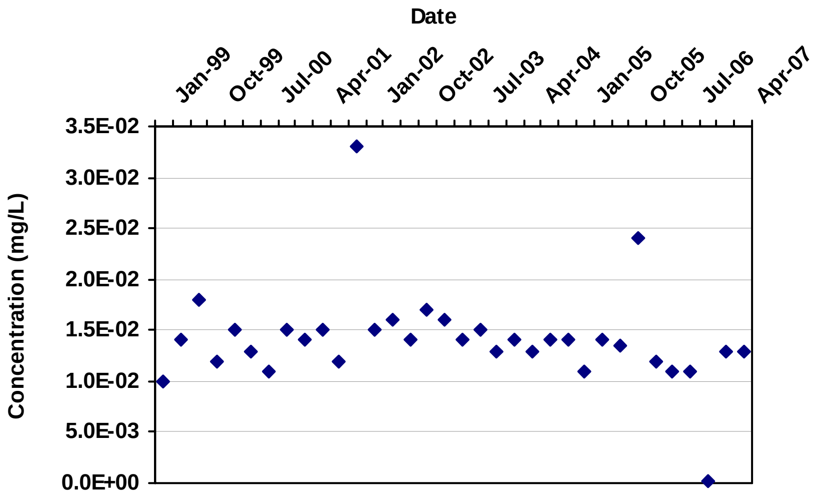
Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
F-12	T	10/11/2004	MANGANESE	9.6E-03		1	1
F-12	T	1/10/2005	MANGANESE	4.9E-03		1	1
F-12	T	4/18/2005	MANGANESE	4.8E-02		1	1
F-12	T	7/26/2005	MANGANESE	5.7E-02		1	1
F-12	T	10/25/2005	MANGANESE	1.8E-02		1	1
F-12	T	1/9/2006	MANGANESE	6.3E-02		1	1
F-12	T	4/17/2006	MANGANESE	6.1E-02		1	1
F-12	T	7/10/2006	MANGANESE	6.4E-02		1	1
F-12	T	10/10/2006	MANGANESE	5.7E-02		1	1
F-12	T	1/10/2007	MANGANESE	5.5E-02		1	1
F-12	T	4/10/2007	MANGANESE	5.9E-02		1	1

Note: Increasing (I); Probably Increasing (PI); Stable (S); Probably Decreasing (PD); Decreasing (D); No Trend (NT); Not Applicable (N/A) - Due to insufficient Data (< 4 sampling events); ND = Non-detect

MAROS Mann-Kendall Statistics Summary

Well: F-14
Well Type: T
COC: VINYL CHLORIDE

Time Period: 1/1/1999 **to** 4/15/2007
Consolidation Period: No Time Consolidation
Consolidation Type: Geometric Mean
Duplicate Consolidation: Average
ND Values: Specified Detection Limit
J Flag Values : Actual Value



Mann Kendall S Statistic: -115

Confidence in Trend: 95.4%

Coefficient of Variation: 0.34

Mann Kendall Concentration Trend: (See Note) D

Data Table:

Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
F-14	T	1/19/1999	VINYL CHLORIDE	1.0E-02		1	1
F-14	T	4/12/1999	VINYL CHLORIDE	1.4E-02		1	1
F-14	T	7/12/1999	VINYL CHLORIDE	1.8E-02		1	1
F-14	T	10/18/1999	VINYL CHLORIDE	1.2E-02		1	1
F-14	T	1/10/2000	VINYL CHLORIDE	1.5E-02		1	1
F-14	T	4/17/2000	VINYL CHLORIDE	1.3E-02		1	1
F-14	T	7/17/2000	VINYL CHLORIDE	1.1E-02		1	1
F-14	T	10/16/2000	VINYL CHLORIDE	1.5E-02		1	1
F-14	T	1/16/2001	VINYL CHLORIDE	1.4E-02		1	1
F-14	T	4/23/2001	VINYL CHLORIDE	1.5E-02		1	1
F-14	T	7/16/2001	VINYL CHLORIDE	1.2E-02		1	1
F-14	T	10/23/2001	VINYL CHLORIDE	3.3E-02		1	1
F-14	T	1/16/2002	VINYL CHLORIDE	1.5E-02		1	1
F-14	T	4/8/2002	VINYL CHLORIDE	1.6E-02		1	1
F-14	T	7/15/2002	VINYL CHLORIDE	1.4E-02		1	1
F-14	T	10/14/2002	VINYL CHLORIDE	1.7E-02		1	1
F-14	T	1/13/2003	VINYL CHLORIDE	1.6E-02		1	1
F-14	T	4/14/2003	VINYL CHLORIDE	1.4E-02		1	1
F-14	T	7/14/2003	VINYL CHLORIDE	1.5E-02		1	1
F-14	T	10/15/2003	VINYL CHLORIDE	1.3E-02		1	1
F-14	T	1/26/2004	VINYL CHLORIDE	1.4E-02		1	1
F-14	T	4/19/2004	VINYL CHLORIDE	1.3E-02		1	1

