# AIR QUALITY RESEARCH PROGRAM

**Texas Commission on Environmental Quality**
**Contract Number 582-10-94300**
**Awarded to The University of Texas at Austin**

**Quarterly Report**

**March 1, 2014 through May 31, 2014**

**Submitted to**

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**June 10, 2014**

**Texas Air Quality Research Program**

**Quarterly Report**

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## Overview

The goals of the State of Texas Air Quality Research Program (AQRP) are:

(i) to support scientific research related to Texas air quality, in the areas of emissions inventory development, atmospheric chemistry, meteorology and air quality modeling,

(ii) to integrate AQRP research with the work of other organizations, and

(iii) to communicate the results of AQRP research to air quality decision-makers and stakeholders.

On April 30, 2010, the Texas Commission on Environmental Quality (TCEQ) contracted with the University of Texas at Austin to administer the AQRP. For the 2010-2011 biennium, the AQRP had approximately $4.9 million in funding available. Following discussions with the TCEQ and an Independent Technical Advisory Committee (ITAC) concerning research priorities, the AQRP released its first request for proposals in May 2010. Forty-five proposals, requesting $12.9 million in research funding were received. After review by the ITAC for technical merit, and by the TCEQ for relevancy to the State's air quality research needs, the results of the reviews were forwarded to the AQRP's Advisory Council, which made final funding decisions in late August 2010. A total of 15 proposals were selected for funding. As of November 30, 2011, all projects have been completed. Final reports on all but one project have been posted to the AQRP website.

In June 2011, the TCEQ renewed the AQRP for the 2012-2013 biennium. Funding of $1,000,000 for the FY 2012 period was awarded in February 2012. An additional $1,000,000 for the FY 2013 period was awarded in June 2012. At the same time an additional $160,000 was awarded for FY 2012, to support funding for two specific air quality projects recommended by the TCEQ. A call for proposals was released in May 2012. Thirty-two proposals, requesting $5 million in research funding were received. The proposals were reviewed by the ITAC and the TCEQ. The Advisory Council selected 14 projects for funding. The 2012 – 2013 research

projects were completed on November 30, 2013. The final reports for the projects have been posted to the AQRP website.

In June 2013, the TCEQ renewed the AQRP for the 2014-2015 biennium via Amendment 9 of the Grant. At this time the TCEQ also awarded an additional $2,500,000 in FY 2013 funds to the AQRP. 10 % of these funds were allocated for Project Administration, and the remaining funds were allocated to the Research program. Initiated by the renewal, the AQRP developed the FY 2014/2015 research priorities and submitted them to the ITAC for input and to the TCEQ for review.

Funding of $1,000,000 for FY 2014 and $1,000,000 for FY 2015 was awarded via Amendment 10 in October 2013. A call for proposals was released and by the November 22, 2013 due date, 31 proposals requesting $5.8 million in research funding were received. In December and January the ITAC and the TCEQ reviewed the proposals. On February 21, the Advisory Council selected 15 projects for funding, with one project on hold while TCEQ completed their review.

In early March, project Principal Investigators (PIs) were notified of the decision of the Advisory Council. AQRP Project Managers and TCEQ Project Liaisons were assigned to each project. A kick-off call was held with the project teams to discuss the development of the Work Plans which consist of the project scope of work, budget and justification, and quality assurance project plan (QAPP). The TCEQ completed their review of the final project to be recommended for funding and the Council approved the final project on April 2, 2014.

Throughout March, April, and May, project administration staff have focused on putting contracts in place with each entity involved in the research projects. Project Managers have worked with the project teams to complete and approve the Work Plans. An update of the status of each project is listed in the Research Projects section of this report.

## BACKGROUND

Section 387.010 of HB 1796 (81st Legislative Session), directs the Texas Commission on Environmental Quality (TCEQ, Commission) to establish the Texas Air Quality Research Program (AQRP).

> Sec. 387.010. AIR QUALITY RESEARCH. (a) The commission shall contract with a nonprofit organization or institution of higher education to establish and administer a program to support research related to air quality.
>
> (b) The board of directors of a nonprofit organization establishing and administering the research program related to air quality under this section may not have more than 11 members, must include two persons with relevant scientific expertise to be nominated by the commission, and may not include more than four county judges selected from counties in the Houston-Galveston-Brazoria and Dallas-Fort Worth nonattainment areas. The two persons with relevant scientific expertise to be

nominated by the commission may be employees or officers of the commission, provided that they do not participate in funding decisions affecting the granting of funds by the commission to a nonprofit organization on whose board they serve.

(c) The commission shall provide oversight as appropriate for grants provided under the program established under this section.

(d) A nonprofit organization or institution of higher education shall submit to the commission for approval a budget for the disposition of funds granted under the program established under this section.

(e) A nonprofit organization or institution of higher education shall be reimbursed for costs incurred in establishing and administering the research program related to air quality under this section. Reimbursable administrative costs of a nonprofit organization or institution of higher education may not exceed 10 percent of the program budget.

(f) A nonprofit organization that receives grants from the commission under this section is subject to Chapters 551 and 552, Government Code.

The University of Texas at Austin was selected by the TCEQ to administer the program. A contract for the administration of the AQRP was established between the TCEQ and the University of Texas at Austin on April 30, 2010 for the 2010-2011 biennium, and was renewed in June 2011 for the 2012-2013 biennium and in June 2013 for the 2014-2015 biennium. Consistent with the provisions in HB 1796, up to 10% of the available funding is to be used for program administration; the remainder (90%) of the available funding is to be used for research projects, individual project management activities, and meeting expenses associated with an Independent Technical Advisory Committee (ITAC).

## RESEARCH PROJECT CYCLE

The Research Program is being implemented through a 9 step cycle. The steps in the cycle are described from project concept generation to final project evaluation for a single project cycle.

1.) The project cycle is initiated by developing (in year 1) or updating (in subsequent years) the strategic research priorities. The AQRP Director, in consultation with the ITAC, and the TCEQ, develop research priorities; the research priorities are released along with a Request for Proposals.

2.) Project proposals relevant to the research priorities are solicited. The Request for Proposals can be found at http://aqrp.ceer.utexas.edu/ .

3.) The Independent Technical Advisory Committee (ITAC) performs a scientific and technical evaluation of the proposals.

4.) The project proposals and ITAC recommendations are forwarded to the TCEQ. The TCEQ evaluates the project recommendations from the ITAC and comments on the relevancy of the projects to the State's air quality research needs.

5.) The recommendations from the ITAC and the TCEQ are presented to the Council and the Council selects the proposals to be funded. The Council also provides comments on the strategic research priorities.

6.) All Investigators are notified of the status of their proposals, either funded, not funded, or not funded at this time, but being held for possible reconsideration if funding becomes available.

7.) Funded projects are assigned a Project Manager at UT-Austin and a Project Liaison at TCEQ. The project manager at UT-Austin is responsible for ensuring that project objectives are achieved in a timely manner and that effective communication is maintained among investigators involved in multi-institution projects. The Project Manager has responsibility for documenting progress toward project measures of success for each project. The Project Manager works with the researchers, and the TCEQ, to create an approved work plan for the project.

    The Project Manager also works with the researchers, TCEQ and the Program's Quality Assurance officer to develop an approved Quality Assurance Project Plan (QAPP) for each project. The Project Manager reviews monthly, annual and final reports from the researchers and works with the researchers to address deficiencies.

8.) The AQRP Director and the Project Manager for each project describe progress on the project in the ITAC and Council meetings dedicated to on-going project review.

9.) The project findings are communicated through multiple mechanisms. Final reports are posted to the Program web site; research briefings are developed for the public and air quality decision makers; and a bi-annual research conference/data workshop is held.

Steps 1 – 9 have all been completed for both the 2010-2011 and 2012-2013 biennia. For the 2014 – 2015 biennium Steps 1 through 6 have been completed. Steps 7 and 8 are in progress.

## RESEARCH PROJECTS

Research Projects for FY 2010-2011 and FY 2012-2013 are now completed. All projects have submitted final invoices and those invoices have been paid. The Final Report for each project is posted on the AQRP website at http://aqrp.ceer.utexas.edu/projects.cfm. A list of publications resulting from these research projects is shown below and can also be found on the AQRP website.

A final summary of the projects approved for funding for FY 2012-2013is shown below. It is followed by a description of the new projects approved for funding for FY 2014-2015.

### FY 2012 – 2013 Projects

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**Project 12-004** Active - March 1, 2013 Completed – November 30, 2013

***DISCOVER-AQ Ground Sites Infrastructure Support***

University of Texas at Austin – Vincent Torres

**Funding Amount:** $1,691,944 **Expended Amount:** $941,402.05

**Amount Returned to AQRP:** $750,541.95

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**Project 13-005** Active – January 15, 2013 Completed – November 30, 2013

***Quantification of industrial emissions of VOCs, $NO_2$ and $SO_2$ by SOF and mobile DOAS during DISCOVER AQ***

Chalmers University – Johan Mellqvist
University of Houston – Barry Lefer

**Funding Amount:** $177,553
($129,047 Chalmers, $48,506 UH)

**Expended Amount:** $173,975.24
($129,047 Chalmers, $44,928.24 UH)

**Amount Returned to AQRP:** $3,577.76
($0.00 Chalmers, $3,577.76 UH)

**Project 12-006** Active – February 8, 2013 Completed – November 30, 2013

***Environmental chamber experiments and CMAQ modeling to improve mechanisms to model ozone formation from HRVOCs***

University of California - Riverside – Gookyoung Heo
Texas A&M University – Qi Ying

**Funding Amount:** $146,259
($101,765 UC-R, $44,494 TAMU)

**Expended Amount:** $143,899.22
($101,765 UC-R, $42,134.22 TAMU)

**Amount Returned to AQRP:** $2,359.78
($0.00 UC-R, $2,359.78 TAMU)

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**Project 12-011** Active – January 17, 2013 Completed – November 30, 2013

***Investigation of Global Modeling and Lightning NOx Emissions as Sources of Regional Background Ozone in Texas***

ENVIRON International – Chris Emery

**Funding Amount:** $77,420

**Expended Amount:** $77,410.16

**Amount Returned to AQRP:** $9.84

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**Project 12-012** Active - December 19, 2012 Completed – November 30, 2013

***Interactions Between Organic Aerosol and NOy: Influence on Oxidant Production***

University of Texas at Austin – Lea H. Ruiz
ENVIRON International – Greg Yarwood

**Funding Amount:** $148,837
($79,463 UT Austin, $69,374 Environ)

**Expended Amount:** $148,546.58
($79,173.94 UT Austin, $69,372.64 Environ)

**Amount Returned to AQRP:** $290.42
($289.06 UT Austin, $1.36 Environ)

**Project 12-013** Active – December 14, 2012 Completed – November 30, 2013

***Development of Transformation Rate of $SO_2$ to Sulfate for the Houston Ship Channel using the TexAQS 2006 Field Study Data***

ENVIRON International – Ralph Morris

**Funding Amount:** $59,974 **Expended Amount:** $59,960.93

**Amount Returned to AQRP:** $13.07

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**Project 13-016** Active – November 20, 2012 Completed – November 30, 2013

***Ozonesonde launches from the University of Houston and Smith Point, Texas in Support of DISCOVER AQ***

Valparaiso University – Gary Morris
University of Houston – Barry Lefer

**Funding Amount:** $86,667
($66,821 Valparaiso, $19,846 UH)

**Expended Amount:** $80,922.40
($66,821 Valparaiso, $14,101.40 UH)

**Amount Returned to AQRP:** $5,744.60
($0.00 Valparaiso, $5,744.60 UH)

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**Project 12-018** Active – January 8, 2013 Completed – November 30, 2013

***The Effects of Uncertainties in Fire Emissions Estimates on Predictions of Texas Air Quality***

University of Texas at Austin – Elena McDonald-Buller
ENVIRON International – Chris Emery

**Funding Amount:** $106,970
($85,282 UT Austin, $21,688 Environ)

**Expended Amount:** $106,884.06
($85,197.80 UT Austin, $21,686.26 Environ)

**Amount Returned to AQRP:** $85.94
($84.20 UT Austin, $1.74 Environ)

**Project 13-022** Active – January 29, 2013 Completed – November 30, 2013

***Surface Measurements of PM, VOCs, and Photochemically Relevant Gases in Support of DISCOVER-AQ***

Rice University – Robert Griffin
University of Houston – Barry Lefer

**Funding Amount:** $206,815
($89,912 Rice, $116,903 UH)

**Expended Amount:** $192,004.33
($75,881.86 Rice, $116,122.47 UH)

**Amount Returned to AQRP:** $14,810.67
($14,030.14 Rice, $780.53 UH)

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**Project 13-024** Active – February 20, 2013 Completed – November 30, 2013

***Surface Measurement of Trace Gases in Support of DISCOVER-AQ in Houston in Summer 2013***

University of Maryland – Xinrong Ren

**Funding Amount:** $90,444

**Expended Amount:** $89,658.88

**Amount Returned to AQRP:** $785.12

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**Project 12-028** Active – January 29, 2013 Completed – November 30, 2013

***Implementation and evaluation of new HONO mechanisms in a 3-D Chemical Transport Model for Spring 2009 in Houston***

University of Houston – Barry Lefer
UCLA – Jochen Stutz
Environ – Greg Yarwood
UNC at Chapel Hill – Will Vizuette

**Funding Amount:** $117,269
($19,599 UH, $17,944 UCLA, $44,496 Environ, $35,230 UNC)

**Expended Amount:** $114,022.02
($16,586.51 UH, $17,709.51 UCLA, $44,496 Environ, $35,230 UNC)

**Amount Returned to AQRP:** $3,246.98
($3,012.49 UH, $234.49 UCLA, $0.00 Environ, $0.00 UNC)

**Project 12-032** Active – January 25, 2013 Completed – November 30, 2013

***Collect, Analyze, and Archive Filters at two DISCOVER-AQ Houston Focus Areas: Initial Characterization of PM Formation and Emission Environmental Chamber Experiments to Evaluate NOx Sinks and Recycling in Atmospheric Chemical Mechanisms***

Baylor University – Rebecca Sheesley

**Funding Amount:** $45,972 **Expended Amount:** $43,642.21

**Amount Returned to AQRP:** $2,329.79

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**Project 12-TN1** Active – February 21, 2013 Completed – November 30, 2013

***Investigation of surface layer parameterization of the WRF model and its impact on the observed nocturnal wind speed bias***

University of Maryland – Daniel Tong and Pius Lee

**Funding Amount:** $64,994 **Expended Amount:** $64,537.12

**Amount Returned to AQRP:** $456.88

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**Project 12-TN2** Active – February 21, 2013 Completed – November 30, 2013

***Development of IDL-based geospatial data processing framework for meteorology and air quality modeling***

University of Maryland – Daniel Tong
HyunCheol Kim

AQRP Project Manager – Gary McGaughey
TCEQ Project Liaison – Bright Dornblaser

**Funding Amount:** $69,985 **Expended Amount:** $68,362.27

**Amount Returned to AQRP:** $1,622.73

**FY 2014 – 2015 Projects**

**Project 14-002** **STATUS: Work Plan under Review**

***Analysis of Airborne Formaldehyde Data Over Houston Texas Acquired During the 2013 DISCOVER-AQ and SEAC4RS Campaigns***

University of Colorado - Boulder – Alan Fried
University of Maryland – Christopher Loughner
AQRP Project Manager – Gary McGaughey
TCEQ Project Liaison – Jim Smith

**Funding Amount:** $199,895
($150,508 UC-Boulder, $49,387 U of Maryland)

**Executive Summary**

During summer months the greater Houston-Galveston-Brazoria Metropolitan Area (HGBMA) often experiences elevated levels of ozone exceeding federal standards, particularly during hot and stagnant wind conditions. Although significant progress has been achieved understanding the major causes of these events over the past 10 years, there are still major unanswered questions related to sources of ozone from highly reactive volatile organic compounds (HRVOC's) emitted by large petrochemical facilities throughout the HGBMA. The toxic trace gas formaldehyde ($CH_2O$) is produced as an intermediate when these HRVOC's breakdown in the atmosphere, and ozone and radicals are formed when $CH_2O$ further breaks down. Therefore a comprehensive understanding of $CH_2O$ emissions, photochemical production rates, and transport processes is needed. Unfortunately, despite extensive efforts and advances from past studies, there are still major gaps in understanding related to the importance of directly emitted $CH_2O$ from sources such as petrochemical flaring operations and automotive emissions relative to secondarily produced $CH_2O$ from HRVOC's produced downwind, affecting large geographic areas far removed from the petrochemical facilities. Updating the emission inventories and temporal trends for $CH_2O$ and its HRVOC precursors are two additional areas requiring attention.

