APPENDIX J

AIR QUALITY TECHNICAL SUPPORT DOCUMENTS

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Near-Field
Air Quality Technical Support Document
for the
West Tavaputs Plateau
Oil and Gas Producing Region
Environmental Impact Statement

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1.0 INTRODUCTION

This Technical Support Document describes the process used to develop the Near-Field Air Quality impact assessment for the Bureau of Land Management (BLM), Price Field Office, Draft Environmental Impact Statement (DEIS) for West Tavaputs Plateau Area (WTP). The WTP Project Area is located approximately 30 miles east-northeast of Price, Utah and covers approximately 137,700 acres in an existing oil and gas producing region located in Duchesne and Carbon Counties, Utah. Surface ownership in the project area is approximately 87% federal (managed by the Bureau of Land Management [BLM]), 8% State of Utah (managed by State of Utah School and Institutional Trust Lands Administration [SITLA]), and 5% private.

This document provides a detailed description of the procedures applied for the EIS analysis to quantify potential ambient air quality impacts that may result from the implementation of the WTP Project alone and in conjunction with other cumulative sources of air pollutant emissions.

2.0 PROJECT DESCRIPTION

The WTP Project Area currently contains 71 active producing wells, with accompanying production related facilities, roads, and pipelines. An additional 30 wells approved under the WTP Drilling Program EA (UT-070-2004-28) are proposed for development. Total gas compression and treatment capacity is currently 16,000 horsepower (hp) within the WTP at the existing Dry Canyon facility.

The proposed wells would be drilled to all potentially productive formations in the WTP Project Area: the Wasatch, North Horn, Mesa Verde, Dakota, Cedar Mountain, Navajo, and Wingate Formations, and other formations found to be productive. The majority of the wells would be spaced at one well per 80 acres or less. However, geologic characteristics that are currently poorly defined and which would be better defined through future drilling, would dictate the well density necessary to effectively drain the natural gas within the WTP Project Area.

Each of the geologic formations in the WTP Project Area has a unique permeability, which requires variable well spacing techniques for effective drainage of the gas reservoirs. Some of the economically productive geologic formations would be effectively drained by downhole well densities of one well per 160 acres, most by well densities of one well per 80 acres, and others would likely require well densities of up to one well per 40 acres (Wasatch and Mesa Verde formations). In general, deeper formations require lesser downhole well density. The number of wells per well pad would therefore, vary dramatically, depending on the required downhole well density as well as topographic considerations. Formations that can be produced by a single well per 80 acres, that are accessible, and that have a single production formation, could be developed by well pads with single well bores. Formations that require downhole well densities of one well per 40 acres, that are adjacent to topographically inaccessible lands, and that have multiple productive horizons could be developed using well pads with up to as many as eight wells per pad.

Bill Barrett Corporation (BBC) proposes the following primary components for development under the Proposed Action:

- Up to 807 natural gas wells from up to 538 pads over an 8 year development period, 33 year life of project (LOP);
- Up to 9 drilling rigs operating year round;

- Up to 3,656 acres short-term surface disturbance (wells, access roads, pipelines, compressor stations); and
- Approximately 24,000 compression horsepower would be added to the existing system, for a total of 40,000 horsepower (hp) within the WTP Project Area.

After construction of well pads and roads, drilling and completion of a well, and interconnection to the gathering pipelines, each well pad would consist of a wellhead, a three-phase separator (to separate gas, produced water, and hydrocarbon condensate), and a condensate tank. Approximately 25 % of wells would require individual dehydrators and gas powered pump jacks. The gas would be moved to central production facilities (CPF) that would include multiple compressor engines, a central separator, and central glycol dehydration units. After processing, the gas would then be transported to a sales pipeline for further distribution.

Emissions to the atmosphere from the proposed project would consist of the criteria pollutants nitrogen oxides (NO_x), carbon monoxide (CO), particulates (PM_{10} and $PM_{2.5}$), sulfur dioxide (SO_2), and volatile organic compounds (VOC), and various hazardous air pollutants (HAP). These pollutants would be emitted from the following activities and sources:

- Well pad and road construction: equipment producing fugitive dust while moving and leveling earth;
- Drilling: vehicles generating fugitive dust on access roads, and drill rig engine exhaust;
- Completion: vehicles generating fugitive dust on access roads, frac pump engine and generator emissions, and completion flaring emissions;
- Vehicle tailpipe emissions associated with all development phases;
- Well production operations: three-phase separator emissions, flashing and breathing emissions from a condensate tank, well site dehydrator emissions, and pump jack engine emissions; and
- Central production facility: compressor engines and central glycol dehydration unit emissions, flare emissions from central dehydrators, and central flashing and breathing emissions from condensate tanks.

Tables 2-1 through 2-5 show summaries of the emissions inventories for Alternatives A, B, C, D, and E respectively. The detailed description of emission sources, emission factors, and quantified total emissions is shown in Appendix J-1.

Table 2-1. WTP Annual Emissions for the Proposed Action

Pollutant	Project Emissions (tons/year)		Total Emissions [a] (tons/year)
	Well Development	Project Production	
Criteria Pollutants & VOC			
NO_x	570.2	795.5	1,366
CO	681.7	959.3	1,641
VOC	106.3	12,024	12,130
SO_2	12.5	0.69	13.1
PM_{10}	6,654.4	1,687	8,944

Table 2-1. WTP Annual Emissions for the Proposed Action			
Pollutant	**Project Emissions (tons/year)**		**Total Emissions [a] (tons/year)**
	Well Development	**Project Production**	
$PM_{2.5}$	1,036.9	292.6	1,422
Hazardous Air Pollutants			
Benzene	0	95.7	95.7
Toluene	0	73.1	73.1
Ethylbenzene	0	1.96	1.96
Xylene	0	18.4	18.4
n-Hexane	0	223	223
Formaldehyde	0.75	20.9	21.7
Total HAPs	0.75	433	434
Greenhouse Gases			
CO_2	70,977	482,563	553,539
CH_4	79.3	2,550	2,629

In addition to the Proposed Action, the following four alternatives are considered in the NEPA analysis:

- Alternative B – No Action (81 wells from 54 pads, 17,600 hp additional compression for 33,600 hp total compression, 3 rigs year round for 2 years, 27 year LOP)
- Alternative C – Transportation Reduction (807 wells from 538 pads, 40,000 hp total compression, 2-6 Tier II rigs year round for 15 years, 40 year LOP, tank emissions controlled 95% VOC reduction when individual tank emissions exceed 5 tons/year)
- Alternative D – Conservation Alternative (558 wells from 348 pads, 11,200 hp additional compression for a total of 27,200 horsepower compression, 7 Tier II rigs seasonally for 21 years, 46 year LOP, tank emissions controlled 95% VOC reduction when individual tank emissions exceed 5 tons/year)
- Alternative E – BLM Preferred Alternative (807 wells from 494 pads, 40,000 hp total compression, year-round drilling, 7 Tier II rigs per year for 9 years provided surface disturbance and air quality thresholds are not exceeded, 34 year LOP, tank emissions controlled 95% VOC reduction when individual tank emissions exceed 5 tons/year)

Table 2-2. WTP Annual Emissions for Alternative B			
Pollutant	**Project Emissions (tons/year)**		**Total Emissions [a] (tons/year)**
	Well Development	**Project Production**	
Criteria Pollutants & VOC			
NO_x	165	315	480
CO	222	409	631
VOC	35.2	1,067	1,102
SO_2	3.68	0.06	3.7

Table 2-2. WTP Annual Emissions for Alternative B			
Pollutant	**Project Emissions (tons/year)**		**Total Emissions [a] (tons/year)**
	Well Development	**Project Production**	
PM_{10}	2,230	157	2,386
$PM_{2.5}$	346.5	37.3	384
Hazardous Air Pollutants			
Benzene	0	8.60	8.6
Toluene	0	6.22	6.2
Ethylbenzene	0	0.03	2.6E-02
Xylene	0	1.95	2.0
n-Hexane	0	12.0	12.0
Formaldehyde	0.18	13.2	13
Total HAPs	0.18	41.9	42
Greenhouse Gases			
CO_2	23,772	112,860	136,632
CH_4	27.0	1,849	1,876

Table 2-3. WTP Annual Emissions for Alternative C			
Pollutant	**Project Emissions (tons/year)**		**Total Emissions [a] (tons/year)**
	Well Development	**Project Production**	
Criteria Pollutants & VOC			
NO_x	133	793	926
CO	239	955	1,193
VOC	40.5	6,937	6,977
SO_2	4.84	0.60	5.44
PM_{10}	2,784	934	3,719
$PM_{2.5}$	2,067	182	2,249
Hazardous Air Pollutants			
Benzene	0	39.5	39.5
Toluene	0	22.6	22.6
Ethylbenzene	0	0.12	0.12
Xylene	0	6.63	6.63
n-Hexane	0	101	101
Formaldehyde	0.28	20.9	21.2
Total HAPs	0.28	191.2	191.5
Greenhouse Gases			
CO_2	26,598	482,563	509,160
CH_4	29.6	2,009	2,038

Table 2-4. WTP Annual Emissions for Alternative D

Pollutant	Project Emissions (tons/year)		Total Emissions [a] (tons/year)
	Well Development	Project Production	
Criteria Pollutants & VOC			
NO_x	89	480	569
CO	152	584	736
VOC	25.9	4,833	4,859
SO_2	3.25	0.58	3.83
PM_{10}	1,626	811	2,437
$PM_{2.5}$	1,310	148	1,458
Hazardous Air Pollutants			
Benzene	0	28.9	28.9
Toluene	0	16.7	16.7
Ethylbenzene	0	0.08	0.08
Xylene	0	5.13	5.13
n-Hexane	0	67.1	67.1
Formaldehyde	0.17	10.7	10.9
Total HAPs	0.17	129	129
Greenhouse Gases			
CO_2	17,664	310,278	327,942
CH_4	19.3	1,877	1,896

Table 2-5. WTP Annual Emissions for Alternative E

Pollutant	Project Emissions (tons/year)		Total Emissions [a] (tons/year)
	Well Development	Project Production	
Criteria Pollutants & VOC			
NO_x	281	574	856
CO	529	822	1,351
VOC	81.9	6,929	7,011
SO_2	9.92	0.58	10.50
PM_{10}	5,097	823	5,921
$PM_{2.5}$	770	156	926
Hazardous Air Pollutants			
Benzene	0.00	39.3	39.3
Toluene	0.00	21.5	21.5
Ethylbenzene	0.00	0.11	0.11
Xylene	0.00	6.61	6.61
n-Hexane	0.00	94.2	94.2
Formaldehyde	0.53	19.8	20.3
Total HAPs	0.53	181.5	182.0
Greenhouse Gases			

Table 2-5. WTP Annual Emissions for Alternative E			
Pollutant	Project Emissions (tons/year)		Total Emissions [a] (tons/year)
	Well Development	Project Production	
CO_2	55,414	445,835	501,249
CH_4	61.1	1,957	2,018

In order to bracket impacts, a decision was made in conjunction with the BLM National Air Quality modeling team to model/quantify emissions from the following three Alternatives:

- Alternative A (Proposed Action)
- Alternative B (No Action)
- Alternative E (BLM Preferred)

Since the majority of development/operation near-field impacts were equivalent to Alternative A impacts, no additional modeling beyond Alternative A was necessary. However, in the case of PM_{10} and $PM_{2.5}$, Alternative A impacts were scaled according to traffic counts to estimate impacts from the additional project alternatives, as discussed in more detail in the following sections.

3.0 NEAR-FIELD DISPERSION MODEL AND METEOROLOGY

The AERMOD-Prime model (Version 04300) has been promulgated in the EPA Guideline on Air Quality Models to replace ISCST3 as the primary dispersion model for assessing near-field impacts (40 CFR Part 51 in 9 Nov 05,Vol 70 # 216 FR 68218-68261), and was therefore applied in this analysis. The AERMOD system contains three primary components: AERMOD-Prime (dispersion model with prime building downwash algorithms), AERMAP (terrain preprocessor), and AERMET (meteorological preprocessor). A special feature of AERMOD-Prime includes the capability to more accurately represent boundary layer meteorology and dynamics, and is therefore an improvement over the ISC dispersion model.

The AERMET system utilizes both surface and upper air measurements in order to estimate profiles of wind, turbulence, and temperature in the Planetary Boundary Layer (PBL). Minimum meteorological data requirements to run AERMET generally include horizontal wind speed, horizontal wind direction, ambient temperature, surface characteristics (Albedo, Bowen Ratio, Surface Roughness), cloud cover, and a morning upper air sounding. The recent version of the model, however, has incorporated the Bulk Richardson Number scheme which removes the model dependence on cloud cover if Solar Radiation and Temperature Change with Height (SRDT) data are available. This is especially important in areas where cloud cover data are unavailable or considered to be non-representative.

Another requirement for successful model performance is that the meteorological data be representative of the conditions affecting the transport and dispersion of pollutants within the modeling domain. Generally, this means that the surface characteristics surrounding the meteorological monitoring site should be similar to those within the modeling domain. While degree of similarity may correlate with proximity of the monitoring site to the project site, meteorological data measured at more distant sites may be considered representative as long as it adequately represents the meteorology and surface characteristics of the modeling domain.

In evaluating the meteorological data available to drive AERMOD, several surface data sources were considered. While data from Automated Surface Observing System (ASOS) installations are available near the WTP Project Area, there are several drawbacks to the application of this data. Problems associated with ASOS data include a 6 meter (versus 10 meter) wind and temperature data measurement, a higher percentage of calm winds due to a higher detectable wind speed threshold, as well as the vertical limitation of the cloud cover measurements (limited to 12,000 feet).

In consideration of these limitations, this analysis utilized five years of recent surface measurements collected at Canyonlands National Park as part of the Clean Air Status and Trends Network (CASTNET) operated by the US Environmental Protection Agency (USEPA) and National Park Service (NPS). Evaluation of the surface characteristics surrounding the data collection site indicate that the data is likely to be representative of the meteorological conditions encountered within the modeling domain. Furthermore, the availability of SRDT data at this site allowed the application of the Bulk Richardson Number scheme providing an alternative to the less reliable ASOS data. The five years of surface data collected at Canyonlands was combined with National Weather Service twice-daily upper air soundings available at Grand Junction Walker Field in order to generate the meteorological parameters to drive AERMOD. Extracted from the Canyonlands data was wind speed, wind direction, horizontal wind deviation (sigma theta), solar radiation, and delta temperature (difference between 9m and 2m probes). Missing data or data outside acceptable ranges was reviewed and replaced as necessary using regulatory guidance along with professional judgment. The wind rose for the developed data is shown on **Figure 3-1**.

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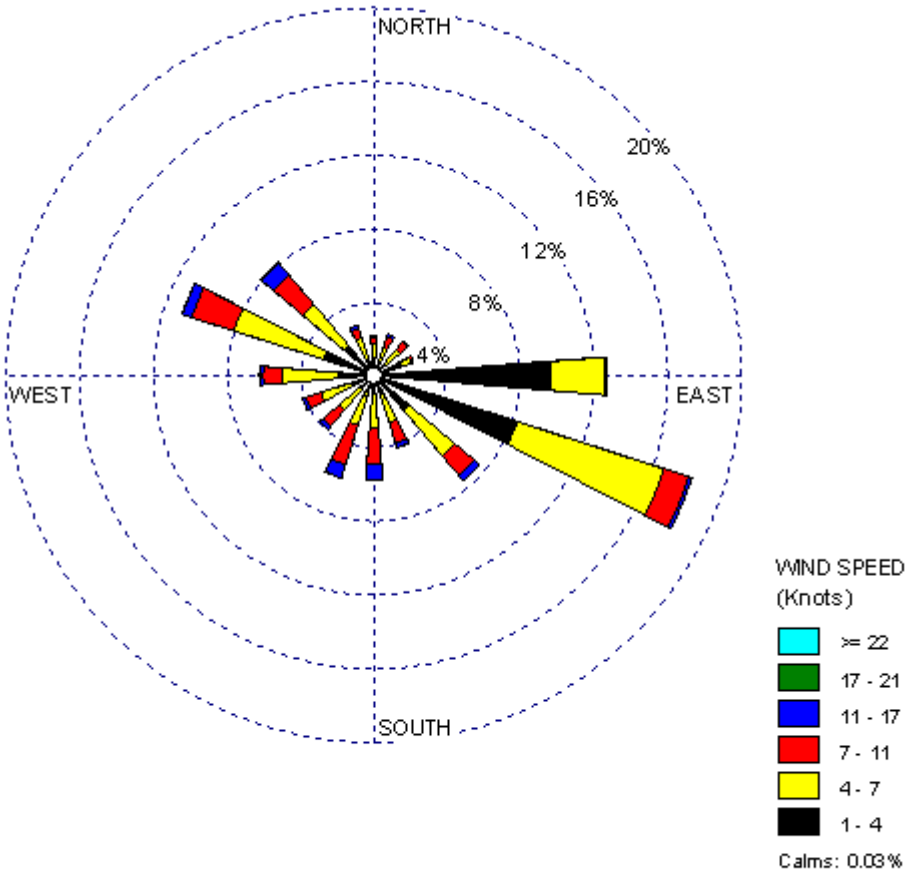
Figure 3-1

Wind Rose from AERMET Canyonlands NP Data 1995-1999
Wind Speed Direction (blowing from)



Average Wind Speed 5.52 Knots

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4.0 SIGNIFICANCE CRITERIA

Scales of measurement, or significance criteria, must be defined to evaluate potential air quality impacts. Potential impacts to near-field air quality that would result from the implementation of the WTP project were compared to the significance criteria listed below.

4.1 UTAH AND NATIONAL AIR QUALITY STANDARDS

Utah and National Ambient Air Quality Standards (UAAQS and NAAQS) have been promulgated for the purpose of protecting human health and welfare with an adequate margin of safety. Pollutants for which standards have been determined include sulfur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), ozone (O_3), and particulate matter less than 10 microns in diameter (PM_{10}) and less than 2.5 microns in diameter ($PM_{2.5}$). The applicable ambient air quality standards are summarized in **Table 4-1.**

Under the Prevention of Significant Deterioration (PSD) provisions of the Clean Air Act (CAA), incremental increases of specific pollutant concentrations are limited above a legally defined baseline level. Many national parks and wilderness areas are designated as PSD Class I. The PSD program protects air quality within Class I areas by allowing only slight incremental increases in pollutant concentrations. Areas of Utah not designated as PSD Class I are classified as Class II. For Class II areas, greater incremental increases in ambient pollutant concentrations are allowed. The PSD increments for both Class I and II areas are also shown in **Table 4-1.**

Throughout this impact analysis, all comparisons with PSD increments are intended only to evaluate potential significance, and do not represent a regulatory PSD increment consumption analysis. PSD Increment consumption analyses are typically applied to large industrial sources during the permitting process, and are solely the responsibility of the State of Utah with USEPA oversight.

Table 4-1. Ambient Criteria Pollutant Concentrations, National and State Ambient Air Quality Standards, and PSD Increments

Pollutant	Averaging Period(s)	Uinta Basin Background Concentration[a] ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)	PSD Class I Increment ($\mu g/m^3$)	PSD Class II Increment ($\mu g/m^3$)
SO_2	Annual 24-hour 3-hour	5 10 20	80 365 1,300	2 5 25	20 91 512
NO_2 NO_2[d]	Annual 1-hour	17 na	100 188	2.5 na	25 na
PM_{10}	Annual 24-hour	NA 63.3	NA 150	4 8	17 30
$PM_{2.5}$	Annual 24-hour	11 15/52[b]	15 35	None None	None None
CO CO	8-hour 1-hour	1,111 1,111	10,000 40,000	None None	None None
O_3	8-hour	105	147	None	None

[a] Source: Utah Division of Environmental Quality - Division of Air Quality (UDAQ).

.[b] The state of Utah currently does not require $PM_{2.5}$ modeling for new sources and does not have an official background. The $PM_{2.5}$ concentrations given in this table represent 98th percentile values from limited $PM_{2.5}$ monitoring conducted in Vernal and Uintah/Duchesne Counties in 2007. The smaller figure is representative of average summer concentrations, while the larger value is representative of winter inversion conditions, based on this monitoring.

[c] Because the winter inversion $PM_{2.5}$ value does not represent typical conditions in the project area, the value for average summer conditions was used in analyzing $PM_{2.5}$ impacts from the Proposed Action. The $PM_{2.5}$ monitoring location in Uintah/Duchesne counties, Utah was located in an urban setting with a high density of inhabitants and in proximity to highways (Highway 40 and Highway 191). As such, the higher, winter time inversion $PM_{2.5}$ concentration value reflects impacts from activities and activity levels not expected in the rural and sparsely inhabited region of the Proposed Action. Potential impacts from agricultural activities and wood burning would not be expected to measurable contribute to $PM_{2.5}$ concentrations in the region of the Proposed Action.
[d] The NAAQS (effective 4/12/10) for 1-hour NO_2 is based on a three-year average of the 98th percentile of the yearly maximum of 1-hour daily maximums.
na = not available, values have not been established

4.2 ACUTE AND CHRONIC HAP EXPOSURE THRESHOLDS

Hazardous Air Pollutants (HAPs) associated with the WTP Project and cumulative sources include BTEX (benzene, toluene, ethylbenzene, and xylene), formaldehyde, and n-hexane. Hydrogen sulfide (H_2S) is not expected to constitute a significant portion of the gas stream and therefore was not modeled. Since there are no applicable federal ambient air quality standards for the above pollutants, Reference Concentrations (RfC) for chronic inhalation exposure, and Reference Exposure Levels (REL) for acute inhalation exposures are applied as significance criteria. **Table 4-2** provides the RfCs and RELs. The RfCs represent an estimate of the continuous (i.e. annual average) inhalation exposure rate to the human population (including sensitive subgroups such as children and the elderly) without an appreciable risk of harmful effects. The RELs represent the acute (i.e. one-hour average) concentration at or below which no adverse health effects are expected. Both the RfC and REL guideline values are for non-cancer effects.

Table 4-2. HAP Reference Exposure Levels and Reference Concentrations

Hazardous Air Pollutant (HAP)	Reference Exposure Level [REL 1-hr Average] ($\mu g/m^3$)	Reference Concentration [1] [RfC Annual Average] ($\mu g/m^3$)
Benzene	1,300 [2]	30
Toluene	37,000 [2]	400
Ethylbenzene	350,000 [3]	1,000
Xylenes	22,000 [2]	100
n-Hexane	390,000 [3]	200
Formaldehyde	94[2]	9.8

[1] EPA Air Toxics Database, Table 1 (EPA 2002a)
[2] EPA Air Toxics Database, Table 2 (EPA 2002a)
[3] Immediately Dangerous to Life or Health (IDLH)/10, EPA Air Toxics Database, Table 2 (EPA 2002a) since no available REL

The State of Utah has adopted Toxic Screening Levels (TSLs) which are applied during the air permitting process to assist in the evaluation of hazardous air pollutants released into the atmosphere (Utah Department of Environmental Quality-Air Quality Division 2000). The TSLs are derived from Threshold Limit Values (TLVs) published in the American Conference of Governmental Industrial Hygienists (ACGIH) – "Threshold Limit Values for Chemical Substances and Physical Agents" (American Conference of Governmental Industrial Hygienists 2003). These levels are not standards that must be met, but screening thresholds which if exceeded, would suggest that additional information is needed to evaluate potential health and environmental impacts. The TSLs are compared against modeling concentrations for averaging

periods of 1-hour (short-term) and 24-hour (chronic). **Table 4-3** lists the corresponding TSLs for each applicable HAP.

Table 4-3. Utah Toxic Screening Levels (TSLs)	
Pollutant and Averaging Time	**Toxic Screening Levels[b] ($\mu g/m^3$)**
Formaldehyde (1-hour)	37
Benzenea (24-hour)	53
Toluene (24-hour)	6,280
Xylene (1-hour)	65,129
Xylene (24-hour)	14,473
n-Hexane (24-hour)	5,875

[a] Although there exists an acute TLV for benzene, the State of Utah does not apply a comparison to an acute TSL since the chronic TSL is more stringent.
[b] Source: Utah Department of Environmental Quality - Air Quality Division (2000).

Diesel emissions have the potential to cause adverse health effects. The EPA has recognized that diesel exhaust has the potential to cause long-term (chronic) respiratory damage and short-term (acute) irritation (eye, throat, bronchial) and respiratory symptoms. Evidence also suggests that diesel exhaust is a likely human carcinogen with potential to cause lung cancer from long-term inhalation exposure. However, the carcinogenic effect of diesel exhaust on humans has not been definitively proven due to a lack of conclusive exposure data (EPA 2002b).

The primary source of project diesel emissions would be during the well development phase. Heavy equipment used during well construction and drill rigs would emit the majority of the project diesel exhaust. Diesel exhaust is a complex mixture of organic and inorganic compounds distributed among the gaseous and particulate phases. Therefore, measuring the concentration and composition of diesel exhaust can be extremely difficult. No single constituent of diesel exhaust serves as a unique marker of exposure; however, the levels of fine particles (the majority being $PM_{2.5}$) or elemental carbon (both of which are much higher in diesel emissions than in other combustion products) can be used as surrogate indices of diesel exhaust particulate matter (DPM) (EPA 2002b). A DPM RfC of 5 µg/m3 extrapolated from animal studies is considered to be the best current marker for chronic non-cancer respiratory effects of diesel exhaust on humans (EPA 2003). The DPM RfC of 5 $\mu g/m^3$ is applied to assess the chronic non-cancer respiratory effects of diesel exhaust during the well development phase.

4.3 INCREMENTAL CANCER RISK

To assess long-term exposure from carcinogenic HAP emissions, traditional risk assessment methods are applied and the risk for the maximally exposed individual (MEI) and most likely exposure (MLE) are compared to the generally acceptable risk range of one additional cancer per one million exposed persons (1×10^{-6}) to one additional cancer per ten thousand exposed persons (1×10^{-4}) (EPA 1993). Benzene and formaldehyde, the project HAP carcinogens, are evaluated. For the MEI risk, it is assumed that a person is exposed continuously (24 hours per day, 365 days per year) for the life of project (LOP). For the MLE risk, an adjustment was made for the amount of time a family stays at a residence (nine years) and for the portion of time spent away from the home (64 percent of the day) (EPA 1997). It is further assumed that households are exposed to one-quarter of the maximum concentration the remaining (36 percent) of the time. Exposure adjustment factors of 0.4 for the MEI (28/70) and 0.095 for the MLE [(9/70)*((0.64*1)+(0.36*0.25))] are applied to the estimated cancer risk to account for the actual time that an individual could be exposed during a 70-year lifetime. The chronic inhalation cancer risk factors for benzene and formaldehyde are presented in **Table 4-4.**

Table 4-4. Carcinogenic Unit Risk Factors	
Hazardous Air Pollutant	**Carcinogenic Unit Risk Factor [Annual Inhalation Exposure] ($1/\mu g/m^3$)**
Formaldehyde[1]	1.3×10^{-5}
Benzene[1]	2.2×10^{-6} - 7.8×10^{-6}

Source: [1] EPA Integrated Risk Information System (IRIS) database (EPA 2003). A range of risk factors is available for benzene.

5.0 SUB-GRID IMPACTS

5.1 SUB-GRID DEVELOPMENT EMISSIONS

The major pollutant associated with development activities would be PM_{10} and $PM_{2.5}$ generated by earth-moving and traffic activities. Additional pollutants would be emitted from vehicle and equipment exhaust. Based upon the proposed development plan, a matrix of 15 adjacent well pads was created on 40-acre spacing to simulate a potential development scenario. This matrix was created to simulate a "likely" development scenario of 6 drill rigs, 6 completion rigs, and 3 pad construction activities. In order to alleviate some of the extensive AERMOD processing times associated with area source emissions, PM_{10} and $PM_{2.5}$ results from the 6 x 6 x 3 matrix were scaled based on traffic counts for the additional two alternatives where emissions were quantified. and The construction-, drilling-, and completion-related air quality impacts were analyzed for the 6 x 6 x 3 matrix with the assumption that development activities would be separated by a sufficient distance and time such that the short-term impacts from one development area would not overlap with other development activities in more distant areas within the project boundary.

A well pad and access road complex was characterized by an individual well pad and an access road right-of-way approximately 1700 feet long by 30 feet wide extending from the existing road network to the well pad. Although a road could be oriented in any direction, the use of five years of meteorological data adequately characterizes the maximum short-term impacts regardless of orientation.

Receptors were spaced at 100-meter intervals with a buffer zone of 100 meters from the access road and the well pad. The buffer zone criteria were based on minimum distances that heavy equipment operators would allow public access to construction. The receptor grid extended out to 2,000 meters beyond the buffer zone. Receptor elevations were assumed to be at the base elevation of well site sources (i.e., flat terrain). The modeled sources (well pad and access road) are shown on **Figure 5-1**.

Modeling for construction activities involved PM_{10} and $PM_{2.5}$ emissions from the operation of a backhoe, loader, crawler tractor, and grader. Modeling for the drilling activities involved the traffic-generated fugitive dust as well as criteria pollutant emissions from a drill rig. Modeling for completion activities involved the vehicle-generated fugitive dust and well fracturing emissions. The fugitive dust generated from vehicles traveling to and from the site was scaled to the section of road near the pad. All of the PM_{10} and $PM_{2.5}$ emissions were then assumed to emanate from the well pad and short section of access road.

Based on the proposed project schedule, a well pad and associated access road would be constructed in about 14 days. The time to drill a well would range from 13 days for shallower downhole formations to 26 days for directional wells. A well would then be completed in about 29 days. Well drilling and completion was assumed to occur 24 hours per day, while construction activities were assumed to occur 10 hours per day; from 7am to 5pm. However, fracturing a well takes three hours per well which was assumed to occur between 11am to 2pm.

Criteria pollutant emissions were predicted for comparison to applicable short-term ambient air quality standards. Comparison to annual thresholds is provided for consistency. However, the annual impacts assume that the activity would occur for an entire year at the same location, which is not the case.

Fugitive dust emissions were modeled as area sources with the release parameters listed in **Table 5-1**. Drill rig and well fracturing pump and generator engine stacks were modeled as point sources with the release parameters listed in **Table 5-2**.

Emission rates were derived according to the averaging period being modeled. For instance, annual fugitive dust emission rates incorporated a natural control efficiency based on annual precipitation rates. However, short-term fugitive dust emission rates reflected the maximum 24-hour emissions that could be observed during a dry period. The maximum predicted short-term emissions from well development are shown in **Table 5-3,** while annual emission rates are presented in **Table 5-4**.

Table 5-1. WTP Development Area Source Release Parameters

Source	Dimensions (meters)		Release Height[a] (meters)	Initial sigma Z [b] (meters)
	X-Dimension	Y-Dimension		
Pad	87	87	5	4.65
Access Road Segment (7 equal segments)	9	76	5	4.65

[a] Typical values used in modeling fugitive dust range from 0 to 6 meters. Tailpipe emissions immediately rise and dust plumes from vehicles can rise from one to two times the vehicle height trucks are generally higher than cars, hence 5 meters.
[b] Sigma z = (2 * release ht.)/2.15. (See the ISC Model User's Guide [EPA 1995], pp 3-28 to 3-35 for further information)

Table 5-2. WTP Proposed Action Development Point Source Release Parameters

Source	Stack Height (m)	Stack Diameter (m)	Exit Velocity (m/s)	Temperature (k)
Drill Rig	7.6	0.1	50	800
Fracturing Engines	9.1	0.3048	35	811

Table 5-3. WTP Proposed Action Short-Term Development Emission Rates				
Activity	**Duration**	**Maximum PM_{10} Emission Rate (lbs/hr)**	**Maximum $PM_{2.5}$ Emission Rate (lbs/hr)**	**Maximum SO_2 Emission Rate (lbs/hr)**
Construction (per pad)	14 days			
Earth Moving		1.38	1.08	0.10
Drilling (per well)	13 to 26 days			
Drill Rig		0.23	0.19	0.16
Vehicle Traffic		0.07	0.01	4.5E-05
Completion (per well)				
Well Fracturing	3 hours	2.12	1.79	1.44
Vehicle Traffic	29 days	0.10	0.02	5.49E-05

Table 5-4. WTP Proposed Action Annual Development Emission Rates					
Activity	**Duration**	**Maximum NO_x Emission Rate (lbs/hr)**	**Maximum DPM Emission Rate (lbs/hr)**	**Maximum $PM_{2.5}$ Emission Rate (lbs/hr)**	**Maximum SO_2 Emission Rate (lbs/hr)**
Construction (per pad)	14 days				
Earth Moving		1.71	0.12	0.49	0.05
Drilling (per well)	13 to 26 days				
Drill Rig		9.54	0.19	0.19	0.16
Vehicle Traffic		9.32 E-04	-	8.1E-03	3.84E-03
Completion (per well)					
Well Fracturing	3 hours	19.71	0.41	0.41	0.33
Vehicle Traffic	29 days	0.001	-	0.01	5.49E-05

5.2 SUB-GRID DEVELOPMENT RESULTS

5.2.1 Alternative A (Proposed Action)

Well development impacts as compared to the NAAQS for the Proposed Action are shown in **Table 5-5**. Since well development activities are temporary and short-term in nature, comparisons to PSD increments are not appropriate. The short-term results show that there is potential for the NAAQS to be slightly exceeded for $PM_{2.5}$ 24-hour average. The annual PM_{10} results demonstrate that even if these activities lasted for an entire year in the same location, the effects would still be less than all applicable standards. **Figure 5-1** illustrates the eighth-maximum $PM_{2.5}$ 24-hr impacts graphically.

Table 5-5. WTP Proposed Action Potential Development Impacts						
Pollutant and Averaging Period	Averaging Period	Ambient Air Concentration ($\mu g/m^3$)[a]				
		Predicted	Background[b]	Total	NAAQS	% of NAAQS (Project + Background)
SO_2	3-Hour	9.58	20	29.6	1,300	2%
	24-Hour	2.41	10	12.4	365	3%
	Annual	0.4	5	5.4	80	7%
NO_2	Annual	23.3	17	40.3	100	40%
PM_{10}	24-Hour	39.0	63.3	102	150	68%
$PM_{2.5}$	24-Hour [c]	7.69	15/52 [d]	22.7 [e]	35	65%
	Annual	1.89	11	12.9	15	86%

[a] μ/m^3 is micrograms of pollutant per cubic meter of air
[b] Source: Utah Division of Environmental Quality - Division of Air Quality (UDAQ).
[c] Concentration estimate represents the eighth maximum 24-hour $PM_{2.5}$ concentrations (on average over 3 years).
[d] The state of Utah currently does not require $PM_{2.5}$ modeling for new sources and does not have an official background. The $PM_{2.5}$ concentrations given in this table represent 98th percentile values from limited $PM_{2.5}$ monitoring conducted in Vernal and Uintah/Duchesne Counties in 2007. The smaller figure is representative of average summer concentrations, while the larger value is representative of winter inversion conditions, based on this monitoring.
[e] Because the winter inversion $PM_{2.5}$ value does not represent typical conditions in the project area, the value for average summer conditions was used in analyzing $PM_{2.5}$ impacts from the Proposed Action. The $PM_{2.5}$ monitoring location in Uintah/Duchesne counties, Utah was located in an urban setting with a high density of inhabitants and in proximity to highways (Highway 40 and Highway 191). As such, the higher, winter time inversion $PM_{2.5}$ concentration value reflects impacts from activities and activity levels not expected in the rural and sparsely inhabited region of the Proposed Action. Potential impacts from agricultural activities and wood burning would not be expected to measurable contribute to $PM_{2.5}$ concentrations in the region of the Proposed Action.

Diesel particulate matter (DPM) resulting from heavy equipment used during well construction, drill rigs, and temporary engines used during the well fracturing process was evaluated against the DPM RfC of 5 $\mu g/m^3$ for chronic non-cancer respiratory effects of diesel exhaust on humans (EPA 2003). The maximum predicted annual DPM concentration of 0.4 $\mu g/m^3$ represents 9 % of the DPM RfC.

5.2.2 Alternative B (No Action)

Based on the proposed drilling schedule and locations of potential development, a development matrix of 2 drill rigs, 2 completion rigs, and 1 pad construction activity on 40-acre spacing was created to simulate a likely development scenario for Alternative B. Annual NO_2 and DPM impacts were modeled and compared to standards. Results show that impacts would be only slightly less than those under Alternative A (annual NO_2 plus background = 32 % of NAAQS, annual DPM = 8 % of DPM RfC).

Fugitive dust (PM_{10} and $PM_{2.5}$) impacts modeled under Alternative A were scaled against traffic counts in order to estimate impacts under Alternative B. Total traffic counts for each matrix configuration for each alternative were summed on a per well/per pad basis and used to develop the scaling factor for Alternative B. **Table 5-6** presents the traffic counts and scaling factor applied while **Table 5-7** summarizes estimated fugitive dust impacts.

5.2.3 Alternative E (BLM Preferred)

Since the 6 x 6 x 3 matrix applied in Alternative A is likely to closely represent the development configuration observed under Alternative E, no near-field modeling was performed for Alternative E. Development impacts are therefore estimated to be equivalent to those predicted for Alternative A.

Table 5-6. Traffic Counts and Scaling Factors Used to Estimate Potential PM_{10} and $PM_{2.5}$ Impacts

Activity	Total Round Trip Traffic per Development Configuration [a]		Scaling Factor Applied to Alternative B
	Alt A (6x6x3)	Alt B (2x2x1)	
Construction	105	35	-
Drilling	1248	416	-
Completion	2088	696	-
Total	**3441**	**1147**	**0.33**

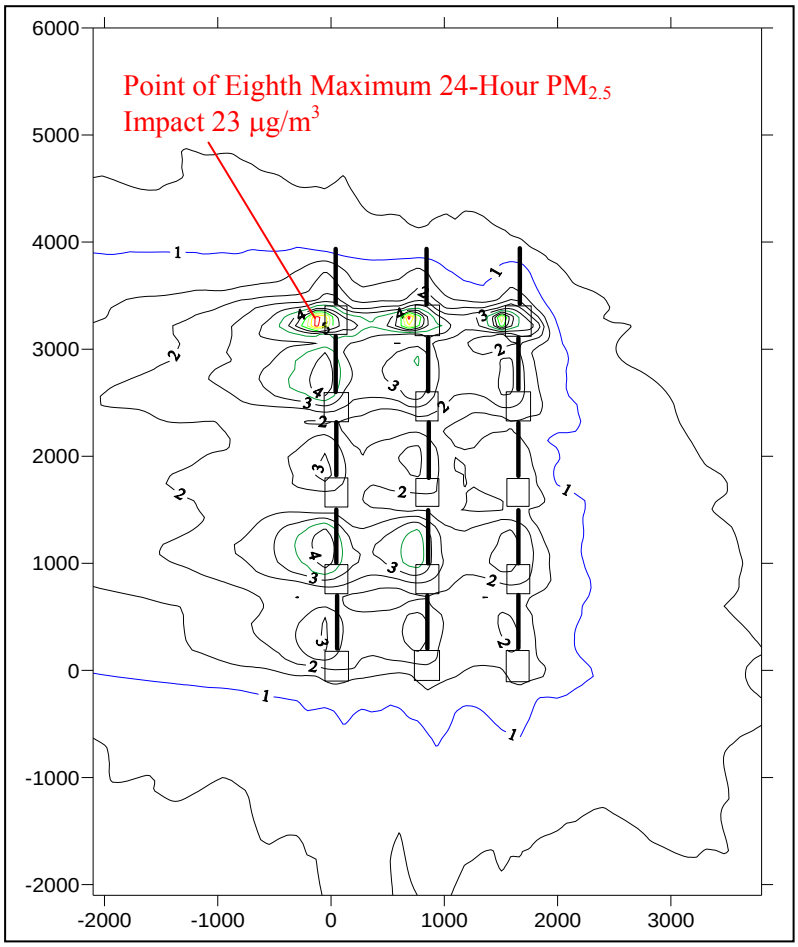
[a] The matrix configuration represents the number of drill rigs, number of completion rigs, and number of well construction activities assumed for each alternative. The total round trips per well or well pad were summed according to the number of activities represented by the matrix. The number of total trips for each alternative was divided by the total number of vehicle trips for Alternative A to arrive at a scaling factor.

Table 5-7. WTP Alternative B Estimated Potential Development Impacts

Pollutant and Averaging Period	Averaging Period	Ambient Air Concentration ($\mu g/m^3$)[a]				
		Predicted	Background	Total	NAAQS	% of NAAQS (Project + Background)
PM_{10}	24-Hour	12.9	28	40.9	150	27%
$PM_{2.5}$	24-Hour[b]	2.54	15/52[c]	17.5[d]	35	50%
	Annual	0.62	11	11.62	15	74%

[a] Source: Utah Division of Environmental Quality - Division of Air Quality (UDAQ).
[b] Concentration estimate represents the eighth maximum 24-hour $PM_{2.5}$ concentrations (on average over 3 years).
[c] The state of Utah currently does not require $PM_{2.5}$ modeling for new sources and does not have an official background. The $PM_{2.5}$ concentrations given in this table represent 98th percentile values from limited $PM_{2.5}$ monitoring conducted in Vernal and Uintah/Duchesne Counties in 2007. The smaller figure is representative of average summer concentrations, while the larger value is representative of winter inversion conditions, based on this monitoring.
[d] Because the winter inversion $PM_{2.5}$ value does not represent typical conditions in the project area, the value for average summer conditions was used in analyzing $PM_{2.5}$ impacts from the Proposed Action. The $PM_{2.5}$ monitoring location in Uintah/Duchesne counties, Utah was located in an urban setting with a high density of inhabitants and in proximity to highways (Highway 40 and Highway 191). As such, the higher, winter time inversion $PM_{2.5}$ concentration value reflects impacts from activities and activity levels not expected in the rural and sparsely inhabited region of the Proposed Action. Potential impacts from agricultural activities and wood burning would not be expected to measurable contribute to $PM_{2.5}$ concentrations in the region of the Proposed Action.

Figure 5-1. Eighth-Maximum 24-Hour $PM_{2.5}$ Proposed Action Development Impacts ($\mu g/m^3$)



Contour Interval = 0.5 $\mu g/m^3$

Well Pad and Access Road

$\mu g/m^3$ = micrograms per cubic meter

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5.3 SUB-GRID HAZARDOUS AIR POLLUTANT EMISSIONS

A "most-likely scenario" was developed to assess the HAP impacts. A modeling grid was developed with the largest proposed compressor station (11,200 horsepower) in the center surrounded by 6 well pads. Since approximately half of the proposed well pads will have at least two directionally drilled wells drilled from existing locations, the twin well per pad scenario was modeled in order to identify the maximum ambient air HAP concentrations that could occur in the WTP Project Area from multiple facilities. The HAP results would be equivalent for all project alternatives and therefore only one scenario was modeled. HAP emissions were modeled for the following sources:

- Gas well pads: dehydrator emissions, condensate tank emissions and gas powered pump jack engine emissions; and
- Compressor stations: An 11,200 horsepower compressor station with associated compressor engine emissions and dehydrator/condensate tank emissions controlled by a flare.

Receptors were spaced at 25 meters along the perimeter of the well pads and compressor station. Receptor spacing of 100 meters was utilized from the facility perimeters out to 2 kilometers.

Modeled results were compared to the acute, chronic, and carcinogenic thresholds listed in Section 4.0 for each applicable HAP.

The compressor engines and well pad sources were modeled as point sources with the release parameters listed in **Table 5-8**.

Table 5-8. WTP HAP Point Source Release Parameters[a]

Source	Stack height (m)	Temperature (K)	Exit Velocity (m/sec)	Stack Diameter (m)
Compressor Engine (Natural Gas)	12.2	811	25	0.305
CS Heater	4.6	700	2.8402	0.2286
CS Dehy Flare	6.096	810.93	20	0.0508
CS Tank Flare	6.096	810.93	20	0.0508
Well Dehydrator	3.65	366	0.001	0.05
pump jack engine	2.56	810.93	15.667	0.1036
Well Tank Flash	6.7056	280.93	0.001	0.0508
Wellsite Heaters	4.6	700	2.8402	0.2286

[a] Data a combination of previous installation and typical manufacturers specifications.

Table 5-9 shows the estimated HAP emissions from each individual facility. Emissions from well pad production equipment are representative of the maximum for all proposed formations within the CWSA.

Table 5-9. WTP Proposed Action HAP Emission Rates						
Facility	Maximum Emission Rate (lbs/hour/pad) [a]					
	Benzene	Toluene	Ethylbenzene	Xylenes	n-Hexane	Formaldehyde
Compressor Engine (Natural Gas)	0.0202	7.15E-03	3.18E-04	2.50E-03	None	0.2600
CS Dehydrator Flare	0.5863	0.5860	None	0.1955	0.0865	None
CS Tank Heater	1.6E-06	2.6E-06	None	None	0.0014	5.6E-05
CSTVent	0.0479	0.0264	0.0004	0.0028	0.2050	None
Well Dehydrator	0.068	0.084	0.004	0.024	0.008	None
pump jack engine	0.0010	3.6E-04	1.6E-05	1.3E-04	None	0.0131
Well Tank Vent	0.0165	0.0091	None	0.0010	0.0703	None
Wellsite Heaters	6.9E-06	1.1E-05	None	None	5.9E-03	2.5E-04

[a] Emission rates are based on assumption that facilities would operate continuously for a year

5.4 SUB-GRID HAZARDOUS AIR POLLUTANT RESULTS

Short-term impacts from HAP exposure were assessed by comparing one-hour average impacts to the HAP-specific acute REL (reference exposure level) and annual average impacts to the HAP-specific RfC (reference concentration for continuous inhalation exposure). The REL is the acute concentration at or below which no adverse health effects are expected. The RfC is the average concentration, i.e., an annual average, at or below which no long-term adverse health effects are expected. Both of these guideline values are for non-cancer effects.

Table 5-10 presents the predicted results in comparison to the State of Utah TSLs for averaging periods of 1-hour (short-term) and 24-hour (chronic).

Table 5-10. WTP Proposed Action Utah Toxic Screening Level (TSL) Impacts			
Pollutant and Averaging Time	Predicted Maximum Impact ($\mu g/m^3$)	Toxic Screening Levels[b] ($\mu g/m^3$)	Percent of TSL
Benzene[a] (24-hour)	38.0	53	72%
Toluene (24-hour)	43.1	6,280	1%
Ethylbenzene (1-hour)	3.8	54,274	<1%
Ethylbenzene (24-hour)	1.6	14,473	<1%
Xylene (1-hour)	53.2	65,129	<1%
Xylene (24-hour)	12.6	14,473	<1%
n-Hexane (24-hour)	15.4	5,875	<1%
Formaldehyde (1-hour)	28.9	37	78%

[a] Although there exists an acute TLV for benzene, the State of Utah does not apply a comparison to an acute TSL since the chronic TSL is more stringent.
[b] Source: Utah Department of Environmental Quality - Air Quality Division (2000).

Table 5-11 presents the acute RELs and RfCs for non-cancer effects for the Proposed Action. The predicted maximum concentrations of all HAPs are compared against the REL and RfC for each pollutant.

Table 5-11. WTP Proposed Action Non-Carcinogenic Acute REL and RfC Impacts

HAP	REL ($\mu g/m^3$)	Predicted Maximum 1-Hour Impact ($\mu g/m^3$)	% of REL	RfC[c] ($\mu g/m^3$)	Predicted Maximum Annual Impact ($\mu g/m^3$)	% of RfC
Benzene	1,300 [a]	160	12%	30	8.15	27%
Toluene	37,000 [a]	160	<1%	400	8.16	2.0%
Ethylbenzene	350,000 [b]	3.8	<1%	1,000	0.26	<1%
Xylenes	22,000 [a]	53.2	<1%	100	2.68	2.7%
n-Hexane	390,000 [b]	56.1	<1%	200	2.83	1.4%
Formaldehyde	94 [a]	28.9	31%	9.8	0.99	10%

[a] EPA Air Toxics Database, Table 2 (EPA 2002a)
[b] Immediately Dangerous to Life or Health (IDLH)/10, EPA Air Toxics Database, Table 2 (EPA 2002a) since no available REL
[c] EPA Air Toxics Database, Table 1 (EPA 2002a)

Figure 6-1 illustrates the concentration contours for the highest 1-hour benzene concentration under the Proposed Action. For all modeling years, the maxima all pollutants was at the boundary of the proposed compressor station.

Since benzene and formaldehyde are carcinogenic, annual average concentrations of these two HAPs were modeled and expressed as a long-term cancer risk (based on 70- year exposure). Cancer risk was estimated for two exposure scenarios: 1) most likely exposure (MLE) for residents and 2) a maximally exposed individual (MEI) corresponding to an individual that could be exposed for the entire life of the project (assumed as 28 years of production [the last 5 years of project life are for abandonment and reclamation]), such as compressor station workers. For the MEI risk, it is assumed that a person is exposed continuously (24 hours per day, 365 days per year) for the life of project (LOP). For the MLE risk, an adjustment will be made for the amount of time a family stays at a residence (nine years) and for the portion of time spent away from the home (64 percent of the day) (EPA 1997). It will further be assumed that households are exposed to one-quarter of the maximum concentration the remaining (36 percent) of the time. Exposure adjustment factors of 0.47 for the MEI (28/70) and 0.095 for the MLE [(9/70)*((0.64*1)+(0.36*0.25))] will be applied to the estimated cancer risk to account for the actual time that an individual could be exposed during a 70-year lifetime. Resultant exposure adjustment factors for the MLE and MEI scenarios of 0.095 and 0.47 were applied to the estimated cancer risk to account for the actual time that an individual would be exposed during a 70-year lifetime.

Table 5-12 presents the unit risk factor, exposure adjustment factor, and the estimated cancer risk for the MLE and MEI exposure scenarios for benzene and formaldehyde. The unit risk factor is a slope factor that when multiplied by the ambient air concentration provides an estimate of the probability of one additional person contracting cancer based on continuous exposure over a 70-year lifetime. A range of unit risk factors is available for benzene.

Table 5-12. WTP Proposed Action Potential Carcinogenic HAP Risk					
HAP	**Exposure Scenario**	**Unit Risk Factor ($1/\mu g/m^3$)**	**Exposure Adjustment Factor**	**Modeled Annual Impact ($\mu g/m^3$)**	**Cancer Risk**
Benzene	MLE	2.2 E-06 to 7.8 E-06	0.095	8.15	1.7 E-06 to 6.0 E-06
Formaldehyde	MLE	1.3×10^{-5}	0.095	0.99	1.2E-06
Benzene	MEI	2.2 E-06 to 7.8 E-06	0.40	8.15	7.2 E-06 to 2.5 E-05
Formaldehyde	MEI	1.3 E-05	0.40	0.99	5.1 E-06

The increased cancer risk from benzene and formaldehyde are cumulative, because an individual is exposed to both compounds at the same time. Therefore for the increased risk to individuals receiving the most likely dose is $2.9 \times 10^{-6}$to 7.3×10^{-6}. A maximally exposed individual would have an increased risk of 1.2×10^{-5} to 3.1×10^{-5}. There is uncertainty involved in adding cancer risk estimates together. However it is common when carcinogens have similar target organs or modes of action. Benzene is a known human carcinogen, exposure is known to cause leukemia. Formaldehyde is a probable carcinogen, exposure is suspected to cause leukemia. Therefore this is a conservative estimate. The generally acceptable risk range is 1×10^{-6} to 1×10^{-4}.

6.0 NEAR-FIELD IMPACTS

The near-field impact assessment considered NO_X, CO, PM_{10}, and $PM_{2.5}$ emissions during the operational phase of the WTP after full-field development. Since SO_2 emissions from vehicle exhaust would be less than one ton per year, these emissions were not included in the near-field modeling. All facilities were assumed to operate continuously throughout the year. Alternative A (Proposed Action) was the only scenario modeled. Impacts from additional alternatives would be equivalent to Alternative A, with the exception of fugitive dust from operations, which was scaled according to vehicle traffic estimates as discussed below.

6.1 MODELING SETUP

A “worst case scenario” representative model was created. A modeling grid was developed with the largest proposed compressor station (11,200 horsepower) in the center surrounded by six well pads. Since approximately half of the proposed well pads will have at least two directionally drilled wells drilled from existing locations, the twin well per pad scenario was modeled in order to identify the maximum ambient air Criteria pollutant concentrations that could occur in the WTP Project Area from multiple facilities. The Criteria pollutant results would be equivalent for all project alternatives and therefore only one scenario was modeled. Criteria pollutant emissions were modeled for the following sources:

- Gas well pads: condensate tank heater emissions and gas powered pump jack engine emissions;

- Compressor stations: An 11,200 horsepower compressor station with associated compressor engines emissions, dehydrator emissions controlled by a flare, and condensate tank vent and heater emissions; and
- Traffic on unpaved roads: tailpipe and fugitive dust emissions.

Receptors were spaced at 25 meters along the perimeter of the well pads and the perimeter of the compressor station. Receptor spacing of 100 meters was utilized from the facility perimeters out to 2 kilometers.

6.2 EMISSIONS

Project emission sources were modeled as both point and area sources. Point sources consisted of the following:

- Seven 1600 horsepower compressor engines,
- eight tank heaters, and
- two pump-jack engines and two wellsite heaters per well pad.

Emissions resulting from road dust generated by vehicles and the vehicle exhaust on these access roads were characterized as an area source 532 meters long by 15 meters wide. One road segment was associated with each well pad (six total road segments). A maximum of three vehicles per well per day were assumed to travel each road.

Table 6-1 summarizes the point source modeling emission rates calculated from the estimated annual emissions for the full-field WTP Proposed Action operations. **Table 6-2** summarizes the area source PM_{10} and $PM_{2.5}$ emission rates. Annual emission rates assumed that all sources would emit continuously throughout the year. Annual fugitive dust emissions assumed a natural emission control from 73 days of precipitation (NCDC data for Nutters Ranch, UT 1963-1986). Short-term fugitive dust emission rates assumed 12-hour per day vehicle operation and conservatively did not include factors for dust control. The release parameters for all WTP point and area sources are described in **Tables 6-3 and 6-4.**

Table 6-1. WTP Proposed Action Point Source Modeling Emission Rates (lbs/hour)

Pollutant	Compressor Station (CS) Engine	CS Tank Heater	Pump Jack Engine	Wellsite Heater
NOx	5.291	0.0375	0.265	0.243
CO	7.055	0.0315	0.3527	0.2758
PM_{10}	0.2487	0.0057	0.0124	0.0250
$PM_{2.5}$	0.2487	0.0057	0.0124	0.0250

Table 6-2. WTP Proposed Action Area Source Modeling Emission Rates (lbs/hour)	
Pollutant	**Fugitive Dust/Vehicle Tailpipe**
NOx	0.0523
CO	0.2270
PM_{10}	0.1588
$PM_{2.5}$	0.0243

Table 6-3. WTP Proposed Action Point Source Release Parameters

Equipment	Stack height (m)	Temperature (K)	Exit Velocity (m/sec)	Stack Diameter (m)
Compressor Engine	12.2	811	25	0.3048
CS Tank Heater	6.096	810.93	20	0.0508
Pump Jack Engine	2.56	810.93	15.667	0.1036
Wellsite Heater	4.6	700	2.840	0.2286

Table 6-4. WTP Proposed Action Area Source Release Parameters

Source	Dimensions (meters)		Release Height	Initial sigma z[a]
	X-Dimension	Y-Dimension	(meters)	(meters)
Fugitive Dust/Vehicle tailpipe	15.24	532.45	5	3.26

[a] For large sources, sigma z = release ht./2.15. (See the ISC Model User's Guide [EPA, 1995], pp 3-28 to 3-35 for further information)

6.3 NEAR-FIELD RESULTS

6.3.1 Alternative A (Proposed Action)

Impacts from the WTP Proposed Action within the near-field analysis area were estimated using dispersion modeling. Results of the near-field modeling for each of the highest value of the five years of meteorological data, with the added background concentrations, are presented in **Table 6-5**. The predicted impacts are compared to applicable Utah and NAAQS standards and applicable PSD Class II increments. All comparisons with PSD Class II increments are intended only to evaluate potential significance, and do not represent a regulatory PSD increment consumption analysis. PSD increment consumption analyses are typically applied to large industrial sources during permitting, and are solely the responsibility of the State of Utah with EPA oversight.

Figure 6-2 illustrates the concentration contours for the highest annual NO_2 concentration under the Proposed Action. For all modeling years, the maxima all pollutants was near the boundary of the proposed compressor station.

Table 6-5. WTP Proposed Action Near-Field Operations Predicted Impacts					
Pollutant	**Averaging Period**	**Predicted Concentration ($\mu g/m^3$)**	**% of PSD Class II Increment**	**Project + Background [a] ($\mu g/m^3$)**	**% of NAAQS (Project + Background)**
NO_2	Annual	22.5	90%	39.5	40%
PM_{10}	24-hour	10.7	36%	74.0	49%
$PM_{2.5}$	Annual	1.23	NA	12.2	82%
$PM_{2.5}$	24-hour [b]	4.03	NA	19.0[c]	54%
CO	1-hour	786	NA	1897	5%
CO	8-hour	433	NA	1544	15%

[a] with NO_2 annual background 17 $\mu g/m^3$
[a] with PM_{10} 24-hour background 63 $\mu g/m^3$
[a] with $PM_{2.5}$ annual background 11 $\mu g/m^3$
[a] with $PM_{2.5}$ 24-hour background 15 $\mu g/m^3$
[a] with CO 1-hour background 1,111 $\mu g/m^3$
[a] with CO 8-hour background 1,111 $\mu g/m^3$
[b] Represents eighth-maximum concentration averaged over three years

[c] The state of Utah currently does not require $PM_{2.5}$ modeling for new sources and does not have an official background. The $PM_{2.5}$ provided by UDEQ (15 and 52 $\mu g/m^3$) represent 98th percentile values from limited $PM_{2.5}$ monitoring conducted in Vernal and Uintah/Duchesne Counties in 2007. The smaller figure is representative of average summer concentrations, while the larger value is representative of winter inversion conditions, based on this monitoring. Because the winter inversion $PM_{2,5}$ value does not represent typical conditions in the project area, the value for average summer conditions was used in analyzing $PM_{2.5}$ impacts from the Proposed Action. The $PM_{2.5}$ monitoring location in Uintah/Duchesne counties, Utah was located in an urban setting with a high density of inhabitants and in proximity to highways (Highway 40 and Highway 191). As such, the higher, winter time inversion $PM_{2.5}$ concentration value reflects impacts from activities and activity levels not expected in the rural and sparsely inhabited region of the Proposed Action. Potential impacts from agricultural activities and wood burning would not be expected to measurable contribute to $PM_{2.5}$ concentrations in the region of the Proposed Action.

6.3.2 Alternative B (No Action) and Alternative E (BLM Preferred)

Because the largest compressor station and the maximum amount of traffic for a given well during operations was modeled for the Proposed Action and the alternatives would be similar, estimated potential impacts will be the same for Alternatives B and E. Since control devices would be applied to well site condensate tanks and dehydration units, the HAP impacts would be less near the well pads. However, the maximum HAP impacts for Alternatives C, D and E would be near the compressor station and therefore similar to the Proposed Action.

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Figure 6-1. Maximum Predicted Potential Operation Benzene 1-Hr Impacts (µg/m³)

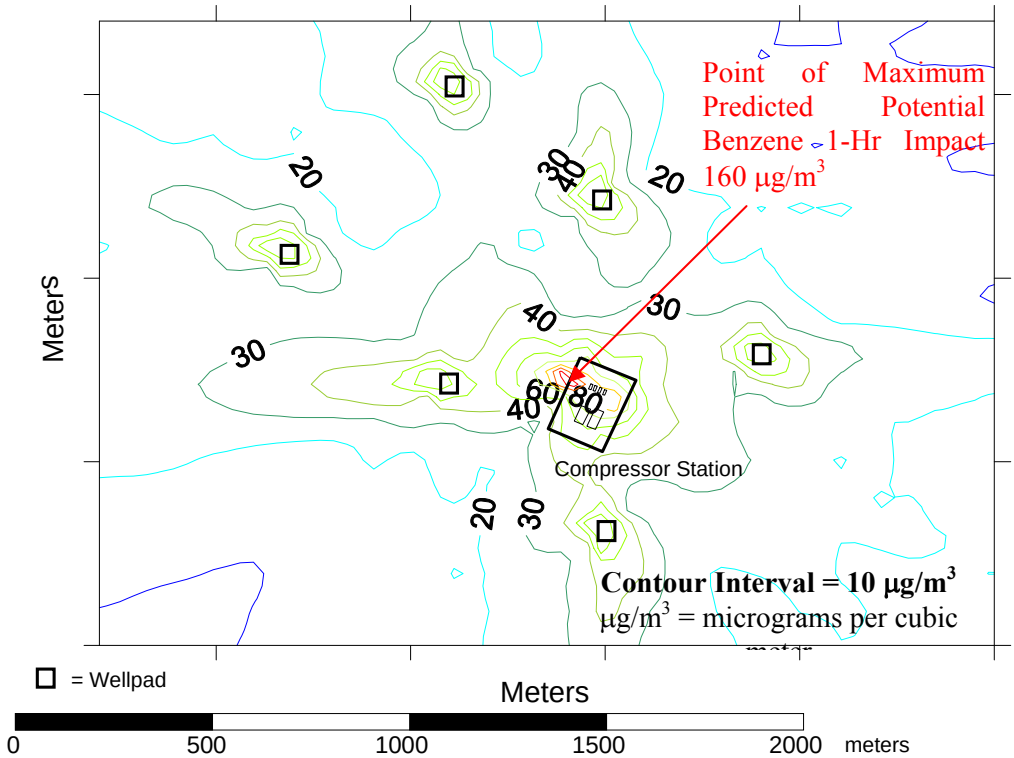
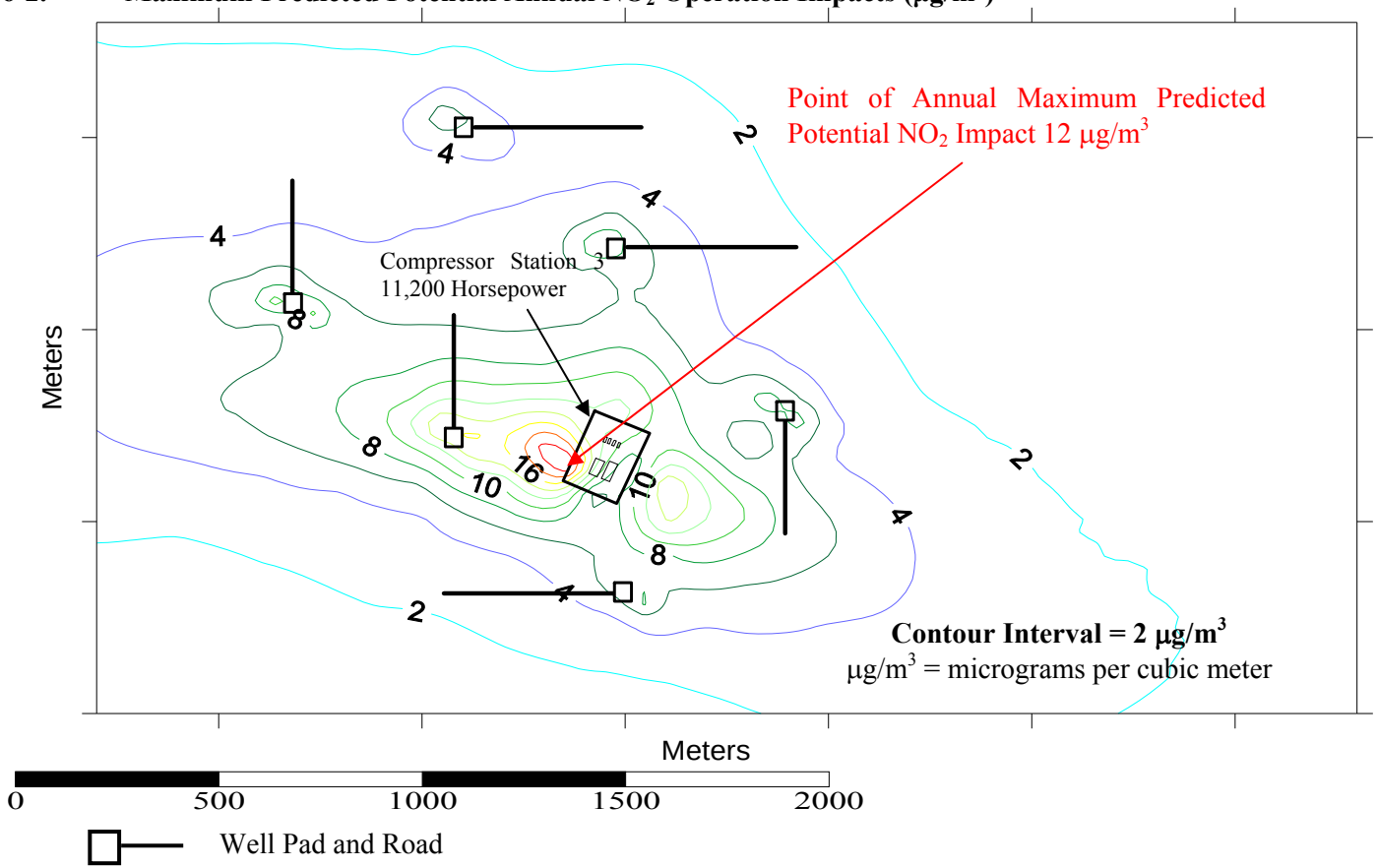


Figure 6-2. Maximum Predicted Potential Annual NO_2 Operation Impacts ($\mu g/m^3$)



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EMISSIONS INVENTORY

ALTERNATIVE A - PROPOSED ACTION

Existing												
	71	Total wells currently in Operation in WTP										
	30	Wells to be developed in WTP (already approved under WTP Drilling Program EA - UT-070-2004-28)										
Proposed												
	Total New Wells	807		wells	days		percent					
	Total New Pads	538	0.667	46	46	deep downhole	0.05700					
	Average Number of Wells Per Pad	1.5		24	92	deep directional	0.02974					
	Number of Producing Wells at Peak Development (Year 8)	807		492	13	downhole	0.60967					
	Number of Producing Pads at Peak Development (Year 8)	538		245	26	directional	0.30359					
	Total Deep Wells (Proponent)	70		**807**	21.1772							
	Total Shallow Wells (Proponent)	737										
Drilling												
	New Well pad/road construction											
	Drilling (Max Year 1)	112	new well pads per year for	8	years							
		168	new wells per year for	8	years							
		51	directional									
		102	downhole	downhole	directional							
		15	deep	10	5							
	Short-Term Well Pad Disturbance	1532	acres									
		2.8476	acres/pad (average for all pads)									
	ROW Disturbance											
	Roads	865	acres									
		1.6078	acres/pad									
		178	miles									
		0.3309	miles/pad	1746.91	250							
	Pipeline	978	acres									
		1.8178	acres/pad									
		201	miles									
		0.3736	miles/pad									
	Power lines	0	acres									
		0	acres/pad									35
		0	miles (cross country)									
		0	miles/pad									
	Other	281										
	Pits	0										
	TOTAL SHORT-TERM ACRES	3656										
	SHORT-TERM WELL/ROAD DISTURB PER PAD	6.2732										
	Average Round Trip Distance for Drilling/Construction Traffic On Unpaved Roadways =	74	miles (estimated from project area road system).									
	Average Round Trip Distance for Drilling/Construction Traffic On Paved & Unpaved Roadways =	168						max # of simultaneous operations				

								Spring summer fall	Winter			
	New well pad/access road construction (average)	14	days per pad	10	hrs/day	140	Total Hours	9	0			
	Time to drill, log and case one gas well (average, directional/downhole)	20	days per well	24	hrs/day	480	Total Hours	9	9			
	Time to complete each well (average)	31	days per well	24	hrs/day	750	Total Hours	9	9			
	Time to reclaim	6	days per well	8	hrs/day	48	Total Hours					
	Time to Frac a well	1	days per well	3	hrs/day	3	Total Hours	2				
	Rig Size (hp)	875	hp	shallow (750-1000)								
		2250	hp	deep (1500-3000)		70 deep wells total (9%)			(estimated - 9 mths * 31 days/mth / 7 days/pad = ~ 40 pads per year)			
	Proposed Action esimates majority of well spacing will be 80 acres. However, impacts evaluated at 40 and 80 acre spacing scenarios								(average, between 3 and 9 rigs will be operting)			
									(estimated - 46.5 days/well * 36 well completions/year / 365 days = ~5 simultaneous completions)			
Completion												
	3 hours frac time per well		15									
	5000hp hp frac pump engines											
	avg of 70% load											
	2 or 3 10-50 hp gensets	75	hp									
	Wells will be flared ot sold to pipeline during completion testing. Assume all flared for conservatism.											
Production												
	Pumper Vehicle Traffic: 1 new pumpers visits 75% wells daily											
	Each reclaimed production well pad will occupy 1.9 acre (weighted avg sec2.1.1.1)		1.85		80586	sq ft	283.88	283.877				
	Each completed well pad will have well head, 500Mbtu/hr separator heater, condensate oil tanks, 25% of Pa						86.53	86.526				
	Approximately 10% of wells would have gas powered pump jack engines											
	Pumper Vehicle Traffic: 1 new pumper inspects 12 wells/day. 30 new pumpers are estimated during Peak Year (full-field development). 3000 miles/month per pumper (estimate)											
	Typical Well Production:											
	0.4 MMscfd gas per well peak production rate based on peak of 250MMscfd (Proposed Action)											
	1.5 bbls/day average condensate production per well (Chapter 2)											
	8 bbls/day water production (Chapter 2)											
	Gas Samples: Use wet gas Inlet sample from Dry Canyon for CS Dehys											
	Liquid Samples: Use liquid sample from Dry Canyon for compressor station flash											
Compression and Dehydration												
	Central Dehydratation at Compressor Stations											
	Dry Canyon Existing: 10@1600 hp = 16000 hp											
	3 New Stations: 2@6400 hp stations (4-1600 hp engines) and 1@11200 hp station (7-1600 hp engines) = 24000 hp New under Proposed Action											
	Each Station will disturb 5 acres											
	Each Unit will have emission controls (1.5 g/hp-hr NOx, 2.0 CO, 1.0 VOC to reflect current UT BACT)											
	CS are 5 acre sites w/building dimensions accroding to Ch 2 diagrams					20234.28	142.247					
	Dehy Building according to Ch 2 diagram						217800	363	600			
	45 Year LOP											
	Assume 500 Mbtu/hr tank heaters, 500 Mbtu Dehy Reboiler Heaters											

Buys & Associates, Inc. **Environmental Consultants**	Project: WTP Proposed Action Inventory Date: 9/11/2008

1. Well Pad/Access Road/Pipeline Construction Fugitive Dust Emissions

Assumptions:

Hours of Construction	14	days per well pad (Proposed Action)
	10	hours/day
	140	hours per well pad
Pieces of Equipment	4	- 1 Backhoe
		- 1 Loader
		- 1 Crawler Tractor
		- 1 Grader
Watering Control Efficiency	50	percent (Assumption)
Soil Moisture Content	7.9	percent (AP-42 Table 11.9-3, 10/98)
Soil Silt Content	6.9	percent (AP-42 Table 11.9-3, 10/98)
PM10 Multiplier	0.75 * PM15	(AP-42 Table 11.9-1, 10/98)
PM2.5 Multiplier	0.105 * TSP	(AP-42 Table 11.9-1, 10/98)

Equations: From AP-42 tables 11.9-1 and 11.9-3 for
Bulldozing Overburden Emissions, Western Surface Coal Mining, 10/98

Emissions (TSP lbs/hr) = 5.7 * (soil silt content %)^1.2 * (soil moisture content %)^-1.3* Control Efficiency

Emissions (PM15 lbs/hr) = 1.0 * (soil silt content %)^1.5 * (soil moisture content %)^-1.4 * Control Efficiency

Emissions = 1.97 lbs TSP/hour/piece of equipment

Emissions = 0.50 lbs PM15/hour/piece of equipment

	Fugitive Dust Emissions [a]		
	lbs/hr	**tons/well**	**tons/yr [b]**
TSP	7.88	0.5517	61.79
PM15	1.51	0.1054	11.80
PM10	1.13	0.0790	8.85
PM2.5	0.83	0.0579	6.49

a Backhoe/Grader/Loader emissions are conservatively estimated as equivalent to Bulldozing emissions.

b Assumes construction rate specified by Proponent

Note: The majority of new pipeline will be installed adjacent to proposed access roads and will not result significant additional surface disturbance.

Buys & Associates, Inc. **Environmental Consultants**	Project: WTP Proposed Action Inventory Date: 9/11/2008

2. Reclamation Fugitive Dust Emissions

Assumptions:

Hours of Construction	6	days per well pad (Estimate)
	8	hours/day
	48	hours per well pad
Pieces of Equipment	1	- Grader
Watering Control Efficiency	50	percent (Assumption)
Soil Moisture Content	7.9	percent (AP-42 Table 11.9-3, 10/98)
Soil Silt Content	6.9	percent (AP-42 Table 11.9-3, 10/98)
PM10 Multiplier	0.75 * PM15	(AP-42 Table 11.9-1, 10/98)
PM2.5 Multiplier	0.105 * TSP	(AP-42 Table 11.9-1, 10/98)

Equations: From AP-42 tables 11.9-1 and 11.9-3 for
Bulldozing Overburden Emissions, Western Surface Coal Mining, 10/98

Emissions (TSP lbs/hr) = 5.7 * (soil silt content %)^1.2 * (soil moisture content %)^-1.3* Control Efficiency

Emissions (PM15 lbs/hr) = 1.0 * (soil silt content %)^1.5 * (soil moisture content %)^-1.4 * Control Efficiency

Emissions = 1.97 lbs TSP/hour/piece of equipment

Emissions = 0.50 lbs PM15/hour/piece of equipment

	Fugitive Dust Emissions [a]		
	lbs/hr	**tons/well**	**tons/yr [b]**
TSP	1.97	0.0473	5.30
PM15	1.51	0.0361	4.05
PM10	1.13	0.0271	3.04
PM2.5	0.21	0.0050	0.56

a Backhoe/Grader/Loader emissions are conservatively estimated as equivalent to Bulldozing emissions.

b Assumes construction rate specified by Proponent

Note: The majority of new pipeline will be installed adjacent to proposed access roads and will not result significant additional surface disturbance.

Buys & Associates, Inc.
Environmental Consultants

Project: WTP Proposed Action Inventory
9/11/2008

3. Unpaved Road Fugitive Dust Emissions

Calculation AP-42, Chapter 13.2.2
December 2003

E (PM10) / VMT = 1.5 * (S/12)^0.9 * (W/3)^0.45 * (365-p)/365)
E (PM2.5) / VMT = 0.23 * (S/12)^0.9 + (W/3)^0.45
Silt Content (S) 7 Mean value Table 13.2.2-1 for Gravel Surfaces
Round Trip Miles 74
Precipitation Days (P) 73 days per year (NCDC data for Nutters Ranch, UT 1963-1986)

		Average	Round					
	Vehicle Type	**Weight**	**Trips per**	**PM10**	**PM10/Pad**	**PM10/Pad**	**PM2.5/Pad**	**PM2.5/Pad**
		(lbs)	**Well [a]**	**(lb/VMT)**	**(lbs)**	**(lb/day)**	**(lbs)**	**(lb/day)**
Construction (days/pad and road)	14							
	Haul Trucks	80,000	7					
	Light Trucks	20,000	28					
	Mean Vehicle Weight	32,000	35	1.569119	4064.0	290.3	623.1	44.5
					PM10/Annual Pads		**PM2.5/Annual Pads**	
					(tons)		**(tons)**	
					227.6		34.9	
		Average	**Round**					
	Vehicle Type	**Weight**	**Trips per**	**PM10**	**PM10/Well**	**PM10/Well**	**PM2.5/Well**	**PM2.5/Well**
		(lbs)	**Well [a]**	**(lb/VMT)**	**(lbs)**	**(lb/day)**	**(lbs)**	**(lb/day)**
Drilling, Downhole (days/well)	13							
	Haul Trucks	80,000	26					
	Logging/Mud Trucks	70,000	6.5					
	Water Trucks	60,000	19.5					
	Light Trucks	8,000	52					
	Mean Vehicle Weight	39,625	104	1.727526	13295.0	1022.7	2038.6	156.8
					PM10/Annual Wells		**PM2.5/Annual Wells**	
					(tons)		**(tons)**	
					680.9		104.4	
		Average	**Round**					
	Vehicle Type	**Weight**	**Trips per**	**PM10**	**PM10/Well**	**PM10/Well**	**PM2.5/Well**	**PM2.5/Well**
		(lbs)	**Well [a]**	**(lb/VMT)**	**(lbs)**	**(lb/day)**	**(lbs)**	**(lb/day)**
Drilling, Deep Downhole(days/well)	46							
	Haul Trucks	80,000	92					
	Logging/Mud Trucks	70,000	23					
	Water Trucks	60,000	69					
	Light Trucks	8,000	184					
	Mean Vehicle Weight	39,625	368	1.727526	47044.0	1022.7	7213.4	156.8
					PM10/Annual Wells		**PM2.5/Annual Wells**	
					(tons)		**(tons)**	
					225.3		34.5	
		Average	**Round**					
	Vehicle Type	**Weight**	**Trips per**	**PM10**	**PM10/Well**	**PM10/Well**	**PM2.5/Well**	**PM2.5/Well**
		(lbs)	**Well [a]**	**(lb/VMT)**	**(lbs)**	**(lb/day)**	**(lbs)**	**(lb/day)**
Drilling, Directional (days/well)	26							
	Haul Trucks	80,000	52					
	Logging/Mud Trucks	70,000	13					
	Water Trucks	60,000	39					
	Light Trucks	8,000	104					
	Mean Vehicle Weight	39,625	208	1.727526	26590.1	1022.7	4077.1	156.8
					PM10/Annual Wells		**PM2.5/Annual Wells**	
					(tons)		**(tons)**	
					678.1		104.0	
		Average	**Round**					
	Vehicle Type	**Weight**	**Trips per**	**PM10**	**PM10/Well**	**PM10/Well**	**PM2.5/Well**	**PM2.5/Well**
		(lbs)	**Well [a]**	**(lb/VMT)**	**(lbs)**	**(lb/day)**	**(lbs)**	**(lb/day)**
Drilling, Deep Directional (days/well)	92							
	Haul Trucks	80,000	184					
	Logging/Mud Trucks	70,000	46					
	Water Trucks	60,000	138					
	Light Trucks	8,000	368					
	Mean Vehicle Weight	39,625	736	1.727526	94087.9	1022.7	14426.8	156.8
					PM10/Annual Wells		**PM2.5/Annual Wells**	
					(tons)		**(tons)**	
					235.0		36.0	
		Average	**Round**					
	Vehicle Type	**Weight**	**Trips per**	**PM10**	**PM10/Well**	**PM10/Well**	**PM2.5/Well**	**PM2.5/Well**
		(lbs)	**Well [a]**	**(lb/VMT)**	**(lbs)**	**(lb/day)**	**(lbs)**	**(lb/day)**
Completion (days/well)	31.25							
	Semi/Transport/Water/Sand	80,000	203					
	Haul Trucks	80,000	29					
	Light Trucks	8,000	116					
	Mean Vehicle Weight	56,000	348	2.018473	51979.7	1663.4	7970.2	255.0
					PM10/Annual Wells		**PM2.5/Annual Wells**	
					(tons)		**(tons)**	
					4366.3		669.5	
		Average	**Round**					
	Vehicle Type	**Weight**	**Trips per**	**PM10**	**PM10/Day**	**PM10/Day**	**PM2.5/Day**	**PM2.5/Day**
		(lbs)	**Well [a]**	**(lb/VMT)**	**(lbs)**	**(lb/day)**	**(lbs)**	**(lb/day)**
Reclamation (days/well)	6							
	Haul Trucks	80,000	6					
	Light Trucks	8,000	18					
	Mean Vehicle Weight	26,000	24	1.429145	2538.2	423.0	389.2	64.9
					PM10/Annual Wells		**PM2.5/Annual Wells**	
					(tons)		**(tons)**	
					213.2		32.7	
		Average	**Round**					
	Vehicle Type	**Weight**	**Trips per**	**PM10**	**PM10/Day**	**PM10/Day**	**PM2.5/Day**	**PM2.5/Day**
		(lbs)	**Day [a]**	**(lb/VMT)**	**(lbs)**	**(lb/day)**	**(lbs)**	**(lb/day)**
Infrastructure Development	**365**							
	Haul Trucks	80,000	12					
	Light Trucks	8,000	13					
		42,560	25	1.783976	3300.4	9.0	506.1	1.4
					PM10/Annual Wells		**PM2.5/Annual Wells**	
					(tons)		**(tons)**	
					602.3		92.4	
Annual Traffic Fugitive Dust Emissions (tons/year)					**7228.66**		**1108.39**	

a Traffic Estimates are based upon an approximately 14-days construction, 13-days drilling at downhole locations (shallow wells), 26-days drilling at direction wells (shallow wells), 29-days completion, and 6-days infrastructure development per well or well pad as appropriate.

Buys & Associates, Inc. **Environmental Consultants**	Project: WTP Proposed Action Inventory Date: 9/11/2008

4. Wind Erosion Fugitive Dust Emissions

Assumptions

Threshold Friction Velocity U_t*	1.02	m/s (2.28 mph) for well pads (AP-42 Table 13.2.5-2 Overburden - Western Surface Coal Mine
	1.33	m/s (2.97 mph) for roads (AP-42 Table 13.2.5-2 Roadbed material)
Initial Disturbance Area	1843.0	acres total initial disturbance for roads/pipelines (Proposed Action)
	7,458,345	square meters total initial disturbance for roads/pipelines
	1,813	acres total initial disturbance for well pads and other facilities (Proposed Action)
	7,336,939	square meters total initial disturbance for well pads and other facilities
	3,656	acres total disturbance
Exposed Surface Type	Flat	
Meteorological Data	2002 Grand Junction (obtained from NCDC website)	
Fastest Mile Wind Speed U_{10}^+	20.1	meters/sec (45 mph) reported as fastest 2-minute wind speed for Grand Junction (2002)
Number soil of disturbances	2	for well pads and facilities (Assumption, disturbance at construction and reclamation)
	Constant	for dirt roads
Development Period	8	years (Proposed Action)

Equations

Friction Velocity $U^* = 0.053\ U_{10}^+$

Erosion Potential P (g/m^2/period) = $58*(U^*-U_t^*)^2 + 25*(U^*-U_t^*)$ for $U^*>U_t^*$, P = 0 for $U^*< U_t^*$

Emissions (tons/year) = Erosion Potential(g/m^2/period)*Disturbed Area(m^2)*Disturbances/year*(k)/(453.6 g/lb)/2000 lbs/ton/Develop Period

Particle Size Multiplier (k)		
30 um	**<10 um**	**<2.5 um**
1.0	0.5	0.2

Maxium U_{10}^+ Wind Speed (m/s)	Maximum U* Friction Velocity m/s	Well U_t* Threshold Velocity[a] m/s	Well Pad Erosion Potential g/m^2	Road U_t* Threshold Velocity[a] m/s	Road Erosion Potential g/m^2
20.12	1.07	1.02	1.28	1.33	0.00

Wind Erosion Emissions

Particulate Species	Wells (tons/year)	Roads/Pipelines (tons/year)
TSP	2.58	0.00
PM10	1.29	0.00
PM2.5	0.52	0.00

Buys & Associates, Inc. **Environmental Consultants**	Project: WTP Proposed Action Inventory Date: 9/11/2008

5. Construction Tailpipe Emissions

Assumptions:

Average Round Trip Distance	168.0	miles (Estimated from project area and existing road system)
Hours of Construction	140	hours per site (Proposed Action)
Number of Heavy Diesel Truck Trips	7	(Proposed Action)
Number of Pickup Trips	28	(Proposed Action)
Diesel Fuel sulfur content	0.05	% (Typical value)
Diesel Fuel density	7.08	lbs/gallon (Typical value)
Heavy Haul Diesel Fuel Efficiency	10	miles/gallon (Typical value)
Heavy Duty Pickup Fuel Efficiency	15	miles/gallon (Typical value)

Equations:

For NOx, CO and VOC:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (g/mile)} * \text{\# Trips} * \text{Trip Distance (miles)}}{\text{453.6 (g/lb)} * \text{2000 (lb/tons)}}$$

The NOx, CO and VOC emission factors for the above equation are from AP-42, while the SO2 emissions are calculated on a mass balance basis utilizing the following equation:

$$\text{SO2 E. Factor (g/mi)} = \frac{\text{Fuel Density (lb/gal)} * \text{453.6 (g/lb)} * \text{Fuel Sulfur Content} * \text{2 (S / SO2)}}{\text{Vehicle Fuel Efficiency (miles/gal)}}$$

Construction Vehicles	Heavy Haul Trucks			Heavy Duty Pickups			Total [d]	
	E. Factor [a] (g/mile)	Emissions (lb/hr)	Emissions (tons/yr/well)	E. Factor [b] (g/mile)	Emissions (lb/hr)	Emissions (tons/yr/well)	Emissions (lb/hr)	Emissions (tons/yr)
Criteria Pollutants & VOC								
NO_x	8.130	0.151	0.011	3.030	0.224	0.016	0.375	2.940
CO	17.090	0.316	0.022	33.640	2.492	0.174	2.808	22.017
VOC [c]	4.600	0.085	0.006	4.646	0.344	0.024	0.429	3.366
SO_2	0.321	0.006	0.000	0.214	0.016	0.001	0.022	0.171
Greenhouse Gases								
CH_4 [e]	0.230	0.004	0.000	0.184	0.014	0.001	0.018	0.140

a AP-42 Append. H Table 7.1.2 - H.D. Diesel Powered Vehicles, High Altitude, 1991 - 1997 Model Year, 50,000 miles (6/95)
b AP-42 Append. H Table 4.1A.2 - H.D. Gasoline Vehicles, High Altitude, 1991 - 1997 Vehicle Year, 50,000 miles (6/95)
c Emission factor is for total Hydrocarbons - Methane Offset
d Assumes construction rate specified by Proponent
e AP-42 Append. H Tables 7.10A.2 and 4.10A.2 H.D. Methane Offsets, High Altitude, 1986+ and 1988+ Vehicle Year

Buys & Associates, Inc. **Environmental Consultants**	Project: WTP Proposed Action Inventory Date: 9/11/2008

6. Drilling Tailpipe Emissions

Assumptions:

Average Round Trip Distance	168.0	miles (Estimated from project area and existing road system)
Hours of Operation	480	hours per site (Proposed Action)
Number of Heavy Diesel Truck Trips	85	(Proposed Action weighted average)
Number of Pickup Trips	85	(Proposed Action weighted average)
Diesel Fuel sulfur content	0.05	% (Typical value)
Diesel Fuel density	7.08	lbs/gallon (Typical value)
Heavy Haul Diesel Fuel Efficiency	10	miles/gallon (Typical value)
Heavy Duty Pickup Fuel Efficiency	15	miles/gallon (Typical value)

Equations:

For NOx, CO and VOC:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (g/mile)} * \text{\# Trips} * \text{Trip Distance (miles)}}{\text{453.6 (g/lb)} * \text{2000 (lb/tons)}}$$

The NOx, CO and VOC emission factors for the above equation are from AP-42, while the SO2 emissions are calculated on a mass balance basis utilizing the following equation:

$$\text{SO2 E. Factor (g/mi)} = \frac{\text{Fuel Density (lb/gal)} * \text{453.6 (g/lb)} * \text{Fuel Sulfur Content} * \text{2 (S / SO2)}}{\text{Vehicle Fuel Efficiency (miles/gal)}}$$

Drilling Vehicles	Heavy Haul Trucks			Heavy Duty Pickups			Total [d]	
	E. Factor [a] (g/mile)	Emissions (lb/hr)	Emissions (tons/yr/well)	E. Factor [b] (g/mile)	Emissions (lb/hr)	Emissions (tons/yr/well)	Emissions (lb/hr)	Emissions (tons/yr)
Criteria Pollutants & VOC								
NO_x	8.13	0.531	0.128	3.03	0.198	0.048	0.729	29.411
CO	17.09	1.117	0.268	33.64	2.199	0.528	3.316	133.693
VOC [c]	4.600	0.301	0.072	1.656	0.108	0.026	0.409	16.487
SO_2	0.32	0.021	0.005	0.21	0.014	0.003	0.035	1.411
Greenhouse Gases								
CH_4 [e]	0.230	0.015	0.004	0.184	0.012	0.003	0.027	0.727

a AP-42 Append. H Table 7.1.2 - H.D. Diesel Powered Vehicles, High Altitude, 1991 - 1997 Model Year, 50,000 miles (6/95)
b AP-42 Append. H Table 4.1A.2 - H.D. Gasoline Vehicles, High Altitude, 1991 - 1997 Vehicle Year, 50,000 miles (6/95)
c Emission factor is for total Hydrocarbons - Methane Offset
d Assumes construction rate specified by Proponent
e AP-42 Append. H Tables 7.10A.2 and 4.10A.2 H.D. Methane Offsets, High Altitude, 1986+ and 1988+ Vehicle Year

Buys & Associates, Inc. **Environmental Consultants**	Project: WTP Proposed Action Inventory Date: 9/11/2008

7. Completion Tailpipe Emissions

Assumptions:

Average Round Trip Distance	168.0	miles (Estimated from project area and existing road system)
Hours of Operation	750.00	hours per site (Proposed Action)
Number of Heavy Diesel Truck Trips	232	(Proponent)
Number of Pickup Trips	116	(Proponent)
Diesel Fuel sulfur content	0.05	% (Typical value)
Diesel Fuel density	7.08	lbs/gallon (Typical value)
Heavy Haul Diesel Fuel Efficiency	10	miles/gallon (Typical value)
Heavy Duty Pickup Fuel Efficiency	15	miles/gallon (Typical value)

Equations:

For NOx, CO and VOC:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (g/mile)} * \text{\# Trips} * \text{Trip Distance (miles)}}{\text{453.6 (g/lb)} * \text{2000 (lb/tons)}}$$

The NOx, CO and VOC emission factors for the above equation are from AP-42, while the SO2 emissions are calculated on a mass balance basis utilizing the following equation:

$$\text{SO2 E. Factor (g/mi)} = \frac{\text{Fuel Density (lb/gal)} * \text{453.6 (g/lb)} * \text{Fuel Sulfur Content} * \text{2 (S / SO2)}}{\text{Vehicle Fuel Efficiency (miles/gal)}}$$

Completion Vehicles	Heavy Haul Trucks			Heavy Duty Pickups			Total [d]	
	E. Factor [a] (g/mile)	Emissions (lb/hr)	Emissions (tons/yr/well)	E. Factor [b] (g/mile)	Emissions (lb/hr)	Emissions (tons/yr/well)	Emissions (lb/hr)	Emissions (tons/yr)
Criteria Pollutants & VOC								
NO_x	8.13	0.931	0.349	3.03	0.174	0.065	1.105	69.615
CO	17.09	1.958	0.734	33.64	1.927	0.723	3.885	244.755
VOC [c]	4.600	0.527	0.198	1.656	0.095	0.036	0.622	39.178
SO_2	0.32	0.037	0.014	0.21	0.012	0.005	0.049	3.091
Greenhouse Gases								
CH_4 [e]	0.230	0.026	0.010	0.184	0.011	0.004	0.037	1.549

a AP-42 Append. H Table 7.1.2 - H.D. Diesel Powered Vehicles, High Altitude, 1991 - 1997 Model Year, 50,000 miles (6/95)
b AP-42 Append. H Table 4.1A.2 - H.D. Gasoline Vehicles, High Altitude, 1991 - 1997 Vehicle Year, 50,000 miles (6/95)
c Emission factor is for total Hydrocarbons - Methane Offset
d Assumes construction rate specified by Proponent
e AP-42 Append. H Tables 7.10A.2 and 4.10A.2 H.D. Methane Offsets, High Altitude, 1986+ and 1988+ Vehicle Year

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8. Development Tailpipe Emissions

Assumptions:

Average Round Trip Distance	168.0	miles (Estimated from project area and existing road system)
Hours of Operation	48	hours per site (Assumption)
Number of Heavy Diesel Truck Trips	6	(Assumption)
Number of Pickup Trips	18	(Assumption)
Diesel Fuel sulfur content	0.05	% (Typical value)
Diesel Fuel density	7.08	lbs/gallon (Typical value)
Heavy Haul Diesel Fuel Efficiency	10	miles/gallon (Typical value)
Heavy Duty Pickup Fuel Efficiency	15	miles/gallon (Typical value)

Equations:

For NOx, CO and VOC:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (g/mile)} * \text{\# Trips} * \text{Trip Distance (miles)}}{\text{453.6 (g/lb)} * \text{2000 (lb/tons)}}$$

The NOx, CO and VOC emission factors for the above equation are from AP-42, while the SO2 emissions are calculated on a mass balance basis utilizing the following equation:

$$\text{SO2 E. Factor (g/mi)} = \frac{\text{Fuel Density (lb/gal)} * \text{453.6 (g/lb)} * \text{Fuel Sulfur Content} * \text{2 (S / SO2)}}{\text{Vehicle Fuel Efficiency (miles/gal)}}$$

Development Vehicles	Heavy Haul Trucks			Heavy Duty Pickups			Total [d]	
	E. Factor [a] (g/mile)	Emissions (lb/hr)	Emissions (tons/yr/well)	E. Factor [b] (g/mile)	Emissions (lb/hr)	Emissions (tons/yr/well)	Emissions (lb/hr)	Emissions (tons/yr)
Criteria Pollutants & VOC								
NO_x	8.13	0.376	0.009	3.03	0.421	0.010	0.797	2.143
CO	17.09	0.791	0.019	33.64	4.672	0.112	5.463	14.686
VOC [c]	4.600	0.213	0.005	1.656	0.230	0.006	0.443	1.191
SO_2	0.32	0.015	0.000	0.21	0.030	0.001	0.045	0.120
Greenhouse Gases								
CH_4 [e]	0.230	0.011	0.000	0.184	0.026	0.001	0.036	0.097

a AP-42 Append. H Table 7.1.2 - H.D. Diesel Powered Vehicles, High Altitude, 1991 - 1997 Model Year, 50,000 miles (6/95)
b AP-42 Append. H Table 4.1A.2 - H.D. Gasoline Vehicles, High Altitude, 1991 - 1997 Vehicle Year, 50,000 miles (6/95)
c Emission factor is for total Hydrocarbons - Methane Offset
d Assumes construction rate specified by Proponent
e AP-42 Append. H Tables 7.10A.2 and 4.10A.2 H.D. Methane Offsets, High Altitude, 1986+ and 1988+ Vehicle Year

Buys & Associates, Inc.
Environmental Consultants

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9. Construction Heavy Equipment Tailpipe Emissions

Assumptions:

Hours of Operation	140	hours/site (Proposed Action)
Development Rate	112	new pads per year (Proposed Action)
Load Factor	0.4	(Assumed typical value)
Backhoe Size	100	hp (Assumed Typical value)
Crawler Tractor/Loader Size	150	hp (Assumed Typical value)
Motor Grader Size	135	hp (Assumed Typical value)

Equations:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (g/hp-hr)} * \text{Rated Horsepower (hp)} * \text{Operating Hours (hrs)} * \text{Load Factor (Dimensionless)}}{\text{453.6 (g/lb)} * \text{2000 (lb/tons)}}$$

Heavy Const. Vehicles	Backhoe			Crawler Tractor			Grader			Loader		
	E. Factor [a] (g/hp-hr)	Emissions (lb/hr)	Emissions[e] (tons/yr)	E. Factor [a] (g/hp-hr)	Emissions (lb/hr)	Emissions[e] (tons/yr)	E. Factor [b] (g/hp-hr)	Emissions (lb/hr)	Emissions[e] (tons/yr)	E. Factor [a] (g/hp-hr)	Emissions (lb/hr)	Emissions[e] (tons/yr)
NO_x	8.15	0.719	5.635	8.15	1.078	8.452	7.14	0.850	6.664	8.15	1.078	8.452
CO	2.28	0.201	1.576	2.28	0.302	2.364	1.54	0.183	1.437	2.28	0.302	2.364
VOC [c]	0.37	0.033	0.256	0.37	0.049	0.384	0.36	0.043	0.336	0.37	0.049	0.384
PM_{10} [d]	0.5	0.044	0.346	0.5	0.066	0.519	0.63	0.075	0.588	0.5	0.066	0.519
$PM_{2.5}$ [d]	0.5	0.044	0.346	0.5	0.066	0.519	0.63	0.075	0.588	0.5	0.066	0.519
SO_2	0.22	0.019	0.152	0.22	0.029	0.228	0.22	0.026	0.205	0.22	0.029	0.228
Formaldehyde	0.22	0.019	0.152	0.22	0.029	0.228	0.12	0.014	0.112	0.22	0.029	0.228

Heavy Const. Vehicles	Total	
	Emissions (lb/hr)	Emissions[e] (tons/yr)
NO_x	3.725	29.202
CO	0.988	7.743
VOC [c]	0.173	1.359
PM_{10} [d]	0.251	1.971
$PM_{2.5}$ [d]	0.251	1.971
SO_2	0.104	0.814
Formaldehyde	0.092	0.720

a AP-42 Volume II, Mobile Sources, Nonroad Vehicles, Table 11-7.1 Off-highway truck
b AP-42 Volume II, Mobile Sources, Nonroad Vehicles, Table 11-7.1 Motor Grader
c Emission Factor represents total Hydrocarbon Emissions
d All emitted particulate matter assumed to be PM2.5
e Assumes construction rate specified by Proponent

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10. Drill Rig Engine Emissions

Assumptions:

Hours of Operation	480	hours/ well (Proposed Action)
Development Rate	168	total wells per year (Proposed Action)
	9%	average deep wells per year (based on Propoent estimate of 70 deep wells total Project)
	15	deep well per year
	153	shallow wells per year
Load Factor	0.4	(Assumed typical value)
Rig Size	875	hp (Proponent Estimate - shallow wells)
	2250	hp (Proponent Estimate - deep wells)
	994	hp (weighted average based on ratio of shallow to deep wells)
Diesel Fuel Sulfur Content	0.05	% (typical value)

Equations:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (lb/hp-hr)} * \text{Rated Horsepower (hp)} * \text{Operating Hours (hrs)} * \text{Load Factor (Dimensionless)}}{\text{2000 (lb/tons)}}$$

SO2 E. Factor (lb/hp-hr) = Fuel sulfur content * 0.00809

Species	Drill Rig Emissions				
	E. Factor [a] (lb/hp-hr)	Emissions (lb/hr)	Emissions [e] (tons/yr)		
Criteria Pollutants & VOC					
NO_x	0.024	9.545	384.854	6.900	6.050
CO	0.0055	2.187	88.196		
VOC [b]	0.000705	0.280	11.305		
PM_{10} [c]	0.000573	0.228	9.188		
$PM_{2.5}$ [d]	0.000479	0.191	7.681		
SO_2	0.0004045	0.161	6.486		
Greenhouse Gases					
CO_2	1.16	461.341	18,601.260		
CH_4 [b]	0.000705	0.280	11.305		

a AP-42 Volume I, Large Stationary Diesel Engines Table 3.4-1, 10/96
b Emission Factor represents total Hydrocarbon Emissions
c Total particulate emission factor is 0.0007, PM10 fraction determined from Table 3.4-2
d Total particulate emission factor is 0.0007, PM2.5 fraction determined from Table 3.4-2
e Assumes rate specified by Proponent

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11. Well Fracturing Pump and Generator Engines

Assumptions:

Average Hours of Operation	3	Hours/Well (Proponents)
Development Rate	168	wells per year (Proposed Action)
Load Factor	0.7	(Proponents)
Frac Pump Engine Horsepower	5,000	Horsepower (Proponents)
Temporary Generator Horsepower	75	Horsepower (Proponents: 2-3 engines @ 10-50 hp each)
Diesel Fuel Sulfur Content	0.05	% (typical value)

Equations:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (lb/hp-hr)} * \text{Rated Horsepower (hp)} * \text{Operating Hours (hrs)} * \text{Load Factor (Dimensionless)}}{\text{2000 (lb/tons)}}$$

SO2 E. Factor (lb/hp-hr) = Fuel sulfur content * 0.00809

Species	Frac Pump Engine Emissions		
	E. Factor [a] (lb/hp-hr)	Emissions (lb/hr)	Emissions [e] (tons/yr)
Criteria Pollutants & VOC			
NO_x	0.024	84.000	21.168
CO	0.0055	19.250	4.851
VOC [b]	0.000705	2.468	0.622
PM_{10} [c]	0.000573	2.006	0.505
$PM_{2.5}$ [d]	0.000479	1.677	0.422
SO_2	0.0004045	1.416	0.357
Greenhouse Gases			
CO_2	1.16	4,060.000	1,023.120
CH_4 [b]	0.000705	2.468	0.622

Species	Generator Engine Emissions		
	E. Factor [f] (lb/hp-hr)	Emissions (lb/hr)	Emissions [e] (tons/yr)
Criteria Pollutants			
NO_x	0.031	1.628	0.410
CO	0.006680	0.351	0.088
VOC [b]	0.002470	0.130	0.033
PM_{10}	0.002200	0.116	0.029
$PM_{2.5}$ [g]	0.002200	0.116	0.029
SO_2	0.0004045	0.021	0.005
Greenhouse Gases			
CO_2	1.08	3,780.000	952.560
CH_4 [b]	0.002470	8.645	2.179

a AP-42 Volume I, Large Stationary Diesel Engines Table 3.4-1, 10/96
b Emission Factor represents total Hydrocarbon Emissions
c Total particulate emission factor is 0.0007, PM10 fraction determined from Table 3.4-2
d Total particulate emission factor is 0.0007, PM2.5 fraction determined from Table 3.4-2
e Assumes maximum development scenario
f AP-42 Table 3.3-1, Emission Factors for Uncontrolled Gasoline and Diesel Industrial Engines, 10/96
g All particulates are PM10

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12. Completion Flare Emissions

Assumptions

Hours of Operation	2	days (Typical)
Amount of Gas Flared	5	MMscf/well (Assumption, based on initial Production Rates)
Average Gas Heat Content	1066	Btu/scf (Wellsite Gas Composition)
Average Gas VOC Content	8.089	weight % (Wellsite Gas Composition)
Average Mole Weight	18.3	lb/lb-mole (Wellsite Gas Composition)
Development rate	168	gas wells per year

Equations

NOx/CO Emissions (lb/well) = Emission Factor (lb/MM Btu) * Gas Amount (MMscf/well) * Heat Content (Btu/scf)

