**Revised Scope of Work for the Remainder of Phase II of the Western Air Quality Study (WAQS)**

**August 2015 – March 2016**

**BACKGROUND**

Ramboll Environ US Corporation (Ramboll Environ) and the University of North Carolina at Chapel Hill Institute for the Environment (UNC-IE) are conducting Phase II of the Western Air Quality Study (WAQS) under contract to WESTAR. Phase II of the WAQS was to perform 11 Tasks during the September 2014 through July 2015 period, subsequently amended to be complete by December 31, 2015; now the end date is to be extended to March 31, 2016. One purpose of the WAQS is to provide modeling databases and support to the Intermountain West Data Warehouse (IWDW) being operated out of Colorado State University (CSU). At the outset of the WAQS Phase II, the Scope of Work (SoW) was developed under the existing 2014-2017 workplan for the IWDW-WAQS project as directed by the IWDW-WAQS Oversight Committee. The WAQS Phase II work has been reviewed and overseen under the direction of the IWDW Technical Committee throughout Phase II.

During Fall 2014, the Oversight (then called Steering) Committee directed WESTAR/WRAP to have Ramboll Environ and UNC-IE increase the Model Performance Evaluation effort on the IWDW-WAQS 2011a modeling platform. Those efforts required the reallocation of effort within existing Phase II contract tasks[[1]](#footnote-1), discussed and approved by the Oversight (then called Steering) Committee on their December 17, 2014 conference call. Then on July 30, 2015, the IWDW Oversight Committee identified the need to again revise the WAQS Phase II SoW by formally amending the contract. The principal July 30th changes are to stop work on developing a new Photochemical Grid Model (PGM) modeling platform for 2014 and redirect resources toward more analysis of the 2011b PGM modeling platform including conducting CMAQ 2011b base case modeling and CMAQ and CAMx future year modeling. The Ramboll Environ and UNC-IE WAQS contracting team have worked with the IWDW-WAQS Technical Director at WESTAR and developed a spreadsheet of Tasks and Costs that de-obligates money from some of the existing 11 Tasks (e.g., those related to the 2014 modeling platform) and adds 9 new Tasks related to the additional base and future year PGM modeling using the 2011b modeling platform. The net total cost for Phase II remains the same.

This document is a narrative of the specific changes in the WAQS Phase II SoW that will be performed between August 2015 and March 2016, as amended in the WESTAR contract with Ramboll Environ and UNC-IE.

**REVISED WAQS PHASE II SOW**

Below is a narrative for the revised SoW for remainder effort under Phase II of the WAQS to be performed during August 2015 through March 2016 under the current eleven and six new Tasks.

**Task 1: 2011 CMAQ Modeling**

Objective: To perform 2011 base case modeling using the CMAQ modeling system and the 2011 modeling platform and conduct a model performance evaluation.

Status: With the exception of the CAMx-CMAQ guidance document, this task completed in August 2015. The guidance document is being replaced by a fact-sheet Wiki with a table comparing the different options in each model along with a brief narrative describing the options.

Deliverables:

* 3SAQS CMAQ version 5.0.2 2011 modeling platform, including all data, codes, and scripts, loaded onto the 3-State Data Warehouse ([**Completed: August 2015**](http://vibe.cira.colostate.edu/wiki/wiki/1072))
* Annual 2011 CMAQ modeling on the 3SAQS 36/12/4-km modeling domains; final simulation results loaded on the 3-State Data Warehouse (**Completed: March 2015**)
* CMAQ Model Performance Evaluation (MPE) and CAMx comparison report ([**Completed: June 2015**](http://vibe.cira.colostate.edu/wiki/Attachments/Modeling/3SAQS_Base11a_MPE_Final_18Jun2015.pdf))
* 3SAQS air quality modeling guidance document describing when and how to use CAMx and CMAQ ([**Wiki Page**](http://vibe.cira.colostate.edu/wiki/wiki/1061/camx-and-cmaq-technical-summary) **comparing CMAQ and CAMx technical features – February 2015**)

Remaining Work: Task closed and additional modeling and MPE work will be carried out under new Task 13.

