APPENDIX TO MEMORANDUM OF UNDERSTANDING AMONG THE U.S. DEPARTMENT OF AGRICULTURE, U.S. DEPARTMENT OF THE INTERIOR, AND U.S. ENVIRONMENTAL PROTECTION AGENCY, REGARDING AIR QUALITY ANALYSES AND MITIGATION FOR FEDERAL OIL AND GAS DECISIONS THROUGH THE NEPA PROCESS

(06/20/11)

MODELING APPROACHES TO EVALUATE AIR QUALITY FOR NEPA DECISIONS REGARDING FEDERAL OIL & GAS

The purpose of this Appendix is to provide information when modeling is required by Section V.E.3.c of the Memorandum of Understanding (MOU). Section V.A of the MOU says "The analysis of impacts to air quality and AQRVs will be conducted in accordance with current technical standards, guidance, and practices and will be used to inform the decision-maker, Agencies [BLM, EPA, Forest Service, FWS, and NPS], and the public." Section V.D. of the MOU says "[c]onsistent with NEPA and its implementing regulations, the Lead Agency will complete and document supporting air quality and AQRVs analyses prior to Federal oil and gas planning, leasing, or field development decisions."

Modeling is required when criteria described in MOU Section V.E.3 are met. This appendix provides general direction on approaches, models, and underlying principles to accomplish technical tasks while encouraging and optimizing resource efficiencies. Initially some of the modeling efforts may require additional investments. However, the outlined approaches encourage, to the maximum extent practicable, the reuse of pre-existing major modeling components and data to reduce overall resource commitments over time.

The Appendix is comprised of this introduction, and these two additional components:

- Two tables (A and B) of general air quality analysis approaches for a variety of conditions (*e.g.,* planning phase, data quantity/quality, and potential air quality impacts); and
- A matrix summarizing characteristics of currently available air quality models, applicability, and references (Overview Matrix Of Air Quality Model Characteristics).

Also attached is a concept paper describing a Reusable Modeling Framework, which provides an example of a complex air quality modeling system designed for multiple uses.

Consistent with the provisions of Section V. of the MOU, the Lead Agency selects the appropriate air quality models and technical approaches. Nevertheless, the Lead Agency must collaborate and engage the Agencies and technical workgroups, if convened, in selecting air quality models and technical approaches (see MOU Sections V.A., V.C. and V.E.1.). Early use of the approaches outlined in this Appendix will assist in making air quality modeling more efficient, effective, and save time and expense.

NOTES: (1) If the Lead Agency cannot complete necessary quantitative analyses (e.g. if a reasonably foreseeable number of wells cannot be determined, see MOU Section V.E.1), the Lead Agency should follow the procedures in MOU Section V.D. (2) This Appendix supports implementation of the MOU and does not supersede the provisions and process established in the MOU. (3) If disputes arise about application of the Appendix, follow the MOU dispute resolution provisions (Section VII). (4) This Appendix may be updated to reflect current knowledge and science as provided in the MOU.

The following tables describe various analysis approaches:

- Table A is used when the Lead Agency has determined a reasonably foreseeable number of wells utilizing limited or general information. The number of wells or associated emissions can be expressed as a range (*e.g.,* low, medium, high).
- Table B is used when the Lead Agency has determined a reasonably foreseeable number of wells (*e.g.,* specific number and location).

