WIND TUNNEL TESTING REPORT

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EXECUTIVE SUMMARY

As part of the Phase I Pre-Design Investigation for Onondaga Lake, wind tunnel tests were conducted on sediment samples collected from three Sediment Management Units (SMUs 1, 6, and 7) in accordance with the NYSDEC-approved Air Emission and Odor Work Plan. This testing program provides data that is representative of emission conditions from remediation-related sources, thereby allowing further analysis, comparison to emissions modeling activities, and future ambient air modeling to estimate potential air quality and odor impacts. The tests measured emission rates for chemicals of interest and odors per unit time for a given emitting area from a series of five potential source conditions under monitored wind speed, humidity, and temperature conditions. This report summarizes the results, and provides recommendations for chemical parameters and emission rates to be used for further analysis.

The sediments from each of three SMUs were homogenized and split into a variety of slurry mixtures (10 and 1 percent by weight) and tested while actively mixed or quiescent to simulate emissions from active and inactive dredging and sediment placement operations. Twenty-two compounds, groups of compounds, and odor parameters were analyzed. Due to the relatively low concentrations of certain compounds in the source sediments, some of the emissions were less than the reporting limits of the analytical procedure and sample size. In these cases, half of the reporting limit was conservatively used as the emission rate.

In general, measured emission patterns match well with those described in literature. The emission rates estimated from these wind tunnel tests generally increased with increasing sediment concentration and Henry's constant, and decreased with the elapsed time. The greatest emission rates were observed in either the undiluted exposed sediment or 10% mixed slurry. These results can be applied to sediments with different concentrations. The SMU 1 sediments had the highest emission rates, which seems reasonable because the SMU 1 sediment also contained the highest levels of chemical concentrations of any of the three SMUs tested.

In addition to chemical emission rates, an odor analysis was also included as part of this investigation. Odor persistency, intensity, detection threshold and recognition threshold were analyzed for each of the SMUs tested. The detection threshold and recognition threshold are reported in odor units, and can be measured and modeled like chemical concentrations. The odor emission rates generally decreased as test time progressed and decreased with solids content in the slurries. Although containing substantially lower chemical concentrations than the other SMUs, SMU 6 sediments had the strongest odor.

In conclusion, the wind-tunnel tests were successful in generating usable data for further analysis. Of the original twenty-two compounds or parameters, the following ten compounds or parameters should be included in the preliminary emissions modeling:

Benzene,
Ethylbenzene,
Chlorobenzene,
Dichlorobenzene,
Trichlorobenzene,
Hexachlorobenzene,
Xylenes,
Toluene,
Naphthalene, and
Odor Recognition Threshold.

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TECHNICAL TERMS AND ACRONYMS

COI	Chemicals of Interest
DT	Detection Threshold for odor
LCS/LCSD	Laboratory Control Spike/Laboratory Control Spike Duplicate
LCSD	Laboratory Control Spike Duplicate
mg/Kg	Milligram per Kilogram
mg/L	Milligram per Liter
mph	Miles per hour
MRL	Method Reporting Limit
MS/MSD	Matrix Spike/Matrix Spike Duplicate
OU	Odor Units
$OU/m^2/hr$	Odor Unit per square meter per hour
QA/QC	Quality Assurance/Quality Control
RH	Relative Humidity
RL	Reporting Limit
RT	Recognition Threshold for odor
SCA	Sediment Consolidation Area
SMU	Sediment Management Unit
TSS	Total Suspended Solids
ug/L	Microgram per Liter
$ug/m^2/hr$	Microgram per Square Meter per Hour
VOC	Volatile Organic Compounds

1.0 INTRODUCTION

As part of the Phase I Pre-Design Investigation for Onondaga Lake, SERVICE Engineering Group (SERVICE) conducted bench scale wind tunnel tests on sediment samples collected from the lake. This testing program provides data that is representative of emission conditions from remediation-related sources, suitable for further analysis.

The methodology of these tests is described in the NYSDEC-approved Air Emission and Odor Work Plan (Parsons, 2005), which was peer reviewed (as were the results of this investigation and this summary report) by Dr. Thibodeaux of Louisiana State University and Mr. Charles McGinley of St. Croix Sensory-an odor testing and evaluation firm. Their resumes are presented in Appendix A. The objectives of the tests described in the work plan were to measure emission rates for volatile chemicals of interest (COI) and odors per unit time for a given emitting area from a series of five source conditions under monitored conditions. This Testing Report summarizes the results of these tests, and presents recommendations for utilizing these results in a dispersion modeling analysis.

Sediment samples from three Sediment Management Units (SMUs 1, 6, and 7) within Onondaga Lake were tested for five different potential emission scenarios to simulate various processes and conditions that may be encountered during remediation of the lake. Emission rates were measured from the following conditions:

- A 10% solids solution mixed continuously that may represent active areas of operations such as the immediate dredging area and a portion of the SCA discharge area.
- A 10% solids solution under quiescent conditions that may represent emissions after shutdown in active areas at the end of a shift or for the first part of the weekend.
- A 1% solids solution mixed continuously that may represent emissions from areas around, but not near, the dredge where natural convection is the primary cause of suspended solids.
- A 1% solids solution under quiescent conditions that may represent emissions from areas around, but not near, the dredge after dredging shutdown at the end of a shift.
- Exposed Sediment at in situ moisture content under quiescent conditions that may represent emissions from exposed sediment such as might be found in portions of the SCA, barges, or in stockpiles.

To obtain the data required to measure the mass emission rates, air was pulled into the bench-scale wind tunnel at room temperature at a speed of approximately 2.7 miles per hour, humidified, and the flow straightened prior to passing over a sample tank of known dimensions containing a sediment or slurry sample. The exposed air was then remixed and sampled by steadily drawing known volumes of air through a variety of contaminant-specific sorbent tubes or by using tedlar bags. A detailed description of the wind tunnel testing is presented in Section 2.0.

The air analytical data (ug/m^3) was converted to an emission rate ($ug/(m^2xhr)$) by calculating the total of each COI emitted during each time interval and dividing this by the sample tank surface area (m^2) and time interval duration (hr). The same process was used to estimate the odor emission rates and intensities using Odor Units instead of micrograms. The total mass was calculated by multiplying the COI concentration (ug/m^3) by the total airflow (m^3) through the wind tunnel. The total airflow through the wind tunnel was obtained by integrating the airflow data over time using the Trapezoidal Rule with Unequally Spaced Data.

Concentration (ug/m^3) x Total Flow (m^3) = Total Mass (ug)
Total Mass (ug) / [Surface Area (m^2) x Duration (hr)] = Emission Rate ($ug/(m^2$ x hr))

For example, the following is the conversion of the concentration to the emission rate for Benzene for SMU 1, 10% Mixed, 0 – 2 Hour interval:

(29 ug/m^3) x (380.35 m^3) = 11,030.20 ug
(11,030.20 ug)/((0.124 m^2) x (2 hr)) = 44,476.62 ug / (m^2 x hr)

2.0 WIND TUNNEL TEST DESCRIPTION

2.1 Sampling

Ten-gallon samples were collected by Parsons personnel at locations in SMU 1, 6 and 7 to account for matrix, chemical and odor differences between the SMUs. The locations and the rationale for each location were described in the Work Plan. Vibracore sediment samples were screened in the field with a PID for the presence of volatiles, extruded into five-gallon pails and topped off with water. By topping with water, volatile losses from sediment to air were reduced due to the emission resistance of the water. Samples were sealed with a gasketed lid, refrigerated, and shipped to SERVICE in accordance with SOPs. At SERVICE, samples were refrigerated until used. Lake water was also collected to use with the sediment to make slurries.

2.2 Apparatus

A schematic for the air emission test apparatus is shown in Figure 1. A galvanized steel cone was constructed as a contraction zone at the inlet of the wind tunnel to facilitate smooth entry of air. A humidifying zone was incorporated into the construction of the tunnel, which consisted of three humidifier pads. Water was gravity fed to the pads from a constant temperature water bath. A set of baffles was placed immediately upstream and downstream of the humidifying zone to maximize exposure of the incoming air to the evaporative surface and to eliminate the possibility of localized moisture segregation. To straighten the airflow and allow evaporation of water droplets, a length of approximately four feet of wind tunnel was used after the baffles. A honeycomb panel 5.08 cm (2 inch) thick was placed immediately before the sediment/slurry tank in order to evenly distribute and straighten the airflow. Sample chambers were constructed to hold a 25.4-cm (10 inch) depth of slurry or a 12.7 cm (5 inch) depth of sediment. All chambers were constructed with a surface area of 1238.7 cm^2 (192 in^2). An inert rubber gasket was affixed to the chamber edges to create an airtight fit. An in-tank slurry mixer was built using PVC piping and two pumps. A set of baffles was placed downstream of the sample chambers, and prior to the air sampling ports to homogenize the airflow. Air sampling ports were placed along the centerline of the wind tunnel with the sampling tubes extending into the center of the airflow to reduce the possibility of boundary layer effects associated with the walls. A 14-inch 1,800 cubic feet per minute fan was used to pull air through the wind tunnel.

Prior to testing, vertical velocity profiles and smoker testing were conducted to assure laminar flow over the sediment /slurry sample and well mixed conditions in the air sampling area.

2.3 Procedure

Prior to the beginning of wind tunnel testing, the headspace above separate sediment samples from SMUs 1 and 7 were analyzed to ensure the health and safety of the odor panel. The headspace samples were drawn from a sealed five-gallon bucket using portable sample pumps. Approximately 20 liters of air was drawn through sampling tubes for chemical analysis and 10 liters of air was sampled for odor equipment calibration.

The following is the general procedure used in conducting the wind tunnel testing. Variations that occurred and the basis for those deviations from plan are discussed in subsequent sections.

The bulk sediment for each SMU was shipped in multiple five-gallon buckets. The containers for each SMU were individually placed into a rotary mixer and blended until completely homogenized. The time required to completely mix the sample varied with each container. The compositing of each SMU was accomplished by placing equal amounts of material from all the buckets of a given SMU into a clean five-gallon bucket, which was completely filled and sealed, where the sediment was homogenized in a horizontal rotary mixer. Prior to the start of any sampling or slurry preparation, the selected container was remixed while sealed in the same rotary mixer for a minimum of one hour to redistribute any solids that had settled. In this way, volatile losses were minimized while achieving critical homogenization of the sediments. Chemical characterization of the sediments and slurries occurred after this mixing and preparation, so the measured emission rates correlate to the actual VOC content of the tested material. To mix slurries, appropriate amounts of sediment and lake water filled a 15-gallon Slurry Mixing Tank (SMT), which was sealed and homogenized in the rotary mixer.

Samples of the homogenized sediment were obtained before the beginning of the Exposed Sediment, 10% Mixed and 1% Mixed test runs and analyzed for COIs and physical characteristics. The sediment used to prepare the 10% mixed and quiescent slurries were obtained from the same homogenized container, therefore, the pre-test sediment concentrations

for the two were presumed to be the same. Similarly, the sediment use to prepare the 1% mixed and quiescent slurries were obtained from the same homogenized container, though not the same sample as was used for the 10% tests. Triplicate samples from each were taken to determine the percent solids of the sediment. The percent solids results before and after the tests are found in Table 1.

The flux chamber was filled with approximately 31.5 liters (8.32 gal) of slurry or 15.75 liters (4.16 gal) of sediment depending upon the conditions of the test. Air was passed over the sample surface at 2.5-3.0 miles per hour (mph), averaging 2.7 mph, with approximately 80% relative humidity (RH) for all slurries. The sediment samples were tested at ambient RH to measure emissions during sediment drying. Inlet airflow was monitored by means of a hot wire anemometer. A thermohygrometer was used to monitor exit air temperature and RH. The data obtained is shown in Figures 2 through 4 and Tables 2 through 7.

2.4 Air Sampling

The air stream was sampled for COIs by drawing air through contaminant-specific media using a vacuum pump. Airflow through each sampling train was controlled using valves that were calibrated prior to testing. Airflow through the sample train and through the wind tunnel was documented to calculate emission rates.

Odor samples were collected using a VAC'SCENT sample vessel with tedlar bags supplied by St. Croix Sensory. Upon collection, each tedlar bag containing the sample was maintained at temperatures equal to or greater than the room temperature to prevent condensation and submitted to St. Croix Sensory within 30 hours of sampling. For each condition simulated, volatile emissions samples were collected for sequential periods of 2, 4, and 16 hours (for a total of 22 hours), then sent to the analytical laboratory for analysis.

Upon completion of each exposed sediment test and selected slurry tests, the bulk solids were sampled again to evaluate depletion of the COIs. Water from selected 10% Mixed slurry tests was analyzed to determine the dissolved concentration of COIs in the water column. For PAHs, samples were filtered using a pressure filter with a 0.45-micron filter. To eliminate the potential

loss of VOCs associated with filtering, the VOC samples were not filtered. They were allowed to settle for a minimum of seven days, and the sample was drawn off the extreme top of the vial by inserting a syringe through the cap.

Equipment (e.g., Pyrex or stainless steel mixing bowls, spatulas, spoons, split spoons and other reusable sampling devices) used to homogenize or collect samples for chemical testing was decontaminated prior to re-use in accordance with SOPs. To minimize the potential for contaminant migration and/or cross contamination, the wind tunnel testing apparatus was also decontaminated after each test. A sample of the final rinsate water from each decontamination was analyzed (See Appendix B for the data and Appendix E for the QC review.), indicating decontamination procedures were effective.

2.5 Odor Analysis

As described in the approved Work Plan, odor thresholds were determined by St. Croix Sensory Laboratory using a presentation method called the "3-alternative forced choice" method or the "triangular forced-choice" method and a certified odor panel. Assessors were tested with a standard odorant (n-butanol) and were required to meet specific sensitivity criteria outlined in the European testing standard. Assessors maintained a defined standard deviation of n-butanol threshold measurements in order to satisfy repeatability requirements of the standard. The certified odor panel session used five trained, experienced, and certified assessors. These assessors were presented each odor sample twice. Final results were retrospectively screened in order to evaluate and identify assessors who may have a specific hypersensitivity to the odor sample presented.

When the actual odor emission is just detectable, it is known as the Detection Threshold (DT) and is defined as one Odor Unit (OU). The Recognition Threshold (RT) is the dilution ratio at which the assessor first detects the odor's character ("smells like..."). These RT odor units can be scaled and modeled in an air dispersion model to identify down-wind receptor areas, odor strength, and frequency of odor recognition.

The odor intensity (I) is the relative strength of the odor above the RT. The odor referencing is accomplished by a comparison of the odor intensity of the odor sample to the odor intensity of a series of concentrations of the reference odorant, which is butanol. The odor intensity of an odor sample is expressed in parts per million (ppm) of butanol and can be correlated to modeled RT values.

Odor persistency is a term used to describe the rate at which an odor's perceived intensity decreases as the odor is diluted. The odor intensity (I) is related to the odor concentration (C) by the following equation, where;
'K' is the constant and 'n' is the exponent:

$$I = K(C)^n$$

$$\log I = n \log C + \log K \text{ [logarithmic transformation]}$$

This function is determined from intensity measurements of an odor at various dilutions and at full strength concentration plotted logarithmically with the odor intensity on one axis and the odor dilution ratio on the other axis. The resultant straight line for the log-log plot is specific for each odor, with the slope of the line, n, representing relative persistency; a flatter slope represents a more persistent odor.

Odor testing results are presented in Appendix C.

2.6 Changes and Corrective Actions

2.6.1 Air Flow Rate

Due to the restrictive nature of the three trickle media humidifiers, the planned air velocity of five miles per hour was unattainable. The maximum velocity that could be maintained was approximately 2.7 miles per hour (average of all 15 runs). SMU 1 runs averaged 2.5 mph, SMU 6 was 2.6 mph, and SMU 7 averaged 3.0 mph. The wind speed in the tunnel is a critical factor, as if the wind speed is too low, air side resistance may occur, and the measured concentrations may under represent conditions in the field. After calculations using the Mass Transfer Coefficient equations found in Fountain, 2005 and discussions with Kenneth Fountain, it was concluded that at velocities equal to or greater than 2.5 mph, air-side resistance to mass transfer

due to increasing air saturation is minimal. SERVICE decided not to attempt to change the humidifier configuration or fan size to increase the airflow, but to keep similar airflow throughout all tests, and consistently high humidity during slurry tests. The average air velocities for each test run are given in Tables 2 – 7 and are shown in Figures 2 – 4. Because the wind speed achieved was adequate, no adverse effect is expected from this change.

2.6.2 Humidity

A series of three trickle media placed perpendicular to the airflow were used instead of an inline bubble trap to introduce moisture to the air. During initial wind tunnel setup, condensation began to form on the walls of the tunnel as the air approached saturation (RH = 100%). When air is near its saturation point, moisture containing chemicals condenses from the air if even slightly cooled. Chemicals in the condensate would not be included in the air sample, so it was important to avoid condensation during testing. Therefore, test runs involving slurries were conducted with 80-85% RH to minimize evaporative loss and prevent condensation while minimizing evaporation (as opposed to chemical emissions) from the slurries. In order to facilitate drying of the sediment during the exposed sediment tests, lower ambient humidity was used rather than the 50% humidity stated in the Work Plan. The average humidity for each of the test runs is shown in Tables 2 – 7 and Figures 2 – 4. These changes improved the quality of the data by avoiding a negative bias from volatile loss to condensation, and improving drying potential for exposed sediments.

2.6.3 Slurry Mixing

The work plan indicated that Quiescent samples would be slowly mixed during the test at a rate less vigorous than the Mixed samples. Considering the quiet conditions this emission rate is to simulate, no mixing was conducted during the Quiescent tests. Quiescent samples were mixed until time zero of testing, and were not actively mixed during the test. This approach more closely simulates the natural convective forces in play for this type of source.

2.6.4 Decanting Water from Exposed Sediment Tests

The sediment for the SMU 1 Exposed Sediment test run was placed into the sample tank and sealed approximately 48 hours prior to beginning the test. This led to the formation of a layer of

porewater on the surface from consolidation. The initial test run was halted after approximately two hours to remove the water blanket. Approximately 1.57 liters of consolidation water was removed from the sample tank. This was the only test run where the surface of the sediment dried during the test. Odor samples were removed two hours early from the 6-22 hour interval in order to facilitate the St. Croix Sensory odor testing schedule.

On subsequent Exposed Sediment tests, the sediment tanks were not filled until just prior to the initiation of the tests for SMU 6 and SMU 7. Water was not decanted from the sediment surface and the surface of the samples did not dry.

2.6.5 PCB Testing

PCBs were not analyzed in the sediment or slurry samples due to a sampling error. As shown in Tables 15 and 17, PCBs were analyzed in the SMU 1 and SMU 7 air samples for the 10% Mixed test runs and were not detected.

2.7 General Observations

2.7.1 Organic matter

Small particles of what are believe to have been organic matter were observed floating on the surface of the slurries. These particles were generally less than one centimeter in length and approximately 0.5 mm in diameter. The number of particles varied from test to test but SMU 6 had the greatest amount and there tended to be more on the 10% mixed runs. See the photo of the water's surface in Figure 5.

2.7.2 Film or sheen on surface

To some extent, all of the slurry test runs for all SMUs had a thin film develop on the surface. This film was apparent within the first hour of the test run, and appeared to be organic material that was released during agitation of the slurry. For SMUs 1 and 7, the film usually was very thin and in most cases dissipated during the 6-22 hour time interval. Foam was visible on the surface of the slurry for the SMU 7 10% Mixed test run. This foam did not cover the entire surface and dissipated during the 6-22 time interval. The film that was present on the SMU 6 slurries was noticeably thicker and a darker brown in color. See Figure 5. An iridescent sheen

was only visible on the SMU 6 10% Quiescent slurry. Approximately 10 spots were present and each was less than two centimeters in diameter. They quickly dissipated and were completely gone by the end of the 2-6 hour time interval. The presence of this film is not believed to have a significant impact on the volatile and odor emissions measured in the tunnel.

2.7.3 Drying Surface of Sediment

Although there was not any water blanket on the top or large areas of ponding, the sediment surface did not dry out completely for the Exposed Sediment tests for SMU 6 and SMU 7. See Figure 6 (photos of exposed Sediment Surfaces at end of tests).

3.0 STUDY-WIDE RESULTS

This section summarizes study-wide findings common to all three SMUs tested. It is organized by medium. Section 4.0 will present findings by SMU.

3.1 Sediment

The rationale for sediment sample location selection within Onondaga Lake was to resample locations with high concentrations of specific compounds based on historical data. As indicated in Table 8 and Figure 7, on average, the concentrations of the COIs in the sediment received for the wind tunnel test exceeded the area-weighted average concentrations presented in Appendix C of the Onondaga Lake Feasibility Study (Parsons, 2004). At least one sample from the three SMUs equaled or exceeded the area-weighted averages. In many cases, at these concentrations, the tests resulted in measurable emissions that can be easily scaled upward or downward. In other cases, such as hexachlorobenzene, half the reporting limit can be used to conservatively estimate emissions for key compounds. The samples are representative of the SMUs and are useful for the purpose of this study.

A detailed analytical chemistry summary for all of the COIs are given in Tables 9, 10, and 11 for SMUs 1, 6 and 7 respectively, with analytical reports presented in Appendices B, C and D.

3.2 Slurry

Although initially mixed in accordance with the work plan, the effective pre-test solids content of these groups after settling in the tank while being mixed were 5 – 12 % and 0.5 – 1.18% for the nominal 10% and 1% tests respectively as shown in Table 1. This variety is primarily due to the inherent heterogeneity of suspended slurries and presence of settling sand in the samples. Vertically integrated samplers were used to capture a representative section of the tank contents.

The concentration of COIs in the slurries are presented in Tables 12, 13 and 14 for SMUs 1, 6 and 7 respectively. Pre-test slurry concentrations were calculated from the sediment concentration and the mixing ratios with the lake water.

Figure 8 indicates the percent of change in concentrations in the slurry after testing from the SMUs. The percentage value is derived by dividing the pre-test concentration minus the post-test concentration into the pre-test concentration. A value of 100% indicates depletion, where a compound was reduced to non-detect. A value of zero was set for compounds that were not detected before and after the test. Except for naphthalene, the COIs were not depleted from the tank during the test because they were measurable in the after-test samples. Except for naphthalene, there was generally less depletion from the 1% Quiescent tests.

3.3 Air

3.3.1 COIs

A total of twenty-two compounds, groups of compounds (xylenes), and odor parameters (Detection and Recognition Thresholds and Intensity) were analyzed during the wind tunnel testing. The tested parameters are listed in Tables 15-17 for SMUs 1, 6 and 7 respectively. Of the COIs analyzed, only six compounds were detected with any consistency. The six chemicals, in order of decreasing emission rates, are:

- Toluene,
- Xylenes,
- Benzene,
- Naphthalene,
- Chlorobenzene, and
- Ethylbenzene.

As shown in Figures 9, 10, and 11, the emission rates generally (and with some exceptions) increased with increasing Henry's constant, and K_{oc} values. They also increase with increased sediment concentration, and decreased with elapsed time. These findings are consistent with literature, which shows that emission rates for soluble, volatile contaminants vary in predictable ways. For example, Valsaraj (1997a) observed: "The flux increased with increasing suspended sediment concentration in water, increasing Henry's constant (volatility) and decreasing sediment/water partition constant for the chemical." If not actively mixed, emissions diminish with time (Price, 1999). "The most soluble, with the lowest partition between sediment and water, have the highest initial emission rates and the greatest drop in those rates over time" (Costello, 2003). Thibodeaux (2004) confirms that these experimental observations are

consistent with mathematical modeling and is due to the slow replenishment of volatiles from the sediment in unmixed samples. In longer term tests, Fountain (2005) found that emission rates from exposed sediment initially rise until the surface sediments dry and air channels develop in the sediment which quickly deplete the available volatiles, causing a rapid drop in concentrations.

Only the SMU 1 sediment surface actually dried during the test. Sediment tested for SMUs 6 and 7 released consolidation water faster than evaporation losses, resulting in a thin layer of water overlaying the sediment. Given these conditions, the greatest emission rates were observed in either the Exposed or 10% Mixed scenarios as shown in Figures 12-14 and Tables 15-17. Note that the analytical results from the Appendices were converted to emission rates in these tables as described in Section 1.0, so the numerical values in the laboratory reports and the tables differ.

3.3.2 Odor

Odor Units (OU) for Detection Thresholds (DT) and Recognition Thresholds (RT) are the maximum number of dilutions at which the odor can first be detected or recognized. Thus a sample that is first recognizable at five dilutions is stronger than a sample that is recognizable at only three dilutions. These dilutions define OUs and can be converted to emission rates in the same manner as chemical concentrations. The odor emission rates behaved in a classic manner, decreasing as time progressed and with decreasing solids content for SMUs 1 and 6. Also, the mixed and quiescent samples with the same solids content had very similar emission rates. SMU 7 differed from the other two SMUs in that both the 10% and 1% mixed slurries had recognition and detection rates roughly equal to or greater than the exposed sediment, and mixed runs had higher emissions than quiescent runs. These behaviors are shown in Figures 15-17 with test results presented in Appendix C.

The odor Intensity (I) is the relative strength of the odor above the Recognition Threshold. The odor intensity (defined as an equivalent concentration of n-butanol) decreased with time and with slurry dilution. As shown on Figures 15-17, only SMU 1 had a higher emission rate for Exposed

Sediment than slurries. This may be due to the fact that it was the only sample that actually dried during the test.

Odor Persistency is a term used to describe the rate at which an odor's perceived intensity decreases as the odor is diluted, i.e. in the atmosphere down-wind from the odor source. The rate of change in Intensity verses odor concentration is not the same for all odors. The Persistency of an odor can be represented as a "dose-response" function, which is determined from Intensity measurements of an odor at full strength and at several dilution levels above the RT. A log-log plot of odor Intensity versus dilution ratio provides a straight line, where the slope and intercept are unique for each odor. A higher intercept indicates a greater Intensity. A flatter slope represents a higher Persistence.

The Persistency of the tested sediment and slurries are calculated and presented in Table 18 and in Figures 18-20. These figures indicate the three SMUs are quite similar in their Intensity and Persistence, with SMU 1 having the least Intensity, and SMU 6 having the most. SMU 1 and 6 have similar Persistency, and are somewhat more persistent than SMU 7, which has the greatest slope.

4.0 RESULTS BY SMU

This section presents the data by SMU and describes some differences that are unique to each SMU.

4.1 SMU 1

4.1.1 Sediment

This sediment is classified as a silt with 91.2% of the material passing the #200 sieve as shown in Appendix B. The average percent solids for the SMU 1 sediments was approximately 45% and is shown in Table 1. The pre-test sediment analytical concentrations are given in Table 9.

4.1.2 Slurry

The 10% Mixed slurry remained well agitated throughout the duration of the wind tunnel test with a pre-test Total Suspended Solids (TSS) of 3,800 mg/L and a post-test TSS of 4,600 mg/L. The 1% Mixed slurry, however, showed a decrease in the TSS from 3,400 mg/L to 370 mg/L. The reason for the drop is not clear. These results are given in Table 19. TSS in quiescent samples dropped to less than 2% of the original TSS during the 22-hour test.

4.1.3 Air

4.1.3.1 COIs

Headspace

Prior to the beginning of the wind tunnel testing, a sample of air in the headspace of a container of actively mixed, room-temperature sediment was analyzed for the health and safety of the odor panel as well as to calibrate the sensory equipment. The results are presented in Table 20.

Wind Tunnel

The maximum emission rates were noted during the 0 – 2-hour time interval. The minimum measured emission rate was during the 6 – 22 hour time interval for the 1% Quiescent test run. The emission rates for each detectable COI are shown in Figure 12 and the emission rates for the COIs are given in Table 15. Compounds that had non-detects are illustrated at ½ the Reporting Limit (RL) in a checkerboard pattern.

4.1.3.2 Odor

Emission rates of odor from the wind tunnel had a maximum DT of 3.8 OUs/m^2/hr during the 0 – 2-hour interval of the Exposed Sediment test. The maximum RT of 2.2 OUs/m^2/hr was also obtained during this time interval. RT values will be scaled up by the ambient dispersion model to reflect the larger actual areas of emissions. Odor emission rates are shown in Figure 15 and Table 15. The Intensity of the odor remained close to the same for each time interval regardless of the percent solids but declined over time within individual test runs.

4.2 SMU 6

4.2.1 Sediment

This sediment is classified as a silty sand based on the grain size analysis presented in Appendix B. The concentrations of COIs in this SMU were substantially lower than concentrations from SMUs 1 and 7, with roughly 49% of the analyses returning nondetect results. The sediment concentrations for the COIs can be found in Table 10. The average percent solids for the SMU 6 sediment was approximately 62% as shown in Table 1.

4.2.2 Slurry

Due to the low initial sediment concentrations, 42% of the post-wind tunnel test slurry analyses were non-detects as given in Table 13.

The 10% Mixed and 1% Mixed slurries were well agitated during the test run with approximately half (39-60%) of the solids settling out during the test as shown in Table 19. This decrease was expected due to the amount of sand present.

4.2.3 Air

4.2.3.1 COIs

Due to the low concentration of COIs in the source sediment, few compounds were detected during testing of SMU 6. Three compounds were detectable in all samples analyzed (Benzene, Toluene, and Xylenes) and three more were detected in at least half of the samples (Chlorobenzene, Ethylbenzene, and Naphthalene). The remainder of the COIs were either rarely or never detected as illustrated in Table 16 and Figure 13. Compounds that had non-detects are

illustrated at ½ the Reporting Limit, and marked in the figures by a checkerboard pattern and shown in the tables with a "U" qualifier. The emission rates were usually greatest during the Exposed Sediment test but were variable throughout all slurry testing and no clear pattern was observed.

4.2.3.2 Odor

Although the concentrations of COIs in SMU 6 sediments were significantly lower than those of SMU 1 sediments, the maximum DT (4.4 OUs/m^2/hr) and RT (2.4 OUs/m^2/hr) were greater. The DT and RT behave similarly to those observed during the SMU 1 testing, as does the Persistence. The results for the odor analysis can be found in Figures 16 and 19, and Tables 16 and 18.

4.3 SMU 7

4.3.1 Sediment

This sediment is classified as a silt, with 96.5% passing the #200 sieve as shown in Appendix B. The sediment that was used for the wind tunnel testing had lower COI concentrations than SMU 1, but higher than SMU 6. The average percent solids for the SMU 7 sediments was approximately 50% as shown in Table 1. The pre-test sediment concentrations are given in Table 11.

4.3.2 Slurry

The pretest solids content of the 10% slurries was an average of 11.88% but some settling occurred during the testing resulting in a post-test solids content of 7.1% at the end of the Mixed test run. The 1% slurry mixtures had an initial average solids content of 1.18% and the Mixed test experienced similar settling to end with a solids content of 0.34% as shown in Table 1. The 10% Mixed slurry remained well agitated throughout the duration of the wind tunnel test shown by a pre-test Total Suspended Solids (TSS) of 27,000 mg/L and a post test TSS of 21,000 mg/L. The 1% Mixed slurry showed a decrease in the TSS from 6,800 mg/L to 2,400 mg/L. These results are given in Table 19.

4.3.3 Air

4.3.3.1 COIs

Headspace

Prior to the beginning of the wind tunnel testing, a sample of the air in the headspace of a container of actively mixed, room-temperature sediment was analyzed for the health and safety of the odor panel as well as to calibrate the sensory equipment. The results are presented in Table 20.

Wind Tunnel

Some COIs with low concentrations in the source sediment lead to a significant number of non-detects for the air analyses. Five compounds were detected with a reasonable consistency. They are:

- Toluene,
- Xylenes,
- Benzene,
- Naphthalene, and
- Ethylbenzene.

The emission rates for each detectable COI are shown in Figure 14. Compounds that had non-detects are illustrated by ½ the Reporting Limit in a checkerboard pattern. The emission rates for all COIs are given in Table 17.

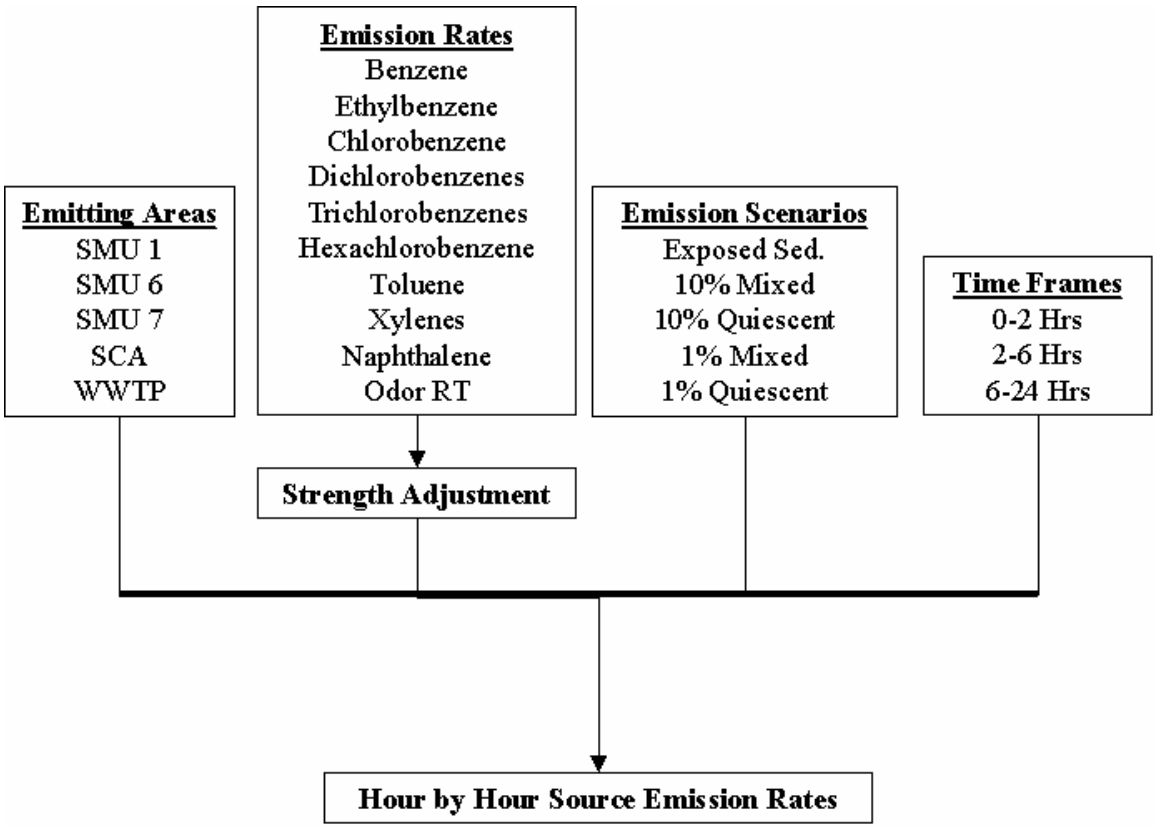
4.3.3.2 Odor

The maximum DT observed during the wind tunnel testing was 4.0 OUs/m^2/hr during the 0 – 2-hour interval of the Exposed Sediment and 10% Mixed tests. The maximum RT of 2.6 OUs/m^2/hr was also obtained during this time interval for the 10% Mixed test. These values will be scaled up by the ambient dispersion model to reflect the actual areas of emissions and air exposure. The DT and RT emission rates were variable in their behavior with only a decline over time being consistent. This is shown in Figure 17 and Table 17. The Intensity of the odor and its Persistency (as shown in Table 18 and Figure 20) have a behavior similar to but slightly less than that observed during the SMU 6 testing.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

This testing program provided data for volatiles and odors that are representative of emission conditions from remediation-related sources. Relatively non-volatile COIs like heavier PAHs, mercury and PCBs were not detected in the emissions. By conducting a series of tests simulating a variety of conditions shown below, a rich set of emission sources are available to characterize emission rates for COIs and odors in detail.



When combined with meteorological data in an ambient air dispersion model, emission rates can match planned remedial activities and determine the potential for adverse impacts from emissions and odor during the Pre-Design Investigation and address potential for mitigation as needed. Emissions rates during dredging activities can be estimated using linear theoretical relationships between sediment concentrations and measured emission rates.

As shown in Figures 9, 10, and 11, the emissions generally, but not always, followed expected trends. For example, increasing emission rates are expected with increasing Henry's Law

constant and decreasing log of the octanol/carbon partition coefficient (log K_{OC}). However, based on the Henry's Law constant, the emission rates were lower than expected for xylenes in all SMUs and for ethylbenzene in SMUs 6 and 7. Emission rates were higher than expected for toluene in all SMUs and for ethylbenzene in SMUs 1 and 7 with respect to the log K_{OC}.

Another expectation is that the emission rates would decrease with elapsed time as the compounds are depleted. As shown in Figures 12, 13, and 14, this trend was generally followed with two notable exceptions. In all three SMUs, the highest emission rates for toluene and xylenes were found during the 2 – 6 hour interval for nearly 100% of the samples. This suggests that these compounds may be more "tightly" bound in the sediments causing a delay in their availability.

One additional consideration is the fact that background conditions (i.e., wind tunnel inflow VOC concentrations) at the test facility were not measured during the wind tunnel testing. Based on a review of mass balance calculations performed on data collected during this investigation, it appears likely that the Benzene, Toluene, Ethylbenzene, and Xylenes (BTEX) emissions detected were impacted by background conditions. The mass balance issue is most apparent in the SMU 6 and 7 data, where tested sediments contain far lower concentrations of these compounds than SMU 1. Ambient air quality monitoring data generated by the Minnesota Pollution Control Agency (MPCA, 2008) and similar reports for indoor air generated by NYSDEC have shown that BTEX concentrations in air can be commonly found at levels comparable to those measured in the SMU 6 & 7 tests. The results for the MPCA ambient air monitoring for the Minneapolis/St. Paul area can be found on their website at http://www.pca.state.mn.us/data/edaAir/ambientList.cfm.

As a result, the presence of background BTEX concentrations should be reflected in future use of the results obtained during this testing. It is recommended for future testing that mitigative steps be taken to measure, reduce, or otherwise mitigate the impact of background concentrations in future wind tunnel studies.

5.2 Recommendations

Two principal factors were considered when recommending which data should be used for further analysis. They are:

- The completeness of detections in sediment, slurries and air during the wind tunnel experiments, and
- Comparison of sediment concentrations to the area-weighted averages at each SMU (During the RI) to evaluate the relative strength of the sediment tested.

If analysis of an air sample of a compound returned non-detects for all or most conditions, SERVICE recommends that the compound not be considered further at this time. For compounds that were mostly non-detectable but were below average concentration or had potential to emit at significant rates, SERVICE recommends they be conservatively evaluated using ½ the Reporting Limit. These recommendations and rationale are detailed in Table 21 and outlined below.

There are ten compounds or parameters for which SERVICE recommends further consideration.

Benzene,
Ethylbenzene,
Chlorobenzene,
Dichlorobenzene,
Trichlorobenzene,
Hexachlorobenzene,
Xylenes,
Toluene,
Naphthalene, and
Odor Recognition Threshold.

SERVICE recommends that the balance of the COIs not be considered further at this time because they do not emit at a significant or measurable rate. Data use of emission rates generated as part of this Investigation will include verification of emissions modeling being conducted as a separate part of this investigation, and comparison to future wind tunnel activities conducted.

Recognition Threshold is recommended for modeling over Detection Threshold because multiples of it is most often used as the criterion for establishing odor limits. For odor, DTs will be used to scale odor and Intensity and Persistence values may be used to interpret the RT modeled results.

Additional recommendations for future wind tunnel testing should be considered. Vertical and horizontal wind speed profile measurements near the sampling tubes could be used to verify that calm and stable air flow is maintained throughout the test. In order to demonstrate that concentration levels are not sensitive to sampling location, future testing could include collection of samples at the same time with the same flow rate from multiple locations within the cross section. Furthermore, preliminary screening of sediment could be conducted to ensure that samples are used with COI concentrations near the high end of the range.

One data gap identified from this Investigation was a characterization of the odors sampled from the tunnel. To fill this data gap, a Work Plan to further characterize the odors qualitatively and quantitatively was submitted under the title "Onondaga Lake Pre-Design Investigations: Phase II Work Plan Addendum 5 (Parsons, December 2006)". The testing and subsequent sample analysis was performed in November and December 2006. The results of the testing were submitted in May 2007 in a report titled "Onondaga Lake Pre-Design Investigation: Phase II Odorant Characterization and Analysis Summary Report".

