Alabama-Coushatta Tribe of Texas Community-Scale Air Toxics Ambient Monitoring Project Proposal 2015

1. SUMMARY INFORMATION

a) Project Title: A Real Time Air Toxics Monitoring System for Assessing Community Exposure near Tribal Oil and Gas Sites

b) Applicant Information:

Name: Alabama-Coushatta Tribe of Texas
Address: 571 State Park Road 56, Livingston, TX 77351
Contact Person: Cecilia Flores, Minerals Management Technician
Telephone: 936-933-8420; Fax: 936-563-1144
Email: flores.cecilia@actribe.org

c) Funding Requested: $750,000
d) Total Project Cost: $750,000
e) Project Period: October 1, 2015 – September 30, 2018
f) DUNS Number: 072196355
g) Funding Source: U. S. Environmental Protection Agency (EPA), CFDA# 66.034

2. WORK PLAN

a) Basis and Rationale

Alabama-Coushatta Tribe of Texas (Tribe) natural resources management programs includes the Tribal Environmental Office (TEO), Tribal Oil and Gas Department (O&G), and Tribal Forestry, and Cultural and Historic Preservation Office. The mission of the TEO is to protect the Tribe's human health and natural resources. Established in 1996, it operates under the following EPA grants: 1) General Assistance Program (GAP); and 2) Clean Water Act (CWA 106) and previously 3) Clean Air Act Section 105. The TEO's activities include: 1) building capacity and infrastructure, including planning and development; 2) administrative, technical, and legal communication; and 3) environmental education of Tribal members. The O&G program maintains complete files on production, revenue, oil & gas well files, lease agreements and all data pertaining to the Tribal minerals. The department is responsible for negotiating mineral lease agreements, evaluating well sites, monitoring gas production in real time, negotiating right of way agreements, arranging permits for land use by seismograph crews and other entities requesting temporary occupation of Tribal lands, and interacting with federal agencies. The O&G has also conducted public seminars for the benefit of Tribal members so that they will have a better understanding of the various activities associated with drilling and production.

The Alabama Coushatta Indian Reservation in Livingston, Texas is located in the heart of the Double A Wells gas/condensate field. Currently there are nine producing gas/condensate wells on Reservation land. This production has been the major source of revenue for the Tribe. Over the years, the Tribe has acquired a database consisting of thirteen square miles of 3D seismic data, well data and production data from the area surrounding the Reservation. Interpretation and evaluation of the geological and geophysical data is ongoing in an effort to study reservoir characteristics and evaluate drilling locations for future development.

The Tribe seeks not only to develop its mineral resources, but also to balance this development with the protection of human health and the environment, in the best interests of its members. The EPA's 2005 National Air Toxics Assessment (NATA) identified as high risk priorities several Hazardous Air Pollutants (HAPs) that are likely emitted by oil and gas sites. Benzene, which was identified by the NATA as a regional cancer risk driver, is a ubiquitous fugitive and combustion emission from oil and gas operations, along with other aromatic HAPs such as toluene, ethylbenzene, and xylenes. Several aldehyde HAPs are products of incomplete combustion from flares, reboilers, and compressor engines. Among the aldehydes, formaldehyde was identified by the NATA as a national cancer risk driver, acrolein as a national non-cancer risk driver, and acetaldehyde as a national cancer risk contributor.

Our proposal addresses Category 1 of the solicitation's scope of work, entitled "Community-Scale Monitoring." Specifically, we propose to deploy a real time monitoring system to enable fast, adaptive HAP monitoring of Tribal areas in the vicinity of oil and gas sites in response to reported nuisances and health symptoms, as well as rapid identification of emission points within oil and gas facilities that are likely responsible for monitored ambient peak concentrations and any associated Tribal resident complaints. Such a system will be useful not only near oil and gas sites, but anywhere industry is concentrated near residential areas, and where there are local concerns regarding human exposure to toxic air pollution. The project objectives are as follows:

- Delineate local scale HAP concentration gradients, and the extent to which high concentrations of HAPs are due to the presence of oil and gas facilities;
- Characterize and quantify emission sources, including source signatures of specific oil and gas facilities, for both routine emissions and transient emission events;
- Determine the relationship between reported health symptoms and emissions from specific oil and gas activities, such as hydraulic fracturing and flaring;
- Develop a baseline reference frame of HAP concentrations to support assessments of community exposure, health impacts, and the effectiveness of emission controls; and
- Evaluate a 3D micro-scale Eulerian air quality model for use in exposure assessment.

b) Technical Approach

The Tribe will work with the Houston Advanced Research Center (HARC) in deploying a real-time monitoring system roughly once a week for 3 years with the following capabilities:

- Mobile measurement of ambient concentrations of BTEX compounds (benzene, toluene, ethylbenzene, and xylenes), and aldehyde HAPs, including formaldehyde, acetaldehyde, and acrolein, with ~1 sec time response and sub-ppb Limit of Detection (LOD);
- Real-time broadcasting of ambient concentration data over the World Wide Web;
- Web-enabled real-time recording of citizen complaints of air quality nuisances and health symptoms via mobile smart devices; and
- Near-real time source attribution and neighborhood air quality impact assessment.

The mobile platform (see Figure 1) and basic instrumentation suite, as well as the calibration, measurement, quality assurance, and data broadcasting protocol have been described in detail by Olaguer et al. (2014). Briefly, the mobile lab consists of the following components:

- A Ford E-350 van equipped with a 225 A alternator, two deep cycle auxiliary batteries, and a square wave inverter to provide 13 A at 120 V AC of continuous electrical power;
- A global positioning system (GPS) to record the van's position;
- An ultrasonic anemometer to measure wind speed and direction, and a temperature and humidity probe, all mounted on a rotatable 3-foot pole on top of the van;
- An IONICON proton transfer reaction—mass spectrometer (PTR-MS) for measuring BTEX compounds, as well as acetaldehyde;
- A Gast vacuum compressor pump, and a ¼'' perfluoroalkoxy (PFA) sample line between the top of the rotatable pole and the PTR-MS;
- A Nafion dehumidifier to decrease interferences with water vapor; and
- A mobile hotspot for Internet access, and an onboard computer.

Figure 1. Mobile laboratory to be used as the basis for the proposed system.

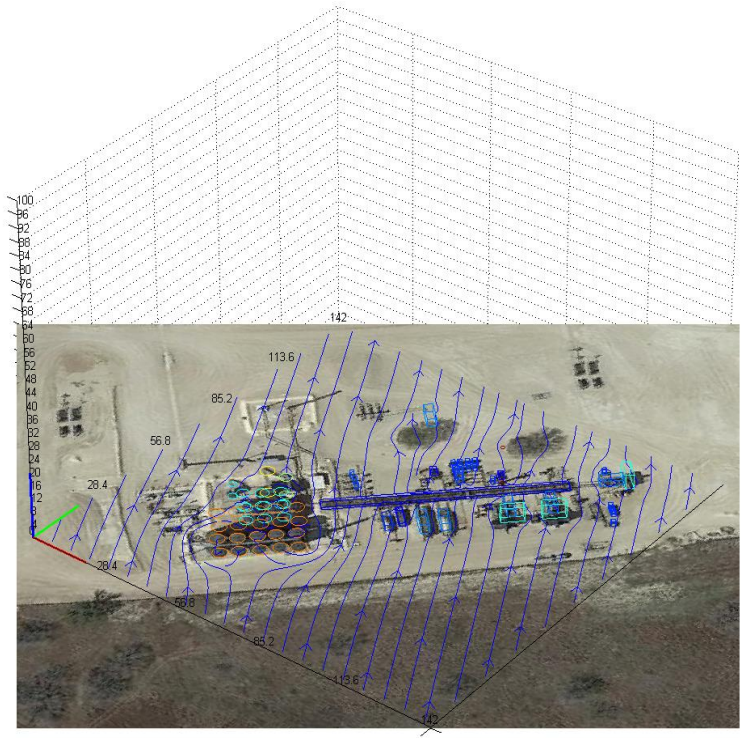
Lower left: PTR-MS
Upper left: Van cargo section and roof-mounted GPS
Center: Rotatable pole with sampling line and portable meteorological station
Upper right: Driver's station
Lower right: On-board computer and instrument operator's station.