MAROS Mann-Kendall Statistics Summary

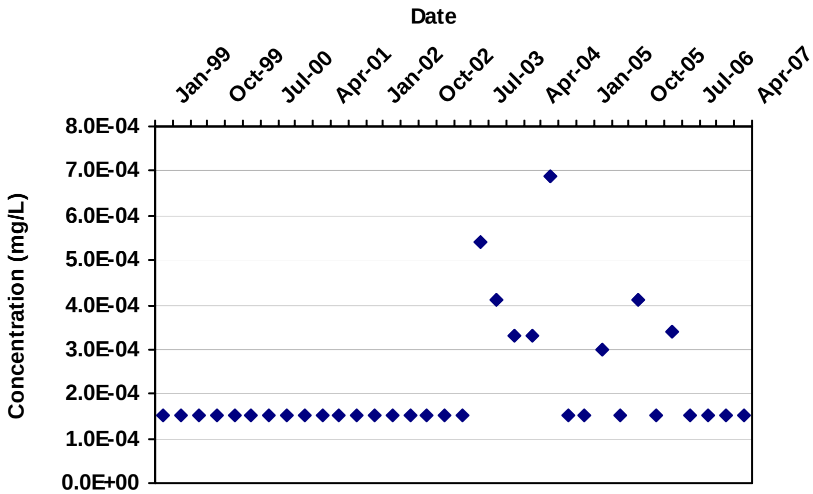
Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
F-14	T	7/26/2004	VINYL CHLORIDE	1.4E-02		1	1
F-14	T	10/11/2004	VINYL CHLORIDE	1.4E-02		1	1
F-14	T	1/10/2005	VINYL CHLORIDE	1.1E-02		1	1
F-14	T	4/18/2005	VINYL CHLORIDE	1.4E-02		1	1
F-14	T	7/26/2005	VINYL CHLORIDE	1.3E-02		1	1
F-14	T	10/25/2005	VINYL CHLORIDE	2.4E-02		1	1
F-14	T	1/9/2006	VINYL CHLORIDE	1.2E-02		1	1
F-14	T	4/17/2006	VINYL CHLORIDE	1.1E-02		1	1
F-14	T	7/10/2006	VINYL CHLORIDE	1.1E-02		1	1
F-14	T	10/10/2006	VINYL CHLORIDE	1.4E-04	ND	1	0
F-14	T	1/10/2007	VINYL CHLORIDE	1.3E-02		1	1
F-14	T	4/10/2007	VINYL CHLORIDE	1.3E-02		1	1

Note: Increasing (I); Probably Increasing (PI); Stable (S); Probably Decreasing (PD); Decreasing (D); No Trend (NT); Not Applicable (N/A) - Due to insufficient Data (< 4 sampling events); ND = Non-detect

MAROS Mann-Kendall Statistics Summary

Well: F-15
Well Type: T
COC: TRICHLOROETHYLENE (TCE)

Time Period: 1/1/1999 **to** 4/10/2007
Consolidation Period: No Time Consolidation
Consolidation Type: Geometric Mean
Duplicate Consolidation: Average
ND Values: Specified Detection Limit
J Flag Values : Actual Value



Mann Kendall S Statistic: 92

Confidence in Trend: 91.1%

Coefficient of Variation: 0.61

Mann Kendall Concentration Trend: (See Note) PI

Data Table:

Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
F-15	T	1/19/1999	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
F-15	T	4/12/1999	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
F-15	T	7/12/1999	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
F-15	T	10/18/1999	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
F-15	T	1/10/2000	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
F-15	T	4/17/2000	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
F-15	T	7/17/2000	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
F-15	T	10/16/2000	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
F-15	T	1/16/2001	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
F-15	T	4/23/2001	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
F-15	T	7/16/2001	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
F-15	T	10/23/2001	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
F-15	T	1/16/2002	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
F-15	T	4/8/2002	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
F-15	T	7/15/2002	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
F-15	T	10/14/2002	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
F-15	T	1/13/2003	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
F-15	T	4/14/2003	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
F-15	T	7/14/2003	TRICHLOROETHYLENE (TCE)	5.4E-04		1	1
F-15	T	10/15/2003	TRICHLOROETHYLENE (TCE)	4.1E-04		1	1
F-15	T	1/26/2004	TRICHLOROETHYLENE (TCE)	3.3E-04		1	1
F-15	T	4/19/2004	TRICHLOROETHYLENE (TCE)	3.3E-04		1	1

