Neighborhood Air Toxics Modeling Project
For
Houston and Corpus Christi
Case # 2:11-MC-00044

Phase 1B
Monitoring Network Extension

Quarterly Report for the Period

July 1, 2013 through September 30, 2013

Submitted to

The Honorable Janis Graham Jack
United States District Court for the Southern District of Texas
Corpus Christi, Texas

Ms. Kathleen Aisling
United States Environmental Protection Agency, Region 6
Dallas, Texas

Ms. Susan Clewis
Texas Commission on Environmental Quality, Region 14
Corpus Christi, Texas

Submitted by

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I. Introduction

On February 1, 2008, the United States District Court entered an Order (D.E. 981, Order (pp.1, 7-11)) regarding unclaimed settlement funds in Lease Oil Antitrust Litigation (No.11) Docket No. MDL No.1206. The Court requested a detailed project proposal from Dr. David Allen, the Gertz Regents Professor in Chemical Engineering and the Director of the Center for Energy and Environmental Resources at The University of Texas at Austin (UT Austin), regarding the use of $9,643,134.80 in the Settlement Fund. The proposal was for a project titled "Neighborhood Air Toxics Modeling Project for Houston and Corpus Christi" (hereinafter "Air Toxics Project"). The Air Toxics Project was proposed in two stages. In Stage 1, UT Austin was to develop, apply, demonstrate and make publicly available, neighborhood-scale air quality modeling tools for toxic air pollutants in Corpus Christi, Texas (Phase 1A) and extend the operation of the air quality monitoring network in Corpus Christi, Texas (Phase 1B). The ambient monitoring results from were to be used in synergy with the neighborhood-scale models to improve the understanding of emissions and the spatial distribution of air toxics in the region.

On February 21, 2008, the United States District Court for the Southern District of Texas issued an order to the Clerk of the Court to distribute funds in the amount of $4,586,014.92, plus accrued interest, to UT Austin for the purposes of implementing Stage 1 of the Air Toxics Project as described in the detailed proposal submitted to the Court by UT Austin on February 15, 2008 (D.E. 998).

Under the Order to Distribute Funds in MDL No. 1206, on March 3, 2008, at the direction of the Settlement Administrator, $4,602,598.66 was disbursed to UT Austin for Stage 1 of the Project. This amount includes the interest accrued prior to distribution from the MDL No. 1206 Settlement Fund.

In Stage 2, subject to the availability of funds, it was planned that UT Austin would extend the modeling to the Houston, Texas ship channel region, develop a mobile monitoring station that could be deployed in Corpus Christi and in other regions of Texas and/or further extend the operating life of the existing stationary network in the same or a modified spatial configuration. Based on the decision of the U.S. Court of Appeals for the 5th Circuit on June 27, 2011, UT Austin will not be receiving the Stage 2 funding at any point in the future. Further, work on the modeling portion of Stage 1 (Phase 1A) was completed June 30, 2011. Hence, all future progress reports will describe only work on Stage 1 Phase 1B (extending the operation of the air quality monitoring network).

The air quality monitoring network was originally authorized on October 1, 2003, when the United States District Court for the Southern District of Texas issued an order to the Clerk of the Court to distribute funds in the amount of $6,700,000, plus interest accrued, to The University of Texas at Austin (UT Austin) to implement the court ordered condition of probation (COCP) project *Corpus Christi Air Monitoring and Surveillance Camera Installation and Operation* (Project). Those funds have been expended. Funding for the air quality monitoring network originally created for the COCP Project is now provided through Stage 1 Phase 1B of the Air Toxics Project.

This Stage 1 Phase 1B quarterly report has been prepared pursuant to the requirements of the Air Toxics project and is being submitted to the United States District Court, the United States Environmental Protection Agency (EPA), and the Texas Commission on Environmental Quality (TCEQ).

II. Air Toxics Project – Stage 1 - Phase 1B Overview

A. Scope and Objectives

Phase 1B of the project reserves approximately 65% of the initial Stage 1 project funds, or approximately $3 million, to extend the operation of the Corpus Christi ambient air monitoring network.

B. Goals

Under Phase 1B, the project team will continue the operation of the monitoring network initiated under the Corpus Christi Air Monitoring and Surveillance Camera Project.

III. Air Toxics Project – Stage 1 – Phase 1B Progress Report

The focus of work during the quarter ending September 30, 2013, has been directed to the following activities funded by the Stage 1 Phase 1B extension of the Corpus Christi Air Monitoring network.

A. Operations and Maintenance Phase of the Project

A detailed description of the data analyses for this quarter appears in Appendix A, pages 8 through 24, and a summary of these analyses appears in this section.

The Project currently consists of a network of six (6) air monitoring stations with air monitoring instruments and surveillance camera equipment. A map showing locations of the COCP Project monitoring sites along with TCEQ sites appears in Figure 1, on page 4. Table 1, on pages 4 and 5, identifies the location and instrumentation found at each of the COCP Project sites. TCEQ sites and some of the sites farther from the COCP area than the TCEQ sites, operated by Texas A&M at Kingsville (TAMUK), provide additional data used in these analyses.

Figure 1. Corpus Christi Monitoring Sites, "X" marks site recently terminated

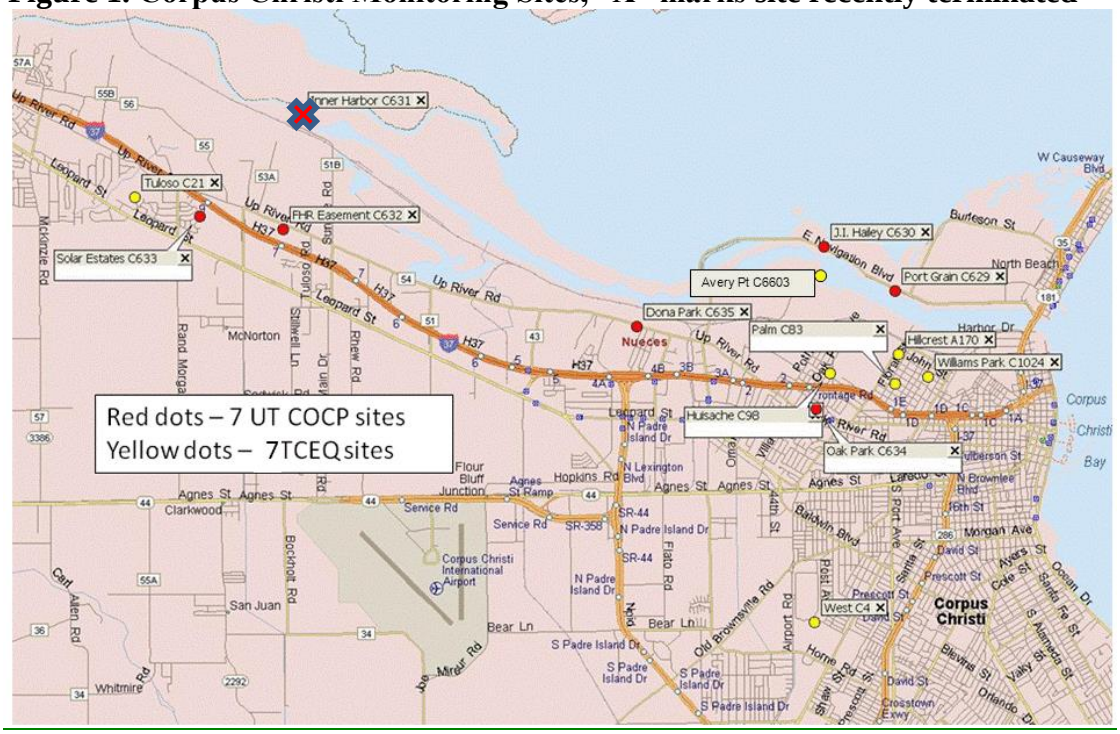

Table 1. Schedule of Air Monitoring Sites, Locations and Major Instrumentation

TCEQ CAMS#	Description of Site Location	Monitoring Equipment				
		Auto GC	TNMHC (T) / Canister (C)	H_2S & SO_2	Met Station	Camera
634	Oak Park Recreation Center (**OAK**)	Mar 2005 to date	C: Dec 2004 to Feb 2009 T: Dec 2004 to Apr 2012		Dec 2004 to date	
629	Grain Elevator @ Port of Corpus Christi (**CCG**)		T&C: Dec 2004 to date	Dec 2004 to date	Dec 2004 to date	
630	J. I. Hailey Site @ Port of Corpus Christi (**JIH**)		T&C: Dec 2004 to date	Dec 2004 to date	Dec 2004 to date	
635	TCEQ Monitoring Site C199 @ Dona Park (**DPK**)		T&C: Dec 2004 to date	Dec 2004 to date	Dec 2004 to date	Jan 2005 to date
632	Off Up River Road on Flint Hills Resources Easement (**FHR**)		T&C: Dec 2004 to date	Dec 2004 to date	Dec 2004 to date	
633	Solar Estates Park at end of Sunshine Road (**SOE**)	Mar 2005 to date	C: Dec 2004 to Feb 2009 T: Dec 2004 to Apr 2012	Dec 2004 to date	Dec 2004 to date	Jan 2005 to date
631	*Port of Corpus Christi on West End of CC Inner Harbor (**WEH**) (terminated)*		T&C: Dec 2004 to May 2012	Dec 2004 to May 2012	Dec 2004 to May 2012	

Table 1 (Continued)

Legend

CAMS	continuous ambient monitoring station
Auto GC	automated gas chromatograph
TNMHC	total non-methane hydrocarbon analyzer (all except CAMS 634 & 633 also have canister hydrocarbon samplers)
H_2S	hydrogen sulfide analyzer
SO_2	sulfur dioxide analyzer
Met Station	meteorology station consisting of measurement instruments for wind speed, wind direction, ambient air temperature and relative humidity
Camera	surveillance camera

A discussion of data findings for the quarter appears in Appendix A, pages 8 through 24. Specifically, the appendix contains the following elements:

- **Auto-GC Data Summary –** In examining the validated second quarter of 2013 hourly auto-GC data from Oak Park, Solar Estates, and TCEQ's Palm sites, no individual measurements were found to have exceeded a short-term air monitoring comparison value (AMCV). The validated second quarter average concentrations were below each compound's long-term AMCVs. For third quarter 2013 data, the preliminary values were also below their respective AMCVs. A summary of data appears in Appendix A, pages 13 through 17.