PM/HAP Emissions (lb/well) = Emission Factor (lb/MMscf) * Gas Amount (MMscf/well)

$$\text{Flare Gas Wt. (lb/well)} = \frac{\text{Flare Gas Volume (MMscf/well)} * 10^6 \text{ (scf/MMscf)} * \text{Mole Weight (lb/lb-mole)}}{379.49 \text{ (scf/mole)}}$$

VOC Emissions (lb/well) = Flare Gas Wt. (lb/well) * VOC wt. % * 0.02 (Assumes 98% destruction Efficiency)

Species	**Emission Factor (lb/MMBtu)**	**Well Emissions (lb/well)**	**Well Emissions (lb/hr/well)**	**Total Emissions [e] (tons/yr)**
Criteria Pollutants & VOC				
NO_x [a]	0.068	362.4	7.55	30.44
CO [a]	0.37	1971.9	41.08	165.64
VOC	N.A.	390.0	8.12	32.76
SO_x [b]	0.00	0.0	0.00	0.00
TSP [c]	7.6	38	0.792	3.192
PM_{10} [c]	7.6	38	0.792	3.192
$PM_{2.5}$ [c]	7.6	38	0.792	3.192
Hazardous Air Pollutants				
Benzene [d]	0.0021	0.0105	0.0002	0.001
Toluene [d]	0.0034	0.017	0.0004	0.001
Hexane [d]	1.8	9	0.1875	0.756
Formaldehyde [d]	0.075	0.375	0.0078	0.032
Greenhouse Gases				
CO_2 [c]	120,000	600,000	12,500	50,400
CH_4 [a]	0.14	746.1	15.54	62.67

a AP-42 Table 13.5-1, Emission Factors for Flare Operations, 9/91
b Assumes produced gas contains no sulfur
c AP-42 Table 1.4-2, Emission Factors for Natural Gas Combustion, 3/98 (All Particulates are PM1.0)
d AP-42 Table 1.4-3, Emission Factors for Organic Compounds from Natural Gas Combustion, 3/98
e Assumes proposed development rate

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13. Well Development Emissions Summary

Species	Well Development Emissions (tons/year) [a]				Wind Erosion	Total [a] (tons/yr)
	Construction	Drilling	Completion	Development & Reclamation		
Criteria Pollutants & VOC						
NO_x	32.1	414.3	121.6	2.1		570.2
CO	29.8	221.9	415.3	14.7		681.7
VOC	4.7	27.8	72.6	1.2		106.3
SO_2	1.0	7.9	3.5	0.1		12.5
PM_{10}	238.4	1,828.4	4,370.0	818.6	1.3	7,256.7
$PM_{2.5}$	43.4	286.6	673.1	125.6	0.5	1,129.3
Hazardous Air Pollutants						
Benzene			0.001			
Toluene			0.001			
Ethylbenzene			0.756			
Xylene			0.032			
n-Hexane			0.756			
Formaldehyde	0.7		0.032			0.8
Total HAPs	0.7	0.0	1.6	0.0	0.0	0.8
Greenhouse Gases						
CO_2		18,601.3	52,375.7			70,976.9
CH_4	0.1	12.0	67.0	0.1		79.3

[a] Emissions for Peak Field Development

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14. Average Produced Gas Characteristics
Inlet Wet Gas Sample Average of Seven Samples from BBC area wellsites

Gas Heat Value (wet): 1065.9 Btu/scf

C1-C2 Wt. Fraction:	0.8742
VOC Wt. Fraction:	0.0809
Non-HC Wt. Fraction:	0.0449
Total:	1.0000

COMPONENT	MOLE PERCENT	COMPONENT MOLE WEIGHT (lb/lb-mole)	NET MOLE WEIGHT (lb/lb-mole)	WEIGHT FRACTION	GROSS HEATING VALUE (BTU/scf)	NET DRY HEATING VALUE (BTU/scf)	LOWER HEATING VALUE (BTU/scf)	NET LOW HEATING VALUE (BTU/scf)
Methane	90.1926	16.043	14.470	0.791	1010.000	910.946	910.000	820.753
Ethane	5.0663	30.070	1.523	0.083	1769.800	89.664	1618.000	81.973
Propane	1.5002	44.097	0.662	0.036	2516.200	37.748	2316.000	34.745
i-Butane	0.3123	58.123	0.182	0.010	3252.100	10.156	3005.000	9.385
n-Butane	0.3302	58.123	0.192	0.010	3262.400	10.771	3013.000	9.948
i-Pentane	0.1359	72.150	0.098	0.005	4000.900	5.437	3698.000	5.025
n-Pentane	0.0980	72.150	0.071	0.004	4008.800	3.927	3708.000	3.632
Hexanes	0.2603	86.177	0.224	0.012	4756.200	12.380	4404.000	11.463
Heptanes	0.0305	100.204	0.031	0.002	5502.500	1.678	5100.000	1.556
Octanes	0.0133	114.231	0.015	0.001	6249.100	0.833		0.000
Nonanes	0.0047	128.258	0.006	0.000	6996.400	0.331		0.000
Decanes	0.0000	142.285	0.000	0.000	7743.200	0.000		0.000
Benzene	0.0000	78.120	0.000	0.000	3715.500	0.000		0.000
Toluene	0.0000	92.130	0.000	0.000	4444.600	0.000		0.000
Ethylbenzene	0.0000	106.160	0.000	0.000	5191.500	0.000		0.000
Xylenes	0.0000	106.160	0.000	0.000	5183.500	0.000		0.000
n-Hexane	0.0000	86.177	0.000	0.000	4756.200	0.000		0.000
Helium	0.0000	4.003	0.000	0.000	0.000	0.000	0.000	0.000
Nitrogen	0.5155	28.013	0.144	0.008	0.000	0.000	0.000	0.000
Carbon Dioxide	1.5401	44.010	0.678	0.037	0.000	0.000	0.000	0.000
Oxygen	0.0000	32.000	0.000	0.000	0.000	0.000	0.000	0.000
Hydrogen Sulfide	0.0000	34.080	0.000	0.000	637.100	0.000	588.000	0.000
TOTAL	100.00		18.30	1.00		1083.87		978.48

Relative Mole Weight (lb/lb-mole) = [Mole Percent * Molecular weight (lb/lb-mole)] / 100

Weight Fraction = Net Mole Weight / Total Mole Weight

HAP Fractions estimated from GRI Published Factors

15. Wellsite Pumping Unit Engines

Assumptions:

Pumpjack Engine Size: 40 Horsepower (Proponent)
Number of Wells Requiring Pumping Unit Engines: 80.7 wells (Estimated at 10 % of Peak Production Wells)

Equations:

$$\text{Emissions (lbs/hr)} = \frac{\text{Emission Factor (g/hp-hr)} * \text{Power (hp)}}{453.6 \text{ g/lb}}$$

Pollutant	Emission Factor [3] (lb/MMBtu)	Emission Factor (g/hp-hr)	Emissions (lb/hr/well)	Total Emissions Proposed Action (tons/yr)
Criteria Pollutants & VOC				
NOx [5]		1.5	0.13	46.8
CO [5]		2.0	0.18	62.3
VOC [5]		1.0	0.09	31.2
PM10 [1,4]	0.0194	0.070	0.01	2.2
PM2.5 [1,4]	0.0194	0.070	0.01	2.2
SO_2 [2]	0.0	0.000	0.00	0.0
Hazardous Air Pollutants				
Benzene [1]	0.001580	0.00574	5.1E-04	0.2
Toluene [1]	0.000558	0.00203	1.8E-04	0.1
Ethylbenzene [1]	0.000025	0.00009	7.9E-06	0.0
Xylenes [1]	0.000195	0.00071	6.2E-05	0.0
Formaldehyde [1]	0.0205	0.07	6.6E-03	2.3
Greenhouse Gases				
CO_2 [1]	110.0	399.52000	35.23	12,453.0
CH_4 [1]	0.2	0.83536	0.07	26.0

0.75

1 - AP-42 Table 3.2-3 Uncontrolled Emission Factors for 4-Stroke Rich-Burn Engines, 7/00
2 - Fuel gas is assumed to be free from sulfur compounds
3 - Conversion from lb/MMBtu to g/hp-hr assumes an average heat rate of 8,000 Btu/hp-hr (*3.632)
4 - PM = sum of PM filterable and PM condensable
5 - Utah typical BACT control rates for internal combustion engines

16. Wellsite Dehydrator Emissions

Assumptions

Average Production Rate: 0.384 MMscf/day/well (Average for life of the well, Proposed Action)
Number of Active Wells Requiring Separators: 807 wells at Peak Production
Wells Requiring Dehydrators: 202 (25% of wells, Proposed Action)

Gas Composition: Inlet Gas Sample from Average of Seven Existing Wells

Inlet Gas Conditions: Inlet gas saturated at 200 psi and 70 F (Proponent Estimate)

Glycol Circulation Rate: 3 gallons/ lb of water
(Typical operating rate)

Calculations

Dehydrator emissions were simulated using GRI GlyCalc version 4.0

Controls

Emissions

Species	Well Dehydrator Emissions (lbs/hr/well)	Well Dehydrator Emissions (tons/year/well)	Total Project Emissions (tons/year)
Total VOC	0.156	0.68	138
Hazardous Air Pollutants			
Benzene	0.0340	0.15	30.0
Toluene	0.0420	0.18	37.1
Ethylbenzene	0.0020	0.01	1.77
Xylenes	0.0120	0.05	10.6
n-Hexane	0.0040	0.02	3.53
Greenhouse Gases			
CH_4	0.090	0.39	79.5

Flare to achieve 95% Control Efficiency controlling tank and dehydrator emissions on wellpad
(Proposed Action)

17. Wellsite Heater Emissions

Assumptions

Dehydrator Reboiler Heater Size	750	Mbtu/hr (Proposed Action)
Separator Heater Size	500	Mbtu/hr (Proposed Action)
Tank Heater Size	500	Mbtu/hr (Proponent)
Wells Requiring Separators:	807	wells at Peak Production
Wells Requiring Dehydrators:	202	(25% of wells, Proposed Action)
Wells Requiring Tank Heaters:	807	per pad (one to two tanks per pad, Proposed Action)
Firing Rate	6,480	hours/year (Proponent)
Fuel Gas Heat Value	1066	Btu/scf (Gas Analyses from Dry Canyon Facility)
Fuel Gas VOC Content	0.081	by weight (Gas Analyses from Dry Canyon Facility)

Equations

$$\text{Fuel Consumption (MMscf/yr)} = \frac{\text{Heater Size (MBtu/hr)} * 1{,}000 \text{ (Btu/MBtu)} * \text{Hours of Operation (hrs/yr)}}{\text{Fuel Heat Value (Btu/scf)} * 1{,}000{,}000 \text{ (scf/MMscf)}}$$

$$\text{NOx/CO/TOC Emissions (tons/yr)} = \frac{\text{AP-42 E.Factor (lbs/MMscf)} * \text{Fuel Consumption (MMscf/yr)} * \text{Fuel heating Value (Btu/scf)}}{2{,}000 \text{ (lbs/ton)} * 1{,}000 \text{ (Btu/scf - Standard Fuel Heating Value)}}$$

$$\text{VOC Emissions (tons/yr)} = \text{TOC Emissions (tons/yr)} * \text{VOC wt. fraction}$$

Species	Wellsite Heater Emissions - Separators			Wellsite Heater Emissions - Dehydrators			Wellsite Heater Emissions - Tanks			
	Emission Factor (lb/MMscf)	Well Emissions (lb/hr/well)	Total Emissions (tons/yr)	Emission Factor (lb/MMscf)	Well Emissions (lb/hr/well)	Total Emissions (tons/yr)	Emission Factor (lb/MMscf)	Well Emissions (lb/hr/well)	Total Emissions (tons/yr)	Total Emissions (tons/yr)
Criteria Pollutants & VOC										
NO_x [a]	100	0.047	122.652	100	0.070	45.995	100	0.047	122.652	291.299
CO [a]	84	0.039	103.028	84	0.059	38.635	84	0.039	103.028	244.691
TOC [c]	11	0.005	13.492	11	0.008	5.059	11	0.005	13.492	32.043
VOC	N.A.	0.000	1.091	N.A.	0.001	0.409	N.A.	0.000	1.091	2.592
SO_x [b]	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.000
TSP [c]	7.6	0.004	9.322	7.6	0.005	3.496	7.6	0.004	9.322	22.139
PM_{10} [c]	7.6	0.004	9.322	7.6	0.005	3.496	7.6	0.004	9.322	22.139
$PM_{2.5}$ [c]	7.6	0.004	9.322	7.6	0.005	3.496	7.6	0.004	9.322	22.139
Hazardous Air Pollutants										
Benzene [d]	0.0021	9.9E-07	0.003	0.0021	1.5E-06	0.001	0.0021	9.9E-07	0.003	0.006
Toluene [d]	0.0034	1.6E-06	0.004	0.0034	2.4E-06	0.002	0.0034	1.6E-06	0.004	0.010
Hexane [d]	1.8	8.4E-04	2.208	1.8	1.3E-03	0.828	1.8	8.4E-04	2.208	5.243
Formaldehyde [d]	0.075	3.5E-05	0.092	0.075	5.3E-05	0.034	0.075	3.5E-05	0.092	0.218
Greenhouse Gases										
CO_2 [c]	120,000	56.29	147,182.73	120,000	84.436	55,193.524	120,000	56.29	147,182.730	349,558.985
CH_4 [c]	2.3	0.001	2.821	2.3	0.002	1.058	2.3	0.001	2.821	6.700

a AP-42 Table 1.4-1, Emission Factors for Natural Gas Combustion, 7/98
b Assumes produced gas contains no sulfur
c AP-42 Table 1.4-2, Emission Factors for Natural Gas Combustion, 7/98 (All Particulates are PM1.0)
d AP-42 Table 1.4-3, Emission Factors for Organic Compounds from Natural Gas Combustion, 7/98

18. Wellsite Condensate Storage Tank Flash/Working/Standing Emissions

Assumptions:

Average Condensate Production Rate: 1.5 bbls condensate per day (Average for life of the well, Proposed Action))
Number of Active Wells: 807 wells at Peak Production

Separator Conditions : 150 psi and 105 F (Proponent Average Estimate)
API Gravity of Sales Oil: 52.3

Calculations:

Condensate tank flashing/working/breathing emissions estimated with E&P Tanks 2.0
Dry Canyon Compressor Station Liquid Sample Dated 2/21/04

Emissions:

Component	Wellsite Flash/Work/Breathing (lb/hr/well)	Wellsite Flash/Work/Breathing (tons/year/well)	Total Emissions (tons/yr)
Total VOC	1.476	6.463	5215.780
Hazardous Air Pollutants			
Benzene	8.2E-03	0.036	29.108
Toluene	4.5E-03	0.020	16.012
Ethylbenzene	4.5E-05	0.000	0.159
Xylenes	5.1E-04	0.002	1.803
n-Hexane	3.5E-02	0.154	124.279
Greenhouse Gases			
CO_2	0.009	0.038	31.017
CH_4	0.139	0.607	489.798

Buys & Associates, Inc. **Environmental Consultants**	Project: WTP Proposed Action Inventory Date: 9/11/2008

19. Well Blowdown Emissions

Assumptions: During Production, a percentage of the wells are periodically blown down to unload fluids

# of New Producing Wells	807	wells at Peak Production (Year 20)
Blowdown Frequency	104	Wells per Year (2 per week for 52 weeks for 1 hour each, Project Proponents)
Blowdown Volume	16	Mscf/event (Estimated from Average Production Data)
Annual Blowdown Volume	1.7	MMscf/year

COMPONENT	MOLECULAR WEIGHT (lb/lb-mole)	MOLE PERCENT	RELATIVE MOLE WEIGHT (lb/lb-mole)	WEIGHT Fraction	COMPONENT FLOW RATE (Mscf/hr)	COMPONENT FLOW RATE (lb/hr/well)	COMPONENT FLOW RATE (tons/yr)
Methane	16.043	90.193	14.470	0.791	14.418	609.536	1648.184
Ethane	30.07	5.066	1.523	0.083	0.810	64.176	173.531
Propane	44.097	1.500	0.662	0.036	0.240	27.868	75.355
i-Butane	58.123	0.312	0.182	0.010	0.050	7.646	20.676
n-Butane	58.123	0.330	0.192	0.010	0.053	8.084	21.858
i-Pentane	72.15	0.136	0.098	0.005	0.022	4.130	11.168
n-Pentane	72.15	0.098	0.071	0.004	0.016	2.977	8.050
Hexanes	86.177	0.260	0.224	0.012	0.042	9.449	25.550
Heptanes	100.204	0.031	0.031	0.002	0.005	1.287	3.481
Octanes	114.231	0.013	0.015	0.001	0.002	0.641	1.734
Nonanes	128.258	0.005	0.006	0.000	0.001	0.255	0.691
Decanes +	142.285	0.000	0.000	0.000	0.000	0.000	0.000
Benzene	78.12	0.000	0.000	0.000	0.000	0.000	0.000
Toluene	92.13	0.000	0.000	0.000	0.000	0.000	0.000
Ethylbenzene	106.16	0.000	0.000	0.000	0.000	0.000	0.000
Xylenes	106.16	0.000	0.000	0.000	0.000	0.000	0.000
n-Hexane	86.177	0.000	0.000	0.000	0.000	0.000	0.000
Helium	4.003	0.000	0.000	0.000	0.000	0.000	0.000
Nitrogen	28.013	0.516	0.144	0.008	0.082	6.083	16.449
Carbon Dioxide	44.01	1.540	0.678	0.037	0.246	28.553	77.207
Oxygen	32	0.000	0.000	0.000	0.000	0.000	0.000
Hydrogen Sulfide	34.08	0.000	0.000	0.000	0.000	0.000	0.000
VOC SUBTOTAL		**2.68535714**	**1.480**	**0.081**	**0.429**	**62.339**	**168.564**
HAP SUBTOTAL		**0**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
TOTAL		**100.000**	**18.295**	**1.000**	**16**	**770.686**	**2083.936**

Buys & Associates, Inc. Environmental Consultants	Project: WTP Proposed Action Inventory Date: 9/11/2008

20. Liquid Level Controller Emissions

Company: **BBC**

Location: **WTP EIS**

GAS COMPONENT	MOLECULAR WEIGHT (lb/lb-mole)	MOLE PERCENT	RELATIVE MOLE WEIGHT (lb/lb-mole)	WEIGHT PERCENT	COMPONENT FLOW RATE (Mscf/day)	COMPONENT FLOW RATE (lb/hr)	COMPONENT FLOW RATE (tons/yr/well)
Methane	16.043	91.307	14.64838201	81.48852235	0.83271984	1.46680681	6.424613828
Ethane	30.07	5.305	1.5952135	8.874126225	0.0483816	0.159735732	0.699642507
Propane	44.097	1.536	0.67732992	3.767966612	0.01400832	0.067824019	0.297069203
i-Butane	58.123	0.337	0.19587451	1.089644193	0.00307344	0.019613775	0.085908333
n-Butane	58.123	0.387	0.22493601	1.25131247	0.00352944	0.02252383	0.098654377
i-Pentane	72.15	0.166	0.119769	0.666271458	0.00151392	0.011992996	0.052529322
n-Pentane	72.15	0.117	0.0844155	0.469600967	0.00106704	0.008452895	0.037023679
Hexanes	86.177	0.113	0.09738001	0.541722159	0.00103056	0.009751088	0.042709765
Heptanes	100.204	0.042	0.04208568	0.234121412	0.00038304	0.004214224	0.018458301
Octanes	114.231	0.008	0.00913848	0.050837098	0.00007296	0.000915076	0.004008033
Nonanes	128.258	0	0	0	0	0	0
Decanes +	142.285	0	0	0	0	0	0
Benzene	78.12	0.01	0.007812	0.043457928	0.0000912	0.00078225	0.003426254
Toluene	92.13	0.006	0.0055278	0.03075099	0.00005472	0.000553523	0.00242443
Ethylbenzene	106.16	0	0	0	0	0	0
Xylenes	106.16	0.001	0.0010616	0.00590565	0.00000912	0.000106303	0.000465606
n-Hexane	86.177	0.041	0.03533257	0.196554058	0.00037392	0.003538005	0.015496464
Helium	4.003	0.018	0.00072054	0.004008343	0.00016416	7.21508E-05	0.000316021
Nitrogen	28.013	0.223	0.06246899	0.347513171	0.00203376	0.006255294	0.027398189
Carbon Dioxide	44.01	0.383	0.1685583	0.937684912	0.00349296	0.016878483	0.073927754
Oxygen	32	0	0	0	0	0	0
Hydrogen Sulfide	34.08	0	0	0	0	0	0
VOC SUBTOTAL		**2.764**	**1.50066308**	**8.348144994**	**0.02520768**	**0.150267983**	**0.658173768**
HAP SUBTOTAL		**0.058**	**0.04973397**	**0.276668626**	**0.00052896**	**0.004980081**	**0.021812754**
TOTAL		**100**	**17.97600642**	**100**	**0.912**	**1.800016454**	**7.884072067**

EQUIPMENT SPECIFICATIONS

Gas Consumption Rate:	0.912 Mscf/day
Days of Operation:	365 days/year

	Number of Wells	VOC emissions (tons/year)
Alternative A	807	1062

Buys & Associates, Inc.
Environmental Consultants

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21. Trace Pump Emissions

Company: **BBC**
Location: **WTP EIS**

GAS COMPONENT	MOLECULAR WEIGHT (lb/lb-mole)	MOLE PERCENT	RELATIVE MOLE WEIGHT (lb/lb-mole)	WEIGHT PERCENT	COMPONENT FLOW RATE (Mscf/day)	COMPONENT FLOW RATE (lb/hr)	COMPONENT FLOW RATE (tons/yr/well)
Methane	16.043	91.307	14.64838201	81.48852235	13.148208	23.16010753	58.91931355
Ethane	30.07	5.305	1.5952135	8.874126225	0.76392	2.522143139	6.416332147
Propane	44.097	1.536	0.67732992	3.767966612	0.221184	1.070905563	2.724383752
i-Butane	58.123	0.337	0.19587451	1.089644193	0.048528	0.30969118	0.787854363
n-Butane	58.123	0.387	0.22493601	1.25131247	0.055728	0.355639427	0.904746701
i-Pentane	72.15	0.166	0.119769	0.666271458	0.023904	0.189363093	0.481739708
n-Pentane	72.15	0.117	0.0844155	0.469600967	0.016848	0.133466758	0.339539432
Hexanes	86.177	0.113	0.09738001	0.541722159	0.016272	0.153964547	0.391685808
Heptanes	100.204	0.042	0.04208568	0.234121412	0.006048	0.066540378	0.169278721
Octanes	114.231	0.008	0.00913848	0.050837098	0.001152	0.01444857	0.036757163
Nonanes	128.258	0	0	0	0	0	0
Decanes +	142.285	0	0	0	0	0	0
Benzene	78.12	0.01	0.007812	0.043457928	0.00144	0.012351314	0.031421742
Toluene	92.13	0.006	0.0055278	0.03075099	0.000864	0.008739835	0.02223414
Ethylbenzene	106.16	0	0	0	0	0	0
Xylenes	106.16	0.001	0.0010616	0.00590565	0.000144	0.001678463	0.00427001
n-Hexane	86.177	0.041	0.03533257	0.196554058	0.005904	0.055863243	0.14211609
Helium	4.003	0.018	0.00072054	0.004008343	0.002592	0.001139224	0.002898185
Nitrogen	28.013	0.223	0.06246899	0.347513171	0.032112	0.098767804	0.251265294
Carbon Dioxide	44.01	0.383	0.1685583	0.937684912	0.055152	0.266502358	0.677982
Oxygen	32	0	0	0	0	0	0
Hydrogen Sulfide	34.08	0	0	0	0	0	0
VOC SUBTOTAL		**2.764**	**1.50066308**	**8.348144994**	**0.398016**	**2.37265237**	**6.03602763**
HAP SUBTOTAL		**0.058**	**0.04973397**	**0.276668626**	**0.008352**	**0.078632855**	**0.200041982**
TOTAL		**100**	**17.97600642**	**100**	**14.4**	**28.42131242**	**72.30381881**

PUMP SPECIFICATIONS

Pump Mfg.:	LEON
Injection Pressure:	20 psi
Mfg. Gas Consumption Rate:	10 scf/min
Gas Consumption Rate:	14.40 Mscf/day
Days of Operation:	212 days/year

	Number of Wells	VOC emissions (tons/year)
Alternative A	807	4871

Buys & Associates, Inc.
Environmental Consultants

Project: WTP Proposed Action Inventory
Date: 9/11/2008

22. Pneumatic Methanol Injection Pump Emissions

Company: **BBC**
Location: **WTP EIS**

GAS COMPONENT	MOLECULAR WEIGHT (lb/lb-mole)	MOLE PERCENT	RELATIVE MOLE WEIGHT (lb/lb-mole)	WEIGHT PERCENT	COMPONENT FLOW RATE (Mscf/day)	COMPONENT FLOW RATE (lb/hr)	COMPONENT FLOW RATE (tons/yr)
Methane	16.043	91.307	14.64838201	81.48852235	0.39444624	0.694803226	1.767579407
Ethane	30.07	5.305	1.5952135	8.874126225	0.0229176	0.075664294	0.192489964
Propane	44.097	1.536	0.67732992	3.767966612	0.00663552	0.032127167	0.081731513
i-Butane	58.123	0.337	0.19587451	1.089644193	0.00145584	0.009290735	0.023635631
n-Butane	58.123	0.387	0.22493601	1.25131247	0.00167184	0.010669183	0.027142401
i-Pentane	72.15	0.166	0.119769	0.666271458	0.00071712	0.005680893	0.014452191
n-Pentane	72.15	0.117	0.0844155	0.469600967	0.00050544	0.004004003	0.010186183
Hexanes	86.177	0.113	0.09738001	0.541722159	0.00048816	0.004618936	0.011750574
Heptanes	100.204	0.042	0.04208568	0.234121412	0.00018144	0.001996211	0.005078362
Octanes	114.231	0.008	0.00913848	0.050837098	0.00003456	0.000433457	0.001102715
Nonanes	128.258	0	0	0	0	0	0
Decanes +	142.285	0	0	0	0	0	0
Benzene	78.12	0.01	0.007812	0.043457928	0.0000432	0.000370539	0.000942652
Toluene	92.13	0.006	0.0055278	0.03075099	0.00002592	0.000262195	0.000667024
Ethylbenzene	106.16	0	0	0	0	0	0
Xylenes	106.16	0.001	0.0010616	0.00590565	0.00000432	5.03539E-05	0.0001281
n-Hexane	86.177	0.041	0.03533257	0.196554058	0.00017712	0.001675897	0.004263483
Helium	4.003	0.018	0.00072054	0.004008343	0.00007776	3.41767E-05	8.69456E-05
Nitrogen	28.013	0.223	0.06246899	0.347513171	0.00096336	0.002963034	0.007537959
Carbon Dioxide	44.01	0.383	0.1685583	0.937684912	0.00165456	0.007995071	0.02033946
Oxygen	32	0	0	0	0	0	0
Hydrogen Sulfide	34.08	0	0	0	0	0	0
VOC SUBTOTAL		**2.764**	**1.50066308**	**8.348144994**	**0.01194048**	**0.071179571**	**0.181080829**
HAP SUBTOTAL		**0.058**	**0.04973397**	**0.276668626**	**0.00025056**	**0.002358986**	**0.006001259**
TOTAL		**100**	**17.97600642**	**100**	**0.432**	**0.852639373**	**2.169114564**

PUMP SPECIFICATIONS

Pump Mfg.:	Western	
Piston Size:	0.625	inch
Injection Pressure:	30	psi
Pump Rate:	2.00	gallons/day
Gas Consumption Rate:	0.43	Mscf/day
Days of Operation:	212	days/year

	Number of Wells	VOC emissions (tons/year)
Alternative A	807	146

23. Operations Vehicle Tailpipe Emissions

Assumptions:

Number of New Pumpers:	30	(Proposed Action Number of Pumpers at Peak Production)
Pumper Mileage:	3,000	miles/pumper/month (Assumption)
Total Annual New Pumper Mileage:	1,080,000	miles/year
Number of Condensate Haul Truck Round Trips:	15	trips per day (Based on Peak Production Proposed Action)
Average Round Trip Mileage for Condensate Transport:	168	miles (Estimate from Vernal)
Total Annual Condensate Truck Mileage:	919,800	miles/year
Number of Water Haul Truck Round Trips:	81	trips per day (Based on Peak Production Proposed Action)
Average Round Trip Mileage for Water Transport:	10	miles (Average distance to water injection facility)
Total Annual Water Truck Mileage:	295,650	miles/year
Daily Hours of Operation:	12	hours per day (Assumption)
Annual Hours of Operation:	4368	hours per year
Fuel sulfur content	0.05	% (Typical value)
Fuel density	7.08	lbs/gallon (Typical value)
Heavy Duty Pickup Fuel Efficiency	15	miles/gallon (Typical value)
Heavy Haul Diesel Fuel Efficiency	10	miles/gallon (Typical value)

Equations:

For NOx, CO and VOC:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (g/mile)} * \text{Vehicle Miles Traveled (miles/yr)}}{\text{453.6 (g/lb)} * \text{2000 (lb/tons)}}$$

The NOx, CO and VOC emission factors for the above equation are from AP-42, while the SO2 emissions are calculated on a mass balance basis utilizing the following equation:

$$\text{SO2 E. Factor (g/mi)} = \frac{\text{Fuel Density (lb/gal)} * \text{453.6 (g/lb)} * \text{Fuel Sulfur Content} * \text{2 (S / SO2)}}{\text{Vehicle Fuel Efficiency (miles/gal)}}$$

Pumper Vehicles	Heavy Duty Pickups			Heavy Haul Trucks			Total	
	E. Factor [a] (g/mile)	Emissions (lb/hr)	Emissions (tons/yr)	E. Factor [b] (g/mile)	Emissions (lb/hr)	Emissions (tons/yr)	Emissions (lb/hr)	Emissions (tons/yr)
Criteria Pollutants & VOC								
NO_x	3.03	1.652	3.607	8.13	4.987	10.892	6.639	14.500
CO	33.64	18.337	40.048	17.09	10.484	22.897	28.821	62.944
VOC [c]	1.656	0.903	1.971	4.600	2.822	6.163	3.725	8.134
SO_2	0.21	0.117	0.255	0.32	0.197	0.430	0.314	0.685
Greenhouse Gases								
CH_4 [d]	0.184	0.100	0.219	0.230	0.141	0.308	0.241	0.527

a AP-42 Append H Table 4.1A.2 - H.D. Gasoline Vehicles, High Altitude, 1991 - 1997 Vehicle Year, 50,000 miles (6/95)
b AP-42 Append. H Table 7.1.2 - H.D. Diesel Powered Vehicles, High Altitude, 1991 - 1997 Model Year, 50,000 miles (6/95)
c Emission factor is for total Hydrocarbons - Methane Offset
d AP-42 Append. H Tables 7.10A.2 and 4.10A.2 H.D. Methane Offsets, High Altitude, 1986+ and 1988+ Vehicle Year

Buys & Associates, Inc.
Environmental Consultants

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24. Operations Traffic Fugitive Dust Emissions

Calculation AP-42, Chapter 13.2.2
December 2003

E (PM10) / VMT = 1.5 * (S/12)^0.9 * (W/3)^0.45 * (365-p)/365)
E (PM2.5) / VMT = 0.23 * (S/12)^0.9 + (W/3)^0.45 * (365-p)/365)
Silt Content (S) 7 Mean value Table 13.2.2-1 for Gravel Surfaces
Average Round Trip Miles 42 miles on unpaved roads
(Average of Pumper,Condensate, and Water Hauling Distance)
365 days (Estimate)
Precipitation Days (P) 73 days per year (NCDC data for Nutters Ranch, UT 1963-1986)

Vehicle Type	Ave. Weight (lbs)	Round Trips per Day*	PM10 (lb/VMT)	Total PM10 (lbs)	PM10 (lb/day)	Total PM2.5 (lbs)	PM2.5 (lb/day)
Pickup Truck: Crew	7,000	30.0					
Haul Truck: Oil	48,000	15.000					
Haul Truck: Water	48,000	81.000					
Mean Weight	38,238	126.000	1.70005	3,283,781.94	8,996.66	503,513.23	1379.5
Annual Traffic Fugitive Dust Emissions (tons/year)				**1,641.89**		**251.76**	

*Round trips per day at peak production (Proposed Action)

0.208178 round trips/well
0.017696 lb/hr

0.127504

25. Well Production Summary

Species	Production Heaters (tons/yr)	Storage Tanks (tons/yr)	Well Dehydrators (tons/yr)	Well Pumping Unit Engines (tons/yr)	Pneumatic Devices (tons/yr)	Operations Vehicle (tons/yr)	Well Blowdown (tons/yr)	Total Well Production [a] (tons/yr)
Criteria Pollutants & VOC								
NO_x	291.3			46.8		14.5		352.6
CO	244.7			62.3		62.9		370.0
VOC	32.0	5,215.8	137.9	31.2	6,079	8.1	168.6	11,673
SO_2	0.0			0.0		0.7		0.7
PM_{10}	22.1			2.2		1,641.9		1,666.2
$PM_{2.5}$	22.1			2.2		251.8		276.1
Hazardous Air Pollutants								
Benzene	6.1E-03	29.1	30.0	0.2	28.9		0.0E+00	88.2
Toluene	9.9E-03	16.0	37.1	0.1	13.6		0.0E+00	66.8
Ethylbenzene		0.2	1.8	2.8E-03	0.0		0.0E+00	1.9
Xylene		1.8	10.6	2.2E-02	3.9		0.0E+00	16.4
n-Hexane	5.2	124.3	3.5		87.1		0.0E+00	220.1
Formaldehyde	0.2			2.3				2.5
Total HAPs	5.5	171.4	83.1	2.6		0.0	0.0E+00	396.0
Greenhouse Gases								
CO_2	349,559.0	31.0		12,453.0			77.2	362,120.2
CH_4	6.7	489.8	79.5	26.0		0.5	1,648.2	2,250.8

[a] Emissions for Peak Field Development

26. Pump Station Generators

Assumptions:

Generator at each Pump Station:	400	Horsepower (one Generator/pumpstation)
Salt Water Supply pumps:	400	Horsepower (one pump/water supply well)
Water Supply pumps:	400	Horsepower (one pump/water supply well)
Project Total:	6,400	Horsepower (Ch. 2- 4 pump stations,6salt water, 6 water supply)

Equations:

$$\text{Emissions (lbs/hr)} = \frac{\text{Emission Factor (g/hp-hr)} * \text{Power (hp)}}{453.6 \text{ g/lb}}$$

Pollutant	Emission Factor [3] (lb/MMBtu)	Emission Factor (g/hp-hr)	Emissions (lb/hr/engine)	Emissions (tons/yr/engine)	Total Emissions [5] Proposed Action (tons/yr)
Criteria Pollutants & VOC					
NOx [6]	2.21	1.5	1.32	6	93
CO [6]	3.72	2.0	1.8	8	124
VOC [1]	2.96E-02	0.108	0.09	0.4	6.6
PM10 [1,4]	1.94E-02	0.070	0.06	0.3	4.4
PM2.5 [1,4]	1.94E-02	0.070	0.06	0.3	4.4
SO_2 [2]	0.0	0.000	0.00	0.0	0.0
Hazardous Air Pollutants [7]					
Benzene [1]	1.58E-03	2.87E-03	0.00	1.1E-02	0.2
Toluene [1]	5.58E-04	1.01E-03	8.94E-04	3.9E-03	0.1
Ethylbenzene [1]	2.48E-05	4.50E-05	3.97E-05	1.7E-04	2.8E-03
Xylenes [1]	1.95E-04	3.54E-04	3.12E-04	1.4E-03	2.2E-02
Formaldehyde [1]	2.05E-02	1.79E-02	0.02	0.1	1.1
Greenhouse Gases					
CO2 [1]	110.0	399.5	352.3	1,543	24,690
CH4 [1]	0.2	0.83536	0.74	3.2	51.6

1 - AP-42 Table 3.2-3 Uncontrolled Emission Factors for 4-Stroke Rich-Burn Engines, 7/00
2 - Fuel gas is assumed to be free from sulfur compounds
3 - Conversion from lb/MMBtu to g/hp-hr assumes an average heat rate of 8,000 Btu/hp-hr (*3.632)
4 - PM = sum of PM filterable and PM condensable
5 - Proposed Action Total Annual Emissions for 4 Pump Stations (1,600 hp)
6 - BACT emission levels
7 - BACT requires 76% control of Formaldehyde, which controls other HAPs by 50%

Buys & Associates, Inc.
Environmental Consultants

Project: WTP Proposed Action Inventory
Date: 9/11/2008

27. Average Produced Gas Characteristics
Inlet Wet Gas Sample from BBC Dry Canyon Compressor Station, dated 2/18/2004

Gas Heat Value (wet): 1082.2 Btu/scf

Sample Temperature: 108 F
Sample Pressure: 790 psi

C1-C2 Wt. Fraction: 0.9035
VOC Wt. Fraction: 0.0835
Non-HC Wt. Fraction: 0.0130
Total: 1.0000

COMPONENT	MOLE PERCENT	COMPONENT MOLE WEIGHT (lb/lb-mole)	NET MOLE WEIGHT (lb/lb-mole)	WEIGHT FRACTION	GROSS HEATING VALUE (BTU/scf)	NET DRY HEATING VALUE (BTU/scf)	LOWER HEATING VALUE (BTU/scf)	NET LOW HEATING VALUE (BTU/scf)
Methane	91.3030	16.043	14.648	0.815	1010.000	922.160	910.000	830.857
Ethane	5.3050	30.070	1.595	0.089	1769.800	93.888	1618.000	85.835
Propane	1.5360	44.097	0.677	0.038	2516.200	38.649	2316.000	35.574
i-Butane	0.3370	58.123	0.196	0.011	3252.100	10.960	3005.000	10.127
n-Butane	0.3870	58.123	0.225	0.013	3262.400	12.625	3013.000	11.660
i-Pentane	0.1600	72.150	0.115	0.006	4000.900	6.401	3698.000	5.917
n-Pentane	0.1170	72.150	0.084	0.005	4008.800	4.690	3708.000	4.338
Hexanes	0.1270	86.177	0.109	0.006	4756.200	6.040	4404.000	5.593
Heptanes	0.0340	100.204	0.034	0.002	5502.500	1.871	5100.000	1.734
Octanes+	0.0080	114.231	0.009	0.001	6249.100	0.500		0.000
Nonanes	0.0000	128.258	0.000	0.000	6996.400	0.000		0.000
Decanes	0.0000	142.285	0.000	0.000	7743.200	0.000		0.000
Benzene	0.0100	78.120	0.008	0.000	3715.500	0.372		0.000
Toluene	0.0060	92.130	0.006	0.000	4444.600	0.267		0.000
Ethylbenzene	0.0000	106.160	0.000	0.000	5191.500	0.000		0.000
Xylenes	0.0010	106.160	0.001	0.000	5183.500	0.052		0.000
n-Hexane	0.0410	86.177	0.035	0.002	4756.200	1.950		0.000
Helium	0.0090	4.003	0.000	0.000	0.000	0.000	0.000	0.000
Nitrogen	0.2230	28.013	0.062	0.003	0.000	0.000	0.000	0.000
Carbon Dioxide	0.3830	44.010	0.169	0.009	0.000	0.000	0.000	0.000
Oxygen	0.0090	32.000	0.003	0.000	0.000	0.000	0.000	0.000
Hydrogen Sulfide	0.0000	34.080	0.000	0.000	637.100	0.000	588.000	0.000
TOTAL	100.00		17.98	1.00		1100.43		991.64

Relative Mole Weight (lb/lb-mole) = [Mole Percent * Molecular weight (lb/lb-mole)] / 100

Weight Fraction = Net Mole Weight / Total Mole Weight

28. Central Compression

Assumptions:

Total Existing Compression: 16,000 Horsepower (Dry Canyon Facility)
Total New Compression: 24,000 Horsepower (Proposed Action)

Equations:

$$\text{Emissions (lbs/hr)} = \frac{\text{Emission Factor (g/hp-hr)} * \text{Power (hp)}}{453.6 \text{ g/lb}}$$

Pollutant	Emission Factor [3] (lb/MMBtu)	Emission Factor (g/hp-hr)	Emissions (lb/hr/engine) [7]	Emissions 6,400 hp Station (tons/yr)	Emissions 6,400 hp Station (tons/yr)	Emissions 11,200 hp Station (tons/yr)	Total Emissions [5] Proposed Action (tons/yr)
Criteria Pollutants & VOC							
NOx [6]		1.5	5.29	92.7	92.7	162.2	347.6
CO [6]		2.0	7.05	123.6	123.6	216.3	463.5
VOC [6]		1.0	3.53	61.8	61.8	108.2	231.7
PM10 [1,4]	0.0194	0.070	0.25	4.4	4.4	7.6	16.3
PM2.5 [1,4]	0.0194	0.070	0.25	4.4	4.4	7.6	16.3
SO_2 [2]	0.0	0.000	0.00	0.0	0.0	0.0	0.0
Hazardous Air Pollutants							
Benzene [1]	0.001580	0.00574	0.02	0.4	0.4	0.6	1.3
Toluene [1]	0.000558	0.00203	0.01	0.1	0.1	0.2	0.5
Ethylbenzene [1]	0.000025	0.00009	3.2E-04	0.0	0.0	0.0	0.0
Xylenes [1]	0.000195	0.00071	2.5E-03	0.0	0.0	0.1	0.2
Formaldehyde [1]	0.0205	0.07446	0.26	4.6	4.6	8.1	17.3
Greenhouse Gases							
CO2 [1]	110.00	399.52	1,409.24	24,690.5	24,690.5	43,208.3	92,587.2
CH4 [1]	0.2	0.83536	2.95	51.6	51.6	90.3	193.6

1 - AP-42 Table 3.2-3 Uncontrolled Emission Factors for 4-Stroke Rich-Burn Engines, 7/00
2 - Fuel gas is assumed to be free from sulfur compounds
3 - Conversion from lb/MMBtu to g/hp-hr assumes an average heat rate of 8,000 Btu/hp-hr (*3.632)
4 - PM = sum of PM filterable and PM condensable
5 - Proposed Action Total Annual Emissions for New Compression (24,000 hp)
6 - Assumed equivalent control rates for internal combustion engines located at existing Dry Canyon Facility
7 - Each individual engine estimated at 1,600 hp (Proposed Action)

Buys & Associates, Inc. **Environmental Consultants**	Project: WTP Proposed Action Inventory Date: 9/11/2008

29. Central TEG Dehydrator Emissions

Assumptions

Peak Field Production Rate: 250 MMscf/day
807 Active Wells at Peak Production

Gas Composition: Inlet Gas Sample from Dry Canyon Compresor Station, dated 2/18/04

Inlet Gas Conditions: Inlet gas saturated at 600 psi and 108 F

Glycol Circulation Rate: 3 gallons/ lb of water
(Typical operating rate)

Calculations

Dehydrator emissions were simulated using GRI GlyCalc version 4.0

Controls

Condenser/Combustor > 95% Control Efficiency in order to meet Federal MACT Standards
Condenser Operating Conditions: 120 deg. F, 11.5 psia

Emissions

Species	Central Dehydrator Emissions 67MMscfd Station (tons/year)	Central Dehydrator Emissions 67MMscfd Station (tons/year)	Central Dehydrator Emissions 117MMscfd Station (tons/year)	Total Project Emissions (tons/year)	
Total VOC	8.46	8.46	14.77	31.69	
Hazardous Air Pollutants					lbs/hr/eng
Benzene	1.47	1.47	2.57	5.51	0.146575
Toluene	1.47	1.47	2.57	5.51	0.146495
Ethylbenzene	0.00	0.00	0.00	0.00	0
Xylenes	0.49	0.49	0.86	1.84	0.048876
n-Hexane	0.22	0.22	0.38	0.81	0.021615
Greenhouse Gases					
CH_4	12.28	12.28	21.44	46.00	

Each station throughput estimated according to the ratio of new compression proposed at each station and based on a peak field production rate of 250MMscfd

30. Central Facility Heater Emissions

Assumptions

Dehydrator Reboiler Heater	500	Mbtu/hr (Estimate based on Dry Canyon Facility)
Tank Heater Size	500	Mbtu/hr (Estimate based on Dry Canyon Facility)
Total Heater Requirmement Facility 1	3,000	Mbtu/hr (Proposed Action Estimate, 2-Dehydrator Reboiler Heaters, 4-Tank Heaters)
Total Heater Requirmement Facility 2	3,000	Mbtu/hr (Proposed Action Estimate, 2-Dehydrator Reboiler Heaters, 4-Tank Heaters)
Total Heater Requirmement Facility 3	6,000	Mbtu/hr (Proposed Action Estimate, 4-Dehydrator Reboiler Heaters, 8-Tank Heaters)
Firing Rate	30	minutes/hour on average for entire year (Typical value)
	4380	hours/year
Fuel Gas Heat Value	992	Btu/scf (Gas Analyses from Dry Canyon Facility)
Fuel Gas VOC Content	0.083	by weight (Gas Analyses from Dry Canyon Facility)

Equations 466.69048 360000 217800 363

$$\text{Fuel Consumption (MMscf/yr)} = \frac{\text{Heater Size (MBtu/hr)} * 1{,}000\ \text{(Btu/MBtu)} * \text{Hours of Operation (hrs/yr)}}{\text{Fuel Heat Value (Btu/scf)} * 1{,}000{,}000\ \text{(scf/MMscf)}}$$

$$\text{NOx/CO/TOC Emissions (tons/yr)} = \frac{\text{AP-42 E.Factor (lbs/MMscf)} * \text{Fuel Consumption (MMscf/yr)} * \text{Fuel heating Value (Btu/scf)}}{2{,}000\ \text{(lbs/ton)} * 1{,}000\ \text{(Btu/scf - Standard Fuel Heating Value)}}$$

VOC Emissions (tons/yr) = TOC Emissions (tons/yr) * VOC wt. fraction

Species	Central Heater Emissions - Facility 1			Central Heater Emissions - Facility 2			Central Heater Emissions - Facility 3			
	Emission Factor (lb/MMscf)	Well Emissions (lb/hr)	Total Emissions (tons/yr)	Emission Factor (lb/MMscf)	Well Emissions (lb/hr)	Total Emissions (tons/yr)	Emission Factor (lb/MMscf)	Well Emissions (lb/hr)	Total Emissions (tons/yr)	Total Emissions (tons/yr)
Criteria Pollutants & VOC										
NO_x [a]	100	0.300	0.657	100	0.300	0.657	100	0.600	1.314	2.628
CO [a]	84	0.252	0.552	84	0.252	0.552	84	0.504	1.104	2.208
TOC [c]	11	0.033	0.072	11	0.033	0.072	11	0.066	0.145	0.289
VOC	N.A.	0.003	0.006	N.A.	0.003	0.006	N.A.	0.006	0.012	0.024
SO_x [b]	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.000
TSP [c]	7.6	0.023	0.050	7.6	0.023	0.050	7.6	0.046	0.100	0.200
PM_{10} [c]	7.6	0.023	0.050	7.6	0.023	0.050	7.6	0.046	0.100	0.200
$PM_{2.5}$ [c]	7.6	0.023	0.050	7.6	0.023	0.050	7.6	0.046	0.100	0.200
Hazardous Air Pollutants										
Benzene [d]	2.1E-03	6.3E-06	1.4E-05	2.1E-03	6.3E-06	1.4E-05	0.0021	1.3E-05	2.8E-05	5.5E-05
Toluene [d]	3.4E-03	1.0E-05	2.2E-05	3.4E-03	1.0E-05	2.2E-05	0.0034	2.0E-05	4.5E-05	8.9E-05
Hexane [d]	1.8E+00	5.4E-03	1.2E-02	1.8E+00	5.4E-03	1.2E-02	1.8	1.1E-02	2.4E-02	4.7E-02
Formaldehyde [d]	7.5E-02	2.3E-04	4.9E-04	7.5E-02	2.3E-04	4.9E-04	0.075	4.5E-04	9.9E-04	2.0E-03
Greenhouse Gases										
CO_2 [c]	120,000	360.00	788.40	120,000	360.00	788.40	120,000	720.00	1,576.80	3,153.600
CH_4 [c]	2.3	0.007	0.015	2.3	0.007	0.015	2.3	0.014	0.030	0.060

a AP-42 Table 1.4-1, Emission Factors for Natural Gas Combustion, 7/98
b Assumes produced gas contains no sulfur
c AP-42 Table 1.4-2, Emission Factors for Natural Gas Combustion, 7/98 (All Particulates are PM1.0)
d AP-42 Table 1.4-3, Emission Factors for Organic Compounds from Natural Gas Combustion, 7/98

31. Central Facility Condensate Storage Tank Flash/Working/Standing Emissions

Assumptions:

Average Condensate Production Rate :

Facility 1	100 bbls condensate per day (Estimate Based on Dry Canyon Compressor Station Volumes)
Facility 2	100 bbls condensate per day (Estimate Based on Dry Canyon Compressor Station Volumes)
Facility 3	175 bbls condensate per day (Estimate Based on Dry Canyon Compressor Station Volumes)

Separator Conditions : 100 psi and 40 F (Sample Conditions)

Calculations:

Condensate tank flashing/working/breathing emissions estimated with E&P Tanks 2.0
Dry Canyon Compressor Station Liquid Sample Dated 2/21/04
Controlled to 95% efficiency (Proposed Action)

Emissions:

Component	Facility 1 Flash/Work/Breathing (tons/yr)	Facility 2 Flash/Work/Breathing (tons/yr)	Facility 3 Flash/Work/Breathing (tons/yr)	Total Emissions (tons/yr)
Total VOC	21.544	21.544	37.702	80.79
Hazardous Air Pollutants				
Benzene	0.120	0.120	0.210	0.450
Toluene	0.066	0.066	0.116	0.248
Ethylbenzene	0.001	0.001	0.002	0.004
Xylenes	0.007	0.007	0.012	0.026
n-Hexane	0.513	0.513	0.898	1.924
Greenhouse Gases				
CO_2	2.564	2.564	4.487	9.615
CH_4	2.023	2.023	3.540	7.586

32. Central Facility Emission Summary

Central Facility 1

Pollutant	Central Compression Emissions 6,400 hp (tons/year)	Central Dehydrator Emissions 67MMscfd (tons/year)	Central Heater Emissions (tons/year)	Central Condensate Tank Emissions (tons/year)	Total Facility Emissions (tons/year)
Criteria Pollutants & VOC					
NO_x	92.7		0.7		93.4
CO	123.6		0.6		124.2
VOC	61.8	8.5	0.0	21.5	91.8
SO_2	0.0		0.0		0.0
PM_{10}	4.4		0.0		4.4
$PM_{2.5}$	4.4		0.0		4.4
Hazardous Air Pollutants					
Benzene	0.4	1.5	0.0	0.1	1.9
Toluene	0.1	1.5	0.0	0.1	1.7
Ethylbenzene	0.0	0.0		0.0	0.0
Xylene	0.0	0.5		0.0	0.5
n-Hexane		0.2	0.0	0.5	0.7
Formaldehyde	4.6		0.0		4.6
Total HAPs	5.1	3.6	0.0	0.7	9.5
Greenhouse Gases					
CO_2	24,690.5		788.4	2.6	25,481.4
CH_4	51.6	12.3	0.0	2.0	65.9

Central Facility 2

Pollutant	Central Compression Emissions 6,400 hp (tons/year)	Central Dehydrator Emissions 67MMscfd (tons/year)	Central Heater Emissions (tons/year)	Central Condensate Tank Emissions (tons/year)	Total Facility Emissions (tons/year)
Criteria Pollutants & VOC					
NO_x	92.7		0.7		93.4
CO	123.6		0.6		124.2
VOC	61.8	8.5	0.0	21.5	91.8
SO_2	0.0		0.0		0.0
PM_{10}	4.4		0.0		4.4
$PM_{2.5}$	4.4		0.0		4.4
Hazardous Air Pollutants					
Benzene	0.4	1.5	0.0	0.1	1.9
Toluene	0.1	1.5	0.0	0.1	1.7
Ethylbenzene	0.0	0.0		0.0	0.0
Xylene	0.0	0.5		0.0	0.5
n-Hexane		0.2	0.0	0.5	0.7
Formaldehyde	4.6		0.0		4.6
Total HAPs	5.1	3.6	0.0	0.7	9.5
Greenhouse Gases					
CO_2	24,690.5		788.4	2.6	25,481.4
CH_4	51.6	12.3	0.0	2.0	65.9

Central Facility 3

Pollutant	Central Compression Emissions 11,200 hp (tons/year)	Central Dehydrator Emissions 117MMscfd (tons/year)	Central Heater Emissions (tons/year)	Central Condensate Tank Emissions (tons/year)	Total Facility Emissions (tons/year)		
Criteria Pollutants & VOC							
NO_x	162.2		1.3		163.5		
CO	216.3		1.1		217.4		
VOC	108.2	14.8	0.0	37.7	160.6		
SO_2	0.0		0.0		0.0		
PM_{10}	7.6		0.1		7.7		
$PM_{2.5}$	7.6		0.1		7.7		
Hazardous Air Pollutants							
Benzene	0.6	2.6	0.0	0.2	3.4	0.1417	0.0202
Toluene	0.2	2.6	0.0	0.1	2.9	0.0500	0.0071
Ethylbenzene	0.0	0.0		0.0	0.0	0.0022	0.0003
Xylene	0.1	0.9		0.0	0.9	0.0175	0.0025
n-Hexane		0.4	0.0	0.9	1.3	0.0000	0.0000
Formaldehyde	8.1				8.1	1.8385	0.2626
Total HAPs	9.0	6.4	0.0	1.2	16.6	2.0499	0.2928
Greenhouse Gases							
CO_2	43,208.3		1,576.8	4.5	44,789.6		
CH_4	90.3	21.4	0.0	3.5	115.4		

33. Total Project Production Related Emissions Summary

Pollutant	Total Project Production Related Emissions (tons/year) [a]					Total Production (tons/year)
	Well Production (tons/year)	Pump Generators (tons/year)	Central Facility 1 (tons/year)	Central Facility 2 (tons/year)	Central Facility 3 (tons/year)	
Criteria Pollutants & VOC						
NO_x	352.6	92.7	93.4	93.4	163.5	795.5
CO	370.0	123.6	124.2	124.2	217.4	959.3
VOC	11,673.0	6.6	91.8	91.8	160.6	12,023.9
SO_2	0.7	0.0	0.0	0.0	0.0	0.7
PM_{10}	1,666.2	4.4	4.4	4.4	7.7	1,687.1
$PM_{2.5}$	276.1	4.4	x	4.4	7.7	292.6
Hazardous Air Pollutants						
Benzene	88.2	0.2	1.9	1.9	3.4	95.7
Toluene	66.8	0.1	1.7	1.7	2.9	73.1
Ethylbenzene	1.9	2.8E-03	0.0	0.0	0.0	2.0
Xylene	16.4	2.2E-02	0.5	0.5	0.9	18.4
n-Hexane	220.1	0.0	0.7	0.7	1.3	222.9
Formaldehyde	2.5	1.1	4.6	4.6	8.1	20.9
Total HAPs	396.0	1.4	9.5	9.5	16.6	433.0
Greenhouse Gases						
CO_2	362,120.2	24,689.9	25,481.4	25,481.4	44,789.6	482,562.5
CH_4	2,250.8	51.6	65.9	65.9	115.4	2,549.6

a Emissions for Peak Field Development

Pollutant	Project Emissions (tons/year)		Total Emissions [a] (tons/year)
	Well Development	Project Production	
Criteria Pollutants & VOC			
NO_x	570.2	795.5	1,366
CO	681.7	959.3	1,641
VOC	106.3	12,024	12,130
SO_2	12.5	0.69	13.1
PM_{10}	7,256.7	1,687	8,944
$PM_{2.5}$	1,129.3	292.6	1,422
Hazardous Air Pollutants			
Benzene	0.00	95.7	95.7
Toluene	0.00	73.1	73.1
Ethylbenzene	0.00	1.96	1.96
Xylene	0.00	18.4	18.4
n-Hexane	0.00	223	223
Formaldehyde	0.75	20.9	21.7

EMISSIONS INVENTORY

ALTERNATIVE B - NO ACTION

Existing												
	71	Total wells currently in Operation in WTP										
	30	Wells to be developed in WTP (already approved under WTP Drilling Program EA - UT-070-2004-28)										
Proposed												
	Total New Wells	81										
	Total New Pads	54	0.666666667									
	Average Number of Wells Per Pad	1.5										
	Number of Producing Wells at Peak Development	81		54	13	downhole	0.666666667					
	Number of Producing Pads at Peak Development	54		27	26	directional	0.333333333					
	Total Deep Wells (Proponent)	0		81	17.33333333							
	Total Shallow Wells (Proponent)	81										
Drilling												
	New Well pad/road construction											
	Drilling (Max Year 1)	27	new well pads per year for	2	years							
	LOP = 22 YRS	60	new wells per year for	2	years							
		20	directional									
		40	downhole									
	Short-Term Well Pad Disturbance	154	acres									
		2.8519	acres/pad (average for all pads)									
	ROW Disturbance											
	Roads	157	acres									
		2.9074	acres/pad									
		32.36	miles									
		0.3284	miles/pad	1733.877551	248							
	Pipeline	220	acres									
		4.0741	acres/pad									
		45.55	miles									
		0.8435	miles/pad									
	Power lines	0	acres									
		0	acres/pad									35
		0	miles (cross country)									
		0	miles/pad									
	Other	95										
	Pits	0										
	TOTAL SHORT-TERM ACRES	626										
	SHORT-TERM WELL/ROAD DISTURB PER PAD	9.833333333										
	Average Round Trip Distance for Drilling/Construction Traffic On Unpaved Roadways =	74	miles (estimated from project area road system).									
	Average Round Trip Distance for Drilling/Construction Traffic On Paved & Unpaved Roadways =	168						max # of simultaneous operations				
								Spring summer fall	Winter			
	New well pad/access road construction (average)	14	days per pad	10	hrs/day	140	Total Hours	3	0			
	Time to drill, log and case one gas well (average, directional/downhole)	17	days per well	24	hrs/day	416	Total Hours	3	3			
	Time to complete each well (average)	29	days per well	24	hrs/day	696	Total Hours	3	3			
	Time to Frac a well	1	days per well	3	hrs/day	3	Total Hours	2				
	Rig Size (hp)	875	hp	shallow (750-1000)								
		2250	hp	deep (1500-3000)	0 deep wells total (0%)				(estimated - 9 mths * 31 days/mth / 7 days/pad = ~ 40 pads per year)			
	Proposed Action esimates majority of well spacing will be 80 acres. However, impacts evaluated at 40 and 80 acre spacing scenarios								(average, between 3 and 9 rigs will be operting)			
									(estimated - 46.5 days/well * 36 well completions/year / 365 days = ~5 simultaneous completions)			
Completion												
	3 hours frac time per well		15									
	5000hp hp frac pump engines											
	avg of 70% load											
	2 or 3 10-50 hp gensets	75	hp									
	Wells will be flared ot sold to pipeline during completion testing. Assume all flared for conservatism.											
Production												
	Pumper Vehicle Traffic: 1 new pumpers visits 75% wells weekly											
	Each reclaimed production well pad will occupy 1.9 acre (weighted avg sec2.1.1.1)		1.85		80586	sq ft	283.8767338	283.8767338				
	Each completed well pad will have well head, 500Mbtu/hr separator heater, condensate oil tanks, 25% of Pads would have individual dehy (750MBtu/hr avg heater size)						86.52562847	86.52562847				
	Approximately 10% of wells would have gas powered pump jack engines											
	Pumper Vehicle Traffic: 1 new pumper inspects 12 wells/day. 6 new pumpers are estimated during Peak Year (full-field development). Each well inspected daily. 3000 miles/month per pumper (estimate)											
	Typical Well Production:											
	0.4 MMscfd gas per well peak production rate											

	1 bbls/day average condensate production per well (per Tyler Ashcroft email 8.9.2006)											
	8 bbls/day water production (per T. Ashcroft 8.9.2006 email)											
	Gas Samples: Use wet gas Inlet sample from Dry Canyon for CS Dehys											
	Liquid Samples: Use liquid sample from Dry Canyon for compressor station flash											
Compression and Dehydration												
	Central Dehydratation at Compressor Stations											
	Dry Canyon Existing: 10@1600 hp = 16000 hp											
	2 New Stations: 1@6400 hp stations (4-1600 hp engines) and 1@11200 hp station (7-1600 hp engines) = 17600 hp New under Alt B											
	Each Station will disturb 5 acres											
	Each Unit will have emission controls (1.5 g/hp-hr NOx, 2.0 CO, 1.0 VOC to reflect current UT BACT)											
	CS are 5 acre sites w/building dimensions accroding to Ch 2 diagrams					20234.28	142.2472495					
	Dehy Building according to Ch 2 diagram						217800	363	600			
	22 Year LOP											
	Assume 500 Mbtu/hr tank heaters, 500 Mbtu Dehy Reboiler Heaters											

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1. Well Pad/Access Road/Pipeline Construction Fugitive Dust Emissions

Assumptions:

Hours of Construction	14	days per well pad (Chapter 2)
	10	hours/day
	140	hours per well pad
Pieces of Equipment	4	- 1 Backhoe
		- 1 Loader
		- 1 Crawler Tractor
		- 1 Grader
Watering Control Efficiency	50	percent (Assumption)
Soil Moisture Content	7.9	percent (AP-42 Table 11.9-3, 10/98)
Soil Silt Content	6.9	percent (AP-42 Table 11.9-3, 10/98)
PM10 Multiplier	0.75 * PM15	(AP-42 Table 11.9-1, 10/98)
PM2.5 Multiplier	0.105 * TSP	(AP-42 Table 11.9-1, 10/98)

Equations: From AP-42 tables 11.9-1 and 11.9-3 for
Bulldozing Overburden Emissions, Western Surface Coal Mining, 10/98

Emissions (TSP lbs/hr) = 5.7 * (soil silt content %)^1.2 * (soil moisture content %)^-1.3* Control Efficiency

Emissions (PM15 lbs/hr) = 1.0 * (soil silt content %)^1.5 * (soil moisture content %)^-1.4 * Control Efficiency

Emissions = 1.97 lbs TSP/hour/piece of equipment

Emissions = 0.50 lbs PM15/hour/piece of equipment

	Fugitive Dust Emissions [a]		
	lbs/hr	**tons/well**	**tons/yr [b]**
TSP	7.88	0.5517	14.90
PM15	1.51	0.1054	2.85
PM10	1.13	0.0790	2.13
PM2.5	0.83	0.0579	1.56

a Backhoe/Grader/Loader emissions are conservatively estimated as equivalent to Bulldozing emissions.

b Assumes construction rate specified by Proponent

Note: The majority of new pipeline will be installed adjacent to proposed access roads and will not result significant additional surface disturbance.

2. Reclamation Fugitive Dust Emissions

Assumptions:

Hours of Construction	2	days per well pad (Estimate)
	8	hours/day
	16	hours per well pad
Pieces of Equipment	1	- Grader
Watering Control Efficiency	50	percent (Assumption)
Soil Moisture Content	7.9	percent (AP-42 Table 11.9-3, 10/98)
Soil Silt Content	6.9	percent (AP-42 Table 11.9-3, 10/98)
PM10 Multiplier	0.75 * PM15	(AP-42 Table 11.9-1, 10/98)
PM2.5 Multiplier	0.105 * TSP	(AP-42 Table 11.9-1, 10/98)

Equations: From AP-42 tables 11.9-1 and 11.9-3 for
Bulldozing Overburden Emissions, Western Surface Coal Mining, 10/98

Emissions (TSP lbs/hr) = 5.7 * (soil silt content %)^1.2 * (soil moisture content %)^-1.3* Control Efficiency

Emissions (PM15 lbs/hr) = 1.0 * (soil silt content %)^1.5 * (soil moisture content %)^-1.4 * Control Efficiency

Emissions = 1.97 lbs TSP/hour/piece of equipment

Emissions = 0.50 lbs PM15/hour/piece of equipment

	Fugitive Dust Emissions [a]		
	lbs/hr	**tons/well**	**tons/yr [b]**
TSP	1.97	0.0158	0.43
PM15	1.51	0.0120	0.33
PM10	1.13	0.0090	0.24
PM2.5	0.21	0.0017	0.04

a Backhoe/Grader/Loader emissions are conservatively estimated as equivalent to Bulldozing emissions.

b Assumes construction rate specified by Proponent

Note: The majority of new pipeline will be installed adjacent to proposed access roads and will not result significant additional surface disturbance.

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3. Unpaved Road Fugitive Dust Emissions

Calculation AP-42, Chapter 13.2.2
December 2003

E (PM10) / VMT = 1.5 * (S/12)^0.9 * (W/3)^0.45 * (365-p)/365)
E (PM2.5) / VMT = 0.23 * (S/12)^0.9 + (W/3)^0.45
Silt Content (S) 7 Mean value Table 13.2.2-1 for Gravel Surfaces
Round Trip Miles 74
Precipitation Days (P) 73 days per year (NCDC data for Nutters Ranch, UT 1963-1986)

		Average	**Round**					
	Vehicle Type	**Weight**	**Trips per**	**PM10**	**PM10/Pad**	**PM10/Pad**	**PM2.5/Pad**	**PM2.5/Pad**
		(lbs)	**Well [a]**	**(lb/VMT)**	**(lbs)**	**(lb/day)**	**(lbs)**	**(lb/day)**
Construction (days/pad and road)	14							
	Haul Trucks	80,000	7					
	Light Trucks	20,000	28					
	Mean Vehicle Weight	32,000	35	1.569119	4064.0	290.3	623.1	44.5
					PM10/Annual Pads		**PM2.5/Annual Pads**	
					(tons)		**(tons)**	
					54.9		8.4	
		Average	**Round**					
	Vehicle Type	**Weight**	**Trips per**	**PM10**	**PM10/Well**	**PM10/Well**	**PM2.5/Well**	**PM2.5/Well**
		(lbs)	**Well [a]**	**(lb/VMT)**	**(lbs)**	**(lb/day)**	**(lbs)**	**(lb/day)**
Drilling, Downhole (days/well)	13							
	Haul Trucks	80,000	26					
	Logging/Mud Trucks	70,000	6.5					
	Water Trucks	60,000	19.5					
	Light Trucks	8,000	52					
	Mean Vehicle Weight	39,625	104	1.727526	13295.0	1022.7	2038.6	156.8
					PM10/Annual Wells		**PM2.5/Annual Wells**	
					(tons)		**(tons)**	
					265.9		40.8	
		Average	**Round**					
	Vehicle Type	**Weight**	**Trips per**	**PM10**	**PM10/Well**	**PM10/Well**	**PM2.5/Well**	**PM2.5/Well**
		(lbs)	**Well [a]**	**(lb/VMT)**	**(lbs)**	**(lb/day)**	**(lbs)**	**(lb/day)**
Drilling, Directional (days/well)	26							
	Haul Trucks	80,000	52					
	Logging/Mud Trucks	70,000	13					
	Water Trucks	60,000	39					
	Light Trucks	8,000	104					
	Mean Vehicle Weight	39,625	208	1.727526	26590.1	1022.7	4077.1	156.8
					PM10/Annual Wells		**PM2.5/Annual Wells**	
					(tons)		**(tons)**	
					265.9		40.8	
		Average	**Round**					
	Vehicle Type	**Weight**	**Trips per**	**PM10**	**PM10/Well**	**PM10/Well**	**PM2.5/Well**	**PM2.5/Well**
		(lbs)	**Well [a]**	**(lb/VMT)**	**(lbs)**	**(lb/day)**	**(lbs)**	**(lb/day)**
Completion (days/well)	29							
	Semi/Transport/Water/Sand	80,000	203					
	Haul Trucks	80,000	29					
	Light Trucks	8,000	116					
	Mean Vehicle Weight	56,000	348	2.018473	51979.7	1792.4	7970.2	274.8
					PM10/Annual Wells		**PM2.5/Annual Wells**	
					(tons)		**(tons)**	
					1559.4		239.1	
		Average	**Round**					
	Vehicle Type	**Weight**	**Trips per**	**PM10**	**PM10/Day**	**PM10/Day**	**PM2.5/Day**	**PM2.5/Day**
		(lbs)	**Well [a]**	**(lb/VMT)**	**(lbs)**	**(lb/day)**	**(lbs)**	**(lb/day)**
Field Development and Reclamation (days/well)	6							
	Haul Trucks	80,000	6					
	Light Trucks	8,000	18					
	Mean Vehicle Weight	26,000	24	1.429145	2538.2	423.0	389.2	64.9
					PM10/Annual Wells		**PM2.5/Annual Wells**	
					(tons)		**(tons)**	
					76.1		11.7	
Annual Traffic Fugitive Dust Emissions (tons/year)					**2222.20**		**340.74**	

a Traffic Estimates are based upon an approximately 14-days construction, 13-days drilling at downhole locations (shallow wells), 26-days drilling at direction wells (shallow wells), 29-days completion, and 6-days infrastructure development per well or well pad as appropriate.

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4. Wind Erosion Fugitive Dust Emissions

Assumptions

Threshold Friction Velocity U_t*	1.02	m/s (2.28 mph) for well pads (AP-42 Table 13.2.5-2 Overburden - Western Surface Coal Mine
	1.33	m/s (2.97 mph) for roads (AP-42 Table 13.2.5-2 Roadbed material)
Initial Disturbance Area	377.0	acres total initial disturbance for roads/pipelines (Chapter 2)
	1,525,662	square meters total initial disturbance for roads/pipelines
	249	acres total initial disturbance for well pads and other facilities (Chapter 2)
	1,007,666	square meters total initial disturbance for well pads and other facilities
	626	acres total disturbance
Exposed Surface Type	Flat	
Meteorological Data	2002	Grand Junction (obtained from NCDC website)
Fastest Mile Wind Speed U_{10}^+	20.1	meters/sec (45 mph) reported as fastest 2-minute wind speed for Grand Junction (2002)
Number soil of disturbances	2	for well pads and facilities (Assumption, disturbance at construction and reclamation)
	Constant	for dirt roads
Development Period	2	years (Chapter 2)

Equations

Friction Velocity $U^* = 0.053\ U_{10}^+$

Erosion Potential P (g/m^2/period) = $58*(U^*-U_t^*)^2 + 25*(U^*-U_t^*)$ for $U^*>U_t^*$, P = 0 for $U^*< U_t^*$

Emissions (tons/year) = Erosion Potential(g/m^2/period)*Disturbed Area(m^2)*Disturbances/year*(k)/(453.6 g/lb)/2000 lbs/ton/Develop Period

Particle Size Multiplier (k)		
30 um	**<10 um**	**<2.5 um**
1.0	0.5	0.2

Maxium U_{10}^+ Wind Speed (m/s)	Maximum U* Friction Velocity m/s	Well U_t* Threshold Velocity[a] m/s	Well Pad Erosion Potential g/m^2	Road U_t* Threshold Velocity[a] m/s	Road Erosion Potential g/m^2
20.12	1.07	1.02	1.28	1.33	0.00

Wind Erosion Emissions

Particulate Species	Wells (tons/year)	Roads/Pipelines (tons/year)
TSP	1.42	0.00
PM10	0.71	0.00
PM2.5	0.28	0.00

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5. Construction Tailpipe Emissions

Assumptions:

Average Round Trip Distance	168.0	miles (Estimated from project area and existing road system)
Hours of Construction	140	hours per site (Chapter 2)
Number of Heavy Diesel Truck Trips	7	(Chapter 2)
Number of Pickup Trips	28	(Chapter 2)
Diesel Fuel sulfur content	0.05	% (Typical value)
Diesel Fuel density	7.08	lbs/gallon (Typical value)
Heavy Haul Diesel Fuel Efficiency	10	miles/gallon (Typical value)
Heavy Duty Pickup Fuel Efficiency	15	miles/gallon (Typical value)

Equations:

For NOx, CO and VOC:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (g/mile)} * \text{\# Trips} * \text{Trip Distance (miles)}}{453.6\ \text{(g/lb)} * 2000\ \text{(lb/tons)}}$$

The NOx, CO and VOC emission factors for the above equation are from AP-42, while the SO2 emissions are calculated on a mass balance basis utilizing the following equation:

$$\text{SO2 E. Factor (g/mi)} = \frac{\text{Fuel Density (lb/gal)} * 453.6\ \text{(g/lb)} * \text{Fuel Sulfur Content} * 2\ \text{(S / SO2)}}{\text{Vehicle Fuel Efficiency (miles/gal)}}$$

Construction Vehicles	Heavy Haul Trucks			Heavy Duty Pickups			Total [d]	
	E. Factor [a] (g/mile)	Emissions (lb/hr)	Emissions (tons/yr/well)	E. Factor [b] (g/mile)	Emissions (lb/hr)	Emissions (tons/yr/well)	Emissions (lb/hr)	Emissions (tons/yr)
Criteria Pollutants & VOC								
NO_x	8.130	0.151	0.011	3.030	0.224	0.016	0.375	0.709
CO	17.090	0.316	0.022	33.640	2.492	0.174	2.808	5.308
VOC [c]	4.600	0.085	0.006	4.646	0.344	0.024	0.429	0.811
SO_2	0.321	0.006	0.000	0.214	0.016	0.001	0.022	0.041
Greenhouse Gases								
CH_4 [e]	0.230	0.004	0.000	0.184	0.014	0.001	0.018	0.034

a AP-42 Append. H Table 7.1.2 - H.D. Diesel Powered Vehicles, High Altitude, 1991 - 1997 Model Year, 50,000 miles (6/95)
b AP-42 Append. H Table 4.1A.2 - H.D. Gasoline Vehicles, High Altitude, 1991 - 1997 Vehicle Year, 50,000 miles (6/95)
c Emission factor is for total Hydrocarbons - Methane Offset
d Assumes construction rate specified by Proponent
e AP-42 Append. H Tables 7.10A.2 and 4.10A.2 H.D. Methane Offsets, High Altitude, 1986+ and 1988+ Vehicle Year

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6. Drilling Tailpipe Emissions

Assumptions:

Average Round Trip Distance	168.0	miles (Estimated from project area and existing road system)
Hours of Operation	416	hours per site (Chapter 2)
Number of Heavy Diesel Truck Trips	69	(Chapter 2)
Number of Pickup Trips	69	(Chapter 2)
Diesel Fuel sulfur content	0.05	% (Typical value)
Diesel Fuel density	7.08	lbs/gallon (Typical value)
Heavy Haul Diesel Fuel Efficiency	10	miles/gallon (Typical value)
Heavy Duty Pickup Fuel Efficiency	15	miles/gallon (Typical value)

Equations:

For NOx, CO and VOC:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (g/mile)} * \text{\# Trips} * \text{Trip Distance (miles)}}{\text{453.6 (g/lb)} * \text{2000 (lb/tons)}}$$

The NOx, CO and VOC emission factors for the above equation are from AP-42, while the SO2 emissions are calculated on a mass balance basis utilizing the following equation:

$$\text{SO2 E. Factor (g/mi)} = \frac{\text{Fuel Density (lb/gal)} * \text{453.6 (g/lb)} * \text{Fuel Sulfur Content} * \text{2 (S / SO2)}}{\text{Vehicle Fuel Efficiency (miles/gal)}}$$

Drilling Vehicles	Heavy Haul Trucks			Heavy Duty Pickups			Total [d]	
	E. Factor [a] (g/mile)	Emissions (lb/hr)	Emissions (tons/yr/well)	E. Factor [b] (g/mile)	Emissions (lb/hr)	Emissions (tons/yr/well)	Emissions (lb/hr)	Emissions (tons/yr)
Criteria Pollutants & VOC								
NO_x	8.13	0.502	0.104	3.03	0.187	0.039	0.689	8.597
CO	17.09	1.055	0.219	33.64	2.077	0.432	3.131	39.081
VOC [c]	4.600	0.284	0.059	1.656	0.102	0.021	0.386	4.819
SO_2	0.32	0.020	0.004	0.21	0.013	0.003	0.033	0.412
Greenhouse Gases								
CH_4 [e]	0.230	0.014	0.003	0.184	0.011	0.002	0.026	0.144

a AP-42 Append. H Table 7.1.2 - H.D. Diesel Powered Vehicles, High Altitude, 1991 - 1997 Model Year, 50,000 miles (6/95)
b AP-42 Append. H Table 4.1A.2 - H.D. Gasoline Vehicles, High Altitude, 1991 - 1997 Vehicle Year, 50,000 miles (6/95)
c Emission factor is for total Hydrocarbons - Methane Offset
d Assumes construction rate specified by Proponent
e AP-42 Append. H Tables 7.10A.2 and 4.10A.2 H.D. Methane Offsets, High Altitude, 1986+ and 1988+ Vehicle Year

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7. Completion Tailpipe Emissions

Assumptions:

Average Round Trip Distance	168.0	miles (Estimated from project area and existing road system)
Hours of Operation	696	hours per site (Chapter 2)
Number of Heavy Diesel Truck Trips	232	(Chapter 2)
Number of Pickup Trips	116	(Chapter 2)
Diesel Fuel sulfur content	0.05	% (Typical value)
Diesel Fuel density	7.08	lbs/gallon (Typical value)
Heavy Haul Diesel Fuel Efficiency	10	miles/gallon (Typical value)
Heavy Duty Pickup Fuel Efficiency	15	miles/gallon (Typical value)

Equations:

For NOx, CO and VOC:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (g/mile)} * \text{\# Trips} * \text{Trip Distance (miles)}}{\text{453.6 (g/lb)} * \text{2000 (lb/tons)}}$$

The NOx, CO and VOC emission factors for the above equation are from AP-42, while the SO2 emissions are calculated on a mass balance basis utilizing the following equation:

$$\text{SO2 E. Factor (g/mi)} = \frac{\text{Fuel Density (lb/gal)} * \text{453.6 (g/lb)} * \text{Fuel Sulfur Content} * \text{2 (S / SO2)}}{\text{Vehicle Fuel Efficiency (miles/gal)}}$$

Completion Vehicles	Heavy Haul Trucks			Heavy Duty Pickups			Total [d]	
	E. Factor [a] (g/mile)	Emissions (lb/hr)	Emissions (tons/yr/well)	E. Factor [b] (g/mile)	Emissions (lb/hr)	Emissions (tons/yr/well)	Emissions (lb/hr)	Emissions (tons/yr)
Criteria Pollutants & VOC								
NO_x	8.13	1.004	0.349	3.03	0.187	0.065	1.191	24.863
CO	17.09	2.110	0.734	33.64	2.077	0.723	4.186	87.412
VOC [c]	4.600	0.568	0.198	1.656	0.102	0.036	0.670	13.992
SO_2	0.32	0.040	0.014	0.21	0.013	0.005	0.053	1.104
Greenhouse Gases								
CH_4 [e]	0.230	0.028	0.010	0.184	0.011	0.004	0.040	0.374

a AP-42 Append. H Table 7.1.2 - H.D. Diesel Powered Vehicles, High Altitude, 1991 - 1997 Model Year, 50,000 miles (6/95)
b AP-42 Append. H Table 4.1A.2 - H.D. Gasoline Vehicles, High Altitude, 1991 - 1997 Vehicle Year, 50,000 miles (6/95)
c Emission factor is for total Hydrocarbons - Methane Offset
d Assumes construction rate specified by Proponent
e AP-42 Append. H Tables 7.10A.2 and 4.10A.2 H.D. Methane Offsets, High Altitude, 1986+ and 1988+ Vehicle Year

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8. Development Tailpipe Emissions

Assumptions:

Average Round Trip Distance	168.0	miles (Estimated from project area and existing road system)
Hours of Operation	20	hours per site (Assumption)
Number of Heavy Diesel Truck Trips	6	(Assumption)
Number of Pickup Trips	18	(Assumption)
Diesel Fuel sulfur content	0.05	% (Typical value)
Diesel Fuel density	7.08	lbs/gallon (Typical value)
Heavy Haul Diesel Fuel Efficiency	10	miles/gallon (Typical value)
Heavy Duty Pickup Fuel Efficiency	15	miles/gallon (Typical value)

Equations:

For NOx, CO and VOC:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (g/mile)} * \text{\# Trips} * \text{Trip Distance (miles)}}{\text{453.6 (g/lb)} * \text{2000 (lb/tons)}}$$

The NOx, CO and VOC emission factors for the above equation are from AP-42, while the SO2 emissions are calculated on a mass balance basis utilizing the following equation:

$$\text{SO2 E. Factor (g/mi)} = \frac{\text{Fuel Density (lb/gal)} * \text{453.6 (g/lb)} * \text{Fuel Sulfur Content} * \text{2 (S / SO2)}}{\text{Vehicle Fuel Efficiency (miles/gal)}}$$

Development Vehicles	Heavy Haul Trucks			Heavy Duty Pickups			Total [d]	
	E. Factor [a] (g/mile)	Emissions (lb/hr)	Emissions (tons/yr/well)	E. Factor [b] (g/mile)	Emissions (lb/hr)	Emissions (tons/yr/well)	Emissions (lb/hr)	Emissions (tons/yr)
Criteria Pollutants & VOC								
NO_x	8.13	0.903	0.009	3.03	1.010	0.010	1.913	0.517
CO	17.09	1.899	0.019	33.64	11.213	0.112	13.112	3.540
VOC [c]	4.600	0.511	0.005	1.656	0.552	0.006	1.063	0.287
SO_2	0.32	0.036	0.000	0.21	0.071	0.001	0.107	0.029
Greenhouse Gases								
CH_4 [e]	0.230	0.026	0.000	0.184	0.061	0.001	0.087	0.023

a AP-42 Append. H Table 7.1.2 - H.D. Diesel Powered Vehicles, High Altitude, 1991 - 1997 Model Year, 50,000 miles (6/95)
b AP-42 Append. H Table 4.1A.2 - H.D. Gasoline Vehicles, High Altitude, 1991 - 1997 Vehicle Year, 50,000 miles (6/95)
c Emission factor is for total Hydrocarbons - Methane Offset
d Assumes construction rate specified by Proponent
e AP-42 Append. H Tables 7.10A.2 and 4.10A.2 H.D. Methane Offsets, High Altitude, 1986+ and 1988+ Vehicle Year

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9. Construction Heavy Equipment Tailpipe Emissions

Assumptions:

Hours of Operation	140	hours/site (Chapter 2)
Development Rate	27	new pads per year (Chapter 2)
Load Factor	0.4	(Assumed typical value)
Backhoe Size	100	hp (Assumed Typical value)
Crawler Tractor/Loader Size	150	hp (Assumed Typical value)
Motor Grader Size	135	hp (Assumed Typical value)

Equations:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (g/hp-hr)} * \text{Rated Horsepower (hp)} * \text{Operating Hours (hrs)} * \text{Load Factor (Dimensionless)}}{\text{453.6 (g/lb)} * \text{2000 (lb/tons)}}$$

Heavy Const. Vehicles	Backhoe			Crawler Tractor			Grader			Loader		
	E. Factor [a] (g/hp-hr)	Emissions (lb/hr)	Emissions[e] (tons/yr)	E. Factor [a] (g/hp-hr)	Emissions (lb/hr)	Emissions[e] (tons/yr)	E. Factor [b] (g/hp-hr)	Emissions (lb/hr)	Emissions[e] (tons/yr)	E. Factor [a] (g/hp-hr)	Emissions (lb/hr)	Emissions[e] (tons/yr)
NO_x	8.15	0.719	1.358	8.15	1.078	2.038	7.14	0.850	1.607	8.15	1.078	2.038
CO	2.28	0.201	0.380	2.28	0.302	0.570	1.54	0.183	0.347	2.28	0.302	0.570
VOC [c]	0.37	0.033	0.062	0.37	0.049	0.093	0.36	0.043	0.081	0.37	0.049	0.093
PM_{10} [d]	0.5	0.044	0.083	0.5	0.066	0.125	0.63	0.075	0.142	0.5	0.066	0.125
$PM_{2.5}$ [d]	0.5	0.044	0.083	0.5	0.066	0.125	0.63	0.075	0.142	0.5	0.066	0.125
SO_2	0.22	0.019	0.037	0.22	0.029	0.055	0.22	0.026	0.050	0.22	0.029	0.055
Formaldehyde	0.22	0.019	0.037	0.22	0.029	0.055	0.12	0.014	0.027	0.22	0.029	0.055

Heavy Const. Vehicles	Total	
	Emissions (lb/hr)	Emissions[e] (tons/yr)
NO_x	3.725	7.040
CO	0.988	1.867
VOC [c]	0.173	0.328
PM_{10} [d]	0.251	0.475
$PM_{2.5}$ [d]	0.251	0.475
SO_2	0.104	0.196
Formaldehyde	0.092	0.174

a AP-42 Volume II, Mobile Sources, Nonroad Vehicles, Table 11-7.1 Off-highway truck
b AP-42 Volume II, Mobile Sources, Nonroad Vehicles, Table 11-7.1 Motor Grader
c Emission Factor represents total Hydrocarbon Emissions
d All emitted particulate matter assumed to be PM2.5
e Assumes construction rate specified by Proponent

10. Drill Rig Engine Emissions

Assumptions:

Hours of Operation	416	hours/ well (Chapter 2)
Development Rate	60	total wells per year (Chapter 2)
	0%	average deep wells per year (based on Propoent estimate)
	0	deep well per year
	60	shallow wells per year
Load Factor	0.4	(Assumed typical value)
Rig Size	875	hp (Proponent Estimate - shallow wells)
	2250	hp (Proponent Estimate - deep wells)
	875	hp (weighted average based on ratio of shallow to deep wells)
Diesel Fuel Sulfur Content	0.05	% (typical value)

Equations:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (lb/hp-hr)} * \text{Rated Horsepower (hp)} * \text{Operating Hours (hrs)} * \text{Load Factor (Dimensionless)}}{\text{2000 (lb/tons)}}$$

SO2 E. Factor (lb/hp-hr) = Fuel sulfur content * 0.00809

Species	Drill Rig Emissions		
	E. Factor [a] (lb/hp-hr)	Emissions (lb/hr)	Emissions [e] (tons/yr)
Criteria Pollutants & VOC			
NO_x	0.024	8.400	104.832
CO	0.0055	1.925	24.024
VOC [b]	0.000705	0.247	3.079
PM_{10} [c]	0.000573	0.201	2.503
$PM_{2.5}$ [d]	0.000479	0.168	2.092
SO_2	0.0004045	0.142	1.767
Greenhouse Gases			
CO_2	1.16	406.000	5,066.880
CH_4 [b]	0.000705	0.247	3.079

a AP-42 Volume I, Large Stationary Diesel Engines Table 3.4-1, 10/96
b Emission Factor represents total Hydrocarbon Emissions
c Total particulate emission factor is 0.0007, PM10 fraction determined from Table 3.4-2
d Total particulate emission factor is 0.0007, PM2.5 fraction determined from Table 3.4-2
e Assumes rate specified by Proponent

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11. Well Fracturing Pump and Generator Engines

Assumptions:

Average Hours of Operation	3	Hours/Well (Proponents)
Development Rate	60	wells per year (Chapter 2)
Load Factor	0.7	(Proponents)
Frac Pump Engine Horsepower	5,000	Horsepower (Proponents)
Temporary Generator Horsepower	75	Horsepower (Proponents: 2-3 engines @ 10-50 hp each)
Diesel Fuel Sulfur Content	0.05	% (typical value)

Equations:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (lb/hp-hr)} * \text{Rated Horsepower (hp)} * \text{Operating Hours (hrs)} * \text{Load Factor (Dimensionless)}}{\text{2000 (lb/tons)}}$$

SO2 E. Factor (lb/hp-hr) = Fuel sulfur content * 0.00809

Species	Frac Pump Engine Emissions		
	E. Factor [a] (lb/hp-hr)	Emissions (lb/hr)	Emissions [e] (tons/yr)
Criteria Pollutants & VOC			
NO_x	0.024	84.000	7.560
CO	0.0055	19.250	1.733
VOC [b]	0.000705	2.468	0.222
PM_{10} [c]	0.000573	2.006	0.180
$PM_{2.5}$ [d]	0.000479	1.677	0.151
SO_2	0.0004045	1.416	0.127
Greenhouse Gases			
CO_2	1.16	4,060.000	365.400
CH_4 [b]	0.000705	2.468	0.222

Species	Generator Engine Emissions		
	E. Factor [f] (lb/hp-hr)	Emissions (lb/hr)	Emissions [e] (tons/yr)
Criteria Pollutants			
NO_x	0.031	1.628	0.146
CO	0.006680	0.351	0.032
VOC [b]	0.002470	0.130	0.012
PM_{10}	0.002200	0.116	0.010
$PM_{2.5}$ [g]	0.002200	0.116	0.010
SO_2	0.0004045	0.021	0.002
Greenhouse Gases			
CO_2	1.08	3,780.000	340.200
CH_4 [b]	0.002470	8.645	0.778

a AP-42 Volume I, Large Stationary Diesel Engines Table 3.4-1, 10/96
b Emission Factor represents total Hydrocarbon Emissions
c Total particulate emission factor is 0.0007, PM10 fraction determined from Table 3.4-2
d Total particulate emission factor is 0.0007, PM2.5 fraction determined from Table 3.4-2
e Assumes maximum development scenario
f AP-42 Table 3.3-1, Emission Factors for Uncontrolled Gasoline and Diesel Industrial Engines, 10/96
g All particulates are PM10

12. Completion Flare Emissions

Assumptions

Hours of Operation	2	days (Typical)
Amount of Gas Flared	5	MMscf/well (Assumption, based on initial Production Rates)
Average Gas Heat Content	1066	Btu/scf (Wellsite Gas Composition)
Average Gas VOC Content	8.089	weight % (Wellsite Gas Composition)
Average Mole Weight	18.3	lb/lb-mole (Wellsite Gas Composition)
Development rate	60	gas wells per year

Equations

NOx/CO Emissions (lb/well) = Emission Factor (lb/MM Btu) * Gas Amount (MMscf/well) * Heat Content (Btu/scf)

PM/HAP Emissions (lb/well) = Emission Factor (lb/MMscf) * Gas Amount (MMscf/well)

$$\text{Flare Gas Wt. (lb/well)} = \frac{\text{Flare Gas Volume (MMscf/well)} * 10^6 \text{ (scf/MMscf)} * \text{Mole Weight (lb/lb-mole)}}{379.49 \text{ (scf/mole)}}$$

VOC Emissions (lb/well) = Flare Gas Wt. (lb/well) * VOC wt. % * 0.02 (Assumes 98% destruction Efficiency)

Species	Emission Factor (lb/MMBtu)	Well Emissions (lb/well)	Well Emissions (lb/hr/well)	Total Emissions [e] (tons/yr)
Criteria Pollutants & VOC				
NO_x [a]	0.068	362.4	7.55	10.87
CO [a]	0.37	1971.9	41.08	59.16
VOC	N.A.	390.0	8.12	11.70
SO_x [b]	0.00	0.0	0.00	0.00
TSP [c]	7.6	38	0.792	1.140
PM_{10} [c]	7.6	38	0.792	1.140
$PM_{2.5}$ [c]	7.6	38	0.792	1.140
Hazardous Air Pollutants				
Benzene [d]	0.0021	0.0105	2.2E-04	3.2E-04
Toluene [d]	0.0034	0.017	3.5E-04	5.1E-04
Hexane [d]	1.8	9	0.188	0.270
Formaldehyde [d]	0.075	0.375	0.008	0.011
Greenhouse Gases				
CO_2 [c]	120,000	600,000	12,500	18,000
CH_4 [a]	0.14	746.1	15.54	22.38

a AP-42 Table 13.5-1, Emission Factors for Flare Operations, 9/91
b Assumes produced gas contains no sulfur
c AP-42 Table 1.4-2, Emission Factors for Natural Gas Combustion, 3/98 (All Particulates are PM1.0)
d AP-42 Table 1.4-3, Emission Factors for Organic Compounds from Natural Gas Combustion, 3/98
e Assumes proposed development rate

13. Well Development Emissions Summary

Species	Well Development Emissions (tons/year) [a]				Wind Erosion	Total [a] (tons/yr)
	Construction	Drilling	Completion	Development & Reclamation		
Criteria Pollutants & VOC						
NO_x	7.7	113.4	43.4	0.5		165.1
CO	7.2	63.1	148.3	3.5		222.2
VOC	1.1	7.9	25.9	0.3		35.2
SO_2	0.2	2.2	1.2	0.0		3.7
PM_{10}	57.5	534.3	1,560.7	76.4	0.7	2,229.6
$PM_{2.5}$	10.5	83.6	240.4	11.7	0.3	346.5
Hazardous Air Pollutants						
Benzene			3.2E-04			
Toluene			5.1E-04			
Ethylbenzene						
Xylene						
n-Hexane			0.3			
Formaldehyde	0.2		1.1E-02			0.2
Total HAPs	0.2	0.0	0.3	0.0	0.0	0.2
Greenhouse Gases						
CO_2		5,066.9	18,705.6			23,772.5
CH_4	0.0	3.2	23.8	0.0		27.0

[a] Emissions for Peak Field Development

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14. Average Produced Gas Characteristics
Inlet Wet Gas Sample Average of Seven Samples from BBC area wellsites

Gas Heat Value (wet): 1065.9 Btu/scf

C1-C2 Wt. Fraction:	0.8742
VOC Wt. Fraction:	0.0809
Non-HC Wt. Fraction:	0.0449
Total:	1.0000

COMPONENT	MOLE PERCENT	COMPONENT MOLE WEIGHT (lb/lb-mole)	NET MOLE WEIGHT (lb/lb-mole)	WEIGHT FRACTION	GROSS HEATING VALUE (BTU/scf)	NET DRY HEATING VALUE (BTU/scf)	LOWER HEATING VALUE (BTU/scf)	NET LOW HEATING VALUE (BTU/scf)
Methane	90.1926	16.043	14.470	0.791	1010.000	910.946	910.000	820.753
Ethane	5.0663	30.070	1.523	0.083	1769.800	89.664	1618.000	81.973
Propane	1.5002	44.097	0.662	0.036	2516.200	37.748	2316.000	34.745
i-Butane	0.3123	58.123	0.182	0.010	3252.100	10.156	3005.000	9.385
n-Butane	0.3302	58.123	0.192	0.010	3262.400	10.771	3013.000	9.948
i-Pentane	0.1359	72.150	0.098	0.005	4000.900	5.437	3698.000	5.025
n-Pentane	0.0980	72.150	0.071	0.004	4008.800	3.927	3708.000	3.632
Hexanes	0.2603	86.177	0.224	0.012	4756.200	12.380	4404.000	11.463
Heptanes	0.0305	100.204	0.031	0.002	5502.500	1.678	5100.000	1.556
Octanes	0.0133	114.231	0.015	0.001	6249.100	0.833		0.000
Nonanes	0.0047	128.258	0.006	0.000	6996.400	0.331		0.000
Decanes	0.0000	142.285	0.000	0.000	7743.200	0.000		0.000
Benzene	0.0000	78.120	0.000	0.000	3715.500	0.000		0.000
Toluene	0.0000	92.130	0.000	0.000	4444.600	0.000		0.000
Ethylbenzene	0.0000	106.160	0.000	0.000	5191.500	0.000		0.000
Xylenes	0.0000	106.160	0.000	0.000	5183.500	0.000		0.000
n-Hexane	0.0000	86.177	0.000	0.000	4756.200	0.000		0.000
Helium	0.0000	4.003	0.000	0.000	0.000	0.000	0.000	0.000
Nitrogen	0.5155	28.013	0.144	0.008	0.000	0.000	0.000	0.000
Carbon Dioxide	1.5401	44.010	0.678	0.037	0.000	0.000	0.000	0.000
Oxygen	0.0000	32.000	0.000	0.000	0.000	0.000	0.000	0.000
Hydrogen Sulfide	0.0000	34.080	0.000	0.000	637.100	0.000	588.000	0.000
TOTAL	100.00		18.30	1.00		1083.87		978.48

Relative Mole Weight (lb/lb-mole) = [Mole Percent * Molecular weight (lb/lb-mole)] / 100

Weight Fraction = Net Mole Weight / Total Mole Weight

HAP Fractions estimated from GRI Published Factors

15. Wellsite Pumping Unit Engines

Assumptions:

Pumpjack Engine Size: 40 Horsepower (Proponent)
Number of Wells Requiring Pumping Unit Engines: 8 wells (Estimated at 10 % of Peak Production Wells)

Equations:

$$\text{Emissions (lbs/hr)} = \frac{\text{Emission Factor (g/hp-hr)} * \text{Power (hp)}}{453.6 \text{ g/lb}}$$

Pollutant	Emission Factor [3] (lb/MMBtu)	Emission Factor (g/hp-hr)	Emissions (lb/hr/well)	Total Emissions Alternative B (tons/yr)
Criteria Pollutants & VOC				
NOx [5]		1.5	0.13	4.7
CO [5]		2.0	0.18	6.3
VOC [5]		1.0	0.09	3.1
PM10 [1,4]	0.0194	0.070	0.01	0.2
PM2.5 [1,4]	0.0194	0.070	0.01	0.2
SO_2 [2]	0.0	0.000	0.00	0.0
Hazardous Air Pollutants				
Benzene [1]	0.001580	0.00574	0.00	0.0
Toluene [1]	0.000558	0.00203	0.00	0.0
Ethylbenzene [1]	0.000025	0.00009	0.00	0.0
Xylenes [1]	0.000195	0.00071	0.00	0.0
Formaldehyde [1]	0.0205	0.07	0.01	0.2
Greenhouse Gases				
CO_2 [1]	110.0	399.52000	35.23	1,249.9
CH_4 [1]	0.2	0.83536	0.07	2.6

1 - AP-42 Table 3.2-3 Uncontrolled Emission Factors for 4-Stroke Rich-Burn Engines, 7/00
2 - Fuel gas is assumed to be free from sulfur compounds
3 - Conversion from lb/MMBtu to g/hp-hr assumes an average heat rate of 8,000 Btu/hp-hr (*3.632)
4 - PM = sum of PM filterable and PM condensable
5 - Worse-case BACT control rates for rich/lean burn internal combustion engines

16. Wellsite Dehydrator Emissions

Assumptions

Average Production Rate: 0.384 MMscf/day/well (Average for life of the well, Chapter 2)
Number of Active Wells Requiring Separators: 81 wells at Peak Production
Wells Requiring Dehydrators: 20 (25% of wells, Chapter 2)

Gas Composition: Inlet Gas Sample from Average of Seven Existing Wells

Inlet Gas Conditions: Inlet gas saturated at 200 psi and 70 F (Proponent Estimate)

Glycol Circulation Rate: 3 gallons/ lb of water
(Typical operating rate)

Calculations

Dehydrator emissions were simulated using GRI GlyCalc version 4.0

Controls

Flare to achieve 95% Control Efficiency controlling tank and dehydrator emissions on wellpad (Proposed Action)

Emissions

Species	Well Dehydrator Emissions (lbs/hr/well)	Well Dehydrator Emissions (tons/year/well)	Total Project Emissions (tons/year)
Total VOC	0.01	0.03	0.69
Hazardous Air Pollutants			
Benzene	0.00	0.01	0.15
Toluene	0.00	0.01	0.19
Ethylbenzene	0.00	0.00	0.01
Xylenes	0.00	0.00	0.05
n-Hexane	0.00	0.00	0.02
Greenhouse Gases			
CH_4	0.00	0.02	0.40

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17. Wellsite Heater Emissions

Assumptions

Dehydrator Reboiler Heater Size	750	Mbtu/hr (Chapter 2)
Separator Heater Size	500	Mbtu/hr (Chapter 2)
Tank Heater Size	500	Mbtu/hr (Proponent)
Wells Requiring Separators:	81	wells at Peak Production
Wells Requiring Dehydrators:	20	(25% of wells, Chapter 2)
Wells Requiring Tank Heaters:	81	per pad (one to two tanks per pad, Chapter 2)
Firing Rate	6,480	hours/year (Proponent)
Fuel Gas Heat Value	1066	Btu/scf (Gas Analyses from Dry Canyon Facility)
Fuel Gas VOC Content	0.081	by weight (Gas Analyses from Dry Canyon Facility)

Equations

$$\text{Fuel Consumption (MMscf/yr)} = \frac{\text{Heater Size (MBtu/hr)} * 1{,}000\ \text{(Btu/MBtu)} * \text{Hours of Operation (hrs/yr)}}{\text{Fuel Heat Value (Btu/scf)} * 1{,}000{,}000\ \text{(scf/MMscf)}}$$

$$\text{NOx/CO/TOC Emissions (tons/yr)} = \frac{\text{AP-42 E.Factor (lbs/MMscf)} * \text{Fuel Consumption (MMscf/yr)} * \text{Fuel heating Value (Btu/scf)}}{2{,}000\ \text{(lbs/ton)} * 1{,}000\ \text{(Btu/scf - Standard Fuel Heating Value)}}$$

VOC Emissions (tons/yr) = TOC Emissions (tons/yr) * VOC wt. fraction

Species	Wellsite Heater Emissions - Separators			Wellsite Heater Emissions - Dehydrators			Wellsite Heater Emissions - Tanks			
	Emission Factor (lb/MMscf)	Well Emissions (lb/hr/well)	Total Emissions (tons/yr)	Emission Factor (lb/MMscf)	Well Emissions (lb/hr/well)	Total Emissions (tons/yr)	Emission Factor (lb/MMscf)	Well Emissions (lb/hr/well)	Total Emissions (tons/yr)	Total Emissions (tons/yr)
Criteria Pollutants & VOC										
NO_x [a]	100	0.047	12.311	100	0.070	4.617	100	0.047	12.311	29.238
CO [a]	84	0.039	10.341	84	0.059	3.878	84	0.039	10.341	24.560
TOC [c]	11	0.005	1.354	11	0.008	0.508	11	0.005	1.354	3.216
VOC	N.A.	0.000	0.110	N.A.	0.001	0.041	N.A.	0.000	0.110	0.260
SO_x [b]	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.000
TSP [c]	7.6	0.004	0.936	7.6	0.005	0.351	7.6	0.004	0.936	2.222
PM_{10} [c]	7.6	0.004	0.936	7.6	0.005	0.351	7.6	0.004	0.936	2.222
$PM_{2.5}$ [c]	7.6	0.004	0.936	7.6	0.005	0.351	7.6	0.004	0.936	2.222
Hazardous Air Pollutants										
Benzene [d]	0.0021	9.9E-07	2.6E-04	0.0021	1.5E-06	9.7E-05	2.1E-03	9.9E-07	2.6E-04	6.1E-04
Toluene [d]	0.0034	1.6E-06	4.2E-04	0.0034	2.4E-06	1.6E-04	3.4E-03	1.6E-06	4.2E-04	9.9E-04
Hexane [d]	1.8	8.4E-04	0.222	1.8	1.3E-03	0.083	1.8	8.4E-04	0.222	0.526
Formaldehyde [d]	0.075	3.5E-05	9.2E-03	0.075	5.3E-05	3.5E-03	7.5E-02	3.5E-05	9.2E-03	0.022
Greenhouse Gases										
CO_2 [c]	120,000	56.29	14,772.99	120,000	84.436	5,539.870	120,000	56.29	14,772.988	35,085.846
CH_4 [c]	2.3	0.001	0.283	2.3	0.002	0.106	2.3	0.001	0.283	0.672

a AP-42 Table 1.4-1, Emission Factors for Natural Gas Combustion, 7/98
b Assumes produced gas contains no sulfur
c AP-42 Table 1.4-2, Emission Factors for Natural Gas Combustion, 7/98 (All Particulates are PM1.0)
d AP-42 Table 1.4-3, Emission Factors for Organic Compounds from Natural Gas Combustion, 7/98