Improvements to be made to the mobile monitoring system include the following:

- Deployment of a cryogenic trap to minimize interference with water vapor beyond the capability of the Nafion dryer, and to improve the transmission of formaldehyde through the dehumidifier unit to the PTR-MS (Jobson and McCoskey, 2010); and
- Implementation of a bisulfite solution scrubber system to resolve isobaric aldehyde/ alkene interferences in PTR-MS measurements of acrolein (Knighton et al., 2007).

The instrument readings will be sent to a Cloud database hosted on Amazon Web Services using custom-coded LabView software on the onboard computer. The database will be monitored in real time for updates from the mobile laboratory and securely recorded in a Javascript-based Web-mapping application to display the location of the van on a map, as well as the readings of the various instruments in tables in charts for live monitoring in a Web browser (see Figure 2). The broadcast data will be visible to Tribal residents, who will report air quality nuisances, industrial emission events, and possible associated health symptoms at the time of occurrence using mobile device and Web application software to be developed by HARC.

Figure 2. Hypothetical Web browser screenshot of the real-time data broadcasting system.



References

Jobson, B. T. and J. K. McCoskey, 2010. Sample drying to improve HCHO measurements by PTR-MS instruments: Laboratory and field measurements. *Atmos. Chem. Phys.*, *10*, 1821-1835.

Knighton, W. B. et al., 2007. Laboratory evaluation of an aldehyde scrubber system specifically for the detection of acrolein. *J. Air Waste Manag. Assoc.*, *57*, 1370-1378.

Olaguer, E. P. et al., 2014. New methods for assessing the impacts of nearby gas drilling and production on neighborhood air quality and human health. *Environ. Health Insights*, accepted.

Figure 3. Digital morphological model of a typical oil and gas production facility, together with wind streamlines (blue contours with arrows) predicted by the QUIC model at the surface.

c) Data Analysis

Source attribution and plume reconstruction will be performed using two published and peer-reviewed models: 1) the Quick Urban Industrial Complex (QUIC) wind model (Singh et al., 2008); and 2) the HARC 3D micro-scale forward and adjoint air quality model (Olaguer, 2012; Olaguer, 2013; Olaguer et al., 2013). We will construct 3D morphological models of oil and gas sites and surrounding Tribal areas based on industrial permits and aerial and surface photography for use in wind simulations with the QUIC model, as demonstrated in Figure 3. The QUIC model output will then be fed to the HARC air quality model for use in source attribution and plume reconstruction on a fast GPU workstation based on mobile lab observations within ~1 hour after monitoring has been performed. This will enable adaptive monitoring of suspected sources.

Table 1. Flare emissions inferred by Olaguer et al. (2014) using a mobile laboratory.

Flare Type	Benzene (tpy)	Toluene (tpy)	Xylenes (tpy)
Routine (~1-hr avg)	15.1	16.2	11.1
Major (~1-hr avg)	242.5	352.2	248.5
Permitted (1-yr avg)	0.1	0.2	0.2

Table 1 and Figure 3 are derived from Olaguer et al. (2014), who quantified emissions of BTEX from flares in the Eagle Ford Shale based on mobile lab measurements and subsequent 4D variational (4Dvar) data assimilation with the HARC model. Table 1 shows the emissions inferred from the inverse model for typical routine and major flares. Figure 3a compares the results of a plume reconstruction for benzene using a 700 m × 700 m inner grid with 20 m horizontal resolution with corresponding mobile lab observations during the major flare event of Table 1. Figure 3b, on the other hand, extrapolates the benzene plume beyond the area of the mobile lab observations using a 4 km × 4 km outer grid with a horizontal resolution of 200 m.

