3. EMISSION INVENTORY DEVELOPMENT

This section summarizes the emission inventory used in the Pinedale Anticline Project Environmental Impact Statement (EIS) air quality modeling. More details on the emission inventory are provided in the "Pinedale Anticline Oil and Gas Exploration and Development Project Air Emissions Inventory" document (BLM, 1999).

The Pinedale Anticline Project emissions sources are defined as:

- well pad and resource road construction (fugitive dust, mobile equipment, etc.),
- well drilling,
- well completion and testing (flaring),
- well operation (including dehydration, flashing, and other miscellaneous equipment), and
- gas compression.

Emissions inventories were developed for these activities for NO_x, SO_2, CO, PM_{10}, $PM_{2.5}$, VOCs, and HAPs. The HAPs consist of xylene, benzene, toluene, ethylbenzene, n-hexane and formaldehyde. The inventory was developed for individual sources that were then summed to represent the entire well field. This inventory represents the "potential to emit," which assumes operation of wells and compressors for 8,760 hours per year.

Pinedale Anticline Project Emissions Estimation

These types of new sources are similar throughout southwest Wyoming and both well construction and well production methods are similar from field to field. Therefore, the emissions estimation methodologies used in the Jonah II EIS to calculate emissions from well construction and some of the well production sources was also used in calculation of the Project emissions.

Emissions estimation methodologies from the Jonah II EIS (BLM, 1998) for all construction sources and the production heaters were used for the Project EIS. Emissions from the condensate storage tanks were estimated using the HYSYS model and the GLYCALC model were used to estimate emissions from glycol dehydration sources. Gas analyses and operating parameters from Jonah II wells (provided by McMurry Oil Company) were used as input to the emission estimation models. VOC emissions from process fugitives account for less than one percent of the inventory, and were assumed to be negligible for the Project.

Full field development is expected to consist of 700 producing well locations. Note that the air quality modeling also analyzed a 500 producing well Project Alternative that was obtained from the 700 well scenario by ratio (i.e., multiplying the 700 well results by 5/7). Two different well configurations were also analyzed in the air quality modeling, a Project Wide (PW) scenario with the wells spread across the Project area and a scenario where the wells area concentrated on the Anticline Crest (AC). The maximum required compression is expected to be 26,000 horsepower (hp) which could support production of approximately 350 million cubic feet per day (MMCFD) of natural gas for the entire field. Assuming that nine

barrels of condensate are produced for every million cubic feet (MMCF) of natural gas, total condensate production from the field would be 3,150 barrels per day (bbl/day). For purposes of this analysis, VOCs were calculated based on these production rates and assuming that twenty percent of the gas produced was from wells requiring Best Available Control Technology (BACT). It was assumed that no controls were required for the glycol dehydration units. Emissions from flashing and glycol dehydration was estimated by ratio of the results of HYSYS and GLYCALC simulations of Jonah II wells provided by McMurry Oil Company.

Combustion emissions from flaring were calculated assuming that twenty percent of the total condensate was produced from wells requiring BACT, typically determined to be flares for condensate tanks. An average quantity of gas flared per barrel of condensate produced was used to determine the total quantity of gas flared.

Compressor emissions were calculated for 26,000 horsepower. The compressor emission factors for pollutants other than NO_x and CO were taken from AP-42, Section 3.2 (2/97, draft section under review)[1]. NOx emissions were quantified for the alternatives of 1.5, 1.0 and 0.7 grams per horsepower hour (g/hp–hr). CO emissions were quantified at 3.0 g/hp–hr.

Cumulative Impact Emission Estimates

The purpose of the cumulative impact analysis is to present the total impacts from the Project, along with all existing sources (natural and anthropogenic) within the selected source domain as of December 31, 1998, and reasonable foreseeable development (RFD) sources. Four pollutants, PM_{10}, $PM_{2.5}$, SO_2 and NOx, were inventoried for the permitted regional sources to be used in the cumulative impacts analysis, and only NO_x was inventoried for all other RFD sources. Existing sources within the source domain (see Figure 2-1 or 4-1), as determined by BLM in consultation with the cooperating agencies, were included.

Actual versus Potential Emissions

Actual emissions are defined as the average of the actual emissions over the previous two years for Federal permit applicability purposes. For purposes of this analysis, which is unrelated to permitting, actual emissions are used when emission inventories were submitted to the WDEQ/AQD for a minimum of a one-year period. Potential to emit (PTE) is a maximum emission value, over which a source is not allowed to emit through a permit condition. It is an artificial value developed for permit enforcement purposes and is almost always higher than actual emissions. Actual emissions were inventoried for the sources in existence as of December 31, 1998, which have operational histories documented in the WDEQ/AQD inventory record. PTE was used for all other individual sources including those in the category of RFD. For the RFD area sources (such as other oil and gas projects), PTE was calculated assuming a reasonable estimate of the number of sources to be operated. Both

[1] EPA, Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources. The draft Section 3.2 (Natural Gas-Fired Reciprocating Engines) is being used to estimate emissions from uncontrolled 2-stroke clean burn engines. The current Section 3.2 (Heavy-Duty Natural Gas-Fired Pipeline Compressor Engines and Turbines) does not contain the equivalent emission factors.

annual average and maximum hourly emission rates, if available, were collected and used in the modeling analyses. Where maximum hourly emission rates were not available, an hourly emission rate was calculated from the average annual rates.