6.0 REFERENCES

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TABLES

Table 1: Slurry Solids Content

		Pre-test - Measured			
	Sediment (%)	**10% Mixed (%)**	**10% Quiescent (%)**	**1% Mixed (%)**	**1% Quiescent (%)**
SMU 1	45.1	5.52	7.47	0.94	0.71
SMU 6	61.7	7.80	7.80	0.80	0.50
SMU 7	50.7	11.88	10.17	1.18	0.80

		Post-test - Measured			
	Sediment (%)	**10% Mixed (%)**	**10% Quiescent (%)**	**1% Mixed (%)**	**1% Quiescent (%)**
SMU 1	NA	NA	NA	NA	NA
SMU 6	NA	1.83	NA	NA	NA
SMU 7	NA	7.1	NA	0.34	NA

NA = Not Analyzed

Table 2:SMU 1 Air Temperature, Humidity, and Flow

SMU1-1M				SMU1-1Q				SMU1-10M				SMU1-10Q				SMU1-In Situ			
Time (Hrs)	Temp (^{O}F)	Humidity (%)	Air Flow (ft/min)	Time (Hrs)	Temp (^{O}F)	Humidity (%)	Air Flow (ft/min)	Time (Hrs)	Temp (^{O}F)	Humidity (%)	Air Flow (ft/min)	Time (Hrs)	Temp (^{O}F)	Humidity (%)	Air Flow (ft/min)	Time (Hrs)	Temp (^{O}F)	Humidity (%)	Air Flow (ft/min)
0.00	68.5	80.9	234	0.00	66.2	75.0	201	0.00	63.3	78.6	194	0.00	57.0	72.1	196	0.00	66.2	45.0	242
0.62	63.8	85.3	221	0.35	68.5	87.0	194	0.67	61.5	84.5	202	0.27	59.3	72.0	223	0.37	69.6	33.3	233
1.03	64.4	83.3	219	1.35	67.6	84.4	195	1.25	64.9	88.8	196	1.07	61.1	69.3	228	0.82	70.3	29.3	237
1.57	64.0	83.0	222	1.58	68.0	85.5	195	1.75	64.0	87.6	205	1.52	64.0	81.0	222	1.30	70.1	28.5	241
1.97	64.0	83.8	231	1.97	68.0	84.4	191	2.22	64.0	86.8	239	1.85	63.8	81.0	221	2.00	70.5	28.6	238
2.05	65.3	83.5	228	2.13	68.5	83.8	183	2.93	63.3	87.3	219	2.12	64.5	81.2	237	2.12	70.3	28.1	232
2.53	63.5	84.5	228	2.68	68.0	84.8	181	3.63	62.9	87.2	234	2.72	63.5	79.3	232	3.12	70.3	27.0	232
3.13	64.0	84.1	222	3.18	68.0	84.9	190	4.12	62.7	86.9	225	3.32	63.6	80.3	238	4.12	70.5	25.3	233
4.45	64.0	83.4	243	3.75	68.0	84.0	181	4.75	61.1	85.0	220	3.87	63.8	80.8	234	5.12	70.3	25.1	233
4.83	64.0	83.6	243	4.28	67.8	83.8	180	5.28	60.9	80.9	227	4.68	62.6	78.7	224	6.12	69.6	26.0	234
5.27	63.1	80.6	247	4.72	67.6	83.2	189	5.75	60.8	79.5	227	5.23	64.2	82.0	223	6.33	69.0	26.9	237
5.72	61.8	81.3	239	5.20	67.8	83.0	180	6.17	60.4	77.4	213	5.68	63.3	80.9	219	17.12	70.5	28.6	238
6.03	63.5	78.8	241	6.08	68.0	84.7	190	6.43	60.6	79.7	230	6.03	62.4	79.6	214	17.73	70.1	29.6	240
6.15	63.6	77.5	241	6.28	68.3	82.7	182	17.92	60.9	79.1	227	6.28	62.9	80.1	221	19.18	70.3	29.7	240
20.58	64.4	69.6	241	6.70	68.5	87.0	174	18.82	60.6	80.4	234	19.02	60.0	72.7	221	20.23	70.1	31.4	240
20.97	63.5	77.4	245	11.20	68.0	85.0	182	19.22	60.6	80.2	226	19.35	62.2	71.3	226	21.40	71.0	30.6	240
21.63	64.9	79.1	222	21.70	65.0	73.2	180	19.87	60.4	79.0	217	19.72	69.4	86.2	223	22.00	70.5	31.7	240
21.93	64.7	79.7	226	21.98	65.1	69.6	179	20.47	60.9	80.0	219	20.30	68.5	85.7	219				
								21.22	60.8	78.7	227	20.80	67.4	84.0	220				
								21.72	60.4	78.4	221	21.65	67.4	84.6	220				
								21.97	60.8	78.2	227	21.95	66.0	83.1	223				
Maximum	**68.5**	**85.3**	**247.0**		**68.5**	**87.0**	**201.0**		**64.9**	**88.8**	**239.0**		**69.4**	**86.2**	**238.0**		**71.0**	**45.0**	**242.0**
Minimum	**61.8**	**69.6**	**219.0**		**65.0**	**69.6**	**174.0**		**60.4**	**77.4**	**194.0**		**57.0**	**69.3**	**196.0**		**66.2**	**25.1**	**232.0**
Average	**64.2**	**81.1**	**232.9**		**67.6**	**82.6**	**185.9**		**61.7**	**82.1**	**220.4**		**63.7**	**79.3**	**223.0**		**70.0**	**29.7**	**237.1**

(A) For example: SMU 1, 1% Quiescent would be SMU1-1Q

Table 3: SMU 1 Sediment/Slurry Temperature

SMU1-1M		SMU1-1Q		SMU1-10M		SMU1-10Q		SMU1-In Situ	
Time (Hrs)	Temp (^{O}F)	Time (Hrs)	Temp (^{O}F)	Time (Hrs)	Temp (^{O}F)	Time (Hrs)	Temp (^{O}F)	Time (Hrs)	Temp (^{O}F)
0.00	70.0	0.00	70.0	0.00	69.5	0.00	71.0	0.00	66.5
0.62	69.5	0.35	70.5	0.67	71.0	0.27	71.5	0.45	66.5
1.03	70.0	1.35	70.5	1.25	70.5	1.07	70.5	0.93	66.0
1.57	71.5	1.58	70.5	1.75	71.0	1.52	71.0	1.63	66.5
1.97	71.0	1.97	70.5	2.22	72.0	1.85	70.5	1.75	66.0
2.05	71.0	2.13	70.5	2.93	72.0	2.12	70.5	2.75	65.5
2.53	71.5	2.68	70.5	3.63	72.0	2.72	70.5	3.75	66.0
3.13	71.5	3.18	70.5	4.12	71.5	3.32	72.0	4.75	65.5
4.45	72.5	3.75	70.5	4.75	72.5	3.87	70.5	5.75	66.0
4.83	72.5	4.28	70.5	5.28	72.5	4.68	69.5	5.97	65.5
5.27	73.0	4.72	71.0	5.75	74.0	5.23	69.5	16.75	66.5
5.72	72.0	5.20	70.5	6.17	71.5	5.68	69.5	17.37	66.0
6.03	72.5	6.08	70.5	6.43	73.0	6.03	69.5	18.82	66.0
6.15	72.0	6.28	70.0	17.92	72.0	6.28	70.5	19.87	65.5
20.58	74.0	6.70	70.0	18.82	72.0	19.02	67.5	21.03	67.0
20.97	73.5	11.20	69.0	19.22	72.5	19.35	67.5	21.63	66.0
21.63	74.5	21.70	68.5	19.87	72.0	19.72	67.5		
21.93	74.0	21.98	68.5	20.47	72.5	20.30	67.5		
				21.22	72.5	20.80	68.0		
				21.72	72.5	21.65	67.5		
				21.97	72.5	21.95	69.0		
Avg	**74.5**		**71.0**		**74.0**		**72.0**		**67.0**
Min	**69.5**		**68.5**		**69.5**		**67.5**		**65.5**
Max	**72.0**		**70.1**		**72.0**		**69.6**		**66.1**

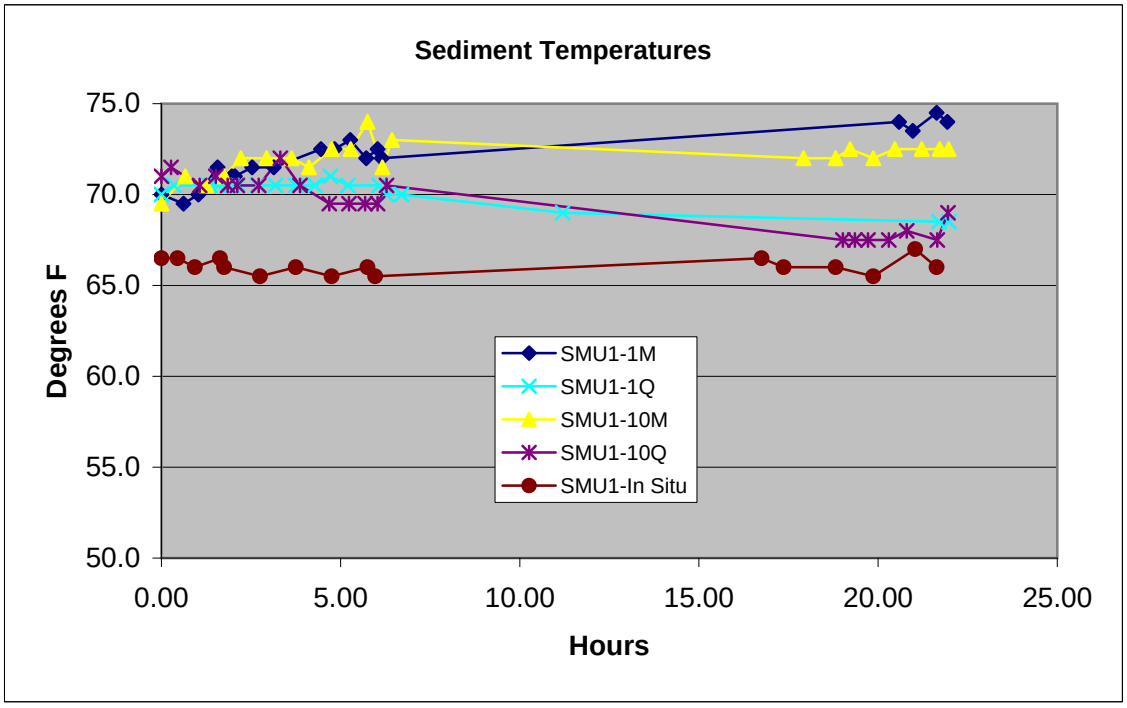


Table 4: SMU 6 Air Temperature, Humidity, and Flow

SMU6-1M				SMU6-1Q				SMU6-10M				SMU6-10Q				SMU6-In Situ			
Time (Hrs)	Temp (^{O}F)	Humidity (%)	Air Flow (ft/min)	Time (Hrs)	Temp (^{O}F)	Humidity (%)	Air Flow (ft/min)	Time (Hrs)	Temp (^{O}F)	Humidity (%)	Air Flow (ft/min)	Time (Hrs)	Temp (^{O}F)	Humidity (%)	Air Flow (ft/min)	Time (Hrs)	Temp (^{O}F)	Humidity (%)	Air Flow (ft/min)
0.00	61.7	83.2	195	0.00	62.7	79.6	266	0.00	63.1	75.5	193	0.00	63.5	80.3	228	0.00	67.6	37.6	239
0.25	63.3	85.0	202	0.43	62.2	78.9	251	0.42	63.1	81.0	193	0.53	62.6	80.8	211	0.20	68.3	37.4	233
1.50	62.9	85.8	217	0.93	63.1	83.7	256	1.37	64.5	82.3	195	0.95	63.1	80.6	230	0.50	68.0	38.8	226
1.93	62.0	84.5	225	1.82	63.5	77.4	265	1.65	65.1	87.4	188	1.57	62.7	80.5	249	0.92	68.0	38.9	232
2.08	62.0	84.2	221	1.97	64.0	80.0	261	2.13	65.3	82.9	198	1.97	62.4	79.4	240	1.53	68.0	38.9	226
2.60	59.0	80.6	214	2.10	63.4	79.7	258	2.75	64.7	82.1	203	2.13	62.6	79.1	228	2.00	68.7	38.4	239
3.08	60.8	82.8	223	2.65	63.1	79.7	260	3.30	63.8	81.2	196	2.80	62.4	80.1	248	2.13	68.5	38.6	234
3.70	60.0	78.6	219	3.27	63.6	79.5	262	3.80	65.1	80.9	197	3.55	62.6	79.7	240	2.77	68.9	38.5	236
4.38	59.9	77.8	218	3.78	64.2	80.4	283	4.40	63.6	80.5	195	3.97	61.3	77.5	229	3.50	68.5	39.0	234
5.10	60.9	78.8	227	4.15	62.2	77.8	267	4.83	66.2	83.3	205	4.77	64.2	80.6	236	3.92	68.5	39.1	234
5.62	60.9	78.5	219	4.67	64.4	84.7	262	5.30	64.7	81.8	199	5.40	63.6	81.0	232	4.58	68.9	39.4	236
6.05	61.1	78.0	228	5.17	64.4	81.6	267	5.80	66.5	82.8	215	5.82	63.8	81.1	247	5.95	70.1	35.4	234
6.15	61.1	76.6	228	5.60	62.9	78.2	267	6.10	65.6	80.4	207	6.10	63.6	80.5	238	6.25	69.9	39.4	200
6.57	62.0	80.2	238	6.22	65.6	82.9	270	6.25	66.0	80.9	196	6.25	63.3	80.9	244	7.18	63.9	41.8	200
6.98	62.9	80.8	225	6.42	68.0	88.6	273	6.72	66.3	80.4	210	6.60	64.7	82.5	237	7.37	70.8	40.1	264
7.37	61.3	78.4	225	8.55	65.1	81.9	263	7.00	68.0	81.6	213	6.88	63.8	81.2	234	7.72	68.9	40.5	255
11.83	61.7	79.5	218	21.77	60.0	75.7	246	9.57	65.6	81.5	194	21.77	67.1	58.3	247	8.05	69.0	40.4	246
21.30	60.6	68.0	206	21.95	63.1	78.5	256	10.00	65.6	75.4	203	22.07	67.0	79.8	236	10.55	68.0	34.2	245
21.72	60.4	79.4	224					21.67	63.3	72.4	214					11.23	68.1	34.4	246
21.98	65.6	79.6	225					21.92	63.1	73.7	205					21.52	69.0	25.5	236
																21.88	67.1	28.8	232
Maxim	**65.6**	**85.8**	**238.0**		**68.0**	**88.6**	**283.0**		**68.0**	**87.4**	**215.0**		**67.1**	**82.5**	**249.0**		**70.8**	**41.8**	**264.0**
Minimu	**59.0**	**68.0**	**195.0**		**60.0**	**75.7**	**246.0**		**63.1**	**72.4**	**188.0**		**61.3**	**58.3**	**211.0**		**63.9**	**25.5**	**200.0**
Averag	**61.5**	**80.0**	**219.9**		**63.6**	**80.5**	**262.9**		**65.0**	**80.4**	**201.0**		**63.6**	**79.1**	**236.3**		**68.4**	**37.4**	**234.6**

(A) For example: SMU6, 1% Quiescent would be SMU6-1Q

Table 5: SMU 6 Sediment Temperature

SMU6-1M		SMU6-1Q		SMU6-10M		SMU6-10Q		SMU6-In Situ	
Time (Hrs)	Temp (^{O}F)	Time (Hrs)	Temp (^{O}F)	Time (Hrs)	Temp (^{O}F)	Time (Hrs)	Temp (^{O}F)	Time (Hrs)	Temp (^{O}F)
0.00	65.0	0.00	65.0	0.00	57.0	0.00	61.0	0.00	66.0
0.25	65.0	0.43	65.5	0.42	58.0	0.53	61.5	0.20	65.5
1.50	66.5	0.93	66.0	1.37	61.5	0.95	62.5	0.50	65.5
1.93	68.0	1.82	66.0	1.65	61.5	1.57	63.0	0.92	65.5
2.08	68.0	1.97	66.0	2.13	62.5	1.97	63.5	1.53	66.0
2.60	68.0	2.10	66.5	2.75	64.5	2.13	63.5	2.00	65.5
3.08	68.5	2.65	65.5	3.30	65.0	2.80	64.0	2.13	65.5
3.70	69.0	3.27	66.0	3.80	66.0	3.55	64.0	2.77	65.5
4.38	69.0	3.78	67.0	4.40	66.5	3.97	64.5	3.50	65.5
5.10	69.5	4.15	66.5	4.83	67.5	4.77	65.5	3.92	65.5
5.62	69.5	4.67	66.5	5.30	68.0	5.40	66.0	4.58	65.5
6.05	71.0	5.17	66.5	5.80	69.0	5.82	66.0	5.95	65.5
6.15	70.5	5.60	66.5	6.10	69.0	6.10	66.0	6.25	65.5
6.57	70.5	6.22	67.0	6.25	69.5	6.25	66.5	7.18	65.5
6.98	71.0	6.42	66.5	6.72	69.5	6.60	67.0	7.37	65.5
7.37	71.0	8.55	67.0	7.00	70.0	6.88	66.5	7.72	65.5
11.83	71.0	21.77	66.5	9.57	71.5	21.77	66.5	8.05	65.5
21.30	70.5	21.95	66.5	10.00	72.0	22.07	67.0	10.55	65.5
21.72	70.5			21.67	72.5			11.23	65.0
21.98	71.0			21.92	72.5			21.52	65.0
								21.88	65.0
Avg	**71.0**		**67.0**		**72.5**		**67.0**		**66.0**
Min	**65.0**		**65.0**		**57.0**		**61.0**		**65.0**
Max	**69.2**		**66.3**		**66.7**		**64.7**		**65.5**

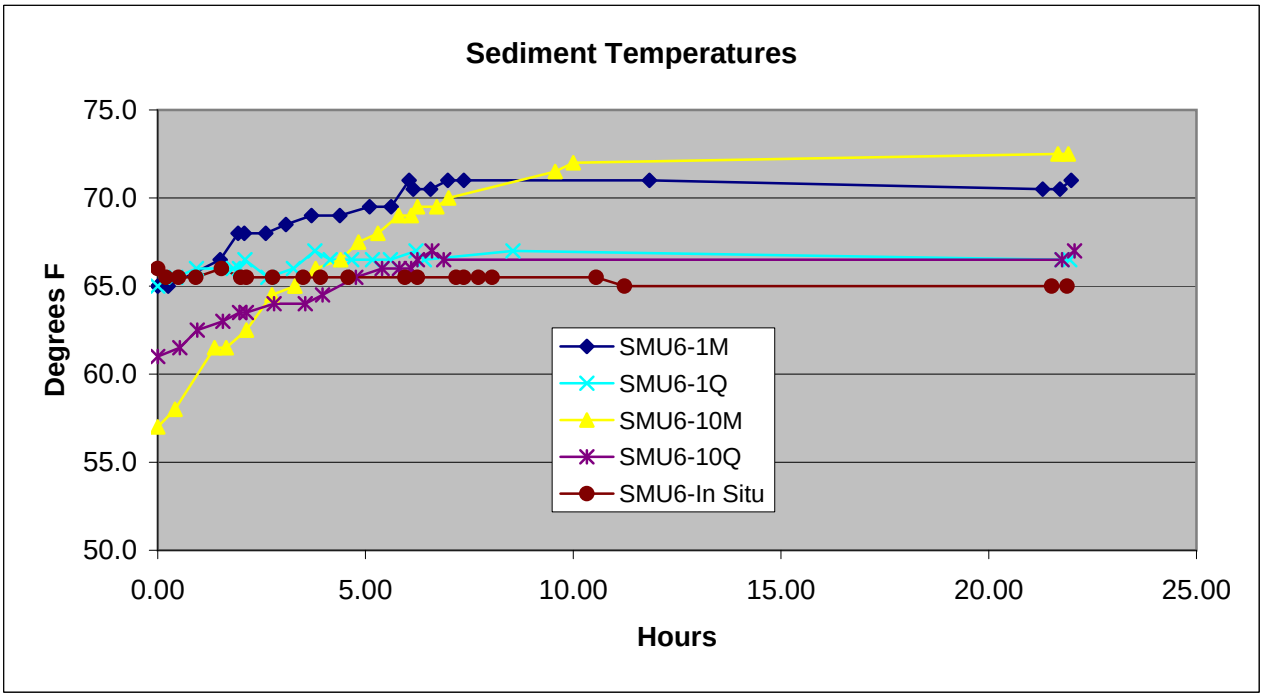


Table 6: SMU 7 Air Temperature, Humidity, and Flow

SMU7-1M				SMU7-1Q				SMU7-10M				SMU7-10Q				SMU7-In Situ			
Time (Hrs)	Temp (^{O}F)	Humidity (%)	Air Flow (ft/min)	Time (Hrs)	Temp (^{O}F)	Humidity (%)	Air Flow (ft/min)	Time (Hrs)	Temp (^{O}F)	Humidity (%)	Air Flow (ft/min)	Time (Hrs)	Temp (^{O}F)	Humidity (%)	Air Flow (ft/min)	Time (Hrs)	Temp (^{O}F)	Humidity (%)	Air Flow (ft/min)
0.00	68.1	84.1	287	0.00	65.6	72.1	248	0.00	71.0	80.7	196	0.00	66.5	81.8	250	0.00	70.8	18.9	225
0.33	67.6	84.4	292	0.43	66.5	81.9	247	0.27	67.6	87.9	272	0.42	66.7	86.5	248	0.97	71.9	16.4	265
0.82	66.2	84.2	291	0.87	65.1	80.8	236	0.62	67.1	86.7	268	0.70	66.0	86.5	250	1.23	70.5	16.3	287
1.02	65.6	84.2	283	1.47	65.8	81.8	240	0.98	67.8	88.6	268	1.23	65.1	84.3	275	1.48	71.9	16.0	270
1.42	65.8	84.3	280	1.95	66.0	82.6	236	1.37	67.8	89.4	268	1.97	64.9	84.1	270	1.82	70.5	16.2	277
1.97	65.4	81.6	277	2.10	65.3	81.3	237	1.80	66.3	87.3	274	2.10	66.5	86.1	270	2.12	72.3	15.7	276
2.10	64.5	84.5	273	2.60	67.1	82.3	246	1.97	67.1	87.6	278	2.62	66.0	87.1	267	2.58	71.0	16.0	280
3.17	66.0	83.9	299	3.03	68.1	84.7	241	2.17	66.7	86.8	271	3.07	66.2	85.0	273	3.05	72.5	15.9	277
3.67	66.7	84.3	289	3.48	66.3	82.2	246	2.43	66.9	87.0	272	3.68	66.0	84.0	267	3.62	72.5	15.8	272
4.05	65.6	82.3	278	4.25	65.6	79.3	248	2.88	66.5	88.7	275	4.10	64.9	83.8	262	4.25	71.7	15.8	279
4.38	66.5	83.8	270	4.78	66.9	81.9	240	3.33	66.5	87.0	284	4.72	66.3	85.7	274	4.77	72.1	15.7	260
4.92	67.2	83.6	279	5.35	66.9	82.0	254	4.42	65.6	85.6	291	5.30	66.0	85.0	281	5.22	70.5	15.8	272
5.43	65.8	83.7	271	5.75	65.8	81.3	244	4.73	66.3	86.6	283	5.73	66.9	86.1	282	5.88	70.5	15.2	277
5.97	68.0	84.8	273	6.00	67.4	84.5	238	5.72	65.1	84.7	275	6.08	64.9	83.1	274	6.10	71.9	15.3	270
6.17	68.0	84.9	278	6.20	64.7	82.0	237	6.12	65.3	85.8	268	6.22	64.4	83.3	267	6.30	71.0	15.6	265
6.42	68.0	85.2	292	6.55	65.6	82.4	248	6.30	65.4	86.0	269	6.50	66.3	85.2	278	6.50	71.4	15.7	267
10.22	64.2	80.0	258	7.02	65.6	82.5	239	6.87	65.1	87.5	271	11.18	65.1	81.1	267	6.98	69.8	15.0	273
10.55	66.2	83.9	255	11.42	65.3	80.2	232	7.15	64.5	84.9	272	11.60	65.6	83.0	270	21.62	70.5	13.7	272
21.50	64.5	80.4	272	21.35	67.1	80.7	238	9.02	64.2	84.0	270	21.53	63.8	76.0	272	21.78	69.8	13.9	269
21.88	62.9	77.8	271	21.60	67.8	80.6	231	9.45	64.7	86.6	272	21.87	66.5	81.2	275	21.98	69.9	13.9	260
				21.83	68.0	83.0	232	21.67	61.8	84.1	261	22.00	65.6	79.9	266				
								21.97	65.6	84.1	266								
Maximum	**68.1**	**85.2**	**299.0**		**68.1**	**84.7**	**254.0**		**71.0**	**89.4**	**291.0**		**66.9**	**87.1**	**282.0**		**72.5**	**18.9**	**287.0**
Minimum	**62.9**	**77.8**	**255.0**		**64.7**	**72.1**	**231.0**		**61.8**	**80.7**	**196.0**		**63.8**	**76.0**	**248.0**		**69.8**	**13.7**	**225.0**
Average	**66.1**	**83.3**	**278.4**		**64.7**	**81.4**	**240.9**		**66.1**	**86.3**	**269.3**		**65.7**	**83.8**	**268.5**		**71.2**	**15.6**	**269.7**

(A) For example: SMU7, 1% Quiescent would be SMU7-1Q

Table 7: SMU 7 Sediment Temperature

SMU7-1M		SMU7-1Q		SMU7-10M		SMU7-10Q		SMU7-In Situ	
Time (Hrs)	Temp (^{O}F)	Time (Hrs)	Temp (^{O}F)	Time (Hrs)	Temp (^{O}F)	Time (Hrs)	Temp (^{O}F)	Time (Hrs)	Temp (^{O}F)
0.00	54.5	0.00	68.5	0.00	68.5	0.00	68.0	0.00	69.0
0.33	54.5	0.43	69.0	0.27	68.5	0.42	68.5	0.97	69.5
0.82	56.5	0.87	69.0	0.62	69.5	0.70	68.5	1.23	69.0
1.02	56.5	1.47	69.0	0.98	69.5	1.23	68.0	1.48	69.5
1.42	58.5	1.95	69.0	1.37	70.0	1.97	68.0	1.82	69.0
1.97	60.0	2.10	69.0	1.80	70.5	2.10	68.0	2.12	69.0
2.10	61.0	2.60	69.0	1.97	70.5	2.62	68.5	2.58	68.5
3.17	63.5	3.03	69.0	2.17	70.5	3.07	68.5	3.05	68.5
3.67	65.0	3.48	69.0	2.43	71.0	3.68	68.5	3.62	68.5
4.05	65.0	4.25	69.5	2.88	71.5	4.10	68.5	4.25	68.5
4.38	66.5	4.78	68.5	3.33	72.0	4.72	68.5	4.77	68.5
4.92	67.0	5.35	69.0	4.42	72.0	5.30	69.0	5.22	68.0
5.43	68.5	5.75	68.5	4.73	72.5	5.73	68.5	5.88	68.5
5.97	68.5	6.00	68.5	5.72	73.0	6.08	69.0	6.10	68.0
6.17	69.0	6.20	69.0	6.12	73.0	6.22	68.5	6.30	68.0
6.42	69.0	6.55	69.0	6.30	72.5	6.50	69.0	6.50	68.0
10.22	72.0	7.02	69.0	6.87	73.0	11.18	68.5	6.98	68.0
10.55	72.5	11.42	68.5	7.15	73.5	11.60	68.5	21.62	66.5
21.50	74.0	21.35	68.0	9.02	73.5	21.53	68.0	21.78	66.5
21.88	74.0	21.60	68.0	9.45	74.0	21.87	68.5	21.98	66.5
		21.83	67.5	21.67	74.5	22.00	68.0		
				21.97	74.5				
Avg	**74.0**		**69.5**		**74.5**		**69.0**		**69.5**
Min	**54.5**		**67.5**		**68.5**		**68.0**		**66.5**
Max	**64.8**		**68.7**		**71.7**		**68.4**		**68.3**

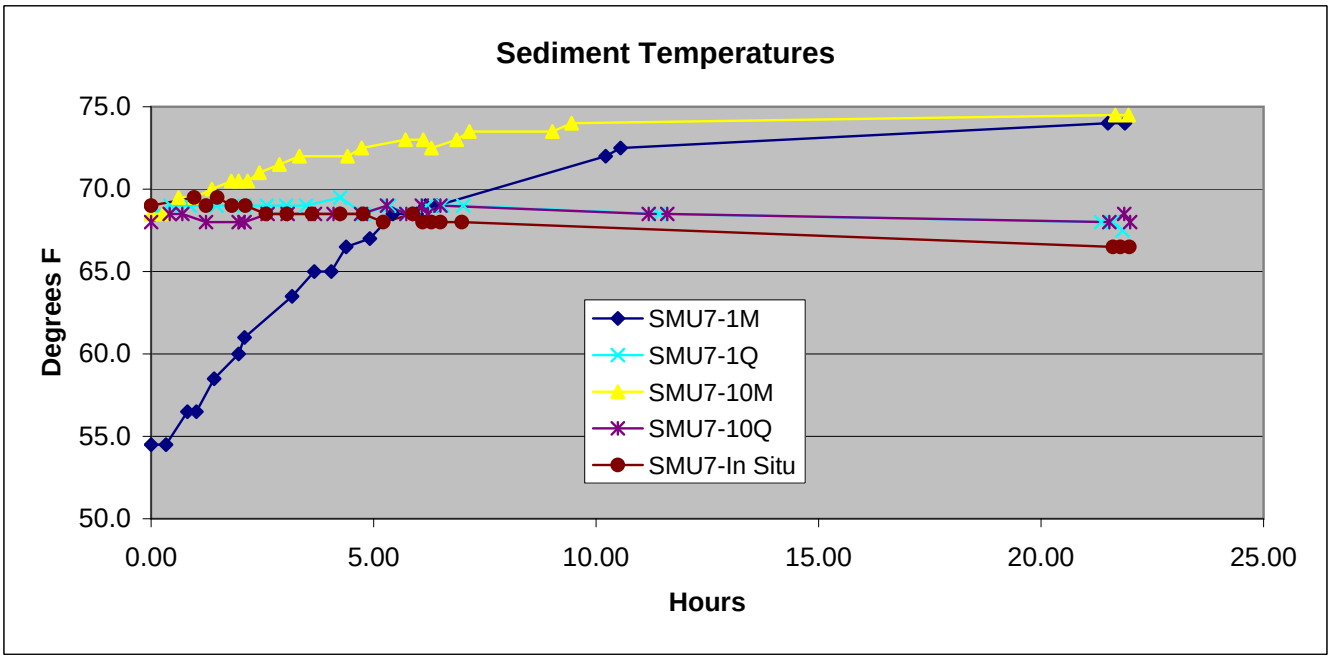


Table 8: Sediment Concentrations Compared to Area-Weighted Average

Chemical	SMU 1 Average* (mg/kg) Sediment	SMU 1 Actual (mg/kg) Sediment	SMU 1 % of Average	SMU 6 Average** (mg/kg) Sediment	SMU 6 Actual (mg/kg) Sediment	SMU 6 % of Average	SMU 7 Average** (mg/kg) Sediment	SMU 7 Actual (mg/kg) Sediment	SMU 7 % of Average
Benzene	5	15	276%	0.13	0.04	32%	1	1	85%
Chlorobenzene	22	63	282%	0.49	0.09	19%	13	10	79%
Ethylbenzene	3	3	99%	0.22	0.04	19%	1	1	68%
1,4 DCB***	51	96	190%	0.63	0.06	10%	56	19	35%
Toluene	13	18	136%	0.11	0.06	58%	3	2	74%
Xylenes	57	70	122%	0.32	0.27	82%	10	6	59%
Fluorene	5	21	421%	1.35	3.00	222%	6	93	1476%
Mercury	17	18	107%	2.86	1.12	39%	21	40	193%
Naphthalene	157	180	115%	2.93	4.83	165%	27	127	470%
Phenanthrene	8	5	64%	5.18	12.07	233%	6	37	614%
Pyrene	4	2	54%	3.63	10.83	298%	4	11	279%
Avg % of expected			170%			107%			312%

* The Area Weighted Average Concentration Data is from Appendix B of the Feasibility Study for the Depth Interval 0-3 meters

** The Area Weighted Average Concentration Data is from Appendix B of the Feasibility Study for the Depth Interval 0-2 meters

*** The Area Weighted Average value for 1,4 Dichlorobenzene is the Area Weighted Average Value from the sum of Dichlorobenzenes

Table 9: SMU 1 Pre-test Sediment Concentrations

Work Order #	505992		506008		506042		
Parsons Sample #	OL-STA-10029		OL-STA-10029		OL-STA-10029		
sample id - SERVICE	10029-IN-PR		10029-10M-PR		10029-1M-PR		
sample id - lab	0505992-01 (Soil)		0506008-01 (Soil)		0506042-02 (Soil)		
	Exposed Concentration (mg/Kg dry)		***10 % Mixed Concentration (mg/Kg dry)***		***1% Mixed Concentration (mg/Kg dry)***		***Average Concentration (mg/Kg dry)***
Chemical/Parameter	*Sediment*	*Flags*	*Sediment*	*Flags*	*Sediment*	*Flags*	*Sediment*
VOCs							
Benzene	1.31		20		23		14.77
Chlorobenzene	45		77		67		63.00
Ethylbenzene	1.29		5		2.5		2.93
1,4 Dichlorobenzene	60		150		78		96.00
1,2,3 Trichlorobenzene	9.6		80		0.48		30.03
1,2,4 Trichlorobenzene	25		230		34		96.33
1,3,5 Trichlorobenzene	not listed		not listed		not listed		
Hexachlorobenzene	0.22		0.065		0.065		0.12
Toluene	20		19		16		18.33
Xylenes (o-,m-,p-)	64		97		49		70.00
PAHs							
Fluorene	23		17		23		21.00
Naphthalene	230		140		170		180.00
Phenanthrene	7.2		3.5				5.35
Pyrene	3.1		1.4				2.25
Other Compounds							
PCBs (undifferentiated)	not listed		not listed		not listed		
Phenol	5.1		8.3		6		6.47
Mercury	18		17		19		18.00

Note:
Results for Hexachlorobenzene from semi-volatile analysis results
Nondetects flagged with a "U" and reported at 1/2 the RL

Table 10: SMU 6 Pre-test Sediment Concentrations

Work Order #	506249		506265		506279		
Parsons Sample #	OL-STA-60028		OL-STA-60028		OL-STA-60028		
sample id - SERVICE	60028-IN-PR		60028-10M-PR		60028-1M-PR		
sample id - lab	0506249-01 (Soil)		0506265-01 (Soil)		0506279-02 (Soil)		
	Exposed Concentration (mg/Kg dry)		***10 % Mixed Concentration (mg/Kg dry)***		***1% Mixed Concentration (mg/Kg dry)***		***Average Concentration (mg/Kg dry)***
Chemical/Parameter	*Sediment*	*Flags*	*Sediment*	*Flags*	*Sediment*	*Flags*	*Sediment*
VOCs							
Benzene	0.04	U	0.043	U	0.041	U	0.04
Chlorobenzene	0.12		0.043	U	0.11		0.09
Ethylbenzene	0.04	U	0.043	U	0.041	U	0.04
1,4 Dichlorobenzene	0.11		0.043	U	0.041	U, B	0.06
1,2,3 Trichlorobenzene	0.04	U	0.043	U	0.041	U, B	0.04
1,2,4 Trichlorobenzene	0.04	U	0.043	U	0.041	U	0.04
1,3,5 Trichlorobenzene	not listed		not listed		not listed		
Hexachlorobenzene	0.105	U	0.11	U	0.11	U	0.11
Toluene	0.04	U	0.043	U	0.1		0.06
Xylenes (o-,m-,p-)	0.3		0.187		0.31		0.27
PAHs							
Fluorene	2.1		2.6		4.3		3.00
Naphthalene	3.3		5.1		6.1		4.83
Phenanthrene	7.2		11		18		12.07
Pyrene	6.5		11		15		10.83
Other Compounds							
PCBs (undifferentiated)	not listed		not listed		not listed		
Phenol	0.105	U	0.11	U	0.11	U	0.11
Mercury	0.69		0.87		1.8		1.12

Note:
Results for Hexachlorobenzene from semi-volatile analysis results
Nondetects flagged with a "U" and reported at 1/2 the RL
"B" = Analyte detected in method blank.

Table 11: SMU 7 Pre-test Sediment Concentrations

Work Order #	506400		506408		506445		
Parsons Sample #	OL-STA-70015		OL-STA-70015		OL-STA-70015		
sample id SERVICE	70015-IN-PR		70015-10M-PR		70015-1M-PR		
sample id lab	0506400-01 (Soil)		0506408-03 (Soil)		0506445-02 (Soil)		
	Exposed Concentration (mg/Kg dry)		***10 % Mixed Concentration (mg/Kg dry)***		***1% Mixed Concentration (mg/Kg dry)***		***Average Concentration (mg/Kg dry)***
Chemical/Parameter	*Sediment*	*Flags*	*Sediment*	*Flags*	*Sediment*	*Flags*	*Sediment*
VOCs							
Benzene	0.78		1.2		1.1		1.03
Chlorobenzene	9.7		11		10		10.23
Ethylbenzene	0.66		0.475		0.92		0.69
1,4 Dichlorobenzene	17		21		20		19.33
1,2,3 Trichlorobenzene	0.25	B	0.475		0.09		0.27
1,2,4 Trichlorobenzene	2.5		2.8		2.6		2.63
1,3,5 Trichlorobenzene	not listed		not listed		not listed		
Hexachlorobenzene	0.135		0.125		0.12		0.13
Toluene	1.5		2.2		2		1.90
Xylenes (o-,m-,p-)	5.2		6.1		6.3		5.87
PAHs							
Fluorene	100		90		89		93.00
Naphthalene	130		120		130		126.67
Phenanthrene	38		32		41		37.00
Pyrene	13		11		9.3		11.10
Other Compounds							
PCBs (undifferentiated)	not listed		not listed		not listed		
Phenol	0.135		0.125		0.12		0.13
Mercury	38		43		38		39.67

Note:
Results for Hexachlorobenzene from semi-volatile analysis results
Nondetects flagged with a "U" and reported at 1/2 the RL
"B" = Analyte detected in method blank.

Table 12: SMU 1 Post Test Slurry Concentrations

Work Order #	506028		506041		506069		506071	
Parsons Sample #	OL-STA-10029		OL-STA-10029		OL-STA-10029		OL-STA-10029	
sample id - SERVICE	10029-10M-PO		10029-10Q-PO		10029-1M-PO		10029-1Q-PO	
sample id - lab	0506028-01		0506041-01		0506069-03		0506071-02	
	10 % Mixed Concentration (ug/L)		***10 % Quiescent Concentration (ug/L)***		***1% Mixed Concentration (ug/L)***		***1% Quiescent Concentration (ug/L)***	
Chemical/Parameter	*Slurry*	*Flags*	*Slurry*	*Flags*	*Slurry*	*Flags*	*Slurry*	*Flags*
VOCs								
Benzene	370		1300		20		110	
Chlorobenzene	1100		1600		120		340	
Ethylbenzene	48		42		7.7		12	
1,4 Dichlorobenzene	800		730		180		250	
1,2,3 Trichlorobenzene	5	U	2.5	U	0.5	U	2.5	U
1,2,4 Trichlorobenzene	140		69		59		53	
1,3,5 Trichlorobenzene	not listed		not listed		not listed		not listed	
Hexachlorobenzene	2.85	U	2.5	U	2.6	U	2.6	U
Toluene	390		710		31		96	
Xylenes (o-,m-,p-)	1010		870		169		270	
PAHs								
Fluorene	5.6		3.9		3		2.8	
Naphthalene	2800		2100		1.3		1.1	
Phenanthrene	9.7		4.2		3.4		3.2	
Pyrene	2.3		1	U	0.95		0.53	
Other Compounds								
PCBs (undifferentiated)	not listed		not listed		not listed		not listed	
Phenol	820		650		5	U	5.3	
Mercury	81		0.021		13		1	

Notes:
Results for Hexachlorobenzene from semi-volatile analysis results
Nondetects flagged with a "U" and reported at 1/2 the RL

Table 13: SMU 6 Post Test Slurry Concentrations

Work Order #	506265		506277		506328		506399	
Parsons Sample #	OL-STA-60028		OL-STA-60028		OL-STA-60028		OL-STA-60028	
sample id - SERVICE	60028-10M-PO		60028-10Q-PO		60028-1M-PO		60028-1Q-PO	
sample id - lab	0506265-04		0506277-04		0506328-01		0506399-01	
Chemical/Parameter	***10 % Mixed Concentration (ug/L)*** *Slurry*	*Flags*	***10 % Quiescent Concentration (ug/L)*** *Slurry*	*Flags*	***1% Mixed Concentration (ug/L)*** *Slurry*	*Flags*	***1% Quiescent Concentration (ug/L)*** *Slurry*	*Flags*
VOCs								
Benzene	1	U	0.5	U	1	U	0.5	U
Chlorobenzene	3.1		2.4		2.9		1.4	
Ethylbenzene	1	U	0.5	U	1	U	0.5	U
1,4 Dichlorobenzene	4		1.8		3.1		1.8	
1,2,3 Trichlorobenzene	1	U	0.5	U	1	U	0.5	U, B
1,2,4 Trichlorobenzene	1	U	0.5	U	1	U	0.5	U, B
1,3,5 Trichlorobenzene	not listed		not listed		not listed		not listed	
Hexachlorobenzene	3.5	U	3.25	U	3.55	U	2.65	U
Toluene	1	U	0.5	U	1	U	0.5	U
Xylenes (o-,m-,p-)	8.3		7.3		8.4		1.8	
PAHs								
Fluorene	6.1		5.1		7.3		1.05	U
Naphthalene	14		3.25	U	0.86		2.65	U
Phenanthrene	8.3		4.8		9.9		1.05	U
Pyrene	2.1		2		2.7		1.3	
Other Compounds								
PCBs (undifferentiated)	not listed		not listed		not listed		not listed	
Phenol	7	U	6.5	U	7	U	5.5	U
Mercury	0.1	U	0.1	U	0.17		0.1	U

Notes:
Results for Hexachlorobenzene from semi-volatile analysis results
Nondetects flagged with a "U" and reported at 1/2 the RL
"B" = Analyte detected in method blank.