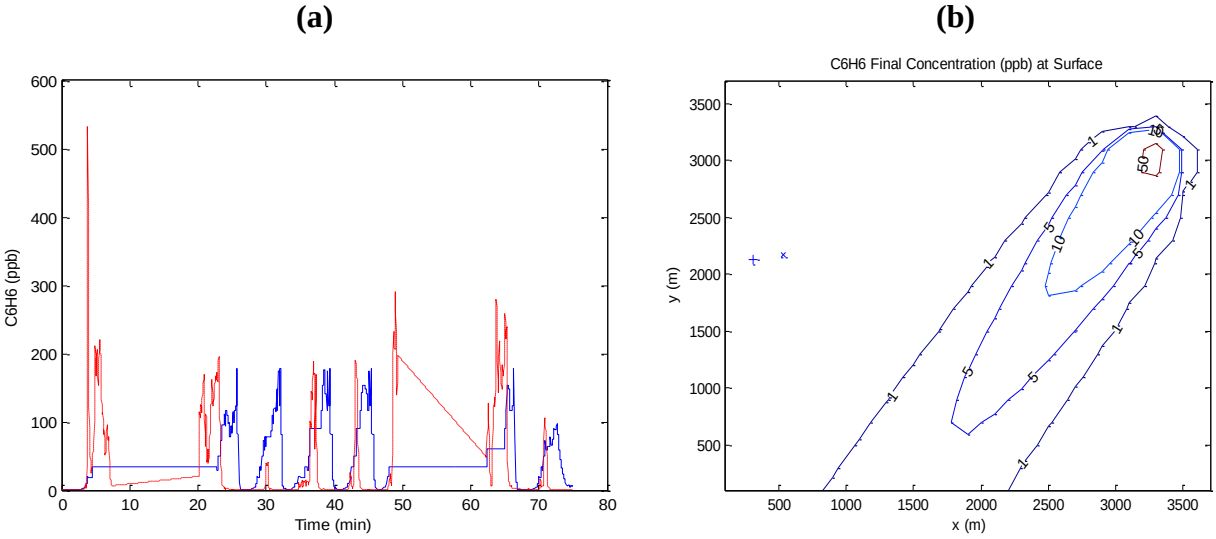


Figure 3. (a) Mobile lab observations of benzene (red dashes) and HARC model plume reconstruction (blue line) based on emissions inferred by 4Dvar data assimilation for the major flare of Table 1. (b) Extrapolation of benzene plume by the HARC model beyond the area of the mobile lab observations.

An initial baseline community health survey will be designed and implemented during the early stages of the proposed study to link spatially measured community and neighborhood ambient air exposures with time-linked health symptoms directly reported through the Web-based interface to which all recruited subjects will have access. Statistical software such as SAS will be used for health data management and statistical analyses. Basic statistical reports with tabulations, frequency distributions, and graphs will be routinely produced to gain a better understanding of the data, ensure data quality, and inform data analyses.

References

Singh B. et al., 2008. Evaluation of the QUIC-URB fast response urban wind model for a cubical building array and wide building street canyon. *Environ. Fluid Mech., 8*, 281-312.
Olaguer E. P., 2012. The potential near source ozone impacts of upstream oil and gas industry emissions. *J. Air and Waste Management Assoc., 62*, 966-977.
Olaguer E. P., 2013. Application of an adjoint neighborhood scale chemistry transport model to the attribution of primary formaldehyde at Lynchburg Ferry during TexAQS II. *J. Geophys. Res.-Atmos., 118*, 4936-4946.
Olaguer, E. P. et al., 2013. Attribution of primary formaldehyde and sulfur dioxide at Texas City during SHARP/FLAIR using an adjoint chemistry transport model. *J. Geophys. Res.-Atmos., 118*, 11,317-11,326.

