

SCOPE OF WORK FOR PHASE III OIL & GAS EMISSION INVENTORY

INTRODUCTION

Following the development of two Western U.S. regional emissions inventory efforts developed by the Western Regional Air Partnership (WRAP) focusing on oil and gas emissions sources, the Independent Petroleum Association of Mountain States (IPAMS) is interested in sponsoring the development of a third, or Phase III, regional inventory. IPAMS members represent many of the oil and gas operators in the Rocky Mountain states of New Mexico, Colorado, Wyoming, Utah, North Dakota, and Montana. IPAMS has participated in the development of the previous Phase II WRAP emissions inventory of oil and gas area sources, and through this effort has identified the need to improve both the regional WRAP inventory and the state inventories to reflect more detailed information on emissions from equipment and exploration and production (E&P) activity. This effort would focus on updating emissions of the criteria pollutants – NO_x, CO, VOCs, PM and SO_x – for the most current baseline year of 2006, from all oil and gas point and area sources in these states. The work would also include revised projections to future years to be used for modeling purposes by WRAP, state and federal environmental agencies, or other interested parties. This work will create a detailed mechanism for oil and gas production companies to annually report information on activity and equipment in order to be able to easily update and improve any future inventory.

This work will be divided into three broad parts:

- (1) an emissions inventory for the Denver-Julesburg (D-J) Basin in Colorado;
- (2) an emissions inventory for all other major basins in Colorado; and
- (3) an emissions inventory for all other Rocky Mountain states' basins with significant oil and gas development activity

The reason for considering this inventory in three phases is due to the low emissions reporting threshold of the Colorado state inventory. In Colorado, any oil and gas air emissions source emitting 2 tons per year (tpy) or more of any criteria pollutant is required to obtain a permit and report these emissions. The emissions reported by oil and gas producers who submit permits are typically the potential-to-emit (PTE) of the source, rather than actual emissions. Thus, the state of Colorado has available to it a detailed inventory of the PTE of most oil and gas emissions sources in the state. Parts (1) and (2) of this work will focus on updating and improving this database of information to reflect the best available data, and including improved estimates of those sources not already estimated in the Colorado state inventory. Part (1), focusing on the D-J Basin in which the Denver metropolitan area is located, will attempt to improve the emissions inventory for this basin in an effort to incorporate this improved inventory in the upcoming 8-hour ozone SIP modeling effort that the state of Colorado is undergoing. Parts (1) and (2) will be based on the existing permitted sources inventory in Colorado, and will make improvements to this inventory.

Part (3) will develop a detailed inventory beginning with basic information about equipment and activity and expand this to estimate basin and county-level emissions, similar to the methodology used in the previous WRAP oil and gas inventories. This effort will use data and lessons learned from Parts (1) and (2) to facilitate the calculation of emissions from source categories for development of a region-wide inventory of oil and gas sources.

INVENTORY SCOPE

The scope for Parts (1), (2) and (3) of the IPAMS emission inventory is as follows:

Pollutants

All three parts of this work will focus on:

- NO_x
- SO_x
- PM
- VOC
- CO

Hazardous air pollutant (HAP) and greenhouse gas (GHG) emissions are not in the scope of this work.

Temporal

All basin inventories will include an estimate of emissions for a base year of 2006, and for up to three future years for each basin, depending on the regulatory particulars of each state. For example, Colorado 8-hour ozone SIP modeling uses future years of 2010 and 2020. Annual, average summer day and average winter day emissions will be reported.

In addition, this work will develop an annual reporting tool that will allow producers to input information that can then be used to easily update the inventory, for the geographic regions covered in each part, on a yearly basis. Thus the inventory will eventually be developed for every year between 2006 and 2020 as producer data updates are added to the reporting tool.

Geographic Scope

In Part (1) emissions will be estimated only for the D-J basin, in order to provide a revised emissions inventory for use in the upcoming 8-hour ozone SIP modeling to be conducted for Denver Metropolitan area.

In Part (2) the geographic scope will be further expanded to include all other major basins and production areas in Colorado, which include the San Juan North basin in the south of the state, the Piceance basin, and part of the Southwestern Wyoming basin.