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18. Wellsite Condensate Storage Tank Flash/Working/Standing Emissions

Assumptions:

Average Condensate Production Rate: 1.5 bbls condensate per day (Average for life of the well, Proposed Action))
Number of Active Wells: 81 wells at Peak Production

Separator Conditions : 150 psi and 105 F (Proponent Average Estimate)
API Gravity of Sales Oil: 52.3

Calculations:

Condensate tank flashing/working/breathing emissions estimated with E&P Tanks 2.0
Dry Canyon Compressor Station Liquid Sample Dated 2/21/04

Emissions:

Component	Wellsite Flash/Work/Breathing (lb/hr/well)	Wellsite Flash/Work/Breathing (tons/year/well)	Total Emissions (tons/yr)
Total VOC	0.074	0.324	26.254
Hazardous Air Pollutants			
Benzene	4.0E-04	1.8E-03	1.4E-01
Toluene	2.3E-04	9.9E-04	8.0E-02
Ethylbenzene	0.0E+00	0.0E+00	0.0E+00
Xylenes	3.0E-05	1.3E-04	1.1E-02
n-Hexane	1.8E-03	7.7E-03	0.623
Greenhouse Gases			
CO_2	0.009	0.039	3.193
CH_4	0.007	0.031	2.483

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19. Well Blowdown Emissions

Assumptions: During Production, a percentage of the wells are periodically blown down to unload fluids

# of New Producing Wells	81	wells at Peak Production (Year 20)
Blowdown Frequency	104	Wells per Year (2 per week for 52 weeks for 1 hour each, Project Proponents)
Blowdown Volume	16	Mscf/event (Estimated from Average Production Data)
Annual Blowdown Volume	1.7	MMscf/year

COMPONENT	MOLECULAR WEIGHT (lb/lb-mole)	MOLE PERCENT	RELATIVE MOLE WEIGHT (lb/lb-mole)	WEIGHT Fraction	COMPONENT FLOW RATE (Mscf/hr)	COMPONENT FLOW RATE (lb/hr/well)	COMPONENT FLOW RATE (tons/yr)
Methane	16.043	90.193	14.470	0.791	14.418	609.536	1648.184
Ethane	30.07	5.066	1.523	0.083	0.810	64.176	173.531
Propane	44.097	1.500	0.662	0.036	0.240	27.868	75.355
i-Butane	58.123	0.312	0.182	0.010	0.050	7.646	20.676
n-Butane	58.123	0.330	0.192	0.010	0.053	8.084	21.858
i-Pentane	72.15	0.136	0.098	0.005	0.022	4.130	11.168
n-Pentane	72.15	0.098	0.071	0.004	0.016	2.977	8.050
Hexanes	86.177	0.260	0.224	0.012	0.042	9.449	25.550
Heptanes	100.204	0.031	0.031	0.002	0.005	1.287	3.481
Octanes	114.231	0.013	0.015	0.001	0.002	0.641	1.734
Nonanes	128.258	0.005	0.006	0.000	0.001	0.255	0.691
Decanes +	142.285	0.000	0.000	0.000	0.000	0.000	0.000
Benzene	78.12	0.000	0.000	0.000	0.000	0.000	0.000
Toluene	92.13	0.000	0.000	0.000	0.000	0.000	0.000
Ethylbenzene	106.16	0.000	0.000	0.000	0.000	0.000	0.000
Xylenes	106.16	0.000	0.000	0.000	0.000	0.000	0.000
n-Hexane	86.177	0.000	0.000	0.000	0.000	0.000	0.000
Helium	4.003	0.000	0.000	0.000	0.000	0.000	0.000
Nitrogen	28.013	0.516	0.144	0.008	0.082	6.083	16.449
Carbon Dioxide	44.01	1.540	0.678	0.037	0.246	28.553	77.207
Oxygen	32	0.000	0.000	0.000	0.000	0.000	0.000
Hydrogen Sulfide	34.08	0.000	0.000	0.000	0.000	0.000	0.000
VOC SUBTOTAL		**2.68535714**	**1.480**	**0.081**	**0.429**	**62.339**	**168.564**
HAP SUBTOTAL		**0**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
TOTAL		**100.000**	**18.295**	**1.000**	**16**	**770.686**	**2083.936**

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20. Liquid Level Controller Emissions

Company: **BBC**
Location: **WTP EIS**

GAS COMPONENT	MOLECULAR WEIGHT (lb/lb-mole)	MOLE PERCENT	RELATIVE MOLE WEIGHT (lb/lb-mole)	WEIGHT PERCENT	COMPONENT FLOW RATE (Mscf/day)	COMPONENT FLOW RATE (lb/hr)	COMPONENT FLOW RATE (tons/yr/well)
Methane	16.043	91.307	14.64838201	81.48852235	0.83271984	1.46680681	6.424613828
Ethane	30.07	5.305	1.5952135	8.874126225	0.0483816	0.159735732	0.699642507
Propane	44.097	1.536	0.67732992	3.767966612	0.01400832	0.067824019	0.297069203
i-Butane	58.123	0.337	0.19587451	1.089644193	0.00307344	0.019613775	0.085908333
n-Butane	58.123	0.387	0.22493601	1.25131247	0.00352944	0.02252383	0.098654377
i-Pentane	72.15	0.166	0.119769	0.666271458	0.00151392	0.011992996	0.052529322
n-Pentane	72.15	0.117	0.0844155	0.469600967	0.00106704	0.008452895	0.037023679
Hexanes	86.177	0.113	0.09738001	0.541722159	0.00103056	0.009751088	0.042709765
Heptanes	100.204	0.042	0.04208568	0.234121412	0.00038304	0.004214224	0.018458301
Octanes	114.231	0.008	0.00913848	0.050837098	0.00007296	0.000915076	0.004008033
Nonanes	128.258	0	0	0	0	0	0
Decanes +	142.285	0	0	0	0	0	0
Benzene	78.12	0.01	0.007812	0.043457928	0.0000912	0.00078225	0.003426254
Toluene	92.13	0.006	0.0055278	0.03075099	0.00005472	0.000553523	0.00242443
Ethylbenzene	106.16	0	0	0	0	0	0
Xylenes	106.16	0.001	0.0010616	0.00590565	0.00000912	0.000106303	0.000465606
n-Hexane	86.177	0.041	0.03533257	0.196554058	0.00037392	0.003538005	0.015496464
Helium	4.003	0.018	0.00072054	0.004008343	0.00016416	7.21508E-05	0.000316021
Nitrogen	28.013	0.223	0.06246899	0.347513171	0.00203376	0.006255294	0.027398189
Carbon Dioxide	44.01	0.383	0.1685583	0.937684912	0.00349296	0.016878483	0.073927754
Oxygen	32	0	0	0	0	0	0
Hydrogen Sulfide	34.08	0	0	0	0	0	0
VOC SUBTOTAL		**2.764**	**1.50066308**	**8.348144994**	**0.02520768**	**0.150267983**	**0.658173768**
HAP SUBTOTAL		**0.058**	**0.04973397**	**0.276668626**	**0.00052896**	**0.004980081**	**0.021812754**
TOTAL		**100**	**17.97600642**	**100**	**0.912**	**1.800016454**	**7.884072067**

EQUIPMENT SPECIFICATIONS

Gas Consumption Rate:	0.912 Mscf/day
Days of Operation:	365 days/year

	Number of Wells	VOC emissions (tons/year)
Alternative B	81	107

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21. Trace Pump Emissions

Company: **BBC**

Location: **WTP EIS**

GAS COMPONENT	MOLECULAR WEIGHT (lb/lb-mole)	MOLE PERCENT	RELATIVE MOLE WEIGHT (lb/lb-mole)	WEIGHT PERCENT	COMPONENT FLOW RATE (Mscf/day)	COMPONENT FLOW RATE (lb/hr)	COMPONENT FLOW RATE (tons/yr/well)
Methane	16.043	91.307	14.64838201	81.48852235	13.148208	23.16010753	58.91931355
Ethane	30.07	5.305	1.5952135	8.874126225	0.76392	2.522143139	6.416332147
Propane	44.097	1.536	0.67732992	3.767966612	0.221184	1.070905563	2.724383752
i-Butane	58.123	0.337	0.19587451	1.089644193	0.048528	0.30969118	0.787854363
n-Butane	58.123	0.387	0.22493601	1.25131247	0.055728	0.355639427	0.904746701
i-Pentane	72.15	0.166	0.119769	0.666271458	0.023904	0.189363093	0.481739708
n-Pentane	72.15	0.117	0.0844155	0.469600967	0.016848	0.133466758	0.339539432
Hexanes	86.177	0.113	0.09738001	0.541722159	0.016272	0.153964547	0.391685808
Heptanes	100.204	0.042	0.04208568	0.234121412	0.006048	0.066540378	0.169278721
Octanes	114.231	0.008	0.00913848	0.050837098	0.001152	0.01444857	0.036757163
Nonanes	128.258	0	0	0	0	0	0
Decanes +	142.285	0	0	0	0	0	0
Benzene	78.12	0.01	0.007812	0.043457928	0.00144	0.012351314	0.031421742
Toluene	92.13	0.006	0.0055278	0.03075099	0.000864	0.008739835	0.02223414
Ethylbenzene	106.16	0	0	0	0	0	0
Xylenes	106.16	0.001	0.0010616	0.00590565	0.000144	0.001678463	0.00427001
n-Hexane	86.177	0.041	0.03533257	0.196554058	0.005904	0.055863243	0.14211609
Helium	4.003	0.018	0.00072054	0.004008343	0.002592	0.001139224	0.002898185
Nitrogen	28.013	0.223	0.06246899	0.347513171	0.032112	0.098767804	0.251265294
Carbon Dioxide	44.01	0.383	0.1685583	0.937684912	0.055152	0.266502358	0.677982
Oxygen	32	0	0	0	0	0	0
Hydrogen Sulfide	34.08	0	0	0	0	0	0
VOC SUBTOTAL		**2.764**	**1.50066308**	**8.348144994**	**0.398016**	**2.37265237**	**6.03602763**
HAP SUBTOTAL		**0.058**	**0.04973397**	**0.276668626**	**0.008352**	**0.078632855**	**0.200041982**
TOTAL		**100**	**17.97600642**	**100**	**14.4**	**28.42131242**	**72.30381881**

PUMP SPECIFICATIONS

Pump Mfg.:	LEON
Injection Pressure:	20 psi
Mfg. Gas Consumption Rate:	10 scf/min
Gas Consumption Rate:	14.40 Mscf/day
Days of Operation:	212 days/year

	Number of Wells	VOC emissions (tons/year)
Alternative B	81	489

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22. Pneumatic Methanol Injection Pump Emissions

Company: **BBC**

Location: **WTP EIS**

GAS COMPONENT	MOLECULAR WEIGHT (lb/lb-mole)	MOLE PERCENT	RELATIVE MOLE WEIGHT (lb/lb-mole)	WEIGHT PERCENT	COMPONENT FLOW RATE (Mscf/day)	COMPONENT FLOW RATE (lb/hr)	COMPONENT FLOW RATE (tons/yr)
Methane	16.043	91.307	14.64838201	81.48852235	0.39444624	0.694803226	1.767579407
Ethane	30.07	5.305	1.5952135	8.874126225	0.0229176	0.075664294	0.192489964
Propane	44.097	1.536	0.67732992	3.767966612	0.00663552	0.032127167	0.081731513
i-Butane	58.123	0.337	0.19587451	1.089644193	0.00145584	0.009290735	0.023635631
n-Butane	58.123	0.387	0.22493601	1.25131247	0.00167184	0.010669183	0.027142401
i-Pentane	72.15	0.166	0.119769	0.666271458	0.00071712	0.005680893	0.014452191
n-Pentane	72.15	0.117	0.0844155	0.469600967	0.00050544	0.004004003	0.010186183
Hexanes	86.177	0.113	0.09738001	0.541722159	0.00048816	0.004618936	0.011750574
Heptanes	100.204	0.042	0.04208568	0.234121412	0.00018144	0.001996211	0.005078362
Octanes	114.231	0.008	0.00913848	0.050837098	0.00003456	0.000433457	0.001102715
Nonanes	128.258	0	0	0	0	0	0
Decanes +	142.285	0	0	0	0	0	0
Benzene	78.12	0.01	0.007812	0.043457928	0.0000432	0.000370539	0.000942652
Toluene	92.13	0.006	0.0055278	0.03075099	0.00002592	0.000262195	0.000667024
Ethylbenzene	106.16	0	0	0	0	0	0
Xylenes	106.16	0.001	0.0010616	0.00590565	0.00000432	5.03539E-05	0.0001281
n-Hexane	86.177	0.041	0.03533257	0.196554058	0.00017712	0.001675897	0.004263483
Helium	4.003	0.018	0.00072054	0.004008343	0.00007776	3.41767E-05	8.69456E-05
Nitrogen	28.013	0.223	0.06246899	0.347513171	0.00096336	0.002963034	0.007537959
Carbon Dioxide	44.01	0.383	0.1685583	0.937684912	0.00165456	0.007995071	0.02033946
Oxygen	32	0	0	0	0	0	0
Hydrogen Sulfide	34.08	0	0	0	0	0	0
VOC SUBTOTAL		**2.764**	**1.50066308**	**8.348144994**	**0.01194048**	**0.071179571**	**0.181080829**
HAP SUBTOTAL		**0.058**	**0.04973397**	**0.276668626**	**0.00025056**	**0.002358986**	**0.006001259**
TOTAL		**100**	**17.97600642**	**100**	**0.432**	**0.852639373**	**2.169114564**

PUMP SPECIFICATIONS

Pump Mfg.:	Western
Piston Size:	0.625 inch
Injection Pressure:	30 psi
Pump Rate:	2.00 gallons/day
Gas Consumption Rate:	0.43 Mscf/day
Days of Operation:	212 days/year

	Number of Wells	VOC emissions (tons/year)
Alternative B	81	15

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23. Operations Vehicle Tailpipe Emissions

Assumptions:

Number of New Pumpers:	3	(Proposed Action Number of Pumpers at Peak Production)
Pumper Mileage:	3,000	miles/pumper/month (Assumption)
Total Annual New Pumper Mileage:	108,000	miles/year
Number of Condensate Haul Truck Round Trips:	1	trips per day (Based on Peak Production)
Average Round Trip Mileage for Condensate Transport:	168	miles (Estimate from Vernal)
Total Annual Condensate Truck Mileage:	61,320	miles/year
Number of Water Haul Truck Round Trips:	7	trips per day (Based on Peak Production)
Average Round Trip Mileage for Water Transport:	10	miles (Average distance to water injection facility)
Total Annual Water Truck Mileage:	25,550	miles/year
Daily Hours of Operation:	12	hours per day (Assumption)
Annual Hours of Operation:	4368	hours per year
Fuel sulfur content	0.05	% (Typical value)
Fuel density	7.08	lbs/gallon (Typical value)
Heavy Duty Pickup Fuel Efficiency	15	miles/gallon (Typical value)
Heavy Haul Diesel Fuel Efficiency	10	miles/gallon (Typical value)

Equations:

For NOx, CO and VOC:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (g/mile)} * \text{Vehicle Miles Traveled (miles/yr)}}{\text{453.6 (g/lb)} * \text{2000 (lb/tons)}}$$

The NOx, CO and VOC emission factors for the above equation are from AP-42, while the SO2 emissions are calculated on a mass balance basis utilizing the following equation:

$$\text{SO2 E. Factor (g/mi)} = \frac{\text{Fuel Density (lb/gal)} * \text{453.6 (g/lb)} * \text{Fuel Sulfur Content} * \text{2 (S / SO2)}}{\text{Vehicle Fuel Efficiency (miles/gal)}}$$

Pumper Vehicles	Heavy Duty Pickups			Heavy Haul Trucks			Total	
	E. Factor [a] (g/mile)	Emissions (lb/hr)	Emissions (tons/yr)	E. Factor [b] (g/mile)	Emissions (lb/hr)	Emissions (tons/yr)	Emissions (lb/hr)	Emissions (tons/yr)
Criteria Pollutants & VOC								
NO_x	3.03	0.165	0.361	8.13	0.356	0.778	0.522	1.139
CO	33.64	1.834	4.005	17.09	0.749	1.636	2.583	5.641
VOC [c]	1.656	0.090	0.197	4.600	0.202	0.440	0.292	0.638
SO_2	0.21	0.012	0.025	0.32	0.014	0.031	0.026	0.056
Greenhouse Gases								
CH_4 [d]	0.184	0.010	0.022	0.230	0.010	0.022	0.020	0.044

a AP-42 Append H Table 4.1A.2 - H.D. Gasoline Vehicles, High Altitude, 1991 - 1997 Vehicle Year, 50,000 miles (6/95)
b AP-42 Append. H Table 7.1.2 - H.D. Diesel Powered Vehicles, High Altitude, 1991 - 1997 Model Year, 50,000 miles (6/95)
c Emission factor is for total Hydrocarbons - Methane Offset
d AP-42 Append. H Tables 7.10A.2 and 4.10A.2 H.D. Methane Offsets, High Altitude, 1986+ and 1988+ Vehicle Year

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24. Operations Traffic Fugitive Dust Emissions

Calculation AP-42, Chapter 13.2.2
December 2003

E (PM10) / VMT = 1.5 * (S/12)^0.9 * (W/3)^0.45 * (365-p)/365)
E (PM2.5) / VMT = 0.23 * (S/12)^0.9 + (W/3)^0.45 * (365-p)/365)
Silt Content (S) 7 Mean value Table 13.2.2-1 for Gravel Surfaces
Average Round Trip Miles 42 miles on unpaved roads
(Average of Pumper,Condensate, and Water Hauling Distance)
Precipitation Days (P) 73 days per year (NCDC data for Nutters Ranch, UT 1963-1986)

365 days (Estimate)

Vehicle Type	Ave. Weight (lbs)	Round Trips per Day*	PM10 (lb/VMT)	Total PM10 (lbs)	PM10 (lb/day)	Total PM2.5 (lbs)	PM2.5 (lb/day)
Pickup Truck: Crew	7,000	3.0					
Haul Truck: Oil	48,000	1.000					
Haul Truck: Water	48,000	7.000					
Mean Weight	36,818	11.000	1.671346	281,839.07	772.16	43,215.32	118.4

Annual Traffic Fugitive Dust Emissions (tons/year)				**140.92**		**21.61**	

*Round trips per day at peak production (Chapter 2)

25. Well Production Summary

Species	Production Heaters (tons/yr)	Storage Tanks (tons/yr)	Well Dehydrators (tons/yr)	Well Pumping Unit Engines (tons/yr)	Pneumatic Devices (tons/yr)	Operations Vehicle (tons/yr)	Well Blowdown (tons/yr)	Total Well Production [a] (tons/yr)
Criteria Pollutants & VOC								
NO_x	29.2			4.7		1.1		35.1
CO	24.6			6.3		5.6		36.5
VOC	3.2	26.3	0.7	3.1	610.2	0.6	168.6	812.7
SO_2	0.0			0.0		0.1		0.1
PM_{10}	2.2			0.2		140.9		143.4
$PM_{2.5}$	2.2			0.2		21.6		24.1
Hazardous Air Pollutants								
Benzene	0.0	0.1	0.2	1.8E-02	2.9		0.0	3.2
Toluene	0.0	0.1	0.2	6.3E-03	1.4		0.0	1.6
Ethylbenzene		0.0	0.0	2.8E-04	0.0		0.0	0.0
Xylene		0.0	0.1	2.2E-03	0.4		0.0	0.5
n-Hexane	0.5	0.6	0.0		8.7		0.0	9.9
Formaldehyde	0.0			0.2				0.3
Total HAPs	0.5	0.9	0.4	0.3		0.0	0.0	15.5
Greenhouse Gases								
CO_2	35,085.8	3.2		1,249.9			77.2	36,416.2
CH_4	0.7	2.5	0.4	2.6		0.0	1,648.2	1,654.4

[a] Emissions for Peak Field Development

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26. Saltwater Disposal Pumps/Water Supply Pump Generators

Assumptions:

Salt Water Disposal well pumps:	400	Horsepower (one pump/salt water disposal well)
Water Supply pumps:	400	Horsepower (one pump/water supply well)
Project Total:	1,600	Horsepower (Ch. 2- 2salt water, 2 water supply)

Equations:

$$\text{Emissions (lbs/hr)} = \frac{\text{Emission Factor (g/hp-hr)} * \text{Power (hp)}}{453.6 \text{ g/lb}}$$

Pollutant	Emission Factor [3] (lb/MMBtu)	Emission Factor (g/hp-hr)	Emissions (lb/hr/engine)	Emissions (tons/yr/engine)	Total Emissions [5] Alternative B (tons/yr)
Criteria Pollutants & VOC					
NOx [6]	2.21	1.5	1.32	6	23
CO [6]	3.72	2.0	1.8	8	31
VOC [1]	2.96E-02	0.108	0.09	0.4	1.7
PM10 [1,4]	1.94E-02	0.070	0.06	0.3	1.1
PM2.5 [1,4]	1.94E-02	0.070	0.06	0.3	1.1
SO_2 [2]	0.0	0.000	0.00	0.0	0.0
Hazardous Air Pollutants [7]					
Benzene [1]	1.58E-03	2.87E-03	0.00	1.1E-02	4.4E-02
Toluene [1]	5.58E-04	1.01E-03	8.94E-04	3.9E-03	1.6E-02
Ethylbenzene [1]	2.48E-05	4.50E-05	3.97E-05	1.7E-04	7.0E-04
Xylenes [1]	1.95E-04	3.54E-04	3.12E-04	1.4E-03	5.5E-03
Formaldehyde [1]	2.05E-02	1.79E-02	0.02	0.1	0.3
Greenhouse Gases					
CO2 [1]	110.0	399.5	352.3	1,543	6,172
CH4 [1]	0.2	0.83536	0.74	3.2	12.9

1 - AP-42 Table 3.2-3 Uncontrolled Emission Factors for 4-Stroke Rich-Burn Engines, 7/00
2 - Fuel gas is assumed to be free from sulfur compounds
3 - Conversion from lb/MMBtu to g/hp-hr assumes an average heat rate of 8,000 Btu/hp-hr (*3.632)
4 - PM = sum of PM filterable and PM condensable
5 - Alternative B Total Annual Emissions for 2 saltwater disposal wells, 2 water supply wells
6 - BACT emission levels
7 - BACT requires 76% control of Formaldehyde, which controls other HAPs by 50%

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27. Average Produced Gas Characteristics
Inlet Wet Gas Sample from BBC Dry Canyon Compressor Station, dated 2/18/2004

Gas Heat Value (wet): 1082.2 Btu/scf

Sample Temperature: 108 F
Sample Pressure: 790 psi

C1-C2 Wt. Fraction: 0.9035
VOC Wt. Fraction: 0.0835
Non-HC Wt. Fraction: 0.0130
Total: 1.0000

COMPONENT	MOLE PERCENT	COMPONENT MOLE WEIGHT (lb/lb-mole)	NET MOLE WEIGHT (lb/lb-mole)	WEIGHT FRACTION	GROSS HEATING VALUE (BTU/scf)	NET DRY HEATING VALUE (BTU/scf)	LOWER HEATING VALUE (BTU/scf)	NET LOW HEATING VALUE (BTU/scf)
Methane	91.3030	16.043	14.648	0.815	1010.000	922.160	910.000	830.857
Ethane	5.3050	30.070	1.595	0.089	1769.800	93.888	1618.000	85.835
Propane	1.5360	44.097	0.677	0.038	2516.200	38.649	2316.000	35.574
i-Butane	0.3370	58.123	0.196	0.011	3252.100	10.960	3005.000	10.127
n-Butane	0.3870	58.123	0.225	0.013	3262.400	12.625	3013.000	11.660
i-Pentane	0.1600	72.150	0.115	0.006	4000.900	6.401	3698.000	5.917
n-Pentane	0.1170	72.150	0.084	0.005	4008.800	4.690	3708.000	4.338
Hexanes	0.1270	86.177	0.109	0.006	4756.200	6.040	4404.000	5.593
Heptanes	0.0340	100.204	0.034	0.002	5502.500	1.871	5100.000	1.734
Octanes+	0.0080	114.231	0.009	0.001	6249.100	0.500		0.000
Nonanes	0.0000	128.258	0.000	0.000	6996.400	0.000		0.000
Decanes	0.0000	142.285	0.000	0.000	7743.200	0.000		0.000
Benzene	0.0100	78.120	0.008	0.000	3715.500	0.372		0.000
Toluene	0.0060	92.130	0.006	0.000	4444.600	0.267		0.000
Ethylbenzene	0.0000	106.160	0.000	0.000	5191.500	0.000		0.000
Xylenes	0.0010	106.160	0.001	0.000	5183.500	0.052		0.000
n-Hexane	0.0410	86.177	0.035	0.002	4756.200	1.950		0.000
Helium	0.0090	4.003	0.000	0.000	0.000	0.000	0.000	0.000
Nitrogen	0.2230	28.013	0.062	0.003	0.000	0.000	0.000	0.000
Carbon Dioxide	0.3830	44.010	0.169	0.009	0.000	0.000	0.000	0.000
Oxygen	0.0090	32.000	0.003	0.000	0.000	0.000	0.000	0.000
Hydrogen Sulfide	0.0000	34.080	0.000	0.000	637.100	0.000	588.000	0.000
TOTAL	100.00		17.98	1.00		1100.43		991.64

Relative Mole Weight (lb/lb-mole) = [Mole Percent * Molecular weight (lb/lb-mole)] / 100

Weight Fraction = Net Mole Weight / Total Mole Weight

28. Central Compression

Assumptions:

Total Existing Compression: 16,000 Horsepower (Dry Canyon Facility)
Total New Compression: 17,600 Horsepower (Alternative B)

Equations:

$$\text{Emissions (lbs/hr)} = \frac{\text{Emission Factor (g/hp-hr)} * \text{Power (hp)}}{453.6 \text{ g/lb}}$$

Pollutant	Emission Factor [3] (lb/MMBtu)	Emission Factor (g/hp-hr)	Emissions (lb/hr/engine) [7]	Emissions 6,400 hp Station (tons/yr)	Emissions 11,200 hp Station (tons/yr)	Total Emissions [5] Alternative B (tons/yr)
Criteria Pollutants & VOC						
NOx [6]		1.5	5.29	92.7	162.2	254.9
CO [6]		2.0	7.05	123.6	216.3	339.9
VOC [6]		1.0	3.53	61.8	108.2	169.9
PM10 [1,4]	0.0194	0.070	0.25	4.4	7.6	12.0
PM2.5 [1,4]	0.0194	0.070	0.25	4.4	7.6	12.0
SO_2 [2]	0.0	0.000	0.00	0.0	0.0	0.0
Hazardous Air Pollutants						
Benzene [1]	0.001580	0.00574	0.02	0.4	0.6	1.0
Toluene [1]	0.000558	0.00203	0.01	0.1	0.2	0.3
Ethylbenzene [1]	0.000025	0.00009	0.00	0.0	0.0	0.0
Xylenes [1]	0.000195	0.00071	0.00	0.0	0.1	0.1
Formaldehyde [1]	0.0205	0.07446	0.26	4.6	8.1	12.7
Greenhouse Gases						
CO2 [1]	110.00	399.52	1,409.24	24,690.5	43,208.3	67,897.3
CH4 [1]	0.2	0.83536	2.95	51.6	90.3	142.0

1 - AP-42 Table 3.2-3 Uncontrolled Emission Factors for 4-Stroke Rich-Burn Engines, 7/00
2 - Fuel gas is assumed to be free from sulfur compounds
3 - Conversion from lb/MMBtu to g/hp-hr assumes an average heat rate of 8,000 Btu/hp-hr (*3.632)
4 - PM = sum of PM filterable and PM condensable
5 - Alternative B Total Annual Emissions for New Compression (17,600 hp)
6 - Assumed equivalent control rates for internal combustion engines located at existing Dry Canyon Facility
7 - Each individual engine estimated at 1,600 hp (Chapter 2)

29. Central TEG Dehydrator Emissions

Assumptions

Total Dehydrator Capacity 183 MMscf/day (Estimated based on proposed compression capacity)
81 Active Wells at Peak Production

Gas Composition: Inlet Gas Sample from Dry Canyon Compresor Station, dated 2/18/04

Inlet Gas Conditions: Inlet gas saturated at 600 psi and 108 F

Glycol Circulation Rate: 3 gallons/ lb of water
(Typical operating rate)

Calculations

Dehydrator emissions were simulated using GRI GlyCalc version 4.0

Controls

Condenser/Combustor > 95% Control Efficiency in order to meet Federal MACT Standards
Condenser Operating Conditions: 120 deg. F, 11.5 psia

Emissions

Species	Central Dehydrator Emissions 67MMscfd Station (tons/year)	Central Dehydrator Emissions 117MMscfd Station (tons/year)	Total Project Emissions (tons/year)
Total VOC	8.46	14.77	23.23
Hazardous Air Pollutants			
Benzene	1.47	2.57	4.04
Toluene	1.47	2.57	4.04
Ethylbenzene	0.00	0.00	0.00
Xylenes	0.49	0.86	1.35
n-Hexane	0.22	0.38	0.60
Greenhouse Gases			
CH_4	12.28	21.44	33.72

Each station dehy capacity estimated according to the ratio of new compression proposed at each station

30. Central Facility Heater Emissions

Assumptions

Dehydrator Reboiler Heater	500	Mbtu/hr (Estimate based on Dry Canyon Facility)
Tank Heater Size	500	Mbtu/hr (Estimate based on Dry Canyon Facility)
Total Heater Requirmement Facility 1	3,000	Mbtu/hr (Chapter 2 Estimate, 2-Dehydrator Reboiler Heaters, 4-Tank Heaters)
Total Heater Requirmement Facility 2	6,000	Mbtu/hr (Chapter 2 Estimate, 4-Dehydrator Reboiler Heaters, 8-Tank Heaters)
Firing Rate	30	minutes/hour on average for entire year (Typical value)
	4380	hours/year
Fuel Gas Heat Value	992	Btu/scf (Gas Analyses from Dry Canyon Facility)
Fuel Gas VOC Content	0.083	by weight (Gas Analyses from Dry Canyon Facility)

Equations

$$\text{Fuel Consumption (MMscf/yr)} = \frac{\text{Heater Size (MBtu/hr)} * 1{,}000\ \text{(Btu/MBtu)} * \text{Hours of Operation (hrs/yr)}}{\text{Fuel Heat Value (Btu/scf)} * 1{,}000{,}000\ \text{(scf/MMscf)}}$$

$$\text{NOx/CO/TOC Emissions (tons/yr)} = \frac{\text{AP-42 E.Factor (lbs/MMscf)} * \text{Fuel Consumption (MMscf/yr)} * \text{Fuel heating Value (Btu/scf)}}{2{,}000\ \text{(lbs/ton)} * 1{,}000\ \text{(Btu/scf - Standard Fuel Heating Value)}}$$

VOC Emissions (tons/yr) = TOC Emissions (tons/yr) * VOC wt. fraction

Species	Central Heater Emissions - Facility 1			Central Heater Emissions - Facility 2			
	Emission Factor (lb/MMscf)	Well Emissions (lb/hr)	Total Emissions (tons/yr)	Emission Factor (lb/MMscf)	Well Emissions (lb/hr)	Total Emissions (tons/yr)	Total Emissions (tons/yr)
Criteria Pollutants & VOC							
NO_x [a]	100	0.300	0.657	100	0.600	1.314	1.971
CO [a]	84	0.252	0.552	84	0.504	1.104	1.656
TOC [c]	11	0.033	0.072	11	0.066	0.145	0.217
VOC	N.A.	0.003	0.006	N.A.	0.006	0.012	0.018
SO_x [b]	0.00	0.000	0.000	0.00	0.000	0.000	0.000
TSP [c]	7.6	0.023	0.050	7.6	0.046	0.100	0.150
PM_{10} [c]	7.6	0.023	0.050	7.6	0.046	0.100	0.150
$PM_{2.5}$ [c]	7.6	0.023	0.050	7.6	0.046	0.100	0.150
Hazardous Air Pollutants							
Benzene [d]	0.0021	6.3E-06	1.4E-05	0.0021	1.3E-05	2.8E-05	4.1E-05
Toluene [d]	0.0034	1.0E-05	2.2E-05	0.0034	2.0E-05	4.5E-05	6.7E-05
Hexane [d]	1.8	5.4E-03	0.012	1.8	0.011	0.024	0.035
Formaldehyde [d]	0.075	2.3E-04	4.9E-04	0.075	4.5E-04	0.001	0.001
Greenhouse Gases							
CO_2 [c]	120,000	360.00	788.40	120,000	720.00	1,576.80	2,365.200
CH_4 [c]	2.3	0.007	0.015	2.3	0.014	0.030	0.045

a AP-42 Table 1.4-1, Emission Factors for Natural Gas Combustion, 7/98
b Assumes produced gas contains no sulfur
c AP-42 Table 1.4-2, Emission Factors for Natural Gas Combustion, 7/98 (All Particulates are PM1.0)
d AP-42 Table 1.4-3, Emission Factors for Organic Compounds from Natural Gas Combustion, 7/98

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31. Central Facility Condensate Storage Tank Flash/Working/Standing Emissions

Assumptions:

Average Condensate Production Rate :

Facility 1 — 100 bbls condensate per day (Estimate Based on Dry Canyon Compressor Station Volumes)

Facility 2 — 175 bbls condensate per day (Estimate Based on Dry Canyon Compressor Station Volumes)

Separator Conditions : 100 psi and 40 F (Sample Conditions)

Calculations:

Condensate tank flashing/working/breathing emissions estimated with E&P Tanks 2.0
Dry Canyon Compressor Station Liquid Sample Dated 2/21/04
Flare to control stock tank and dehydrator emissions with 95% control efficiency

Emissions:

Component	Facility 1 Flash/Work/Breathing (tons/yr)	Facility 2 Flash/Work/Breathing (tons/yr)	Total Emissions (tons/yr)
Total VOC	21.544	37.700	59.244
Hazardous Air Pollutants			
Benzene	0.120	0.210	0.330
Toluene	0.066	0.116	0.182
Ethylbenzene	0.000	0.001	0.001
Xylenes	0.007	0.013	0.020
n-Hexane	0.513	0.898	1.411
Greenhouse Gases			
CO_2	2.564	4.487	7.051
CH_4	2.023	3.541	5.564

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32. Central Facility Emission Summary

Central Facility 1

Pollutant	Central Compression Emissions 6,400 hp (tons/year)	Central Dehydrator Emissions 67MMscfd (tons/year)	Central Heater Emissions (tons/year)	Central Condensate Tank Emissions (tons/year)	Total Facility Emissions (tons/year)
Criteria Pollutants & VOC					
NO_x	92.7		0.7		93.4
CO	123.6		0.6		124.2
VOC	61.8	8.5	0.0	21.5	91.8
SO_2	0.0		0.0		0.0
PM_{10}	4.4		0.0		4.4
$PM_{2.5}$	4.4		0.0		4.4
Hazardous Air Pollutants					
Benzene	0.4	1.5	1.4E-05	0.1	1.9
Toluene	0.1	1.5	2.2E-05	0.1	1.7
Ethylbenzene	5.6E-03	0.0E+00		0.0E+00	5.6E-03
Xylene	4.4E-02	0.5		7.0E-03	0.5
n-Hexane		0.2	1.2E-02	0.5	0.7
Formaldehyde	4.6		4.9E-04		4.6
Total HAPs	5.1	3.6	1.2E-02	0.7	9.5
Greenhouse Gases					
CO_2	24,690.5		788.4	2.6	25,481.4
CH_4	51.6	12.3	0.0	2.0	65.9

Central Facility 2

Pollutant	Central Compression Emissions 11,200 hp (tons/year)	Central Dehydrator Emissions 117MMscfd (tons/year)	Central Heater Emissions (tons/year)	Central Condensate Tank Emissions (tons/year)	Total Facility Emissions (tons/year)
Criteria Pollutants & VOC					
NO_x	162.2		1.3		163.5
CO	216.3		1.1		217.4
VOC	108.2	14.8	0.0	37.7	160.6
SO_2	0.0		0.0		0.0
PM_{10}	7.6		0.1		7.7
$PM_{2.5}$	7.6		0.1		7.7
Hazardous Air Pollutants					
Benzene	0.6	2.6	0.0	0.2	3.4
Toluene	0.2	2.6	0.0	0.1	2.9
Ethylbenzene	0.0	0.0		0.0	0.0
Xylene	0.1	0.9		0.0	0.9
n-Hexane		0.4	0.0	0.9	1.3
Formaldehyde	8.1				8.1
Total HAPs	9.0	6.4	0.0	1.2	16.6
Greenhouse Gases					
CO_2	43,208.3		1,576.8	4.5	44,789.6
CH_4	90.3	21.4	0.0	3.5	115.4

33. Total Project Production Related Emissions Summary

Pollutant	Total Project Production Related Emissions (tons/year) [a]				Total Production (tons/year)
	Well Production (tons/year)	Pump Generators (tons/year)	Central Facility 1 (tons/year)	Central Facility 2 (tons/year)	
Criteria Pollutants & VOC					
NO_x	35.1	23.2	93.4	163.5	315.1
CO	36.5	30.9	124.2	217.4	408.9
VOC	812.7	1.7	91.8	160.6	1,066.8
SO_2	0.1	0.0	0.0	0.0	0.1
PM_{10}	143.4	1.1	4.4	7.7	156.6
$PM_{2.5}$	24.1	1.1	4.4	7.7	37.3
Hazardous Air Pollutants					
Benzene	3.2	4.4E-02	1.9	3.4	8.6
Toluene	1.6	1.6E-02	1.7	2.9	6.2
Ethylbenzene	0.0	7.0E-04	0.0	0.0	0.0
Xylene	0.5	5.5E-03	0.5	0.9	2.0
n-Hexane	9.9		0.7	1.3	12.0
Formaldehyde	0.3	0.3	4.6	8.1	13.2
Total HAPs	15.5	0.3	9.5	16.6	41.9
Greenhouse Gases					
CO_2	36,416.2	6172.5	25,481.4	44,789.6	112,859.7
CH_4	1,654.4	12.9	65.9	115.4	1,848.6

a Emissions for Peak Field Development

34. Total Project Emissions Summary

Pollutant	Project Emissions (tons/year)		Total Emissions [a] (tons/year)
	Well Development	Project Production	
Criteria Pollutants & VOC			
NO_x	165	315	480
CO	222	409	631
VOC	35.2	1,067	1,102
SO_2	3.68	0.06	3.7
PM_{10}	2,230	157	2,386
$PM_{2.5}$	346.5	37.3	384
Hazardous Air Pollutants			
Benzene	0	8.60	8.6
Toluene	0	6.22	6.2
Ethylbenzene	0	0.03	2.6E-02
Xylene	0	1.95	2.0
n-Hexane	0	12.0	12.0
Formaldehyde	0.18	13.2	13
Total HAPs	0.18	41.9	42
Greenhouse Gases			
CO_2	23,772	112,860	136,632
CH_4	27.0	1,849	1,876

a Emissions for Peak Field Development

EMISSIONS INVENTORY

ALTERNATIVE C – TRANSPORTATION REDUCTION

Existing												
	71	Total wells currently in Operation in WTP										
	30	Wells to be developed in WTP (already approved under WTP Drilling Program EA - UT-070-2004-28)										
Proposed												
	Total New Wells	807		wells	days		percent					
	Total New Pads	538	0.666666667	46	46	deep downhole	0.05700					
	Average Number of Wells Per Pad	1.5000		24	92	directional	0.02974					
	Number of Producing Wells at Peak Development (Year 9)	807		492	13	downhole	0.60967					
	Number of Producing Pads at Peak Development (Year 9)	538		245	26	directional	0.30359					
	Total Deep Wells (Proponent)	70		807	21.1772							
	Total Shallow Wells (Proponent)	737										
Drilling												
	New Well pad/road construction											
	Drilling (Max Year 1)	41	new well pads per year for	15	years							
		62	new wells per year for	15	years							
		19	directional									
		38	downhole	downhole	directional							
		5	deep	4	2							
	Short-Term Well Pad Disturbance	1532	acres									
		2.8476	acres/pad (average for all pads)									
	ROW Disturbance											
	Roads	854	acres									
		1.5874	acres/pad									
		176.2	miles									
		0.3275	miles/pad	1729.249071	247							
	Pipeline	984	acres									
		1.8290	acres/pad									
		203.1	miles									
		0.3775	miles/pad									
	Power lines	0	acres									
		0	acres/pad									35
		0	miles (cross country)									
		0	miles/pad									
	Other	256										
	Pits	0										
	TOTAL SHORT-TERM ACRES	3626										
	SHORT-TERM WELL/ROAD DISTURB PER PAD	6.2639										
	Average Round Trip Distance for Drilling/Construction Traffic On Unpaved Roadways =	84	miles (estimated from project area road system -using trail canyon alternate route).									
	Average Round Trip Distance for Drilling/Construction Traffic On Paved & Unpaved	178						max # of simultaneous operations				
								Spring summer fall	Winter			
	New well pad/access road construction (average)	14	days per pad	10	hrs/day	140	Total Hours	9	0			

	Time to drill, log and case one gas well (average, directional/downhole)	21	days per well	24	hrs/day	508	Total Hours	9	9			
	Time to complete each well (average)	31	days per well	24	hrs/day	750	Total Hours	9	9			
	Time to Frac a well	1	days per well	3	hrs/day	3	Total Hours	2				
	Rig Size (hp)	875	hp	shallow (750-1000)								
		2250	hp	deep (1500-3000)	70 deep wells total (9%)				(estimated - 9 mths * 31 days/mth / 7 days/pad = ~ 40 pads per year)			
	Proposed Action esimates majority of well spacing will be 80 acres. However, impacts evaluated at 40 and 80 acre spacing scenarios								(average, between 3 and 9 rigs will be operting)			
									(estimated - 46.5 days/well * 36 well completions/year / 365 days = ~5 simultaneous completions)			
Completion												
	3 hours frac time per well		15									
	5000hp hp frac pump engines											
	avg of 70% load											
	2 or 3 10-50 hp gensets	75	hp									
	Wells will be flared ot sold to pipeline during completion testing. Assume all flared for											
Production												
	Pumper Vehicle Traffic: 1 new pumpers visits 75% wells daily											
	Each reclaimed production well pad will occupy 1.9 acre (weighted avg sec2.1.1.1)		1.85		80586	sq ft	283.876734	283.8767338				
	Each completed well pad will have well head, 500Mbtu/hr separator heater, condensate oil tanks, 25% of Pads would have individual dehy						86.5256285	86.52562847				
	Approximately 10% of wells would have gas powered pump jack engines											
	Pumper Vehicle Traffic: 1 new pumper inspects 12 wells/day. 30 new pumpers are estimated during Peak Year (full-field development). 3000 miles/month per pumper (estimate)											
	Typical Well Production:											
	0.4 MMscfd gas per well peak production rate based on peak of 250MMscfd (Proposed Action)											
	1 bbls/day average condensate production per well (per Tyler Ashcroft email 8.9.2006)											
	8 bbls/day water production (per T. Ashcroft 8.9.2006 email)											
	Gas Samples: Use wet gas Inlet sample from Dry Canyon for CS Dehys											
	Liquid Samples: Use liquid sample from Dry Canyon for compressor station flash											
Compression and Dehydration												
	Central Dehydratation at Compressor Stations											
	Dry Canyon Existing: 10@1600 hp = 16000 hp											
	3 New Stations: 2@6400 hp stations (4-1600 hp engines) and 1@11200 hp station (7-1600 hp engines) = 24000 hp New under Proposed Action											
	Each Station will disturb 5 acres											
	Each Unit will have emission controls (1.5 g/hp-hr NOx, 2.0 CO, 1.0 VOC to reflect current UT											
	CS are 5 acre sites w/building dimensions accroding to Ch 2 diagrams					20234.28	142.24725					
	Dehy Building according to Ch 2 diagram						217800	363	600			
	45 Year LOP											
	Assume 500 Mbtu/hr tank heaters, 500 Mbtu Dehy Reboiler Heaters											

Buys & Associates, Inc. **Environmental Consultants**	Project: WTP Alternative C Inventory Date: 9/17/2008

1. Well Pad/Access Road/Pipeline Construction Fugitive Dust Emissions

Assumptions:

Hours of Construction	14	days per well pad (Chapter 2)
	10	hours/day
	140	hours per well pad
Pieces of Equipment	4	- 1 Backhoe
		- 1 Loader
		- 1 Crawler Tractor
		- 1 Grader
Watering Control Efficiency	50	percent (Assumption)
Soil Moisture Content	7.9	percent (AP-42 Table 11.9-3, 10/98)
Soil Silt Content	6.9	percent (AP-42 Table 11.9-3, 10/98)
PM10 Multiplier	0.75 * PM15	(AP-42 Table 11.9-1, 10/98)
PM2.5 Multiplier	0.105 * TSP	(AP-42 Table 11.9-1, 10/98)

Equations: From AP-42 tables 11.9-1 and 11.9-3 for
Bulldozing Overburden Emissions, Western Surface Coal Mining, 10/98

Emissions (TSP lbs/hr) = 5.7 * (soil silt content %)^1.2 * (soil moisture content %)^-1.3* Control Efficiency

Emissions (PM15 lbs/hr) = 1.0 * (soil silt content %)^1.5 * (soil moisture content %)^-1.4 * Control Efficiency

Emissions = 1.97 lbs TSP/hour/piece of equipment

Emissions = 0.50 lbs PM15/hour/piece of equipment

	Fugitive Dust Emissions [a]		
	lbs/hr	**tons/well**	**tons/yr [b]**
TSP	7.88	0.5517	22.80
PM15	1.51	0.1054	4.36
PM10	1.13	0.0790	3.27
PM2.5	0.83	0.0579	2.39

a Backhoe/Grader/Loader emissions are conservatively estimated as equivalent to Bulldozing emissions.

b Assumes construction rate specified by Proponent

Note: The majority of new pipeline will be installed adjacent to proposed access roads and will not result significant additional surface disturbance.

Buys & Associates, Inc. **Environmental Consultants**	Project: WTP Alternative C Inventory Date: 9/17/2008

2. Reclamation Fugitive Dust Emissions

Assumptions:

Hours of Construction	2	days per well pad (Estimate)
	8	hours/day
	16	hours per well pad
Pieces of Equipment	1	- Grader
Watering Control Efficiency	50	percent (Assumption)
Soil Moisture Content	7.9	percent (AP-42 Table 11.9-3, 10/98)
Soil Silt Content	6.9	percent (AP-42 Table 11.9-3, 10/98)
PM10 Multiplier	0.75 * PM15	(AP-42 Table 11.9-1, 10/98)
PM2.5 Multiplier	0.105 * TSP	(AP-42 Table 11.9-1, 10/98)

Equations: From AP-42 tables 11.9-1 and 11.9-3 for
Bulldozing Overburden Emissions, Western Surface Coal Mining, 10/98

Emissions (TSP lbs/hr) = 5.7 * (soil silt content %)^1.2 * (soil moisture content %)^-1.3* Control Efficiency

Emissions (PM15 lbs/hr) = 1.0 * (soil silt content %)^1.5 * (soil moisture content %)^-1.4 * Control Efficiency

Emissions = 1.97 lbs TSP/hour/piece of equipment

Emissions = 0.50 lbs PM15/hour/piece of equipment

	Fugitive Dust Emissions [a]		
	lbs/hr	**tons/well**	**tons/yr [b]**
TSP	1.97	0.0158	0.65
PM15	1.51	0.0120	0.50
PM10	1.13	0.0090	0.37
PM2.5	0.21	0.0017	0.07

a Backhoe/Grader/Loader emissions are conservatively estimated as equivalent to Bulldozing emissions.

b Assumes construction rate specified by Proponent

Note: The majority of new pipeline will be installed adjacent to proposed access roads and will not result significant additional surface disturbance.

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3. Unpaved Road Fugitive Dust Emissions

Calculation AP-42, Chapter 13.2.2
December 2003

E (PM10) / VMT = 1.5 * (S/12)^0.9 * (W/3)^0.45 * (365-p)/365)
E (PM2.5) / VMT = 0.23 * (S/12)^0.9 + (W/3)^0.45
Silt Content (S) 7 Mean value Table 13.2.2-1 for Gravel Surfaces
Round Trip Miles 84
Precipitation Days (P) 73 days per year (NCDC data for Nutters Ranch, UT 1963-1986)

		Average	**Round**					
	Vehicle Type	**Weight**	**Trips per**	**PM10**	**PM10/Pad**	**PM10/Pad**	**PM2.5/Pad**	**PM2.5/Pad**
		(lbs)	**Well [a]**	**(lb/VMT)**	**(lbs)**	**(lb/day)**	**(lbs)**	**(lb/day)**
Construction (days/pad and road)	14							
	Haul Trucks	80,000	7					
	Light Trucks	20,000	28					
	Mean Vehicle Weight	32,000	35	1.569119	4613.2	329.5	707.4	50.5
					PM10/Annual Pads		**PM2.5/Annual Pads**	
					(tons)		**(tons)**	
					95.3		14.6	
		Average	**Round**					
	Vehicle Type	**Weight**	**Trips per**	**PM10**	**PM10/Well**	**PM10/Well**	**PM2.5/Well**	**PM2.5/Well**
		(lbs)	**Well [a]**	**(lb/VMT)**	**(lbs)**	**(lb/day)**	**(lbs)**	**(lb/day)**
Drilling, Downhole (days/well)	13							
	Haul Trucks	80,000	26					
	Logging/Mud Trucks	70,000	6.5					
	Water Trucks	60,000	19.5					
	Light Trucks	8,000	52					
	Mean Vehicle Weight	39,625	104	1.727526	15091.7	1160.9	2314.1	178.0
					PM10/Annual Wells		**PM2.5/Annual Wells**	
					(tons)		**(tons)**	
					285.2		43.7	
		Average	**Round**					
	Vehicle Type	**Weight**	**Trips per**	**PM10**	**PM10/Well**	**PM10/Well**	**PM2.5/Well**	**PM2.5/Well**
		(lbs)	**Well [a]**	**(lb/VMT)**	**(lbs)**	**(lb/day)**	**(lbs)**	**(lb/day)**
Drilling, Deep Downhole (days/well)	46							
	Haul Trucks	80,000	92					
	Logging/Mud Trucks	70,000	23.0					
	Water Trucks	60,000	69.0					
	Light Trucks	8,000	184					
	Mean Vehicle Weight	39,625	368	1.727526	53401.3	1160.9	8188.2	178.0
					PM10/Annual Wells		**PM2.5/Annual Wells**	
					(tons)		**(tons)**	
					94.4		1.5	
		Average	**Round**					
	Vehicle Type	**Weight**	**Trips per**	**PM10**	**PM10/Well**	**PM10/Well**	**PM2.5/Well**	**PM2.5/Well**
		(lbs)	**Well [a]**	**(lb/VMT)**	**(lbs)**	**(lb/day)**	**(lbs)**	**(lb/day)**
Drilling, Directional (days/well)	26							
	Haul Trucks	80,000	52					
	Logging/Mud Trucks	70,000	13					
	Water Trucks	60,000	39					
	Light Trucks	8,000	104					
	Mean Vehicle Weight	39,625	208	1.727526	30183.3	1160.9	4628.1	178.0
					PM10/Annual Wells		**PM2.5/Annual Wells**	
					(tons)		**(tons)**	
					284.1		43.6	
		Average	**Round**					
	Vehicle Type	**Weight**	**Trips per**	**PM10**	**PM10/Well**	**PM10/Well**	**PM2.5/Well**	**PM2.5/Well**
		(lbs)	**Well [a]**	**(lb/VMT)**	**(lbs)**	**(lb/day)**	**(lbs)**	**(lb/day)**
Drilling, Deep Directional (days/well)	92							
	Haul Trucks	80,000	184					
	Logging/Mud Trucks	70,000	46					
	Water Trucks	60,000	138					
	Light Trucks	8,000	368					
	Mean Vehicle Weight	39,625	736	1.727526	106802.5	1160.9	16376.4	178.0
					PM10/Annual Wells		**PM2.5/Annual Wells**	
					(tons)		**(tons)**	
					98.5		1663.0	
		Average	**Round**					
	Vehicle Type	**Weight**	**Trips per**	**PM10**	**PM10/Well**	**PM10/Well**	**PM2.5/Well**	**PM2.5/Well**
		(lbs)	**Well [a]**	**(lb/VMT)**	**(lbs)**	**(lb/day)**	**(lbs)**	**(lb/day)**
Completion (days/well)	31.25							
	Semi/Transport/Water/Sand	80,000	203					
	Haul Trucks	80,000	29					
	Light Trucks	8,000	116					
	Mean Vehicle Weight	56,000	348	2.018473	59004.0	1888.1	9047.3	289.5
					PM10/Annual Wells		**PM2.5/Annual Wells**	
					(tons)		**(tons)**	
					1829.1		280.5	
		Average	**Round**					
	Vehicle Type	**Weight**	**Trips per**	**PM10**	**PM10/Day**	**PM10/Day**	**PM2.5/Day**	**PM2.5/Day**
		(lbs)	**Well [a]**	**(lb/VMT)**	**(lbs)**	**(lb/day)**	**(lbs)**	**(lb/day)**
Field Development and Reclamation (days/well)	6							
	Haul Trucks	80,000	6					
	Light Trucks	8,000	18					
	Mean Vehicle Weight	26,000	24	1.429145	2881.2	480.2	441.8	73.6
					PM10/Annual Wells		**PM2.5/Annual Wells**	
					(tons)		**(tons)**	
					89.3		13.7	
Annual Traffic Fugitive Dust Emissions (tons/year)					**2775.90**		**2060.64**	

a Traffic Estimates are based upon an approximately 14-days construction, 13-days drilling at downhole locations (shallow wells), 26-days drilling at direction wells (shallow wells), 29-days completion, and 6-days infrastructure development per well or well pad as appropriate.

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4. Wind Erosion Fugitive Dust Emissions

Assumptions

Threshold Friction Velocity U_t^*	1.02	m/s (2.28 mph) for well pads (AP-42 Table 13.2.5-2 Overburden - Western Surface Coal Mine
	1.33	m/s (2.97 mph) for roads (AP-42 Table 13.2.5-2 Roadbed material)
Initial Disturbance Area	1838.0	acres total initial disturbance for roads/pipelines (Chapter 2)
	7,438,110	square meters total initial disturbance for roads/pipelines
	1,788	acres total initial disturbance for well pads and other facilities (Chapter 2)
	7,235,768	square meters total initial disturbance for well pads and other facilities
	3,626	acres total disturbance
Exposed Surface Type	Flat	
Meteorological Data	2002	Grand Junction (obtained from NCDC website)
Fastest Mile Wind Speed U_{10}^+	20.1	meters/sec (45 mph) reported as fastest 2-minute wind speed for Grand Junction (2002)
Number soil of disturbances	2	for well pads and facilities (Assumption, disturbance at construction and reclamation)
	Constant	for dirt roads
Development Period	15	years (Chapter 2)

Equations

Friction Velocity $U^* = 0.053\ U_{10}^+$

Erosion Potential P (g/m^2/period) = $58*(U^*-U_t^*)^2 + 25*(U^*-U_t^*)$ for $U^*>U_t^*$, P = 0 for $U^*< U_t^*$

Emissions (tons/year) = Erosion Potential(g/m^2/period)*Disturbed Area(m^2)*Disturbances/year*(k)/(453.6 g/lb)/2000 lbs/ton/Develop Period

Particle Size Multiplier (k)		
30 um	**<10 um**	**<2.5 um**
1.0	0.5	0.2

Maxium U_{10}^+ Wind Speed (m/s)	Maximum U* Friction Velocity m/s	Well U_t^* Threshold Velocity[a] m/s	Well Pad Erosion Potential g/m^2	Road U_t^* Threshold Velocity[a] m/s	Road Erosion Potential g/m^2
20.12	1.07	1.02	1.28	1.33	0.00

Wind Erosion Emissions

Particulate Species	Wells (tons/year)	Roads/Pipelines (tons/year)
TSP	1.36	0.00
PM10	0.68	0.00
PM2.5	0.27	0.00

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5. Construction Tailpipe Emissions

Assumptions:

Average Round Trip Distance	178.0	miles (Estimated from project area and existing road system)
Hours of Construction	140	hours per site (Chapter 2)
Number of Heavy Diesel Truck Trips	7	(Chapter 2)
Number of Pickup Trips	28	(Chapter 2)
Diesel Fuel sulfur content	0.05	% (Typical value)
Diesel Fuel density	7.08	lbs/gallon (Typical value)
Heavy Haul Diesel Fuel Efficiency	10	miles/gallon (Typical value)
Heavy Duty Pickup Fuel Efficiency	15	miles/gallon (Typical value)

Equations:

For NOx, CO and VOC:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (g/mile)} * \text{\# Trips} * \text{Trip Distance (miles)}}{\text{453.6 (g/lb)} * \text{2000 (lb/tons)}}$$

The NOx, CO and VOC emission factors for the above equation are from AP-42, while the SO2 emissions are calculated on a mass balance basis utilizing the following equation:

$$\text{SO2 E. Factor (g/mi)} = \frac{\text{Fuel Density (lb/gal)} * \text{453.6 (g/lb)} * \text{Fuel Sulfur Content} * \text{2 (S / SO2)}}{\text{Vehicle Fuel Efficiency (miles/gal)}}$$

Construction Vehicles	Heavy Haul Trucks			Heavy Duty Pickups			Total [d]	
	E. Factor [a] (g/mile)	Emissions (lb/hr)	Emissions (tons/yr/well)	E. Factor [b] (g/mile)	Emissions (lb/hr)	Emissions (tons/yr/well)	Emissions (lb/hr)	Emissions (tons/yr)
Criteria Pollutants & VOC								
NO_x	8.130	0.160	0.011	3.030	0.238	0.017	0.397	1.150
CO	17.090	0.335	0.023	33.640	2.640	0.185	2.975	8.609
VOC [c]	4.600	0.090	0.006	4.646	0.365	0.026	0.455	1.316
SO_2	0.321	0.006	0.000	0.214	0.017	0.001	0.023	0.067
Greenhouse Gases								
CH_4 [e]	0.230	0.005	0.000	0.184	0.014	0.001	0.019	0.055

a AP-42 Append. H Table 7.1.2 - H.D. Diesel Powered Vehicles, High Altitude, 1991 - 1997 Model Year, 50,000 miles (6/95)
b AP-42 Append. H Table 4.1A.2 - H.D. Gasoline Vehicles, High Altitude, 1991 - 1997 Vehicle Year, 50,000 miles (6/95)
c Emission factor is for total Hydrocarbons - Methane Offset
d Assumes construction rate specified by Proponent
e AP-42 Append. H Tables 7.10A.2 and 4.10A.2 H.D. Methane Offsets, High Altitude, 1986+ and 1988+ Vehicle Year

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6. Drilling Tailpipe Emissions

Assumptions:

Average Round Trip Distance	178.0	miles (Estimated from project area and existing road system)
Hours of Operation	508	hours per site (Chapter 2)
Number of Heavy Diesel Truck Trips	85	(Chapter 2)
Number of Pickup Trips	85	(Chapter 2)
Diesel Fuel sulfur content	0.05	% (Typical value)
Diesel Fuel density	7.08	lbs/gallon (Typical value)
Heavy Haul Diesel Fuel Efficiency	10	miles/gallon (Typical value)
Heavy Duty Pickup Fuel Efficiency	15	miles/gallon (Typical value)

Equations:

For NOx, CO and VOC:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (g/mile)} * \text{\# Trips} * \text{Trip Distance (miles)}}{\text{453.6 (g/lb)} * \text{2000 (lb/tons)}}$$

The NOx, CO and VOC emission factors for the above equation are from AP-42, while the SO2 emissions are calculated on a mass balance basis utilizing the following equation:

$$\text{SO2 E. Factor (g/mi)} = \frac{\text{Fuel Density (lb/gal)} * \text{453.6 (g/lb)} * \text{Fuel Sulfur Content} * \text{2 (S / SO2)}}{\text{Vehicle Fuel Efficiency (miles/gal)}}$$

Drilling Vehicles	Heavy Haul Trucks			Heavy Duty Pickups			Total [d]	
	E. Factor [a] (g/mile)	Emissions (lb/hr)	Emissions (tons/yr/well)	E. Factor [b] (g/mile)	Emissions (lb/hr)	Emissions (tons/yr/well)	Emissions (lb/hr)	Emissions (tons/yr)
Criteria Pollutants & VOC								
NO_x	8.13	0.532	0.135	3.03	0.198	0.050	0.730	11.500
CO	17.09	1.118	0.284	33.64	2.200	0.559	3.318	52.276
VOC [c]	4.600	0.301	0.076	1.656	0.108	0.028	0.409	6.447
SO_2	0.32	0.021	0.005	0.21	0.014	0.004	0.035	0.552
Greenhouse Gases								
CH_4 [e]	0.230	0.015	0.004	0.184	0.012	0.003	0.027	0.284

a AP-42 Append. H Table 7.1.2 - H.D. Diesel Powered Vehicles, High Altitude, 1991 - 1997 Model Year, 50,000 miles (6/95)
b AP-42 Append. H Table 4.1A.2 - H.D. Gasoline Vehicles, High Altitude, 1991 - 1997 Vehicle Year, 50,000 miles (6/95)
c Emission factor is for total Hydrocarbons - Methane Offset
d Assumes construction rate specified by Proponent
e AP-42 Append. H Tables 7.10A.2 and 4.10A.2 H.D. Methane Offsets, High Altitude, 1986+ and 1988+ Vehicle Year

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7. Completion Tailpipe Emissions

Assumptions:

Average Round Trip Distance	178.0	miles (Estimated from project area and existing road system)
Hours of Operation	750	hours per site (Chapter 2)
Number of Heavy Diesel Truck Trips	232	(Proponent)
Number of Pickup Trips	116	(Proponent)
Diesel Fuel sulfur content	0.05	% (Typical value)
Diesel Fuel density	7.08	lbs/gallon (Typical value)
Heavy Haul Diesel Fuel Efficiency	10	miles/gallon (Typical value)
Heavy Duty Pickup Fuel Efficiency	15	miles/gallon (Typical value)

Equations:

For NOx, CO and VOC:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (g/mile)} * \text{\# Trips} * \text{Trip Distance (miles)}}{\text{453.6 (g/lb)} * \text{2000 (lb/tons)}}$$

The NOx, CO and VOC emission factors for the above equation are from AP-42, while the SO2 emissions are calculated on a mass balance basis utilizing the following equation:

$$\text{SO2 E. Factor (g/mi)} = \frac{\text{Fuel Density (lb/gal)} * \text{453.6 (g/lb)} * \text{Fuel Sulfur Content} * \text{2 (S / SO2)}}{\text{Vehicle Fuel Efficiency (miles/gal)}}$$

Completion Vehicles	Heavy Haul Trucks			Heavy Duty Pickups			Total [d]	
	E. Factor [a] (g/mile)	Emissions (lb/hr)	Emissions (tons/yr/well)	E. Factor [b] (g/mile)	Emissions (lb/hr)	Emissions (tons/yr/well)	Emissions (lb/hr)	Emissions (tons/yr)
Criteria Pollutants & VOC								
NO_x	8.13	0.987	0.370	3.03	0.184	0.069	1.171	27.221
CO	17.09	2.075	0.778	33.64	2.042	0.766	4.116	95.703
VOC [c]	4.600	0.558	0.209	1.656	0.101	0.038	0.659	15.319
SO_2	0.32	0.039	0.015	0.21	0.013	0.005	0.052	1.208
Greenhouse Gases								
CH_4 [e]	0.230	0.028	0.010	0.184	0.011	0.004	0.039	0.606

a AP-42 Append. H Table 7.1.2 - H.D. Diesel Powered Vehicles, High Altitude, 1991 - 1997 Model Year, 50,000 miles (6/95)
b AP-42 Append. H Table 4.1A.2 - H.D. Gasoline Vehicles, High Altitude, 1991 - 1997 Vehicle Year, 50,000 miles (6/95)
c Emission factor is for total Hydrocarbons - Methane Offset
d Assumes construction rate specified by Proponent
e AP-42 Append. H Tables 7.10A.2 and 4.10A.2 H.D. Methane Offsets, High Altitude, 1986+ and 1988+ Vehicle Year

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8. Development Tailpipe Emissions

Assumptions:

Average Round Trip Distance	178.0	miles (Estimated from project area and existing road system)
Hours of Operation	20	hours per site (Assumption)
Number of Heavy Diesel Truck Trips	6	(Assumption)
Number of Pickup Trips	18	(Assumption)
Diesel Fuel sulfur content	0.05	% (Typical value)
Diesel Fuel density	7.08	lbs/gallon (Typical value)
Heavy Haul Diesel Fuel Efficiency	10	miles/gallon (Typical value)
Heavy Duty Pickup Fuel Efficiency	15	miles/gallon (Typical value)

Equations:

For NOx, CO and VOC:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (g/mile)} * \text{\# Trips} * \text{Trip Distance (miles)}}{\text{453.6 (g/lb)} * \text{2000 (lb/tons)}}$$

The NOx, CO and VOC emission factors for the above equation are from AP-42, while the SO2 emissions are calculated on a mass balance basis utilizing the following equation:

$$\text{SO2 E. Factor (g/mi)} = \frac{\text{Fuel Density (lb/gal)} * \text{453.6 (g/lb)} * \text{Fuel Sulfur Content} * \text{2 (S / SO2)}}{\text{Vehicle Fuel Efficiency (miles/gal)}}$$

Development Vehicles	Heavy Haul Trucks			Heavy Duty Pickups			Total [d]	
	E. Factor [a] (g/mile)	Emissions (lb/hr)	Emissions (tons/yr/well)	E. Factor [b] (g/mile)	Emissions (lb/hr)	Emissions (tons/yr/well)	Emissions (lb/hr)	Emissions (tons/yr)
Criteria Pollutants & VOC								
NO_x	8.13	0.957	0.010	3.03	1.070	0.011	2.027	0.838
CO	17.09	2.012	0.020	33.64	11.881	0.119	13.893	5.742
VOC [c]	4.600	0.542	0.005	1.656	0.585	0.006	1.126	0.466
SO_2	0.32	0.038	0.000	0.21	0.076	0.001	0.113	0.047
Greenhouse Gases								
CH_4 [e]	0.230	0.027	0.000	0.184	0.065	0.001	0.092	0.038

a AP-42 Append. H Table 7.1.2 - H.D. Diesel Powered Vehicles, High Altitude, 1991 - 1997 Model Year, 50,000 miles (6/95)
b AP-42 Append. H Table 4.1A.2 - H.D. Gasoline Vehicles, High Altitude, 1991 - 1997 Vehicle Year, 50,000 miles (6/95)
c Emission factor is for total Hydrocarbons - Methane Offset
d Assumes construction rate specified by Proponent
e AP-42 Append. H Tables 7.10A.2 and 4.10A.2 H.D. Methane Offsets, High Altitude, 1986+ and 1988+ Vehicle Year

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9. Construction Heavy Equipment Tailpipe Emissions

Assumptions:

Hours of Operation	140	hours/site (Chapter 2)
Development Rate	41	new pads per year (Chapter 2)
Load Factor	0.4	(Assumed typical value)
Backhoe Size	100	hp (Assumed Typical value)
Crawler Tractor/Loader Size	150	hp (Assumed Typical value)
Motor Grader Size	135	hp (Assumed Typical value)

Equations:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (g/hp-hr)} * \text{Rated Horsepower (hp)} * \text{Operating Hours (hrs)} * \text{Load Factor (Dimensionless)}}{\text{453.6 (g/lb)} * \text{2000 (lb/tons)}}$$

Heavy Const. Vehicles	Backhoe			Crawler Tractor			Grader			Loader		
	E. Factor [a] (g/hp-hr)	Emissions (lb/hr)	Emissions[e] (tons/yr)	E. Factor [a] (g/hp-hr)	Emissions (lb/hr)	Emissions[e] (tons/yr)	E. Factor [b] (g/hp-hr)	Emissions (lb/hr)	Emissions[e] (tons/yr)	E. Factor [a] (g/hp-hr)	Emissions (lb/hr)	Emissions[e] (tons/yr)
NO_x	8.15	0.719	2.079	8.15	1.078	3.119	7.14	0.850	2.459	8.15	1.078	3.119
CO	2.28	0.201	0.582	2.28	0.302	0.873	1.54	0.183	0.530	2.28	0.302	0.873
VOC [c]	0.37	0.033	0.094	0.37	0.049	0.142	0.36	0.043	0.124	0.37	0.049	0.142
PM_{10} [d]	0.5	0.044	0.128	0.5	0.066	0.191	0.63	0.075	0.217	0.5	0.066	0.191
$PM_{2.5}$ [d]	0.5	0.044	0.128	0.5	0.066	0.191	0.63	0.075	0.217	0.5	0.066	0.191
SO_2	0.22	0.019	0.056	0.22	0.029	0.084	0.22	0.026	0.076	0.22	0.029	0.084
Formaldehyde	0.22	0.019	0.056	0.22	0.029	0.084	0.12	0.014	0.041	0.22	0.029	0.084

Heavy Const. Vehicles	Total	
	Emissions (lb/hr)	Emissions[e] (tons/yr)
NO_x	3.725	10.777
CO	0.988	2.857
VOC [c]	0.173	0.502
PM_{10} [d]	0.251	0.727
$PM_{2.5}$ [d]	0.251	0.727
SO_2	0.104	0.300
Formaldehyde	0.092	0.266

a AP-42 Volume II, Mobile Sources, Nonroad Vehicles, Table 11-7.1 Off-highway truck
b AP-42 Volume II, Mobile Sources, Nonroad Vehicles, Table 11-7.1 Motor Grader
c Emission Factor represents total Hydrocarbon Emissions
d All emitted particulate matter assumed to be PM2.5
e Assumes construction rate specified by Proponent

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10. Drill Rig Engine Emissions

Assumptions:

Hours of Operation	508	hours/ well (Chapter 2)
Development Rate	62	total wells per year (Chapter 2)
	9%	average deep wells per year (based on Propoent estimate of 70 deep wells total Project)
	5	deep well per year
	57	shallow wells per year
Load Factor	0.4	(Assumed typical value)
Rig Size	875	hp (Proponent Estimate - shallow wells)
	2250	hp (Proponent Estimate - deep wells)
	994	hp (weighted average based on ratio of shallow to deep wells)
Diesel Fuel Sulfur Content	0.05	% (typical value)

Equations:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (lb/hp-hr)} * \text{Rated Horsepower (hp)} * \text{Operating Hours (hrs)} * \text{Load Factor (Dimensionless)}}{\text{2000 (lb/tons)}}$$

SO2 E. Factor (lb/hp-hr) = Fuel sulfur content * 0.00809

Species	Drill Rig Emissions		
	E. Factor [a] (lb/hp-hr)	Emissions (lb/hr)	Emissions [g] (tons/yr)
Criteria Pollutants & VOC			
NO_x	9.92E-03	3.946	62
CO	1.685E-03	0.670	10.557
VOC [b]	6.61E-04	0.263	4.1
PM_{10} [c]	2.901E-04	0.115	1.818
$PM_{2.5}$ [d]	2.901E-04	0.115	1.818
SO_2 [e]	0.0004045	0.161	2.535
Greenhouse Gases			
CO_2 [e]	1.16	461.341	7,269
CH_4 [e,f]	0.000705	0.280	4.42

[a] EPA Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling--Compression-Ignition NR-009c, April 2004
[b] Nonmethanehydrocarbons
[c] Total Particulates
[d] All PM10 assumed to be PM2.5 (based on ???)
[e] AP-42 Volume I, Large Stationary Diesel Engines Table 3.4-1, 10/96
[f] Emission Factor represents total Hydrocarbon Emissions
[g] Assumes rate specified by Proponent

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11. Well Fracturing Pump and Generator Engines

Assumptions:

Average Hours of Operation	3	Hours/Well (Proponents)
Development Rate	62	wells per year (Proposed Action)
Load Factor	0.7	(Proponents)
Frac Pump Engine Horsepower	5,000	Horsepower (Proponents)
Temporary Generator Horsepower	75	Horsepower (Proponents: 2-3 engines @ 10-50 hp each)
Diesel Fuel Sulfur Content	0.05	% (typical value)

Equations:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (lb/hp-hr)} * \text{Rated Horsepower (hp)} * \text{Operating Hours (hrs)} * \text{Load Factor (Dimensionless)}}{\text{2000 (lb/tons)}}$$

SO2 E. Factor (lb/hp-hr) = Fuel sulfur content * 0.00809

Species	Frac Pump Engine Emissions		
	E. Factor [a] (lb/hp-hr)	Emissions (lb/hr)	Emissions [e] (tons/yr)
Criteria Pollutants & VOC			
NO_x	0.024	84.000	7.812
CO	0.0055	19.250	1.790
VOC [b]	0.000705	2.468	0.229
PM_{10} [c]	0.000573	2.006	0.187
$PM_{2.5}$ [d]	0.000479	1.677	0.156
SO_2	0.0004045	1.416	0.132
Greenhouse Gases			
CO_2	1.16	4,060.000	377.580
CH_4 [b]	0.000705	2.468	0.229

Species	Generator Engine Emissions		
	E. Factor [f] (lb/hp-hr)	Emissions (lb/hr)	Emissions [e] (tons/yr)
Criteria Pollutants			
NO_x	0.031	1.628	0.151
CO	0.006680	0.351	0.033
VOC [b]	0.002470	0.130	0.012
PM_{10}	0.002200	0.116	0.011
$PM_{2.5}$ [g]	0.002200	0.116	0.011
SO_2	0.0004045	0.021	0.002
Greenhouse Gases			
CO_2	1.08	3,780.000	351.540
CH_4 [b]	0.002470	8.645	0.804

a AP-42 Volume I, Large Stationary Diesel Engines Table 3.4-1, 10/96
b Emission Factor represents total Hydrocarbon Emissions
c Total particulate emission factor is 0.0007, PM10 fraction determined from Table 3.4-2
d Total particulate emission factor is 0.0007, PM2.5 fraction determined from Table 3.4-2
e Assumes maximum development scenario
f AP-42 Table 3.3-1, Emission Factors for Uncontrolled Gasoline and Diesel Industrial Engines, 10/96
g All particulates are PM10

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12. Completion Flare Emissions

Assumptions

Hours of Operation	2	days (Typical)
Amount of Gas Flared	5	MMscf/well (Assumption, based on initial Production Rates)
Average Gas Heat Content	1066	Btu/scf (Wellsite Gas Composition)
Average Gas VOC Content	8.089	weight % (Wellsite Gas Composition)
Average Mole Weight	18.3	lb/lb-mole (Wellsite Gas Composition)
Development rate	62	gas wells per year

Equations

NOx/CO Emissions (lb/well) = Emission Factor (lb/MM Btu) * Gas Amount (MMscf/well) * Heat Content (Btu/scf)

PM/HAP Emissions (lb/well) = Emission Factor (lb/MMscf) * Gas Amount (MMscf/well)

$$\text{Flare Gas Wt. (lb/well)} = \frac{\text{Flare Gas Volume (MMscf/well)} * 10^6 \text{ (scf/MMscf)} * \text{Mole Weight (lb/lb-mole)}}{379.49 \text{ (scf/mole)}}$$

VOC Emissions (lb/well) = Flare Gas Wt. (lb/well) * VOC wt. % * 0.02 (Assumes 98% destruction Efficiency)

Species	**Emission Factor (lb/MMBtu)**	**Well Emissions (lb/well)**	**Well Emissions (lb/hr/well)**	**Total Emissions [e] (tons/yr)**
Criteria Pollutants & VOC				
NO_x [a]	0.068	362.4	7.55	11.23
CO [a]	0.37	1971.9	41.08	61.13
VOC	N.A.	390.0	8.12	12.09
SO_x [b]	0.00	0.0	0.00	0.00
TSP [c]	7.6	38	0.792	1.178
PM_{10} [c]	7.6	38	0.792	1.178
$PM_{2.5}$ [c]	7.6	38	0.792	1.178
Hazardous Air Pollutants				
Benzene [d]	0.0021	0.0105	0.000	0.000
Toluene [d]	0.0034	0.017	0.000	0.001
Hexane [d]	1.8	9	0.188	0.279
Formaldehyde [d]	0.075	0.375	0.008	0.012
Greenhouse Gases				
CO_2 [c]	120,000	600,000	12,500	18,600
CH_4 [a]	0.14	746.1	15.54	23.13

a AP-42 Table 13.5-1, Emission Factors for Flare Operations, 9/91
b Assumes produced gas contains no sulfur
c AP-42 Table 1.4-2, Emission Factors for Natural Gas Combustion, 3/98 (All Particulates are PM1.0)
d AP-42 Table 1.4-3, Emission Factors for Organic Compounds from Natural Gas Combustion, 3/98
e Assumes proposed development rate

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13. Well Development Emissions Summary

Species	Well Development Emissions (tons/year) [a]				Wind Erosion	Total [a] (tons/yr)
	Construction	Drilling	Completion	Development & Reclamation		
Criteria Pollutants & VOC						
NO_x	11.9	73.7	46.4	0.8		132.8
CO	11.5	62.8	158.7	5.7		238.7
VOC	1.8	10.6	27.6	0.5		40.5
SO_2	0.4	3.1	1.3	0.0		4.8
PM_{10}	99.3	763.9	1,830.5	89.7	0.7	2,784.1
$PM_{2.5}$	17.7	1,753.7	281.8	13.8	0.3	2,067.3
Hazardous Air Pollutants						
Benzene			0.0			
Toluene			0.0			
Ethylbenzene						
Xylene						
n-Hexane			0.3			
Formaldehyde	0.3		0.0			0.3
Total HAPs	0.3	0.0	0.3	0.0	0.0	0.3
Greenhouse Gases						
CO_2		7,268.8	19,329.1			26,597.9
CH_4	0.1	4.7	24.8	0.0		29.6

[a] Emissions for Peak Field Development

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14. Average Produced Gas Characteristics
Inlet Wet Gas Sample Average of Seven Samples from BBC area wellsites

Gas Heat Value (wet): 1065.9 Btu/scf

C1-C2 Wt. Fraction: 0.8742
VOC Wt. Fraction: 0.0809
Non-HC Wt. Fraction: 0.0449
Total: 1.0000

COMPONENT	MOLE PERCENT	COMPONENT MOLE WEIGHT (lb/lb-mole)	NET MOLE WEIGHT (lb/lb-mole)	WEIGHT FRACTION	GROSS HEATING VALUE (BTU/scf)	NET DRY HEATING VALUE (BTU/scf)	LOWER HEATING VALUE (BTU/scf)	NET LOW HEATING VALUE (BTU/scf)
Methane	90.1926	16.043	14.470	0.791	1010.000	910.946	910.000	820.753
Ethane	5.0663	30.070	1.523	0.083	1769.800	89.664	1618.000	81.973
Propane	1.5002	44.097	0.662	0.036	2516.200	37.748	2316.000	34.745
i-Butane	0.3123	58.123	0.182	0.010	3252.100	10.156	3005.000	9.385
n-Butane	0.3302	58.123	0.192	0.010	3262.400	10.771	3013.000	9.948
i-Pentane	0.1359	72.150	0.098	0.005	4000.900	5.437	3698.000	5.025
n-Pentane	0.0980	72.150	0.071	0.004	4008.800	3.927	3708.000	3.632
Hexanes	0.2603	86.177	0.224	0.012	4756.200	12.380	4404.000	11.463
Heptanes	0.0305	100.204	0.031	0.002	5502.500	1.678	5100.000	1.556
Octanes	0.0133	114.231	0.015	0.001	6249.100	0.833		0.000
Nonanes	0.0047	128.258	0.006	0.000	6996.400	0.331		0.000
Decanes	0.0000	142.285	0.000	0.000	7743.200	0.000		0.000
Benzene	0.0000	78.120	0.000	0.000	3715.500	0.000		0.000
Toluene	0.0000	92.130	0.000	0.000	4444.600	0.000		0.000
Ethylbenzene	0.0000	106.160	0.000	0.000	5191.500	0.000		0.000
Xylenes	0.0000	106.160	0.000	0.000	5183.500	0.000		0.000
n-Hexane	0.0000	86.177	0.000	0.000	4756.200	0.000		0.000
Helium	0.0000	4.003	0.000	0.000	0.000	0.000	0.000	0.000
Nitrogen	0.5155	28.013	0.144	0.008	0.000	0.000	0.000	0.000
Carbon Dioxide	1.5401	44.010	0.678	0.037	0.000	0.000	0.000	0.000
Oxygen	0.0000	32.000	0.000	0.000	0.000	0.000	0.000	0.000
Hydrogen Sulfide	0.0000	34.080	0.000	0.000	637.100	0.000	588.000	0.000
TOTAL	100.00		18.30	1.00		1083.87		978.48

Relative Mole Weight (lb/lb-mole) = [Mole Percent * Molecular weight (lb/lb-mole)] / 100

Weight Fraction = Net Mole Weight / Total Mole Weight

HAP Fractions estimated from GRI Published Factors

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15. Wellsite Pumping Unit Engines

Assumptions:

Pumpjack Engine Size: 40 Horsepower (Proponent)
Number of Wells Requiring Pumping Unit Engines: 80.7 wells (Estimated at 10 % of Peak Production Wells)

Equations:

$$\text{Emissions (lbs/hr)} = \frac{\text{Emission Factor (g/hp-hr)} * \text{Power (hp)}}{453.6 \text{ g/lb}}$$

Pollutant	Emission Factor [3] (lb/MMBtu)	Emission Factor (g/hp-hr)	Emissions (lb/hr/well)	Total Emissions Alternative C (tons/yr)
Criteria Pollutants & VOC				
NOx [5]		1.5	0.13	46.8
CO [5]		2.0	0.18	62.3
VOC [5]		1.0	0.09	31.2
PM10 [1,4]	0.0194	0.070	0.01	2.2
PM2.5 [1,4]	0.0194	0.070	0.01	2.2
SO_2 [2]	0.0	0.000	0.00	0.0
Hazardous Air Pollutants				
Benzene [1]	0.001580	0.00574	0.00	0.2
Toluene [1]	0.000558	0.00203	0.00	0.1
Ethylbenzene [1]	0.000025	0.00009	0.00	0.0
Xylenes [1]	0.000195	0.00071	0.00	0.0
Formaldehyde [1]	0.0205	0.07	0.01	2.3
Greenhouse Gases				
CO_2 [1]	110.0	399.52000	35.23	12,453.0
CH_4 [1]	0.2	0.83536	0.07	26.0

1 - AP-42 Table 3.2-3 Uncontrolled Emission Factors for 4-Stroke Rich-Burn Engines, 7/00
2 - Fuel gas is assumed to be free from sulfur compounds
3 - Conversion from lb/MMBtu to g/hp-hr assumes an average heat rate of 8,000 Btu/hp-hr (*3.632)
4 - PM = sum of PM filterable and PM condensable
5 - Utah typical BACT control rates for internal combustion engines

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16. Wellsite Dehydrator Emissions

Assumptions

Average Production Rate: 0.384 MMscf/day/well (Average for life of the well, Chapter 2)
Number of Active Wells Requiring Separators: 807 wells at Peak Production
Wells Requiring Dehydrators: 202 (25% of wells, Chapter 2)

Gas Composition: Inlet Gas Sample from Average of Seven Existing Wells

Inlet Gas Conditions: Inlet gas saturated at 200 psi and 70 F (Proponent Estimate)

Glycol Circulation Rate: 3 gallons/ lb of water
(Typical operating rate)

Calculations

Dehydrator emissions were simulated using GRI GlyCalc version 4.0

Controls

Flare to achieve 95% Control Efficiency controlling tank and dehydrator emissions on wellpad (Chapter 2)

Emissions

Species	**Well Dehydrator Emissions (lbs/hr/well)**	**Well Dehydrator Emissions (tons/year/well)**	**Total Project Emissions (tons/year)**
Total VOC	0.0078	0.03	6.89
Hazardous Air Pollutants			
Benzene	0.0017	0.01	1.50
Toluene	0.0021	0.01	1.86
Ethylbenzene	0.0001	4.38E-04	0.09
Xylenes	0.0006	2.63E-03	0.53
n-Hexane	0.0002	8.76E-04	0.18
Greenhouse Gases			
CH_4	0.005	0.02	3.98

17. Wellsite Heater Emissions

Assumptions

Dehydrator Reboiler Heater Size	750	Mbtu/hr (Chapter 2)
Separator Heater Size	500	Mbtu/hr (Chapter 2)
Tank Heater Size	500	Mbtu/hr (Proponent)
Wells Requiring Separators:	807	wells at Peak Production
Wells Requiring Dehydrators:	202	(25% of wells, Chapter 2)
Wells Requiring Tank Heaters:	807	per pad (one to two tanks per pad, Chapter 2)
Firing Rate	6,480	hours/year (Proponent)
Fuel Gas Heat Value	1066	Btu/scf (Gas Analyses from Dry Canyon Facility)
Fuel Gas VOC Content	0.081	by weight (Gas Analyses from Dry Canyon Facility)

Equations

$$\text{Fuel Consumption (MMscf/yr)} = \frac{\text{Heater Size (MBtu/hr)} * 1{,}000\ \text{(Btu/MBtu)} * \text{Hours of Operation (hrs/yr)}}{\text{Fuel Heat Value (Btu/scf)} * 1{,}000{,}000\ \text{(scf/MMscf)}}$$

$$\text{NOx/CO/TOC Emissions (tons/yr)} = \frac{\text{AP-42 E.Factor (lbs/MMscf)} * \text{Fuel Consumption (MMscf/yr)} * \text{Fuel heating Value (Btu/scf)}}{2{,}000\ \text{(lbs/ton)} * 1{,}000\ \text{(Btu/scf - Standard Fuel Heating Value)}}$$

$$\text{VOC Emissions (tons/yr)} = \text{TOC Emissions (tons/yr)} * \text{VOC wt. fraction}$$

Species	Wellsite Heater Emissions - Separators			Wellsite Heater Emissions - Dehydrators			Wellsite Heater Emissions - Tanks			
	Emission Factor (lb/MMscf)	Well Emissions (lb/hr/well)	Total Emissions (tons/yr)	Emission Factor (lb/MMscf)	Well Emissions (lb/hr/well)	Total Emissions (tons/yr)	Emission Factor (lb/MMscf)	Well Emissions (lb/hr/well)	Total Emissions (tons/yr)	Total Emissions (tons/yr)
Criteria Pollutants & VOC										
NO_x [a]	100	0.047	122.652	100	0.070	45.995	100	0.047	122.652	291.299
CO [a]	84	0.039	103.028	84	0.059	38.635	84	0.039	103.028	244.691
TOC [c]	11	0.005	13.492	11	0.008	5.059	11	0.005	13.492	32.043
VOC	N.A.	0.000	1.091	N.A.	0.001	0.409	N.A.	0.000	1.091	2.592
SO_x [b]	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.000
TSP [c]	7.6	0.004	9.322	7.6	0.005	3.496	7.6	0.004	9.322	22.139
PM_{10} [c]	7.6	0.004	9.322	7.6	0.005	3.496	7.6	0.004	9.322	22.139
$PM_{2.5}$ [c]	7.6	0.004	9.322	7.6	0.005	3.496	7.6	0.004	9.322	22.139
Hazardous Air Pollutants										
Benzene [d]	0.0021	0.000	0.003	0.0021	0.000	0.001	0.0021	0.000	0.003	0.006
Toluene [d]	0.0034	0.000	0.004	0.0034	0.000	0.002	0.0034	0.000	0.004	0.010
Hexane [d]	1.8	0.001	2.208	1.8	0.001	0.828	1.8	0.001	2.208	5.243
Formaldehyde [d]	0.075	0.000	0.092	0.075	0.000	0.034	0.075	0.000	0.092	0.218
Greenhouse Gases										
CO_2 [c]	120,000	56.29	147,182.73	120,000	84.436	55,193.524	120,000	56.29	147,182.730	349,558.985
CH_4 [c]	2.3	0.001	2.821	2.3	0.002	1.058	2.3	0.001	2.821	6.700

a AP-42 Table 1.4-1, Emission Factors for Natural Gas Combustion, 7/98
b Assumes produced gas contains no sulfur
c AP-42 Table 1.4-2, Emission Factors for Natural Gas Combustion, 7/98 (All Particulates are PM1.0)
d AP-42 Table 1.4-3, Emission Factors for Organic Compounds from Natural Gas Combustion, 7/98

18. Wellsite Condensate Storage Tank Flash/Working/Standing Emissions

Assumptions:

Average Condensate Production Rate: 1.5 bbls condensate per day (Average for life of the well, Chapter 2))
Number of Active Wells: 807 wells at Peak Production

Separator Conditions : 150 psi and 105 F (Proponent Average Estimate)
API Gravity of Sales Oil: 52.3

Calculations:

Condensate tank flashing/working/breathing emissions estimated with E&P Tanks 2.0
Dry Canyon Compressor Station Liquid Sample Dated 2/21/04
Controlled with 95% efficiency

Emissions:

Component	Wellsite Flash/Work/Breathing (lb/hr/well)	Wellsite Flash/Work/Breathing (tons/year/well)	Total Emissions (tons/yr)
Total VOC	0.074	0.323	260.805
Hazardous Air Pollutants			
Benzene	4.050E-04	1.77E-03	1.432
Toluene	2.250E-04	9.86E-04	0.795
Ethylbenzene	0.000E+00	0.00E+00	0.000
Xylenes	3.000E-05	1.31E-04	0.106
n-Hexane	0.002	7.69E-03	6.203
Greenhouse Gases			
CO_2	0.009	0.038	31.017
CH_4	0.007	0.030	24.495

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19. Well Blowdown Emissions

Assumptions: During Production, a percentage of the wells are periodically blown down to unload fluids

# of New Producing Wells	807	wells at Peak Production (Year 20)
Blowdown Frequency	104	Wells per Year (2 per week for 52 weeks for 1 hour each, Project Proponents)
Blowdown Volume	16	Mscf/event (Estimated from Average Production Data)
Annual Blowdown Volume	1.7	MMscf/year

COMPONENT	MOLECULAR WEIGHT (lb/lb-mole)	MOLE PERCENT	RELATIVE MOLE WEIGHT (lb/lb-mole)	WEIGHT Fraction	COMPONENT FLOW RATE (Mscf/hr)	COMPONENT FLOW RATE (lb/hr/well)	COMPONENT FLOW RATE (tons/yr)
Methane	16.043	90.193	14.470	0.791	14.418	609.536	1648.184
Ethane	30.07	5.066	1.523	0.083	0.810	64.176	173.531
Propane	44.097	1.500	0.662	0.036	0.240	27.868	75.355
i-Butane	58.123	0.312	0.182	0.010	0.050	7.646	20.676
n-Butane	58.123	0.330	0.192	0.010	0.053	8.084	21.858
i-Pentane	72.15	0.136	0.098	0.005	0.022	4.130	11.168
n-Pentane	72.15	0.098	0.071	0.004	0.016	2.977	8.050
Hexanes	86.177	0.260	0.224	0.012	0.042	9.449	25.550
Heptanes	100.204	0.031	0.031	0.002	0.005	1.287	3.481
Octanes	114.231	0.013	0.015	0.001	0.002	0.641	1.734
Nonanes	128.258	0.005	0.006	0.000	0.001	0.255	0.691
Decanes +	142.285	0.000	0.000	0.000	0.000	0.000	0.000
Benzene	78.12	0.000	0.000	0.000	0.000	0.000	0.000
Toluene	92.13	0.000	0.000	0.000	0.000	0.000	0.000
Ethylbenzene	106.16	0.000	0.000	0.000	0.000	0.000	0.000
Xylenes	106.16	0.000	0.000	0.000	0.000	0.000	0.000
n-Hexane	86.177	0.000	0.000	0.000	0.000	0.000	0.000
Helium	4.003	0.000	0.000	0.000	0.000	0.000	0.000
Nitrogen	28.013	0.516	0.144	0.008	0.082	6.083	16.449
Carbon Dioxide	44.01	1.540	0.678	0.037	0.246	28.553	77.207
Oxygen	32	0.000	0.000	0.000	0.000	0.000	0.000
Hydrogen Sulfide	34.08	0.000	0.000	0.000	0.000	0.000	0.000
VOC SUBTOTAL		**2.68535714**	**1.480**	**0.081**	**0.429**	**62.339**	**168.564**
HAP SUBTOTAL		**0**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
TOTAL		**100.000**	**18.295**	**1.000**	**16**	**770.686**	**2083.936**

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20. Liquid Level Controller Emissions

Company: **BBC**
Location: **WTP EIS**

GAS COMPONENT	MOLECULAR WEIGHT (lb/lb-mole)	MOLE PERCENT	RELATIVE MOLE WEIGHT (lb/lb-mole)	WEIGHT PERCENT	COMPONENT FLOW RATE (Mscf/day)	COMPONENT FLOW RATE (lb/hr)	COMPONENT FLOW RATE (tons/yr/well)
Methane	16.043	91.307	14.64838201	81.48852235	0.83271984	1.46680681	6.424613828
Ethane	30.07	5.305	1.5952135	8.874126225	0.0483816	0.159735732	0.699642507
Propane	44.097	1.536	0.67732992	3.767966612	0.01400832	0.067824019	0.297069203
i-Butane	58.123	0.337	0.19587451	1.089644193	0.00307344	0.019613775	0.085908333
n-Butane	58.123	0.387	0.22493601	1.25131247	0.00352944	0.02252383	0.098654377
i-Pentane	72.15	0.166	0.119769	0.666271458	0.00151392	0.011992996	0.052529322
n-Pentane	72.15	0.117	0.0844155	0.469600967	0.00106704	0.008452895	0.037023679
Hexanes	86.177	0.113	0.09738001	0.541722159	0.00103056	0.009751088	0.042709765
Heptanes	100.204	0.042	0.04208568	0.234121412	0.00038304	0.004214224	0.018458301
Octanes	114.231	0.008	0.00913848	0.050837098	0.00007296	0.000915076	0.004008033
Nonanes	128.258	0	0	0	0	0	0
Decanes +	142.285	0	0	0	0	0	0
Benzene	78.12	0.01	0.007812	0.043457928	0.0000912	0.00078225	0.003426254
Toluene	92.13	0.006	0.0055278	0.03075099	0.00005472	0.000553523	0.00242443
Ethylbenzene	106.16	0	0	0	0	0	0
Xylenes	106.16	0.001	0.0010616	0.00590565	0.00000912	0.000106303	0.000465606
n-Hexane	86.177	0.041	0.03533257	0.196554058	0.00037392	0.003538005	0.015496464
Helium	4.003	0.018	0.00072054	0.004008343	0.00016416	7.21508E-05	0.000316021
Nitrogen	28.013	0.223	0.06246899	0.347513171	0.00203376	0.006255294	0.027398189
Carbon Dioxide	44.01	0.383	0.1685583	0.937684912	0.00349296	0.016878483	0.073927754
Oxygen	32	0	0	0	0	0	0
Hydrogen Sulfide	34.08	0	0	0	0	0	0
VOC SUBTOTAL		**2.764**	**1.50066308**	**8.348144994**	**0.02520768**	**0.150267983**	**0.658173768**
HAP SUBTOTAL		**0.058**	**0.04973397**	**0.276668626**	**0.00052896**	**0.004980081**	**0.021812754**
TOTAL		**100**	**17.97600642**	**100**	**0.912**	**1.800016454**	**7.884072067**

EQUIPMENT SPECIFICATIONS

Gas Consumption Rate:	0.912 Mscf/day
Days of Operation:	365 days/year

	Number of Wells	VOC emissions (tons/year)
Alternative C	807	1062

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Project: WTP Alternative C Inventory
Date: 9/17/2008

21. Trace Pump Emissions

Company: **BBC**
Location: **WTP EIS**

GAS COMPONENT	MOLECULAR WEIGHT (lb/lb-mole)	MOLE PERCENT	RELATIVE MOLE WEIGHT (lb/lb-mole)	WEIGHT PERCENT	COMPONENT FLOW RATE (Mscf/day)	COMPONENT FLOW RATE (lb/hr)	COMPONENT FLOW RATE (tons/yr/well)
Methane	16.043	91.307	14.64838201	81.48852235	13.148208	23.16010753	58.91931355
Ethane	30.07	5.305	1.5952135	8.874126225	0.76392	2.522143139	6.416332147
Propane	44.097	1.536	0.67732992	3.767966612	0.221184	1.070905563	2.724383752
i-Butane	58.123	0.337	0.19587451	1.089644193	0.048528	0.30969118	0.787854363
n-Butane	58.123	0.387	0.22493601	1.25131247	0.055728	0.355639427	0.904746701
i-Pentane	72.15	0.166	0.119769	0.666271458	0.023904	0.189363093	0.481739708
n-Pentane	72.15	0.117	0.0844155	0.469600967	0.016848	0.133466758	0.339539432
Hexanes	86.177	0.113	0.09738001	0.541722159	0.016272	0.153964547	0.391685808
Heptanes	100.204	0.042	0.04208568	0.234121412	0.006048	0.066540378	0.169278721
Octanes	114.231	0.008	0.00913848	0.050837098	0.001152	0.01444857	0.036757163
Nonanes	128.258	0	0	0	0	0	0
Decanes +	142.285	0	0	0	0	0	0
Benzene	78.12	0.01	0.007812	0.043457928	0.00144	0.012351314	0.031421742
Toluene	92.13	0.006	0.0055278	0.03075099	0.000864	0.008739835	0.02223414
Ethylbenzene	106.16	0	0	0	0	0	0
Xylenes	106.16	0.001	0.0010616	0.00590565	0.000144	0.001678463	0.00427001
n-Hexane	86.177	0.041	0.03533257	0.196554058	0.005904	0.055863243	0.14211609
Helium	4.003	0.018	0.00072054	0.004008343	0.002592	0.001139224	0.002898185
Nitrogen	28.013	0.223	0.06246899	0.347513171	0.032112	0.098767804	0.251265294
Carbon Dioxide	44.01	0.383	0.1685583	0.937684912	0.055152	0.266502358	0.677982
Oxygen	32	0	0	0	0	0	0
Hydrogen Sulfide	34.08	0	0	0	0	0	0
VOC SUBTOTAL		**2.764**	**1.50066308**	**8.348144994**	**0.398016**	**2.37265237**	**6.03602763**
HAP SUBTOTAL		**0.058**	**0.04973397**	**0.276668626**	**0.008352**	**0.078632855**	**0.200041982**
TOTAL		**100**	**17.97600642**	**100**	**14.4**	**28.42131242**	**72.30381881**

PUMP SPECIFICATIONS

Pump Mfg.:	LEON
Injection Pressure:	20 psi
Mfg. Gas Consumption Rate:	10 scf/min
Gas Consumption Rate:	14.40 Mscf/day
Days of Operation:	212 days/year

	Number of Wells	VOC emissions (tons/year)
Alternative C	807	4871

Buys & Associates, Inc.
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Project: WTP Alternative C Inventory
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22. Pneumatic Methanol Injection Pump Emissions

Company: **BBC**
Location: **WTP EIS**

GAS COMPONENT	MOLECULAR WEIGHT (lb/lb-mole)	MOLE PERCENT	RELATIVE MOLE WEIGHT (lb/lb-mole)	WEIGHT PERCENT	COMPONENT FLOW RATE (Mscf/day)	COMPONENT FLOW RATE (lb/hr)	COMPONENT FLOW RATE (tons/yr)
Methane	16.043	91.307	14.64838201	81.48852235	0.39444624	0.694803226	1.767579407
Ethane	30.07	5.305	1.5952135	8.874126225	0.0229176	0.075664294	0.192489964
Propane	44.097	1.536	0.67732992	3.767966612	0.00663552	0.032127167	0.081731513
i-Butane	58.123	0.337	0.19587451	1.089644193	0.00145584	0.009290735	0.023635631
n-Butane	58.123	0.387	0.22493601	1.25131247	0.00167184	0.010669183	0.027142401
i-Pentane	72.15	0.166	0.119769	0.666271458	0.00071712	0.005680893	0.014452191
n-Pentane	72.15	0.117	0.0844155	0.469600967	0.00050544	0.004004003	0.010186183
Hexanes	86.177	0.113	0.09738001	0.541722159	0.00048816	0.004618936	0.011750574
Heptanes	100.204	0.042	0.04208568	0.234121412	0.00018144	0.001996211	0.005078362
Octanes	114.231	0.008	0.00913848	0.050837098	0.00003456	0.000433457	0.001102715
Nonanes	128.258	0	0	0	0	0	0
Decanes +	142.285	0	0	0	0	0	0
Benzene	78.12	0.01	0.007812	0.043457928	0.0000432	0.000370539	0.000942652
Toluene	92.13	0.006	0.0055278	0.03075099	0.00002592	0.000262195	0.000667024
Ethylbenzene	106.16	0	0	0	0	0	0
Xylenes	106.16	0.001	0.0010616	0.00590565	0.00000432	5.03539E-05	0.0001281
n-Hexane	86.177	0.041	0.03533257	0.196554058	0.00017712	0.001675897	0.004263483
Helium	4.003	0.018	0.00072054	0.004008343	0.00007776	3.41767E-05	8.69456E-05
Nitrogen	28.013	0.223	0.06246899	0.347513171	0.00096336	0.002963034	0.007537959
Carbon Dioxide	44.01	0.383	0.1685583	0.937684912	0.00165456	0.007995071	0.02033946
Oxygen	32	0	0	0	0	0	0
Hydrogen Sulfide	34.08	0	0	0	0	0	0
VOC SUBTOTAL		**2.764**	**1.50066308**	**8.348144994**	**0.01194048**	**0.071179571**	**0.181080829**
HAP SUBTOTAL		**0.058**	**0.04973397**	**0.276668626**	**0.00025056**	**0.002358986**	**0.006001259**
TOTAL		**100**	**17.97600642**	**100**	**0.432**	**0.852639373**	**2.169114564**

PUMP SPECIFICATIONS

Pump Mfg.:	Western
Piston Size:	0.625 inch
Injection Pressure:	30 psi
Pump Rate:	2.00 gallons/day
Gas Consumption Rate:	0.43 Mscf/day
Days of Operation:	212 days/year