Table 14: SMU 7 Post Test Slurry Concentrations

Work Order #	506423		506445		506487		506504	
Parsons Sample #	OL-STA-70015		OL-STA-70015		OL-STA-70015		OL-STA-70015	
sample id - SERVICE	70015-10M-PO		70015-10Q-PO		70015-1M-PO		70015-1Q-PO	
sample id - lab	0506423-01		0506445-01		0506487-01		0506504-01	
	10 % Mixed Concentration (ug/L)		***10 % Quiescent Concentration (ug/L)***		***1% Mixed Concentration (ug/L)***		***1% Quiescent Concentration (ug/L)***	
Chemical/Parameter	*Slurry*	*Flags*	*Slurry*	*Flags*	*Slurry*	*Flags*	*Slurry*	*Flags*
VOCs								
Benzene	53		70		1	U	8.6	
Chlorobenzene	370		410		27		92	
Ethylbenzene	16		14		2.8		6.4	
1,4 Dichlorobenzene	380		380		90		120	
1,2,3 Trichlorobenzene	1	U	2.5	U	1	U	2.5	U
1,2,4 Trichlorobenzene	24		21		17		8.1	
1,3,5 Trichlorobenzene	not listed		not listed		not listed		not listed	
Hexachlorobenzene	3.65	U	3.1	U	2.85	U	2.65	U
Toluene	100		72		3.4		13	
Xylenes (o-,m-,p-)	192		79		5.4		14.5	
PAHs								
Fluorene	11		11		7.1		5.8	
Naphthalene	600		6.3		2.85	U	2.65	U
Phenanthrene	12		13		7.3		4.2	
Pyrene	1.3		1.6		0.66		0.8	
Other Compounds								
PCBs (undifferentiated)	not listed		not listed		not listed		not listed	
Phenol	7.5	U	6	U	5.5	U	5.5	U
Mercury	0.1		0.1	U	0.1	U	0.1	U

Notes:
Results for Hexachlorobenzene from semi-volatile analysis results
Nondetects flagged with a "U" and reported at 1/2 the RL

Table 15
SMU 1 Air and Odor Emission Rates

Chemical/Parameter	Concentration (mg/Kg)	0 - 2 Hour Emission Rate (ug/m2/hr) (except where noted)									
	Sediment	Exposed	Flags	10% Mixed	Flags	10% Quiescent	Flags	1% Mixed	Flags	1% Quiescent	Flags
VOCs											
Benzene	14.77	38,114		44,477		34,501		22,334		14,777	
Chlorobenzene	63	8,796	U	30,980		8,226	U	19,503		7,246	U
Ethylbenzene	2.93	20,695		7,515	U	7,903	U	7,707	U	6,962	U
1,4 Dichlorobenzene	96	10,003	U	8,895	U	9,355	U	9,122	U	8,241	U
1,2,3 Trichlorobenzene	30.03	10,089	U	8,972	U	9,436	U	9,201	U	8,312	U
1,2,4 Trichlorobenzene	96.33	9,744	U	8,665	U	9,113	U	8,886	U	8,028	U
1,3,5 Trichlorobenzene		10,089	U	8,972	U	9,436	U	9,201	U	8,312	U
Hexaclorobenzene	0.12	3,147	U	2,799	U	2,944	U	2,870	U	2,593	U
Toluene	18.33	105,374		65,335		41,130		38,376		37,511	
Xylenes (o-,m-,p-)	70	102,787		58,433		24,839		23,906		19,608	
PAHs											
Fluorene	21	3,104	U	2,761	U	2,903	U	2,831	U	2,558	U
Naphthalene	180	15,780		36,195		19,516		26,266		7,389	
Phenanthrene		3,173	U	2,822	U	2,968	U	2,894	U	2,614	U
Pyrene		3,320	U	2,952	U	3,105	U	3,028	U	2,735	U
Other Compounds											
PCBs (undifferentiated)		-	NA	1,066	U	-	NA	-	NA	-	NA
Phenol	6.47	7,364	U	6,549	U	6,887	U	6,716	U	6,067	U
Mercury	18	57	U	51	U	53	U	52	U	47	U
Hydrogen Sulfide		-	NA	77	U	-	NA	79	U	-	NA
Mercaptans		-	NA	153	U	-	NA	157	U	-	NA
Ammonia		-	NA	383	U	-	NA	393	U	-	NA
Odor Parameters											
Detection Threshold (OUs)		42.794		27.212		27.539		19.970		15.923	
Recognition Threshold (OUs)		24.776		16.746		14.829		13.313		10.615	
Intensity (ppm n-butanol)		0.766		0.524		0.685		0.645		0.726	
Persistence		-0.011		-0.007		-0.008		-0.010		-1.129	
Amines		-	NA	169	U	-	NA	-	NA	-	NA
Reduced Sulfur Gases		-	NA	16,870		-	NA	-	NA	-	NA
Average Test Conditions											
Sed Temp (degrees F)		66.1		72.0		69.6		72.0		70.1	
Air Temp (degrees F)		70.0		61.7		63.7		64.2		67.6	
Humidity (%)		29.7		82.1		79.3		81.1		82.6	
Air Velocity (Mi/Hr)		2.69		2.50		2.53		2.65		2.11	
Cross Section Area (m2)		0.046		0.046		0.046		0.046		0.046	

NA = Not Analyzed
U=Undetected value is 0.5 times Reporting Limit

Table 15
SMU 1 Air and Odor Emission Rates

Chemical/Parameter	*Concentration (mg/Kg)*	*2 - 6 Hour Emission Rate (ug/m2/hr) (except where noted)*									
	Sediment	*Exposed*	*Flags*	*10% Mixed*	*Flags*	*10% Quiescent*	*Flags*	*1% Mixed*	*Flags*	*1% Quiescent*	*Flags*
VOCs											
Benzene	14.77	31,119		44,259		33,788		16,196		17,134	
Chlorobenzene	63	4,289	U	28,313		13,035		13,224		3,335	U
Ethylbenzene	2.93	18,167		15,051		3,997	U	4,045	U	10,346	
1,4 Dichlorobenzene	96	4,870	U	12,692		4,723	U	4,780	U	3,787	U
1,2,3 Trichlorobenzene	30.03	4,937	U	4,776	U	4,788	U	4,846	U	3,839	U
1,2,4 Trichlorobenzene	96.33	4,735	U	4,580	U	4,593	U	4,647	U	3,682	U
1,3,5 Trichlorobenzene		4,903	U	4,743	U	4,756	U	4,813	U	3,813	U
Hexaclorobenzene	0.12	1,531	U	1,481	U	4,030		1,502	U	1,190	U
Toluene	18.33	90,498		81,521		54,458		37,807		54,150	
Xylenes (o-,m-,p-)	70	89,825		85,101		57,509		41,769		52,842	
PAHs											
Fluorene	21	1,514	U	1,464	U	1,468	U	1,486	U	1,177	U
Naphthalene	180	13,760		50,117		18,827		24,599		7,521	
Phenanthrene		1,548	U	1,497	U	1,501	U	1,519	U	1,203	U
Pyrene		1,615	U	1,562	U	1,566	U	1,585	U	1,256	U
Other Compounds											
PCBs (undifferentiated)		-	NA	564	U	-	NA	-	NA	-	NA
Phenol	6.47	3,591	U	3,474	U	3,483	U	3,525	U	2,793	U
Mercury	18	28	U	27	U	27	U	27	U	22	U
Hydrogen Sulfide		-	NA	81	U	-	NA	39	U	-	NA
Mercaptans		-	NA	163	U	-	NA	79	U	-	NA
Ammonia		-	NA	407	U	-	NA	197	U	-	NA
Odor Parameters											
Detection Threshold (OUs)		45.047		18.839		38.131		26.626		15.923	
Recognition Threshold (OUs)		24.776		12.559		21.184		15.532		10.615	
Intensity (ppm n-butanol)		0.806		0.302		0.343		0.222		0.423	
Persistence		-0.010		-0.004		-0.005		-0.004		-0.006	
Amines		-	NA	-	NA	-	NA	-	NA	-	NA
Reduced Sulfur Gases		-	NA	-	NA	-	NA	-	NA	-	NA
Average Test Conditions											
Sed Temp (degrees F)		66.1		72.0		69.6		72.0		70.1	
Air Temp (degrees F)		70.0		61.7		63.7		64.2		67.6	
Humidity (%)		29.7		82.1		79.3		81.1		82.6	
Air Velocity (Mi/Hr)		2.69		2.50		2.53		2.65		2.11	
Cross Section Area (m2)		0.046		0.046		0.046		0.046		0.046	

NA = Not Analyzed
U=Undetected value is 0.5 times Reporting Limit

Table 15
SMU 1 Air and Odor Emission Rates

Chemical/Parameter	*Concentration (mg/Kg)*	*6 - 22 Hour Emission Rate (ug/m2/hr) (except where noted)*									
	Sediment	*Exposed*	*Flags*	*10% Mixed*	*Flags*	*10% Quiescent*	*Flags*	*1% Mixed*	*Flags*	*1% Quiescent*	*Flags*
VOCs											
Benzene	14.77	16,463		20,318		10,250		9,996		12,105	
Chlorobenzene	63	2,222		16,679		952	U	4,754		1,696	
Ethylbenzene	2.93	10,581		8,628		3,318		5,512		8,118	
1,4 Dichlorobenzene	96	5,546		14,268		1,079	U	6,692		5,065	
1,2,3 Trichlorobenzene	30.03	1,175	U	1,114	U	1,093	U	1,239	U	891	U
1,2,4 Trichlorobenzene	96.33	1,127	U	3,381		1,049	U	1,188	U	854	U
1,3,5 Trichlorobenzene		7,464		3,973		1,086	U	1,231	U	4,047	
Hexaclorobenzene	0.12	364	U	346	U	339	U	384	U	276	U
Toluene	18.33	52,105	U	47,763		27,091		29,501		40,227	
Xylenes (o-,m-,p-)	70	52,585	U	52,312		22,851		28,826		40,591	
PAHs											
Fluorene	21	360	U	792		335	U	379	U	273	U
Naphthalene	180	7,992		79,757		5,876		7,148		3,393	
Phenanthrene		368	U	1,395	U	342	U	388	U	279	U
Pyrene		384	U	1,456	U	358	U	405	U	291	U
Other Compounds											
PCBs (undifferentiated)		-	NA	131	U	-	NA	-	NA	-	NA
Phenol	6.47	1,854	U	1,986	U	796	U	1,972		1,648	
Mercury	18	7	U	6	U	6	U	7	U	5	U
Hydrogen Sulfide		-	NA	76	U	-	NA	10	U	-	NA
Mercaptans		-	NA	152	U	-	NA	20	U	-	NA
Ammonia		-	NA	379	U	-	NA	49	U	-	NA
Odor Parameters											
Detection Threshold (OUs)		18.019		20.932		25.420		13.313		8.846	
Recognition Threshold (OUs)		10.361		12.559		19.065		11.094		5.308	
Intensity (ppm n-butanol)		0.096		0.071		0.066		0.066		0.106	
Persistence	`	-0.002		-0.001		-0.001		-0.001		-0.001	
Amines		-	NA	-	NA	-	NA	-	NA	-	NA
Reduced Sulfur Gases		-	NA	-	NA	-	NA	-	NA	-	NA
Average Test Conditions											
Sed Temp (degrees F)		66.1		72.0		69.6		72.0		70.1	
Air Temp (degrees F)		70.0		61.7		63.7		64.2		67.6	
Humidity (%)		29.7		82.1		79.3		81.1		82.6	
Air Velocity (Mi/Hr)		2.69		2.50		2.53		2.65		2.11	
Cross Section Area (m2)		0.046		0.046		0.046		0.046		0.046	

NA = Not Analyzed
U=Undetected value is 0.5 times Reporting Limit

Table 16
SMU 6 Air and Odor Emission Rates

Chemical/Parameter	*Concentration (mg/Kg)* Sediment	*0-2 Hour Emission Rate (ug/m2/hr) (except where noted)* Exposed	Flags	10% Mixed	Flags	10% Quiescent	Flags	1% Mixed	Flags	1% Quiescent	Flags
VOCs											
Benzene	0.170	34,603		11,039		14,692		14,762		23,992	
Chlorobenzene	0.220	8,609	U	7,190	U	8,612	U	7,682	U	9,485	U
Ethylbenzene	0.170	25,488		6,908	U	8,275	U	7,381	U	9,113	U
1,4 Dichlorobenzene	0.194	9,790	U	8,177	U	9,794	U	8,737	U	10,787	U
1,2,3 Trichlorobenzene	0.170	9,875	U	8,248	U	9,879	U	8,812	U	10,880	U
1,2,4 Trichlorobenzene	0.170	9,537	U	7,966	U	9,541	U	8,511	U	10,508	U
1,3,5 Trichlorobenzene		9,875	U	8,248	U	9,879	U	8,812	U	10,880	U
Hexaclorobenzene	0.108	3,081	U	2,573	U	3,082	U	2,749	U	3,394	U
Toluene	0.190	101,784		27,915		43,568		42,931		71,604	
Xylenes (o-,m-,p-)	0.266	124,571		7,049		22,797		21,089		32,361	
PAHs											
Fluorene	3.000	3,038	U	2,538	U	3,040	U	2,711	U	3,348	U
Naphthalene	4.833	3,106	U	2,594	U	3,107	U	2,772	U	3,422	U
Phenanthrene	12.067	3,106	U	2,594	U	3,107	U	2,772	U	3,422	U
Pyrene	10.833	3,249	U	2,714	U	3,251	U	2,900	U	3,580	U
Other Compounds											
PCBs (undifferentiated)		-	NA	-	NA	-	NA	-	NA	-	NA
Phenol	0.108	10,803	U	9,023	U	10,808	U	9,641	U	11,903	U
Mercury	1.120	56	U	47	U	56	U	50	U	61	U
Hydrogen Sulfide		-	NA	70	U	-		75	U	-	NA
Mercaptans		-	NA	141	U	-		151	U	-	NA
Ammonia		-	NA	352	U	-		377	U	-	NA
Odor Parameters											
Detection Threshold (OUs)		49.107		30.592		35.978		20.918		20.015	
Recognition Threshold (OUs)		26.786		15.296		22.487		12.551		12.509	
Intensity (ppm n-butanol)		0.484		1.613		1.008		0.847		0.887	
Persistence		-0.003		-0.016		-0.012		-0.010		-0.013	
Amines		-	NA	-	NA	-		-	NA	-	NA
Reduced Sulfur Gases		-	NA	-	NA	-		-	NA	-	NA
Average Test Conditions											
Sed Temp (degrees F)		65.5		66.7		64.7		69.2		66.3	
Air Temp (degrees F)		68.4		65.0		63.6		61.5		63.6	
Humidity (%)		37.4		80.4		79.1		80.0		80.5	
Air Velocity (Mi/Hr)		2.67		2.28		2.69		2.50		2.99	
Cross Section Area (m2)		0.046		0.046		0.046		0.046		0.046	

NA = Not Analyzed
U=Undetected value is 0.5 times Reporting Limit

Table 16
SMU 6 Air and Odor Emission Rates

Chemical/Parameter	*Concentration (mg/Kg)*	*2 - 6 Hour Emission Rate (ug/m2/hr) (except where noted)*									
	Sediment	*Exposed*	*Flags*	*10% Mixed*	*Flags*	*10% Quiescent*	*Flags*	*1% Mixed*	*Flags*	*1% Quiescent*	*Flags*
VOCs											
Benzene	0.170	41,631		16,856		13,620		12,914		26,237	
Chlorobenzene	0.220	4,213	U	3,612	U	4,272	U	3,920	U	4,779	U
Ethylbenzene	0.170	32,379		8,386		8,946		8,440		13,437	
1,4 Dichlorobenzene	0.194	4,783	U	4,101	U	4,850	U	4,451	U	1,359	U
1,2,3 Trichlorobenzene	0.170	4,849	U	4,157	U	4,917	U	4,512	U	5,500	U
1,2,4 Trichlorobenzene	0.170	4,650	U	3,987	U	4,716	U	4,328	U	5,275	U
1,3,5 Trichlorobenzene		4,816	U	4,129	U	4,884	U	4,482	U	1,368	U
Hexaclorobenzene	0.108	1,503	U	1,289	U	1,525	U	1,399	U	1,705	U
Toluene	0.190	135,300		41,928		43,894		43,202		76,648	
Xylenes (o-,m-,p-)	0.266	157,272		40,512		44,061		40,588		62,968	
PAHs											
Fluorene	3.000	1,487	U	1,275	U	1,508	U	1,384	U	1,687	U
Naphthalene	4.833	7,979		3,598		4,088		3,767		1,724	U
Phenanthrene	12.067	1,520	U	1,303	U	1,541	U	1,414	U	1,724	U
Pyrene	10.833	1,586	U	1,360	U	1,608	U	1,476	U	1,799	U
Other Compounds		-									
PCBs (undifferentiated)		-	NA	-	NA	-	NA	-	NA	-	NA
Phenol	0.108	5,295	U	4,540	U	5,369	U	4,927	U	6,006	U
Mercury	1.120	27	U	23	U	28	U	25	U	31	U
Hydrogen Sulfide		-	NA	71	U	-	NA	77	U	-	NA
Mercaptans		-	NA	142	U	-	NA	154	U	-	NA
Ammonia		-	NA	354	U	-	NA	384	U	-	NA
Odor Parameters											
Detection Threshold (OUs)		37.946		28.680		44.973		33.469		27.520	
Recognition Threshold (OUs)		24.554		13.384		26.984		20.918		22.517	
Intensity (ppm n-butanol)		0.262		0.605		0.383		0.403		0.323	
Persistence		-0.003		-0.006		-0.006		-0.004		-0.005	
Amines		-	NA	-	NA	-	NA	-	NA	-	NA
Reduced Sulfur Gases		-	NA	-	NA	-	NA	-	NA	-	NA
Average Test Conditions											
Sed Temp (degrees F)		65.5		66.7		64.7		69.2		66.3	
Air Temp (degrees F)		68.4		65.0		63.6		61.5		63.6	
Humidity (%)		37.4		80.4		79.1		80.0		80.5	
Air Velocity (Mi/Hr)		2.67		2.28		2.69		2.50		2.99	
Cross Section Area (m2)		0.046		0.046		0.046		0.046		0.046	

NA = Not Analyzed
U=Undetected value is 0.5 times Reporting Limit

Table 16
SMU 6 Air and Odor Emission Rates

Chemical/Parameter	*Concentration (mg/Kg)*	*6 - 22 Hour Emission Rate (ug/m2/hr) (except where noted)*									
	Sediment	*Exposed*	*Flags*	*10% Mixed*	*Flags*	*10% Quiescent*	*Flags*	*1% Mixed*	*Flags*	*1% Quiescent*	*Flags*
VOCs											
Benzene	0.170	14,474		6,977		9,551		9,193		10,298	
Chlorobenzene	0.220	1,035	U	895	U	1,038	U	940	U	1,110	U
Ethylbenzene	0.170	11,158		4,838		6,875		6,784		6,311	
1,4 Dichlorobenzene	0.194	1,172	U	1,014	U	1,176	U	1,065	U	5,019	U
1,2,3 Trichlorobenzene	0.170	1,189	U	1,028	U	1,192	U	1,079	U	1,274	U
1,2,4 Trichlorobenzene	0.170	1,140	U	986	U	1,143	U	1,035	U	1,222	U
1,3,5 Trichlorobenzene		3,542		1,021	U	1,184	U	1,072	U	5,054	U
Hexaclorobenzene	0.108	369	U	319	U	370	U	335	U	395	U
Toluene	0.190	49,808		24,328		35,350		33,922	U	35,541	
Xylenes (o-,m-,p-)	0.266	55,307		24,467		34,215		32,601		29,647	
PAHs											
Fluorene	3.000	364	U	315	U	365	U	330	U	390	U
Naphthalene	4.833	2,684		2,013		2,043		2,027		1,907	
Phenanthrene	12.067	372	U	322	U	373	U	338	U	399	U
Pyrene	10.833	389	U	336	U	390	U	353	U	417	U
Other Compounds											
PCBs (undifferentiated)		-	NA	-	NA	-	NA	-	NA	-	NA
Phenol	0.108	2,943		1,119	U	1,297	U	1,175	U	1,387	U
Mercury	1.120	7	U	6	U	7	U	6	U	7	U
Hydrogen Sulfide		-	NA	70	U	-	NA	73	U	-	NA
Mercaptans		-	NA	140	U	-	NA	147	U	-	NA
Ammonia		-	NA	350	U	-	NA	367	U	-	NA
Odor Parameters											
Detection Threshold (OUs)		42.411		15.296		38.227		31.377		22.517	
Recognition Threshold (OUs)		22.321		7.648		22.487		16.735		15.011	
Intensity (ppm n-butanol)		0.076		0.176		0.096		0.086		0.096	
Persistence		-0.001		-0.002		-0.001		-0.001		-0.002	
Amines		-	NA	-	NA	-	NA	-	NA	-	NA
Reduced Sulfur Gases		-	NA	-	NA	-	NA	-	NA	-	NA
Average Test Conditions											
Sed Temp (degrees F)		65.5		66.7		64.7		69.2		66.3	
Air Temp (degrees F)		68.4		65.0		63.6		61.5		63.6	
Humidity (%)		37.4		80.4		79.1		80.0		80.5	
Air Velocity (Mi/Hr)		2.67		2.28		2.69		2.50		2.99	
Cross Section Area (m2)		0.046		0.046		0.046		0.046		0.046	

NA = Not Analyzed
U=Undetected value is 0.5 times Reporting Limit

Table 17
SMU 7 Air and Odor Emission Rates

Chemical/Parameter	Concentration (mg/Kg)	0 - 2 Hour Emission Rate (ug/m2/hr)									
	Sediment	Exposed	Flags	10% Mixed	Flags	10% Quiescent	Flags	1% Mixed	Flags	1% Quiescent	Flags
VOCs											
Benzene	1.03	23,089		19,212		27,478		28,468		22,517	
Chlorobenzene	10.23	9,652	U	10,039	U	9,598	U	10,445	U	8,833	U
Ethylbenzene	0.69	9,273	U	9,646	U	9,222	U	10,036	U	8,487	U
1,4 Dichlorobenzene	19.33	10,977	U	11,417	U	10,916	U	11,879	U	10,046	U
1,2,3 Trichlorobenzene	0.27	11,071	U	11,516	U	38,017		11,981	U	10,132	U
1,2,4 Trichlorobenzene	2.63	10,693	U	11,122	U	10,634	U	11,572	U	9,786	U
1,3,5 Trichlorobenzene		11,071	U	108,661		11,010	U	11,981	U	10,132	U
Hexaclorobenzene	0.13	3,454	U	3,592	U	3,435	U	3,738	U	3,161	U
Toluene	1.9	55,830		44,488		69,259		64,514		46,072	
Xylenes (o-,m-,p-)	5.87	34,823		24,803		29,172		31,745		22,170	
PAHs											
Fluorene	93	3,407	U	3,543	U	3,388	U	3,687	U	3,118	U
Naphthalene	126.67	3,482	U	15,433		10,728		14,644		3,187	U
Phenanthrene	37	3,482	U	3,622	U	3,463	U	3,768	U	3,187	U
Pyrene	11.1	3,643	U	3,789	U	3,623	U	3,943	U	3,334	U
Other Compounds											
PCBs (undifferentiated)		-	NA	10,650	U	-	NA	-	NA	-	NA
Phenol	0.13	12,112	U	12,598		8,036	U	8,745	U	7,396	U
Mercury	39.67	62	U	65	U	62	U	68	U	57	U
Hydrogen Sulfide		-	NA	98	U	-	NA	102	U	-	NA
Mercaptans		-	NA	197	U	-	NA	205	U	-	NA
Ammonia		-	NA	492	U	-	NA	512	U	-	NA
Odor Parameters											
Detection Threshold (OUs)		51.313		51.241		25.545		45.031		22.917	
Recognition Threshold (OUs)		30.788		33.307		17.881		26.489		13.750	
Intensity (ppm n-butanol)		0.565		1.411		0.927		0.444		0.524	
Persistence		-0.010		-0.017		-0.014		-0.006		-0.005	
Amines		-	NA	0.134		-	NA	-	NA	-	NA
Reduced Sulfur Gases		-	NA	0.031		-	NA	-	NA	-	NA
Average Test Conditions											
Sed Temp (degrees F)		68.3		71.7		68.4		64.8		68.7	
Air Temp (degrees F)		71.2		66.1		65.7		66.1		66.3	
Humidity (%)		15.6		86.3		83.8		83.3		81.4	
Air Velocity (Mi/Hr)		3.06		3.06		3.05		3.16		2.74	
Cross Section Area (m2)		0.046		0.046		0.046		0.046		0.046	

NA = Not Analyzed
U=Undetected value is 0.5 times Reporting Limit

Table 17
SMU 7 Air and Odor Emission Rates

Chemical/Parameter	Concentration (mg/Kg)	2 - 6 Hour Emission Rate (ug/m2/hr)									
	Sediment	Exposed	Flags	10% Mixed	Flags	10% Quiescent	Flags	1% Mixed	Flags	1% Quiescent	Flags
VOCs											
Benzene	1.03	26,866		17,276		21,091		25,603		23,888	
Chlorobenzene	10.23	5,001	U	5,052	U	4,889	U	4,984	U	4,382	U
Ethylbenzene	0.69	13,217		4,854	U	10,833		13,994		11,514	
1,4 Dichlorobenzene	19.33	5,677	U	5,735	U	5,551	U	5,658	U	4,975	U
1,2,3 Trichlorobenzene	0.27	5,756	U	5,815	U	5,627	U	5,736	U	5,044	U
1,2,4 Trichlorobenzene	2.63	14,962		5,577	U	5,397	U	5,502	U	4,838	U
1,3,5 Trichlorobenzene		87,461		5,775	U	5,589	U	5,697	U	5,010	U
Hexaclorobenzene	0.13	1,785	U	1,803	U	1,745	U	1,779	U	1,564	U
Toluene	1.9	71,381		49,925		61,931		74,072		65,304	
Xylenes (o-,m-,p-)	5.87	63,929		44,180		53,494		63,518		57,227	
PAHs											
Fluorene	93	1,765	U	1,783	U	1,726	U	1,759	U	1,547	U
Naphthalene	126.67	6,491		12,977		8,877		14,111		6,427	
Phenanthrene	37	1,804	U	1,823	U	1,764	U	1,798	U	1,581	U
Pyrene	11.1	1,883	U	1,902	U	1,841	U	1,876	U	1,650	U
Other Compounds											
PCBs (undifferentiated)		-	NA	5,349	U	-	NA	-	NA	-	NA
Phenol	0.13	6,285	U	6,350		4,094	U	4,173	U	3,669	U
Mercury	39.67	32	U	33	U	32	U	32	U	28	U
Hydrogen Sulfide		-	NA	99	U	-	NA	98	U	-	NA
Mercaptans		-	NA	198	U	-	NA	195	U	-	NA
Ammonia		-	NA	495	U	-	NA	489	U	-	NA
Odor Parameters											
Detection Threshold (OUs)		46.182		76.862		48.535		34.436		22.917	
Recognition Threshold (OUs)		35.919		56.365		33.208		18.542		11.458	
Intensity (ppm n-butanol)		0.403		0.504		0.423		0.242		0.242	
Persistence		-0.005		-0.006		-0.006		-0.004		-0.003	
Amines		-	NA	-	NA	-	NA	-	NA	-	NA
Reduced Sulfur Gases		-	NA	-	NA	-	NA	-	NA	-	NA
Average Test Conditions											
Sed Temp (degrees F)		68.3		71.7		68.4		64.8		68.7	
Air Temp (degrees F)		71.2		66.1		65.7		66.1		66.3	
Humidity (%)		15.6		86.3		83.8		83.3		81.4	
Air Velocity (Mi/Hr)		3.06		3.06		3.05		3.16		2.74	
Cross Section Area (m2)		0.046		0.046		0.046		0.046		0.046	

NA = Not Analyzed
U=Undetected value is 0.5 times Reporting Limit

Table 17
SMU 7 Air and Odor Emission Rates

Chemical/Parameter	*Concentration (mg/Kg)*	*6 - 22 Hour Emission Rate (ug/m2/hr)*									
	Sediment	*Exposed*	*Flags*	*10% Mixed*	*Flags*	*10% Quiescent*	*Flags*	*1% Mixed*	*Flags*	*1% Quiescent*	*Flags*
VOCs											
Benzene	1.03	12,317		12,095		14,127		14,412		14,882	
Chlorobenzene	10.23	1,171	U	3,343		1,174	U	1,157	U	8,126	U
Ethylbenzene	0.69	6,222		5,823		7,394		8,174		9,879	
1,4 Dichlorobenzene	19.33	1,327	U	7,243		4,403		6,510		1,155	U
1,2,3 Trichlorobenzene	0.27	1,345	U	1,321	U	1,349	U	2,839		1,171	U
1,2,4 Trichlorobenzene	2.63	1,290	U	1,267	U	1,293	U	6,293		1,123	U
1,3,5 Trichlorobenzene		1,336	U	1,312	U	3,706		14,973		1,163	U
Hexaclorobenzene	0.13	417	U	410	U	418	U	412	U	363	U
Toluene	1.9	34,223		33,429		42,932		46,654		50,986	
Xylenes (o-,m-,p-)	5.87	30,014		28,217		36,327		38,878		47,003	
PAHs											
Fluorene	93	412	U	404	U	413	U	407	U	358	U
Naphthalene	126.67	2,288		6,901		4,000		4,720		2,613	
Phenanthrene	37	421	U	413	U	422	U	416	U	366	U
Pyrene	11.1	440	U	432	U	441	U	435	U	383	U
Other Compounds											
PCBs (undifferentiated)		-	NA	1,211	U	-	NA	-	NA	-	NA
Phenol	0.13	1,464	U	1,438		2,238		967	U	3,888	
Mercury	39.67	8	U	7	U	8	U	7	U	7	U
Hydrogen Sulfide		-	NA	90	U	-	NA	90	U	-	NA
Mercaptans		-	NA	180	U	-	NA	181	U	-	NA
Ammonia		-	NA	449	U	-	NA	452	U	-	NA
Odor Parameters											
Detection Threshold (OUs)		43.616		28.183		97.070		42.383		18.334	
Recognition Threshold (OUs)		25.657		20.497		61.308		23.840		11.458	
Intensity (ppm n-butanol)		0.076		0.111		0.126		0.060		0.071	
Persistence		-0.001		-0.002		-0.001		-0.001		-0.001	
Amines		-	NA	-	NA	-	NA	-	NA	-	NA
Reduced Sulfur Gases		-	NA	-	NA	-	NA	-	NA	-	NA
Average Test Conditions											
Sed Temp (degrees F)		68.3		71.7		68.4		64.8		68.7	
Air Temp (degrees F)		71.2		66.1		65.7		66.1		66.3	
Humidity (%)		15.6		86.3		83.8		83.3		81.4	
Air Velocity (Mi/Hr)		3.06		3.06		3.05		3.16		2.74	
Cross Section Area (m2)		0.046		0.046		0.046		0.046		0.046	

NA = Not Analyzed
U=Undetected value is 0.5 times Reporting Limit

Table 18: Odor Persistency Data

SMU 1

Exposed Sediment					
0 - 2 Hour		2 - 6 Hour		6 - 22 Hour	
Log of I	Log of DR	Log of I	Log of DR	Log of I	Log of DR
No Data	No Data	No Data	No Data	No Data	No Data
No Data	No Data	No Data	No Data	No Data	No Data
No Data	No Data	No Data	No Data	No Data	No Data
No Data	No Data	No Data	No Data	No Data	No Data
10% Mixed					
0 - 2 Hour		2 - 6 Hour		6 - 22 Hour	
Log of I	Log of DR	Log of I	Log of DR	Log of I	Log of DR
1.11	0.00	1.19	0.00	1.16	0.00
1.03	0.52	1.10	0.52	0.94	0.52
0.92	1.00	0.96	1.00	0.87	1.00
0.87	1.40	0.91	1.40	0.87	1.40
10% Quiescent					
0 - 2 Hour		2 - 6 Hour		6 - 22 Hour	
Log of I	Log of DR	Log of I	Log of DR	Log of I	Log of DR
1.24	0.00	1.24	0.00	1.12	0.00
1.10	0.52	1.07	0.52	1.05	0.52
1.03	1.00	0.99	1.00	0.97	1.00
0.96	1.40	0.91	1.40	0.93	1.40
1% Mixed					
0 - 2 Hour		2 - 6 Hour		6 - 22 Hour	
Log of I	Log of DR	Log of I	Log of DR	Log of I	Log of DR
1.20	0.00	1.06	0.00	1.10	0.00
1.03	0.52	0.92	0.52	1.02	0.52
0.90	1.00	0.87	1.00	0.90	1.00
0.86	1.40	0.80	1.40	0.78	1.40
1% Quiescent					
0 - 2 Hour		2 - 6 Hour		6 - 22 Hour	
Log of I	Log of DR	Log of I	Log of DR	Log of I	Log of DR
1.26	0.00	1.32	0.00	1.32	0.00
1.00	0.52	1.07	0.52	1.15	0.52
0.97	1.00	0.97	1.00	1.09	1.00
0.84	1.40	0.86	1.40	0.97	1.40

Table 18: Odor Persistency Data

SMU 6

Exposed Sediment					
0 - 2 Hour		2 - 6 Hour		6 - 22 Hour	
Log of I	Log of DR	Log of I	Log of DR	Log of I	Log of DR
1.07	0.00	1.11	0.00	1.19	0.00
1.01	0.52	1.04	0.52	1.08	0.52
1.00	1.00	1.00	1.00	1.00	1.00
0.97	1.40	0.89	1.40	0.86	1.40
10% Mixed					
0 - 2 Hour		2 - 6 Hour		6 - 22 Hour	
Log of I	Log of DR	Log of I	Log of DR	Log of I	Log of DR
1.58	0.00	1.50	0.00	1.53	0.00
1.32	0.52	1.35	0.52	1.29	0.52
1.18	1.00	1.21	1.00	1.15	1.00
1.02	1.40	1.09	1.40	1.03	1.40
10% Quiescent					
0 - 2 Hour		2 - 6 Hour		6 - 22 Hour	
Log of I	Log of DR	Log of I	Log of DR	Log of I	Log of DR
1.42	0.00	1.29	0.00	1.27	0.00
1.10	0.52	1.09	0.52	1.05	0.52
1.06	1.00	1.00	1.00	0.98	1.00
0.98	1.40	0.87	1.40	0.89	1.40
1% Mixed					
0 - 2 Hour		2 - 6 Hour		6 - 22 Hour	
Log of I	Log of DR	Log of I	Log of DR	Log of I	Log of DR
1.33	0.00	1.30	0.00	1.23	0.00
1.15	0.52	1.18	0.52	1.15	0.52
1.09	1.00	1.07	1.00	1.06	1.00
0.95	1.40	0.99	1.40	0.95	1.40
1% Quiescent					
0 - 2 Hour		2 - 6 Hour		6 - 22 Hour	
Log of I	Log of DR	Log of I	Log of DR	Log of I	Log of DR
1.35	0.00	1.21	0.00	1.29	0.00
1.15	0.52	1.04	0.52	1.04	0.52
0.98	1.00	0.97	1.00	0.92	1.00
0.90	1.40	0.87	1.40	0.86	1.40

Table 18: Odor Persistency Data

SMU 7

Exposed Sediment					
0 - 2 Hour		2 - 6 Hour		6 - 22 Hour	
Log of I	Log of DR	Log of I	Log of DR	Log of I	Log of DR
1.14	0.00	1.30	0.00	1.18	0.00
0.95	0.52	1.05	0.52	1.01	0.52
0.87	1.00	1.01	1.00	0.89	1.00
0.78	1.40	0.91	1.40	0.88	1.40
10% Mixed					
0 - 2 Hour		2 - 6 Hour		6 - 22 Hour	
Log of I	Log of DR	Log of I	Log of DR	Log of I	Log of DR
1.54	0.00	1.39	0.00	1.34	0.00
1.17	0.52	1.22	0.52	1.16	0.52
1.07	1.00	1.06	1.00	0.94	1.00
0.91	1.40	0.96	1.40	0.86	1.40
10% Quiescent					
0 - 2 Hour		2 - 6 Hour		6 - 22 Hour	
Log of I	Log of DR	Log of I	Log of DR	Log of I	Log of DR
1.36	0.00	1.33	0.00	1.43	0.00
1.21	0.52	1.26	0.52	1.24	0.52
1.08	1.00	1.06	1.00	1.11	1.00
0.87	1.40	0.93	1.40	1.03	1.40
1% Mixed					
0 - 2 Hour		2 - 6 Hour		6 - 22 Hour	
Log of I	Log of DR	Log of I	Log of DR	Log of I	Log of DR
1.04	0.00	1.08	0.00	1.07	0.00
0.93	0.52	0.90	0.52	0.94	0.52
0.87	1.00	0.87	1.00	0.86	1.00
0.83	1.40	0.82	1.40	0.82	1.40
1% Quiescent					
0 - 2 Hour		2 - 6 Hour		6 - 22 Hour	
Log of I	Log of DR	Log of I	Log of DR	Log of I	Log of DR
1.10	0.00	1.08	0.00	1.14	0.00
0.93	0.52	0.91	0.52	0.94	0.52
0.95	1.00	0.90	1.00	0.89	1.00
0.89	1.40	0.84	1.40	0.83	1.40

Notes:

I = Intensity as ppm of Butanol

DR = Dilution Ratio

Table 19
TSS / TOC / DOC and Test Conditions
SMU 1

Service Sample ID	10029-IN-PR	10029-IN-PO	10029-10M-PR	10029-10M-PO	10029-10M-PO	10029-10Q-PR	10029-10Q-PO	10029-1M-PR	10029-1M-PO	10029-1Q-PR	10029-1Q-PO
Lab ID	0505992-01	0505992-02	0506008-02, 0506028-06	0506028-02, 04, 05	0506040-02	0506041-04	0506041-02, 03, 03RE1	0506042-01	0506069-03	0506069-01	0506071-02
Sample Matrix	soil	soil	water	water	soil	water	water	water	water	water	water
	Exposed	*Exposed*	*10% Mixed*	*10% Mixed*	*10% Mixed*	*10% Quiescent*	*10% Quiescent*	*1% Mixed*	*1% Mixed*	*1% Quiescent*	*1% Quiescent*
Soil											
TOC, mg/kg	32800	29500			13400						
Water											
TSS, mg/L			3800	4600		3400	69	3400	370	2700	9
TOC, mg/L			330	100		86	120	13	9.8	12	7.8
DOC, mg/L			NA	110		NA	110	NA	7.4	NA	7.7
Average Test Conditions											
Sed Temp (degrees F)	66.1		72.0			69.6		72.0			70.1
Air Temp (degrees F)	70.0		61.7			63.7		64.2			67.6
Humidity (%)	29.7		82.1			79.3		81.1			82.6
Air Velocity (Mi/Hr)	2.69		2.50			2.53		2.65			2.11
Cross Section Area (m2)	0.046		0.046			0.046		0.046			0.046

Table 19
TSS / TOC / DOC and Test Conditions
SMU 6

Service Sample ID	60028-IN-PR	60028-IN-PO	60028-10M-PR	60028-10M-PO	60028-10Q-PR	60028-10Q-PO	60028-1M-PR	60028-1M-PO	60028-1Q-PR	60028-1Q-PO
Lab ID	0506249-01	0506249-02	0506265-02	0506265-03	0506277-01	0506277-04	0506279-01	0506328-01	0506328-03	0506399-01
Sample Matrix	soil	soil	water	water	water	water	water	water	water	water
	Exposed	*Exposed*	*10% Mixed*	*10% Mixed*	*10% Quiescent*	*10% Quiescent*	*1% Mixed*	*1% Mixed*	*1% Quiescent*	*1% Quiescent*
Soil										
TOC, mg/kg	84500	76400								
Water										
TSS, mg/L			21000	13000	37000	160	22000	8800	3700	15
TOC, mg/L			15	23	15	9.8	16	19	10	5
DOC, mg/L			NA	9.3	NA	9.4	NA	11	NA	4.8
Average Test Conditions										
Sed Temp (degrees F)	65.5		66.7		64.7		69.2		66.3	
Air Temp (degrees F)	68.4		65.0		63.6		61.5		63.6	
Humidity (%)	37.4		80.4		79.1		80.0		80.5	
Air Velocity (Mi/Hr)	2.67		2.28		2.69		2.50		2.99	
Cross Section Area (m2)	0.046		0.046		0.046		0.046		0.046	

Table 19
TSS / TOC / DOC and Test Conditions
SMU 7

Service Sample ID	70015-IN-PR	70015-IN-PO	70015-10M-PR	70015-10M-PO	70015-10M-PO	70015-10Q-PR	70015-10Q-PO	70015-1M-PR	70015-1M-PO	70015-1Q-PR	70015-1Q-PO
Lab ID	0506400-01	0506408-02	0506408-04	0506423-02, 03	0506423-01	0506423-05	0506445-01	0506445-04	0506487-01	0506487-02	0506504-01
Sample Matrix	soil	soil	water	water	soil	water	water	water	water	water	water
	Exposed	*Exposed*	*10% Mixed*	*10% Mixed*	*10% Mixed*	*10% Quiescent*	*10% Quiescent*	*1% Mixed*	*1% Mixed*	*1% Quiescent*	*1% Quiescent*
Soil											
TOC, mg/kg	39400	74500			60200						
Water											
TSS, mg/L			27000	21000		36000	8500	6800	2400	5600	32
TOC, mg/L			37	36		34	36	10	12	11	8.1
DOC, mg/L			NA	29		NA	28	NA	6.7	NA	6.9
Average Test Conditions											
Sed Temp (degrees F)	68.3		71.7			68.4		64.8		68.7	
Air Temp (degrees F)	71.2		66.1			65.7		66.1		66.3	
Humidity (%)	15.6		86.3			83.8		83.3		81.4	
Air Velocity (Mi/Hr)	3.06		3.06			3.05		3.16		2.74	
Cross Section Area (m2)	0.046		0.046			0.046		0.046		0.046	

NA = Not Analyzed

Table 20: Headspace Results SMU 1 and SMU 7

Work Order #	600874	505538	505538
Parsons Sample #	OL-STA-10029	OL-STA-10029	OL-STA-70015
sample id - SERVICE	10031 SMU-1	10030-HS-IN	70015-HS-IN
sample id - lab	0600874-01 (Soil)	Varies	Varies

	SMU 1 Sediment (mg/Kg Dry)		***SMU 1 (mg/m3)***		***SMU 7 (mg/m3)***	
Chemical/Parameter	*Sediment*	*Flags*	*Air*	*Flags*	*Air*	*Flags*
VOCs						
Benzene	7.17		6,007		5,737	
Chlorobenzene	98.33		29,677		12,577	
Ethylbenzene	3.00		787		1,214	
1,4 Dichlorobenzene	283			NA		NA
1,2,3 Trichlorobenzene	8.33			NA		NA
1,2,4 Trichlorobenzene	96.67			NA		NA
1,3,5 Trichlorobenzene		NA		NA		NA
Hexaclorobenzene		NA	85	U	55	U
Toluene	7.33		4,046		7,736	
Xylenes (o-,m-,p-)	38.50		7,685		9,355	
PAHs						
Fluorene		NA	80	U	77	U
Naphthalene	350		1,811		295	
Phenanthrene		NA	81	U	78	U
Pyrene		NA	83	U	81	U
Other CompouUs						
PCBs (undifferentiated)		NA		NA		NA
Phenol		NA	103	U	103	U
Mercury		NA	1	U	1	U
Hydrogen Sulfide		NA		NA		NA
Mercaptans		NA		NA		NA
Ammonia		NA		NA		NA
Odor Parameters			**Odor Units**			
Detection Threshold		NA	6,700		4,400	
Recognition Threshold		NA	3,600		2,400	

Notes:
U = Nondetects and reported at 1/2 the RL
NA = Not Analyzed

Table 21
Modeling Recommendations

Compound/Parameter	Recommendation	Comment
VOCs		
Benzene	Model	Good measurements throughout, correlates best to Odors. Higher than average concentration. Not depleted.
Chlorobenzene	Model	Good measurements in SMU 1. No measured emissions in SMUs 6 or 7 where samples were 45% and 79% of average, so model using 1/2 RL. Not depleted.
Ethylbenzene	Model	A little below average sediment strength. Mostly measured emission rates. Highest measured rates in SMU 6.
1,4 Dichlorobenzene	Model @ 1/2 RL	Mostly not detected in air emissions. Volatility of compound supports modeling at 1/2 RL.
Trichlorobenzenes	Model @ 1/2 RL	Mostly not detected in air emissions. Volatility of compound supports modeling at 1/2 RL.
Hexachlorobenzene	Model @ 1/2 RL	Not detected in sediment samples. Mostly not detected in air emissions. Toxicity of compound supports modeling at 1/2 RL.
Toluene	Model	Good measurements throughout, correlates well to Odors. Higher than average concentration. Not depleted.
Xylenes (o-,m-,p-)	Model	Good measurements throughout, correlates well to Odors. Higher than average concentration. Not depleted.
PAHs		
Fluorene	Do Not Model	Very high concentrations in sediment. Rarely measurable emissions. Not very volatile.
Naphthalene	Model	Good measurements throughout. Higher than average concentration. Typically depleted during test.
Phenanthrene	Do Not Model	Very high concentrations in sediment. Rarely measurable emissions. Not very volatile.
Pyrene	Do Not Model	Very high concentrations in sediment. Rarely measurable emissions. Not very volatile.
Other Compounds		
PCBs (Undifferentiated)	Do Not Model	All non-detects in air samples.
Phenol	Do Not Model	Mostly non-detects in air samples. Not present in sediment sample for SMU 7.
Mercury	Do Not Model	All non-detects in air samples.
Hydrogen Sulfide	Do Not Model	Odorant only. All non-detects in air samples.
Mercaptans	Do Not Model	Odorant only. All non-detects in air samples.
Ammonia	Do Not Model	Odorant only. All non-detects in air samples.
Odor Parameters		
Detection Threshold	Do Not Model	Not useful for impact analysis in dispersion model.
Recognition Threshold	Model	Useful for impact analysis in air dispersion model
Intensity	Do Not Model	Useful to interpret RT from dispersion model.
Persistence	Do Not Model	Useful to interpret RT from dispersion model.