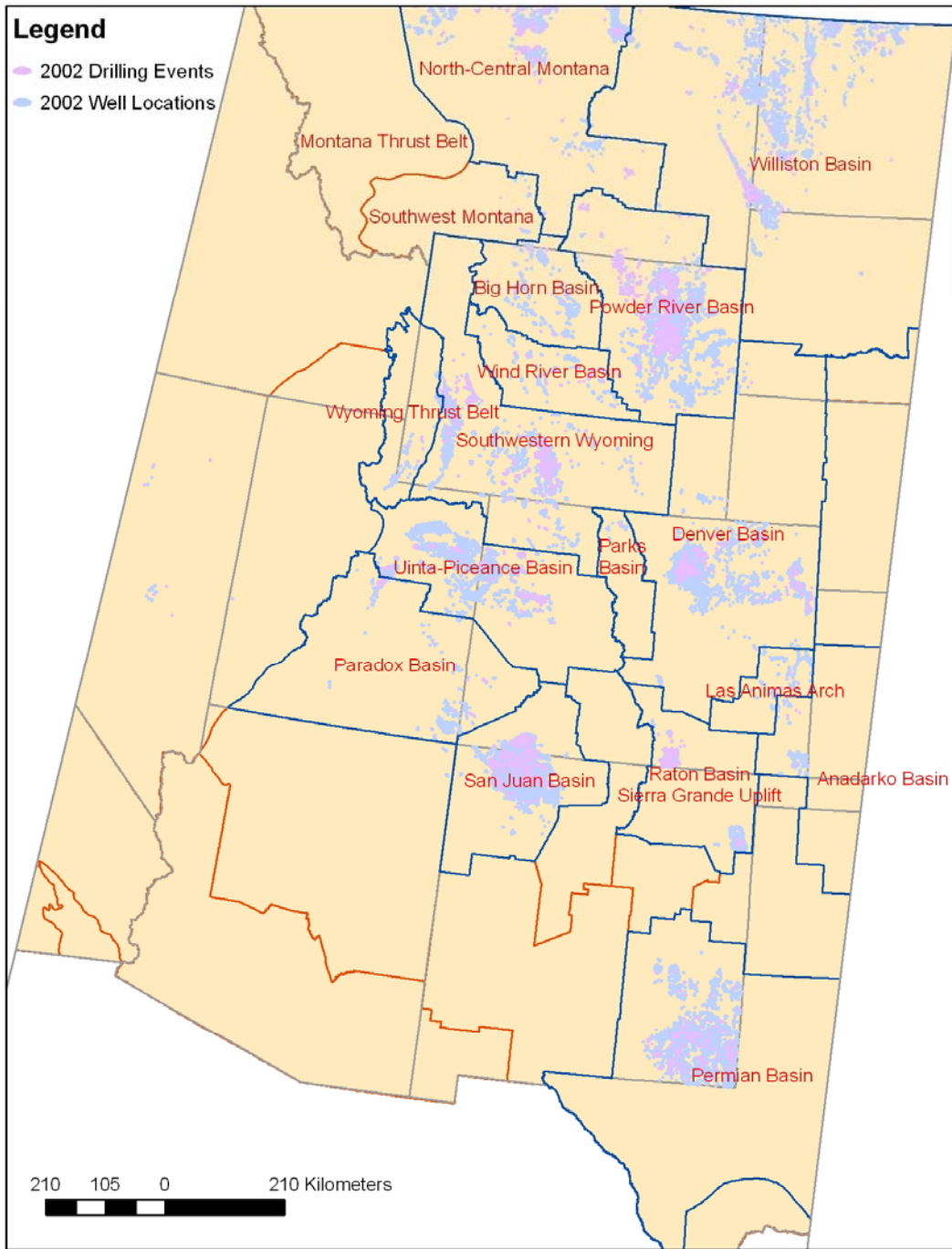
Part (3) will encompass the major basins in the other Rocky Mountain states, excluding Colorado.

The list of basins in New Mexico, Wyoming, Utah, North Dakota, and Montana to be covered by this work is as follows:

1. Denver-Julesburg
2. Uinta Basin (UT portion of the combined Uinta-Piceance Basin)
3. San Juan Basin (North and South)
4. Piceance Basin (CO portion of the combined Uinta-Piceance Basin)
5. Southwest Wyoming (Green River) Basin
6. Powder River Basin
7. Paradox Basin
8. Williston Basin
9. Wind River Basin
10. Big Horn Basin
11. North-Central Montana Basin (Great Plains Basin)

For all three parts, emissions estimates will be presented for the basin, for each county in the geographic region being considered, and for tribal airsheds, or any combination of these.

A map showing the basins of interest with 2002 well and drilling site locations is provided on the following page. This map is intended as a guide to define basin boundaries for those basins listed above. All basin boundaries have been obtained using data from the United States Geological Survey's (USGS) National Oil and Gas Assessment (NOGA) databases (<http://energy.cr.usgs.gov/oilgas/noga/>). Basin boundaries to be used for the project may be revised in the project work plan development.



