Appendix E

MDNR/Environ Contract

NOTICE OF AWARD

State Of Missouri
Office Of Administration
Division Of Purchasing And Materials Management
PO Box 809
Jefferson City, MO 65102-0809
http://www.oa.mo.gov/purch

SOLICITATION NUMBER	CONTRACT TITLE
B3Z11071	Air Quality Consultant Services
CONTRACT NUMBER	**CONTRACT PERIOD**
C311071001	January 14, 2011 through August 31, 2012
REQUISITION NUMBER	**VENDOR NUMBER**
NR 780 34051000001	52124861600
CONTRACTOR NAME AND ADDRESS	**STATE AGENCY'S NAME AND ADDRESS**
ENVIRON INTERNATIONAL CORP 773 SAN MARIN DRIVE STE 2115 NOVATO CA 94998	Missouri Department of Natural Resources Air Pollution Control Program Post Office Box 176 Jefferson City MO 65102

ACCEPTED BY THE STATE OF MISSOURI AS FOLLOWS:

The proposal submitted by ENVIRON International Corporation in response to B3Z11071 is accepted in its entirety.

BUYER	BUYER CONTACT INFORMATION
Julie Kleffner	Phone: 573-751-7656 Fax: 573-526-9817 E-mail: Julie.Kleffner@oa.mo.gov
SIGNATURE OF BUYER	**DATE**
Julie Kleffner	1-14-11

DIRECTOR OF PURCHASING AND MATERIALS MANAGEMENT

James Miluski

James Miluski

STATE OF MISSOURI
OFFICE OF ADMINISTRATION
DIVISION OF PURCHASING AND MATERIALS MANAGEMENT (DPMM)
REQUEST FOR BEST AND FINAL OFFER (BAFO)
FOR REQUEST FOR PROPOSAL (RFP)

BAFO REQUEST NO.: 002
RFP NO.: B3Z11071
TITLE: Air Quality Consultant Services
ISSUE DATE: 12/30/10

REQ NO.: NR 780 34051000001
BUYER: Julie Kleffner
PHONE NO.: (573) 573-751-7656
E-MAIL: Julie.Kleffner@oa.mo.gov

BAFO RESPONSE SHOULD BE RETURNED BY: January 4, 2011 AT 5:00 PM CENTRAL TIME

MAILING INSTRUCTIONS: Print or type **RFP Number** and **Return Due Date** on the lower left hand corner of the envelope or package. Sealed BAFOs should be in DPMM office (301 W High Street, Room 630) by the return date and time.

RETURN BAFO RESPONSE TO:

(U.S. Mail)
DPMM
PO BOX 809
JEFFERSON CITY MO 65102-0809

or

(Courier Service)
DPMM
301 WEST HIGH STREET, RM 630
JEFFERSON CITY MO 65101-1517

CONTRACT PERIOD: Date of Award through 08/31/2012

DELIVER SUPPLIES/SERVICES FOB (Free On Board) DESTINATION TO THE FOLLOWING ADDRESS:

Missouri Department of Natural Resources
Air Pollution Control Program
Post Office Box 176
Jefferson City MO 65102

The offeror hereby declares understanding, agreement and certification of compliance to provide the items and/or services, at the prices quoted, in accordance with all terms and conditions, requirements, and specifications of the original RFP as modified by any previously issued RFP amendments and by this and any previously issued BAFO requests. The offeror agrees that the language of the original RFP as modified by any previously issued RFP amendments and by this and any previously issued BAFO requests shall govern in the event of a conflict with his/her proposal. The offeror further agrees that upon receipt of an authorized purchase order from the Division of Purchasing and Materials Management or when a Notice of Award is signed and issued by an authorized official of the State of Missouri, a binding contract shall exist between the offeror and the State of Missouri.

SIGNATURE REQUIRED

DOING BUSINESS AS (DBA) NAME	LEGAL NAME OF ENTITY/INDIVIDUAL FILED WITH IRS FOR THIS TAX ID NO.
ENVIRON International Corporation	ENVIRON International Corporation
MAILING ADDRESS	IRS FORM 1099 MAILING ADDRESS
773 San Marin Drive, Suite 2115	4350 North Fairfax Drive
CITY, STATE, ZIP CODE	CITY, STATE, ZIP CODE
Novato, CA 94998	Arlington, VA 22203

CONTACT PERSON	EMAIL ADDRESS
Ralph E. Morris	rmorris@environcorp.com
PHONE NUMBER	FAX NUMBER
(415) 899-0700	(415) 899-0707

TAXPAYER ID NUMBER (TIN)	TAXPAYER ID (TIN) TYPE (CHECK ONE)	VENDOR NUMBER (IF KNOWN)
52-124-8616	_X__ FEIN ___ SSN	

VENDOR TAX FILING TYPE WITH IRS (CHECK ONE)

_X__ Corporation ___ Individual ___ State/Local Government ___ Partnership ___ Sole Proprietor ___IRS Tax-Exempt

AUTHORIZED SIGNATURE	DATE
	December 30, 2010
PRINTED NAME	TITLE
Ralph E. Morris	Managing Principal

4.0 METHOD OF PERFORMANCE

4.1 DESCRIPTION OF PROPOSED SERVICES (EXHIBIT E)

TASK 1: MODELING PROTOCOL

Task Leader: Ralph Morris

Objective: To develop a Modeling Protocol for the multi-pollutant and multi-scale emissions and air quality modeling of the St. Louis area.

Approach: We would develop a Modeling Protocol for the St. Louis criteria and air toxics modeling study following EPA's modeling guidance (EPA, 1991, 1999, 2001b, 2007a) and using our extensive experience in preparing Modeling Protocols for SIP modeling and other air quality modeling studies. The main function of the Modeling Protocol is to serve as a means for planning and communicating how the modeling will be performed *before* it occurs (EPA, 1999, pg 95). The protocol guides the technical details of a modeling study and provides a formal framework within which the scientific assumptions, operational details, commitments and expectations of the various participants can be set forth explicitly and means for resolution of potential differences of technical and policy opinion can be worked out openly and within prescribed time and budget constraints.

For the St. Louis modeling study, a detailed Modeling Protocol is even more important because there are several parties directly participating in the modeling including the contracting team, MDNR and IEPA. Thus, all elements needed to perform the modeling study must be identified and the Modeling Protocol should also identify the party responsible for each element of the modeling in order to make sure an important component is not overlooked, which is not usually included in a Modeling Protocol. A modeling component that is frequently overlooked or diminished due to time and/or resource constraints is the Quality Assurance (QA) and Quality Control (QC) elements of the modeling study. Thus, this Modeling Protocol should provide a detailed description of the QA/QC procedures and include a QA/QC check list for each step of the modeling study. The ENVIRON Team has developed detailed QA/QC procedures for modeling studies that are based in part on the national consensus standard for QA/QC (ANSI/ASQC, 1994). This standard describes the necessary management and technical elements for developing and implementing a quality system. It recommends a tiered approach to the design of the specific quality system used in each of the organization's efforts. We intend to prepare the Modeling Protocol in accordance with the EPA guidelines for quality assurance project plans for modeling (EPA, 2002), for QAPPs (EPA, 2001), and the North American Research Strategy for Tropospheric Ozone (NARSTO) Quality Handbook for modeling projects (NARSTO, 1998). The EPA and NARSTO guidance documents were developed particularly for modeling projects, which have different quality assurance concerns than environmental monitoring data collection projects. The work performed in this project involves modeling at the basic research level and for regulatory/policy applications. In order to utilize model outputs for these purposes, it must be established that each model is scientifically sound, robust, and defensible. This is accomplished by following a project planning process that incorporates the following elements as described in the EPA guidance document for modeling:

- A systematic planning process including identification of assessments and related performance criteria;

- Peer reviewed theory and equations;
- A carefully designed life-cycle development process that minimizes errors;
- Documentation of any changes from original plans;
- Clear documentation of assumptions, theory, and parameterization that is detailed enough so others can understand the model output;
- Input data and parameters that are accurate and appropriate for the problem; and
- Output data that can be used to help inform decision making.

One of the purposes of the Modeling Protocol is to establish and encourage a continuous improvement process that will result in clearly defined data quality objectives, documentation, procedures, and requirements for QA benchmarks and reports. A rigorous quality system will assist in ensuring that the quality of the project products are known, defensible, and meet the user's data quality objectives. This system will also enable the modeling team to systematically plan to accommodate the additional work that will be required to ensure high-quality results.