Criteria for Source Inclusions in the Cumulative Impact Assessment

Impacts from all sources operating in 1995 are represented by the baseline concentration data (discussed in Chapter 4 and shown in Table 4-2) . Impacts from the Project, sources not in operation as of 1995, and sources included in the category of RFD were determined using dispersion modeling and added to this measured baseline. All new and expected sources since June 30, 1995 are included in the cumulative impact assessment. As discussed above, these sources include permitted and RFD sources and are referred to as the post-95 soures. The cumulative impact assessment was based on the combined impacts of the Project and post-95 sources.

Existing sources are divided between those in operation prior to July 1995 and those beginning operation from July 1995 through December 1998. Emissions from sources in operation prior to July 1995 are included in measurements taken by ambient monitors located within the study area (see Table 4-2). The inclusion criteria for sources in operation between July 1995 and December 1998 are the following:

- Source is located within the source domain boundary;
- Source was issued a permit by WDEQ/AQD after June 1, 1993;
- Source began operating after July 1, 1995; and
- Source began operating before January 1999.

The source inventory prepared for the Continental Divide/Wamsutter II and South Baggs Natural Gas Development Projects EIS hereinafter referred to as "CD/Wamsutter II" (BLM, 1999c) was used as a starting point. Any changes in status of sources on that list and new sources subsequent to that list were added to or subtracted from the source inventory. Where actual emissions are available (for a minimum of a one-year period), they were substituted for the potentials on that inventory. Information on the sources documented subsequent to the CD/Wamsutter II list were collected from the WDEQ/AQD permit files. Actual emissions from operating sources were taken from the annual emissions inventories. (Note that all emissions increases were included in the modeling analyses, but emissions decreases were included only if they are documented as occurring at major sources and confirmed by the WDEQ/AQD). Emission changes resulting from modifications in well configurations after 1995 were estimated from the 1995 to 1998 change in total gas production in each county, as documented on the Wyoming Oil and Gas Conservation Commission (WOGCC) website (www.wogcc.state.wy.us). A NOx emission factor (in terms of mass per volume of gas produced) was derived from the emissions inventory and applied to the change in gas production per county.

Reasonably Foreseeable Development Sources

The purpose of including the Reasonably Foreseeable Development (RFD) in an EIS is to disclose to the public the nature and scope of anticipated future development and its impacts. Future development has different degrees of certainty ranging from highly speculative to absolutely certain. BLM believes that it is appropriate to disclose and quantify the impacts of the more certain future development, but quantified impacts associated with highly speculative development are of little decision-making value.

RFD projects are segregated below according to a judgement on their degree of certainty. Emissions and impacts from projects with a high degree of certainty were quantified and included in the cumulative impact analysis. Impacts from projects of a higher level of speculation, were discussed in qualitative terms.

Inclusion criteria for RFD include those potential sources that are permitted but not yet operating. Permitting in this sense includes sources with WDEQ/AQD Section 21 permits and/or that have been authorized or are currently being authorized through the NEPA process. Potential emissions from the Project development alternatives were included in the RFD inventory. Section 21 permit sources was included if they met all of the following criteria:

- Source is located within the source domain boundary;
- Source was issued a WDEQ/AQD permit after June 1, 1993;
- Source has not allowed its permit to expire; and
- Source has not begun operating as of January 1999.

These included sources were inventoried at their permitted potentials to emit (Note that the inclusion criteria for existing sources beginning operation after June 1995 but before January 1999 and RFD sources from this section can be combined for a single cumulative permitted source emissions inventory).

Projects that are either undergoing or have completed NEPA authorization and for which sources were included in the inventory include:

- Riley Ridge,
- Burley,
- Big Piney-LaBarge CAP,
- Soda Unit,
- Castle Creek,
- Hickey-Table Mountain,
- Road Hollow,
- Stagecoach,
- BTA Bravo,
- East LaBarge,
- Bird Canyon,
- Essex Mountain,
- Moxa Arch,
- Fontenelle,

- Jonah II,
- Creston-Blue Gap,
- Mulligan Draw,
- Dripping Rock/Cedar Break,
- Sierra Madre,
- Hay Reservoir,
- Jack Morrow Hills,
- Continental Divide, inclusive of Greater Wamsutter (CD/GW),
- Upper Green River,
- Hoback Basin, and
- South Baggs.

All of these projects are gas development projects with well-head sources and some also have compression. Only NOx emissions are estimated from these sources. For the well-head sources, this estimate was made by using the number of wells remaining to be drilled after December 1998 and the NOx emission factor calculated for the Project emissions (0.065 tons per year per well[2]). For the Continental Divide wells, the project-specific NOx emission factor of 0.08 tons per year per well[3] was used.

NOx emissions from compression unpermitted as of January 1999 were modeled as RFD sources for five of these projects: Continental Divide, Fontenelle, Moxa Arch, South Baggs, and Jack Morrow Hills[4].