- **Benzene Summary** – A review of the nine years of data is presented, with focus on the quarterly means from 2005 through 2013 third quarters, appears in Appendix A, pages 18 through 20.

- **Analysis of Sulfur Dioxide at Several Sites** – The JIH CAMS 630 site had measured concentrations high enough and often enough to violate the SO_2 annual National Ambient Air Quality Standards (NAAQS), but concentrations have recently declined. Trends from various CAMS sites are examined. These issues are expanded upon in Appendix A, pages 20 through 24.

B. Project Management and Planning

Project Management and Planning during this period has focused on the following four (4) major activities.

1. **Air Monitoring Operations**
   Operations and maintenance of the six monitoring sites reporting data via the TCEQ LEADS is on-going. The data can be accessed and reviewed at the project website (http://www.utexas.edu/research/ceer/ccaqp/).

2. **Communication and Reporting**
   The status of the Project has been communicated through the website, which is operational with portions under continual updating, quarterly and annual reports, and meetings of a Community Advisory Board.

3. **Budget Monitoring**
   Budget monitoring during the period has focused on projects costs for Stage 1 Phase IB – Sites Operation and Maintenance costs. Financial reports for the quarter are included in Appendix B, pages 25 through 27.

4. **Other Contributions**
   There were no other contributions made to the project during this quarter.

III. Financial Report

As required, the following financial summary information is provided. Details supporting this financial summary are included in Appendix B, pages 26 through 27.

A. Total Amount of Air Toxics Project Funds and Other Funds Received Under the Project
   The Air Toxics Project funds received through September 30, 2013 totals $3,135,698.46. This total includes interest earned through September 30, 2013, in the amount of $390,326.78.

B. Detailed List of the Actual Expenditures Paid from Air Toxics Project Funds Stage 1 Phase 1B through September 30, 2013
   Expenditures of Air Toxics Project funds during this quarter totaled $195,777.65. The funds remaining in the Air Toxics account (not spent for Stage 1 Phase 1A) are in a separate account so that separate financial reports can be generated.

C. Total Interest Earned on Air Toxics Project Funds through September 30, 2013
   The interest earned during this quarter totaled $462.67. A report providing detailed calculations of the interest earned on the Air Toxics Project funds is included in Appendix B, pages 26 through 27.

D. Balance as of September 30, 2013, in the Air Toxics Project Account
   The balance in the Air Toxics Project account, including interest earned totals $2,515,705.45.

E. Anticipated Expenditures for the Funds Remaining in the Air Toxics Project Account – Stage 1 Phase 1A
   There are no additional expenditures anticipated for Stage 1 Phase 1A.

F. Anticipated Expenditures for the Funds Remaining in the Air Toxics Project Account – Stage 1 Phase 1B
   All funds remaining after the close of Stage 1 Phase 1A have been allocated to Stage 1 Phase 1B, and the extension of the operation of the Corpus Christi ambient monitoring network.

The Stage 1 Phase 1A Neighborhood Air Toxics Modeling Project was originally allocated a budget of $2,277,564. As of June 30, 2011, total and final expenditures on Phase 1A totaled $1,863,081.22. The remaining funds totaling $414,482.78, have been transferred, with the Court's permission, to a new account to allow for easier tracking of the expenses as they are utilized for Stage 1 Phase 1B, the extension of the Corpus Christi Air Monitoring Project.

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APPENDIX A

Data Analysis for Corpus Christi Quarterly Report

July 1, 2013 through September 30, 2013

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Data Analysis for Corpus Christi Quarterly Report

This technical report describes results of monitoring and analysis of data under the Air Toxics Project Stage 1 Phase 1B. The primary focus is on the period July 1 through September 30, 2013. The monitoring network is shown earlier in this report in Figure 1, on page 4, and is described in Table 2, below. This report contains the following elements:

- A summary of Oak Park, Solar Estates, and Palm (TCEQ) auto-GC data for the second and third quarters of 2013;
- Information on the trends for benzene concentrations at the two project auto-GCs in residential areas, now for a full eight years of data, with nine instances of complete second and third quarters, and at the TCEQ's Palm auto-GC with three years of data (since June 2010); and
- A discussion of the sulfur dioxide (SO_2) data from UT and TCEQ sites.

Table 2. Schedule of air monitoring sites, locations and major instrumentation

TCEQ CAMS#	Description of Site Location	Monitoring Equipment showing month/year of operations				
		Auto-GC	TNMHC (T) / Canister (C)	H_2S & SO_2	Met Station	Camera
634	Oak Park Recreation Center (**OAK**)	3/05 to date	C: 12/04 to 2/09 T: 12/04 to 4/12		12/04 to date	
629	Grain Elevator @ Port of Corpus Christi (**CCG**)		T&C: 12/04 to date	12/04 to date	12/04 to date	
630	J. I. Hailey Site @ Port of Corpus Christi (**JIH**)		T&C: 12/04 to date	12/04 to date	12/04 to date	
635	TCEQ Monitoring Site C199 @ Dona Park (**DPK**)		T&C: 12/04 to date	12/04 to date	12/04 to date	1/05 to date
632	Off Up River Road on Flint Hills Resources Easement (**FHR**)		T&C: 12/04 to date	12/04 to date	12/04 to date	
633	Solar Estates Park at end of Sunshine Road (**SOE**)	3/05 to date	C: 12/04 to 2/09 T: 12/04 to 4/12	12/04 to date	12/04 to date	1/05 to date
631	*Port of Corpus Christi on West End of CC Inner Harbor (**WEH**) (terminated)*		T&C: 12/04 to 5/12	12/04 to 5/12	12/04 to 5/12	

Legend

CAMS	continuous ambient monitoring station
Auto-GC	automated gas chromatograph
TNMHC	total non-methane hydrocarbon analyzer (all except CAMS 633 & 634 also have canister hydrocarbon samplers)
H_2S	hydrogen sulfide analyzer
SO_2	sulfur dioxide analyzer
Met Station	meteorology station consisting of measurement instruments for wind speed, wind direction, ambient air temperature and relative humidity
Camera	surveillance camera

Glossary of terms

- **Pollutant concentrations** – Concentrations of most gaseous pollutants are expressed in units denoting their "mixing ratio" in air; i.e., the ratio of the number molecules of the pollutant to the total number of molecules per unit volume of air. Because concentrations for all gases other than molecular oxygen, nitrogen, and argon are very low, the mixing ratios are usually scaled to express a concentration in terms of "parts per million" (ppm) or "parts per billion" (ppb). Sometimes the units are explicitly expressed as ppm-volume (ppmV) or ppb-volume (ppbV) where 1 ppmV indicates that one molecule in one million molecules of ambient air is the compound of interest and 1 ppbV indicates that one molecule in one billion molecules of ambient air is the compound of interest. In general, air pollution standards and health effects screening levels are expressed in ppmV or ppbV units. Because hydrocarbon species may have a chemical reactivity related to the number of carbon atoms in the molecule, mixing ratios for these species are often expressed in ppb-carbon (ppbV times the number of carbon atoms in the molecule), to reflect the ratio of carbon atoms in that species to the total number of molecules in the volume. This is relevant to our measurement of auto-GC species and TNMHC, which are reported in ppbC units. For the purpose of relating hydrocarbons to health effects, this report notes hydrocarbon concentrations in converted ppbV units. However, because TNMHC is a composite of all species with different numbers of carbons, it cannot be converted to ppbV. Pollutant concentration measurements are time-stamped based on the start time of the sample, in Central Standard Time (CST), with sample duration noted.

- **Auto-GC** – The automated gas chromatograph collects a sample for 40 minutes, and then automatically analyzes the sample for a target list of 46 hydrocarbon species. These include benzene and 1,3-butadiene, which are air toxics, various species that have relatively low odor thresholds, and a range of gasoline and vehicle exhaust components. Auto-GCs operate at Solar Estates CAMS 633 and Oak Park CAMS 634. In June 2010 TCEQ began operating an auto-GC at Palm CAMS 83 at 1511 Palm Drive in the Hillcrest neighborhood.