RL = Reporting Limit for analytical test
NA = Not Available

FIGURES

Figure 1
Air Emission Test Apparatus
Process Flow Diagram

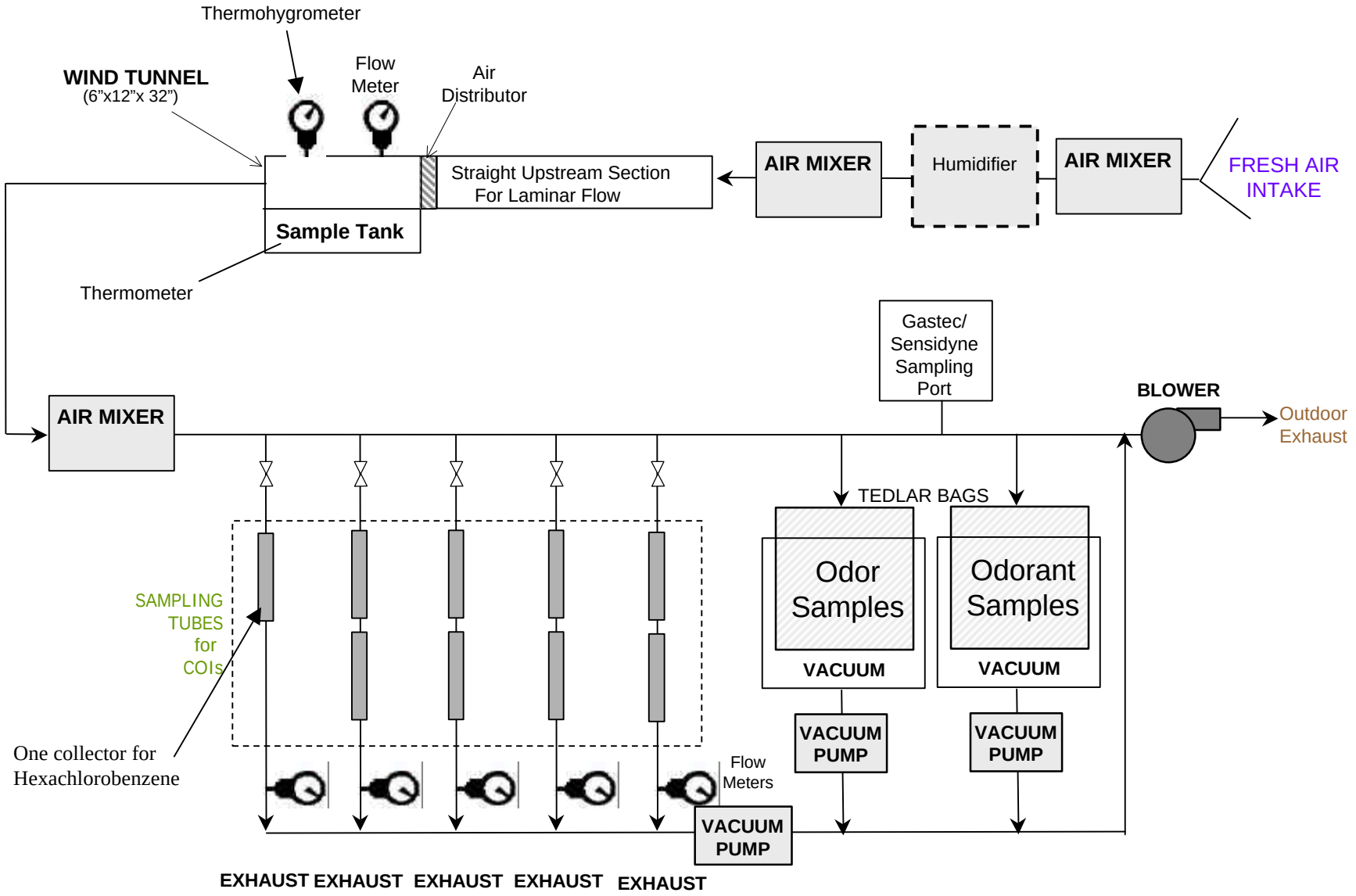


Figure 2: SMU 1 Air Temperature, Humidity, and Flow

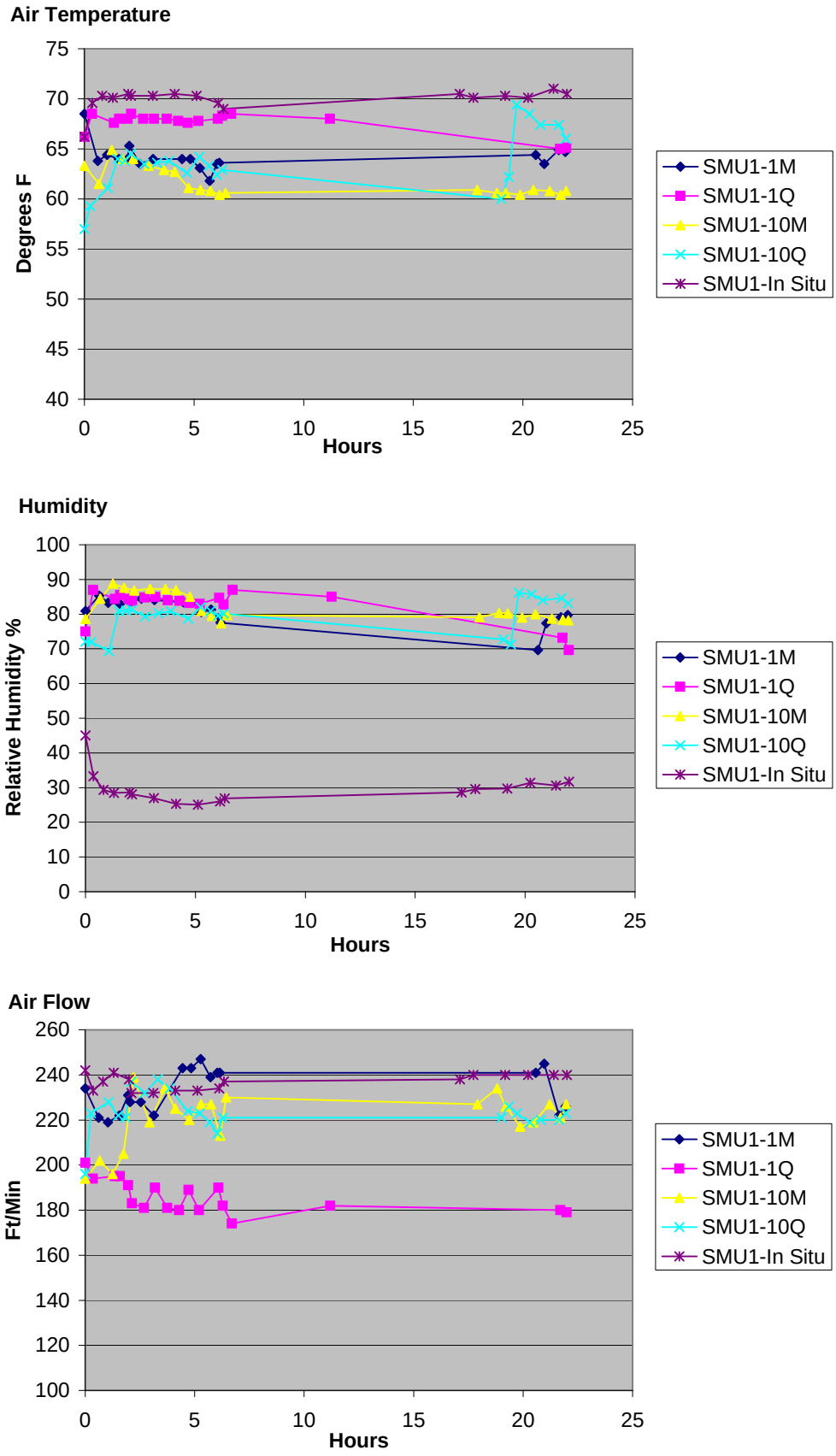


Figure 3: SMU 6 Air Temperature, Humidity, and Flow

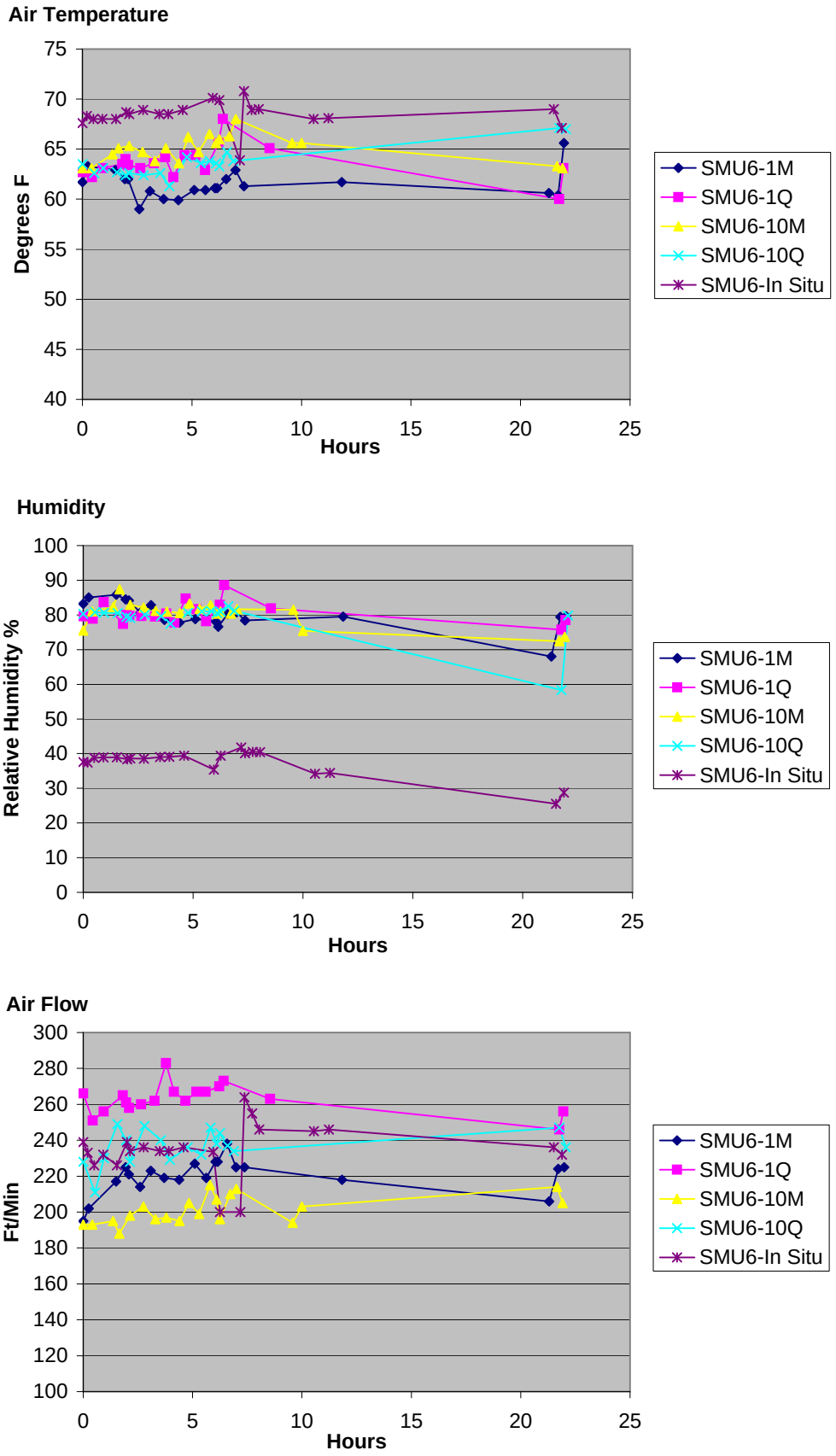


Figure 4: SMU 7 Air Temperature, Humidity, and Flow

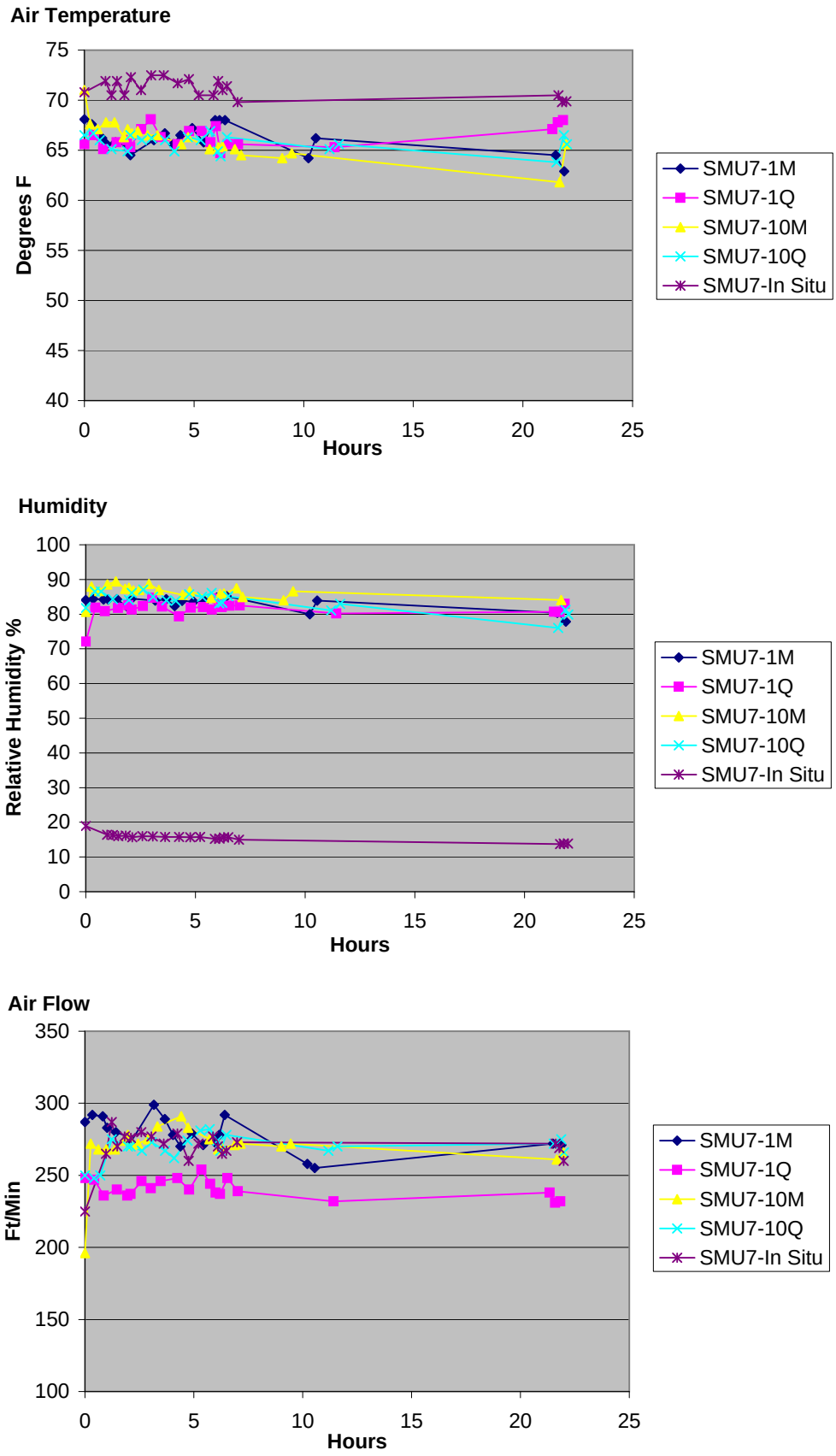


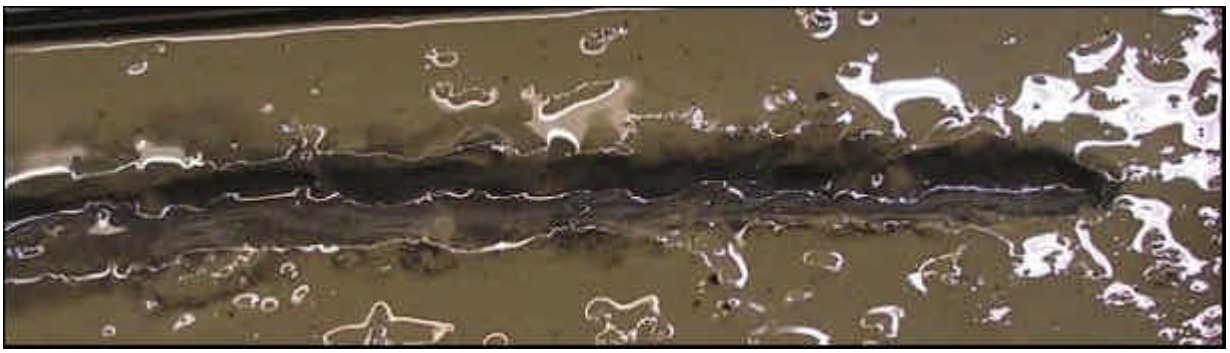
Figure 5
SMU 6 - 10% Slurry
Samples
During Test

SMU 6 10% Slurry after 22 hours of exposure with some scum

Figure 6
Sediment Samples
After Test

SMU 1 Sediment after decanting and 22 hours of exposure

SMU 6 Sediment after 22 hours of exposure



SMU 7 Sediment after 22 hours of exposure

Figure 7
Sediment Concentrations Compared to Area-Weighted Averages

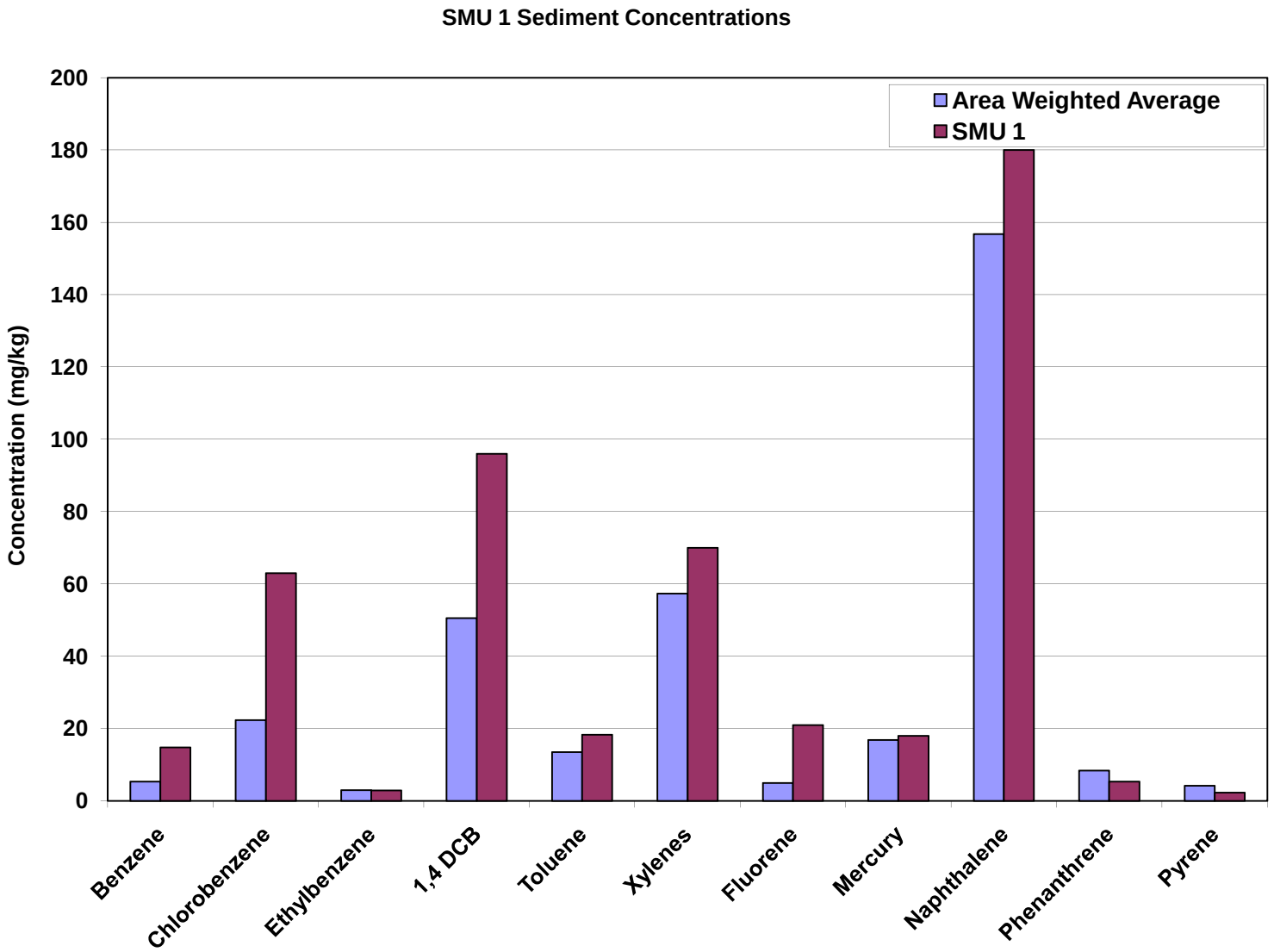


Figure 7
Sediment Concentrations Compared to Area-Weighted Averages

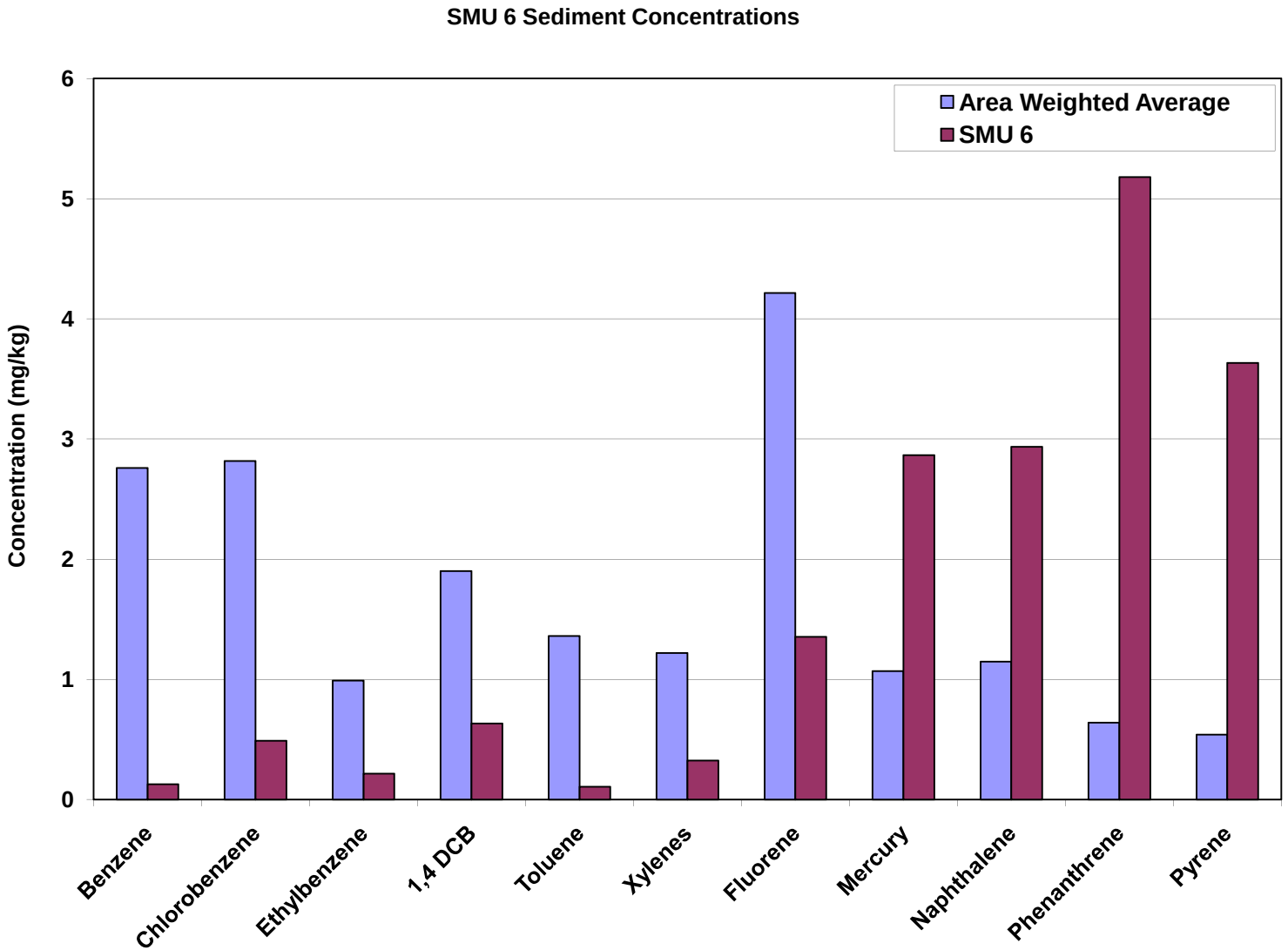


Figure 7
Sediment Concentrations Compared to Area-Weighted Averages

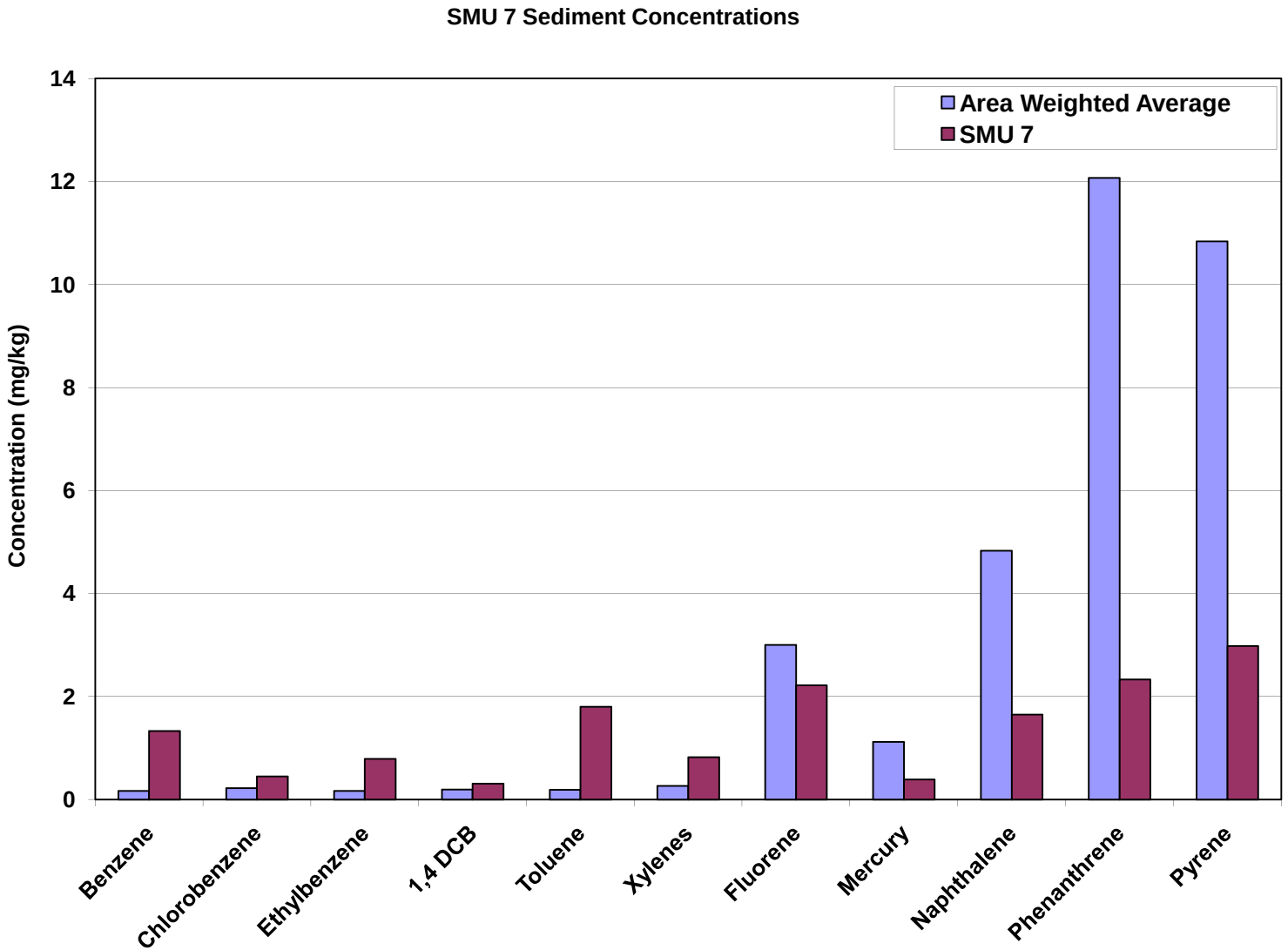


Figure 8: Percentage Change in Slurry Concentrations After Tests

(Pre-test value minus the post-test value) divided by the Pre-test value
e.g. 100 % equals depletion, 0% equals non-detect before and after

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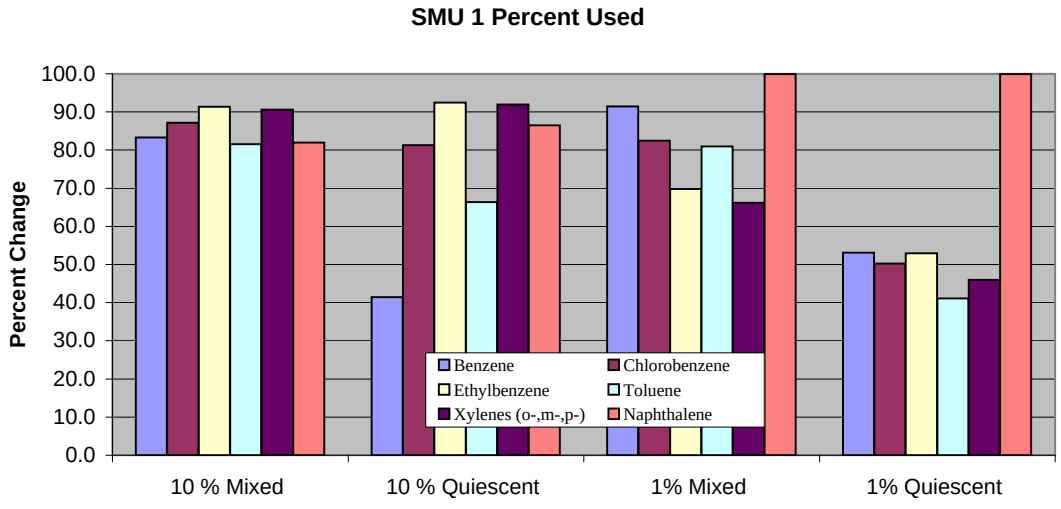

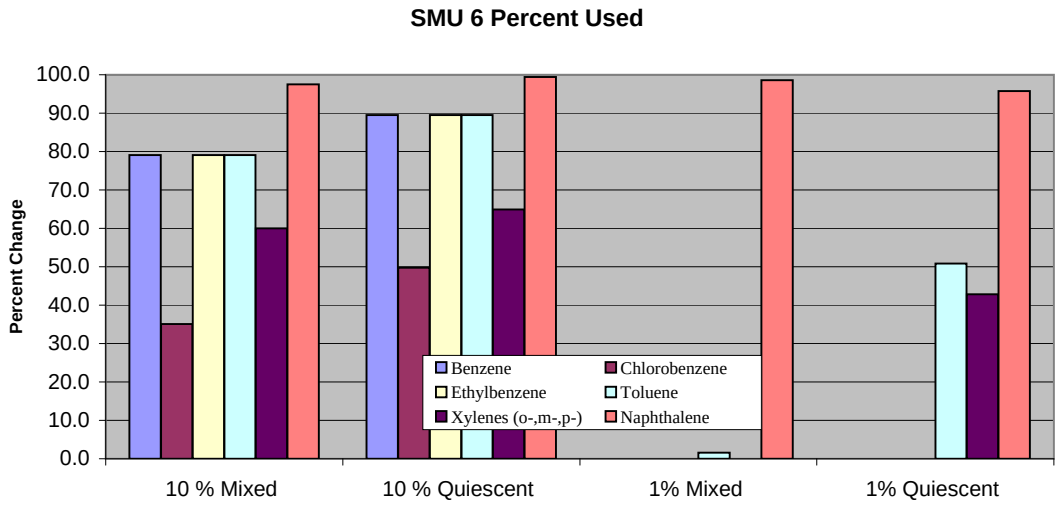

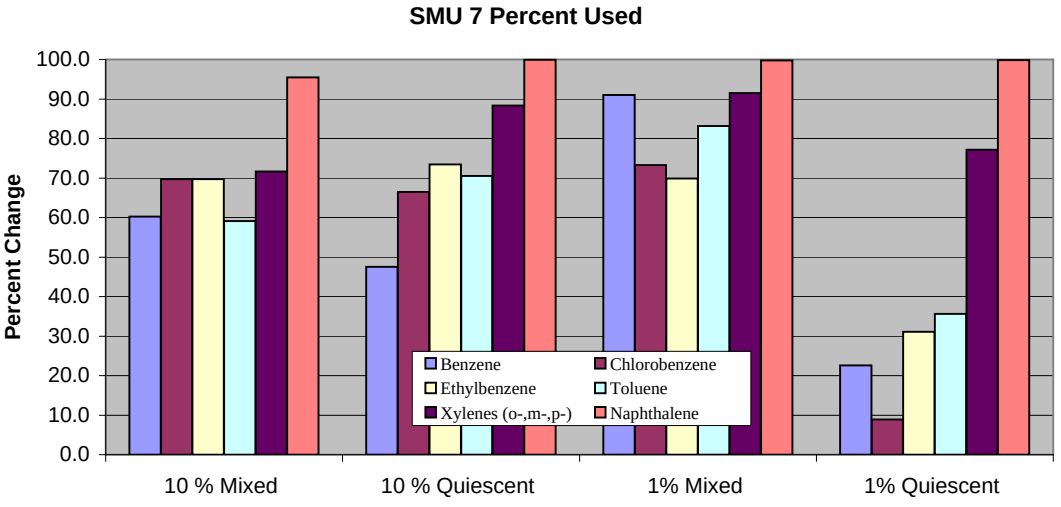

Figure 9: SMU 1 Emission Rates vs. Henry's Law Constant and Koc (Normalized to Sediment Concentration)

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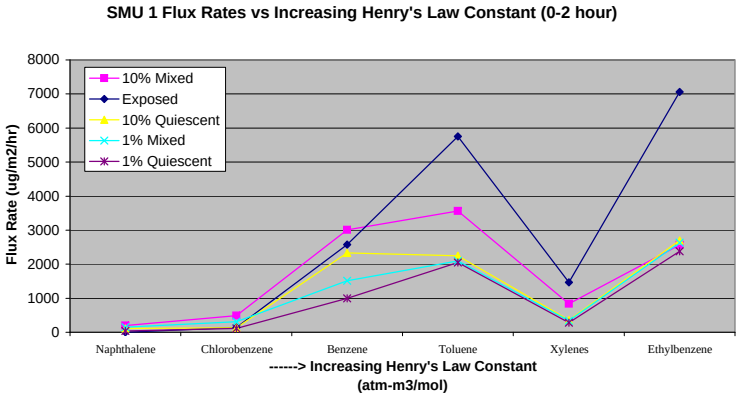

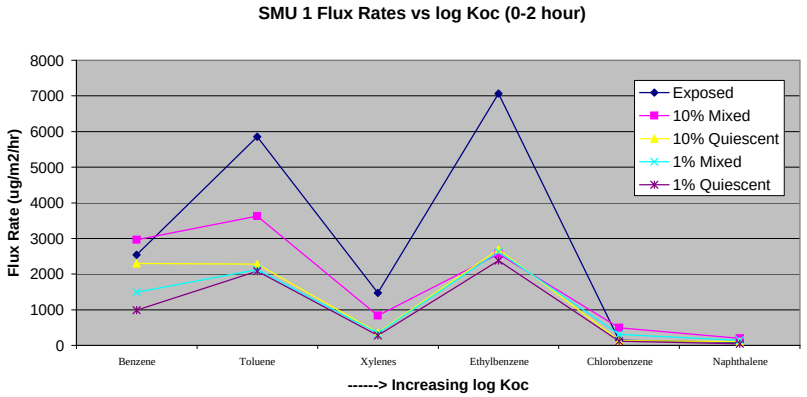

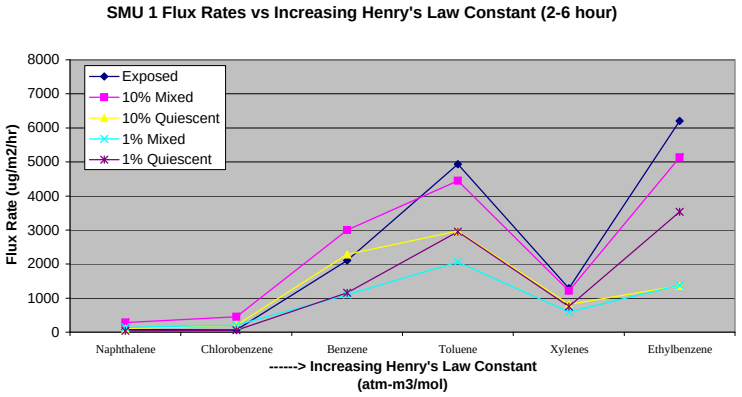

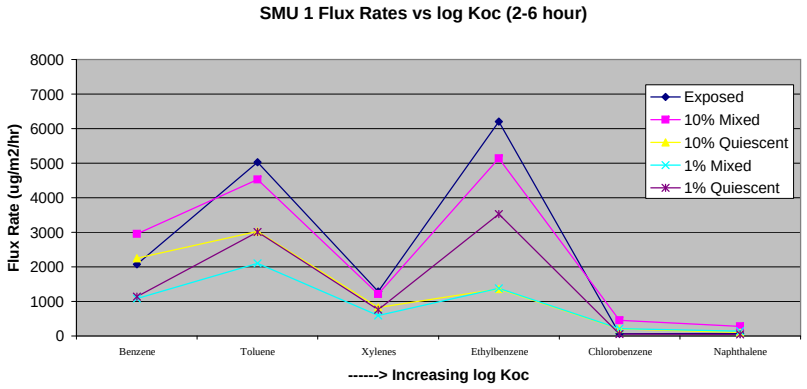

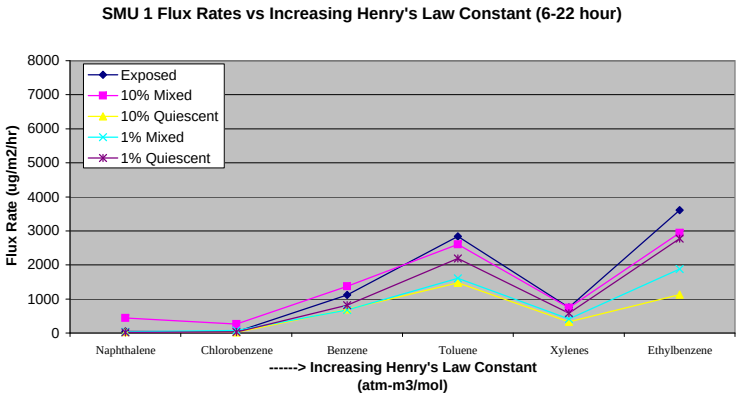

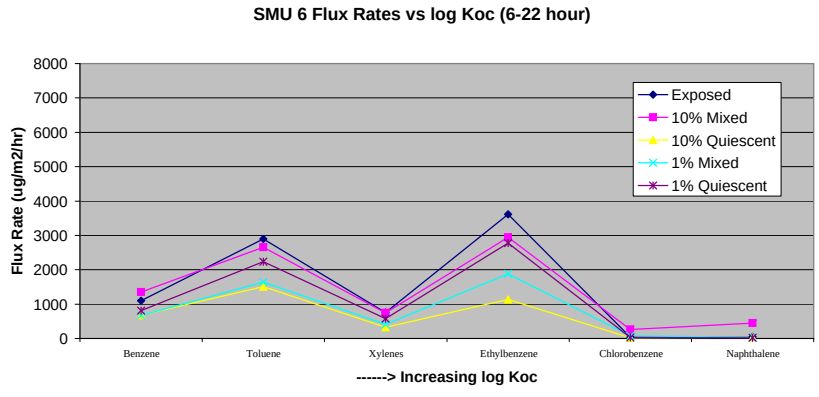

Results normalized by dividing the emission rates by the actual sediment concentration