As set forth in EPA guidance, the protocol governing the complete study should cover all required aspects as summarized below (EPA, 2007):

- Synthesis of recent relevant modeling studies
- Identification of all participating stakeholders
- Management/communication procedures
- Conflict resolution methodology
- Conceptual model of the air quality problem
- Episode selection criteria and methodology
- Model domain and resolution
- Emission, meteorological & AQ model selection
- Model selection and science configurations
- Model justification (40CFR51, Appendix W)
- Model input preparation methods, including:
  - Emissions processing methodology and data sources that will be used
  - Spatial, temporal and speciation allocations factors
  - Temperatures to be used for biogenics and SMOKE-MOVES modeling
  - Vegetation and land cover data used
  - Chemistry mechanisms and parameters
  - Vertical turbulent exchange coefficients (e.g., ACM2, Kv)
- Scientific peer-review of modeling procedures
- Data requirements for AQ modeling
- Data requirement for WOE analyses
- Emissions QA methods
- Model evaluation procedures & criteria
- Diagnostic/sensitivity/uncertainty methodology
- Procedures to use if model performance fails

- Weight of Evidence (WOE) analyses
- Outcomes from WOEs that suggest attainment
- Sensitivity & other tests to select control measures
- Recommend future year control strategy runs
- Methods for interpreting modeled outcomes
- Archival, documentation, and reporting
- Deliverables and schedule
- Procedures for updating protocol during study
- Computing resource requirements

As stated in the RFP, the St. Louis modeling domain will consist of four levels of grid nesting: (1) a 36 km continental U.S. (CONUS) domain; (2) a 12 km central/eastern U.S. domain; (3) a 4 km St. Louis urban area domain; and (4) a "1 km domain" that would be "narrowly focused around the core St. Louis metropolitan area." The RFP notes that the ozone modeling would use the 36/12/4 km domains and the "1 km domain" would be used for the $PM_{2.5}$ and air toxics modeling. During the November 9, 2010 pre-bid conference call a questions was raised regarding the source of the meteorological data and the response was that we would use the 2007 WRF meteorological model simulation performed by the states of Iowa and North Carolina. These are the same data as being used in the SEMAP study and currently only include a 36 km CONUS and 12 km eastern U.S. (inclusive of Texas eastward) and does not include meteorological data for a 4 km St. Louis urban-scale or 1 km domain focused on the St. Louis core area. In the RFP Amendment Number 1, the performance of 4 km and 1 km WRF meteorological modeling was added to the scope of work.

The WRF meteorological model uses a and odd (e.g., 3:1) nesting ratio when run with two-way grid nesting and the CMAQ BCON processor assumes a grid nesting ratio of 3:1. Thus, nesting a 1 km domain within a 4 km domain may be difficult, but not impossible. One easy way around this issue is to use a 1.33 km grid resolution instead of the 1 km resolution that retains a 3:1 nesting ratio between the 4 km and 1.33 km domains. If a 1 km grid resolution is desired, then 1 km WRF simulations can be performed using one-way grid nesting within the 4 km WRF output (nest-down). For the PGM modeling, either the CAMx model could be used that does not have the 3:1 grid nesting limitation, or modifications could be made to the CMAQ BCON processor to allow alternative grid nesting ratios. In any event, we would work with the MDNR to select the most optimal finest modeling grid that is anticipated to be either 1 km or 1.33 km.

In the past, most SIP modeling studies have prepared Modeling Protocols to address a single pollutant (e.g., ozone or $PM_{2.5}$). In the previous round of SIP modeling for St. Louis, the proposed Task Leader (R. Morris) led the development of a unified Modeling Protocol that addressed both ozone and $PM_{2.5}$ SIP modeling within a single protocol (ENVIRON and Alpine, 2005a). In this new round of modeling for St. Louis air quality modeling, the simulation of air toxics as part of the CAP is added into the mix.

The RFP has a 30 day schedule to prepare a Modeling Protocol after contract initiation. It will be a challenge to get up to speed on all the air quality issues associate with ozone and $PM_{2.5}$ attainment demonstration and air toxics modeling in St. Louis and prepare a comprehensive Modeling Protocol within this time frame. Fortunately, the ENVIRON Team is already educated on these issues:

- ENVIRON led the previous round of ozone and $PM_{2.5}$ SIPs for the St. Louis area for both the MDNR and IEPA so is well aware of the issues, stakeholders and procedures necessary for modeling of the area;
- Washington University has been intimately involved in the CAP air toxics monitoring and data analysis as well as performing ambient air quality monitoring and data analysis of air quality issues in St. Louis for many years including operation of the St. Louis PM SuperSite;
- The unique regional-scale and local-scale aspects of the $PM_{2.5}$ problem in St. Louis requires innovative hybrid PGM/plume modeling in the attainment demonstration, a procedure that has only been performed by ENVIRON in the St. Louis and Birmingham $PM_{2.5}$ SIPs;
- ERG is in charge of the NEI point source inventory and has develop stationary point and area source emissions in numerous studies to support SIP development;
- ENVIRON performed the Detroit multi-scale and multi-pollutant (e.g., ozone and air toxics) Detroit study for EPA/OAQPS that provided insight into linked air toxics and criteria pollutant issues;
- ENVIRON led the Birmingham $PM_{2.5}$ SIP modeling that required a hybrid local-scale (AERMOD) and regional-scale (CMAQ) attainment demonstration modeling approach similar to what ENVIRON did for IEPA in the Illinois St. Louis $PM_{2.5}$ modeling; and
- ENVIRON was heavily involved in the Multiple Air Toxics Exposure Study (MATES-III[1]) that used PGM modeling to simulate many air toxics (including DPM) in Southern California and is one of the most extensive and definitive air toxics modeling study using a PGM performed to date.

The Task Leader for this Task has extensive and demonstrated experience in preparing Modeling Protocols for numerous applications throughout the U.S. and abroad dating back to the 1980s. Some of the more recent Modeling Protocols that he has developed include for the last round of St. Louis ozone and $PM_{2.5}$ SIPs (ENVIRON and Alpine, 2005a), for the southeastern States regional haze (VISTAS; ENVIRON, Alpine and UCR, 2004) and ozone and PM 2.5 (ASIP; Morris et al., 2006b) SIPs, for the Birmingham $PM_{2.5}$ SIP (ENVIRON and Alpine, 2007); for the CENRAP regional haze SIP (ENVIRON and UCR, 2005) and for the Denver ozone SIP modeling (Morris et al., 2007).

The development of the Conceptual Model for ozone, $PM_{2.5}$ and air toxics is an important component of the Modeling Protocol as it drives the design of the modeling system needed to demonstrate attainment of the ozone and $PM_{2.5}$ NAAQS and simulate air toxics in St. Louis. For example, the St. Louis $PM_{2.5}$ problem is due to a combination of regional/urban and local sources. Not accounting for the local source contribution would lead to modeling approach that would be deficient for $PM_{2.5}$ attainment demonstration modeling. The ENVIRON Team has more experience than any other group in working with ambient air quality and meteorological data and photochemical modeling for the St. Louis area and have developed such a Conceptual Model for ozone and $PM_{2.5}$ that can be enhanced and updated for this study. Washington University involvement in the St. Louis CAP and ENVIRON experience with MATES-III and the EPA Detroit fine-scale ozone and air toxics will prove invaluable in extending the Conceptual Model to address air toxics in the St. Louis area.

[1] http://www.aqmd.gov/prdas/matesIII/matesIII.html

Deliverables: A hard copy and electronic copy of a draft Modeling Protocol would be submitted within thirty (30) days of project initiation. The MDNR and IEPA would provide comments and changes to the Modeling Protocol that would be implemented in a Final Modeling Protocol that would be submitted within fifteen (15) days of receipt of comments from MDNR and IEPA on the draft Modeling Protocol.

TASK 2: BASE CASE MODEL-READY EMISSION INPUTS

Task Leaders: Paula Fields, Chris Lindhjem, Tanarit Sakulyanontvittaya and Ou Nopmongcol.

Objective: To generate SMOKE-ready emission inputs for point, area, non-road mobile and biogenic emissions and PGM model-ready emissions for on-road mobile sources for the 36/12/4/1 km domains and the June 1 through September 30, 2007 modeling period. We intend to provide SMOKE-ready inputs and on-road mobile source emission inputs that can be used with the CMAQ and/or CAMx photochemical rid model (PGM). The CMAQ2CAMx processor can be readily used to map CMAQ-ready emission inputs to the CAMx model. The ability to use both models may be valuable asset for the MDNR/IEPA if performance of one model appears better or as an element in the attainment demonstration weight of evidence (WOE) analysis.

This Task would be accomplished in four Subtasks as follows.

Subtask 2a: 2007 Base Year On-Road Mobile Source PGM Model-Ready Emission Inputs for June 1 through September 30, 2007

Under this task we would use the SMOKE-MOVES model to generate PGM-ready on-road mobile source emission inputs for ozone, $PM_{2.5}$ and air toxics modeling. The on-road mobile source PGM emissions inputs would be prepared for the June 1 through September 30, 2007 period and the 36/12/4/1 km domains. Note that the RFP says that ozone modeling inputs are only needed for the 36/12/4 km domain, but since $PM_{2.5}$ modeling requires all ozone precursor information then ozone precursors will also be provided for the 1 km domain. This Task would be led by Chris Lindhjem.

In December 2009, the EPA Office of Transportation and Air Quality (OTAQ) publicly released the first version of the Motor Vehicle Emissions Simulator (MOVES)[2] as a replacement to MOBILE6 that must be used for generating on-road mobile source emissions in future SIPs, including those being developed as part of the St. Louis study. MOVES is much more computationally demanding than MOBILE6 and is much more sensitive to meteorological parameters, including temperature and relative humidity. The separate running of MOVES for each day of the June 1 through September 30, 2007 modeling period would be impossible given its computational requirements. To address this issue, the EPA Office of Air Quality Planning and Standards (OAQPS) contracted with ENVIRON and UNC to implement a computationally efficient MOVES emissions capability in SMOKE. There are three steps to the SMOKE-MOVES modeling system:

1. Meteorological preprocessing of grid cell temperature and humidity using a tool developed by UNC.

[2] http://www.epa.gov/otaq/models/moves/index.htm

2. Running a driver script for MOVES, which assembles the runspec files, build county data input MySQL tables, and launches the MOVES runspec files for multiple counties in batch, developed by ENVIRON.
3. Running a post-processing script speciates the PM emission rates, drops unnecessary fields to control file size, and formats other aspects of the lookup tables so they are transformed into SMOKE-ready files, developed by ENVIRON.