MAROS Mann-Kendall Statistics Summary

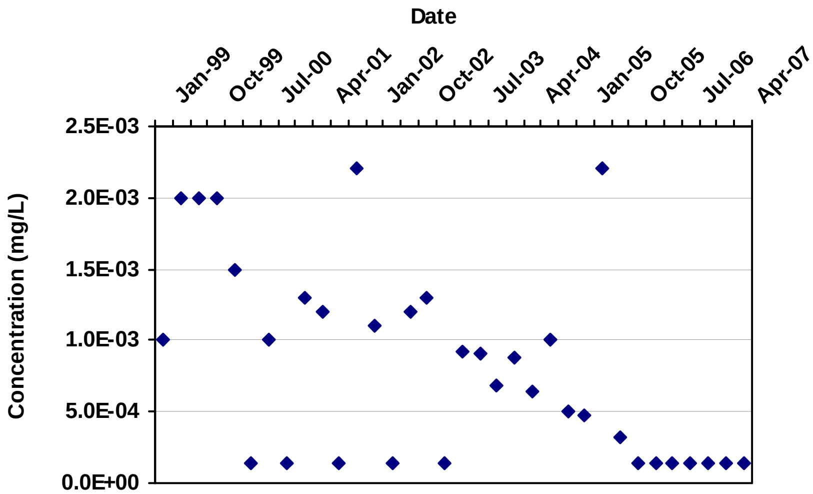
Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
F-15	T	7/26/2004	TRICHLOROETHYLENE (TCE)	6.9E-04		1	1
F-15	T	10/11/2004	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
F-15	T	1/10/2005	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
F-15	T	4/18/2005	TRICHLOROETHYLENE (TCE)	3.0E-04		1	1
F-15	T	7/26/2005	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
F-15	T	10/25/2005	TRICHLOROETHYLENE (TCE)	4.1E-04		1	1
F-15	T	1/9/2006	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
F-15	T	4/17/2006	TRICHLOROETHYLENE (TCE)	3.4E-04		1	1
F-15	T	7/10/2006	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
F-15	T	10/10/2006	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
F-15	T	1/10/2007	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0
F-15	T	4/10/2007	TRICHLOROETHYLENE (TCE)	1.5E-04	ND	1	0

Note: Increasing (I); Probably Increasing (PI); Stable (S); Probably Decreasing (PD); Decreasing (D); No Trend (NT); Not Applicable (N/A) - Due to insufficient Data (< 4 sampling events); ND = Non-detect

MAROS Mann-Kendall Statistics Summary

Well: NE-23
Well Type: S
COC: VINYL CHLORIDE

Time Period: 1/1/1999 **to** 4/15/2007
Consolidation Period: No Time Consolidation
Consolidation Type: Geometric Mean
Duplicate Consolidation: Average
ND Values: Specified Detection Limit
J Flag Values : Actual Value



Mann Kendall S Statistic: -246

Confidence in Trend: 100.0%

Coefficient of Variation: 0.83

Mann Kendall Concentration Trend: (See Note) D

Data Table:

Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
NE-23	S	1/19/1999	VINYL CHLORIDE	1.0E-03		1	1
NE-23	S	4/12/1999	VINYL CHLORIDE	2.0E-03		1	1
NE-23	S	7/12/1999	VINYL CHLORIDE	2.0E-03		1	1
NE-23	S	10/18/1999	VINYL CHLORIDE	2.0E-03		1	1
NE-23	S	1/10/2000	VINYL CHLORIDE	1.5E-03		1	1
NE-23	S	4/17/2000	VINYL CHLORIDE	1.4E-04	ND	1	0
NE-23	S	7/17/2000	VINYL CHLORIDE	1.0E-03		1	1
NE-23	S	10/16/2000	VINYL CHLORIDE	1.4E-04	ND	1	0
NE-23	S	1/16/2001	VINYL CHLORIDE	1.3E-03		1	1
NE-23	S	4/23/2001	VINYL CHLORIDE	1.2E-03		1	1
NE-23	S	7/16/2001	VINYL CHLORIDE	1.4E-04	ND	1	0
NE-23	S	10/23/2001	VINYL CHLORIDE	2.2E-03		1	1
NE-23	S	1/16/2002	VINYL CHLORIDE	1.1E-03		1	1
NE-23	S	4/8/2002	VINYL CHLORIDE	1.4E-04	ND	1	0
NE-23	S	7/15/2002	VINYL CHLORIDE	1.2E-03		1	1
NE-23	S	10/14/2002	VINYL CHLORIDE	1.3E-03		1	1
NE-23	S	1/13/2003	VINYL CHLORIDE	1.4E-04	ND	1	0
NE-23	S	4/14/2003	VINYL CHLORIDE	9.2E-04		1	1
NE-23	S	7/14/2003	VINYL CHLORIDE	9.1E-04		1	1
NE-23	S	10/15/2003	VINYL CHLORIDE	6.8E-04		1	1
NE-23	S	1/26/2004	VINYL CHLORIDE	8.8E-04		1	1
NE-23	S	4/19/2004	VINYL CHLORIDE	6.4E-04		1	1