**Task 2: Source Apportionment Modeling**

Objective: To prepare a source apportionment modeling plan and conduct geographic-specific and source category-specific ozone and particulate matter source apportionment (SA) modeling using the 2011 CAMx and CMAQ modeling platforms.

Status: Ongoing, in middle of first round of Geographic SA modeling.

Deliverables:

* Source apportionment design document ([**Completed: June 2015**](http://vibe.cira.colostate.edu/wiki/Attachments/Modeling/3SAQS_SA_Plan_2011_Draft_v4_06-02-2015.pdf))
* Source apportionment results available through visualization tools on the 3SDW website. (**Ongoing/Expected Completion: February 2016**)
* Report documenting the source apportionment modeling results and examples on how to use the source apportionment visualization tools. (**Ongoing/Expected Completion: February 2016**)

Remaining Work: Original SoW remains: (1) Geographic SA; (2) Source Category SA; (3) Detailed 4 km domain SA; and (4) Web-based SA visualization tool.

**Task 3: Sensitivity Tests/Model Improvements**

Objective: To perform air quality modeling sensitivity tests using the 2011 modeling platform designed to investigate and improve model performance.

Status: Work continued on the CAMx 2011b base case in July 2015 with the run completed and MPE initiated.

Deliverables:

* Work Plan describing the sensitivity tests to be conducted (**Completed: August 2014**).
* Memo describing the sensitivity modeling, including an integrated sensitivity, with recommendations for improving the 3SAQS 2011 version A (or current version) air quality modeling platform ([**Wiki Pages**](http://vibe.cira.colostate.edu/wiki/wiki/1018/3saqs-2011a-modeling-platform) **for completed sensitivities**).
* Updated/new input data sets and/or model configuration options to improve 3SAQS air quality model performance (**Completed: WRF Winter Configuration, MOVES 2014 Sensitivity, MOZART no-Dust ICBCs, 0.5x Residential Wood Combustion Emissions, NEI2011v2 emissions**)

Remaining Work: Task closed and new 2011b base case and MPE work will be carried out under new Task 12.

**Task 4: Deposition and Visibility Analysis**

Objective: To provide more detailed analysis of 2011 modeling platform visibility and deposition performance.

Status: Task completed in June 2015.

Deliverables:

* Document describing the analysis of the CMAQ and CAMx 2011 visibility and deposition modeling results and how that will improve the application to 2014 ([**Completed: 3SAQS 2011 MPE Report, June 2015**](http://vibe.cira.colostate.edu/wiki/Attachments/Modeling/3SAQS_Base11a_MPE_Final_18Jun2015.pdf)).

Remaining Work: None.

**Task 5: 2014 Data Analysis and Modeling Plan**

Objective: To develop a modeling and data analysis plan for modeling/analysis of the 2014 calendar year.

Status: Draft 2014 modeling plan under review by the Technical Committee.

Deliverables:

* 2014 modeling protocol version 1 ([**Completed: July 2015**](http://vibe.cira.colostate.edu/wiki/Attachments/Modeling/WAQS_2014_DataAnalysis_Modeling_Plan_Draft_21July2015.docx)**)**
* Documentation of lessons learned from 2008 and 2011 3SAQS WRF/SMOKE/CAMx modeling (**Ongoing/Expected Completion: September 2015**)

Remaining Work: Will prepare finalize 2014 model plan, Response-to-Comments, and lessons learned documents.

**Task 6: 2014 WRF Meteorological Modeling**

Objective: To perform WRF meteorological modeling for developing a preliminary 2014 CAMx/CMAQ modeling platform.