The new SMOKE-MOVES tool developed by ENVIRON/UNC was released in July 2010.[3]

Because of its computational requirements, the SMOKE-MOVES on-road mobile source emissions modeling is expected to be on the critical path for meeting the St. Louis modeling study schedule. Thus, we have identified the 4/1 km St. Louis domains **and upwind portions of the 12 km domain** as being most important for defining detailed hourly day-specific on-road mobile source emissions inputs as well as other counties in Missouri and Illinois. A more simplified MOVES mobile source emissions approach may be used in counties far away from St. Louis. As identified in the RFP Amendment Number 1, the MOVES runs themselves will not be exercised under this contract. Instead the 2007 base year MOVES outputs will be provided by MDNR for Missouri and Illinois. In our base effort we are assuming, as stated in the RFP Amendment Number 1, that the MDNR would provide all of the MOVES outputs necessary for running the SMOKE-MOVES tool for counties in Missouri and Illinois and the June 1 through September 30, 2007 time period. Our base effort will process the 2007 MOVES output files through the MOVES to SMOKE tool, and then perform SMOKE modeling to generate CMAQ-ready 2007 emission files. However, to provide MDNR with flexibility in case they are unable to provide all of the MOVES outputs for counties in Missouri and Illinois necessary to run the SMOKE-MOVES tool, we also propose an optional task to run MOVES **for the states of Missouri, Illinois, Kansas and Oklahoma** (**Task 2a.1**). As the developers of the MOVES portion of the SMOKE-MOVES module, ENVIRON is by far the most up to speed and efficient group to perform the St. Louis SMOKE-MOVES modeling, meet the St. Louis schedule and generate the on-road mobile source emission inputs correctly the first time.

Under Task 2a.1 ENVIRON runs MOVES for Missouri, Illinois, Kansas and Oklahoma. The approach for running MOVES for SMOKE relies on the concept of "representative counties" or identifying counties from a region that share the same fuel parameters, fleet age distribution and inspection/maintenance (I/M) programs. Modeling emission factors for one county to represent the group avoids unnecessary duplicative MOVES runs. Each representative county is modeled at a range of speeds and temperatures to produce emission rates lookup tables (grams/mile or grams/vehicle/hour, depending on emission process). Thus, any county with unique distribution of VMT, vehicle population, roadway speed and grid cell temperatures can be modeled in SMOKE without rerunning MOVES. **We would acquire necessary MOVES input files for age distribution, fuels and I/M programs from the states, EPA and RPOs, including the states of Missouri, Illinois, Kansas and Oklahoma**. Local data for the St. Louis nonattainment counties and vicinity would be requested from EWGCOG, MDNR and IEPA. The ENVIRON Team will use the scripts to generate the meteorological data for MOVES and set up the multiple runspec files for MOVES for each representative county. The MOVES runs would be executed using ENVIRON's MOVES-dedicated computer cluster of eight machines (one master and seven workers), reducing run time required to produce lookup tables.

[3] http://www.cmascenter.org/help/documentation.cfm?MODEL=smoke&VERSION=moves_tool&temp_id=99999

Required data for our base effort to use the MOVES lookup tables in SMOKE include: county-specific activity for VMT and vehicle population, average speed by roadway type, and grid cell temperature and humidity. ENVIRON assumes that SMOKE activity data for county level VMT and vehicle population will be provided for each SCC, and in particular that states will use the MOVES Technical Guidance approach to filling any data gaps in known vehicle population.

> Data Acquisition for SMOKE modeling: Two sets of data need to be provided in order to use the SMOKE-MOVES modeling system: (1) MOVES emission factor outputs, and (2) SMOKE inputs for VMT, population, and speeds. The MOVES inputs may only be available for representative counties, whereas SMOKE vehicle activity needs to be developed by states for all counties in the domain. The MOVES outputs provided by MDNR must cover the range of meteorological conditions during the four-month modeling episode. In addition, the MOVES-to-SMOKE post-processing script requires that the MOVES runs are to be initiated with the pre-processing script distributed with the SMOKE-MOVES modeling system to generate MOVES look-up tables. ENVIRON will develop a separate SMOKE input file to associate all counties to a representative county.

As identified in the RFP Amendment number 1, the SMOKE-MOVES outputs to be provided by MDNR will include link-specific runs for the St. Louis non-attainment area, and county level runs for the rest of the counties in Missouri and Illinois. We have some concerns with the link processing. While SMOKE v2.7 has a capability to process link VMT with MOVES emissions factors, this feature has been minimally tested and known bugs still exist. We will contact SMOKE model developer to get an interim version of SMOKE that can appropriately process link-based VMT.

For areas outside of Missouri and Illinois, ENIVRON will contact EPA, other states, and the Regional Planning Organizations to request 2007 MOVES outputs. The SEMAP study is already applying SMOKE-MOVES for the 2007 calendar year so would be a particularly valuable source of data for the St. Louis study. However, ENVIRON has doubts about the widespread availability of these MOVES outputs across the entire U.S., as states are only recently beginning to learn SMOKE-MOVES. Furthermore, EPA currently does not have county level emissions for the entire nation because county level data for VMT, population, and age distribution are not included in the MOVES model. Because a county level implementation for nationwide modeling is not yet available, EPA has used other methods in recent rulemakings to estimate national emissions on a county basis. Specifically, for EPA Transport Rule Modeling, EPA has prepared county level emissions for on-road mobile sources using state-wide runs of the DRAFT 2009 version of MOVES and using county scaling factors developed from MOBILE6-based emissions using the National Mobile Inventory Model (NMIM) for calendar years 2005, 2012 and 2014. In the likely event that MOVES output are not available for a portion of the 36 km domain, 2007 MOVES based on-road mobile source emissions may be obtained by scaling between the 2005 and 2012 emission inventories and provide county emissions to SMOKE to be modeled like an area source.

After extensive data collection efforts, the ENVIRON Team will compute the on-road mobile source emissions by running the UNC meteorological data processing scripts with the WRF data processed by MCIP. ENVIRON will then use the post-processing script in the SMOKE-MOVES tool to reformat the MOVES lookup tables for input to SMOKE and then run SMOKE for on-road mobile sources.

During the November 9, 2010 pre-bid conference call for the RFP the MDNR requested that SMOKE-MOVES be run for each day of the June 1 through September 2010 modeling period. Performing SMOKE-MOVES modeling for four months and the 36/12/4/1 km domain would require prohibitive computational time that may compromise the St. Louis modeling study's schedule. The ENVIRON Team has several ideas on how the SMOKE-MOVES processing can be sped up for this study:

- Use of MOVES adapted to Linux. EPA distributes a Windows version of MOVES. Recently MOVES has been ported over to Linux where it runs faster.
- Focus everyday SMOKE-MOVES modeling on the 4/1 km St. Louis domains. We expect the contributions of the day-specific meteorological effects on mobile source emissions outside of the St. Louis urban area to be much less than from within the St. Louis nonattainment area. Thus, a reduced time period for MOVES modeling can be used for the 36/12 km domains without a loss of technical rigor. For example, we can adopt the LADCO monthly weekday and weekend day approach or the VISTAS one representative week from each month modeling approach.

The ENVIRON Team would develop a proposed SMOKE-MOVES modeling approach for the St. Louis and provide it to MDNR/IEPA along with the options and their trade-off for review. Based on discussions a final SMOKE-MOVES modeling approach would be adopted. These trade-offs include the St. Louis modeling schedule objective to obtain PGM-ready on-road mobile source emissions inputs within 60 days of receipt of MOVES outputs from the states and RPOs.

VOC and PM speciation profiles within SMOKE-MOVES would be updated using the Task 2d data to include the ability to generate on-road mobile source emissions for the various air toxics species of interest. Note that MOVES also has the capability to output several air toxics explicitly (i.e., benzene, MTBE, naphthalene, 1,3-butatadiene, formaldehyde, acetaldehyde and acrolein), which is a subset of the air toxics species requested in the RFP. We would set up SMOKE-MOVES to output air toxics both ways.

The SMOKE modeling would be subjected to a rigorous QA/QC that would include the following checks by an independent third party, including the Task Leader:

- Review and summary of the 2007 MOVES emissions outputs for each representative county and the county mappings.
- Display of the county level VMT and vehicle population data for 2007 and compare back to the 2002 VMT data used in the previous St. Louis SIP modeling identifying any anomalous growth.
- Graphical visualization of the spatial distribution of the on-road mobile source emissions across the 36/12/4/1 km domains and the temporal (monthly, day-of-week and diurnal) distributions of the on-road mobile source emissions.

The SMOKE processing would be run for the CMAQ model format. The CMAQ2CAMx processor would then be used to generate the CAMx-ready inputs.

Deliverables: On-road mobile source emission inputs for the June 1 through September 30, 2007 period and the 36/12/4/1 km grids. The MOVE-to-SMOKE and SMOKE model set up and a documentation on the modeling analysis would also be provided. MOVES setup would also be provided if option 2.a.1 and/or 2.a.2 was awarded. If we encounter difficulties with the SMOKE-link processing due to limitation of SMOKE capability, we will consult with MDNR to develop a plan consistent with SMOKE capabilities and the budget and schedule.