Oil and Gas Emissions Sources

Oil and gas emissions sources that would be estimated in this work include all combustion sources (e.g. engines, heaters, flares) as well as other VOC sources from oil and gas E&P (e.g. fugitive, venting, blowdowns). The complete list of emissions sources that will be considered are:

- Natural gas processing plants
- Large compressor stations
- Lateral/wellhead compressor engines
- Drilling rigs
- Workover rigs/frac rigs
- CBM pump engines
- Salt-water disposal engines
- Artificial lift engines (pumpjacks)
- Vapor recovery unit (VRU) compressor engines
- Miscellaneous gas-fired engines
- Oil well heaters
- Gas well heaters
- Miscellaneous gas-fired heaters or boilers
- Flaring
- Oil well tanks – breathing losses, gas venting, flashing emissions
- Gas well tanks – breathing losses, gas venting, flashing emissions
- Pneumatic devices
- Oil well fugitive emissions
- Gas well fugitive emissions
- Gas well completions
- Venting
- Blowdowns
- Dehydrators
- Amine units
- Gas well truck loading
- Oil well truck loading
- Pipeline/compressor station fugitive emissions
- Landfarms
- Water treatment/water injection facilities

Each of these emissions sources may require a different methodology for estimating annual emissions. The estimation methods are discussed below in the methodology and technical approach section for each task.

TECHNICAL APPROACH

The technical approach for estimating emissions from oil and gas sources varies between the three parts of the study as a result of the permitting threshold for sources in Colorado of 2 tpy. This threshold is lower than in other states, where the permitting threshold varies from 25 tpy to

40 tpy. The technical approach for each Part of the study is described below. Note: Utah has a five tpy threshold.

Part (1) – Emissions Estimates in the D-J Basin Colorado

These emissions estimates will require detailed information on gas/oil well count and gas/oil well production throughout the D-J Basin. This information will be obtained by ENVIRON by obtaining the database of all Western states 2006 oil and gas well locations, production, and related information from PI Wight's EnergyData, Inc. (approx \$5000 fee for a one year license).

Prior to any emissions estimates, ENVIRON will prepare a map showing the well locations, basins, states/counties, and tribal areas of interest, generated using Geographic Information Systems (GIS) software.

IPAMS members and participating companies represent a significant fraction of the oil and gas activity in the D-J Basin. However some producing wells may be owned and operated by companies not participating in this effort. In that case, emissions for the participating companies will be estimated following the methodologies described below, and these estimates will be used to scale up the emissions to account for wells belonging to missing companies on the basis of well count or production as appropriate.

1. Emissions Estimates for Baseline Year 2006 – Permitted Sources

Due to Colorado's 2 tpy reporting threshold, many oil and gas emissions sources are already in the Colorado Department of Public Health and the Environment's (CDPHE) database of permitted sources. This database will form the basis for revising emissions in the D-J Basin for a baseline year of 2006.

ENVIRON will obtain the complete CDPHE database and segregate this database by production company for all sources located in Colorado counties that fall within the boundaries of the D-J Basin. The segregation of the database will require manipulation of the database using a database programming tool, and GIS analysis to intersect sources with the boundaries of the D-J Basin. The result will be sub-sets of the CDPHE database, containing all of the oil and gas emissions sources for one company in the D-J Basin that are reported in the CDPHE's permitted sources database. These sub-sets of the database will be provided to each company participating in this effort. This will include data from permits for the large compressor stations and natural gas processing plants operated by participating companies in the D-J Basin. Companies will begin by reviewing their sub-sets to determine whether and which sources are still active and whether any sources are missing. Inactive sources will be removed from the database and new sources added as needed. Documentation of added or removed sources from the database sub-sets should be maintained by each company (CDPHE may require this information). Companies will then revise the emissions in their database sub-sets following calculations accepted by the applicable state regulating agency. Companies will be required to keep detailed records of their revised calculations for purposes of quality control (QC) of the emissions calculations (CDPHE may require that companies produce this documentation for review).

ENVIRON will provide a QC check on the emissions calculations by spot-checking 5-10 separate calculations from each participating company per source category. This QC check will be done for the following major source categories, but others may be included at the suggestion of IPAMS members:

- Compressor engines
- Tank emissions (oil and gas)
- Dehydrator units
- Flares

The QC check will consist of verifying that calculations have been made accurately according to Colorado state guidelines, and will require detailed information on these calculations for each source included in the QC check.

2. Emissions Estimates for Baseline Year 2006 – Unpermitted Sources

A number of oil and gas sources are not included in the CDPHE database of permitted sources' emissions. Emissions estimates for these sources will be conducted separately by ENVIRON using data from the companies. The sources that have been identified as not being part of the CDPHE database are:

- Drilling rigs
- Exempt engines (engines below 50 hp)
- Heaters (gas well and oil well)
- Pneumatic devices
- Fugitive emissions (gas well and oil well)
- Well completions
- Well blowdowns

Following are descriptions of how these emissions sources will be estimated. In all cases producers must provide sufficient detailed information to characterize the sources and the activity such that emissions calculations can be conducted. ENVIRON will work with the producers to develop survey forms that will be used to query the operators for information relevant to estimating emissions from these unpermitted sources. Total emissions for the basin will be scaled up on the basis of engine count, well count, or gas/oil/water production as described below.