	Number of Wells	VOC emissions (tons/year)
Alternative C	807	146

Buys & Associates, Inc. **Environmental Consultants**	Project: WTP Alternative C Inventory Date: 9/17/2008

23. Operations Vehicle Tailpipe Emissions

Assumptions:

Number of New Pumpers:	30	(Number of Pumpers at Peak Production)
Pumper Mileage:	3,000	miles/pumper/month (Assumption)
Total Annual New Pumper Mileage:	1,080,000	miles/year
Number of Condensate Haul Truck Round Trips:	15	trips per day (Based on Peak Production)
Average Round Trip Mileage for Condensate Transport:	178	miles (Estimate from Vernal)
Total Annual Condensate Truck Mileage:	974,550	miles/year
Number of Water Haul Truck Round Trips:	0	trips per day (Alternative E, water will be piped)
Average Round Trip Mileage for Water Transport:	0	miles (Average distance to water injection facility)
Total Annual Water Truck Mileage:	0	miles/year
Daily Hours of Operation:	12	hours per day (Assumption)
Annual Hours of Operation:	4368	hours per year
Fuel sulfur content	0.05	% (Typical value)
Fuel density	7.08	lbs/gallon (Typical value)
Heavy Duty Pickup Fuel Efficiency	15	miles/gallon (Typical value)
Heavy Haul Diesel Fuel Efficiency	10	miles/gallon (Typical value)

Equations:

For NOx, CO and VOC:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (g/mile)} * \text{Vehicle Miles Traveled (miles/yr)}}{\text{453.6 (g/lb)} * \text{2000 (lb/tons)}}$$

The NOx, CO and VOC emission factors for the above equation are from AP-42, while the SO2 emissions are calculated on a mass balance basis utilizing the following equation:

$$\text{SO2 E. Factor (g/mi)} = \frac{\text{Fuel Density (lb/gal)} * \text{453.6 (g/lb)} * \text{Fuel Sulfur Content} * \text{2 (S / SO2)}}{\text{Vehicle Fuel Efficiency (miles/gal)}}$$

Pumper Vehicles	Heavy Duty Pickups			Heavy Haul Trucks			Total	
	E. Factor [a] (g/mile)	Emissions (lb/hr)	Emissions (tons/yr)	E. Factor [b] (g/mile)	Emissions (lb/hr)	Emissions (tons/yr)	Emissions (lb/hr)	Emissions (tons/yr)
Criteria Pollutants & VOC								
NO_x	3.03	1.652	3.607	8.13	3.999	8.734	5.651	12.341
CO	33.64	18.337	40.048	17.09	8.406	18.359	26.743	58.406
VOC [c]	1.656	0.903	1.971	4.600	2.263	4.942	3.165	6.913
SO_2	0.21	0.117	0.255	0.32	0.158	0.345	0.275	0.600
Greenhouse Gases								
CH_4 [d]	0.184	0.100	0.219	0.230	0.113	0.247	0.213	0.466

a AP-42 Append H Table 4.1A.2 - H.D. Gasoline Vehicles, High Altitude, 1991 - 1997 Vehicle Year, 50,000 miles (6/95)
b AP-42 Append. H Table 7.1.2 - H.D. Diesel Powered Vehicles, High Altitude, 1991 - 1997 Model Year, 50,000 miles (6/95)
c Emission factor is for total Hydrocarbons - Methane Offset
d AP-42 Append. H Tables 7.10A.2 and 4.10A.2 H.D. Methane Offsets, High Altitude, 1986+ and 1988+ Vehicle Year

Buys & Associates, Inc.
Environmental Consultants

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24. Operations Traffic Fugitive Dust Emissions

Calculation AP-42, Chapter 13.2.2
December 2003

365 days (Estimate)

E (PM10) / VMT = 1.5 * (S/12)^0.9 * (W/3)^0.45 * (365-p)/365)
E (PM2.5) / VMT = 0.23 * (S/12)^0.9 + (W/3)^0.45 * (365-p)/365)

Silt Content (S)	7	Mean value Table 13.2.2-1 for Gravel Surfaces
Average Round Trip Miles	84	miles on unpaved roads (Average of Pumper,Condensate)
Precipitation Days (P)	73	days per year (NCDC data for Nutters Ranch, UT 1963-1986)

Vehicle Type	Ave. Weight (lbs)	Round Trips per Day*	PM10 (lb/VMT)	Total PM10 (lbs)	PM10 (lb/day)	Total PM2.5 (lbs)	PM2.5 (lb/day)
Pickup Truck: Crew	7,000	30.0					
Haul Truck: Oil	48,000	15.000					
Mean Weight	20,667	45.000	1.288873	1,778,257.54	4,871.94	272,666.16	747.0

Annual Traffic Fugitive Dust Emissions (tons/year)				**889.13**		**136.33**	

*Round trips per day at peak production

Buys & Associates, Inc.
Environmental Consultants

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25. Well Production Summary

Species	Production Heaters (tons/yr)	Storage Tanks (tons/yr)	Well Dehydrators (tons/yr)	Well Pumping Unit Engines (tons/yr)	Pneumatic Devices (tons/yr)	Operations Vehicle (tons/yr)	Well Blowdown (tons/yr)	Total Well Production [a] (tons/yr)
Criteria Pollutants & VOC								
NO_x	291.3			46.8		12.3		350.4
CO	244.7			62.3		58.4		365.4
VOC	32.0	260.8	6.9	31.2	6,079.5	6.9	168.6	6,585.9
SO_2	0.0			0.0		0.6		0.6
PM_{10}	22.1			2.2		889.1		913.5
$PM_{2.5}$	22.1			2.2		136.3		160.7
Hazardous Air Pollutants								
Benzene	0.0	1.4	1.5	0.2	28.9		0.0	32.0
Toluene	0.0	0.8	1.9	0.1	13.6		0.0	16.3
Ethylbenzene		0.0	0.1	0.0	0.0		0.0	0.1
Xylene		0.1	0.5	2.2E-02	3.9		0.0	4.6
n-Hexane	5.2	6.2	0.2		87.1		0.0	98.7
Formaldehyde	0.2			2.3				2.5
Total HAPs	5.5	8.5	4.2	2.6		0.0	0.0	154.3
Greenhouse Gases								
CO_2	349,559.0	31.0		12,453.0			77.2	362,120.2
CH_4	6.7	24.5	4.0	26.0		0.5	1,648.2	1,709.9

[a] Emissions for Peak Field Development

Buys & Associates, Inc. **Environmental Consultants**	Project: WTP Alternative C Inventory Date: 9/17/2008

26. Pump Station /Saltwater Disposal Pumps/Water Supply Pump Generators

Assumptions:

Generator at each Pump Station:	400	Horsepower (one Generator/pumpstation)
Salt Water Disposal well pumps:	400	Horsepower (one pump/salt water disposal well)
Water Supply pumps:	400	Horsepower (one pump/water supply well)
Project Total:	6,400	Horsepower (Ch. 2- 4 pump stations,6salt water, 6 water supply)

Equations:

$$\text{Emissions (lbs/hr)} = \frac{\text{Emission Factor (g/hp-hr)} * \text{Power (hp)}}{453.6 \text{ g/lb}}$$

Pollutant	Emission Factor [3] (lb/MMBtu)	Emission Factor (g/hp-hr)	Emissions (lb/hr/engine)	Emissions (tons/yr/engine)	Total Emissions [5] Alternative C (tons/yr)
Criteria Pollutants & VOC					
NOx [6]	2.21	1.5	1.32	6	93
CO [6]	3.72	2.0	1.8	8	124
VOC [1]	2.96E-02	0.108	0.09	0.4	6.6
PM10 [1,4]	1.94E-02	0.070	0.06	0.3	4.4
PM2.5 [1,4]	1.94E-02	0.070	0.06	0.3	4.4
SO_2 [2]	0.0	0.000	0.00	0.0	0.0
Hazardous Air Pollutants [7]					
Benzene [1]	1.58E-03	2.87E-03	0.00	1.1E-02	0.2
Toluene [1]	5.58E-04	1.01E-03	8.94E-04	3.9E-03	0.1
Ethylbenzene [1]	2.48E-05	4.50E-05	3.97E-05	1.7E-04	2.8E-03
Xylenes [1]	1.95E-04	3.54E-04	3.12E-04	1.4E-03	2.2E-02
Formaldehyde [1]	2.05E-02	1.79E-02	0.02	0.1	1.1
Greenhouse Gases					
CO2 [1]	110.0	399.5	352.3	1,543	24,690
CH4 [1]	0.2	0.83536	0.74	3.2	51.6

1 - AP-42 Table 3.2-3 Uncontrolled Emission Factors for 4-Stroke Rich-Burn Engines, 7/00
2 - Fuel gas is assumed to be free from sulfur compounds
3 - Conversion from lb/MMBtu to g/hp-hr assumes an average heat rate of 8,000 Btu/hp-hr (*3.632)
4 - PM = sum of PM filterable and PM condensable
5 - Alternative C Total Annual Emissions for 4 Pump Stations (1,600 hp), 6 saltwater disposal wells, 6 water supply
6 - BACT emission levels
7 - BACT requires 76% control of Formaldehyde, which controls other HAPs by 50%

Buys & Associates, Inc. Environmental Consultants	Project: WTP Alternative C Inventory Date: 9/17/2008

27. Average Produced Gas Characteristics
Inlet Wet Gas Sample from BBC Dry Canyon Compressor Station, dated 2/18/2004

Gas Heat Value (wet): 1082.2 Btu/scf

Sample Temperature: 108 F
Sample Pressure: 790 psi

C1-C2 Wt. Fraction:	0.9035
VOC Wt. Fraction:	0.0835
Non-HC Wt. Fraction:	0.0130
Total:	1.0000

COMPONENT	MOLE PERCENT	COMPONENT MOLE WEIGHT (lb/lb-mole)	NET MOLE WEIGHT (lb/lb-mole)	WEIGHT FRACTION	GROSS HEATING VALUE (BTU/scf)	NET DRY HEATING VALUE (BTU/scf)	LOWER HEATING VALUE (BTU/scf)	NET LOW HEATING VALUE (BTU/scf)
Methane	91.3030	16.043	14.648	0.815	1010.000	922.160	910.000	830.857
Ethane	5.3050	30.070	1.595	0.089	1769.800	93.888	1618.000	85.835
Propane	1.5360	44.097	0.677	0.038	2516.200	38.649	2316.000	35.574
i-Butane	0.3370	58.123	0.196	0.011	3252.100	10.960	3005.000	10.127
n-Butane	0.3870	58.123	0.225	0.013	3262.400	12.625	3013.000	11.660
i-Pentane	0.1600	72.150	0.115	0.006	4000.900	6.401	3698.000	5.917
n-Pentane	0.1170	72.150	0.084	0.005	4008.800	4.690	3708.000	4.338
Hexanes	0.1270	86.177	0.109	0.006	4756.200	6.040	4404.000	5.593
Heptanes	0.0340	100.204	0.034	0.002	5502.500	1.871	5100.000	1.734
Octanes+	0.0080	114.231	0.009	0.001	6249.100	0.500		0.000
Nonanes	0.0000	128.258	0.000	0.000	6996.400	0.000		0.000
Decanes	0.0000	142.285	0.000	0.000	7743.200	0.000		0.000
Benzene	0.0100	78.120	0.008	0.000	3715.500	0.372		0.000
Toluene	0.0060	92.130	0.006	0.000	4444.600	0.267		0.000
Ethylbenzene	0.0000	106.160	0.000	0.000	5191.500	0.000		0.000
Xylenes	0.0010	106.160	0.001	0.000	5183.500	0.052		0.000
n-Hexane	0.0410	86.177	0.035	0.002	4756.200	1.950		0.000
Helium	0.0090	4.003	0.000	0.000	0.000	0.000	0.000	0.000
Nitrogen	0.2230	28.013	0.062	0.003	0.000	0.000	0.000	0.000
Carbon Dioxide	0.3830	44.010	0.169	0.009	0.000	0.000	0.000	0.000
Oxygen	0.0090	32.000	0.003	0.000	0.000	0.000	0.000	0.000
Hydrogen Sulfide	0.0000	34.080	0.000	0.000	637.100	0.000	588.000	0.000
TOTAL	100.00		17.98	1.00		1100.43		991.64

Relative Mole Weight (lb/lb-mole) = [Mole Percent * Molecular weight (lb/lb-mole)] / 100

Weight Fraction = Net Mole Weight / Total Mole Weight

28. Central Compression

Assumptions:

Total Existing Compression: 16,000 Horsepower (Dry Canyon Facility)
Total New Compression: 24,000 Horsepower (Chapter 2)

Equations:

$$\text{Emissions (lbs/hr)} = \frac{\text{Emission Factor (g/hp-hr)} * \text{Power (hp)}}{453.6 \text{ g/lb}}$$

Pollutant	Emission Factor [3] (lb/MMBtu)	Emission Factor (g/hp-hr)	Emissions (lb/hr/engine) [7]	Emissions 6,400 hp Station (tons/yr)	Emissions 6,400 hp Station (tons/yr)	Emissions 11,200 hp Station (tons/yr)	Total Emissions [5] Alternative C (tons/yr)
Criteria Pollutants & VOC							
NOx [6]		1.5	5.29	92.7	92.7	162.2	347.6
CO [6]		2.0	7.05	123.6	123.6	216.3	463.5
VOC [6]		1.0	3.53	61.8	61.8	108.2	231.7
PM10 [1,4]	0.0194	0.070	0.25	4.4	4.4	7.6	16.3
PM2.5 [1,4]	0.0194	0.070	0.25	4.4	4.4	7.6	16.3
SO_2 [2]	0.0	0.000	0.00	0.0	0.0	0.0	0.0
Hazardous Air Pollutants							
Benzene [1]	0.001580	0.00574	0.02	0.4	0.4	0.6	1.3
Toluene [1]	0.000558	0.00203	0.01	0.1	0.1	0.2	0.5
Ethylbenzene [1]	0.000025	0.00009	0.00	0.0	0.0	0.0	0.0
Xylenes [1]	0.000195	0.00071	0.00	0.0	0.0	0.1	0.2
Formaldehyde [1]	0.0205	0.07446	0.26	4.6	4.6	8.1	17.3
Greenhouse Gases							
CO2 [1]	110.00	399.52	1,409.24	24,690.5	24,690.5	43,208.3	92,587.2
CH4 [1]	0.2	0.83536	2.95	51.6	51.6	90.3	193.6

1 - AP-42 Table 3.2-3 Uncontrolled Emission Factors for 4-Stroke Rich-Burn Engines, 7/00
2 - Fuel gas is assumed to be free from sulfur compounds
3 - Conversion from lb/MMBtu to g/hp-hr assumes an average heat rate of 8,000 Btu/hp-hr (*3.632)
4 - PM = sum of PM filterable and PM condensable
5 - Alternative C Total Annual Emissions for New Compression (24,000 hp)
6 - Assumed equivalent control rates for internal combustion engines located at existing Dry Canyon Facility
7 - Each individual engine estimated at 1,600 hp (Chapter 2)

Buys & Associates, Inc. Environmental Consultants	Project: WTP Alternative C Inventory Date: 9/17/2008

29. Central TEG Dehydrator Emissions

Assumptions

Peak Field Production Rate: 250 MMscf/day
807 Active Wells at Peak Production

Gas Composition: Inlet Gas Sample from Dry Canyon Compresor Station, dated 2/18/04

Inlet Gas Conditions: Inlet gas saturated at 600 psi and 108 F

Glycol Circulation Rate: 3 gallons/ lb of water
(Typical operating rate)

Calculations

Dehydrator emissions were simulated using GRI GlyCalc version 4.0

Controls

Condenser/Combustor > 95% Control Efficiency in order to meet Federal MACT Standards
Condenser Operating Conditions: 120 deg. F, 11.5 psia

Emissions

Species	Central Dehydrator Emissions 67MMscfd Station (tons/year)	Central Dehydrator Emissions 67MMscfd Station (tons/year)	Central Dehydrator Emissions 117MMscfd Station (tons/year)	Total Project Emissions (tons/year)
Total VOC	8.46	8.46	14.77	31.69
Hazardous Air Pollutants				
Benzene	1.47	1.47	2.57	5.51
Toluene	1.47	1.47	2.57	5.51
Ethylbenzene	0.00	0.00	0.00	0.00
Xylenes	0.49	0.49	0.86	1.84
n-Hexane	0.22	0.22	0.38	0.81
Greenhouse Gases				
CH_4	12.28	12.28	21.44	46.00

Each station throughput estimated according to the ratio of new compression proposed at each station and based on a peak field production rate of 250MMscfd

30. Central Facility Heater Emissions

Assumptions

Dehydrator Reboiler Heater	500	Mbtu/hr (Estimate based on Dry Canyon Facility)
Tank Heater Size	500	Mbtu/hr (Estimate based on Dry Canyon Facility)
Total Heater Requirmement Facility 1	3,000	Mbtu/hr (Chapter 2 Estimate, 2-Dehydrator Reboiler Heaters, 4-Tank Heaters)
Total Heater Requirmement Facility 2	3,000	Mbtu/hr (Chapter 2 Estimate, 2-Dehydrator Reboiler Heaters, 4-Tank Heaters)
Total Heater Requirmement Facility 3	6,000	Mbtu/hr (Chapter 2 Estimate, 4-Dehydrator Reboiler Heaters, 8-Tank Heaters)
Firing Rate	30	minutes/hour on average for entire year (Typical value)
	4380	hours/year
Fuel Gas Heat Value	992	Btu/scf (Gas Analyses from Dry Canyon Facility)
Fuel Gas VOC Content	0.083	by weight (Gas Analyses from Dry Canyon Facility)

Equations

$$\text{Fuel Consumption (MMscf/yr)} = \frac{\text{Heater Size (MBtu/hr)} * 1{,}000\ \text{(Btu/MBtu)} * \text{Hours of Operation (hrs/yr)}}{\text{Fuel Heat Value (Btu/scf)} * 1{,}000{,}000\ \text{(scf/MMscf)}}$$

$$\text{NOx/CO/TOC Emissions (tons/yr)} = \frac{\text{AP-42 E.Factor (lbs/MMscf)} * \text{Fuel Consumption (MMscf/yr)} * \text{Fuel heating Value (Btu/scf)}}{2{,}000\ \text{(lbs/ton)} * 1{,}000\ \text{(Btu/scf - Standard Fuel Heating Value)}}$$

VOC Emissions (tons/yr) = TOC Emissions (tons/yr) * VOC wt. fraction

Species	Central Heater Emissions - Facility 1			Central Heater Emissions - Facility 2			Central Heater Emissions - Facility 3			
	Emission Factor (lb/MMscf)	Well Emissions (lb/hr)	Total Emissions (tons/yr)	Emission Factor (lb/MMscf)	Well Emissions (lb/hr)	Total Emissions (tons/yr)	Emission Factor (lb/MMscf)	Well Emissions (lb/hr)	Total Emissions (tons/yr)	Total Emissions (tons/yr)
Criteria Pollutants & VOC										
NO_x [a]	100	0.300	0.657	100	0.300	0.657	100	0.600	1.314	2.628
CO [a]	84	0.252	0.552	84	0.252	0.552	84	0.504	1.104	2.208
TOC [c]	11	0.033	0.072	11	0.033	0.072	11	0.066	0.145	0.289
VOC	N.A.	0.003	0.006	N.A.	0.003	0.006	N.A.	0.006	0.012	0.024
SO_x [b]	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.000
TSP [c]	7.6	0.023	0.050	7.6	0.023	0.050	7.6	0.046	0.100	0.200
PM_{10} [c]	7.6	0.023	0.050	7.6	0.023	0.050	7.6	0.046	0.100	0.200
$PM_{2.5}$ [c]	7.6	0.023	0.050	7.6	0.023	0.050	7.6	0.046	0.100	0.200
Hazardous Air Pollutants										
Benzene [d]	0.0021	0.000	0.000	0.0021	0.000	0.000	0.0021	0.000	0.000	0.000
Toluene [d]	0.0034	0.000	0.000	0.0034	0.000	0.000	0.0034	0.000	0.000	0.000
Hexane [d]	1.8	0.005	0.012	1.8	0.005	0.012	1.8	0.011	0.024	0.047
Formaldehyde [d]	0.075	0.000	0.000	0.075	0.000	0.000	0.075	0.000	0.001	0.002
Greenhouse Gases										
CO_2 [c]	120,000	360.00	788.40	120,000	360.00	788.40	120,000	720.00	1,576.80	3,153.600
CH_4 [c]	2.3	0.007	0.015	2.3	0.007	0.015	2.3	0.014	0.030	0.060

a AP-42 Table 1.4-1, Emission Factors for Natural Gas Combustion, 7/98
b Assumes produced gas contains no sulfur
c AP-42 Table 1.4-2, Emission Factors for Natural Gas Combustion, 7/98 (All Particulates are PM1.0)
d AP-42 Table 1.4-3, Emission Factors for Organic Compounds from Natural Gas Combustion, 7/98

31. Central Facility Condensate Storage Tank Flash/Working/Standing Emissions

Assumptions:

Average Condensate Production Rate :

Facility 1	100	bbls condensate per day (Estimate Based on Dry Canyon Compressor Station Volumes)
Facility 2	100	bbls condensate per day (Estimate Based on Dry Canyon Compressor Station Volumes)
Facility 3	175	bbls condensate per day (Estimate Based on Dry Canyon Compressor Station Volumes)

Separator Conditions : 110 psi and 40 F (Sample Conditions)

Calculations:

Condensate tank flashing/working/breathing emissions estimated with E&P Tanks 2.0
Dry Canyon Compressor Station Liquid Sample Dated 2/21/04
Flare to control stock tank and dehydrator emissions with 95% control efficiency

Emissions:

Component	Facility 1 Flash/Work/Breathing (tons/yr)	Facility 2 Flash/Work/Breathing (tons/yr)	Facility 3 Flash/Work/Breathing (tons/yr)	Total Emissions (tons/yr)
Total VOC	21.544	21.544	37.700	80.788
Hazardous Air Pollutants				
Benzene	0.120	0.120	0.210	0.450
Toluene	0.066	0.066	0.116	0.248
Ethylbenzene	0.000	0.000	0.001	0.001
Xylenes	0.007	0.007	0.013	0.027
n-Hexane	0.513	0.513	0.898	1.924
Greenhouse Gases				
CO_2	2.564	2.564	4.487	9.615
CH_4	2.023	2.023	3.541	7.587

32. Central Facility Emission Summary

Central Facility 1

Pollutant	Central Compression Emissions 6,400 hp (tons/year)	Central Dehydrator Emissions 67MMscfd (tons/year)	Central Heater Emissions (tons/year)	Central Condensate Tank Emissions (tons/year)	Total Facility Emissions (tons/year)
Criteria Pollutants & VOC					
NO_x	92.7		0.7		93.4
CO	123.6		0.6		124.2
VOC	61.8	8.5	0.0	21.5	91.8
SO_2	0.0		0.0		0.0
PM_{10}	4.4		0.0		4.4
$PM_{2.5}$	4.4		0.0		4.4
Hazardous Air Pollutants					
Benzene	0.4	1.5	0.0	0.1	1.9
Toluene	0.1	1.5	0.0	0.1	1.7
Ethylbenzene	0.0	0.0		0.0	0.0
Xylene	0.0	0.5		0.0	0.5
n-Hexane		0.2	0.0	0.5	0.7
Formaldehyde	4.6		0.0		4.6
Total HAPs	5.1	3.6	0.0	0.7	9.5
Greenhouse Gases					
CO_2	24,690.5		788.4	2.6	25,481.4
CH_4	51.6	12.3	0.0	2.0	65.9

Central Facility 2

Pollutant	Central Compression Emissions 6,400 hp (tons/year)	Central Dehydrator Emissions 67MMscfd (tons/year)	Central Heater Emissions (tons/year)	Central Condensate Tank Emissions (tons/year)	Total Facility Emissions (tons/year)
Criteria Pollutants & VOC					
NO_x	92.7		0.7		93.4
CO	123.6		0.6		124.2
VOC	61.8	8.5	0.0	21.5	91.8
SO_2	0.0		0.0		0.0
PM_{10}	4.4		0.0		4.4
$PM_{2.5}$	4.4		0.0		4.4
Hazardous Air Pollutants					
Benzene	0.4	1.5	0.0	0.1	1.9
Toluene	0.1	1.5	0.0	0.1	1.7
Ethylbenzene	0.0	0.0		0.0	0.0
Xylene	0.0	0.5		0.0	0.5
n-Hexane		0.2	0.0	0.5	0.7
Formaldehyde	4.6		0.0		4.6
Total HAPs	5.1	3.6	0.0	0.7	9.5
Greenhouse Gases					
CO_2	24,690.5		788.4	2.6	25,481.4
CH_4	51.6	12.3	0.0	2.0	65.9

Central Facility 3

Pollutant	Central Compression Emissions 11,200 hp (tons/year)	Central Dehydrator Emissions 117MMscfd (tons/year)	Central Heater Emissions (tons/year)	Central Condensate Tank Emissions (tons/year)	Total Facility Emissions (tons/year)
Criteria Pollutants & VOC					
NO_x	162.2		1.3		163.5
CO	216.3		1.1		217.4
VOC	108.2	14.8	0.0	37.7	160.6
SO_2	0.0		0.0		0.0
PM_{10}	7.6		0.1		7.7
$PM_{2.5}$	7.6		0.1		7.7
Hazardous Air Pollutants					
Benzene	0.6	2.6	0.0	0.2	3.4
Toluene	0.2	2.6	0.0	0.1	2.9
Ethylbenzene	0.0	0.0		0.0	0.0
Xylene	0.1	0.9		0.0	0.9
n-Hexane		0.4	0.0	0.9	1.3
Formaldehyde	8.1				8.1
Total HAPs	9.0	6.4	0.0	1.2	16.6
Greenhouse Gases					
CO_2	43,208.3		1,576.8	4.5	44,789.6
CH_4	90.3	21.4	0.0	3.5	115.4

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Project: WTP Alternative C Inventory
Date: 9/17/2008

33. Total Project Production Related Emissions Summary

Pollutant	Total Project Production Related Emissions (tons/year) [a]					Total Production (tons/year)
	Well Production (tons/year)	Pump Generators (tons/year)	Central Facility 1 (tons/year)	Central Facility 2 (tons/year)	Central Facility 3 (tons/year)	
Criteria Pollutants & VOC						
NO_x	350.4	92.7	93.4	93.4	163.5	793.3
CO	365.4	123.6	124.2	124.2	217.4	954.7
VOC	6,585.9	6.6	91.8	91.8	160.6	6,936.8
SO_2	0.6	0.0	0.0	0.0	0.0	0.6
PM_{10}	913.5	4.4	4.4	4.4	7.7	934.4
$PM_{2.5}$	160.7	4.4	4.4	4.4	7.7	181.6
Hazardous Air Pollutants						
Benzene	32.0	0.2	1.9	1.9	3.4	39.5
Toluene	16.3	0.1	1.7	1.7	2.9	22.6
Ethylbenzene	0.1	2.8E-03	0.0	0.0	0.0	0.1
Xylene	4.6	2.2E-02	0.5	0.5	0.9	6.6
n-Hexane	98.7		0.7	0.7	1.3	101.5
Formaldehyde	2.5	1.1	4.6	4.6	8.1	20.9
Total HAPs	154.3	1.4	9.5	9.5	16.6	191.2
Greenhouse Gases						
CO_2	362,120.2	24689.9	25,481.4	25,481.4	44,789.6	482,562.5
CH_4	1,709.9	51.6	65.9	65.9	115.4	2,008.7

a Emissions for Peak Field Development

34. Total Project Emissions Summary

Pollutant	Project Emissions (tons/year)		Total Emissions [a] (tons/year)
	Well Development	Project Production	
Criteria Pollutants & VOC			
NO_x	133	793	926
CO	239	955	1,193
VOC	40.5	6,937	6,977
SO_2	4.84	0.60	5.44
PM_{10}	2,784	934	3,719
$PM_{2.5}$	2,067	182	2,249
Hazardous Air Pollutants			
Benzene	0.00	39.5	39.5
Toluene	0.00	22.6	22.6
Ethylbenzene	0.00	0.12	0.12
Xylene	0.00	6.63	6.63
n-Hexane	0.00	101	101
Formaldehyde	0.28	20.9	21.2
Total HAPs	0.28	191.2	191.5
Greenhouse Gases			
CO_2	26,598	482,563	509,160
CH_4	29.6	2,009	2,038

a Emissions for Peak Field Development

EMISSIONS INVENTORY

ALTERNATIVE D – CONSERVATION ALTERNATIVE

Existing												
	71	Total wells currently in Operation in WTP										
	30	Wells to be developed in WTP (already approved under WTP Drilling Program EA - UT-070-2004-28)										
Proposed												
	Total New Wells	558		wells	days		percent					
	Total New Pads	348	0.623655914	46	46	deep downhole	0.08244					
	Average Number of Wells Per Pad	1.6034		24	92	directional	0.04301					
	Number of Producing Wells at Peak Development (Year 9)	558		302	13	downhole	0.54122					
	Number of Producing Pads at Peak Development (Year 9)	348		186	26	directional	0.33333					
	Total Deep Wells (Proponent)	70		558	23.4516							
	Total Shallow Wells (Proponent)	488										
Drilling												
	New Well pad/road construction											
	Drilling (Max Year 1)	25	new well pads per year for	21	years							
		40	new wells per year for	21	years							
		13	directional									
		22	downhole	downhole	directional							
		5	deep	3	2							
	Short-Term Well Pad Disturbance	990	acres									
		2.8448	acres/pad (average for all pads)									
	ROW Disturbance											
	Roads	614	acres									
		1.7644	acres/pad									
		126.56	miles									
		0.3637	miles/pad	1920.22069	274							
	Pipeline	726	acres									
		2.0862	acres/pad									
		149.7	miles									
		0.4302	miles/pad									
	Power lines	0	acres									
		0	acres/pad									35
		0	miles (cross country)									
		0	miles/pad									
	Other	180										
	Pits	0										
	TOTAL SHORT-TERM ACRES	2510										
	SHORT-TERM WELL/ROAD DISTURB PER PAD	6.6954										
	Average Round Trip Distance for Drilling/Construction Traffic On Unpaved Roadways =	74	miles (estimated from project area road system).									
	Average Round Trip Distance for Drilling/Construction Traffic On Paved & Unpaved Roadways =	168						max # of simultaneous operations				
								Spring summer fall	Winter			
	New well pad/access road construction (average)	14	days per pad	10	hrs/day	140	Total Hours	9	0			
	Time to drill, log and case one gas well (average, directional/downhole)	23	days per well	24	hrs/day	563	Total Hours	9	9			
	Time to complete each well (average)	31	days per well	24	hrs/day	750	Total Hours	9	9			
	Time to Frac a well	1	days per well	3	hrs/day	3	Total Hours	2				
	Rig Size (hp)	875	hp	shallow (750-1000)								
		2250	hp	deep (1500-3000)	70 deep wells total (9%)				(estimated - 9 mths * 31 days/mth / 7 days/pad = ~ 40 pads per year)			
	Proposed Action esimates majority of well spacing will be 80 acres. However, impacts evaluated at 40 and 80 acre spacing scenarios								(average, between 3 and 9 rigs will be operting)			
									(estimated - 46.5 days/well * 36 well completions/year / 365 days = ~5 simultaneous completions)			
Completion												
	3 hours frac time per well		15									
	5000hp hp frac pump engines											
	avg of 70% load											
	2 or 3 10-50 hp gensets	75	hp									

	Wells will be flared ot sold to pipeline during completion testing. Assume all flared for conservatism.											
Production												
	Pumper Vehicle Traffic: 1 new pumpers visits 75% wells daily											
	Each reclaimed production well pad will occupy 1.9 acre (weighted avg sec2.1.1.1)		1.85		80586	sq ft	283.876734	283.8767338				
	Each completed well pad will have well head, 500Mbtu/hr separator heater, condensate oil tanks, 25% of Pads would have individual dehy (750MBtu/hr avg heater size)						86.5256285	86.52562847				
	Approximately 10% of wells would have gas powered pump jack engines											
	Pumper Vehicle Traffic: 1 new pumper inspects 12 wells/day. 30 new pumpers are estimated during Peak Year (full-field development). 3000 miles/month per pumper (estimate)											
	Typical Well Production:											
	0.4 MMscfd gas per well peak production rate based on peak of 250MMscfd (Proposed Action)											
	1 bbls/day average condensate production per well (per Tyler Ashcroft email 8.9.2006)											
	8 bbls/day water production (per T. Ashcroft 8.9.2006 email)											
	Gas Samples: Use wet gas lnlet sample from Dry Canyon for CS Dehys											
	Liquid Samples: Use liquid sample from Dry Canyon for compressor station flash											
Compression and Dehydration												
	Central Dehydratation at Compressor Stations											
	Dry Canyon Existing: 10@1600 hp = 16000 hp											
	3 New Stations: 2@6400 hp stations (4-1600 hp engines) and 1@11200 hp station (7-1600 hp engines) = 24000 hp New under Proposed Action											
	Each Station will disturb 5 acres											
	Each Unit will have emission controls (1.5 g/hp-hr NOx, 2.0 CO, 1.0 VOC to reflect current UT BACT)											
	CS are 5 acre sites w/building dimensions accroding to Ch 2 diagrams					20234.28	142.24725					
	Dehy Building according to Ch 2 diagram						217800	363	600			
	45 Year LOP											
	Assume 500 Mbtu/hr tank heaters, 500 Mbtu Dehy Reboiler Heaters											

Buys & Associates, Inc. **Environmental Consultants**	Project: WTP Alternative D Inventory Date: 9/10/2008

1. Well Pad/Access Road/Pipeline Construction Fugitive Dust Emissions

Assumptions:

Hours of Construction	14	days per well pad (Chapter 2)
	10	hours/day
	140	hours per well pad
Pieces of Equipment	4	- 1 Backhoe
		- 1 Loader
		- 1 Crawler Tractor
		- 1 Grader
Watering Control Efficiency	50	percent (Assumption)
Soil Moisture Content	7.9	percent (AP-42 Table 11.9-3, 10/98)
Soil Silt Content	6.9	percent (AP-42 Table 11.9-3, 10/98)
PM10 Multiplier	0.75 * PM15	(AP-42 Table 11.9-1, 10/98)
PM2.5 Multiplier	0.105 * TSP	(AP-42 Table 11.9-1, 10/98)

Equations: From AP-42 tables 11.9-1 and 11.9-3 for
Bulldozing Overburden Emissions, Western Surface Coal Mining, 10/98

Emissions (TSP lbs/hr) = 5.7 * (soil silt content %)^1.2 * (soil moisture content %)^-1.3* Control Efficiency

Emissions (PM15 lbs/hr) = 1.0 * (soil silt content %)^1.5 * (soil moisture content %)^-1.4 * Control Efficiency

Emissions = 1.97 lbs TSP/hour/piece of equipment

Emissions = 0.50 lbs PM15/hour/piece of equipment

	Fugitive Dust Emissions [a]		
	lbs/hr	**tons/well**	**tons/yr [b]**
TSP	7.88	0.5517	13.76
PM15	1.51	0.1054	2.63
PM10	1.13	0.0790	1.97
PM2.5	0.83	0.0579	1.45

a Backhoe/Grader/Loader emissions are conservatively estimated as equivalent to Bulldozing emissions.

b Assumes construction rate specified by Proponent

Note: The majority of new pipeline will be installed adjacent to proposed access roads and will not result significant additional surface disturbance.

2. Reclamation Fugitive Dust Emissions

Assumptions:

Hours of Construction	2	days per well pad (Estimate)
	8	hours/day
	16	hours per well pad
Pieces of Equipment	1	- Grader
Watering Control Efficiency	50	percent (Assumption)
Soil Moisture Content	7.9	percent (AP-42 Table 11.9-3, 10/98)
Soil Silt Content	6.9	percent (AP-42 Table 11.9-3, 10/98)
PM10 Multiplier	0.75 * PM15	(AP-42 Table 11.9-1, 10/98)
PM2.5 Multiplier	0.105 * TSP	(AP-42 Table 11.9-1, 10/98)

Equations: From AP-42 tables 11.9-1 and 11.9-3 for
Bulldozing Overburden Emissions, Western Surface Coal Mining, 10/98

Emissions (TSP lbs/hr) = 5.7 * (soil silt content %)^1.2 * (soil moisture content %)^-1.3* Control Efficiency

Emissions (PM15 lbs/hr) = 1.0 * (soil silt content %)^1.5 * (soil moisture content %)^-1.4 * Control Efficiency

Emissions = 1.97 lbs TSP/hour/piece of equipment

Emissions = 0.50 lbs PM15/hour/piece of equipment

	Fugitive Dust Emissions [a]		
	lbs/hr	**tons/well**	**tons/yr [b]**
TSP	1.97	0.0158	0.39
PM15	1.51	0.0120	0.30
PM10	1.13	0.0090	0.23
PM2.5	0.21	0.0017	0.04

a Backhoe/Grader/Loader emissions are conservatively estimated as equivalent to Bulldozing emissions.

b Assumes construction rate specified by Proponent

Note: The majority of new pipeline will be installed adjacent to proposed access roads and will not result significant additional surface disturbance.

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Project: WTP Alternative D Inventory
9/10/2008

3. Unpaved Road Fugitive Dust Emissions

Calculation AP-42, Chapter 13.2.2
December 2003

E (PM10) / VMT = 1.5 * (S/12)^0.9 * (W/3)^0.45 * (365-p)/365)
E (PM2.5) / VMT = 0.23 * (S/12)^0.9 + (W/3)^0.45
Silt Content (S) 7 Mean value Table 13.2.2-1 for Gravel Surfaces
Round Trip Miles 74
Precipitation Days (P) 73 days per year (NCDC data for Nutters Ranch, UT 1963-1986)

		Average	Round					
	Vehicle Type	Weight	Trips per	PM10	PM10/Pad	PM10/Pad	PM2.5/Pad	PM2.5/Pad
		(lbs)	Well [a]	(lb/VMT)	(lbs)	(lb/day)	(lbs)	(lb/day)
Construction (days/pad and road)	14							
	Haul Trucks	80,000	7					
	Light Trucks	20,000	28					
	Mean Vehicle Weight	32,000	35	1.569119	4064.0	290.3	623.1	44.5
					PM10/Annual Pads		**PM2.5/Annual Pads**	
					(tons)		**(tons)**	
					50.7		7.8	
		Average	Round					
	Vehicle Type	Weight	Trips per	PM10	PM10/Well	PM10/Well	PM2.5/Well	PM2.5/Well
		(lbs)	Well [a]	(lb/VMT)	(lbs)	(lb/day)	(lbs)	(lb/day)
Drilling, Downhole (days/well)	13							
	Haul Trucks	80,000	26					
	Logging/Mud Trucks	70,000	6.5					
	Water Trucks	60,000	19.5					
	Light Trucks	8,000	52					
	Mean Vehicle Weight	39,625	104	1.727526	13295.0	1022.7	2038.6	156.8
					PM10/Annual Wells		**PM2.5/Annual Wells**	
					(tons)		**(tons)**	
					143.9		22.1	
		Average	Round					
	Vehicle Type	Weight	Trips per	PM10	PM10/Well	PM10/Well	PM2.5/Well	PM2.5/Well
		(lbs)	Well [a]	(lb/VMT)	(lbs)	(lb/day)	(lbs)	(lb/day)
Drilling, Deep Downhole (days/well)	46							
	Haul Trucks	80,000	92					
	Logging/Mud Trucks	70,000	23.0					
	Water Trucks	60,000	69.0					
	Light Trucks	8,000	184					
	Mean Vehicle Weight	39,625	368	1.727526	47044.0	1022.7	7213.4	156.8
					PM10/Annual Wells		**PM2.5/Annual Wells**	
					(tons)		**(tons)**	
					77.6		1.6	
		Average	Round					
	Vehicle Type	Weight	Trips per	PM10	PM10/Well	PM10/Well	PM2.5/Well	PM2.5/Well
		(lbs)	Well [a]	(lb/VMT)	(lbs)	(lb/day)	(lbs)	(lb/day)
Drilling, Directional (days/well)	26							
	Haul Trucks	80,000	52					
	Logging/Mud Trucks	70,000	13					
	Water Trucks	60,000	39					
	Light Trucks	8,000	104					
	Mean Vehicle Weight	39,625	208	1.727526	26590.1	1022.7	4077.1	156.8
					PM10/Annual Wells		**PM2.5/Annual Wells**	
					(tons)		**(tons)**	
					177.3		27.2	
		Average	Round					
	Vehicle Type	Weight	Trips per	PM10	PM10/Well	PM10/Well	PM2.5/Well	PM2.5/Well
		(lbs)	Well [a]	(lb/VMT)	(lbs)	(lb/day)	(lbs)	(lb/day)
Drilling, Deep Directional (days/well)	92							
	Haul Trucks	80,000	184					
	Logging/Mud Trucks	70,000	46					
	Water Trucks	60,000	138					
	Light Trucks	8,000	368					
	Mean Vehicle Weight	39,625	736	1.727526	94087.9	1022.7	14426.8	156.8
					PM10/Annual Wells		**PM2.5/Annual Wells**	
					(tons)		**(tons)**	
					80.9		1079.8	
		Average	Round					
	Vehicle Type	Weight	Trips per	PM10	PM10/Well	PM10/Well	PM2.5/Well	PM2.5/Well
		(lbs)	Well [a]	(lb/VMT)	(lbs)	(lb/day)	(lbs)	(lb/day)
Completion (days/well)	31.25							
	Semi/Transport/Water/Sand	80,000	203					
	Haul Trucks	80,000	29					
	Light Trucks	8,000	116					
	Mean Vehicle Weight	56,000	348	2.018473	51979.7	1663.4	7970.2	255.0
					PM10/Annual Wells		**PM2.5/Annual Wells**	
					(tons)		**(tons)**	
					1039.6		159.4	
		Average	Round					
	Vehicle Type	Weight	Trips per	PM10	PM10/Day	PM10/Day	PM2.5/Day	PM2.5/Day
		(lbs)	Well [a]	(lb/VMT)	(lbs)	(lb/day)	(lbs)	(lb/day)
Field Development and Reclamation (days/well)	6							
	Haul Trucks	80,000	6					
	Light Trucks	8,000	18					
	Mean Vehicle Weight	26,000	24	1.429145	2538.2	423.0	389.2	64.9
					PM10/Annual Wells		**PM2.5/Annual Wells**	
					(tons)		**(tons)**	
					50.8		7.8	
Annual Traffic Fugitive Dust Emissions (tons/year)					**1620.73**		**1305.61**	

a Traffic Estimates are based upon an approximately 14-days construction, 13-days drilling at downhole locations (shallow wells), 26-days drilling at direction wells (shallow wells), 29-days completion, and 6-days infrastructure development per well or well pad as appropriate.

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4. Wind Erosion Fugitive Dust Emissions

Assumptions

Threshold Friction Velocity U_t*	1.02	m/s (2.28 mph) for well pads (AP-42 Table 13.2.5-2 Overburden - Western Surface Coal Mine
	1.33	m/s (2.97 mph) for roads (AP-42 Table 13.2.5-2 Roadbed material)
Initial Disturbance Area	1340.0	acres total initial disturbance for roads/pipelines (Chapter 2)
	5,422,779	square meters total initial disturbance for roads/pipelines
	1,170	acres total initial disturbance for well pads and other facilities (Chapter 2)
	4,734,815	square meters total initial disturbance for well pads and other facilities
	2,510	acres total disturbance
Exposed Surface Type	Flat	
Meteorological Data	2002 Grand Junction (obtained from NCDC website)	
Fastest Mile Wind Speed U_{10}^+	20.1	meters/sec (45 mph) reported as fastest 2-minute wind speed for Grand Junction (2002)
Number soil of disturbances	2	for well pads and facilities (Assumption, disturbance at construction and reclamation)
	Constant	for dirt roads
Development Period	21	years (Chapter 2)

Equations

Friction Velocity $U^* = 0.053\ U_{10}^+$

Erosion Potential P (g/m^2/period) = $58*(U^*-U_t^*)^2 + 25*(U^*-U_t^*)$ for $U^*>U_t^*$, P = 0 for $U^*< U_t^*$

Emissions (tons/year) = Erosion Potential(g/m^2/period)*Disturbed Area(m^2)*Disturbances/year*(k)/(453.6 g/lb)/2000 lbs/ton/Develop Period

Particle Size Multiplier (k)		
30 um	**<10 um**	**<2.5 um**
1.0	0.5	0.2

Maxium U_{10}^+ Wind Speed (m/s)	**Maximum U* Friction Velocity m/s**	**Well U_t* Threshold Velocity[a] m/s**	**Well Pad Erosion Potential g/m^2**	**Road U_t* Threshold Velocity[a] m/s**	**Road Erosion Potential g/m^2**
20.12	1.07	1.02	1.28	1.33	0.00

Wind Erosion Emissions

Particulate Species	**Wells (tons/year)**	**Roads/Pipelines (tons/year)**
TSP	0.64	0.00
PM10	0.32	0.00
PM2.5	0.13	0.00

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5. Construction Tailpipe Emissions

Assumptions:

Average Round Trip Distance	168.0	miles (Estimated from project area and existing road system)
Hours of Construction	140	hours per site (Chapter 2)
Number of Heavy Diesel Truck Trips	7	(Chapter 2)
Number of Pickup Trips	28	(Chapter 2)
Diesel Fuel sulfur content	0.05	% (Typical value)
Diesel Fuel density	7.08	lbs/gallon (Typical value)
Heavy Haul Diesel Fuel Efficiency	10	miles/gallon (Typical value)
Heavy Duty Pickup Fuel Efficiency	15	miles/gallon (Typical value)

Equations:

For NOx, CO and VOC:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (g/mile)} * \text{\# Trips} * \text{Trip Distance (miles)}}{\text{453.6 (g/lb)} * \text{2000 (lb/tons)}}$$

The NOx, CO and VOC emission factors for the above equation are from AP-42, while the SO2 emissions are calculated on a mass balance basis utilizing the following equation:

$$\text{SO2 E. Factor (g/mi)} = \frac{\text{Fuel Density (lb/gal)} * \text{453.6 (g/lb)} * \text{Fuel Sulfur Content} * \text{2 (S / SO2)}}{\text{Vehicle Fuel Efficiency (miles/gal)}}$$

Construction Vehicles	Heavy Haul Trucks			Heavy Duty Pickups			Total [d]	
	E. Factor [a] (g/mile)	Emissions (lb/hr)	Emissions (tons/yr/well)	E. Factor [b] (g/mile)	Emissions (lb/hr)	Emissions (tons/yr/well)	Emissions (lb/hr)	Emissions (tons/yr)
Criteria Pollutants & VOC								
NO_x	8.130	0.151	0.011	3.030	0.224	0.016	0.375	0.655
CO	17.090	0.316	0.022	33.640	2.492	0.174	2.808	4.904
VOC [c]	4.600	0.085	0.006	4.646	0.344	0.024	0.429	0.750
SO_2	0.321	0.006	0.000	0.214	0.016	0.001	0.022	0.038
Greenhouse Gases								
CH_4 [e]	0.230	0.004	0.000	0.184	0.014	0.001	0.018	0.031

a AP-42 Append. H Table 7.1.2 - H.D. Diesel Powered Vehicles, High Altitude, 1991 - 1997 Model Year, 50,000 miles (6/95)
b AP-42 Append. H Table 4.1A.2 - H.D. Gasoline Vehicles, High Altitude, 1991 - 1997 Vehicle Year, 50,000 miles (6/95)
c Emission factor is for total Hydrocarbons - Methane Offset
d Assumes construction rate specified by Proponent
e AP-42 Append. H Tables 7.10A.2 and 4.10A.2 H.D. Methane Offsets, High Altitude, 1986+ and 1988+ Vehicle Year

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6. Drilling Tailpipe Emissions

Assumptions:

Average Round Trip Distance	168.0	miles (Estimated from project area and existing road system)
Hours of Operation	563	hours per site (Chapter 2)
Number of Heavy Diesel Truck Trips	94	(Chapter 2)
Number of Pickup Trips	94	(Chapter 2)
Diesel Fuel sulfur content	0.05	% (Typical value)
Diesel Fuel density	7.08	lbs/gallon (Typical value)
Heavy Haul Diesel Fuel Efficiency	10	miles/gallon (Typical value)
Heavy Duty Pickup Fuel Efficiency	15	miles/gallon (Typical value)

Equations:

For NOx, CO and VOC:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (g/mile)} * \text{\# Trips} * \text{Trip Distance (miles)}}{\text{453.6 (g/lb)} * \text{2000 (lb/tons)}}$$

The NOx, CO and VOC emission factors for the above equation are from AP-42, while the SO2 emissions are calculated on a mass balance basis utilizing the following equation:

$$\text{SO2 E. Factor (g/mi)} = \frac{\text{Fuel Density (lb/gal)} * \text{453.6 (g/lb)} * \text{Fuel Sulfur Content} * \text{2 (S / SO2)}}{\text{Vehicle Fuel Efficiency (miles/gal)}}$$

Drilling Vehicles	Heavy Haul Trucks			Heavy Duty Pickups			Total [d]	
	E. Factor [a] (g/mile)	Emissions (lb/hr)	Emissions (tons/yr/well)	E. Factor [b] (g/mile)	Emissions (lb/hr)	Emissions (tons/yr/well)	Emissions (lb/hr)	Emissions (tons/yr)
Criteria Pollutants & VOC								
NO_x	8.13	0.502	0.141	3.03	0.187	0.053	0.689	7.755
CO	17.09	1.055	0.297	33.64	2.077	0.584	3.131	35.250
VOC [c]	4.600	0.284	0.080	1.656	0.102	0.029	0.386	4.347
SO_2	0.32	0.020	0.006	0.21	0.013	0.004	0.033	0.372
Greenhouse Gases								
CH_4 [e]	0.230	0.014	0.004	0.184	0.011	0.003	0.026	0.179

a AP-42 Append. H Table 7.1.2 - H.D. Diesel Powered Vehicles, High Altitude, 1991 - 1997 Model Year, 50,000 miles (6/95)
b AP-42 Append. H Table 4.1A.2 - H.D. Gasoline Vehicles, High Altitude, 1991 - 1997 Vehicle Year, 50,000 miles (6/95)
c Emission factor is for total Hydrocarbons - Methane Offset
d Assumes construction rate specified by Proponent
e AP-42 Append. H Tables 7.10A.2 and 4.10A.2 H.D. Methane Offsets, High Altitude, 1986+ and 1988+ Vehicle Year

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7. Completion Tailpipe Emissions

Assumptions:

Average Round Trip Distance	168.0 miles	(Estimated from project area and existing road system)
Hours of Operation	750 hours per site	(Chapter 2)
Number of Heavy Diesel Truck Trips	232	(Proponent)
Number of Pickup Trips	116	(Proponent)
Diesel Fuel sulfur content	0.05 %	(Typical value)
Diesel Fuel density	7.08 lbs/gallon	(Typical value)
Heavy Haul Diesel Fuel Efficiency	10 miles/gallon	(Typical value)
Heavy Duty Pickup Fuel Efficiency	15 miles/gallon	(Typical value)

Equations:

For NOx, CO and VOC:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (g/mile)} * \text{\# Trips} * \text{Trip Distance (miles)}}{\text{453.6 (g/lb)} * \text{2000 (lb/tons)}}$$

The NOx, CO and VOC emission factors for the above equation are from AP-42, while the SO2 emissions are calculated on a mass balance basis utilizing the following equation:

$$\text{SO2 E. Factor (g/mi)} = \frac{\text{Fuel Density (lb/gal)} * \text{453.6 (g/lb)} * \text{Fuel Sulfur Content} * \text{2 (S / SO2)}}{\text{Vehicle Fuel Efficiency (miles/gal)}}$$

Completion Vehicles	Heavy Haul Trucks			Heavy Duty Pickups			Total [d]	
	E. Factor [a] (g/mile)	Emissions (lb/hr)	Emissions (tons/yr/well)	E. Factor [b] (g/mile)	Emissions (lb/hr)	Emissions (tons/yr/well)	Emissions (lb/hr)	Emissions (tons/yr)
Criteria Pollutants & VOC								
NO_x	8.13	0.931	0.349	3.03	0.174	0.065	1.105	16.575
CO	17.09	1.958	0.734	33.64	1.927	0.723	3.885	58.275
VOC [c]	4.600	0.527	0.198	1.656	0.095	0.036	0.622	9.328
SO_2	0.32	0.037	0.014	0.21	0.012	0.005	0.049	0.736
Greenhouse Gases								
CH_4 [e]	0.230	0.026	0.010	0.184	0.011	0.004	0.037	0.345

a AP-42 Append. H Table 7.1.2 - H.D. Diesel Powered Vehicles, High Altitude, 1991 - 1997 Model Year, 50,000 miles (6/95)
b AP-42 Append. H Table 4.1A.2 - H.D. Gasoline Vehicles, High Altitude, 1991 - 1997 Vehicle Year, 50,000 miles (6/95)
c Emission factor is for total Hydrocarbons - Methane Offset
d Assumes construction rate specified by Proponent
e AP-42 Append. H Tables 7.10A.2 and 4.10A.2 H.D. Methane Offsets, High Altitude, 1986+ and 1988+ Vehicle Year

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8. Development Tailpipe Emissions

Assumptions:

Average Round Trip Distance	168.0	miles (Estimated from project area and existing road system)
Hours of Operation	20	hours per site (Assumption)
Number of Heavy Diesel Truck Trips	6	(Assumption)
Number of Pickup Trips	18	(Assumption)
Diesel Fuel sulfur content	0.05	% (Typical value)
Diesel Fuel density	7.08	lbs/gallon (Typical value)
Heavy Haul Diesel Fuel Efficiency	10	miles/gallon (Typical value)
Heavy Duty Pickup Fuel Efficiency	15	miles/gallon (Typical value)

Equations:

For NOx, CO and VOC:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (g/mile)} * \text{\# Trips} * \text{Trip Distance (miles)}}{\text{453.6 (g/lb)} * \text{2000 (lb/tons)}}$$

The NOx, CO and VOC emission factors for the above equation are from AP-42, while the SO2 emissions are calculated on a mass balance basis utilizing the following equation:

$$\text{SO2 E. Factor (g/mi)} = \frac{\text{Fuel Density (lb/gal)} * \text{453.6 (g/lb)} * \text{Fuel Sulfur Content} * \text{2 (S / SO2)}}{\text{Vehicle Fuel Efficiency (miles/gal)}}$$

Development Vehicles	Heavy Haul Trucks			Heavy Duty Pickups			Total [d]	
	E. Factor [a] (g/mile)	Emissions (lb/hr)	Emissions (tons/yr/well)	E. Factor [b] (g/mile)	Emissions (lb/hr)	Emissions (tons/yr/well)	Emissions (lb/hr)	Emissions (tons/yr)
Criteria Pollutants & VOC								
NO_x	8.13	0.903	0.009	3.03	1.010	0.010	1.913	0.477
CO	17.09	1.899	0.019	33.64	11.213	0.112	13.112	3.271
VOC [c]	4.600	0.511	0.005	1.656	0.552	0.006	1.063	0.265
SO_2	0.32	0.036	0.000	0.21	0.071	0.001	0.107	0.027
Greenhouse Gases								
CH_4 [e]	0.230	0.026	0.000	0.184	0.061	0.001	0.087	0.022

a AP-42 Append. H Table 7.1.2 - H.D. Diesel Powered Vehicles, High Altitude, 1991 - 1997 Model Year, 50,000 miles (6/95)
b AP-42 Append. H Table 4.1A.2 - H.D. Gasoline Vehicles, High Altitude, 1991 - 1997 Vehicle Year, 50,000 miles (6/95)
c Emission factor is for total Hydrocarbons - Methane Offset
d Assumes construction rate specified by Proponent
e AP-42 Append. H Tables 7.10A.2 and 4.10A.2 H.D. Methane Offsets, High Altitude, 1986+ and 1988+ Vehicle Year

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9. Construction Heavy Equipment Tailpipe Emissions

Assumptions:

Hours of Operation	140 hours/site (Chapter 2)
Development Rate	25 new pads per year (Chapter 2)
Load Factor	0.4 (Assumed typical value)
Backhoe Size	100 hp (Assumed Typical value)
Crawler Tractor/Loader Size	150 hp (Assumed Typical value)
Motor Grader Size	135 hp (Assumed Typical value)

Equations:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (g/hp-hr)} * \text{Rated Horsepower (hp)} * \text{Operating Hours (hrs)} * \text{Load Factor (Dimensionless)}}{453.6\ \text{(g/lb)} * 2000\ \text{(lb/tons)}}$$

Heavy Const. Vehicles	Backhoe			Crawler Tractor			Grader			Loader		
	E. Factor [a] (g/hp-hr)	Emissions (lb/hr)	Emissions[e] (tons/yr)	E. Factor [a] (g/hp-hr)	Emissions (lb/hr)	Emissions[e] (tons/yr)	E. Factor [b] (g/hp-hr)	Emissions (lb/hr)	Emissions[e] (tons/yr)	E. Factor [a] (g/hp-hr)	Emissions (lb/hr)	Emissions[e] (tons/yr)
NO_x	8.15	0.719	1.255	8.15	1.078	1.883	7.14	0.850	1.484	8.15	1.078	1.883
CO	2.28	0.201	0.351	2.28	0.302	0.527	1.54	0.183	0.320	2.28	0.302	0.527
VOC [c]	0.37	0.033	0.057	0.37	0.049	0.085	0.36	0.043	0.075	0.37	0.049	0.085
PM_{10} [d]	0.5	0.044	0.077	0.5	0.066	0.115	0.63	0.075	0.131	0.5	0.066	0.115
$PM_{2.5}$ [d]	0.5	0.044	0.077	0.5	0.066	0.115	0.63	0.075	0.131	0.5	0.066	0.115
SO_2	0.22	0.019	0.034	0.22	0.029	0.051	0.22	0.026	0.046	0.22	0.029	0.051
Formaldehyde	0.22	0.019	0.034	0.22	0.029	0.051	0.12	0.014	0.025	0.22	0.029	0.051

Heavy Const. Vehicles	Total	
	Emissions (lb/hr)	Emissions[e] (tons/yr)
NO_x	3.725	6.504
CO	0.988	1.725
VOC [c]	0.173	0.303
PM_{10} [d]	0.251	0.439
$PM_{2.5}$ [d]	0.251	0.439
SO_2	0.104	0.181
Formaldehyde	0.092	0.160

a AP-42 Volume II, Mobile Sources, Nonroad Vehicles, Table 11-7.1 Off-highway truck
b AP-42 Volume II, Mobile Sources, Nonroad Vehicles, Table 11-7.1 Motor Grader
c Emission Factor represents total Hydrocarbon Emissions
d All emitted particulate matter assumed to be PM2.5
e Assumes construction rate specified by Proponent

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10. Drill Rig Engine Emissions

Assumptions:

Hours of Operation	563	hours/ well (Chapter 2)
Development Rate	40	total wells per year (Chapter 2)
	9%	average deep wells per year (based on Propoent estimate of 70 deep wells total Project)
	3	deep well per year
	37	shallow wells per year
Load Factor	0.4	(Assumed typical value)
Rig Size	875	hp (Proponent Estimate - shallow wells)
	2250	hp (Proponent Estimate - deep wells)
	994	hp (weighted average based on ratio of shallow to deep wells)
Diesel Fuel Sulfur Content	0.05	% (typical value)

Equations:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (lb/hp-hr)} * \text{Rated Horsepower (hp)} * \text{Operating Hours (hrs)} * \text{Load Factor (Dimensionless)}}{\text{2000 (lb/tons)}}$$

SO2 E. Factor (lb/hp-hr) = Fuel sulfur content * 0.00809

Species	Drill Rig Emissions		
	E. Factor [a]	Emissions	Emissions [g]
	(lb/hp-hr)	(lb/hr)	(tons/yr)
Criteria Pollutants & VOC			
NO_x	9.92E-03	3.946	44
CO	1.685E-03	0.670	7.542
VOC [b]	6.61E-04	0.263	3.0
PM_{10} [c]	2.901E-04	0.115	1.299
$PM_{2.5}$ [d]	2.901E-04	0.115	1.299
SO_2 [e]	0.0004045	0.161	1.811
Greenhouse Gases			
CO_2 [e]	1.16	461.341	5,193
CH_4 [e,f]	0.000705	0.280	3.16

[a] EPA Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling--Compression-Ignition NR-009c, April 2004
[b] Nonmethanehydrocarbons
[c] Total Particulates
[d] All PM10 assumed to be PM2.5 (based on ???)
[e] AP-42 Volume I, Large Stationary Diesel Engines Table 3.4-1, 10/96
[f] Emission Factor represents total Hydrocarbon Emissions
[g] Assumes rate specified by Proponent

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11. Well Fracturing Pump and Generator Engines

Assumptions:

Average Hours of Operation	3	Hours/Well (Proponents)
Development Rate	40	wells per year (Chapter 2)
Load Factor	0.7	(Proponents)
Frac Pump Engine Horsepower	5,000	Horsepower (Proponents)
Temporary Generator Horsepower	75	Horsepower (Proponents: 2-3 engines @ 10-50 hp each)
Diesel Fuel Sulfur Content	0.05	% (typical value)

Equations:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (lb/hp-hr)} * \text{Rated Horsepower (hp)} * \text{Operating Hours (hrs)} * \text{Load Factor (Dimensionless)}}{\text{2000 (lb/tons)}}$$

SO2 E. Factor (lb/hp-hr) = Fuel sulfur content * 0.00809

Species	Frac Pump Engine Emissions		
	E. Factor [a] (lb/hp-hr)	Emissions (lb/hr)	Emissions [e] (tons/yr)
Criteria Pollutants & VOC			
NO_x	0.024	84.000	5.040
CO	0.0055	19.250	1.155
VOC [b]	0.000705	2.468	0.148
PM_{10} [c]	0.000573	2.006	0.120
$PM_{2.5}$ [d]	0.000479	1.677	0.101
SO_2	0.0004045	1.416	0.085
Greenhouse Gases			
CO_2	1.16	4,060.000	243.600
CH_4 [b]	0.000705	2.468	0.148

Species	Generator Engine Emissions		
	E. Factor [f] (lb/hp-hr)	Emissions (lb/hr)	Emissions [e] (tons/yr)
Criteria Pollutants			
NO_x	0.031	1.628	0.098
CO	0.006680	0.351	0.021
VOC [b]	0.002470	0.130	0.008
PM_{10}	0.002200	0.116	0.007
$PM_{2.5}$ [g]	0.002200	0.116	0.007
SO_2	0.0004045	0.021	0.001
Greenhouse Gases			
CO_2	1.08	3,780.000	226.800
CH_4 [b]	0.002470	8.645	0.519

a AP-42 Volume I, Large Stationary Diesel Engines Table 3.4-1, 10/96
b Emission Factor represents total Hydrocarbon Emissions
c Total particulate emission factor is 0.0007, PM10 fraction determined from Table 3.4-2
d Total particulate emission factor is 0.0007, PM2.5 fraction determined from Table 3.4-2
e Assumes maximum development scenario
f AP-42 Table 3.3-1, Emission Factors for Uncontrolled Gasoline and Diesel Industrial Engines, 10/96
g All particulates are PM10

12. Completion Flare Emissions

Assumptions

Hours of Operation	2	days (Typical)
Amount of Gas Flared	5	MMscf/well (Assumption, based on initial Production Rates)
Average Gas Heat Content	1066	Btu/scf (Wellsite Gas Composition)
Average Gas VOC Content	8.089	weight % (Wellsite Gas Composition)
Average Mole Weight	18.3	lb/lb-mole (Wellsite Gas Composition)
Development rate	40	gas wells per year

Equations

NOx/CO Emissions (lb/well) = Emission Factor (lb/MM Btu) * Gas Amount (MMscf/well) * Heat Content (Btu/scf)

PM/HAP Emissions (lb/well) = Emission Factor (lb/MMscf) * Gas Amount (MMscf/well)

$$\text{Flare Gas Wt. (lb/well)} = \frac{\text{Flare Gas Volume (MMscf/well)} * 10^6 \text{ (scf/MMscf)} * \text{Mole Weight (lb/lb-mole)}}{379.49 \text{ (scf/mole)}}$$

VOC Emissions (lb/well) = Flare Gas Wt. (lb/well) * VOC wt. % * 0.02 (Assumes 98% destruction Efficiency)

Species	Emission Factor (lb/MMBtu)	Well Emissions (lb/well)	Well Emissions (lb/hr/well)	Total Emissions [e] (tons/yr)
Criteria Pollutants & VOC				
NO_x [a]	0.068	362.4	7.55	7.25
CO [a]	0.37	1971.9	41.08	39.44
VOC	N.A.	390.0	8.12	7.80
SO_x [b]	0.00	0.0	0.00	0.00
TSP [c]	7.6	38	0.792	0.760
PM_{10} [c]	7.6	38	0.792	0.760
$PM_{2.5}$ [c]	7.6	38	0.792	0.760
Hazardous Air Pollutants				
Benzene [d]	0.0021	0.0105	0.000	0.000
Toluene [d]	0.0034	0.017	0.000	0.000
Hexane [d]	1.8	9	0.188	0.180
Formaldehyde [d]	0.075	0.375	0.008	0.008
Greenhouse Gases				
CO_2 [c]	120,000	600,000	12,500	12,000
CH_4 [a]	0.14	746.1	15.54	14.92

a AP-42 Table 13.5-1, Emission Factors for Flare Operations, 9/91
b Assumes produced gas contains no sulfur
c AP-42 Table 1.4-2, Emission Factors for Natural Gas Combustion, 3/98 (All Particulates are PM1.0)
d AP-42 Table 1.4-3, Emission Factors for Organic Compounds from Natural Gas Combustion, 3/98
e Assumes proposed development rate

Buys & Associates, Inc. Environmental Consultants	Project: WTP Alternative D Inventory Date: 9/10/2008

13. Well Development Emissions Summary

Species	Well Development Emissions (tons/year) [a]				Wind Erosion	Total [a] (tons/yr)
	Construction	Drilling	Completion	Development & Reclamation		
Criteria Pollutants & VOC						
NO_x	7.2	52.2	29.0	0.5		88.8
CO	6.6	42.8	98.9	3.3		151.6
VOC	1.1	7.3	17.3	0.3		25.9
SO_2	0.2	2.2	0.8	0.0		3.3
PM_{10}	53.1	481.0	1,040.5	51.0	0.3	1,625.9
$PM_{2.5}$	9.7	1,131.9	160.3	7.8	0.1	1,309.8
Hazardous Air Pollutants						
Benzene			0.0			
Toluene			0.0			
Ethylbenzene						
Xylene						
n-Hexane			0.2			
Formaldehyde	0.2		0.0			0.2
Total HAPs	0.2	0.0	0.2	0.0	0.0	0.2
Greenhouse Gases						
CO_2		5,193.2	12,470.4			17,663.6
CH_4	0.0	3.3	15.9	0.0		19.3

[a] Emissions for Peak Field Development

Buys & Associates, Inc. **Environmental Consultants**	Project: WTP Alternative D Inventory Date: 9/10/2008

14. Average Produced Gas Characteristics
Inlet Wet Gas Sample Average of Seven Samples from BBC area wellsites

Gas Heat Value (wet): 1065.9 Btu/scf

C1-C2 Wt. Fraction:	0.8742
VOC Wt. Fraction:	0.0809
Non-HC Wt. Fraction:	0.0449
Total:	1.0000

COMPONENT	MOLE PERCENT	COMPONENT MOLE WEIGHT (lb/lb-mole)	NET MOLE WEIGHT (lb/lb-mole)	WEIGHT FRACTION	GROSS HEATING VALUE (BTU/scf)	NET DRY HEATING VALUE (BTU/scf)	LOWER HEATING VALUE (BTU/scf)	NET LOW HEATING VALUE (BTU/scf)
Methane	90.1926	16.043	14.470	0.791	1010.000	910.946	910.000	820.753
Ethane	5.0663	30.070	1.523	0.083	1769.800	89.664	1618.000	81.973
Propane	1.5002	44.097	0.662	0.036	2516.200	37.748	2316.000	34.745
i-Butane	0.3123	58.123	0.182	0.010	3252.100	10.156	3005.000	9.385
n-Butane	0.3302	58.123	0.192	0.010	3262.400	10.771	3013.000	9.948
i-Pentane	0.1359	72.150	0.098	0.005	4000.900	5.437	3698.000	5.025
n-Pentane	0.0980	72.150	0.071	0.004	4008.800	3.927	3708.000	3.632
Hexanes	0.2603	86.177	0.224	0.012	4756.200	12.380	4404.000	11.463
Heptanes	0.0305	100.204	0.031	0.002	5502.500	1.678	5100.000	1.556
Octanes	0.0133	114.231	0.015	0.001	6249.100	0.833		0.000
Nonanes	0.0047	128.258	0.006	0.000	6996.400	0.331		0.000
Decanes	0.0000	142.285	0.000	0.000	7743.200	0.000		0.000
Benzene	0.0000	78.120	0.000	0.000	3715.500	0.000		0.000
Toluene	0.0000	92.130	0.000	0.000	4444.600	0.000		0.000
Ethylbenzene	0.0000	106.160	0.000	0.000	5191.500	0.000		0.000
Xylenes	0.0000	106.160	0.000	0.000	5183.500	0.000		0.000
n-Hexane	0.0000	86.177	0.000	0.000	4756.200	0.000		0.000
Helium	0.0000	4.003	0.000	0.000	0.000	0.000	0.000	0.000
Nitrogen	0.5155	28.013	0.144	0.008	0.000	0.000	0.000	0.000
Carbon Dioxide	1.5401	44.010	0.678	0.037	0.000	0.000	0.000	0.000
Oxygen	0.0000	32.000	0.000	0.000	0.000	0.000	0.000	0.000
Hydrogen Sulfide	0.0000	34.080	0.000	0.000	637.100	0.000	588.000	0.000
TOTAL	100.00		18.30	1.00		1083.87		978.48

Relative Mole Weight (lb/lb-mole) = [Mole Percent * Molecular weight (lb/lb-mole)] / 100

Weight Fraction = Net Mole Weight / Total Mole Weight

HAP Fractions estimated from GRI Published Factors

Buys & Associates, Inc. **Environmental Consultants**	Project: WTP Alternative D Inventory Date: 9/10/2008

15. Wellsite Pumping Unit Engines

Assumptions:

Pumpjack Engine Size: 40 Horsepower (Proponent)
Number of Wells Requiring Pumping Unit Engines: 55.8 wells (Estimated at 10 % of Peak Production Wells)

Equations:

$$\text{Emissions (lbs/hr)} = \frac{\text{Emission Factor (g/hp-hr)} * \text{Power (hp)}}{453.6 \text{ g/lb}}$$

Pollutant	Emission Factor [3] (lb/MMBtu)	Emission Factor (g/hp-hr)	Emissions (lb/hr/well)	Total Emissions Alternative D (tons/yr)
Criteria Pollutants & VOC				
NOx [5]		1.5	0.13	32.3
CO [5]		2.0	0.18	43.1
VOC [5]		1.0	0.09	21.6
PM10 [1,4]	0.0194	0.070	0.01	1.5
PM2.5 [1,4]	0.0194	0.070	0.01	1.5
SO_2 [2]	0.0	0.000	0.00	0.0
Hazardous Air Pollutants				
Benzene [1]	0.001580	0.00574	5.06E-04	0.1
Toluene [1]	0.000558	0.00203	1.79E-04	4.4E-02
Ethylbenzene [1]	0.000025	0.00009	7.94E-06	1.9E-03
Xylenes [1]	0.000195	0.00071	6.25E-05	1.5E-02
Formaldehyde [1]	0.0205	0.07	0.01	1.6
Greenhouse Gases				
CO_2 [1]	110.0	399.52000	35.23	8,610.6
CH_4 [1]	0.2	0.83536	0.07	18.0

1 - AP-42 Table 3.2-3 Uncontrolled Emission Factors for 4-Stroke Rich-Burn Engines, 7/00
2 - Fuel gas is assumed to be free from sulfur compounds
3 - Conversion from lb/MMBtu to g/hp-hr assumes an average heat rate of 8,000 Btu/hp-hr (*3.632)
4 - PM = sum of PM filterable and PM condensable
5 - Utah typical BACT control rates for internal combustion engines

16. Wellsite Dehydrator Emissions

Assumptions

Average Production Rate: 0.384 MMscf/day/well (Average for life of the well, Chapter 2)
Number of Active Wells Requiring Separators: 558 wells at Peak Production
Wells Requiring Dehydrators: 140 (25% of wells, Chapter 2)

Gas Composition: Inlet Gas Sample from Average of Seven Existing Wells

Inlet Gas Conditions: Inlet gas saturated at 200 psi and 70 F (Proponent Estimate)

Glycol Circulation Rate: 3 gallons/ lb of water
(Typical operating rate)

Calculations

Dehydrator emissions were simulated using GRI GlyCalc version 4.0

Controls

Flare to achieve 95% Control Efficiency controlling tank and dehydrator emissions on wellpad (Chapter 2)

Emissions

Species	Well Dehydrator Emissions (lbs/hr/well)	Well Dehydrator Emissions (tons/year/well)	Total Project Emissions (tons/year)
Total VOC	0.0078	0.03	4.77
Hazardous Air Pollutants			
Benzene	0.0017	0.01	1.04
Toluene	0.0021	0.01	1.28
Ethylbenzene	0.0001	4.38E-04	0.06
Xylenes	0.0006	2.63E-03	0.37
n-Hexane	0.0002	8.76E-04	0.12
Greenhouse Gases			
CH_4	0.005	0.02	2.75

17. Wellsite Heater Emissions

Assumptions

Dehydrator Reboiler Heater Size	750	Mbtu/hr (Chapter 2)
Separator Heater Size	500	Mbtu/hr (Chapter 2)
Tank Heater Size	500	Mbtu/hr (Proponent)
Wells Requiring Separators:	558	wells at Peak Production
Wells Requiring Dehydrators:	140	(25% of wells, Chapter 2)
Wells Requiring Tank Heaters:	522	per pad (one to two tanks per pad, Chapter 2)
Firing Rate	6,480	hours/year (Proponent)
Fuel Gas Heat Value	1066	Btu/scf (Gas Analyses from Dry Canyon Facility)
Fuel Gas VOC Content	0.081	by weight (Gas Analyses from Dry Canyon Facility)

Equations

$$\text{Fuel Consumption (MMscf/yr)} = \frac{\text{Heater Size (MBtu/hr)} * 1{,}000\ \text{(Btu/MBtu)} * \text{Hours of Operation (hrs/yr)}}{\text{Fuel Heat Value (Btu/scf)} * 1{,}000{,}000\ \text{(scf/MMscf)}}$$

$$\text{NOx/CO/TOC Emissions (tons/yr)} = \frac{\text{AP-42 E.Factor (lbs/MMscf)} * \text{Fuel Consumption (MMscf/yr)} * \text{Fuel heating Value (Btu/scf)}}{2{,}000\ \text{(lbs/ton)} * 1{,}000\ \text{(Btu/scf - Standard Fuel Heating Value)}}$$

$$\text{VOC Emissions (tons/yr)} = \text{TOC Emissions (tons/yr)} * \text{VOC wt. fraction}$$

Species	Wellsite Heater Emissions - Separators			Wellsite Heater Emissions - Dehydrators			Wellsite Heater Emissions - Tanks			
	Emission Factor (lb/MMscf)	Well Emissions (lb/hr/well)	Total Emissions (tons/yr)	Emission Factor (lb/MMscf)	Well Emissions (lb/hr/well)	Total Emissions (tons/yr)	Emission Factor (lb/MMscf)	Well Emissions (lb/hr/well)	Total Emissions (tons/yr)	Total Emissions (tons/yr)
Criteria Pollutants & VOC										
NO_x [a]	100	0.047	84.808	100	0.070	31.803	100	0.047	79.336	195.947
CO [a]	84	0.039	71.239	84	0.059	26.714	84	0.039	66.643	164.596
TOC [c]	11	0.005	9.329	11	0.008	3.498	11	0.005	8.727	21.554
VOC	N.A.	0.000	0.755	N.A.	0.001	0.283	N.A.	0.000	0.706	1.743
SO_x [b]	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.000
TSP [c]	7.6	0.004	6.445	7.6	0.005	2.417	7.6	0.004	6.030	14.892
PM_{10} [c]	7.6	0.004	6.445	7.6	0.005	2.417	7.6	0.004	6.030	14.892
$PM_{2.5}$ [c]	7.6	0.004	6.445	7.6	0.005	2.417	7.6	0.004	6.030	14.892
Hazardous Air Pollutants										
Benzene [d]	0.0021	0.000	0.002	0.0021	0.000	0.001	0.0021	0.000	0.002	0.004
Toluene [d]	0.0034	0.000	0.003	0.0034	0.000	0.001	0.0034	0.000	0.003	0.007
Hexane [d]	1.8	0.001	1.527	1.8	0.001	0.572	1.8	0.001	1.428	3.527
Formaldehyde [d]	0.075	0.000	0.064	0.075	0.000	0.024	0.075	0.000	0.060	0.147
Greenhouse Gases										
CO_2 [c]	120,000	56.29	101,769.47	120,000	84.436	38,163.552	120,000	56.29	95,203.699	235,136.723
CH_4 [c]	2.3	0.001	1.951	2.3	0.002	0.731	2.3	0.001	1.825	4.507

a AP-42 Table 1.4-1, Emission Factors for Natural Gas Combustion, 7/98
b Assumes produced gas contains no sulfur
c AP-42 Table 1.4-2, Emission Factors for Natural Gas Combustion, 7/98 (All Particulates are PM1.0)
d AP-42 Table 1.4-3, Emission Factors for Organic Compounds from Natural Gas Combustion, 7/98

18. Wellsite Condensate Storage Tank Flash/Working/Standing Emissions

Assumptions:

Average Condensate Production Rate: 1.5 bbls condensate per day (Average for life of the well, Chapter 2))
Number of Active Wells: 558 wells at Peak Production

Separator Conditions : 150 psi and 105 F (Proponent Average Estimate)
API Gravity of Sales Oil: 52.3

Calculations:

Condensate tank flashing/working/breathing emissions estimated with E&P Tanks 2.0
Dry Canyon Compressor Station Liquid Sample Dated 2/21/04
Controlled with 95% efficiency

Emissions:

Component	Wellsite Flash/Work/Breathing (lb/hr/well)	Wellsite Flash/Work/Breathing (tons/year/well)	Total Emissions (tons/yr)
Total VOC	0.074	0.323	180.333
Hazardous Air Pollutants			
Benzene	4.050E-04	1.77E-03	0.990
Toluene	2.250E-04	9.86E-04	0.550
Ethylbenzene	0.000E+00	0.00E+00	0.000
Xylenes	3.000E-05	1.31E-04	0.073
n-Hexane	0.002	7.69E-03	4.289
Greenhouse Gases			
CO_2	0.009	0.038	21.446
CH_4	0.007	0.030	16.937

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19. Well Blowdown Emissions

Assumptions: During Production, a percentage of the wells are periodically blown down to unload fluids

# of New Producing Wells	558	wells at Peak Production (Year 20)
Blowdown Frequency	104	Wells per Year (2 per week for 52 weeks for 1 hour each, Project Proponents)
Blowdown Volume	16	Mscf/event (Estimated from Average Production Data)
Annual Blowdown Volume	1.7	MMscf/year

COMPONENT	MOLECULAR WEIGHT (lb/lb-mole)	MOLE PERCENT	RELATIVE MOLE WEIGHT (lb/lb-mole)	WEIGHT Fraction	COMPONENT FLOW RATE (Mscf/hr)	COMPONENT FLOW RATE (lb/hr/well)	COMPONENT FLOW RATE (tons/yr)
Methane	16.043	90.193	14.470	0.791	14.418	609.536	1648.184
Ethane	30.07	5.066	1.523	0.083	0.810	64.176	173.531
Propane	44.097	1.500	0.662	0.036	0.240	27.868	75.355
i-Butane	58.123	0.312	0.182	0.010	0.050	7.646	20.676
n-Butane	58.123	0.330	0.192	0.010	0.053	8.084	21.858
i-Pentane	72.15	0.136	0.098	0.005	0.022	4.130	11.168
n-Pentane	72.15	0.098	0.071	0.004	0.016	2.977	8.050
Hexanes	86.177	0.260	0.224	0.012	0.042	9.449	25.550
Heptanes	100.204	0.031	0.031	0.002	0.005	1.287	3.481
Octanes	114.231	0.013	0.015	0.001	0.002	0.641	1.734
Nonanes	128.258	0.005	0.006	0.000	0.001	0.255	0.691
Decanes +	142.285	0.000	0.000	0.000	0.000	0.000	0.000
Benzene	78.12	0.000	0.000	0.000	0.000	0.000	0.000
Toluene	92.13	0.000	0.000	0.000	0.000	0.000	0.000
Ethylbenzene	106.16	0.000	0.000	0.000	0.000	0.000	0.000
Xylenes	106.16	0.000	0.000	0.000	0.000	0.000	0.000
n-Hexane	86.177	0.000	0.000	0.000	0.000	0.000	0.000
Helium	4.003	0.000	0.000	0.000	0.000	0.000	0.000
Nitrogen	28.013	0.516	0.144	0.008	0.082	6.083	16.449
Carbon Dioxide	44.01	1.540	0.678	0.037	0.246	28.553	77.207
Oxygen	32	0.000	0.000	0.000	0.000	0.000	0.000
Hydrogen Sulfide	34.08	0.000	0.000	0.000	0.000	0.000	0.000
VOC SUBTOTAL		**2.68535714**	**1.480**	**0.081**	**0.429**	**62.339**	**168.564**
HAP SUBTOTAL		**0**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
TOTAL		**100.000**	**18.295**	**1.000**	**16**	**770.686**	**2083.936**

Buys & Associates, Inc.
Environmental Consultants

Project: WTP Alternative D Inventory
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20. Liquid Level Controller Emissions

Company: **BBC**
Location: **WTP EIS**

GAS COMPONENT	MOLECULAR WEIGHT (lb/lb-mole)	MOLE PERCENT	RELATIVE MOLE WEIGHT (lb/lb-mole)	WEIGHT PERCENT	COMPONENT FLOW RATE (Mscf/day)	COMPONENT FLOW RATE (lb/hr)	COMPONENT FLOW RATE (tons/yr/well)
Methane	16.043	91.307	14.64838201	81.48852235	0.83271984	1.46680681	6.424613828
Ethane	30.07	5.305	1.5952135	8.874126225	0.0483816	0.159735732	0.699642507
Propane	44.097	1.536	0.67732992	3.767966612	0.01400832	0.067824019	0.297069203
i-Butane	58.123	0.337	0.19587451	1.089644193	0.00307344	0.019613775	0.085908333
n-Butane	58.123	0.387	0.22493601	1.25131247	0.00352944	0.02252383	0.098654377
i-Pentane	72.15	0.166	0.119769	0.666271458	0.00151392	0.011992996	0.052529322
n-Pentane	72.15	0.117	0.0844155	0.469600967	0.00106704	0.008452895	0.037023679
Hexanes	86.177	0.113	0.09738001	0.541722159	0.00103056	0.009751088	0.042709765
Heptanes	100.204	0.042	0.04208568	0.234121412	0.00038304	0.004214224	0.018458301
Octanes	114.231	0.008	0.00913848	0.050837098	0.00007296	0.000915076	0.004008033
Nonanes	128.258	0	0	0	0	0	0
Decanes +	142.285	0	0	0	0	0	0
Benzene	78.12	0.01	0.007812	0.043457928	0.0000912	0.00078225	0.003426254
Toluene	92.13	0.006	0.0055278	0.03075099	0.00005472	0.000553523	0.00242443
Ethylbenzene	106.16	0	0	0	0	0	0
Xylenes	106.16	0.001	0.0010616	0.00590565	0.00000912	0.000106303	0.000465606
n-Hexane	86.177	0.041	0.03533257	0.196554058	0.00037392	0.003538005	0.015496464
Helium	4.003	0.018	0.00072054	0.004008343	0.00016416	7.21508E-05	0.000316021
Nitrogen	28.013	0.223	0.06246899	0.347513171	0.00203376	0.006255294	0.027398189
Carbon Dioxide	44.01	0.383	0.1685583	0.937684912	0.00349296	0.016878483	0.073927754
Oxygen	32	0	0	0	0	0	0
Hydrogen Sulfide	34.08	0	0	0	0	0	0
VOC SUBTOTAL		**2.764**	**1.50066308**	**8.348144994**	**0.02520768**	**0.150267983**	**0.658173768**
HAP SUBTOTAL		**0.058**	**0.04973397**	**0.276668626**	**0.00052896**	**0.004980081**	**0.021812754**
TOTAL		**100**	**17.97600642**	**100**	**0.912**	**1.800016454**	**7.884072067**

EQUIPMENT SPECIFICATIONS

Gas Consumption Rate:	0.912 Mscf/day
Days of Operation:	365 days/year

	Number of Wells	VOC emissions (tons/year)
Alternative D	558	735

Buys & Associates, Inc.
Environmental Consultants

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21. Trace Pump Emissions

Company: **BBC**
Location: **WTP EIS**

GAS COMPONENT	MOLECULAR WEIGHT (lb/lb-mole)	MOLE PERCENT	RELATIVE MOLE WEIGHT (lb/lb-mole)	WEIGHT PERCENT	COMPONENT FLOW RATE (Mscf/day)	COMPONENT FLOW RATE (lb/hr)	COMPONENT FLOW RATE (tons/yr/well)
Methane	16.043	91.307	14.64838201	81.48852235	13.148208	23.16010753	58.91931355
Ethane	30.07	5.305	1.5952135	8.874126225	0.76392	2.522143139	6.416332147
Propane	44.097	1.536	0.67732992	3.767966612	0.221184	1.070905563	2.724383752
i-Butane	58.123	0.337	0.19587451	1.089644193	0.048528	0.30969118	0.787854363
n-Butane	58.123	0.387	0.22493601	1.25131247	0.055728	0.355639427	0.904746701
i-Pentane	72.15	0.166	0.119769	0.666271458	0.023904	0.189363093	0.481739708
n-Pentane	72.15	0.117	0.0844155	0.469600967	0.016848	0.133466758	0.339539432
Hexanes	86.177	0.113	0.09738001	0.541722159	0.016272	0.153964547	0.391685808
Heptanes	100.204	0.042	0.04208568	0.234121412	0.006048	0.066540378	0.169278721
Octanes	114.231	0.008	0.00913848	0.050837098	0.001152	0.01444857	0.036757163
Nonanes	128.258	0	0	0	0	0	0
Decanes +	142.285	0	0	0	0	0	0
Benzene	78.12	0.01	0.007812	0.043457928	0.00144	0.012351314	0.031421742
Toluene	92.13	0.006	0.0055278	0.03075099	0.000864	0.008739835	0.02223414
Ethylbenzene	106.16	0	0	0	0	0	0
Xylenes	106.16	0.001	0.0010616	0.00590565	0.000144	0.001678463	0.00427001
n-Hexane	86.177	0.041	0.03533257	0.196554058	0.005904	0.055863243	0.14211609
Helium	4.003	0.018	0.00072054	0.004008343	0.002592	0.001139224	0.002898185
Nitrogen	28.013	0.223	0.06246899	0.347513171	0.032112	0.098767804	0.251265294
Carbon Dioxide	44.01	0.383	0.1685583	0.937684912	0.055152	0.266502358	0.677982
Oxygen	32	0	0	0	0	0	0
Hydrogen Sulfide	34.08	0	0	0	0	0	0
VOC SUBTOTAL		**2.764**	**1.50066308**	**8.348144994**	**0.398016**	**2.37265237**	**6.03602763**
HAP SUBTOTAL		**0.058**	**0.04973397**	**0.276668626**	**0.008352**	**0.078632855**	**0.200041982**
TOTAL		**100**	**17.97600642**	**100**	**14.4**	**28.42131242**	**72.30381881**

PUMP SPECIFICATIONS

Pump Mfg.:	LEON
Injection Pressure:	20 psi
Mfg. Gas Consumption Rate:	10 scf/min
Gas Consumption Rate:	14.40 Mscf/day
Days of Operation:	212 days/year

	Number of Wells	VOC emissions (tons/year)
Alternative D	558	3368

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22. Pneumatic Methanol Injection Pump Emissions

Company: **BBC**
Location: **WTP EIS**

GAS COMPONENT	MOLECULAR WEIGHT (lb/lb-mole)	MOLE PERCENT	RELATIVE MOLE WEIGHT (lb/lb-mole)	WEIGHT PERCENT	COMPONENT FLOW RATE (Mscf/day)	COMPONENT FLOW RATE (lb/hr)	COMPONENT FLOW RATE (tons/yr)
Methane	16.043	91.307	14.64838201	81.48852235	0.39444624	0.694803226	1.767579407
Ethane	30.07	5.305	1.5952135	8.874126225	0.0229176	0.075664294	0.192489964
Propane	44.097	1.536	0.67732992	3.767966612	0.00663552	0.032127167	0.081731513
i-Butane	58.123	0.337	0.19587451	1.089644193	0.00145584	0.009290735	0.023635631
n-Butane	58.123	0.387	0.22493601	1.25131247	0.00167184	0.010669183	0.027142401
i-Pentane	72.15	0.166	0.119769	0.666271458	0.00071712	0.005680893	0.014452191
n-Pentane	72.15	0.117	0.0844155	0.469600967	0.00050544	0.004004003	0.010186183
Hexanes	86.177	0.113	0.09738001	0.541722159	0.00048816	0.004618936	0.011750574
Heptanes	100.204	0.042	0.04208568	0.234121412	0.00018144	0.001996211	0.005078362
Octanes	114.231	0.008	0.00913848	0.050837098	0.00003456	0.000433457	0.001102715
Nonanes	128.258	0	0	0	0	0	0
Decanes +	142.285	0	0	0	0	0	0
Benzene	78.12	0.01	0.007812	0.043457928	0.0000432	0.000370539	0.000942652
Toluene	92.13	0.006	0.0055278	0.03075099	0.00002592	0.000262195	0.000667024
Ethylbenzene	106.16	0	0	0	0	0	0
Xylenes	106.16	0.001	0.0010616	0.00590565	0.00000432	5.03539E-05	0.0001281
n-Hexane	86.177	0.041	0.03533257	0.196554058	0.00017712	0.001675897	0.004263483
Helium	4.003	0.018	0.00072054	0.004008343	0.00007776	3.41767E-05	8.69456E-05
Nitrogen	28.013	0.223	0.06246899	0.347513171	0.00096336	0.002963034	0.007537959
Carbon Dioxide	44.01	0.383	0.1685583	0.937684912	0.00165456	0.007995071	0.02033946
Oxygen	32	0	0	0	0	0	0
Hydrogen Sulfide	34.08	0	0	0	0	0	0
VOC SUBTOTAL		**2.764**	**1.50066308**	**8.348144994**	**0.01194048**	**0.071179571**	**0.181080829**
HAP SUBTOTAL		**0.058**	**0.04973397**	**0.276668626**	**0.00025056**	**0.002358986**	**0.006001259**
TOTAL		**100**	**17.97600642**	**100**	**0.432**	**0.852639373**	**2.169114564**

PUMP SPECIFICATIONS

Pump Mfg.:	Western
Piston Size:	0.625 inch
Injection Pressure:	30 psi
Pump Rate:	2.00 gallons/day
Gas Consumption Rate:	0.43 Mscf/day
Days of Operation:	212 days/year

	Number of Wells	VOC emissions (tons/year)
Alternative D	558	101

23. Operations Vehicle Tailpipe Emissions

Assumptions:

Number of New Pumpers:	30	(Number of Pumpers at Peak Production)
Pumper Mileage:	3,000	miles/pumper/month (Assumption)
Total Annual New Pumper Mileage:	1,080,000	miles/year
Number of Condensate Haul Truck Round Trips:	15	trips per day (Based on Peak Production)
Average Round Trip Mileage for Condensate Transport:	168	miles (Estimate from Vernal)
Total Annual Condensate Truck Mileage:	919,800	miles/year
Number of Water Haul Truck Round Trips:	0	trips per day (Alternative E, water will be piped)
Average Round Trip Mileage for Water Transport:	0	miles (Average distance to water injection facility)
Total Annual Water Truck Mileage:	0	miles/year
Daily Hours of Operation:	12	hours per day (Assumption)
Annual Hours of Operation:	4368	hours per year
Fuel sulfur content	0.05	% (Typical value)
Fuel density	7.08	lbs/gallon (Typical value)
Heavy Duty Pickup Fuel Efficiency	15	miles/gallon (Typical value)
Heavy Haul Diesel Fuel Efficiency	10	miles/gallon (Typical value)

Equations:

For NOx, CO and VOC:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (g/mile)} * \text{Vehicle Miles Traveled (miles/yr)}}{\text{453.6 (g/lb)} * \text{2000 (lb/tons)}}$$

The NOx, CO and VOC emission factors for the above equation are from AP-42, while the SO2 emissions are calculated on a mass balance basis utilizing the following equation:

$$\text{SO2 E. Factor (g/mi)} = \frac{\text{Fuel Density (lb/gal)} * \text{453.6 (g/lb)} * \text{Fuel Sulfur Content} * \text{2 (S / SO2)}}{\text{Vehicle Fuel Efficiency (miles/gal)}}$$

Pumper Vehicles	Heavy Duty Pickups			Heavy Haul Trucks			Total	
	E. Factor [a] (g/mile)	Emissions (lb/hr)	Emissions (tons/yr)	E. Factor [b] (g/mile)	Emissions (lb/hr)	Emissions (tons/yr)	Emissions (lb/hr)	Emissions (tons/yr)
Criteria Pollutants & VOC								
NO_x	3.03	1.652	3.607	8.13	3.774	8.243	5.426	11.850
CO	33.64	18.337	40.048	17.09	7.934	17.327	26.271	57.375
VOC [c]	1.656	0.903	1.971	4.600	2.135	4.664	3.038	6.635
SO_2	0.21	0.117	0.255	0.32	0.149	0.326	0.266	0.580
Greenhouse Gases								
CH_4 [d]	0.184	0.100	0.219	0.230	0.107	0.233	0.207	0.452

a AP-42 Append H Table 4.1A.2 - H.D. Gasoline Vehicles, High Altitude, 1991 - 1997 Vehicle Year, 50,000 miles (6/95)
b AP-42 Append. H Table 7.1.2 - H.D. Diesel Powered Vehicles, High Altitude, 1991 - 1997 Model Year, 50,000 miles (6/95)
c Emission factor is for total Hydrocarbons - Methane Offset
d AP-42 Append. H Tables 7.10A.2 and 4.10A.2 H.D. Methane Offsets, High Altitude, 1986+ and 1988+ Vehicle Year

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24. Operations Traffic Fugitive Dust Emissions

Calculation AP-42, Chapter 13.2.2
December 2003

365 days (Estimate)

E (PM10) / VMT = 1.5 * (S/12)^0.9 * (W/3)^0.45 * (365-p)/365)
E (PM2.5) / VMT = 0.23 * (S/12)^0.9 + (W/3)^0.45 * (365-p)/365)

Silt Content (S)	7	Mean value Table 13.2.2-1 for Gravel Surfaces
Average Round Trip Miles	74	miles on unpaved roads (Average of Pumper,Condensate)
Precipitation Days (P)	73	days per year (NCDC data for Nutters Ranch, UT 1963-1986)

Vehicle Type	Ave. Weight (lbs)	Round Trips per Day*	PM10 (lb/VMT)	Total PM10 (lbs)	PM10 (lb/day)	Total PM2.5 (lbs)	PM2.5 (lb/day)
Pickup Truck: Crew	7,000	30.0					
Haul Truck: Oil	48,000	15.000					
Mean Weight	20,667	45.000	1.288873	1,566,560.21	4,291.95	240,205.90	658.1

Annual Traffic Fugitive Dust Emissions (tons/year)			**783.28**		**120.10**	

*Round trips per day at peak production

25. Well Production Summary

Species	Production Heaters (tons/yr)	Storage Tanks (tons/yr)	Well Dehydrators (tons/yr)	Well Pumping Unit Engines (tons/yr)	Pneumatic Devices (tons/yr)	Operations Vehicle (tons/yr)	Well Blowdown (tons/yr)	Total Well Production [a] (tons/yr)
Criteria Pollutants & VOC								
NO_x	195.9			32.3		11.9		240.1
CO	164.6			43.1		57.4		265.1
VOC	21.6	180.3	4.8	21.6	4,204	6.6	168.6	4,607.1
SO_2	0.0			0.0		0.6		0.6
PM_{10}	14.9			1.5		783.3		799.7
$PM_{2.5}$	14.9			1.5		120.1		136.5
Hazardous Air Pollutants								
Benzene	0.0	1.0	1.0	0.1	20.0		0.0	22.1
Toluene	0.0	0.5	1.3	4.4E-02	8.8		0.0	10.7
Ethylbenzene		0.0	0.1	1.9E-03	0.0		0.0	0.1
Xylene		0.1	0.4	1.5E-02	2.7		0.0	3.2
n-Hexane	3.5	4.3	0.1		56.3		0.0	64.3
Formaldehyde	0.1			1.6				1.8
Total HAPs	3.7	5.9	2.9	1.8		0.0	0.0	102.1
Greenhouse Gases								
CO_2	235,136.7	21.4		8,610.6			77.2	243,846.0
CH_4	4.5	16.9	2.7	18.0		0.5	1,648.2	1,690.8

[a] Emissions for Peak Field Development

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26. Pump Station Generators

Assumptions:

Generator at each Pump Station:	400	Horsepower (one Generator/pumpstation)
Salt Water Supply pumps:	400	Horsepower (one pump/water supply well)
Water Supply pumps:	400	Horsepower (one pump/water supply well)
Project Total:	6,000	Horsepower (Ch. 2- 3 pump stations,6salt water, 6 water supply)

Equations:

$$\text{Emissions (lbs/hr)} = \frac{\text{Emission Factor (g/hp-hr)} * \text{Power (hp)}}{453.6 \text{ g/lb}}$$

Pollutant	Emission Factor [3] (lb/MMBtu)	Emission Factor (g/hp-hr)	Emissions (lb/hr/engine)	Emissions (tons/yr/engine)	Total Emissions [5] Alternative D (tons/yr)
Criteria Pollutants & VOC					
NOx [6]	2.21	1.5	1.32	6	75
CO [6]	3.72	2.0	1.8	8	100
VOC [1]	2.96E-02	0.108	0.09	0.4	5.4
PM10 [1,4]	1.94E-02	0.070	0.06	0.3	3.5
PM2.5 [1,4]	1.94E-02	0.070	0.06	0.3	3.5
SO_2 [2]	0.0	0.000	0.00	0.0	0.0
Hazardous Air Pollutants [7]					
Benzene [1]	1.58E-03	2.87E-03	0.00	1.1E-02	0.1
Toluene [1]	5.58E-04	1.01E-03	8.94E-04	3.9E-03	0.1
Ethylbenzene [1]	2.48E-05	4.50E-05	3.97E-05	1.7E-04	2.3E-03
Xylenes [1]	1.95E-04	3.54E-04	3.12E-04	1.4E-03	1.8E-02
Formaldehyde [1]	2.05E-02	1.79E-02	0.02	0.1	0.9
Greenhouse Gases					
CO2 [1]	110.0	399.5	352.3	1,543	20,061
CH4 [1]	0.2	0.83536	0.74	3.2	41.9

1 - AP-42 Table 3.2-3 Uncontrolled Emission Factors for 4-Stroke Rich-Burn Engines, 7/00
2 - Fuel gas is assumed to be free from sulfur compounds
3 - Conversion from lb/MMBtu to g/hp-hr assumes an average heat rate of 8,000 Btu/hp-hr (*3.632)
4 - PM = sum of PM filterable and PM condensable
5 - Alternative D Total Annual Emissions for 4 Pump Stations (1,600 hp)
6 - BACT emission levels
7 - BACT requires 76% control of Formaldehyde, which controls other HAPs by 50%

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27. Average Produced Gas Characteristics
Inlet Wet Gas Sample from BBC Dry Canyon Compressor Station, dated 2/18/2004

Gas Heat Value (wet): 1082.2 Btu/scf

Sample Temperature: 108 F
Sample Pressure: 790 psi

C1-C2 Wt. Fraction:	0.9035
VOC Wt. Fraction:	0.0835
Non-HC Wt. Fraction:	0.0130
Total:	1.0000

COMPONENT	MOLE PERCENT	COMPONENT MOLE WEIGHT (lb/lb-mole)	NET MOLE WEIGHT (lb/lb-mole)	WEIGHT FRACTION	GROSS HEATING VALUE (BTU/scf)	NET DRY HEATING VALUE (BTU/scf)	LOWER HEATING VALUE (BTU/scf)	NET LOW HEATING VALUE (BTU/scf)
Methane	91.3030	16.043	14.648	0.815	1010.000	922.160	910.000	830.857
Ethane	5.3050	30.070	1.595	0.089	1769.800	93.888	1618.000	85.835
Propane	1.5360	44.097	0.677	0.038	2516.200	38.649	2316.000	35.574
i-Butane	0.3370	58.123	0.196	0.011	3252.100	10.960	3005.000	10.127
n-Butane	0.3870	58.123	0.225	0.013	3262.400	12.625	3013.000	11.660
i-Pentane	0.1600	72.150	0.115	0.006	4000.900	6.401	3698.000	5.917
n-Pentane	0.1170	72.150	0.084	0.005	4008.800	4.690	3708.000	4.338
Hexanes	0.1270	86.177	0.109	0.006	4756.200	6.040	4404.000	5.593
Heptanes	0.0340	100.204	0.034	0.002	5502.500	1.871	5100.000	1.734
Octanes+	0.0080	114.231	0.009	0.001	6249.100	0.500		0.000
Nonanes	0.0000	128.258	0.000	0.000	6996.400	0.000		0.000
Decanes	0.0000	142.285	0.000	0.000	7743.200	0.000		0.000
Benzene	0.0100	78.120	0.008	0.000	3715.500	0.372		0.000
Toluene	0.0060	92.130	0.006	0.000	4444.600	0.267		0.000
Ethylbenzene	0.0000	106.160	0.000	0.000	5191.500	0.000		0.000
Xylenes	0.0010	106.160	0.001	0.000	5183.500	0.052		0.000
n-Hexane	0.0410	86.177	0.035	0.002	4756.200	1.950		0.000
Helium	0.0090	4.003	0.000	0.000	0.000	0.000	0.000	0.000
Nitrogen	0.2230	28.013	0.062	0.003	0.000	0.000	0.000	0.000
Carbon Dioxide	0.3830	44.010	0.169	0.009	0.000	0.000	0.000	0.000
Oxygen	0.0090	32.000	0.003	0.000	0.000	0.000	0.000	0.000
Hydrogen Sulfide	0.0000	34.080	0.000	0.000	637.100	0.000	588.000	0.000
TOTAL	100.00		17.98	1.00		1100.43		991.64