Status: Completed 2014 36/12/4 WRF meteorological modeling in August and beginning WRF MPE

Deliverables:

* WRF 2014 Modeling Protocol (**Ongoing/Expected Completion: September 2015**).
* 3SAQS WRF 2014 modeling platform, including all data, codes, and scripts, loaded onto the 3-State Data Warehouse (**Ongoing/Expected Completion: September 2015**)
* Annual 2014 WRF modeling on the 3SAQS 36/12/4-km modeling domains; final simulation results loaded on the 3-State Data Warehouse (**Ongoing/Expected Completion: October 2015**)
* WRF Model Performance Evaluation (MPE) report (**Ongoing/Expected Completion: November 2015**)

Remaining Work: Will finish 2014 WRF MPE and prepare report completing task as originally envisioned.

**Task 7: 2014 Emission Platform Development and Testing**

Objective: To develop a preliminary 2014 emissions inventory for use in the preliminary CAMx/CMAQ 2014 modeling platform.

Status: Initiated 2014 emissions data gathering in July-August 2015. Stopped work in August 2015.

Deliverables:

* 2014prelim emissions inventory development plan (**Included as part of the 2014 Data Analysis and Modeling Plan under Task 5;** [**Completed: July 2015**](http://vibe.cira.colostate.edu/wiki/Attachments/Modeling/WAQS_2014_DataAnalysis_Modeling_Plan_Draft_21July2015.docx))
* 3SAQS SMOKE 2014 modeling platform, including all data, codes, and scripts, loaded onto the 3-State Data Warehouse. (**Discontinued**)
* Annual 2014 SMOKE modeling on the 3SAQS 36/12 modeling domains; final simulation results loaded on the 3-State Data Warehouse. (**Discontinued**)
* 3SAQS emission trends report comparing 2008, 2011, and 2014 emissions data. (**Discontinued**)
* Memo describing the lessons learned in building the final 2011 and preliminary 2014 emissions modeling platforms and the next steps for future 2014 emissions data and modeling. (**Discontinued**)

Remaining Work: None.

**Task 8: Preliminary 2014 Air Quality Modeling**

Objective: To develop a preliminary 2014 air quality modeling platform and perform base case modeling and model performance evaluation.

Status: Not started.

Deliverables:

* 2014 CAMx/CMAQ Modeling Protocol. (**Included as part of the 2014 Data Analysis and Modeling Plan under Task 5;** [**Completed: July 2015**](http://vibe.cira.colostate.edu/wiki/Attachments/Modeling/WAQS_2014_DataAnalysis_Modeling_Plan_Draft_21July2015.docx))
* 3SAQS CAMx and CMAQ preliminary 2014 modeling platforms, including all data, codes, and scripts, loaded onto the 3-State Data Warehouse. (**Discontinued**)
* Annual 2014 CAMx and CMAQ modeling on the 3SAQS preliminary 36/12-km modeling domains; final simulation results loaded on the 3-State Data Warehouse. (**Discontinued**)
* 3SAQS air quality trends report comparing modeled 2008, 2011, and 2014 ozone, PM, visibility and deposition trends in the three-state region. (**Discontinued**)

Remaining Work: None.

**Task 9: WRF Winter Ozone Modeling**

Objective: To develop an operational winter modeling configuration for WRF that can be used with CAMx/CMAQ for simulating winter ozone events.

Status: Finished winter WRF modeling.

Deliverables:

* Work Plan reviewing research to date on winter ozone modeling and procedures for conducting Task 9 winter ozone WRF modeling. ([**Completed: March 2015**](http://vibe.cira.colostate.edu/wiki/Attachments/Work%20plans/WSAQS_WRF_Winter_Modeling_Final.pdf))
* 3SAQS WRF 2011 wintertime modeling platform, including all data, codes, and scripts, loaded onto the 3-State Data Warehouse. (**Completed: September 2015**)
* January-March, December 2011 WRF modeling on the 3SAQS 36/12/4-km modeling domains using the 3SAQS wintertime configuration; final simulation results loaded on the 3-State Data Warehouse (**Completed: July 2015**)
* Final memo documenting the testing and configuration of the 3SAQS WRF wintertime modeling platform (**Expected** **Completion: September 2015**)

Remaining Work: None.