- **Total non-methane hydrocarbons (TNMHC)** – TNMHC represent a large fraction of the total volatile organic compounds released into the air by human and natural processes. TNMHC is an unspeciated total of all hydrocarbons, and individual species must be resolved by other means, such as with canisters or auto-GCs. However, the time resolution of the TNMHC instrument is much shorter than the auto-GC, and results are available much faster than with canisters. TNMHC analyzers operate at the sites that do not take continuous hydrocarbon measurements with auto-GCs (CAMS 629, 630, 632, and 635).

- **Canister** – Electro-polished stainless steel canisters are filled with air samples when an independent sensor detects that *elevated* (see below) levels of hydrocarbons (TNMHC) are present. Samples are taken for 20 minutes to try to capture the chemical make-up of the air. In most cases, the first time on any day that the monitored TNMHC concentration exceeds 2000 ppbC at a site for a continuous period of 15 minutes or more, the system will trigger and a sample will be collected. Samples are sent to UT Austin and are

analyzed in a lab to resolve some 60 hydrocarbon and 12 chlorinated species. Canister samplers operate at the four active sites that do not take continuous hydrocarbon measurements with auto-GCs (CAMS 629, 630, 632, and 635).

- **Air Monitoring Comparison Values (AMCV) –** The TCEQ uses AMCVs in assessing ambient data. Two valuable online documents ("Fact Sheet" and "Uses of ESLs and AMCVs Document") that explain AMCVs are at http://www.tceq.texas.gov/toxicology/AirToxics.html (accessed October 2013). The following text is an excerpt from the TCEQ "Fact Sheet" document:

> Effects Screening Levels are chemical-specific air concentrations set to protect human health and welfare. Short-term ESLs are based on data concerning acute health effects, the potential for odors to be a nuisance, and effects on vegetation, while long-term ESLs are based on data concerning chronic health and vegetation effects. Health-based ESLs are set below levels where health effects would occur whereas welfare-based ESLs (odor and vegetation) are set based on effect threshold concentrations. The ESLs are screening levels, **not ambient air standards.** Originally, the same long- and short-term ESLs were used for both air permitting and air monitoring.
>
> There are significant differences between performing health effect reviews of air permits using ESLs, and the various forms of ambient air monitoring data. The Toxicology Division is using the term "air monitoring comparison values" (AMCVs) in evaluations of air monitoring data in order to make more meaningful comparisons. "AMCVs" is a collective term and refers to all odor-, vegetative-, and health-based values used in reviewing air monitoring data. Similar to ESLs, AMCVs are chemical-specific air concentrations set to protect human health and welfare. Different terminology is appropriate because air *permitting* and air *monitoring* programs are different.

- **Rationale for Differences between ESLs and AMCVs** – A very specific difference between the permitting program and monitoring program is that permits are applied to one company or facility at a time, whereas monitors may collect data on emissions from several companies or facilities or other source types (e.g., motor vehicles). Thus, the protective ESL for permitting is set lower than the AMCV in anticipation that more than one permitted emission source may contribute to monitored concentrations.

- **National Ambient Air Quality Standards (NAAQS) –** U.S. Environmental Protection Agency (EPA) has established a set of standards for several air pollutions described in the Federal Clean Air Act[1]. NAAQS are defined in terms of *levels* of concentrations and particular *forms*. For example, the NAAQS for particulate matter with size at or less than 2.5 microns ($PM_{2.5}$) has a *level* of 12 micrograms per cubic meter averaged over 24-hours, and a *form* of the annual average based on four quarterly averages, averaged over three years. Individual concentrations measured above the level of the NAAQS are called *exceedances*. The number calculated from a monitoring site's data to compare to the level of the standard is called the site's *design value*, and the highest design value in the area for a year is the regional design value used to assess overall NAAQS compliance. A monitor or a region that does not comply with a NAAQS is said to be *noncompliant*. At

[1] See http://epa.gov/air/criteria.html accessed October 2013

some point after a monitor or region has been in noncompliance, the U.S. EPA may choose to label the region as *nonattainment*. A nonattainment designation triggers requirements under the Federal Clean Air Act for the development of a plan to bring the region back into compliance.

A more detailed description of NAAQS can be found on the EPA's Website at http://www.epa.gov/air/criteria.html (accessed October 2013).

One species measured by this project and regulated by a NAAQS is sulfur dioxide (SO_2). Effective June 2, 2010, EPA modified the SO_2 NAAQS to include a level of 0.075 ppm, or 75 ppb averaged over one hour, with a form of the three-year average of the annual 99^{th} percentiles of the daily maximum one-hour averages. There is also a secondary SO_2 standard of 0.500 ppm (500 ppb) over three hours, not to be exceeded more than once in any one year.

- **Elevated Concentrations** – In the event that measured pollutant concentrations are above a set threshold they are referred to as "elevated concentrations." The values for these thresholds are summarized by pollutant below. As a precursor to reviewing the data, the reader should understand the term "*statistical significance*." In the event that a concentration is higher than one would typically measure over, say, the course of a week, then one might conclude that a specific transient assignable cause may have been the pollution source, because experience shows the probability of such a measurement occurring under normal operating conditions is small. Such an event may be labeled "statistically significant" at level 0.01, meaning the observed event is rare enough that it is not expected to happen more often than once in 100 trials. This does not necessarily imply the occurrence of a violation of a health-based standard. A discussion of "elevated concentrations" and "statistical significance" by pollutant type follows:

    - For H_2S, any measured concentration greater than the level of the state residential standards, which is 80 ppb over 30 minutes, is considered "elevated." For SO_2, any measured concentration greater than the level of the NAAQS, which is 75 ppb over one hour, is considered "elevated." Note that the concentrations of SO_2 and H_2S need not persist long enough to constitute an exceedance of the standard to be regarded as elevated. In addition, any closely spaced values that are statistically significantly (at 0.01 level) greater than the long-run average concentration for a period of one hour or more will be considered "elevated" because of their unusual appearance, as opposed to possible health consequence. The rationale for doing so is that unusually high concentrations at a monitor may suggest the existence of unmonitored concentrations closer to the source area that are potentially above the state's standards.
    - For TNMHC, any measured concentration greater than the canister triggering threshold of 2000 ppbC is considered "elevated." Note that the concentrations need not persist long enough to trigger a canister (900 seconds) to be considered elevated.
    - For benzene and other air toxics in canister samples or auto-GC measurements, any concentration above the AMCV is considered "elevated." Note that 20-

minute canister samples and 40-minute auto-GC measurements are both compared with the short-term AMCV.

- Some hydrocarbon species measured in canister samples or by the auto-GC generally appear in the air in very low concentrations close to the method detection level. Similar to the case above with H_2S and SO_2, any values that are statistically significantly (at 0.01 level) greater than the long-run average concentration at a given time or annual quarter will be considered "elevated" because of their unusual appearance, as opposed to possible health consequence. The rationale for doing so is that unusually high concentrations at a monitor may suggest an unusual emission event in the area upwind of the monitoring site.

1. Auto-GC Data Summaries in Residential Areas

In this section the results of semi-continuous sampling for hydrocarbons at the three Corpus Christi auto-GC sites – UT's Solar Estates CAMS 633, UT's Oak Park CAMS 634, and TCEQ's Palm CAMS 83 – are presented. These three sites are located in residential areas. Solar Estates and Oak Park are generally downwind of industrial emissions under northerly winds. Palm, located near the TCEQ's Hillcrest and Williams Park sites in Figure 1, on page 4, is generally downwind under northerly and westerly winds. In examining aggregated data one observes similar patterns of hydrocarbons at all three sites.

Table 3, below, lists the data completeness from the project auto-GCs from January 2011 through summer 2013 for months for which data validation has been completed. When data are missing the reason is generally owing to quality assurance steps or maintenance procedures. The project regularly exceeds the 75 percent data recovery goal.

Table 3. Percent data recovery by month, 2011-2013, validated data only

Date	Oak Park	Solar Est.	Date	Oak Park	Solar Est.	Date	Oak Park	Solar Est.
Jan 2011	100	96	Jan 2012	94	99	Jan 2013	100	100
Feb 2011	84	77	Feb 2012	90	98	Feb 2013	94	99
Mar 2011	100	95	Mar 2012	97	100	Mar 2013	97	100
Apr 2011	100	80*	Apr 2012	94	100	Apr 2013	100	100
May 2011	78	100	May 2012	77*	96	May 2013	99	99
Jun 2011	69*	93	Jun 2012	65	97	Jun 2013	**75***	**91***
Jul 2011	95	96	Jul 2012	98	93*	Jul 2013	98	99
Aug 2011	56	95	Aug 2012	99	93*	Aug 2013	87	98
Sep 2011	92	78	Sep 2012	99	100			
Oct 2011	99	83	Oct 2012	98	93			
Nov 2011	97	94	Nov 2012	99	88			
Dec 2011	100	100	Dec 2012	97	99			
						Average 2011-13	**91**	**95**

* Months with planned preventive maintenance

Table 4, on page 15, summarizes the validated average data values from the second quarter of 2013. Data in this table are available to TCEQ staff at http://rhone3.tceq.texas.gov/cgi-bin/agc_summary.pl (accessed October 2013). Table 5, on page 16, summarizes the as-yet-unvalidated average data values from the third quarter of 2013.