Figure 10: SMU 6 Emision Rates vs. Henry's Law Constant & Koc (Normalized to Sediment Concentration)

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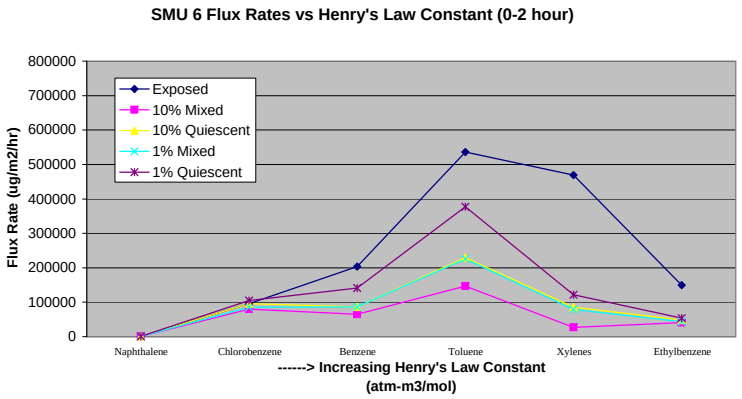

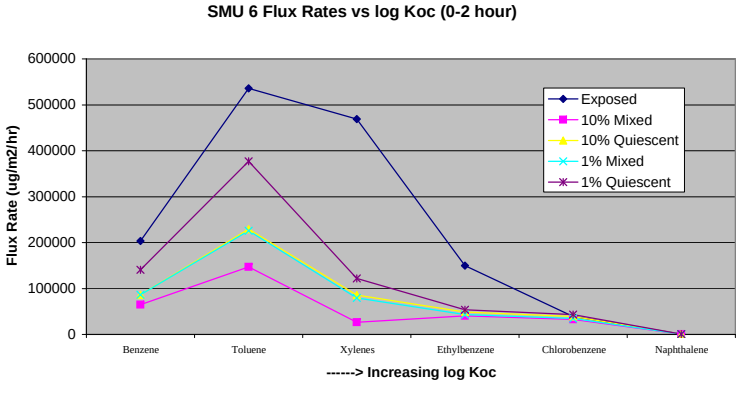

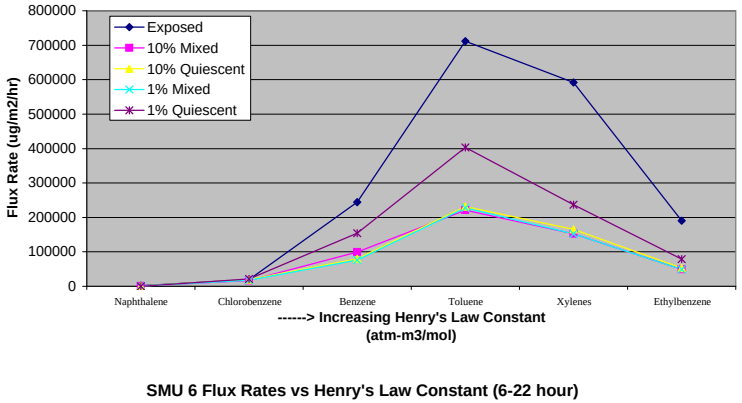

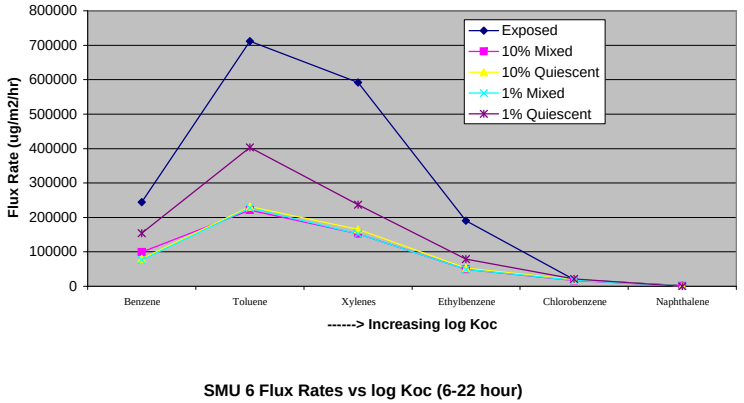

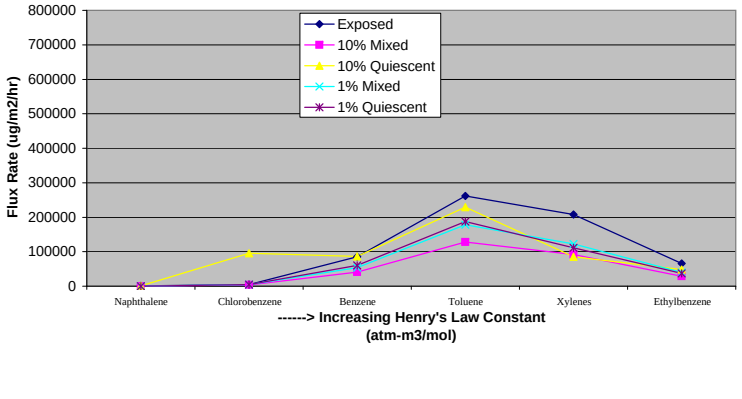

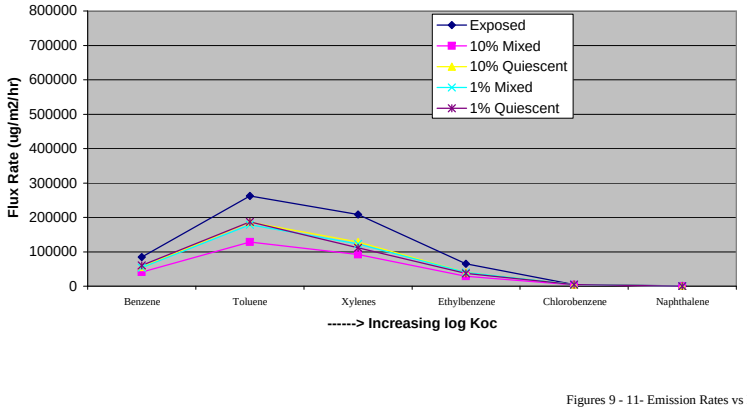

Figure 11: SMU 7 Emission Rates vs. Henry's Law Constant & Koc (Normalized to Sediment Concentration)

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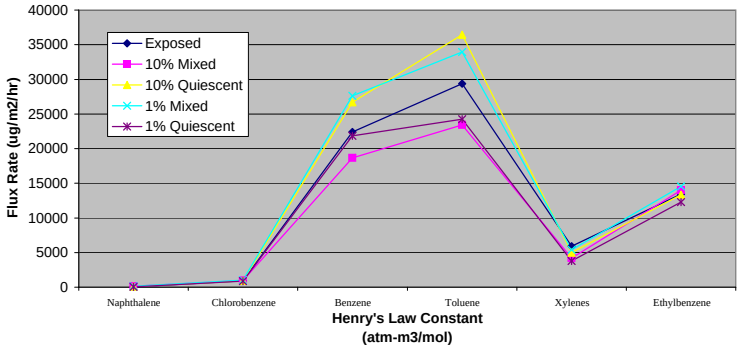
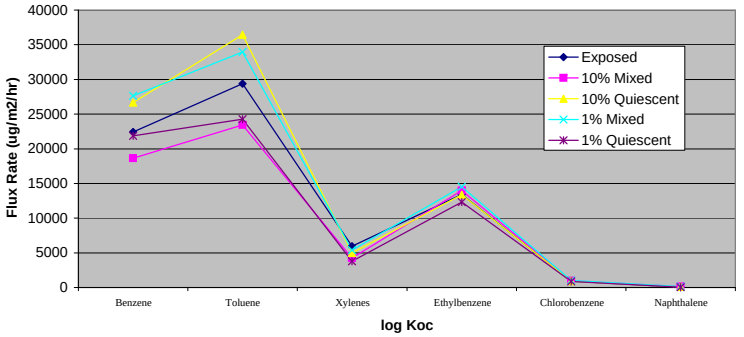
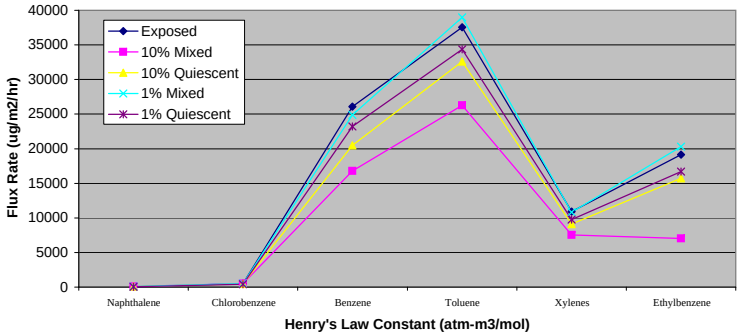
SMU 7 Flux Rates vs Henry's Law Constant (0-2 hour)



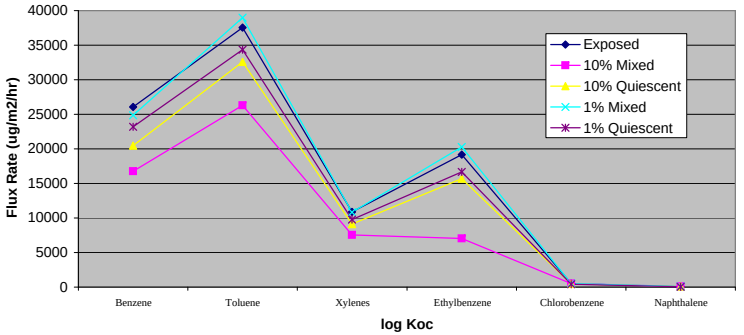
SMU 7 Flux Rates vs log Koc (0-2 hour)



SMU 7 Flux Rates vs Henry's Law Constant (2-6 hour)



SMU 7 Flux Rates vs log Koc (2-6 hour)



SMU 7 Flux Rates vs Henry's Law Constant (6-22 hour)

SMU 7 Flux Rates vs log Koc (6-22 hour)

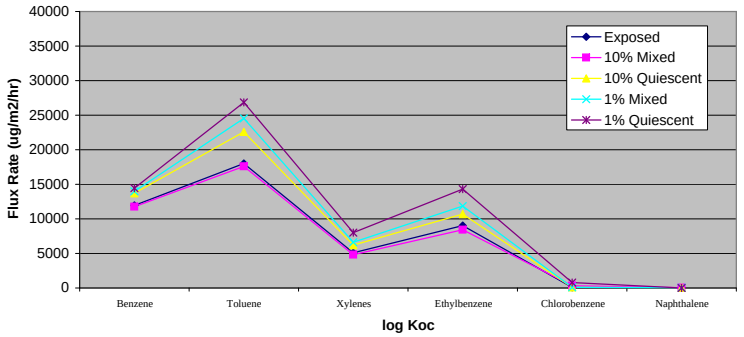
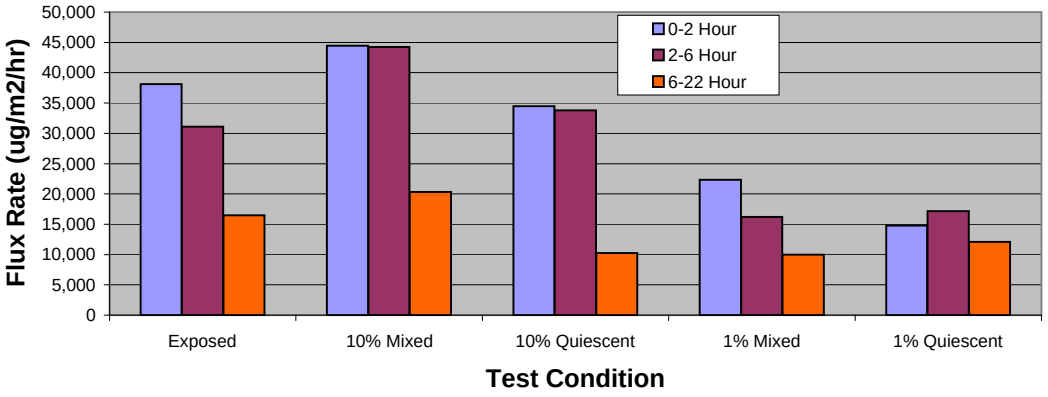
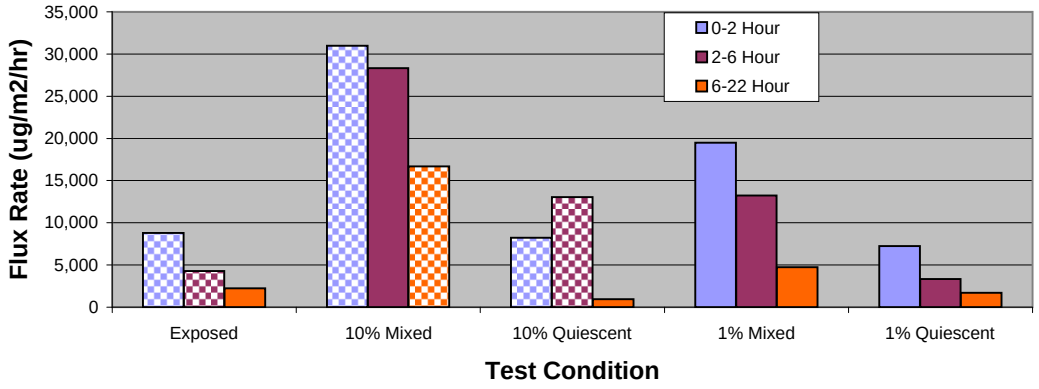


Figure 12: SMU 1 Emission Rates

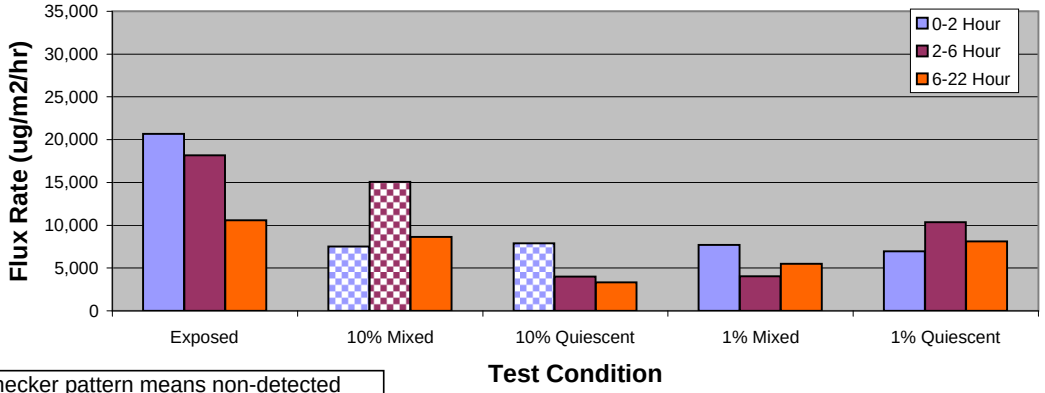
Benzene Flux Rates



Chlorobenzene Flux Rates



Ethylbenzene Flux Rates

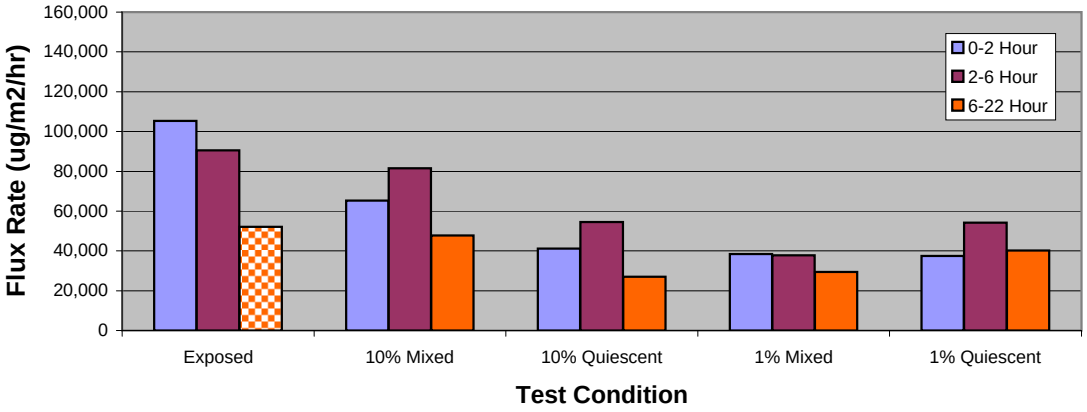


Checker pattern means non-detected and is recorded at half the Reporting

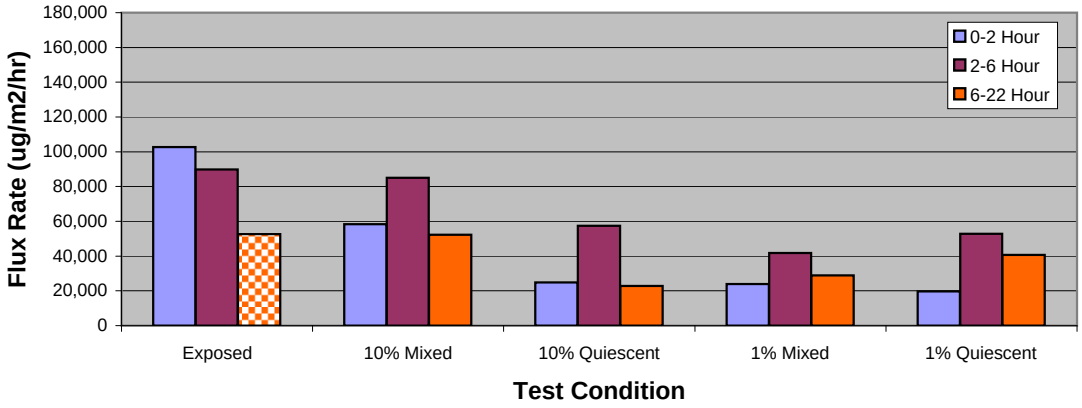
Note: Values are different than reported analytical chemistry due to conversion to flux rates (per m2 per hr).

Figure 12: SMU 1 Emission Rates

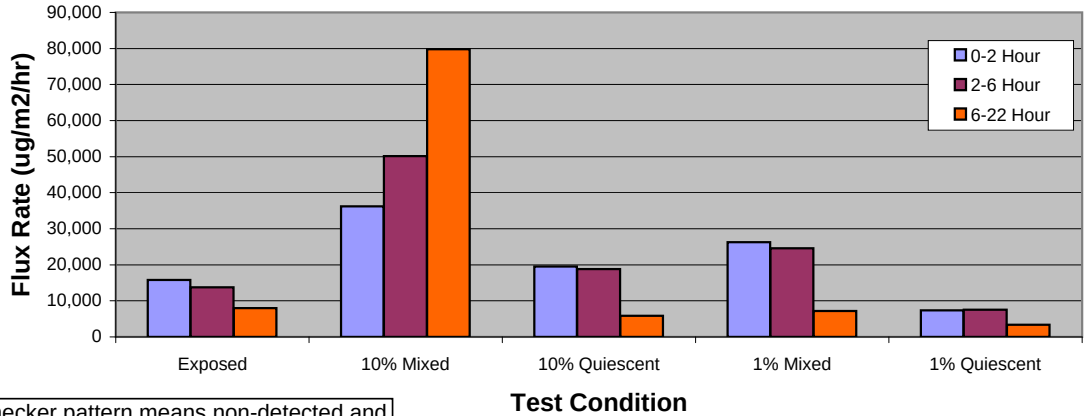
Toluene Flux Rates



Xylenes Flux Rates



Naphthalene Flux Rates



Checker pattern means non-detected and is recorded at half the Reporting Limit

Note: Values are different than reported analytical chemistry due to conversion to flux rates (per m2 per hr).

Figure 13: SMU 6 Emission Rates

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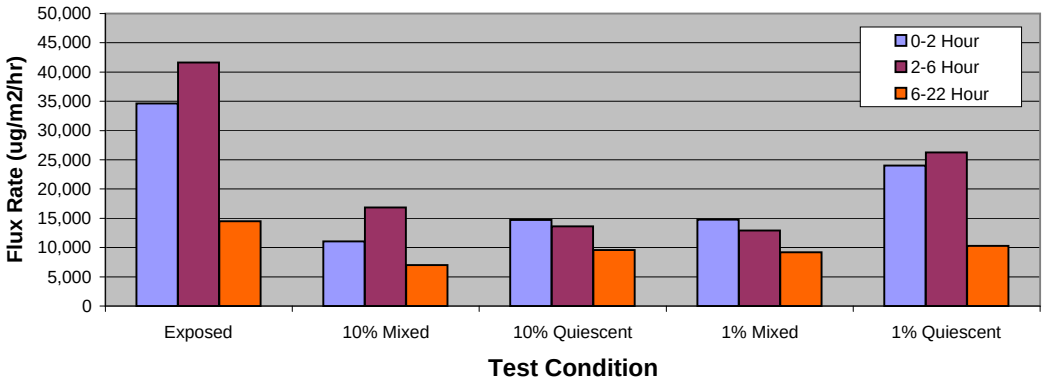
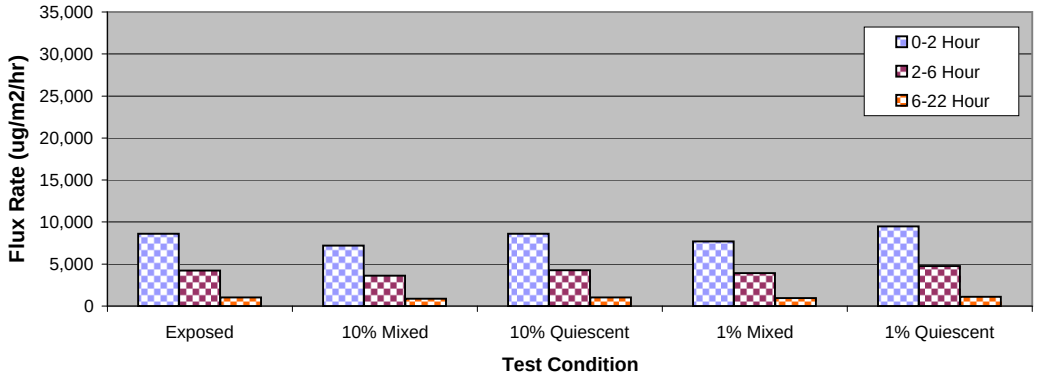
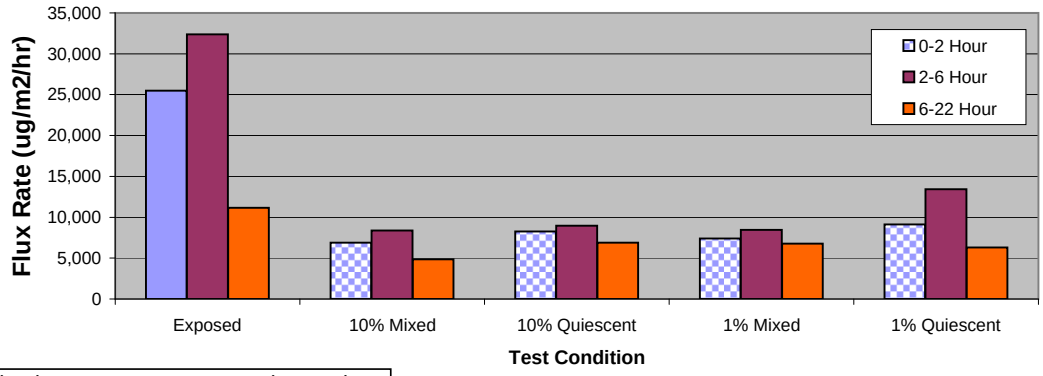
Benzene Flux Rates



Chlorobenzene Flux Rates



Ethylbenzene Flux Rates

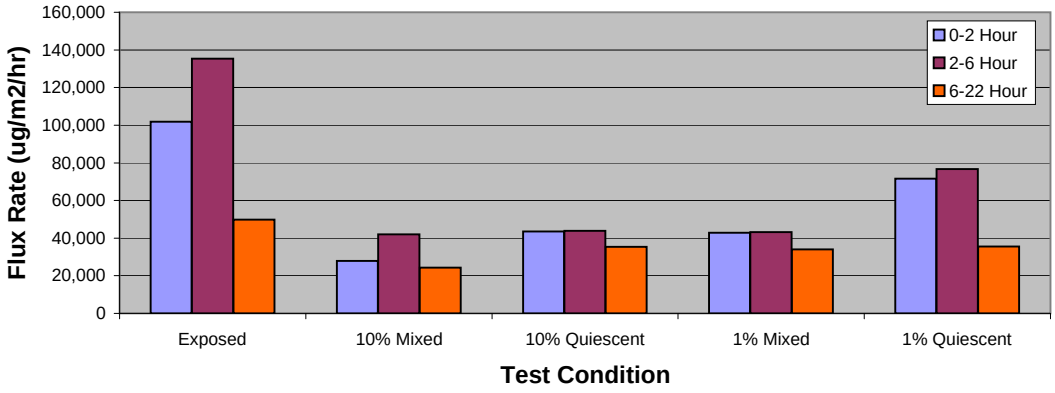


Checker pattern means non-detected and is recorded at half the Reporting

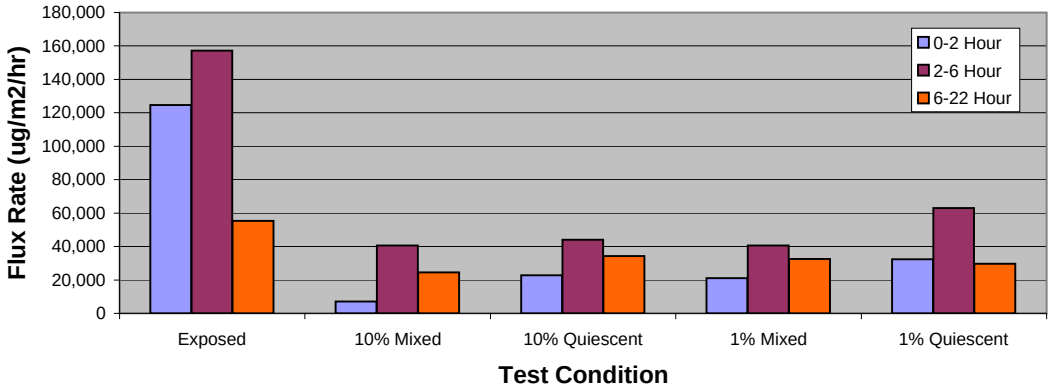
Note: Values are different than reported analytical chemistry due to conversion to flux rates (per m2 per hr).

Figure 13: SMU 6 Emission Rates

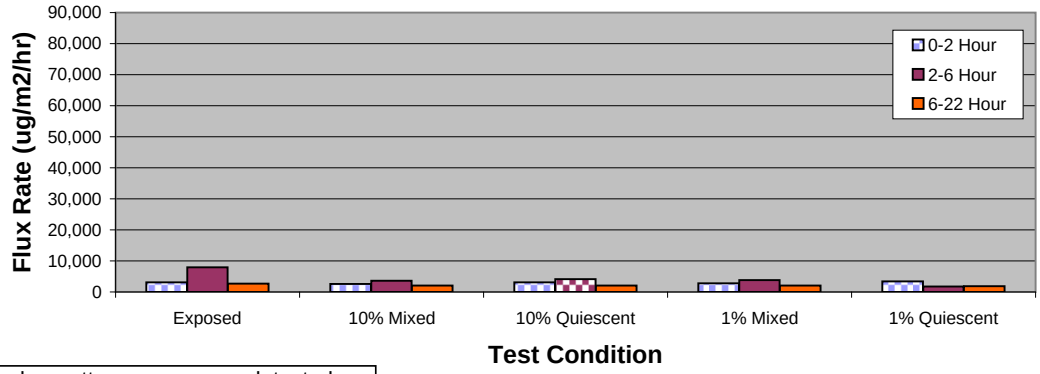
Toluene Flux Rates



Xylenes Flux Rates



Naphthalene Flux Rates



Checker pattern means non-detected and is recorded at half the Reporting

Note: Values are different than reported analytical chemistry due to conversion to flux rates (per m2 per hr).

Figure 14: SMU 7 Emission Rates

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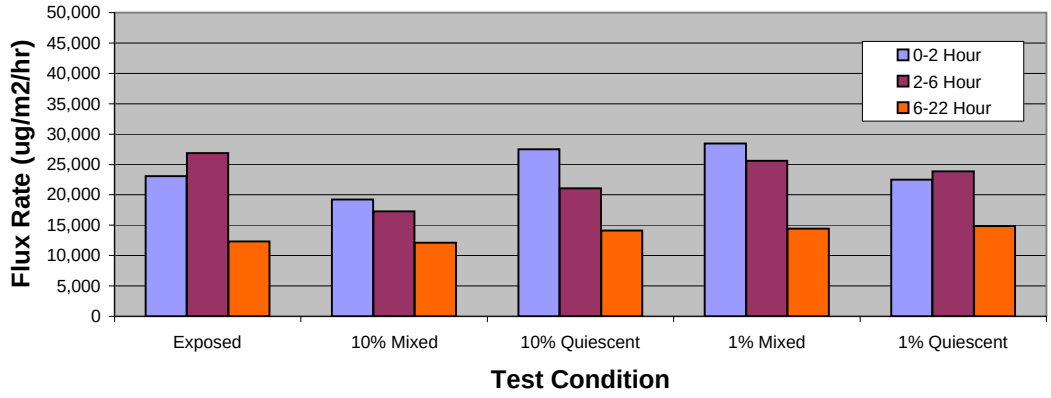
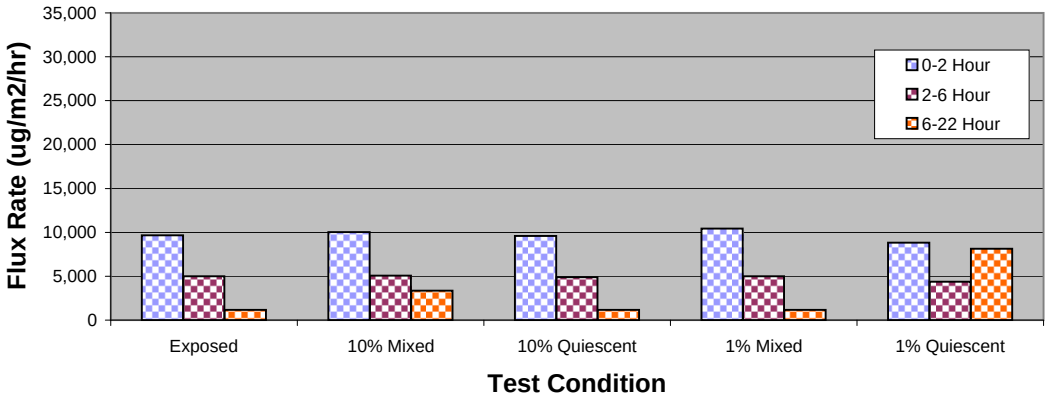
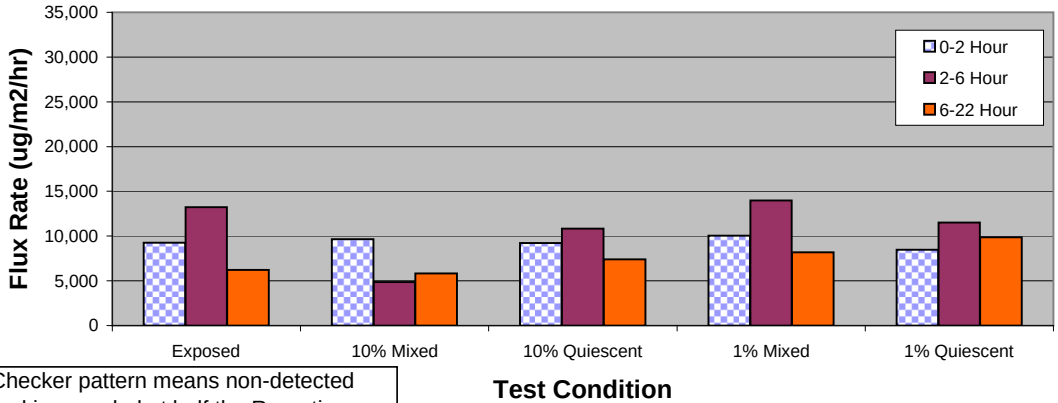
Benzene Flux Rates



Chlorobenzene Flux Rates



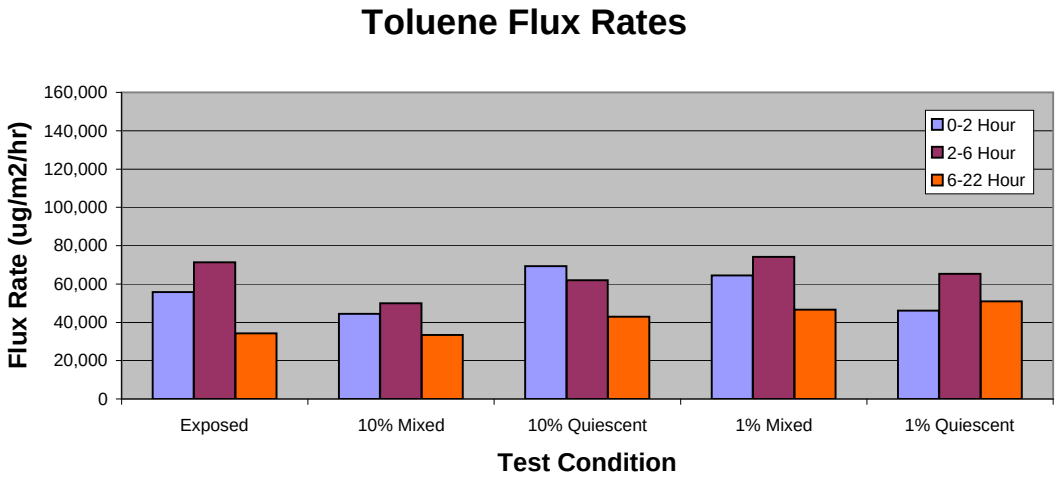
Ethylbenzene Flux Rates

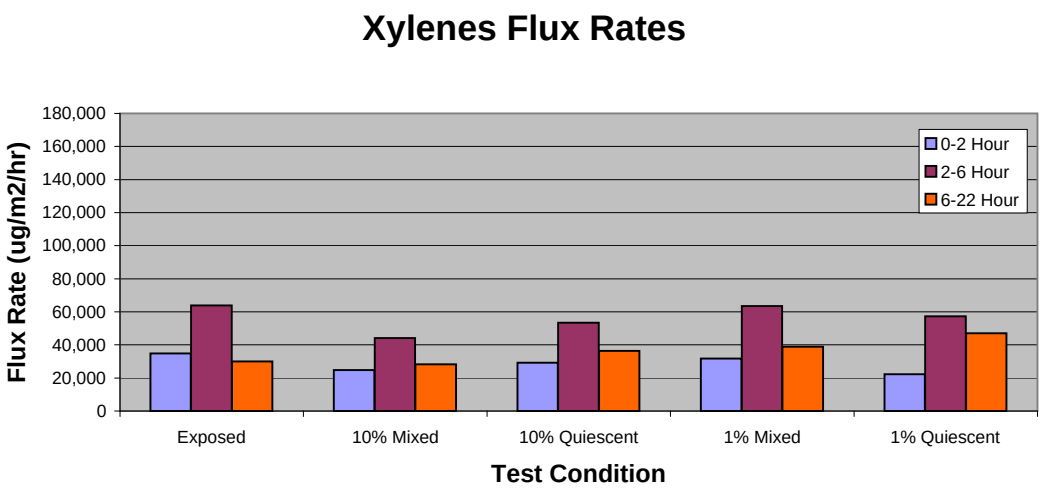


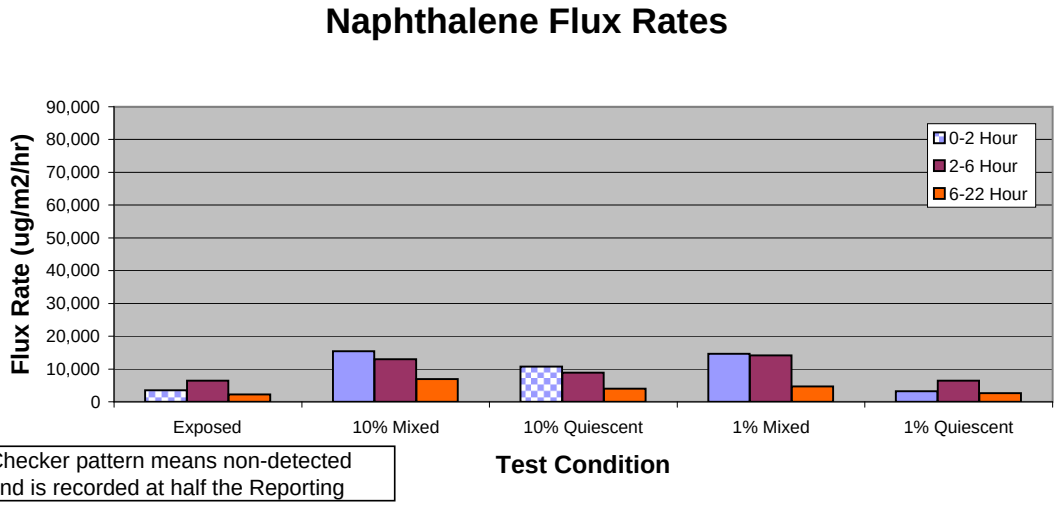
Checker pattern means non-detected and is recorded at half the Reporting

Note: Values are different than reported analytical chemistry due to conversion to flux rates (per m2 per hr).

Figure 14: SMU 7 Emission Rates



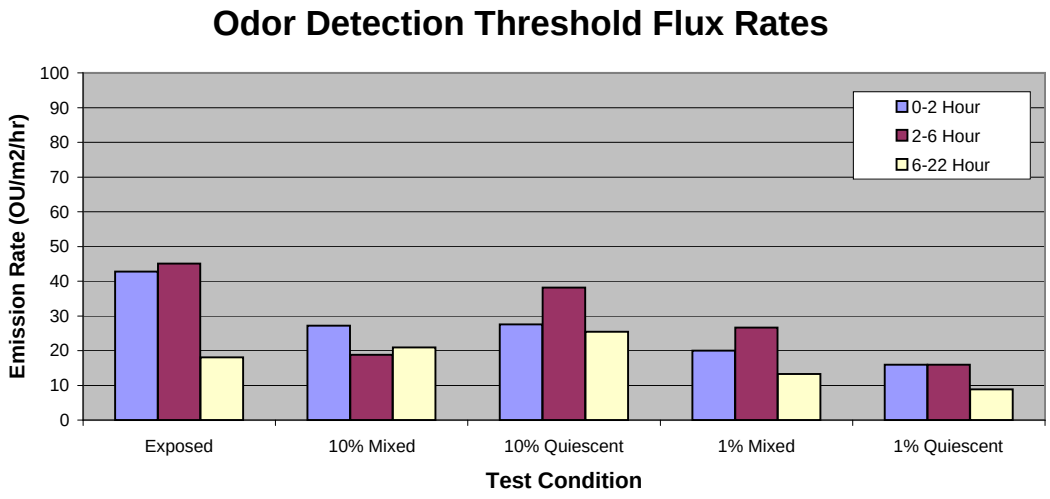


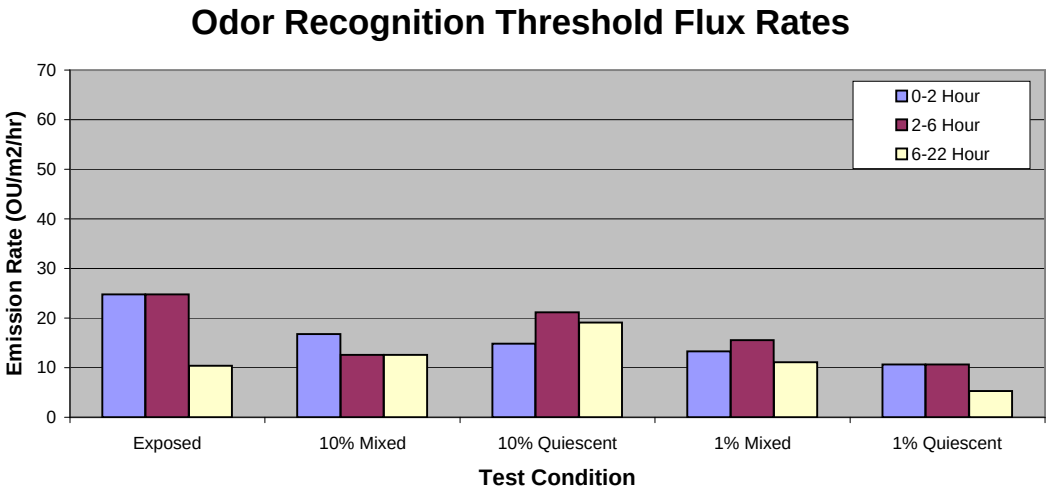


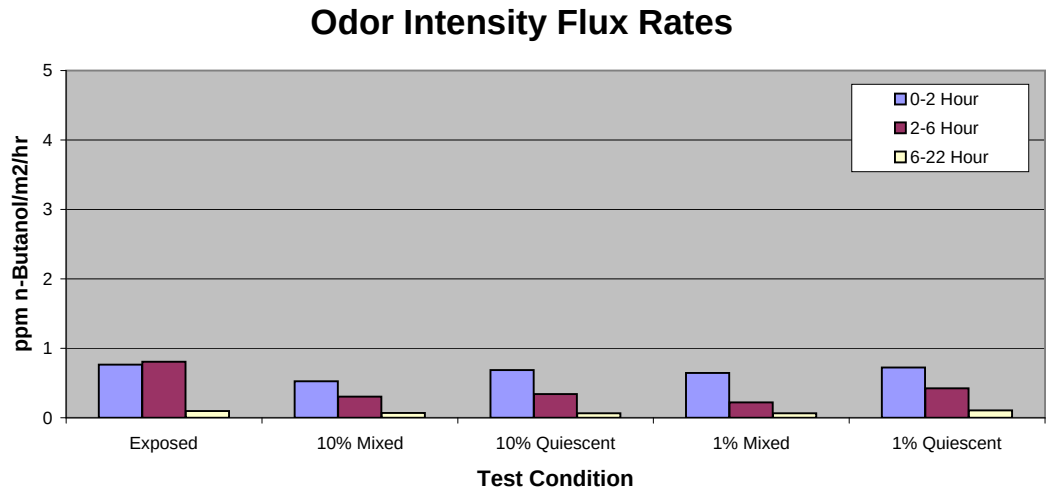
Checker pattern means non-detected and is recorded at half the Reporting

Note: Values are different than reported analytical chemistry due to conversion to flux rates (per m2 per hr).