Relative Mole Weight (lb/lb-mole) = [Mole Percent * Molecular weight (lb/lb-mole)] / 100

Weight Fraction = Net Mole Weight / Total Mole Weight

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28. Central Compression

Assumptions:

Total Existing Compression: 16,000 Horsepower (Dry Canyon Facility)
Total New Compression: 11,200 Horsepower (Chapter 2)

Equations:

$$\text{Emissions (lbs/hr)} = \frac{\text{Emission Factor (g/hp-hr)} * \text{Power (hp)}}{453.6 \text{ g/lb}}$$

Pollutant	Emission Factor [3] (lb/MMBtu)	Emission Factor (g/hp-hr)	Emissions (lb/hr/engine) [7]	Emissions 3,200 hp Station (tons/yr)	Emissions 3,200 hp Station (tons/yr)	Emissions 4,800 hp Station (tons/yr)	Total Emissions [5] Alternative D (tons/yr)
Criteria Pollutants & VOC							
NOx [6]		1.5	5.29	46.4	46.4	69.5	162.2
CO [6]		2.0	7.05	61.8	61.8	92.7	216.3
VOC [6]		1.0	3.53	30.9	30.9	46.4	108.1
PM10 [1,4]	0.0194	0.070	0.25	2.2	2.2	3.3	7.6
PM2.5 [1,4]	0.0194	0.070	0.25	2.2	2.2	3.3	7.6
SO_2 [2]	0.0	0.000	0.00	0.0	0.0	0.0	0.0
Hazardous Air Pollutants							
Benzene [1]	0.001580	0.00574	0.02	0.2	0.2	0.3	0.6
Toluene [1]	0.000558	0.00203	0.01	0.1	0.1	0.1	0.2
Ethylbenzene [1]	0.000025	0.00009	0.00	0.0	0.0	0.0	0.0
Xylenes [1]	0.000195	0.00071	0.00	0.0	0.0	0.0	0.1
Formaldehyde [1]	0.0205	0.07446	0.26	2.3	2.3	3.5	8.1
Greenhouse Gases							
CO2 [1]	110.00	399.52	1,409.24	12,345.2	12,345.2	18,517.8	43,207.3
CH4 [1]	0.2	0.83536	2.95	25.8	25.8	38.7	90.3

1 - AP-42 Table 3.2-3 Uncontrolled Emission Factors for 4-Stroke Rich-Burn Engines, 7/00
2 - Fuel gas is assumed to be free from sulfur compounds
3 - Conversion from lb/MMBtu to g/hp-hr assumes an average heat rate of 8,000 Btu/hp-hr (*3.632)
4 - PM = sum of PM filterable and PM condensable
5 - Alternative D Total Annual Emissions for New Compression (24,000 hp)
6 - Assumed equivalent control rates for internal combustion engines located at existing Dry Canyon Facility
7 - Each individual engine estimated at 1,600 hp (Chapter 2)

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29. Central TEG Dehydrator Emissions

Assumptions

Peak Field Production Rate: 250 MMscf/day
558 Active Wells at Peak Production

Gas Composition: Inlet Gas Sample from Dry Canyon Compresor Station, dated 2/18/04

Inlet Gas Conditions: Inlet gas saturated at 600 psi and 108 F

Glycol Circulation Rate: 3 gallons/ lb of water
(Typical operating rate)

Calculations

Dehydrator emissions were simulated using GRI GlyCalc version 4.0

Controls

Condenser/Combustor > 95% Control Efficiency in order to meet Federal MACT Standards
Condenser Operating Conditions: 120 deg. F, 11.5 psia

Emissions

Species	Central Dehydrator Emissions 67MMscfd Station (tons/year)	Central Dehydrator Emissions 67MMscfd Station (tons/year)	Central Dehydrator Emissions 117MMscfd Station (tons/year)	Total Project Emissions (tons/year)
Total VOC	8.46	8.46	14.77	31.69
Hazardous Air Pollutants				
Benzene	1.47	1.47	2.57	5.51
Toluene	1.47	1.47	2.57	5.51
Ethylbenzene	0.00	0.00	0.00	0.00
Xylenes	0.49	0.49	0.86	1.84
n-Hexane	0.22	0.22	0.38	0.81
Greenhouse Gases				
CH_4	12.28	12.28	21.44	46.00

Each station throughput estimated according to the ratio of new compression proposed at each station and based on a peak field production rate of 250MMscfd

30. Central Facility Heater Emissions

Assumptions

Dehydrator Reboiler Heater	500	Mbtu/hr (Estimate based on Dry Canyon Facility)
Tank Heater Size	500	Mbtu/hr (Estimate based on Dry Canyon Facility)
Total Heater Requirmement Facility 1	3,000	Mbtu/hr (Chapter 2 Estimate, 2-Dehydrator Reboiler Heaters, 4-Tank Heaters)
Total Heater Requirmement Facility 2	3,000	Mbtu/hr (Chapter 2 Estimate, 2-Dehydrator Reboiler Heaters, 4-Tank Heaters)
Total Heater Requirmement Facility 3	6,000	Mbtu/hr (Chapter 2 Estimate, 4-Dehydrator Reboiler Heaters, 8-Tank Heaters)
Firing Rate	30	minutes/hour on average for entire year (Typical value)
	4380	hours/year
Fuel Gas Heat Value	992	Btu/scf (Gas Analyses from Dry Canyon Facility)
Fuel Gas VOC Content	0.083	by weight (Gas Analyses from Dry Canyon Facility)

Equations

$$\text{Fuel Consumption (MMscf/yr)} = \frac{\text{Heater Size (MBtu/hr)} * 1{,}000\ \text{(Btu/MBtu)} * \text{Hours of Operation (hrs/yr)}}{\text{Fuel Heat Value (Btu/scf)} * 1{,}000{,}000\ \text{(scf/MMscf)}}$$

$$\text{NOx/CO/TOC Emissions (tons/yr)} = \frac{\text{AP-42 E.Factor (lbs/MMscf)} * \text{Fuel Consumption (MMscf/yr)} * \text{Fuel heating Value (Btu/scf)}}{2{,}000\ \text{(lbs/ton)} * 1{,}000\ \text{(Btu/scf - Standard Fuel Heating Value)}}$$

$$\text{VOC Emissions (tons/yr)} = \text{TOC Emissions (tons/yr)} * \text{VOC wt. fraction}$$

Species	Central Heater Emissions - Facility 1			Central Heater Emissions - Facility 2			Central Heater Emissions - Facility 3			
	Emission Factor (lb/MMscf)	Well Emissions (lb/hr)	Total Emissions (tons/yr)	Emission Factor (lb/MMscf)	Well Emissions (lb/hr)	Total Emissions (tons/yr)	Emission Factor (lb/MMscf)	Well Emissions (lb/hr)	Total Emissions (tons/yr)	Total Emissions (tons/yr)
Criteria Pollutants & VOC										
NO_x [a]	100	0.300	0.657	100	0.300	0.657	100	0.600	1.314	2.628
CO [a]	84	0.252	0.552	84	0.252	0.552	84	0.504	1.104	2.208
TOC [c]	11	0.033	0.072	11	0.033	0.072	11	0.066	0.145	0.289
VOC	N.A.	0.003	0.006	N.A.	0.003	0.006	N.A.	0.006	0.012	0.024
SO_x [b]	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.000
TSP [c]	7.6	0.023	0.050	7.6	0.023	0.050	7.6	0.046	0.100	0.200
PM_{10} [c]	7.6	0.023	0.050	7.6	0.023	0.050	7.6	0.046	0.100	0.200
$PM_{2.5}$ [c]	7.6	0.023	0.050	7.6	0.023	0.050	7.6	0.046	0.100	0.200
Hazardous Air Pollutants										
Benzene [d]	0.0021	0.000	0.000	0.0021	0.000	0.000	0.0021	0.000	0.000	0.000
Toluene [d]	0.0034	0.000	0.000	0.0034	0.000	0.000	0.0034	0.000	0.000	0.000
Hexane [d]	1.8	0.005	0.012	1.8	0.005	0.012	1.8	0.011	0.024	0.047
Formaldehyde [d]	0.075	0.000	0.000	0.075	0.000	0.000	0.075	0.000	0.001	0.002
Greenhouse Gases										
CO_2 [c]	120,000	360.00	788.40	120,000	360.00	788.40	120,000	720.00	1,576.80	3,153.600
CH_4 [c]	2.3	0.007	0.015	2.3	0.007	0.015	2.3	0.014	0.030	0.060

a AP-42 Table 1.4-1, Emission Factors for Natural Gas Combustion, 7/98
b Assumes produced gas contains no sulfur
c AP-42 Table 1.4-2, Emission Factors for Natural Gas Combustion, 7/98 (All Particulates are PM1.0)
d AP-42 Table 1.4-3, Emission Factors for Organic Compounds from Natural Gas Combustion, 7/98

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Project: WTP Alternative D Inventory
Date: 9/10/2008

31. Central Facility Condensate Storage Tank Flash/Working/Standing Emissions

Assumptions:

Average Condensate Production Rate :

Facility 1	100 bbls condensate per day (Estimate Based on Dry Canyon Compressor Station Volumes)
Facility 2	100 bbls condensate per day (Estimate Based on Dry Canyon Compressor Station Volumes)
Facility 3	175 bbls condensate per day (Estimate Based on Dry Canyon Compressor Station Volumes)

Separator Conditions : 110 psi and 40 F (Sample Conditions)

Calculations:

Condensate tank flashing/working/breathing emissions estimated with E&P Tanks 2.0
Dry Canyon Compressor Station Liquid Sample Dated 2/21/04
Flare to control stock tank and dehydrator emissions with 95% control efficiency

Emissions:

Component	Facility 1 Flash/Work/Breathing (tons/yr)	Facility 2 Flash/Work/Breathing (tons/yr)	Facility 3 Flash/Work/Breathing (tons/yr)	Total Emissions (tons/yr)
Total VOC	21.544	21.544	37.700	80.788
Hazardous Air Pollutants				
Benzene	0.120	0.120	0.210	0.450
Toluene	0.066	0.066	0.116	0.248
Ethylbenzene	0.000	0.000	0.001	0.001
Xylenes	0.007	0.007	0.013	0.027
n-Hexane	0.513	0.513	0.898	1.924
Greenhouse Gases				
CO_2	2.564	2.564	4.487	9.615
CH_4	2.023	2.023	3.541	7.587

32. Central Facility Emission Summary

Central Facility 1

Pollutant	Central Compression Emissions 3,200 hp (tons/year)	Central Dehydrator Emissions 67MMscfd (tons/year)	Central Heater Emissions (tons/year)	Central Condensate Tank Emissions (tons/year)	Total Facility Emissions (tons/year)
Criteria Pollutants & VOC					
NO_x	46.4		0.7		47.0
CO	61.8		0.6		62.4
VOC	30.9	8.5	0.0	21.5	60.9
SO_2	0.0		0.0		0.0
PM_{10}	2.2		0.0		2.2
$PM_{2.5}$	2.2		0.0		2.2
Hazardous Air Pollutants					
Benzene	0.2	1.5	0.0	0.1	1.8
Toluene	0.1	1.5	0.0	0.1	1.6
Ethylbenzene	0.0	0.0		0.0	0.0
Xylene	0.0	0.5		0.0	0.5
n-Hexane		0.2	0.0	0.5	0.7
Formaldehyde	2.3		0.0		2.3
Total HAPs	2.6	3.6	0.0	0.7	6.9
Greenhouse Gases					
CO_2	12,345.2		788.4	2.6	13,136.2
CH_4	25.8	12.3	0.0	2.0	40.1

Central Facility 2

Pollutant	Central Compression Emissions 3,200 hp (tons/year)	Central Dehydrator Emissions 67MMscfd (tons/year)	Central Heater Emissions (tons/year)	Central Condensate Tank Emissions (tons/year)	Total Facility Emissions (tons/year)
Criteria Pollutants & VOC					
NO_x	46.4		0.7		47.0
CO	61.8		0.6		62.4
VOC	30.9	8.5	0.0	21.5	60.9
SO_2	0.0		0.0		0.0
PM_{10}	2.2		0.0		2.2
$PM_{2.5}$	2.2		0.0		2.2
Hazardous Air Pollutants					
Benzene	0.2	1.5	0.0	0.1	1.8
Toluene	0.1	1.5	0.0	0.1	1.6
Ethylbenzene	0.0	0.0		0.0	0.0
Xylene	0.0	0.5		0.0	0.5
n-Hexane		0.2	0.0	0.5	0.7
Formaldehyde	2.3		0.0		2.3
Total HAPs	2.6	3.6	0.0	0.7	6.9
Greenhouse Gases					
CO_2	12,345.2		788.4	2.6	13,136.2
CH_4	25.8	12.3	0.0	2.0	40.1

Central Facility 3

Pollutant	Central Compression Emissions 4,800 hp (tons/year)	Central Dehydrator Emissions 117MMscfd (tons/year)	Central Heater Emissions (tons/year)	Central Condensate Tank Emissions (tons/year)	Total Facility Emissions (tons/year)
Criteria Pollutants & VOC					
NO_x	69.5		1.3		70.8
CO	92.7		1.1		93.8
VOC	46.4	14.8	0.0	37.7	98.8
SO_2	0.0		0.0		0.0
PM_{10}	3.3		0.1		3.4
$PM_{2.5}$	3.3		0.1		3.4
Hazardous Air Pollutants					
Benzene	0.3	2.6	0.0	0.2	3.0
Toluene	0.1	2.6	0.0	0.1	2.8
Ethylbenzene	0.0	0.0		0.0	0.0
Xylene	0.0	0.9		0.0	0.9
n-Hexane		0.4	0.0	0.9	1.3
Formaldehyde	3.5				3.5
Total HAPs	3.8	6.4	0.0	1.2	11.5
Greenhouse Gases					
CO_2	18,517.8		1,576.8	4.5	20,099.1
CH_4	38.7	21.4	0.0	3.5	63.7

33. Total Project Production Related Emissions Summary

Pollutant	Total Project Production Related Emissions (tons/year) [a]					Total Production (tons/year)
	Well Production (tons/year)	Pump Generators (tons/year)	Central Facility 1 (tons/year)	Central Facility 2 (tons/year)	Central Facility 3 (tons/year)	
Criteria Pollutants & VOC						
NO_x	240.1	75.3	47.0	47.0	70.8	480.3
CO	265.1	100.4	62.4	62.4	93.8	584.0
VOC	4,607.1	5.4	60.9	60.9	98.8	4,833.1
SO_2	0.6	0.0	0.0	0.0	0.0	0.6
PM_{10}	799.7	3.5	2.2	2.2	3.4	811.1
$PM_{2.5}$	136.5	3.5	2.2	2.2	3.4	147.9
Hazardous Air Pollutants						
Benzene	22.1	0.1	1.8	1.8	3.0	28.9
Toluene	10.7	0.1	1.6	1.6	2.8	16.7
Ethylbenzene	0.1	2.3E-03	0.0	0.0	0.0	0.1
Xylene	3.2	1.8E-02	0.5	0.5	0.9	5.1
n-Hexane	64.3	0.0	0.7	0.7	1.3	67.1
Formaldehyde	1.8	0.9	2.3	2.3	3.5	10.7
Total HAPs	102.1	1.1	6.9	6.9	11.5	128.5
Greenhouse Gases						
CO_2	243,846.0	20,060.6	13,136.2	13,136.2	20,099.1	310,278.1
CH_4	1,690.8	41.9	40.1	40.1	63.7	1,876.8

a Emissions for Peak Field Development

Pollutant	Project Emissions (tons/year)		Total Emissions [a] (tons/year)
	Well Development	Project Production	
Criteria Pollutants & VOC			
NO_x	89	480	569
CO	152	584	736
VOC	25.9	4,833	4,859
SO_2	3.25	0.58	3.83
PM_{10}	1,626	811	2,437
$PM_{2.5}$	1,310	148	1,458
Hazardous Air Pollutants			
Benzene	0.00	28.9	28.9
Toluene	0.00	16.7	16.7
Ethylbenzene	0.00	0.08	0.08
Xylene	0.00	5.13	5.13
n-Hexane	0.00	67.1	67.1
Formaldehyde	0.17	10.7	10.9

Existing												
	71	Total wells currently in Operation in WTP										
	30	Wells to be developed in WTP (already approved under WTP Drilling Program EA - UT-070-2004-28)										
Proposed												
	Total New Wells	807		wells	days		percent					
	Total New Pads	494	0.612143742	46	46	deep downhole	0.05700					
	Average Number of Wells Per Pad	1.6336		24	92	deep directional	0.02974					
	Number of Producing Wells at Peak Development (Year 9)	807		448	13	downhole	0.55514					
	Number of Producing Pads at Peak Development (Year 9)	494		289	26	directional	0.35812					
	Total Deep Wells (Proponent)	70		807	21.8860							
	Total Shallow Wells (Proponent)	737										
Drilling												
	New Well pad/road construction											
	Drilling (Max Year 1)	78	new well pads per year for	9	years							
		128	new wells per year for	9	years							
		46	directional									
		71	downhole	downhole	directional							
		11	deep	7	4							
	Short-Term Well Pad Disturbance	1407	acres									
		2.8482	acres/pad (average for all pads)									
	ROW Disturbance											
	Roads	815	acres									
		1.6498	acres/pad									
		168	miles									
		0.3401	miles/pad	1795.62753	257							
	Pipeline	936	acres									
		1.8947	acres/pad									
		193.18	miles									
		0.3911	miles/pad									
	Power lines	0	acres									
		0	acres/pad									35
		0	miles (cross country)									
		0	miles/pad									
	Other	241										
	Pits	0										
	TOTAL SHORT-TERM ACRES	3399										
	SHORT-TERM WELL/ROAD DISTURB PER PAD	6.3927										
	Average Round Trip Distance for Drilling/Construction Traffic On Unpaved Roadways =	74	miles (estimated from project area road system).									
	Average Round Trip Distance for Drilling/Construction Traffic On Paved & Unpaved Roadways =	168						max # of simultaneous operations				
								Spring summer fall	Winter			
	New well pad/access road construction (average)	14	days per pad	10	hrs/day	140	Total Hours	9	0			
	Time to drill, log and case one gas well (average, directional/downhole)	22	days per well	24	hrs/day	525	Total Hours	9	9			
	Time to complete each well (average)	31	days per well	24	hrs/day	750	Total Hours	9	9			
	Time to Frac a well	1	days per well	3	hrs/day	3	Total Hours	2				
	Rig Size (hp)	875	hp	shallow (750-1000)								
		2250	hp	deep (1500-3000)	70 deep wells total (9%)				(estimated - 9 mths * 31 days/mth / 7 days/pad = ~ 40 pads per year)			
	Proposed Action esimates majority of well spacing will be 80 acres. However, impacts evaluated at 40 and 80 acre spacing scenarios								(average, between 3 and 9 rigs will be operting)			
									(estimated - 46.5 days/well * 36 well completions/year / 365 days = ~5 simultaneous completions)			
Completion												
	3 hours frac time per well		15									
	5000hp hp frac pump engines											
	avg of 70% load											

EMISSIONS INVENTORY

ALTERNATIVE E – AGENCY PREFERRED ALTERNATIVE

	2 or 3 10-50 hp gensets	75	hp									
	Wells will be flared ot sold to pipeline during completion testing. Assume all flared for conservatism.											
Production												
	Pumper Vehicle Traffic: 1 new pumpers visits 75% wells daily											
	Each reclaimed production well pad will occupy 1.9 acre (weighted avg sec2.1.1.1)		1.85		80586	sq ft	283.876734	283.8767338				
	Each completed well pad will have well head, 500Mbtu/hr separator heater, condensate oil tanks, 25% of Pads would have individual dehy (750MBtu/hr avg heater size)						86.5256285	86.52562847				
	Approximately 10% of wells would have gas powered pump jack engines											
	Pumper Vehicle Traffic: 1 new pumper inspects 12 wells/day. 30 new pumpers are estimated during Peak Year (full-field development). 3000 miles/month per pumper (estimate)											
	Typical Well Production:											
	0.4 MMscfd gas per well peak production rate based on peak of 250MMscfd (Proposed Action)											
	1 bbls/day average condensate production per well (per Tyler Ashcroft email 8.9.2006)											
	8 bbls/day water production (per T. Ashcroft 8.9.2006 email)											
	Gas Samples: Use wet gas Inlet sample from Dry Canyon for CS Dehys											
	Liquid Samples: Use liquid sample from Dry Canyon for compressor station flash											
Compression and Dehydration												
	Central Dehydratation at Compressor Stations											
	Dry Canyon Existing: 10@1600 hp = 16000 hp											
	3 New Stations: 2@6400 hp stations (4-1600 hp engines) and 1@11200 hp station (7-1600 hp engines) = 24000 hp New under Proposed Action											
	Each Station will disturb 5 acres											
	Each Unit will have emission controls (1.5 g/hp-hr NOx, 2.0 CO, 1.0 VOC to reflect current UT BACT)											
	CS are 5 acre sites w/building dimensions accroding to Ch 2 diagrams					20234.28	142.24725					
	Dehy Building according to Ch 2 diagram						217800	363	600			
	45 Year LOP											
	Assume 500 Mbtu/hr tank heaters, 500 Mbtu Dehy Reboiler Heaters											

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1. Well Pad/Access Road/Pipeline Construction Fugitive Dust Emissions

Assumptions:

Hours of Construction	14	days per well pad (Proposed Action)
	10	hours/day
	140	hours per well pad
Pieces of Equipment	4	- 1 Backhoe
		- 1 Loader
		- 1 Crawler Tractor
		- 1 Grader
Watering Control Efficiency	50	percent (Assumption)
Soil Moisture Content	7.9	percent (AP-42 Table 11.9-3, 10/98)
Soil Silt Content	6.9	percent (AP-42 Table 11.9-3, 10/98)
PM10 Multiplier	0.75 * PM15	(AP-42 Table 11.9-1, 10/98)
PM2.5 Multiplier	0.105 * TSP	(AP-42 Table 11.9-1, 10/98)

Equations: From AP-42 tables 11.9-1 and 11.9-3 for
Bulldozing Overburden Emissions, Western Surface Coal Mining, 10/98

Emissions (TSP lbs/hr) = 5.7 * (soil silt content %)^1.2 * (soil moisture content %)^-1.3* Control Efficiency

Emissions (PM15 lbs/hr) = 1.0 * (soil silt content %)^1.5 * (soil moisture content %)^-1.4 * Control Efficiency

Emissions = 1.97 lbs TSP/hour/piece of equipment

Emissions = 0.50 lbs PM15/hour/piece of equipment

	Fugitive Dust Emissions[a]		
	lbs/hr	**tons/well**	**tons/yr [b]**
TSP	7.88	0.5517	43.23
PM15	1.51	0.1054	8.26
PM10	1.13	0.0790	6.19
PM2.5	0.83	0.0579	4.54

a Backhoe/Grader/Loader emissions are conservatively estimated as equivalent to Bulldozing emissions.

b Assumes construction rate specified by Proponent

Note: The majority of new pipeline will be installed adjacent to proposed access roads and will not result significant additional surface disturbance.

Buys & Associates, Inc. **Environmental Consultants**	Project: WTP Alternative E Inventory Date: 3/1/2010

2. Reclamation Fugitive Dust Emissions

Assumptions:

Hours of Construction	2	days per well pad (Estimate)
	8	hours/day
	16	hours per well pad
Pieces of Equipment	1	- Grader
Watering Control Efficiency	50	percent (Assumption)
Soil Moisture Content	7.9	percent (AP-42 Table 11.9-3, 10/98)
Soil Silt Content	6.9	percent (AP-42 Table 11.9-3, 10/98)
PM10 Multiplier	0.75 * PM15	(AP-42 Table 11.9-1, 10/98)
PM2.5 Multiplier	0.105 * TSP	(AP-42 Table 11.9-1, 10/98)

Equations: From AP-42 tables 11.9-1 and 11.9-3 for
Bulldozing Overburden Emissions, Western Surface Coal Mining, 10/98

Emissions (TSP lbs/hr) = 5.7 * (soil silt content %)^1.2 * (soil moisture content %)^-1.3* Control Efficiency

Emissions (PM15 lbs/hr) = 1.0 * (soil silt content %)^1.5 * (soil moisture content %)^-1.4 * Control Efficiency

Emissions = 1.97 lbs TSP/hour/piece of equipment

Emissions = 0.50 lbs PM15/hour/piece of equipment

	Fugitive Dust Emissions[a]		
	lbs/hr	**tons/well**	**tons/yr [b]**
TSP	1.97	0.0158	1.24
PM15	1.51	0.0120	0.94
PM10	1.13	0.0090	0.71
PM2.5	0.21	0.0017	0.13

a Backhoe/Grader/Loader emissions are conservatively estimated as equivalent to Bulldozing emissions.

b Assumes construction rate specified by Proponent

Note: The majority of new pipeline will be installed adjacent to proposed access roads and will not result significant additional surface disturbance.

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3. Unpaved Road Fugitive Dust Emissions

Calculation AP-42, Chapter 13.2.2
December 2003

E (PM10) / VMT = 1.5 * (S/12)^0.9 * (W/3)^0.45 * (365-p)/365)
E (PM2.5) / VMT = 0.23 * (S/12)^0.9 + (W/3)^0.45
Silt Content (S) 7 Mean value Table 13.2.2-1 for Gravel Surfaces
Round Trip Miles 74
Precipitation Days (P) 73 days per year (NCDC data for Nutters Ranch, UT 1963-1986)

		Average	**Round**					
	Vehicle Type	**Weight**	**Trips per**	**PM10**	**PM10/Pad**	**PM10/Pad**	**PM2.5/Pad**	**PM2.5/Pad**
		(lbs)	**Well [a]**	**(lb/VMT)**	**(lbs)**	**(lb/day)**	**(lbs)**	**(lb/day)**
Construction (days/pad and road)	14							
	Haul Trucks	80,000	7					
	Light Trucks	20,000	28					
	Mean Vehicle Weight	32,000	35	1.569119	4064.0	290.3	623.1	44.5
					PM10/Annual Pads		**PM2.5/Annual Pads**	
					(tons)		**(tons)**	
					159.2		24.4	
		Average	**Round**					
	Vehicle Type	**Weight**	**Trips per**	**PM10**	**PM10/Well**	**PM10/Well**	**PM2.5/Well**	**PM2.5/Well**
		(lbs)	**Well [a]**	**(lb/VMT)**	**(lbs)**	**(lb/day)**	**(lbs)**	**(lb/day)**
Drilling, Downhole (days/well)	13							
	Haul Trucks	80,000	26					
	Logging/Mud Trucks	70,000	6.5					
	Water Trucks	60,000	19.5					
	Light Trucks	8,000	52					
	Mean Vehicle Weight	39,625	104	1.727526	13295.0	1022.7	2038.6	156.8
					PM10/Annual Wells		**PM2.5/Annual Wells**	
					(tons)		**(tons)**	
					472.4		72.4	
		Average	**Round**					
	Vehicle Type	**Weight**	**Trips per**	**PM10**	**PM10/Well**	**PM10/Well**	**PM2.5/Well**	**PM2.5/Well**
		(lbs)	**Well [a]**	**(lb/VMT)**	**(lbs)**	**(lb/day)**	**(lbs)**	**(lb/day)**
Drilling, Deep Downhole (days/well)	46							
	Haul Trucks	80,000	92					
	Logging/Mud Trucks	70,000	23.0					
	Water Trucks	60,000	69.0					
	Light Trucks	8,000	184					
	Mean Vehicle Weight	39,625	368	1.727526	47044.0	1022.7	7213.4	156.8
					PM10/Annual Wells		**PM2.5/Annual Wells**	
					(tons)		**(tons)**	
					171.6		1.4	
		Average	**Round**					
	Vehicle Type	**Weight**	**Trips per**	**PM10**	**PM10/Well**	**PM10/Well**	**PM2.5/Well**	**PM2.5/Well**
		(lbs)	**Well [a]**	**(lb/VMT)**	**(lbs)**	**(lb/day)**	**(lbs)**	**(lb/day)**
Drilling, Directional (days/well)	26							
	Haul Trucks	80,000	52					
	Logging/Mud Trucks	70,000	13					
	Water Trucks	60,000	39					
	Light Trucks	8,000	104					
	Mean Vehicle Weight	39,625	208	1.727526	26590.1	1022.7	4077.1	156.8
					PM10/Annual Wells		**PM2.5/Annual Wells**	
					(tons)		**(tons)**	
					609.4		93.4	
		Average	**Round**					
	Vehicle Type	**Weight**	**Trips per**	**PM10**	**PM10/Well**	**PM10/Well**	**PM2.5/Well**	**PM2.5/Well**
		(lbs)	**Well [a]**	**(lb/VMT)**	**(lbs)**	**(lb/day)**	**(lbs)**	**(lb/day)**
Drilling, Deep Directional (days/well)	92							
	Haul Trucks	80,000	184					
	Logging/Mud Trucks	70,000	46					
	Water Trucks	60,000	138					
	Light Trucks	8,000	368					
	Mean Vehicle Weight	39,625	736	1.727526	94087.9	1022.7	14426.8	156.8
					PM10/Annual Wells		**PM2.5/Annual Wells**	
					(tons)		**(tons)**	
					179.1		27.5	
		Average	**Round**					
	Vehicle Type	**Weight**	**Trips per**	**PM10**	**PM10/Well**	**PM10/Well**	**PM2.5/Well**	**PM2.5/Well**
		(lbs)	**Well [a]**	**(lb/VMT)**	**(lbs)**	**(lb/day)**	**(lbs)**	**(lb/day)**
Completion (days/well)	31.25							
	Semi/Transport/Water/Sand	80,000	203					
	Haul Trucks	80,000	29					
	Light Trucks	8,000	116					
	Mean Vehicle Weight	56,000	348	2.018473	51979.7	1663.4	7970.2	255.0
					PM10/Annual Wells		**PM2.5/Annual Wells**	
					(tons)		**(tons)**	
					3326.7		510.1	
		Average	**Round**					
	Vehicle Type	**Weight**	**Trips per**	**PM10**	**PM10/Day**	**PM10/Day**	**PM2.5/Day**	**PM2.5/Day**
		(lbs)	**Well [a]**	**(lb/VMT)**	**(lbs)**	**(lb/day)**	**(lbs)**	**(lb/day)**
Field Development and Reclamation (days/well)	6							
	Haul Trucks	80,000	6					
	Light Trucks	8,000	18					
	Mean Vehicle Weight	26,000	24	1.429145	2538.2	423.0	389.2	64.9
					PM10/Annual Wells		**PM2.5/Annual Wells**	
					(tons)		**(tons)**	
					162.4		24.9	
Annual Traffic Fugitive Dust Emissions (tons/year)					**5080.85**		**754.16**	

a Traffic Estimates are based upon an approximately 14-days construction, 13-days drilling at downhole locations (shallow wells), 26-days drilling at direction wells (shallow wells), 29-days completion, and 6-days infrastructure development per well or well pad as appropriate.

Buys & Associates, Inc. **Environmental Consultants**	Project: WTP Alternative E Inventory Date: 3/1/2010

4. Wind Erosion Fugitive Dust Emissions

Assumptions

Threshold Friction Velocity U_t*	1.02	m/s (2.28 mph) for well pads (AP-42 Table 13.2.5-2 Overburden - Western Surface Coal Mine
	1.33	m/s (2.97 mph) for roads (AP-42 Table 13.2.5-2 Roadbed material)
Initial Disturbance Area	1751.0	acres total initial disturbance for roads/pipelines (Chapter 2)
	7,086,034	square meters total initial disturbance for roads/pipelines
	1,648	acres total initial disturbance for well pads and other facilities (Chapter 2)
	6,669,209	square meters total initial disturbance for well pads and other facilities
	3,399	acres total disturbance
Exposed Surface Type	Flat	
Meteorological Data	2002	Grand Junction (obtained from NCDC website)
Fastest Mile Wind Speed U_{10}^+	20.1	meters/sec (45 mph) reported as fastest 2-minute wind speed for Grand Junction (2002)
Number soil of disturbances	2	for well pads and facilities (Assumption, disturbance at construction and reclamation)
	Constant	for dirt roads
Development Period	9	years (Proposed Action)

Equations

Friction Velocity $U^* = 0.053\ U_{10}^+$

Erosion Potential P (g/m^2/period) = $58*(U^*-U_t^*)^2 + 25*(U^*-U_t^*)$ for $U^*>U_t^*$, P = 0 for $U^*< U_t^*$

Emissions (tons/year) = Erosion Potential(g/m^2/period)*Disturbed Area(m^2)*Disturbances/year*(k)/(453.6 g/lb)/2000 lbs/ton/Develop Period

Particle Size Multiplier (k)		
30 um	**<10 um**	**<2.5 um**
1.0	0.5	0.2

Maxium U_{10}^+ Wind Speed (m/s)	**Maximum U* Friction Velocity m/s**	**Well U_t* Threshold Velocity[a] m/s**	**Well Pad Erosion Potential g/m^2**	**Road U_t* Threshold Velocity[a] m/s**	**Road Erosion Potential g/m^2**
20.12	1.07	1.02	1.28	1.33	0.00

Wind Erosion Emissions

Particulate Species	**Wells (tons/year)**	**Roads/Pipelines (tons/year)**
TSP	2.09	0.00
PM10	1.04	0.00
PM2.5	0.42	0.00

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5. Construction Tailpipe Emissions

Assumptions:

Average Round Trip Distance	168.0 miles (Estimated from project area and existing road system)
Hours of Construction	140 hours per site (Chapter 2)
Number of Heavy Diesel Truck Trips	7 (Chapter 2)
Number of Pickup Trips	28 (Chapter 2)
Diesel Fuel sulfur content	0.05 % (Typical value)
Diesel Fuel density	7.08 lbs/gallon (Typical value)
Heavy Haul Diesel Fuel Efficiency	10 miles/gallon (Typical value)
Heavy Duty Pickup Fuel Efficiency	15 miles/gallon (Typical value)

Equations:

For NOx, CO and VOC:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (g/mile)} * \text{\# Trips} * \text{Trip Distance (miles)}}{\text{453.6 (g/lb)} * \text{2000 (lb/tons)}}$$

The NOx, CO and VOC emission factors for the above equation are from AP-42, while the SO2 emissions are calculated on a mass balance basis utilizing the following equation:

$$\text{SO2 E. Factor (g/mi)} = \frac{\text{Fuel Density (lb/gal)} * \text{453.6 (g/lb)} * \text{Fuel Sulfur Content} * \text{2 (S / SO2)}}{\text{Vehicle Fuel Efficiency (miles/gal)}}$$

Construction Vehicles	Heavy Haul Trucks			Heavy Duty Pickups			Total [d]	
	E. Factor [a] (g/mile)	Emissions (lb/hr)	Emissions (tons/yr/well)	E. Factor [b] (g/mile)	Emissions (lb/hr)	Emissions (tons/yr/well)	Emissions (lb/hr)	Emissions (tons/yr)
Criteria Pollutants & VOC								
NO_x	8.130	0.151	0.011	3.030	0.224	0.016	0.375	2.057
CO	17.090	0.316	0.022	33.640	2.492	0.174	2.808	15.403
VOC [c]	4.600	0.085	0.006	4.646	0.344	0.024	0.429	2.355
SO_2	0.321	0.006	0.000	0.214	0.016	0.001	0.022	0.120
Greenhouse Gases								
CH_4 [e]	0.230	0.004	0.000	0.184	0.014	0.001	0.018	0.098

a AP-42 Append. H Table 7.1.2 - H.D. Diesel Powered Vehicles, High Altitude, 1991 - 1997 Model Year, 50,000 miles (6/95)
b AP-42 Append. H Table 4.1A.2 - H.D. Gasoline Vehicles, High Altitude, 1991 - 1997 Vehicle Year, 50,000 miles (6/95)
c Emission factor is for total Hydrocarbons - Methane Offset
d Assumes construction rate specified by Proponent
e AP-42 Append. H Tables 7.10A.2 and 4.10A.2 H.D. Methane Offsets, High Altitude, 1986+ and 1988+ Vehicle Year

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6. Drilling Tailpipe Emissions

Assumptions:

Average Round Trip Distance	168.0 miles	(Estimated from project area and existing road system)
Hours of Operation	525 hours per site	(Chapter 2)
Number of Heavy Diesel Truck Trips	88	(Chapter 2)
Number of Pickup Trips	88	(Chapter 2)
Diesel Fuel sulfur content	0.05 %	(Typical value)
Diesel Fuel density	7.08 lbs/gallon	(Typical value)
Heavy Haul Diesel Fuel Efficiency	10 miles/gallon	(Typical value)
Heavy Duty Pickup Fuel Efficiency	15 miles/gallon	(Typical value)

Equations:

For NOx, CO and VOC:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (g/mile)} * \text{\# Trips} * \text{Trip Distance (miles)}}{\text{453.6 (g/lb)} * \text{2000 (lb/tons)}}$$

The NOx, CO and VOC emission factors for the above equation are from AP-42, while the SO2 emissions are calculated on a mass balance basis utilizing the following equation:

$$\text{SO2 E. Factor (g/mi)} = \frac{\text{Fuel Density (lb/gal)} * \text{453.6 (g/lb)} * \text{Fuel Sulfur Content} * \text{2 (S / SO2)}}{\text{Vehicle Fuel Efficiency (miles/gal)}}$$

Drilling Vehicles	Heavy Haul Trucks			Heavy Duty Pickups			Total [d]	
	E. Factor [a] (g/mile)	Emissions (lb/hr)	Emissions (tons/yr/well)	E. Factor [b] (g/mile)	Emissions (lb/hr)	Emissions (tons/yr/well)	Emissions (lb/hr)	Emissions (tons/yr)
Criteria Pollutants & VOC								
NO_x	8.13	0.502	0.132	3.03	0.187	0.049	0.689	23.158
CO	17.09	1.055	0.277	33.64	2.077	0.545	3.131	105.271
VOC [c]	4.600	0.284	0.075	1.656	0.102	0.027	0.386	12.982
SO_2	0.32	0.020	0.005	0.21	0.013	0.003	0.033	1.111
Greenhouse Gases								
CH_4 [e]	0.230	0.014	0.004	0.184	0.011	0.003	0.026	0.526

a AP-42 Append. H Table 7.1.2 - H.D. Diesel Powered Vehicles, High Altitude, 1991 - 1997 Model Year, 50,000 miles (6/95)
b AP-42 Append. H Table 4.1A.2 - H.D. Gasoline Vehicles, High Altitude, 1991 - 1997 Vehicle Year, 50,000 miles (6/95)
c Emission factor is for total Hydrocarbons - Methane Offset
d Assumes construction rate specified by Proponent
e AP-42 Append. H Tables 7.10A.2 and 4.10A.2 H.D. Methane Offsets, High Altitude, 1986+ and 1988+ Vehicle Year

Buys & Associates, Inc. **Environmental Consultants**	Project: WTP Alternative E Inventory Date: 3/1/2010

7. Completion Tailpipe Emissions

Assumptions:

Average Round Trip Distance	168.0	miles (Estimated from project area and existing road system)
Hours of Operation	750	hours per site (Chapter 2)
Number of Heavy Diesel Truck Trips	232	(Proponent)
Number of Pickup Trips	116	(Proponent)
Diesel Fuel sulfur content	0.05	% (Typical value)
Diesel Fuel density	7.08	lbs/gallon (Typical value)
Heavy Haul Diesel Fuel Efficiency	10	miles/gallon (Typical value)
Heavy Duty Pickup Fuel Efficiency	15	miles/gallon (Typical value)

Equations:

For NOx, CO and VOC:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (g/mile)} * \text{\# Trips} * \text{Trip Distance (miles)}}{\text{453.6 (g/lb)} * \text{2000 (lb/tons)}}$$

The NOx, CO and VOC emission factors for the above equation are from AP-42, while the SO2 emissions are calculated on a mass balance basis utilizing the following equation:

$$\text{SO2 E. Factor (g/mi)} = \frac{\text{Fuel Density (lb/gal)} * \text{453.6 (g/lb)} * \text{Fuel Sulfur Content} * \text{2 (S / SO2)}}{\text{Vehicle Fuel Efficiency (miles/gal)}}$$

Completion Vehicles	**Heavy Haul Trucks**			**Heavy Duty Pickups**			**Total [d]**	
	E. Factor [a] (g/mile)	**Emissions (lb/hr)**	**Emissions (tons/yr/well)**	**E. Factor [b] (g/mile)**	**Emissions (lb/hr)**	**Emissions (tons/yr/well)**	**Emissions (lb/hr)**	**Emissions (tons/yr)**
Criteria Pollutants & VOC								
NO_x	8.13	0.931	0.349	3.03	0.174	0.065	1.105	53.040
CO	17.09	1.958	0.734	33.64	1.927	0.723	3.885	186.480
VOC [c]	4.600	0.527	0.198	1.656	0.095	0.036	0.622	29.850
SO_2	0.32	0.037	0.014	0.21	0.012	0.005	0.049	2.355
Greenhouse Gases								
CH_4 [e]	0.230	0.026	0.010	0.184	0.011	0.004	0.037	1.084

a AP-42 Append. H Table 7.1.2 - H.D. Diesel Powered Vehicles, High Altitude, 1991 - 1997 Model Year, 50,000 miles (6/95)
b AP-42 Append. H Table 4.1A.2 - H.D. Gasoline Vehicles, High Altitude, 1991 - 1997 Vehicle Year, 50,000 miles (6/95)
c Emission factor is for total Hydrocarbons - Methane Offset
d Assumes construction rate specified by Proponent
e AP-42 Append. H Tables 7.10A.2 and 4.10A.2 H.D. Methane Offsets, High Altitude, 1986+ and 1988+ Vehicle Year

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8. Development Tailpipe Emissions

Assumptions:

Average Round Trip Distance	168.0	miles (Estimated from project area and existing road system)
Hours of Operation	20	hours per site (Assumption)
Number of Heavy Diesel Truck Trips	6	(Assumption)
Number of Pickup Trips	18	(Assumption)
Diesel Fuel sulfur content	0.05	% (Typical value)
Diesel Fuel density	7.08	lbs/gallon (Typical value)
Heavy Haul Diesel Fuel Efficiency	10	miles/gallon (Typical value)
Heavy Duty Pickup Fuel Efficiency	15	miles/gallon (Typical value)

Equations:

For NOx, CO and VOC:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (g/mile)} * \text{\# Trips} * \text{Trip Distance (miles)}}{\text{453.6 (g/lb)} * \text{2000 (lb/tons)}}$$

The NOx, CO and VOC emission factors for the above equation are from AP-42, while the SO2 emissions are calculated on a mass balance basis utilizing the following equation:

$$\text{SO2 E. Factor (g/mi)} = \frac{\text{Fuel Density (lb/gal)} * \text{453.6 (g/lb)} * \text{Fuel Sulfur Content} * \text{2 (S / SO2)}}{\text{Vehicle Fuel Efficiency (miles/gal)}}$$

Development Vehicles	Heavy Haul Trucks			Heavy Duty Pickups			Total [d]	
	E. Factor [a] (g/mile)	Emissions (lb/hr)	Emissions (tons/yr/well)	E. Factor [b] (g/mile)	Emissions (lb/hr)	Emissions (tons/yr/well)	Emissions (lb/hr)	Emissions (tons/yr)
Criteria Pollutants & VOC								
NO_x	8.13	0.903	0.009	3.03	1.010	0.010	1.913	1.499
CO	17.09	1.899	0.019	33.64	11.213	0.112	13.112	10.274
VOC [c]	4.600	0.511	0.005	1.656	0.552	0.006	1.063	0.833
SO_2	0.32	0.036	0.000	0.21	0.071	0.001	0.107	0.084
Greenhouse Gases								
CH_4 [e]	0.230	0.026	0.000	0.184	0.061	0.001	0.087	0.068

a AP-42 Append. H Table 7.1.2 - H.D. Diesel Powered Vehicles, High Altitude, 1991 - 1997 Model Year, 50,000 miles (6/95)
b AP-42 Append. H Table 4.1A.2 - H.D. Gasoline Vehicles, High Altitude, 1991 - 1997 Vehicle Year, 50,000 miles (6/95)
c Emission factor is for total Hydrocarbons - Methane Offset
d Assumes construction rate specified by Proponent
e AP-42 Append. H Tables 7.10A.2 and 4.10A.2 H.D. Methane Offsets, High Altitude, 1986+ and 1988+ Vehicle Year

Buys & Associates, Inc. **Environmental Consultants**	Project: WTP Alternative E Inventory Date: 3/1/2010

9. Construction Heavy Equipment Tailpipe Emissions

Assumptions:

Hours of Operation	140	hours/site (Chapter 2)
Development Rate	78	new pads per year (Proposed Action)
Load Factor	0.4	(Assumed typical value)
Backhoe Size	100	hp (Assumed Typical value)
Crawler Tractor/Loader Size	150	hp (Assumed Typical value)
Motor Grader Size	135	hp (Assumed Typical value)

Equations:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (g/hp-hr) * Rated Horsepower (hp)* Operating Hours (hrs) * Load Factor (Dimensionless)}}{\text{453.6 (g/lb) * 2000 (lb/tons)}}$$

Heavy Const. Vehicles	Backhoe			Crawler Tractor			Grader			Loader		
	E. Factor [a] (g/hp-hr)	Emissions (lb/hr)	Emissions[e] (tons/yr)	E. Factor [a] (g/hp-hr)	Emissions (lb/hr)	Emissions[e] (tons/yr)	E. Factor [b] (g/hp-hr)	Emissions (lb/hr)	Emissions[e] (tons/yr)	E. Factor [a] (g/hp-hr)	Emissions (lb/hr)	Emissions[e] (tons/yr)
NO_x	8.15	0.719	3.942	8.15	1.078	5.913	7.14	0.850	4.662	8.15	1.078	5.913
CO	2.28	0.201	1.103	2.28	0.302	1.654	1.54	0.183	1.006	2.28	0.302	1.654
VOC [c]	0.37	0.033	0.179	0.37	0.049	0.268	0.36	0.043	0.235	0.37	0.049	0.268
PM_{10} [d]	0.5	0.044	0.242	0.5	0.066	0.363	0.63	0.075	0.411	0.5	0.066	0.363
$PM_{2.5}$ [d]	0.5	0.044	0.242	0.5	0.066	0.363	0.63	0.075	0.411	0.5	0.066	0.363
SO_2	0.22	0.019	0.106	0.22	0.029	0.160	0.22	0.026	0.144	0.22	0.029	0.160
Formaldehyde	0.22	0.019	0.106	0.22	0.029	0.160	0.12	0.014	0.078	0.22	0.029	0.160

Heavy Const. Vehicles	Total	
	Emissions (lb/hr)	Emissions[e] (tons/yr)
NO_x	3.725	20.430
CO	0.988	5.417
VOC [c]	0.173	0.951
PM_{10} [d]	0.251	1.379
$PM_{2.5}$ [d]	0.251	1.379
SO_2	0.104	0.569
Formaldehyde	0.092	0.504

a AP-42 Volume II, Mobile Sources, Nonroad Vehicles, Table 11-7.1 Off-highway truck
b AP-42 Volume II, Mobile Sources, Nonroad Vehicles, Table 11-7.1 Motor Grader
c Emission Factor represents total Hydrocarbon Emissions
d All emitted particulate matter assumed to be PM2.5
e Assumes construction rate specified by Proponent

Buys & Associates, Inc. **Environmental Consultants**	Project: WTP Alternative E Inventory Date: 3/1/2010

10. Drill Rig Engine Emissions

Assumptions:

Hours of Operation	525 hours/ well (Proposed Action)
Development Rate	128 total wells per year (Proposed Action) 9% average deep wells per year (based on Propoent estimate of 70 deep wells total Project) 11 deep well per year 117 shallow wells per year
Load Factor	0.4 (Assumed typical value)
Rig Size	875 hp (Proponent Estimate - shallow wells) 2250 hp (Proponent Estimate - deep wells) 994 hp (weighted average based on ratio of shallow to deep wells)
Diesel Fuel Sulfur Content	0.05 % (typical value)

Equations:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (lb/hp-hr)} * \text{Rated Horsepower (hp)} * \text{Operating Hours (hrs)} * \text{Load Factor (Dimensionless)}}{\text{2000 (lb/tons)}}$$

SO2 E. Factor (lb/hp-hr) = Fuel sulfur content * 0.00809

Species	Drill Rig Emissions		
	E. Factor [a] (lb/hp-hr)	Emissions (lb/hr)	Emissions [g] (tons/yr)
Criteria Pollutants & VOC			
NO_x	9.92E-03	3.946	133
CO	1.685E-03	0.670	22.525
VOC [b]	6.61E-04	0.263	8.8
PM_{10} [c]	2.901E-04	0.115	3.879
$PM_{2.5}$ [d]	2.901E-04	0.115	3.879
SO_2 [e]	0.0004045	0.161	5.408
Greenhouse Gases			
CO_2 [e]	1.16	461.341	15,509
CH_4 [e,f]	0.000705	0.280	9.43

[a] EPA Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling--Compression-Ignition NR-009c, April 2004
[b] Nonmethanehydrocarbons
[c] Total Particulates
[d] All PM10 assumed to be PM2.5 (based on ???)
[e] AP-42 Volume I, Large Stationary Diesel Engines Table 3.4-1, 10/96
[f] Emission Factor represents total Hydrocarbon Emissions
[g] Assumes rate specified by Proponent

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11. Well Fracturing Pump and Generator Engines

Assumptions:

Average Hours of Operation	3	Hours/Well (Proponents)
Development Rate	128	wells per year (Proposed Action)
Load Factor	0.7	(Proponents)
Frac Pump Engine Horsepower	5,000	Horsepower (Proponents)
Temporary Generator Horsepower	75	Horsepower (Proponents: 2-3 engines @ 10-50 hp each)
Diesel Fuel Sulfur Content	0.05	% (typical value)

Equations:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (lb/hp-hr) * Rated Horsepower (hp)* Operating Hours (hrs) * Load Factor (Dimensionless)}}{\text{2000 (lb/tons)}}$$

SO2 E. Factor (lb/hp-hr) = Fuel sulfur content * 0.00809

Species	Frac Pump Engine Emissions		
	E. Factor [a] (lb/hp-hr)	Emissions (lb/hr)	Emissions [e] (tons/yr)
Criteria Pollutants & VOC			
NO_x	0.024	84.000	16.128
CO	0.0055	19.250	3.696
VOC [b]	0.000705	2.468	0.474
PM_{10} [c]	0.000573	2.006	0.385
$PM_{2.5}$ [d]	0.000479	1.677	0.322
SO_2	0.0004045	1.416	0.272
Greenhouse Gases			
CO_2	1.16	4,060.000	779.520
CH_4 [b]	0.000705	2.468	0.474

Species	Generator Engine Emissions		
	E. Factor [f] (lb/hp-hr)	Emissions (lb/hr)	Emissions [e] (tons/yr)
Criteria Pollutants			
NO_x	0.031	1.628	0.312
CO	0.006680	0.351	0.067
VOC [b]	0.002470	0.130	0.025
PM_{10}	0.002200	0.116	0.022
$PM_{2.5}$ [g]	0.002200	0.116	0.022
SO_2	0.0004045	0.021	0.004
Greenhouse Gases			
CO_2	1.08	3,780.000	725.760
CH_4 [b]	0.002470	8.645	1.660

a AP-42 Volume I, Large Stationary Diesel Engines Table 3.4-1, 10/96
b Emission Factor represents total Hydrocarbon Emissions
c Total particulate emission factor is 0.0007, PM10 fraction determined from Table 3.4-2
d Total particulate emission factor is 0.0007, PM2.5 fraction determined from Table 3.4-2
e Assumes maximum development scenario
f AP-42 Table 3.3-1, Emission Factors for Uncontrolled Gasoline and Diesel Industrial Engines, 10/96
g All particulates are PM10

12. Completion Flare Emissions

Assumptions

Hours of Operation	2	days (Typical)
Amount of Gas Flared	5	MMscf/well (Assumption, based on initial Production Rates)
Average Gas Heat Content	1066	Btu/scf (Wellsite Gas Composition)
Average Gas VOC Content	8.089	weight % (Wellsite Gas Composition)
Average Mole Weight	18.3	lb/lb-mole (Wellsite Gas Composition)
Development rate	128	gas wells per year

Equations

NOx/CO Emissions (lb/well) = Emission Factor (lb/MM Btu) * Gas Amount (MMscf/well) * Heat Content (Btu/scf)

PM/HAP Emissions (lb/well) = Emission Factor (lb/MMscf) * Gas Amount (MMscf/well)

$$\text{Flare Gas Wt. (lb/well)} = \frac{\text{Flare Gas Volume (MMscf/well)} * 10^6 \text{ (scf/MMscf)} * \text{Mole Weight (lb/lb-mole)}}{379.49 \text{ (scf/mole)}}$$

VOC Emissions (lb/well) = Flare Gas Wt. (lb/well) * VOC wt. % * 0.02 (Assumes 98% destruction Efficiency)

Species	Emission Factor (lb/MMBtu)	Well Emissions (lb/well)	Well Emissions (lb/hr/well)	Total Emissions [e] (tons/yr)
Criteria Pollutants & VOC				
NO_x [a]	0.068	362.4	7.55	23.19
CO [a]	0.37	1971.9	41.08	126.20
VOC	N.A.	390.0	8.12	24.96
SO_x [b]	0.00	0.0	0.00	0.00
TSP [c]	7.6	38	0.792	2.432
PM_{10} [c]	7.6	38	0.792	2.432
$PM_{2.5}$ [c]	7.6	38	0.792	2.432
Hazardous Air Pollutants				
Benzene [d]	0.0021	0.0105	0.000	0.001
Toluene [d]	0.0034	0.017	0.000	0.001
Hexane [d]	1.8	9	0.188	0.576
Formaldehyde [d]	0.075	0.375	0.008	0.024
Greenhouse Gases				
CO_2 [c]	120,000	600,000	12,500	38,400
CH_4 [a]	0.14	746.1	15.54	47.75

a AP-42 Table 13.5-1, Emission Factors for Flare Operations, 9/91
b Assumes produced gas contains no sulfur
c AP-42 Table 1.4-2, Emission Factors for Natural Gas Combustion, 3/98 (All Particulates are PM1.0)
d AP-42 Table 1.4-3, Emission Factors for Organic Compounds from Natural Gas Combustion, 3/98
e Assumes proposed development rate

13. Well Development Emissions Summary

Species	Well Development Emissions (tons/year)[a]				Wind Erosion	Total [a] (tons/yr)
	Construction	Drilling	Completion	Development & Reclamation		
Criteria Pollutants & VOC						
NO_x	22.5	155.8	92.7	1.5		272.5
CO	20.8	127.8	316.4	10.3		475.3
VOC	3.3	21.8	55.3	0.8		81.3
SO_2	0.7	6.5	2.6	0.1		9.9
PM_{10}	166.8	1,436.4	3,329.5	163.2	1.0	5,096.9
$PM_{2.5}$	30.3	198.6	512.9	25.0	0.4	767.3
Hazardous Air Pollutants						
Benzene			0.0			
Toluene			0.0			
Ethylbenzene						
Xylene						
n-Hexane			0.6			
Formaldehyde	0.5		0.0			0.5
Total HAPs	0.5	0.0	0.6	0.0	0.0	0.5
Greenhouse Gases						
CO_2		15,508.8	39,905.3			55,414.1
CH_4	0.1	10.0	51.0	0.1		61.1

[a] Emissions for Peak Field Development

Buys & Associates, Inc. Environmental Consultants	Project: WTP Alternative E Inventory Date: 3/1/2010

14. Average Produced Gas Characteristics
Inlet Wet Gas Sample Average of Seven Samples from BBC area wellsites

Gas Heat Value (wet): 1065.9 Btu/scf

C1-C2 Wt. Fraction: 0.8742
VOC Wt. Fraction: 0.0809
Non-HC Wt. Fraction: 0.0449
Total: 1.0000

COMPONENT	MOLE PERCENT	COMPONENT MOLE WEIGHT (lb/lb-mole)	NET MOLE WEIGHT (lb/lb-mole)	WEIGHT FRACTION	GROSS HEATING VALUE (BTU/scf)	NET DRY HEATING VALUE (BTU/scf)	LOWER HEATING VALUE (BTU/scf)	NET LOW HEATING VALUE (BTU/scf)
Methane	90.1926	16.043	14.470	0.791	1010.000	910.946	910.000	820.753
Ethane	5.0663	30.070	1.523	0.083	1769.800	89.664	1618.000	81.973
Propane	1.5002	44.097	0.662	0.036	2516.200	37.748	2316.000	34.745
i-Butane	0.3123	58.123	0.182	0.010	3252.100	10.156	3005.000	9.385
n-Butane	0.3302	58.123	0.192	0.010	3262.400	10.771	3013.000	9.948
i-Pentane	0.1359	72.150	0.098	0.005	4000.900	5.437	3698.000	5.025
n-Pentane	0.0980	72.150	0.071	0.004	4008.800	3.927	3708.000	3.632
Hexanes	0.2603	86.177	0.224	0.012	4756.200	12.380	4404.000	11.463
Heptanes	0.0305	100.204	0.031	0.002	5502.500	1.678	5100.000	1.556
Octanes	0.0133	114.231	0.015	0.001	6249.100	0.833		0.000
Nonanes	0.0047	128.258	0.006	0.000	6996.400	0.331		0.000
Decanes	0.0000	142.285	0.000	0.000	7743.200	0.000		0.000
Benzene	0.0000	78.120	0.000	0.000	3715.500	0.000		0.000
Toluene	0.0000	92.130	0.000	0.000	4444.600	0.000		0.000
Ethylbenzene	0.0000	106.160	0.000	0.000	5191.500	0.000		0.000
Xylenes	0.0000	106.160	0.000	0.000	5183.500	0.000		0.000
n-Hexane	0.0000	86.177	0.000	0.000	4756.200	0.000		0.000
Helium	0.0000	4.003	0.000	0.000	0.000	0.000	0.000	0.000
Nitrogen	0.5155	28.013	0.144	0.008	0.000	0.000	0.000	0.000
Carbon Dioxide	1.5401	44.010	0.678	0.037	0.000	0.000	0.000	0.000
Oxygen	0.0000	32.000	0.000	0.000	0.000	0.000	0.000	0.000
Hydrogen Sulfide	0.0000	34.080	0.000	0.000	637.100	0.000	588.000	0.000
TOTAL	100.00		18.30	1.00		1083.87		978.48

Relative Mole Weight (lb/lb-mole) = [Mole Percent * Molecular weight (lb/lb-mole)] / 100

Weight Fraction = Net Mole Weight / Total Mole Weight

HAP Fractions estimated from GRI Published Factors

Buys & Associates, Inc. Environmental Consultants	Project: WTP Alternative E Inventory Date: 3/1/2010

15. Wellsite Pumping Unit Engines

Assumptions:

Pumpjack Engine Size: 40 Horsepower (Proponent)
Number of Wells Requiring Pumping Unit Engines: 80.7 wells (Estimated at 10 % of Peak Production Wells)

Equations:

$$\text{Emissions (lbs/hr)} = \frac{\text{Emission Factor (g/hp-hr)} * \text{Power (hp)}}{453.6 \text{ g/lb}}$$

Pollutant	Emission Factor [3] (lb/MMBtu)	Emission Factor (g/hp-hr)	Emissions (lb/hr/well)	Total Emissions Proposed Action (tons/yr)
Criteria Pollutants & VOC				
NOx [5]		1.5	0.13	46.8
CO [5]		2.0	0.18	62.3
VOC [5]		1.0	0.09	31.2
PM10 [1,4]	0.0194	0.070	0.01	2.2
PM2.5 [1,4]	0.0194	0.070	0.01	2.2
SO_2 [2]	0.0	0.000	0.00	0.0
Hazardous Air Pollutants				
Benzene [1]	0.001580	0.00574	0.00	0.2
Toluene [1]	0.000558	0.00203	0.00	0.1
Ethylbenzene [1]	0.000025	0.00009	0.00	0.0
Xylenes [1]	0.000195	0.00071	0.00	0.0
Formaldehyde [1]	0.0205	0.07	0.01	2.3
Greenhouse Gases				
CO_2 [1]	110.0	399.52000	35.23	12,453.0
CH_4 [1]	0.2	0.83536	0.07	26.0

1 - AP-42 Table 3.2-3 Uncontrolled Emission Factors for 4-Stroke Rich-Burn Engines, 7/00
2 - Fuel gas is assumed to be free from sulfur compounds
3 - Conversion from lb/MMBtu to g/hp-hr assumes an average heat rate of 8,000 Btu/hp-hr (*3.632)
4 - PM = sum of PM filterable and PM condensable
5 - Utah typical BACT control rates for internal combustion engines

16. Wellsite Dehydrator Emissions

Assumptions

Average Production Rate: 0.384 MMscf/day/well (Average for life of the well, Proposed Action)
Number of Active Wells Requiring Separators: 807 wells at Peak Production
Wells Requiring Dehydrators: 202 (25% of wells, Proposed Action)

Gas Composition: Inlet Gas Sample from Average of Seven Existing Wells

Inlet Gas Conditions: Inlet gas saturated at 200 psi and 70 F (Proponent Estimate)

Glycol Circulation Rate: 3 gallons/ lb of water
(Typical operating rate)

Calculations

Dehydrator emissions were simulated using GRI GlyCalc version 4.0

Controls

Flare to achieve 95% Control Efficiency controlling tank and dehydrator emissions on wellpad (Proposed Action)

Emissions

Species	Well Dehydrator Emissions (lbs/hr/well)	Well Dehydrator Emissions (tons/year/well)	Total Project Emissions (tons/year)
Total VOC	0.0078	0.03	6.89
Hazardous Air Pollutants			
Benzene	0.0017	0.01	1.50
Toluene	0.0021	0.01	1.86
Ethylbenzene	0.0001	4.38E-04	0.09
Xylenes	0.0006	2.63E-03	0.53
n-Hexane	0.0002	8.76E-04	0.18
Greenhouse Gases			
CH_4	0.005	0.02	3.98

17. Wellsite Heater Emissions

Assumptions

Dehydrator Reboiler Heater Size	750 Mbtu/hr (Proposed Action)
Separator Heater Size	500 Mbtu/hr (Proposed Action)
Tank Heater Size	500 Mbtu/hr (Proponent)
Wells Requiring Separators:	807 wells at Peak Production
Wells Requiring Dehydrators:	202 (25% of wells, Proposed Action)
Wells Requiring Tank Heaters:	741 per pad (one to two tanks per pad, Proposed Action)
Firing Rate	6,480 hours/year (Proponent)
Fuel Gas Heat Value	1066 Btu/scf (Gas Analyses from Dry Canyon Facility)
Fuel Gas VOC Content	0.081 by weight (Gas Analyses from Dry Canyon Facility)

Equations

$$\text{Fuel Consumption (MMscf/yr)} = \frac{\text{Heater Size (MBtu/hr)} * 1{,}000\ \text{(Btu/MBtu)} * \text{Hours of Operation (hrs/yr)}}{\text{Fuel Heat Value (Btu/scf)} * 1{,}000{,}000\ \text{(scf/MMscf)}}$$

$$\text{NOx/CO/TOC Emissions (tons/yr)} = \frac{\text{AP-42 E.Factor (lbs/MMscf)} * \text{Fuel Consumption (MMscf/yr)} * \text{Fuel heating Value (Btu/scf)}}{2{,}000\ \text{(lbs/ton)} * 1{,}000\ \text{(Btu/scf - Standard Fuel Heating Value)}}$$

VOC Emissions (tons/yr) = TOC Emissions (tons/yr) * VOC wt. fraction

Species	Wellsite Heater Emissions - Separators			Wellsite Heater Emissions - Dehydrators			Wellsite Heater Emissions - Tanks			
	Emission Factor (lb/MMscf)	Well Emissions (lb/hr/well)	Total Emissions (tons/yr)	Emission Factor (lb/MMscf)	Well Emissions (lb/hr/well)	Total Emissions (tons/yr)	Emission Factor (lb/MMscf)	Well Emissions (lb/hr/well)	Total Emissions (tons/yr)	Total Emissions (tons/yr)
Criteria Pollutants & VOC										
NO_x [a]	100	0.047	122.652	100	0.070	45.995	100	0.047	112.621	281.268
CO [a]	84	0.039	103.028	84	0.059	38.635	84	0.039	94.602	236.265
TOC [c]	11	0.005	13.492	11	0.008	5.059	11	0.005	12.388	30.939
VOC	N.A.	0.000	1.091	N.A.	0.001	0.409	N.A.	0.000	1.002	2.503
SO_x [b]	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.000
TSP [c]	7.6	0.004	9.322	7.6	0.005	3.496	7.6	0.004	8.559	21.376
PM_{10} [c]	7.6	0.004	9.322	7.6	0.005	3.496	7.6	0.004	8.559	21.376
$PM_{2.5}$ [c]	7.6	0.004	9.322	7.6	0.005	3.496	7.6	0.004	8.559	21.376
Hazardous Air Pollutants										
Benzene [d]	0.0021	0.000	0.003	0.0021	0.000	0.001	0.0021	0.000	0.002	0.006
Toluene [d]	0.0034	0.000	0.004	0.0034	0.000	0.002	0.0034	0.000	0.004	0.010
Hexane [d]	1.8	0.001	2.208	1.8	0.001	0.828	1.8	0.001	2.027	5.063
Formaldehyde[d]	0.075	0.000	0.092	0.075	0.000	0.034	0.075	0.000	0.084	0.211
Greenhouse Gases										
CO_2 [c]	120,000	56.29	147,182.73	120,000	84.436	55,193.524	120,000	56.29	135,145.481	337,521.735
CH_4 [c]	2.3	0.001	2.821	2.3	0.002	1.058	2.3	0.001	2.590	6.469

a AP-42 Table 1.4-1, Emission Factors for Natural Gas Combustion, 7/98
b Assumes produced gas contains no sulfur
c AP-42 Table 1.4-2, Emission Factors for Natural Gas Combustion, 7/98 (All Particulates are PM1.0)
d AP-42 Table 1.4-3, Emission Factors for Organic Compounds from Natural Gas Combustion, 7/98

Buys & Associates, Inc.
Environmental Consultants

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18. Wellsite Condensate Storage Tank Flash/Working/Standing Emissions

Assumptions:

Average Condensate Production Rate: 1.5 bbls condensate per day (Average for life of the well, Proposed Action))
Number of Active Wells: 807 wells at Peak Production

Separator Conditions : 150 psi and 105 F (Proponent Average Estimate)
API Gravity of Sales Oil: 52.3

Calculations:

Condensate tank flashing/working/breathing emissions estimated with E&P Tanks 2.0
Dry Canyon Compressor Station Liquid Sample Dated 2/21/04
Controlled with 95% efficiency

Emissions:

Component	Wellsite Flash/Work/Breathing (lb/hr/well)	Wellsite Flash/Work/Breathing (tons/year/well)	Total Emissions (tons/yr)
Total VOC	0.074	0.323	260.805
Hazardous Air Pollutants			
Benzene	4.050E-04	1.77E-03	1.432
Toluene	2.250E-04	9.86E-04	0.795
Ethylbenzene	0.000E+00	0.00E+00	0.000
Xylenes	3.000E-05	1.31E-04	0.106
n-Hexane	0.002	7.69E-03	6.203
Greenhouse Gases			
CO_2	0.009	0.038	31.017
CH_4	0.007	0.030	24.495

Buys & Associates, Inc. Environmental Consultants	Project: WTP Alternative E Inventory Date: 3/1/2010

19. Well Blowdown Emissions

Assumptions: During Production, a percentage of the wells are periodically blown down to unload fluids

# of New Producing Wells	807	wells at Peak Production (Year 20)
Blowdown Frequency	104	Wells per Year (2 per week for 52 weeks for 1 hour each, Project Proponents)
Blowdown Volume	16	Mscf/event (Estimated from Average Production Data)
Annual Blowdown Volume	1.7	MMscf/year

COMPONENT	MOLECULAR WEIGHT (lb/lb-mole)	MOLE PERCENT	RELATIVE MOLE WEIGHT (lb/lb-mole)	WEIGHT Fraction	COMPONENT FLOW RATE (Mscf/hr)	COMPONENT FLOW RATE (lb/hr/well)	COMPONENT FLOW RATE (tons/yr)
Methane	16.043	90.193	14.470	0.791	14.418	609.536	1648.184
Ethane	30.07	5.066	1.523	0.083	0.810	64.176	173.531
Propane	44.097	1.500	0.662	0.036	0.240	27.868	75.355
i-Butane	58.123	0.312	0.182	0.010	0.050	7.646	20.676
n-Butane	58.123	0.330	0.192	0.010	0.053	8.084	21.858
i-Pentane	72.15	0.136	0.098	0.005	0.022	4.130	11.168
n-Pentane	72.15	0.098	0.071	0.004	0.016	2.977	8.050
Hexanes	86.177	0.260	0.224	0.012	0.042	9.449	25.550
Heptanes	100.204	0.031	0.031	0.002	0.005	1.287	3.481
Octanes	114.231	0.013	0.015	0.001	0.002	0.641	1.734
Nonanes	128.258	0.005	0.006	0.000	0.001	0.255	0.691
Decanes +	142.285	0.000	0.000	0.000	0.000	0.000	0.000
Benzene	78.12	0.000	0.000	0.000	0.000	0.000	0.000
Toluene	92.13	0.000	0.000	0.000	0.000	0.000	0.000
Ethylbenzene	106.16	0.000	0.000	0.000	0.000	0.000	0.000
Xylenes	106.16	0.000	0.000	0.000	0.000	0.000	0.000
n-Hexane	86.177	0.000	0.000	0.000	0.000	0.000	0.000
Helium	4.003	0.000	0.000	0.000	0.000	0.000	0.000
Nitrogen	28.013	0.516	0.144	0.008	0.082	6.083	16.449
Carbon Dioxide	44.01	1.540	0.678	0.037	0.246	28.553	77.207
Oxygen	32	0.000	0.000	0.000	0.000	0.000	0.000
Hydrogen Sulfide	34.08	0.000	0.000	0.000	0.000	0.000	0.000
VOC SUBTOTAL		**2.68535714**	**1.480**	**0.081**	**0.429**	**62.339**	**168.564**
HAP SUBTOTAL		**0**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
TOTAL		**100.000**	**18.295**	**1.000**	**16**	**770.686**	**2083.936**

20. Liquid Level Controller Emissions

Company: **BBC**
Location: **WTP EIS**

GAS COMPONENT	MOLECULAR WEIGHT (lb/lb-mole)	MOLE PERCENT	RELATIVE MOLE WEIGHT (lb/lb-mole)	WEIGHT PERCENT	COMPONENT FLOW RATE (Mscf/day)	COMPONENT FLOW RATE (lb/hr)	COMPONENT FLOW RATE (tons/yr/well)
Methane	16.043	91.307	14.64838201	81.48852235	0.83271984	1.46680681	6.424613828
Ethane	30.07	5.305	1.5952135	8.874126225	0.0483816	0.159735732	0.699642507
Propane	44.097	1.536	0.67732992	3.767966612	0.01400832	0.067824019	0.297069203
i-Butane	58.123	0.337	0.19587451	1.089644193	0.00307344	0.019613775	0.085908333
n-Butane	58.123	0.387	0.22493601	1.25131247	0.00352944	0.02252383	0.098654377
i-Pentane	72.15	0.166	0.119769	0.666271458	0.00151392	0.011992996	0.052529322
n-Pentane	72.15	0.117	0.0844155	0.469600967	0.00106704	0.008452895	0.037023679
Hexanes	86.177	0.113	0.09738001	0.541722159	0.00103056	0.009751088	0.042709765
Heptanes	100.204	0.042	0.04208568	0.234121412	0.00038304	0.004214224	0.018458301
Octanes	114.231	0.008	0.00913848	0.050837098	0.00007296	0.000915076	0.004008033
Nonanes	128.258	0	0	0	0	0	0
Decanes +	142.285	0	0	0	0	0	0
Benzene	78.12	0.01	0.007812	0.043457928	0.0000912	0.00078225	0.003426254
Toluene	92.13	0.006	0.0055278	0.03075099	0.00005472	0.000553523	0.00242443
Ethylbenzene	106.16	0	0	0	0	0	0
Xylenes	106.16	0.001	0.0010616	0.00590565	0.00000912	0.000106303	0.000465606
n-Hexane	86.177	0.041	0.03533257	0.196554058	0.00037392	0.003538005	0.015496464
Helium	4.003	0.018	0.00072054	0.004008343	0.00016416	7.21508E-05	0.000316021
Nitrogen	28.013	0.223	0.06246899	0.347513171	0.00203376	0.006255294	0.027398189
Carbon Dioxide	44.01	0.383	0.1685583	0.937684912	0.00349296	0.016878483	0.073927754
Oxygen	32	0	0	0	0	0	0
Hydrogen Sulfide	34.08	0	0	0	0	0	0
VOC SUBTOTAL		**2.764**	**1.50066308**	**8.348144994**	**0.02520768**	**0.150267983**	**0.658173768**
HAP SUBTOTAL		**0.058**	**0.04973397**	**0.276668626**	**0.00052896**	**0.004980081**	**0.021812754**
TOTAL		**100**	**17.97600642**	**100**	**0.912**	**1.800016454**	**7.884072067**

EQUIPMENT SPECIFICATIONS

Gas Consumption Rate:	0.912 Mscf/day
Days of Operation:	365 days/year

	Number of Wells	VOC emissions (tons/year)
Alternative E	807	1062

21. Trace Pump Emissions

Company: **BBC**
Location: **WTP EIS**

GAS COMPONENT	MOLECULAR WEIGHT (lb/lb-mole)	MOLE PERCENT	RELATIVE MOLE WEIGHT (lb/lb-mole)	WEIGHT PERCENT	COMPONENT FLOW RATE (Mscf/day)	COMPONENT FLOW RATE (lb/hr)	COMPONENT FLOW RATE (tons/yr/well)
Methane	16.043	91.307	14.64838201	81.48852235	13.148208	23.16010753	58.91931355
Ethane	30.07	5.305	1.5952135	8.874126225	0.76392	2.522143139	6.416332147
Propane	44.097	1.536	0.67732992	3.767966612	0.221184	1.070905563	2.724383752
i-Butane	58.123	0.337	0.19587451	1.089644193	0.048528	0.30969118	0.787854363
n-Butane	58.123	0.387	0.22493601	1.25131247	0.055728	0.355639427	0.904746701
i-Pentane	72.15	0.166	0.119769	0.666271458	0.023904	0.189363093	0.481739708
n-Pentane	72.15	0.117	0.0844155	0.469600967	0.016848	0.133466758	0.339539432
Hexanes	86.177	0.113	0.09738001	0.541722159	0.016272	0.153964547	0.391685808
Heptanes	100.204	0.042	0.04208568	0.234121412	0.006048	0.066540378	0.169278721
Octanes	114.231	0.008	0.00913848	0.050837098	0.001152	0.01444857	0.036757163
Nonanes	128.258	0	0	0	0	0	0
Decanes +	142.285	0	0	0	0	0	0
Benzene	78.12	0.01	0.007812	0.043457928	0.00144	0.012351314	0.031421742
Toluene	92.13	0.006	0.0055278	0.03075099	0.000864	0.008739835	0.02223414
Ethylbenzene	106.16	0	0	0	0	0	0
Xylenes	106.16	0.001	0.0010616	0.00590565	0.000144	0.001678463	0.00427001
n-Hexane	86.177	0.041	0.03533257	0.196554058	0.005904	0.055863243	0.14211609
Helium	4.003	0.018	0.00072054	0.004008343	0.002592	0.001139224	0.002898185
Nitrogen	28.013	0.223	0.06246899	0.347513171	0.032112	0.098767804	0.251265294
Carbon Dioxide	44.01	0.383	0.1685583	0.937684912	0.055152	0.266502358	0.677982
Oxygen	32	0	0	0	0	0	0
Hydrogen Sulfide	34.08	0	0	0	0	0	0
VOC SUBTOTAL		**2.764**	**1.50066308**	**8.348144994**	**0.398016**	**2.37265237**	**6.03602763**
HAP SUBTOTAL		**0.058**	**0.04973397**	**0.276668626**	**0.008352**	**0.078632855**	**0.200041982**
TOTAL		**100**	**17.97600642**	**100**	**14.4**	**28.42131242**	**72.30381881**

PUMP SPECIFICATIONS

Pump Mfg.:	LEON	
Injection Pressure:	20	psi
Mfg. Gas Consumption Rate:	10	scf/min
Gas Consumption Rate:	14.40	Mscf/day
Days of Operation:	212	days/year

	Number of Wells	VOC emissions (tons/year)
Alternative E	807	4871

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Environmental Consultants

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22. Pneumatic Methanol Injection Pump Emissions

Company: **BBC**
Location: **WTP EIS**

GAS COMPONENT	MOLECULAR WEIGHT (lb/lb-mole)	MOLE PERCENT	RELATIVE MOLE WEIGHT (lb/lb-mole)	WEIGHT PERCENT	COMPONENT FLOW RATE (Mscf/day)	COMPONENT FLOW RATE (lb/hr)	COMPONENT FLOW RATE (tons/yr)
Methane	16.043	91.307	14.64838201	81.48852235	0.39444624	0.694803226	1.767579407
Ethane	30.07	5.305	1.5952135	8.874126225	0.0229176	0.075664294	0.192489964
Propane	44.097	1.536	0.67732992	3.767966612	0.00663552	0.032127167	0.081731513
i-Butane	58.123	0.337	0.19587451	1.089644193	0.00145584	0.009290735	0.023635631
n-Butane	58.123	0.387	0.22493601	1.25131247	0.00167184	0.010669183	0.027142401
i-Pentane	72.15	0.166	0.119769	0.666271458	0.00071712	0.005680893	0.014452191
n-Pentane	72.15	0.117	0.0844155	0.469600967	0.00050544	0.004004003	0.010186183
Hexanes	86.177	0.113	0.09738001	0.541722159	0.00048816	0.004618936	0.011750574
Heptanes	100.204	0.042	0.04208568	0.234121412	0.00018144	0.001996211	0.005078362
Octanes	114.231	0.008	0.00913848	0.050837098	0.00003456	0.000433457	0.001102715
Nonanes	128.258	0	0	0	0	0	0
Decanes +	142.285	0	0	0	0	0	0
Benzene	78.12	0.01	0.007812	0.043457928	0.0000432	0.000370539	0.000942652
Toluene	92.13	0.006	0.0055278	0.03075099	0.00002592	0.000262195	0.000667024
Ethylbenzene	106.16	0	0	0	0	0	0
Xylenes	106.16	0.001	0.0010616	0.00590565	0.00000432	5.03539E-05	0.0001281
n-Hexane	86.177	0.041	0.03533257	0.196554058	0.00017712	0.001675897	0.004263483
Helium	4.003	0.018	0.00072054	0.004008343	0.00007776	3.41767E-05	8.69456E-05
Nitrogen	28.013	0.223	0.06246899	0.347513171	0.00096336	0.002963034	0.007537959
Carbon Dioxide	44.01	0.383	0.1685583	0.937684912	0.00165456	0.007995071	0.02033946
Oxygen	32	0	0	0	0	0	0
Hydrogen Sulfide	34.08	0	0	0	0	0	0
VOC SUBTOTAL		**2.764**	**1.50066308**	**8.348144994**	**0.01194048**	**0.071179571**	**0.181080829**
HAP SUBTOTAL		**0.058**	**0.04973397**	**0.276668626**	**0.00025056**	**0.002358986**	**0.006001259**
TOTAL		**100**	**17.97600642**	**100**	**0.432**	**0.852639373**	**2.169114564**

PUMP SPECIFICATIONS

Pump Mfg.:	Western	
Piston Size:	0.625	inch
Injection Pressure:	30	psi
Pump Rate:	2.00	gallons/day
Gas Consumption Rate:	0.43	Mscf/day
Days of Operation:	212	days/year

	Number of Wells	VOC emissions (tons/year)
Alternative E	807	146

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23. Operations Vehicle Tailpipe Emissions

Assumptions:

Number of New Pumpers:	30	(Number of Pumpers at Peak Production)
Pumper Mileage:	3,000	miles/pumper/month (Assumption)
Total Annual New Pumper Mileage:	1,080,000	miles/year
Number of Condensate Haul Truck Round Trips:	15	trips per day (Based on Peak Production)
Average Round Trip Mileage for Condensate Transport:	168	miles (Estimate from Vernal)
Total Annual Condensate Truck Mileage:	919,800	miles/year
Number of Water Haul Truck Round Trips:	0	trips per day (Alternative E, water will be piped)
Average Round Trip Mileage for Water Transport:	0	miles (Average distance to water injection facility)
Total Annual Water Truck Mileage:	0	miles/year
Daily Hours of Operation:	12	hours per day (Assumption)
Annual Hours of Operation:	4368	hours per year
Fuel sulfur content	0.05	% (Typical value)
Fuel density	7.08	lbs/gallon (Typical value)
Heavy Duty Pickup Fuel Efficiency	15	miles/gallon (Typical value)
Heavy Haul Diesel Fuel Efficiency	10	miles/gallon (Typical value)

Equations:

For NOx, CO and VOC:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (g/mile)} * \text{Vehicle Miles Traveled (miles/yr)}}{\text{453.6 (g/lb)} * \text{2000 (lb/tons)}}$$

The NOx, CO and VOC emission factors for the above equation are from AP-42, while the SO2 emissions are calculated on a mass balance basis utilizing the following equation:

$$\text{SO2 E. Factor (g/mi)} = \frac{\text{Fuel Density (lb/gal)} * \text{453.6 (g/lb)} * \text{Fuel Sulfur Content} * \text{2 (S / SO2)}}{\text{Vehicle Fuel Efficiency (miles/gal)}}$$

Pumper Vehicles	**Heavy Duty Pickups**			**Heavy Haul Trucks**			**Total**	
	E. Factor [a] (g/mile)	**Emissions (lb/hr)**	**Emissions (tons/yr)**	**E. Factor [b] (g/mile)**	**Emissions (lb/hr)**	**Emissions (tons/yr)**	**Emissions (lb/hr)**	**Emissions (tons/yr)**
Criteria Pollutants & VOC								
NO_x	3.03	1.652	3.607	8.13	3.774	8.243	5.426	11.850
CO	33.64	18.337	40.048	17.09	7.934	17.327	26.271	57.375
VOC [c]	1.656	0.903	1.971	4.600	2.135	4.664	3.038	6.635
SO_2	0.21	0.117	0.255	0.32	0.149	0.326	0.266	0.580
Greenhouse Gases								
CH_4 [d]	0.184	0.100	0.219	0.230	0.107	0.233	0.207	0.452

a AP-42 Append H Table 4.1A.2 - H.D. Gasoline Vehicles, High Altitude, 1991 - 1997 Vehicle Year, 50,000 miles (6/95)
b AP-42 Append. H Table 7.1.2 - H.D. Diesel Powered Vehicles, High Altitude, 1991 - 1997 Model Year, 50,000 miles (6/95)
c Emission factor is for total Hydrocarbons - Methane Offset
d AP-42 Append. H Tables 7.10A.2 and 4.10A.2 H.D. Methane Offsets, High Altitude, 1986+ and 1988+ Vehicle Year

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24. Operations Traffic Fugitive Dust Emissions

Calculation AP-42, Chapter 13.2.2
December 2003

E (PM10) / VMT = 1.5 * (S/12)^0.9 * (W/3)^0.45 * (365-p)/365)
E (PM2.5) / VMT = 0.23 * (S/12)^0.9 + (W/3)^0.45 * (365-p)/365)
Silt Content (S) 7 Mean value Table 13.2.2-1 for Gravel Surfaces
Average Round Trip Miles 74 miles on unpaved roads
(Average of Pumper,Condensate)
365 days (Estimate) Precipitation Days (P) 73 days per year (NCDC data for Nutters Ranch, UT 1963-1986)

Vehicle Type	Ave. Weight (lbs)	Round Trips per Day*	PM10 (lb/VMT)	Total PM10 (lbs)	PM10 (lb/day)	Total PM2.5 (lbs)	PM2.5 (lb/day)
Pickup Truck: Crew	7,000	30.0					
Haul Truck: Oil	48,000	15.000					
Mean Weight	20,667	45.000	1.288873	1,566,560.21	4,291.95	240,205.90	658.1
Annual Traffic Fugitive Dust Emissions (tons/year)				**783.28**		**120.10**	

*Round trips per day at peak production

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25. Well Production Summary

Species	Production Heaters (tons/yr)	Storage Tanks (tons/yr)	Well Dehydrators (tons/yr)	Well Pumping Unit Engines (tons/yr)	Pneumatic Devices (tons/yr)	Operations Vehicle (tons/yr)	Well Blowdown (tons/yr)	Total Well Production [a] (tons/yr)
Criteria Pollutants & VOC								
NO_x	281.3			46.8		11.9		339.9
CO	236.3			62.3		57.4		356.0
VOC	30.9	260.8	6.9	31.2	6,079	6.6	168.6	6,584.5
SO_2	0.0			0.0		0.6		0.6
PM_{10}	21.4			2.2		783.3		806.9
$PM_{2.5}$	21.4			2.2		120.1		143.7
Hazardous Air Pollutants								
Benzene	0.0	1.4	1.5	0.2	28.9		0.0	32.0
Toluene	0.0	0.8	1.9	0.1	12.5		0.0	15.2
Ethylbenzene		0.0	0.1	0.0	0.0		0.0	0.1
Xylene		0.1	0.5	0.0	3.9		0.0	4.6
n-Hexane	5.1	6.2	0.2		80.0		0.0	91.4
Formaldehyde	0.2			2.3				2.5
Total HAPs	5.3	8.5	4.2	2.6		0.0	0.0	145.9
Greenhouse Gases								
CO_2	337,521.7	31.0		12,453.0			77.2	350,082.9
CH_4	6.5	24.5	4.0	26.0		0.5	1,648.2	1,709.6

[a] Emissions for Peak Field Development

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26. Average Produced Gas Characteristics
Inlet Wet Gas Sample from BBC Dry Canyon Compressor Station, dated 2/18/2004

Gas Heat Value (wet): 1082.2 Btu/scf

Sample Temperature: 108 F
Sample Pressure: 790 psi

C1-C2 Wt. Fraction:	0.9035
VOC Wt. Fraction:	0.0835
Non-HC Wt. Fraction:	0.0130
Total:	1.0000

COMPONENT	MOLE PERCENT	COMPONENT MOLE WEIGHT (lb/lb-mole)	NET MOLE WEIGHT (lb/lb-mole)	WEIGHT FRACTION	GROSS HEATING VALUE (BTU/scf)	NET DRY HEATING VALUE (BTU/scf)	LOWER HEATING VALUE (BTU/scf)	NET LOW HEATING VALUE (BTU/scf)
Methane	91.3030	16.043	14.648	0.815	1010.000	922.160	910.000	830.857
Ethane	5.3050	30.070	1.595	0.089	1769.800	93.888	1618.000	85.835
Propane	1.5360	44.097	0.677	0.038	2516.200	38.649	2316.000	35.574
i-Butane	0.3370	58.123	0.196	0.011	3252.100	10.960	3005.000	10.127
n-Butane	0.3870	58.123	0.225	0.013	3262.400	12.625	3013.000	11.660
i-Pentane	0.1600	72.150	0.115	0.006	4000.900	6.401	3698.000	5.917
n-Pentane	0.1170	72.150	0.084	0.005	4008.800	4.690	3708.000	4.338
Hexanes	0.1270	86.177	0.109	0.006	4756.200	6.040	4404.000	5.593
Heptanes	0.0340	100.204	0.034	0.002	5502.500	1.871	5100.000	1.734
Octanes+	0.0080	114.231	0.009	0.001	6249.100	0.500		0.000
Nonanes	0.0000	128.258	0.000	0.000	6996.400	0.000		0.000
Decanes	0.0000	142.285	0.000	0.000	7743.200	0.000		0.000
Benzene	0.0100	78.120	0.008	0.000	3715.500	0.372		0.000
Toluene	0.0060	92.130	0.006	0.000	4444.600	0.267		0.000
Ethylbenzene	0.0000	106.160	0.000	0.000	5191.500	0.000		0.000
Xylenes	0.0010	106.160	0.001	0.000	5183.500	0.052		0.000
n-Hexane	0.0410	86.177	0.035	0.002	4756.200	1.950		0.000
Helium	0.0090	4.003	0.000	0.000	0.000	0.000	0.000	0.000
Nitrogen	0.2230	28.013	0.062	0.003	0.000	0.000	0.000	0.000
Carbon Dioxide	0.3830	44.010	0.169	0.009	0.000	0.000	0.000	0.000
Oxygen	0.0090	32.000	0.003	0.000	0.000	0.000	0.000	0.000
Hydrogen Sulfide	0.0000	34.080	0.000	0.000	637.100	0.000	588.000	0.000
TOTAL	100.00		17.98	1.00		1100.43		991.64

Relative Mole Weight (lb/lb-mole) = [Mole Percent * Molecular weight (lb/lb-mole)] / 100

Weight Fraction = Net Mole Weight / Total Mole Weight

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27. Central Compression

Assumptions:

Total Existing Compression: 16,000 Horsepower (Dry Canyon Facility)
Total New Compression: 24,000 Horsepower (Chapter 2)

Equations:

$$\text{Emissions (lbs/hr)} = \frac{\text{Emission Factor (g/hp-hr)} * \text{Power (hp)}}{453.6 \text{ g/lb}}$$

Pollutant	Emission Factor [3] (lb/MMBtu)	Emission Factor (g/hp-hr)	Emissions (lb/hr/engine) [7]	Emissions 6,400 hp Station (tons/yr)	Emissions 6,400 hp Station (tons/yr)	Emissions 11,200 hp Station (tons/yr)	Total Emissions [5] Proposed Action (tons/yr)
Criteria Pollutants & VOC							
NOx [6]		1.5	5.29	92.7	92.7	162.2	347.6
CO [6]		2.0	7.05	123.6	123.6	216.3	463.5
VOC [6]		1.0	3.53	61.8	61.8	108.2	231.7
PM10 [1,4]	0.0194	0.070	0.25	4.4	4.4	7.6	16.3
PM2.5 [1,4]	0.0194	0.070	0.25	4.4	4.4	7.6	16.3
SO_2 [2]	0.0	0.000	0.00	0.0	0.0	0.0	0.0
Hazardous Air Pollutants							
Benzene [1]	0.001580	0.00574	0.02	0.4	0.4	0.6	1.3
Toluene [1]	0.000558	0.00203	0.01	0.1	0.1	0.2	0.5
Ethylbenzene [1]	0.000025	0.00009	0.00	0.0	0.0	0.0	0.0
Xylenes [1]	0.000195	0.00071	0.00	0.0	0.0	0.1	0.2
Formaldehyde [1]	0.0205	0.07446	0.26	4.6	4.6	8.1	17.3
Greenhouse Gases							
CO2 [1]	110.00	399.52	1,409.24	24,690.5	24,690.5	43,208.3	92,587.2
CH4 [1]	0.2	0.83536	2.95	51.6	51.6	90.3	193.6

1 - AP-42 Table 3.2-3 Uncontrolled Emission Factors for 4-Stroke Rich-Burn Engines, 7/00
2 - Fuel gas is assumed to be free from sulfur compounds
3 - Conversion from lb/MMBtu to g/hp-hr assumes an average heat rate of 8,000 Btu/hp-hr (*3.632)
4 - PM = sum of PM filterable and PM condensable
5 - Proposed Action Total Annual Emissions for New Compression (24,000 hp)
6 - Assumed equivalent control rates for internal combustion engines located at existing Dry Canyon Facility
7 - Each individual engine estimated at 1,600 hp (Chapter 2)

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28. Central TEG Dehydrator Emissions

Assumptions

Peak Field Production Rate: 250 MMscf/day
807 Active Wells at Peak Production

Gas Composition: Inlet Gas Sample from Dry Canyon Compresor Station, dated 2/18/04

Inlet Gas Conditions: Inlet gas saturated at 600 psi and 108 F

Glycol Circulation Rate: 3 gallons/ lb of water
(Typical operating rate)

Calculations

Dehydrator emissions were simulated using GRI GlyCalc version 4.0

Controls

Condenser/Combustor > 95% Control Efficiency in order to meet Federal MACT Standards
Condenser Operating Conditions: 120 deg. F, 11.5 psia

Emissions

Species	Central Dehydrator Emissions 67MMscfd Station (tons/year)	Central Dehydrator Emissions 67MMscfd Station (tons/year)	Central Dehydrator Emissions 117MMscfd Station (tons/year)	Total Project Emissions (tons/year)
Total VOC	8.46	8.46	14.77	31.69
Hazardous Air Pollutants				
Benzene	1.47	1.47	2.57	5.51
Toluene	1.47	1.47	2.57	5.51
Ethylbenzene	0.00	0.00	0.00	0.00
Xylenes	0.49	0.49	0.86	1.84
n-Hexane	0.22	0.22	0.38	0.81
Greenhouse Gases				
CH_4	12.28	12.28	21.44	46.00

Each station throughput estimated according to the ratio of new compression proposed at each station and based on a peak field production rate of 250MMscfd

29. Central Facility Heater Emissions

Assumptions

Dehydrator Reboiler Heater	500	Mbtu/hr (Estimate based on Dry Canyon Facility)
Tank Heater Size	500	Mbtu/hr (Estimate based on Dry Canyon Facility)
Total Heater Requirmement Facility 1	3,000	Mbtu/hr (Proposed Action Estimate, 2-Dehydrator Reboiler Heaters, 4-Tank Heaters)
Total Heater Requirmement Facility 2	3,000	Mbtu/hr (Proposed Action Estimate, 2-Dehydrator Reboiler Heaters, 4-Tank Heaters)
Total Heater Requirmement Facility 3	6,000	Mbtu/hr (Proposed Action Estimate, 4-Dehydrator Reboiler Heaters, 8-Tank Heaters)
Firing Rate	30	minutes/hour on average for entire year (Typical value)
	4380	hours/year
Fuel Gas Heat Value	992	Btu/scf (Gas Analyses from Dry Canyon Facility)
Fuel Gas VOC Content	0.083	by weight (Gas Analyses from Dry Canyon Facility)

Equations

$$\text{Fuel Consumption (MMscf/yr)} = \frac{\text{Heater Size (MBtu/hr)} * 1{,}000\ \text{(Btu/MBtu)} * \text{Hours of Operation (hrs/yr)}}{\text{Fuel Heat Value (Btu/scf)} * 1{,}000{,}000\ \text{(scf/MMscf)}}$$

$$\text{NOx/CO/TOC Emissions (tons/yr)} = \frac{\text{AP-42 E.Factor (lbs/MMscf)} * \text{Fuel Consumption (MMscf/yr)} * \text{Fuel heating Value (Btu/scf)}}{2{,}000\ \text{(lbs/ton)} * 1{,}000\ \text{(Btu/scf - Standard Fuel Heating Value)}}$$

$$\text{VOC Emissions (tons/yr)} = \text{TOC Emissions (tons/yr)} * \text{VOC wt. fraction}$$

Species	Central Heater Emissions - Facility 1			Central Heater Emissions - Facility 2			Central Heater Emissions - Facility 3			
	Emission Factor (lb/MMscf)	Well Emissions (lb/hr)	Total Emissions (tons/yr)	Emission Factor (lb/MMscf)	Well Emissions (lb/hr)	Total Emissions (tons/yr)	Emission Factor (lb/MMscf)	Well Emissions (lb/hr)	Total Emissions (tons/yr)	Total Emissions (tons/yr)
Criteria Pollutants & VOC										
NO_x [a]	100	0.300	0.657	100	0.300	0.657	100	0.600	1.314	2.628
CO [a]	84	0.252	0.552	84	0.252	0.552	84	0.504	1.104	2.208
TOC [c]	11	0.033	0.072	11	0.033	0.072	11	0.066	0.145	0.289
VOC	N.A.	0.003	0.006	N.A.	0.003	0.006	N.A.	0.006	0.012	0.024
SO_x [b]	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.000
TSP [c]	7.6	0.023	0.050	7.6	0.023	0.050	7.6	0.046	0.100	0.200
PM_{10} [c]	7.6	0.023	0.050	7.6	0.023	0.050	7.6	0.046	0.100	0.200
$PM_{2.5}$ [c]	7.6	0.023	0.050	7.6	0.023	0.050	7.6	0.046	0.100	0.200
Hazardous Air Pollutants										
Benzene [d]	0.0021	0.000	0.000	0.0021	0.000	0.000	0.0021	0.000	0.000	0.000
Toluene [d]	0.0034	0.000	0.000	0.0034	0.000	0.000	0.0034	0.000	0.000	0.000
Hexane [d]	1.8	0.005	0.012	1.8	0.005	0.012	1.8	0.011	0.024	0.047
Formaldehyde [d]	0.075	0.000	0.000	0.075	0.000	0.000	0.075	0.000	0.001	0.002
Greenhouse Gases										
CO_2 [c]	120,000	360.00	788.40	120,000	360.00	788.40	120,000	720.00	1,576.80	3,153.600
CH_4 [c]	2.3	0.007	0.015	2.3	0.007	0.015	2.3	0.014	0.030	0.060

a AP-42 Table 1.4-1, Emission Factors for Natural Gas Combustion, 7/98
b Assumes produced gas contains no sulfur
c AP-42 Table 1.4-2, Emission Factors for Natural Gas Combustion, 7/98 (All Particulates are PM1.0)
d AP-42 Table 1.4-3, Emission Factors for Organic Compounds from Natural Gas Combustion, 7/98

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30. Central Facility Condensate Storage Tank Flash/Working/Standing Emissions

Assumptions:

Average Condensate Production Rate :

Facility 1	100	bbls condensate per day (Estimate Based on Dry Canyon Compressor Station Volumes)
Facility 2	100	bbls condensate per day (Estimate Based on Dry Canyon Compressor Station Volumes)
Facility 3	175	bbls condensate per day (Estimate Based on Dry Canyon Compressor Station Volumes)

Separator Conditions : 110 psi and 40 F (Sample Conditions)

Calculations:

Condensate tank flashing/working/breathing emissions estimated with E&P Tanks 2.0
Dry Canyon Compressor Station Liquid Sample Dated 2/21/04
Flare to control stock tank and dehydrator emissions with 95% control efficiency

Emissions:

Component	Facility 1 Flash/Work/Breathing (tons/yr)	Facility 2 Flash/Work/Breathing (tons/yr)	Facility 3 Flash/Work/Breathing (tons/yr)	Total Emissions (tons/yr)
Total VOC	21.544	21.544	37.700	80.788
Hazardous Air Pollutants				
Benzene	0.120	0.120	0.210	0.450
Toluene	0.066	0.066	0.116	0.248
Ethylbenzene	0.000	0.000	0.001	0.001
Xylenes	0.007	0.007	0.013	0.027
n-Hexane	0.513	0.513	0.898	1.924
Greenhouse Gases				
CO_2	2.564	2.564	4.487	9.615
CH_4	2.023	2.023	3.541	7.587

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31. Central Facility Emission Summary

Central Facility 1

Pollutant	Central Compression Emissions 6,400 hp (tons/year)	Central Dehydrator Emissions 67MMscfd (tons/year)	Central Heater Emissions (tons/year)	Central Condensate Tank Emissions (tons/year)	Total Facility Emissions (tons/year)
Criteria Pollutants & VOC					
NO_x	92.7		0.7		93.4
CO	123.6		0.6		124.2
VOC	61.8	8.5	0.0	21.5	91.8
SO_2	0.0		0.0		0.0
PM_{10}	4.4		0.0		4.4
$PM_{2.5}$	4.4		0.0		4.4
Hazardous Air Pollutants					
Benzene	0.4	1.5	0.0	0.1	1.9
Toluene	0.1	1.5	0.0	0.1	1.7
Ethylbenzene	0.0	0.0		0.0	0.0
Xylene	0.0	0.5		0.0	0.5
n-Hexane		0.2	0.0	0.5	0.7
Formaldehyde	4.6		0.0		4.6
Total HAPs	5.1	3.6	0.0	0.7	9.5
Greenhouse Gases					
CO_2	24,690.5		788.4	2.6	25,481.4
CH_4	51.6	12.3	0.0	2.0	65.9

Central Facility 2

Pollutant	Central Compression Emissions 6,400 hp (tons/year)	Central Dehydrator Emissions 67MMscfd (tons/year)	Central Heater Emissions (tons/year)	Central Condensate Tank Emissions (tons/year)	Total Facility Emissions (tons/year)
Criteria Pollutants & VOC					
NO_x	92.7		0.7		93.4
CO	123.6		0.6		124.2
VOC	61.8	8.5	0.0	21.5	91.8
SO_2	0.0		0.0		0.0
PM_{10}	4.4		0.0		4.4
$PM_{2.5}$	4.4		0.0		4.4
Hazardous Air Pollutants					
Benzene	0.4	1.5	0.0	0.1	1.9
Toluene	0.1	1.5	0.0	0.1	1.7
Ethylbenzene	0.0	0.0		0.0	0.0
Xylene	0.0	0.5		0.0	0.5
n-Hexane		0.2	0.0	0.5	0.7
Formaldehyde	4.6		0.0		4.6
Total HAPs	5.1	3.6	0.0	0.7	9.5
Greenhouse Gases					
CO_2	24,690.5		788.4	2.6	25,481.4
CH_4	51.6	12.3	0.0	2.0	65.9

Central Facility 3

Pollutant	Central Compression Emissions 11,200 hp (tons/year)	Central Dehydrator Emissions 117MMscfd (tons/year)	Central Heater Emissions (tons/year)	Central Condensate Tank Emissions (tons/year)	Total Facility Emissions (tons/year)
Criteria Pollutants & VOC					
NO_x	162.2		1.3		163.5
CO	216.3		1.1		217.4
VOC	108.2	14.8	0.0	37.7	160.6
SO_2	0.0		0.0		0.0
PM_{10}	7.6		0.1		7.7
$PM_{2.5}$	7.6		0.1		7.7
Hazardous Air Pollutants					
Benzene	0.6	2.6	0.0	0.2	3.4
Toluene	0.2	2.6	0.0	0.1	2.9
Ethylbenzene	0.0	0.0		0.0	0.0
Xylene	0.1	0.9		0.0	0.9
n-Hexane		0.4	0.0	0.9	1.3
Formaldehyde	8.1				8.1
Total HAPs	9.0	6.4	0.0	1.2	16.6
Greenhouse Gases					
CO_2	43,208.3		1,576.8	4.5	44,789.6
CH_4	90.3	21.4	0.0	3.5	115.4

32. Total Project Production Related Emissions Summary

Pollutant	Total Project Production Related Emissions (tons/year) [a]				Total Production (tons/year)
	Well Production (tons/year)	Central Facility 1 (tons/year)	Central Facility 2 (tons/year)	Central Facility 3 (tons/year)	
Criteria Pollutants & VOC					
NO_x	339.9	93.4	93.4	163.5	690.1
CO	356.0	124.2	124.2	217.4	821.7
VOC	6,584.5	91.8	91.8	160.6	6,928.8
SO_2	0.6	0.0	0.0	0.0	0.6
PM_{10}	806.9	4.4	4.4	7.7	823.4
$PM_{2.5}$	143.7	x	4.4	7.7	155.8
Hazardous Air Pollutants					
Benzene	32.0	1.9	1.9	3.4	39.3
Toluene	15.2	1.7	1.7	2.9	21.5
Ethylbenzene	0.1	0.0	0.0	0.0	0.1
Xylene	4.6	0.5	0.5	0.9	6.6
n-Hexane	91.4	0.7	0.7	1.3	94.2
Formaldehyde	2.5	4.6	4.6	8.1	19.8
Total HAPs	145.9	9.5	9.5	16.6	181.5
Greenhouse Gases					
CO_2	350,082.9	25,481.4	25,481.4	44,789.6	445,835.4
CH_4	1,709.6	65.9	65.9	115.4	1,956.9

a Emissions for Peak Field Development

33. Total Project Emissions Summary

Pollutant	Project Emissions (tons/year)		Total Emissions [a] (tons/year)
	Well Development	Project Production	
Criteria Pollutants & VOC			
NO_x	272	690	963
CO	475	822	1,297
VOC	81.3	6,929	7,010
SO_2	9.92	0.58	10.50
PM_{10}	5,097	823	5,920
$PM_{2.5}$	767	156	923
Hazardous Air Pollutants			
Benzene	0.00	39.3	39.3
Toluene	0.00	21.5	21.5
Ethylbenzene	0.00	0.11	0.11
Xylene	0.00	6.61	6.61
n-Hexane	0.00	94.2	94.2
Formaldehyde	0.53	19.8	20.3
Total HAPs	0.53	181.5	182.0
Greenhouse Gases			
CO_2	55,414	445,835	501,249
CH_4	61.1	1,957	2,018

a Emissions for Peak Field Development

Far-Field Air Quality Technical Support Document
West Tavaputs Plateau
Oil and Gas Producing Region
Draft Environmental Impact Statement

September 2008

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Bureau of Land Management
Price Field Office
Price, Utah

Under Direction of:
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1.0 INTRODUCTION

This Technical Support Document (TSD) describes the process used to develop the Far-Field Air Quality Impact Analysis for the Bureau of Land Management (BLM), Price Field Office, Draft Environmental Impact Statement (EIS) for West Tavaputs Plateau Area (WTP). The WTP Project Area is located approximately 30 miles east-northeast of Price, Utah and covers approximately 137,700 acres in an existing oil and gas producing region located in Duchesne and Carbon Counties, Utah. Surface ownership in the project area is approximately 87% federal (managed by the Bureau of Land Management [BLM]), 8% State of Utah (managed by State of Utah School and Institutional Trust Lands Administration [SITLA]), and 5% private.