MAROS Mann-Kendall Statistics Summary

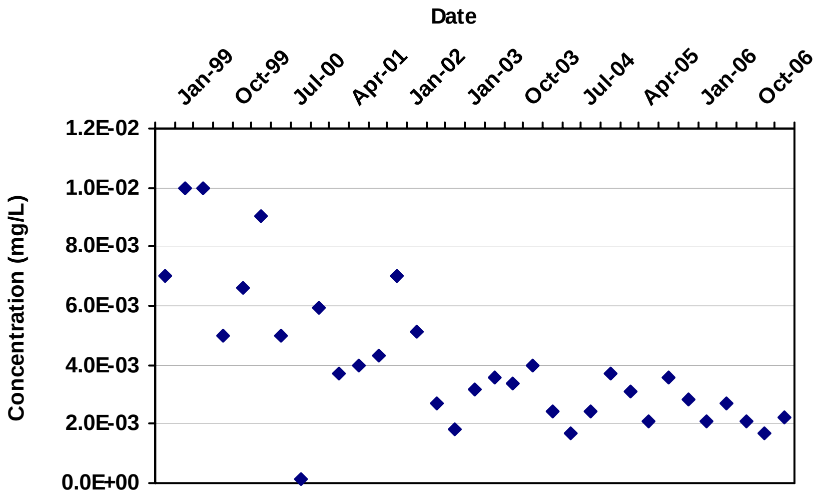
Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
NE-23	S	7/26/2004	VINYL CHLORIDE	1.0E-03		1	1
NE-23	S	10/11/2004	VINYL CHLORIDE	5.0E-04		1	1
NE-23	S	1/10/2005	VINYL CHLORIDE	4.8E-04		1	1
NE-23	S	4/18/2005	VINYL CHLORIDE	2.2E-03		1	1
NE-23	S	7/26/2005	VINYL CHLORIDE	3.2E-04		1	1
NE-23	S	10/25/2005	VINYL CHLORIDE	1.4E-04	ND	1	0
NE-23	S	1/9/2006	VINYL CHLORIDE	1.4E-04	ND	1	0
NE-23	S	4/17/2006	VINYL CHLORIDE	1.4E-04	ND	1	0
NE-23	S	7/10/2006	VINYL CHLORIDE	1.4E-04	ND	1	0
NE-23	S	10/10/2006	VINYL CHLORIDE	1.4E-04	ND	1	0
NE-23	S	1/10/2007	VINYL CHLORIDE	1.4E-04	ND	1	0
NE-23	S	4/10/2007	VINYL CHLORIDE	1.4E-04	ND	1	0

Note: Increasing (I); Probably Increasing (PI); Stable (S); Probably Decreasing (PD); Decreasing (D); No Trend (NT); Not Applicable (N/A) - Due to insufficient Data (< 4 sampling events); ND = Non-detect

MAROS Mann-Kendall Statistics Summary

Well: TR-1D
Well Type: S
COC: VINYL CHLORIDE

Time Period: 1/1/1999 **to** 4/15/2007
Consolidation Period: No Time Consolidation
Consolidation Type: Geometric Mean
Duplicate Consolidation: Average
ND Values: Specified Detection Limit
J Flag Values : Actual Value



Mann Kendall S Statistic: -292

Confidence in Trend: 100.0%

Coefficient of Variation: 0.59

Mann Kendall Concentration Trend: (See Note) D

Data Table:

Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
TR-1D	S	1/19/1999	VINYL CHLORIDE	7.0E-03		1	1
TR-1D	S	4/12/1999	VINYL CHLORIDE	1.0E-02		1	1
TR-1D	S	7/12/1999	VINYL CHLORIDE	1.0E-02		1	1
TR-1D	S	10/18/1999	VINYL CHLORIDE	5.0E-03		1	1
TR-1D	S	1/10/2000	VINYL CHLORIDE	6.6E-03		1	1
TR-1D	S	4/17/2000	VINYL CHLORIDE	9.0E-03		1	1
TR-1D	S	7/17/2000	VINYL CHLORIDE	5.0E-03		1	1
TR-1D	S	10/16/2000	VINYL CHLORIDE	1.4E-04	ND	1	0
TR-1D	S	1/16/2001	VINYL CHLORIDE	5.9E-03		1	1
TR-1D	S	4/23/2001	VINYL CHLORIDE	3.7E-03		1	1
TR-1D	S	7/16/2001	VINYL CHLORIDE	4.0E-03		1	1
TR-1D	S	10/23/2001	VINYL CHLORIDE	4.3E-03		1	1
TR-1D	S	1/16/2002	VINYL CHLORIDE	7.0E-03		1	1
TR-1D	S	4/8/2002	VINYL CHLORIDE	5.1E-03		1	1
TR-1D	S	10/14/2002	VINYL CHLORIDE	2.7E-03		1	1
TR-1D	S	1/13/2003	VINYL CHLORIDE	1.8E-03		1	1
TR-1D	S	4/14/2003	VINYL CHLORIDE	3.2E-03		1	1
TR-1D	S	7/14/2003	VINYL CHLORIDE	3.6E-03		1	1
TR-1D	S	10/15/2003	VINYL CHLORIDE	3.4E-03		1	1
TR-1D	S	1/26/2004	VINYL CHLORIDE	4.0E-03		1	1
TR-1D	S	4/19/2004	VINYL CHLORIDE	2.4E-03		1	1
TR-1D	S	7/26/2004	VINYL CHLORIDE	1.7E-03		1	1