Figure 15: SMU 1 Odor Parameters

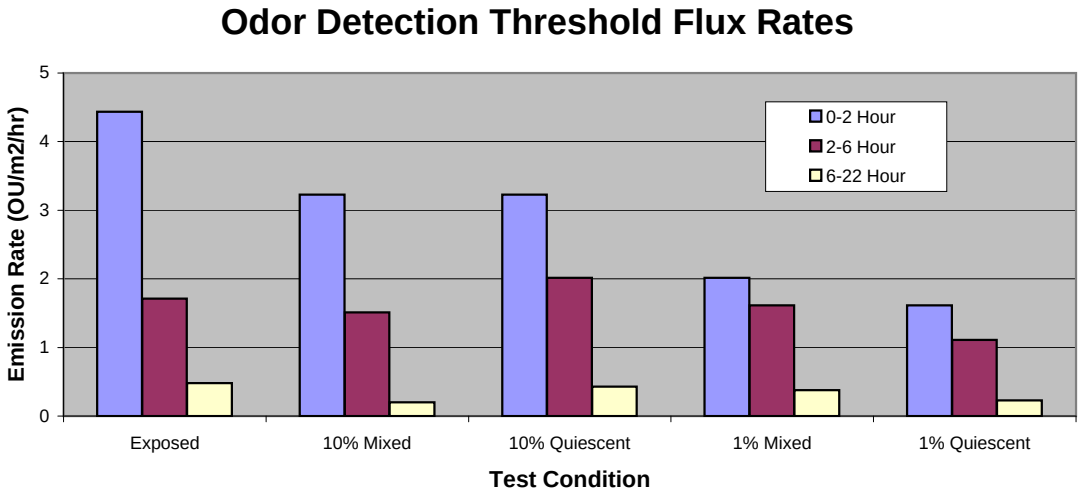


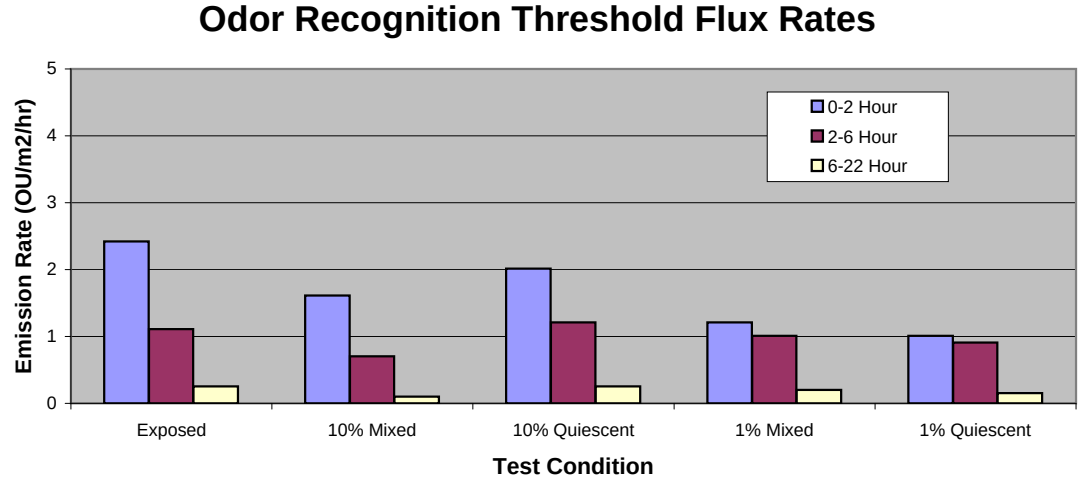


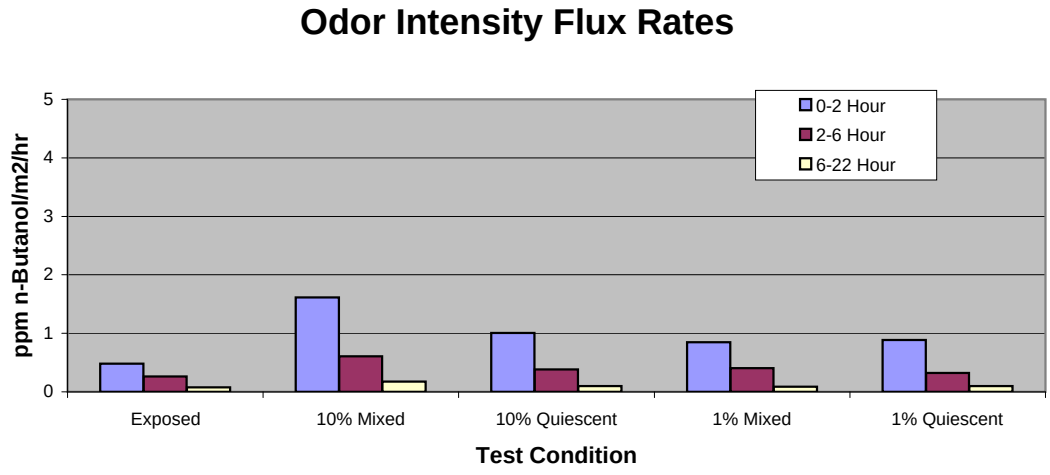


Note: Values are different than reported analytical chemistry due to conversion to flux rates (per m2 per hr).

Figure 16: SMU 6 Odor Parameters

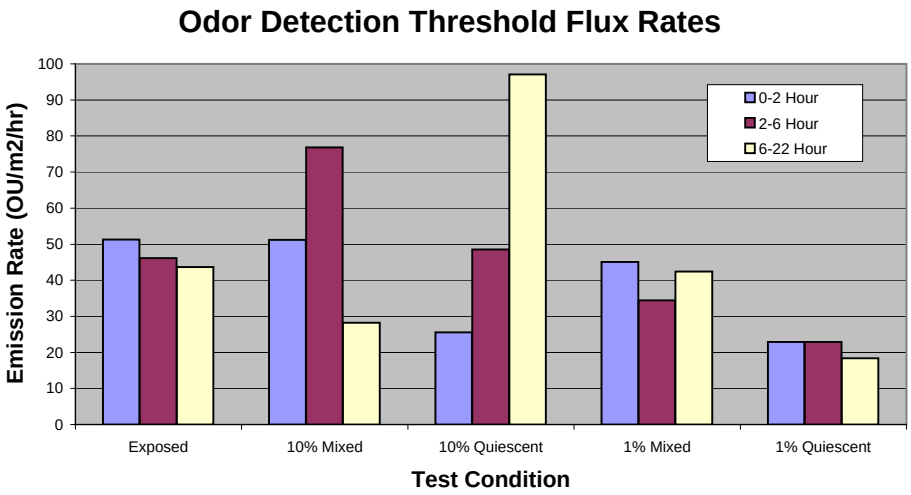


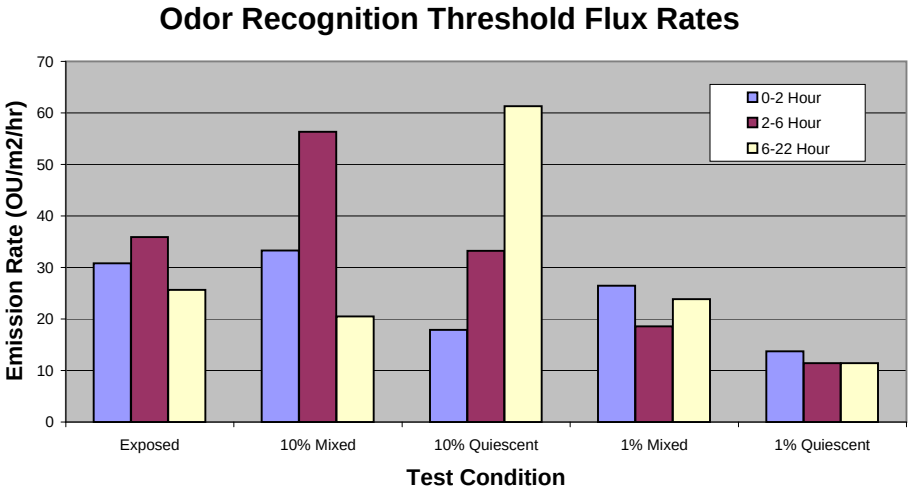


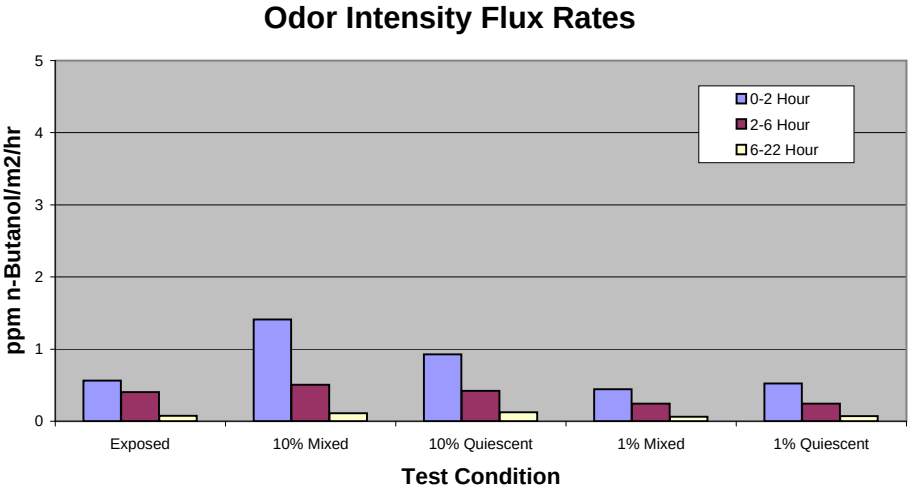


Note: Values are different than reported analytical chemistry due to conversion to flux rates (per m2 per hr).

Figure 17: SMU 7 Odor Parameters





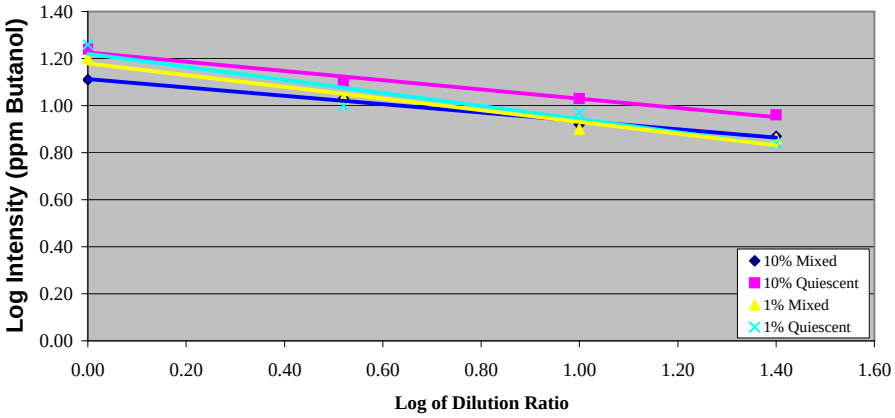


Note: Values are different than reported analytical chemistry due to conversion to flux rates (per m2 per hr).

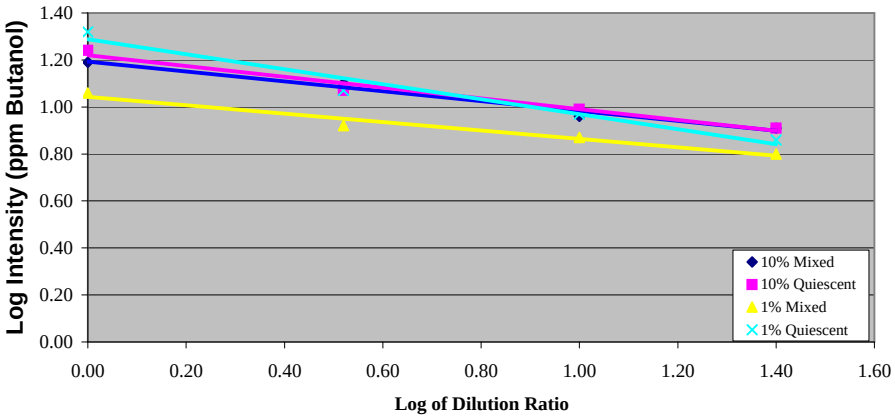
Figure 18: SMU 1 Odor Persistency

SERVICE ENGINEERING GROUP

SMU 1: 0 - 2 Hour Odor Persistency



SMU 1: 2 - 6 Hour Odor Persistency



SMU 1: 6 - 22 Hour Odor Persistency

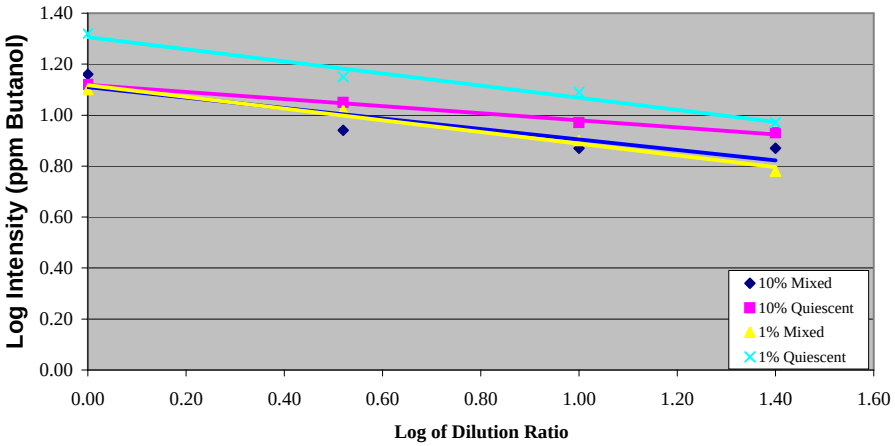
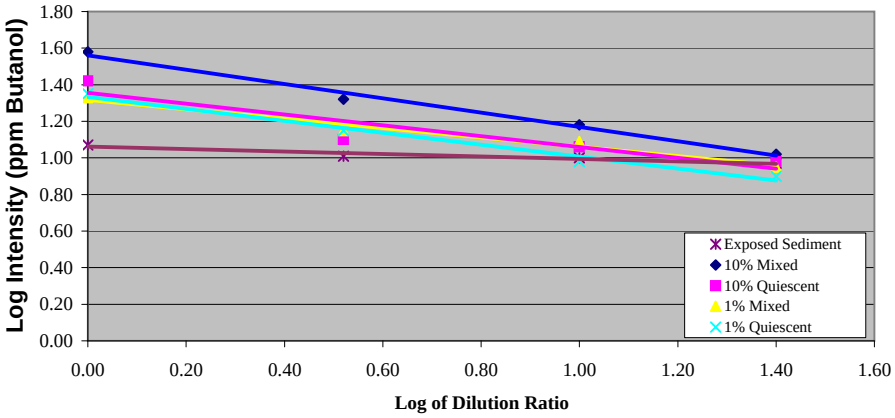


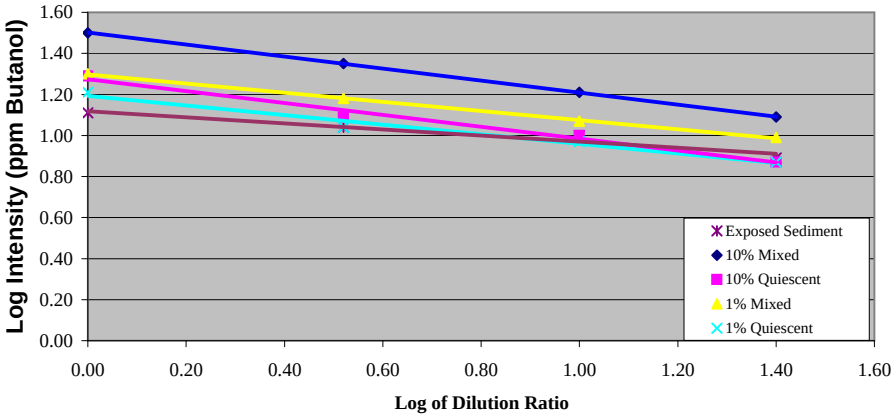
Figure 19: SMU 6 Odor Persistency

SERVICE ENGINEERING GROUP

SMU 6: 0 - 2 Hour Odor Persistency



SMU 6: 2 - 6 Hour Odor Persistency



SMU 6: 6 - 22 Hour Odor Persistency

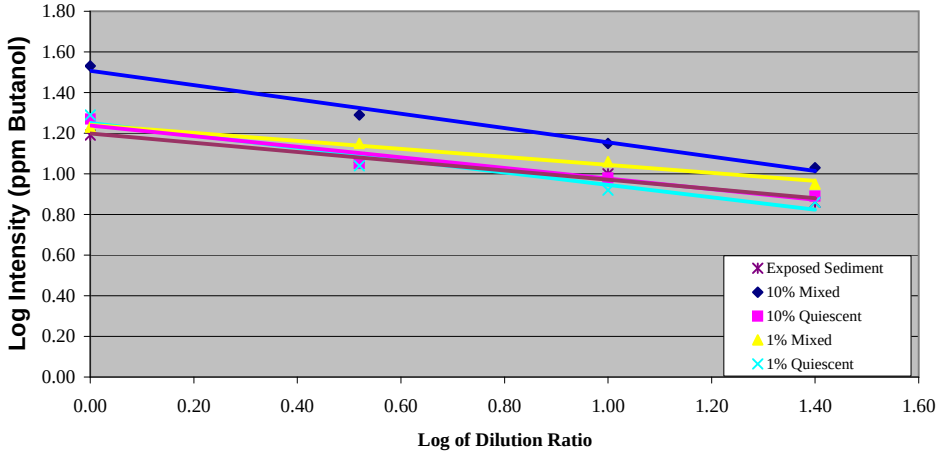
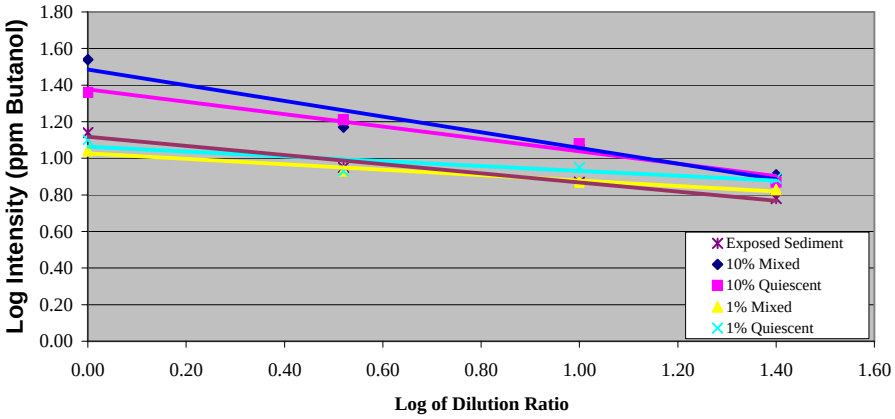


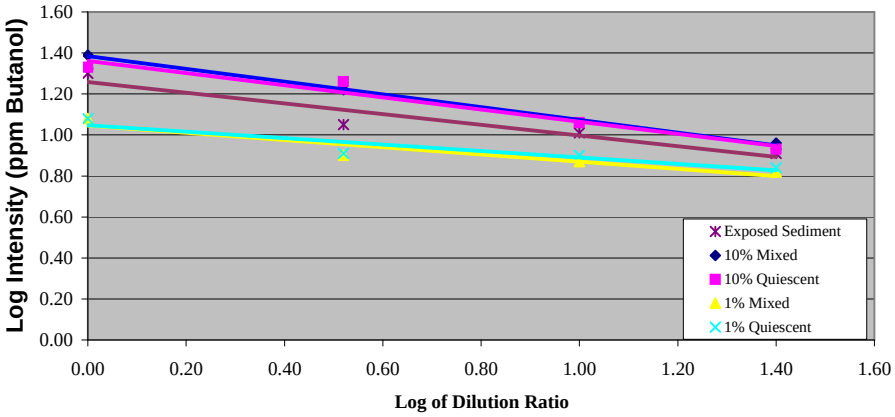
Figure 20: SMU 7 Odor Persistency

SERVICE ENGINEERING GROUP

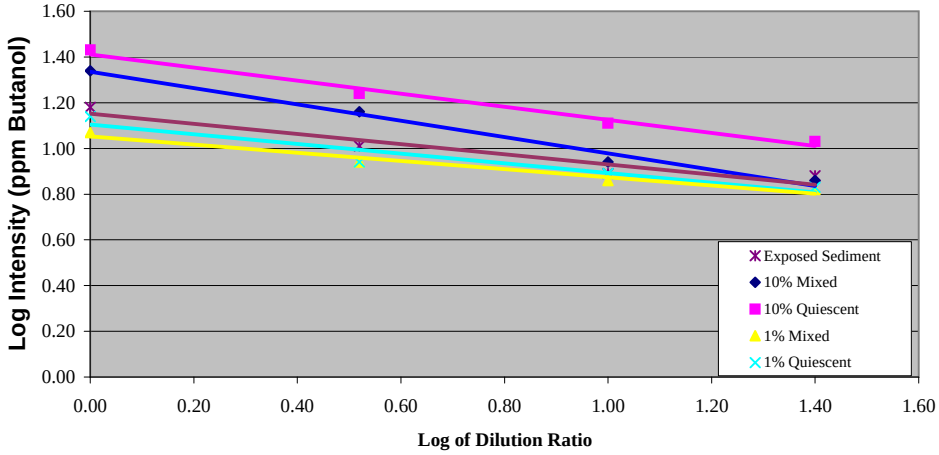
SMU 7: 0 - 2 Hour Odor Persistency



SMU 7: 2 - 6 Hour Odor Persistency



SMU 7: 6 - 22 Hour Odor Persistency



APPENDIX A

RESUMES OR PEER REVIEWERS

APPENDIX A

RESUMES OR PEER REVIEWERS

RESUME
(Revised January 10, 2006)

Louis Joseph Thibodeaux

Jesse Coates Professor of Engineering in Chemical Engineering
Gordon A. and Mary Cain Department of Chemical Engineering
Emeritus Director of Hazardous Substance Research Center (S/SW)
Louisiana State University
Baton Rouge, LA 70803
Phone: (225) 578-3055; FAX 578-1476
E-Mail: thibod@lsu.edu

PERSONAL DATA

Date of birth:	November 13, 1939
Place of birth:	Church Point, Louisiana
Home address:	3449 Tezcucco Drive, Baton Rouge, LA 70820
Wife:	Elwana Joyce Lasiter
Place of birth:	Wewoka, Oklahoma
Children:	Scott b. August 8, '61, Michele b. April 21, '64 Seven grandchildren!
Hobbies:	History, horses, and Cajun music

EDUCATION

Ph.D., Chemical Engineering, Louisiana State University, 1968
M.S., Chemical Engineering, Louisiana State University, 1966
B.S., Petroleum-Chemical Engineering, Louisiana State University, 1962
(five year course equivalent to separate degrees in each discipline).

The *italicized* listed items in the table of contents are also the standard "Biographical Data" required by LSU Policy Statement-36, pages 46-49 (Revision 5, July 1, 1997).

PROFESSIONAL EXPERIENCE

Academic

Jesse Coates Professor of Engineering in Chemical Engineering, August 1990 to present.
Adjunct Professor in Department of Civil and Environ. Eng. LSU-BR July 1999 to present.
Director of U.S. EPA Hazardous Substance Research Center, South/Southwest; 1991-'95.
Director of U.S.EPA Center of Excellence in Hazardous Waste Research. 1984-'91.
Professor of Chemical Engineering, Louisiana State University. August 1984 to 1990.
Professor of Chemical Engineering, U.of Arkansas; Fayetteville.1977-'84.
Visiting Professor, Centre d'Information Geologique, Ecole Nationale Superieure des Mines de Paris, Fontainbleau, France; August 1991 to January 1992.
Visiting Professor of Chemical Engineering, University of Exeter, Exeter,

England; January to June 1983.
Associate Prof. Chemical Engineering, U. Arkansas; 1972-'77.
Visiting Professor of Chemical Engineering, Oregon State University; Aug.1974-Jan.'75.
Assistant Prof. Chemical Engineering, U.of Arkansas; 1968-'72.
Research Assistant, National Council for Air and Stream Improvement, Division Eng. Research; L.S.U., Baton Rouge; June 1965 to February 1968
Research Assistant, Institute of Saline Studies, Division Eng. Res., L.S.U, Baton Rouge; September 1964 to June 1965.

TABLE OF CONTENTS

Consultant and Expert Witness to (from 1980 to present): Service Engineering Group, Inc., MN. # U.S. EPA, Athens, GA./RTI International. 2005. # U.S EPA Science Advisory Board, Wash., DC. 2005-'04. # Ungaretti & Harris, LLP, Chicago IL., 2003-'04, # Lawler, Matusky & Skelly Engineers, NY. 2000-2002. # Malcolm Pirnie, Inc. CA. 2000-2001.# Breazeale, Sachse & Wilson. L.L.P. LA 2000-2001.# Baron and Budd, TX. 1999-2001. # Kean, Miller, Hawthorne, et al. LLP, LA. 1999-2001. # General Electric Corp.,NY. 1999. # URS-

Greiner/Woodward Clyde(US STEEL), WA. 1999-2000. # Hashemite Kingdom of Jordan, General Corp. Environmental Protection, Amman, Jordan. 1999. # Aluminum Company of America, PA. 1998-2000. # Allied-Signal Corp., CANADA. 1998-2000. # SOLUTIA (Monsanto Company), AL.1998-2001. # Bartlett vs. BFI Chemical Services, LA 1996 to 1999. # Hartman Consulting Group, Seattle, WA; 1996 to 1998; # Exxon Refinery, Baton Rouge, LA; 1996 to 1998; # Dames and Moore Group, Salem, NH; 1996 to 1998; # Friloux vs. Campbell Wells, Inc., 1996 to 1997. # Olin Chemicals, Charleston, TN, 1994 to 1998; # Department of Justice, Washington, D.C.; # U.S. vs Montrose et al,; 1992 to 1998; # Ethyl Corporation (Combustion Inc.), Baton Rouge, LA; 1991 to 1998; # Reichhold Chemical Inc. (Newsom Brothers Site), Columbia, MS; 1991-1993; # U.S. EPA Risk Reduction Engineering Laboratory, Cincinnati, OH, 1990, 1991; # Balsam Environmental Consultants, Inc., Salem, NH, 1987 to 1990; # PEI Associates, Washington, D.C., 1987; # Life-Systems, Inc., Cleveland, OH 1987; # Dynamac Corporation, N.J., 1986; # U.S. Army Corps of Engineers, Vicksburg, MS, 1986, 1987, 1988, 1989, 1995; # Woodard-Clyde Consultants, Walnut Creek, CA, 1986; # Battelle Institute, 1985; # Fred G. Hart, Associates, NY, 1984; # Anderson-Nichols, Palo Alto, CA, 1984; # Proctor and Gamble, Cincinnati, OH, 1984, 1986; # Lawler, Matusky & Skelly, NY, 1985; # Weyerhaeuser, Tacoma, WA, 1985; # Great Lakes Chemical, El Dorado, AR, 1983; # U.S. Corps of Engineers, Tacoma, WA, 1983; # Ethyl Corporation, Baton Rouge, LA 1983, 1984, 1986, 1990; # Ethyl, Exxon, Dow, Petroprocessor vs USEPA, Baton Rouge, LA 1983; # Arkansas Department Pollution Control and Ecology, and USEPA vs Vertac Chemical, Little Rock, AR, 1979-1980. # Consultant to nine companies prior to 1980.

Industrial Employment:

International Paper Company, Natchez, MS; Summer, 1970
Georgia Kraft Company (Mead Corporation), Rome GA; Summer 1968 and 1969
Nat. Council Air and Stream Improv., Baton Rouge, LA; Summers 1965,66, & 67.
U.S. Rubber Company, Scotts Bluff, LA; Summer 1964.
E.I. duPont de Nemours and Company; Aiken, S.C.; June 1962 to February 1964

TEACHING AND UNIVERSITY SERVICE plus SERVICE TO STATE OF LOUISIANA

Undergraduate Courses

Chemical Processes and Kinetics; Transport Science, Momentum; Transport Science, Heat and Mass; Environmental Chemodynamics (New course 1987); Unit Operations;Undergraduate Research Course (New 1998); Engineering Measurements Laboratory.

Graduate Courses

Advanced Mathematics for Chemical Engineers (University of Arkansas)
Transport Phenomena (Mass) (University of Arkansas)
Advanced Reactor Design (University of Arkansas)
Environmental Chemodynamics (1st Sem. Grad also)
Hazardous Waste Treatment (Civil Engineering/Team taught)

Committees (LSU and University of Arkansas combined)

University Committees and Related Activities.

Department Environmental Studies Review Committee, Office of Academic Affairs(2005).Research Misconduct Committee(PS-69), Office of the Chancellor(2005). Research Misconduct Committee, Office of Vice Chancellor for Research and Graduate Studies(2004). Twenty Year Anniversary Haz. Waste/Sub. Research Center Committee, Student Relations Committee-member, Hazardous Waste Committee-member, University Research Council-member, Graduate Council-member, Academies Committee(ad hoc), University Environmental Task Force Committee(ad hoc), Professional Ethics(ad hoc).

College of Engineering

Ad Hoc Comm. to initiate Letter of Intent for Coastal Eng. Grad. Program. Faculty Promotion and Tenure Comm.(2005).
Awards Committee(2004-5).
MemberCoordinatingCouncil for Environment and Technological Hazards Prevention, Service Course Committee, Tenure Committee
Computer Use (ad hoc), Graduate Curriculum Committee, Petroleum Eng. Dept. Promotion and Tenure Comm., Engineering Math (ad hoc), Environmental Task Force Committee (chair), Review committee, professorships and distinguish chairs, Review Panel, Advisor to Expert (Dean Ed McLaughlin) USA vs Petroprocessors of La., Inc., et al (1990-1997), Engineering Diploma Ceremony(every semester), Environmental Engineering (Civil-Env. Dept.) ABET Review preparation committee, Texaco Chair Selection (Petroleum Engineering), LaSITE Committee (Chair),Technology Enhancement Committee (COTEC), Inter-College Environmental Cooperative, Environmental State-of-the-State V-2000 (Chair) & Advisory Committee 1999-2000.

Department of Chemical Engineering

Department Directions in Research (ad hoc)
Ethyl/Gautreaux Chair Search Committee
Recitation Sections - Its use in Ch.E. Teaching
Promotion and Tenure Committee

Service to State of Louisiana

Department Natural Resources Public Hearing, oral and written testimony Jan. 29, 1998

.

Service to Federal Government

U.S. House of Representatives, Committee of Transportation and Infrastructure, Subcommittee on Water Resources and Environment. Testimony on environmental dredging effectiveness and remediation of contaminated bed-sediment. Rayburn House Office Bldg., Wash. D.C., 12 April 2000.

U. S. EPA Office of Emergency and Remedial Response (OERR). Briefing meeting on the effectiveness on environmental dredging. Wash. D.C. 6 June 2000.

U. S. Member of Congress , James L. Oberstar. Brief of dredging effectiveness. Rayburn House Office Bldg.. Wash. D.C. , 20 June 2000.

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Books

ENVIRONMENTAL CHEMODYNAMICS - Movement of Chemicals In Air, Water and Soil, 2nd Edition, J. Wiley, N.Y. (1996) 593 p. [ISBN 0-471-61297-2]

CHEMODYNAMICS - Environmental Movement of Chemicals in Air, Water, and Soil, John Wiley, New York (1979), 501 p. [ISBN 0-471-04720-1]

"Ion-Exchange Resin Diffusion Coefficients and Resin Phase Ion Diffusivities", Doctoral Dissertation, Jesse Coates, Advisor, Louisiana State University, Baton Rouge, LA, 1968.

Thibodeaux, L.J. and Pavlou, S.P., Editors. NATIONAL SYMPOSIUM on CONTAMINATED SEDIMENTS - Coupling Risk Reduction with Sustainable Management and Reuse, Conf. Proc. 19, Transportation Research Board, National Research Council, Washington, D.C. , 1999.

Books in preparation.

ENVIRONMENTAL CHEMODYNAMICS - Movement of Chemicals In Air, Water and Soil, 3nd Edition, J. Wiley, N.Y. (2006?) XXX p. [ISBN 0-471-XXXXX-3]

HANDBOOK ON ENVIRONMENTAL MASS-TRANSPORT COEFFICIENTS, LJ Thibodeaux and D Mackay, Negotiating with publisher, (2007?). XXX p. [ISBN X-XXX-XXXXX-X].

Book Chapters

Thibodeaux, LJ. 2005. Environmental Chemodynamics. Encyclopedia of Chemical Processing.S. Lee, Editor. Taylor & Francis, NY. Pg.891-989.

Thibodeaux, L.J., D.D.Reible and K.T.Valsaraj. 2002. Non-Particle Resuspension Chemical Transport From Stream Beds. Chapter 7 in: " Chemicals in the Environment-Fate, Impacts, and Remediation". ACS Symposium Series 806. American Chemical Society. Wash. DC.

Reible, D.D. and L. J. Thibodeaux. Contaminated Sediment Management Technical Papers.
Appendix C-Using Natural Processes to Define Exposure from Sediments. Sediment Management Work Group, Detroit, MI. 1999.

Thibodeaux, L.J., contributing member. "Contaminated Sediments in Ports and Waterways," H. Bokuniewicz and K. Kamlet, Co-Chairs; Committee on Contaminated Marine Sediments, National Research Council, Washington, D.C., 1997 (Primary author Ch.5).

G.J. Thoma, D.D. Reible, K.T. Valsaraj, L.J. Thibodeaux and D.D. Timberlake, "Capping of contaminated sediments: Experimental results and mathematical

models", Chapter 19 in *Emerging Technologies in Hazardous Waste Management VI*, D.W. Tedder and F.G. Pohland (editors), American Academy of Environmental Engineers, Washington, D.C. (1996)

Contributing author, "The Multi-Media Fate Model-A Vital Tool for Predicting the Fate of Chemicals," Editors: C.E. Cowan, et al., Soc. Environ. Toxic. and Chemistry, SETAC Press, Pensacola, FL, 1995.

"Modeling Air Emissions from Contaminated Sediment Dredged Materials," (K.T. Valsaraj, L.J. Thibodeaux and D.D. Reible) ASTM Special Technical Publication (STP 1293) on *Dredging, Remediation and Containment of Contaminated Sediments*, ASTM, Philadelphia, PA (1995).

Smith, J.S., K.T. Valsaraj and L.J. Thibodeaux, "An Innovative Air-Water Exchange Process for the Treatment of Waste Waters", B. Jahne and E. Monahan (eds), Air-Water Gas Transfer, AEON Verlag (1995).

Thibodeaux, L.J., contributing member. "Ranking Hazardous Waste Sites," P.L. McCarty, Chair., Committee of Remedial Action Priorities for Hazardous Waste Sites, National Academy Press, Washington, D.C., 1994.

Valsaraj, K.T., X.Y. Lu, and L.J. Thibodeaux, "Removal of Hydrophobic Organic Compounds from the Aqueous Phase: Continuous Non-Foaming Adsorptive Bubble Separation Processes", Chapter 9 in ACS Symposium Series No. 509 Environmental Remediation, G.F. Vandergrift, D.T. Read and I.R. Tasker (Eds), ACS Books Dept., Washington, D.C., pages 116-126 (1992).

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Valaraj, K.T. and L.J. Thibodeaux, "Equilibrium Adsorption of Chemicals Vapors on Dry Soils: Model Predictions vs Experimental Data", Chapter 10 in Fate of Pesticides and Chemicals in the Environment, Environ. Sci. and Technol: A Wiley Interscience Series of Texts and Monographs, J.L. Schnoor (Ed.), John Wiley & Sons, NY, pages 155-174 (1992).
The above simultaneously published in Russian as Proceedings of the Soviet-American Symposium, Iowa City, Oct. 1987, entitled: Fate of Pesticides and Chemicals in the Environment, M.A. Novitsky, Ed., Leningrad Gidrometeoizdat (1991).

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McKay, D., W.Y. Shiu, K.T. Valsaraj, and L.J. Thibodeaux, "Air-Water Transfer: The Role Partitioning", in Air-Water Mass Transfer, S.C. Wilhelms and J.S. Gulliver (Eds), American Soc. Civil Engineers, New York, NY (1991).

Valsaraj, K.T. and L.J. Thibodeaux, "Solvent Sublation - A Non-Foaming Adsorptive Bubble Process for Separation of Waste Streams", Ch. 28 in Advances in Coal and Mineral Processing Using Flotation, Soc. Mining Engineers, Littleton, CO, S. Chander, Editor, 1989, pages 255-265.

Thibodeaux, L.J., "Theoretical Chemodynamic Models for Predicting Volatile Emissions to Air from Dredged Materials Disposal", In Intermedial Pollutionm Transport, Edited by D.T. Allen, et al., Penun Press, N.Y. 1989, p. 121-159.

Whitmer, A.M., A.F. Ramenofsky, J. Thomas, L.J. Thibodeaux, S.D. Field and B.J. Miller, "Stability or Instability: The Role of Diffusion in Trace Element Studies", Ch. 5 in Archaeological Method and Theory, Vol. 1, M.B. Schiffer, Editor, Univ. Arizona Press, Tucson, 1989.

Thibodeaux, L.J. and S.M. Withers, "Hazardous Chemicals in the Natural Environment-Mobility of Constituents", Chemical Engineering Education in a Changing Environment, S.I. Sandler and B.A. Finlayson, Editors, American Institute Chem. Engineers, New York (1988), p. 153-172.

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Savant, S.A., D.D. Reible, G.S. Gipson, J.D. Boyle and L.J. Thibodeaux, “An Investigation of the Significance of Convective Transport in River Sediments”, *Health and Environmental Research on Complex Organic Mixtures*, Gray, R., E. Chess, P. Mellinger, R. Riley and D. Springer, eds. DOE Symposium Series, Vol. 62 (1987).

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Thibodeaux, L.J., and H.D. Scott, Chapter 4, Air/Soil Exchange Coefficients, in Environmental Exposure from Chemicals, Volume I, W. Brock Neely and G.E. Blau, Editors, CRC Press, Inc., Boca Raton, FL (1985).

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Thibodeaux, L.J., C. Springer and S. Chatrathi, Chapter 17, Simulation Study of the Volatilization of Polychlorinated Biphenyls from Landfill Disposal Sites, in Environmental and Solid Waste, C.W. Francis and S.I. Auerbach, Editors, Butterworth Publishers, Woburn, MA (1983).

Thibodeaux, L.J., Chapter 5, Offsite Transport of 2,3,7,8-Tetrachlorodibenzo-p-

dioxin from a Production Disposal Facility, in Chlorinated Dioxins and Dibenzofurans in the Total Environment, G. Choudhary, L.H. Keith and C. Rappe, Editors, Butterworth Publishers, Woburn, MA (1983).

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Journal Articles (Refereed)

JH Pardue, WH Moe, D Mcinnis, LJ Thibodeaux, KT Valsaraj, E. Maciasz, I Van Heerden, N Korevec, & QZ Yuan.O T. 2005. "Chemical and microbiological parameters in New Orleans floodwater following hurricane Katrina", Environ. Sci. & Technology, 39(22), 8591-8599.

LJ Thibodeaux. 2005 "Recent advances in our understanding of sediment-to-water contaminant fluxes-The soluble release fraction". Aquatic Ecosystem Health and Management Journal., Vol. 8, (7), p.1-9.

L. Aguilar and LJ Thibodeaux. 2005. " Kinetics of Peat Soil Dissolved Organic Carbon Release to Surface Water. Part 1. Laboratory Experiments." CHEMOSPHERE. Vol. 58, Issue 10, p. 1309-1318.

L.J. Thibodeaux and L. Aguilar 2005. "Kinetics of Peat Soil Dissolved Organic Carbon Release to Surface Water. Part 2. A Chemodynamic Process Model". CHEMOSPHERE. Vol. 60, p.1190-1196.

MJ Erickson, CL Turner and LJ Thibodeaux. 2005. "Field Observation and Modeling of Dissolved Fraction Sediment-Water Exchange Coefficients for PCBs in the Hudson River". Environ. Science and Technol., vol. 39, no. 2., p 549-556.

LJ. Thibodeaux, H. Hulls, R. Raghunathan, KT Valrasaj, M. Costello, and DD Reible.l. 2004. "Laboratory Simulation of Chemical Evaporation from Dredge-Produced Sediment Slurries". Environmental Engineering Science. Vol. 21. No. 6.p. 730-740.

WJ Mills, ER Bennett, CE Schmidt and LJ Thibodeaux. 2004. "Approaches for obtaining quantitative vapor emissions estimates of PCBs and other SVOCs from contaminated Sites". Environmental Toxicology and Chemistry, Vol. 23, No. 10, pp.2457-2464.

LJ Thibodeaux and VI Bierman. 2003. The Bioturbation Driven Chemical Release Process.Environmental Science and Technology. July1, 253A-258A.

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Thibodeaux, L.J., "Sources and Initiating Mechanisms for Chemical Contamination of Groundwater", Seminar-Grounded Water Contamination in Louisiana - Issues and Answers, Baton Rouge, February 27, 1986.

Thibodeaux, L.J., "Volatile Chemical Emissions from Toxic and Hazardous Waste in Land Disposal and Treatment Operations - A Review of Selected Literature", Second Annual Conference Current Topics in Hazardous Waste Control, Georgia Tech. Research Institute, Atlanta, February 6-8, 1985.

Thibodeaux, L.J., "Volatile Organic Chemicals from Land Disposal of Waste - Mechanism Emissions and Control Strategies", Feature Paper III, Technology Transfer Conference No. 6, Ministry of Environment, Ontario, Toronto, Canada, December 11-12, 1985.

Thibodeaux, L.J., "Treatment of Hazardous Waste from Chemical Plants and Refineries", Chemical Processing Table Top Show and Seminar, Baton Rouge, LA, September 25, 1985.