Subtask 2b: 2007 Base Year Emissions Inventory – Point, Area, and Nonroad Source Emissions

The development of the point, area, and nonroad mobile emissions inputs for the 2007 base year emissions inventory would be led by Paula Fields and have three steps: (1) Identify and compile appropriate existing emissions inventory data; (2) Quality assure emissions inventory data; and (3) Generate SMOKE input files and documentation.

Identify and Compile Appropriate Existing Emissions Inventory Data

The first step for compilation of the point, area, and nonroad county-level emissions data for the 2007 base year will be to ascertain the availability of the emissions data by contacting relevant RPOs, U.S. EPA, and, potentially, some states. After determining the availability of the emissions data, the ENVIRON team will then request the inventory data from all relevant entities.

As shown in Attachment 2 of the RFP, the proposed modeling domains for the St. Louis AQMP Study are quite extensive – the 36 km domain includes the entire contiguous U.S. and significant portions of Canada and Mexico, while the smaller 12 km domain includes most of the contiguous U.S. (excluding Western states) and some portions of Canada and Mexico. Because of the extent of these modeling domains, it is not practical to assemble county-level emission data "from scratch" on a state-by-state basis. Instead, the ENVIRON team will utilize existing emission inventories that have been developed by Regional Planning Organizations (RPOs), U.S. EPA (i.e., the National Emissions Inventory), and individual states. This will allow a 2007 base year emissions inventory to be developed in the most cost-effective manner possible.

There are five RPOs within the contiguous U.S:

- Western Regional Air Partnership (WRAP)
- Central Regional Air Planning Association (CENRAP)
- Midwest Regional Planning Organization (Midwest RPO)
- Visibility Improvement State and Tribal Association of the Southeast (VISTAS)
- Mid-Atlantic/Northeast Visibility Union (MANE-VU)

Missouri is a member state of CENRAP (affiliated with the Central States Air Resource Agencies [CENSARA], while Illinois is a member state of the Midwest Regional Planning Organization (affiliated with the Lake Michigan Air Directors Consortium [LADCO]). In recent years, each of

the five RPOs has undertaken various emissions inventory development efforts. Many of these RPO emissions inventories were developed in support of regional haze and visibility State Implementation Plans (SIPs). As an example, both WRAP and CENRAP have developed 2002 base year inventories and 2018 future year inventories in support of regional haze- and visibility-related activities. However, other RPOs have developed additional emissions inventories in support of ozone- and fine particulate-related activities. For example, Midwest RPO/LADCO has also developed emissions inventories for 2005, 2007, and 2009.

At the present time, a particularly promising and preferred source of regional emissions data for the 2007 base case model-ready emission input is the Southeastern Modeling, Analysis, and Planning (SEMAP) Project sponsored by the Southeastern States Air Resources Managers (SESARM). The base year for the SEMAP project (2007) is the same as required by MDNR, as well as the modeling domain. Based on the latest June 2010 SEMAP update, the point source inventories were complete, while the area and nonroad mobile source inventories were near complete.[4] For purposes of this proposal, the ENVIRON team assumes that the SEMAP 2007 emissions inventory for point, area, and nonroad mobile sources will be available in time to use for the development of the 2007 base year inventory. It is also assumed that these data are in valid NIF format. However, if any of these data are not available, then alternative data sources will be utilized, as described below.

A less preferred alternative to the use of the SEMAP emissions inventory might be the U.S. National Emissions Inventory (NEI), which is often utilized as a starting data set for various regional emissions inventories. However, the NEI is developed on a triennial basis and the NEI inventory years (i.e., 2005 and 2008) do not match the 2007 base case inventory year required by MDNR. In order for NEI emissions data to be used for the 2007 base case model emission input, the NEI emission data would need to be adjusted by either projecting 2005 emissions forward to 2007 or backcasting 2008 emissions back to 2007. This adjustment would be potentially be resource-intensive. The ENVIRON team previously utilized NEI data when they developed the 2002 base year emissions inventory for the WRAP. Alternatively, it could be assumed that 2008 emissions are equivalent to 2007 emissions for MDNR's purposes. Similarly, other existing RPO inventories could potentially be utilized in developing the 2007 base case model emission input.

In addition to the NEI and other RPO inventories, some state inventory information may be useful in developing the 2007 base case model emission input. Although it is not practical to individually obtain and compile county-level emissions data for each state, collection of detailed inventory data may be preferable for states (or portions of states) in close proximity to the St. Louis metropolitan area (e.g., Missouri, Illinois, etc.). In particular, major point sources (i.e., sources with Title V or Part 70 operating permits) are required to report emissions annually. These annual emissions are compiled by U.S. EPA, but are not available on-line to the general public. However, states will likely maintain records of these reported annual emissions. These records could be used to revise or supplement available region-wide emissions data.

Both the 36 km and 12 km domains include portions of Canada and Mexico. Extensive data collection will not be conducted to obtain base case model emission inputs from either country.

[4] Boylan and Methier, 2010. "Southeastern Modeling, Analysis, and Planning (SEMAP) Project". PowerPoint presentation. Air Directors' Meeting Presentations, Atlanta, Georgia. June 8-10.

The ENVIRON team will rely upon previous inventory and modeling efforts to obtain emissions for Canada and Mexico. For example, ERG is intimately familiar with Mexico emissions since they assisted the Mexican government in developing the 1999 Mexico National Emissions Inventory and subsequently developed the associated future projections for 2008, 2012, 2018, and 2030. Any forecasting or backcasting of emissions data from Canada and Mexico to the base case year of 2007 will likely be limited to linear interpolation; otherwise, available emissions data will likely be used "as is" without any temporal adjustment to account for differing inventory years.

Quality Assure Emissions Inventory Data

After identifying and compiling the most appropriate emissions inventories, the ENVIRON team will conduct some basic high-level quality assurance (QA) on the received emissions data. It is expected that some level of QA will have already been conducted by the RPOs, U.S. EPA, and states during their previous compilation and use of the inventory data. However, the additional QA by the ENVIRON team will increase the overall confidence in the quality of the base case model emission input. Although the ENVIRON team's QA procedures may be limited by project schedule and/or resources, the procedures will include, at a minimum, the following: review of available inventory documentation and metadata, completeness check of source categories and pollutants, identification of sources or source categories that are "outliers" (i.e., emissions that are obviously incorrect by several orders of magnitude), accuracy of point source coordinates, and completeness check of point source stack parameters. Having previously developed large inventory databases for U.S. EPA, WRAP, and other agencies, the ENVIRON team will rely on their experience and expertise to determined the specific QA procedures that should be utilized for this project's QA. Data deficiencies identified through the QA procedures will be discussed with MDNR and other relevant agencies; potential gap filling options, if necessary, will also be discussed.

Generate SMOKE Input Files and Documentation

Next, the ENVIRON team will generate SMOKE input files based upon the 2007 base year point, area, and nonroad county-level emissions data using previous developed scripts and procedures. The ENVIRON team has generated SMOKE input files for a number of other similar projects. According the SEMAP inventory timeline, it is possible that some of the received emissions data will already be in the requested SMOKE input format. If so, then the amount of required SMOKE input formatting will be reduced. However, for purposes of this proposal, the ENVIRON team assumes that none of the SEMAP 2007 emissions inventory data will be in the requested SMOKE input format. It is also assumed that the SEMAP 2007 emissions inventory data are in valid NIF format. Prior to submitting the generated SMOKE input files to MDNR, the ENVIRON team will conduct additional QA on these files. This QA will focus on ensuring that the domain- and state-level pollutant totals from the generated SMOKE input files are comparable to the emission data provided by the applicable entities (e.g., RPOs, U.S. EPA, states, etc.), thereby confirming that the SMOKE input file generation process was executed properly.

After completion of this additional QA, the ENVIRON team will submit the SMOKE input files to MDNR. In addition, the ENVIRON team will submit all relevant documentation associated with the development of the point, area, and nonroad SMOKE input files. This documentation will

clearly explain in a transparent manner the data, procedures, and assumptions used to develop the delivered SMOKE input files.

Based upon the amended RFP, the point, area, and nonroad emissions data in SMOKE input format must be submitted to MDNR within 30 days of acceptance of the Modeling Protocol. However, additional information from the bidder's call indicated that there may be some additional schedule flexibility dependent upon data availability and delivery promptness from relevant entities. In particular, the amended RFP indicates that written requests can be made for deliverable extensions. Nevertheless, the ENVIRON team is aware of the time sensitivity associated with this project and will expedite delivery of the point, area, and nonroad emissions data in SMOKE input format to MDNR to the greatest extent possible.

Deliverables: SMOKE-ready emission inputs for point, area and non-road mobile sources for the 2007 base year and all states within the 36/12/4/1 km domains along with Canada and Mexico. Relevant documentation related to the development of the 2007 base case point, area and non-road emissions that clearly explain in a transparent manner the data, procedures, and assumptions used to develop the delivered SMOKE input files as well as the QA/QC steps taken in their development.

TASK 3: REGIONAL MODELING INPUTS

Under this task, the ENVIRON Team will develop additional meteorological inputs, boundary conditions, initial conditions and photolysis rate files needed to run the PGMs.