**Task 10: O&G Survey and Preliminary 2014 O&G Emissions**

Objective: To develop new surveys to characterize 2014 O&G emissions and develop preliminary 2014 O&G emissions for the three-state region..

Status: In middle of developing 2014 O&G emissions and surveys.

Deliverables:

* Basin-aggregated survey data on activity, equipment, processes and gas compositions for the source categories for the D-J, Piceance and Uinta Basins. (**Discontinued**)
* Preliminary 2014 O&G emissions formatted for SMOKE. (**Discontinued)**
* Transfer all 2014 O&G data to IWDW. (**Ongoing/Expected Completion: September 2015**)

Remaining Work: None.

**Task 11: Project Management**

Objective: To manage project, attend conference calls, prepare monthly progress reports, etc.

Status: Ongoing.

Deliverables:

* Weekly conference calls with WAQS Technical Director (**Ongoing/Expected Completion: End of Contract**)
* Additional conference calls with WAQS participants (**Ongoing/Expected Completion: End of Contract**)
* Preparation of PPTs for WAQS Technical and Oversight Committee Meetings and Webinars (**Ongoing/Expected Completion: End of Contract**)
* Attendance of WAQS meetings (**Ongoing/Expected Completion: End of Contract**
* Monthly invoices and progress reports. (**Ongoing/Expected Completion: End of Contract**)

Remaining Work: New SoW, continued project management, and continued participation in project meetings to end of Phase II.

**New Task 12: Finish CAMx 2011b Base Case and Model Performance Evaluation**

Objective: To finish the CAMx 2011b 36/12/4 km base case and model performance evaluation.

Comment: Continuation of Task 3 Model Improvements. Include summaries of the winter ozone modeling and oil and gas inventory analyses completed under Task 3. Include recommendations for future research into improving the winter model and oil and gas emissions.

Deliverables:

* 2011b Modeling Protocol Addendum (**Expected Completion: September 2015**)
* Discuss what changed from 2011a Modeling Protocol.
* 2011b MPE Addendum (**Expected Completion: September 2015**)
* Short summary of 2011b MPE and webpage with 2011b MPE products, including site-specific model-to-observations comparisons at monitoring sites in the 4-km modeling domain.
* Emissions Trends Report Addendum (**Expected Completion: October 2015**)
* Addendum to 2008, 2011 and 2020 emissions trends report with 2011b update
* Summarize winter ozone modeling and provide recommendations for future research on improving the winter ozone model (**Expected Completion: November 2015**)
* Summarize oil and gas inventory status and provide recommendations for future research (**Expected Completion: November 2015**)
* Transfer of CAMx 2011b database and outputs to IWDW (**Expected Completion: November 2015**)

**New Task 13: CMAQ 2011b Base Case and Model Performance Evaluation**

Objective: To perform CMAQ 2011b base case modeling.

Comment: Prepare ICBCs, emissions, and meteorology data for input to CMAQ for annual 36/12/4-km modeling. Conduct model performance evaluation, including site-specific model-to-observations comparisons at monitoring sites in the 4-km modeling domain.

Deliverables:

* 2011b Modeling Protocol Addendum (**Expected Completion: September 2015**)
* Discuss what changed from 2011a Modeling Protocol.
* Conduct annual 2011 CMAQ modeling on the WAQS 36/12/4-km modeling domains; final simulation results, input/output data, scripts, model code to the IWDW. (**Expected Completion: November 2015**)
* 2011b MPE Addendum (**Expected Completion: December 2015**)
* Short summary of 2011b MPE and webpage with 2011 MPE products, including site-specific model-to-observations comparisons at monitoring sites in the 4-km modeling domain.