d) Environmental Justice Impacts

The EPA's *Policy on Environmental Justice for Working with Federally Recognized Tribes and Indigenous Peoples* seeks to address disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations, including Native Americans. The proposed project directly addresses environmental justice issues by providing the most advanced means to date for Tribal residents to gain air quality information to protect their health, including the timely identification of air quality nuisances, emission events, and dangerous health impacts, and their specific causes. This will then facilitate the development of strategies to mitigate adverse health impacts due to the exposure of Tribal residents to toxic air pollution.

e) Community Collaboration / Outreach

The Tribe Department of Natural Resources will actively recruit Tribal residents for the study; collaborate with HARC in training them in the use of smart mobile device applications for the reporting of air quality nuisances, industrial emission events, and human health symptoms; and continue community engagement activities beyond the life of the project. Outreach activities such as community presentations, environmental health fairs, and mobile laboratory demonstrations will be conducted periodically to ensure successful rates of community participation during the study.

f) Outcomes, Outputs, Performance Measures

Our proposal supports EPA's 2014-2018 Strategic Plan Goal 1, Objective 1.1 by reducing greenhouse gas emissions as a co-benefit in mitigating exposure to toxic air pollution, especially from combustion sources. It also supports Strategic Plan Goal 1, Objective 1.2 by reducing risk

from toxic air pollutants. Moreover, our proposed project advances understanding of air toxics science, impacts, and mitigation approaches, and provides insights for developing strategies to reduce air toxics emissions and HAPs that have substantial environmental and human health benefits, including the reduction of potential adverse health impacts.

Expected outputs from the proposed project include: 1) publicly available HAP data via the real time data broadcasting system and a project archive; 2) industrial source profiles generated by the inverse modeling and source attribution strategy; and 3) community-specific assessments of air toxics problems resulting from mobile real time observation-based pollution plume reconstructions. Outputs will also include quarterly progress reports (according to a schedule to be established by the EPA), an interim final report (approximately six months prior to contract end date), and a final report (within 90 days of completion of the period of performance) as required by the solicitation. Expected short-term project outcomes include: 1) neighborhood-specific problem identification; 2) increased community awareness via direct project participation; 3) improved real-time measurement techniques; and 4) improved use of advanced high resolution air quality models. Expected mid-term outcomes include: 1) enhanced enforcement of air quality regulations; 2) wider awareness of new real-time monitoring and modeling techniques; and 3) communities empowered with new information to mitigate HAPs. Expected long-term outcomes include: 1) reduced HAP emissions and ambient concentrations, 2) reduced human exposure to HAPs; and 3) reduced adverse health effects from HAPs.

Project performance measures include: 1) volume of participation in the reporting system; 2) project deliverables, presentations, and scientific publications that explicitly quantify variations in ambient HAP concentrations within Tribal areas, the oil and gas source signatures that may help explain them, and associations with nuisances and health symptoms reported by Tribal residents; 3) the successful enforcement of air quality regulations involving Tribal oil and gas sites identified as having significant unreported emissions; and 4) a consequent decline in reported health symptoms over the three-year performance period.

g) Programmatic Capability and Past Performance

Alabama Coushatta Tribe of Texas (Tribe)

Project Title:	ALC188 and CASTNET
Funding Source:	AMEC Environment & Infrastructure, Inc.
Federal Program:	U.S. Environmental Protection Agency Clean Air Act
Project Funds:	Individual contractor is paid by AMEC on a monthly basis
Performance Period:	April 2004 - Current
Project Description:	ALC188 and CASTNET sites monitor real time ambient ozone concentrations and filter packs to measure concentrations of sulfate, nitrate, nitric acid, sulfur dioxide, chlorine, ammonium, calcium, sodium, magnesium, and potassium. This monitoring site is at the same site previously funded by ATC-CAA Section 105 Tribal Air Pollution Control Program. This ALC 188 and CASTNET monitoring site, currently, on the Alabama-Coushatta Tribe's tribal trust land is the only site in the Southeast Texas Region. Tribe maintains the site grounds and roads, pays

the utilities and a tribal member is the monitoring technician. The technician accurately and consistently submits data and changes filters on monitoring equipment on the ALC188 and CASTNET site.