Task 3a: Development of Meteorological Fields for the 4 and 1 km Domains

Task Leader: Bart Brashers

Objective: To develop meteorological parameters suitable for running the PGMs over the 4 and 1 km file-scale grids.

As stated in the RFP, the St. Louis modeling domain will consist of four levels of grid nesting: (1) a 36 km continental U.S. (CONUS) domain; (2) a 12 km central/eastern U.S. domain; (3) a 4 km St. Louis urban area domain; and (4) a "1 km domain" that would be "narrowly focused around the core St. Louis metropolitan area." The RFP notes that the ozone modeling would use the 36/12/4 km domains and the "1 km domain" would be used for the $PM_{2.5}$ and air toxics modeling.

ENVIRON will acquire the July through September 2007 WRF model outputs for the 36 km and 12 km domain. Although the 36 km domain is not needed for running WRF at finer scales, it is needed for the 36 km PGM modeling. Because the 36/12 km WRF runs have already been completed, it is impossible to run a 2-way nest between the 12 and 4 km domains. In a 2-way nest run, information from the fine grid is aggregated and fed back to the coarse grid such that the coarse grid variables "react" to the fine grid variables. This requires both grids to be run simultaneously, which will not be the case for the 4 km WRF run since the 12 km domain WRF simulation has already been performed. A 4 km grid spacing domain would have a 3:1 nesting ratio compared to the 12 km coarse domain. A nested 1 km grid spacing domain would have a 4:1 nesting ratio compared to the 4 km domain. Using the more standard 3:1 ratio from the 4 km domain would produce a 1.33 km grid spacing domain.

The WRF development team at UCAR/NCAR recommends using only odd grid spacing ratios for two-way nesting of real-data applications (3:1 or 5:1 ratios). One-way nesting may use even grid spacing ratios. The reasons for this recommendation have to do with the details of the numerical methods, and the likelihood of growing $2\Delta X$ noise appearing in the coarse grid output and feeding back to the finer grid. Simply stated, a two-way nested grid must use a grid spacing ratio of 3:1, while a one-way nested grid may use a ratio of 4:1.

At grid spacing scales of about 5 km or less, there is also little demonstrated improvement in model skill when using two-way nesting compared to one-way nesting. Two-way nesting simply doesn't produce statistically better results than one-way nesting.

From a computational standpoint, the CPU time spent on the coarser grids in a 36/12/4 km WRF run is small in comparison to the CPU time spent on the finest grid. If MDNR is unsatisfied with the physics choices of the 2007 36/12 WRF run, it would be possible to re-run WRF from scratch using model options more appropriate for the photochemical model. This would also allow for using the latest version of WRF rather than the same version used for the 36/12 km runs.

ENVIRON will run WRF using a one-way 4 km spacing 3:1 nested domain covering eastern Missouri and western Illinois. The domain will be approximately 60 by 60 grid points, or 240 by 240 km in size, and encompass all of the St. Louis nonattainment counties with a buffer region. Because the RFP specified a 1 km grid focused on the core St. Louis area, ENVIRON will run WRF using a one-way 1 km spacing 4:1 nested domain covering the urban core of St. Louis (note that MDNR may wish to switch to a 1.33 km domain to preserve the 3:1 grid nesting, the exact definition of the "1 km domain" will be specific in the Modeling Protocol with concurrence from the MDNR and the AQMP Technical Workgroup). The 1 km domain will be approximately 60 by 60 grid points (i.e. 60 by 60 km) and will encompass the I-70/I-270/I-255 ring of freeways encircling the city center. Note that the 1 km domain will include Granite City where $PM_{2.5}$ concentrations are influenced by local sources. The WRF physics choices and vertical layer structure will, by necessity, be consistent with the 36/12 km WRF runs. One potential difference between the 36/12 km and 4/1 km WRF simulations is the specification of subgrid-scale convective processes that are needed in the 36/12 km WRF simulations because the grid spacing is too coarse to resolve most convective activity. Such subgrid-scale convection physics options will not be needed for the 1 km WRF simulations and may not be needed using a 4 km grid resolution as well.

The details of the WRF modeling will be developed in cooperation with MDNR and documented in the Modeling Protocol prior to performing the WRF simulations. During the protocol process, MDNR may choose to request that ENVIRON re-run the 12 and 36 km domains to facilitate switching WRF versions, physics parameter choices, boundary layer schemes, or vertical layer structure. MDNR may also request that ENVIRON use a two-way, 3:1 nested grid to produce 12 km and 1.33 km grid spacing domains. Alternatively, MDNR may choose to request a 4:1 ratio in the nest-down procedure from the 12 km domain, leading to 3 km nested run. This could be run with a two-way, 3:1 nested domain at 1 km resolution. ENVIRON will provide guidance to MDNR as to WRF best practices, and help guide MDNR through this maze of choices.

Task 3b: Development of Additional Modeling Inputs

Task Leader: Bonyoung Koo

Objective: To develop the other (non-emission) inputs for the PGMs, the 36/12/4/1 km domains and the June 1 through September 30, 2007 modeling period.

Under this task we would prepare the other modeling inputs for the two PGMs, the four nested domains and the modeling period. These inputs include:

- Boundary Conditions (BCs) for the most outer 36 km CONUS domain (BCs for the other finer grid domains are based on processing of the output from the next coarsest grid domain).
- Initial Concentrations (IC) that represent concentrations at the start of the simulation (June 1, 2010).
- Photolysis Rates and related input files (e.g., ozone column data).
- Scripts for operating the two PGMs.

The RFP also mentions the development of top concentration inputs. However, the current versions of CMAQ and CAMx both use a zero gradient top boundary condition (i.e., the concentrations above the model top are assumed to be the same as in the top layer of the model), so there are no top concentration inputs needed by the PGMs.

The 2007 lateral BCs around the 36 km domain would be based on output from a global chemistry model. Output data from either the Harvard GEOS-Chem[5] or NCAR Mozart[6] global chemistry model would be processed to provide day-specific BCs for the 36 km domain and the June 1 through September 30, 2007 modeling period.

Ozone column data from the Total Ozone Mapping Spectrometer (TOMS[7]) satellite observations would be downloaded and processed for input into CMAQ and CAMx for the modeling periods and domains. Frequently there may be missing periods in the TOMS data that must be filled. Thus, careful QA/QC and range checks need to be performed on the TOMS data to make sure there are no periods of missing or faulty data. Any missing or faulty TOMS data are typically filled in by holding the ozone column data constant from the last day of valid data. Since ozone column values typically evolve fairly slowly from day to day the filling in of missing data for limited periods does not introduce any significant uncertainties into the model results.

We would also provide model scripts for the two PGMs set up for a typical model configuration. Make files for compiling the two PGMs using the recommended model configuration would also be provided. The recommended model configuration would be provided in the Task 1 Modeling Protocol. We would also provide scripts for processing PGM output for generating BCs for the next finer grid domain.

The PGM inputs would be subjected to QA/QC including a one day test simulation.

Deliverables: Within thirty (30) days of acceptance of the Modeling Protocol we would provide the other (non-emission) inputs and scripts for operating the PGMs. Documentation on their development and QA/QC results would also be provided.

TASK 4: ON-GOING ASSISTANCE/QUALITY ASSURANCE OF EMISSIONS AND AIR QUAITY MODELING

Task Leaders: Bonyoung Koo and Paula Fields

Objectives: To provide quality assurance (QA) of the emissions and air quality modeling being conducted by the MDNR, IEPA and AQMP Technical Workgroup.

Under this task we would provide QA and technical assistance to the MDNR, IEPA and AQMP Technical Workgroup as needed and as limited by available resources allocated to this task. Independent QA of the emissions modeling performed by the MDNR/IEPA/AQMP Workgroup would be conducted. We would also conduct a model performance evaluation (MPE) of the PGM(s) for ozone, PM components, ozone and PM precursors and air toxics to help identify any issues in the model inputs.

[5] http://acmg.seas.harvard.edu/geos/
[6] http://www.acd.ucar.edu/gctm/mozart/
[7] http://jwocky.gsfc.nasa.gov/

The ENVIRON Team will conduct additional QA of point, area, and nonroad sources emissions data prior to the generation of SMOKE input files. Due to the magnitude of the emission records, this will not be a line-by-line QA. Rather, high-level QA procedures will be utilized that examine potential emission "outliers", source category and pollutant completeness, and the point source distribution of point sources. Additional QA associated with the emissions data in conjunction with the subsequent associated emissions and air quality modeling may be deemed necessary by MDNR throughout the duration of the project. The ENVIRON Team will be responsive to MDNR's requests for additional QA on an as needed basis.

The additional assistance may include, but not be limited to, the following: model compilation assistance, developing and training in the use of pre- and post-processing tools for compliance evaluations of the new primary and secondary ozone standards, and/or suggested revisions to the model inputs and configuration to improve base case model performance. We anticipate that the assistance would be provided by conference calls, e-mails or on-site visit during one of the three meetings planned under Task 7.

Deliverables: Documentation on the QA/QC of the emissions and air quality modeling that includes a model performance evaluation and recommendations for sensitivity tests designed to improve model performance.

TASK 5: FUTURE YEAR MODEL-READY EMISSION INPUTS
Task Leader: Chris Lindhjem and Paula Fields

Objective: To generate SMOKE-ready area, point and non-road source emission inputs and SMOKE-MOVES ready future year VMT estimates for the selected future year, 34/12/4/1 km modeling domains and June-September 2007 modeling period.