This document provides a detailed description of the procedures applied for the EIS analysis to quantify potential ambient air quality and air quality related values (AQRV) impacts that may result from the implementation of the WTP Project alone and in conjunction with other cumulative sources of air pollutant emissions. The emissions inventories for the Proposed Action and alternatives is shown as Appendix J-1.

1.1 OVERVIEW OF APPROACH

The WTP Far-Field TSD was performed in accordance with a written protocol defining methodologies designed to quantify potential air quality impacts from the proposed WTP Project and surrounding development. This protocol was prepared by Buys and Associates with refinements resulting from review and input from the Bureau of Land Management, Utah Department of Environmental Quality, U.S. Forest Service, National Park Service, Environmental Protection Agency (EPA) Region VIII, and Project proponents. This procedure ensured that the air quality assessment methodology was technically acceptable to all parties providing input.

Potential ambient air quality impacts that could result upon implementation of the WTP Project were assessed at two different distance scales. The Far-Field analysis is focused on project related and cumulative impacts upon areas of special concern (i.e., Federally designated Class I areas and sensitive Class II areas). The Near-Field analysis is focused on potential impacts for all areas within and relatively near the WTP Project area.

To assess potential far-field impacts, the CALPUFF set of models were applied. The CALPUFF set of models (CALMET, CALPUFF, CALPOST, and associated utilities) were designed specifically to assess ambient air quality impacts at significant distances from the source and therefore long pollutant travel times. For this analysis, the following versions of the models were applied: CALMET Version 5.53a, Level 040716; CALPUFF Version 5.754, Level 060202; and CALPOST Version 5.6393, Level 060202.

The CALPUFF set of models were applied for meteorological calendar years 2001, 2002 and 2003 and included cumulative impacts from the Project sources, permitted and tribal sources, oil and gas well sources, sources associated with reasonably foreseeable development, and sources associated with reasonably foreseeable future actions. The predicted pollutant concentrations were compared to the National Air Quality Standards (NAAQS) and (for informational purposes only) to the Prevention of Significant Deterioration (PSD) Class I and II increments. In addition, the predicted concentration and deposition results were processed to evaluate potential visibility and acid deposition impacts for comparison with the Federal Land Manager (FLM) Limits of Acceptable Change (LAC). The results of the CALPUFF analysis for the Proposed Action and Alternatives are provided in Section 6.

2.0 PROJECT DESCRIPTION

The WTP Project Area currently contains 71 active producing wells, with accompanying production related facilities, roads, and pipelines. An additional 30 wells approved under the WTP Drilling Program EA (UT-070-2004-28) are proposed for development. Total gas compression and treatment capacity is currently 16,000 horsepower (hp) within the WTP at the existing Dry Canyon facility.

The proposed wells would be drilled to all potentially productive formations in the WTP Project Area: the Wasatch, North Horn, Mesa Verde, Dakota, Cedar Mountain, Navajo, and Wingate Formations, and other formations found to be productive. The majority of the wells would be spaced at one well per 80 acres or less. However, geologic characteristics that are currently poorly defined and which would be better defined through future drilling, would dictate the well density necessary to effectively drain the natural gas within the WTP Project Area.

Each of the geologic formations in the WTP Project Area has a unique permeability, which requires variable well spacing techniques for effective drainage of the gas reservoirs. Some of the economically productive geologic formations would be effectively drained by downhole well densities of one well per 160 acres, most by well densities of one well per 80 acres, and others would likely require well densities of up to one well per 40 acres (Wasatch and Mesa Verde formations). In general, deeper formations require lesser downhole well density. The number of wells per well pad would therefore, vary dramatically, depending on the required downhole well density as well as topographic considerations. Formations that can be produced by a single well per 80 acres, that are accessible, and that have a single production formation, could be developed by well pads with single well bores. Formations that require downhole well densities of one well per 40 acres, that are adjacent to topographically inaccessible lands, and that have multiple productive horizons could be developed using well pads with up to as many as eight wells per pad.

Bill Barrett Corporation (BBC) proposes the following primary components for development under the Proposed Action:

- Up to 809 natural gas wells from up to 539 pads over an 8 year development period, 28 year life of project (LOP);
- Up to 9 drilling rigs operating year round;
- Up to 3,250 acres short-term surface disturbance (wells, access roads, pipelines, compressor stations); and
- Approximately 24,000 compression horsepower would be added to the existing system, for a total of 40,000 horsepower within the WTP Project Area.

In addition to the Proposed Action, the following four alternatives are considered in the NEPA analysis:

<u>Alternative B</u> – No Action (71 wells from 54 pads, 33,600 hp compression, 3 rigs year round for 1.2 years, 22 year LOP)

<u>Alternative C</u> – Transportation Reduction (809 wells from 539 pads, 40,000 hp compression, 2-6 rigs year round for 12 years, 32 year LOP)

Alternative D – Conservation Alternative (522 wells from 348 pads, 11,200 hp compression, 7 rigs seasonally for 20 years, 40 year LOP)

Alternative E – BLM Preferred Alternative (Year-round drilling, no limitation on number of rigs per year provided surface disturbance and air quality thresholds are not exceeded)

After construction of well pads and roads, drilling and completion of a well, and interconnection to the gathering pipelines, each well pad would consist of a wellhead, a three-phase separator (to separate gas, produced water, and hydrocarbon condensate), and a condensate tank. Approximately 25 % of wells would require individual dehydrators and gas powered pump jacks. The gas would be moved to central production facilities (CPF) that would include multiple compressor engines, a central separator, and central glycol dehydration units. After processing, the gas would then be transported to a sales pipeline for further distribution.

Emissions to the atmosphere from the proposed project would consist of the criteria pollutants nitrogen oxides (NO_x), carbon monoxide (CO), particulates (PM_{10} and $PM_{2.5}$), sulfur dioxide (SO_2), volatile organic compounds (VOC), and various hazardous air pollutants (HAP). These pollutants would be emitted from the following activities and sources:

- Well pad and road construction: equipment producing fugitive dust while moving and leveling earth;
- Drilling: vehicles generating fugitive dust on access roads, and drill rig engine exhaust;
- Completion: vehicles generating fugitive dust on access roads, frac pump engine and generator emissions, and completion flaring emissions;
- Vehicle tailpipe emissions associated with all development phases;
- Well production operations: three-phase separator emissions, flashing and breathing emissions from a condensate tank, and pump jack engine emissions; and
- Central production facility: compressor engines and central glycol dehydration unit emissions.

Derivation of the emission rates applied for this analysis is detailed separately in the emissions inventories shown as Appendix J-1.

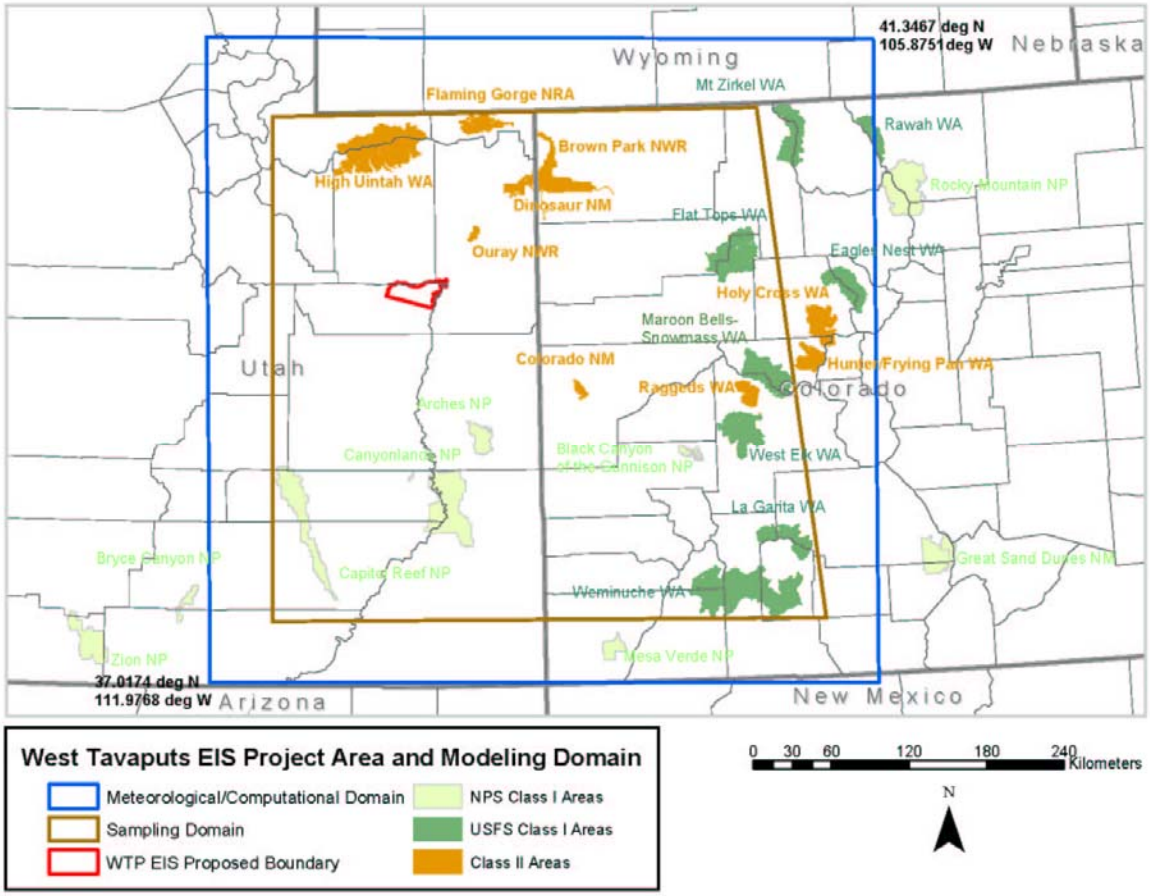
3.0 METEOROLOGICAL MODELING

3.1 MODEL DOMAIN

The initial step in the Far-Field analysis is determining the extent of the study area domain and performing the meteorological modeling. For this study, the study area domain was developed through a review of the locations of the proposed project sources and areas of interest for the impact analysis. A proposed study domain was then presented in the assessment protocol and subsequently refined through the incorporation of comments from the project stakeholders.

The Far-Field analysis domain is presented in **Figure 3-1**. The meteorological and computational grid size is 516 km x 496 km (129 x 124 cells, 4 km spacing). The sampling grid size is a subset of these grids (412 km x 400 km) and includes sixteen areas of special concern (i.e., national parks, wilderness areas, national monuments, national wildlife refuges, and a national recreation area). The analysis domain was developed on a Lambert Conformal Conic projection (LCC), with a first and second standard latitude parallels at 30 degrees and 60 degrees. The reference latitude and longitude were chosen arbitrarily and defined the origin of the Lambert conformal projection coordinates (0, 0). The southwest corner of the domain (37.0174 N, 111.9768 W) was chosen as the reference point with the intention that all values within the modeling domain had a positive X and Y value.

Figure 3-1. Modeling Domain



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3.2 METEOROLOGICAL, TERRAIN, AND LAND USE DATA

CALMET includes a diagnostic wind model which combines surface and upper-air meteorological data with diagnostic effects of terrain and other factors to generate three-dimensional wind fields. CALMET also includes other interpolation algorithms to generate three-dimensional temperature, pressure, stability, and other meteorological variables and two-dimensional precipitation fields. The CALMET modeling (and subsequent CALPUFF modeling) was performed on a 4-km grid (129 grid cells east-west and 124 grid cells north-south). As there are only a limited number of meteorological stations available in the nearly 60,000 square mile analysis domain, and since there is considerable complex terrain in the area, the CALMET diagnostic model was provided with three years of course grid (36-km) resolution MM5 simulation. As an input to CALMET, the MM5 prognostic meteorological results were used to provide initial mesoscale flow features. The CALMET diagnostic algorithms and local observations were then applied to refine and further characterize local wind variations at a 4-km resolution.

In addition to the mesoscale flow feature input, CALMET requires terrain and land use data in addition to upper air data and local, sub-mesoscale surface meteorology and precipitation data. Each of these data sets are discussed in the following sub-sections.

3.2.1 Mesoscale Meteorological Data

The Fifth Generation Mesoscale Model (MM5), developed and maintained by the Pennsylvania State University and National Center for Atmospheric Research (PSU/NCAR), was used to supply hourly meteorological fields for input to CALMET. Three years (2001, 2002 and 2003) of MM5 data was obtained from Alpine Geophysics (2006). CALMET uses the MM5 (36-km resolution) data as an "initial guess" field for the fine grid (4-km resolution) wind field simulations using a diagnostic wind field module. The methodology used by CALMET accounts for local terrain effects on the wind field. For example, CALMET includes the local up and down-valley diurnal flow that is missed by most meteorological observations and coarse grid simulations. The MM5 simulation for calendar year 2002 was prepared using two modeling domains, a mother domain and a nested domain. The mother domain covered the continental U.S. and used a grid spacing of 36 km. The nested domain covered western U.S. Class I areas and used a grid spacing of 12 km. Therefore, the MM5 grid spacing for the 2002 modeling simulation was 12-km within the WTP Project domain. However, the grid spacing for the 2001 and 2003 continental-scale MM5 simulations was 36-km within the WTP Project domain.

3.2.2 Terrain and Land Use Data

In order to refine the local wind fields, CALMET requires land use and terrain data. Land use and terrain data as developed by United States Geological Survey (USGS) are available for download for various 1-degree quadrangles (1:250,000 scale).

The terrain data were derived from 3-arc second (approximately 90-meter spacing) digital elevation model (DEM) produced by the United States Geological Survey (USGS). **Figure 3-2** presents the terrain for the model domain.

The land use data were derived from USGS Composite Theme Grid (CTG) data that are provided with a resolution of 200 meters. Missing data within the USGS land use data files were filled using the global data set, with a resolution of 900 meters. The USGS land use data contains 38 different use categories, while the CALMET model is capable of utilizing only 14 use categories.

Therefore, a cross-reference was applied to the USGS land use categories to format the data for use in CALMET. Land use categories were defined according the default parameters in CALMET pre-processing utilities. The USGS 200-meter grid data were overlain on the CALMET 4-km by 4-km grid, and the predominate land use type was selected to represent land use for the 4 km cell. **Figure 3-3** presents the terrain along with the USGS land use categories for the modeling domain.

The bias for each layer was set to represent the relative weight given to the vertically extrapolated surface observations versus the upper air sounding data in the computation of the initial guess field. The bias parameter corresponds to the cell layer below the cell face height. The –1 indicates no influence of upper air stations, while +1 indicates no influence of surface observations. The bias settings and vertical grid structure for the WTP analysis are shown in **Table 3-1**.

Table 3-1. Summary of Cell Heights and Bias Settings

Cell Face #	Cell Face Height (meters)	Bias Parameter
1	0	--
2	20	-1
3	40	-0.8
4	80	-0.4
5	160	-0.2
6	320	0
7	640	0
8	1,000	0
9	1,500	0
10	2,000	0.2
11	2,500	0.4
12	3,000	0.8
13	3,500	1

Wind speed and wind direction data from observation stations were only allowed to influence the Step 1 wind field at a distance determined by setting the radius-of-influence parameter. The maximum radius of influence for surface (RMAX1) and upper air stations (RMAX2) was set to 50 km and 200 km, respectively. The distance from an observation station at which the observations and Step 1 wind field were equally weighted was set to 4 km for the surface layer (R1) and 10 km for layers aloft (R2). Radius of influence for terrain features (TERRAD) was set to 12 km.

3.2.3 Upper Air Meteorological Data

CALMET provides two options for upper air data, in one option, upper air flow is derived only from the MM5 simulation. In the second option, upper air flow is derived from a combination of the MM5 simulation and available local upper air meteorological data. This second option was applied for the WTP study. Three upper air stations operated by the National Weather Service in or surrounding the WTP study domain were utilized in the analysis: Riverton, WY; Salt Lake City, UT; and Grand Junction, Colorado.

Figure 3-2. Terrain Features of Modeling Domain (elevation in meters)

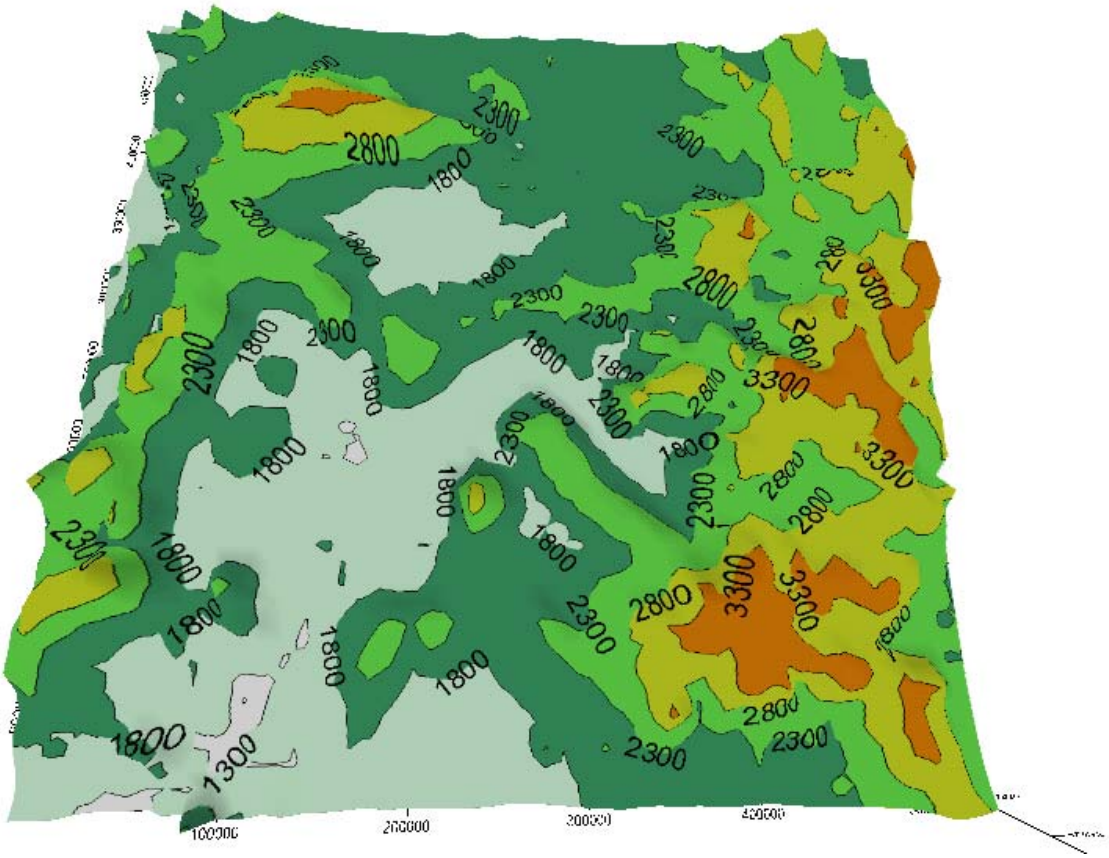
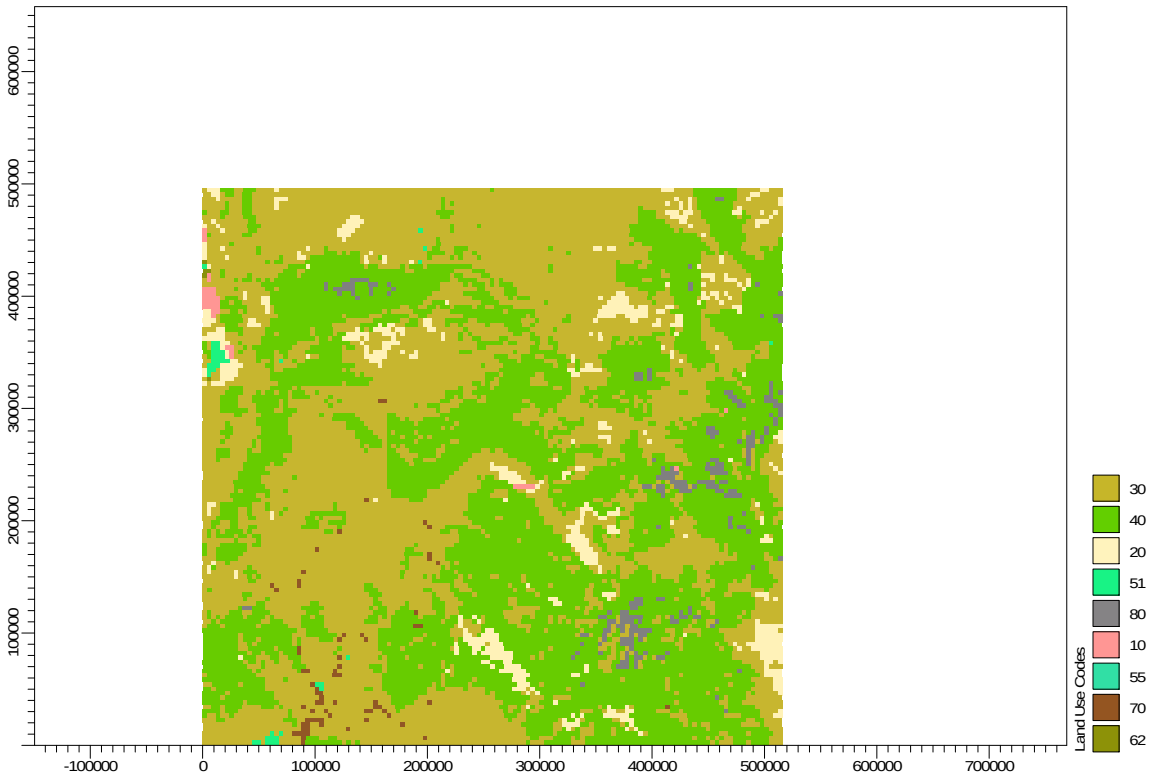


Figure 3-3. Land Use Categories within the Modeling Domain



3.2.4 Surface Meteorological Data

The National Climatic Data Center (NCDC) provides Integrated Surface Hourly (ISH) observational data for the United States. Three years (2001-2003) of data were obtained for use in CALMET. The ISH database consists of quality controlled surface observations collected from three input sources: TD3280 (NCDC and Navy Hourly Observations), TD3240 (NCDC hourly precipitation, and AFCCC DATSAV3 (hourly observations). The ISH database is composed of worldwide surface weather observations from about 20,000 stations, collected and stored from sources such as the Automated Weather Network (AWN), the Global Telecommunications System (GTS), the Automated Surface Observing System (ASOS), and data keyed from paper forms.

In total, the WTP surface meteorological data set included 28 surface meteorological data stations from CO, UT, and WY as shown in **Figure 3-4** and listed in **Table 3-2**.

3.2.5 Surface Precipitation Data

Data for 46 (2001), 43 (2002), and 49 (2003) precipitation stations within the WTP study domain were utilized. The precipitation data were acquired from TD3240 NCDC hourly precipitation only database. The data were pre-processed and examined for conformance with the format required by the CALMET precipitation processors. Stations within the domain with less than 6,000 annual hours of completeness were omitted. The precipitation stations included in the analysis are presented in **Figure 3-5** and listed in **Table 3-3**.

3.3 CALMET METEOROLOGICAL MODELING

To develop the final wind field, stability class, precipitation, and other data needed by CALPUFF, the MM5, upper air, terrain, land use, surface meteorology, and precipitation data are all input into the CALMET model. When running the CALMET model, the user must select among a number of options through the CALMET input control file. The options within CALMET were set in accordance with the Interagency Workgroup on Air Quality Modeling (IWAQM) guidelines. Separate CALMET runs were conducted on a bi-monthly basis for years 2001, 2002, and 2003. An example of the CALMET control file used for the January 1st-15th 2001 WTP simulation is presented in Appendix J-1.

As a quality assurance check of the input data and CALMET model results, wind fields on selected days were analyzed and visually compared to terrain features. The results of this analysis, an example of which is shown in **Figure 3-6**, and **Figure 3-7** indicate that the CALMET results accurately represent the expected surface and upper air wind fields based upon the given mesoscale meteorological features and local scale land use and terrain features. The CALMET model was applied bi-monthly for 2001-2003 meteorological data and the results subsequently used as the meteorological input for the CALPUFF model.

Table 3-2. Surface Meteorological Stations

Station Name	State	Station ID	Call Sign	Lat	Long	Number of Data Hours		
						2001	2002	2003
Alamosa/San Luis Valley	CO	724620	ALS	37.43	-105.87	10532	10424	10923
Aspen/Sardy Field	CO	724676	ASE	39.22	-106.87	9953	9442	9833
Broomfield/Jeffco	CO	724699	BJC	39.92	-105.12	6180	6127	6224
Colorado Springs Muni	CO	724660	COS	38.82	-104.72	10432	9991	10457
Cortez (Montezuma) CO	CO	724767	CEZ	37.30	-108.63	8583	8637	8951
Craig-Moffat (AMOS)	CO	725700	CAG	40.50	-107.53	9563	10077	10907
Denver Intl AP	CO	725650	DEN	39.83	-104.65	11640	11540	11692
Eagle Co. Regional	CO	724675	EGE	39.65	-106.92	8515	17687	24760
Fort Collins (AWOS)	CO	724769	FNL	40.45	-105.02	8587	21291	25271
Grand Junction Walker	CO	724760	GJT	39.13	-108.53	10932	10619	10643
Gunnison Co. (AWOS)	CO	724677	GUC	38.53	-106.93	8568	20328	24379
Hayden/Yampa (AWOS)	CO	725715	HDN	40.48	-107.22	7971	17520	25468
Leadville/Lake Co.	CO	724673	LXV	39.22	-106.32	8639	8790	9417
Meeker	CO	724674	EEO	40.05	-107.90	8603	8715	8888
Montrose Co. Arpt.	CO	724675	MTJ	38.50	-107.90	8466	8658	8731
Pueblo Memorial AP	CO	724640	PUB	38.28	-104.50	11572	10971	11102
Rifle/Garfield Rgnl	CO	725717	RIL	39.53	-107.72	8606	8694	9091
Telluride Regional	UT	724627	TEX	37.95	-107.90	6967	19351	11505
Hill AFB/Ogden	UT	725755	HIF	41.12	-111.97	9964	8388	9056
Moab/Canyonlands	UT	724776	CNY	38.75	-109.75	8454	8670	8715
Price/Carbon (RAMOS)	UT	724700	PUC	39.62	-110.75	8347	8426	8596
Provo Muni (AWOS)	UT	725724	PVU	40.22	-111.72	8643	21279	25651
Salt Lake City Intl	UT	725720	SLC	40.78	-111.97	11483	10797	10171
Vernal	UT	725705	VEL	40.43	-109.52	8546	8606	9091
Bryce	UT	724756	BCE	37.70	-112.15	8435	8687	9433
Evanston/Burns Fld	WY	725775	EVW	41.28	-111.03	17148	8721	9745
Laramie General Brees	WY	725645	LAR	41.32	-105.68	9319	9267	9502
Rock Springs Apt	WY	725744	RKS	41.60	-109.07	12159	9153	9646

Table 3-3. Surface Precipitation Stations

Station Name	State	Station ID	Lat	Long	Number Valid of Data Hours		
					2001	2002	2003
Alamosa San Luis AP	CO	50130	37.26	-105.52	8759	*	8632
Allenspark 2NNW	CO	50183	40.13	-105.32	7210	8110	6598
Antero Reservoir	CO	50263	39.00	-105.54	7979	7767	*
Aspen 1SW	CO	50372	39.11	-106.50	6361	*	8592
Cochetopa Creek	CO	51713	38.27	-106.46	7732	7932	8708
Crested Butte	CO	51959	38.53	-106.59	8738	7046	8684
Denver/Stapleton Intl	CO	52220	39.46	-104.52	*	6845	6811

Table 3-3. Surface Precipitation Stations

Station Name	State	Station ID	Lat	Long	Number Valid of Data Hours		
					2001	2002	2003
Dinosaur	CO	52286	40.15	-108.58	7256	7234	*
Drake	CO	52354	40.26	-105.20	*	7292	7085
Grand Junction, Co	CO	53488	38.97	-108.32	8759	8759	8727
Grand Lake 6 SSW	CO	53500	40.11	-105.52	7349	8357	8630
Gunnison 3 SW	CO	53662	38.32	-106.58	7966	8207	8738
Lawson	CO	54877	39.46	-105.37	8352	8750	7824
Meeker 3 W	CO	55484	40.01	-107.58	7932	7622	8714
Mesa Verde	CO	55531	37.12	-108.29	8699	8246	6965
Northgate	CO	55982	40.56	-106.20	7046	*	7138
Ouray	CO	56203	38.01	-107.40	7591	7678	8437
Pleasant View 2 W	CO	56591	37.36	-108.48	6782	*	7260
Rifle	CO	57031	39.32	-107.48	8245	8277	7203
Rustic 9 WSW	CO	57296	40.42	-105.43	*	*	8422
Saguache	CO	57337	38.05	-106.08	8516	7733	8084
Telluride 4 WNW	CO	58204	37.57	-107.52	7891	7317	8059
Williams Fork Dam	CO	59096	40.02	-106.12	8756	7820	8720
Angle	UT	420168	38.15	-111.58	6007	7365	7872
Arches	UT	420336	38.37	-109.37	7862	*	7308
Blanding	UT	420738	37.37	-109.29	7468	8659	8645
Bryce Canyon N P HQ	UT	421008	37.38	-112.10	7740	7203	*
Cedar Point	UT	421308	37.43	-109.05	8074	6741	*
Coalville 13 E	UT	421590	40.56	-111.09	7322	7763	8609
Cottonwood Weir	UT	421759	40.37	-111.47	*	*	*
Echo Dam	UT	422385	40.58	-111.26	7792	8721	7579
Ephraim Sorensens FD	UT	422578	39.22	-111.35	8732	8759	7946
Fairview 8 N	UT	422702	39.45	-111.25	7815	8743	*
Flaming Gorge	UT	422864	40.56	-109.25	*	*	*
Green River Aviation	UT	423418	38.59	-110.09	8017	*	7794
Hanksville	UT	423611	38.22	-110.43	7883	7901	*
Moon Lake	UT	425815	40.34	-110.30	8616	7967	8515
Mountain Dell Dam	UT	425892	40.45	-111.43	7310	7002	6414
Neola 8 N	UT	426127	40.32	-110.04	7520	7363	8291
Nephi	UT	426135	39.42	-111.50	*	6534	7773
Oakley 3NE	UT	426374	40.44	-111.14	6343	8735	7817
Olmstead P H	UT	426455	40.19	-111.39	*	*	8693
Perry	UT	426757	41.27	-112.02	*	*	7215
Price	UT	427026	39.36	-110.49	8035	8055	7842
Provo BYU	UT	427064	40.15	-111.39	*	6524	7072
Richfield Radio KSVC	UT	427260	38.46	-112.05	7293	7843	7776
Roosevelt Radio	UT	427395	40.17	-109.58	7012	*	7992

Table 3-3. Surface Precipitation Stations

Station Name	State	Station ID	Lat	Long	Number Valid of Data Hours		
					2001	2002	2003
Salt Lake City/Intl UT	UT	427598	40.47	-111.58	8759	*	8756
Santaquin 1 NE	UT	427690	39.59	-111.47	6131	*	6140
Scofield Skyline Mine	UT	427729	39.41	-111.12	8734	8372	8693
Soldier Summit	UT	427959	39.56	-111.05	*	*	6441
Strawberry Hwy Station	UT	428371	40.15	-111.09	*	*	8659
Upper American Fork	UT	428939	40.26	-111.44	8734	8556	7909
Evanston 1 E	WY	483100	41.16	-110.57	7816	7904	6543
Laramie 2 WSW	WY	485420	41.18	-105.38	7210	7824	7162
Mountains View	WY	486555	41.17	-110.19	*	7650	6400
Mud Springs	WY	486597	41.19	-108.55	7790	7116	*
Rock Springs AP	WY	487845	41.36	-109.04	*	8249	*
Saratoga 4N	WY	487955	41.30	-106.47	8181	7919	6661

*Station data omitted due to data completeness/validation issues

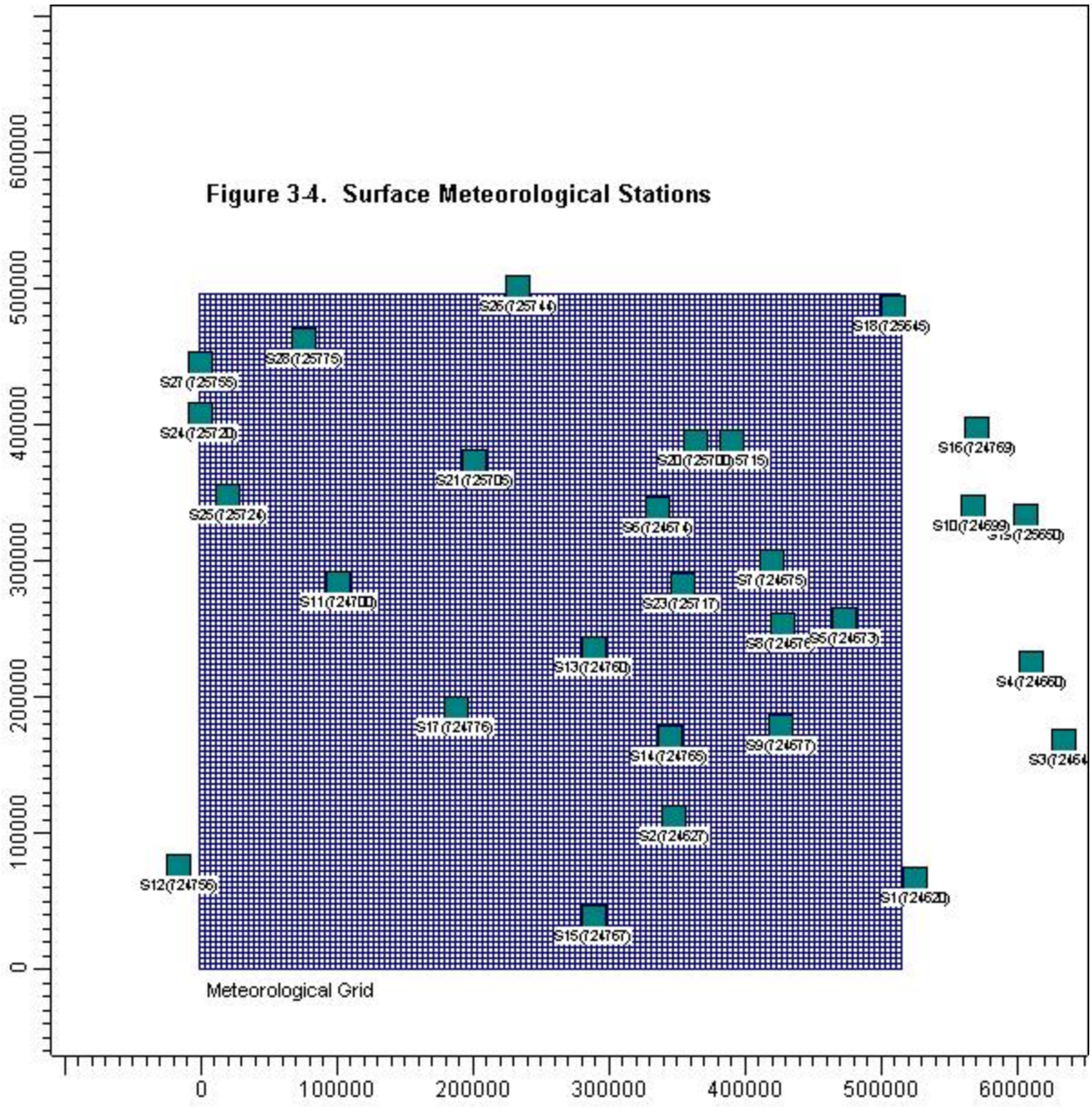


Figure 3-4. Surface Meteorological Stations
S26(125744)
S18(125645)
S28(125775)
S27(125755)
S24(125720)
S16(124769)
S21(125705)
S25(125724)
S10(124699)
S6(124674)
S7(124675)
S11(124700)
S23(125717)
S8(124676)
S5(124673)
S13(124760)
S4(124660)
S17(124776)
S14(124765)
S9(124677)
S2(124627)
S12(124756)
S1(124620)
S15(124767)
Meteorological Grid
0
100000
200000
300000
400000
500000
600000

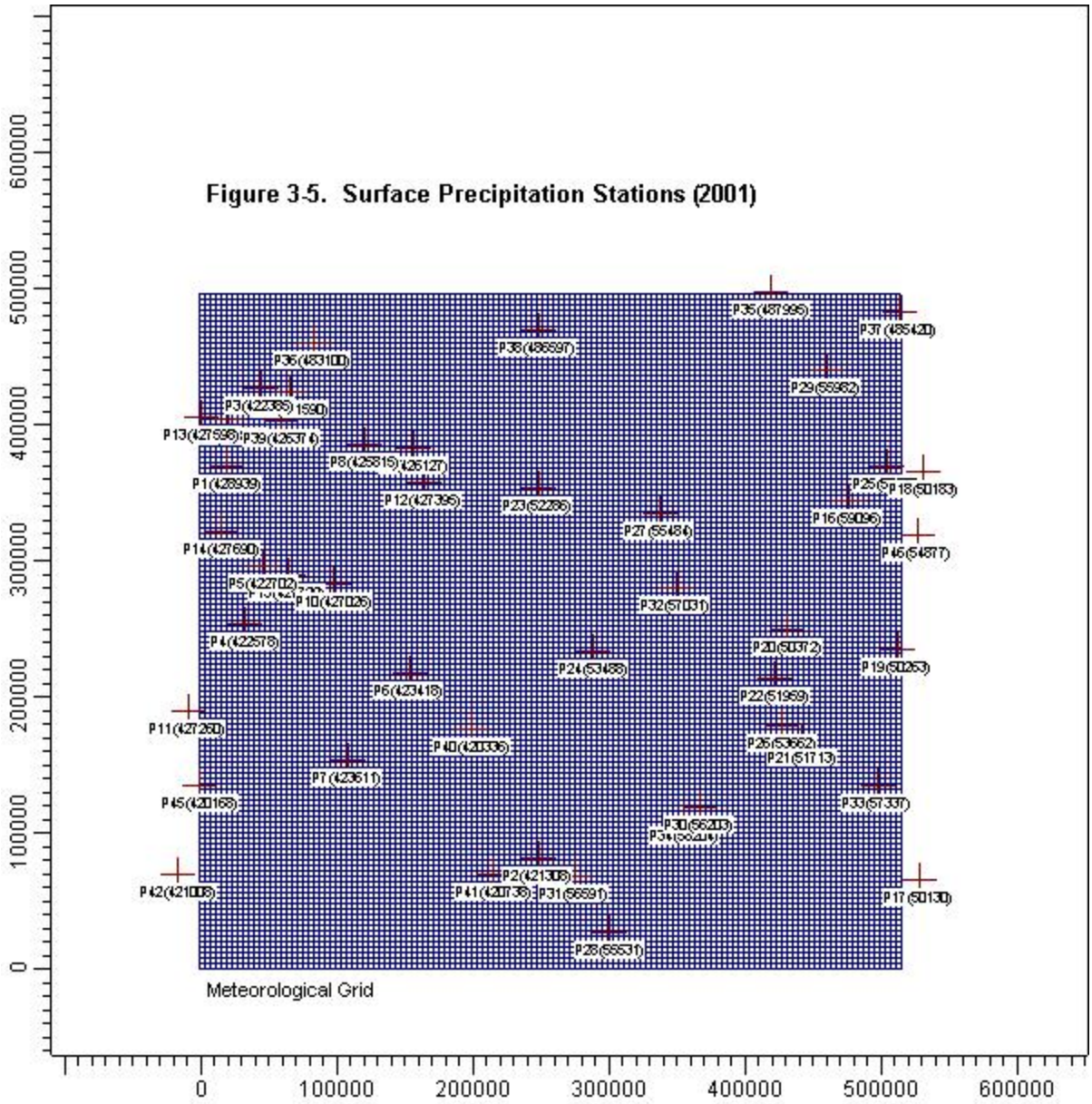


Figure 3-5. Surface Precipitation Stations (2001)
Meteorological Grid
0
100000
200000
300000
400000
500000
600000

Figure 3-6. Wind Field for February 1, 2001, Hour 17, Level 1

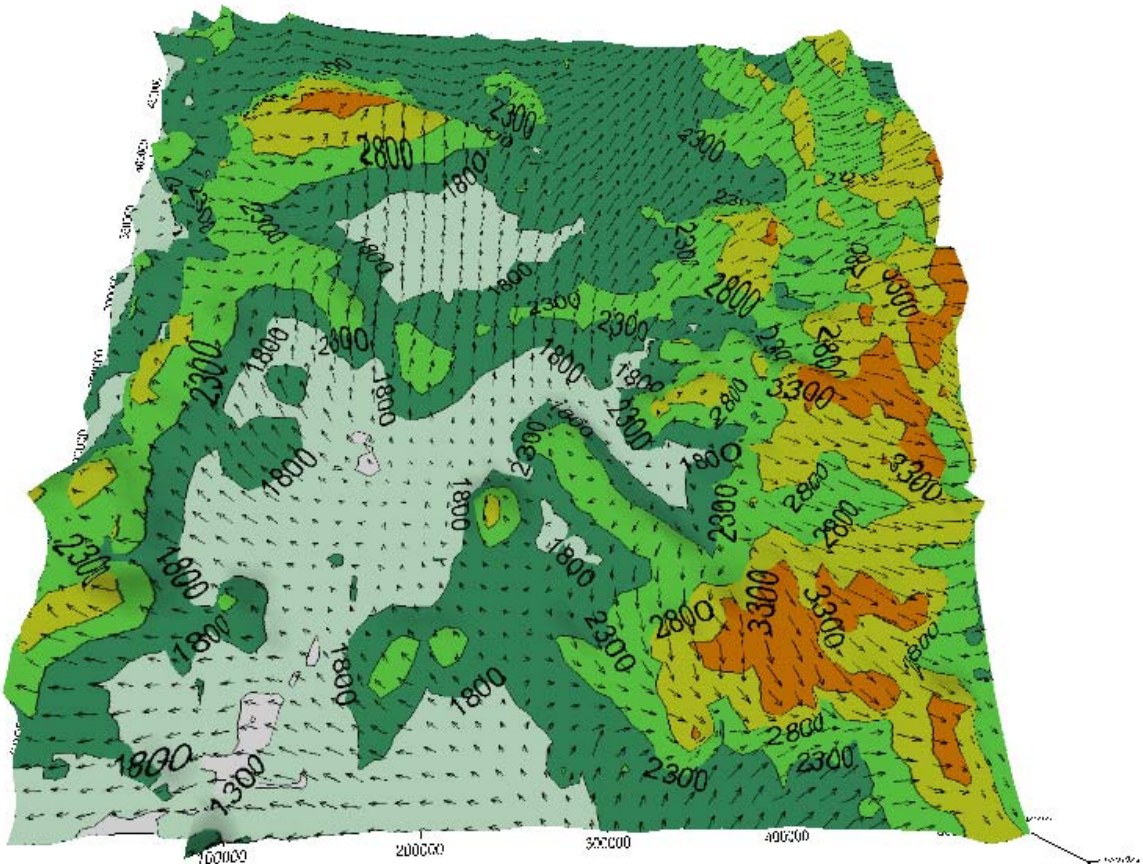
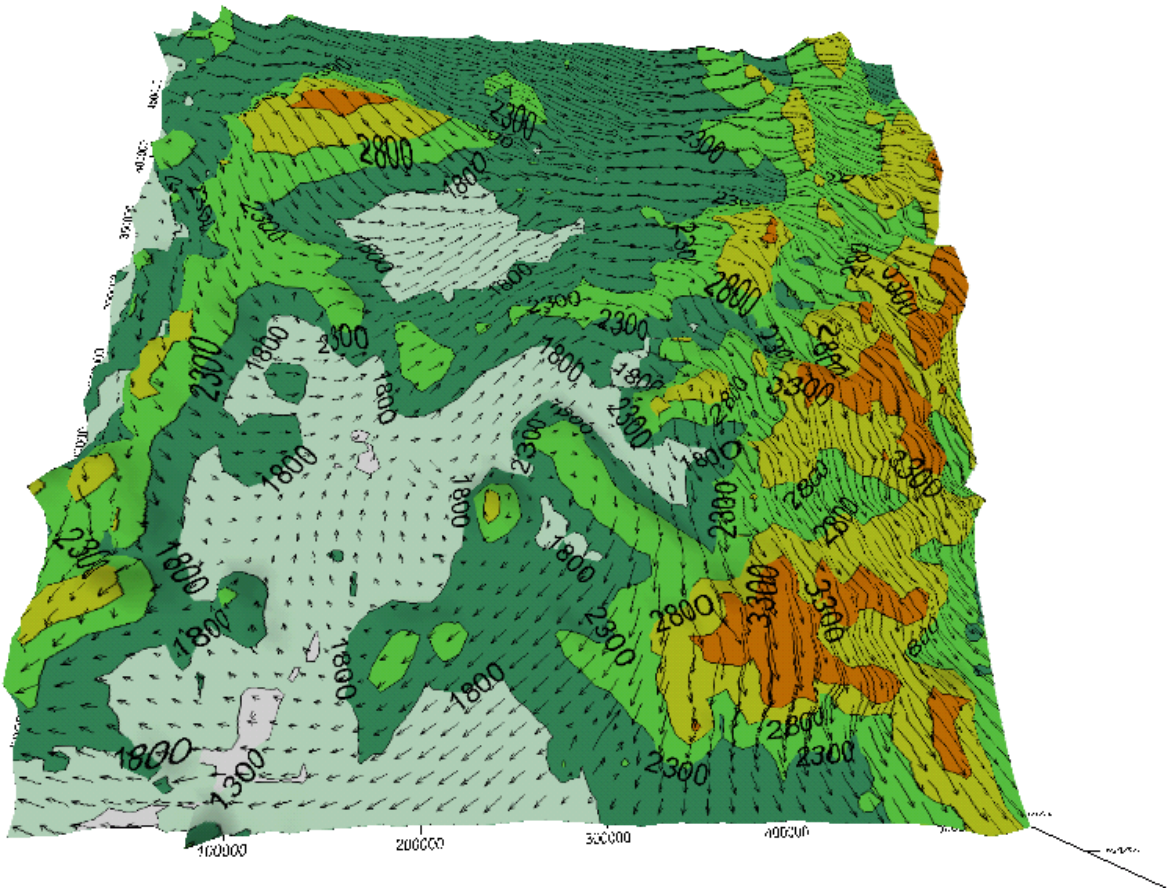


Figure 3-7. Wind Field for February 1, 2001, Hour 17, Level 8



4.0 CALPUFF DISPERSION MODELING

The CALPUFF model utilizes the CALMET meteorological output in addition to emission source data and an extensive set of control parameters to calculate ambient concentrations of pollutants at each model receptor. An example CALPUFF input file (for WTP Proposed Action Sources, January 2001) is presented in Appendix J-2. The CALPUFF input parameters utilized for the WTP analysis follow the IWAQM guidelines.

4.1 MODEL RECEPTORS

One of the primary inputs to the CALPUFF model is the receptor locations. For the WTP analysis, the standard set of receptors for each Class I and sensitive Class II area were applied. Individual receptors were utilized in the model to represent seven high elevation lakes identified for acid deposition analysis. The areas of special concern were as follows:

Table 4-1. Class I and Sensitive Class II Areas

Sensitive Area	Federal Land Manager	PSD Designation
Arches NP	NPS	I
Black Canyon of the Gunnison WA	FS	I
Canyonlands NP	NPS	I
Capitol Reef NP	NPS	I
Flat Tops WA	FS	I
La Garita WA	FS	I
Maroon Bells-Snowmass WA	FS	I
Weminuche WA	FS	I
West Elk WA	FS	I
Brown Park NWR	FWS	II
Colorado NM	NPS	II
Dinosaur NM	NPS	II
Flaming Gorge NRA	NPS	II
High Uintas WA	FS	II
Ouray NWR	FWS	II
Ragged WA	FS	II

NPS – National Park Service
FS – US Forest Service
FWS – US Fish and Wildlife Service

The high elevation lakes identified for analysis were as follows:

Table 4-2. Sensitive Lakes

Location	Sensitive Lake
Flat Tops WA	Ned Wilson
Flat Tops WA	Upper Ned Wilson
High Uintah WA	Dean
High Uintah WA	Pine Island
Maroon Bells WA	Moon
Raggeds WA	Deep Creek #1
West Elk WA	S. Golden

The receptor grids for the areas of special concern are presented in **Figure 4-1**.

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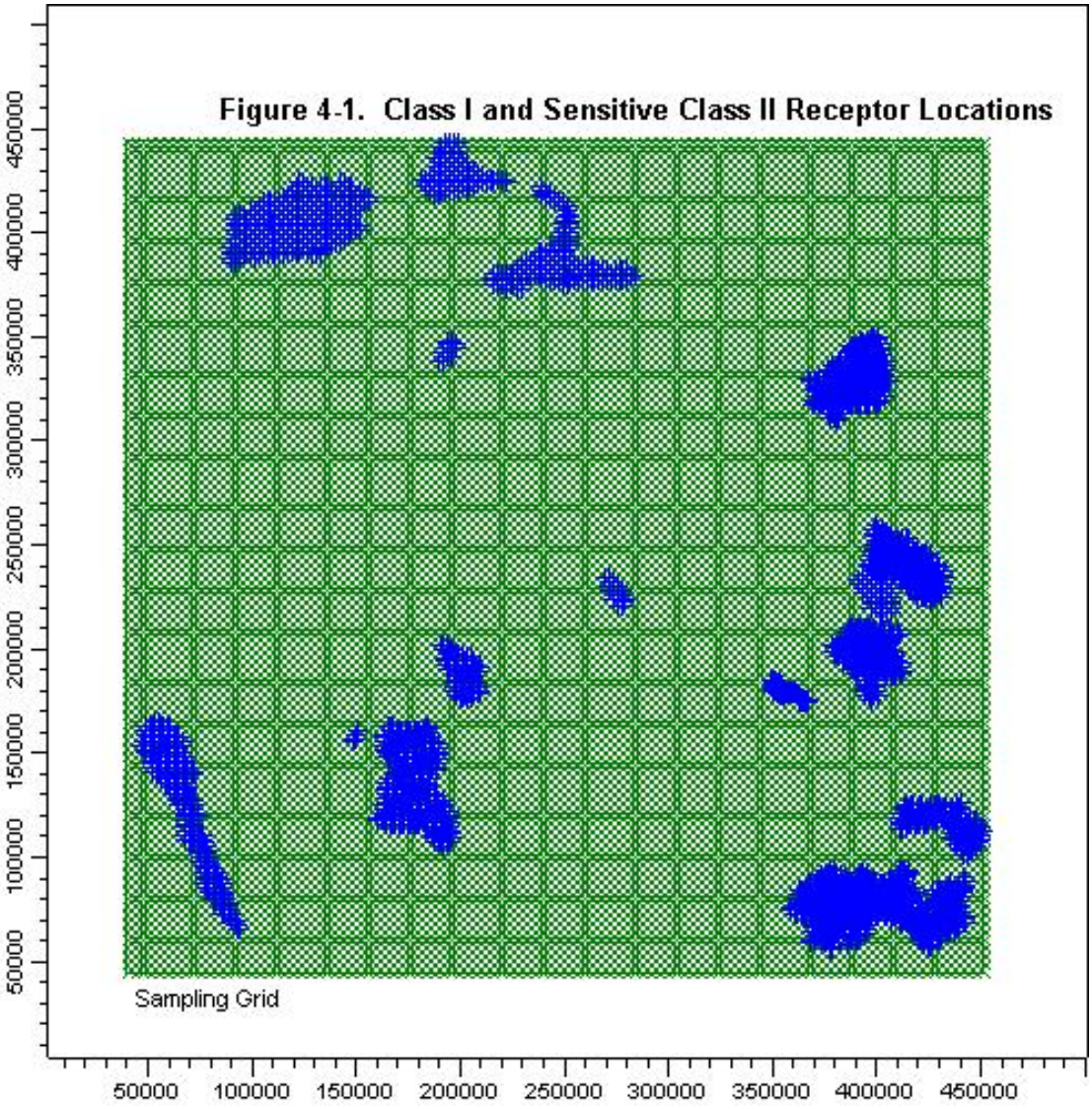
Figure 4-1. Class I and Sensitive Class II Receptor Locations
Sampling Grid
50000
100000
150000
200000
250000
300000
350000
400000
450000

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4.2 OTHER CALPUFF CONSIDERATIONS

In addition to the meteorological data and receptor grids previously described, CALPUFF requires an ozone data file for use with the chemical transformation module. The ozone data utilized for this analysis made use of hourly data collected at Canyonlands National Park, Mesa Verde National Park, and Gothic Clean Air Status and Trends Network (CASTNet) ozone monitors as well as data collected at the Logan State and Local Air Monitoring Station (SLAMS) will be used in the analysis. A default background ozone concentration of 80 ppb was used when hourly ozone data were missing.

A background ammonia concentration is also required for the chemical transformation calculations. The default ammonia concentration for arid lands of 1 ppb was used as recommended in by EPA (1998) for the CALPUFF model.

Eight pollutant species were modeled in the analysis, with five species being emitted from sources and three species being computed internally by the model. The emitted and computed species were as follows:

- SO_2 (emitted)
- SO_4 (computed)
- NO_x (emitted)
- HNO_3 (computed)
- NO_3 (computed)
- PMC (emitted)
- $PM_{2.5}$ (emitted)

In order to bracket impacts, the CALPUFF model was applied individually for four emission source groups. The four sets of CALPUFF runs were as follows:

- WTP Alternative A (Proposed Action)
- WTP Alternative B (No Action)
- WTP Alternative E (BLM Preferred Alternative)
- Cumulative Sources (Oil & Gas Wells, Permitted, RFD, RFFA)

The output files from each of the above listed model runs were subsequently post-processed to obtain the necessary results. Additionally, cumulative impacts were summed with each of the three project alternatives to derive total impacts under each scenario.

5.0 PROCESSING OF CALPUFF MODEL RESULTS

5.1 APPEND, CALSUM AND POSTUTIL PROGRAMS

In order to obtain data useful for comparing to standards and levels of acceptable change (LACs), the CALPUFF model output files must be processed with the CALPOST model and associated utilities. Two utility programs were applied in order to prepare the CALPUFF results for use in CALPOST; APPEND and POSTUTIL.

The APPEND utility was applied to combine the individual monthly data periods into a single annual run. For each source group, the append utility was applied individually for pollutant concentration, dry deposition flux, and wet deposition flux data.

The POSTUTIL utility was applied for three functions: 1) to sum the wet and dry deposition fluxes and in turn calculate the total nitrogen (N) and total sulfur (S) deposition rates, and 2) to repartition nitric acid (HNO_3) and nitrate (NO_3) concentration to determine the potential ammonia (NH_3) limiting effects on the development of nitrate; and 3) to sum results obtained from different CALPUFF runs for different source groups. POSTUTIL computes the total sulfate concentrations from all sources and estimates available ammonia for nitrate formation after the preferential scavenging of ammonia by sulfate. This allows non-linearity associated with ammonia limiting effects to be included in the predicted impacts. An assumed background ammonia concentration of 1 ppb was utilized for the repartition calculations.

5.2 CALPOST PROCESSING

Following the preparation of the CALPUFF files with the APPEND, CALSUM and POSTUTIL utilities, the CALPOST program was applied to determine the predicted pollutant concentrations, deposition fluxes and visibility impacts for each area of special concern.

5.2.1 Visibility Calculations

The visibility assessment methodology utilized for this analysis utilized the BLM suggested method for performing visibility impact assessments (S. Archer, personal communication, July 19th, 2006). This method involved a first level screening analysis for visibility following the recommendations in the FLAG (2000) Guideline document. Specifically, this analysis compared daily modeled primary (PMC and $PM_{2.5}$) and secondary (sulfate and nitrate) particulate matter concentrations to seasonal "natural" background conditions and monthly relative humidity (f[RH]) values. Using CALPOST, this analysis is referred to as FLAG Method 6. From this comparison, a potential change in deciview was calculated. FLAG identified a 0.5 dv (5 percent change in extinction) threshold as the "Limit of Acceptable Change" (LAC) for a single source impact, and a 1.0 deciview (10 percent change in extinction) threshold for the cumulative impacts of several sources.

Visibility impacts were evaluated at both mandatory Federal Class I areas and at specific Class II areas of concern as listed in **Table 4-1.** The Class II areas included in this analysis were included at the request of some of the members of the stakeholder group (National Park Service, US Forest Service, etc.). These Class II areas have no visibility protection under local, State, or Federal laws. These areas are included in the analysis strictly to meet the disclosure requirements under NEPA and to provide decision-makers with sufficient information.

Modeled concentrations were first compared to "natural" background conditions as recommended in the FLAG (2000) Guideline document. Since the analysis was conducted for multiple emission sources simultaneously, the FLAG 10-percent change in extinction (1.0 deciview) "just noticeable change" threshold was used to assess the significance of potential impacts.

If the seasonal screening analysis indicated that predicted changes in visibility exceeded the 1.0 deciview LAC on more than one day per year, a daily refined analysis was conducted based on hourly IMPROVE optical monitoring data measured at Canyonlands National Park for 1987 through 2004 (S. Archer, personal communication, July 19th, 2006).

5.2.2 Calculating Changes in Lake Acid Neutralizing Capacity

The deposition of sulfate and nitrate species from air pollution sources may cause changes in water body chemistry and can impact the acid neutralizing capacity (ANC) of high elevation lakes. Potential ANC impacts were calculated manually by applying the screening methodology prescribed by the US Forest Service (USDA-FS, January 2000a). Total annual nitrogen (N) and sulfur (S) deposition fluxes as averaged by CALPOST were input to the following equations to calculate the potential change in ANC.

% Alkalinity Change = [Hdep/ANC(o)] X 100 where:

ANC(o) = baseline ANC for lake catchment in eq, or
ANC(o) = W * P * (1-Et) *A *(10,000m^2/ha) * 10^6 eq/μeq * 10^3 liters/m^3
W = watershed area in ha
P = average annual precipitation in meters
Et = fraction of precipitation lost to evaporation and transpiration (0.33 assumed)
A = Baseline Alkalinity (μeq/l)
Hdep = acid deposition in eq = [H(s) + H(n)] * W * 10,000 m^2/ha
Hs = sulfur dep in eq/m^2/yr = Ds * ha/10,000 m^2 * 1,000 g/kg * eq/16 g S
Hn = nitrogen dep in eq/m^2/yr = Ds * ha/10,000 m^2 * 1,000 g/kg * eq/14 g N
Ds = sulfur deposition in kg/ha/yr for all sulfur species
Dn = nitrogen deposition in kg/ha/yr from all nitrogen species

As indicated in the above equations, baseline alkalinity levels for the high elevation lakes of concern are required for the ANC impact calculations. Baseline ANC data were obtained from USFS (J. Sorkin, personal communication, January 11, 2006). The basis for the background ANC data is the 10th percentile of measurements observed at the lake outlet. **Table 5-1** summarizes the baseline ANC data for the lakes of interest.

Table 5-1. Baseline ANC Levels for Lakes of Special Concern

Location	Sensitive Lake	Background ANC (μeq/l)
Flat Tops WA	Ned Wilson	38.0
Flat Tops WA	Upper Ned Wilson	12.6
High Uintah WA	Dean	57.3
High Uintah WA	Pine Island	95.6
Maroon Bells WA	Moon	51.5
Raggeds WA	Deep Creek #1	44.3
West Elk WA	S. Golden	111.0

5.2.3 Terrestrial Deposition Calculations

Terrestrial deposition impacts were predicted for dry and wet nitrogen (N) and sulfur (S) chemical species using the CALPUFF multiple-resistance routine for predicting dry deposition and the empirical scavenging coefficient approach for predicting wet deposition. Dry and wet deposition fluxes of gaseous and particulate N and S species were processed through POSTUTIL and CALPOST to obtain total (wet + dry) N and S deposition reported as the rate of material deposited on an area (micrograms per cubic meter per second or $\mu g\ m^{-3}\ sec^{-1}$). These values were compared to the USDA-Forest Service (Fox *et al* 1989) threshold values of 3 kilograms per hectare per year (kg/ha/yr) for total sulfur and 5 kg/ha/yr for total nitrogen.

5.2.4 Ambient Air Quality Standard and PSD Increment Comparison

Predicted maximum pollutant concentrations that could occur as a result of the implementation of each Alternative and Cumulative sources are compared with the National ambient air quality standards and PSD Class I and Class II increments.

6.0 ANALYSIS RESULTS

Results of the Far-Field analysis are summarized in the following tables. Impacts for each of the following emission source groups are presented.

1) WTP Alternative A (Proposed Action)
2) WTP Alternative B (No Action)
3) WTP Alternative E (BLM Preferred Alternative)
4) Cumulative Sources (Oil & Gas Wells, Permitted, RFD, RFFA)
5) Cumulative + WTP Alternative A (Proposed Action)
6) Cumulative + WTP Alternative B (No Action)
7) Cumulative + WTP Alternative E (BLM Preferred Alternative)

The emissions inventories for the cumulative analysis are presented in Appendix J-2. For the above listed emission source groups, impacts to air quality and air quality related values were predicted for each of 16 areas of special concern and seven high elevation lakes. Since there were no predictions of more than one day with visibility decreases at Class I areas under the Proposed Action or alternatives, refined visibility analysis was not conducted for the Proposed Action and alternatives. Detailed discussions concerning the predicted impacts are presented in the West Tavaputs Plateau Oil & Gas Development Draft EIS (BLM 2007).

Table 6-1. WTP Alternative A (Proposed Action) Screening Visibility Impacts

Area of Special Concern	2001			2002			2003		
	Days Δ dV >0.5	Days Δ dV >1.0	Max Δ dV	Days Δ dV >0.5	Days Δ dV >1.0	Max Δ dV	Days Δ dV >0.5	Days Δ dV >1.0	Max Δ dV
Arches NP (I)	2	0	0.78	3	0	0.84	6	0	0.93
Black Canyon of the Gunnison WA (I)	0	0	0.15	0	0	0.29	0	0	0.12
Canyonlands NP (I)	5	1	1.41	4	0	0.72	3	0	0.91
Capitol Reef NP (I)	1	0	0.60	0	0	0.42	0	0	0.43
Flat Tops WA (I)	0	0	0.49	0	0	0.21	0	0	0.30
La Garita WA (I)	0	0	0.05	0	0	0.10	0	0	.05
Maroon Bells-Snowmass WA (I)	0	0	0.25	0	0	0.17	0	0	0.21
Weminuche WA (I)	0	0	0.05	0	0	0.08	0	0	0.06
West Elk WA (I)	0	0	0.15	0	0	0.23	0	0	0.17
Dinosaur NM (II)	79	28	2.72	56	11	1.46	60	13	1.54
Brown Park NWR (II)	7	0	0.82	6	0	0.65	4	0	0.67
Colorado NM (II)	1	0	0.51	2	0	0.54	1	0	0.53
Flaming Gorge NRA (II)	4	0	00.79	6	0	0.84	1	0	0.72
Ouray NWR (II)	181	121	6.51	152	95	5.76	130	82	5.53
Ragged WA (II)	0	0	0.18	0	0	0.19	0	0	0.21
High Uintas WA (II)	0	0	0.35	11	4	1.56	3	0	0.82

Table 6-2. WTP Alternative B (No Action) Screening Visibility Impacts

Area of Special Concern	2001			2002			2003		
	Days Δ dV >0.5	Days Δ dV >1.0	Max Δ dV	Days Δ dV >0.5	Days Δ dV >1.0	Max Δ dV	Days Δ dV >0.5	Days Δ dV >1.0	Max Δ dV
Arches NP (I)	0	0	0.20	0	0	0.29	0	0	0.32
Black Canyon of the Gunnison WA (I)	0	0	0.05	0	0	0.11	0	0	0.04
Canyonlands NP (I)	0	0	0.28	0	0	0.26	0	0	0.31
Capitol Reef NP (I)	0	0	0.21	0	0	0.15	0	0	0.16
Flat Tops WA (I)	0	0	0.11	0	0	0.08	0	0	0.10
La Garita WA (I)	0	0	0.02	0	0	0.03	0	0	0.02
Maroon Bells-Snowmass WA (I)	0	0	0.05	0	0	0.06	0	0	0.07
Weminuche WA (I)	0	0	0.02	0	0	0.03	0	0	0.02
West Elk WA (I)	0	0	0.03	0	0	0.08	0	0	0.06
Dinosaur NM (II)	1	0	0.54	1	0	0.52	1	0	0.51
Brown Park NWR (II)	0	0	0.23	0	0	0.24	0	0	0.23
Colorado NM (II)	0	0	0.12	0	0	0.20	0	0	0.19
Flaming Gorge NRA (II)	0	0	0.26	0	0	0.31	0	0	0.26
Ouray NWR (II)	65	14	1.64	48	8	1.91	46	7	1.88
Ragged WA (II)	0	0	0.03	0	0	0.06	0	0	0.07
High Uintas WA (II)	0	0	0.09	1	0	0.55	0	0	0.28

Table 6-3. WTP Alternative E (BLM Preferred) Screening Visibility Impacts

Area of Special Concern	2001			2002			2003		
	Days Δ dV >0.5	Days Δ dV >1.0	Max Δ dV	Days Δ dV >0.5	Days Δ dV >1.0	Max Δ dV	Days Δ dV >0.5	Days Δ dV >1.0	Max Δ dV
Arches NP (I)	0	0	0.49	1	0	0.69	3	0	0.77
Black Canyon of the Gunnison WA (I)	0	0	0.11	0	0	0.24	0	0	0.10
Canyonlands NP (I)	4	0	0.67	2	0	0.61	3	0	0.59
Capitol Reef NP (I)	1	0	0.50	0	0	0.35	0	0	0.36
Flat Tops WA (I)	0	0	0.26	0	0	0.18	0	0	0.25
La Garita WA (I)	0	0	0.04	0	0	0.08	0	0	0.04
Maroon Bells-Snowmass WA (I)	0	0	0.12	0	0	0.14	0	0	0.17
Weminuche WA (I)	0	0	0.04	0	0	0.07	0	0	0.05
West Elk WA (I)	0	0	0.07	0	0	0.19	0	0	0.14
Dinosaur NM (II)	53	7	1.28	41	3	1.22	39	4	1.24
Brown Park NWR (II)	1	0	0.55	2	0	0.55	1	0	0.55
Colorado NM (II)	0	0	0.28	0	0	0.45	0	0	0.44
Flaming Gorge NRA (II)	1	0	0.64	3	0	0.71	1	0	0.61
Ouray NWR (II)	156	87	3.86	132	65	4.59	111	57	4.36
Ragged WA (II)	0	0	0.08	0	0	0.15	0	0	0.17
High Uintas WA (II)	0	0	0.22	8	3	1.28	2	0	0.69

Table 6-4. WTP Cumulative Screening Visibility Impacts

Area of Special Concern	2001			2002			2003		
	Days Δ dV >0.5	Days Δ dV >1.0	Max Δ dV	Days Δ dV >0.5	Days Δ dV >1.0	Max Δ dV	Days Δ dV >0.5	Days Δ dV >1.0	Max Δ dV
Arches NP (I)	16	5	2.05	23	6	1.52	21	7	2.05
Black Canyon of the Gunnison WA (I)	4	1	1.02	10	4	1.36	3	1	1.18
Canyonlands NP (I)	20	5	1.80	15	3	1.99	17	2	1.71
Capitol Reef NP (I)	9	2	2.21	8	2	1.38	6	0	0.86
Flat Tops WA (I)	19	4	1.42	27	7	1.51	20	7	1.87
La Garita WA (I)	0	0	0.26	2	0	0.59	0	0	0.43
Maroon Bells-Snowmass WA (I)	11	1	1.30	30	3	1.61	17	2	1.50
Weminuche WA (I)	0	0	0.46	0	0	0.49	0	0	0.45
West Elk WA (I)	4	0	0.62	10	1	1.03	7	0	0.85
Dinosaur NM (II)	215	143	7.11	189	138	11.79	182	116	9.02
Brown Park NWR (II)	83	36	2.76	92	45	4.21	62	31	3.18
Colorado NM (II)	22	9	1.86	44	12	2.28	38	10	2.20
Flaming Gorge NRA (II)	38	9	1.92	55	28	3.81	33	11	3.22
Ouray NWR (II)	359	349	15.81	363	362	19.11	361	354	21.06
Ragged WA (II)	17	2	1.45	27	7	1.82	23	3	1.21
High Uintas WA (II)	15	2	1.03	46	29	4.84	19	9	4.34

Table 6-5. WTP Alternative A + Cumulative Screening Visibility Impacts

Area of Special Concern	2001			2002			2003		
	Days Δ dV >0.5	Days Δ dV >1.0	Max Δ dV	Days Δ dV >0.5	Days Δ dV >1.0	Max Δ dV	Days Δ dV >0.5	Days Δ dV >1.0	Max Δ dV
Arches NP (I)	25	10	2.54	31	8	1.87	29	14	2.38
Black Canyon of the Gunnison WA (I)	7	1	1.06	16	4	1.52	5	1	1.29
Canyonlands NP (I)	26	14	2.46	24	11	2.54	26	9	2.26
Capitol Reef NP (I)	15	6	2.80	8	5	1.74	8	2	1.29
Flat Tops WA (I)	20	5	1.48	34	7	1.71	36	9	1.87
La Garita WA (I)	0	0	0.28	2	0	0.68	0	0	0.45
Maroon Bells-Snowmass WA (I)	18	1	1.34	33	5	1.73	23	3	1.71
Weminuche WA (I)	0	0	0.49	1	0	0.51	0	0	0.47
West Elk WA (I)	6	0	0.63	11	1	1.12	7	0	0.93
Dinosaur NM (II)	233	174	9.09	204	153	13.03	196	135	10.24
Brown Park NWR (II)	107	51	3.11	99	60	4.83	74	39	3.51
Colorado NM (II)	27	12	1.98	48	17	2.40	44	14	2.36
Flaming Gorge NRA (II)	59	16	2.71	68	34	4.08	45	16	3.70
Ouray NWR (II)	359	350	17.53	363	362	21.46	361	355	21.79
Ragged WA (II)	21	3	1.45	31	7	1.86	24	4	1.21
High Uintas WA (II)	24	6	1.32	51	34	6.07	27	13	4.63

Table 6-6. WTP Alternative B + Cumulative Screening Visibility Impacts

Area of Special Concern	2001			2002			2003		
	Days Δ dV >0.5	Days Δ dV >1.0	Max Δ dV	Days Δ dV >0.5	Days Δ dV >1.0	Max Δ dV	Days Δ dV >0.5	Days Δ dV >1.0	Max Δ dV
Arches NP (I)	17	7	2.23	23	7	1.65	23	9	2.17
Black Canyon of the Gunnison WA (I)	5	1	1.03	10	4	1.42	3	1	1.22
Canyonlands NP (I)	20	6	1.93	21	8	2.18	18	4	1.89
Capitol Reef NP (I)	12	2	2.41	8	2	1.49	8	1	1.01
Flat Tops WA (I)	19	4	1.43	29	7	1.58	35	8	1.75
La Garita WA (I)	0	0	0.27	2	0	0.62	0	0	0.43
Maroon Bells-Snowmass WA (I)	38	6	1.75	30	4	1.65	18	3	1.57
Weminuche WA (I)	0	0	0.47	0	0	0.49	0	0	0.46
West Elk WA (I)	4	0	0.62	11	1	1.06	7	0	0.88
Dinosaur NM (II)	233	157	7.46	193	145	12.22	186	124	9.46
Brown Park NWR (II)	89	41	2.88	95	50	4.44	64	35	3.30
Colorado NM (II)	22	9	1.90	46	13	2.33	40	10	2.25
Flaming Gorge NRA (II)	46	11	2.18	60	33	3.90	36	12	3.40
Ouray NWR (II)	359	349	15.86	363	362	19.70	361	355	21.20
Ragged WA (II)	18	2	1.45	28	7	1.84	24	4	1.21
High Uintas WA (II)	18	2	1.07	47	30	5.27	22	9	4.44

Table 6-7. WTP Alternative E + Cumulative Screening Visibility Impacts

Area of Special Concern	2001			2002			2003		
	Days Δ dV >0.5	Days Δ dV >1.0	Max Δ dV	Days Δ dV >0.5	Days Δ dV >1.0	Max Δ dV	Days Δ dV >0.5	Days Δ dV >1.0	Max Δ dV
Arches NP (I)	19	7	2.46	30	7	1.82	28	12	2.33
Black Canyon of the Gunnison WA (I)	5	1	1.05	15	4	1.49	5	1	1.27
Canyonlands NP (I)	23	11	2.13	24	9	2.44	24	7	2.16
Capitol Reef NP (I)	13	3	2.71	8	4	1.68	8	1	1.22
Flat Tops WA (I)	20	5	1.47	32	7	1.68	36	8	1.85
La Garita WA (I)	0	0	0.27	2	0	0.67	0	0	0.45
Maroon Bells-Snowmass WA (I)	16	1	1.33	33	5	1.71	22	3	1.67
Weminuche WA (I)	0	0	0.48	1	0	0.51	0	0	0.47
West Elk WA (I)	5	0	0.63	11	1	1.11	7	0	0.93
Dinosaur NM (II)	229	169	7.96	202	152	12.81	192	131	10.05
Brown Park NWR (II)	101	46	3.05	98	59	4.73	70	38	3.46
Colorado NM (II)	27	10	1.96	47	17	2.93	43	12	2.33
Flaming Gorge NRA (II)	55	14	2.56	68	33	4.04	39	14	3.63
Ouray NWR (II)	359	350	16.89	363	362	20.82	361	355	21.43
Ragged WA (II)	19	3	1.45	30	7	1.86	24	4	1.21
High Uintas WA (II)	21	4	1.16	51	34	5.86	25	12	4.58

Table 6-8. WTP Cumulative Refined Visibility Impacts

Area of Special Concern	2001				2002				2003			
	Min Days Δ dV >0.5	Min Days Δ dV >1.0	Max Days Δ dV >0.5	Max Days Δ dV >1.0	Min Days Δ dV >0.5	Min Days Δ dV >1.0	Max Days Δ dV >0.5	Max Days Δ dV >1.0	Min Days Δ dV >0.5	Min Days Δ dV >1.0	Max Days Δ dV >0.5	Max Days Δ dV >1.0
Arches NP (I)	1	0	10	7	0	0	11	3	2	0	8	1
Black Canyon of the Gunnison WA (I)	-	-	-	-	0	0	5	2	-	-	-	-
Canyonlands NP (I)	1	0	4	1	0	0	8	3	1	0	8	2
Capitol Reef NP (I)	0	0	3	1	0	0	7	3	-	-	-	-
Flat Tops WA (I)	0	0	3	1	1	0	7	2	1	0	9	1
La Garita WA (I)	-	-	-	-	-	-	-	-	-	-	-	-
Maroon Bells-Snowmass WA (I)	-	-	-	-	1	0	9	2	2	0	8	1
Weminuche WA (I)	-	-	-	-	-	-	-	-	-	-	-	-
West Elk WA (I)	-	-	-	-	-	-	-	-	-	-	-	-
Dinosaur NM (II)	1	0	8	2	113	52	150	92	104	57	143	99
Brown Park NWR (II)	81	38	117	68	23	1	55	18	25	4	46	20
Colorado NM (II)	13	1	32	9	11	0	40	8	4	0	16	3
Flaming Gorge NRA (II)	3	0	14	3	3	0	24	2	14	0	28	14
Ouray NWR (II)	2	0	12	5	251	165	305	229	299	275	356	332
Ragged WA (II)	294	262	350	328	288	249	347	309	3	0	8	2
High Uintas WA (II)	0	0	6	1	0	0	6	0	14	5	26	15

Table 6-9. WTP Alternative A + Cumulative Refined Visibility Impacts

Area of Special Concern	2001				2002				2003			
	Min Days Δ dV >0.5	Min Days Δ dV >1.0	Max Days Δ dV >0.5	Max Days Δ dV >1.0	Min Days Δ dV >0.5	Min Days Δ dV >1.0	Max Days Δ dV >0.5	Max Days Δ dV >1.0	Min Days Δ dV >0.5	Min Days Δ dV >1.0	Max Days Δ dV >0.5	Max Days Δ dV >1.0
Arches NP (I)	3	0	17	4	4	0	12	2	4	0	18	3
Black Canyon of the Gunnison WA (I)	4	0	11	2	1	0	5	1	-	-	-	-
Canyonlands NP (I)	5	0	14	5	4	0	13	3	4	0	11	2
Capitol Reef NP (I)	3	0	12	5	0	0	5	1	0	0	3	1
Flat Tops WA (I)	2	0	11	2	2	0	10	3	2	0	14	4
La Garita WA (I)	-	-	-	-	-	-	-	-	-	-	-	-
Maroon Bells-Snowmass WA (I)	-	-	-	-	3	0	10	2	1	0	9	2
Weminuche WA (I)	-	-	-	-	-	-	-	-	-	-	-	-
West Elk WA (I)	-	-	-	-	-	-	-	-	-	-	-	-
Dinosaur NM (II)	140	72	180	109	124	70	155	108	106	48	144	83
Brown Park NWR (II)	36	9	69	30	31	7	59	27	17	2	40	15
Colorado NM (II)	24	1	55	19	7	0	22	5	5	0	17	4
Flaming Gorge NRA (II)	10	0	34	8	19	4	39	19	5	0	19	6
Ouray NWR (II)	259	205	316	259	299	277	356	336	295	273	351	329
Ragged WA (II)	288	261	347	315	4	0	10	2	1	0	6	1
High Uintas WA (II)	2	0	9	1	19	9	32	20	3	0	13	7

Table 6-10. WTP Alternative B + Cumulative Refined Visibility Impacts

Area of Special Concern	2001				2002				2003			
	Min Days Δ dV >0.5	Min Days Δ dV >1.0	Max Days Δ dV >0.5	Max Days Δ dV >1.0	Min Days Δ dV >0.5	Min Days Δ dV >1.0	Max Days Δ dV >0.5	Max Days Δ dV >1.0	Min Days Δ dV >0.5	Min Days Δ dV >1.0	Max Days Δ dV >0.5	Max Days Δ dV >1.0
Arches NP (I)	0	0	11	3	2	0	8	1	1	0	14	3
Black Canyon of the Gunnison WA (I)	-	-	-	-	1	0	5	1	-	-	-	-
Canyonlands NP (I)	1	0	11	3	1	0	10	2	1	0	6	1
Capitol Reef NP (I)	1	0	9	3	0	0	5	1	-	-	-	-
Flat Tops WA (I)	1	0	7	2	1	0	9	1	2	0	13	4
La Garita WA (I)	-	-	-	-	-	-	-	-	-	-	-	-
Maroon Bells-Snowmass WA (I)	2	0	9	2	2	0	9	2	1	0	8	2
Weminuche WA (I)	-	-	-	-	-	-	-	-	-	-	-	-
West Elk WA (I)	-	-	-	-	-	-	-	-	-	-	-	-
Dinosaur NM (II)	123	59	160	97	112	60	148	102	90	41	129	70
Brown Park NWR (II)	24	2	60	22	26	7	51	22	15	1	34	12
Colorado NM (II)	15	0	44	11	5	0	18	4	4	0	15	3
Flaming Gorge NRA (II)	5	0	26	4	17	1	31	17	4	0	14	6
Ouray NWR (II)	255	186	309	241	299	275	356	332	294	266	350	329
Ragged WA (II)	288	257	347	310	3	0	9	2	0	0	6	1
High Uintas WA (II)	0	0	7	0	15	6	29	18	2	0	11	7

Table 6-11. WTP Alternative E + Cumulative Refined Visibility Impacts

Area of Special Concern	2001				2002				2003			
	Min Days Δ dV >0.5	Min Days Δ dV >1.0	Max Days Δ dV >0.5	Max Days Δ dV >1.0	Min Days Δ dV >0.5	Min Days Δ dV >1.0	Max Days Δ dV >0.5	Max Days Δ dV >1.0	Min Days Δ dV >0.5	Min Days Δ dV >1.0	Max Days Δ dV >0.5	Max Days Δ dV >1.0
Arches NP (I)	0	0	11	3	2	0	8	1	1	0	14	3
Black Canyon of the Gunnison WA (I)	-	-	-	-	1	0	5	1	-	-	-	-
Canyonlands NP (I)	1	0	11	3	1	0	10	2	1	0	6	1
Capitol Reef NP (I)	1	0	9	3	0	0	5	1	-	-	-	-
Flat Tops WA (I)	1	0	7	2	1	0	9	1	2	0	13	4
La Garita WA (I)	-	-	-	-	-	-	-	-	-	-	-	-
Maroon Bells-Snowmass WA (I)	-	-	-	-	2	0	9	2	1	0	8	2
Weminuche WA (I)	-	-	-	-	-	-	-	-	-	-	-	-
West Elk WA (I)	-	-	-	-	-	-	-	-	-	-	-	-
Dinosaur NM (II)	123	59	160	97	112	60	148	102	90	41	129	70
Brown Park NWR (II)	24	2	60	22	26	7	51	22	15	1	34	12
Colorado NM (II)	15	0	44	11	5	0	18	4	4	0	15	3
Flaming Gorge NRA (II)	5	0	26	4	17	1	31	17	4	0	14	6
Ouray NWR (II)	255	186	309	241	299	275	356	332	294	266	350	329
Ragged WA (II)	288	257	347	310	3	0	9	2	0	0	6	1
High Uintas WA (II)	0	0	7	0	15	6	29	18	2	0	11	7

Table 6-12. WTP Alternative A (Proposed Action) Nitrogen and Sulfur Deposition						
Area of Special Concern	2001		2002		2003	
	N Dep (kg/ha/yr)	S Dep (kg/ha/yr)	N Dep (kg/ha/yr)	S Dep (kg/ha/yr)	N Dep (kg/ha/yr)	S Dep (kg/ha/yr)
Arches NP (I)	1.32E-03	1.54E-05	1.62E-03	2.05E-05	1.49E-03	1.84E-05
Black Canyon of the Gunnison WA (I)	6.71E-04	7.66E-06	5.50E-04	6.81E-06	6.70E-04	7.64E-06
Canyonlands NP (I)	9.73E-04	1.04E-05	7.61E-04	1.02E-05	1.01E-03	1.29E-05
Capitol Reef NP (I)	3.73E-04	3.82E-06	1.63E-04	2.58E-06	2.53E-04	3.47E-06
Flat Tops WA (I)	8.11E-04	1.02E-05	6.73E-04	9.62E-06	1.16E-03	1.34E-05
La Garita WA (I)	2.52E-04	2.98E-06	2.12E-04	3.00E-06	2.49E-04	3.22E-06
Maroon Bells-Snowmass WA (I)	5.65E-04	6.85E-06	4.36E-04	6.02E-06	6.54E-04	7.47E-06
Weminuche WA (I)	2.38E-04	2.97E-06	2.05E-04	2.95E-06	2.41E-04	2.95E-06
West Elk WA (I)	5.28E-04	6.29E-06	3.87E-04	5.30E-06	5.21E-04	6.15E-06
Dinosaur NM (II)	8.82E-03	1.01E-04	5.05E-03	6.31E-05	5.68E-03	6.62E-05
Brown Park NWR (II)	4.53E-03	5.48E-05	2.67E-03	3.37E-05	2.83E-03	3.50E-05
Colorado NM (II)	1.72E-03	1.96E-05	1.32E-03	1.80E-05	1.60E-03	2.04E-05
Flaming Gorge NRA (II)	3.12E-03	3.81E-05	2.18E-03	2.89E-05	2.21E-03	2.84E-05
Ouray NWR (II)	1.84E-02	1.93E-04	1.33E-02	1.56E-04	1.29E-02	1.43E-04
Ragged WA (II)	5.10E-04	6.29E-06	3.82E-04	5.42E-06	5.26E-04	6.28E-06
High Uintas WA (II)	1.69E-03	2.23E-05	1.58E-03	2.19E-05	1.80E-03	2.28E-05

Table 6-13. WTP Alternative B (No Action) Nitrogen and Sulfur Deposition						
Area of Special Concern	2001		2002		2003	
	N Dep (kg/ha/yr)	S Dep (kg/ha/yr)	N Dep (kg/ha/yr)	S Dep (kg/ha/yr)	N Dep (kg/ha/yr)	S Dep (kg/ha/yr)
Arches NP (I)	5.04E-04	5.51E-06	6.22E-04	7.34E-06	5.62E-04	6.60E-06
Black Canyon of the Gunnison WA (I)	2.54E-04	2.74E-06	2.11E-04	2.43E-06	2.56E-04	2.73E-06
Canyonlands NP (I)	3.71E-04	3.73E-06	2.91E-04	3.66E-06	3.82E-04	4.62E-06
Capitol Reef NP (I)	1.35E-04	1.37E-06	6.33E-05	9.25E-07	9.55E-05	1.24E-06
Flat Tops WA (I)	3.05E-04	3.66E-06	2.51E-04	3.44E-06	4.32E-04	4.80E-06
La Garita WA (I)	9.65E-05	1.07E-06	7.97E-05	1.07E-06	9.50E-05	1.16E-06
Maroon Bells-Snowmass WA (I)	2.13E-04	2.45E-06	1.66E-04	2.16E-06	2.47E-04	2.68E-06
Weminuche WA (I)	9.01E-05	1.06E-06	7.73E-05	1.06E-06	9.08E-05	1.06E-06
West Elk WA (I)	2.00E-04	2.25E-06	1.48E-04	1.89E-06	1.98E-04	2.20E-06
Dinosaur NM (II)	3.33E-03	3.62E-05	1.91E-03	2.26E-05	2.15E-03	2.37E-05
Brown Park NWR (II)	1.71E-03	1.96E-05	1.02E-03	1.20E-05	1.07E-03	1.25E-05
Colorado NM (II)	6.51E-04	7.03E-06	5.05E-04	6.43E-06	6.04E-04	7.31E-06
Flaming Gorge NRA (II)	1.17E-03	1.37E-05	8.20E-04	1.04E-05	8.45E-04	1.02E-05
Ouray NWR (II)	6.67E-03	6.91E-05	4.95E-03	5.60E-05	4.73E-03	5.10E-05
Ragged WA (II)	1.92E-04	2.25E-06	1.45E-04	1.94E-06	1.99E-04	2.24E-06
High Uintas WA (II)	6.16E-04	7.98E-06	5.71E-04	7.86E-06	6.40E-04	8.16E-06

Table 6-14. WTP Alternative E (BLM Preferred) Nitrogen and Sulfur Deposition						
Area of Special Concern	2001		2002		2003	
	N Dep (kg/ha/yr)	S Dep (kg/ha/yr)	N Dep (kg/ha/yr)	S Dep (kg/ha/yr)	N Dep (kg/ha/yr)	S Dep (kg/ha/yr)
Arches NP (I)	1.20E-03	1.18E-05	1.47E-03	1.56E-05	1.35E-03	1.41E-05
Black Canyon of the Gunnison WA (I)	6.11E-04	5.85E-06	5.00E-04	5.19E-06	6.09E-04	5.83E-06
Canyonlands NP (I)	8.85E-04	7.96E-06	6.92E-04	7.81E-06	9.17E-04	9.84E-06
Capitol Reef NP (I)	3.39E-04	2.92E-06	1.48E-04	1.97E-06	2.30E-04	2.64E-06
Flat Tops WA (I)	7.38E-04	7.80E-06	6.11E-04	7.34E-06	1.06E-03	1.02E-05
La Garita WA (I)	2.30E-04	2.28E-06	1.93E-04	2.29E-06	2.26E-04	2.47E-06
Maroon Bells-Snowmass WA (I)	5.14E-04	5.22E-06	3.96E-04	4.61E-06	5.95E-04	5.71E-06
Weminuche WA (I)	2.17E-04	2.26E-06	1.86E-04	2.25E-06	2.19E-04	2.26E-06
West Elk WA (I)	4.81E-04	4.80E-06	3.52E-04	4.04E-06	4.74E-04	4.69E-06
Dinosaur NM (II)	8.02E-03	7.71E-05	4.59E-03	4.82E-05	5.16E-03	5.06E-05
Brown Park NWR (II)	4.12E-03	4.18E-05	2.43E-03	2.57E-05	2.57E-03	2.67E-05
Colorado NM (II)	1.56E-03	1.50E-05	1.20E-03	1.37E-05	1.45E-03	1.56E-05
Flaming Gorge NRA (II)	2.84E-03	2.91E-05	1.99E-03	2.21E-05	2.01E-03	2.17E-05
Ouray NWR (II)	1.67E-02	1.47E-04	1.21E-02	1.19E-04	1.17E-02	1.09E-04
Ragged WA (II)	4.64E-04	4.80E-06	3.47E-04	4.13E-06	4.79E-04	4.78E-06
High Uintas WA (II)	1.54E-03	1.70E-05	1.43E-03	1.67E-05	1.64E-03	1.74E-05

Table 6-15. WTP Cumulative Nitrogen and Sulfur Deposition						
Area of Special Concern	2001		2002		2003	
	N Dep (kg/ha/yr)	S Dep (kg/ha/yr)	N Dep (kg/ha/yr)	S Dep (kg/ha/yr)	N Dep (kg/ha/yr)	S Dep (kg/ha/yr)
Arches NP (I)	8.83E-03	1.30E-02	7.17E-03	1.17E-02	7.86E-03	1.43E-02
Black Canyon of the Gunnison WA (I)	7.90E-03	4.28E-03	7.23E-03	4.71E-03	9.35E-03	5.58E-03
Canyonlands NP (I)	6.13E-03	1.24E-02	3.58E-03	1.42E-02	4.40E-03	1.31E-02
Capitol Reef NP (I)	3.46E-03	3.91E-03	9.22E-04	4.36E-03	1.45E-03	5.69E-03
Flat Tops WA (I)	3.80E-02	7.26E-03	2.76E-02	6.89E-03	4.05E-02	1.06E-02
La Garita WA (I)	2.67E-03	1.76E-03	2.41E-03	2.31E-03	3.64E-03	2.44E-03
Maroon Bells-Snowmass WA (I)	2.80E-02	4.54E-03	2.69E-02	4.08E-03	3.58E-02	5.71E-03
Weminuche WA (I)	2.37E-03	2.03E-03	2.01E-03	2.05E-03	3.30E-03	2.61E-03
West Elk WA (I)	8.37E-03	3.75E-03	6.94E-03	4.09E-03	1.07E-02	5.03E-03
Dinosaur NM (II)	1.55E-01	3.86E-02	1.07E-01	3.09E-02	9.92E-02	3.15E-02
Brown Park NWR (II)	5.77E-02	2.05E-02	3.70E-02	1.57E-02	3.80E-02	1.55E-02
Colorado NM (II)	2.04E-02	1.08E-02	1.87E-02	1.01E-02	1.93E-02	1.08E-02
Flaming Gorge NRA (II)	2.75E-02	1.30E-02	2.26E-02	1.33E-02	2.10E-02	1.05E-02
Ouray NWR (II)	7.09E-01	3.32E-02	7.98E-01	2.85E-02	7.54E-01	3.05E-02
Ragged WA (II)	2.69E-02	4.23E-03	2.26E-02	4.09E-03	2.91E-02	5.18E-03
High Uintas WA (II)	9.76E-03	1.61E-02	1.04E-02	1.68E-02	1.13E-02	1.78E-02

Table 6-16. WTP Alternative A + Cumulative Nitrogen and Sulfur Deposition						
Area of Special Concern	2001		2002		2003	
	N Dep (kg/ha/yr)	S Dep (kg/ha/yr)	N Dep (kg/ha/yr)	S Dep (kg/ha/yr)	N Dep (kg/ha/yr)	S Dep (kg/ha/yr)
Arches NP (I)	1.02E-02	1.30E-02	8.79E-03	1.18E-02	9.35E-03	1.43E-02
Black Canyon of the Gunnison WA (I)	8.57E-03	4.29E-03	7.78E-03	4.72E-03	1.00E-02	5.59E-03
Canyonlands NP (I)	7.10E-03	1.24E-02	4.34E-03	1.42E-02	5.40E-03	1.31E-02
Capitol Reef NP (I)	3.83E-03	3.91E-03	1.07E-03	4.37E-03	1.70E-03	5.69E-03
Flat Tops WA (I)	3.88E-02	7.27E-03	2.82E-02	6.90E-03	4.16E-02	1.07E-02
La Garita WA (I)	2.92E-03	1.76E-03	2.63E-03	2.31E-03	3.89E-03	2.44E-03
Maroon Bells-Snowmass WA (I)	2.85E-02	4.55E-03	2.73E-02	4.08E-03	3.63E-02	5.72E-03
Weminuche WA (I)	2.61E-03	2.03E-03	2.21E-03	2.05E-03	3.54E-03	2.61E-03
West Elk WA (I)	8.87E-03	3.76E-03	7.30E-03	4.10E-03	1.12E-02	5.04E-03
Dinosaur NM (II)	1.64E-01	3.86E-02	1.11E-01	3.10E-02	1.05E-01	3.15E-02
Brown Park NWR (II)	6.22E-02	2.05E-02	3.96E-02	1.57E-02	4.08E-02	1.55E-02
Colorado NM (II)	2.20E-02	1.08E-02	1.99E-02	1.01E-02	2.08E-02	1.09E-02
Flaming Gorge NRA (II)	3.07E-02	1.30E-02	2.48E-02	1.33E-02	2.32E-02	1.05E-02
Ouray NWR (II)	7.24E-01	3.33E-02	8.08E-01	2.86E-02	7.64E-01	3.06E-02
Ragged WA (II)	2.74E-02	4.24E-03	2.30E-02	4.10E-03	2.96E-02	5.19E-03
High Uintas WA (II)	1.14E-02	1.61E-02	1.20E-02	1.68E-02	1.31E-02	1.78E-02

Table 6-17. WTP Alternative B + Cumulative Nitrogen and Sulfur Deposition						
Area of Special Concern	2001		2002		2003	
	N Dep (kg/ha/yr)	S Dep (kg/ha/yr)	N Dep (kg/ha/yr)	S Dep (kg/ha/yr)	N Dep (kg/ha/yr)	S Dep (kg/ha/yr)
Arches NP (I)	9.34E-03	1.30E-02	7.79E-03	1.17E-02	8.42E-03	1.43E-02
Black Canyon of the Gunnison WA (I)	8.15E-03	4.28E-03	7.44E-03	4.71E-03	9.61E-03	5.59E-03
Canyonlands NP (I)	6.50E-03	1.24E-02	3.88E-03	1.42E-02	4.77E-03	1.31E-02
Capitol Reef NP (I)	3.59E-03	3.91E-03	9.79E-04	4.37E-03	1.54E-03	5.69E-03
Flat Tops WA (I)	3.83E-02	7.27E-03	1.08E-01	6.89E-03	4.09E-02	1.07E-02
La Garita WA (I)	2.76E-03	1.76E-03	2.49E-03	2.31E-03	3.73E-03	2.44E-03
Maroon Bells-Snowmass WA (I)	2.82E-02	4.55E-03	2.70E-02	4.08E-03	3.60E-02	5.71E-03
Weminuche WA (I)	2.46E-03	2.03E-03	2.08E-03	2.05E-03	3.39E-03	2.61E-03
West Elk WA (I)	8.56E-03	3.75E-03	7.08E-03	4.09E-03	1.09E-02	5.03E-03
Dinosaur NM (II)	1.59E-01	3.86E-02	1.08E-01	3.09E-02	1.01E-01	3.15E-02
Brown Park NWR (II)	5.94E-02	2.05E-02	3.80E-02	1.57E-02	3.90E-02	1.55E-02
Colorado NM (II)	2.10E-02	1.08E-02	1.91E-02	1.01E-02	1.99E-02	1.08E-02
Flaming Gorge NRA (II)	2.87E-02	1.30E-02	2.35E-02	1.33E-02	2.18E-02	1.05E-02
Ouray NWR (II)	7.14E-01	3.32E-02	8.02E-01	2.85E-02	7.57E-01	3.05E-02
Ragged WA (II)	2.71E-02	4.23E-03	2.27E-02	4.09E-03	2.93E-02	5.19E-03
High Uintas WA (II)	1.04E-02	1.61E-02	1.10E-02	1.68E-02	1.20E-02	1.78E-02

Table 6-18. WTP Alternative E + Cumulative Nitrogen and Sulfur Deposition						
Area of Special Concern	2001		2002		2003	
	N Dep (kg/ha/yr)	S Dep (kg/ha/yr)	N Dep (kg/ha/yr)	S Dep (kg/ha/yr)	N Dep (kg/ha/yr)	S Dep (kg/ha/yr)
Arches NP (I)	1.00E-02	1.30E-02	8.64E-03	1.17E-02	9.21E-03	1.43E-02
Black Canyon of the Gunnison WA (I)	8.51E-03	4.29E-03	7.73E-03	4.71E-03	9.96E-03	5.59E-03
Canyonlands NP (I)	7.01E-03	1.24E-02	4.28E-03	1.42E-02	5.31E-03	1.31E-02
Capitol Reef NP (I)	3.80E-03	3.91E-03	1.06E-03	4.37E-03	1.68E-03	5.69E-03
Flat Tops WA (I)	3.88E-02	7.27E-03	2.82E-02	6.90E-03	4.15E-02	1.07E-02
La Garita WA (I)	2.90E-03	1.76E-03	2.61E-03	2.31E-03	3.86E-03	2.44E-03
Maroon Bells-Snowmass WA (I)	2.85E-02	4.55E-03	2.72E-02	4.08E-03	3.63E-02	5.71E-03
Weminuche WA (I)	2.59E-03	2.03E-03	2.19E-03	2.05E-03	3.52E-03	2.61E-03
West Elk WA (I)	8.82E-03	3.76E-03	7.27E-03	4.10E-03	1.11E-02	5.04E-03
Dinosaur NM (II)	1.63E-01	3.86E-02	1.11E-01	3.09E-02	1.04E-01	3.15E-02
Brown Park NWR (II)	6.18E-02	2.05E-02	3.94E-02	1.57E-02	4.05E-02	1.55E-02
Colorado NM (II)	2.19E-02	1.08E-02	1.98E-02	1.01E-02	2.07E-02	1.08E-02
Flaming Gorge NRA (II)	3.04E-02	1.30E-02	2.46E-02	1.33E-02	2.30E-02	1.05E-02
Ouray NWR (II)	7.22E-01	1.30E-02	8.07E-01	2.86E-02	7.63E-01	3.06E-02
Ragged WA (II)	2.74E-02	4.24E-03	2.29E-02	4.10E-03	2.95E-02	5.19E-03
High Uintas WA (II)	1.13E-02	1.61E-02	1.18E-02	1.68E-02	1.30E-02	1.78E-02