Table A. Consult this table when:		
A reasonably foreseeable number of oil or gas wells and associated emission inventory has been developed, utilizing limited or general information; the reasonably foreseeable number of wells and associated emissions are expressed as a range (*e.g.,* low, medium, high).		
Long Range Transport Assessment Approach	**'Add-on' Photochemical Approach**	**Local Assessment Approach**
When: Actions that contain single (or small group) source scenarios. Conducive to providing regional assessments of cumulative and incremental impacts. Transport distances greater than 50km.	***When:*** Actions that contain large scale source scenarios. Conducive to providing regional assessments of cumulative and incremental impacts.	***When:*** Actions likely to result in local air quality impacts. Transport distances less than 50km.
Description: Conduct modeling with estimates of emissions and estimated meteorological and geographic information for single or small groups of sources. This analysis may be used for new projects or proposals that lack specific development information but contain source scenarios that warrant additional review. This approach utilizes EPA guideline approved models for near (local) and far-field analysis. Models tend to be specific to an AQ pollutant, approved purpose, and regulatory application. Impact estimates are generated for ambient concentration, atmospheric deposition, and AQRVs. ***Note:*** Additional narrative may be necessary to describe how uncertainties affect air quality impact estimates.	***Description:*** Conduct regional scale modeling with estimates of emissions and estimated meteorological and geographic information with complex photochemical processes. This analysis may be used for new projects or proposals that lack specific development information but contain large scale or complex photochemical source scenarios that warrant additional review. For this approach, reasonable estimates of incremental emissions are reentered into an existing photochemical modeling system to fully assess impacts based on reasonably foreseeable scenarios. ***Note:*** Additional narrative may be necessary to describe how uncertainties affect air quality impact estimates.	***Description:*** Conduct local scale modeling analysis with emission estimates, meteorological, and geographic information for single sources. May be used when local AQ impact potential is great. Must consider the uncertainties associated with running near-field models with limited or general information. ***Note:*** Additional narrative is likely to be needed to describe air quality issues, emission uncertainties, and their affects on estimated impacts. Commitment to complete additional analysis may be necessary when requisite information becomes available.
Models*: Long range transport models such as CALPUFF, SCIPUFF	***Models**** Photochemical models such as CMAQ, CAMX	***Models****: AERMOD / AERSCREEN, VISCREEN, PLUVUE II, CALPUFF
Maximizing resources, time, and costs: Lead Agencies are encouraged to develop and utilize modeling methods that promote optimal resource efficiencies. Early planning often can result in datasets (meteorology, emissions, etc…), modeling systems, and analysis outputs that can be applied to a broad range of agency actions requiring air quality models. Reusing aspects of air quality modeling results in substantial time and cost savings, especially with repetitive similar applications. Early modeling considerations substantially reduce modeling development requirements in all subsequent project development phases. Modeling systems that evaluate varied growth patterns (expressed in the form of low, medium, and high) offers reuse potential for both results and modeling systems. An example of a Reusable Modeling Framework (RMF) with emphasis on growth patterns using a complex photochemical model is found in the RMF example attached to this Appendix. The RMF concept could be applied to additional models, domains, and agency actions. MOU Section V.E.4.b describes criteria to eliminate air quality modeling requirements based on availability of existing modeling.		

**An overview of model characteristics can be found in the following Matrix of Air Quality Modeling Characteristics.*

<table>
<tr><td colspan="2">Table B: Consult this Table When</td></tr>
<tr><td colspan="2">A reasonably foreseeable number of oil or gas wells (e.g., specific number and location)
and associated emission inventory has been developed.</td></tr>
<tr><th>Dispersion Model Approach</th><th>‘Add on’ Photochemical Approach</th></tr>
<tr><td>When: For criteria pollutants, toxics/HAPs, AQRVs (FLAG), small-medium scale & number of sources, EPA guideline (regulatory), screening & refined modeling options.</td><td>When: Projects or plans with large geographic extent, large number of sources, or present complex issues with ozone and secondary particulate impacts.</td></tr>
<tr><td>Description: Conduct modeling with project specific emission, meteorological, and geographic information.
This approach recommends EPA guideline models, or alternative models that meet Appendix W guidelines on model applications for near (local) and far-field analysis. Models tend to be specific to an AQ pollutant, approved purpose, and regulatory application. Impact estimates are generated for ambient concentration, atmospheric deposition, and AQRVs.
Although these models make up the primary air quality modeling tool chest, most do not handle complex scenarios, advanced chemical reactivity, or large numbers of sources commonly associated with regional scale oil & gas development.
This modeling approach is the current state-of-practice and is likely for most project specific AQ impact assessments. Re-use of domains, meteorology, and file configuration minimizes resources and costs.</td><td>Description: Conduct regional scale modeling with project specific emission, meteorological, and geographic information with complex photochemical processes.
This approach utilizes a regional scale ‘one atmosphere’ simulation of a wide variety of AQ pollutants with a large geographic extent. Emissions are gridded, allow for chemical transformation, and offer a variety of transportation mechanisms to address near and far-field transport. Impact estimates are generated for ambient concentration, atmospheric deposition, and AQRVs.
‘Add on’ means to insert project specific incremental emission estimates into an existing regional scale modeling system. Re-use of existing baseline inventories, meteorology, and model setup greatly reduce resources necessary for model application.
The ‘Add on’ photochemical approach is anticipated to become the state-of-practice in coming years.</td></tr>
<tr><td>Models*: AERMOD / AERSCREEN, VISCREEN, PLUVUE II, CALPUFF, SCIPUFF</td><td>Models*: CMAQ, CAMX</td></tr>
<tr><td colspan="2">Maximizing resources, time, and costs: Lead Agencies are encouraged to develop and utilize modeling methods that promote optimal resource efficiencies. Early planning often can result in datasets (meteorology, emissions, etc…), modeling systems, and analysis outputs that can be applied to a broad range of agency actions requiring air quality models. Reusing aspects of air quality modeling results in substantial time and cost savings, especially with repetitive similar applications. Early modeling considerations substantially reduce modeling development requirements in all subsequent project development phases. Modeling systems that evaluate varied growth patterns (expressed in the form of low, medium, and high) offers reuse potential for both results and modeling systems. An example of a Reusable Modeling Framework (RMF) with emphasis on growth patterns using a complex photochemical model is found in the RMF example attached to this Appendix. The RMF concept could be applied to additional models, domains, and agency actions. MOU Section V.E.4.b describes criteria to eliminate air quality modeling requirements based on availability of existing modeling.</td></tr>
</table>