To address these issues, a collaborative team, comprised of scientists from the University of Colorado, the University of Maryland, and the NASA Goddard Space Flight Facility, will analyze ambient measurements of $CH_2O$ they acquired on the NASA P3 and DC-8 aircraft during the 2013 DISCOVER-AQ (Deriving Information on Surface Conditions from Column and Vertically Resolved Observations Relevant to Air Quality) and 2013 SEAC$^4$RS (Studies of Emissions and Atmospheric Composition, Clouds and Climate Coupling by Regional Surveys) studies, respectively.

The analysis will rely on the Community Multiscale Air Quality (CMAQ) model with Process Analysis, in very high-resolution mode (1 km resolution), driven by the WRF (Weather Research and Forecasting) meteorological model. The analysis will begin by identifying favorable time periods, such as Sept. 25, 2013, when sampling large petrochemical and refinery plumes under favorable meteorological conditions as well as other clearly identifiable sources (e.x., ship plumes, etc.) close to their source and downwind. The high resolution WRF-CMAQ model results will be compared with observations downwind at various times to arrive at updated

emission rates for $CH_2O$ and to help in validating the model meteorology and chemistry. The CMAQ model will be run in the Process Analysis Mode to quantify the relative importance of the major $CH_2O$ sources. The analysis will conclude with an effort to compare select airborne $CH_2O$ measurements with 24-hour averaged cartridge measurements acquired by The Texas Commission on Environmental Quality (TCEQ) every 6$^{th}$ day at the Clinton, Deer Park and Channelview sites as a means to further validate and/or provide error bounds, for such long-term $CH_2O$ data in the greater HGBMA.

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**Project 14-003** **STATUS: Active – May 28, 2014**

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***Update and evaluation of model algorithms needed to predict Particulate Matter from Isoprene***

University of North Carolina – Chapel Hill – William Vizuete

AQRP Project Manager – Elena McDonald-Buller
TCEQ Project Liaison – Jim Price

**Funding Amount:** $200,000

**Executive Summary**

Terrestrial vegetation emits into the atmosphere large quantities (~500 teragrams C) of the reactibe diolefin isoprene ($C_5H_8$). Isoprene emissions in eastern Texas and northern Louisiana are some of the largest in the United States. Photochemical oxidation of isoprene leads to significant yields of gas-phase intermediates that contribute to fine particulate matter (PM2.5). The production of isoprene-derived PM2.5 is enhanced when mixed with anthropogenic emissions from urban areas like those found in Houston. To predict PM production from isoprene requires fundamental parameters needed to describe the efficiency with which gas phase intermediates react on the surface of atmospheric particles. Recently, EPA updated a regulatory chemical mechanism to include the formation of these new gas-phase isoprene-derived intermediates. Furthermore, the project investigators recently collaborated with the EPA to update the CMAQ model to predict isoprene-derived PM explicitly across the eastern US. This updated gas- and aerosol-phase framework found in CMAQ remains to be validated against systematically conducted chamber experiments. Thus, we first propose to conduct a series of new experiments at UNC to quantitatively measure the reactive uptake of the two predominant isoprene-derived gas phase intermediates to PM of different inorganic compositions. By providing these new fundamental measurements, we will be able to more directly evaluate the aerosol-phase processes added to the model. This work will produce a model evaluation of isoprene SOA formation against existing UNC outdoor smog chamber experiments. This project will also deliver performance data needed to bound uncertainties in key parameters used by CAMx to predict isoprene derived PM. This work directly addresses the stated priority area of investigating the transformation of gas-phase pollutants to particulate matter that impact Texas air quality.

**Project 14-004** **STATUS: Work Plan under Review**

***Emission Source region contributions to a high surface ozone episode during DISCOVER-AQ***

University of Maryland – Christopher Loughner AQRP Project Manager – Gary McGaughey
Morgan State University – Melanie Follette-Cook TCEQ Project Liaison – Doug Boyer

**Funding Amount:** $109,111
($55,056 Univ. of Maryland, $54,055 Morgan State Univ.)

**Executive Summary**

The highest ozone air pollution episode in the Houston, TX region in 2013 occurred September 24-26, which coincided with the DISCOVER-AQ (Deriving Information on Surface Conditions and Vertically Resolved Observations Relevant to Air Quality) field campaign. The maximum 8-hour average ozone peaked on September 25 at LaPorte Sylvan Beach reaching 124 ppbv. We propose to analyze this air pollution episode to quantify how emissions from various source regions (i.e., Houston, Dallas, Beaumont/Port Arthur, Lake Charles, LA, Oklahoma, etc.) contributed to Houston's poor air quality. This work will examine the importance of regional emissions and transport on local air quality.

The investigators will use a combination of model simulations and space-, aircraft-, and ground-based observations to investigate the roles of both regional transport and local emissions on air quality in Houston, TX for this event. This work will improve understanding of ozone formation and accumulation by examining the spatial patterns of emissions within and outside of Texas and the transport processes that contributed to high ozone in Houston.

The investigators will use Weather Research and Forecasting (WRF) and Community Multi-scale Air quality (CMAQ) model output along with ground- and aircraft-based observations obtained during the DISCOVER-AQ field campaign to identify plumes that entered the Houston metropolitan area and contributed to high surface ozone concentrations. The investigators will identify the origins of plumes by calculating back trajectories from the WRF simulation. CMAQ simulations performed with source apportionment will be analyzed to determine the contributions of various source regions on surface ozone concentrations in the Houston metropolitan area. In addition, satellite observations (Ozone Monitoring Instrument (OMI) tropospheric nitrogen dioxide, OMI ozone profiles, Measurement Of Pollution In The Troposphere (MOPITT) carbon monoxide, and Moderate Resolution Imaging Spectrometer (MODIS) and Visible Infrared Imaging Radiometer Suite (VIIRS) aerosol optical depth) will be analyzed to determine if they were able to detect the regional transport of air pollution and subsequent buildup in the Houston metropolitan area.

**Project 14-006** **STATUS: Awaiting Contract Execution**

***Characterization of Boundary-Layer Meteorology during DISCOVER-AQ Using Radar Wind Profiler and Balloon Sounding Measurements***

Sonoma Technology, Inc. – Clinton MacDonald
Valparaiso University – Gary Morris
AQRP Project Manager – Gary McGaughey
TCEQ Project Liaison – Dave Westenbarger

**Funding Amount:** $65,588
($49,979 Sonoma Technology, $15,609 Valparaiso)

**Executive Summary**

As part of the DISCOVER-AQ (Deriving Information on Surface Conditions from Column and Vertically Resolved Observations Relevant to Air Quality) program in August and September 2013, Sonoma Technology, Inc. and the National Oceanic and Atmospheric Administration, with support from the AQRP, operated radar wind profilers (RWPs) at four sites in the greater Houston area to collect boundary layer wind data. In addition, a permanent network of three RWPs also provided data during this study. Also, Pennsylvania State University and the Valparaiso University/University of Houston team conducted daily meteorological and ozone soundings on most days during DISCOVER-AQ. The combination of these data offers a rich source of boundary layer meteorological data and can be used to provide insight into the processes that influence the air quality in Houston.

To address questions about meteorological conditions during the DISCOVER-AQ study and to provide useful information to other researchers, this project will (1) characterize boundary layer meteorological processes on all aircraft flight days and high ozone days during the DISCOVER-AQ study period; (2) provide context to the DISCOVER-AQ boundary layer characteristics by comparing them to characteristics observed on high ozone days during the TexAQS-II project in 2005 and 2006 and over the past 10 years for the month of September; and (3) provide continuous daytime boundary layer height data at the seven RWP sites for the entire study period. The results from this project will be documented in a final report, distributed to other researchers, and presented at an end-of-project meeting in Austin in June 2015.

**Project 14-007** **STATUS: Work Plan under Review**

***Improved Analysis of VOC, NO2, SO2 and HCHO data from SOF, mobile DOAS and MW-DOAS during DISCOVER-AQ***

Chalmers University – Johan Mellqvist
University of Houston – Barry Leffer
AQRP Project Manager – David Sullivan
TCEQ Project Liaison – John Jolly

**Funding Amount:** $97,260
($74,179 Chalmers, $23,081 UH)

**Executive Summary**

Mobile optical remote sensing measurements by the SOF and mobile DOAS techniques were carried out in the Houston area during September 2013 as part of the NASA Discover Air Quality experiment. Atmospheric gas column measurements of $SO_2$, $NO_2$, HCHO and VOCs were carried out in a box around the Houston Ship channel, in parallel with flights by two aircraft from NASA. In this project the collected optical remote sensing data will be reanalyzed, improved and compared to other data. In particular, the investigators will work with radiative transfer modeling to minimize cloud effects.

In addition, during the 2013 field campaign a new VOC sensor was used to map ratios of the ground concentrations of alkanes and aromatic VOCs downwind of various industries. In this project the investigators will refine the spectral analysis for measurements of the aromatic VOCs from this sensor and compare the data to parallel measurements with other techniques and write a scientific paper.

This project will support the AQRP priority research area: "Improving the understanding of ozone and particulate matter (PM) formation, and quantifying the characteristics of emissions in Texas through analysis of data collected during the DISCOVER-AQ and SEAC4RS campaigns."

**Project 14-008** **STATUS: Active – April 17, 2014**

***Investigation of Input Parameters for Biogenic Emissions Modeling in Texas during Drought Years***

The University of Texas at Austin – Elena McDonald-Buller

AQRP Project Manager – David Sullivan
TCEQ Project Liaison – Barry Exum

**Funding Amount:** $175,000

**Executive Summary**

The role of isoprene and other biogenic volatile organic compounds (BVOCs) in the formation of tropospheric ozone has been recognized as critical for air quality planning in Texas. In the southwestern United States, drought is a recurring phenomenon and, in addition to other extreme weather events, can impose profound and complex effects on human populations and the environment. Understanding these effects on vegetation and biogenic emissions is important as Texas concurrently faces requirements to achieve and maintain attainment with the National Ambient Air Quality Standard (NAAQS) for ozone in several large metropolitan areas. Previous research has indicated that biogenic emissions estimates are influenced by potentially competing effects in model input parameters during drought and that uncertainties surrounding several key input parameters remain high. The primary objective of the project is to evaluate and inform improvements in the representation of one of these key input parameters, soil moisture, through the use of simulated and observational datasets. The Model of Emissions of Gases and Aerosols from Nature (MEGAN) will be used to explore the sensitivity of biogenic emission estimates to alternative soil moisture representations.

**Project Update**

The project began on April 17, 2014. A kick-off meeting was held for the project participants to discuss available soil moisture databases and initial project activities.

**Project 14-009** **STATUS: Work Plan under Review**

***Analysis of Surface Particulate Matter and Trace Gas Data Generated during the Houston Operations of DISCOVER-AQ***

Rice University – Robert Griffin
University of Houston – Barry Lefer

AQRP Project Manager – Elena McDonald-Buller
TCEQ Project Liaison – Shantha Daniel

**Funding Amount:** $219,232
($109,867 Rice, $109,365 UH)

**Executive Summary**

In recent years, the National Aeronautics and Space Administration (NASA) has placed considerable emphasis on the use of satellite remote sensing in the measurement of species such as $O_3$ and PM that constitute air pollution. However, additional data are needed to aid in the development of methods to distinguish between low- and high-level pollution in these measurements. To that end, NASA established a program titled Deriving Information on Surface Conditions from Column and Vertically Resolved Observations Relevant to Air Quality (DISCOVER-AQ). DISCOVER-AQ began in summer 2011 with work in the Mid-Atlantic Coast that featured satellite, airborne, and ground-based sampling. The DISCOVER-AQ program conducted operations in and near Houston in September 2013.

During the Houston operations of DISCOVER-AQ, there was a need for ground-based measurement support. The predecessor to this project filled that need by providing quantitative measurements of sub-micron particle size and composition and mixing ratios of volatile organic compounds (VOCs) and other photochemically relevant gases such as $O_3$ and oxides of nitrogen ($NO_x$ = nitric oxide (NO) plus nitrogen dioxide ($NO_2$)). The instrumentation for these measurements was deployed using the University of Houston (UH) mobile laboratory. The current project focuses on the analysis of data generated during the mobile laboratory operations during DISCOVER-AQ. To date, work has focused simply on contracting issues and development of a work plan and a quality assurance plan.

**Project 14-011** **STATUS: Awaiting Council Approval**

***Targeted Improvements in the Fire Inventory from NCAR (FINN) Model for Texas Air Quality Planning***

The University of Texas at Austin – Elena McDonald-Buller
Environ – Christopher Emery

AQRP Project Manager – David Sullivan
TCEQ Project Liaison – Jim MacKay

**Funding Amount:** $179,586
($151,167 UT-Austin, $28,419 Environ)

**Executive Summary**

Wildland fires and open burning can be substantial sources of ozone precursors and particulate matter. The influence of fire events on air quality in Texas has been well documented by observational studies. During the 2012-2013 fiscal year of the Air Quality Research Program (AQRP), Dr. Elena McDonald-Buller, Dr. Christine Wiedinmyer, and Mr. Chris Emery led a project (#12-018) that evaluated the sensitivity of emissions estimates from the Fire INventory from NCAR (FINNv1; Wiedinmyer et al. 2011) to the variability in input parameters and the effects on modeled air quality using the Comprehensive Air Quality Model with Extensions (CAMx; ENVIRON, 2011). The project included an analysis of the climatology of fires in Texas and neighboring regions, comparisons of fire emission estimates between the FINN and BlueSky/SmartFire (Larkin 2009; Chinkin et al., 2009) modeling frameworks, evaluation of the sensitivity of FINN emissions estimates to key input parameters and data sources, and assessment of the effects of FINN sensitivities on Texas air quality. Among the many findings of the study were the needs for targeted improvements in land cover characterization, burned area estimation, fuel loadings, and emissions factors. These needs were particularly pronounced in areas with agricultural burning. This project addresses specific improvements in FINN that will support fire emissions estimates for Texas and the next public release of the FINN model. Fire emissions and air quality modeling will focus on 2012 to support TCEQ's air quality planning efforts.