Thibodeaux, L.J., "Chemodynamics in the Natural Environment: Mass-Transport of Chemicals at the Sediment/Water Interface", University of Akron, Akron, OH, February 14, 1985.

Thibodeaux, L.J., "Chemodynamics in the Natural Environment: The Mass-Transport of Chemicals at the Sediment/Water Interface", U.S. EPA, Athens Environmental Research Laboratory, Athens, GA, January 9, 1986.

Savant, S.A., D.D. Reible and L.J. Thibodeaux, "Modeling Convective Transport in River Sediments", to be presented at the National Meeting of the American Chemical Society, Anaheim, CA, September 1986.

Groves, F.R., D.D. Reible and L.J. Thibodeaux, "Estimation of Physical and Chemical Properties of Waste Organic Mixtures Associated with Land Pollution", presented at the National Meeting of the ACS, Miami, FL, May, 1985.

Thibodeaux, L.J., "Sources and Initiating Mechanisms for Chemical Contamination of Groundwater", Groundwater Contamination Issues in Louisiana, Feb. 27, 1986, Baton Rouge, LA.

Springer, C., K.T. Valsaraj and L.J. Thibodeaux, "Emissions of Volatile Organic Chemicals from Landfills and Wastepiles, Paper presented at the Seventh Annual Meeting of the Society for Environmental Toxicology and Chemistry, Theme Session "Sources and Fate of Trace Organics in the Atmosphere" held in Alexandria, VA, November 2-5, 1986.

Thibodeaux, L.J., "Chemodynamics in the Natural Environment: Mass-Transfer of Chemicals at the Sediment/Water Interface", Tulane University, New Orleans, LA, February, 1987.

Baron, J.A., D.D. Reible and L.J. Thibodeaux, "The Natural Recovery Processes of Marine Sediment Contaminated During Offshore Drilling Activities", Presentation 61, Env. Chem. 194th Amer. Chem. Soc. Nat. Mtg., N.O. Aug. 30 - Sept. 4, 1987.

Valsaraj, K.T. and L.J. Thibodeaux, "Diffused Aeration and Solvent Sublation for the Removal of Volatile from Aqueous Systems", Paper presented before the Division of Environmental Chemistry, National ACS Meeting in New Orleans, LA, August 30 - September 4, 1987, Div. Env. Chem. ACS - Preprint Abs., 27 (2), 220-222 (1987).

Poe, S.H., K.T. Valsaraj and L.J. Thibodeaux, "Equilibrium Vapor Phase Adsorption of Volatile Organic Chemicals by Dry Soils", Paper presented before the Division of Environmental Chemistry, National ACS Meeting in New Orleans, LA, August 30 - September 4, 1987, Div. Env. Chem. ACS - Preprint Abs., 27, 223-225 (1987).

Valsaraj, K.T., A. Velaga, J.S. Cho and L.J. Thibodeaux, "Comparison of Experimental and Calculated Stage Efficiencies in a Packed Cross-Flow Cascade for Methanol-Water Separations", Paper presented before the Industrial Engineering Chemistry Division, ACS National Meeting in New Orleans, LA, August 30 - September 4, 1987.

Valsaraj, K.T. and L.J. Thibodeaux, "Equilibrium Adsorption of Chemical Vapors onto Surface Soils: Model Predictions and Experimental Data", USA/USSR Symp. on the "Fate and Transport of Pesticides and Chemicals in the Environment" at Univ. Iowa, Iowa City, Oct. 12-16, 1987.

Thibodeaux, L.J., and K.T. Valsaraj, "The Role of Physical Adsorption in Determining the Equilibrium Vapor Pressure of Volatile Organic Chemicals Above Landfills, Landfarms and Surface Soils", Presentation to Society for Env. Tox. and Chemistry, Pensacola, FL, Nov. 9-12, 1987.

Thibodeaux, L.J., "Chemical Transport Processes Across the Mud-Water Interface of Natural Aquatic Environments", Presentation before the Environmental Service and Technology Chapter of the Technical Community of Monsanto, St. Louis, MO, May 15, 1987.

Thibodeaux, L.J., "Overview of Research at the Hazardous Waste Research Center at LSU", 1987 Conf. on Haz. Waste Res., Kansas State University, Manhattan, KS, May 20, 1987.

Thibodeaux, L.J., "Chemical Transport Across the Mud-Water Interface", N.O. Section AIChE, N.O., Jan. 12, 1988.

Thibodeaux, L.J., "Chemical Transport Across the Mud-Water Interface: Is this Chemical Engineering?", Univ. of Kentucky, Lexington, KY, April 15, 1988.

Thibodeaux, L.J., K.T. Valsaraj and D.P. Harrison, "Efficiencies of Volatile Organic Air Stripping in a Packed Crossflow Cascade", Paper presented at the Second Annual Symposium on Hazardous Waste Research Sponsored by the LSU EPA Center of Excellence Hazardous Waste Research Center, Baton Rouge, LA, October 25-26, 1988.

Thibodeaux, L.J., "Chemical Transport Processes Across the Mud-Water Interface of Natural Aquatic Environments", Invited Seminar, Vanderbilt University, Nashville, TN, February 20, 1989.

Locicero, L., D. Wood, K.T. Valsaraj, L.J. Thibodeaux and D.P. Harrison, "Air Stripping of Volatile Organics from Groundwater Using Packed Crisscrossflow Cascades, Paper presented at the 1989 AIChE Spring National Meeting in Houston, TX, April 26-29, 1989.

Velaga, A, K.T. Valsaraj and L.J. Thibodeaux, "Estimation of Interfacial Areas in Packed Crisscrossflow Distillation Columns", Paper presented at the 1989 AIChE Spring National Meeting in Houston, TX, April 26-29, 1989.

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Stripping of Volatile Organics from Groundwater Using Packed Crisscross Flow Cascades", Paper presented at the 196th ACS National Meeting held in Dallas, TX, April 9-14, 1989.

Baron, J.A., L.J. Thibodeaux, K.T. Valsaraj and D.D. Reible, "Transport of Hydrophobic Chemicals Into and Out of Bed Sediments Laboratory Simulations", Paper presented at the 32nd Annual Meeting of the International Association of Great Lakes Research (IAGLR) held at the University of Wisconsin, Madison, WI, May 30-June 2, 1989.

Koulermos, A.C., L.J. Thibodeaux, K.T. Valsaraj and D.D. Reible, "Do Colloids Have Significant Chemical Transport Properties in Bed Sediments?", Paper presented at the 32nd Annual Meeting of IAGLR held at University of Wisconsin, Madison, WI, May 30-June 2, 1989.

Thibodeaux, L.J., "Theoretical Chemodynamic Models for Predicting Volatile Emissions to Air from Dredged Material Disposal", Workshop on Intermedia Transport of Pollutants: Modeling and Field Measurements, Los Angeles, August 23-26, 1989.

Thibodeaux, L.J., D.D. Reible, K.T. Valsaraj and X. Wang, "Theory of In-Situ Capping of Contaminated Sediments", Paper presented at the Second Annual HWRC Symposium, Louisiana State University, Baton Rouge, LA, October, 1989.

Harrison, D.P., K.T. Valsaraj and L.J. Thibodeaux, "Air Stripping of VOCs from Groundwater Using Crisscross Flow Cascades", Paper presented at the Second Annual HWRC Research Symposium, Louisiana State University, Baton Rouge, LA, October, 1989.

Reible, D.D., L.J. Thibodeaux, et al., Paper 120a, American Inst. Chem. Eng. Mtg., San Francisco, CA, Nov. 5-10, 1989.

Valsaraj, K.T. and L.J. Thibodeaux, "Solvent Sublation - An Adsorptive Bubble Process for the Removal of Hydrophobic Compounds from Aqueous Solution", Paper presented at the Second Annual HWRC Research Symposium at LSU, Baton Rouge, LA, October 1989.

Koulermos, A.C., L.J. Thibodeaux, K.T. Valsaraj and D.D. Reible, "Influence of Natural Colloids on the Transport and Fate of Organic Pollutants in Aquatic Systems", Paper presented at the 10th Annual Meeting of SETAC, October 29-November 2, 1989.

Bosworth, W. and L.J. Thibodeaux, Paper 120c, American. Inst. Chem. Eng. Mtg., San Francisco, CA, Nov. 5-9, 1989.

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Thibodeaux, L.J., K. Nadler, K.T. Valsaraj and D.D. Reible, "The Effect of Moisture on Volatile Organic Chemical Vapor-to-Particle Partitioning with Atmospheric Aerosols - Competitive Adsorption Theory Predictions", Paper presented at the Symposium on Environmental Chemistry in honor of Philip W.

West, 45th Southwest Regional ACS Meeting, Baton Rouge, LA, December 6-8, 1989.

Valsaraj, K.T. and L.J. Thibodeaux, "Solvent Sublation - A Non Foaming Adsorptive Bubble Process for the Separation of Waste Streams", Presented at the Engineering Foundation Conference on Advances in Flotation for Coal and Mineral Processing held at Sheration Palm Coast Resort, Florida, December 3-8, 1989.

Thoma, G.J., A.C. Koulermos, K.T. Valsaraj, D.D. Reible and L.J. Thibodeaux, "The Effects of Porewater Colloids on the Transport of Hydrophobic Compounds from Bed Sediments", Paper presented at the Symposium on "Organic Substances and Sediments in Water" at the National ACS Meeting in Boston, MA, April, 1990.

Lu, X.Y., K.T. Valsaraj and L.J. Thibodeaux, "Continuous Countercurrent Solvent Sublation of Hydrophobic Compounds from Aqueous Solutions", Paper presented at the 200th National ACS Meeting in Washington, DC, August 26-31, 1990.

McKay, D., W.Y. Shiu, K.T. Valsaraj and L.J. Thibodeaux, "Air-Water Transfer: Role of Partitioning", Paper presented at the Second International Conference on Gas Transfer at Water Surfaces held at the University of Minnesota, Minneapolis, MN, September 10-11, 1990.

Wang, X.Q., L.J. Thibodeaux, K.T. Valsaraj and D.D. Reible, "In-Situ Capping of Contaminated Bed Sediments In-Situ", Paper presented at Third Annual Symposium of the Hazardous Waste Research Center, LSU, Baton Rouge, October 22, 1990.

Thibodeaux, L.J., "Beach Hydraulics and Chemodynamics of Oil Constituents and Nutrients for in situ Bioremediation", Coastal and Waterways Oil Spill Conference, LSU, Baton Rouge, Oct. 25, 1990.

Valsaraj, K.T., X.Y. Lu and L.J. Thibodeaux, "Continuous Non-Foaming Adsorptive Bubble Separation Processes for the Removal of Hydrophobic Organics from the Aqueous Phase, Paper presented at the Symposium on Separations Science in Environmental Chemistry, ACS National Meeting, Atlanta, GA, April 14-19, 1991.

Harrison, D.P., D.M. Wetzel, K.T. Valsaraj, L.J. Thibodeaux and E. Mertooetomo, "Criss-Cross Flow Stripping of Volatile Organics from Wastewater", Paper accepted for the Symposium on Separations in Wastewater Cleanup, AIChE National Meeting, Pittsburgh, Pa, August, 18-21, 1991.

Valsaraj, K.T. and L.J. Thibodeaux, "Non-Foaming Adsorptive Bubble Processes for Wastewater Treatment", Invited paper for the National Meeting of the American Society of Mining Engineers, Phoenix, AZ, April 1992.

Lecture for L.K. Cecil Award, title: "Environ. Ch.E. Fluxion", AIChE, Minn., MN; Aug. 10, 1992.

Thibodeaux, L.J., D.D. Reible and K.T. Valsaraj, "Quantitative Release Rates of

Bed Sediment Contaminants," paper presented at the Contaminated Sediment Assessment Methods Workshop held at the Village of Galilee, Narangansett, RI, May 6-8, 1991.

Reible, D.D. (presenter), S.A. Savant-Mahliet, K.T. Valsaraj, L.J. Thibodeaux and G.J. Thoma, "Comparison of Physical Transport Processes in Noncohesive River Sediments," paper presented at the 1991 national Conference on Hydraulic Engineering Special Session on "Transport Processes at the Interface of Water Column and Bottom Sediment" sponsored by the American Society of Civil Engineers, held in Nashville, TN from July 29 to August 2, 1991.

Thoma, G. (presenter), K.T. Valsaraj, D.D. Reible, L.J. Thibodeaux and W. Bosworth, "The Effectiveness of In-Situ Capping of Contaminated Sediments: A Feasibility Study," Paper No. 18a at the 1992 Spring National Meeting of the American Institute of Chemical Engineers, New Orleans, LA, March 29-April 2, 1992.

Thoma, G. (presenter), D.D. Reible, K.T. Valsaraj and L.J. Thibodeaux, "Bench Scale Testing of Capping as an In-Situ Remediation Alternative for Contaminated Sediments," paper no. 51g for the Symposium on Remediation of Contaminated Sediments, Summer National AIChE meeting held in Minneapolis, MN, August 9-12, 1992.

Valsaraj, K.T. (presenter), G.J. Thoma, D.D. Reible and L.J. Thibodeaux, "Transport of Colloids from Bed Sediments," paper presented to the IAWQ Sediments Conference in Milwaukee, WI, June 1993.

Reible, D.D. (presenter), L.J. Thibodeaux and J.W. Fleeger, "Pollutant Fluxes to Aquatic Systems Via Coupled Biological and Physicochemical Bed-Seminet Processes," paper presented to the IAWQ Sediments Conference in Milwaukee, WI, June 1993.

Fleeger, J.W. (presenter), M.A. Todar, D.D. Reible, L.J. Thibodeaux and K.T. Valsaraj, "The Effect of Bioturbation by Tubificid Oligochaetes on Pollutant Flux from Contaminated Sediment," paper for 1994 Ocean Sciences Meeting sponsored by AGU and the ASLO, San Diego, CA, February. 1994.

Thoma, G. (presenter), D. Reible, K. Valsaraj and L. Thibodeaux, "Efficiency of Capping Contaminated Sediments In-Situ. Mathematics of Diffusion and Adsorption in the Capping Layer," paper for the ACS Symposium on Emerging Technologies in Hazardous Waste Management VI held in Atlanta, GA on September 19-21, 1994.

Smith, J.S., K.T. Valsaraj and L.J. Thibodeaux, "An Innovative Air-Water Exchange Process for the Treatment of Wastewaters," paper accepted for presentation to the 3rd International Symposium on Air-Water Gas Transfer to be held at the Heidelberg University, Germany on July 24-27, 1995.

Thibodeaux, L.J. (presenter), K.T. Valsaraj and D.D. Reible, "Pollutant Fluxes to Aquatic Systems via Coupled Biological and Physicochemical Bed-Sediment Processes", 19th Annual RREL Hazardous Waste Research Symposium, April 13-15, 1993, Cinn., OH.

Thibodeaux, L.J. (presenter), K.T. Valsaraj and D.D. Reible, "A Quasi-Steady-State Pollutant Flux Methodology for Predicting Risk Reduction," ASTM Symposium on Dredging, Remediation and Containment of Contaminated Sediments, Montreal, Canada, June 23-24, 1994.

Valsaraj, K.T., L.J. Thibodeaux (presenter) and D.D. Reible, "Modeling Air Emissions from Contaminated Dredged Materials," ASTM Symposium on Dredging, Remediation and Containment of Contaminated Sediments, Montreal, Canada, June 23-24, 1994.

Thibodeaux, L.J., "The Exchange Rate Constants in Exposure Assessment Models," Soc. Environ. Toxic. and Chem., 4th European Congress, Brussels, Belgium, April 11-19, 1994.

Thibodeaux, L.J. (presenter), D.D. Rebile, and K.T. Valsaraj, "So You Want to Remediate Contaminated Mud! These are Your Five Choices," Amer. Soc. Civil Eng., 2nd International Conf. on Dredging, Lake Buena Vista, FL; Nov. 13-16, 1994.

Thibodeaux, L.J. (presenter), K.T. Valsaraj and D.D. Reible, "Capping Contaminated Sediments - The Theoretical Basis and Laboratory Experimental Evidence for Chemical Containment," Amer. Soc. Civil. Eng., 2nd International Conf. on Dredging, Lake Buena Vista, FL, November 13-16, 1994.

Thibodeaux, L.J., K.T. Valsaraj (presenter), J.M. Brannon, and D.D. Reible, "Modeling Air Emissions from Contaminated Dredged Materials," U.S.EPA Risk Reduction Env. Lab., 21st Annual Res. Symp., April 4-6, 1995, Cincinnati, OH; also presented at ASTM symposium on Dredging, Remediation and Containment of Contaminated Sediments, Montreal, Quebec, Canada, June 1994.

Valsaraj, K.T. (presenter), L.J. Thibodeaux and D.D. Reible, "Pollutant Fluxes to Aquatic Systems via Bed-Sediment," U.S. EPA Risk Reduction Env. Lab., 21st Annual Res. Symp., April 4-6, 1995, Cincinnati, OH.

Thibodeaux, L.J., K.T. Valsaraj and D.D. Reible, "Natural Recovery Field Investigation: Chlorinated Organics in Olsen's Bayou," 1995 Five Centers Research Conference, July 23-26, Gleneden Bleach, OR.

Popov, V., L. Maranto, K.T. Valsaraj, D.D. Reible, L.J. Thibodeaux, M.A. Todaro and J. Fleeger, "Pollutant Fluxes to Aquatic Systems via Bed-Sediment Processes," paper presented at the 21st Annual EPA/RREL Research Symposium held at The Westin Hotel, Cincinnati, OH on April 4-6, 1995.

Valsaraj, K.T., L.J. Thibodeaux, D.D. Reible, J.M. Brannon, T.E. Myers and C.B. Price, “Volatile Chemical Emissions from Contaminated Dredged Materials: Laboratory Measurements and Models”, Proceedings of the Air and Waste Management Association, 1996.

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Smith, J.S., K.T. Valsaraj and L.J. Thibodeaux, "An Innovative Air-Water Exchange Process for the Treatment of Wastewaters," paper presented at the 3rd International Symposium on Air-Water Gas Transfer held at the Heidelberg University, Germany on July 24-27, 1995.

Thibodeaux, L.J., and K.T. Valsaraj, "Physicochemical Property Needs for Environmental Chemical Engineering Applications," paper 47a, 1995 AIChE Meeting, Miami, FL, November (Invited paper).

Valsaraj, K.T., L.J. Thibodeaux, D.D. Reible, J.M. Branden, T.E. Myers and C. Price, "Volatile Chemical Emission from Contaminated Dredged Materials: Laboratory Measurements and Models," Air and Water Management Association Meeting, Nashville, TN, June 1996.

L.J. Thibodeaux, K.T. Valsaraj and D.D. Reible, "Contaminated Bed-Sediment Remediation-Using in situ capping," International Forum Ecology and Development (ECODES'96) University of Matanzas, Matanzas, Cuba; June 3-7, 1996.

K.T. Valsaraj, L.J. Thibodeaux and D.D. Reible, "Managing Contaminated Bed-Sediment - A Review," Fifth World Congress of Chemical Engineering, Paper 64g, San Diego, CA; July 14-18, 1996.

K.T. Valsaraj, L.J. Thibodeaux, "On the Linear Driving Force and Particle Diffusion Models for Sorption Kinetics on Suspended Particles," Paper 57f, AIChE 1997 Spring National Meeting, Mar. 9-13, 1997; Houston, TX.

DeSeze, G., K.T. Valsaraj, L.J. Thibodeaux, D.D. Reible, “Study of the Air-Sediment Partition Constant of Some Polynuclear Aromatic Hydrocarbons and Dibenzofuran,” Proceedings of the WERC/HSRC ‘97 Joint Conference on the Environment, Albuquerque, NM, April 1997.

L.J. Thibodeaux and James Carver, "Hindcasting Volatile Chemical Emissions to Air from Ponded Recycled Oil," Paper 57e; AIChE 1997 Spring National Meeting, Mar. 9-13, 1997; Houston, TX.

O. Omojola, L.J. Thibodeaux, M. Novitsky, "Effect of Thin Layer Caps on Cesium-contaminated Bed Sediment Remediation," Paper ENVR-53, American Chemical Society Mtg., New Orleans, LA; Mar. 24-28, 1996.

K.T. Valsaraj, L.J. Thibodeaux and D.D. Reible, "Volatile Chemical Emissions from Contaminated Dredged Materials: Laboratory Measurements and Models," Air and Waste Management Association Meeting, Paper A1265, Nashville, TN; June 24-27, 1996.

L.J. Thibodeaux, D.D. Reible and K.T. Valsaraj, "Biotarbation Enhanced Chemical Transport: A Laboratory Simulation with Two Organisms," The Benthic Boundary-Transport Processor and Biogeochemistry, Max Planck Inst., Bremen, GR; 17-21 June, 1996 (Invited).

K.T. Valsaraj, L.J. Thibodeaux, D.D. Reible, and R. Ravikrishna, "Air Emissions form Contaminated Sediments and Dredged Materials. 1 . Experimental Data", 211th ACS National Meeting New Orleans, LA; March 24-28, 1996.

Alex D.W. Acholony, T.J. Stewart, L.J. Thibodeaux and K.T. Valsaraj, "Benthic Invertebrates of Lake Yazoo and Yazoo River: A Preliminary Report", Mississippi Academy Sciences, 61st Annual Meeting, Biloxi, MI; Feb. 20-21, 1997.

Valsaraj, K.T., R. Ravikrishna, D. Reible, L.J. Thibodeaux, T.E. Myers, C.B. Price, J.M. Brannon," Air Emissions from Contaminated Sediments and Dredged Materials," Proceedings of the WERC/HSRC '97 Joint Conference on the Environment, Albuquerque, NM, April 1997.

Shephard, A., D.D. Reible, J. Fleeger, K.T. Valsaraj and L.J. Thibodeaux, "Fate of Pyrene during Oligochaete Bioturbation," Proceedings of the WERC/HSRC '97 Joint Conference on the Environment, Albuquerque, NM, April 1997.

Choy, B., B. Walsh, D.D. Reible, K.T. Valsaraj and L.J. Thibodeaux, "Effects of Vapour Diffusion and Capillary Suction on the Transport of Volatile NAPL in a Sediment Column," Proceedings of the WERC/HSRC '97 Joint Conference on the Environment, Albuquerque, NM, April 1997.

Cheah, E.P.E., B.W. Walsh, D.D. Reible, K.T. Valsaraj and L.J. Thibodeaux, "Simulation of Soil Washing with Surfactant," Proceedings of the WERC/HSRC '97 Joint Conference on the Environment, Albuquerque, NM, April 1997.

Mohanty, S., D.D. Reible, K.T. Valsaraj, and L.J. Thibodeaux, "Transport of Semi-Volatile Contaminants in Sediments with Drying Dynamic Water Saturation Profiles," Proceedings of the WERC/HSRC '97 Joint Conference on the Environment, Albuquerque, NM, April 1997.

Choy, B., B. Walsh, D.D. Reible, K.T Valsaraj, and L.J. Thibodeaux, "Transport of Semi-Volatile Contaminants in Sediments with Drying Dynamic Water Saturation Profiles," Proceedings of the WERC/HSRC '97 Joint Conference on the Environment, Albuquerque, NM, April 1997.

G. de Seze, K.T. Valsaraj, D.D. Reible, and L.J. Thibodeaux**,** "Sediment/Air Equilibrium Partitioning of Hydrophobic Organic Compounds", Soc. Env. Tox. And Chemistry 8th Annual European Meeting, Bordeaux, France; April 14-18, 1998.

L. Oubre, L.J. Thibodeaux, E. Overton and K. Carney, "Field measurements of Evaporative Flux of Benzene and Selected Alkanes from a Deep Oil Pool", Presentation 120b, 1998 Spring National Meeting, AlChE, New Orleans, LA; May 8-12, 1998.

W. Harris, K. Hawkins, L.J. Thibodeaux, "Refinery Spills Evaporation Models - A Spreadsheet Tool", Presentation 120c, 1998 Spring National Meeting, AlChE, New Orleans; May 8-12, 1998.

L.J. Thibodeaux, D.D. Reible and K.T. Valsaraj, "Effectiveness and Limitations

of Remedial Dredging": a) ECODES '98, University of Matanzas, Cuba; June 4-6, 1998, b) Blasland, Bouck and Lee, Inc. Sediment Management Seminar, New Orleans, LA; Feb. 9-10, 1998 (Invited).

L.J. Thibodeaux, D.D. Reible and K.T. Valsaraj, "Containment Research on Contaminated Sediment and Contaminated Dredged Material Management - A Review", Presentation National Conference on Management and Treatment of Contaminated Sediments, US Env. Protection Agency, Cincinnati, OH; May 13-14, 1997 (Invited).

B. Tansel, S. Rafiuddin, L.J. Thibodeaux and J. Proni, "Dynamic Aspects of Metal Speciation in the Miami River Sediments in Relation to Particle Size Distribution and Chemical Heterogeneity", HSRC/WERC Conference, Albuquerque, NM; April 21-24, 1997.

L.J. Thibodeaux and K.T. Valsaraj, "On the Linear - Driving Force Model For Sorption Kinetics of Organic Compounds on Suspended Particles", Amer. Chem. Soc. Meeting, Las Vegas, NV; Sept. 7-11, 1997.

Thibodeaux, L.J., G. Chandra, J.S. Smith, K.T. Valsaraj, "Air-to-Water Partitioning of D4-Siloxane: A review of Laboratory Measurements", Paper 11L. 1998 Annual Mtg., American Inst. Chem. Eng., Miami Beach.

Soc. Env. Toxicology & Chem. "The Role of Natural Processes in Evaluating Contaminated Sediment Sites". Paper No. 013. DD Reible speaker. Philadelphia, PA. 1999.

Soc. Env. Toxicology & Chem. "A Study of the Effectiveness of Environmental Dredging" Paper No. 017. DD Reible speaker. Philadelphia, PA. 1999.

Soc. Env. Toxicology & Chem. "A Multimedia Chemical Model for Louisiana's Industrial Corridor". Paper No. 057. B. Pederson speaker. Philadelphia, PA. 1999.

Soc. Env. Toxicology & Chem. "Effectiveness of Environmental Dredging-Findings From Case Studies". Paper No. 107. Philadelphia, PA. 1999.

American Bar Assoc., Div. of Environment, Energy and Resources."Environmental Dredging". New Orleans, LA 2000.

Soc. Env. Toxicology & Chem."A Multimedia Model for Assessing Chemical Fate During Environmental Dredging". Paper 294. F. Sanchez speaker. Nashville, TN. 2000.

Soc. Env. Toxicology & Chem. "The Effects of Oil and Grease on the Mobility of PAHs in Contaminated Sediments". Paper 387. R. Ravikrishna speaker. Nashville, TN. 2000.

Amer. Chem. Soc. "Bioturbation Driven Transport of Hydrophobic Organic Contaminants from Bed Sediment". Paper No. 164. Washington , DC. 2000.

Amer. Chem. Soc. "Non-particle Resuspension Transport Coefficients for Contaminants in Stream Beds. Paper No. 331. Washington, DC. 2000.

Environmental State of the State-V. " A Multimedia Chemical Model of Louisiana's Industrial Corridor". Platform presentation. Baton Rouge, LA. 2000.

Environmental State of the State-V. "A Multimedia Model for Assessing Chemical Fate During Environmental Dredging". Poster presentation. F. Sanchez presenter. Baton Rouge, LA. 2000.

(This presentation section is "getting-out-of-hand". So as to limit its size in 2001 a summary format was adopted to reporting only oral and poster presentations given by me.)

2001:

Two oral ones at Int. Assoc. Great Lakes Res. In June. Subject: PCB release from bed-sediments. **One** poster at EPA Forum Managing Cont. Sed. in May ; subject of soluble release mass-transfer coefficient. **One** oral at 17 th Int. Conf. Contaminated Soils, etc. in October on subject of lab measurements of volatiles from dredged materials. **One** oral at LSU Environmental Lecture Series on the state of environmental research at LSU in September. **One** oral at Int. Conf. On Remediation of CS in Venice IT; subject was effectiveness of environmental dredging model; month was October.

2002:

One oral at Dredging 2002 on subject of multimedia modeling of dredging effectiveness; month was May. **One** leader of oral discussion group session: "Dredging isn't the Solution to Remediating CS" at Dredging 2002 as well. **One** oral seminar to University of New Hampshire on subject of modeling dredging effectiveness; month was June. **One** poster "River and Lake Bottom Water Mass-Transfer Coefficient Measurements" SETAC mtg.**Two** posters, AEHMS mtg. Kinetics of peat soil DOC release and Volatilization rates from DM- Lit Review.

2003:

One Platform presentation "Predicting Chemodynamics of Solubilization from Particles". Venice, IT. Remediation Sediments. **One** platform "Theory & Transport HOC Desorption Particles" ACS New Orleans, LA. **One** platform "Metals an Organics Release from Resuspensions". EPA Superfund Res. Mtg. Cinn., OH**.**

2004:

One Platform presentation "Bio-turbation driven chemical transport in bed sediments", Amer. Soc. Limnology and Oceanography, Savannah, GA **One** platform "Kinetics of DOC release from bed sediments: Laboratory simulation". **One** Poster "Kinetics of DOC release from bed-sediments: Theoretical mode l" ACS Philadelphia, PA. **One** platform presentation "Chemical release from dredge related particle suspensions" and **one** poster (with Justin Birdwell), "Kinetics of chemical release-a review of laboratory studies ",Las Vegas, NV. EPA HSRC Centers annual mtg.

2005:

One Invited Platform presentation "The continuing debate on the

sediment-to-water contaminant release: significant factors other that re-suspension and physical instabilities", and **Two** posters; "Kinetics of chemical release-a review of laboratory studies"(with Justin Birdwell.), "Volatile PAH releases from dredged material-Wind tunnel simulation studies"(with Kenny Fountain) presented at Third International Conference on Remediation of Contaminated Sediments, New Orleans, LA Jan. 24-27. **One** platform presentation: "A magnetite tracer protocol for seasonal measurements of bed sediment bio-diffusion coefficients", 2005 Joint Assembly American Geophysical Union, etc., New Orleans, LA. 23-27 May. **One** invited Platform presentation: "The continuing debate on the sediment-to-water contaminant release: significant factors other that re-suspension and physical instabilities", 55th Canadian Chemical Engineering Congress, Toronto, Oct. 16-19. **Two** platform presentations: "PAH volatile emissions from dredged material-2. Model development and interpretation" and "PAH volatile emissions from dredged material-1.Wind-tunnel measurements and results", plus **One** co-authored "Volatile emissions from sediment and dredged material suspensions during remediation". Society of Environmental Toxicology and Chemistry NA 26th Annual Mtg. Baltimore, MD. 13-17 November.

CONTINUATION EDUCATION PRODUCTS

"Chemodynamics, Transport and Fate of Chemicals in the Environment." After the appearance of the textbook Chemodynamics and starting in 1981 a CE course based on the material has had a continuous record of presentations to date as follows:

-Rohm and Haas Company, Toxicology Department, Spring House, PA . Oct. 2-4, 2000.

- American Institute of Chemical Engineers, National Headquarters, N.Y. arranged **43 presentation** in conjunction with national meetings in the USA.
- University of Missouri, Columbia, Engineering Extension Center has arranged **8 presentations** in midwestern states.
- University of Arkansas and LSU Continuation Education Departments has had 3 arranged presentations.
- U.S. Environmental Protection Agency, Cincinnati Laboratory has requested and arranged 3 in-house presentations.
- U.S. Environmental Protection Agency, Region VI, Dallas, Texas has requested and arranged 2 in-house presentations.
- Environmental Chemical Engineering courses. Prior to the appearance of Chemo. I participated in four environmental engineering short courses on topics ranging from wastewater treatment to air pollution control. These courses were in the years 1969, 1971, 1979 and 1981. A once offered chemodynamic related course was offered by the American Petroleum Institute Specialty Conference in 1985.

"In situ Capping of Contaminated Sediment- A Seminar for Decision Makers," Originator and organizer w/Weldon Bosworth, Nancy Davis and Danny Reible; Chicago, IL; Nov. 20-21-1996.

"Fundamentals of Chemical Transport and Fate for Ecological Exposure Assessment," w/K.T. Valsaraj; Society Environmental Toxicology and

Chemistry; Washington, D.C. 1997.

"Understanding Contaminated Harbor and River Sediment- Remediation", University of Wisconsin- Madison Department of Engineering Professional Development, with numerous co-lecturers, June 7-9, 2000.

"Innovative Approaches to the in-situ Assessment and Remediation of Contaminated Sites". Lecturer in NSF Pan-American Advanced Studies Institute. Rio de Janeiro, BZ. July- August, 2002.

PROFESSIONAL ORGANIZATION OFFICES HELD

American Institute of Chemical Engineers, Baton Rouge Section.
Executive Committee(2003). Chair (2002), Vice Chair, 2000(elected),Executive Committee, 1994 (elected)
Executive Committee, 1995 (elected)
American Institute Chemical Engineers, Environmental Division:
Past Chairman, 1987; Chairman, 1986; First Vice Chairman, 1985; Second Vice Chairman, 1984 (elected); Treasurer, 1982-83 (elected); Secretary, 1981 (elected)
American Water Resources Association, Arkansas Section
President, 1975 (elected)
Meeting Program Chair, 1972-74.
Sigma Xi, Hon. Res. Society, Univ. of Arkansas Chapter
President, 1977 (elected)
Meeting Chair
Environmental Research Consortium of Louisiana, Environmental State of the State-V Conference. Baton Rouge, LA. 2000.
Session Chair
Dredging 2002, American Society of Civil Engineers 2002.
American Institute of Chemical Engineers, National Annual meetings 1974, 1983 to 1985, 1989, 1997, 1998 (2), 1999, 2004.
American Chemical Society, National Chair at annual meetings 1976, 1985 and 1987, 1996.
American Soc. Civil. Engineers, DREDGING '94
Fifth World Congress of Chemical Engineering, 1996.
Canadian Soc. Chemical Engineering, 2005.

PROFESSIONAL ENGINEER REGISTRATIONS

State of Louisiana No. 11762 (Chemical Engineering and Environmental Engineering-Emeritus status in 2004.)
State of Arkansas No. 4114 (Chemical Engineering-Emeritus status)

INVITED ACTIVITIES

LECTURES, SEMINARS AND VISITS:

American Institute Chemical Engineers, National Speakers Bureau Tours.
Commencing in 1987; also in 1989, 1994 thru 1999. I was invited to be a

part of this tour: New Orleans Section 1987; Southwest Louisiana Section 1989; In 1994, the Speakers Bureau Tour involved: Pudget Sound Section, Seattle, WA; Northern California Section, San Francisco, CA; San Diego Section, San Diego, CA.

Local Section, AICHE (ACS), (Sigma Xi):

Bartlesville, OK 1972; Mid-Michigan 1976; Bartlesville, OK 1977; Central Arkansas, AR 1978; El Dorado, AR 1988; Baton Rouge 1989; Lehigh Valley Chapter 1990; Tallahassee 1999; Pensacola(ACS) 2000, Baton Rouge, LA(Sigma Xi)2000.

Industrial and Government Laboratories

Norton Chemical, Akron, OH 1979
Dow Chemical, Freeport, TX 1982
Monsanto Company, St. Louis, MO 1982
U.S. EPA Environmental Laboratory, Athens, GA 1986
Monsanto Company, St. Louis, MO 1987
Battelle Northwest Laboratory, Richland, WA 1989
Waterways Experiment Station, USAE, Vicksburg, MS 1995
Dow-Corning, Midland, MI 1996.
U.S. EPA, Cinn, OH 1997
Blasland, Bouck and Lee, Inc., Syracuse, NY 1997 and 1998
Sediment Management Work Group (Inaugural Meeting), Chicago, IL 1998
Limno-Tech Inc., Ann Arbor, MI 2000.

Universities

University of Florida, Gainesville 1967
University of Arkansas, Fayetteville, 1969, 1979, 1980
University of Missouri, Rolla 1980
Oklahoma State University, Stillwater 1981
Renssalaer Polytechnic Institute, Troy 1981
Swiss Federal Institute (EAWAG), Zurich, Switzerland 1981
University Exeter, Exeter, England 1983
University Toronto, Toronto, Canada 1985
University of Akron, Akron 1985
Tulane University, New Orleans 1987
University of Kentucky, Lexington 1988
University of Illinois, Urbana-Champaign 1989
Washington State University, Pullman, WA 1990
Lehigh University, Bethlehem, PA 1990
Florida Institute of Technology, Melbourne, FA 1993
Michigan Technology University, Haughton, MI 1994
University of Minnesota, Minneapolis, MN 1994
University Gaja Mada, Yogjakarta, Indonesia, Dec. 1995.
University Matanzas, Mantanzas, CUBA, June 1996.
Johns Hopkins University, Baltimore, MD, 1996.
Max Planck Institute for Marine Microbiology, Bremen, Germany, June 1996.
University of Missouri Rolla, Rolla, MO, 1998
Auburn University, Auburn, AL, 1999

Rice University, Houston, TX 1999.
Pontifica Universidade Catholica do Rio de Janeiro, Brasil, 2000.
University of New Hampshire, HN. 2002.
University of Deleware, Newark, DE. 2003.
University of Illinois-Chicago, IL. Feb. 2005.
Univ.Michigam, Ann Arbor, MI. April 6, 2006(scheduled)

International Invitations-Lecturships and Scientific Visits.

1.**USSR**-1981.
Delegation member. U.S. Environmental Protection Agency, USA/USSR Agreement of Corporation in Field of Environmental Protection, Project 02.03-31 on "Forms and Mechanisms by which Pesticides and Chemicals are Transported in Soil, Water, and Biota", part of Nixon-Breshnev accords of 1972.

- Symposium, "Prediction of Pesticide Behavior in the Environment", Oct. 21-27, 1981, Yerevan, Armenia USSR. Attend symposium at Academy of Sciences and present, protocol preparation committee member, manuscript prepared for symp. book chapter.

Host: Dr. G. Bailey, USEPA Athens, Ga.
Post Symposium follow-up activities:

- Symposium, "The Fate of Pesticides and Chemicals in the Environment", Oct. 4-18, 1987, University of Iowa.
- Exchange, Dr. D. Reible 1988 to Soviet Institute of Experimental Meterology, Obninsk, USSR
- Hosted Dr. Michael Novitskiy and Oleg Vozzhennikov, Society Institute of Experimental Meteorology 1989 to LSU (co-host with D.D. Reible)
- Visiting Scientist from "TYPHOON"; Valentine Popov at LSU 1993 and 1994 for 6 months plus 6 months extended stay
- Exchange visit, L.J. Thibodeaux 1994, 10 days to Russian Institute of Experimental Meteorology; see 4. Russia-1994 below.
- Dr. Michael Novitsky visited L.S.U., 3 months in 1994.

2. **France**-1986.
Fr./USA Bilateral Agreement. Sponsored by the US EPA Wash., DC. EPA Representative to initiate cooperative hazardous waste projects. Sept. 22-26.

-Paris. Office pollution prevention, Ministry of Environment.
-Villeurbanne. National Inst. Applied Sciences.
-Lagnieu. Society TREDI.
-Fontainbleau. Ecole de Mines de Paris. Geologique Mathematique Inst.
-Paris La Defense. Elf Aquitaine.
-Orleans. Bureau Res. Geology and Minerals.
-Palaiseau. Ecole Polytechnique.
Host: Md. J. Aloisi de Larderel, Ministry Environment.

3. **China**-1987.
Ministry of Petroleum Industry, The Peoples Republic of China, Beijing. Invited lecturer. Delivered a series of lectures and workshops on the subject of Environmental Chemodynamics and hazardous waste research topics. December 11-30.

-Ministry of Petroleum Industry, Beijing.
-Beijing Graduate School of Eastern China, Institute of petroleum, Beijing.
-Jianghan Petroleum Institute, Jiangling, Hubei.
-Department of Applied Chemistry, Jiangling, Hebei.
Host: Dr. Xian-qin Wang.

4. **Russia**-1994.
Continuing activities of exchange program; see 1. USSR-1981. Research laboratory visits and consulting with researchers and faculty members on environmental chemodynamic topics. SPA "TYPHOON" Institute of Experimental Meteorology. May 5-15.
-Department 1. Monitoring of organic pollutants and heavy metals.
-Department. 7. Monitoring of radionuclides in environment.
-Department 8. Mathematical modeling of chemicals in the environment.
-Delivered Institute lecture.
Host: Dr. Michail Noritzkiy.

5. **Indonesia**-1997.
Invitation as Visiting Scholar to Gadjah Mada University Chemical Engineering Department to present lectures and workshop on environmental chemodynamic topics plus to consult with faculty on research project of pesticede fate in rice fields. Yogyakarta, Indonesia. Nov. 22-Dec.16.
-Teachin env. chemo. shortcourse.
-Research progress in env. chemo.
-Research project iniation pesticides in rice fields.
-University lecture.
Host: Dr. Edia Rahayuningshi.

6. **Jordan**-1999.
Invited special consultant to Central Director of Jordanian EPA. June 16-Amman.
-Environmental impacts of phosphate mining.
-SAWQA hazardous landfill, desing and construction evalustion.
-Shortcourse on hazardors waste and env. chemo. to EPA scientist and engineers.
Host: Dr. Kamal Qaiai, Director.

7. **Brasil**-2000.
Visiting lecturer and researcher to Departmento de Ciencia dos Materiais e Metalurgia, Pontifica Universidade Catholica do Rio de Janiero, Brasil. June 1-30, 2000. Re-visit in Feburary 2001.
-Shortcourse in environmental chemodynamics.
-Initiate environmental model research project on chemicals in Guantabara Bay.
Host: Dr. Roberto Carvalho.