Following the compilation of the 2007 base case model-ready emissions inputs, the ENVIRON Team will proceed with the development and compilation of future year model-ready emissions inputs (i.e., growth and control factors). The specific future year is not explicitly identified in the RFP, but will be specified by MDNR after U.S. EPA's promulgation of the final 8-hour ozone standard by the end of 2010. In any event, the ENVIRON Team will develop and compile the future year model-ready emissions inputs based upon the future year to be identified by MDNR/IEPA. The ENVIRON Team has previous experience in developing growth and control factors during their projection of the 2002 base year WRAP inventory to the 2018 future year as well as numerous other SIP studies.

As part of the ENVIRON Team's development of the future year growth and control factors, we will first identify any future year inventories that have previously been developed by other inventory and modeling efforts that could be potentially utilized. For instance, the SEMAP project sponsored by SESARM is developing future year inventories for 2013, 2017, and 2020. The SEMAP project indicated scheduled inventory development and SMOKE modeling in late 2010 and early 2011; however, there may have been delays in this schedule. These future inventories may be useful for the development of growth and control factors, particularly if MDNR's selected future year is 2013, 2017, or 2020. In addition, it was previously mentioned that 2018 future year inventories were developed by RPOs in support of regional haze- and visibility-related activities. Also, ERG was directly involved in the development of future year projections for 2008, 2012, 2018, and 2030 in Mexico

It should be pointed out that the ENVIRON Team will not blindly use future year growth and control factors from inventories previously developed by other efforts. The team will carefully examine the inventory documentation to determine the extent that these future year inventories represent that conditions desired for MDNR's future year base case emissions. It is possible that these future year growth and control factors could be used directly. However, it is more likely that some adjustments might be needed (e.g., different future years, additional federal or state rules, etc.) before the future year inventories could be used. Also, it may be necessary to develop the future year growth and control factors without relying on previously developed future year inventories.

Regardless of the specific future year ultimately chosen by MDNR, the future year base case emissions will be affected by two factors relative to the 2007 base year: controls and growth. This work, along with QA and development of SMOKE input files for the future year, is described next.

Develop Control Factors

The ENVIRON Team will identify any existing and "on the books" control measures due to existing federal and state (i.e., Missouri and Illinois) rules in effect or expected to be in effect through the future year that reduce emissions which contribute to ozone and $PM_{2.5}$. These control measures are not already be accounted for in the 2007 base year emissions inventory. In addition, only those control measures that will be implemented with a high degree of certainty will be considered for the future year base case. Control measures that are hypothetical or have a low probability of implementation will not be included. Since ERG has been working as one of U.S. EPA's prime air regulatory contractors, the ENVIRON Team will have an excellent understanding of the federal rules that must be examined for development of relevant growth factors.

Develop Growth Factors

Future year growth is driven by population growth within the inventory domain for many area source categories, as well as changes in industrial activity for point sources and some area source categories. Demographic data from the U.S. Census Bureau and state demographers will be appropriate for some types of area source categories. In addition, sector-specific fuel use projections from the Energy Information Administration's *Annual Energy Outlook (AEO)* will be appropriate for other area source categories. Previously, U.S. EPA assumed in its guidance for projections development, particularly for point sources, that economic growth (typically expressed as economic output) is an appropriate surrogate for emissions growth. This was an underlying assumption for U.S. EPA's Economic Growth Analysis System (EGAS) model. However, U.S. EPA is currently conducting research examining the validity of this assumption through detailed analysis of energy or combustion emissions versus non-energy or process emissions for 10 key industries (i.e., petroleum refining, pulp and paper, iron and steel, cement, primary aluminum, secondary aluminum, black carbon, copper, sulfuric acid, and glass). The ENVIRON team will consider U.S. EPA's latest findings in their development of the future year base case emissions.

In order to develop appropriate growth factors for MDNR's future year, the ENVIRON Team will rely on its previous experience in projecting inventories and will utilize population demographic projections, sector-specific fuel projections from *AEO*, and economic output projections, as well

as U.S. EPA's latest research findings to develop appropriate growth and control factors. In addition, the ENVIRON Team will attempt to identify those sources that will close down between 2007 and the future year.

Typically, the control factor is represented by a number between 0 and 1, where 0 represents no controls/uncontrolled and 1 represents 100 percent control (e.g., complete suppression, source elimination, etc.). The growth factor is represented by a number 0 or greater. A growth factor greater than 1 indicates growth, while a growth factor less than 1 indicates negative growth (i.e., shrinkage). A growth factor of exactly 1 represents no growth or unchanged activity, while a growth factor of exactly 0 represents facility shutdown or elimination of a particular source category.

Quality Assure Factors and Develop SMOKE Input Files

After developing the relevant growth and control factors for the future year inventory, the ENVIRON Team will efficiently conduct a QA review of the developed growth and control factors. This review will focus on identifying those growth and control factors that appear to be "outliers" (i.e., excessively large or small). For "outliers" identified, the underlying activity data will be examined to determine any possible reasons for the excessively large or small values. If "outliers" are identified, the ENVIRON Team will consult with MDNR to identify potential alternative factors. Following this QA review, the ENVIRON Team will convert the growth and control factors into emission model-ready format and then deliver them to MDNR. The growth and control factors will be delivered to MDNR within 180 days of the effective date of the contract, along with any associated documentation.

On-Road Mobile Sources

We would acquire or project future year Vehicle Miles Travelled (VMT) estimates for counties in the 36/12/4/1 km modeling domain and reformat them for the SMOKE-MOVES module. As stated in the RFP Amendment Number 1, the MDNR will perform the future year MOVES modeling to generate MOVES outputs for counties in Missouri and Illinois and the future year. For counties outside of Missouri and Illinois, we would obtain MOVES outputs from the RPOs (e.g., SEMAP and LADCO) or EPA and provide them to MDNR. Based on potential changes in county vehicle characteristics (e.g., adoption of an I/M or fuel program), the representative county cross reference file would be updated. We would provide SMOKE-MOVES set-up for the base year to MDNR and advise MDNR on how to update it for the future year on-road mobile source emissions modeling. The MDNR would then apply the SMOKE-MOVES tool using the future year VMT and MOVES output files as well as the same June-September 2007 meteorological conditions as used for the base year. The MDNR would then provide the ENVIRON Team with the resulting PGM-ready on-road mobile source emissions inputs and the ENVIRON Team would QA the on-road emissions by examining the spatial and temporal distributions and by animating the differences with the 2007 base year on-road mobile source emissions to assure the future year on-road mobile source emissions are changing as expected.

Deliverable: Future year SMOKE-ready area, point and non-road mobile emission inputs for the modeling period and four domains. SMOKE-MOVES ready year future year VMT data and advice on operating SMOKE-MOVES for the future year. Documentation on the future year emissions development procedures and QA/QC including growth and control assumptions.

TASK 6: FINAL MODELING REPORT

Task Leader: Ralph Morris

Objective: To develop a final modeling report that documents the St. Louis emissions and air quality modeling study suitable for inclusion in the St. Louis ozone and $PM_{2.5}$ SIP as an air quality Technical Support Document (TSD).

This Task would prepare a final report on the St. Louis emissions and air quality modeling that would be used as the air quality TSD for the St. Louis ozone and $PM_{2.5}$ SIP. The report would not only document the emissions and PGM input develop, QA and model performance evaluation conducted by the ENVIRON Team, but also the modeling activities of the MDNR, IEPA and AQMP Technical Workgroup, as well as other activities related to the study. For example, SEMAP has hired a contractor (AER) to perform a third party independent evaluation of the 2007 36/12 km WRF meteorological model output whose results would be synthesized in the final report. The assembling of documentation from many different groups into a coherent final report requires intimate knowledge of all aspects of the modeling study and close cooperation with the study participants. The Task Leader for this task was responsible for assembling the TSDs for the previous St. Louis ozone and $PM_{2.5}$ SIPs so is well aware of the procedures that are needed to accomplish this task.

An outline for the final report would be developed early in the process and the report would be filled out as the study unfolds. The elements of the final report would be similar to the TSD prepared for the previous St. Louis ozone and $PM_{2.5}$ SIP and include the study design and working group members and roles, Conceptual Model, procedures used to develop model inputs and their QA/QC, model performance evaluation, sensitivity tests conducted and any model improvements, future year emission projection assumptions and control strategy assessment, procedures and results of the attainment demonstration modeling and the additional weight of evidence (EOE) to support the modeled attainment demonstration.

The goal of this task would be to obtain an approved final report by at least thirty (30) days of the end of the contract. This means that a draft final report would be required at least sixty (60) days before the end of the contract in order to have sufficient review time for the MDNR, IEPA and AQMP Technical Work group.

Deliverables: Draft and Final Report.

TASK 7: PROJECT MANAGEMENT AND MEETINGS

Task Leader: Ralph Morris

Objective: To manage the St. Louis modeling study and have three on-site meetings.

Under this task we would manage the St. Louis modeling study and participate in three on-site meetings on the study. It is anticipated that the on-site meetings would occur in St. Louis or Jefferson City, but other cities could also be accommodated (e.g., Springfield). One of the three on-site meetings may be an oral presentation on the final results if requested by MDNR. We are assuming that meetings would be attended by two people from the ENVIRON Team who would likely be the Project Manager (Ralph Morris) and Jay Turner. Others from the ENVIROIN Team would be available via conference call if needed.