**Project 14-016** **STATUS: Work Plan under Review**

***Improved Land Cover and Emission Factor Inputs for Estimating Biogenic Isoprene and Monoterpene Emissions for Texas Air Quality Simulations***

Environ – Greg Yarwood

AQRP Project Manager – Elena McDonald-Buller
TCEQ Project Liaison – Mark Estes

**Funding Amount:** $271,911

**Executive Summary**

The exchange of gases and aerosols between the Earth's surface and the atmosphere is an important factor in determining atmospheric composition and regional air quality. Accurate quantification of emission fluxes is a necessary step in developing air pollution control strategies. In some cases emissions can be directly measured (e.g., point sources with continuous emission monitors) or can be estimated with reasonable confidence (e.g., point sources that have well-defined operating parameters). In contrast, large uncertainties are associated with area sources including emissions from vegetation, and in particular, emissions of biogenic volatile organic compounds (BVOCs). Vegetation is the largest source of VOC emissions to the global atmosphere. The oxidation of BVOCs in the atmosphere affects ozone, aerosol and acid deposition. Current BVOC emission estimates are based on measurements for individual plants that must be scaled up to represent landscapes and adjusted for environmental conditions. There is a critical need for independent BVOC emission inputs for air quality models.

AQRP Project 14-016 will use aircraft observations from the 2013 Southeast Atmosphere Study (SAS) and the 2006 Texas Air Quality Study (TexAQS) to assess and reduce uncertainties associated with a widely-used BVOC emissions model, namely the Model of Emissions of Gases and Aerosol from Nature version (MEGAN). The eddy covariance technique will be used to directly quantify BVOC emission fluxes for all suitable aircraft observations from the SAS study. Using the relationship between BVOC fluxes and concentrations derived from this subset of SAS aircraft data, BVOC emission fluxes will be estimated for 2013 SAS and 2006 TexAQS flights in the southeastern U.S. and Texas, respectively. In addition, the investigators will improve the land cover and emission factor input data sets that are considered the major uncertainties associated with BVOC emission estimates. The overall benefit of this project will be more accurate BVOC emission estimates that can be used in Texas air quality simulations that are critical for scientific understanding and the development of effective regulatory control strategies that will enhance efforts to improve and maintain clean air.

**Project 14-017** **STATUS: Work Plan under Review**

***Incorporating Space-borne Observations to Improve Biogenic Emission Estimates in Texas***

University of Alabama - Huntsville – Arastoo Pour Biazar
Rice University – Daniel Cohan

AQRP Project Manager – Elena McDonald-Buller
TCEQ Project Liaison – Mark Estes

**Funding Amount:** $199,982
($137,003 UAH, $62,979 Rice)

**Executive Summary**

One of the challenges in understanding the Texas air quality has been the uncertainties in estimating the biogenic hydrocarbon emissions. Biogenic volatile organic compounds, BVOCs, play a critical role in atmospheric chemistry, particularly in ozone and particulate matter (PM) formation. In southeast Texas, BVOCs (mostly as isoprene) are the dominant summertime source of reactive hydrocarbon. Despite significant efforts by the State of Texas in improving BVOC estimates, the errors in emission inventories remain a concern. This is partly due to the diversity of the land use/land cover (LU/LC) over southeast Texas coupled with a complex weather pattern, and partly due to the fact that isoprene is highly reactive and relating atmospheric observations of isoprene to the emissions source (vegetation) relies on many meteorological factors that control the emission, chemistry, and atmospheric transport.

BVOC estimates depend on the amount of radiation reaching the canopy (Photosynthetically Active Radiation, PAR), and temperature. However, the treatment of temperature and PAR is not uniform across emissions models and still poses a problem when evaluating the inventories. Recent studies show that the largest uncertainty comes from the model solar radiation estimates and that using satellite-based PAR would be preferable. Emissions from soils also remain as one of the poorly quantified sources of NOx (nitrogen oxides) in most air quality models. Soils can be the largest source of NOx in rural regions where low-NOx conditions make ozone production efficiency especially high, contributing to background ozone levels.

The overall objective of the current activity is to advance our understanding of Texas Air Quality by utilizing satellite observations and the new advances in biogenic emissions modeling to improve biogenic emission estimates. This work specifically addresses a priority area in Texas AQ studies by improving biogenic emission estimates. In particular, the objectives are:

(1) To provide satellite-based PAR estimates for Texas during selected periods of 2006 and the Discover-AQ period (September, 2013).

(2) To produce an improved biogenic emission estimate for Texas and help in the evaluation of biogenic emission inventories over Texas by providing the best model representation of the atmospheric condition during the observations used for evaluation.

(3) To prepare and use a new soil NOx scheme that provides more mechanistic representation of how emissions respond to nitrogen deposition, fertilizer application, and changing meteorology.

The University of Alabama in Huntsville (UAH) currently generates a set of products from the Geostationary Operational Environmental Satellite (GOES) that includes surface incident short-wave radiation as well as cloud albedo and cloud top temperature. Under this activity, UAH will produce the Photosynthetically Active Radiation (PAR) needed in the estimation of biogenic hydrocarbon emissions. Satellite-derived PAR will be evaluated against previous satellite-based products as well as surface observations for the summer of 2006 and also during Texas Discover-AQ campaign. Furthermore, the new PAR retrievals will be used in MEGAN (the Model of Emissions of Gases and Aerosols from Nature) to generate BVOC emissions.

The new soil NOx scheme to be used is an implementation of the Berkeley-Dalhousie Soil NOx Parameterization (BDSNP) within MEGAN. A series of sensitivity simulations will be performed and evaluated against Discover-AQ observations to test the impact of satellite-derived PAR and the new soil NOx emission model on air quality simulations.

**Project 14-023** **STATUS: Active – May 23, 2014**

***Assessment of Two Remote Sensing Technologies to Control Flare Performance***

The University of Texas at Austin – Vincent Torres
Aerodyne Research, Inc. – Scott Herndon
Leak Surveys, Inc. – Joshua Furry
Providence Photonics, LLC – Yongshen Zeng

AQRP Project Manager – David Sullivan
TCEQ Project Liaison – Russell Nettles

**Funding Amount:** $480,741
($239,773 UT-Austin, $157,066 Aerodyne, $26,716 Leak Survey, $57,186 Providence Photonics)

**Executive Summary**

Industrial flares are devices used at industrial facilities to safely dispose of relief gases in an environmentally compliant manner through the use of combustion. Recent studies of industrial air- and steam-assisted flares have shown that merely complying with federal regulations like the Environmental Protection Agency's 40CFR § 60.18 and 40CFR § 63.11, do not ensure the flare will operate with at high combustion efficiency when combusting hydrocarbons over the entire range of operating scenarios for dual service flares. For vent gas streams containing hydrocarbons, the combustion efficiency (CE) is the percentage of the total hydrocarbon stream entering the flare that burns completely to form only carbon dioxide and water. It is desirable to have high combustion efficiency at all times to maximize flare performance.

The purpose of the proposed project is to conduct a series of field tests using an operational, full-scale industrial flare at a Petrologistics, LLC plant in Houston, Texas, to determine the technical, economic and operational feasibility of two approaches designed to maximize flare performance. These approaches continuously measure or determine the flare's combustion efficiency and would use this information to adjust the steam assist to the flare to adjust the flare's performance. To assess the technical performance of the approaches, the combustion efficiency measurements of each approach will be compared to an independent direct sampling measurement (the reference measurement) of the flare's combustion efficiency to determine the accuracy and completeness of the measurements obtained from the two approaches. For the field tests, the performance of the flare will not be controlled by either of the two approaches so that the prescribed test plan can be conducted with the flare. After the test series, the economic and operational feasibility will be evaluated based on the operational and safety characteristics observed during the tests and the estimated cost to implement each approach.

**Project 14-024** **STATUS: Work Plan under Review**

***Sources of Organic Particulate Matter in Houston: Evidence from DISCOVER-AQ Data, Modeling and Experiments***

The University of Texas at Austin – Lea Hildebrandt Ruiz
Environ – Greg Yarwood
University of California – Riverside – Gookyoung Heo

AQRP Project Manager – Elena McDonald-Buller
TCEQ Project Liaison – Shantha Daniel

**Funding Amount:** $300,000
($163,282 UT-Austin, $101,404 Environ, $35,314 UC – Riverside)

**Executive Summary**

The United States Environmental Protection Agency recently lowered the annual National Ambient Air Quality Standard (NAAQS) for particulate matter smaller than 2.5 μm in diameter ($PM_{2.5}$) from 15 to 12 μg $m^{-3}$. This new annual standard brings the Houston region near to non-attainment for $PM_{2.5}$, underlining the importance of understanding the composition and sources of $PM_{2.5}$ in Houston. Recent measurements made during the month of September indicate that a majority of $PM_{2.5}$ in the Houston region is composed of organic material. An improved understanding of Houston organic aerosol is therefore essential and will directly benefit the Texas Commission on Environmental Quality (TCEQ) in understanding how to manage Houston's air quality.

Project 14-024 will focus on improving our understanding of the contributions of intermediate volatility organic compounds (IVOC) to formation of secondary organic aerosol (SOA). IVOCs, specifically large alkanes and polycyclic aromatic hydrocarbons, are largely excluded from current emission inventories because these compounds fall between the definitions of volatile organic compounds (VOC) and primary organic $PM_{2.5}$. Emissions of IVOC are expected to be high in Houston, due to the combination of petrochemical industry and mobile source emissions, and the contributions of IVOC to SOA appear to be important but underestimated. Work will include analysis of recently collected ambient data during DISCOVER-AQ on PM concentration and composition, new environmental chamber experiments on the SOA formation potential of IVOC, and photochemical modeling of the Houston region. Modeling of the formation of SOA from VOC and IVOC precursors will use a new state of the art approach based on the Volatility Basis Set (VBS) that has recently been implemented in the Comprehensive Air-quality Model with extensions (CAMx).

**Project 14-025** **STATUS: Active – May 21, 2014**

***Development and Evaluation of an Interactive Sub-Grid Cloud Framework for the CAMx Photochemical Model***

Environ – Christopher Emery
Texas A&M University – John Nielson-Gammon
AQRP Project Manager – Gary McGaughey
TCEQ Project Liaison – Khalid Al-Wali

**Funding Amount:** $256,261
($135,735 Environ, $120,526 TAMU)

**Executive Summary**

The US Environmental Protection Agency (EPA) requires the use of photochemical models to demonstrate that emission control plans will achieve the federal standard for ground-level ozone (EPA, 2007). The TCEQ uses the Comprehensive Air quality Model with extensions (CAMx) for research and regulatory photochemical modeling. Previous research conducted for the TCEQ has concluded that improvements to the CAMx modeling system, including a sub-grid cloud convection treatment, are necessary to reduce model under prediction biases in oxidized nitrogen compounds in the upper troposphere. Cloud convection at sub-grid scales is an important mechanism for exchanging boundary layer air with the free troposphere and for chemical processing. The current sub-grid cloud approach within CAMx influences photolysis rates, scavenging by rainfall, and aqueous chemistry at grid scale, but does not explicitly treat these processes at cloud scale and does not include sub-grid convective transport.

Small-scale clouds are often widespread but they are not explicitly resolved by the grid scales employed in regional meteorological and photochemical modeling applications. The physical effects from these sub-grid clouds are difficult to characterize accurately, but they can substantially influence many different atmospheric processes, including: boundary layer mixing, ventilation, and deep vertical transport of heat, moisture, and chemical tracers; radiative transfer and surface heat budgets; spatio-temporal precipitation patterns, intensity and wet scavenging rates; chemistry via photolysis and aqueous reactions; and certain environmentally-sensitive emission sectors (e.g., biogenic). Cloud convection is also an important component for long-range transport of ozone, PM, and precursors. The effects of sub-grid clouds on vertical transport, chemistry, and wet scavenging are addressed to varying degrees in off-line photochemical models (i.e., models like CAMx that operate separately from meteorological models that supply environmental inputs). However, the spatio-temporal distributions of such clouds, and all the processes that occur within them, must be re-diagnosed because meteorological models do not export necessary information from their sub-grid cloud parameterizations. This leads to potentially large inconsistencies between the models.

Under this AQRP Project, ENVIRON and collaborators at the Texas A&M University (TAMU) will incorporate and extensively evaluate an explicit sub-grid cloud model within CAMx. The primary goal of this work is to introduce shallow and deep convective cloud mixing at sub-grid scales. Further, the investigators will develop an approach to improve interactions with chemistry

and wet deposition to operate explicitly at sub-grid scales in tandem with the cloud mixing scheme. The approach will tie into recent updates implemented in the Weather Research and Forecasting (WRF) model by researchers at EPA, whereby specific sub-grid cloud fields will be passed to CAMx to define their spatio-temporal distributions and mixing rates for the new sub-grid cloud algorithm. This will yield a more consistent cloud-mixing-chemistry system across the WRF and CAMx models. The new CAMx treatment will be tested for three convective episodes that occurred during the September 2013 Houston DISCOVER-AQ field study and the Spring 2008 START08 field study, particularly addressing tropospheric profiles of NOx, ozone, and other chemical tracers by comparing to in situ profiles from aircraft measurements. The new model will be provided to TCEQ to support future regulatory and research-oriented ozone and PM modeling.

**Project 14-026** **STATUS: Active – May 21, 2014**

***Quantifying ozone production from light alkenes using novel measurements of hydroxynitrate reaction products in Houston during the NASA SEAC4RS project***

Environ – Thomas Ryerson AQRP Project Manager – Gary McGaughey
California Institute of Technology – Paul Wennberg TCEQ Project Liaison – Chris Kite

**Funding Amount:** $231,182
($135,782 Environ, $95,400 CalTech)

**Executive Summary**

The objective of this project is to improve and quantify our understanding of ozone ($O_3$) and formaldehyde (HCHO) production from industrial emissions of Highly Reactive Volatile Organic Compounds (HRVOCs) in the Houston area. Aircraft flights during the National Aeronautics and Space Administration (NASA) Studies of Emissions and Atmospheric Composition, Clouds and Climate Coupling by Regional Surveys (SEAC$^4$RS) project encountered plumes with enhanced $O_3$ downwind of petrochemical facilities in Houston. For example, on 25 September 2013, ground monitoring downwind of the Ship Channel showed 5-minute average $O_3$ values peaking at 165 ppb and are associated with elevated concentrations of the oxidation products of HRVOCs. HRVOCs, specifically ethene, propene, butenes and 1,3-butadiene, have been implicated in these types of high ozone events but quantifying the relative contributions of individual HRVOCs to $O_3$ formation has been difficult.

The project objective will be accomplished by a combination of data analysis and reactive plume modeling. Data taken aboard the NASA DC-8 research aircraft during the 2013 SEAC$^4$RS project in Houston will be analyzed. Chemical compounds called β-hydroxynitrates are formed when HRVOCs react in the atmosphere in the presence of nitrogen oxides (NOx). Measurements of the $C_2$-$C_4$ hydroxynitrates aboard the DC-8 provide a novel means to link observed enhancements of $O_3$ and HCHO to reactions of specific HRVOCs. Analyzing the data will provide a robust first-order attribution of observed $O_3$ and HCHO enhancements to the oxidation of individual HRVOCs emitted from the Houston Ship Channel. The plumes of HRVOCs and $O_3$ that the DC-8 intercepted will be analyzed further to estimate what emissions of HRVOCs and NOx gave rise to each plume. A reactive plume model (SCICHEM) will be used to model these plumes and test chemical reaction mechanisms for individual HRVOCs. The model sensitivity to plume expansion rates will be evaluated to test how plume dilution influences chemical processing and therefore how grid model resolution can influence assessments for HRVOC sources. The benefits of this project to the TCEQ will be a data-driven assessment of the contributions of individual HRVOCs to $O_3$ and HCHO enhancements downwind of the Houston ship channel and improved modeling tools for assessing the air quality impacts of HRVOC emissions in the Texas State Implementation Plan (SIP).