a. Drilling Rigs

In general the information collected by producers and operators and delivered to ENVIRON must be grouped in some manner that representative engines can be determined for the entire basin. In the case of drilling rigs, engines should be grouped by technology or horsepower or both. Technology groupings would include the Tier standard of the engine, whether it is equipped with any emissions control device, and what fuel the engine uses. For all engines, basic information would be required about:

- emissions rate (lb/hr of all pollutants)
- time of operation for a typical drilling event in the basin
- depth of a typical drilling event in the basin
- fuel consumed during a typical drilling event

This information would be used to calculate emissions for each engine following the basic equation below:

$$(1) \quad E_{engine} = ER_{engine} \times t_{drilling}$$

where ER_{engine} is the emissions rate of an engine (lb/hr), and $t_{drilling}$ is the drilling time for an average well in the basin. The emissions rate of the engine would incorporate both the load factor and the emissions factor of the engine at a particular load. The onus is on the operators to provide accurate (lb/hr) emissions rates that will be based on load and other operational parameters. The operators should include the evaluation process to calculate the emission factors. (Colorado may require this information at some point)

Following this emissions calculation for each engine, total basin-wide emissions for drilling rigs would be summed based on the grouping of the data. Drilling databases from the state OGCCs or the PI Dwight database would be used to determine depths for all drilling events in the basin.

b. Exempt Engines

Exempt engines are those that do not require permitting in Colorado, which are generally smaller engines below 50 hp. Emissions from these engines would be calculated following Equation (1) above for drilling rigs. Operators will need to provide the emissions rates of these engines (lb/hr) and documentation of how this emissions rate was derived. Similarly to drilling rigs, total basin-wide emissions for exempt engines would be summed based on the grouping of the data.

c. Heaters

Heater emissions would be calculated on the basis of the emissions factor of the heater as derived from the EPA's AP-42 guidance, the heat rate of gas to the heater, and the annual usage of the heater. Corrections would be made for the BTU content of the gas on a field or basin level. The basic equation for estimating heater emissions is below:

$$(2) \quad E_{basin,heaters} = EF_{heaters} \times \dot{Q}_{gas} \times t_{annual}$$

where EF is the emissions factor for a particular pollutant, \dot{Q}_{gas} is the heat rate of natural gas to the heater, and t_{annual} is the annual usage of the heater which accounts for both cycling of the heater and the amount of time the heater is used annually.

d. Pneumatic Devices

Pneumatic device emissions will be estimated by determining the numbers and types of pneumatic devices used at typical gas well setups in the D-J Basin. Operators will need to provide information on typical pneumatic devices used at gas well sites. The bleed rates of these devices per unit of gas produced will be determined by either measurements made by producers or using the guidance from the EPA's Natural Gas Star Program. Basin-wide emissions will be estimated by scaling up the estimations for a single device or single well by the total gas production.

e. Fugitive Emissions

Fugitive emissions will be estimated using EPA emissions factors and equipment counts. A typical well setup will be developed for oil, and gas wells. This is necessary since the distribution of the service of the components will vary between oil production (more heavy liquid components) and gas production (more gas/vapor and light liquid components). Operators will be required to provide information about typical components in oil and gas wells in their operations in the D-J Basin.

Single-well emissions would be estimated by combining these equipment counts and emission rates into a single aggregate annual natural gas emission rate for each type of well. Then, by combining that rate with the gas composition, VOC emission rates for each well (with units of ton VOC per conventional gas well) can be estimated. Emissions would be scaled to the basin by multiplying by total number of active oil and gas wells in the basin. Using a similar component leak path method, fugitive emissions could also be estimated for compressor stations.

f. Well Completions

Emissions from well completions would be estimated on the basis of the volume of gas vented during completion and the VOC content of that gas, obtained from gas composition analyses. This information will be provided by operators on an individual well basis or for a group of wells (for which the gas composition is considered relatively similar). If flaring or green completion techniques are used, operators must provide this information as well as any data necessary to estimate emissions from flaring (emissions factors, gas volume flared or gas rate to the flares, etc.) or green completions.

g. Well Blowdowns

Well blowdown emissions would be estimated following the methodologies described as part of the EPA Natural Gas Star program. Any information needed to estimate emissions from blowdowns following the EPA guidance would be required from the operators.

3. Emissions Projections for Future Years

Using GIS analysis, a spreadsheet would be developed to calculate scaling factors to be used to generate emissions for up to three future years in the D-J Basin. These factors would be based on all available information for future production projections, including projections provided by companies, RMPs, RODs, EIRs, and production curves from the PI Wight database. ENVIRON will assess well count projections provided by companies against available well counts in RMPs, EISs, etc. and will work with the IPAMS Air Quality Integrator to resolve any discrepancies between these data sources for purposes of developing the future years scaling factors. Once the scaling factors are developed, they will be applied to the 2006 inventory to generate future years' emissions projections.

All future year emissions projections will take into account existing or newly "on-the-books" regulations which would affect emissions from any of these sources. This would include both federal regulations and regulations specific to Colorado (e.g. Regulation 7).