As noted in the preceding paragraph, Tables 4 and 5 show the averages (arithmetic mean of measured values) for 27 hydrocarbon species for the periods of interest, and Table 4 also shows the maximum one-hour values and the maximum 24-hour average concentrations for the second quarter's validated data. All concentration values in the tables are in ppbV units. No concentrations or averages of concentrations from the 27 species were greater than TCEQ's air monitoring comparison values (AMCV). The average data columns in Table 4 for the validated second quarter 2013 data and Table 5 for the as-yet-unvalidated third quarter 2013 data are shown graphically in Figures 2 and 3, respectively, on page 17. Figures 2 and 3 are plotted on the same y-axis scale, so they can be compared directly. Mean concentrations for species that measured consistently above their respective method detection limits are generally comparable for the second and third quarters each year (late spring, summer, early fall), and are generally lower than the first and fourth quarters (winter, early spring, late fall). More frequent maritime southerly flow in the spring and summer is a contributor to lower concentrations in the second and third quarters. Lower wind speeds and more northerly winds contribute to higher concentrations in the first and fourth quarters. As can be observed by comparing Figures 2 and 3, average concentrations for all species were very similar between recent second and third quarters.

The rows for ***benzene*** are bold-faced in Tables 4 and 5 owing to the concern that the concentrations for this species tend to be closer to the AMCV than are concentrations of other species. The benzene short-term AMCV is 180 ppbV and the benzene long-term AMCV is 1.4 ppbV.

Table 4. Validated auto-GC statistics 2nd quarter 2013

Units ppbV	Oak 2Q13			Solar 2Q13			Palm 2Q13		
Species	**Peak 1hr**	**Peak 24hr**	**Mean**	**Peak 1hr**	**Peak 24hr**	**Mean**	**Peak 1hr**	**Peak 24hr**	**Mean**
Ethane	69.568	15.077	4.442	144.871	19.637	4.653	222.451	33.471	5.739
Ethylene	27.417	1.724	0.315	8.017	0.929	0.210	21.966	1.487	0.278
Propane	67.729	15.386	2.538	56.291	8.502	2.702	236.683	23.032	3.169
Propylene	5.620	0.544	0.146	1.938	0.445	0.121	6.030	0.822	0.205
Isobutane	49.580	6.952	0.945	25.659	3.538	0.872	126.361	10.846	1.328
n-Butane	121.468	9.691	1.426	24.603	4.685	1.233	401.445	26.004	1.945
t-2-Butene	3.305	0.212	0.037	1.102	0.068	0.012	1.146	0.293	0.038
1-Butene	2.537	0.177	0.027	1.938	0.281	0.029	1.655	0.405	0.088
c-2-Butene	3.160	0.174	0.022	1.160	0.064	0.008	0.849	0.253	0.026
Isopentane	148.230	19.617	1.222	25.523	2.130	0.673	280.260	18.182	1.273
n-Pentane	78.226	10.959	0.744	10.122	1.655	0.469	320.272	20.357	0.848
1,3-Butadiene	0.433	0.066	0.022	4.432	0.217	0.009	0.745	0.065	0.026
t-2-Pentene	7.414	0.398	0.040	1.471	0.071	0.005	2.229	0.465	0.053
1-Pentene	4.629	0.251	0.022	0.822	0.043	0.005	3.608	0.346	0.032
c-2-Pentene	3.785	0.198	0.017	0.740	0.035	0.002	1.290	0.236	0.027
n-Hexane	16.042	1.887	0.253	4.181	0.546	0.173	164.354	10.824	0.306
Benzene	**5.282**	**0.972**	**0.193**	**1.669**	**0.339**	**0.093**	**24.048**	**1.719**	**0.166**
Cyclohexane	5.899	0.993	0.120	4.831	0.628	0.082	44.415	2.974	0.094
Toluene	7.634	2.951	0.261	1.425	0.342	0.104	50.832	3.535	0.237
Ethyl Benzene	0.674	0.103	0.023	0.181	0.040	0.011	3.295	0.231	0.014
m&p -Xylene	4.676	0.380	0.079	2.757	0.370	0.070	24.150	1.652	0.089
o-Xylene	0.972	0.117	0.024	0.292	0.057	0.013	4.537	0.321	0.025
Isopropyl Benzene	0.956	0.228	0.009	0.435	0.020	0.002	0.545	0.060	0.003
1,3,5-Tri-methylbenzene	0.325	0.080	0.006	0.645	0.070	0.007	2.483	0.161	0.007
1,2,4-Tri-methylbenzene	0.517	0.158	0.024	0.488	0.074	0.013	2.029	0.154	0.021
n-Decane	0.822	0.115	0.019	2.142	0.237	0.022	2.720	0.172	0.013
1,2,3-Tri-methylbenzene	0.396	0.212	0.009	0.143	0.046	0.003	0.411	0.043	0.015

Table 5. Unvalidated auto-GC mean statistics 3rd quarter 2013

Units ppbV	Oak 3Q13	Solar 3Q13	Palm 3Q13
Species	**Mean**	**Mean**	**Mean**
Ethane	4.024	4.601	4.597
Ethylene	0.311	0.221	0.267
Propane	2.507	2.898	2.801
Propylene	0.157	0.161	0.129
Isobutane	0.967	1.052	1.268
n-Butane	1.286	1.312	2.120
t-2-Butene	0.038	0.014	0.035
1-Butene	0.024	0.012	0.063
c-2-Butene	0.034	0.010	0.023
Isopentane	1.063	0.826	1.250
n-Pentane	0.611	0.548	0.639
1,3-Butadiene	0.032	0.014	0.022
t-2-Pentene	0.049	0.013	0.057
1-Pentene	0.027	0.008	0.048
c-2-Pentene	0.023	0.005	0.030
n-Hexane	0.261	0.220	0.261
Benzene	**0.178**	**0.106**	**0.145**
Cyclohexane	0.139	0.114	0.086
Toluene	0.235	0.142	0.211
Ethyl Benzene	0.026	0.016	0.015
m&p -Xylene	0.094	0.080	0.087
o-Xylene	0.031	0.019	0.025
Isopropyl Benzene	0.013	0.003	0.002
1,3,5-Trimethylbenzene	0.015	0.007	0.007
1,2,4-Trimethylbenzene	0.043	0.017	0.021
n-Decane	0.030	0.022	0.013
1,2,3-Trimethylbenzene	0.023	0.006	0.019

Figure 2. Mean ppbV for 27 species at three auto-GCs, 2nd quarter 2013 (validated data)

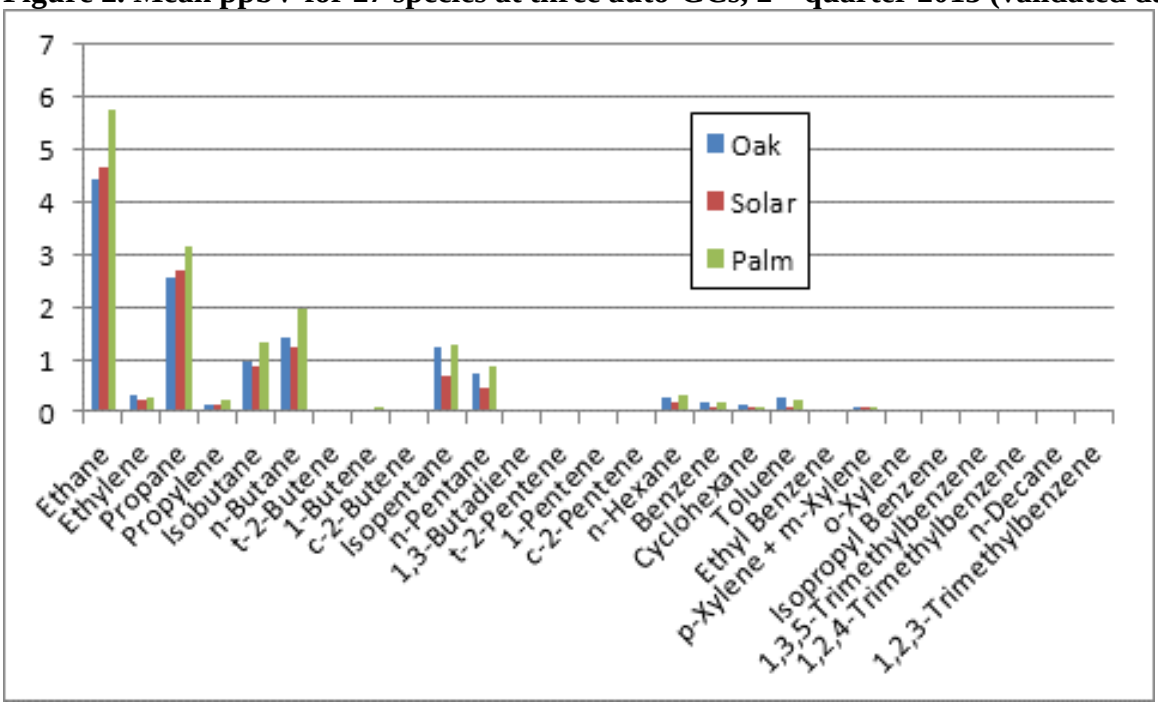
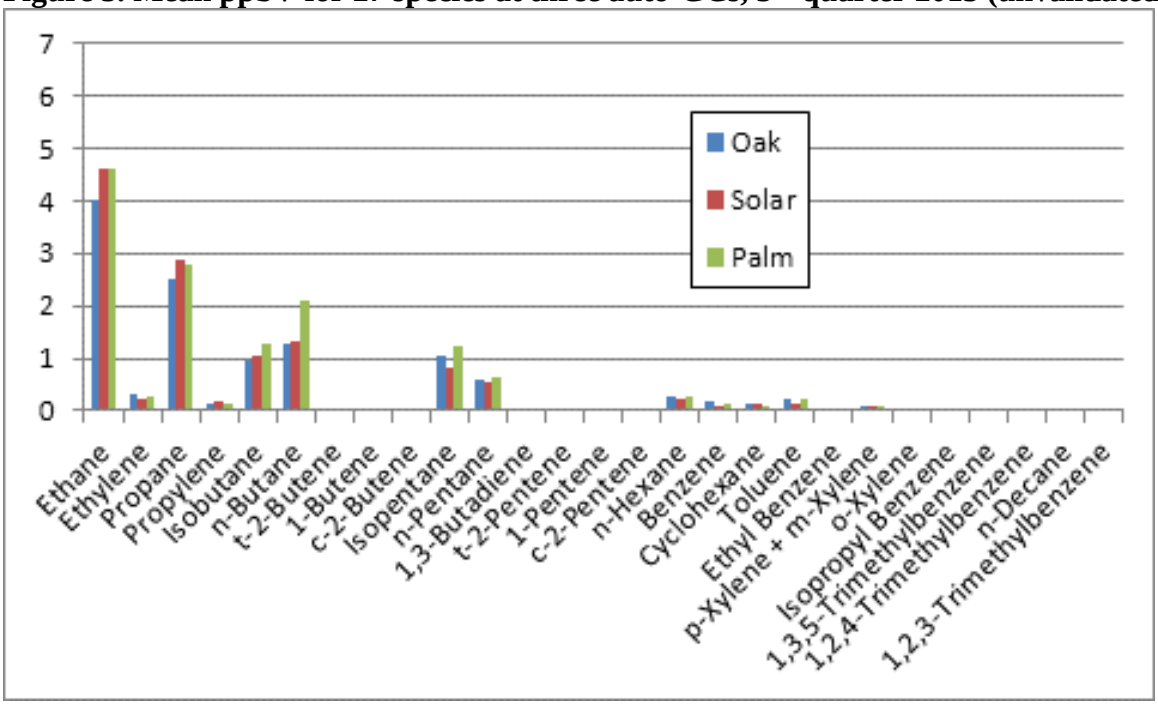