MAROS Mann-Kendall Statistics Summary

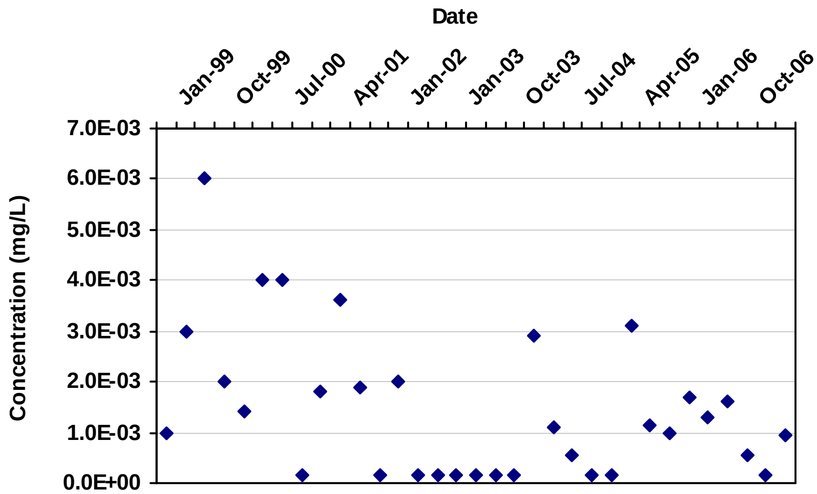
Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
TR-1D	S	10/11/2004	VINYL CHLORIDE	2.4E-03		1	1
TR-1D	S	1/10/2005	VINYL CHLORIDE	3.7E-03		1	1
TR-1D	S	4/18/2005	VINYL CHLORIDE	3.1E-03		1	1
TR-1D	S	7/26/2005	VINYL CHLORIDE	2.1E-03		1	1
TR-1D	S	10/25/2005	VINYL CHLORIDE	3.6E-03		1	1
TR-1D	S	1/9/2006	VINYL CHLORIDE	2.8E-03		1	1
TR-1D	S	4/17/2006	VINYL CHLORIDE	2.1E-03		1	1
TR-1D	S	7/10/2006	VINYL CHLORIDE	2.7E-03		1	1
TR-1D	S	10/10/2006	VINYL CHLORIDE	2.1E-03		1	1
TR-1D	S	1/10/2007	VINYL CHLORIDE	1.7E-03		1	1
TR-1D	S	4/10/2007	VINYL CHLORIDE	2.2E-03		1	1

Note: Increasing (I); Probably Increasing (PI); Stable (S); Probably Decreasing (PD); Decreasing (D); No Trend (NT); Not Applicable (N/A) - Due to insufficient Data (< 4 sampling events); ND = Non-detect

MAROS Mann-Kendall Statistics Summary

Well: TR-3D
Well Type: S
COC: VINYL CHLORIDE

Time Period: 1/1/1999 **to** 4/15/2007
Consolidation Period: No Time Consolidation
Consolidation Type: Geometric Mean
Duplicate Consolidation: Average
ND Values: Specified Detection Limit
J Flag Values : Actual Value



Mann Kendall S Statistic: -115

Confidence in Trend: 96.2%

Coefficient of Variation: 1.00

Mann Kendall Concentration Trend: (See Note) D

Data Table:

Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
TR-3D	S	1/19/1999	VINYL CHLORIDE	1.0E-03		1	1
TR-3D	S	4/12/1999	VINYL CHLORIDE	3.0E-03		1	1
TR-3D	S	7/12/1999	VINYL CHLORIDE	6.0E-03		1	1
TR-3D	S	10/18/1999	VINYL CHLORIDE	2.0E-03		1	1
TR-3D	S	1/10/2000	VINYL CHLORIDE	1.4E-03		1	1
TR-3D	S	4/17/2000	VINYL CHLORIDE	4.0E-03		1	1
TR-3D	S	7/17/2000	VINYL CHLORIDE	4.0E-03		1	1
TR-3D	S	10/16/2000	VINYL CHLORIDE	1.4E-04	ND	1	0
TR-3D	S	1/16/2001	VINYL CHLORIDE	1.8E-03		1	1
TR-3D	S	4/23/2001	VINYL CHLORIDE	3.6E-03		1	1
TR-3D	S	7/16/2001	VINYL CHLORIDE	1.9E-03		1	1
TR-3D	S	10/23/2001	VINYL CHLORIDE	1.4E-04	ND	1	0
TR-3D	S	1/16/2002	VINYL CHLORIDE	2.0E-03		1	1
TR-3D	S	4/8/2002	VINYL CHLORIDE	1.4E-04	ND	1	0
TR-3D	S	10/14/2002	VINYL CHLORIDE	1.4E-04	ND	1	0
TR-3D	S	1/13/2003	VINYL CHLORIDE	1.4E-04	ND	1	0
TR-3D	S	4/14/2003	VINYL CHLORIDE	1.4E-04	ND	1	0
TR-3D	S	7/14/2003	VINYL CHLORIDE	1.4E-04	ND	1	0
TR-3D	S	10/15/2003	VINYL CHLORIDE	1.4E-04	ND	1	0
TR-3D	S	1/26/2004	VINYL CHLORIDE	2.9E-03		1	1
TR-3D	S	4/19/2004	VINYL CHLORIDE	1.1E-03		1	1
TR-3D	S	7/26/2004	VINYL CHLORIDE	5.5E-04		1	1

MAROS Mann-Kendall Statistics Summary

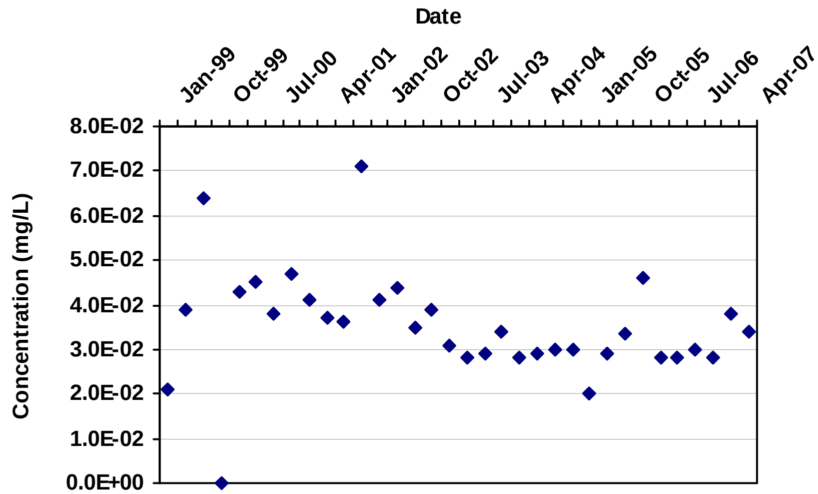
Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
TR-3D	S	10/11/2004	VINYL CHLORIDE	1.4E-04	ND	1	0
TR-3D	S	1/10/2005	VINYL CHLORIDE	1.4E-04	ND	1	0
TR-3D	S	4/18/2005	VINYL CHLORIDE	3.1E-03		1	1
TR-3D	S	7/26/2005	VINYL CHLORIDE	1.2E-03		1	1
TR-3D	S	10/25/2005	VINYL CHLORIDE	9.7E-04		1	1
TR-3D	S	1/9/2006	VINYL CHLORIDE	1.7E-03		1	1
TR-3D	S	4/17/2006	VINYL CHLORIDE	1.3E-03		1	1
TR-3D	S	7/10/2006	VINYL CHLORIDE	1.6E-03		1	1
TR-3D	S	10/10/2006	VINYL CHLORIDE	5.4E-04		1	1
TR-3D	S	1/10/2007	VINYL CHLORIDE	1.4E-04	ND	1	0
TR-3D	S	4/10/2007	VINYL CHLORIDE	9.5E-04		1	1

Note: Increasing (I); Probably Increasing (PI); Stable (S); Probably Decreasing (PD); Decreasing (D); No Trend (NT); Not Applicable (N/A) - Due to insufficient Data (< 4 sampling events); ND = Non-detect

MAROS Mann-Kendall Statistics Summary

Well: TR-4D
Well Type: S
COC: VINYL CHLORIDE

Time Period: 1/1/1999 **to** 4/15/2007
Consolidation Period: No Time Consolidation
Consolidation Type: Geometric Mean
Duplicate Consolidation: Average
ND Values: Specified Detection Limit
J Flag Values : Actual Value