Since production forecasts will be considered Confidential Business Information (CBI) as it relates to tying projections to individual company names, any company-provided production or

well count projection will be kept confidential and the spreadsheet with this data would link to a separate spreadsheet showing the average scaling factors for various source categories for the D-J Basin. It is the average scaling factors which would be used to scale baseline emissions to the future years.

It is expected that companies will provide production projections for condensate, oil and gas. Well count projections will be provided as well as production projections. The well count information will be used to reconcile the well count based emission projection versus the production based emission projection in order to assess a path forward for the remaining IPAMS area and provide a comparison where well count projections are the only option. For this task, projections are needed only for purposes of estimating future year emissions. However, for purposes of generating a useful annual reporting tool, production data and production and well count projections will be updated regularly, as described in the annual reporting section below.

4. Emissions Reporting for 2006 and future years

For 2006 emissions and future year emissions, the final emissions estimates will be reported by source category on a basin, county and tribal airshed basis, or any combination of these. The emissions will be provided in spreadsheet format.

Part (2) – Emissions Estimates for Other Colorado Basins

This task will use the same technical approach and methodologies described above for the D-J Basin to estimate emissions from all other basins in Colorado. This task will also estimate emissions for 2006 and provide emissions projections for up to three future years. The annual reporting tool described below will be applicable to all basins in Colorado, so that updates can be easily made to the emissions inventories for all future years between 2006 and 2020 as the data become available. Additional companies will need to participate in providing data for Part (2), including information on engines, other equipment and activity. Gas, oil and condensate production for all activity in Colorado will be obtained from the companies and checked against the PI Wight database. Similarly to Part (1) above, emissions will be reported on a basin, county and tribal airshed level by aggregating the data from individual companies within each area of interest.

Any lessons learned from Part (1) that contribute to changes in the methodology would be applied to Part (2). Furthermore, any unpermitted sources identified in other Colorado basins which were not present, and therefore not estimated, in the D-J Basin would be addressed in Part (2).

Part (3) – Emissions Estimates for All Other States

For other Rocky Mountain states, the state inventories do not include detailed information on oil and gas sources in the CDPHE database. Emissions estimates for other states will be developed using a bottom-up methodology, similar to that for unpermitted sources in Colorado. For each basin, the basin total, as well as county level and tribal airshed emissions will be reported, or any combination of these. Emissions will be estimated for 2006 and up to three future years, but the annual reporting tool will also facilitate projecting emissions for all years between 2006 and 2020.

Similar to Part (1) above, future year projections will make use of all available data for each basin from company production projections or well count projections, RMPs, EIRs, and RODs. State-specific and federal regulations that would affect future year emissions would be incorporated into the future year projections.

For this Part of the work, emissions from all oil and gas sources will need to be estimated since it is expected that many sources will not be captured by various state inventory databases. The estimation methodologies are discussed below for all sources, and will rely on detailed information from producers on the equipment and activity of this equipment. This will be obtained through a survey effort, similar to Parts (1) and (2) above, but more detailed in scope as the survey will need to address more emissions sources than for the D-J Basin. Gas and oil production and well count information will be obtained from producers as well as from the PI Wight database, similar to the data needs for Parts (1) and (2) of this work.

For drilling rigs, compressor engines, all other engines (e.g. workover engines, VRU compressor engines, etc.), heaters, pneumatic devices, oil and gas well fugitive emissions, well completions, and well blowdowns, the methodology for estimating these emissions will be similar to what was described in Part (1) for unpermitted sources in Colorado. The remaining source categories which will need to be estimated in all basins outside Colorado are:

- CBM pump engines
- Oil well tanks – breathing, venting, flashing
- Gas well tanks – breathing, venting, flashing
- Dehydrators
- Amine units
- Flaring
- Gas well truck loading
- Oil well truck loading
- Pipeline/compressor station fugitives
- Landfarms
- Water Treatment Facilities

The technical approach for estimating these emissions is described below.

a. CBM Pump Engines

CBM pump engine emissions estimates will be conducted similar to emissions for other engines, on the basis of an emissions rate that will be developed by operators, and information on the duration of activities. The emissions rate should include any correction for load factor, emissions factor at load, or other operational constraints affecting the emissions factor, and the data used to develop the emissions rate should be documented by participating operators. Alternatively, an emissions rate per volume of water pumped can be developed by producers and total emissions for an individual well's CBM pump engine would be estimated using total produced water for that well. Emissions would be scaled up for a basin/county/tribal airshed on the basis of engine count, or water production depending on the format of the emissions rates.

b. Oil and Gas Well Tanks – Breathing, Venting, Flashing Emissions

Tank emissions will be split between oil production tanks (located at oil wells) and condensate production tanks (located at gas wells). In order to determine whether tanks are servicing oil or gas wells, two methodologies can be used to make this determination:

1. If a well is registered as an oil well, the associated oil tanks would be considered oil production tanks, and if the well is registered as a gas well, the tanks would be considered condensate tanks.
2. If the API gravity of the oil or condensate is 35-40 degrees or below, the tank would be considered an oil tank, if higher it would be considered a condensate tank.