Figure 3. Mean ppbV for 27 species at three auto-GCs, 3rd quarter 2013 (unvalidated data)



2. Benzene Concentrations in Residential Areas

As has been discussed in past reports, benzene concentrations in the recent years are lower than in the first three years of operation at the two auto-GCs operated at Oak Park CAMS 634 and Solar Estates CAMS 633. Also, in recent years (2008 – 2013), concentration averages have generally shown little variation. No individual one-hour benzene values have been measured above the AMCV since the beginning of monitoring. A time series for Oak Park hourly benzene in ppbV units with two points annotated by date appears in Figure 4, below. The two points from 6:00 CST Saturday January 27, 2007 and 4:00 CST Friday November 6, 2009 are identified as statistical outliers in that they are unusually high given the balance of the data. The same graph is reproduced without the two outlier points in Figure 5, below. The time series for Solar Estates appears in Figure 6, on page 19. Note the different y-axis scales for the two sites, as Oak Park does tend to measure higher concentrations than Solar Estates. Figure 7, on page 19, shows the time series for the three-year old TCEQ Palm auto-GC, with an apparent outlier on January 30, 2012 indicated. Note that for all three sites, the data from the third quarter 2013 have not all been validated yet.

Figure 4. Oak Park hourly benzene March 2005 – September 30, 2013, ppbV units, individual elevated values noted, no observations greater than the TCEQ's AMCV

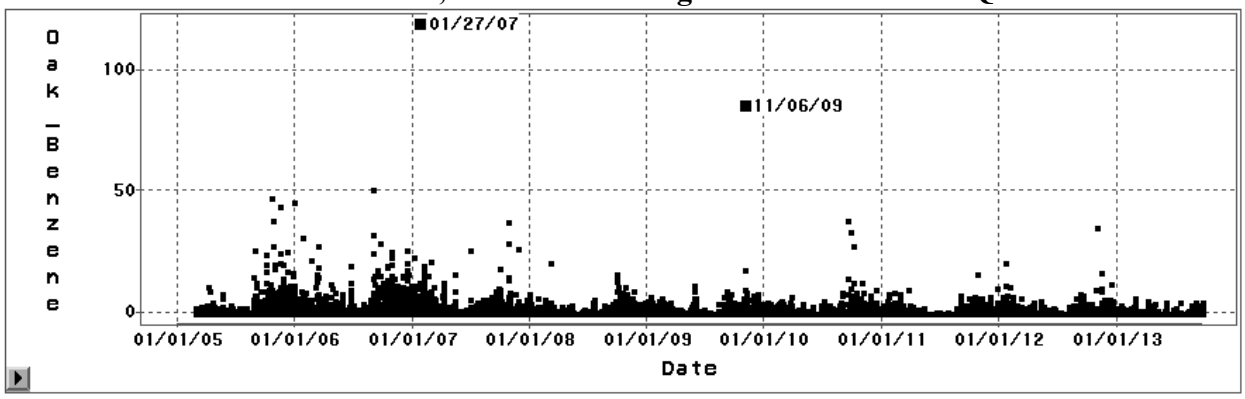


Figure 5. Oak Park hourly benzene Mar. 2005 – September 30, 2013, ppbV units, two outliers from January 27, 2007 and November 6, 2009 removed

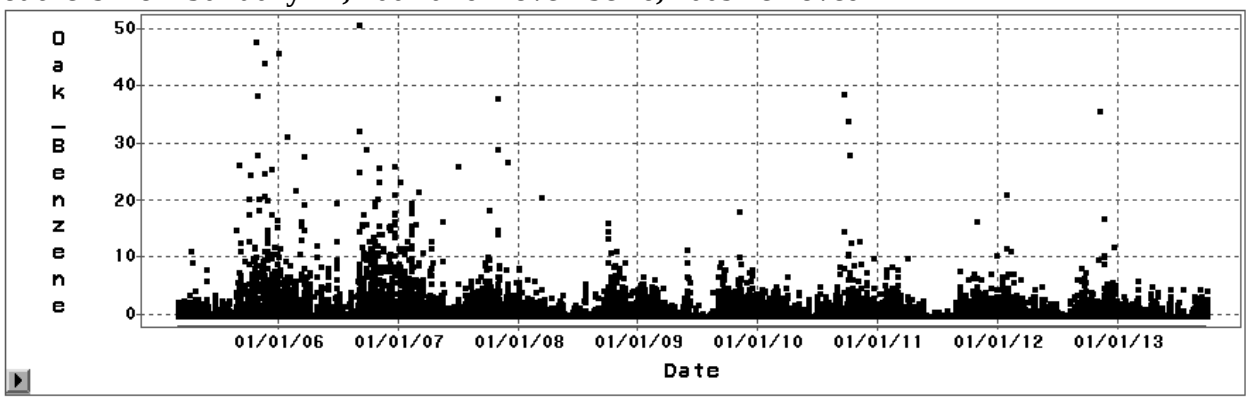


Figure 6. Solar Estates hourly benzene Mar. 2005 – September 30, 2013, ppbV units, no observations greater than the TCEQ's AMCV

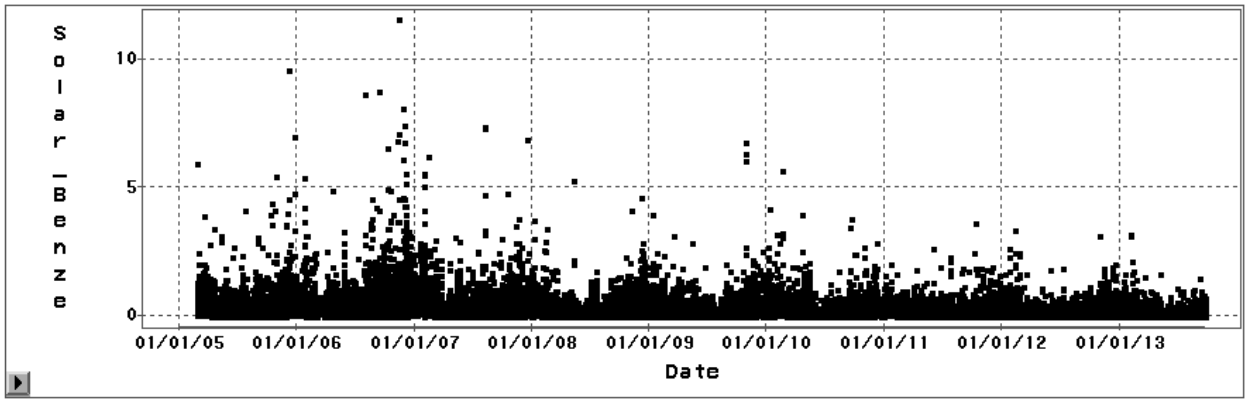


Figure 7. TCEQ Palm hourly benzene June 1, 2010 – September 30, 2013, ppbV units, individual elevated value noted, no observations greater than the TCEQ's AMCV