Mann Kendall S Statistic: -169

Confidence in Trend: 99.4%

Coefficient of Variation: 0.35

Mann Kendall Concentration Trend: (See Note) D

Data Table:

Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
TR-4D	S	1/19/1999	VINYL CHLORIDE	2.1E-02		1	1
TR-4D	S	4/12/1999	VINYL CHLORIDE	3.9E-02		1	1
TR-4D	S	7/12/1999	VINYL CHLORIDE	6.4E-02		1	1
TR-4D	S	10/18/1999	VINYL CHLORIDE	1.4E-04	ND	1	0
TR-4D	S	1/10/2000	VINYL CHLORIDE	4.3E-02		1	1
TR-4D	S	4/17/2000	VINYL CHLORIDE	4.5E-02		1	1
TR-4D	S	7/17/2000	VINYL CHLORIDE	3.8E-02		1	1
TR-4D	S	10/16/2000	VINYL CHLORIDE	4.7E-02		1	1
TR-4D	S	1/16/2001	VINYL CHLORIDE	4.1E-02		1	1
TR-4D	S	4/23/2001	VINYL CHLORIDE	3.7E-02		1	1
TR-4D	S	7/16/2001	VINYL CHLORIDE	3.6E-02		1	1
TR-4D	S	10/23/2001	VINYL CHLORIDE	7.1E-02		1	1
TR-4D	S	1/16/2002	VINYL CHLORIDE	4.1E-02		1	1
TR-4D	S	4/8/2002	VINYL CHLORIDE	4.4E-02		1	1
TR-4D	S	7/15/2002	VINYL CHLORIDE	3.5E-02		1	1
TR-4D	S	10/14/2002	VINYL CHLORIDE	3.9E-02		1	1
TR-4D	S	1/13/2003	VINYL CHLORIDE	3.1E-02		1	1
TR-4D	S	4/14/2003	VINYL CHLORIDE	2.8E-02		1	1
TR-4D	S	7/14/2003	VINYL CHLORIDE	2.9E-02		1	1
TR-4D	S	10/15/2003	VINYL CHLORIDE	3.4E-02		1	1
TR-4D	S	1/26/2004	VINYL CHLORIDE	2.8E-02		1	1
TR-4D	S	4/19/2004	VINYL CHLORIDE	2.9E-02		1	1

MAROS Mann-Kendall Statistics Summary

Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
TR-4D	S	7/26/2004	VINYL CHLORIDE	3.0E-02		1	1
TR-4D	S	10/11/2004	VINYL CHLORIDE	3.0E-02		1	1
TR-4D	S	1/10/2005	VINYL CHLORIDE	2.0E-02		1	1
TR-4D	S	4/18/2005	VINYL CHLORIDE	2.9E-02		1	1
TR-4D	S	7/26/2005	VINYL CHLORIDE	3.4E-02		1	1
TR-4D	S	10/25/2005	VINYL CHLORIDE	4.6E-02		1	1
TR-4D	S	1/9/2006	VINYL CHLORIDE	2.8E-02		1	1
TR-4D	S	4/17/2006	VINYL CHLORIDE	2.8E-02		1	1
TR-4D	S	7/10/2006	VINYL CHLORIDE	3.0E-02		1	1
TR-4D	S	10/10/2006	VINYL CHLORIDE	2.8E-02		1	1
TR-4D	S	1/10/2007	VINYL CHLORIDE	3.8E-02		1	1
TR-4D	S	4/10/2007	VINYL CHLORIDE	3.4E-02		1	1

Note: Increasing (I); Probably Increasing (PI); Stable (S); Probably Decreasing (PD); Decreasing (D); No Trend (NT); Not Applicable (N/A) - Due to insufficient Data (< 4 sampling events); ND = Non-detect

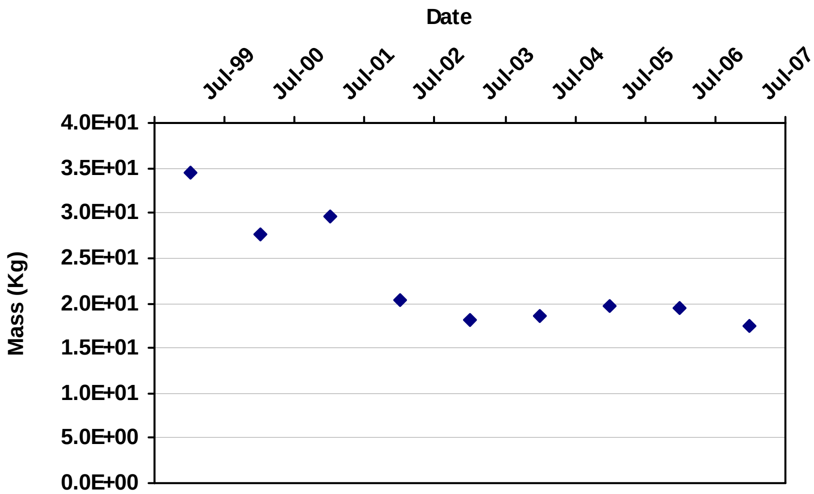
MAROS Zeroth Moment Analysis

Project: Taylor Road **User Name:** MV

Location: Hillsborough County **State:** Florida

COC: VINYL CHLORIDE

Change in Dissolved Mass Over Time



Porosity: 0.05

Saturated Thickness:

Uniform: 400 ft

Mann Kendall S Statistic:

-24

Confidence in Trend:

99.4%

Coefficient of Variation:

0.27

Zeroth Moment Trend:

D

Data Table:

Effective Date	Constituent	Estimated Mass (Kg)	Number of Wells
7/1/1999	VINYL CHLORIDE	3.4E+01	24
7/1/2000	VINYL CHLORIDE	2.8E+01	26
7/1/2001	VINYL CHLORIDE	3.0E+01	27
7/1/2002	VINYL CHLORIDE	2.0E+01	27
7/1/2003	VINYL CHLORIDE	1.8E+01	27
7/1/2004	VINYL CHLORIDE	1.9E+01	27
7/1/2005	VINYL CHLORIDE	2.0E+01	27
7/1/2006	VINYL CHLORIDE	1.9E+01	26
7/1/2007	VINYL CHLORIDE	1.7E+01	26

Note: Increasing (I); Probably Increasing (PI); Stable (S); Probably Decreasing (PD); Decreasing (D); No Trend (NT); Not Applicable (N/A) - Due to insufficient Data (< 4 sampling events); ND = Non-detect. Moments are not calculated for sample events with less than 6 wells.

MAROS Zeroth Moment Analysis

Project:

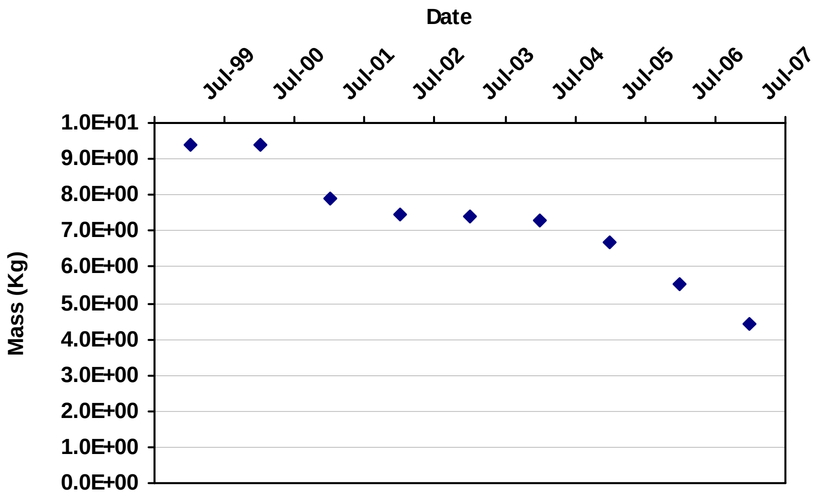
User Name:

Location:

State:

COC: TRICHLOROETHYLENE (TCE)

Change in Dissolved Mass Over Time



Porosity: 0.00

Saturated Thickness:

Variable

Mann Kendall S Statistic:

-16

Confidence in Trend:

94.0%

Coefficient of Variation:

0.28

Zeroth Moment Trend:

PD

Data Table:

Effective Date	Constituent	Estimated Mass (Kg)	Number of Wells
7/1/1999	TRICHLOROETHYLENE (TCE)	9.4E+00	24
7/1/2000	TRICHLOROETHYLENE (TCE)	9.4E+00	26
7/1/2001	TRICHLOROETHYLENE (TCE)	7.9E+00	27
7/1/2002	TRICHLOROETHYLENE (TCE)	7.4E+00	27
7/1/2003	TRICHLOROETHYLENE (TCE)	7.4E+00	27
7/1/2004	TRICHLOROETHYLENE (TCE)	7.3E+00	27
7/1/2005	TRICHLOROETHYLENE (TCE)	6.7E+00	27
7/1/2006	TRICHLOROETHYLENE (TCE)	5.5E+00	26
7/1/2007	TRICHLOROETHYLENE (TCE)	4.4E+00	26

Note: Increasing (I); Probably Increasing (PI); Stable (S); Probably Decreasing (PD); Decreasing (D); No Trend (NT); Not Applicable (N/A) - Due to insufficient Data (< 4 sampling events); ND = Non-detect. Moments are not calculated for sample events with less than 6 wells.