Emissions factors for condensate production tanks at gas wells will be calculated using HYSYS and adding EPA TANKS for working and breathing losses. A (lb/bbl) emission factor would be established by the producers by basin and possibly by formation if needed. If an emissions factor is estimated by formation, the number of tanks in each formation in each basin will be used as the basis for scaling up tank emissions to the basin level. Otherwise it is anticipated that the producers will provide the (lb/bbl) emissions factors for a basin and the total emissions from gas well tanks will be estimated by scaling up to the total condensate production (bbls) in the basin.

Oil production tank flash emission factors will be calculated using the Vasquez-Beggs Correlation. EPA TANKS would also be run to calculate working and breathing losses for oil tanks. A (lb/bbl) emission factor would be established by basin and possibly by formation if needed. Again the scaling up to the basin level will be for wells in a particular formation if that approach is used, or by total oil production (bbls) in the basin if that approach is used.

c. Dehydrators

Emissions estimates for dehydrators will be conducted on a basin level using the GRI GLYCalc software. An average wet gas sample in each basin will be used along with other average basin wide parameters needed by the software in order to estimate a basin-wide emissions factor (lb/MMscf). The program is able to account for whether the circulating fluid is tri-ethylene glycol (TEG), di-ethylene glycol (DEG) or ethylene glycol (EG). Operators would be required to provide the necessary information on dehydrator units to facilitate this calculation.

d. Amine Units

Amine unit emissions calculations will follow a procedure similar to that for dehydrators, described in section (c) above, but using the AMINECalc software. Producers will provide an emissions factor for amine units by basin which will be scaled up on the basis of production or unit count, consistent with the format in which the emissions factor is estimated.

e. Flaring

Emissions factors for flaring have been developed as part of ENVIRON's NMED study and are based on information from the most recent EPA studies. These emission factors will be reviewed by the producers and may be updated. Flaring emissions are calculated using the number of flares and the annual flaring rate at each flare. This information must be provided by producers for all flares in the basin, including upset flares (for which some assumptions will have to be made). The basic calculation follows the equation below:

$$(3) \quad E_{basin,flaring} = EF_{flaring} \times Q_{flaring}$$

where $EF_{flaring}$ is the flaring emissions factor for a particular pollutant, and $Q_{flaring}$ is the volume of gas flared. Emissions factors for particular pollutants from flaring will be reviewed with the producers to reconcile any discrepancies and ensure that the most recent data on flaring emissions is utilized.

f. Truck Loading

Emissions from truck loading can be estimated using emissions rates tracked by producers or other studies that have been conducted (e.g. NMOGA). These would need to be combined with gas composition analyses to account for differing VOC content in gas. Generally these emissions are calculated as VOC per barrels of condensate loaded, therefore the production of condensate as obtained from producers will be used to scale up emissions on basin-wide basis.

g. Pipeline/Compressor Station Fugitives

Producers will provide emissions factors for pipeline/compressor station fugitive emissions on a basin level. Emissions will be estimated by scaling these factors by total gas production in the basin.

h. Landfarms

Producers will provide emissions factors for landfarms. Emissions for a basin will be determined by scaling these emissions factors with respect to whatever base unit was used to derive the factors.

i. Water Treatment/Water Injection Facilities

Producers will provide emissions factors for water treatment/water injection facilities. Emissions for a basin will be determined by scaling these emissions factors with respect to whatever base unit was used to derive the factors.

Annual Reporting Tool

In an effort to facilitate annual reporting of emissions for future inventory efforts, an annual reporting tool will be developed to assist participating companies in annually updating the inventory. For the Colorado basins and for other states, this annual reporting tool will be based on the work described above for estimating the baseline emissions for 2006. The annual reporting tool will require information to update the annual emissions inventory that will consist of gas, oil and condensate production information for purposes of scaling up to basin-wide emissions. This will be provided by each participating company, and also checked against the PI Wight database.

Equipment and Activity Information

For Parts (1) and (2), companies will supply information to ENVIRON that encompasses all the oil and gas emissions sources identified above that are not included in state inventories. For Part (3) it is assumed that none of these sources are in state inventories, and thus companies will be

required to provide detailed information for all oil and gas sources identified. This will include as detailed of an inventory as possible for each company for the 2006 baseline year. ENVIRON will roll this data up to a simplified format for updating subsequent years. It is expected that a spreadsheet or series of spreadsheets will be generated for each company with averaged equipment and activity assumptions from the baseline 2006 inventory estimates. Operators will not update the equipment, emissions factors, and activity information for the annual update tool unless significant changes are expected to occur in this information, such as due to a new regulatory requirement by state or federal agencies. The simplified emissions factors, activity and equipment assumptions will then be used to scale emissions from the previous year using data on oil, gas, condensate, water, and drilling counts from the current year.