**New Task 14: Prepare Future Year 36/12/4 km emissions inputs using SMOKE**

Objective: To perform SMOKE emissions modeling of EPA NEI2011v2 modeling platform future year emission projections and merge with 2011b biogenic and fires to generate model-ready future year emission inputs for the WAQS 36/12/4 km domains. The selection of the future year will be based on several factors:

* Guidance from the IWDW Technical Oversight Committee
* Timing of the release of future year emissions by EPA
* Needs for NEPA analyses in the region
* Regulatory decisions/requirements for ozone and regional haze planning.

In July 2015 EPA released 2017 emissions projections off of the 2011v2 base year. The 2017 data release was accompanied by a Notice of Data Availability (NODA) and Technical Support Document (TSD). EPA expects to release 2025 projections in early October. By mid-October (~October 16) 2015 we request that the IWDW Oversight/Technical Committees provide guidance on whether to proceed with simulating 2017 or 2025 future year emissions, if the latter are available from EPA at that time.

Comment: IWDW Oversight/Technical Committee to decide whether to perform this optional task around October 2015. Task would start in October 2015.

Deliverables:

* CAMx and CMAQ-ready 36/12/4 km future year emissions inputs (**Expected Completion: December 2015)**.
* Emissions Trends Report Addendum with future year emissions added (**Expected Completion: January 2016)**.
* Transfer of future year 36/12/4 km emission inputs to IWDW. (**Expected Completion: January 2016)**.

**New Task 15: CAMx Future Year 36/12/4 km Modeling**

Objective: To perform CAMx 36/12/4 km modeling and analysis using the future year emissions developed under Task 14.

Comment: IWDW Oversight/Technical Committee to decide whether to perform this optional task around October 2015.

Deliverables:

* Conduct annual future year CAMx modeling on the WAQS 36/12/4-km modeling domains; final simulation results, input/output data, scripts, model code to the IWDW. (**Expected Completion: February 2016**)
* Future Year Modeling Report with MATS ozone and PM2.5 projections. (**Expected Completion: March 2016**)
* Transfer of Future Year CAMx results, including 3-D output files, to IWDW. (**Expected Completion: March 2016**)

**New Task 16: CMAQ Future Year 36/12/4 km Modeling**

Objective: To perform CMAQ 36/12/4 km modeling and analysis using the future year emissions developed under Task 14.

Comment: IWDW Oversight/Technical Committee to decide whether to perform this optional task around October 2015.

Deliverables:

* Conduct annual future year CMAQ modeling on the WAQS 36/12/4-km modeling domains; final simulation results, input/output data, scripts, model code to the IWDW. (**Expected Completion: February 2016**)
* Future Year Modeling Report with MATS ozone and PM2.5 projections. (**Expected Completion: March 2016**)
* Transfer of Future Year CAMx results, including 3-D output files, to IWDW. (**Expected Completion: March 2016**)

**New Task 17: Intermountain West Data Warehouse Support**

Objective: To support the IWDW including weekly calls, design issues, data definitions, and other support as needed.

Comment: IWDW needs air quality modeling experts to help design functionality of data warehouse. Includes the acquisition of additional short/long-term data storage and computing hardware on the UNC modeling server to support the additional simulations ongoing and planned under this contract.

Deliverables:

* Weekly conference call updates. (**Expected Completion: Ongoing through end of contract**)
* Additional topical conference calls. (**Expected Completion: Ongoing through end of contract**)
* IWDW data support. (**Expected Completion: Ongoing through end of contract**)
* IWDW programming and documentation support. (**Expected Completion: Ongoing through end of contract**)
* Data storage and computing hardware for UNC modeling center needed to support computing and data requirements for 2011a sensitivity modeling, 2011b CMAQ and CAMx, and 2011b-> future year SMOKE/CMAQ/CAMx simulations (10 Tb of offline data storage; 10 Tb of online RAID storage; CPU cycles) (**Expected Completion: September 2015**)

1. – Memo to Steering Committee - Base11a Modeling Platform Next Steps, 17Dec2014 [↑](#footnote-ref-1)