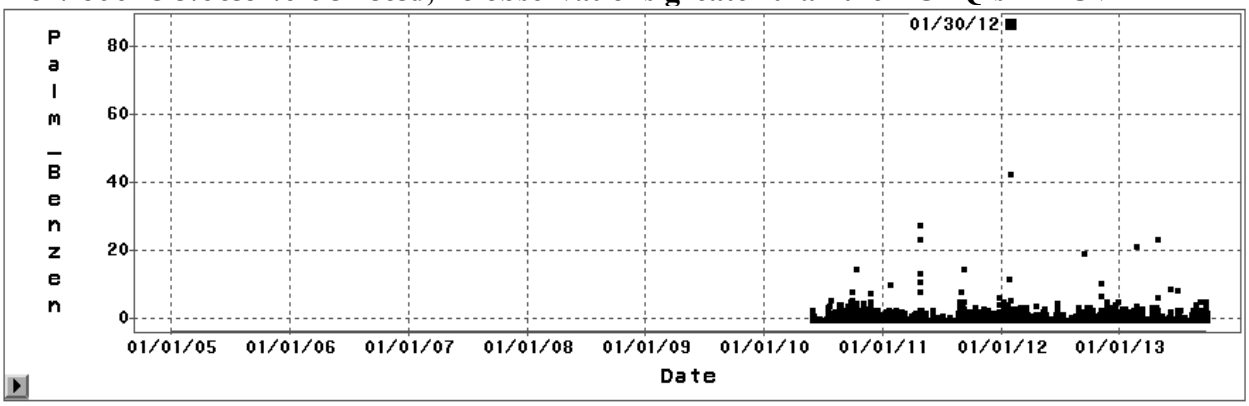
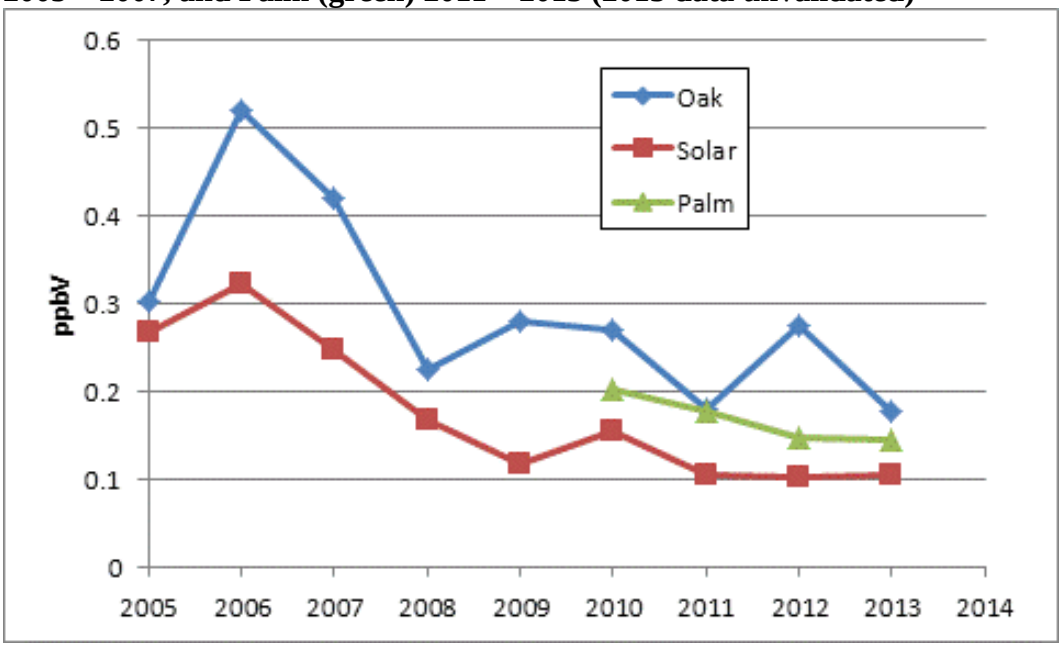


Table 6, on page 20, shows the third quarter average concentrations from the auto-GCs for benzene from 2005 – 2013 (2013 data unvalidated). Because monitoring began in March 2005, this is the first opportunity to look at nine years of the third quarter's data. The third quarter means are graphed in Figure 8, on page 20. The means for TCEQ's Palm site are shown for 2010 through 2013 only. The third quarter averages at UT sites from 2008 through 2013 are statistically significantly lower than in the third quarters of the project's first two years, and this finding is similar to findings for other quarters in recent reports on this project.

Table 6. Mean statistics for Benzene at Oak Park and Solar Estates, 3rd quarter 2005 – 2013, Palm 2011 – 2013, ppbV units (2013 data unvalidated)

3rd qtr/year	Oak	Solar	Palm
2005	0.302	0.268	
2006	0.520	0.322	
2007	0.421	0.248	
2008	0.226	0.169	
2009	0.281	0.119	
2010	0.271	0.155	0.203
2011	0.180	0.106	0.179
2012	0.275	0.103	0.147
2013	0.178	0.106	0.145

Figure 8. Mean concentrations of benzene during third quarters of each year at Oak Park (blue) and Solar Estates (red), 2005 – 2013 with lower values in 2008 – 2013 compared with 2005 – 2007, and Palm (green) 2011 – 2013 (2013 data unvalidated)



3. Sulfur Dioxide Measurements at Corpus Christi Monitors

Since monitoring of SO_2 began, concentrations have been high enough frequently enough that the JIH CAMS 630 site does not comply with the EPA's current SO_2 NAAQS (described on pages 11 and 12). However, concentrations appear to have declined over the course of 2012 and 2013 at JIH CAMS 630. If the lower concentrations continue through 2013, then the JIH site would come into compliance with the NAAQS.

Research to date has concluded that emissions from ships operating in the Corpus Christi ship channel and docked along the shores are major contributors to elevated SO_2 concentrations at JIH and to some extent at other sites. The main source of SO_2 is believed to be the result of

emissions from diesel engines used in dockside ships' auxiliary engines running on high-sulfur diesel fuel. However, over the course of the last half of 2012 and 2013 to date, SO_2 concentrations at JIH have been lower than early 2012 and earlier years. On June 1, 2012 new regulations for sulfur content in diesel fuel for marine vessels went into effect. Thus, both small ships motoring in the ship channel and large ships docked in the ship channel are likely now producing lower emissions of SO_2.

The change in measured concentrations at JIH CAMS 630 is reflected in Figure 9, below, showing the time series graphs for hourly SO_2 values for the third quarter by year, 2009 – 2013, and in Figure 10, on page 22, showing the graphs for hourly SO_2 values by wind direction for the third quarter by year, 2009 – 2013. The graphs for 2009, 2010, and 2011 show the episodic nature and directionality (to the south) of the SO_2 elevated concentrations.

Figure 9. Comparison of SO_2 hourly concentrations (ppb) at JIH CAMS 630 for the third quarters of 2009 through 2013