Oil and Gas Production Information

Companies will provide production and well count projections for condensate, oil and gas. This data will be held Business Confidential as it relates to tying projections to individual company names. The well count information will be used to reconcile the well count based emission projection versus the production based emission projection in order to provide a comparison where well count projections are the only option. Projections will be provided for every year through 2020. Companies will supply estimated well count and oil and gas production information for each year through 2020 on an annual basis. This methodology will allow for an annual correction to emission projections by applying a multiplier to future year projections. If oil and gas production projections are not available well count projections will be used. Well decline rates will be applied when using well count projections.

An annual correction will be applied to emission projections by comparing projected emissions against the annually reported actual emissions and through comparing each previous year's well count and/or production projections against the annually reported well count and/or production projections. ENVIRON will assess well count projections provided by companies against available well counts in RMPs, EISs, etc. and will work with the IPAMS integrator to apply discrepancies.

Actual oil and gas production information sorted by basin from the PI Dwight database will be used annually to reconcile production projections and to ensure that all the actual production is accounted for annually.

PROJECT MANAGEMENT AND REPORTING

Reporting

Following the completion of sub-tasks, ENVIRON will summarize the results of these sub-tasks in a series of technical memoranda. These technical memoranda are in addition to any specific deliverables required for completion of a task, such as surveys or spreadsheet data. Technical memoranda will be submitted following the completion of the following sub-tasks:

- 2006 emissions estimates for D-J Basin
- Future year emissions projections for D-J Basin
- 2006 emissions estimates for all other basins/areas in Colorado
- Future year emissions estimates for all other basins/areas in Colorado

- 2006 emissions estimates for other Rocky Mountain States
- Future year emissions estimates for other Rocky Mountain States
- Development of an annual reporting tool

In addition to these technical memoranda, ENVIRON will provide interim reports upon completion of major tasks or parts of the overall work. The technical memoranda will serve as the basis for generating these interim reports. Interim reports will be provided upon completion of the following tasks:

- 2006 and future year emissions estimates for the D-J Basin
- 2006 and future year emissions estimates for all other Colorado basins
- 2006 and future year emissions estimates for all other Rocky Mountain States

Following the interim reports ENVIRON will prepare a draft final report for submission to IPAMS and WRAP. After receiving comments on the draft final report, a final report will be prepared and submitted.

Project Communication

ENVIRON will provide monthly progress reports to IPAMS, in addition to the reports listed above. If desired, we can also have regular (monthly or biweekly) conference calls to update IPAMS and other interested parties on progress and to discuss any specific data needs or other issues as they arise. ENVIRON staff also use email extensively to ask questions, raise issues and suggest solutions, and provide updates and interim results.

SCHEDULE

To be determined

TASKS TO BE PERFORMED

Task 1: Prepare project work plan

Finalize scope of work with input from IPAMS and WRAP. Prepare a draft project work plan to be posted on the WRAP Oil & Gas Work Group web page. Participate in conference calls with IPAMS, WRAP and other interested parties to discuss comments on the draft, and finalize the work plan in response to comments received. It is expected that as the project progresses there will be changes to the approach defined in the work plan, and these will be documented in technical memos.

Deliverables: Draft and final project work plans

Task 2: Obtain new base year 2006 well locations/productions and drilling data bases

Obtain the database of all Western states 2006 oil & gas well locations, production, and related information from PI Wight's EnergyData, Inc. (approx \$5000 fee for a one-year license).

Prepare a map for each state and/or basin showing the well locations, basins, states/counties, and tribal areas of interest, generated using Geographic Information Systems (GIS) software.

Use GIS to derive the well counts and production data to be used to calculate the 2006 emissions for each combination of basin/county/tribal airshed.

Deliverables: 2006 wells database with any additional processing performed by ENVIRON, and map as described above.

Task 3: Obtain and distribute CDPHE database of permitted sources for 2006 for the D-J basin

Obtain the CDPHE database of permitted sources in the state of Colorado for 2006. Segregate this database by company and source location (using GIS) to provide participating companies with a subset of the database corresponding to their sources in the D-J Basin.

Deliverable: Excel or other database output containing each individual producer's sources and emissions for D-J Basin.

Task 4: Develop initial survey for obtaining producer information for unpermitted sources for the D-J Basin

Discuss with IPAMS all data to be provided by the producers, for all oil and gas emissions sources. Prepare draft surveys, as Excel files with internal documentation, for review by IPAMS. Excel survey files will be prepared for each type of source emissions data to be requested.

Review and discuss the draft survey files with IPAMS and other stakeholders (especially API companies), and revise survey files in response to comments.

Deliverables: Draft and final survey files to be used to obtain producer data for the D-J basin.