**Project 14-029** **STATUS: Work Plan under Review**

***Spatial and temporal resolution of primary and secondary particulate matter in Houston during DISCOVER-AQ***

Baylor University – Rebecca Sheesley

AQRP Project Manager – Elena McDonald-Buller
TCEQ Project Liaison – Shantha Daniel

**Funding Amount:** $178,679

**Executive Summary**

This projects builds on a previously-funded AQRP project tasked at the initial elemental carbon (EC), organic carbon (OC), and optical black carbon (BC) characterization of particulate matter (PM) at Moody Tower and Manvel Croix during DISCOVER-AQ Houston Texas 2013 (AQRP 12-032). Under the original framework of PIs Sheesley and Usenko's AQRP ECOC Project, samples were to be collected over the entire DISCOVER-AQ sampling period at two primary sites in Houston: Moody Tower (urban) and Manvel Croix (southern suburb). Collaborations developed during the early stages of this project increased the sampling intensity at the two primary sites and expanded PM sampling efforts to Conroe (far north suburb) and La Porte (urban industrial).

The overall goals of this project are to analyze the filter samples collected in the previous project and to quantify the strength of PM formation and PM emission sources, including shipping emissions, motor vehicle exhaust, biomass burning and biogenic emissions, across the Houston metropolitan area. This work builds on the strengths of DISCOVER-AQ, specifically the spatial and temporal sampling strategies (i.e. multiple ground-based sites sampled for approximately 28 days). These strategies allows for the examination of both regional and long-range transport as well as anthropogenic and biogenic influences on air quality. The project will characterize PM through the quantification of water-soluble OC, organic tracers, EC, OC, $^{14}C$, select inorganic ions, and elemental tracers from PM filters collected from four DISCOVER-AQ anchor sites including Moody Tower, Manvel Croix, Conroe, and La Porte. PIs will apply a combination of radiocarbon source apportionment of organic and elemental carbon with source-specific organic and inorganic molecular tracers to tightly constrain urban and regional, fossil and biomass burning/biogenic sources.

**Project 14-030** **STATUS: Work Plan under Review**

***Improving Modeled Biogenic Isoprene Emissions under Drought Conditions and Evaluating Their Impact on Ozone Formation***

Texas A&M University – Qi Ying

AQRP Project Manager – Elena McDonald-Buller
TCEQ Project Liaison – Mark Estes

**Funding Amount:** $176,109

**Executive Summary**

Isoprene emitted from biogenic sources plays an important role in atmospheric chemistry that leads to the formation of ozone and secondary particulate matter (PM). Although drought has been thought to affect biogenic emissions, the capability of the current drought parameterization to adjust the impact of soil moisture on isoprene emissions has not been critically evaluated, especially under severe drought conditions in Texas. The impact of this change in isoprene emissions on regional ozone concentrations is also unclear. In this study, biogenic isoprene emissions during two seven-month episodes, one representing a relatively wet year (2007) and one representing a severe drought year (2011) will be estimated using the most recent version of the MEGAN biogenic emission model (MEGAN v2.1). Emissions during the severe drought year 2011 will be estimated using several different soil moisture parameterization schemes, including one that will be developed in this study based on additional field and climate-controlled laboratory measurements of isoprene emissions at leaf-level for selected Texas tree species. The Community Multiscale Air Quality Model (CMAQ) will be used to simulate isoprene, isoprene oxidation products and ozone concentrations during the dry and wet episodes. The predicted concentrations will be evaluated against all available measurements to evaluate the ability of different drought parameterization schemes and quantify the impact of drought on biogenic isoprene emission and ozone concentrations in Texas. Optimal configuration of the WRF model that is most appropriate for meteorology and soil moisture simulations during the drought seasons will also be investigated.

**Publications from Past Projects:**

**FY10-11**

**10-006**

Johansson, J., Johan Mellqvist, Jerker Samuelsson, Brian Offerle, Jana Moldanova , Bernhard Rappenglück, Barry Lefer, and James Flynn (2014) , Formaldehyde Quantitative Measurements and Modeling of Industrial Formaldehyde Emissions in the Greater Houston Area during Campaigns in 2009 and 2011, Journal of Geophysical Research: Atmospheres, 119, DOI: 10.1002/2013JD020159

Johansson, J. K. E., J. Mellqvist, J. Samuelsson, B. Offerle, B. Lefer, B. Rappenglück, J. Flynn, and G. Yarwood(2014), Emission measurements of alkenes, alkanes, SO2, and NO2 from stationary sources in Southeast Texas over a 5 year period using SOF and mobile DOAS, J. Geophys. Res. Atmos., 119, doi:10.1002/2013JD020485.

**10-008**

Digar, A., D.S. Cohan, X. Xiao, K.M. Foley, B. Koo, and G. Yarwood (2013). Constraining ozone-precursor responsiveness using ambient measurements. *Journal of Geophysical Research*, 118(2), 1005-1019, doi:10.1029/2012JD018100.

**10-009**

The following papers were submitted to Industrial & Engineering Chemistry Research for a Special Issue on Industrial Flaring:

Torres, V.M., Herndon, S., Wood, E., Al-Fadhli, F.M., Allen, D.T., Emissions of Nitrogen Oxides from Flares Operating at Low Flow Conditions, *Industrial & Engineering Chemistry Research,* 51, 12600-12605, DOI: 10.1021/ie300179x (2012)

Pavlovic, R.T., Al-Fadhli, Kimura, Y., Allen, D.T., and McDonald-Buller, E.C. Impacts of Emission Variability and Flare Combustion Efficiency on Ozone Formation in the Houston-Galveston-Brazoria Area, *Industrial & Engineering Chemistry Research,* 51, 12593-12599, DOI: 10.1021/ie203052w (2012).

Knighton, W.B., Herndon, S.C., Franklin, J.F., Wood, E.C., Wormhoudt, J., Brooks, W., Fortner, E.C., and Allen, D.T. Direct measurement of volatile organic compound emissions from industrial flares using real-time on-line techniques: Proton Transfer Reaction Mass Spectrometry and Tunable Infrared Laser Differential Absorption Spectroscopy, *Industrial & Engineering Chemistry Research,* 51, 12674-12684, DOI: 10.1021/ie202695v (2012)

Torres, V.M., Herndon, S., Kodesh, Z., Nettles, R., and Allen, D.T. "Industrial flare performance at low flow conditions: Part 1. Study Overview" *Industrial & Engineering Chemistry Research,* 51, 12559-12568, DOI: 10.1021/ie202674t (2012).

Torres, V.M., Herndon, S. and Allen, D.T. "Industrial flare performance at low flow conditions: Part 2. Air and Steam assisted flares" *Industrial & Engineering Chemistry Research,* 51, 12569-12576, DOI: 10.1021/ie202675f (2012)

Herndon, S.C., Nelson, D.D., Wood, E.C., Knighton, W.B., Kolb, C.E., Kodesh, Z., Torres, V.M., and Allen, D.T., Application of the carbon balance method to flare emissions characteristics, *Industrial & Engineering Chemistry Research,* 51, 12577-12585, DOI: 10.1021/ie202676b (2012)

Al-Fadhli, F.M., Kimura, Y., McDonald-Buller, E.C., and Allen, D.T. Impact of flare destruction efficiency and products of incomplete combustion on ozone formation in Houston, Texas, *Industrial & Engineering Chemistry Research,* 51, 12663-12673, DOI: 10.1021/ie201400z (2012).

The following presentations were given at the Air& Waste Management Association June 2012 Conference, and papers were published in the Conference Proceedings:

Torres, V.M., Allen, D.T., Herndon, S. and Kodesh, Z., Overview of the Texas Commission on Environmental Quality 2010 Flare Study, Air and Waste Association Annual Meeting, Extended Abstract 2012-A-437-AWMA, San Antonio, June, 2012.

Torres, V.M., Al-Fadhli, F.M., Allen, D.T., Herndon, S., and Wood, E., NOx Emissions from Industrial Flaring, Air and Waste Association Annual Meeting, Extended Abstract 2012-A-315-AWMA, San Antonio, June, 2012.

**10-015**
The following papers are currently under development:

*Measurements of Nitryl Chloride in Several Metropolitan Areas and Comparison with Regional Models*
J.M. Roberts, H. Osthoff, E.J. Williams, B. Lerner, J.A. Neuman, J.B. Nowak, S.B. Brown, W.P. Dube, N.L. Wagner, T.B. Ryerson, I.B. Pollack, J.S. Holloway, A. Middlebrook, R. Bahreini, B. Koo, G. Yarwood
In preparation for Journal of Geophysical Research

*Hydrochloric acid at the Pasadena ground site during CalNex 2010 and its role as a source of aerosol chloride*
J.M. Roberts, P.R. Veres, A.K. Cochran, C. Warneke, J. de Gouw, R. Weber, R. Ellis, T. Vandenboer, J. Murphy, B. Koo, G. Yarwood
In preparation for Journal of Geophysical Research

**10-020**
Several papers are expected to be published based on this Project. Their titles and current status are below:

Accepted in Journal of Geophysical Research:
*The Effects of NOx Control and Plume Mixing on Nighttime Chemical Processing of Plumes from Coal-Fired Power Plants.*
Steven S. Brown, William P. Dubé, Prakash Karamchandani, Greg Yarwood, Jeff Peischl, Thomas B. Ryerson, J. Andrew Neuman, John B. Nowak, John S. Holloway, Rebecca A. Washenfelder, Charles A. Brock, Gregory J. Frost, Michael, Trainer, David D. Parrish, Frederick C. Fehsenfeld and A. R. Ravishankara

In preparation for Journal of Geophysical Research:
*Biogenic VOC Oxidation and Organic Aerosol Formation within an Urban Nocturnal Boundary Layer – Aircraft Vertical Profiles in Houston, TX.*
Steven S. Brown, William P. Dubé, Roya Bahreini, Ann M. Middlebrook, Charles A. Brock, Carsten Warneke, Joost A. de Gouw, Rebecca A. Washenfelder, Elliot Atlas, Jeff Peischl, Thomas B. Ryerson, J. Andrew Neuman, Jonathan B. Nowak, Michael Trainer, David D. Parrish, Frederick C. Feshenfeld and A. R. Ravishankara

In preparation for Atmosphere:
*Reactive Plume Modeling to Investigate NOx Reactions and Transport at Night*
Prakash Karamchandani, Shu-Yun Chen, Greg Yarwood, Steven S. Brown, David Parrish

In preparation for Atmosphere:
*Modeling Overnight Power Plant Plume Impacts on Next-Day Ozone Using a Plume-in-Grid Technique*
Greg Yarwood, Chris Emery, Steven S. Brown, David Parrish

**10-021**
The Project Investigators presented findings from this project at the Air & Waste Management Association June 2012 Conference. The title of the submitted abstract was *Dry Deposition of Ozone to Built Environment Surfaces* and the authors are Yosuke Kimura, Dustin Poppendeck, Erin Darling, Elena McDonald-Buller, and Richard Corsi

**10-022**
Kanwar Devesh Singh, Preeti Gangadharan, Daniel Chen, Helen H. Lou, Xianchang Li, P. Richmond, "CFD Modeling of Laboratory Flames and an Industrial Flare," manuscript submitted to Journal of the Air & Waste Management Association (under revision).

Kanwar Devesh Singh, Preeti Gangadharan, Daniel Chen, Helen H. Lou, Xianchang Li, P. Richmond, " Parametric Study of Ethylene Flare Operations and Validation of a Reduced Combustion Mechanism," Engineering Applications of Computational Fluid Mechanics, Vol. 8, No. 2, pp. 211–228 (2014).

Hitesh S. Vaid, Kanwar Devesh Singh, Helen H. Lou, Daniel Chen, Peyton Richmond, "A Run Time Combustion Zoning Technique towards the EDC Approach in Large-Scale CFD Simulations," International Journal of Numerical Methods for Heat and Fluid Flow, Vol. 24 No. 1, 2014, pp. 21-35.

K. Singh, T. Dabade, H. Vaid, P. Gangadharan, D. Chen, H. Lou, X. Li, K. Li, C. Martin, "Computational Fluid Dynamics Modeling of Industrial Flares Operated in Stand-By Mode," Industrial Flares special issue, Ind. & Eng. Chem. Research, 51 (39), 12611-12620, October, 2012.

H. Lou, D. Chen, C. Martin, X. Li, K. Li, H. Vaid, K. Singh, P. Gangadharan, "Optimal Reduction of the C1-C3 Combustion Mechanism for the Simulation of Flaring, " Industrial & Engineering Chemistry Research, Industrial flares special issue, 51 (39), 12697-12705, October, 2012.

H. Lou, C. Martin, D. Chen, X. Li, K. Li, H. Vaid, A. Tula, K. Singh,"Validation of a Reduced Combustion Mechanism for Light Hydrocarbons," Clean Technologies and Environmental Policy, Volume 14, Issue 4, pp 737-748, August 2012, DOI 10.1007/s10098-011-0441-6.

Helen H. Lou, Christopher B. Martin, Daniel Chen, Xianchang Li, Kyuen Li, Hitesh Vaid, Anjan Tula Kumar, Kanwar Devesh Singh, & Doyle P. Bean, "A reduced reaction mechanism for the simulation in ethylene flare combustion," Clean Technologies and Environmental Policy, Volume 14, Issue 2, pp 229-239, April 2012, doi:10.1007/s10098-011-0394-9.

**10-024**
The Project Investigators have submitted articles to the following journals:
J. Geophysical Research (in revision)
Atmospheric Environment (in review)

**10-032**
Ren, X., D. van Duin, M. Cazorla, S. Chen, J. Mao, L. Zhan, W. H. Brune, J. H. Flynn, N. Grossberg, B. L. Lefer, B. Rappengluck, K. W. Wong. C. Tsai, J. Stutz, J. E. Dibb, B. T. Jobson, W. T. Luke and P. Kelley (2013), Atmospheric oxidation chemistry and ozone production: Results from SHARP 2009 in Houston, Texas, *Journal of Geophysical Research-Atmospheres,118*,5770-5780,doi:10.1002/jgrd.50342.

**10-042**
Heo, G., McDonald-Buller, E.C., Carter, W.P.L., Yarwood, G., Whitten, G.Z. and Allen, D.T. "Modeling Ozone Formation from Alkene Reactions using the Carbon Bond Chemical Mechanism, *Atmospheric Environment*, 59, 141-150, DOI: 10.1016/j.atmosenv.2012.05.042 (2012).

Heo, G. Y. Kimura, E. McDonald-Buller, D. T. Allen, G. Yarwood, G. Z. Whitten Evaluation of a New Toluene Mechanism For Carbon Bond 05 Using Environmental Chamber Data and Ambient Data, Air and Waste Management Association Annual Meeting, Paper #154, Detroit, June 2009

In preparation for Atmospheric Environment: *Environmental chamber experiments to evaluate NOx removal and recycling represented in atmospheric mechanisms for air quality modeling*
Gookyoung Heo, William Carter, Greg Yarwood, Gary Z. Whitten, David T. Allen

In preparation for Atmospheric Environment: *Evaluation of mechanisms for modeling ozone formation from isoprene in SAPRC-07 and CB6 using environmental chamber data with low initial NOx*
Gookyoung Heo, William Carter, Greg Yarwood

**10-045**
Olga Pikelnaya, James H. Flynn, Catalina Tsai, and Jochen Stutz (2013), Imaging DOAS detection of primary formaldehyde and sulfur dioxide emissions from petrochemical flares, Journal of Geophysical Reserch, Volume 118, Issue 15, pages 8716–8728, 16 August 2013, DOI: 10.1002/jgrd.50643

The following papers were submitted to Industrial & Engineering Chemistry Research for a Special Issue on Industrial Flaring. The paper edition of this special edition will come out in Fall 2012, but the online versions are available now.