Cumulative Emission Inventory Locations

The locations of the Project and post-95 sources modeled using CALPUFF are shown in Figure 3-1. These sources are broken down by point and area sources and by the Project, permitted, and RFD source categories. For the Project sources, the three potential locations of the compressors are indicated by the point source symbols near the Project area. Compressor location C1 is the one in the middle and compressor location C2 is just south of the Project area. Finally, compressor location C3 is the most northerly location.

[2] Assumes a 0.75 MMBtu/hour three-phase separator heater operating 15 minutes per hour during October through April, a 0.125 MMBTU/hour dehydration heater operating 15 minutes per hour year-round, and flares installed on a fraction of the wells, as described in Section 4.1.

[3] Assumes a 0.25 MMBtu/hour three-phase separator heater operating fulltime during October through March and a 0.125 MMBtu/hour dehydration heater operating 30 minutes per hour year-round, as provi.ded by TRC (3/5/99).

[4] A NO_X emission rate of 1.5 g/hp-hr was assumed for the RFD compressor sources

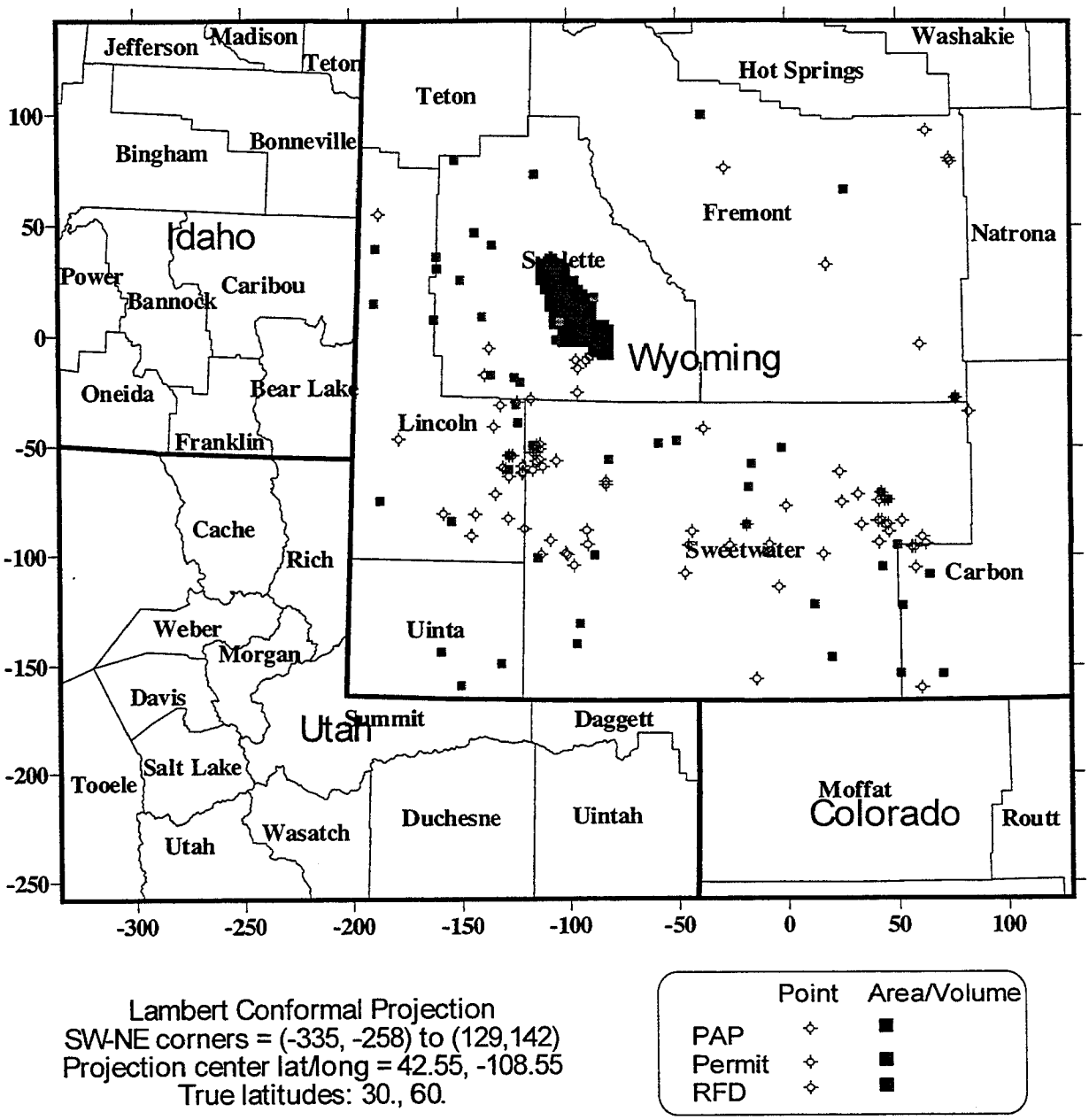

Figure 3-1. Locations of the Project and post-95 point and area sources used in the Pinedale Anticline Project EIS CALPUFF modeling.