Houston Advanced Research Center (HARC)

Project Title:	Analysis, Management, and Restoration of Air Quality in Harris County
Funding Source:	U.S. Department of the Interior, CFDA#15.668
Federal Program:	Fish and Wildlife Service, Coastal Impact Assistance Program (CIAP)
Project Funds:	$3,302,940
Performance Period:	04/01/2012 – 04/30/2015
Grant Recipient:	Harris County, Texas
Sub-Recipient:	HARC
Project Description	This is an on-going collaboration between Harris County and HARC, which has successfully managed over $20 million of Texas State and federal air quality research funds since 2002, including about $9 million of air quality monitoring and field study projects. The current CIAP-funded project entails several subtasks, including: 1a) improvement of VOC point source emission inventories; 1b) improvement of HONO, NO_x and VOC emission inventories from mobile sources; 1c) analysis of historical ozone trends in the Houston region; 2a) particulate matter inventory; 2b) diesel engine testing; 2c) particulate matter emissions and control database; 2d) analysis of particulate matter chemistry; 3a) the Benzene and other Toxics Exposure (BEE-TEX) study; 3b) development of a neighborhood scale model for ambient exposure to air toxics; and 3c) further development of the Air Research Information Infrastructure (ARII).
Project Performance:	Two annual reports have been successfully submitted on-time to the program sponsor, including several fulfilled deliverables. These deliverables included final reports for Tasks 1a and 1b); a technical report describing the application of data mining techniques to the detection of emission events based on air quality monitors in Houston; and several published papers in peer-reviewed scientific journals describing the analysis of data from previous air quality field studies in the Houston region, and the development and application of the HARC 3D neighborhood scale air quality model. Most of the aforementioned published papers were authored or co-authored by HARC personnel. Preparations for the upcoming BEE-TEX field study in the Houston Ship Channel during February 2015 have also been made, including the modification of the ARII Web portal to allow for real time data broadcasting of field study remote sensing and mobile lab measurements, as well as near-real time computer aided tomography, plume reconstruction, and source attribution. The majority of HARC's funding is federal or federal flow through, and as such it must undergo external audits on those funds. HARC has had no material weaknesses or compliance issues in well over 15 years.

h) Detailed Budget Narrative

Prime Contractor – Alabama Coushatta Tribe of Texas (Tribe)

1. **Salaries and Wages** –The Tribe will hire one (temporary) full-time tribal employee (Air Quality Technician) at approximately 100% FTE to coordinate the project, assist in the analysis of air quality and human health data, provide environmental education programs related to the project (one per quarter), and provide community engagement support. **The total Tribe salary cost for the project will be $86,126.**

2. Fringe Benefits – The Tribe's fringe benefits include FICA, SUT, Workers Compensation, Health Insurance, Long Term Disability, Life Insurance, and Retirement. **The total Tribe fringe benefit costs for the project will be $35,999.**

3. Travel – Local travel costs related to the project include fuel and oil, and vehicle use and mileage. **The total Tribe travel cost will be $2,700**.

4. Supplies – Supplies required for the conduct of Tribe activities during the project include educational and outreach materials. **The total Tribe supplies cost will be $600.**

5. Other Direct Costs – Other direct costs include utilities, telephone, postage, and freight. **The total Tribe other direct costs will be $4,800.**

6. Indirect Costs (IDC) – The Alabama-Coushatta Tribe's current negotiated indirect rate is 65.31% based on annual salary for one Full-Time Equivalent Tribal Employee at 2080 hours per year. **The total Tribe IDC costs to the project will be $56,249**.

7. The total prime contractor costs will be $186,474.

Subcontractor – Houston Advanced Research Center (HARC)

1. Salaries and Wages –The HARC budget anticipates salary costs to support the following key team members:

Title	% FTE	First Year Salary Cost	Total Salary Cost
Principal Investigator	23%	$33,730	$105,237
Postdoctoral Scientist	24%	$11,250	$ 35,100
Research Technician	48%	$15,000	$ 46,800
Research Tech Specialist	1%	$ 1,156	$ 3,608
GIS Research Associate	10%	$ 5,459	$ 17,032
	Total	$66,595	$207,778

The salary estimates include a minor cost of living adjustment in each of the subsequent years. **The total HARC salary costs for the project will be $207,778**.