Knighton, W.; Herndon, Scott; Wood, Ezra; Fortner, Edward; Onasch, Timothy; Wormhoudt, Joda; Kolb, Charles; Lee, Ben; Zavala, Miguel; Molina, Luisa; Jones, Marvin, "*Detecting fugitive emissions of 1, 3-butadiene and styrene from a petrochemical facility: An application of a mobile laboratory and a modified proton transfer reaction mass spectrometer – NO + PTR-MS"*
Status: Published Online
Wood, E.; Herndon, S.; Fortner, E.C.; Onasch, T.' Wormhoudt, J.; Kolb, C.E.; Knighton, W.B.; Lee, B.; Zavala, M.; Molina, L.; Jones, M., "*Combustion and Destruction/Removal efficiencies of in-use chemical flares in the greater Houston area"*.
Status: Published Online

This project has also resulted in the following publications:
Olga Pikelnaya, Jochen Stutz, Scott Herndon, Ezra Wood, Oluwayemisi Oluwole, George Mount, Elena Spinei, William Vizuete, Evan Couzo, "*Formaldehyde and Olefin from Large Industrial Sources (FLAIR) in Houston, TX – Campaign Overview"*, in preparation for Journal of Geophysical Research

Olga Pikelnaya, Scott Herndon, Ezra Wood, and Jochen Stutz, "*Observations of emissions from ships in the Houston Ship Channel during 2009 FLAIR campaign,"* under development.

**FY12-13**

**12-006**

Journal Papers:

Gookyoung Heo, Peng Wang, Qi Ying, Ron Thomas, William P.L. Carter. Using chemically detailed emissions data to test assumptions used in developing chemical mechanisms: a case study for southeast Texas, USA. [To be submitted to Atmospheric Environment in Summer 2014]

Peng Wang, Gookyoung Heo, William P.L. Carter, Qi Ying. Comparison of a detailed and a lumped version of SAPRC-11 photochemical mechanism during a summer ozone episode. [To be submitted to Atmospheric Environment in Summer 2014]

Gookyoung Heo, Chia-Li Chen, Ping Tang, William P.L. Carter. Evaluation of mechanisms for major terminal and internal alkenes with environmental chamber data. [To be submitted to Atmospheric Environment in Summer 2014]

Gookyoung Heo, Shunsuke Nakao, William P.L. Carter. Evaluation of mechanisms for 1,3-butadiene with environmental chamber data. [To be submitted to Atmospheric Environment in Summer 2014]

Conference Paper:

Heo, G., Carter, W.P.L., Wang, P., Ying, Q., Thomas, R. (2013). Evaluating and improving atmospheric chemical mechanisms used for modeling ozone formation from alkenes. Presented at the 12th Annual CMAS Conference, Chapel Hill, NC, October 28-30, 2013.

**12-012**

Conference presentations:

C. Faxon, J. Bean, L. Hildebrandt Ruiz. Evidence of atmospheric chlorine chemistry in Conroe, TX: Regional implications. American Chemical Society Southwest Regional Meeting, November 2013, Waco, TX.

J. Bean, C. Faxon, L. Hildebrandt Ruiz. Atmospheric processing of pollutants in the Houston Region: First insights from DISCOVER-AQ. American Chemical Society Southwest Regional Meeting, November 2013, Waco, TX.

L. Hildebrandt Ruiz, J. Bean, G. Yarwood, B. Koo, U. Nopmongcol. Formation and Gas-Particle Partitioning of Organic Nitrates: Influence on Ozone Production. American Association for Aerosol Research Annual Meeting, October 2013, Portland, OR.

Planned publications:

C. Faxon, J. Bean and L. Hildebrandt Ruiz. Preliminary title “Significant Inland Concentrations of ClNO2 Detected in Conroe TX during DISCOVER-AQ 2013”. Submission planned for August 2014.

J. Bean, C. Faxon and L. Hildebrandt Ruiz. Manuscript summarizing particle-phase measurements from DISCOVER-AQ. Submission planned for late 2014.

**13-016**
Gary Morris presented a poster entitled "Tropospheric Ozone Pollution Project (TOPP) Overview: A Context for DISCOVER-AQ Houston 2013" at the DISCOVER-AQ Science Team Meeting on February 27, 2014.

**13-024**
NASA AQAST meeting at Rice University in Houston, TX (Jan. 14-16, 2014), where Xinrong Ren gave a talk titled: "Measurements of trace gases at the Manvel Croix and Galveston sites during DISCOVER-AQ";

NASA DISCOVER-AQ science meeting at NASA Langley in Hampton, VA, where Winston Luke gave a talk titled: "NOAA/Air Resources Laboratory Surface Observations at Galveston and Manvel-Croix: Summary and Comparison with Aircraft Data".

A paper is in preparation with the intent to submit to Atmospheric Chemistry and Physics within about 6 months.

**12-028**
Implementation and Refinement of a Surface Model for HONO formation in a 3-D Chemical Transport Model. Prakash Karamchandani[1], Chris Emery[1], Greg Yarwood[1], Barry Lefer[2], Jochen Stutz[3], Evan Couzo[4], and William Vizuete[5]. ([1]ENVIRON, [2]University of Houston, [3]University of California-Los Angeles, [4]Massachusetts Institute of Technology, and [5]University of North Carolina.)

Impacts of heterogeneous HONO formation on radical sources and ozone chemistry in Houston, Texas. Evan Couzo[1], Barry Lefer[2], Jochen Stutz[3], Greg Yarwood[4], Prakash Karamchandani[4], Barron Henderson[5], and William Vizuete[1]. ([1]University of North Carolina (now at MIT), [2]University of Houston, [3]University of California-Los Angeles, [4]ENVIRON, [5]University of Florida.)

**12-032**
Poster at the American Geophysical Union national meeting (Dec 2013) *Initial characterization of surface-based carbonaceous aerosol during DISCOVER-AQ in Houston, TX* Rebecca J. Sheesley, Tate E. Barrett, Subin Yoon, Adelaide Clark and Sascha Usenko

Poster at the DISCOVER-AQ Science Working Group meeting (Feb 2014) *Initial characterization of surface-based carbonaceous aerosol during DISCOVER-AQ in Houston, TX* Rebecca J. Sheesley, Tate E. Barrett, Subin Yoon, Adelaide Clark and Sascha Usenko

Manuscript in preparation. Submission planned to Atmospheric Environment in summer 2014. Draft title: "*Initial characterization of surface-based carbonaceous aerosol during DISCOVER-AQ in Houston, TX*."

**12-TN1**

Presentation:

"A regional chemical reanalysis prototype" Pius Lee , Greg Carmichael, Tianfeng Chai, Rick Saylor, Li Pan, Hyuncheol Kim, Daniel Tong, and Ariel Stein

Poster:

"Preliminary analyses of flight measurements and CMAQ simulation during Southeast Nexus (SENEX) field experiment" Li Pan, Pius Lee , Hyun Cheol Kim, Daniel Tong ,Rick Saylor and Tianfeng Chai

Publication:

Pius Lee, Fantine Ngan, Hang Lei, Barry Baker, Bright Dornblaser, Gary McGauhey,and Daniel Tong. An Application for Improving Air Quality: a Houston Case Study, Earthzine 2014 [available at: http://www.earthzine.org/2014/03/29/an-application-for-improving-air-quality-a-houston-case-study/?shareadraft=baba698217_53330c8eab882]

**12-TN2**

The project team presented at the Community Modeling and Analysis System (CMAS) Conference in October 2013.

Presentations:

"HCHO and NO2 column comparisons between OMI, GOME-2 and CMAQ during 2013 SENEX campaign (21 slides)" Hyun Cheol Kim, Li Pan, Pius Lee, Rick Saylor, and Daniel Tong

Posters:

Fine-scale comparison of GOME-2, OMI and CMAQ NO2 columns over Southern California in 2008" Hyun Cheol Kim, Sang-Mi Lee, Fong Ngan, and Pius Lee

## FINANCIAL STATUS REPORT

Initial funding for fiscal year 2010 was established at $2,732,071.00. In late May 2010 an amendment was issued increasing the budget by $40,000. Funding for fiscal year 2011 was established at $2,106,071, for a total award of $4,878,142 for the FY 2010/2011 biennium. FY 2010 funds were fully expended in early 2012 and the FY 2011 funds expired on June 30, 2013 with a remaining balance of $0.11.

In February 2012, funding of $1,000,000 was awarded for FY 2012. In June 2012, an additional $160,000 was awarded in FY 2012 funds and $1,000,000 was awarded in FY 2013 funds, for a total of $2,160,000 in funding for the FY 2012/2013 biennium.

In April 2013, the grant was amended to reduce the FY 2012 funds by $133,693.60 and increase the FY 2011 funds by the same amount.

In June 2013, the grant was amended to increase the FY 2013 funds by $2,500,000.

In October 2013, the grant was amended to award FY 2014 funds of $1,000,000 and FY 2015 funds of $1,000,000. The budget for each fiscal year can be found in Appendix C.

FY 2012 funds were fully expended at the end of April 2014.

For each biennium (and fiscal year) the funds were distributed across several different reporting categories as required under the contract with TCEQ. The reporting categories are:

Program Administration – limited to 10% of the overall funding (per Fiscal Year)
This category includes all staffing, materials and supplies, and equipment needed to administer the overall AQRP. It also includes the costs for the Council meetings.

ITAC
These funds are to cover the costs, largely travel expenses, for the ITAC meetings.

Project Management – limited to 8.5% of the funds allocated for Research Projects
Each research project will be assigned a Project Manager to ensure that project objectives are achieved in a timely manner and that effective communication is maintained among investigators in multi-institution projects. These funds are to support the staffing and performance of project management.

Research Projects / Contractual
These are the funds available to support the research projects that are selected for funding.

### Program Administration

Program Administration includes salaries and fringe benefits for those overseeing the program as a whole, as well as, materials and supplies, travel, equipment, and other expenses. This category allows indirect costs in the amount of 10% of salaries and wages.

During the reporting period several staff members were involved, part time, in the administration of the AQRP. Dr. David Allen, Principal Investigator and AQRP Director, is responsible for the overall administration of the AQRP. James Thomas, AQRP Manager, is responsible for assisting Dr. Allen in the program administration. Maria Stanzione, AQRP Grant Manager, with assistance from Rachael Bushn, Melanie Allbritton, and Susan McCoy each provided assistance with program organization and financial management. This included managing the contracting process. Denzil Smith is responsible for the AQRP Web Page development and for data management.

Fringe benefits for the administration of the AQRP were initially budgeted to be 22% of salaries and wages across the term of the project. It should be noted that this was an estimate, and actual fringe benefit expenses have been reported for each month. The fringe benefit amount and percentage fluctuate each month depending on the individuals being paid from the account, their salary, their FTE percentage, the selected benefit package, and other variables. For example, the amount of fringe benefits is greater for a person with family medical insurance versus a person with individual medical insurance. At the end of the project, the overall total of fringe benefit expensed is expected to be at or below 22% of the total salaries and wages. Actual fringe benefit expenses to date are included in the spreadsheets above.

As discussed in previous Quarterly Reports, the AQRP Administration requested and received permission to utilize funds in future fiscal years. This is for all classes of funds including Administration, ITAC, Project Management, and Contractual. As of the writing of this report, the FY 10, 11, and 12 funds have been fully expended. This same procedure will be followed for the FY 13, 14, and 15 funds.

In May 2014, UT-Austin received a Contract Extension for the AQRP. This extension will continue the program through April 27, 2016.

Table 1: AQRP Administration Budget

**Administration Budget (includes Council Expenses)**
**FY 2010/2011**

| Budget Category | | FY10 Budget | FY11 Budget | Total | Expenses | Pending Expenses | Remaining Balance |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| Personnel/Salary | | $202,816.67 | $172,702.06 | $375,518.73 | $375,518.73 | $0.00 | $0.00 |
| Fringe Benefits | | $38,665.65 | $33,902.95 | $72,568.60 | $72,568.60 | $0.00 | $0.00 |
| Travel | | $346.85 | $0.00 | $346.85 | $346.85 | $0.00 | $0.00 |
| Supplies | | $15,096.14 | $101.25 | $15,197.39 | $15,197.39 | $0.00 | $0.00 |
| Equipment | | | | | | | |
| | | | | | | | |
| Total Direct Costs | | $256,925.31 | $206,706.26 | $463,631.57 | $463,631.57 | $0.00 | $0.00 |
| | | | | | | | |
| Authorized Indirect Costs | | $20,281.69 | $17,270.20 | $37,551.89 | $37,551.89 | $0.00 | $0.00 |
| 10% of Salaries and Wages | | | | | | | |
| **Total Costs** | | **$277,207** | **$223,976.46** | **$501,183.46** | **$501,183.46** | **$0.00** | **$0.00** |
| | | | | | | | |
| Fringe Rate | | 22% | 22% | | 19% | | |

**Administration Budget (includes Council Expenses)**
**FY 2012/2013**

| Budget Category | | FY12 Budget | FY13 Budget | Total | Expenses | Pending Expenses | Remaining Balance |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| Personnel/Salary | | $74,238.65 | $265,040.00 | $339,278.65 | $171,453.43 | $0.00 | $167,825.22 |
| Fringe Benefits | | $17,068.38 | $47,706.00 | $64,774.38 | $40,085.87 | $0.00 | $24,688.51 |
| Travel | | $339.13 | $750.00 | $1,089.13 | $339.13 | $0.00 | $750.00 |
| Supplies | | $3,560.62 | $10,000.00 | $13,560.62 | $9,151.56 | $0.00 | $4,409.06 |
| Equipment | | | | | | | |
| | | | | | | | |
| Total Direct Costs | | $95,206.78 | $323,496.00 | $418,702.78 | $221,029.99 | $0.00 | $197,672.79 |
| | | | | | | | |
| Authorized Indirect Costs | | $7,423.86 | $26,504.00 | $33,927.86 | $17,145.33 | $0.00 | $16,782.53 |
| 10% of Salaries and Wages | | | | | | | |
| **Total Costs** | | **$102,630.64** | **$350,000.00** | **$452,630.64** | **$238,175.32** | **$0.00** | **$214,455.32** |
| | | | | | | | |
| Fringe Rate | | 22% | 22% | | 23% | | |

**Administration Budget (includes Council Expenses)**
**FY 2014/2015**

| Budget Category | | FY14 Budget | FY15 Budget | Total | Expenses | Pending Expenses | Remaining Balance |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| Personnel/Salary | | $70,000.00 | $70,000.00 | $140,000.00 | $0.00 | $0.00 | $140,000.00 |
| Fringe Benefits | | $15,150.00 | $15,150.00 | $30,300.00 | $0.00 | $0.00 | $30,300.00 |
| Travel | | $350.00 | $350.00 | $700.00 | $0.00 | $0.00 | $700.00 |
| Supplies | | $7,500.00 | $7,500.00 | $15,000.00 | $0.00 | $0.00 | $15,000.00 |
| Equipment | | | | | | | |
| | | | | | | | |
| Total Direct Costs | | $93,000.00 | $93,000.00 | $186,000.00 | $0.00 | $0.00 | $186,000.00 |
| | | | | | | | |
| Authorized Indirect Costs | | $7,000.00 | $7,000.00 | $14,000.00 | $0.00 | $0.00 | $14,000.00 |
| 10% of Salaries and Wages | | | | | | | |
| **Total Costs** | | **$100,000.00** | **$100,000.00** | **$200,000.00** | **$0.00** | **$0.00** | **$200,000.00** |
| | | | | | | | |
| Fringe Rate | | 22% | 22% | | 0% | | |

## ITAC

There were no ITAC expenses during this reporting period.