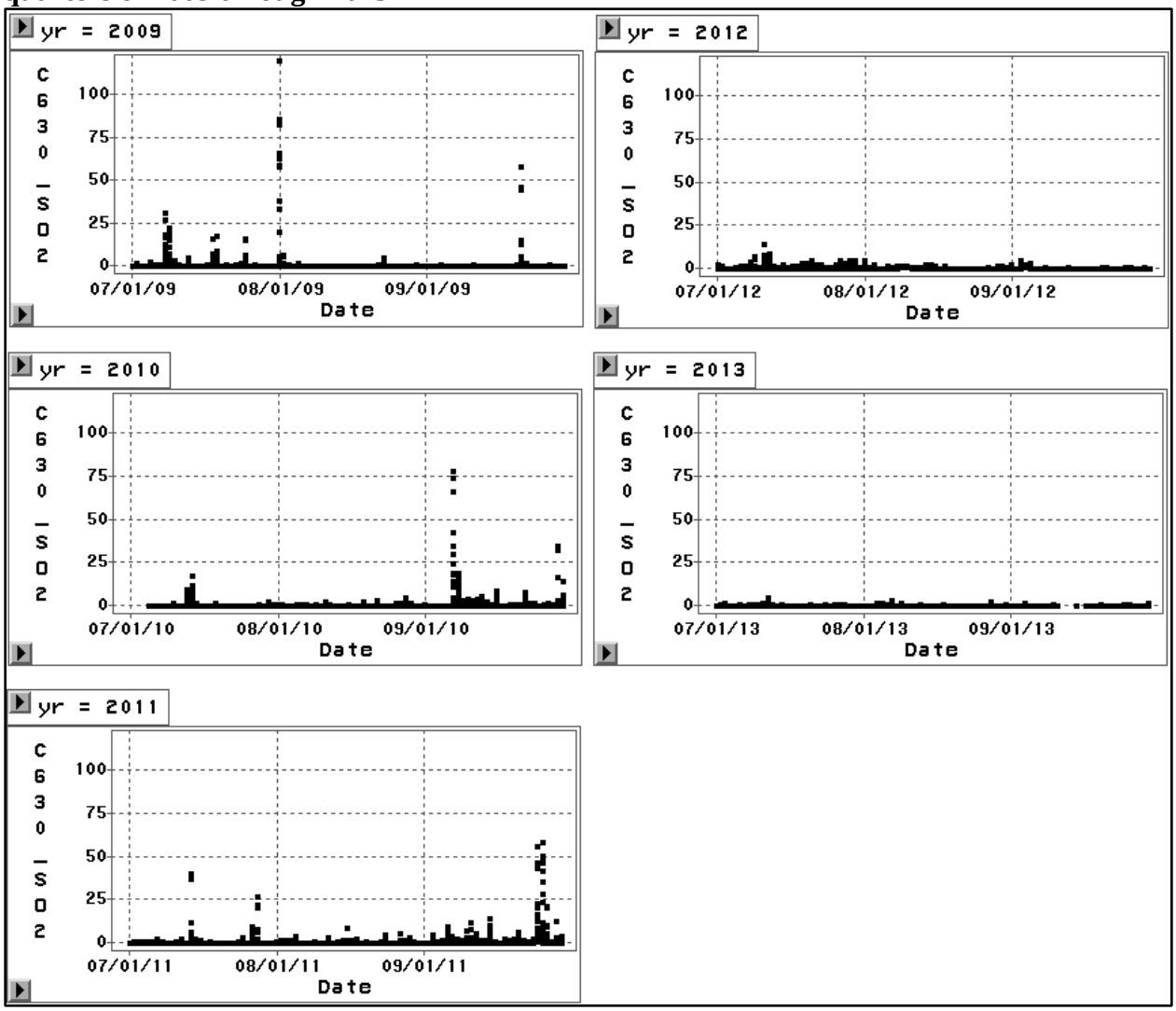
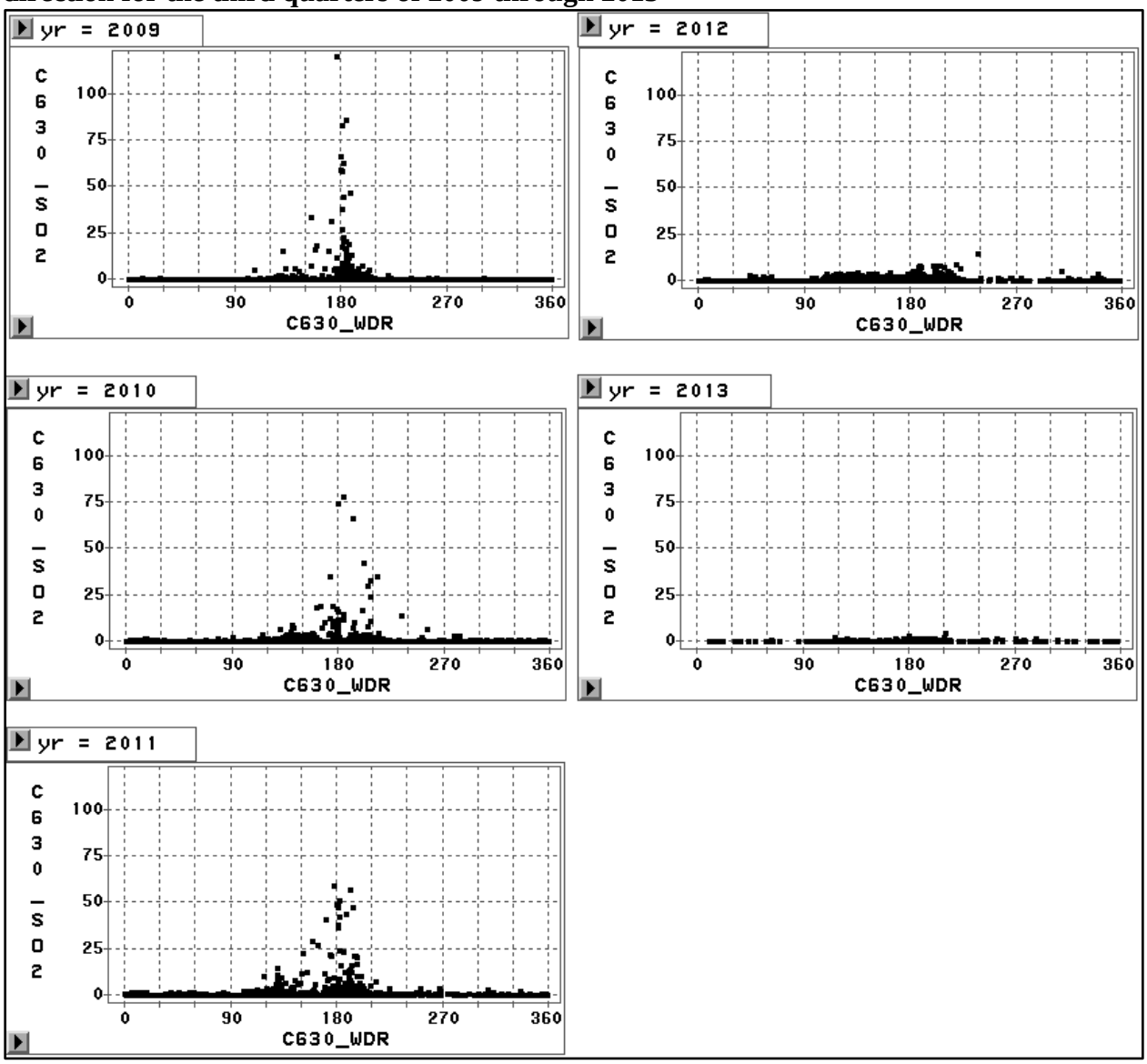


Figure 10. Comparison of SO_2 hourly concentrations (ppb) at JIH CAMS 630 by wind direction for the third quarters of 2009 through 2013



The JIH CAMS 630 site is located on the north side of the ship channel. On the south side the TCEQ contracts with URS Corp. to operate the Avery Point CAMS 6603 site. Figure 11, on page 23, shows the relative positions of these two sites in an aerial map from Google Earth Pro.

Figure 11. Aerial map of area around J. I. Hailey CAMS 630 and Avery Point CAMS 6603 (distance between sites = 0.32 miles)

In terms of third quarter data, the Avery Point site did not operate in the third quarter of the year preceding the June 1, 2012 rule on low-sulfur fuels. Figure 12, on page 24 shows the time series for hourly measurements of SO_2 at Avery Point from late-December 2011 to September 20, 2013. Although some values as high as the level of the NAAQS (75 ppb) have been recorded at Avery Point since June 1, 2012, the frequency of elevated concentrations has declined since that date. Specifically:

- Over the 153 days from December 29, 2011 to May 31, 2012, the one-hour maximum for SO_2 at Avery Point exceeded 75 ppb on ten days;
- over the 486 days from June 1, 2012 to September 30, 2013, the one-hour maximum for SO_2 at Avery Point exceeded 75 ppb on three days.

Figure 13, on page 24, shows the change in average SO_2 concentration by wind direction (five-degree bins) for the periods before and after June 1, 2012. The highest average concentrations

are still associated with the docks to the northeast and northwest. Note that the June 1, 2012 regulations only reduced SO_2 emissions, and did not completely eliminate SO_2 emissions.

Figure 12. Avery Point CAMS 6603 time series hourly SO_2 ppb units, December 29, 2011 – September 30, 2013

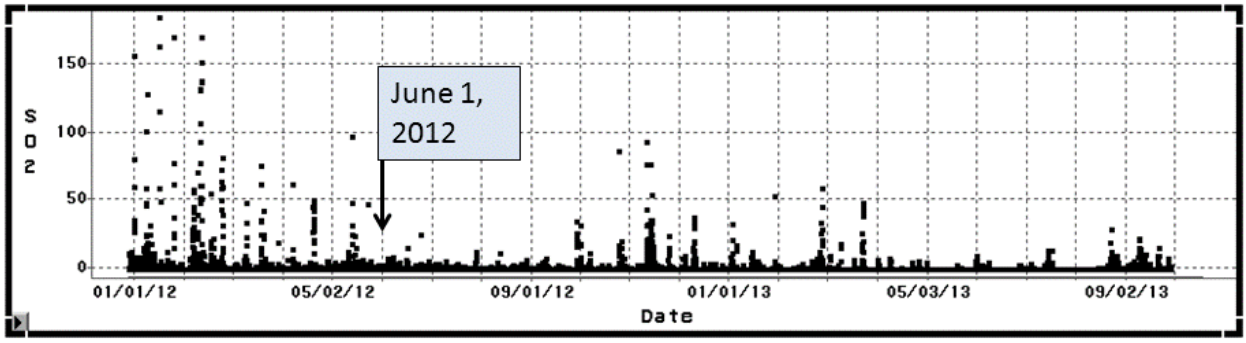
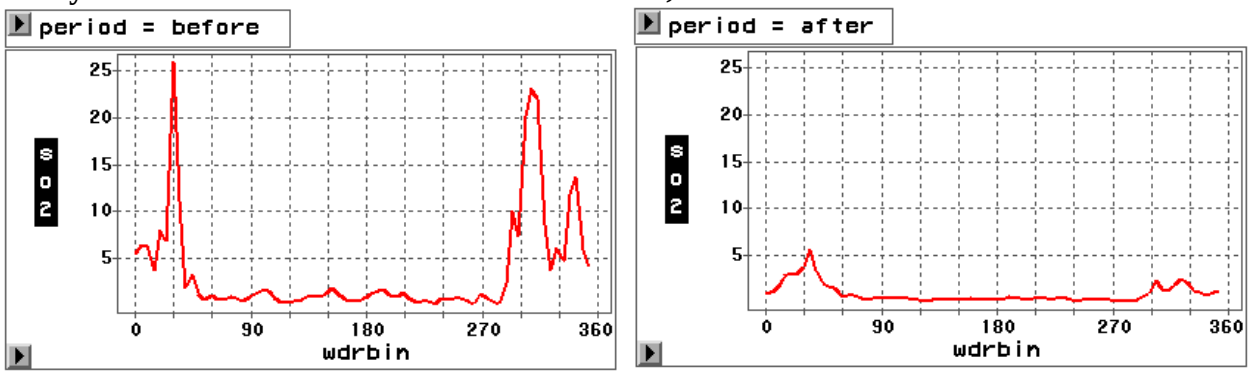