Task 5: Obtain producer data on unpermitted sources for the D-J Basin and estimate emissions

Using the survey files developed in Task 4, obtain and process producer data for the D-J basin for unpermitted sources. Data from the three largest producers in the basin will be required at a minimum – EnCana, Noble, and Anadarko, which account for about 80% of the production in the basin.

There will be two types of missing data:

- Missing producers. It would be preferable to get as close to 100% participation in this effort as possible, but the emissions per well for the basin will be estimated based on the data received, which should be at least the 80% covered by the three IPAMS companies.
- Producer provided data, but some fields missing. ENVIRON will work with the producers on how to fill in missing data, using data from other producers in the basin.

Deliverable: Database of producer data received, with calculated basin average emissions per well/process estimated.

Task 6: Combine revised database of permitted sources and conduct QC of revised calculations

Conduct spot-checks of the revised emissions calculations for 5-10 examples of at least four different source categories for each participating company as a QC measure. Once QC checks are completed, combine all revised subsets of the CDPHE database that were provided to participating companies into a single database for the entire D-J Basin.

Deliverable: Revised CDPHE permitted sources database for the D-J Basin.

Task 7: Estimate 2006 and future year oil and gas emissions for the D-J Basin

Using the summary spreadsheets generated in Task 5 for the unpermitted sources and the production information for 2006 for the D-J Basin, develop basin-wide and county/tribal airshed level emissions estimates for unpermitted sources for the entire basin. Combine this information with the revised database of permitted sources as modified by the producers to reflect actual emissions.

Develop a spreadsheet of scaling factors used to generate up to three future years emissions in the basin. These factors would be based on all available information, but would preferentially use company projections – aggregated to remove company names and company-specific information – and RMPs/EIRs/RODs. Scaling factors would be developed on the basis of gas/oil production or well count as appropriate to the source being scaled, and will take into account production decline. Emissions will then be estimated by applying these scaling factors to the 2006 estimated emissions to generate future year emissions projections.

Deliverables: 2006 and future year emissions summaries for the D-J Basin on a county and tribal airshed level.

Task 8 – Task 12: Obtain data and estimate emissions for other Colorado basins/areas

Perform Task 3 – Task 7 for the remaining basins in Colorado. Any lessons learned from the inventory effort for the D-J Basin will be applied to the expanded inventory for the entire state.

Deliverables: Similar to those for the D-J Basin including a Technical Memo for each basin.

Task 13: Develop expanded survey for all other states

Using the experience with the D-J Basin and other Colorado basins surveys, develop an expanded survey to request all necessary information on all oil and gas sources from participating companies for other Rocky Mountain States. ENVIRON will work with IPAMS to ensure that the expanded survey will address specific questions necessary to characterize activity for sources that would have been permitted sources in Colorado, as well as the unpermitted sources that are estimated for all basins.

Deliverable: Draft and final survey to provide to participating companies operating in New Mexico, Wyoming, Utah and Montana.

Task 14: Estimate emissions for base and future years for all other states

Estimate emissions from oil and gas equipment in all other basins in regions of interest using the methodologies described in the technical approach section above and develop basin-wide, county and tribal airshed inventories using the same scaling methodologies as described above. This inventory will be estimated for a base year of 2006 and projections will be made for up to three future years using the same basic methodology as for Colorado.

Deliverables: 2006 and future year basin/county/tribal airshed emissions for all basins in regions of interest in states other than Colorado.

Task 15: Develop an annual reporting tool

Use the results of the Colorado emissions inventory efforts in Parts (1) and (2), and the results of the inventory in Part (3) for other states to develop an annual reporting tool to facilitate the update of equipment, activity and production by the participating companies on a yearly basis. The reporting tool will be a series of spreadsheets that summarize the assumptions of average equipment, activity, and detailed oil, gas and condensate production for each participating company in each region of interest, and then generate the emissions by source category and basin/county/tribal airshed. Companies will provide updates to these categories if changes have been made in the past year, and provide updates to actual production. Production updates will need to be checked against the PI Wight database.

Deliverables: A series of update spreadsheets detailing average equipment and activity assumptions, and production information for each participating company for each basin in which they operate; and a spreadsheet that calculates the emissions based on the updated equipment, activity, and production data.

Task 16: Reporting

A series of technical memoranda will be drafted to summarize the methodology and results of the emissions estimates for the base year and future year for each basin. These technical memoranda will be drafted upon completion of the tasks for each basin. In addition, a combined technical memo will be presented upon completion of emissions estimates for all Colorado basins, and another for all other states' basins.

A draft final report will be submitted for the entire project upon completion of all basin base and future year emissions estimates and the development of the annual reporting tool. The final report will incorporate comments from IPAMS, WRAP, and other interested parties.

Deliverables: A series of technical memoranda on emissions estimates for each basin, in Colorado and other states, as well as interim technical memoranda that summarize all Colorado basins and all basins in other states. A final report will also be submitted that summarizes all work done for the project including the development of an annual reporting tool.