Table 2: ITAC Budget

**ITAC Budget**
**FY 2010/2011**

| Budget Category | | FY10 Budget | FY11 Budget | Total Budget | Expenses | Pending Expenses | Remaining Balance |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| Personnel/Salary | | | | | | | |
| Fringe Benefits | | | | | | | |
| Travel | | $16,378.86 | $6,292.97 | $22,671.83 | $22,671.83 | $0.00 | $0.00 |
| Supplies | | $1,039.95 | $284.67 | $1,324.62 | $1,324.62 | $0.00 | $0.00 |
| | | | | | | | |
| Total Direct Costs | | $17,418.81 | $6,577.64 | $23,996.45 | $23,996.45 | $0.00 | $0.00 |
| | | | | | | | |
| Authorized Indirect Costs | | | | | | | |
| 10% of Salaries and Wages | | | | | | | |
| **Total Costs** | | **$17,418.81** | **$6,577.64** | **$23,996.45** | **$23,996.45** | **$0.00** | **$0.00** |

**ITAC Budget**
**FY 2012/2013**

| Budget Category | | FY12 Budget | FY13 Budget | Total Budget | Expenses | Pending Expenses | Remaining Balance |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| Personnel/Salary | | | | | | | |
| Fringe Benefits | | | | | | | |
| Travel | | $5,323.31 | $0.00 | $5,323.31 | $5,323.31 | $0.00 | $0.00 |
| Supplies | | $231.86 | $0.00 | $231.86 | $231.86 | $0.00 | $0.00 |
| | | | | | | | |
| Total Direct Costs | | $5,555.17 | $0.00 | $5,555.17 | $5,555.17 | $0.00 | $0.00 |
| | | | | | | | |
| Authorized Indirect Costs | | | | | | | |
| 10% of Salaries and Wages | | | | | | | |
| **Total Costs** | | **$5,555.17** | **$0.00** | **$5,555.17** | **$5,555.17** | **$0.00** | **$0.00** |

**ITAC Budget**
**FY 2014/2015**

| Budget Category | | FY14 Budget | FY15 Budget | Total Budget | Expenses | Pending Expenses | Remaining Balance |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| Personnel/Salary | | | | | | | |
| Fringe Benefits | | | | | | | |
| Travel | | $7,000.00 | $7,000.00 | $14,000.00 | $0.00 | $0.00 | $14,000.00 |
| Supplies | | $500.00 | $500.00 | $1,000.00 | $0.00 | $0.00 | $1,000.00 |
| | | | | | | | |
| Total Direct Costs | | $7,500.00 | $7,500.00 | $15,000.00 | $0.00 | $0.00 | $15,000.00 |
| | | | | | | | |
| Authorized Indirect Costs | | | | | | | |
| 10% of Salaries and Wages | | | | | | | |
| **Total Costs** | | **$7,500.00** | **$7,500.00** | **$15,000.00** | **$0.00** | **$0.00** | **$15,000.00** |

## Project Management

During this reporting period Project Managers worked with the project teams to complete the project Work Plans and begin work on the projects.

Table 3: Project Management Budget

**Project Management Budget**
**FY 2010/2011**

| Budget Category | | FY10 Budget | FY11 Budget | Total Budget | Expenses | Pending Expenses | Remaining Balance |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| Personnel/Salary | | $145,337.70 | $121,326.64 | $266,664.34 | $266,664.34 | $0.00 | $0.00 |
| Fringe Benefits | | $28,967.49 | $23,102.60 | $52,070.09 | $52,070.26 | $0.00 | ($0.17) |
| Travel | | | | | | | |
| Supplies | | $778.30 | $207.98 | $986.28 | $986.22 | $0.00 | $0.06.00 |
| | | | | | | | |
| Total Direct Costs | | $175,083.49 | $144,637.22 | $319,720.71 | $319,720.82 | $0.00 | ($0.11) |
| | | | | | | | |
| Authorized Indirect Costs | | $14,533.77 | $12,132.66 | $26,666.43 | $26,666.32 | $0.00 | $0.11 |
| 10% of Salaries and Wages | | | | | | | |
| **Total Costs** | | **$189,617.26** | **$156,769.88** | **$346,387.14** | **$346,387.14** | **$0.00** | **$0.00** |

**Project Management Budget**
**FY 2012/2013**

| Budget Category | | FY12 Budget | FY13 Budget | Total Budget | Expenses | Pending Expenses | Remaining Balance |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| Personnel/Salary | | $53,384.46 | $77,000.00 | $130,384.46 | $118,267.89 | $0.00 | $12,116.57 |
| Fringe Benefits | | $10,991.04 | $15,300.00 | $26,291.04 | $23,087.83 | $0.00 | $3,203.21 |
| Travel | | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 |
| Supplies | | $967.98 | $6,000.00 | $6,967.98 | $1,452.52 | $0.00 | $5,515.46 |
| | | | | | | | |
| Total Direct Costs | | $65,343.48 | $98,300.00 | $163,643.48 | $142,808.24 | $0.00 | $20,835.24 |
| | | | | | | | |
| Authorized Indirect Costs | | $5,338.44 | $7,700.00 | $13,038.44 | $11,826.79 | $0.00 | $1,211.65 |
| 10% of Salaries and Wages | | | | | | | |
| **Total Costs** | | **$70,681.92** | **$106,000.00** | **$176,681.92** | **$154,635.03** | **$0.00** | **$22,046.89** |

**Project Management Budget**
**FY 2014/2015**

| Budget Category | | FY14 Budget | FY15 Budget | Total Budget | Expenses | Pending Expenses | Remaining Balance |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| Personnel/Salary | | $52,000.00 | $52,000.00 | $104,000.00 | $0.00 | $0.00 | $104,000.00 |
| Fringe Benefits | | $9,300.00 | $9,300.00 | $18,600.00 | $0.00 | $0.00 | $18,600.00 |
| Travel | | | | | | | |
| Supplies | | $1,000.00 | $1,000.00 | $2,000.00 | $0.00 | $0.00 | $2,000.00 |
| | | | | | | | |
| Total Direct Costs | | $62,300.00 | $62,300.00 | $124,600.00 | $0.00 | $0.00 | $124,600.00 |
| | | | | | | | |
| Authorized Indirect Costs | | $5,200.00 | $5,200.00 | $10,400.00 | $0.00 | $0.00 | $10,400.00 |
| 10% of Salaries and Wages | | | | | | | |
| **Total Costs** | | **$67,500.00** | **$67,500.00** | **$135,000.00** | **$0.00** | **$0.00** | **$135,000.00** |

**Research Projects**

FY 2010-2011

The FY 2010 Research/Contractual budget was originally funded at $2,286,000. After all transfers, it was increased by $1,827.93. The FY 2011 Research/Contractual budget was originally funded at $1,736,063. After all transfers, it was increased by $377.62, plus an additional $116,000 from FY 2012 funds that were changed to FY 2011 funds. This is an overall net increase of $13,205.55 to the Research/Contractual funds (and net reduction in Project Management/ITAC funds). ($105,000 in FY 2012 research funds were transferred to FY 2011, the remaining $11,000 were transfers from Project Management funds.)

All FY 2010 Research Project funding was fully expensed before the expiration of FY 2010 funds in June 2012. The FY 2011 Research Project funding that remained after all FY 2011 research projects were completed was allocated to FY 2012-2013 projects. This included the funds that were reallocated from FY 2012 to FY 2011. The funds were allocated to project 13-016 Valparaiso and project 13-004 Discover AQ Infrastructure. Both projects utilized their FY 2011 funds (project 13-004 $116,000 and project 13-016 $20,168.90) by June 30, 2013. A remaining balance of $0.11 was returned to TCEQ.

Table 4 on the following 2 pages illustrates the 2010-2011 Research Projects, including the funding awarded to each project and the total expenses reported on each project through the expiration of the FY 2011 funds on June 30, 2013.

FY 2012-2013

The FY 2012 Research/Contractual budget was originally funded at $815,000. Transfers to date have increased the budget by $32,438.67. These funds were fully expended as of April 2014. The FY 2013 Research Contractual budget was originally funded at $835,000. In June 2013, Amendment 9 increased this budget by $2,100,000. (The remaining $400,000 was allocated to Admin and Project Management.) Transfers to date have increased that by an additional $109,000 for a total FY 2013 Research Contractual budget of $3,044,000. Total FY 2013 research project expenditures are $1,321,674. The funds that were not expended by the FY 2012 – 2013 research projects will be allocated to projects from the next RFP.

Funds were also transferred from the FY 13 Project Management budget to the Research Projects budget, in order to fund as many research projects as possible.

Table 5 illustrates the 2012-2013 Research Projects, including the funding awarded to each project and the total expenses reported on each project as of May 31, 2014.

FY 2014-2015

The FY 2014 and 2015 Research/Contractual budgets were originally funded at $825,000 each. Research projects are in the process of being awarded to FY 2013, 2014, and 2015 funds.

Table 4: 2010/2011 Contractual Expenses

## Contractual Expenses

| | |
|---|---|
| **FY 10 Contractual Funding** | $2,286,000 |
| **FY 10 Contractual Funding Transfers** | $1,827.93 |
| **FY 10 Total Contractual Funding** | **$2,287,827.93** |

| Project Number | | Amount Awarded (Budget) | Cumulative Expenditures | Remaining Balance |
|---|---|---|---|---|
| 10-008 | Rice University | $128,851 | $126,622.32 | $2,228.68 |
| 10-008 | Environ International | $49,945 | $49,944.78 | $0.22 |
| 10-009 | UT-Austin | $591,332 | $591,306.66 | $25.34 |
| 10-021 | UT-Austin | $248,786 | $248,786.41 | -$0.41 |
| 10-022 | Lamar University | $150,000 | $132,790.80 | $17,209.20 |
| 10-032 | University of Houston | $176,314 | $176,314 | $0 |
| 10-032 | University of New Hampshire | $23,054 | $18,850.65 | $4,203.35 |
| 10-032 | UCLA | $49,284 | $47,171.32 | $2,112.68 |
| 10-034 | University of Houston | $195,054 | $186,657.54 | $8,396.46 |
| 10-042 | Environ International | $237,481 | $237,479.31 | $1.69 |
| 10-045 | UCLA | $149,773 | $142,930.28 | $6,842.72 |
| 10-045 | UNC - Chapel Hill | $33,281 | $33,281 | $0 |
| 10-045 | Aerodyne Research Inc. | $164,988 | $164,988.10 | -$0.10 |
| 10-045 | Washington State University | $50,000 | $50,000 | $0 |
| 10-DFW | UT-Austin | $37,857 | $37,689.42 | $167.58 |
| FY 10 Total Contractual Funding Awarded | | $2,286,000 | | |
| FY 10 Contractual Funding Expended (Init. Projects) | | | $2,244,812.59 | |
| FY 10 Contractual Funds Remaining Unspent after Project Completion | | | | $41,187.41 |
| FY 10 Additional Projects | | | | |
| | Data Storage | $7,015.34 | $7,015.34 | $0 |
| 10-SOS | State of the Science | $36,000.00 | $36,000.00 | $0 |
| FY 10 Contractual Funds Expended to Date* | | | $2,287,827.93 | |
| FY 10 Contractual Funds Remaining to be Spent | | | | $0 |

| | | | | |
|---|---|---|---|---|
| **FY 11 Contractual Funding** | | $1,736,063.00 | | |
| **FY 11 Contractual Funding Transfers** | | $116,377.62 | | |
| **FY 11 Total Contractual Funding** | | **$1,852,440.62** | | |
| | | | | |
| Project Number | | Amount Awarded (Budget) | Cumulative Expenditures | Remaining Balance |
| 10-006 | Chalmers University of Tech | $262,179 | $262,179 | $0 |
| 10-006 | University of Houston | $222,483 | $217,949.11 | $4,533.89 |
| 10-015 | Environ International | $201,280 | $201,278.63 | $1.37 |
| 10-020 | Environ International | $202,498 | $202,493.48 | $4.52 |
| 10-024 | Rice University | $225,662 | $223,769.99 | $1,892.01 |
| 10-024 | University of New Hampshire | $70,747 | $70,719.78 | $27.22 |
| 10-024 | University of Michigan | $64,414 | $60,597.51 | $3,816.49 |
| 10-024 | University of Houston | $98,134 | $88,914.46 | $9,219.54 |
| 10-029 | Texas A&M University | $80,108 | $78,276.97 | $1,831.03 |
| 10-044 | University of Houston | $279,642 | $277,846.38 | $1,795.62 |
| 11-DFW | UT-Austin | $50,952 | $29,261.75 | $21,690.25 |
| FY 11 Total Contractual Funding Awarded | | $1,758,099 | | |
| FY 11 Contractual Funds Expended (Init. Projects) | | | $1,713,287.06 | |
| FY 11 Contractual Funds Remaining Unspent after Project Completion | | | | $44,811.94 |
| FY 11 Additional Projects | | | | |
| | Data Storage | $2,984.66 | $2,984.66 | $0.00 |
| | 12-016 Valparaiso | $20,168.90 | $20,168.90 | $0.00 |
| | 12-004 Discover AQ Infrastructure | $116,000.00 | $115,999.89 | $0.11 |
| FY 11 Contractual Funds Expended to Date* | | | $1,852,440.51 | |
| FY 11 Contractual Funds Remaining to be Spent | | | | $0.11 |
| | | | | |
| Total Contractual Funding | | $4,022,063.00 | | |
| Total Contractual Funding Transfers | | $118,205.55 | | |
| Total Contractual Funding Available | | $4,140,268.55 | | |
| Total Contractual Funds Expended to Date | | | $4,140,268.44 | |
| Total Contractual Funds Remaining | | | | $0.11 |