2. Fringe Benefits – HARC's standard fringe benefits are estimated at the rate of 44% of salaries and wages for the first year, and that rate is adjusted slightly upward in subsequent years. **The total HARC fringe benefit costs for the project will be $95,223.**

3. Travel –. The travel costs are mainly to cover the expenses to travel to and from the test site (120 miles round trip) plus operating the mobile lab on site (6 hours/day x 20 mph = 120 miles/day). At the 2015 mileage rate of $0.575/mile, this would be an expense of $138/day for one day per week for a three year period. **The total travel cost will be $21,528**.

4. Supplies – Consumables will be used mainly in the operation of the mobile lab and PTR-MS, including calibration and peripheral equipment, such as the bisulfate solution scrubber system and cryogenic trap. **The total HARC supplies cost will be $9,987.**

5. Other Direct Costs – Other direct costs include HARC's Allocated Direct Costs. Allocated Direct Costs are direct costs assessed to each project in the Environment Group for use of the Center's facilities on sponsored projects. These are costs that are of a general support nature and are not readily allocable to any given project by a direct method, but are pooled and distributed between all projects based on a standard, approved allocation basis. These costs may include, but are not limited to: rent, utilities, telephone, equipment maintenance, general supplies and gases, etc. These Allocated Direct Costs are not included in HARC's negotiated indirect cost rate, and HARC's Cost Principles, OMB Circular A-122 allow for these allocated direct costs. For budget purposes, Allocated Direct Costs are estimated at 30% of salary costs. The ADC costs do not overlap any other Direct Costs or Indirect Costs. HARC's use of ADC has been audited annually and has been accepted by both Federal and State funding agencies for all projects going back more than a decade. **The total other direct costs will be $62,333.**
6. Indirect Costs (IDC) – HARC is budgeting indirect costs at 42.0% of modified total direct costs (MTDC), which is based on HARC's current federally negotiated rate approved by the U.S. Environmental Protection Agency. **The total IDC costs to the project will be $166,677**.
7. The total subcontractor costs will be $563,526.

The total project costs will be $750,000.

i) Leveraging
The CIAP project described in Section 2g resulted in several resources that are available for the proposed project, including the mobile laboratory, the HARC 3D micro-scale forward and adjoint air quality model, and the real-time data broadcasting system. An initial version of the cryogenic trap to enhance formaldehyde measurements using PTR-MS is also being developed within the same project. The PTR-MS deployed on the mobile lab is a ten-year old instrument owned by HARC, and will be made available for the duration of the proposed project. The total estimated value of the leveraged resources is $300,000.

j) Expenditure of Awarded Grant Funds
The designated Tribe representative, and Dr. Eduardo Olaguer, HARC's Program Director of Air Quality Science, will be responsible for managing the technical aspects of the proposed project. The Tribe Air Quality Specialist, Donna Dickens, Tribal Finance Director, and Ms. Ivy Guice, Chief Financial Officer of HARC, will be the officers responsible for the grant management aspects of the proposed project. The Tribe has managed EPA Financial Assistance Agreements since 1996 under the General Assistance Programs and later Clear Air Act and Clean Water Act Programs. HARC has an electronic system known as IFAS, an integrated fund accounting financial and grants management system, which automates the tracking, inspection, approval, and archival of grants and contracts documents, including scopes of work, budgets, task reports, deliverables, and invoices. Timesheet procedures at both the Tribe and HARC enable the proper tracking and billing of expended hours by their respective employees. Monthly reports will be provided by HARC to the Tribe. Procurement of items will follow Tribe Procurement Policies and Procedures to ensure all purchases are allowable expenditures. Invoices submitted by HARC to the Tribe will provide a breakdown by cost category with monthly and cumulative totals and receipts will be submitted to Tribe for reimbursement.