Participation in conference calls, webinars, meetings and technical presentations as requested by MDNR/IEPA would also be covered under this task. The preparation of monthly progress reports and invoices would also be performed under this task.The monthly progress reports and invoices would include all backup informations as requested in section 2.6.2 of the BAF for the RFP:

- Detailed time sheets of personnel who billed to the project during the month.
- Invoices and documentation of any other expenses that occurred during the month.

More detailed quarterly progress reports would also be prepared by the 15th day of each quarter (i.e., by January 15, April 15, July 15 and October 15) that detail the progress on the study:

- The specific activities performed/completed during the quarterly progress period;
- The specific activities completed to date and the completion date of such activities;
- The specific activities and projected completion date(s) remaining to be completed; and
- Any unexpected problems that may have arisen and their proposed resolution.

Deliverables: Monthly progress reports and invoices, more detailed quarterly progress reports, three on-site meetings, conference calls and project management.

4.2 ECONOMIC IMPACT TO MISSOURI

As required by the RFP, we consider here the economic advantages to the State of Missouri that would be realized as a result of the ENVIRON Team carrying out the proposed project. One of our team members, Jay Turner of Washington University works and lives in St. Louis and therefore payments made to Dr. Turner as a result of the proposed project will benefit the Missouri economy both directly via tax payments due to Missouri and indirectly via increased economic activity. In addition, ENVIRON maintains an office in Maryland Heights, MO with 12 employees.

4.3 PROJECT ORGANIZATION

An overview of the management organization for the proposed project is provided in the chart below (Figure 5). Mr. Ralph Morris of ENVIRON will serve as the overall Project Manager, working closely with and under the direction of the MDNR. Mr. Morris lead the previous St. Louis ozone SIP modeling study and has managed numerous other similar SIP modeling studies as described in Section 2. As noted in Figure 5, each specific work area has been assigned to managers at ENVIRON and ERG who are experts in the related technical fields and have extensive project management experience.

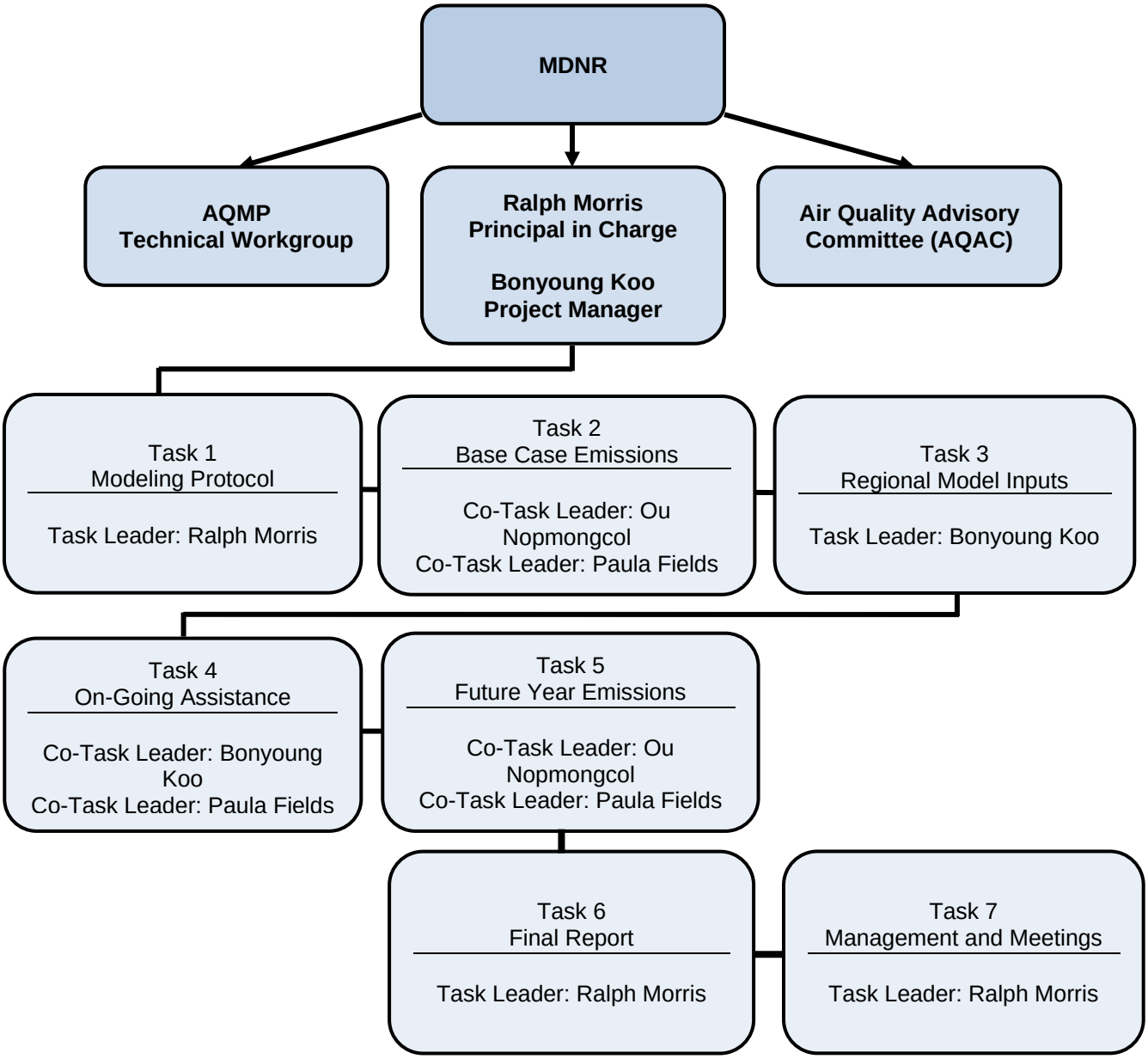


Figure 5. Proposed Organizational Chart.

4.4 SCHEDULE OF EVENTS (EXHIBIT F)

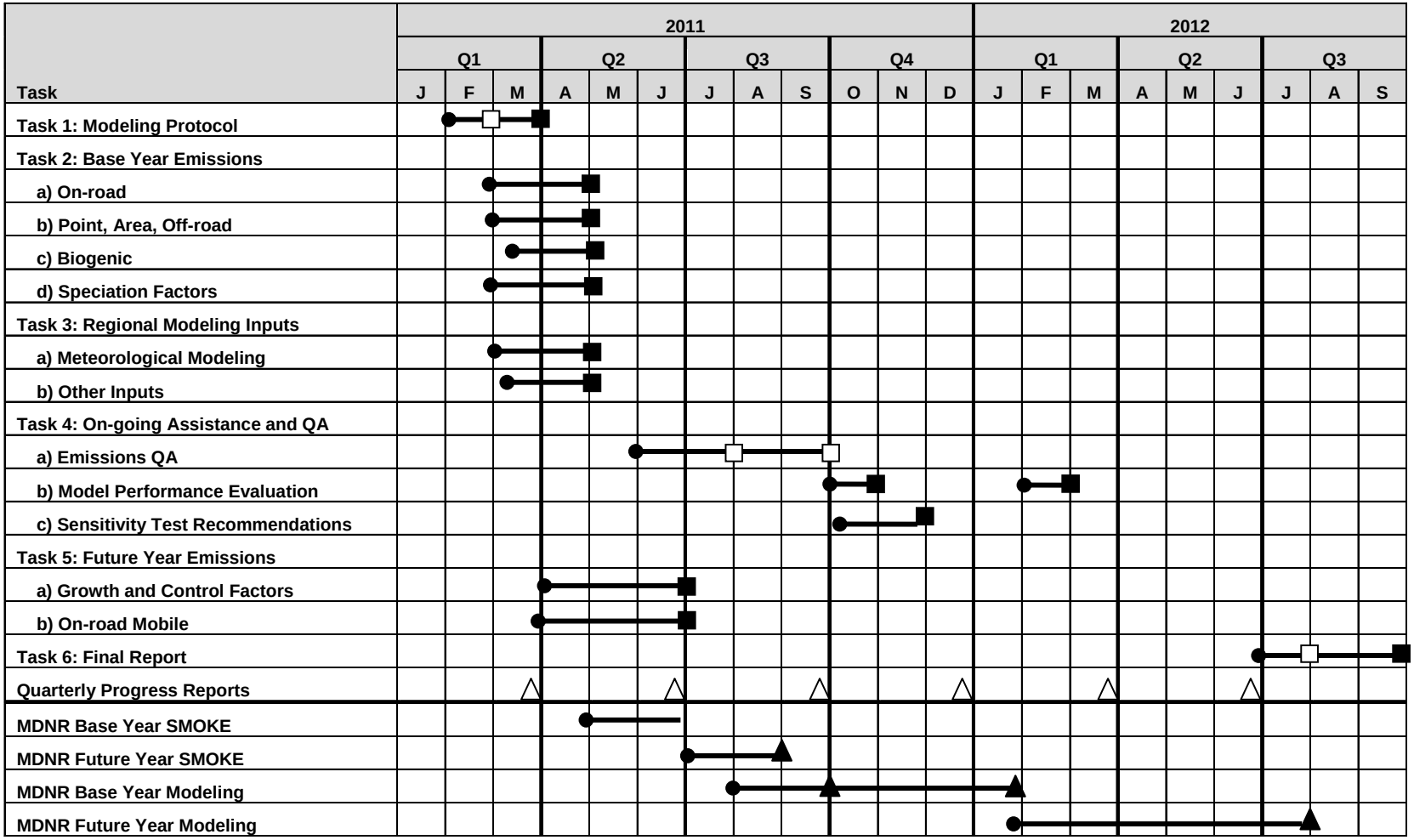
We provide below a summary Schedule of Events for the proposed project which meets the requirements set forth in the RFP. Also included is a timeline chart which shows how timing of each of the tasks relate to one another. The timeline chart indicates our assumptions about the timing and duration of SMOKE and CMAQ modeling that will be carried out by MDNR. These assumptions are based on the deadlines for our work that are specified in the RFP and the project end date (31 August 2012) specified in the RFP. For purposes of laying out the timeline chart, we have assumed a project start date of 1 January 2011 but the entire schedule can be shifted as needed to match the actual project start date without altering the duration of each task.