Table 5. 2012/2013 Contractual Expenses

## Contractual Expenses

| | |
|---|---|
| **FY 12 Contractual Funding** | $815,000.00 |
| **FY 12 Contractual Funding Transfers** | $32,438.67 |
| **FY 12 Total Contractual Funding** | **$847,438.67** |

| Project Number | | Amount Awarded (Budget) | Cumulative Expenditures | Remaining Balance |
|---|---|---|---|---|
| 12-004 | UT-Austin (Torres) | $20,174.10 | $20,174.10 | $0.00 |
| 12-006 | UC-Riverside | $101,765 | $101,765.00 | $0.00 |
| 12-006 | TAMU/TEES | $44,494 | $42,134.22 | $2,359.78 |
| 12-011 | Environ International | $77,420 | $77,410.16 | $9.84 |
| 12-012 | UT-Austin (Hildebrandt) | $79,463 | $79,173.94 | $289.06 |
| 12-012 | Environ International | $69,374 | $69,372.64 | $1.36 |
| 12-013 | Environ International | $59,974 | $59,960.93 | $13.07 |
| 12-018 | UT-Austin (McDonald-Buller) | $85,282 | $85,197.80 | $84.20 |
| 12-018 | Environ International | $21,688 | $21,686.26 | $1.74 |
| 12-028 | University of Houston | $19,599 | $16,586.51 | $3,012.49 |
| 12-028 | UCLA | $17,944 | $17,709.51 | $234.49 |
| 12-028 | Environ International | $44,496 | $44,496.00 | $0.00 |
| 12-028 | UNC - Chapel Hill | $35,230 | $35,230.00 | $0.00 |
| 12-032 | Baylor | $45,972 | $43,642.21 | $2,329.79 |
| 12-TN1 | Maryland | $64,994 | $64,537.12 | $456.88 |
| 12-TN2 | Maryland | $69,985 | $68,362.27 | $1,622.73 |
| FY 12 Total Contractual Funding Awarded | | $847,438.67 | | |
| FY 12 Contractual Funds Expended to Date | | | $847,438.67 | |
| FY 12 Contractual Funds Remaining to be Spent | | | | $0.00 |

NOTE:
Project 12-004 on this page and Project 13-004 on the following page were the same project, with funding split across fiscal years. After all FY12 projects were completed and fully invoiced, the remaining FY12 funds were transferred to 12-004 and 13-004 was reduced by the same amount, so that the total project budget remained the same, but all FY12 funds could be expended.

| | | | | |
|---|---|---|---|---|
| **FY 13 Contractual Funding** | | $835,000 | | |
| **FY 13 Contractual Funding Transfers** | | $2,209,000 | | |
| **FY 13 Total Contractual Funding** | | **$3,044,000** | | |
| Project Number | | Amount Awarded (Budget) | Cumulative Expenditures | Remaining Balance |
| 13-004 | UT-Austin (Torres) | $1,571,124 | $805,228.06 | $765,895.94 |
| 13-005 | Chalmers University of Tech | $129,047 | $129,047.00 | $0.00 |
| 13-005 | University of Houston | $48,506 | $44,928.24 | $3,577.76 |
| 13-016 | Valparaiso | $46,652 | $46,652.10 | $0.00 |
| 13-016 | University of Houston | $19,846 | $14,101.40 | $5,744.60 |
| 13-022 | Rice University | $89,912 | $75,881.86 | $14,030.14 |
| 13-022 | University of Houston | $116,903 | $116,122.47 | $780.53 |
| 13-024 | Maryland | $90,444 | $89,658.88 | $785.12 |
| FY 13 Total Contractual Funding Awarded | | $2,112,434 | | |
| FY 13 Contractual Funds Expended to Date | | | $1,321,620.01 | |
| FY 13 Contractual Funds Remaining to be Spent | | | | $1,722,379.99 |

NOTE:
After all FY13 projects were completed contractual funds in the amount of $1,722,326.30 remained. The funds will be utilized for new projects and will be accounted for on the following page.

| | | | | |
|---|---|---|---|---|
| **FY 13 Remaining Contractual Funding** | | **$1,722,379.99** | | |
| Project Number | | Amount Awarded (Budget) | Cumulative Expenditures | Remaining Balance |
| 14-008 | UT-Austin (McDonald-Buller) | $175,000.00 | $0.00 | $175,000.00 |
| 14-023 | UT-Austin (Torres) | $239,773.00 | $0.00 | $239,773.00 |
| | | | | |
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| | | | | |
| | | | | |
| FY 13 Total Remaining Contractual Funding Awarded | | $414,773.00 | | |
| FY 13 Remaining Contractual Funds Expended | | | $0.00 | |
| FY 13 Remaining Contractual Funds Remaining to be Spent | | | | $1,722,379.99 |
| | | | | |
| Total Contractual Funding | | $3,891,439 | | |
| Total Contractual Funding Awarded | | $2,583,832 | | |
| Total Contractual Funding Remaining to be Awarded | | $1,307,607 | | |
| Total Contractual Funds Expended to Date | | | $2,169,058.68 | |
| Total Contractual Funds Remaining to be Spent | | | | $1,722,379.99 |

# Appendix A

## Financial Reports by Fiscal Year

## FY 2010 and 2011

(Expenditures reported as of August 31, 2013.)

**Administration Budget (includes Council Expenses)**

**FY 2010**

| Budget Category | | FY10 Budget | Cumulative Expenditures | Pending Expenditures | Remaining Balance |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| Personnel/Salary | | $202,816.67 | $202,816.67 | $0.00 | $0.00 |
| Fringe Benefits | | $38,665.65 | $38,665.65 | $0.00 | $0.00 |
| Travel | | $346.85 | $346.85 | $0.00 | $0.00 |
| Supplies | | $15,096.14 | $15,096.14 | $0.00 | $0.00 |
| Equipment | | | | | |
| Other | | | | | |
| Contractual | | | | | |
| | | | | | |
| Total Direct Costs | | $256,925.31 | $256,925.31 | $0.00 | $0.00 |
| | | | | | |
| Authorized Indirect Costs | | $20,281.69 | $20,281.69 | $0.00 | $0.00 |
| 10% of Salaries and Wages | | | | | |
| **Total Costs** | | **$277,207.00** | **$277,207.00** | **$0.00** | **$0.00** |

**Administration Budget (includes Council Expenses)**

**FY 2011**

| Budget Category | | FY11 Budget | Cumulative Expenditures | Pending Expenditures | Remaining Balance |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| Personnel/Salary | | $172,702.06 | $172,702.06 | $0.00 | $0.00 |
| Fringe Benefits | | $33,902.95 | $33,902.95 | $0.00 | $0.00 |
| Travel | | | | | |
| Supplies | | $101.25 | $101.25 | $0.00 | $0.00 |
| Equipment | | | | | |
| Other | | | | | |
| Contractual | | | | | |
| | | | | | |
| Total Direct Costs | | $206,706.26 | $206,706.26 | $0.00 | $0.00 |
| | | | | | |
| Authorized Indirect Costs | | $17,270.20 | $17,270.20 | $0.00 | $0.00 |
| 10% of Salaries and Wages | | | | | |
| **Total Costs** | | **$223,976.46** | **$223,976.46** | **$0.00** | **$0.00** |

**ITAC Budget**

**FY 2010**

| Budget Category | | FY10 Budget | Cumulative Expenditures | Pending Expenditures | Remaining Balance |
|---|---|---|---|---|---|
| | | | | | |
| Personnel/Salary | | | | | |
| Fringe Benefits | | | | | |
| Travel | | $16,378.86 | $16,378.86 | $0.00 | $0.00 |
| Supplies | | $1,039.95 | $1,039.95 | $0.00 | $0.00 |
| Equipment | | | | | |
| Other | | | | | |
| | | | | | |
| Total Direct Costs | | $17,418.81 | $17,418.81 | $0.00 | $0.00 |
| | | | | | |
| Authorized Indirect Costs | | | | | |
| 10% of Salaries and Wages | | | | | |
| **Total Costs** | | **$17,418.81** | **$17,418.81** | **$0.00** | **$0.00** |

**ITAC Budget**

**FY 2011**

| Budget Category | | FY11 Budget | Cumulative Expenditures | Pending Expenditures | Remaining Balance |
|---|---|---|---|---|---|
| | | | | | |
| Personnel/Salary | | | | | |
| Fringe Benefits | | | | | |
| Travel | | $6,292.97 | $6,292.97 | $0.00 | $0.00 |
| Supplies | | $284.67 | $284.67 | $0.00 | $0.00 |
| Equipment | | | | | |
| Other | | | | | |
| | | | | | |
| Total Direct Costs | | $6,577.64 | $6,577.64 | $0.00 | $0.00 |
| | | | | | |
| Authorized Indirect Costs | | | | | |
| 10% of Salaries and Wages | | | | | |
| **Total Costs** | | **$6,577.64** | **$6,577.64** | **$0.00** | **$0.00** |

**Project Management Budget**

**FY 2010**

| Budget Category | | FY10 Budget | Cumulative Expenditures | Pending Expenditures | Remaining Balance |
|---|---|---|---|---|---|
| | | | | | |
| Personnel/Salary | | $145,337.70 | $145,337.70 | $0.00 | $0.00 |
| Fringe Benefits | | $28,967.49 | $28,967.49 | $0.00 | $0.00 |
| Travel | | | | | |
| Supplies | | $778.30 | $778.30 | $0.00 | $0.00 |
| Equipment | | | | | |
| Other | | | | | |
| | | | | | |
| Total Direct Costs | | $175,083.49 | $175,083.49 | $0.00 | $0.00 |
| | | | | | |
| Authorized Indirect Costs | | $14,533.77 | $14,533.77 | $0.00 | $0.00 |
| 10% of Salaries and Wages | | | | | |
| **Total Costs** | | **$189,617.26** | **$189,617.26** | $0.00 | $0.00 |

**Project Management Budget**

**FY 2011**

| Budget Category | | FY11 Budget | Cumulative Expenditures | Pending Expenditures | Remaining Balance |
|---|---|---|---|---|---|
| | | | | | |
| Personnel/Salary | | $121,326.64 | $121,326.64 | $0.00 | $0.00 |
| Fringe Benefits | | $23,102.60 | $23,102.77 | $0.00 | ($0.17) |
| Travel | | | | | |
| Supplies | | $207.98 | $207.92 | $0.00 | $0.06 |
| Equipment | | | | | |
| Other | | | | | |
| | | | | | |
| Total Direct Costs | | $144,637.22 | $144,637.33 | $0.00 | ($0.11) |
| | | | | | |
| Authorized Indirect Costs | | $12,132.66 | $12,132.55 | $0.00 | $0.11 |
| 10% of Salaries and Wages | | | | | |
| **Total Costs** | | **$156,769.88** | **$156,769.88** | $0.00 | **$0.00** |

**AQRP Budget**

**FY 2010**

| Budget Category | | FY10 Budget | Cumulative Expenditures | Pending Expenditures | Remaining Balance |
|---|---|---|---|---|---|
| | | | | | |
| Personnel/Salary | | $202,816.67 | $202,816.67 | $0.00 | $0.00 |
| Fringe Benefits | | $38,665.65 | $38,665.65 | $0.00 | $0.00 |
| Travel | | $346.85 | $346.85 | $0.00 | $0.00 |
| Supplies | | $15,096.14 | $15,096.14 | $0.00 | $0.00 |
| Equipment | | | | | |
| Other | | | | | |
| Contractual | | $2,287,827.93 | $2,287,827.93 | $0.00 | $0.00 |
| ITAC | | $17,418.81 | $17,418.81 | $0.00 | $0.00 |
| Project Management | | $189,617.26 | $189,617.26 | $0.00 | $0.00 |
| | | | | | |
| Total Direct Costs | | $2,751,789.31 | $2,751,789.31 | $0.00 | $0.00 |
| | | | | | |
| Authorized Indirect Costs | | $20,281.69 | $20,281.69 | $0.00 | $0.00 |
| 10% of Salaries and Wages | | | | | |
| **Total Costs** | | **$2,772,071.00** | **$2,772,071.00** | **$0.00** | **$0.00** |

**AQRP Budget**

**FY 2011**

| Budget Category | | FY11 Budget | Cumulative Expenditures | Pending Expenditures | Remaining Balance |
|---|---|---|---|---|---|
| | | | | | |
| Personnel/Salary | | $172,702.06 | $172,702.06 | $0.00 | $0.00 |
| Fringe Benefits | | $33,902.95 | $33,902.95 | $0.00 | $0.00 |
| Travel | | | | | |
| Supplies | | $101.25 | $101.25 | $0.00 | $0.00 |
| Equipment | | | | | |
| Other | | | | | |
| Contractual | | $1,852,440.62 | $1,852,440.51 | $0.00 | $0.11 |
| ITAC | | $6,577.64 | $6,577.64 | $0.00 | ($0.00) |
| Project Management | | $156,769.88 | $156,769.88 | $0.00 | $0.00 |
| | | | | | |
| Total Direct Costs | | $2,222,494.40 | $2,222,494.29 | $0.00 | $0.11 |
| | | | | | |
| Authorized Indirect Costs | | $17,270.20 | $17,270.20 | $0.00 | $0.00 |
| 10% of Salaries and Wages | | | | | |
| **Total Costs** | | **$2,239,764.60** | **$2,239,764.49** | **$0.00** | **$0.11** |

## Appendix B

## Financial Reports by Fiscal Year

## FY 2012 and 2013

(Expenditures reported as of May 31, 2014.)

**Administration Budget (includes Council Expenses)**

**FY 2012**

| Budget Category | | FY12 Budget | Cumulative Expenditures | Pending Expenditures | Remaining Balance |
|---|---|---|---|---|---|
| | | | | | |
| Personnel/Salary | | $74,238.65 | $74,238.65 | $0.00 | $0.00 |
| Fringe Benefits | | $17,068.38 | $17,068.38 | $0.00 | $0.00 |
| Travel | | $339.13 | $339.13 | $0.00 | $0.00 |
| Supplies | | $3,560.62 | $3,560.62 | $0.00 | $0.00 |
| Equipment | | | | | |
| Other | | | | | |
| Contractual | | | | | |
| | | | | | |
| Total Direct Costs | | $95,206.78 | $95,206.78 | $0.00 | $0.00 |
| | | | | | |
| Authorized Indirect Costs | | $7,423.86 | $7,423.86 | $0.00 | $0.00 |
| 10% of Salaries and Wages | | | | | |
| **Total Costs** | | **$102,630.64** | **$102,630.64** | **$0.00** | **$0.00** |

**Administration Budget (includes Council Expenses)**

**FY 2013**

| Budget Category | | FY13 Budget | Cumulative Expenditures | Pending Expenditures | Remaining Balance |
|---|---|---|---|---|---|
| | | | | | |
| Personnel/Salary | | $265,040.00 | $97,214.78 | $0.00 | $167,825.22 |
| Fringe Benefits | | $47,706.00 | $23,017.49 | $0.00 | $24,688.51 |
| Travel | | $750.00 | $0.00 | $0.00 | $750.00 |
| Supplies | | $10,000.00 | $5,590.94 | $0.00 | $4,409.06 |
| Equipment | | | | | |
| Other | | | | | |
| Contractual | | | | | |
| | | | | | |
| Total Direct Costs | | $323,496.00 | $125,823.21 | $0.00 | $197,672.79 |
| | | | | | |
| Authorized Indirect Costs | | $26,504.00 | $9,721.47 | $0.00 | $16,782.53 |
| 10% of Salaries and Wages | | | | | |
| **Total Costs** | | **$350,000.00** | **$135,544.68** | **$0.00** | **$214,455.32** |

**ITAC Budget**

**FY 2012**

| Budget Category | | FY12 Budget | Cumulative Expenditures | Pending Expenditures | Remaining Balance |
|---|---|---|---|---|---|
| | | | | | |
| Personnel/Salary | | | | | |
| Fringe Benefits | | | | | |
| Travel | | $5,323.31 | $5,323.31 | $0.00 | $0.00 |
| Supplies | | $231.86 | $231.86 | $0.00 | $0.00 |
| Equipment | | | | | |
| Other | | | | | |
| Contractual | | | | | |
| | | | | | |
| Total Direct Costs | | $5,555.17 | $5,555.17 | $0.00 | $0.00 |
| | | | | | |
| Authorized Indirect Costs | | | | | |
| 10% of Salaries and Wages | | | | | |
| **Total Costs** | | **$5,555.17** | **$5,555.17** | **$0.00** | **$0.00** |