**An overview of model characteristics can be found in the following Matrix of Air Quality Modeling Characteristics.*

OVERVIEW MATRIX OF AIR QUALITY MODEL CHARACTERISTICS

	Near Field (<50km)			Long Range Transport (>50km) & Photochemical Models		
	AERSCREEN	**VISCREEN/PLUVUE II**	**AERMOD**	**CALPUFF**	**SCIPUFF****	**CMAQ/CAMX**
Description	A conservative single-source *screening* model based on AERMOD for NAAQS and PSD permitting.	Plume blight models for AQRVs and PSD permitting. Visual impacts are estimated by detailing change in color and contrast along a specific view.	*Refined* single/cumulative regulatory model for NAAQS, toxics, and PSD. Used for non-reactive criteria pollutants.	*Refined* long range transport model for AQRVs, NAAQS, and PSD Increment. Contains simplified chemical processes.	*Refined* (alternative) long range model for NAAQS and PSD Increment. Contains more advanced chemical processes.	*Refined* photochemical model with full chemistry. Urban to regional scale model capable of single source or cumulative impact assessments.
Advantages	Quick, easy to setup, and simple operation.	VISCREEN: Quick, easy operation and results. PLUVUE II: Complex blight analysis.	Most widely accepted regulatory model. Extensive documentation/guidance for appropriate use.	Ability to simulate pollutant transport that varies in time and space. Addition of simple chemistry and deposition.	Ability to simulate pollutant transport that varies in time and space. Addition of advanced chemistry.	Primary models for ozone and secondary particulate matter impact. Includes most realistic chemistry.
Disadvantages	Conservative modeling assumptions and results.	Single purpose models with lack of robust guidance.	Not suitable for ozone or AQRV impact analyses.	Numerous model control options, difficult validation, and long run times.	Not widely available and not extensively documented.	Complex setup and operation. Advanced computing requirements.
Required computer resources	Light (laptop)	Light (laptop)	Light/Moderate (PC)	Moderate (robust PC)	Moderate (robust PC)	Heavy (UNIX, cluster)
Required model input data	Pre-set meteorology.	Pre-set meteorology or National Weather Service observations.	National Weather Service or on-site observations.	3-Dimension meteorology	3-Dimensional meteorology	3D meteorology, heavy emissions processing.
Range of costs*	In-house to minimal	In-house / $10K - $75K	$10K – $30K	$10K - $50K	$10K - $75K	$50K - $100K
Factors affecting costs	None	None/Multiple runs	runtime	Meteorology, runtime	Meteorology, runtime	Multiple inputs, runtime
Time to set up, run model	Minutes	Minutes / 1-2 weeks	1-2 Weeks	Days to weeks	Weeks	Weeks to months
Model Developer	EPA	EPA/EPA	EPA	TRC	Lakes Environmental	EPA/Environ
Background, references	40CFR51AppxW	FLAG, 40CFR51AppxW	40CFR51AppxW	FLAG, 40CFR51AppxW	Private	EPA SIP guidance

* **Does not include development of baseline emissions (present or future), meteorological inputs, or contract management. Initial development costs may be more.**

** **SCIPUFF is considered an alternative model under 40 CFR 51 Appx. W but may be considered for long range transport use on a case-by-case basis.**