We understand that it may be necessary to adjust the deliverable deadlines laid out here depending on changing needs of the MDNR and timing of the availability of various pieces of data needed to conduct the work. These data needs and assumptions regarding when each required external data set will become available are spelled out in the footnotes to the table.

Task or Event	Completion Day	Assigned Personnel	Work-hours
Effective Date of Contract	1	N/A	N/A
Draft Modeling Protocol	30	Morris, Koo, Fields	
Final Modeling Protocol	52[8]	Morris, Koo, Fields	
Set up for Base Year SMOKE-MOVES On-Road Mobile Emissions and model input files for 1-2 weeks	Within 60 Days of Receipt of MOVES Output Files from MDNR	Nopmongcol, DenBleyker, Shah, Lindhjem	
Base Year Point, Area, Non-Road Emissions SMOKE Input Files	82[9]	Fields, Billings, Baker, Wolf, Oommen, Manne, Enoch	
SMOKE-BEIS Input Files for Biogenics	82[3]	Sakulyanontvittaya, Nopmongcol	
Speciation Factors	91	Nopmongcol, Shah	
PGM Regional Modeling Inputs	82[3]	Koo, Johnson, Brashers	
Documentation of Emissions QA/QC	Within 60 Days of Receipt of Emissions Files from MDNR	Fields, Nopmongcol, Shah	
Model Performance Evaluation	Within 60 Days of Receipt of Modeling Results from MDNR	Turner, Johnson	
Recommendations for Sensitivity Tests	Within 60 Days of Receipt of Modeling Results from MDNR	Turner, Morris, Koo	
Emissions Model Ready Future Year Growth and Control Factors	181[10]	Fields, Wolf, Oommen, Manne, Enoch	
Set Up for Generating Model-Ready Future Year On-Road Mobile Source Emissions Files	181[4]	Nopmongcol, DenBleyker, Shah, Lindhjem	
Draft Final Report (SIP TSD)	TBD[11]	Morris, Koo, Fields, Wolf	
Final Report (SIP TSD)	TBD[12]	Morris, Koo, Fields, Wolf	
Oral Presentation	TBD[13]	Morris	
Meetings & Conference Calls	TBD	Morris, Koo, Fields, Wolf	
Quarterly Progress Reports	15th Day of Each Calendar Quarter		

[8] Assumes MDNR comments received by Day 37
[9] Assumes final Modeling Protocol approval and all required external data availability by Day 52
[10] Assumes MDNR selection of which future year to model by Day 30
[11] No later than 60 days prior to contract end date (note: RFP says 30 days but that may not result in sufficient review time for MDNR, IEPA and others (e.g., AQMP Technical Workgroup)
[12] Within 14 days of receipt of MDNR comments
[13] Requires minimum of 15 days advance notice from MDNR

Best and Final



4.4 BUDGET (EXHIBIT G)

We provide here our estimated budget for the proposed work described above, presented in the format required by the RFP. In developing our budget estimate, we have paid careful attention to the project requirements specified in the RFP as amended. Our interpretation of the work needed to meet these requirements is clearly described in Section 4.1 above. We note in particular that this includes a requirement to develop PGM-ready, day-specific on-road mobile source emissions as well as PGM-ready meteorological fields at 4 and 1 km resolution over the St. Louis area. Meeting these two requirements will be particularly labor intensive. We would be happy to work with the MDNR to develop alternative approaches if budget restrictions make this impractical. In addition, our cost estimate is based on an assumption about the level of effort that will be required to provide "on-going technical assistance" as required by the RFP. If more or less assistance is required than allowed for here, we will work the MDNR to adjust the budget accordingly.

Guaranteed not to exceed total price: The offeror shall state a guaranteed not-to-exceed total price for performing the services required herein. All costs associated with providing the required services shall be included in the guaranteed not-to-exceed total price. *(commodity code 92605)*

Pricing Page

Line #	Pricing Specification	Price
1	**Total guaranteed not to exceed total price**	**$169,973**

Personnel Classification Prices – The offeror shall state the personnel classification proposed to provide services and the firm fixed price per hour for each classification. If additional space is needed, the offeror may attach copies of this page. The offeror should also provide the name of the person(s) proposed to be assigned to each classification. The offeror should not quote multiple prices for the same personnel classification. *(commodity code 92605*)

Line #	Personnel Classification	Name of Person(s) Proposed	Firm Fixed Price Per Hour
SENIOR LEVEL A senior level personnel classification shall be defined as management/supervisory level and/or highest technically skilled who will be assigned lead roles. All proposed personnel must have higher qualifications than mid-level.			
2	Principal (ENVIRON)	Ralph Morris	$225.00
3	Principal Enginner (ERG)	Paula Fields	$170.78
4	Principal Consultant	Jay Turner	$125.00
5	Senior Consultant (ENVIRON)	Chris Lindhjem	$132.34
		Bart Brashers	
		Bonyoung Koo	
		Uarporn Nopmongcol	
6	Senior Staff Scientist (ERG)	Rick Baker	$132.10
		Richard Billings	
MID-LEVEL A mid-level of personnel classification shall be defined as those who take direction from a manager with respect to the execution of the project but do not require significant supervision. Additionally, those in the mid-level possess mature, marketable skills and experience in their given area of expertise. All proposed personnel must have higher qualifications than entry-level			
7	Mid-Level Engineer (ERG)	Marty Wolf	$122.69
8	Staff Scientist (ERG)	Regi Oommen	$104.92
9	Senior Associate (ENVIRON)	Jeremiah Johnson	$97.71
ENTRY-LEVEL An entry-level of personnel classification shall be defined as those who take detailed instructions from a manager and have limited to no decision-making authority. Additionally, the skills of those in the entry-level are not as mature as those at mid-level and they posses limited experience in their given area of expertise. All proposed personnel must have at least six (6) months of experience in the proposed area and be past any personnel probationary period.			
10	Associate (ENVIRON)	Tejas Shah	$93.31
		Allison DenBleyker	
		Tan Sakulyanontvittaya	
		Piti Piyachaturawat	
11	Associate Engineer (ERG)	Gopi Manne	$93.42
12	Support Staff (ENVIRON)	Cindy Smith	$84.10
13	Staff Support (ERG)	Staci Enoch	$73.56
		Lilian Ponton	

EXHIBIT G

BUDGET/PRICE ANALYSIS

The offeror should complete the following table in sufficient detail for information regarding the services proposed

Budget Categories	Quantity	Unit Price	Total
Professional Personnel (list)			
1. Principal (ENVIRON)	74	$225.00	$16,650
2.Principal Engineer (ERG)	45	$170.78	$7,685
3.Sr. Consultant (ENVIRON)	320	$132.60	$43,725
4.Sr. Staff Scientist (ERG)	8	$132.10	$1,056
5.Sr. Associate (ENVIRON)	36	$97.71	$3,518
6.Mid-Level Engineer (ERG)	158	$122.69	$19,385
7. Staff Scientist (ERG)	26	$104.92	$2,728
7. Associate (ENVIRON)	376	$92.75	$34,434
8. Associate Engineer (ERG)	73	$93.42	$6,820
7. Dr. Jay Turner	96	$125.00	$12,000
Total Professional Personnel			**$148,001**
Support Personnel (list)			
1. Support Staff (ENVIRON)	54	$84.10	$4,541
1. Staff Support (ERG)	113	$73.56	$8,312
Total Support Personnel			**$12,853**
Travel Expenses (list)			
Air fare (ERG)	0	$0	$0
Ground transp. (ERG)	0	$0	$0
Lodging (ERG)	0	$0	$0
Meals/Incidentals (ERG)	0	$0	$0
Air fare (ENVIRON)	3	$350.00	$1,050
Ground transp. (ENVIRON)	3	$90.00	$270
Lodging (ENVIRON)	3	$120.00	$360
Meals/Incidentals (ENVIRON)	3	$106.67	$320
Total Travel Expenses			**$2,000**
Materials and Supplies (list)			
1. Disk drives for data storage	-		$400
2. Shipping	-		$199
Total Materials and Supplies			**$599**
Other Components/Overhead (List)			
1. Communications (ENVIRON)	-	$	$3,086
2. Computing (ENVIRON)	-	$	$3,086
3. Phone (ERG)	-	$	$348
4. 0% G&A on Subs (ENVIRON)	-	$	$0
Total Other Components/Overhead			**$6,520**
Total Price (must equal the price quoted on the Pricing Page)			**$169,973**