**ITAC Budget**

**FY 2013**

| Budget Category | | FY13 Budget | Cumulative Expenditures | Pending Expenditures | Remaining Balance |
|---|---|---|---|---|---|
| | | | | | |
| Personnel/Salary | | | | | |
| Fringe Benefits | | | | | |
| Travel | | $0.00 | $0.00 | $0.00 | $0.00 |
| Supplies | | $0.00 | $0.00 | $0.00 | $0.00 |
| Equipment | | | | | |
| Other | | | | | |
| Contractual | | | | | |
| | | | | | |
| Total Direct Costs | | $0.00 | $0.00 | $0.00 | $0.00 |
| | | | | | |
| Authorized Indirect Costs | | | | | |
| 10% of Salaries and Wages | | | | | |
| **Total Costs** | | **$0.00** | **$0.00** | **$0.00** | **$0.00** |

**Project Management Budget**

**FY 2012**

| Budget Category | | FY12 Budget | Cumulative Expenditures | Pending Expenditures | Remaining Balance |
|---|---|---|---|---|---|
| | | | | | |
| Personnel/Salary | | $53,384.46 | $53,384.46 | $0.00 | $0.00 |
| Fringe Benefits | | $10,991.04 | $10,991.04 | $0.00 | $0.00 |
| Travel | | $0.00 | $0.00 | $0.00 | $0.00 |
| Supplies | | $967.98 | $967.98 | $0.00 | $0.00 |
| Equipment | | | | | |
| Other | | | | | |
| Contractual | | | | | |
| | | | | | |
| Total Direct Costs | | $65,343.48 | $65,343.48 | $0.00 | $0.00 |
| | | | | | |
| Authorized Indirect Costs | | $5,338.44 | $5,338.44 | $0.00 | $0.00 |
| 10% of Salaries and Wages | | | | | |
| **Total Costs** | | **$70,681.92** | **$70,681.92** | **$0.00** | **$0.00** |

**Project Management Budget**

**FY 2013**

| Budget Category | | FY13 Budget | Cumulative Expenditures | Pending Expenditures | Remaining Balance |
|---|---|---|---|---|---|
| | | | | | |
| Personnel/Salary | | $77,000.00 | $64,883.43 | $0.00 | $12,116.57 |
| Fringe Benefits | | $15,300.00 | $12,096.79 | $0.00 | $3,203.21 |
| Travel | | | | | |
| Supplies | | $6,000.00 | $484.54 | $0.00 | $5,515.46 |
| Equipment | | | | | |
| Other | | | | | |
| Contractual | | | | | |
| | | | | | |
| Total Direct Costs | | $98,300.00 | $77,464.76 | $0.00 | $20,835.24 |
| | | | | | |
| Authorized Indirect Costs | | $7,700.00 | $6,488.35 | $0.00 | $1,211.65 |
| 10% of Salaries and Wages | | | | | |
| **Total Costs** | | **$106,000.00** | **$89,953.11** | **$0.00** | **$22,046.89** |

**AQRP Budget**

**FY 2012**

| Budget Category | | FY12 Budget | Cumulative Expenditures | Pending Expenditures | Remaining Balance |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| Personnel/Salary | | $74,238.65 | $74,238.65 | $0.00 | $0.00 |
| Fringe Benefits | | $17,068.38 | $17,068.38 | $0.00 | $0.00 |
| Travel | | $339.13 | $339.13 | $0.00 | $0.00 |
| Supplies | | $3,560.62 | $3,560.62 | $1.07 | $0.00 |
| Equipment | | $0.00 | $0.00 | $0.00 | $0.00 |
| Other | | $0.00 | $0.00 | $0.00 | $0.00 |
| Contractual | | $847,438.67 | $847,438.67 | $0.00 | $0.00 |
| ITAC | | $5,555.17 | $5,555.17 | $0.00 | $0.00 |
| Project Management | | $70,681.92 | $70,681.92 | $0.00 | $0.00 |
| | | | | | |
| Total Direct Costs | | $1,018,882.54 | $1,018,882.54 | $0.00 | $0.00 |
| | | | | | |
| Authorized Indirect Costs | | $7,423.86 | $7,423.86 | $0.00 | $0.00 |
| 10% of Salaries and Wages | | | | | |
| **Total Costs** | | **$1,026,306.40** | **$1,026,306.40** | **$0.00** | **$0.00** |

**AQRP Budget**

**FY 2013**

| Budget Category | | FY13 Budget | Cumulative Expenditures | Pending Expenditures | Remaining Balance |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| Personnel/Salary | | $265,040.00 | $97,214.78 | $0.00 | $167,825.22 |
| Fringe Benefits | | $47,706.00 | $23,017.49 | $0.00 | $24,688.51 |
| Travel | | $750.00 | $0.00 | $0.00 | $750.00 |
| Supplies | | $10,000.00 | $5,590.94 | $0.00 | $4,409.06 |
| Equipment | | $0.00 | $0.00 | $0.00 | $0.00 |
| Other | | $0.00 | $0.00 | $0.00 | $0.00 |
| Contractual | | $3,044,000.00 | $1,321,620.01 | $0.00 | $1,722,379.99 |
| ITAC | | $0.00 | $0.00 | $0.00 | $0.00 |
| Project Management | | $106,000.00 | $83,953.11 | $0.00 | $22,046.89 |
| | | | | | |
| Total Direct Costs | | $3,473,496.00 | $1,531,396.33 | $0.00 | $1,942,099.67 |
| | | | | | |
| Authorized Indirect Costs | | $26,504.00 | $9,721.47 | $0.00 | $16,782.53 |
| 10% of Salaries and Wages | | | | | |
| **Total Costs** | | **$3,500,000.00** | **$1,541,117.80** | **$0.00** | **$1,958,882.20** |

# Appendix C

## Budgets by Fiscal Year

## FY 2014 and 2015

**Administration Budget (includes Council Expenses)**

**FY 2014**

| Budget Category | | FY14 Budget | Current Expenditures | Cumulative Expenditures | Pending Expenditures | Remaining Balance |
|---|---|---|---|---|---|---|
| | | | May 2014 | | | |
| | | | | | | |
| Personnel/Salary | | $70,000.00 | $0.00 | $0.00 | $0.00 | $70,000.00 |
| Fringe Benefits | | $15,150.00 | $0.00 | $0.00 | $0.00 | $15,150.00 |
| Travel | | $350.00 | $0.00 | $0.00 | $0.00 | $350.00 |
| Supplies | | $7,500.00 | $0.00 | $0.00 | $0.00 | $7,500.00 |
| Equipment | | | | | | |
| Other | | | | | | |
| Contractual | | | | | | |
| | | | | | | |
| Total Direct Costs | | $93,000.00 | $0.00 | $0.00 | $0.00 | $93,000.00 |
| | | | | | | |
| Authorized Indirect Costs | | $7,000.00 | $0.00 | $0.00 | $0.00 | $7,000.00 |
| 10% of Salaries and Wages | | | | | | |
| **Total Costs** | | **$100,000.00** | **$0.00** | **$0.00** | **$0.00** | **$100,000.00** |

**Administration Budget (includes Council Expenses)**

**FY 2015**

| Budget Category | | FY15 Budget | Current Expenditures | Cumulative Expenditures | Pending Expenditures | Remaining Balance |
|---|---|---|---|---|---|---|
| | | | May 2014 | | | |
| | | | | | | |
| Personnel/Salary | | $70,000.00 | $0.00 | $0.00 | $0.00 | $70,000.00 |
| Fringe Benefits | | $15,150.00 | $0.00 | $0.00 | $0.00 | $15,150.00 |
| Travel | | $350.00 | $0.00 | $0.00 | $0.00 | $350.00 |
| Supplies | | $7,500.00 | $0.00 | $0.00 | $0.00 | $7,500.00 |
| Equipment | | | | | | |
| Other | | | | | | |
| Contractual | | | | | | |
| | | | | | | |
| Total Direct Costs | | $93,000.00 | $0.00 | $0.00 | $0.00 | $93,000.00 |
| | | | | | | |
| Authorized Indirect Costs | | $7,000.00 | $0.00 | $0.00 | $0.00 | $7,000.00 |
| 10% of Salaries and Wages | | | | | | |
| **Total Costs** | | **$100,000.00** | **$0.00** | **$0.00** | **$0.00** | **$100,000.00** |

**ITAC Budget**

**FY 2014**

| Budget Category | | FY14 Budget | Current Expenditures | Cumulative Expenditures | Pending Expenditures | Remaining Balance |
|---|---|---|---|---|---|---|
| | | | May 2014 | | | |
| | | | | | | |
| Personnel/Salary | | | | | | |
| Fringe Benefits | | | | | | |
| Travel | | $7,000.00 | $0.00 | $0.00 | $0.00 | $7,000.00 |
| Supplies | | $500.00 | $0.00 | $0.00 | $0.00 | $500.00 |
| Equipment | | | | | | |
| Other | | | | | | |
| Contractual | | | | | | |
| | | | | | | |
| Total Direct Costs | | $7,500.00 | $0.00 | $0.00 | $0.00 | $7,500.00 |
| | | | | | | |
| Authorized Indirect Costs | | | | | | |
| 10% of Salaries and Wages | | | | | | |
| **Total Costs** | | **$7,500.00** | **$0.00** | **$0.00** | **$0.00** | **$7,500.00** |

**ITAC Budget**

**FY 2015**

| Budget Category | | FY15 Budget | Current Expenditures | Cumulative Expenditures | Pending Expenditures | Remaining Balance |
|---|---|---|---|---|---|---|
| | | | May 2014 | | | |
| | | | | | | |
| Personnel/Salary | | | | | | |
| Fringe Benefits | | | | | | |
| Travel | | $7,000.00 | $0.00 | $0.00 | $0.00 | $7,000.00 |
| Supplies | | $500.00 | $0.00 | $0.00 | $0.00 | $500.00 |
| Equipment | | | | | | |
| Other | | | | | | |
| Contractual | | | | | | |
| | | | | | | |
| Total Direct Costs | | $7,500.00 | $0.00 | $0.00 | $0.00 | $7,500.00 |
| | | | | | | |
| Authorized Indirect Costs | | | | | | |
| 10% of Salaries and Wages | | | | | | |
| **Total Costs** | | **$7,500.00** | **$0.00** | **$0.00** | **$0.00** | **$7,500.00** |

**Project Management Budget**

**FY 2014**

| Budget Category | | FY14 Budget | Current Expenditures May 2014 | Cumulative Expenditures | Pending Expenditures | Remaining Balance |
|---|---|---|---|---|---|---|
| Personnel/Salary | | $52,000.00 | $0.00 | $0.00 | $0.00 | $52,000.00 |
| Fringe Benefits | | $9,300.00 | $0.00 | $0.00 | $0.00 | $9,300.00 |
| Travel | | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 |
| Supplies | | $1,000.00 | $0.00 | $0.00 | $0.00 | $1,000.00 |
| Equipment | | | | | | |
| Other | | | | | | |
| Contractual | | | | | | |
| | | | | | | |
| Total Direct Costs | | $62,300.00 | $0.00 | $0.00 | $0.00 | $62,300.00 |
| | | | | | | |
| Authorized Indirect Costs | | $5,200.00 | $0.00 | $0.00 | $0.00 | $5,200.00 |
| 10% of Salaries and Wages | | | | | | |
| **Total Costs** | | **$67,500.00** | **$0.00** | **0.00** | **$0.00** | **$67,500.00** |

**Project Management Budget**

**FY 2015**

| Budget Category | | FY15 Budget | Current Expenditures May 2014 | Cumulative Expenditures | Pending Expenditures | Remaining Balance |
|---|---|---|---|---|---|---|
| Personnel/Salary | | $52,000.00 | $0.00 | $0.00 | $0.00 | $52,000.00 |
| Fringe Benefits | | $9,300.00 | $0.00 | $0.00 | $0.00 | $9,300.00 |
| Travel | | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 |
| Supplies | | $1,000.00 | $0.00 | $0.00 | $0.00 | $1,000.00 |
| Equipment | | | | | | |
| Other | | | | | | |
| Contractual | | | | | | |
| | | | | | | |
| Total Direct Costs | | $62,300.00 | $0.00 | $0.00 | $0.00 | $62,300.00 |
| | | | | | | |
| Authorized Indirect Costs | | $5,200.00 | $0.00 | $0.00 | $0.00 | $5,200.00 |
| 10% of Salaries and Wages | | | | | | |
| **Total Costs** | | **$67,500.00** | **$0.00** | **$0.00** | **$0.00** | **$67,500.00** |

**AQRP Budget**

**FY 2014**

| Budget Category | | FY14 Budget | Current Expenditures | Cumulative Expenditures | Pending Expenditures | Remaining Balance |
|---|---|---|---|---|---|---|
| | | | May 2014 | | | |
| Personnel/Salary | | $70,000.00 | $0.00 | $0.00 | $0.00 | $70,000.00 |
| Fringe Benefits | | $15,150.00 | $0.00 | $0.00 | $0.00 | $15,150.00 |
| Travel | | $350.00 | $0.00 | $0.00 | $0.00 | $350.00 |
| Supplies | | $7,500.00 | $0.00 | $0.00 | $0.00 | $7,500.00 |
| Equipment | | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 |
| Other | | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 |
| Contractual | | $825,000.00 | $0.00 | $0.00 | $0.00 | $825,000.00 |
| ITAC | | $7,500.00 | $0.00 | $0.00 | $0.00 | $7,500.00 |
| Project Management | | $67,500.00 | $0.00 | $0.00 | $0.00 | $67,500.00 |
| | | | | | | |
| Total Direct Costs | | $993,000.00 | $0.00 | $0.00 | $0.00 | $993,000.00 |
| | | | | | | |
| Authorized Indirect Costs | | $7,000.00 | $0.00 | $0.00 | $0.00 | $7,000.00 |
| 10% of Salaries and Wages | | | | | | |
| **Total Costs** | | **$1,000,000.00** | **$0.00** | **$0.00** | **$0.00** | **$1,000,000.00** |

**AQRP Budget**

**FY 2015**

| Budget Category | | FY15 Budget | Current Expenditures<br>May 2014 | Cumulative Expenditures | Pending Expenditures | Remaining Balance |
|---|---|---|---|---|---|---|
| Personnel/Salary | | $70,000.00 | $0.00 | $0.00 | $0.00 | $70,000.00 |
| Fringe Benefits | | $15,150.00 | $0.00 | $0.00 | $0.00 | $15,150.00 |
| Travel | | $350.00 | $0.00 | $0.00 | $0.00 | $350.00 |
| Supplies | | $7,500.00 | $0.00 | $0.00 | $0.00 | $7,500.00 |
| Equipment | | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 |
| Other | | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 |
| Contractual | | $825,000.00 | $0.00 | $0.00 | $0.00 | $825,000.00 |
| ITAC | | $7,500.00 | $0.00 | $0.00 | $0.00 | $7,500.00 |
| Project Management | | $67,500.00 | $0.00 | $0.00 | $0.00 | $67,500.00 |
| | | | | | | |
| Total Direct Costs | | $993,000.00 | $0.00 | $0.00 | $0.00 | $993,000.00 |
| | | | | | | |
| Authorized Indirect Costs<br>10% of Salaries and Wages | | $7,000.00 | $0.00 | $0.00 | $0.00 | $7,000.00 |
| **Total Costs** | | **$1,000,000.00** | **$0.00** | **$0.00** | **$0.00** | **$1,000,000.00** |