Table 6-19. WTP Alternative A (Proposed Action) Acid Neutralization Capacity							
Lake	Ned Wilson	Upper Ned Wilson	Dean	Pine Island	Moon	Deep Creek #1	S. Golden
A (μeq/l)	38.5	12.8	57.3	95.6	51.5	44.3	111.0
Watershed area (ha)	8.5	3.1	117	192	251	360	112
Precipitation (m)	1.02	1.02	1.02	1.02	1.02	1.02	1.02
Et	0.33	0.33	0.33	0.33	0.33	0.33	0.33
ANC(o) (eq)	2207.38	266.94	45815.82	125439.4	88339.7	108988.6	84960.29
2001							
Ds (kg/ha/yr)	9.67E-06	9.67E-06	7.60E-06	7.62E-06	2.57E-06	5.85E-06	5.11E-06
Dn (kg/ha/yr)	7.69E-04	7.69E-04	6.69E-04	6.69E-04	2.05E-04	4.74E-04	4.15E-04
Hs ($eq^2/m^2/yr$)	6.05E-08	6.05E-08	4.75E-08	4.76E-08	1.61E-08	3.66E-08	3.20E-08
Hn ($eq^2/m^2/yr$)	5.49E-06	5.49E-06	4.78E-06	4.78E-06	1.46E-06	3.38E-06	2.96E-06
Hdep (eq)	0.471805	0.172042	5.645474	9.259446	3.71491	12.31097	3.354905
Percent ANC change [1]	0.02	0.008121 μeq/l	0.01	0.01	0.00	0.01	0.00
2002							
Ds (kg/ha/yr)	8.82E-06	8.82E-06	7.27E-06	6.87E-06	2.77E-06	4.97E-06	4.23E-06
Dn (kg/ha/yr)	6.15E-04	6.15E-04	6.67E-04	6.16E-04	1.91E-04	3.55E-04	3.10E-04
Hs ($eq^2/m^2/yr$)	5.51E-08	5.52E-08	4.55E-08	4.29E-08	1.73E-08	3.11E-08	2.64E-08
Hn ($eq^2/m^2/yr$)	4.39E-06	4.40E-06	4.76E-06	4.40E-06	1.36E-06	2.54E-06	2.21E-06
Hdep (eq)	0.377993	0.137961	5.623859	8.525535	3.460772	9.248583	2.506196
Percent ANC change [1]	0.02	0.006512 μeq/l	0.01	0.01	0.00	0.01	0.00

Table 6-19. WTP Alternative A (Proposed Action) Acid Neutralization Capacity							
Lake	**Ned Wilson**	**Upper Ned Wilson**	**Dean**	**Pine Island**	**Moon**	**Deep Creek #1**	**S. Golden**
2003							
Ds (kg/ha/yr)	1.21E-05	1.21E-05	9.35E-06	8.96E-06	2.53E-06	5.83E-06	4.97E-06
Dn (kg/ha/yr)	1.06E-03	1.06E-03	8.34E-04	7.97E-04	1.95E-04	4.88E-04	4.07E-04
Hs ($eq^2/m^2/yr$)	7.54E-08	7.56E-08	5.85E-08	5.60E-08	1.58E-08	3.65E-08	3.11E-08
Hn ($eq^2/m^2/yr$)	7.58E-06	7.60E-06	5.96E-06	5.69E-06	1.39E-06	3.49E-06	2.91E-06
Hdep (eq)	0.650486	0.23799	7.039855	11.03316	3.534767	12.68761	3.289076
Percent ANC change [1]	0.03	0.011234 μeq/l	0.02	0.01	0.00	0.01	0.00

[1] For lakes with existing ANC levels less than 25 microequivalents per liter (μeq/l), a LAC of no greater than one μeq/l is applied. For lakes with existing ANC levels greater than 25 μeq/l, the LAC is no greater than a 10 percent change in the background ANC

Table 6-20. WTP Alternative B (No Action) Acid Neutralization Capacity							
Lake	**Ned Wilson**	**Upper Ned Wilson**	**Dean**	**Pine Island**	**Moon**	**Deep Creek #1**	**S. Golden**
A (μeq/l)	38.5	12.8	57.3	95.6	51.5	44.3	111.0
Watershed area (ha)	8.5	3.1	117	192	251	360	112
Precipitation (m)	1.02	1.02	1.02	1.02	1.02	1.02	1.02
Et	0.33	0.33	0.33	0.33	0.33	0.33	0.33
ANC(o) (eq)	2207.38	266.94	45815.82	125439.4	88339.7	108988.6	84960.29
2001							
Ds (kg/ha/yr)	3.46E-06	3.46E-06	2.72E-06	2.73E-06	9.20E-07	2.10E-06	1.83E-06
Dn (kg/ha/yr)	2.89E-04	2.89E-04	2.46E-04	2.46E-04	7.82E-05	1.79E-04	1.56E-04
Hs ($eq^2/m^2/yr$)	2.17E-08	2.17E-08	1.70E-08	1.71E-08	5.75E-09	1.31E-08	1.14E-08
Hn ($eq^2/m^2/yr$)	2.06E-06	2.06E-06	1.75E-06	1.76E-06	5.59E-07	1.28E-06	1.12E-06
Hdep (eq)	0.177317	0.064658	2.073196	3.405637	1.417062	4.641536	1.264726
Percent ANC change [1]	0.01	0.003052 μeq/l	0.00	0.00	0.00	0.00	0.00
2002							
Ds (kg/ha/yr)	3.16E-06	3.16E-06	2.60E-06	2.46E-06	9.91E-07	1.78E-06	1.51E-06
Dn (kg/ha/yr)	2.29E-04	2.30E-04	2.36E-04	2.18E-04	7.17E-05	1.35E-04	1.18E-04
Hs ($eq^2/m^2/yr$)	1.97E-08	1.98E-08	1.63E-08	1.54E-08	6.19E-09	1.11E-08	9.46E-09
Hn ($eq^2/m^2/yr$)	1.64E-06	1.64E-06	1.69E-06	1.55E-06	5.12E-07	9.63E-07	8.41E-07
Hdep (eq)	0.140972	0.051451	1.992068	3.014362	1.300519	3.508318	0.953067
Percent ANC change [1]	0.01	0.002429 μeq/l	0.00	0.00	0.00	0.00	0.00
2003							
Ds (kg/ha/yr)	4.32E-06	4.33E-06	3.35E-06	3.21E-06	9.07E-07	2.09E-06	1.78E-06
Dn (kg/ha/yr)	3.94E-04	3.95E-04	3.03E-04	2.90E-04	7.34E-05	1.85E-04	1.54E-04
Hs ($eq^2/m^2/yr$)	2.70E-08	2.71E-08	2.09E-08	2.01E-08	5.67E-09	1.31E-08	1.11E-08
Hn ($eq^2/m^2/yr$)	2.82E-06	2.82E-06	2.17E-06	2.07E-06	5.24E-07	1.32E-06	1.10E-06
Hdep (eq)	0.241649	0.088405	2.560621	4.020039	1.330577	4.795942	1.247896
Percent ANC change [1]	0.01	0.004173 μeq/l	0.01	0.00	0.00	0.00	0.00

[1] For lakes with existing ANC levels less than 25 microequivalents per liter (μeq/l), a LAC of no greater than one μeq/l is applied. For lakes with existing ANC levels greater than 25 μeq/l, the LAC is no greater than a 10 percent change in the background ANC

Table 6-21. WTP Alternative E (BLM Preferred) Acid Neutralization Capacity

Lake	Ned Wilson	Upper Ned Wilson	Dean	Pine Island	Moon	Deep Creek #1	S. Golden
A (μeq/l)	38.5	12.8	57.3	95.6	51.5	44.3	111.0
Watershed area (ha)	8.5	3.1	117	192	251	360	112
Precipitation (m)	1.02	1.02	1.02	1.02	1.02	1.02	1.02
Et	0.33	0.33	0.33	0.33	0.33	0.33	0.33
ANC(o) (eq)	2207.38	266.94	45815.82	125439.4	88339.7	108988.6	84960.29
2001							
Ds (kg/ha/yr)	7.38E-06	7.38E-06	5.80E-06	5.82E-06	1.96E-06	4.47E-06	3.90E-06
Dn (kg/ha/yr)	7.00E-04	6.99E-04	6.09E-04	6.09E-04	1.87E-04	4.31E-04	3.78E-04
Hs ($eq^2/m^2/yr$)	4.61E-08	4.61E-08	3.62E-08	3.63E-08	1.23E-08	2.79E-08	2.44E-08
Hn ($eq^2/m^2/yr$)	5.00E-06	5.00E-06	4.35E-06	4.35E-06	1.33E-06	3.08E-06	2.70E-06
Hdep (eq)	0.428619	0.156299	5.136051	8.422974	3.376704	11.18423	3.048223
Percent ANC change [1]	0.02	0.007378 μeq/l	0.01	0.01	0.00	0.01	0.00
2002							
Ds (kg/ha/yr)	6.73E-06	6.74E-06	5.55E-06	5.24E-06	2.11E-06	3.80E-06	3.23E-06
Dn (kg/ha/yr)	5.59E-04	5.59E-04	6.06E-04	5.60E-04	1.73E-04	3.23E-04	2.81E-04
Hs ($eq^2/m^2/yr$)	4.21E-08	4.21E-08	3.47E-08	3.28E-08	1.32E-08	2.37E-08	2.02E-08
Hn ($eq^2/m^2/yr$)	3.99E-06	4.00E-06	4.33E-06	4.00E-06	1.24E-06	2.31E-06	2.01E-06
Hdep (eq)	0.342974	0.125176	5.108411	7.742675	3.139186	8.388464	2.273469
Percent ANC change [1]	0.02	0.005909 μeq/l	0.01	0.01	0.00	0.01	0.00
2003							
Ds (kg/ha/yr)	9.20E-06	9.23E-06	7.14E-06	6.84E-06	1.93E-06	4.45E-06	3.80E-06
Dn (kg/ha/yr)	9.65E-04	9.68E-04	7.61E-04	7.26E-04	1.77E-04	4.44E-04	3.70E-04
Hs ($eq^2/m^2/yr$)	5.75E-08	5.77E-08	4.46E-08	4.27E-08	1.21E-08	2.78E-08	2.37E-08
Hn ($eq^2/m^2/yr$)	6.89E-06	6.91E-06	5.43E-06	5.19E-06	1.27E-06	3.17E-06	2.64E-06
Hdep (eq)	5.75E-08	5.77E-08	4.46E-08	4.27E-08	1.21E-08	2.78E-08	2.37E-08
Percent ANC change [1]	0.03	0.010203 μeq/l	0.01	0.01	0.00	0.01	0.00

Table 6-22. WTP Cumulative Acid Neutralization Capacity

Lake	Ned Wilson	Upper Ned Wilson	Dean	Pine Island	Moon	Deep Creek #1	S. Golden
A (μeq/l)	38.5	12.8	57.3	95.6	51.5	44.3	111.0
Watershed area (ha)	8.5	3.1	117	192	251	360	112
Precipitation (m)	1.02	1.02	1.02	1.02	1.02	1.02	1.02
Et	0.33	0.33	0.33	0.33	0.33	0.33	0.33
ANC(o) (eq)	2207.38	266.94	45815.82	125439.4	88339.7	108988.6	84960.29
2001							
Ds (kg/ha/yr)	6.20E-03	6.21E-03	1.23E-02	1.37E-02	1.79E-03	3.86E-03	3.11E-03
Dn (kg/ha/yr)	2.43E-02	2.42E-02	4.21E-03	4.19E-03	2.00E-03	1.29E-02	6.89E-03
Hs ($eq^2/m^2/yr$)	3.88E-05	3.88E-05	7.68E-05	8.55E-05	1.12E-05	2.41E-05	1.94E-05
Hn ($eq^2/m^2/yr$)	1.73E-04	1.73E-04	3.01E-05	2.99E-05	1.43E-05	9.23E-05	4.92E-05
Hdep (eq)	18.02595	6.572137	125.1115	221.7001	63.93103	419.329	76.90949

Table 6-22. WTP Cumulative Acid Neutralization Capacity							
Lake	**Ned Wilson**	**Upper Ned Wilson**	**Dean**	**Pine Island**	**Moon**	**Deep Creek #1**	**S. Golden**
% ANC change	0.82%	0.31022 μeq/l	0.27%	0.18%	0.07%	0.38%	0.09%
2002							
Ds (kg/ha/yr)	5.51E-03	5.52E-03	1.31E-02	1.46E-02	1.71E-03	3.80E-03	3.42E-03
Dn (kg/ha/yr)	1.80E-02	1.79E-02	4.38E-03	4.35E-03	1.78E-03	1.11E-02	5.25E-03
Hs ($eq^2/m^2/yr$)	3.44E-05	3.45E-05	8.19E-05	9.11E-05	1.07E-05	2.38E-05	2.14E-05
Hn ($eq^2/m^2/yr$)	1.28E-04	1.28E-04	3.13E-05	3.11E-05	1.27E-05	7.94E-05	3.75E-05
Hdep (eq)	13.83954	5.037446	132.4208	234.4835	58.8513	371.4658	65.97016
% ANC change	0.63%	0.237779 μeq/l	0.29%	0.19%	0.07%	0.34%	0.08%
2003							
Ds (kg/ha/yr)	8.89E-03	8.90E-03	1.53E-02	1.61E-02	2.11E-03	4.87E-03	4.23E-03
Dn (kg/ha/yr)	2.79E-02	2.78E-02	5.86E-03	5.58E-03	2.92E-03	1.55E-02	8.28E-03
Hs ($eq^2/m^2/yr$)	5.55E-05	5.56E-05	9.53E-05	1.00E-04	1.32E-05	3.04E-05	2.64E-05
Hn ($eq^2/m^2/yr$)	1.99E-04	1.99E-04	4.19E-05	3.98E-05	2.09E-05	1.11E-04	5.92E-05
Hdep (eq)	21.64844	7.884857	160.517	269.0949	85.49026	508.1139	95.89435
% ANC change	0.98%	0.372184 μeq/l	0.35%	0.21%	0.10%	0.47%	0.11%

Table 6-23. WTP Cumulative + Alternative A Acid Neutralization Capacity							
Lake	**Ned Wilson**	**Upper Ned Wilson**	**Dean**	**Pine Island**	**Moon**	**Deep Creek #1**	**S. Golden**
A (μeq/l)	38.5	12.8	57.3	95.6	51.5	44.3	111.0
Watershed area (ha)	8.5	3.1	117	192	251	360	112
Precipitation (m)	1.02	1.02	1.02	1.02	1.02	1.02	1.02
Et	0.33	0.33	0.33	0.33	0.33	0.33	0.33
ANC(o) (eq)	2207.38	266.94	45815.82	125439.4	88339.7	108988.6	84960.29
2001							
Ds (kg/ha/yr)	6.21E-03	6.22E-03	1.23E-02	1.37E-02	1.79E-03	3.87E-03	3.12E-03
Dn (kg/ha/yr)	2.50E-02	2.50E-02	4.88E-03	4.86E-03	2.20E-03	1.34E-02	7.31E-03
Hs ($eq^2/m^2/yr$)	3.88E-05	3.89E-05	7.69E-05	8.56E-05	1.12E-05	2.42E-05	1.95E-05
Hn ($eq^2/m^2/yr$)	1.79E-04	1.79E-04	3.49E-05	3.47E-05	1.57E-05	9.57E-05	5.22E-05
Hdep (eq)	18.49775	6.744145	130.7568	230.9598	67.6461	431.6446	80.26284
% ANC change	0.84%	0.318339 μeq/l	0.29%	0.18%	0.08%	0.40%	0.09%
2002							
Ds (kg/ha/yr)	5.52E-03	5.53E-03	1.31E-02	1.46E-02	1.71E-03	3.81E-03	3.43E-03
Dn (kg/ha/yr)	1.86E-02	1.85E-02	5.05E-03	4.97E-03	1.98E-03	1.15E-02	5.56E-03
Hs ($eq^2/m^2/yr$)	3.45E-05	3.45E-05	8.19E-05	9.11E-05	1.07E-05	2.38E-05	2.14E-05
Hn ($eq^2/m^2/yr$)	1.33E-04	1.32E-04	3.61E-05	3.55E-05	1.41E-05	8.20E-05	3.97E-05
Hdep (eq)	14.21759	5.175394	138.0453	243.0052	62.31159	380.7185	68.47632
% ANC change	0.64%	0.244291 μeq/l	0.30%	0.19%	0.07%	0.35%	0.08%
2003							
Ds (kg/ha/yr)	8.90E-03	8.91E-03	1.53E-02	1.61E-02	2.11E-03	4.88E-03	4.24E-03

Table 6-23. WTP Cumulative + Alternative A Acid Neutralization Capacity							
Lake	**Ned Wilson**	**Upper Ned Wilson**	**Dean**	**Pine Island**	**Moon**	**Deep Creek #1**	**S. Golden**
Dn (kg/ha/yr)	2.89E-02	2.89E-02	6.69E-03	6.37E-03	3.12E-03	1.60E-02	8.69E-03
Hs ($eq^2/m^2/yr$)	5.56E-05	5.57E-05	9.54E-05	1.00E-04	1.32E-05	3.05E-05	2.65E-05
Hn ($eq^2/m^2/yr$)	2.07E-04	2.06E-04	4.78E-05	4.55E-05	2.23E-05	1.14E-04	6.21E-05
Hdep (eq)	22.29891	8.122854	167.5548	280.1294	89.02511	520.7947	99.18419
% ANC change	1.01%	0.383418 μeq/l	0.37%	0.22%	0.10%	0.48%	0.12%

Table 6-24. WTP Cumulative + Alternative B Acid Neutralization Capacity							
Lake	**Ned Wilson**	**Upper Ned Wilson**	**Dean**	**Pine Island**	**Moon**	**Deep Creek #1**	**S. Golden**
A (μeq/l)	38.5	12.8	57.3	95.6	51.5	44.3	111.0
Watershed area (ha)	8.5	3.1	117	192	251	360	112
Precipitation (m)	1.02	1.02	1.02	1.02	1.02	1.02	1.02
Et	0.33	0.33	0.33	0.33	0.33	0.33	0.33
ANC(o) (eq)	2207.38	266.94	45815.82	125439.4	88339.7	108988.6	84960.29
2001							
Ds (kg/ha/yr)	6.21E-03	6.22E-03	1.23E-02	1.37E-02	1.79E-03	3.86E-03	3.11E-03
Dn (kg/ha/yr)	2.46E-02	2.45E-02	4.46E-03	4.44E-03	2.08E-03	1.31E-02	7.05E-03
Hs ($eq^2/m^2/yr$)	3.88E-05	3.88E-05	7.69E-05	8.56E-05	1.12E-05	2.42E-05	1.95E-05
Hn ($eq^2/m^2/yr$)	1.75E-04	1.75E-04	3.18E-05	3.17E-05	1.48E-05	9.36E-05	5.03E-05
Hdep (eq)	18.20318	6.636773	127.1831	225.1038	65.34862	423.9692	78.17364
% ANC change	0.82%	0.313271 μeq/l	0.28%	0.18%	0.07%	0.39%	0.09%
2002							
Ds (kg/ha/yr)	5.51E-03	5.52E-03	1.31E-02	1.46E-02	1.71E-03	3.80E-03	3.43E-03
Dn (kg/ha/yr)	1.82E-02	1.82E-02	4.62E-03	4.57E-03	1.86E-03	1.13E-02	5.37E-03
Hs ($eq^2/m^2/yr$)	3.45E-05	3.45E-05	8.19E-05	9.11E-05	1.07E-05	2.38E-05	2.14E-05
Hn ($eq^2/m^2/yr$)	1.30E-04	1.30E-04	3.30E-05	3.26E-05	1.33E-05	8.04E-05	3.83E-05
Hdep (eq)	13.9806	5.088823	134.4132	237.4942	60.15178	374.9791	66.92475
% ANC change	0.63%	0.240204 μeq/l	0.29%	0.19%	0.07%	0.34%	0.08%
2003							
Ds (kg/ha/yr)	8.89E-03	8.91E-03	1.53E-02	1.61E-02	2.11E-03	4.87E-03	4.23E-03
Dn (kg/ha/yr)	2.83E-02	2.82E-02	6.16E-03	5.87E-03	3.00E-03	1.57E-02	8.44E-03
Hs ($eq^2/m^2/yr$)	5.56E-05	5.57E-05	9.54E-05	1.00E-04	1.32E-05	3.05E-05	2.65E-05
Hn ($eq^2/m^2/yr$)	2.02E-04	2.02E-04	4.40E-05	4.19E-05	2.14E-05	1.12E-04	6.03E-05
Hdep (eq)	21.88996	7.973279	163.0754	273.1155	86.82036	512.9004	97.14381
% ANC change	0.99%	0.376357 μeq/l	0.36%	0.22%	0.10%	0.47%	0.11%

Table 6-25. WTP Cumulative + Alternative E Acid Neutralization Capacity							
Lake	**Ned Wilson**	**Upper Ned Wilson**	**Dean**	**Pine Island**	**Moon**	**Deep Creek #1**	**S. Golden**
A (μeq/l)	38.5	12.8	57.3	95.6	51.5	44.3	111.0
Watershed area (ha)	8.5	3.1	117	192	251	360	112
Precipitation (m)	1.02	1.02	1.02	1.02	1.02	1.02	1.02
Et	0.33	0.33	0.33	0.33	0.33	0.33	0.33
ANC(o) (eq)	2207.38	266.94	45815.82	125439.4	88339.7	108988.6	84960.29
2001							
Ds (kg/ha/yr)	6.21E-03	6.22E-03	1.23E-02	1.37E-02	1.79E-03	3.87E-03	3.12E-03
Dn (kg/ha/yr)	2.50E-02	2.49E-02	4.82E-03	4.80E-03	2.18E-03	1.34E-02	7.27E-03
Hs ($eq^2/m^2/yr$)	3.88E-05	3.89E-05	7.69E-05	8.56E-05	1.12E-05	2.42E-05	1.95E-05
Hn ($eq^2/m^2/yr$)	1.78E-04	1.78E-04	3.44E-05	3.43E-05	1.56E-05	9.54E-05	5.19E-05
Hdep (eq)	18.45448	6.728425	130.2475	230.124	67.30821	430.5134	79.95653
% ANC change	0.84%	0.317597 μeq/l	0.28%	0.18%	0.08%	0.40%	0.09%
2002							
Ds (kg/ha/yr)	5.52E-03	5.52E-03	1.31E-02	1.46E-02	1.71E-03	3.81E-03	3.43E-03
Dn (kg/ha/yr)	1.85E-02	1.85E-02	4.99E-03	4.91E-03	1.96E-03	1.14E-02	5.53E-03
Hs ($eq^2/m^2/yr$)	3.45E-05	3.45E-05	8.19E-05	9.11E-05	1.07E-05	2.38E-05	2.14E-05
Hn ($eq^2/m^2/yr$)	1.32E-04	1.32E-04	3.56E-05	3.51E-05	1.40E-05	8.17E-05	3.95E-05
Hdep (eq)	14.18253	5.162598	137.5304	242.2251	61.99024	379.8548	68.24264
% ANC change	0.64%	0.243687 μeq/l	0.30%	0.19%	0.07%	0.35%	0.08%
2003							
Ds (kg/ha/yr)	8.90E-03	8.91E-03	1.53E-02	1.61E-02	2.11E-03	4.87E-03	4.23E-03
Dn (kg/ha/yr)	2.88E-02	2.88E-02	6.62E-03	6.30E-03	3.10E-03	1.59E-02	8.65E-03
Hs ($eq^2/m^2/yr$)	5.56E-05	5.57E-05	9.54E-05	1.00E-04	1.32E-05	3.05E-05	2.65E-05
Hn ($eq^2/m^2/yr$)	2.06E-04	2.06E-04	4.73E-05	4.50E-05	2.22E-05	1.14E-04	6.18E-05
Hdep (eq)	22.23919	8.101006	166.9245	279.1385	88.69796	519.6392	98.8827
% ANC change	1.01%	0.382386 μeq/l	0.36%	0.22%	0.10%	0.48%	0.12%

Table 6-26. WTP Alternative A (Proposed Action) NAAQS Comparison							
Pollutant	**Averaging Time**	**Maximum Predicted Impact ($\mu g/m^3$)**	**Maximum Impact Location**	**Background Concentration ($\mu g/m^3$)**	**Background Plus Impact ($\mu g/m^3$)**	**NAAQS Standard ($\mu g/m^3$)**	**Impact Percentage of NAAQS**
2001							
NO_2	Annual	0.1	Ouray	17	17	100	17 %
SO_2	3-hour	0.01	Ouray	20	20	1300	2 %
	24-hour	0.006	Ouray	10	10	365	3 %
	Annual	0.0008	Ouray	5	5	80	6 %
PM_{10}	24-hour	14.6	Ouray	28	43	150	28 %
$PM_{2.5}$	24-hour[1]	1.9	Ouray	15/52[a]	16.9	35	48 %
	Annual	0.4	Ouray	11	11.4	15	79 %
2002							
NO_2	Annual	0.1	Ouray	17	17	100	17 %
SO_2	3-hour	0.01	Ouray	20	20	1300	2 %
	24-hour	0.005	Ouray	10	10	365	3 %
	Annual	0.0007	Ouray	5	5	80	6 %
PM_{10}	24-hour	8.6	Ouray	28	37	150	24 %

Table 6-26. WTP Alternative A (Proposed Action) NAAQS Comparison							
Pollutant	**Averaging Time**	**Maximum Predicted Impact (µg/m³)**	**Maximum Impact Location**	**Background Concentration (µg/m³)**	**Background Plus Impact (µg/m³)**	**NAAQS Standard (µg/m³)**	**Impact Percentage of NAAQS**
$PM_{2.5}$	24-hour[1]	1.6	Ouray	15/52[a]	16.6	35	47 %
	Annual	0.3	Ouray	11	11.3	15	75 %
2003							
NO_2	Annual	0.1	Ouray	17	17	100	17 %
SO_2	3-hour	0.02	Ouray	20	20	1300	2 %
	24-hour	0.006	Ouray	10	10	365	3 %
	Annual	0.0006	Ouray	5	5	80	6 %
PM_{10}	24-hour	9.1	Ouray	28	37	150	25 %
$PM_{2.5}$	24-hour[1]	1.3	Ouray	15/52[a]	16.3	35	47 %
	Annual	0.3	Ouray	11	11.3	15	75 %

[1] Represents the modeled "eighth maximum" concentration

[a] The state of Utah currently does not require $PM_{2.5}$ modeling for new sources and does not have an official background. The $PM_{2.5}$ provided by UDEQ (15 and 52 µg/m³) represent 98th percentile values from limited $PM_{2.5}$ monitoring conducted in Vernal and Uintah/Duchesne Counties in 2007. The smaller figure is representative of average summer concentrations, while the larger value is representative of winter inversion conditions, based on this monitoring. Because the winter inversion $PM_{2,5}$ value does not represent typical conditions in the project area, the value for average summer conditions was used in analyzing $PM_{2.5}$ impacts from the Proposed Action. The $PM_{2.5}$ monitoring location in Uintah/Duchesne counties, Utah was located in an urban setting with a high density of inhabitants and in proximity to highways (Highway 40 and Highway 191). As such, the higher, winter time inversion $PM_{2.5}$ concentration value reflects impacts from activities and activity levels not expected in the rural and sparsely inhabited region of the Proposed Action. Potential impacts from agricultural activities and wood burning would not be expected to measurable contribute to $PM_{2.5}$ concentrations in the region of the Proposed Action.

Ambient Air Quality Standards

Significance criteria for potential criteria pollutant impacts include the NAAQS. Utah has adopted the NAAQS as the standard for the State.

Predicted maximum pollutant concentrations that could occur as a result of the implementation of the Proposed Action are summarized in **Table 6-27** and compared with the NAAQS for years 2001-2003. As demonstrated, increases in pollutant concentrations are predicted to occur at levels below the ambient standards.

Table 6-27. WTP Alternative A (Proposed Action) NAAQS Comparison							
Pollutant	**Averaging Time**	**Maximum Predicted Impact (µg/m³)**	**Maximum Impact Location**	**Background Concentration (µg/m³)**	**Background Plus Impact (µg/m³)**	**NAAQS Standard (µg/m³)**	**Impact Percentage of NAAQS**
2001							
NO_2	Annual	0.1	Ouray	17	17	100	17 %
SO_2	3-hour	0.01	Ouray	20	20	1300	2 %
	24-hour	0.006	Ouray	10	10	365	3 %
	Annual	0.0008	Ouray	5	5	80	6 %
PM_{10}	24-hour	14.6	Ouray	28	43	150	28 %
$PM_{2.5}$	24-hour[1]	1.9	Ouray	15/52[a]	16.9	35	48 %

Table 6-27. WTP Alternative A (Proposed Action) NAAQS Comparison

Pollutant	Averaging Time	Maximum Predicted Impact (µg/m^3)	Maximum Impact Location	Background Concentration (µg/m^3)	Background Plus Impact (µg/m^3)	NAAQS Standard (µg/m^3)	Impact Percentage of NAAQS
	Annual	0.4	Ouray	11	11.4	15	76 %
2002							
NO_2	Annual	0.1	Ouray	17	17	100	17 %
SO_2	3-hour	0.01	Ouray	20	20	1300	2 %
	24-hour	0.005	Ouray	10	10	365	3 %
	Annual	0.0007	Ouray	5	5	80	6 %
PM_{10}	24-hour	8.6	Ouray	28	37	150	24 %
$PM_{2.5}$	24-hour[1]	1.6	Ouray	15/52[a]	16.6	35	47 %
	Annual	0.3	Ouray	11	11.3	15	75 %
2003							
NO_2	Annual	0.1	Ouray	17	17	100	17 %
SO_2	3-hour	0.02	Ouray	20	20	1300	2 %
	24-hour	0.006	Ouray	10	10	365	3 %
	Annual	0.0006	Ouray	5	5	80	6 %
PM_{10}	24-hour	9.1	Ouray	28	37	150	25 %
$PM_{2.5}$	24-hour[1]	1.3	Ouray	15/52[a]	16.3	35	47 %
	Annual	0.3	Ouray	11	11.3	15	75 %

[1] Represents the modeled "eighth maximum" concentration

Table 6-28. WTP Alternative B (No Action) NAAQS Comparison

Pollutant	Averaging Time	Maximum Predicted Impact (µg/m^3)	Maximum Impact Location	Background Concentration (µg/m^3)	Background Plus Impact (µg/m^3)	NAAQS Standard (µg/m^3)	Impact Percentage of NAAQS
2001							
NO_2	Annual	0.1	Ouray	17	17	100	17 %
SO_2	3-hour	0.007	Ouray	20	20	1300	2 %
	24-hour	0.002	Ouray	10	10	365	3 %
	Annual	0.0003	Ouray	5	5	80	6 %
PM_{10}	24-hour	2.8	Ouray	28	31	150	21 %
$PM_{2.5}$	24-hour[1]	0.6	Ouray	15/52[a]	15.6	35	45 %
	Annual	0.1	Ouray	11	11.1	15	74 %
2002							
NO_2	Annual	0.03	Ouray	17	17	100	17 %
SO_2	3-hour	0.004	Ouray	20	20	1300	2 %
	24-hour	0.002	Ouray	10	10	365	3 %
	Annual	0.0002	Ouray	5	5	80	6 %
PM_{10}	24-hour	2.6	Ouray	28	31	150	20 %
$PM_{2.5}$	24-hour[1]	0.5	Ouray	15/52[a]	15.5	35	44 %
	Annual	0.09	Ouray	11	11.1	15	74 %
2003							

NO_2	Annual	0.03	Ouray	17	17	100	17 %
SO_2	3-hour	0.006	Ouray	20	20	1300	2 %
	24-hour	0.002	Ouray	10	10	365	3 %
	Annual	0.0002	Ouray	5	5	80	6 %
PM_{10}	24-hour	2.8	Ouray	28	31	150	21 %
$PM_{2.5}$	24-hour[1]	0.4	Ouray	15/52[a]	15.4	35	44 %
	Annual	0.08	Ouray	11	11.1	15	74 %

[1] Represents the modeled "eighth maximum" concentration

[a] The state of Utah currently does not require $PM_{2.5}$ modeling for new sources and does not have an official background. The $PM_{2.5}$ provided by UDEQ (15 and 52 $\mu g/m^3$) represent 98th percentile values from limited $PM_{2.5}$ monitoring conducted in Vernal and Uintah/Duchesne Counties in 2007. The smaller figure is representative of average summer concentrations, while the larger value is representative of winter inversion conditions, based on this monitoring. Because the winter inversion $PM_{2.5}$ value does not represent typical conditions in the project area, the value for average summer conditions was used in analyzing $PM_{2.5}$ impacts from the Proposed Action. The $PM_{2.5}$ monitoring location in Uintah/Duchesne counties, Utah was located in an urban setting with a high density of inhabitants and in proximity to highways (Highway 40 and Highway 191). As such, the higher, winter time inversion $PM_{2.5}$ concentration value reflects impacts from activities and activity levels not expected in the rural and sparsely inhabited region of the Proposed Action. Potential impacts from agricultural activities and wood burning would not be expected to measurable contribute to $PM_{2.5}$ concentrations in the region of the Proposed Action.

Table 6-29. WTP Alternative E (BLM Preferred) NAAQS Comparison

Pollutant	Averaging Time	Maximum Predicted Impact (µg/m^3)	Maximum Impact Location	Background Concentration (µg/m^3)	Background Plus Impact (µg/m^3)	NAAQS Standard (µg/m^3)	Impact Percentage of NAAQS
2001							
NO_2	Annual	0.12122	Ouray	17	17.12122	100	17%
SO_2	3-hour	0.015135	Ouray	20	20.015135	1300	2%
	24-hour	0.004256	Ouray	10	10.0042564	365	3%
	Annual	0.000646	Ouray	5	5.00064614	80	6%
$\%M_{10}$	24-hour	6.6774	Ouray	28	34.6774	150	23%
$PM_{2.5}$	24-hour[1]	1.43	Ouray	15/52[a]	16.43	35	47%
	Annual	0.27	Ouray	11	11.27	15	75%
2002							
NO_2	Annual	0.1	Ouray	17	17	100	17 %
SO_2	3-hour	0.01	Ouray	20	20	1300	2 %
	24-hour	0.004	Ouray	10	10	365	3 %
	Annual	0.0005	Ouray	5	5	80	6 %
PM_{10}	24-hour	6.4	Ouray	28	34	150	23 %
$PM_{2.5}$	24-hour[1]	1.2	Ouray	15/52[a]	16.2	35	46 %
	Annual	0.2	Ouray	11	11.2	15	75 %
2003							
NO_2	Annual	0.1	Ouray	17	17	100	17 %
SO_2	3-hour	0.01	Ouray	20	20	1300	2 %
	24-hour	0.004	Ouray	10	10	365	3 %
	Annual	0.0005	Ouray	5	5	80	6 %
PM_{10}	24-hour	5.3	Ouray	28	33	150	22 %
$PM_{2.5}$	24-hour[1]	1.0	Ouray	15/52[a]	16	35	46 %
	Annual	0.2	Ouray	11	11.2	15	75 %

[1] Represents the modeled "eighth maximum" concentration

Table 6-30. WTP Cumulative NAAQS Comparison

Pollutant	Averaging Time	Maximum Predicted Impact (µg/m^3)	Maximum Impact Location	Background Concentration (µg/m^3)	Background Plus Impact (µg/m^3)	NAAQS Standard (µg/m^3)	Impact Percentage of NAAQS
2001							
NO_2	Annual	7.1	Ouray	17	24	100	24 %
SO_2	3-hour	3.1	Ouray	20	23	1300	2 %
	24-hour	0.8	Dinosaur	10	11	365	3 %
	Annual	0.1	Ouray	5	5	80	6 %
PM_{10}	24-hour	11.4	Ouray	28	39	150	26 %
$PM_{2.5}$	24-hour[1]	2.9	Ouray	15/52[a]	17.9	35	51 %
	Annual	1.2	Ouray	11	12.2	15	81 %
2002							

Table 6-30. WTP Cumulative NAAQS Comparison

Pollutant	Averaging Time	Maximum Predicted Impact (µg/m^3)	Maximum Impact Location	Background Concentration (µg/m^3)	Background Plus Impact (µg/m^3)	NAAQS Standard (µg/m^3)	Impact Percentage of NAAQS
NO_2	Annual	8.6	Ouray	17	26	100	26 %
SO_2	3-hour	2.5	Dinosaur	20	23	1300	2 %
	24-hour	0.7	Dinosaur	10	11	365	3 %
	Annual	0.1	Dinosaur	5	5	80	6 %
PM_{10}	24-hour	13.3	Ouray	28	41	150	28 %
$PM_{2.5}$	24-hour[1]	3.8	Ouray	15/52[a]	18.8	35	54 %
	Annual	1.6	Ouray	11	12.6	15	84 %
2003							
NO_2	Annual	7.7	Ouray	17	25	100	25 %
SO_2	3-hour	1.8	Dinosaur	20	22	1300	2 %
	24-hour	0.8	Dinosaur	10	11	365	3 %
	Annual	0.1	Ouray	5	5	80	6 %
PM_{10}	24-hour	8.3	Ouray	28	41	150	28 %
$PM_{2.5}$	24-hour[1]	4.1	Ouray	15/52[a]	19.1	35	55 %
	Annual	1.4	Ouray	11	12.4	15	83 %

[1] Represents the modeled "eighth maximum" concentration

[a] The state of Utah currently does not require $PM_{2.5}$ modeling for new sources and does not have an official background. The $PM_{2.5}$ provided by UDEQ (15 and 52 µg/m^3) represent 98th percentile values from limited $PM_{2.5}$ monitoring conducted in Vernal and Uintah/Duchesne Counties in 2007. The smaller figure is representative of average summer concentrations, while the larger value is representative of winter inversion conditions, based on this monitoring. Because the winter inversion $PM_{2.5}$ value does not represent typical conditions in the project area, the value for average summer conditions was used in analyzing $PM_{2.5}$ impacts from the Proposed Action. The $PM_{2.5}$ monitoring location in Uintah/Duchesne counties, Utah was located in an urban setting with a high density of inhabitants and in proximity to highways (Highway 40 and Highway 191). As such, the higher, winter time inversion $PM_{2.5}$ concentration value reflects impacts from activities and activity levels not expected in the rural and sparsely inhabited region of the project. Potential impacts from agricultural activities and wood burning would not be expected to measurable contribute to $PM_{2.5}$ concentrations in the region of the Proposed Action.

Table 6-31. WTP Cumulative + Alternative A NAAQS Comparison

Pollutant	Averaging Time	Maximum Predicted Impact (µg/m^3)	Maximum Impact Location	Background Concentration (µg/m^3)	Background Plus Impact (µg/m^3)	NAAQS Standard (µg/m^3)	Impact Percentage of NAAQS
2001							
NO_2	Annual	7.2017	Ouray	17	24.2017	100	24%
SO_2	3-hour	3.0491	Ouray	20	23.0491	1300	2%
	24-hour	0.77897	Canyonlands	10	10.77897	365	3%
	Annual	0.13789	Ouray	5	5.13789	80	6%
PM_{10}	24-hour	19.2172	Ouray	28	47.2172	150	31%
$PM_{2.5}$	24-hour[1]	3.55	Ouray	15/52[a]	18.5537	35	53%
	Annual	1.46	Ouray	11	10.4551	15	83%
2002							
NO_2	Annual	8.6462	Ouray	17	25.6462	100	26%

Table 6-31. WTP Cumulative + Alternative A NAAQS Comparison

Pollutant	Averaging Time	Maximum Predicted Impact (µg/m^3)	Maximum Impact Location	Background Concentration (µg/m^3)	Background Plus Impact (µg/m^3)	NAAQS Standard (µg/m^3)	Impact Percentage of NAAQS
SO_2	3-hour	2.522	Canyonlands	20	22.522	1300	2%
	24-hour	0.71756	Canyonlands	10	10.71756	365	3%
	Annual	0.13739	Ouray	5	5.13739	80	6%
PM_{10}	24-hour	17.0743	Ouray	28	45.0743	150	30%
$PM_{2.5}$	24-hour[1]	4.94	Ouray	15/52[a]	19.94	35	57%
	Annual	1.83	Ouray	11	12.83	15	86%
2003							
NO_2	Annual	7.7896	Ouray	17	24.7896	100	25%
SO_2	3-hour	1.7932	Dinosaur	20	21.7932	1300	2%
	24-hour	0.8257	Canyonlands	10	10.8257	365	3%
	Annual	0.1305	Ouray	5	5.1305	80	6%
PM_{10}	24-hour	16.3439	Ouray	28	44.3439	150	30%
$PM_{2.5}$	24-hour[1]	4.8072	Ouray	15/52[a]	19.81	35	57%
	Annual	1.5999	Ouray	11	12.60	15	84%

[1] Represents the modeled "eighth maximum" concentration

[a] The state of Utah currently does not require $PM_{2.5}$ modeling for new sources and does not have an official background. The $PM_{2.5}$ provided by UDEQ (15 and 52 µg/m^3) represent 98th percentile values from limited $PM_{2.5}$ monitoring conducted in Vernal and Uintah/Duchesne Counties in 2007. The smaller figure is representative of average summer concentrations, while the larger value is representative of winter inversion conditions, based on this monitoring. Because the winter inversion $PM_{2.5}$ value does not represent typical conditions in the project area, the value for average summer conditions was used in analyzing $PM_{2.5}$ impacts from the Proposed Action. The $PM_{2.5}$ monitoring location in Uintah/Duchesne counties, Utah was located in an urban setting with a high density of inhabitants and in proximity to highways (Highway 40 and Highway 191). As such, the higher, winter time inversion $PM_{2.5}$ concentration value reflects impacts from activities and activity levels not expected in the rural and sparsely inhabited region of the Proposed Action. Potential impacts from agricultural activities and wood burning would not be expected to measurable contribute to $PM_{2.5}$ concentrations in the region of the Proposed Action.

Table 6-32. WTP Cumulative + Alternative B NAAQS Comparison

Pollutant	Averaging Time	Maximum Predicted Impact (µg/m^3)	Maximum Impact Location	Background Concentration (µg/m^3)	Background Plus Impact (µg/m^3)	NAAQS Standard (µg/m^3)	Impact Percentage of NAAQS
2001							
NO_2	Annual	7.1356	Ouray	17	24.1356	100	24%
SO_2	3-hour	3.049	Ouray	20	23.049	1300	2%
	24-hour	0.77897	Canyonlands	10	10.77897	365	3%
	Annual	0.13745	Ouray	5	5.13745	80	6%
PM_{10}	24-hour	12.2658	Ouray	28	40.2658	150	27%
$PM_{2.5}$	24-hour[1]	2.9722	Ouray	15/52[a]	17.97	35	51%
	Annual	1.25	Ouray	11	12.25	15	82%
2002							
NO_2	Annual	8.6057	Ouray	17	25.6057	100	26%
SO_2	3-hour	2.522	Canyonlands	20	22.522	1300	2%

Table 6-32. WTP Cumulative + Alternative B NAAQS Comparison

Pollutant	Averaging Time	Maximum Predicted Impact (µg/m^3)	Maximum Impact Location	Background Concentration (µg/m^3)	Background Plus Impact (µg/m^3)	NAAQS Standard (µg/m^3)	Impact Percentage of NAAQS
	24-hour	0.71756	Canyonlands	10	10.71756	365	3%
	Annual	0.13708	Ouray	5	5.13708	80	6%
PM_{10}	24-hour	14.0822	Ouray	28	42.0822	150	28%
$PM_{2.5}$	24-hour[1]	4.1717	Ouray	15/52[a]	19.17	35	55%
	Annual	1.6749	Ouray	11	12.67	15	84%
2003							
NO_2	Annual	7.7524	Ouray	17	24.7524	100	25%
SO_2	3-hour	1.793	Dinosaur	20	21.793	1300	2%
	24-hour	0.82568	Canyonlands	10	10.82568	365	3%
	Annual	0.13021	Ouray	5	5.13021	80	6%
PM_{10}	24-hour	13.7431	Ouray	28	41.7431	150	28%
$PM_{2.5}$	24-hour[1]	4.2567	Ouray	15/52[a]	19.26	35	55%
	Annual	1.4564	Ouray	11	12.46	15	83%

[1] Represents the modeled "eighth maximum" concentration

[a] The state of Utah currently does not require $PM_{2.5}$ modeling for new sources and does not have an official background. The $PM_{2.5}$ provided by UDEQ (15 and 52 µg/m^3) represent 98th percentile values from limited $PM_{2.5}$ monitoring conducted in Vernal and Uintah/Duchesne Counties in 2007. The smaller figure is representative of average summer concentrations, while the larger value is representative of winter inversion conditions, based on this monitoring. Because the winter inversion $PM_{2.5}$ value does not represent typical conditions in the project area, the value for average summer conditions was used in analyzing $PM_{2.5}$ impacts from the Proposed Action. The $PM_{2.5}$ monitoring location in Uintah/Duchesne counties, Utah was located in an urban setting with a high density of inhabitants and in proximity to highways (Highway 40 and Highway 191). As such, the higher, winter time inversion $PM_{2.5}$ concentration value reflects impacts from activities and activity levels not expected in the rural and sparsely inhabited region of the Proposed Action. Potential impacts from agricultural activities and wood burning would not be expected to measurable contribute to $PM_{2.5}$ concentrations in the region of the Proposed Action.

Table 6-33. WTP Cumulative + Alternative E NAAQS Comparison							
Pollutant	**Averaging Time**	**Maximum Predicted Impact ($\mu g/m^3$)**	**Maximum Impact Location**	**Background Concentration ($\mu g/m^3$)**	**Background Plus Impact ($\mu g/m^3$)**	**NAAQS Standard ($\mu g/m^3$)**	**Impact Percentage of NAAQS**
2001							
NO_2	Annual	7.192	Ouray	17	24.192	100	24%
SO_2	3-hour	3.0491	Ouray	20	23.0491	1300	2%
	24-hour	0.77897	Canyonlands	10	10.77897	365	3%
	Annual	0.13773	Ouray	5	5.13773	80	6%
PM_{10}	24-hour	13.7102	Ouray	28	41.7102	150	28%
$PM_{2.5}$	24-hour[1]	3.2073	Ouray	15/52[a]	18.21	35	52%
	Annual	1.3787	Ouray	11	12.38	15	83%
2002							
NO_2	Annual	8.6402	Ouray	17	25.6402	100	26%
SO_2	3-hour	2.522	Canyonlands	20	22.522	1300	2%
	24-hour	0.71756	Canyonlands	10	10.71756	365	3%
	Annual	0.13727	Ouray	5	5.13727	80	6%
PM_{10}	24-hour	15.8129	Ouray	28	43.8129	150	29%
$PM_{2.5}$	24-hour[1]	4.6936	Ouray	15/52[a]	19.69	35	56%
	Annual	1.7731	Ouray	11	12.77	15	85%
2003							
NO_2	Annual	7.7841	Ouray	17	24.7841	100	25%
SO_2	3-hour	1.7931	Dinosaur	20	21.7931	1300	2%
	24-hour	0.82569	Canyonlands	10	10.82569	365	3%
	Annual	0.13039	Ouray	5	5.13039	80	6%
PM_{10}	24-hour	15.2978	Ouray	28	43.2978	150	29%
$PM_{2.5}$	24-hour[1]	4.5766	Ouray	15/52[a]	19.58	35	56%
	Annual	1.5465	Ouray	11	12.55	15	84%

[1] Represents the modeled "eighth maximum" concentration [a] The state of Utah currently does not require $PM_{2.5}$ modeling for new sources and does not have an official background. The $PM_{2.5}$ provided by UDEQ (15 and 52 $\mu g/m^3$) represent 98th percentile values from limited $PM_{2.5}$ monitoring conducted in Vernal and Uintah/Duchesne Counties in 2007. The smaller figure is representative of average summer concentrations, while the larger value is representative of winter inversion conditions, based on this monitoring. Because the winter inversion $PM_{2,5}$ value does not represent typical conditions in the project area, the value for average summer conditions was used in analyzing $PM_{2.5}$ impacts from the Proposed Action. The $PM_{2.5}$ monitoring location in Uintah/Duchesne counties, Utah was located in an urban setting with a high density of inhabitants and in proximity to highways (Highway 40 and Highway 191). As such, the higher, winter time inversion $PM_{2.5}$ concentration value reflects impacts from activities and activity levels not expected in the rural and sparsely inhabited region of the Proposed Action. Potential impacts from agricultural activities and wood burning would not be expected to measurable contribute to $PM_{2.5}$ concentrations in the region of the Proposed Action.

Table 6-34. WTP Alternative A (Proposed Action) PSD Class I & II Comparison						
Area of Special Concern	**NO_2 (% of PSD)**	**SO_2 (% of PSD)**			**PM_{10} (% of PSD)**	
	Annual	**3-hour**	**24-hour**	**Annual**	**24-hour**	**Annual**

Table 6-34. WTP Alternative A (Proposed Action) PSD Class I & II Comparison						
Area of Special Concern	NO_2 (% of PSD)	SO_2 (% of PSD)			PM_{10} (% of PSD)	
	Annual	3-hour	24-hour	Annual	24-hour	Annual
2001						
Arches NP (I)	0	0	0	0	17	1
Black Canyon of the Gunnison WA (I)	0	0	0	0	4	0
Canyonlands NP (I)	0	0	0	0	32	1
Capitol Reef NP (I)	0	0	0	0	10	0
Flat Tops WA (I)	0	0	0	0	10	1
La Garita WA (I)	0	0	0	0	1	0
Maroon Bells-Snowmass WA (I)	0	0	0	0	5	0
Weminuche WA (I)	0	0	0	0	1	0
West Elk WA (I)	0	0	0	0	3	0
Dinosaur NM (II)	0	0	0	0	18	3
Brown Park NWR (II)	0	0	0	0	18	3
Colorado NM (II)	0	0	0	0	3	0
Flaming Gorge NRA (II)	0	0	0	0	4	1
Ouray NWR (II)	1	0	0	0	49	8
Ragged WA (II)	0	0	0	0	1	0
High Uintas WA (II)	0	0	0	0	2	0
2002						
Arches NP (I)	0	0	0	0	12	2
Black Canyon of the Gunnison WA (I)	0	0	0	0	3	0
Canyonlands NP (I)	0	0	0	0	10	1
Capitol Reef NP (I)	0	0	0	0	5	0
Flat Tops WA (I)	0	0	0	0	3	1
La Garita WA (I)	0	0	0	0	1	0
Maroon Bells-Snowmass WA (I)	0	0	0	0	2	0
Weminuche WA (I)	0	0	0	0	1	0
West Elk WA (I)	0	0	0	0	3	0
Dinosaur NM (II)	0	0	0	0	6	2
Brown Park NWR (II)	0	0	0	0	5	1
Colorado NM (II)	0	0	0	0	3	0
Flaming Gorge NRA (II)	0	0	0	0	4	1
Ouray NWR (II)	1	0	0	0	49	1
Ragged WA (II)	0	0	0	0	1	0
High Uintas WA (II)	0	0	0	0	2	0
2003						
Arches NP (I)	0	0	0	0	12	2
Black Canyon of the Gunnison WA (I)	0	0	0	0	2	0
Canyonlands NP (I)	0	0	0	0	14	1
Capitol Reef NP (I)	0	0	0	0	5	0

Table 6-34. WTP Alternative A (Proposed Action) PSD Class I & II Comparison						
Area of Special Concern	NO_2 (% of PSD)	SO_2 (% of PSD)			PM_{10} (% of PSD)	
	Annual	3-hour	24-hour	Annual	24-hour	Annual
Flat Tops WA (I)	0	0	0	0	4	1
La Garita WA (I)	0	0	0	0	1	0
Maroon Bells-Snowmass WA (I)	0	0	0	0	3	0
Weminuche WA (I)	0	0	0	0	1	0
West Elk WA (I)	0	0	0	0	2	0
Dinosaur NM (II)	0	0	0	0	7	1
Brown Park NWR (II)	0	0	0	0	2	0
Colorado NM (II)	0	0	0	0	2	0
Flaming Gorge NRA (II)	0	0	0	0	2	0
Ouray NWR (II)	0	0	0	0	30	6
Ragged WA (II)	0	0	0	0	1	0
High Uintas WA (II)	0	0	0	0	3	0

Table 6-35. WTP Alternative B (No Action) PSD Class I & II Comparison						
Area of Special Concern	NO_2 (% of PSD)	SO_2 (% of PSD)			PM_{10} (% of PSD)	
	Annual	3-hour	24-hour	Annual	24-hour	Annual
2001						
Arches NP (I)	0	0	0	0	3	0
Black Canyon of the Gunnison WA (I)	0	0	0	0	1	0
Canyonlands NP (I)	0	0	0	0	4	0
Capitol Reef NP (I)	0	0	0	0	2	0
Flat Tops WA (I)	0	0	0	0	1	0
La Garita WA (I)	0	0	0	0	0	0
Maroon Bells-Snowmass WA (I)	0	0	0	0	1	0
Weminuche WA (I)	0	0	0	0	0	0
West Elk WA (I)	0	0	0	0	0	0
Dinosaur NM (II)	0	0	0	0	3	1
Brown Park NWR (II)	0	0	0	0	1	0
Colorado NM (II)	0	0	0	0	0	0
Flaming Gorge NRA (II)	0	0	0	0	1	0
Ouray NWR (II)	0	0	0	0	9	2
Ragged WA (II)	0	0	0	0	0	0
High Uintas WA (II)	0	0	0	0	1	0
2002						
Arches NP (I)	0	0	0	0	4	0
Black Canyon of the Gunnison WA (I)	0	0	0	0	1	0
Canyonlands NP (I)	0	0	0	0	3	0
Capitol Reef NP (I)	0	0	0	0	2	0

Table 6-35. WTP Alternative B (No Action) PSD Class I & II Comparison						
Area of Special Concern	NO_2 (% of PSD)	SO_2 (% of PSD)			PM_{10} (% of PSD)	
	Annual	3-hour	24-hour	Annual	24-hour	Annual
Flat Tops WA (I)	0	0	0	0	1	0
La Garita WA (I)	0	0	0	0	0	0
Maroon Bells-Snowmass WA (I)	0	0	0	0	1	0
Weminuche WA (I)	0	0	0	0	0	0
West Elk WA (I)	0	0	0	0	1	0
Dinosaur NM (II)	0	0	0	0	2	0
Brown Park NWR (II)	0	0	0	0	1	0
Colorado NM (II)	0	0	0	0	1	0
Flaming Gorge NRA (II)	0	0	0	0	1	0
Ouray NWR (II)	0	0	0	0	9	2
Ragged WA (II)	0	0	0	0	0	0
High Uintas WA (II)	0	0	0	0	2	0
2003						
Arches NP (I)	0	0	0	0	4	1
Black Canyon of the Gunnison WA (I)	0	0	0	0	0	0
Canyonlands NP (I)	0	0	0	0	4	0
Capitol Reef NP (I)	0	0	0	0	1	0
Flat Tops WA (I)	0	0	0	0	1	0
La Garita WA (I)	0	0	0	0	0	0
Maroon Bells-Snowmass WA (I)	0	0	0	0	1	0
Weminuche WA (I)	0	0	0	0	0	0
West Elk WA (I)	0	0	0	0	1	0
Dinosaur NM (II)	0	0	0	0	2	0
Brown Park NWR (II)	0	0	0	0	1	0
Colorado NM (II)	0	0	0	0	1	0
Flaming Gorge NRA (II)	0	0	0	0	1	0
Ouray NWR (II)	0	0	0	0	9	2
Ragged WA (II)	0	0	0	0	0	0
High Uintas WA (II)	0	0	0	0	1	0

Table 6-36. WTP Alternative E (BLM Preferred) PSD Class I & II Comparison						
Area of Special Concern	NO_2 (% of PSD)	SO_2 (% of PSD)			PM_{10} (% of PSD)	
	Annual	3-hour	24-hour	Annual	24-hour	Annual
2001						
Arches NP (I)	0	0	0	0	7	1
Black Canyon of the Gunnison WA (I)	0	0	0	0	1	0
Canyonlands NP (I)	0	0	0	0	10	1

Table 6-36. WTP Alternative E (BLM Preferred) PSD Class I & II Comparison						
Area of Special Concern	NO_2 (% of PSD)	SO_2 (% of PSD)			PM_{10} (% of PSD)	
	Annual	3-hour	24-hour	Annual	24-hour	Annual
Capitol Reef NP (I)	0	0	0	0	5	0
Flat Tops WA (I)	0	0	0	0	3	0
La Garita WA (I)	0	0	0	0	1	0
Maroon Bells-Snowmass WA (I)	0	0	0	0	1	0
Weminuche WA (I)	0	0	0	0	1	0
West Elk WA (I)	0	0	0	0	1	0
Dinosaur NM (II)	0	0	0	0	6	2
Brown Park NWR (II)	0	0	0	0	2	1
Colorado NM (II)	0	0	0	0	1	0
Flaming Gorge NRA (II)	0	0	0	0	3	0
Ouray NWR (II)	0	0	0	0	22	6
Ragged WA (II)	0	0	0	0	0	0
High Uintas WA (II)	0	0	0	0	1	0
2002						
Arches NP (I)	0	0	0	0	9	1
Black Canyon of the Gunnison WA (I)	0	0	0	0	3	0
Canyonlands NP (I)	0	0	0	0	7	1
Capitol Reef NP (I)	0	0	0	0	4	0
Flat Tops WA (I)	0	0	0	0	2	0
La Garita WA (I)	0	0	0	0	1	0
Maroon Bells-Snowmass WA (I)	0	0	0	0	2	0
Weminuche WA (I)	0	0	0	0	1	0
West Elk WA (I)	0	0	0	0	2	0
Dinosaur NM (II)	0	0	0	0	5	1
Brown Park NWR (II)	0	0	0	0	2	0
Colorado NM (II)	0	0	0	0	1	0
Flaming Gorge NRA (II)	0	0	0	0	2	0
Ouray NWR (II)	0	0	0	0	21	5
Ragged WA (II)	0	0	0	0	0	0
High Uintas WA (II)	0	0	0	0	4	0
2003						
Arches NP (I)	0	0	0	0	9	1
Black Canyon of the Gunnison WA (I)	0	0	0	0	1	0
Canyonlands NP (I)	0	0	0	0	10	1
Capitol Reef NP (I)	0	0	0	0	3	0
Flat Tops WA (I)	0	0	0	0	3	0
La Garita WA (I)	0	0	0	0	1	0
Maroon Bells-Snowmass WA (I)	0	0	0	0	2	0
Weminuche WA (I)	0	0	0	0	1	0
West Elk WA (I)	0	0	0	0	1	0

Table 6-36. WTP Alternative E (BLM Preferred) PSD Class I & II Comparison

Area of Special Concern	NO_2 (% of PSD)	SO_2 (% of PSD)			PM_{10} (% of PSD)	
	Annual	3-hour	24-hour	Annual	24-hour	Annual
Dinosaur NM (II)	0	0	0	0	5	1
Brown Park NWR (II)	0	0	0	0	2	0
Colorado NM (II)	0	0	0	0	2	0
Flaming Gorge NRA (II)	0	0	0	0	1	0
Ouray NWR (II)	0	0	0	0	23	4
Ragged WA (II)	0	0	0	0	1	0
High Uintas WA (II)	0	0	0	0	2	0

Table 6-37. WTP Cumulative PSD Class I & II Comparison

Area of Special Concern	NO_2 (% of PSD)	SO_2 (% of PSD)			PM_{10} (% of PSD)	
	Annual	3-hour	24-hour	Annual	24-hour	Annual
2001						
Arches NP (I)	1	6	10	2	2	0
Black Canyon of the Gunnison WA (I)	0	1	2	0	2	0
Canyonlands NP (I)	1	7	16	2	2	0
Capitol Reef NP (I)	0	6	9	0	2	0
Flat Tops WA (I)	4	1	2	1	5	1
La Garita WA (I)	0	0	0	0	1	0
Maroon Bells-Snowmass WA (I)	3	1	1	0	4	1
Weminuche WA (I)	0	1	1	0	1	0
West Elk WA (I)	1	1	1	0	2	0
Dinosaur NM (II)	4	0	1	0	8	3
Brown Park NWR (II)	1	0	0	0	2	1
Colorado NM (II)	0	0	0	0	1	0
Flaming Gorge NRA (II)	0	0	0	0	1	0
Ouray NWR (II)	28	1	1	1	38	26
Ragged WA (II)	0	0	0	0	1	0
High Uintas WA (II)	0	0	0	0	0	0
2002						
Arches NP (I)	1	7	10	2	2	0
Black Canyon of the Gunnison WA (I)	1	1	2	0	2	0
Canyonlands NP (I)	0	10	14	3	3	0
Capitol Reef NP (I)	0	5	6	1	1	0
Flat Tops WA (I)	3	2	2	1	3	1
La Garita WA (I)	0	1	1	0	1	0
Maroon Bells-Snowmass WA (I)	3	1	2	0	5	1
Weminuche WA (I)	0	0	1	0	0	0
West Elk WA (I)	1	1	1	0	2	0
Dinosaur NM (II)	3	0	1	0	9	2
Brown Park NWR (II)	0	0	0	0	2	0
Colorado NM (II)	0	0	0	0	1	0
Flaming Gorge NRA (II)	0	0	0	0	2	0
Ouray NWR (II)	34	0	1	1	44	31
Ragged WA (II)	0	0	0	0	1	0
High Uintas WA (II)	0	0	0	0	1	0
2003						
Arches NP (I)	1	6	11	2	2	0
Black Canyon of the Gunnison WA (I)	1	1	2	0	1	0

Table 6-37. WTP Cumulative PSD Class I & II Comparison

Area of Special Concern	NO_2 (% of PSD)	SO_2 (% of PSD)			PM_{10} (% of PSD)	
	Annual	3-hour	24-hour	Annual	24-hour	Annual
Canyonlands NP (I)	0	7	17	2	1	0
Capitol Reef NP (I)	0	5	10	1	1	0
Flat Tops WA (I)	4	2	3	1	4	1
La Garita WA (I)	0	0	1	0	1	0
Maroon Bells-Snowmass WA (I)	4	1	2	0	3	1
Weminuche WA (I)	0	0	0	0	1	0
West Elk WA (I)	1	1	1	0	2	0
Dinosaur NM (II)	2	0	1	0	6	2
Brown Park NWR (II)	0	0	0	0	1	0
Colorado NM (II)	0	0	0	0	1	0
Flaming Gorge NRA (II)	0	0	0	0	1	0
Ouray NWR (II)	31	0	1	1	44	29
Ragged WA (II)	0	0	0	0	1	0
High Uintas WA (II)	0	0	0	0	1	0

Table 6-38. WTP Cumulative + Alternative A PSD Class I & II Comparison

Area of Special Concern	NO_2 (% of PSD)	SO_2 (% of PSD)			PM_{10} (% of PSD)	
	Annual	3-hour	24-hour	Annual	24-hour	Annual
2001						
Arches NP (I)	1	6	10	2	17	1
Black Canyon of the Gunnison WA (I)	1	1	2	0	4	0
Canyonlands NP (I)	1	7	16	2	33	1
Capitol Reef NP (I)	0	6	9	0	12	0
Flat Tops WA (I)	4	1	2	1	12	2
La Garita WA (I)	0	0	1	0	1	0
Maroon Bells-Snowmass WA (I)	3	1	1	0	6	1
Weminuche WA (I)	0	1	1	0	1	0
West Elk WA (I)	1	1	1	0	3	0
Dinosaur NM (II)	4	0	1	0	23	5
Brown Park NWR (II)	1	0	0	0	6	1
Colorado NM (II)	0	0	0	0	3	0
Flaming Gorge NRA (II)	0	0	0	0	5	1
Ouray NWR (II)	29	1	1	1	64	33
Ragged WA (II)	0	0	0	0	2	0
High Uintas WA (II)	0	0	0	0	3	0
2002						
Arches NP (I)	1	7	10	2	13	2
Black Canyon of the Gunnison	1	1	2	0	4	1

Table 6-38. WTP Cumulative + Alternative A PSD Class I & II Comparison

Area of Special Concern	NO_2 (% of PSD)	SO_2 (% of PSD)			PM_{10} (% of PSD)	
	Annual	3-hour	24-hour	Annual	24-hour	Annual
WA (I)						
Canyonlands NP (I)	1	10	14	3	11	1
Capitol Reef NP (I)	0	5	6	1	6	0
Flat Tops WA (I)	3	2	2	1	5	2
La Garita WA (I)	0	1	1	0	2	0
Maroon Bells-Snowmass WA (I)	3	1	2	0	5	1
Weminuche WA (I)	0	0	1	0	2	0
West Elk WA (I)	1	1	1	0	4	1
Dinosaur NM (II)	3	0	1	0	14	4
Brown Park NWR (II)	0	0	0	0	3	1
Colorado NM (II)	0	0	0	0	2	1
Flaming Gorge NRA (II)	0	0	0	0	4	1
Ouray NWR (II)	35	0	1	1	57	35
Ragged WA (II)	0	0	0	0	1	0
High Uintas WA (II)	0	0	0	0	6	0
2003						
Arches NP (I)	1	6	11	2	13	2
Black Canyon of the Gunnison WA (I)	1	1	2	0	2	1
Canyonlands NP (I)	1	7	17	2	15	1
Capitol Reef NP (I)	0	4	10	1	5	0
Flat Tops WA (I)	4	2	3	1	6	2
La Garita WA (I)	0	0	1	0	1	0
Maroon Bells-Snowmass WA (I)	4	1	2	0	5	1
Weminuche WA (I)	0	0	1	0	1	0
West Elk WA (I)	1	1	1	0	3	1
Dinosaur NM (II)	2	0	1	0	12	3
Brown Park NWR (II)	0	0	0	0	3	1
Colorado NM (II)	0	0	0	0	2	0
Flaming Gorge NRA (II)	0	0	0	0	2	0
Ouray NWR (II)	31	0	1	1	54	33
Ragged WA (II)	0	0	0	0	1	0
High Uintas WA (II)	0	0	0	0	4	0

Table 6-39. WTP Cumulative + Alternative B PSD Class I & II Comparison

Area of Special Concern	NO_2 (% of PSD)	SO_2 (% of PSD)			PM_{10} (% of PSD)	
	Annual	3-hour	24-hour	Annual	24-hour	Annual
2001						
Arches NP (I)	1	6	10	2	4	1
Black Canyon of the Gunnison WA (I)	0	1	2	0	2	0
Canyonlands NP (I)	1	7	16	2	5	0
Capitol Reef NP (I)	0	6	9	0	4	0
Flat Tops WA (I)	4	1	2	1	5	1
La Garita WA (I)	0	0	1	0	1	0
Maroon Bells-Snowmass WA (I)	3	1	1	0	4	1
Weminuche WA (I)	0	1	1	0	1	0
West Elk WA (I)	1	1	1	0	2	0
Dinosaur NM (II)	4	0	1	0	10	4
Brown Park NWR (II)	1	0	0	0	2	1
Colorado NM (II)	0	0	0	0	1	0
Flaming Gorge NRA (II)	0	0	0	0	2	0
Ouray NWR (II)	29	1	1	1	41	28
Ragged WA (II)	0	0	0	0	1	0
High Uintas WA (II)	0	0	0	0	1	0
2002						
Arches NP (I)	1	7	10	2	5	1
Black Canyon of the Gunnison WA (I)	1	1	2	0	2	0
Canyonlands NP (I)	0	10	14	3	6	0
Capitol Reef NP (I)	0	5	6	1	3	0
Flat Tops WA (I)	3	2	2	1	3	1
La Garita WA (I)	0	1	1	0	1	0
Maroon Bells-Snowmass WA (I)	3	1	2	0	5	1
Weminuche WA (I)	0	0	1	0	1	0
West Elk WA (I)	1	1	1	0	2	0
Dinosaur NM (II)	3	0	1	0	10	3
Brown Park NWR (II)	0	0	0	0	2	1
Colorado NM (II)	0	0	0	0	1	0
Flaming Gorge NRA (II)	0	0	0	0	2	0
Ouray NWR (II)	34	0	1	1	47	32
Ragged WA (II)	0	0	0	0	1	0
High Uintas WA (II)	0	0	0	0	3	0
2003						
Arches NP (I)	1	6	11	2	4	1
Black Canyon of the Gunnison WA (I)	1	1	2	0	2	0

Table 6-39. WTP Cumulative + Alternative B PSD Class I & II Comparison

Area of Special Concern	NO_2 (% of PSD)	SO_2 (% of PSD)			PM_{10} (% of PSD)	
	Annual	3-hour	24-hour	Annual	24-hour	Annual
Canyonlands NP (I)	0	7	17	2	5	1
Capitol Reef NP (I)	0	5	10	1	2	0
Flat Tops WA (I)	4	2	3	1	4	2
La Garita WA (I)	0	0	1	0	1	0
Maroon Bells-Snowmass WA (I)	4	1	2	0	3	1
Weminuche WA (I)	0	0	1	0	1	0
West Elk WA (I)	1	1	1	0	2	0
Dinosaur NM (II)	2	0	1	0	8	2
Brown Park NWR (II)	0	0	0	0	2	0
Colorado NM (II)	0	0	0	0	1	0
Flaming Gorge NRA (II)	0	0	0	0	1	0
Ouray NWR (II)	31	0	1	1	46	30
Ragged WA (II)	0	0	0	0	1	0
High Uintas WA (II)	0	0	0	0	1	0

Table 6-40. WTP Cumulative + Alternative E PSD Class I & II Comparison

Area of Special Concern	NO_2 (% of PSD)	SO_2 (% of PSD)			PM_{10} (% of PSD)	
	Annual	3-hour	24-hour	Annual	24-hour	Annual
2001						
Arches NP (I)	1	6	10	2	8	1
Black Canyon of the Gunnison WA (I)	1	1	2	0	2	0
Canyonlands NP (I)	1	7	16	2	11	1
Capitol Reef NP (I)	0	6	9	0	7	0
Flat Tops WA (I)	4	1	2	1	5	2
La Garita WA (I)	0	0	1	0	1	0
Maroon Bells-Snowmass WA (I)	3	1	1	0	4	1
Weminuche WA (I)	0	1	1	0	1	0
West Elk WA (I)	1	1	1	0	2	0
Dinosaur NM (II)	4	0	1	0	12	5
Brown Park NWR (II)	1	0	0	0	3	1
Colorado NM (II)	0	0	0	0	2	0
Flaming Gorge NRA (II)	0	0	0	0	3	1
Ouray NWR (II)	29	1	1	1	46	31
Ragged WA (II)	0	0	0	0	1	0
High Uintas WA (II)	0	0	0	0	1	0
2002						
Arches NP (I)	1	7	10	2	10	1
Black Canyon of the Gunnison	1	1	2	0	3	1

Table 6-40. WTP Cumulative + Alternative E PSD Class I & II Comparison						
Area of Special Concern	NO_2 (% of PSD)	SO_2 (% of PSD)			PM_{10} (% of PSD)	
	Annual	3-hour	24-hour	Annual	24-hour	Annual
WA (I)						
Canyonlands NP (I)	0	10	14	3	9	1
Capitol Reef NP (I)	0	5	6	1	5	0
Flat Tops WA (I)	3	2	2	1	4	2
La Garita WA (I)	0	1	1	0	1	0
Maroon Bells-Snowmass WA (I)	3	1	2	0	5	1
Weminuche WA (I)	0	0	1	0	1	0
West Elk WA (I)	1	1	1	0	3	0
Dinosaur NM (II)	3	0	1	0	12	4
Brown Park NWR (II)	0	0	0	0	3	1
Colorado NM (II)	0	0	0	0	2	0
Flaming Gorge NRA (II)	0	0	0	0	4	1
Ouray NWR (II)	35	0	1	1	53	34
Ragged WA (II)	0	0	0	0	1	0
High Uintas WA (II)	0	0	0	0	5	0
2003						
Arches NP (I)	1	6	11	2	10	2
Black Canyon of the Gunnison WA (I)	1	1	2	0	2	0
Canyonlands NP (I)	1	7	17	2	11	1
Capitol Reef NP (I)	0	5	10	1	4	0
Flat Tops WA (I)	4	2	3	1	5	2
La Garita WA (I)	0	0	1	0	1	0
Maroon Bells-Snowmass WA (I)	4	1	2	0	4	1
Weminuche WA (I)	0	0	1	0	1	0
West Elk WA (I)	1	1	1	0	2	0
Dinosaur NM (II)	2	0	1	0	11	3
Brown Park NWR (II)	0	0	0	0	3	1
Colorado NM (II)	0	0	0	0	2	0
Flaming Gorge NRA (II)	0	0	0	0	2	0
Ouray NWR (II)	31	0	1	1	51	32
Ragged WA (II)	0	0	0	0	1	0
High Uintas WA (II)	0	0	0	0	3	0

7.0 REFERENCES

Buys & Associates. 2007a. Emissions Inventory for the West Tavaputs Plateau Oil & Gas Development Draft EIS. Prepared for Bureau of Land Management.

Buys & Associates. 2007b. Near-Field Air Quality Impact Assessment Report for the West Tavaputs Plateau Oil & Gas Development Draft EIS. Prepared for Bureau of Land Management.

Fox, Douglas, et al., 1989. A Screening Procedure to Evaluate Air Pollution Effects on Class I Wilderness Areas. Report RM-168. US Department of Agriculture, Rocky Mountain Forest and Range Experiment Station. Fort Collins, CO.

Environmental Protection Agency 1998. Interagency Workgroup on Air Quality Modeling (IWAQM): Phase II Summary Report and Recommendations for Modeling Long Range Transport Impacts. EPA-454/R/98-019, Research Triangle Park, NC, December 1998.

APPENDIX J-1

EXAMPLE CALMET INPUT FILE

```
WTP Calmet Run 1/2001_1


---------------- Run title (3 lines) ----------------------------------------

                    CALMET MODEL CONTROL FILE
                    -------------------------

-------------------------------------------------------------------------------

INPUT GROUP: 0 -- Input and Output File Names


Subgroup (a)
------------
Default Name  Type          File Name
------------  ----          ---------
GEO.DAT       input    ! GEODAT = WTP200~1\GEO.DAT !
SURF.DAT      input    ! SRFDAT = WTP200~2\surf01.dat !
CLOUD.DAT     input    * CLDDAT = *
PRECIP.DAT    input    ! PRCDAT = WTP200~2\PRECIP.DAT !
MM4.DAT       input    ! MM4DAT = C:\CALMET\WTP\EXTRAC~1\2001\01_200~1 !
WT.DAT        input    * WTDAT = *

CALMET.LST    output   ! METLST = WTP200~2\CALMET11.LST !
CALMET.DAT    output   ! METDAT = WTP200~2\CALMET11.DAT !
PACOUT.DAT    output   * PACDAT = *

All file names will be converted to lower case if LCFILES = T
Otherwise, if LCFILES = F, file names will be converted to UPPER CASE
         T = lower case      ! LCFILES = F !
         F = UPPER CASE

NUMBER OF UPPER AIR & OVERWATER STATIONS:

    Number of upper air stations (NUSTA)  No default     ! NUSTA = 3 !
    Number of overwater met stations
                                 (NOWSTA) No default     ! NOWSTA = 0 !

                       !END!
-------------------------------------------------------------------------------
Subgroup (b)
--------------------------------
Upper air files (one per station)
--------------------------------
Default Name  Type       File Name
------------  ----       ---------
UP1.DAT     input   1  ! UPDAT=WTP200~2\UP_24127.DAT!    !END!
UP2.DAT     input   2  ! UPDAT=WTP200~2\UP_24061.DAT!    !END!
UP3.DAT     input   3  ! UPDAT=WTP200~2\UP_23066.DAT!    !END!

-------------------------------------------------------------------------------
Subgroup (c)
----------------------------------------
Overwater station files (one per station)
----------------------------------------
Default Name  Type       File Name
------------  ----       ---------

-------------------------------------------------------------------------------
Subgroup (d)
----------------
Other file names
----------------

Default Name  Type       File Name
------------  ----       ---------
DIAG.DAT      input      * DIADAT = *
PROG.DAT      input      * PRGDAT = *
```

```
TEST.PRT      output     * TSTPRT = *
TEST.OUT      output     * TSTOUT = *
TEST.KIN      output     * TSTKIN = *
TEST.FRD      output     * TSTFRD = *
TEST.SLP      output     * TSTSLP = *

-------------------------------------------------------------------------------
NOTES: (1) File/path names can be up to 70 characters in length
       (2) Subgroups (a) and (d) must have ONE 'END' (surround by
           delimiters) at the end of the group
       (3) Subgroups (b) and (c) must have an 'END' (surround by
           delimiters) at the end of EACH LINE

                        !END!


-----------------------------------------------------------------------------

INPUT GROUP: 1 -- General run control parameters
--------------

     Starting date:   Year (IBYR) -- No default       ! IBYR = 2001 !
                     Month (IBMO) -- No default       ! IBMO = 1 !
                       Day (IBDY) -- No default       ! IBDY = 1 !
                      Hour (IBHR) -- No default       ! IBHR = 0 !

     Base time zone        (IBTZ) -- No default       ! IBTZ = 7 !
        PST = 08, MST = 07
        CST = 06, EST = 05

     Length of run (hours) (IRLG) -- No default       ! IRLG = 360 !

     Run type            (IRTYPE) -- Default: 1       ! IRTYPE = 1 !

        0 = Computes wind fields only
        1 = Computes wind fields and micrometeorological variables
            (u*, w*, L, zi, etc.)
        (IRTYPE must be 1 to run CALPUFF or CALGRID)

     Compute special data fields required
     by CALGRID (i.e., 3-D fields of W wind
     components and temperature)
     in additional to regular            Default: T    ! LCALGRD = T !
     fields ? (LCALGRD)
     (LCALGRD must be T to run CALGRID)

      Flag to stop run after
      SETUP phase (ITEST)             Default: 2       ! ITEST = 2 !
      (Used to allow checking
      of the model inputs, files, etc.)
      ITEST = 1 - STOPS program after SETUP phase
      ITEST = 2 - Continues with execution of
                  COMPUTATIONAL phase after SETUP

!END!

-----------------------------------------------------------------------------

INPUT GROUP: 2 -- Map Projection and Grid control parameters
--------------

     Projection for all (X,Y):
     -------------------------

     Map projection
     (PMAP)                     Default: UTM    ! PMAP = LCC !

         UTM :  Universal Transverse Mercator
         TTM :  Tangential Transverse Mercator
         LCC :  Lambert Conformal Conic
```

```
     PS :  Polar Stereographic
     EM :  Equatorial Mercator
   LAZA :  Lambert Azimuthal Equal Area

False Easting and Northing (km) at the projection origin
(Used only if PMAP= TTM, LCC, or LAZA)
(FEAST)                    Default=0.0     ! FEAST = 0 !
(FNORTH)                   Default=0.0     ! FNORTH = 0 !

UTM zone (1 to 60)
(Used only if PMAP=UTM)
(IUTMZN)                   No Default      ! IUTMZN = 0 !

Hemisphere for UTM projection?
(Used only if PMAP=UTM)
(UTMHEM)                   Default: N      ! UTMHEM = N !
    N   :  Northern hemisphere projection
    S   :  Southern hemisphere projection

Latitude and Longitude (decimal degrees) of projection origin
(Used only if PMAP= TTM, LCC, PS, EM, or LAZA)
(RLAT0)                    No Default      ! RLAT0 = 37.02N !
(RLON0)                    No Default      ! RLON0 = 111.98W !

    TTM :  RLON0 identifies central (true N/S) meridian of projection
           RLAT0 selected for convenience
    LCC :  RLON0 identifies central (true N/S) meridian of projection
           RLAT0 selected for convenience
    PS  :  RLON0 identifies central (grid N/S) meridian of projection
           RLAT0 selected for convenience
    EM  :  RLON0 identifies central meridian of projection
           RLAT0 is REPLACED by 0.0N (Equator)
    LAZA:  RLON0 identifies longitude of tangent-point of mapping plane
           RLAT0 identifies latitude of tangent-point of mapping plane

Matching parallel(s) of latitude (decimal degrees) for projection
(Used only if PMAP= LCC or PS)
(XLAT1)                    No Default      ! XLAT1 = 30.00N !
(XLAT2)                    No Default      ! XLAT2 = 60.00N !

    LCC :  Projection cone slices through Earth's surface at XLAT1 and XLAT2
    PS  :  Projection plane slices through Earth at XLAT1
           (XLAT2 is not used)

----------
Note:  Latitudes and longitudes should be positive, and include a
       letter N,S,E, or W indicating north or south latitude, and
       east or west longitude.  For example,
       35.9  N Latitude  =  35.9N
       118.7 E Longitude = 118.7E


Datum-region
------------

The Datum-Region for the coordinates is identified by a character
string.  Many mapping products currently available use the model of the
Earth known as the World Geodetic System 1984 (WGS-G ).  Other local
models may be in use, and their selection in CALMET will make its output
consistent with local mapping products.  The list of Datum-Regions with
official transformation parameters provided by the National Imagery and
Mapping Agency (NIMA).

NIMA Datum - Regions(Examples)
------------------------------------------------------------------------------
WGS-G     WGS-84 GRS 80, Global coverage
NAS-C     NORTH AMERICAN 1927 Clarke 1866, MEAN FOR (CONUS)
NWS-27    NWS 6370KM Radius, Global Sphere (NAD27)
NWS-84    NWS 6370KM Radius, Global Sphere (WGS84)
ESR-S     ESRI REFERENCE Normal Sphere (6371KM Radius), Global Reference Sphere
```

```
     Datum-region for output coordinates
     (DATUM)                    Default: WGS-G     ! DATUM = WGS-G !


     Horizontal grid definition:
     ---------------------------

     Rectangular grid defined for projection PMAP,
     with X the Easting and Y the Northing coordinate

            No. X grid cells (NX)      No default     ! NX = 129 !
            No. Y grid cells (NY)      No default     ! NY = 124 !

     Grid spacing (DGRIDKM)            No default     ! DGRIDKM = 4 !
                                       Units: km

     Reference grid coordinate of
     SOUTHWEST corner of grid cell (1,1)

        X coordinate (XORIGKM)         No default     ! XORIGKM = 0 !
        Y coordinate (YORIGKM)         No default     ! YORIGKM = 0 !
                                       Units: km


     Vertical grid definition:
     -------------------------

        No. of vertical layers (NZ)    No default     ! NZ = 12 !

        Cell face heights in arbitrary
        vertical grid (ZFACE(NZ+1))    No defaults
                                       Units: m
        !                                      ZFACE                                      =
               0.00,20.00,40.00,80.00,160.00,320.00,640.00,1000.00,1500.00,2000.00,2500.0
               0,3000.00,3500.00 !

!END!


-------------------------------------------------------------------------------

INPUT GROUP: 3 -- Output Options
--------------


    DISK OUTPUT OPTION

       Save met. fields in an unformatted
       output file ?              (LSAVE)  Default: T     ! LSAVE = T !
       (F = Do not save, T = Save)

       Type of unformatted output file:
       (IFORMO)                            Default: 1    ! IFORMO = 1 !

            1 = CALPUFF/CALGRID type file (CALMET.DAT)
            2 = MESOPUFF-II type file     (PACOUT.DAT)


    LINE PRINTER OUTPUT OPTIONS:

       Print met. fields ?  (LPRINT)       Default: F     ! LPRINT = F !
       (F = Do not print, T = Print)
       (NOTE: parameters below control which
              met. variables are printed)

       Print interval
       (IPRINF) in hours                   Default: 1     ! IPRINF = 1 !
       (Meteorological fields are printed
        every  6  hours)
```

```
 Specify which layers of U, V wind component
 to print (IUVOUT(NZ)) -- NOTE: NZ values must be entered
 (0=Do not print, 1=Print)
 (used only if LPRINT=T)        Defaults: NZ*0
 * IUVOUT = *
 -----------------------


 Specify which levels of the W wind component to print
 (NOTE: W defined at TOP cell face --  6  values)
 (IWOUT(NZ)) -- NOTE: NZ values must be entered
 (0=Do not print, 1=Print)
 (used only if LPRINT=T & LCALGRD=T)
 -----------------------------------
                                     Defaults: NZ*0
  * IWOUT = *


 Specify which levels of the 3-D temperature field to print
 (ITOUT(NZ)) -- NOTE: NZ values must be entered
 (0=Do not print, 1=Print)
 (used only if LPRINT=T & LCALGRD=T)
 -----------------------------------
                                     Defaults: NZ*0
  * ITOUT = *

 Specify which meteorological fields
 to print
 (used only if LPRINT=T)             Defaults: 0 (all variables)
 -----------------------


   Variable            Print ?
                   (0 = do not print,
                    1 = print)
   --------        ------------------

! STABILITY = 0 ! - PGT stability class
! USTAR = 0 ! - Friction velocity
! MONIN = 0 ! - Monin-Obukhov length
! MIXHT = 0 ! - Mixing height
! WSTAR = 0 ! - Convective velocity scale
! PRECIP = 0 ! - Precipitation rate
! SENSHEAT = 0 ! - Sensible heat flux
! CONVZI = 0 ! - Convective mixing ht.


 Testing and debug print options for micrometeorological module

    Print input meteorological data and
    internal variables (LDB)         Default: F       ! LDB = F !
    (F = Do not print, T = print)
    (NOTE: this option produces large amounts of output)

    First time step for which debug data
    are printed (NN1)                Default: 1       ! NN1 = 1 !

    Last time step for which debug data
    are printed (NN2)                Default: 1       ! NN2 = 1 !


 Testing and debug print options for wind field module
 (all of the following print options control output to
  wind field module's output files: TEST.PRT, TEST.OUT,
  TEST.KIN, TEST.FRD, and TEST.SLP)

    Control variable for writing the test/debug
    wind fields to disk files (IOUTD)
    (0=Do not write, 1=write)        Default: 0       ! IOUTD = 0 !

    Number of levels, starting at the surface,
```

```
         to print (NZPRN2)                Default: 1       ! NZPRN2 = 1 !

         Print the INTERPOLATED wind components ?
         (IPR0) (0=no, 1=yes)             Default: 0       ! IPR0 = 0 !

         Print the TERRAIN ADJUSTED surface wind
         components ?
         (IPR1) (0=no, 1=yes)             Default: 0       ! IPR1 = 0 !

         Print the SMOOTHED wind components and
         the INITIAL DIVERGENCE fields ?
         (IPR2) (0=no, 1=yes)             Default: 0       ! IPR2 = 0 !

         Print the FINAL wind speed and direction
         fields ?
         (IPR3) (0=no, 1=yes)             Default: 0       ! IPR3 = 0 !

         Print the FINAL DIVERGENCE fields ?
         (IPR4) (0=no, 1=yes)             Default: 0       ! IPR4 = 0 !

         Print the winds after KINEMATIC effects
         are added ?
         (IPR5) (0=no, 1=yes)             Default: 0       ! IPR5 = 0 !

         Print the winds after the FROUDE NUMBER
         adjustment is made ?
         (IPR6) (0=no, 1=yes)             Default: 0       ! IPR6 = 0 !

         Print the winds after SLOPE FLOWS
         are added ?
         (IPR7) (0=no, 1=yes)             Default: 0       ! IPR7 = 0 !

         Print the FINAL wind field components ?
         (IPR8) (0=no, 1=yes)             Default: 0       ! IPR8 = 0 !

!END!


-------------------------------------------------------------------------------

INPUT GROUP: 4 -- Meteorological data options
--------------

    NO OBSERVATION MODE             (NOOBS)  Default: 0     ! NOOBS = 0 !
          0 = Use surface, overwater, and upper air stations
          1 = Use surface and overwater stations (no upper air observations)
              Use MM5 for upper air data
          2 = No surface, overwater, or upper air observations
              Use MM5 for surface, overwater, and upper air data

    NUMBER OF SURFACE & PRECIP. METEOROLOGICAL STATIONS

       Number of surface stations   (NSSTA)  No default     ! NSSTA = 28 !

       Number of precipitation stations
       (NPSTA=-1: flag for use of MM5 precip data)
                                    (NPSTA)  No default     ! NPSTA = 46 !

    CLOUD DATA OPTIONS
       Gridded cloud fields:
                                   (ICLOUD)  Default: 0     ! ICLOUD = 0 !
       ICLOUD = 0 - Gridded clouds not used
       ICLOUD = 1 - Gridded CLOUD.DAT generated as OUTPUT
       ICLOUD = 2 - Gridded CLOUD.DAT read as INPUT
       ICLOUD = 3 - Gridded cloud cover from Prognostic Rel. Humidity

    FILE FORMATS

       Surface meteorological data file format
                                   (IFORMS)  Default: 2     ! IFORMS = 2 !
       (1 = unformatted (e.g., SMERGE output))
```

```
       (2 = formatted   (free-formatted user input))

       Precipitation data file format
                                 (IFORMP)  Default: 2     ! IFORMP = 2 !
       (1 = unformatted (e.g., PMERGE output))
       (2 = formatted   (free-formatted user input))

       Cloud data file format
                                 (IFORMC)  Default: 2     ! IFORMC = 1 !
       (1 = unformatted - CALMET unformatted output)
       (2 = formatted   - free-formatted CALMET output or user input)

!END!


------------------------------------------------------------------------------

INPUT GROUP: 5 -- Wind Field Options and Parameters
--------------


    WIND FIELD MODEL OPTIONS
       Model selection variable (IWFCOD)     Default: 1      ! IWFCOD = 1 !
          0 = Objective analysis only
          1 = Diagnostic wind module

       Compute Froude number adjustment
       effects ? (IFRADJ)                    Default: 1      ! IFRADJ = 1 !
       (0 = NO, 1 = YES)

       Compute kinematic effects ? (IKINE)   Default: 0      ! IKINE = 0 !
       (0 = NO, 1 = YES)

       Use O'Brien procedure for adjustment
       of the vertical velocity ? (IOBR)     Default: 0      ! IOBR = 0 !
       (0 = NO, 1 = YES)

       Compute slope flow effects ? (ISLOPE) Default: 1      ! ISLOPE = 1 !
       (0 = NO, 1 = YES)

       Extrapolate surface wind observations
       to upper layers ? (IEXTRP)            Default: -4     ! IEXTRP = -4 !
       (1 = no extrapolation is done,
        2 = power law extrapolation used,
        3 = user input multiplicative factors
            for layers 2 - NZ used (see FEXTRP array)
        4 = similarity theory used
       -1, -2, -3, -4 = same as above except layer 1 data
            at upper air stations are ignored

       Extrapolate surface winds even
       if calm? (ICALM)                      Default: 0      ! ICALM = 0 !
       (0 = NO, 1 = YES)

       Layer-dependent biases modifying the weights of
       surface and upper air stations (BIAS(NZ))
         -1<=BIAS<=1
       Negative BIAS reduces the weight of upper air stations
         (e.g. BIAS=-0.1 reduces the weight of upper air stations
       by 10%; BIAS= -1, reduces their weight by 100 %)
       Positive BIAS reduces the weight of surface stations
         (e.g. BIAS= 0.2 reduces the weight of surface stations
       by 20%; BIAS=1 reduces their weight by 100%)
       Zero BIAS leaves weights unchanged (1/R**2 interpolation)
       Default: NZ*0
                              ! BIAS = -1,-0.8,-0.4,-0.2,0,0,0,0,0.2,0.4,0.8,1 !

       Minimum distance from nearest upper air station
       to surface station for which extrapolation
       of surface winds at surface station will be allowed
       (RMIN2: Set to -1 for IEXTRP = 4 or other situations
```

```
    where all surface stations should be extrapolated)
                                         Default: 4.    ! RMIN2 = 4 !

   Use gridded prognostic wind field model
   output fields as input to the diagnostic
   wind field model (IPROG)              Default: 0      ! IPROG = 14 !
   (0 = No, [IWFCOD = 0 or 1]
    1 = Yes, use CSUMM prog. winds as Step 1 field, [IWFCOD = 0]
    2 = Yes, use CSUMM prog. winds as initial guess field [IWFCOD = 1]
    3 = Yes, use winds from MM4.DAT file as Step 1 field [IWFCOD = 0]
    4 = Yes, use winds from MM4.DAT file as initial guess field [IWFCOD = 1]
    5 = Yes, use winds from MM4.DAT file as observations [IWFCOD = 1]
    13 = Yes, use winds from MM5.DAT file as Step 1 field [IWFCOD = 0]
    14 = Yes, use winds from MM5.DAT file as initial guess field [IWFCOD = 1]
    15 = Yes, use winds from MM5.DAT file as observations [IWFCOD = 1]

   Timestep (hours) of the prognostic
   model input data   (ISTEPPG)          Default: 1      ! ISTEPPG = 1 !

RADIUS OF INFLUENCE PARAMETERS

   Use varying radius of influence       Default: F      ! LVARY = F !
   (if no stations are found within RMAX1,RMAX2,
    or RMAX3, then the closest station will be used)

   Maximum radius of influence over land
   in the surface layer (RMAX1)          No default      ! RMAX1 = 50 !
                                         Units: km
   Maximum radius of influence over land
   aloft (RMAX2)                         No default      ! RMAX2 = 200 !
                                         Units: km
   Maximum radius of influence over water
   (RMAX3)                               No default      ! RMAX3 = 1 !
                                         Units: km


OTHER WIND FIELD INPUT PARAMETERS

   Minimum radius of influence used in
   the wind field interpolation (RMIN)   Default: 0.1    ! RMIN = 0.1 !
                                         Units: km
   Radius of influence of terrain
   features (TERRAD)                     No default      ! TERRAD = 12 !

                                         Units: km
   Relative weighting of the first
   guess field and observations in the
   SURFACE layer (R1)                    No default      ! R1 = 4 !
   (R1 is the distance from an           Units: km
   observational station at which the
   observation and first guess field are
   equally weighted)

   Relative weighting of the first
   guess field and observations in the
   layers ALOFT (R2)                     No default      ! R2 = 10 !
   (R2 is applied in the upper layers    Units: km
   in the same manner as R1 is used in
   the surface layer).

   Relative weighting parameter of the
   prognostic wind field data (RPROG)    No default      ! RPROG = 0 !
   (Used only if IPROG = 1)              Units: km
   ------------------------

   Maximum acceptable divergence in the
   divergence minimization procedure
   (DIVLIM)                              Default: 5.E-6  ! DIVLIM = 5E-6 !

   Maximum number of iterations in the
   divergence min. procedure (NITER)     Default: 50     ! NITER = 50 !
```

```
   Number of passes in the smoothing
   procedure (NSMTH(NZ))
   NOTE: NZ values must be entered
        Default: 2,(mxnz-1)*4 ! NSMTH = 2,11*4 !

   Maximum number of stations used in
   each layer for the interpolation of
   data to a grid point (NINTR2(NZ))
   NOTE: NZ values must be entered       Default: 99.    ! NINTR2 = 12*99 !

   Critical Froude number (CRITFN)       Default: 1.0    ! CRITFN = 1 !

   Empirical factor controlling the
   influence of kinematic effects
   (ALPHA)                               Default: 0.1    ! ALPHA = 0.1 !

   Multiplicative scaling factor for
   extrapolation of surface observations
   to upper layers (FEXTR2(NZ))          Default: NZ*0.0
   ! FEXTR2 = 12*0 !
   (Used only if IEXTRP = 3 or -3)


BARRIER INFORMATION

   Number of barriers to interpolation
   of the wind fields (NBAR)             Default: 0      ! NBAR = 0 !

   THE FOLLOWING 4 VARIABLES ARE INCLUDED
   ONLY IF NBAR > 0
   NOTE: NBAR values must be entered     No defaults
         for each variable               Units: km

      X coordinate of BEGINNING
      of each barrier (XBBAR(NBAR))      ! XBBAR =  !
      Y coordinate of BEGINNING
      of each barrier (YBBAR(NBAR))      ! YBBAR =  !

      X coordinate of ENDING
      of each barrier (XEBAR(NBAR))      ! XEBAR =  !
      Y coordinate of ENDING
      of each barrier (YEBAR(NBAR))      ! YEBAR =  !


DIAGNOSTIC MODULE DATA INPUT OPTIONS

   Surface temperature (IDIOPT1)         Default: 0      ! IDIOPT1 = 0 !
      0 = Compute internally from
          hourly surface observations
      1 = Read preprocessed values from
          a data file (DIAG.DAT)

      Surface met. station to use for
      the surface temperature (ISURFT)   No default     ! ISURFT = 13 !
      (Must be a value from 1 to NSSTA)
      (Used only if IDIOPT1 = 0)
      --------------------------

   Domain-averaged temperature lapse
   rate (IDIOPT2)                        Default: 0     ! IDIOPT2 = 0 !
      0 = Compute internally from
          twice-daily upper air observations
      1 = Read hourly preprocessed values
          from a data file (DIAG.DAT)

      Upper air station to use for
      the domain-scale lapse rate (IUPT) No default     ! IUPT = 3 !
      (Must be a value from 1 to NUSTA)
      (Used only if IDIOPT2 = 0)
      --------------------------
```

```
   Depth through which the domain-scale
   lapse rate is computed (ZUPT)      Default: 200.  ! ZUPT = 200 !
   (Used only if IDIOPT2 = 0)         Units: meters
   --------------------------

Domain-averaged wind components
(IDIOPT3)                             Default: 0     ! IDIOPT3 = 0 !
   0 = Compute internally from
       twice-daily upper air observations
   1 = Read hourly preprocessed values
       a data file (DIAG.DAT)

   Upper air station to use for
   the domain-scale winds (IUPWND)    Default: -1    ! IUPWND = -1 !
   (Must be a value from -1 to NUSTA)
   (Used only if IDIOPT3 = 0)
   --------------------------

   Bottom and top of layer through
   which the domain-scale winds
   are computed
   (ZUPWND(1), ZUPWND(2))        Defaults: 1., 1000. ! ZUPWND= 1.0, 1.00 !
   (Used only if IDIOPT3 = 0)    Units: meters
   --------------------------

Observed surface wind components
for wind field module (IDIOPT4)  Default: 0     ! IDIOPT4 = 0 !
   0 = Read WS, WD from a surface
       data file (SURF.DAT)
   1 = Read hourly preprocessed U, V from
       a data file (DIAG.DAT)

Observed upper air wind components
for wind field module (IDIOPT5)  Default: 0     ! IDIOPT5 = 0 !
   0 = Read WS, WD from an upper
       air data file (UP1.DAT, UP2.DAT, etc.)
   1 = Read hourly preprocessed U, V from
       a data file (DIAG.DAT)

LAKE BREEZE INFORMATION

   Use Lake Breeze Module  (LLBREZE)
                                     Default: F      ! LLBREZE = F !

    Number of lake breeze regions (NBOX)            ! NBOX = 0 !

 X Grid line 1 defining the region of interest
                                                     ! XG1 =  !
 X Grid line 2 defining the region of interest
                                                     ! XG2 =  !
 Y Grid line 1 defining the region of interest
                                                     ! YG1 =  !
 Y Grid line 2 defining the region of interest
                                                     ! YG2 =  !

  X Point defining the coastline (Straight line)
            (XBCST)  (KM)   Default: none    ! XBCST =  !

  Y Point defining the coastline (Straight line)
            (YBCST)  (KM)   Default: none    ! YBCST =  !

  X Point defining the coastline (Straight line)
            (XECST)  (KM)   Default: none    ! XECST =  !

  Y Point defining the coastline (Straight line)
            (YECST)  (KM)   Default: none    ! YECST =  !


Number of stations in the region     Default: none ! NLB =  !
(Surface stations + upper air stations)
```

```
       Station ID's  in the region   (METBXID(NLB))
       (Surface stations first, then upper air stations)
         ! METBXID =  !

!END!


-------------------------------------------------------------------------------

INPUT GROUP: 6 -- Mixing Height, Temperature and Precipitation Parameters
--------------

    EMPIRICAL MIXING HEIGHT CONSTANTS

       Neutral, mechanical equation
       (CONSTB)                           Default: 1.41   ! CONSTB = 1.41 !
       Convective mixing ht. equation
       (CONSTE)                           Default: 0.15   ! CONSTE = 0.15 !
       Stable mixing ht. equation
       (CONSTN)                           Default: 2400.  ! CONSTN = 2400 !
       Overwater mixing ht. equation
       (CONSTW)                           Default: 0.16   ! CONSTW = 0.16 !
       Absolute value of Coriolis
       parameter (FCORIOL)                Default: 1.E-4  ! FCORIOL = 0.0001 !
                                          Units: (1/s)

    SPATIAL AVERAGING OF MIXING HEIGHTS

       Conduct spatial averaging
       (IAVEZI)  (0=no, 1=yes)            Default: 1      ! IAVEZI = 1 !

       Max. search radius in averaging
       process (MNMDAV)                   Default: 1      ! MNMDAV = 1 !
                                          Units: Grid
                                                 cells
       Half-angle of upwind looking cone
       for averaging (HAFANG)             Default: 30.    ! HAFANG = 30 !
                                          Units: deg.
       Layer of winds used in upwind
       averaging (ILEVZI)                 Default: 1      ! ILEVZI = 1 !
       (must be between 1 and NZ)

    OTHER MIXING HEIGHT VARIABLES

       Minimum potential temperature lapse
       rate in the stable layer above the
       current convective mixing ht.      Default: 0.001  ! DPTMIN = 0.001 !
       (DPTMIN)                           Units: deg. K/m
       Depth of layer above current conv.
       mixing height through which lapse  Default: 200.   ! DZZI = 200 !
       rate is computed (DZZI)            Units: meters

       Minimum overland mixing height     Default:  50.   ! ZIMIN = 50 !
       (ZIMIN)                            Units: meters
       Maximum overland mixing height     Default: 3000.  ! ZIMAX = 3000 !
       (ZIMAX)                            Units: meters
       Minimum overwater mixing height    Default:   50.  ! ZIMINW = 50 !
       (ZIMINW) -- (Not used if observed  Units: meters
       overwater mixing hts. are used)
       Maximum overwater mixing height    Default: 3000.  ! ZIMAXW = 3000 !
       (ZIMAXW) -- (Not used if observed  Units: meters
       overwater mixing hts. are used)


    TEMPERATURE PARAMETERS

       3D temperature from observations or
       from prognostic data? (ITPROG)     Default:0         ! ITPROG = 0 !

          0 = Use Surface and upper air stations
```

```
            (only if NOOBS = 0)
         1 = Use Surface stations (no upper air observations)
            Use MM5 for upper air data
            (only if NOOBS = 0,1)
         2 = No surface or upper air observations
            Use MM5 for surface and upper air data
            (only if NOOBS = 0,1,2)

      Interpolation type
      (1 = 1/R ; 2 = 1/R**2)                Default:1         ! IRAD = 1 !

      Radius of influence for temperature
      interpolation (TRADKM)                Default: 500.     ! TRADKM = 500 !
                                            Units: km

      Maximum Number of stations to include
      in temperature interpolation (NUMTS)  Default: 5        ! NUMTS = 5 !

      Conduct spatial averaging of temp-
      eratures (IAVET)  (0=no, 1=yes)         Default: 1     ! IAVET = 1 !
      (will use mixing ht MNMDAV,HAFANG
       so make sure they are correct)

      Default temperature gradient        Default: -.0098 ! TGDEFB = -0.0098 !
      below the mixing height over
      water (K/m) (TGDEFB)

      Default temperature gradient        Default: -.0045 ! TGDEFA = -0.0045 !
      above the mixing height over
      water (K/m) (TGDEFA)

      Beginning (JWAT1) and ending (JWAT2)
      land use categories for temperature                   ! JWAT1 = 1000 !
      interpolation over water -- Make                      ! JWAT2 = 1000 !
      bigger than largest land use to disable

   PRECIP INTERPOLATION PARAMETERS

      Method of interpolation (NFLAGP)      Default = 2    ! NFLAGP = 2 !
       (1=1/R,2=1/R**2,3=EXP/R**2)
      Radius of Influence (km) (SIGMAP)     Default = 100.0  ! SIGMAP = 100 !
       (0.0 => use half dist. btwn
        nearest stns w & w/out
        precip when NFLAGP = 3)
      Minimum Precip. Rate Cutoff (mm/hr)   Default = 0.01  ! CUTP = 0.01 !
       (values <CUTP = 0.0 mm/hr)
!END!


-------------------------------------------------------------------------------

INPUT GROUP: 7 -- Surface meteorological station parameters
--------------

     SURFACE STATION VARIABLES
     (One record per station --  12  records in all)


             1     2
         Name     ID     X coord.   Y coord.    Time   Anem.
                          (km)       (km)       zone   Ht.(m)
      ----------------------------------------------------------
! SS1  ='S1'    724620   526.696     64.787       7    10.000  !
! SS2  ='S2'    724627   348.938    109.838       7    10.000  !
! SS3  ='S3'    724640   635.970    166.347       7    10.000  !
! SS4  ='S4'    724660   612.029    222.708       7    10.000  !
! SS5  ='S5'    724673   474.296    254.881       7    10.000  !
! SS6  ='S6'    724674   337.401    336.191       7    10.000  !
! SS7  ='S7'    724675   421.132    297.795       7    10.000  !
! SS8  ='S8'    724676   428.246    251.781       7    10.000  !
! SS9  ='S9'    724677   427.914    177.127       7    10.000  !
```

```
! SS10 ='S10'   724699   568.230    337.940       7    10.000  !
! SS11 ='S11'   724700   102.279    282.040       7    10.000  !
! SS12 ='S12'   724756   -14.893     73.926       7    10.000  !
! SS13 ='S13'   724760   289.565    234.642       7    10.000  !
! SS14 ='S14'   724765   345.912    169.204       7    10.000  !
! SS15 ='S15'   724767   289.435     36.665       7    10.000  !
! SS16 ='S16'   724769   571.542    395.530       7    10.000  !
! SS17 ='S17'   724776   188.246    190.012       7    10.000  !
! SS18 ='S18'   725645   510.080    484.380       7    10.000  !
! SS19 ='S19'   725650   607.961    331.731       7    10.000  !
! SS20 ='S20'   725700   365.302    386.213       7    10.000  !
! SS21 ='S21'   725705   202.127    371.630       7    10.000  !
! SS22 ='S22'   725715   390.868    385.527       7    10.000  !
! SS23 ='S23'   725717   355.263    280.999       7    10.000  !
! SS24 ='S24'   725720     0.553    406.208       7    10.000  !
! SS25 ='S25'   725724    21.200    345.946       7    10.000  !
! SS26 ='S26'   725744   234.565    498.682       7    10.000  !
! SS27 ='S27'   725755     0.549    442.795       7    10.000  !
! SS28 ='S28'   725775    76.822    460.462       7    10.000  !

-------------------
      1
        Four character string for station name
        (MUST START IN COLUMN 9)

      2
        Five digit integer for station ID

!END!


-------------------------------------------------------------------------------

INPUT GROUP: 8 -- Upper air meteorological station parameters
--------------

     UPPER AIR STATION VARIABLES
     (One record per station --  3  records in all)

             1     2
         Name    ID      X coord.   Y coord.  Time zone
                           (km)       (km)
        ------------------------------------------------
! US1  ='U1'     24127     2.190    406.531       7 !
! US2  ='U2'     24061   276.932    657.831       7 !
! US3  ='U3'     23066   289.375    233.230       7 !

-------------------
      1
        Four character string for station name
        (MUST START IN COLUMN 9)

      2
        Five digit integer for station ID

!END!


-------------------------------------------------------------------------------

INPUT GROUP: 9 -- Precipitation station parameters
--------------

     PRECIPITATION STATION VARIABLES
     (One record per station --  2  records in all)
     (NOT INCLUDED IF NPSTA = 0)

            1          2
         Name   Station    X coord.  Y coord.
                  Code       (km)      (km)
        -------------------------------------
```

```
! PS1  ='P1'    428939    20.030    368.917  !
! PS2  ='P2'    421308   248.620     80.207  !
! PS3  ='P3'    422385    44.325    426.448  !
! PS4  ='P4'    422578    32.946    252.222  !
! PS5  ='P5'    422702    46.600    295.433  !
! PS6  ='P6'    423418   153.822    216.135  !
! PS7  ='P7'    423611   108.519    152.258  !
! PS8  ='P8'    425815   121.240    384.362  !
! PS9  ='P9'    426127   156.895    381.526  !
! PS10 ='P10'   427026    98.117    281.618  !
! PS11 ='P11'   427260    -9.008    189.199  !
! PS12 ='P12'   427395   164.365    356.575  !
! PS13 ='P13'   427598     0.826    404.773  !
! PS14 ='P14'   427690    16.033    320.435  !
! PS15 ='P15'   427729    64.697    288.397  !
! PS16 ='P16'    59096   476.641    342.957  !
! PS17 ='P17'    50130   528.390     65.278  !
! PS18 ='P18'    50183   531.628    365.163  !
! PS19 ='P19'    50263   512.645    233.898  !
! PS20 ='P20'    50372   431.571    248.030  !
! PS21 ='P21'    51713   442.422    167.594  !
! PS22 ='P22'    51959   422.535    213.214  !
! PS23 ='P23'    52286   248.428    352.019  !
! PS24 ='P24'    53488   289.348    233.193  !
! PS25 ='P25'    53500   505.141    368.482  !
! PS26 ='P26'    53662   427.609    177.468  !
! PS27 ='P27'    55484   337.493    334.397  !
! PS28 ='P28'    55531   301.141     26.324  !
! PS29 ='P29'    55982   460.178    438.935  !
! PS30 ='P30'    56203   367.079    118.006  !
! PS31 ='P31'    56591   274.959     66.770  !
! PS32 ='P32'    57031   350.058    279.285  !
! PS33 ='P33'    57337   497.451    133.478  !
! PS34 ='P34'    58204   356.064    110.205  !
! PS35 ='P35'   487995   419.587    497.284  !
! PS36 ='P36'   483100    83.332    459.108  !
! PS37 ='P37'   485420   514.024    482.534  !
! PS38 ='P38'   486597   248.097    468.694  !
! PS39 ='P39'   426374    59.506    401.455  !
! PS40 ='P40'   420336   199.940    175.943  !
! PS41 ='P41'   420738   216.032     68.281  !
! PS42 ='P42'   421008   -16.339     68.520  !
! PS43 ='P43'   421590    66.111    423.044  !
! PS44 ='P44'   425892    21.290    403.014  !
! PS45 ='P45'   420168    -0.560    133.383  !
! PS46 ='P46'    54877   527.090    317.959  !


-------------------
      1
        Four character string for station name
        (MUST START IN COLUMN 9)

      2
        Six digit station code composed of state
        code (first 2 digits) and station ID (last
        4 digits)

!END!
```