Plenary Lectures and Speaking Activities (invited):

•Evening Address to Second Annual Region VI RCRA Inspector Workshop, April 3, 1990, Toro Hills Country Club, Leesville, LA.
•Hazardous Waste Law Seminar, "Money Pits", Env. Compliance Reporter, Inc., Dec. 18-19, 1989, New Orleans, LA.
•AIChE Design Institute Physical Property Research Open Forum; presentation entitled: "Transport Parameters in the Natural Environment", Nov. 2, 1992, Miami, FL.
•Water Environmental Federation, Speaker at Scientists Breakfast, "Environmental Chemodynamics in the Future", New Orleans, LA, Sept. 20-24, 1992.
•Mediterranean Conference on Environmental Geotechnology, Plenary Speaker, Cesme, TURKEY, May 25-27, 1992.
•Baton Rouge AIChE Section Environmental Conference, banquet speaker, "O_2 Chemodynamics on the Seine", Baton Rouge, LA, Mar. 3, 1993.
•Sediment Management Seminar, Orlando, FL; Feb. 12-13, 1996 (attended by D.D. Reible).
•National Conference on Management and Treatment of Contaminated Sediments, Cincinnati, OH; May 13-14, 1997 (speaker and panelists).
*International Conference on Remediation of Contaminated Sediments. Plenary Speaker. "The Soluble Release Fraction Sediment-to-Water Flux: Recent Advances and Implications for Natural Systems'; Venice, Italy. Sept.-Oct., 2003.
*Sediment Quality Assessment(SQA5). Keynote Speaker. "Recent Advances in our Understanding of Sediment-to-Water Contaminant Fluxes: The Soluble Release Fraction."Aquatic Ecosystem Health and Management Society. Chicago, IL. 16-18 October, 2002.
*****Water Environmental Federation/Association Environmental Engineering and Science Professors Luncheon Speaker. (Withdrew invitation) October 2004.
* 3rd International Conference on Remediation of Contaminated Sediments. Invited speaker. January 2005.
* 55th Canadian Society Chemical Engineering Conference. Invited speaker. October 2005.
* Washington University, St. Louis. Earth Day Speaker, College of Engineering, April 21, 2006 (scheduled).

COMMITTEES, WORKSHOPS, STUDY PANELS, ETC.

NATIONAL ACADEMY OF SCIENCE & ENGINEERING

National Research Council. Review Panelist on "Dredging Effectiveness at Superfund Megasites" Committee. Board of Environmental Studies and Toxicology, Washington, D.C. 2006-200?.

National Research Council, Committee on National Symposium (Co-Chair) on Contaminated Sediments, Transportation Research Board, Washington, D.C. 1997-1999.

National Research Council, Committee on Environmental Management

Technologies Subcommittee on Landfills, Board and Radioactive Waste Management, Commission of Geosciences Environment, and Resources, National Academy Science, Washington, DC 1995-1997.

National Research Council, Committee on Contaminated Marine Sediments, Marine Board, Commission on Engineering and Technical Systems, National Academy Science, Washington, DC 1993-1997.

National Research Council, Committee on Remedial Action Proprieties for Hazardous Waste Sites, Board on Environmental Studies and Toxicology, Commission on Geosciences, Environment, and Resources, NAE., Washington, DC 1991-1994.

National Academy of Sciences. Member of review panel on Dioxin Guidelines, Washington, D.C., Nov. 1988.

National Academy of Sciences. Invited workshop participant, Marine Board study on Contaminated Marine Sediments - Assessment and Remediation, Tampa, FL, May 1988.

National Academy of Sciences/EPA Study on Disposal of Hazardous-Industrial Waste, member of AIChE committee, March - October 1980.

NATIONAL SCIENCE FOUNDATION

National Science Foundation Project "Council on Environmental Quality Conference on Long-Term Environmental Research and Development", Expert panel member Geochemical and Hydrologic Processes and their Protection, May 1984, Washington, D.C.

National Science Foundation, Division of Chemical and Thermal Systems, Workshop on Environmental Issues, Washington, DC, April 11, 1990.

National Science Foundation Panelist Review; Faculty early career development (CAREER) program; Washington, D.C., Jan. 27-28, 1996.

National Science Foundation Panelist Review: Combined Research/Curriculum Development Program; Houghton, MI, Oct. 9-11, 1996, Oct. 9-10, 1997.

US ENVIRONMENTAL PROTECTION AGENCY

US EPA Science Advisory Board Review Panel. Estimating Program Interface (EPI) Suite Review Panel. 2006-200?.

US EPA Science Advisory Board Review Panel. Multimedia, Multicomponent an Multipathway Risk Assessment (3MRA) Modeling System. 2003-04.

US EPA Science Advisory Board. Review panel member. Region 6 sediment/soil sampling plans for New Orleans – Katrina. September 2005.

US EPA Science Advisory Board. Review panel member. Region 4 sediment/soil sampling plans for Mississippi Gulf Coast industrial facilities – Katrina. October 2005

U.S. Environmental Protection Agency, panel member: Major Technical Issues Relating to the Land Disposal of Hazardous Waste, Arlington, VA, May 1981.

U.S. Environmental Protection Agency, workshop member: Determining the Field Applicability of Environmental Assessment Methods", Washington, D.C., March 1982.

U.S. Environmental Protection Agency, workshop member, "Level I and II Exposure Assessment, Washington, D.C. April 1982, Atlanta, GA, April 1982.

U.S. Environmental Protection Agency, reviewer: Technology Development Applications Branch, Pesticides Exposure Assessment, Environmental Research Laboratory, Athens, GA, Feb. 1983.

U.S. Environmental Protection Agency, Peer review panel member: "Dioxin Documents to Assess the Health Risk to Air and Water Media", Cinn., OH, July 1983.

U.S. Environmental Protection Agency, Peer review panel: Proposals for Office of Exploratory Research, Chemistry and Physics, Chicago, IL, Oct. 1985.

U.S. Environmental Protection Agency, Peer review panel member: Hazardous Substance Research Center Superfund Program Competition, Arlington, VA, Aug. 1988.

U.S. EPA, Office of Research and Development, Workshop on "Beach and Nearshore Hydraulics", Seattle, WA, June 15-16, 1989.

U.S. EPA, Environmental Criteria and Assessment Office, Peer Review Workshop", Alternative Fuels Research Strategy", Research Triangle Park, NC, Dec. 8-9, 1989.

U.S. EPA Peer Review - “Integrated Model for Predicting the Fate of Organics in Wastewater Treatment Plants”, RREL Cincinnati, OH, July 15, 1990.

U.S. EPA, Expert Panel on Research Needs in the Area of Remediating Contaminated Sediments, RREL, Cincinnati, OH, May 13-14, 1991.

US DEPARTMENT OF DEFENSE

US DOD SERDP Expert Panel Workshop on “Research and development needs for the in situ management of contaminated sediments”. Charlottesville, VA. 10-12 June. 2004.

US ARMY CORP OF ENGINEERS

US Army COE. “Resuspension Due To Dredging’. Workshop. Arlington, VA 22

Jan. 2003.

US Army COE. Invited workshop participant. “In-Bed Transport Processes that will Enhance or Suppress Chemical Stability”. Environmental Stability of Chemicals in Sediments, 8-10 April 2003. San Diego, CA.

USAE Waterways Experiment Station Capping Meeting-Workshop on Contaminated Sediments, March 1-2, 1995, Vicksburg, MS.

U.S. Army Corp of Engineers Waterways Experiment Station, Workshop member: Development of Leaching Test, Baton Rouge, LA, June 1988.

US DEPARTMENT OF ENERGY

U S. Department of Energy. Invited workshop participant. “Studies of Contaminant Transport in Fluvial Systems at the Tims Branch-Steed Pond System, Savannah River Site”. Environmental Remediation Sciences Division, Office of Biological and Environmental Research, Office of Science. March 4-5, 2003

OTHER.

Application of Multimedia Fate Models to Regulator Decision Making, SETAC Workshop, International Task Force Meeting, April 14-16, Leuven, **BELGIUM**, November 3-5, Denver, CO.

Persistance and Long-Rang Transport of Organic Chemicals, SETAC Pellson Workshop. July13-19, 1998. Fairmont Hot Springs, British Columbia, **CANADA.**

National Council Engineers Examiners. PE Exam Questions Workshop. New Orleans, LA. July 2002.

American Geological Institute Panelist. Peer review of models predicting the fate and export of PCBs in the Lower Fox River below De Pere Dam. Alexander, VA. 2000.

Lavaca Bay Scientific Workshop, Chair of Sub-Group 6. Remediation and Source Control, Houston, TX, Feb. 3-5, 1994.

American Chemical Society Workshop entitled: “The Environmental Fate of Complex Organic Molecules”, May 9-12, 1993; Arlie, VA.

Metal Speciation and Contamination of Aquatic Sediments Workshop, Coordinator and Session Chair, Jeckyll Island, GA; June 8-11, 1993.

Workshop on Effectiveness of Environmental Dredging, Co-chair with John Smith, Baton Rouge, LSU Campus, Feb. 11, 1998.

Unit World Workshop. Center for the Study of Metals in the Environment. University of Delaware, Newark, DE. 3-6 Feb. 2002.

State of Arkansas, Hazardous Waste Technical Advisory Committee, Member: Appointed by Hon. W. Clinton, Governor (Dec. 1979 - Dec. 1981).

Louisiana State University, Scientific Advisory Committee member, Hazardous Waste Research Center (Member while at Univ. Arkansas), Baton Rouge, 1982-83.

State of Louisiana, Department of Environmental Quality Hazardous Waste Advisory Board: Appointed by Hon. Edwin Edward, Governor (1985-1990).

Rice University, Department of Energy and the Environment, Committee member of DOD - Advanced Applied Technology Development Facility, Houston, TX, 1993 - 1996.

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EDITORIAL BOARDS

Journal of Hazardous Materials, G.F. Bennett, Editor, Elsevier Science Publishers, Netherlands.

Environmental Engineering Science. Domenico Grasso, Mary Ann Liebert Inc., Publisher, NY. (Until 2001)

American Environmental Laboratory, Fred Scott, Editor, International Scientific Communications, Publishers, Shelton, CT.

Remediation, S. Simon, Editor, John Wiley & Sons, Inc. NY.

CHEMOSPHERE-Environmental Chemistry, O. Hutzinger Editor-in-Chief. Pergamon Pub., NY, Amsterdam, Singapore, Rio de Janeiro.

VISITING SCHOLARS RECEIVED

Professor Yoshishi Hayashi, Department of Chemical Engineering, Kanazawa University, Japan. Visiting professor sabbatical leave to University of Arkansas on joint crossflow mass transfer research, 1979-1980.

Professor Dr. rer. nat. H.-G. Schecker, Department of Chemical Engineering, Universitat Dortmund, Dortmund W. Germany to University of Arkansas 1983. Visiting Professor in Environmental Chemodynamic Research Laboratory.

Professor X-Q Wang, Environmental Engineering Laboratory Director, University of Petroleum, Beijing, China to LSU. Visiting Professor in Environmental Chemodynamics Laboratory 1989-1990.

Ms. Edia Rahayuningsih,, Gadjah Mada University, Yogyakarta, Indonesia, Jan. to March, 1992, Visited chemodynamics laboratory.

Professor Frances Chin, University of Exeter, GB. July 1993 visited chemodynamics laboratory.

Professor Kamal Qaisi, University of Jordon, Jordon. Aug. 1993 - Aug. 1995 visited hazardous substance research center.

Professor John Gulliver, University of Minnesota, Minneapolis, MN, April 1994. Visited chemodynamics laboratory.

Professor Robert Carvalho, Pontifica Catholic University, Rio de Janero, Brazil, October 1997 an 1999. Visited environmental chemodynamics laboratory**.** Revisited in Feb. 2001.

AWARDS OR PRIZES

UNIVERSITY

Distinguished Award in Teaching and Research, University of Arkansas, Presented by Blue key Arkansas Alumni Association, Inc., 1982.

Named L.S.U. **Distinguished Research Master** for 1994 by Council on Research, Graduate School and Alumni Association.

Designated "**Dr. Mud**" in Academic Portfolio section of the LSU "annual" entitled: The Gumbo, vol. 93, 1995. Page 46-47.

Awarded Off-Campus Duty Assignment for Sabbatical leave to Oregon State University. Oregon USA.(Prof. O. Levenspiel, host.), 1974. (as University of Arkansas Faculty)

Awarded Off-Campus Duty Assignment for Sabbatical leave to University of Exeter, Exeter, England.(Prof. J. Boyle, host.), 1983. (as University of Arkansas Faculty)

Awarded Sabbatical leave to Ecole Nationale Superieure Des Mines De Paris, Fontainebleau, France.(Prof. E. Ledoux, host.). 1991.

COLLEGE

Named **Jesse Coates Professor of Chemical Engineering**, L.S.U., 1990.

Dean's Book Award -LSU foundation. 1996.

Designated the "**Chemodynamics God**", Chemical Engineering Senior Class of 1998.

Outstanding Researcher in Chemical Engineering, College of Engineering, University of Arkansas, 1982.

Award of Excellence in education, research and service to students, Halliburton Education Foundation, 1982.

PROFESSIONAL

American Institute of Chemical Engineers (AIChE) **Environmental Division**

Lawrence K. Cecil Award, 1992.

Elected **Fellow of American Institute of Chemical Engineers**, 1993.

Elected **Diplomate Environmental Engineer in American Academy of Environmental Engineers,** 2000.

American Society Civil Engineers. Environmental and Water Resources Institute Awards.2003. Practice Periodical of Hazardous, Toxic, and Radioactive Waste Management Best Practice-Oriented Paper." Multimedia Chemical Fate Model for Environmental Dredging" Fabian Sanchez, Louis Thibodeaux, KT Valsaraj and DD Reible.

PATENTS

Cascade Crossflow Tower (AF Inv. 19691), L.J. Thibodeaux, D.P. Harrison, and K.T. Valsaraj, U.S. Statutory Invention Registration No.: H1206 through the U.S. Patent Office, July 6, 1993.

GRANTS AND CONTRACTS*

*Does not include Grants and Contracts received as Director of the US EPA funded Center of Excellence Hazardous Waste Research Center (1984-1991) or the Hazardous Substance Research Center South/Southwest (1991-1996). In order-of- magnitude the amounts of these awards were: HWRC=$3.5E6 and HSRC S/SW=$11E6.

Title:	Northwest Arkansas Water Quality Management Study-Industrial Wastewater Survey
Agency:	U.S. EPA
Period of Support:	1970-72
Total Dollars:	$30,000

Title:	A Test Method of Volatile Component Stripping of Wastewater in Cooling Towers
Agency:	U.S. EPA
Period of Support:	1972-73
Annual Dollars:	$38,538
Total Dollars:	$38,538

Title:	The Quantity of Highly Volatile Constituents in Industrial Wastewaters
Agency:	National Science Foundation
Period of Support:	1975-76
Annual Dollars:	$24,185
Total Dollars:	$24,185

Title:	An Aqueous Environmental Simulation Model for Mid-South Lakes and Reservoirs
Agency:	U.S. Dept. Interior
Period of Support:	1973-76
Annual Dollars:	$7,079

Total Dollars: $21,237

Title: Spill of Soluble High Density, Immiscible Chemicals on Water
Agency: USCG, DOT
Period of Support and Annual Dollars: 1977 - $48,520
1978 - $46,654, 1979 - $10,642
Total Dollars: $105,816

Title: Measurement of Volatile Chemical Emissions from Wastewater Basins
Agency: U.S. EPA
Period of Support: 1977, 1978, 1979, (extension)
Total Dollars: $127,782

Title: Emission of Hazardous Chemicals from Surface and Near Surface Impoundments into Air
Agency: U.S. EPA
Period of Support and Annual Dollars:
1980-81 $156,872; 1981-82 $148,457; 1982-83 $154,238
Total Dollars: $459,567

Title: Investigation of Volatile Organic Chemical Emission Control Methods from Hazardous Waste Disposal Operations
Agency: U.S. EPA
Period of Support: 1983-85
Total Dollars: $262,888

Title: An Experimental Study of the Short Range Air Dispersion of Toxics from Area Sources
Agency: U.S. EPA Office of Exposure Assessment
Period of Support: 1986
Total Dollars: $75,000

Title: Single Cell and Cascade Crossflow Packed Towes for Air-Stripping of Volatile Organics - Phase I
Agency: U.S. Air Force
Period of Support: April 1986 - October 1987
Total Dollars: $164,947

Title: Strengthening the Basic Research Capabilities of the HWR
Agency: LEQSF Equipment Enhancement Grant (8g)
Period of Support: 1987-88
Total Dollars: $95,000

Title: Laboratory Investigation of the Natural Recovery Processes of Marine Sediment Contaminated During Offshore Drilling Activities
Agency: LSU Center for Energy Studies
Period of Support: August 1986 - July 1987

Total Dollars: $21,023

Title: Single Cell Cascade Crossflow Packed Towers for Air-Stripping of Volatile Organics - Phase II
Agency: U.S. Air Force
Period of Support: Feb. 1988 - May 1989
Total Dollars: $177,747

Title: Solvent Sublation for Removal of Low Solubility Hydrophobic Compounds from Aqueous Systems
Agency: National Science Foundation (NSF)
Period of Support: May 1989-1991
Total Dollars: $127,076

Title: Single Cell Cascade Crossflow Packed Towers for Air-Stripping of Volatile Organics - III (IPA Assignment Agreement)
Agency: U.S. Air Force
Period of Support: October 1989 to September 1990
Total Dollars: $60,026.42

Title: In-situ Capping of Contaminated Bed Sediments
Agency: U.S. EPA/LSU-HWRC
Period of Support: 1990-91
Total Dollars: $43,367

Title: Experimental Studies of the Efficiency of Capping Bed Sediment In-Situ.
Agency: U.S. EPA/LSU-HWRC
Period of Support: Jan. 11, 1990-Jan. 10, 1992
Total Dollars: $62,312

Title: Colloid Enhanced Transport from Unconsolidated Media
Agency: National Science Foundation-LaSER/EPSCor Program
Period of Support: 1992-96; 1996-97
Total Dollars: $516,987; $(?), continuation, no new money.

Title: Pollutant Fluxes to Aquatic Systems Via Coupled Biological and Physicochemical Bed-Sediment Processes
Agency: U.S. EPA/EPA Hazardous Substances Research Center(S&SW)
Period of Support: 1991-92; 1994-95; 1995-96; 1996-97
Total Dollars: $201,107, $106,718, $101,975; $136,579

Title: An Investigation of Chemical Transport from Contaminated Sediment Through Porous Contaminment Structures
Agency: U.S.EPA/EPA Hazardous Substances Research Center (S&SW)
Period of Support: 1991-93; 1994-95
Total Dollars: $221,655, $44,825

Title: Development of Procedures of the Selection and Design of

	a Cap for In-Situ Treatment of Contaminated Sediments
Agency:	U.S. EPA
Period of Support:	1992-94
Total Dollars:	$186,709
Title:	Modeling of Air Emissions from Contaminated Dredged Materials
Agency:	U.S. EPA Hazardous Substance Research Center
Period of Support:	1994-1999
Total Dollars:	$42,937, $105,519; $105,000, $34,129 (close-out funds)
Title:	In-Situ Capping of Contaminated Sediments
Agency:	U.S. Environmental Protection Agency, RREL, Cincinnati
Period of Support:	1994-1995
Total Dollars:	$118,726
Title:	In-Situ Capping of Contaminated Sediments
Agency:	U.S. Environmental Protection Agency through LSU HSRC (S&SW)
Period of Support:	1995-1996; 1996-97
Total Dollar:	$97,727; $135,356
Title:	Biological Response and Availability of Desorption Resistant Organic Pollutants
Agency:	U.S. EPA/HSRC
Period of Support:	1998-99
Total Dollars:	$188,689 (D.D. Reible, P.I.)
Title:	Effectiveness of Environmental Dredging
Agency:	ALCOA
Period of Support:	1998-2000
Total Dollars:	$99,950 (L.J. Thibodeaux, P.I.)
Title:	Estimating Air Emissions of Organic Compounds During Dredging and Disposal of Contaminated Sediments in CDFs
Agency:	Dept. of the Army
Period of Support:	2000.
Total Dollars:	$53,000(KT Valsaraj and LJ Thibodeaux).
Title:	Chemical Volatilization Rates from Soils and Sediments.
Agency:	Dept. of the Army
Period of Support:	2001
Total Dollars:	$22,050
Title:	Chemical Emissions to Air- Mechanical vs Hydraulic Dredging.
Agency:	US Army Corps of Engineers, Chicago District
Period of Support:	2002
Total Dollars:	$4000.
Title:	Identification Partition Coefficients and Model Formulation.

Agency:	ERDC, US Army COE. Waterways Expt. Sta.., MI.
Period of Support:	2003-‘04
Total Dollars:	$97, 425.(KT Valsaraj, Co PI.)

Title:	Hazardous Substance Res. Center South/SW
Agency:	USEPA
Period of Support:	2001-2004
Total Dollars:	$431,753(LJ Thibodeaux. Co PI)

Title:	Wind Tunnel Measurements Chemical Volatilization CDF
Agency:	ERDC, US Army COE. Waterways Expt. Sta., MI.
Period of Support:	2003-‘04(extended)
Total Dollars:	$60,466.(KT Valsaraj Co PI.).

Title:	Model Developments Volatile Emissions from Ponded CDFs
Agency:	ERDC, US Army COE. Waterways Expt. Sta., MI.
Period of Support:	2004-‘05
Total Dollars:	32,000.

GRADUATE STUDENT

MASTERS DEGREES DIRECTED

Yeager, R.E., "Reaction Products from Natural Gas-Air Flames in a Cyclonic Flow Reactor," 1972.

Reinhardt, J.R., "An Experimental Apparatus for Measurement of Volatile Components in Aqueous Phase," 1972.

Casper, L., III, "An Attempt to Employ A Classical Physical Adsorption Technique for the Determination of the Surface Area of Biological Material," 1973.

McCune, L.T., "A Preliminary Study of the Optimal Start-Up of an Activated Sludge Sewage Treatment Plant," 1973.

Oza, S.B., "Fluid Dynamics of a Cross-Flow Device," 1974.

Jones, J.R., "Air Stripping of Volatile Components in Industrial Wastewater," 1974.

Seward, I.J., "Experimental and Predicted Catalyst Effectiveness Factors for the Hydrogenation of Benzene over Nickel-on-Kieselguhr Catalyst," 1975.

Cheng, C.K., "Deterministic Lake Ecosystem Simulation Model with Application to Beaver Reservoir," 1976.

Khan, A.S., "An Apparatus for Measuring Mass-Transfer Efficiency of a Packed Cross-Flow Cascade," 1977.

Millican, J.D., "The Quantity of Highly Volatile Organic Chemical Constituents in Industrial Wastewater," 1977.

Mourot, M.W., "Determination of the Mass Transfer Area of High Density, Immiscible Chemicals Spilled in Quiescent Aqueous Environments," 1977.

Prasan, V., "Mathematical Simulation of Natural Convection Dissolution and Evaporation of Dense Chemicals From Flat Surface Facing Upward," 1978.

Moncada, D.M., "Crossflow versus Counterflow Efficiency in Packed Towers," 1978.

Lewis, D.J., "Jet Break-up and Droplet Formation from High-Density Chemical Released of Quiescent and Flowing Water," 1978.

Chang, Li-Kow, "On-Bottom Aspects of Immiscible, Heavy, Hazardous Chemicals Spilled in Flowing Aqueous Environments," 1978.

Dickerson, R.L., "A Technique for the Measurement of Certain Wastewater Volatiles," 1980.

Christy, P.S., "Computer Simulation for Spills of Heavy (p>1), Immiscible Chemicals in Rivers," 1980.

Buchelli, A., "The Design, Set Up and Operation of a Countercurrent Gas Crossflow Packed Distillation Tower," 1980.

Boyden, B.H., "Tritium Diffusion in Thorium Fuells, 1980.

Eldridge, B.E., "Distillation in a Packed Crossflow Column," 1981.

Hedden, T.E., Volatile Organic Chemical Emissions from Wastewater Impoundments Under No-Wind Conditions," 1982.

Chatrathi, K., "Design and Testing of a Simulator for Volatile Organic Emission from Landfills," 1983.

Cho, J.S., "A Design Algorithm of Crosscurrent Cascade for Alcohol-Water Separations," 1983.

Lunney, P.D., "Characterization of Wind and Depth Effects Upon Liquid Phase Mass Transfer Coefficients: Simulation Studies," 1983.

Hildebrand, G., "A Pilot Scale Study of Emissions from Hazardous Waste Landfills," 1984.

Formica, S.J., "The Distribution and Transport of a Polychlorinated Biphenyl (PCB) in a Lake Sediment," 1984.

Nguyen, T.N., "Investigation of Floating Immiscible Liquid as a Control Method for Volatile Organic Chemical Evaporation from Surface Impoundments," 1984.

Kuhn, K.A., "Mass Transport on Sediment Side of Natural Streams," 1984 (non graduate).

Buff, R.W., "Transport Processes in Organic Vapor Emissions from Sand," 1984.

Parker, R.S. Pruitt-, "Fences for Reduction of Wind Enhanced Liquid Phase Mass Transfer Coefficients Over Water Bodies," 1984.

Poe, S.H., "Equilibrium Vapor Phase Adsorption of Volatile Organic Chemicals by Dry Soils," 1985.

Thoma, G.J., "The Effectiveness of Poly (Vinyl-Chloride) as a Vapor Barrier for use in Hazardous Waste Landfills," 1986.

Wood, D.F., "Mass Transfer and Pressure Drop for a Cascade Crossflow Packed Column in an Air-Stripping Mode," 1988.

Thomas, J., "An Investigation into the Possibilities of Using Archaeological Data for Studying Metal Movement in Soils Over Long Time Periods," 1988.

Baron, J.A., "Laboratory Simulation and Diffusion Model for Leaching of Organic Chemicals from Marine Bottom Sediment," 1988.

Friday, D.D., "Development and Field Test of an Immobilized Cell Reactor for the Biological Treatment of Volatile Organics in the Aqueous Phase," 1989.

Koulermos, A.C., "An Evaluation of the Physico-Chemical Aspects of Natural Colloids with Reference to their Role in the Transport and Fate of Organic Pollutants in Aquatic Systems," 1989.

Dikshit, M.M., "Modeling and Experimentation in Bioturbation," 1993.

Vdaygiri, S., "Study of Vapor to Particle Partitioning of Semi-Volatile Organic Compounds in Urban Atmosphere," 1994.

Maranto, L., "Bioturbation Enhanced Contaminant Release from Bed Sediments,"1996.

Nagarkatti, M.G., Non-Thesis, 1996.

Pederson, B.M., “A Multimedia Chemical Model for Louisiana’s Chemical Corridor”, 1999.

Duckworth, KT. “The Effectiveness of Environmental Dredging- A Study of Three Sites”, 2000.

Sanchez, F. F. “A Multimedia Model for Assessing Chemical Fate During Dredging of Contaminated Bed-Sediment”. 2001.

Libbers, P. D. “Development of a Magnitite Tracer Protocol for Seasonal Measurement of Bed Sediment Bio-diffusion Coefficients”. 2002.

Rodriguez, M. “Soil Bioturbation-Fauna and Rates”. In progress.

DOCTOR OF PHILOSOPHY DEGREES DIRECTED

Pittaway, K.R., "Liquid-Phase Mass-Transfer Coefficient Measurements in a Crosscurrent Packed Tower," 1976.

Reinhardt, J.R., "Gas-Side Mass-Transfer Coefficient and Interfacial Phenomena of Flat-Bladed Surface Agitators," 1977.

Heck, H.H., III, "The Desorption and Measurement of Selected Volatile Chemicals from an Aerated Stabilization Basin Treating Pulp and Papermill Wastewater," 1984.

Carvanos, J., "Validation of Mathematical Models Predicting the Emission Rates of Selected Organic Solvents from Saturated Soils," 1984 (Columbia University).

Velaga, A., "Estimation of Interfacial Area in a Packed Cross-flow Cascade with Distillation of Ethanol-Water, Methanol-Water and Hexane-Heptane," 1986.

Thoma, G.J., "Studies on the Diffusive Transport of Hydrophobic Organic Chemicals in Bed Sediments," 1994. (co-sponsor with Valsaraj and Reible)

Smith, J.S., "Pilot-Scale Solvent Sublation for the Removal of Hydrophobic Compounds from Wastewaters," 1996. (co-sponsor with Valsaraj).

Birdwell, J. “Kinetics of Chemical Desorption from Soil/Sediment Particles”. In progress; R. Cook, co-advisor.

Ashley, N. “A topic on chemical transport in bed-sediments”. In progress; KT Valsaraj, co-advisor.

Note: In addition I served as examination member on numerous MS and PhD student committees.

GRADUATE STUDENTS ENTERING ACADEMIA

Boyden, B.H., University of New Zealand, 1985(?).
Dickerson, R.L., Clemson University, 1993, Texas Tech., 1998.
Eldridge, B.E., Univ.of Arkansas, 1985, and Univ.of Texas, Austin, 1997.
Heck, H.H., Florida Institute of Technology, 1984.
Chang, Li-Kow, Tri-State University, 1982.
Reinhardt, J.R, University of Louisiana at Lafayette, 1987.
Thoma, G.T., University of Arkansas, 1994.

CITATION OF WORKS BY OTHERS.

Some relative measure of the impact of an individual's works can be obtained by assessing the extent others acknowledged his body of published writings. In the case of acknowledgements written by others some assessment can be acquired by using the information available on the Web of Science (ISI Web of Knowledge).

Overall summary. Results from the WOS show a total of 159 articles, abstracts, textbooks and chapters, presentations, or government reports cited. The total number including self-citations is 1063. Fifty seven percent of these are represented by the top twenty journal publications. There were 59 variant citations for the textbook entitled: ENVIRONMENTAL CHEMODYNAMICS, for a total of 237 citations. The overall total is therefore 1300.

Summary of the top 20 articles. The most cited topics included articles on the subject of bed-sediment chemodynamic processes, chemical partitioning between natural media phases and solvent sublation. Two manuscripts, Nature 325 (6102): 341-343 Jan. 22, 1987 and Water Res. Res. 23 (9): 1763-1768 Sept. 1987 received a total of 179 citations. In the subject chemodynamics of chemical partitioning there were 193 citations in five articles. On the subject of the chemodynamics of bed-sediment transport processes there were 132 citations in seven articles. These were in the environmental field. In the chemical separations field there were four manuscripts that received a total of 54 citations. It is clear that the citation numbers are dominated by the material published in the environmental science and engineering fields. This is to be expected since the number of articles in the chemical separations field was relatively small.

Summary of book citations. The textbook entitled: ENVIRONMENTAL CHEMODYNAMICS is used by undergraduate senior students, graduate students in science and engineering academic departments. Respectively, the 1979 and 1996 editions had 129 and 108 citations for a total of 237. I am a bit surprised to see this high number of science citations for what is consider a graduate entry-level academic textbook. It has been my experience that textbooks are not cited in technical/research journal articles. However, the book was the first in the field and still has few competitors; a total of 8433 copies have been sold.

Autobiographical Sketch of Professional Career - Louis J. Thibodeaux

Destined to work in the environmental chemical engineering field is undeniable; upon graduation (1962); my first job at Savannah River Plant with DuPont was as engineer in containment and treatment high-level and low-level radioactive waste. Here, I was involved with landfill disposal and treatment and storage of aqueous waste. A request for a transfer to the distillation group to do "real" chemical engineering was approved, but shortly thereafter re-entered Louisiana State University Graduate School. The first summer job was with U.S. Rubber, preliminary design of organic industrial waste treatment pilot plant. Graduate research was in advanced wastewater treatment via

ion exchange with fellowship provided by the National Council Air and Stream Improvement, Pulp and Paper Industry. Summer field-work on rivers and streams adjacent to pulp and paper mills in several southeastern US states stimulated an interest into chemical processes in the natural environment. More than likely this experience led to later an environmental chemodynamic focus in both teaching and research.

I joined the faculty at the University of Arkansas upon LSU PhD graduation in sixty-eight. My climb up the promotion and tenure ladder was aided by grant funds for environmental research from federal agencies. Efforts to maintain a funded activity in the chemical separations area failed. However, my interest in the cross-flow cascade device survived at a low level for many years. It involved a new twist to the well known packed tower operation used in chemical separations. This activity made me appear to be a chemical engineer in the classical sense. Funding opportunities and a keen liking of chemical processes in geophysical systems re-directed my research focus, however. Environmental projects in chemical spills in rivers, volatiles from wastewater and nutrient cycling/modeling in lakes pushed chemical separations downward in importance and elevated environmental chemodynamic subjects. Teaching an elective environmental chemical engineering course and having close ties with the environmental teaching and research group in the Civil Engineering Department enhanced my broadening perspective in this field. The idea of environmental chemodynamics was conceived while on sabbatical at Oregon State University in 1975 although the primary purpose was to do laboratory research in cross-flow separations. Five years later Environmental Chemodynamics was published in seventy-nine. Ironically Virgil Freed a chemist at OSU coined the word chemodynamics; our paths never crossed while I was on this sabbatical there. Partnering with Dr. K.T. Valsaraj, a young graduating PhD chemist from Vanderbilt University in order to tend to growing activities in environmental research renewed my interest in chemical separations as well. He involved me with a process called solvent sublation; the topic of his PhD research.

Being selected as Director for the LSU/EPA funded Center of Excellence in Hazardous Waste Research ended the 16 year Arkansas phase of my career in 1984. In Chemical Engineering Department at LSU, I partnered with Danny Reible, a young assistant professor doing air pollutant modeling and tracing research. This Center solidified College of Engineering emphasis in environmental research. A record of high quality performance and productivity by the faculty led to the receipt of USEPA award for a Center in Hazardous Substance Research; this was in ninety-one. Its emphasis was narrowed to focus on the hazardous substances in contaminated bed sediment in natural aquatic systems, but included partnering with similar research groups at Rice University and Georgia Institute of Technology. After four years as HSRC Director and eleven years total with both Centers, I chose not to continue, but to return to full-time teaching and research in the Chemical Engineering Department. Danny Reible was selected as the HSRC Director. Based in large part on the unifying efforts brought to the College by these two Centers, the leadership pushed environmental research to the forefront as a thrust area and the Dean of the College, Ed McLaughlin, initiated efforts for an undergraduate degree in environmental engineering. The first class of Civil-Environmental Engineering graduates was in ninety-seven.

The third edition of Environmental Chemodynamics is scheduled to appear in 2006. I remain very active on all fronts of the University's mission: teaching; research; and service. Valsaraj remains an active partners in all three areas. Danny Reible departed for the University of Texas, Austin in 2004 making active partnering difficult but not impossible. I am working more with undergraduate students and have initiated a senior research course and a junior laboratory experiment with an environmental

chemical engineering emphasis. Two new research directions, multimedia compartment environmental model testing and effectiveness of environmental dredging, reflect my present learning towards research projects with clear and immediate application and less so on those of archival intent and uncertain long-term impact. Services activities, including those in profession societies, national and international committees, consulting and on invitation, traveling abroad to visit universities and environmental meetings and workshops, continue at a high level.

As outlined above, my destiny to be an environmental chemical engineering stemmed largely from my graduate fellowship with the National Council for Air and Stream Improvement and by the rapid rise of concerns about chemical stressors in the environment during the sixties and seventies. Funding to support research in the environmental field into the early nineties was readily available, but competitive nevertheless; whereas, funds for the classical field of chemical separation I had chosen was not. These changing times for chemical engineering gave rise to increased attention to chemical pollution and behavior in the natural environment. As this was reflected in the teaching mission the subject of environmental chemodynamics was born. It was a seemingly natural consequence of applying transport phenomena principles to chemical behavior in air, water and soils. The cross-flow work ended with one patent, however, the solvent sublation work upon which I collaborated with Professor Valsaraj's continues at a low level. The process was applied at Borden Chemical and Plastics Geismer, LA and worked to eliminate naphthalene from an aqueous stream. To date no work is being done in the chemical separations area. However, efforts are ongoing that focus on using chemical engineering principles to enhance natural processes aimed at containing and controlling chemical contaminants more effectively in the natural places where they are found.

CURRICULUM VITAE

Charles M. McGinley, P.E.
Environmental Consultant
McGinley Associates, P.A.

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Stillwater, Minnesota 55082 U.S.A.
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Fax: 651.439.4525
E-Mail: cmcginley@fivesenses.com

PERSONAL DATA:

Birth Date: 12 November 1945
Birth Place: St. Paul, Minnesota
Citizenship: U.S. Citizen

CERTIFICATION AND LICENSURE:

1975 Registered Professional Engineer in Minnesota
Registration No. 11871

EDUCATION:

1970 Bachelor of Chemical Engineering (BChE)
University of Minnesota, Institute of Technology
Minneapolis, Minnesota

1978 Masters Degree in Business Administration, (MBA)
University of St. Thomas
St. Paul, Minnesota

MEMBERSHIPS:

1974 Air & Waste Management Association
1981 Water Environment Federation

INDUSTRY LEADERSHIP:

Technical Program Co-Chair of the AWMA International Specialty Conference on Odors: Indoor and Environmental Air, September 13-15, 1995.

Participant & Contributing Author, “Section 7 -Odor Monitoring & Standards”, “Operations & Design to Control Ultimate Recycling & Disposal Odors of Biosolids Workshop”, EPA National Biosolids Partnership, November, 1999.

Program Co-Chair of the Water Environment Federation International Specialty Conference on Odors and VOC's, April 16-19, 2000.

POSITIONS:

1967-74	Senior Chemical Engineer 3M Company, Central Research & New Business Ventures
1974-77	Senior Enforcement Engineer Minnesota Pollution Control Agency Industrial and Municipal Facilities
1977-80	Manager of Engineering Environmental Systems Division, Geo. A. Hormel & Co. R&D of Air and Water Pollution Control Systems
1980-Present	Principal Engineer, Consultant McGinley Associates, P.A. Environmental Health Engineering
1990-Present	Technical Director St. Croix Sensory, Inc. Odor, Air, Water, Food, Material, and Product Evaluations

VISITING POSITIONS:

1991	Instructor, “Odor Control for Designing Wastewater Pumping Stations”, University of Wisconsin – Madison, College of Engineering, April 1991.
1991-1993	Instructor and Investigating Engineer for the Sydney Water Board “Clean Waterways Program”
1999	Lecturer for CONAMA, National Commission for the Environment, Environmental Regulation Department, Republic of Chile.

PUBLICATIONS: (WEF and AWMA Conference Proceedings)

1990	Characterization & Treatment of Composting Emissions at Hampton Roads
1991	Multi-Stage Control of Air Emissions from Dewatered Sludge Storage
1992	Bench-Scale Removal of Odor VOC's at a Composting Facility
1993	Development of a Database for the Odour Assessment of 36 STP's of the Sydney (Australia) Water Board Using Standard Methods of Olfactometry
1993	East Bay Shore Interceptor and Collection System Odor Control: Innovative and Universal Abatement Methods Applied

1994	International Standard Methods of Olfactometry Used by Major Sewerage Districts for the Assessment of Stationary and Ambient Odors
1994	Estimating Odor Emission Rates from Wastewater Treatment Facilities
1995	"ODOR SCHOOL"® - Curriculum Development for Training Odor Investigators
1997	Olfactometry Flow Rate Criteria - A Multiple Laboratory Study, Part I
1997	Livestock Odor Measurement Using a Venturi Olfactometer
1998	Odor Quantification Methods & Practices at MSW Landfills
1998	Quantification of Industrial and Wastewater Odors
1999	Odor Evaluation Fundamentals & Applications for Indoor Air Quality Research
1999	The 'Gray Line' Between Odor Nuisance and Health Effects
2000	Olfactometry Flow Rate Criteria - A Multiple Laboratory Study, Part II
1999	Olfactomatics: Applied Mathematics for Odor Testing
2000	Elements of Successful Odor/Odour Laws
2000	“Odor Basics”, Understanding & Using Odor Testing
2000	Field Odor Monitoring and Enforcement
2000	Odor Intensity Scales for Enforcement, Monitoring, and Testing
2000	Enforceable Permit Odor Limits
2000	The New European Olfactometry Standard: Implementation, Experience, and Perspective
2001	Impact of the New European Testing Standard on WWTP’s
2002	Odor Testing Biosolids for Decision Making
2002	Standardized Odor Measurement Practices for Air Quality Testing
2004	A Nasal Chemosensory Performance Test for Odor Inspectors
2005	Correction of Olfactometry Results for Hot Odor Samples

SPECIAL PUBLICATIONS:

1993 "Sydney Water Board Tackles H2S Odour Problems", Waste Water International, June, 1993.

1998 "Stalking a Moving Target (Quantification of industrial and wastewater odors is a challenging yet necessary first step in controlling this widespread problem)", Environmental Protection, Stevens Publishing Corp, October 1998

1998 Contributing Author to "Odor & VOC Handbook", Chapter 8, Emission Control Technology, Editor: Harold J. Rafson, McGraw-Hill.

2001 "When is a Smell a Nuisance? (An overview of different approaches taken around the world in setting odor control regulations)", Water Environment & Technology, Water Environment Federation, May, 2000.

2004 "Chapter 2 – Odor Sampling & Measurement", Control of Odors & Emissions from Wastewater Treatment Plants, "Manual of Practice – 22", Water Environment Federation, April, 2004

2003 "Comparison of Field Olfactometers in a Controlled Chamber using Hydrogen Sulfide as the Test Odorant", International Water Association 2nd International Conference on Odour, Singapore, 14-17 September 2003

2004 "Developing a Credible Odor Monitoring Program", American Society of Agricultural Engineers (ASAE) Annual Conference, Ottawa, Canada, August 2004

2005 "Measuring Composting Odors for Decision Making", U.S. Composting Council Annual Conference, San Antonio, TX, 24-26 January 2005

PATENTS:

U.S. Patent No. 6,018,984 "Odor Detecting Apparatus and Method", 1 February, 1999

U.S. Patent No. 6,595,037 "Portable Odor Detection and Measuring Device", 22 July 2003.

PROFESSIONAL BUSINESS PROFILE:

Charles M. McGinley, P.E. is the principal of McGinley Associates, P.A., a firm that specializes in odor issues. Charles is also the technical director of the odor-testing laboratory, St. Croix Sensory, Inc. Charles McGinley has over 30 years of experience related to air quality issues. Since 1980, McGinley Associates and St. Croix Sensory have provided engineering services, testing, technical assistance and training ("ODOR SCHOOL"®.) to a broad range of municipal, government, and industrial concerns in the United States and internationally. St.Croix Sensory is an olfactometer supplier to municipal and university odor laboratories, including the universities of Alberta, Duke, Illinois, Iowa State, Manitoba, Minnesota, Purdue and West Texas A&M.

APPENDIX B

LABORATORY RESULTS - BRAUN INTERTEC

(PROVIDED ON CD AT THE END OF THIS REPORT)

APPENDIX C

LABORATORY RESULTS - ST. CROIX SENSORY, INC.

(PROVIDED ON CD AT THE END OF THIS REPORT)

APPENDIX D

LABORATORY RESULTS - COLUMBIA ANALYTICAL SERVICE, INC

(PROVIDED ON CD AT THE END OF THIS REPORT)

APPENDIX E

LABORATORY REPORTS QA/QC SUMMARIES

(PROVIDED ON CD AT THE END OF THIS REPORT)