Figure 13. Average concentration of SO_2 ppb units by wind direction (5-degree bins) at Avery Point CAMS 6603 before and after June 1, 2012



Conclusions from the Third Quarter 2013 Data

In this quarter's report, several findings have been made:

- No exceedances of the EPA SO_2 NAAQS level were measured this quarter at UT sites or at TCEQ sites, including the TCEQ's Avery Point site. Dockside ship emissions that had affected the UT JIH CAMS 630 site and the Avery Point site appear to have diminished since June 2012, which is likely relatable to new federal rules on marine fuel. If trends continue, the JIH site would come into compliance with the SO_2 NAAQS after 2013.
- Second and third quarter 2013 concentrations at the auto-GCs remain well below the TCEQ's AMCVs for all species tracked for this project. Trends in quarterly average benzene concentrations remain relatively flat.
- Periodic air pollution events continue to be measured on a routine basis.

Further analyses will be provided upon request.

APPENDIX C

Financial Report of Expenditures
Financial Report of Interest Earned

Neighborhood Air Toxics Modeling Project for Houston and Corpus Christi - Phase 1B

Accounting Report for the Quarter
07/01/13 - 09/30/13

A. Total Amount of Air Toxics Funds and Other Funds Received Under This Proposal

Total Grant Amount:	$2,745,371.68
Total Interest Earned:	$390,326.78
Total Funds Received:	**$3,135,698.46**

B. Summary of Expenditures Paid by Air Toxics Funds

		Yr 1 Budget	Year 2 Budget	Adjustments Prior Quarter	Adjustments This Quarter	Adjusted Budget	Prior Activity	Current Activity 07/01/13 - 09/30/13	Encumbrances	Remaining Balance 07/01/13 - 09/30/13
Salaries-Prof	12	$111,654.00	$183,063.49	($29,495.84)	$0.00	$265,221.65	($40,679.52)	($8,573.41)	$0.00	$215,968.72
Fringe	14	$24,563.88	$40,273.97	$0.00	$0.00	$64,837.85	($12,512.38)	($2,557.61)	$0.00	$49,767.86
Salaries-CEER	15	$0.00	$0.00	$29,495.84	$0.00	$29,495.84	($13,387.58)	$0.00	$0.00	$16,108.26
Salary Holding	16	$133,401.93	$0.00	($133,401.93)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Quality Assurance	41	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Cell Phone Allowance	42	$0.00	$300.00	$60.00	$0.00	$360.00	($270.00)	($90.00)	$0.00	$0.00
SEP Reserve	43	$10,800.00	$0.00	$0.00	$0.00	$10,800.00	$0.00	$0.00	$0.00	$10,800.00
Contingency	47	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Monthly M&O	50	$0.00	$0.00	$29,657.32	$0.00	$29,657.32	($17,383.93)	($4,707.67)	($3,853.20)	$3,712.52
Equipment & Spare Parts	51	$0.00	$32,584.00	$0.00	$0.00	$32,584.00	($23,030.84)	($1,292.45)	($800.00)	$7,460.71
Telephone SWB-DSL/RR	52	$0.00	$8,454.00	$1,946.00	$0.00	$10,400.00	($6,547.87)	($2,159.60)	$0.00	$1,692.53
Electric	53	$0.00	$22,438.00	$4,062.00	$0.00	$26,500.00	($16,744.61)	($6,342.08)	$0.00	$3,413.31
Gases	54	$0.00	$10,811.00	$1,439.00	$0.00	$12,250.00	($5,634.14)	($4,760.52)	($282.06)	$1,573.28
Consultant Services - Holding	60	$80,000.00	$0.00	($80,000.00)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Consultant Services - ORSAT/TMSI	61-62	$0.00	$194,750.38	$163,777.00	$0.00	$358,527.38	($204,133.42)	($139,758.09)	$0.00	$14,635.87
Analytical	68	$0.00	$27,839.39	$12,160.61	$0.00	$40,000.00	($27,258.00)	$0.00	$0.00	$12,742.00
Travel	75	$0.00	$3,000.00	$300.00	$0.00	$3,300.00	($1,300.62)	$0.00	$0.00	$1,999.38
Equipment	80	$0.00	$0.00	$45,000.00	$0.00	$45,000.00	$0.00	$0.00	($43,700.00)	$1,300.00
Indirect Costs	90	$54,062.97	$78,527.13	$0.00	$0.00	$132,590.10	($55,332.45)	($25,536.22)	$0.00	$51,721.43
TOTALS		**$414,482.78**	**$602,041.36**	**$45,000.00**	**$0.00**	**$1,061,524.14**	**($424,215.36)**	**($195,777.65)**	**($48,635.26)**	**$392,895.87**

C. Interest Earned by Air Toxics Funds as of 07/01/13 - 09/30/13

Prior Interest Earned:	$389,864.11
Interest Earned This Quarter:	$462.67
Total Interest Earned to Date:	**$390,326.78**

D. Balance of Air Toxics Funds as of 07/01/13 - 09/30/13

Total Grant Amount:	$2,745,371.68
Total Interest Earned:	$390,326.78
Total Expenditures:	($619,993.01)
Remaining Balance:	**$2,515,705.45**

I certify that the numbers are accurate
and reflect acutal expenditures
for the quarter.

Accounting Certification
26-7700-99

Neighborhood Air Toxics Modeling Project for Houston and Corpus Christi - Stage 1 Phase 1A

Accounting Report for the Quarter
07/01/13 - 09/30/13

A. Total Amount of Air Toxics Funds and Other Funds Received Under This Proposal

Total Grant Amount:	$1,863,081.22
Total Interest Earned:	$344,222.10
Interest Transferred to Phase 1B	($344,222.10)
Total Funds Received:	**$1,863,081.22**

B. Summary of Expenditures Paid by Air Toxics Funds

		Yr 1 and Yr2 Budget	Year 3 Budget	Adjustments this Quarter	Adjusted Budget	Prior Activity	Current Activity 07/01/13 - 09/30/13	Encumbrances	Remaining Balance 07/01/13 - 09/30/13
Salaries-Prof	12	$616,882.00	$228,508.00	($95,903.26)	$749,486.74	($749,486.74)	$0.00	$0.00	$0.00
Salaries-CEER	15	$66,780.00	$24,045.00	($11,435.81)	$79,389.19	($79,389.19)	$0.00	$0.00	$0.00
Fringe	14	$149,185.00	$55,852.00	($22,669.10)	$182,367.90	($182,367.90)	$0.00	$0.00	$0.00
Supplies	50	$61,991.00	-$5,831.00	($21,633.36)	$34,526.64	($34,526.64)	$0.00	$0.00	$0.00
Contingency	51	$6,746.00	$27,805.00	($34,551.00)	$0.00	$0.00	$0.00	$0.00	$0.00
Consultants	60	$22,500.00	$2,500.00	($25,000.00)	$0.00	$0.00	$0.00	$0.00	$0.00
Subcontracts	61-63	$600,000.00	$0.00	($54,943.78)	$545,056.22	($545,056.22)	$0.00	$0.00	$0.00
Modeling/Computer Sv	67	$46,500.00	$12,500.00	($59,000.00)	$0.00	$0.00	$0.00	$0.00	$0.00
Computation Center	68	$0.00	$1,800.00	$0.00	$1,800.00	($1,800.00)	$0.00	$0.00	$0.00
Tuition	71	$17,727.00	$0.00	($125.00)	$17,602.00	($17,602.00)	$0.00	$0.00	$0.00
Travel	75	$15,000.00	$5,000.00	($17,403.03)	$2,596.97	($2,596.97)	$0.00	$0.00	$0.00
Equipment	80	$17,500.00	$7,500.00	($17,755.00)	$7,245.00	($7,245.00)	$0.00	$0.00	$0.00
Indirect Costs	90	$243,122.00	$53,952.00	($54,063.44)	$243,010.56	($243,010.56)	$0.00	$0.00	$0.00
TOTALS		$1,863,933.00	**$413,631.00**	**($414,482.78)**	**$1,863,081.22**	**($1,863,081.22)**	**$0.00**	**$0.00**	**$0.00**

C. Interest Earned by COCP Funds as of 09/30/13

Prior Interest Earned:	$344,222.10
Interest Earned This Quarter:	$0.00
Interest Transferred to Phase 1B	-$344,222.10
Total Interest Earned to Date:	**$0.00**

D. Balance of COCP Funds as of 09/30/13

Total Grant Amount:	$1,863,081.22
Total Interest Earned:	$0.00
Total Expenditures:	($1,863,081.22)
Remaining Balance:	**$0.00**

I certify that the numbers are accurate
and reflect acutal expenditures
for the quarter

Accounting Certification

11/14/2013