APPENDIX J-2

EXAMPLE CALPUFF INPUT FILE

```
BBC WTP EIS
Calpuff Run 1_2001

---------------- Run title (3 lines) ----------------------------------------

                    CALPUFF MODEL CONTROL FILE
                    --------------------------

------------------------------------------------------------------------------

INPUT GROUP: 0 -- Input and Output File Names

--------------
Default Name  Type          File Name
------------  ----          ---------
CALMET.DAT    input    * METDAT = *
    or
ISCMET.DAT    input    * ISCDAT = *
    or
PLMMET.DAT    input    * PLMDAT = *
    or
PROFILE.DAT   input    * PRFDAT = *
SURFACE.DAT   input    * SFCDAT = *
RESTARTB.DAT  input    * RSTARTB = *
------------------------------------------------------------------------------
CALPUFF.LST   output   ! PUFLST = C:\WTPEIS\2001\PUFF0101.LST !
CONC.DAT      output   ! CONDAT = C:\WTPEIS\2001\CONC0101.DAT !
DFLX.DAT      output   ! DFDAT = C:\WTPEIS\2001\DFLX0101.DAT !
WFLX.DAT      output   ! WFDAT = C:\WTPEIS\2001\WFLX0101.DAT !

VISB.DAT      output   ! VISDAT = C:\WTPEIS\2001\VISB0101.DAT !
RESTARTE.DAT  output   ! RSTARTE = C:\WTPEIS\2001\RESTART1.dat !
------------------------------------------------------------------------------
Emission Files
--------------
PTEMARB.DAT   input    * PTDAT = *
VOLEMARB.DAT  input    * VOLDAT = *
BAEMARB.DAT   input    * ARDAT = *
LNEMARB.DAT   input    * LNDAT = *
------------------------------------------------------------------------------
Other Files
-----------
OZONE.DAT     input    ! OZDAT = C:\WTPEIS\2001\Ozone01.DAT !
VD.DAT        input    * VDDAT = *
CHEM.DAT      input    * CHEMDAT = *
H2O2.DAT      input    * H2O2DAT = *
HILL.DAT      input    * HILDAT = *
HILLRCT.DAT   input    * RCTDAT = *
COASTLN.DAT   input    * CSTDAT = *
FLUXBDY.DAT   input    * BDYDAT = *
BCON.DAT      input    * BCNDAT = *
DEBUG.DAT     output   * DEBUG = *
MASSFLX.DAT   output   * FLXDAT = *
MASSBAL.DAT   output   * BALDAT = *
FOG.DAT       output   * FOGDAT = *
------------------------------------------------------------------------------
All file names will be converted to lower case if LCFILES = T
Otherwise, if LCFILES = F, file names will be converted to UPPER CASE
         T = lower case      ! LCFILES = F !
         F = UPPER CASE
NOTE: (1) file/path names can be up to 70 characters in length


Provision for multiple input files
----------------------------------

     Number of CALMET.DAT files for run (NMETDAT)
                                     Default: 1       ! NMETDAT = 2 !

     Number of PTEMARB.DAT files for run (NPTDAT)
```

```
                                    Default: 0       ! NPTDAT =  0  !

     Number of BAEMARB.DAT files for run (NARDAT)
                                    Default: 0       ! NARDAT =  0  !

     Number of VOLEMARB.DAT files for run (NVOLDAT)
                                    Default: 0       ! NVOLDAT =  0  !

!END!

-------------
Subgroup (0a)
-------------

  The following CALMET.DAT filenames are processed in sequence if NMETDAT>1

Default Name  Type          File Name
------------  ----          ---------
 none         input    ! METDAT=C:\WTPEIS\2001\CAL01011.DAT     !  !END!
 none         input    ! METDAT=C:\WTPEIS\2001\CAL01012.DAT     !  !END!



--------------------------------------------------------------------------------

INPUT GROUP: 1 -- General run control parameters
--------------

    Option to run all periods found
    in the met. file     (METRUN)   Default: 0       ! METRUN = 0 !

         METRUN = 0 - Run period explicitly defined below
         METRUN = 1 - Run all periods in met. file

     Starting date:   Year (IBYR) -- No default       ! IBYR = 2001 !
     (used only if   Month (IBMO) -- No default       ! IBMO = 1 !
      METRUN = 0)      Day (IBDY) -- No default       ! IBDY = 1 !
                      Hour (IBHR) -- No default       ! IBHR = 0 !

     Base time zone        (XBTZ) -- No default       ! XBTZ = 7 !
        PST = 8., MST = 7.
        CST = 6., EST = 5.

     Length of run (hours) (IRLG) -- No default       ! IRLG = 744 !

     Number of chemical species (NSPEC)
                                    Default: 5       ! NSPEC = 7 !

     Number of chemical species
     to be emitted  (NSE)           Default: 3       ! NSE = 4 !

     Flag to stop run after
     SETUP phase (ITEST)            Default: 2       ! ITEST = 2 !
     (Used to allow checking
     of the model inputs, files, etc.)
           ITEST = 1 - STOPS program after SETUP phase
           ITEST = 2 - Continues with execution of program
                       after SETUP

     Restart Configuration:

        Control flag (MRESTART)      Default: 0       ! MRESTART = 2 !

           0 = Do not read or write a restart file
           1 = Read a restart file at the beginning of
               the run
           2 = Write a restart file during run
           3 = Read a restart file at beginning of run
               and write a restart file during run

        Number of periods in Restart
```

```
   output cycle (NRESPD)        Default: 0       ! NRESPD = 0 !

      0 = File written only at last period
     >0 = File updated every NRESPD periods

Meteorological Data Format (METFM)
                                Default: 1       ! METFM = 1 !

      METFM = 1 - CALMET binary file (CALMET.MET)
      METFM = 2 - ISC ASCII file (ISCMET.MET)
      METFM = 3 - AUSPLUME ASCII file (PLMMET.MET)
      METFM = 4 - CTDM plus tower file (PROFILE.DAT) and
                  surface parameters file (SURFACE.DAT)

PG sigma-y is adjusted by the factor (AVET/PGTIME)**0.2
Averaging Time (minutes) (AVET)
                                Default: 60.0    ! AVET = 60 !
PG Averaging Time (minutes) (PGTIME)
                                Default: 60.0    ! PGTIME = 60 !


!END!


------------------------------------------------------------------------------

INPUT GROUP: 2 -- Technical options
--------------


Vertical distribution used in the
near field (MGAUSS)                Default: 1     ! MGAUSS = 1 !
   0 = uniform
   1 = Gaussian

Terrain adjustment method
(MCTADJ)                           Default: 3     ! MCTADJ = 3 !
   0 = no adjustment
   1 = ISC-type of terrain adjustment
   2 = simple, CALPUFF-type of terrain
       adjustment
   3 = partial plume path adjustment

Subgrid-scale complex terrain
flag (MCTSG)                       Default: 0     ! MCTSG = 0 !
   0 = not modeled
   1 = modeled

Near-field puffs modeled as
elongated 0 (MSLUG)                Default: 0     ! MSLUG = 0 !
   0 = no
   1 = yes (slug model used)

Transitional plume rise modeled ?
(MTRANS)                           Default: 1     ! MTRANS = 1 !
   0 = no  (i.e., final rise only)
   1 = yes (i.e., transitional rise computed)

Stack tip downwash? (MTIP)         Default: 1     ! MTIP = 1 !
   0 = no  (i.e., no stack tip downwash)
   1 = yes (i.e., use stack tip downwash)

Method used to simulate building
downwash? (MBDW)                   Default: 1     ! MBDW = 1 !
   1 = ISC method
   2 = PRIME method

Vertical wind shear modeled above
stack top? (MSHEAR)                Default: 0     ! MSHEAR = 0 !
   0 = no  (i.e., vertical wind shear not modeled)
   1 = yes (i.e., vertical wind shear modeled)
```

```
Puff splitting allowed? (MSPLIT)      Default: 0     ! MSPLIT = 0 !
   0 = no (i.e., puffs not split)
   1 = yes (i.e., puffs are split)

Chemical mechanism flag (MCHEM)       Default: 0     ! MCHEM = 1 !
   0 = chemical transformation not
       modeled
   1 = transformation rates computed
       internally (MESOPUFF II scheme)
   2 = user-specified transformation
       rates used
   3 = transformation rates computed
       internally (RIVAD/ARM3 scheme)
   4 = secondary organic aerosol formation
       computed (MESOPUFF II scheme for OH)

Aqueous phase transformation flag (MAQCHEM)
(Used only if MCHEM = 1, or 3)        Default: 0     ! MAQCHEM = 0 !
   0 = aqueous phase transformation
       not modeled
   1 = transformation rates adjusted
       for aqueous phase reactions

Wet removal modeled ? (MWET)          Default: 1     ! MWET = 1 !
   0 = no
   1 = yes

Dry deposition modeled ? (MDRY)       Default: 1     ! MDRY = 1 !
   0 = no
   1 = yes
   (dry deposition method specified
    for each species in Input Group 3)

Method used to compute dispersion
coefficients (MDISP)                  Default: 3     ! MDISP = 3 !

   1 = dispersion coefficients computed from measured values
       of turbulence, sigma v, sigma w
   2 = dispersion coefficients from internally calculated
       sigma v, sigma w using micrometeorological variables
       (u*, w*, L, etc.)
   3 = PG dispersion coefficients for RURAL areas (computed using
       the ISCST multi-segment approximation) and MP coefficients in
       urban areas
   4 = same as 3 except PG coefficients computed using
       the MESOPUFF II eqns.
   5 = CTDM sigmas used for stable and neutral conditions.
       For unstable conditions, sigmas are computed as in
       MDISP = 3, described above.  MDISP = 5 assumes that
       measured values are read

Sigma-v/sigma-theta, sigma-w measurements used? (MTURBVW)
(Used only if MDISP = 1 or 5)         Default: 3     ! MTURBVW = 3 !
   1 = use sigma-v or sigma-theta measurements
       from PROFILE.DAT to compute sigma-y
       (valid for METFM = 1, 2, 3, 4)
   2 = use sigma-w measurements
       from PROFILE.DAT to compute sigma-z
       (valid for METFM = 1, 2, 3, 4)
   3 = use both sigma-(v/theta) and sigma-w
       from PROFILE.DAT to compute sigma-y and sigma-z
       (valid for METFM = 1, 2, 3, 4)
   4 = use sigma-theta measurements
       from PLMMET.DAT to compute sigma-y
       (valid only if METFM = 3)

Back-up method used to compute dispersion
when measured turbulence data are
missing (MDISP2)                      Default: 3     ! MDISP2 = 3 !
(used only if MDISP = 1 or 5)
```

```
   2 = dispersion coefficients from internally calculated
       sigma v, sigma w using micrometeorological variables
       (u*, w*, L, etc.)
   3 = PG dispersion coefficients for RURAL areas (computed using
       the ISCST multi-segment approximation) and MP coefficients in
       urban areas
   4 = same as 3 except PG coefficients computed using
       the MESOPUFF II eqns.

PG sigma-y,z adj. for roughness?      Default: 0     ! MROUGH = 0 !
(MROUGH)
   0 = no
   1 = yes

Partial plume penetration of          Default: 1     ! MPARTL = 1 !
elevated inversion?
(MPARTL)
   0 = no
   1 = yes

Strength of temperature inversion     Default: 0     ! MTINV = 0 !
provided in PROFILE.DAT extended records?
(MTINV)
   0 = no (computed from measured/default gradients)
   1 = yes

PDF used for dispersion under convective conditions?
                                      Default: 0     ! MPDF = 0 !
(MPDF)
   0 = no
   1 = yes

Sub-Grid TIBL module used for shore line?
                                      Default: 0     ! MSGTIBL = 0 !
(MSGTIBL)
   0 = no
   1 = yes

Boundary conditions (concentration) modeled?
                                      Default: 0     ! MBCON = 0 !
(MBCON)
   0 = no
   1 = yes, using formatted BCON.DAT file
   2 = yes, using unformatted CONC.DAT file


Analyses of fogging and icing impacts due to emissions from
arrays of mechanically-forced cooling towers can be performed
using CALPUFF in conjunction with a cooling tower emissions
processor (CTEMISS) and its associated postprocessors.  Hourly
emissions of water vapor and temperature from each cooling tower
cell are computed for the current cell configuration and ambient
conditions by CTEMISS. CALPUFF models the dispersion of these
emissions and provides cloud information in a specialized format
for further analysis. Output to FOG.DAT is provided in either
'plume mode' or 'receptor mode' format.

Configure for FOG Model output?
                                      Default: 0     ! MFOG = 0 !
(MFOG)
   0 = no
   1 = yes  - report results in PLUME Mode format
   2 = yes  - report results in RECEPTOR Mode format


Test options specified to see if
they conform to regulatory
values? (MREG)                        Default: 1     ! MREG = 1 !

   0 = NO checks are made
   1 = Technical options must conform to USEPA
```

```
            Long Range Transport (LRT) guidance
                       METFM    1 or 2
                       AVET     60. (min)
                       PGTIME   60. (min)
                       MGAUSS   1
                       MCTADJ   3
                       MTRANS   1
                       MTIP     1
                       MCHEM    1 or 3 (if modeling SOx, NOx)
                       MWET     1
                       MDRY     1
                       MDISP    2 or 3
                       MPDF     0 if MDISP=3
                                1 if MDISP=2
                       MROUGH   0
                       MPARTL   1
                       SYTDEP   550. (m)
                       MHFTSZ   0


!END!


-------------------------------------------------------------------------------

INPUT GROUP: 3a, 3b -- Species list
-------------------

------------
Subgroup (3a)
------------

  The following species are modeled:

! CSPEC =          SO2 !            !END!
! CSPEC =          SO4 !            !END!
! CSPEC =          NOX !            !END!
! CSPEC =         HNO3 !            !END!
! CSPEC =          NO3 !            !END!
! CSPEC =         PM10 !            !END!
! CSPEC =          PMF !            !END!


                                                        Dry                 OUTPUT GROUP
    SPECIES          MODELED          EMITTED       DEPOSITED                NUMBER
     NAME         (0=NO, 1=YES)    (0=NO, 1=YES)    (0=NO,                 (0=NONE,
   (Limit: 12                                         1=COMPUTED-GAS        1=1st CGRUP,
    Characters                                        2=COMPUTED-PARTICLE   2=2nd CGRUP,
    in length)                                        3=USER-SPECIFIED)     3= etc.)

!          SO2  =          1,               1,           1,                  0   !
!          SO4  =          1,               0,           2,                  0   !
!          NOX  =          1,               1,           1,                  0   !
!         HNO3  =          1,               0,           1,                  0   !
!          NO3  =          1,               0,           2,                  0   !
!         PM10  =          1,               1,           2,                  0   !
!          PMF  =          1,               1,           2,                  0   !


!END!

-------------
Subgroup (3b)
-------------
  The following names are used for Species-Groups in which results
  for certain species are combined (added) prior to output.  The
  CGRUP name will be used as the species name in output files.
  Use this feature to model specific particle-size distributions
  by treating each size-range as a separate species.
  Order must be consistent with 3(a) above.
```

```
-------------------------------------------------------------------------------


INPUT GROUP: 4 -- Map Projection and Grid control parameters
--------------

     Projection for all (X,Y):
     -------------------------

     Map projection
     (PMAP)                     Default: UTM    ! PMAP = LCC !

         UTM :  Universal Transverse Mercator
         TTM :  Tangential Transverse Mercator
         LCC :  Lambert Conformal Conic
          PS :  Polar Stereographic
          EM :  Equatorial Mercator
        LAZA :  Lambert Azimuthal Equal Area

     False Easting and Northing (km) at the projection origin
     (Used only if PMAP= TTM, LCC, or LAZA)
     (FEAST)                    Default=0.0     ! FEAST = 0 !
     (FNORTH)                   Default=0.0     ! FNORTH = 0 !

     UTM zone (1 to 60)
     (Used only if PMAP=UTM)
     (IUTMZN)                   No Default      ! IUTMZN = 0 !

     Hemisphere for UTM projection?
     (Used only if PMAP=UTM)
     (UTMHEM)                   Default: N      ! UTMHEM = N !
         N   :  Northern hemisphere projection
         S   :  Southern hemisphere projection

     Latitude and Longitude (decimal degrees) of projection origin
     (Used only if PMAP= TTM, LCC, PS, EM, or LAZA)
     (RLAT0)                    No Default      ! RLAT0 = 37.017381N !
     (RLON0)                    No Default      ! RLON0 = 111.976753W !

         TTM :  RLON0 identifies central (true N/S) meridian of projection
                RLAT0 selected for convenience
         LCC :  RLON0 identifies central (true N/S) meridian of projection
                RLAT0 selected for convenience
         PS  :  RLON0 identifies central (grid N/S) meridian of projection
                RLAT0 selected for convenience
         EM  :  RLON0 identifies central meridian of projection
                RLAT0 is REPLACED by 0.0N (Equator)
         LAZA:  RLON0 identifies longitude of tangent-point of mapping plane
                RLAT0 identifies latitude of tangent-point of mapping plane

     Matching parallel(s) of latitude (decimal degrees) for projection
     (Used only if PMAP= LCC or PS)
     (XLAT1)                    No Default      ! XLAT1 = 30N !
     (XLAT2)                    No Default      ! XLAT2 = 60N !

         LCC :  Projection cone slices through Earth's surface at XLAT1 and XLAT2
         PS  :  Projection plane slices through Earth at XLAT1
                (XLAT2 is not used)

     ----------
     Note:  Latitudes and longitudes should be positive, and include a
            letter N,S,E, or W indicating north or south latitude, and
            east or west longitude.  For example,
            35.9  N Latitude  =  35.9N
            118.7 E Longitude = 118.7E


     Datum-region
     ------------
```

```
     The Datum-Region for the coordinates is identified by a character
     string.  Many mapping products currently available use the model of the
     Earth known as the World Geodetic System 1984 (WGS-G ).  Other local
     models may be in use, and their selection in CALMET will make its output
     consistent with local mapping products.  The list of Datum-Regions with
     official transformation parameters provided by the National Imagery and
     Mapping Agency (NIMA).

     NIMA Datum - Regions(Examples)
     ------------------------------------------------------------------------------
     WGS-G     WGS-84 GRS 80, Global coverage
     NAS-C     NORTH AMERICAN 1927 Clarke 1866, MEAN FOR (CONUS)
     NWS-27    NWS 6370KM Radius, Global Sphere (NAD27)
     NWS-84    NWS 6370KM Radius, Global Sphere (WGS84)
     ESR-S     ESRI REFERENCE Normal Sphere (6371KM Radius), Global Reference Sphere

     Datum-region for output coordinates
     (DATUM)                    Default: WGS-G     ! DATUM = WGS-G !


METEOROLOGICAL Grid:

     Rectangular grid defined for projection PMAP,
     with X the Easting and Y the Northing coordinate

            No. X grid cells (NX)      No default     ! NX = 129 !
            No. Y grid cells (NY)      No default     ! NY = 124 !
         No. vertical layers (NZ)      No default     ! NZ = 12 !

           Grid spacing (DGRIDKM)      No default     ! DGRIDKM = 4 !
                                       Units: km

                Cell face heights
                    (ZFACE(nz+1))      No defaults
                                       Units: m
   ! ZFACE =  0.0, 20.0, 40.0, 80.0, 160.0, 320.0, 640.0, 1000.0, 1500.0, 2000.0, 2500.0,
3000.0, 3500.0 !

            Reference Coordinates
           of SOUTHWEST corner of
                 grid cell(1, 1):

            X coordinate (XORIGKM)     No default     ! XORIGKM = 0 !
            Y coordinate (YORIGKM)     No default     ! YORIGKM = 0 !
                                      Units: km


COMPUTATIONAL Grid:

     The computational grid is identical to or a subset of the MET. grid.
     The lower left (LL) corner of the computational grid is at grid point
     (IBCOMP, JBCOMP) of the MET. grid.  The upper right (UR) corner of the
     computational grid is at grid point (IECOMP, JECOMP) of the MET. grid.
     The grid spacing of the computational grid is the same as the MET. grid.

        X index of LL corner (IBCOMP)      No default     ! IBCOMP = 1 !
                  (1 <= IBCOMP <= NX)

        Y index of LL corner (JBCOMP)      No default     ! JBCOMP = 1 !
                  (1 <= JBCOMP <= NY)


        X index of UR corner (IECOMP)      No default     ! IECOMP = 129 !
                  (1 <= IECOMP <= NX)

        Y index of UR corner (JECOMP)      No default     ! JECOMP = 124 !
                  (1 <= JECOMP <= NY)
```

```
SAMPLING Grid (GRIDDED RECEPTORS):

     The lower left (LL) corner of the sampling grid is at grid point
     (IBSAMP, JBSAMP) of the MET. grid.  The upper right (UR) corner of the
     sampling grid is at grid point (IESAMP, JESAMP) of the MET. grid.
     The sampling grid must be identical to or a subset of the computational
     grid.  It may be a nested grid inside the computational grid.
     The grid spacing of the sampling grid is DGRIDKM/MESHDN.

        Logical flag indicating if gridded
        receptors are used (LSAMP)         Default: T     ! LSAMP = T !
        (T=yes, F=no)

        X index of LL corner (IBSAMP)      No default     ! IBSAMP = 11 !
         (IBCOMP <= IBSAMP <= IECOMP)

        Y index of LL corner (JBSAMP)      No default     ! JBSAMP = 12 !
         (JBCOMP <= JBSAMP <= JECOMP)


        X index of UR corner (IESAMP)      No default     ! IESAMP = 113 !
         (IBCOMP <= IESAMP <= IECOMP)

        Y index of UR corner (JESAMP)      No default     ! JESAMP = 111 !
         (JBCOMP <= JESAMP <= JECOMP)


       Nesting factor of the sampling
        grid (MESHDN)                      Default: 1     ! MESHDN = 1 !
        (MESHDN is an integer >= 1)

!END!


-------------------------------------------------------------------------------


INPUT GROUP: 5 -- Output Options
--------------
                                                *                          *
     FILE                        DEFAULT VALUE             VALUE THIS RUN
     ----                        -------------             --------------

   Concentrations (ICON)               1                   ! ICON = 1 !
   Dry Fluxes (IDRY)                   1                   ! IDRY = 1 !
   Wet Fluxes (IWET)                   1                   ! IWET = 1 !
   Relative Humidity (IVIS)            1                   ! IVIS = 1 !
    (relative humidity file is
     required for visibility
     analysis)
   Use data compression option in output file?
   (LCOMPRS)                            Default: T         * LCOMPRS = *

   *
    0 = Do not create file, 1 = create file


    DIAGNOSTIC MASS FLUX OUTPUT OPTIONS:

       Mass flux across specified boundaries
       for selected species reported hourly?
       (IMFLX)                          Default: 0         ! IMFLX = 0 !
         0 = no
         1 = yes (FLUXBDY.DAT and MASSFLX.DAT filenames
                  are specified in Input Group 0)

       Mass balance for each species
       reported hourly?
       (IMBAL)                          Default: 0         ! IMBAL = 0 !
         0 = no
         1 = yes (MASSBAL.DAT filename is
```

```
               specified in Input Group 0)


    LINE PRINTER OUTPUT OPTIONS:

       Print concentrations (ICPRT)    Default: 0         ! ICPRT = 0 !
       Print dry fluxes (IDPRT)        Default: 0         ! IDPRT = 0 !
       Print wet fluxes (IWPRT)        Default: 0         ! IWPRT = 0 !
       (0 = Do not print, 1 = Print)

       Concentration print interval
       (ICFRQ) in hours                Default: 1         ! ICFRQ = 1 !
       Dry flux print interval
       (IDFRQ) in hours                Default: 1         ! IDFRQ = 1 !
       Wet flux print interval
       (IWFRQ) in hours                Default: 1         ! IWFRQ = 1 !

       Units for Line Printer Output
       (IPRTU)                         Default: 1         ! IPRTU = 3 !
                      for            for
                 Concentration    Deposition
           1 =       g/m**3         g/m**2/s
           2 =      mg/m**3        mg/m**2/s
           3 =      ug/m**3        ug/m**2/s
           4 =      ng/m**3        ng/m**2/s
           5 =     Odour Units

       Messages tracking progress of run
       written to the screen ?
       (IMESG)                         Default: 2         ! IMESG = 2 !
         0 = no
         1 = yes (advection step, puff ID)
         2 = yes (YYYYJJJHH, # old puffs, # emitted puffs)


     SPECIES (or GROUP for combined species) LIST FOR OUTPUT OPTIONS

                  ---- CONCENTRATIONS ----    ------ DRY FLUXES ------    ------ WET FLUXES
------   -- MASS FLUX --
   SPECIES
   /GROUP        PRINTED?  SAVED ON DISK?   PRINTED?  SAVED ON DISK?   PRINTED?  SAVED ON
DISK?   SAVED ON DISK?
   -------       ------------------------   ------------------------   ------------------
------   ---------------
!          SO2 =     0,           1,           0,           1,           0,           1,
0   !
!          SO4 =     0,           1,           0,           1,           0,           1,
0   !
!          NOX =     0,           1,           0,           1,           0,           1,
0   !
!         HNO3 =     0,           1,           0,           1,           0,           1,
0   !
!          NO3 =     0,           1,           0,           1,           0,           1,
0   !
!         PM10 =     0,           1,           0,           1,           0,           1,
0   !
!          PMF =     0,           1,           0,           1,           0,           1,
0   !

     OPTIONS FOR PRINTING "DEBUG" QUANTITIES (much output)

       Logical for debug output
       (LDEBUG)                                Default: F     ! LDEBUG = F !

       First puff to track
       (IPFDEB)                                Default: 1     ! IPFDEB = 1 !

       Number of puffs to track
       (NPFDEB)                                Default: 1     ! NPFDEB = 1 !

       Met. period to start output
```

```
       (NN1)                                    Default: 1     ! NN1 = 1 !

       Met. period to end output
       (NN2)                                    Default: 10    ! NN2 = 10 !

!END!


-------------------------------------------------------------------------------


INPUT GROUP: 6a, 6b, & 6c -- Subgrid scale complex terrain inputs
-------------------------

---------------
Subgroup (6a)
---------------
       Number of terrain features (NHILL)       Default: 0     ! NHILL = 0 !

       Number of special complex terrain
       receptors  (NCTREC)                      Default: 0     ! NCTREC = 0 !

       Terrain and CTSG Receptor data for
       CTSG hills input in CTDM format ?
       (MHILL)                                  No Default     ! MHILL = 2 !
       1 = Hill and Receptor data created
           by CTDM processors & read from
           HILL.DAT and HILLRCT.DAT files
       2 = Hill data created by OPTHILL &
           input below in Subgroup (6b);
           Receptor data in Subgroup (6c)

       Factor to convert horizontal dimensions  Default: 1.0   ! XHILL2M = 1.0 !
       to meters (MHILL=1)

       Factor to convert vertical dimensions    Default: 1.0   ! ZHILL2M = 1.0 !
       to meters (MHILL=1)

       X-origin of CTDM system relative to      No Default     ! XCTDMKM = 0.0 !
       CALPUFF coordinate system, in Kilometers (MHILL=1)

       Y-origin of CTDM system relative to      No Default     ! YCTDMKM = 0.0 !
       CALPUFF coordinate system, in Kilometers (MHILL=1)

! END !

---------------
Subgroup (6b)
---------------

                      1 **
     HILL information


HILL            XC         YC        THETAH  ZGRID  RELIEF    EXPO 1    EXPO 2   SCALE 1
SCALE 2    AMAX1     AMAX2
 NO.           (km)       (km)       (deg.)   (m)     (m)       (m)       (m)       (m)
(m)       (m)       (m)
----           ----       ----       ------  -----  ------    ------    ------   -------
-------    -----     -----


---------------
Subgroup (6c)
---------------

    COMPLEX TERRAIN RECEPTOR INFORMATION

                      XRCT         YRCT        ZRCT          XHH
                      (km)         (km)         (m)
                     ------        -----      ------         ----
```

```
-------------------
1
     Description of Complex Terrain Variables:
          XC, YC  = Coordinates of center of hill
          THETAH  = Orientation of major axis of hill (clockwise from
                    North)
          ZGRID   = Height of the  0  of the grid above mean sea
                    level
          RELIEF  = Height of the crest of the hill above the grid elevation
          EXPO 1  = Hill-shape exponent for the major axis
          EXPO 2  = Hill-shape exponent for the major axis
          SCALE 1 = Horizontal length scale along the major axis
          SCALE 2 = Horizontal length scale along the minor axis
          AMAX    = Maximum allowed axis length for the major axis
          BMAX    = Maximum allowed axis length for the major axis

          XRCT, YRCT = Coordinates of the complex terrain receptors
          ZRCT    = Height of the ground (MSL) at the complex terrain
                    Receptor
          XHH     = Hill number associated with each complex terrain receptor
                    (NOTE: MUST BE ENTERED AS A REAL NUMBER)

   **
     NOTE: DATA for each hill and CTSG receptor are treated as a separate
           input subgroup and therefore must end with an input group terminator.

-------------------------------------------------------------------------------


INPUT GROUP: 7 -- Chemical parameters for dry deposition of gases
--------------

      SPECIES      DIFFUSIVITY       ALPHA STAR       REACTIVITY     MESOPHYLL RESISTANCE
HENRY'S LAW COEFFICIENT
       NAME         (cm**2/s)                                                    (s/cm)
(dimensionless)
      -------      -----------       ----------       ----------     --------------------
-----------------------
!           HNO3 =      0.1628,               1,               18,                     0,
8E-8 !
!            NOX =      0.1656,               1,                8,                     5,
3.5 !
!            SO2 =      0.1509,            1000,                8,                     0,
0.04 !


!END!


-------------------------------------------------------------------------------


INPUT GROUP: 8 -- Size parameters for dry deposition of particles
--------------

     For SINGLE SPECIES, the mean and standard deviation are used to
     compute a deposition velocity for NINT (see group 9) size-ranges,
     and these are then averaged to obtain a mean deposition velocity.

     For GROUPED SPECIES, the size distribution should be explicitly
     specified (by the 'species' in the group), and the standard deviation
     for each should be entered as 0.  The model will then use the
     deposition velocity for the stated mean diameter.

      SPECIES      GEOMETRIC MASS MEAN        GEOMETRIC STANDARD
       NAME             DIAMETER                  DEVIATION
                        (microns)                 (microns)
      -------      -------------------        ------------------
!          NO3 =         0.48,                       2   !
```

```
!         PM10 =         6.12,                       2   !
!          PMF =         1.24,                       2   !
!          SO4 =         0.48,                       2   !

!END!


-------------------------------------------------------------------------------


INPUT GROUP: 9 -- Miscellaneous dry deposition parameters
--------------

     Reference cuticle resistance (s/cm)
     (RCUTR)                           Default: 30    ! RCUTR = 30 !
     Reference ground resistance  (s/cm)
     (RGR)                             Default: 10    ! RGR = 10 !
     Reference pollutant reactivity
     (REACTR)                          Default: 8     ! REACTR = 8 !

     Number of particle-size intervals used to
     evaluate effective particle deposition velocity
     (NINT)                            Default: 9     ! NINT = 9 !

     Vegetation state in unirrigated areas
     (IVEG)                            Default: 1     ! IVEG = 1 !
        IVEG=1 for active and unstressed vegetation
        IVEG=2 for active and stressed vegetation
        IVEG=3 for inactive vegetation

!END!


-------------------------------------------------------------------------------


INPUT GROUP: 10 -- Wet Deposition Parameters
---------------


                      Scavenging Coefficient -- Units: (sec)**(-1)

       Pollutant      Liquid Precip.       Frozen Precip.
       ---------      --------------       --------------
!         HNO3 =        6.00E-05,             0.00E00 !
!          NO3 =        1.00E-04,            3.00E-05 !
!          NOX =         0.00E00,             0.00E00 !
!         PM10 =        1.00E-04,            3.00E-05 !
!          PMF =        1.00E-04,            3.00E-05 !
!          SO2 =        3.00E-05,             0.00E00 !
!          SO4 =        1.00E-04,            3.00E-05 !

!END!


-------------------------------------------------------------------------------


INPUT GROUP: 11 -- Chemistry Parameters
---------------

     Ozone data input option (MOZ)     Default: 0            ! MOZ = 1 !
     (Used only if MCHEM = 1, 3, or 4)
        0 = use a monthly background ozone value
        1 = read hourly ozone concentrations from
            the OZONE.DAT data file

     Monthly ozone concentrations
     (Used only if MCHEM = 1, 3, or 4 and
      MOZ = 0 or MOZ = 1 and all hourly O3 data missing)
     (BCKO3) in ppb                    Default: 12*80.
```

```
! BCKO3 = 80, 80, 80, 80, 80, 80, 80, 80, 80, 80, 80, 80 !

Monthly ammonia concentrations
(Used only if MCHEM = 1, or 3)
(BCKNH3) in ppb                  Default: 12*10.
! BCKNH3 = 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1 !

Nighttime SO2 loss rate (RNITE1)
in percent/hour                  Default: 0.2          ! RNITE1 = 0.2 !

Nighttime NOx loss rate (RNITE2)
in percent/hour                  Default: 2.0          ! RNITE2 = 2 !

Nighttime HNO3 formation rate (RNITE3)
in percent/hour                  Default: 2.0          ! RNITE3 = 2 !

H2O2 data input option (MH2O2)    Default: 0            ! MH2O2 = 0 !
(Used only if MAQCHEM = 1)
   0 = use a monthly background H2O2 value
   1 = read hourly H2O2 concentrations from
       the H2O2.DAT data file

Monthly H2O2 concentrations
(Used only if MAQCHEM = 1 and
 MH2O2 = 0 or MH2O2 = 1 and all hourly H2O2 data missing)
(BCKH2O2) in ppb                 Default: 12*1.
! BCKH2O2 = 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00 !


--- Data for SECONDARY ORGANIC AEROSOL (SOA) Option
    (used only if MCHEM = 4)

    The SOA module uses monthly values of:
         Fine particulate concentration in ug/m^3 (BCKPMF)
         Organic fraction of fine particulate     (OFRAC)
         VOC / NOX ratio (after reaction)         (VCNX)
    to characterize the air mass when computing
    the formation of SOA from VOC emissions.
    Typical values for several distinct air mass types are:

       Month    1    2    3    4    5    6    7    8    9   10   11   12
                Jan  Feb  Mar  Apr  May  Jun  Jul  Aug  Sep  Oct  Nov  Dec

    Clean Continental
       BCKPMF   1.   1.   1.   1.   1.   1.   1.   1.   1.   1.   1.   1.
       OFRAC  .15  .15  .20  .20  .20  .20  .20  .20  .20  .20  .20  .15
       VCNX    50.  50.  50.  50.  50.  50.  50.  50.  50.  50.  50.  50.

    Clean Marine (surface)
       BCKPMF  .5   .5   .5   .5   .5   .5   .5   .5   .5   .5   .5   .5
       OFRAC  .25  .25  .30  .30  .30  .30  .30  .30  .30  .30  .30  .25
       VCNX    50.  50.  50.  50.  50.  50.  50.  50.  50.  50.  50.  50.

    Urban - low biogenic (controls present)
       BCKPMF  30.  30.  30.  30.  30.  30.  30.  30.  30.  30.  30.  30.
       OFRAC  .20  .20  .25  .25  .25  .25  .25  .25  .20  .20  .20  .20
       VCNX     4.   4.   4.   4.   4.   4.   4.   4.   4.   4.   4.   4.

    Urban - high biogenic (controls present)
       BCKPMF  60.  60.  60.  60.  60.  60.  60.  60.  60.  60.  60.  60.
       OFRAC  .25  .25  .30  .30  .30  .55  .55  .55  .35  .35  .35  .25
       VCNX    15.  15.  15.  15.  15.  15.  15.  15.  15.  15.  15.  15.

    Regional Plume
       BCKPMF  20.  20.  20.  20.  20.  20.  20.  20.  20.  20.  20.  20.
       OFRAC  .20  .20  .25  .35  .25  .40  .40  .40  .30  .30  .30  .20
       VCNX    15.  15.  15.  15.  15.  15.  15.  15.  15.  15.  15.  15.

    Urban - no controls present
       BCKPMF 100. 100. 100. 100. 100. 100. 100. 100. 100. 100. 100. 100.
       OFRAC  .30  .30  .35  .35  .35  .55  .55  .55  .35  .35  .35  .30
```

```
        VCNX     2.   2.   2.   2.   2.   2.   2.   2.   2.   2.   2.   2.

     Default: Clean Continental
     ! BCKPMF = 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00 !
     ! OFRAC = 0.15, 0.15, 0.20, 0.20, 0.20, 0.20, 0.20, 0.20, 0.20, 0.20, 0.20, 0.15 !
     !  VCNX  =  50.00,  50.00,  50.00,  50.00,  50.00,  50.00,  50.00,  50.00,  50.00,  50.00,
50.00, 50.00 !


!END!


-------------------------------------------------------------------------------


INPUT GROUP: 12 -- Misc. Dispersion and Computational Parameters
---------------

     Horizontal size of puff (m) beyond which
     time-dependent dispersion equations (Heffter)
     are used to determine sigma-y and
     sigma-z (SYTDEP)                          Default: 550.   ! SYTDEP = 550 !

     Switch for using Heffter equation for sigma z
     as above (0 = Not use Heffter; 1 = use Heffter
     (MHFTSZ)                                  Default: 0      ! MHFTSZ = 0 !

     Stability class used to determine plume
     growth rates for puffs above the boundary
     layer (JSUP)                              Default: 5      ! JSUP = 5 !

     Vertical dispersion constant for stable
     conditions (k1 in Eqn. 2.7-3)  (CONK1)    Default: 0.01   ! CONK1 = 0.01 !

     Vertical dispersion constant for neutral/
     unstable conditions (k2 in Eqn. 2.7-4)
     (CONK2)                                   Default: 0.1    ! CONK2 = 0.1 !

     Factor for determining Transition-point from
     Schulman-Scire to Huber-Snyder Building Downwash
     scheme (SS used for Hs <Hb + TBD * HL)
     (TBD)                                     Default: 0.5    ! TBD = 0.5 !
        TBD <0   ==> always use Huber-Snyder
        TBD = 1.5 ==> always use Schulman-Scire
        TBD = 0.5 ==> ISC Transition-point

     Range of land use categories for which
     urban dispersion is assumed
     (IURB1, IURB2)                            Default: 10     ! IURB1 = 10 !
                                                        19     ! IURB2 = 19 !

     Site characterization parameters for single-point Met data files ---------
     (needed for METFM = 2,3,4)

        Land use category for modeling domain
        (ILANDUIN)                             Default: 20     ! ILANDUIN = 20 !

        Roughness length (m) for modeling domain
        (Z0IN)                                 Default: 0.25   ! Z0IN = .25 !

        Leaf area index for modeling domain
        (XLAIIN)                               Default: 3.0    ! XLAIIN = 3.0 !

        Elevation above sea level (m)
        (ELEVIN)                               Default: 0.0    ! ELEVIN = .0 !

        Latitude (degrees) for met location
        (XLATIN)                               Default: -999.  ! XLATIN = -999.0 !

        Longitude (degrees) for met location
        (XLONIN)                               Default: -999.  ! XLONIN = -999.0 !
```

```
Specialized information for interpreting single-point Met data files -----

   Anemometer height (m) (Used only if METFM = 2,3)
   (ANEMHT)                                Default: 10.    ! ANEMHT = 10.0 !

   Form of lateral turbulance data in PROFILE.DAT file
   (Used only if METFM = 4 or MTURBVW = 1 or 3)
   (ISIGMAV)                               Default: 1      ! ISIGMAV = 1 !
       0 = read sigma-theta
       1 = read sigma-v

   Choice of mixing heights (Used only if METFM = 4)
   (IMIXCTDM)                              Default: 0      ! IMIXCTDM = 0 !
       0 = read PREDICTED mixing heights
       1 = read OBSERVED mixing heights

Maximum length of a slug (met. grid units)
(XMXLEN)                                   Default: 1.0    ! XMXLEN = 1 !

Maximum travel distance of a puff/slug (in
grid units) during one sampling step
(XSAMLEN)                                  Default: 1.0    ! XSAMLEN = 1 !

Maximum Number of slugs/puffs release from
one source during one time step
(MXNEW)                                    Default: 99     ! MXNEW = 99 !

Maximum Number of sampling steps for
one puff/slug during one time step
(MXSAM)                                    Default: 99     ! MXSAM = 99 !

Number of iterations used when computing
the transport wind for a sampling step
that includes gradual rise (for CALMET
and PROFILE winds)
(NCOUNT)                                   Default: 2      ! NCOUNT = 2 !

Minimum sigma y for a new puff/slug (m)
(SYMIN)                                    Default: 1.0    ! SYMIN = 1 !

Minimum sigma z for a new puff/slug (m)
(SZMIN)                                    Default: 1.0    ! SZMIN = 1 !

Default minimum turbulence velocities
sigma-v and sigma-w for each
stability class (m/s)
(SVMIN(6) and SWMIN(6))     Default SVMIN : .50,  .50,  .50,  .50,  .50,  .50
                            Default SWMIN : .20,  .12,  .08,  .06,  .03,  .016

                          Stability Class :  A     B     C     D     E     F
                                            ---   ---   ---   ---   ---   ---
                                   ! SVMIN = 0.5, 0.5, 0.5, 0.5, 0.5, 0.5 !
                                   ! SWMIN = 0.2, 0.12, 0.08, 0.06, 0.03, 0.016 !

Divergence criterion for dw/dz across puff
used to initiate adjustment for horizontal
convergence (1/s)
Partial adjustment starts at CDIV(1), and
full adjustment is reached at CDIV(2)
(CDIV(2))                                  Default: 0.0,0.0  ! CDIV = 0, 0 !

Minimum wind speed (m/s) allowed for
non-calm conditions. Also used as minimum
speed returned when using power-law
extrapolation toward surface
(WSCALM)                                   Default: 0.5    ! WSCALM = 0.5 !

Maximum mixing height (m)
(XMAXZI)                                   Default: 3000.  ! XMAXZI = 3000 !
```

```
Minimum mixing height (m)
(XMINZI)                                  Default: 50.    ! XMINZI = 50 !

Default wind speed classes --
5 upper bounds (m/s) are entered;
the 6th class has no upper limit
(WSCAT(5))                      Default   :
                                ISC RURAL : 1.54, 3.09, 5.14, 8.23, 10.8 (10.8+)

                         Wind Speed Class :  1     2     3     4     5
                                            ---   ---   ---   ---   ---
                                  ! WSCAT = 1.54, 3.09, 5.14, 8.23, 10.8 !

Default wind speed profile power-law
exponents for stabilities 1-6
(PLX0(6))                       Default   : ISC RURAL values
                                ISC RURAL : .07, .07, .10, .15, .35, .55
                                ISC URBAN : .15, .15, .20, .25, .30, .30

                          Stability Class :  A     B     C     D     E     F
                                            ---   ---   ---   ---   ---   ---
                                   ! PLX0 = 0.07, 0.07, 0.1, 0.15, 0.35, 0.55 !

Default potential temperature gradient
for stable classes E, F (degK/m)
(PTG0(2))                       Default: 0.020, 0.035
                                   ! PTG0 = 0.02, 0.035 !

Default plume path coefficients for
each stability class (used when option
for partial plume height terrain adjustment
is selected -- MCTADJ=3)
(PPC(6))                  Stability Class :  A     B     C     D     E     F
                             Default  PPC : .50,  .50,  .50,  .50,  .35,  .35
                                            ---   ---   ---   ---   ---   ---
                                    ! PPC = 0.5, 0.5, 0.5, 0.5, 0.35, 0.35 !

Slug-to-puff transition criterion factor
equal to sigma-y/length of slug
(SL2PF)                                Default: 10.        ! SL2PF = 10 !

Puff-splitting control variables ------------------------

  VERTICAL SPLIT
  --------------

  Number of puffs that result every time a puff
  is split - nsplit=2 means that 1 puff splits
  into 2
  (NSPLIT)                             Default:   3        ! NSPLIT = 3 !

  Time(s) of a day when split puffs are eligible to
  be split once again; this is typically set once
  per day, around sunset before nocturnal shear develops.
  24 values: 0 is midnight (00:00) and 23 is 11 PM (23:00)
  0=do not re-split    1=eligible for re-split
  (IRESPLIT(24))                       Default:  Hour 17 = 1
  ! IRESPLIT = 0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,1,0,0,0,0,0,0 !

  Split is allowed only if last hour's mixing
  height (m) exceeds a minimum value
  (ZISPLIT)                            Default: 100.       ! ZISPLIT = 100 !

  Split is allowed only if ratio of last hour's
  mixing ht to the maximum mixing ht experienced
  by the puff is less than a maximum value (this
  postpones a split until a nocturnal layer develops)
  (ROLDMAX)                            Default: 0.25       ! ROLDMAX = 0.25 !


  HORIZONTAL SPLIT
```

```
       ----------------

       Number of puffs that result every time a puff
       is split - nsplith=5 means that 1 puff splits
       into 5
       (NSPLITH)                          Default:   5        ! NSPLITH = 5 !

       Minimum sigma-y (Grid Cells Units) of puff
       before it may be split
       (SYSPLITH)                         Default:  1.0       ! SYSPLITH = 1 !

       Minimum puff elongation rate (SYSPLITH/hr) due to
       wind shear, before it may be split
       (SHSPLITH)                         Default:  2.        ! SHSPLITH = 2 !

       Minimum concentration (g/m^3) of each
       species in puff before it may be split
       Enter array of NSPEC values; if a single value is
       entered, it will be used for ALL species
       (CNSPLITH)                         Default:  1.0E-07   ! CNSPLITH = 1E-7 !

     Integration control variables ------------------------

       Fractional convergence criterion for numerical SLUG
       sampling integration
       (EPSSLUG)                          Default:   1.0e-04  ! EPSSLUG = 0.0001 !

       Fractional convergence criterion for numerical AREA
       source integration
       (EPSAREA)                          Default:   1.0e-06  ! EPSAREA = 1E-6 !

       Trajectory step-length (m) used for numerical rise
       integration
       (DSRISE)                           Default:   1.0      ! DSRISE = 1 !

     Boundary Condition (BC) Puff control variables ------------------------

       Minimum height (m) to which BC puffs are mixed as they are emitted
       (MBCON=2 ONLY).  Actual height is reset to the current mixing height
       at the release point if greater than this minimum.
       (HTMINBC)                          Default:   500.     * HTMINBC = *

       Search radius (km) about a receptor for sampling nearest BC puff.
       BC puffs are typically emitted with a spacing of one grid cell
       length, so the search radius should be greater than DGRIDKM.
       (RSAMPBC)                          Default:   4.       * RSAMPBC = *

       Near-Surface depletion adjustment to concentration profile used when
       sampling BC puffs?
       (MDEPBC)                           Default:   1        * MDEPBC = *
          0 = Concentration is NOT adjusted for depletion
          1 = Adjust Concentration for depletion

!END!


-------------------------------------------------------------------------------


INPUT GROUPS: 13a, 13b, 13c, 13d -- Point source parameters
--------------------------------

---------------
Subgroup (13a)
---------------

     Number of point sources with
     parameters provided below      (NPT1)  No default  ! NPT1 = 40 !

     Units used for point source
     emissions below                (IPTU)  Default: 1  ! IPTU = 3 !
```

```
          1 =        g/s
          2 =       kg/hr
          3 =       lb/hr
          4 =     tons/yr
          5 =     Odour Unit * m**3/s  (vol. flux of odour compound)
          6 =     Odour Unit * m**3/min
          7 =     metric tons/yr

     Number of source-species
     combinations with variable
     emissions scaling factors
     provided below in (13d)        (NSPT1) Default: 0  ! NSPT1 = 0 !

     Number of point sources with
     variable emission parameters
     provided in external file      (NPT2)  No default  ! NPT2 = 0 !

     (If NPT2 > 0, these point
     source emissions are read from
     the file: PTEMARB.DAT)

!END!

---------------
Subgroup (13b)
---------------
                                    a
          POINT SOURCE: CONSTANT DATA
          ----------------------------
                                                                          b
c
  Source      X UTM     Y UTM     Stack   Base     Stack    Exit  Exit    Bldg.  Emission
   No.     Coordinate Coordinate Height Elevation Diameter  Vel.  Temp.   Dwash   Rates
              (km)      (km)       (m)      (m)       (m)  (m/s) (deg. K)
  ------   ---------- ---------- ------  ------   -------- ----- -------- ----- --------
   1 ! SRCNAM = D1 !
   1 ! X =  165.644,  301.705,     7.6, 1755.9,       0.1,    50,    800,  0.0, 5.11E-02,
0.00E00, 3.31E00,
 0.00E00, 0.00E00, 0.00E00, 0.00E00 !
   1 ! FMFAC =        1 !   !END!

   2 ! SRCNAM = D2 !
   2 ! X =  164.170,  300.242,     7.6, 1818.3,       0.1,    50,    800,  0.0, 5.11E-02,
0.00E00, 3.31E00,
 0.00E00, 0.00E00, 0.00E00, 0.00E00 !
   2 ! FMFAC =        1 !   !END!

   3 ! SRCNAM = D3 !
   3 ! X =  163.159,  301.353,     7.6, 1806.0,       0.1,    50,    800,  0.0, 5.11E-02,
0.00E00, 3.31E00,
 0.00E00, 0.00E00, 0.00E00, 0.00E00 !
   3 ! FMFAC =        1 !   !END!

   4 ! SRCNAM = D4 !
   4 ! X =  160.912,  300.813,     7.6, 1846.1,       0.1,    50,    800,  0.0, 5.11E-02,
0.00E00, 3.31E00,
 0.00E00, 0.00E00, 0.00E00, 0.00E00 !
   4 ! FMFAC =        1 !   !END!

   5 ! SRCNAM = D5 !
   5 ! X =  159.558,  299.155,     7.6, 2025.6,       0.1,    50,    800,  0.0, 5.11E-02,
0.00E00, 3.31E00,
 0.00E00, 0.00E00, 0.00E00, 0.00E00 !
   5 ! FMFAC =        1 !   !END!

   6 ! SRCNAM = D6 !
   6 ! X =  161.741,  297.896,     7.6, 1985.0,       0.1,    50,    800,  0.0, 5.11E-02,
0.00E00, 3.31E00,
 0.00E00, 0.00E00, 0.00E00, 0.00E00 !
   6 ! FMFAC =        1 !   !END!
```

```
   7 ! SRCNAM = D7 !
   7 ! X =  156.991,  298.418,     7.6, 1995.3,       0.1,    50,    800,  0.0, 5.11E-02,
0.00E00, 3.31E00,
 0.00E00, 0.00E00, 0.00E00, 0.00E00 !
   7 ! FMFAC =        1 !   !END!

   8 ! SRCNAM = D8 !
   8 ! X =  154.794,  298.418,     7.6, 2033.3,       0.1,    50,    800,  0.0, 5.11E-02,
0.00E00, 3.31E00,
 0.00E00, 0.00E00, 0.00E00, 0.00E00 !
   8 ! FMFAC =        1 !   !END!

   9 ! SRCNAM = D9 !
   9 ! X =  155.534,  293.478,     7.6, 2076.2,       0.1,    50,    800,  0.0, 5.11E-02,
0.00E00, 3.31E00,
 0.00E00, 0.00E00, 0.00E00, 0.00E00 !
   9 ! FMFAC =        1 !   !END!

  10 ! SRCNAM = D10 !
  10 ! X =  157.702,  293.420,     7.6, 1888.9,       0.1,    50,    800,  0.0, 5.11E-02,
0.00E00, 3.31E00,
 0.00E00, 0.00E00, 0.00E00, 0.00E00 !
  10 ! FMFAC =        1 !   !END!

  11 ! SRCNAM = D11 !
  11 ! X =  158.104,  289.676,     7.6, 2099.7,       0.1,    50,    800,  0.0, 5.11E-02,
0.00E00, 3.31E00,
 0.00E00, 0.00E00, 0.00E00, 0.00E00 !
  11 ! FMFAC =        1 !   !END!

  12 ! SRCNAM = D12 !
  12 ! X =  151.392,  289.920,     7.6, 2187.5,       0.1,    50,    800,  0.0, 5.11E-02,
0.00E00, 3.31E00,
 0.00E00, 0.00E00, 0.00E00, 0.00E00 !
  12 ! FMFAC =        1 !   !END!

  13 ! SRCNAM = D13 !
  13 ! X =  149.796,  295.540,     7.6, 2144.2,       0.1,    50,    800,  0.0, 5.11E-02,
0.00E00, 3.31E00,
 0.00E00, 0.00E00, 0.00E00, 0.00E00 !
  13 ! FMFAC =        1 !   !END!

  14 ! SRCNAM = D14 !
  14 ! X =  150.979,  296.873,     7.6, 2135.2,       0.1,    50,    800,  0.0, 5.11E-02,
0.00E00, 3.31E00,
 0.00E00, 0.00E00, 0.00E00, 0.00E00 !
  14 ! FMFAC =        1 !   !END!

  15 ! SRCNAM = D15 !
  15 ! X =  145.595,  294.342,     7.6, 2206.7,       0.1,    50,    800,  0.0, 5.11E-02,
0.00E00, 3.31E00,
 0.00E00, 0.00E00, 0.00E00, 0.00E00 !
  15 ! FMFAC =        1 !   !END!

  16 ! SRCNAM = D16 !
  16 ! X =  143.177,  293.432,     7.6, 2265.5,       0.1,    50,    800,  0.0, 5.11E-02,
0.00E00, 3.31E00,
 0.00E00, 0.00E00, 0.00E00, 0.00E00 !
  16 ! FMFAC =        1 !   !END!

  17 ! SRCNAM = D17 !
  17 ! X =  142.138,  296.698,     7.6, 2212.3,       0.1,    50,    800,  0.0, 5.11E-02,
0.00E00, 3.31E00,
 0.00E00, 0.00E00, 0.00E00, 0.00E00 !
  17 ! FMFAC =        1 !   !END!

  18 ! SRCNAM = D18 !
  18 ! X =  143.732,  297.919,     7.6, 2291.3,       0.1,    50,    800,  0.0, 5.11E-02,
0.00E00, 3.31E00,
 0.00E00, 0.00E00, 0.00E00, 0.00E00 !
  18 ! FMFAC =        1 !   !END!
```

```
  19 ! SRCNAM = D19 !
  19 ! X =  146.272,  298.480,     7.6, 2178.8,       0.1,    50,    800,  0.0, 5.11E-02,
0.00E00, 3.31E00,
 0.00E00, 0.00E00, 0.00E00, 0.00E00 !
  19 ! FMFAC =        1 !   !END!

  20 ! SRCNAM = D20 !
  20 ! X =  140.221,  297.697,     7.6, 2297.4,       0.1,    50,    800,  0.0, 5.11E-02,
0.00E00, 3.31E00,
 0.00E00, 0.00E00, 0.00E00, 0.00E00 !
  20 ! FMFAC =        1 !   !END!

  21 ! SRCNAM = D21 !
  21 ! X =  140.217,  300.245,     7.6, 2299.4,       0.1,    50,    800,  0.0, 5.11E-02,
0.00E00, 3.31E00,
 0.00E00, 0.00E00, 0.00E00, 0.00E00 !
  21 ! FMFAC =        1 !   !END!

  22 ! SRCNAM = D22 !
  22 ! X =  137.721,  300.769,     7.6, 2176.1,       0.1,    50,    800,  0.0, 5.11E-02,
0.00E00, 3.31E00,
 0.00E00, 0.00E00, 0.00E00, 0.00E00 !
  22 ! FMFAC =        1 !   !END!

  23 ! SRCNAM = D23 !
  23 ! X =  137.167,  298.360,     7.6, 2403.5,       0.1,    50,    800,  0.0, 5.11E-02,
0.00E00, 3.31E00,
 0.00E00, 0.00E00, 0.00E00, 0.00E00 !
  23 ! FMFAC =        1 !   !END!

  24 ! SRCNAM = D24 !
  24 ! X =  136.541,  301.427,     7.6, 2087.0,       0.1,    50,    800,  0.0, 5.11E-02,
0.00E00, 3.31E00,
 0.00E00, 0.00E00, 0.00E00, 0.00E00 !
  24 ! FMFAC =        1 !   !END!

  25 ! SRCNAM = D25 !
  25 ! X =  149.893,  299.290,     7.6, 1847.4,       0.1,    50,    800,  0.0, 5.11E-02,
0.00E00, 3.31E00,
 0.00E00, 0.00E00, 0.00E00, 0.00E00 !
  25 ! FMFAC =        1 !   !END!

  26 ! SRCNAM = CS1ENG1 !
  26 ! X =  139.652,  299.024,     9.1, 2300.0,    0.3048,    25,    811,  0.0, 0.00E00,
0.00E00, 5.29E00,
 0.00E00, 0.00E00, 0.00E00, 0.00E00 !
  26 ! FMFAC =        1 !   !END!

  27 ! SRCNAM = CS1ENG2 !
  27 ! X =  139.659,  299.034,     9.1, 2300.0,    0.3048,    25,    811,  0.0, 0.00E00,
0.00E00, 5.29E00,
 0.00E00, 0.00E00, 0.00E00, 0.00E00 !
  27 ! FMFAC =        1 !   !END!

  28 ! SRCNAM = CS1ENG3 !
  28 ! X =  139.666,  299.044,     9.1, 2300.0,    0.3048,    25,    811,  0.0, 0.00E00,
0.00E00, 5.29E00,
 0.00E00, 0.00E00, 0.00E00, 0.00E00 !
  28 ! FMFAC =        1 !   !END!

  29 ! SRCNAM = CS1ENG4 !
  29 ! X =  139.671,  299.054,     9.1, 2300.0,    0.3048,    25,    811,  0.0, 0.00E00,
0.00E00, 5.29E00,
 0.00E00, 0.00E00, 0.00E00, 0.00E00 !
  29 ! FMFAC =        1 !   !END!

  30 ! SRCNAM = CS2ENG1 !
  30 ! X =  148.307,  294.787,     9.1, 2200.0,    0.3048,    25,    811,  0.0, 0.00E00,
0.00E00, 5.29E00,
 0.00E00, 0.00E00, 0.00E00, 0.00E00 !
```

```
  30 ! FMFAC =        1 !   !END!

  31 ! SRCNAM = CS2ENG2 !
  31 ! X =  148.319,  294.783,     9.1, 2200.0,    0.3048,    25,    811,  0.0, 0.00E00,
0.00E00, 5.29E00,
 0.00E00, 0.00E00, 0.00E00, 0.00E00 !
  31 ! FMFAC =        1 !   !END!

  32 ! SRCNAM = CS2ENG3 !
  32 ! X =  148.330,  294.778,     9.1, 2200.0,    0.3048,    25,    811,  0.0, 0.00E00,
0.00E00, 5.29E00,
 0.00E00, 0.00E00, 0.00E00, 0.00E00 !
  32 ! FMFAC =        1 !   !END!

  33 ! SRCNAM = CS2ENG4 !
  33 ! X =  148.341,  294.774,     9.1, 2200.0,    0.3048,    25,    811,  0.0, 0.00E00,
0.00E00, 5.29E00,
 0.00E00, 0.00E00, 0.00E00, 0.00E00 !
  33 ! FMFAC =        1 !   !END!

  34 ! SRCNAM = CS3ENG1 !
  34 ! X =  155.394,  296.047,     9.1, 2195.0,    0.3048,    25,    811,  0.0, 0.00E00,
0.00E00, 5.29E00,
 0.00E00, 0.00E00, 0.00E00, 0.00E00 !
  34 ! FMFAC =        1 !   !END!

  35 ! SRCNAM = CS3ENG2 !
  35 ! X =  155.405,  296.043,     9.1, 2195.0,    0.3048,    25,    811,  0.0, 0.00E00,
0.00E00, 5.29E00,
 0.00E00, 0.00E00, 0.00E00, 0.00E00 !
  35 ! FMFAC =        1 !   !END!

  36 ! SRCNAM = CS3ENG3 !
  36 ! X =  155.416,  296.038,     9.1, 2195.0,    0.3048,    25,    811,  0.0, 0.00E00,
0.00E00, 5.29E00,
 0.00E00, 0.00E00, 0.00E00, 0.00E00 !
  36 ! FMFAC =        1 !   !END!

  37 ! SRCNAM = CS3ENG4 !
  37 ! X =  155.426,  296.034,     9.1, 2195.0,    0.3048,    25,    811,  0.0, 0.00E00,
0.00E00, 5.29E00,
 0.00E00, 0.00E00, 0.00E00, 0.00E00 !
  37 ! FMFAC =        1 !   !END!

  38 ! SRCNAM = CS3ENG5 !
  38 ! X =  155.407,  296.079,     9.1, 2195.0,    0.3048,    25,    811,  0.0, 0.00E00,
0.00E00, 5.29E00,
 0.00E00, 0.00E00, 0.00E00, 0.00E00 !
  38 ! FMFAC =        1 !   !END!

  39 ! SRCNAM = CS3ENG6 !
  39 ! X =  155.419,  296.074,     9.1, 2195.0,    0.3048,    25,    811,  0.0, 0.00E00,
0.00E00, 5.29E00,
 0.00E00, 0.00E00, 0.00E00, 0.00E00 !
  39 ! FMFAC =        1 !   !END!

  40 ! SRCNAM = CS3ENG7 !
  40 ! X =  155.429,  296.070,     9.1, 2195.0,    0.3048,    25,    811,  0.0, 0.00E00,
0.00E00, 5.29E00,
 0.00E00, 0.00E00, 0.00E00, 0.00E00 !
  40 ! FMFAC =        1 !   !END!
```

---

a
Data for each source are treated as a separate input subgroup and therefore must end with an input group terminator.

SRCNAM is a 12-character name for a source
(No default)

```
     X       is an array holding the source data listed by the column headings
             (No default)
     SIGYZI  is an array holding the initial sigma-y and sigma-z (m)
             (Default: 0.,0.)
     FMFAC   is a vertical momentum flux factor (0. or 1.0) used to represent
             the effect of rain-caps or other physical configurations that
             reduce momentum rise associated with the actual exit velocity.
             (Default: 1.0  -- full momentum used)

    b
     0. = No building downwash modeled, 1. = downwash modeled
     NOTE: must be entered as a REAL number (i.e., with decimal point)

    c
     An emission rate must be entered for every pollutant modeled.
     Enter emission rate of zero for secondary pollutants that are
     modeled, but not emitted.  Units are specified by IPTU
     (e.g. 1 for g/s).

---------------
Subgroup (13c)
---------------

           BUILDING DIMENSION DATA FOR SOURCES SUBJECT TO DOWNWASH
           -------------------------------------------------------
Source                                                                  a
 No.       Effective building width and height (in meters) every 10 degrees
------     ---------------------------------------------------------------


--------

    a
     Each pair of width and height values is treated as a separate input
     subgroup and therefore must end with an input group terminator.

---------------
Subgroup (13d)
---------------
                                                 a
          POINT SOURCE: VARIABLE EMISSIONS DATA
          -------------------------------------

     Use this subgroup to describe temporal variations in the emission
     rates given in 13b.  Factors entered multiply the rates in 13b.
     Skip sources here that have constant emissions.  For more elaborate
     variation in source parameters, use PTEMARB.DAT and NPT2 > 0.

     IVARY determines the type of variation, and is source-specific:
     (IVARY)                              Default: 0
           0 =       Constant
           1 =       Diurnal cycle (24 scaling factors: hours 1-24)
           2 =       Monthly cycle (12 scaling factors: months 1-12)
           3 =       Hour & Season (4 groups of 24 hourly scaling factors,
                                    where first group is DEC-JAN-FEB)
           4 =       Speed & Stab. (6 groups of 6 scaling factors, where
                                    first group is Stability Class A,
                                    and the speed classes have upper
                                    bounds (m/s) defined in Group 12
           5 =       Temperature   (12 scaling factors, where temperature
                                    classes have upper bounds (C) of:
                                    0, 5, 10, 15, 20, 25, 30, 35, 40,
                                    45, 50, 50+)



--------
    a
     Data for each species are treated as a separate input subgroup
     and therefore must end with an input group terminator.
```

```
-------------------------------------------------------------------------------


INPUT GROUPS: 14a, 14b, 14c, 14d -- Area source parameters
---------------------------------

---------------
Subgroup (14a)
---------------

     Number of polygon area sources with
     parameters specified below (NAR1)       No default  ! NAR1 = 25 !

     Units used for area source
     emissions below            (IARU)       Default: 1  ! IARU = 1 !
           1 =        g/m**2/s
           2 =       kg/m**2/hr
           3 =       lb/m**2/hr
           4 =     tons/m**2/yr
           5 =     Odour Unit * m/s  (vol. flux/m**2 of odour compound)
           6 =     Odour Unit * m/min
           7 =     metric tons/m**2/yr

     Number of source-species
     combinations with variable
     emissions scaling factors
     provided below in (14d)        (NSAR1) Default: 0  ! NSAR1 = 0 !

     Number of buoyant polygon area sources
     with variable location and emission
     parameters (NAR2)                      No default  ! NAR2 = 0 !
     (If NAR2 > 0, ALL parameter data for
     these sources are read from the file: BAEMARB.DAT)

!END!

---------------
Subgroup (14b)
---------------
                                      a
          AREA SOURCE: CONSTANT DATA
          ----------------------------
                                                          b
Source           Effect.    Base      Initial    Emission
 No.             Height   Elevation   Sigma z     Rates
                   (m)       (m)        (m)
-------          ------    ------     --------   ---------

   1 ! SRCNAM = A1 !
   1 ! X =         7.0,   1755.9, 3.25581395348837, 0.00E00, 0.00E00, 1.09E-06, 0.00E00,
0.00E00, 1.93E-05,
 3.60E-06 !
!END!
   2 ! SRCNAM = A2 !
   2 ! X =         7.0,   1818.3, 3.25581395348837, 0.00E00, 0.00E00, 1.09E-06, 0.00E00,
0.00E00, 1.93E-05,
 3.60E-06 !
!END!
   3 ! SRCNAM = A3 !
   3 ! X =         7.0,   1806.0, 3.25581395348837, 0.00E00, 0.00E00, 1.09E-06, 0.00E00,
0.00E00, 1.93E-05,
 3.60E-06 !
!END!
   4 ! SRCNAM = A4 !
   4 ! X =         7.0,   1846.1, 3.25581395348837, 0.00E00, 0.00E00, 1.09E-06, 0.00E00,
0.00E00, 1.93E-05,
 3.60E-06 !
!END!
   5 ! SRCNAM = A5 !
```

```
   5 ! X =          7.0,    2025.6, 3.25581395348837, 0.00E00, 0.00E00, 1.09E-06, 0.00E00,
0.00E00, 1.93E-05,
 3.60E-06 !
!END!
   6 ! SRCNAM = A6 !
   6 ! X =          7.0,    1985.0, 3.25581395348837, 0.00E00, 0.00E00, 1.09E-06, 0.00E00,
0.00E00, 1.93E-05,
 3.60E-06 !
!END!
   7 ! SRCNAM = A7 !
   7 ! X =          7.0,    1995.3, 3.25581395348837, 0.00E00, 0.00E00, 1.09E-06, 0.00E00,
0.00E00, 1.93E-05,
 3.60E-06 !
!END!
   8 ! SRCNAM = A8 !
   8 ! X =          7.0,    2033.3, 3.25581395348837, 0.00E00, 0.00E00, 1.09E-06, 0.00E00,
0.00E00, 1.93E-05,
 3.60E-06 !
!END!
   9 ! SRCNAM = A9 !
   9 ! X =          7.0,    2076.2, 3.25581395348837, 0.00E00, 0.00E00, 1.09E-06, 0.00E00,
0.00E00, 1.93E-05,
 3.60E-06 !
!END!
  10 ! SRCNAM = A10 !
  10 ! X =          7.0,    1888.9, 3.25581395348837, 0.00E00, 0.00E00, 1.09E-06, 0.00E00,
0.00E00, 1.93E-05,
 3.60E-06 !
!END!
  11 ! SRCNAM = A11 !
  11 ! X =          7.0,    2099.7, 3.25581395348837, 0.00E00, 0.00E00, 1.09E-06, 0.00E00,
0.00E00, 1.93E-05,
 3.60E-06 !
!END!
  12 ! SRCNAM = A12 !
  12 ! X =          7.0,    2187.5, 3.25581395348837, 0.00E00, 0.00E00, 1.09E-06, 0.00E00,
0.00E00, 1.93E-05,
 3.60E-06 !
!END!
  13 ! SRCNAM = A13 !
  13 ! X =          7.0,    2144.2, 3.25581395348837, 0.00E00, 0.00E00, 1.09E-06, 0.00E00,
0.00E00, 1.93E-05,
 3.60E-06 !
!END!
  14 ! SRCNAM = A14 !
  14 ! X =          7.0,    2135.2, 3.25581395348837, 0.00E00, 0.00E00, 1.09E-06, 0.00E00,
0.00E00, 1.93E-05,
 3.60E-06 !
!END!
  15 ! SRCNAM = A15 !
  15 ! X =          7.0,    2206.7, 3.25581395348837, 0.00E00, 0.00E00, 1.09E-06, 0.00E00,
0.00E00, 1.93E-05,
 3.60E-06 !
!END!
  16 ! SRCNAM = A16 !
  16 ! X =          7.0,    2265.5, 3.25581395348837, 0.00E00, 0.00E00, 1.09E-06, 0.00E00,
0.00E00, 1.93E-05,
 3.60E-06 !
!END!
  17 ! SRCNAM = A17 !
  17 ! X =          7.0,    2212.3, 3.25581395348837, 0.00E00, 0.00E00, 1.09E-06, 0.00E00,
0.00E00, 1.93E-05,
 3.60E-06 !
!END!
  18 ! SRCNAM = A18 !
  18 ! X =          7.0,    2291.3, 3.25581395348837, 0.00E00, 0.00E00, 1.09E-06, 0.00E00,
0.00E00, 1.93E-05,
 3.60E-06 !
!END!
  19 ! SRCNAM = A19 !
```

```
  19 ! X =          7.0,   2178.8, 3.25581395348837, 0.00E00, 0.00E00, 1.09E-06, 0.00E00,
0.00E00, 1.93E-05,
 3.60E-06 !
!END!
  20 ! SRCNAM = A20 !
  20 ! X =          7.0,   2297.4, 3.25581395348837, 0.00E00, 0.00E00, 1.09E-06, 0.00E00,
0.00E00, 1.93E-05,
 3.60E-06 !
!END!
  21 ! SRCNAM = A21 !
  21 ! X =          7.0,   2299.4, 3.25581395348837, 0.00E00, 0.00E00, 1.09E-06, 0.00E00,
0.00E00, 1.93E-05,
 3.60E-06 !
!END!
  22 ! SRCNAM = A22 !
  22 ! X =          7.0,   2176.1, 3.25581395348837, 0.00E00, 0.00E00, 1.09E-06, 0.00E00,
0.00E00, 1.93E-05,
 3.60E-06 !
!END!
  23 ! SRCNAM = A23 !
  23 ! X =          7.0,   2403.5, 3.25581395348837, 0.00E00, 0.00E00, 1.09E-06, 0.00E00,
0.00E00, 1.93E-05,
 3.60E-06 !
!END!
  24 ! SRCNAM = A24 !
  24 ! X =          7.0,   2087.0, 3.25581395348837, 0.00E00, 0.00E00, 1.09E-06, 0.00E00,
0.00E00, 1.93E-05,
 3.60E-06 !
!END!
  25 ! SRCNAM = A25 !
  25 ! X =          7.0,   1847.4, 3.25581395348837, 0.00E00, 0.00E00, 1.09E-06, 0.00E00,
0.00E00, 1.93E-05,
 3.60E-06 !
!END!

--------
    a
     Data for each source are treated as a separate input subgroup
     and therefore must end with an input group terminator.
    b
     An emission rate must be entered for every pollutant modeled.
     Enter emission rate of zero for secondary pollutants that are
     modeled, but not emitted.  Units are specified by IARU
     (e.g. 1 for g/m**2/s).

---------------
Subgroup (14c)
---------------

           COORDINATES (UTM-km) FOR EACH VERTEX(4) OF EACH POLYGON
           -------------------------------------------------------
Source                                                            a
 No.       Ordered list of X followed by list of Y, grouped by source
------     ------------------------------------------------------------

   1 ! SRCNAM = A1 !
   1 ! XVERT = 165.644,165.644,166.390,166.390 !
   1 ! YVERT = 301.705,302.451,302.451,301.704 !
!END!
   2 ! SRCNAM = A2 !
   2 ! XVERT = 164.170,164.170,164.916,164.916 !
   2 ! YVERT = 300.242,300.989,300.989,300.242 !
!END!
   3 ! SRCNAM = A3 !
   3 ! XVERT = 163.159,163.159,163.905,163.905 !
   3 ! YVERT = 301.353,302.100,302.100,301.353 !
!END!
   4 ! SRCNAM = A4 !
   4 ! XVERT = 160.912,160.912,161.658,161.658 !
   4 ! YVERT = 300.813,301.559,301.559,300.813 !
!END!
```

```
   5 ! SRCNAM = A5 !
   5 ! XVERT = 159.558,159.558,160.304,160.304 !
   5 ! YVERT = 299.155,299.901,299.901,299.155 !
!END!
   6 ! SRCNAM = A6 !
   6 ! XVERT = 161.741,161.741,162.488,162.488 !
   6 ! YVERT = 297.896,298.642,298.642,297.896 !
!END!
   7 ! SRCNAM = A7 !
   7 ! XVERT = 156.991,156.991,157.737,157.737 !
   7 ! YVERT = 298.418,299.164,299.164,298.418 !
!END!
   8 ! SRCNAM = A8 !
   8 ! XVERT = 154.794,154.794,155.540,155.540 !
   8 ! YVERT = 298.418,299.164,299.164,298.418 !
!END!
   9 ! SRCNAM = A9 !
   9 ! XVERT = 155.534,155.534,156.281,156.281 !
   9 ! YVERT = 293.478,294.225,294.225,293.478 !
!END!
  10 ! SRCNAM = A10 !
  10 ! XVERT = 157.702,157.702,158.448,158.448 !
  10 ! YVERT = 293.420,294.166,294.166,293.420 !
!END!
  11 ! SRCNAM = A11 !
  11 ! XVERT = 158.104,158.104,158.850,158.850 !
  11 ! YVERT = 289.676,290.422,290.422,289.676 !
!END!
  12 ! SRCNAM = A12 !
  12 ! XVERT = 151.392,151.392,152.138,152.138 !
  12 ! YVERT = 289.920,290.666,290.666,289.920 !
!END!
  13 ! SRCNAM = A13 !
  13 ! XVERT = 149.796,149.796,150.542,150.542 !
  13 ! YVERT = 295.540,296.286,296.286,295.539 !
!END!
  14 ! SRCNAM = A14 !
  14 ! XVERT = 150.979,150.979,151.725,151.725 !
  14 ! YVERT = 296.873,297.619,297.619,296.873 !
!END!
  15 ! SRCNAM = A15 !
  15 ! XVERT = 145.595,145.595,146.341,146.341 !
  15 ! YVERT = 294.342,295.088,295.088,294.342 !
!END!
  16 ! SRCNAM = A16 !
  16 ! XVERT = 143.177,143.177,143.923,143.923 !
  16 ! YVERT = 293.432,294.178,294.178,293.432 !
!END!
  17 ! SRCNAM = A17 !
  17 ! XVERT = 142.138,142.138,142.884,142.884 !
  17 ! YVERT = 296.698,297.444,297.444,296.698 !
!END!
  18 ! SRCNAM = A18 !
  18 ! XVERT = 143.732,143.732,144.478,144.478 !
  18 ! YVERT = 297.919,298.666,298.666,297.919 !
!END!
  19 ! SRCNAM = A19 !
  19 ! XVERT = 146.272,146.272,147.018,147.018 !
  19 ! YVERT = 298.480,299.226,299.226,298.480 !
!END!
  20 ! SRCNAM = A20 !
  20 ! XVERT = 140.221,140.221,140.968,140.968 !
  20 ! YVERT = 297.697,298.444,298.444,297.697 !
!END!
  21 ! SRCNAM = A21 !
  21 ! XVERT = 140.217,140.217,140.963,140.963 !
  21 ! YVERT = 300.245,300.991,300.991,300.245 !
!END!
  22 ! SRCNAM = A22 !
  22 ! XVERT = 137.721,137.721,138.467,138.467 !
  22 ! YVERT = 300.769,301.515,301.515,300.769 !
```

```
!END!
  23 ! SRCNAM = A23 !
  23 ! XVERT = 137.167,137.167,137.913,137.913 !
  23 ! YVERT = 298.360,299.107,299.107,298.360 !
!END!
  24 ! SRCNAM = A24 !
  24 ! XVERT = 136.541,136.541,137.287,137.287 !
  24 ! YVERT = 301.427,302.173,302.173,301.427 !
!END!
  25 ! SRCNAM = A25 !
  25 ! XVERT = 149.893,149.893,150.639,150.639 !
  25 ! YVERT = 299.290,300.036,300.036,299.290 !
!END!
```

---

a Data for each source are treated as a separate input subgroup and therefore must end with an input group terminator.

Subgroup (14d)

AREA SOURCE: VARIABLE EMISSIONS DATA [a]

Use this subgroup to describe temporal variations in the emission rates given in 14b. Factors entered multiply the rates in 14b. Skip sources here that have constant emissions. For more elaborate variation in source parameters, use BAEMARB.DAT and NAR2 > 0.

IVARY determines the type of variation, and is source-specific:

```
(IVARY)                                Default: 0
      0 =       Constant
      1 =       Diurnal cycle (24 scaling factors: hours 1-24)
      2 =       Monthly cycle (12 scaling factors: months 1-12)
      3 =       Hour & Season (4 groups of 24 hourly scaling factors,
                               where first group is DEC-JAN-FEB)
      4 =       Speed & Stab. (6 groups of 6 scaling factors, where
                               first group is Stability Class A,
                               and the speed classes have upper
                               bounds (m/s) defined in Group 12
      5 =       Temperature   (12 scaling factors, where temperature
                               classes have upper bounds (C) of:
                               0, 5, 10, 15, 20, 25, 30, 35, 40,
                               45, 50, 50+)
```

---

a Data for each species are treated as a separate input subgroup and therefore must end with an input group terminator.

INPUT GROUPS: 15a, 15b, 15c -- Line source parameters

Subgroup (15a)

Number of buoyant line sources with variable location and emission parameters (NLN2) No default ! NLN2 = 0 !

(If NLN2 > 0, ALL parameter data for these sources are read from the file: LNEMARB.DAT)

```
     Number of buoyant line sources (NLINES)        No default   ! NLINES = 0 !

     Units used for line source
     emissions below                (ILNU)          Default: 1   ! ILNU = 1 !
           1 =        g/s
           2 =       kg/hr
           3 =       lb/hr
           4 =     tons/yr
           5 =     Odour Unit * m**3/s  (vol. flux of odour compound)
           6 =     Odour Unit * m**3/min
           7 =     metric tons/yr

     Number of source-species
     combinations with variable
     emissions scaling factors
     provided below in (15c)        (NSLN1) Default: 0  ! NSLN1 = 0 !

     Maximum number of segments used to model
     each line (MXNSEG)                             Default: 7   ! MXNSEG = 7 !

     The following variables are required only if NLINES > 0.  They are
     used in the buoyant line source plume rise calculations.

        Number of distances at which                Default: 6   ! NLRISE = 6 !
        transitional rise is computed

        Average building length (XL)                No default   * XL = *
                                                    (in meters)

        Average building height (HBL)               No default   * HBL = *
                                                    (in meters)

        Average building width (WBL)                No default   * WBL = *
                                                    (in meters)

        Average line source width (WML)             No default   * WML = *
                                                    (in meters)

        Average separation between buildings (DXL)  No default   * DXL = *
                                                    (in meters)

        Average buoyancy parameter (FPRIMEL)        No default   * FPRIMEL = *
                                                    (in m**4/s**3)

!END!

---------------
Subgroup (15b)
---------------

          BUOYANT LINE SOURCE: CONSTANT DATA
          ----------------------------------

a
Source     Beg. X      Beg. Y      End. X    End. Y     Release    Base        Emission
 No.     Coordinate  Coordinate  Coordinate Coordinate  Height    Elevation      Rates
           (km)        (km)        (km)       (km)       (m)       (m)
------   ----------  ----------  ---------  ----------  -------   ---------    ---------

--------

    a
     Data for each source are treated as a separate input subgroup
     and therefore must end with an input group terminator.

    b
     An emission rate must be entered for every pollutant modeled.
     Enter emission rate of zero for secondary pollutants that are
     modeled, but not emitted.  Units are specified by ILNTU
     (e.g. 1 for g/s).
```

Subgroup (15c)

BUOYANT LINE SOURCE: VARIABLE EMISSIONS DATA[a]

Use this subgroup to describe temporal variations in the emission rates given in 15b. Factors entered multiply the rates in 15b. Skip sources here that have constant emissions.

IVARY determines the type of variation, and is source-specific:
(IVARY) Default: 0

```
      0 =       Constant
      1 =       Diurnal cycle (24 scaling factors: hours 1-24)
      2 =       Monthly cycle (12 scaling factors: months 1-12)
      3 =       Hour & Season (4 groups of 24 hourly scaling factors,
                               where first group is DEC-JAN-FEB)
      4 =       Speed & Stab. (6 groups of 6 scaling factors, where
                               first group is Stability Class A,
                               and the speed classes have upper
                               bounds (m/s) defined in Group 12
      5 =       Temperature   (12 scaling factors, where temperature
                               classes have upper bounds (C) of:
                               0, 5, 10, 15, 20, 25, 30, 35, 40,
                               45, 50, 50+)
```

---

[a] Data for each species are treated as a separate input subgroup and therefore must end with an input group terminator.

INPUT GROUPS: 16a, 16b, 16c -- Volume source parameters

Subgroup (16a)

Number of volume sources with parameters provided in 16b,c (NVL1) No default ! NVL1 = 0 !

Units used for volume source emissions below in 16b (IVLU) Default: 1 ! IVLU = 1 !

```
      1 =        g/s
      2 =       kg/hr
      3 =       lb/hr
      4 =     tons/yr
      5 =     Odour Unit * m**3/s  (vol. flux of odour compound)
      6 =     Odour Unit * m**3/min
      7 =     metric tons/yr
```

Number of source-species combinations with variable emissions scaling factors provided below in (16c) (NSVL1) Default: 0 ! NSVL1 = 0 !

Number of volume sources with variable location and emission parameters (NVL2) No default ! NVL2 = 0 !

(If NVL2 > 0, ALL parameter data for these sources are read from the VOLEMARB.DAT file(s))

```
!END!

---------------
Subgroup (16b)
---------------
                                        a
           VOLUME SOURCE: CONSTANT DATA
           ----------------------------
                                                                                b
          X UTM      Y UTM      Effect.    Base     Initial    Initial    Emission
       Coordinate  Coordinate   Height   Elevation  Sigma y    Sigma z     Rates
          (km)       (km)        (m)       (m)        (m)        (m)
       ----------  ----------   ------    ------    --------   --------   --------


--------
    a
     Data for each source are treated as a separate input subgroup
     and therefore must end with an input group terminator.

    b
     An emission rate must be entered for every pollutant modeled.
     Enter emission rate of zero for secondary pollutants that are
     modeled, but not emitted.  Units are specified by IVLU
     (e.g. 1 for g/s).

---------------
Subgroup (16c)
---------------
                                                 a
          VOLUME SOURCE: VARIABLE EMISSIONS DATA
          --------------------------------------

     Use this subgroup to describe temporal variations in the emission
     rates given in 16b.  Factors entered multiply the rates in 16b.
     Skip sources here that have constant emissions.  For more elaborate
     variation in source parameters, use VOLEMARB.DAT and NVL2 > 0.

     IVARY determines the type of variation, and is source-specific:
     (IVARY)                                Default: 0
           0 =       Constant
           1 =       Diurnal cycle (24 scaling factors: hours 1-24)
           2 =       Monthly cycle (12 scaling factors: months 1-12)
           3 =       Hour & Season (4 groups of 24 hourly scaling factors,
                                    where first group is DEC-JAN-FEB)
           4 =       Speed & Stab. (6 groups of 6 scaling factors, where
                                    first group is Stability Class A,
                                    and the speed classes have upper
                                    bounds (m/s) defined in Group 12
           5 =       Temperature   (12 scaling factors, where temperature
                                    classes have upper bounds (C) of:
                                    0, 5, 10, 15, 20, 25, 30, 35, 40,
                                    45, 50, 50+)



--------
    a
     Data for each species are treated as a separate input subgroup
     and therefore must end with an input group terminator.


--------------------------------------------------------------------------------

INPUT GROUPS: 17a & 17b -- Non-gridded (discrete) receptor information
-----------------------

---------------
Subgroup (17a)
---------------
```

```
     Number of non-gridded receptors (NREC)  No default  ! NREC = 3827 !

!END!

---------------
Subgroup (17b)
---------------
                                                a
           NON-GRIDDED (DISCRETE) RECEPTOR DATA
           ------------------------------------

                  X UTM       Y UTM        Ground        Height   b
Receptor       Coordinate   Coordinate    Elevation   Above Ground
  No.             (km)        (km)           (m)           (m)
--------       ----------   ----------    ---------   ------------


   1 ! X =       385.564,      328.903,      3373.0,           0.0 !   !END!
   2 ! X =       385.600,      329.410,      3392.0,           0.0 !   !END!
   3 ! X =        99.646,      396.049,      3275.0,           0.0 !   !END!
   4 ! X =        94.699,      391.849,      3141.0,           0.0 !   !END!
   5 ! X =       387.549,       73.990,      3544.0,           0.0 !   !END!
   6 ! X =       398.632,      227.072,      3359.0,           0.0 !   !END!
   7 ! X =       404.905,      202.500,      3371.0,           0.0 !   !END!
   8 ! X =       200.471,      175.785,      1328.0,           0.0 !   !END!
   9 ! X =       201.879,      175.827,      1351.0,           0.0 !   !END!
  10 ! X =       203.286,      175.869,      1387.0,           0.0 !   !END!
  11 ! X =       206.102,      175.954,      1221.0,           0.0 !   !END!
  12 ! X =       199.010,      177.545,      1462.0,           0.0 !   !END!
  13 ! X =       200.417,      177.587,      1402.0,           0.0 !   !END!
  14 ! X =       201.825,      177.629,      1336.0,           0.0 !   !END!
  15 ! X =       203.232,      177.671,      1279.0,           0.0 !   !END!
  16 ! X =       204.640,      177.713,      1359.0,           0.0 !   !END!
  17 ! X =       206.047,      177.756,      1386.0,           0.0 !   !END!
  18 ! X =       207.455,      177.799,      1405.0,           0.0 !   !END!
  19 ! X =       208.862,      177.842,      1215.0,           0.0 !   !END!
  20 ! X =       197.550,      179.305,      1364.0,           0.0 !   !END!
  21 ! X =       198.957,      179.347,      1280.0,           0.0 !   !END!
  22 ! X =       200.364,      179.388,      1279.0,           0.0 !   !END!
  23 ! X =       201.771,      179.430,      1284.0,           0.0 !   !END!
  24 ! X =       203.178,      179.472,      1280.0,           0.0 !   !END!
  25 ! X =       204.585,      179.515,      1370.0,           0.0 !   !END!
  26 ! X =       205.992,      179.557,      1462.0,           0.0 !   !END!
  27 ! X =       207.399,      179.601,      1577.0,           0.0 !   !END!
  28 ! X =       210.213,      179.687,      1346.0,           0.0 !   !END!
  29 ! X =       197.497,      181.107,      1280.0,           0.0 !   !END!
  30 ! X =       198.904,      181.148,      1363.0,           0.0 !   !END!
  31 ! X =       200.311,      181.190,      1401.0,           0.0 !   !END!
  32 ! X =       201.717,      181.232,      1340.0,           0.0 !   !END!
  33 ! X =       203.124,      181.274,      1341.0,           0.0 !   !END!
  34 ! X =       204.531,      181.316,      1403.0,           0.0 !   !END!
  35 ! X =       205.937,      181.359,      1485.0,           0.0 !   !END!
  36 ! X =       207.344,      181.402,      1583.0,           0.0 !   !END!
  37 ! X =       208.751,      181.445,      1388.0,           0.0 !   !END!
  38 ! X =       197.444,      182.909,      1340.0,           0.0 !   !END!
  39 ! X =       198.851,      182.950,      1388.0,           0.0 !   !END!
  40 ! X =       200.257,      182.991,      1440.0,           0.0 !   !END!
  41 ! X =       201.663,      183.033,      1402.0,           0.0 !   !END!
  42 ! X =       203.070,      183.075,      1418.0,           0.0 !   !END!
  43 ! X =       204.476,      183.118,      1500.0,           0.0 !   !END!
  44 ! X =       205.882,      183.160,      1584.0,           0.0 !   !END!
  45 ! X =       207.289,      183.203,      1606.0,           0.0 !   !END!
  46 ! X =       208.695,      183.247,      1274.0,           0.0 !   !END!
  47 ! X =       198.798,      184.751,      1426.0,           0.0 !   !END!
  48 ! X =       200.204,      184.793,      1462.0,           0.0 !   !END!
  49 ! X =       201.610,      184.835,      1505.0,           0.0 !   !END!
  50 ! X =       203.016,      184.877,      1517.0,           0.0 !   !END!
  51 ! X =       204.422,      184.919,      1549.0,           0.0 !   !END!
  52 ! X =       205.828,      184.962,      1584.0,           0.0 !   !END!
  53 ! X =       207.233,      185.005,      1431.0,           0.0 !   !END!
  54 ! X =       198.745,      186.553,      1462.0,           0.0 !   !END!
```

```
 55 ! X =       200.150,      186.594,      1517.0,           0.0 !   !END!
 56 ! X =       201.556,      186.636,      1513.0,           0.0 !   !END!
 57 ! X =       202.962,      186.678,      1462.0,           0.0 !   !END!
 58 ! X =       204.367,      186.721,      1463.0,           0.0 !   !END!
 59 ! X =       205.773,      186.763,      1451.0,           0.0 !   !END!
 60 ! X =       207.178,      186.806,      1342.0,           0.0 !   !END!
 61 ! X =       198.692,      188.354,      1523.0,           0.0 !   !END!
 62 ! X =       200.097,      188.396,      1523.0,           0.0 !   !END!
 63 ! X =       201.502,      188.437,      1402.0,           0.0 !   !END!
 64 ! X =       202.907,      188.479,      1401.0,           0.0 !   !END!
 65 ! X =       204.313,      188.522,      1361.0,           0.0 !   !END!
 66 ! X =       205.718,      188.564,      1341.0,           0.0 !   !END!
 67 ! X =       207.123,      188.607,      1340.0,           0.0 !   !END!
 68 ! X =       208.528,      188.651,      1340.0,           0.0 !   !END!
 69 ! X =       194.424,      190.033,      1451.0,           0.0 !   !END!
 70 ! X =       195.829,      190.073,      1460.0,           0.0 !   !END!
 71 ! X =       197.234,      190.114,      1518.0,           0.0 !   !END!
 72 ! X =       198.639,      190.155,      1488.0,           0.0 !   !END!
 73 ! X =       200.044,      190.197,      1407.0,           0.0 !   !END!
 74 ! X =       201.448,      190.239,      1404.0,           0.0 !   !END!
 75 ! X =       202.853,      190.281,      1458.0,           0.0 !   !END!
 76 ! X =       204.258,      190.323,      1494.0,           0.0 !   !END!
 77 ! X =       205.663,      190.366,      1402.0,           0.0 !   !END!
 78 ! X =       207.068,      190.409,      1402.0,           0.0 !   !END!
 79 ! X =       208.472,      190.452,      1440.0,           0.0 !   !END!
 80 ! X =       209.877,      190.495,      1411.0,           0.0 !   !END!
 81 ! X =       194.372,      191.834,      1521.0,           0.0 !   !END!
 82 ! X =       195.777,      191.874,      1524.0,           0.0 !   !END!
 83 ! X =       197.181,      191.915,      1467.0,           0.0 !   !END!
 84 ! X =       198.586,      191.957,      1462.0,           0.0 !   !END!
 85 ! X =       199.990,      191.998,      1493.0,           0.0 !   !END!
 86 ! X =       201.395,      192.040,      1547.0,           0.0 !   !END!
 87 ! X =       202.799,      192.082,      1582.0,           0.0 !   !END!
 88 ! X =       204.204,      192.124,      1481.0,           0.0 !   !END!
 89 ! X =       205.608,      192.167,      1440.0,           0.0 !   !END!
 90 ! X =       207.012,      192.210,      1395.0,           0.0 !   !END!
 91 ! X =       192.916,      193.595,      1491.0,           0.0 !   !END!
 92 ! X =       194.320,      193.635,      1528.0,           0.0 !   !END!
 93 ! X =       195.725,      193.676,      1499.0,           0.0 !   !END!
 94 ! X =       197.129,      193.716,      1491.0,           0.0 !   !END!
 95 ! X =       198.533,      193.758,      1493.0,           0.0 !   !END!
 96 ! X =       199.937,      193.799,      1540.0,           0.0 !   !END!
 97 ! X =       201.341,      193.841,      1584.0,           0.0 !   !END!
 98 ! X =       202.745,      193.883,      1471.0,           0.0 !   !END!
 99 ! X =       204.149,      193.925,      1432.0,           0.0 !   !END!
100 ! X =       205.553,      193.968,      1402.0,           0.0 !   !END!
101 ! X =       206.957,      194.011,      1343.0,           0.0 !   !END!
102 ! X =       192.865,      195.396,      1584.0,           0.0 !   !END!
103 ! X =       194.269,      195.436,      1523.0,           0.0 !   !END!
104 ! X =       195.672,      195.477,      1509.0,           0.0 !   !END!
105 ! X =       197.076,      195.518,      1532.0,           0.0 !   !END!
106 ! X =       198.480,      195.559,      1621.0,           0.0 !   !END!
107 ! X =       199.883,      195.600,      1588.0,           0.0 !   !END!
108 ! X =       201.287,      195.642,      1484.0,           0.0 !   !END!
109 ! X =       204.095,      195.726,      1401.0,           0.0 !   !END!
110 ! X =       205.498,      195.769,      1362.0,           0.0 !   !END!
111 ! X =       194.217,      197.237,      1524.0,           0.0 !   !END!
112 ! X =       195.620,      197.278,      1584.0,           0.0 !   !END!
113 ! X =       197.023,      197.319,      1645.0,           0.0 !   !END!
114 ! X =       198.427,      197.360,      1525.0,           0.0 !   !END!
115 ! X =       199.830,      197.401,      1460.0,           0.0 !   !END!
116 ! X =       192.762,      198.998,      1585.0,           0.0 !   !END!
117 ! X =       194.165,      199.038,      1587.0,           0.0 !   !END!
118 ! X =       195.568,      199.079,      1575.0,           0.0 !   !END!
119 ! X =       196.971,      199.120,      1492.0,           0.0 !   !END!
120 ! X =       191.308,      200.759,      1640.0,           0.0 !   !END!
121 ! X =       192.710,      200.799,      1560.0,           0.0 !   !END!
122 ! X =       194.113,      200.839,      1513.0,           0.0 !   !END!
123 ! X =       365.598,      173.672,      2133.0,           0.0 !   !END!
124 ! X =       366.302,      173.710,      2214.0,           0.0 !   !END!
125 ! X =       367.006,      173.748,      2428.0,           0.0 !   !END!
```

```
126 ! X =       367.710,      173.787,      2435.0,           0.0 !   !END!
127 ! X =       363.437,      174.458,      2197.0,           0.0 !   !END!
128 ! X =       364.141,      174.496,      2011.0,           0.0 !   !END!
129 ! X =       364.845,      174.534,      2011.0,           0.0 !   !END!
130 ! X =       365.549,      174.572,      2242.0,           0.0 !   !END!
131 ! X =       366.253,      174.610,      2384.0,           0.0 !   !END!
132 ! X =       366.957,      174.648,      2424.0,           0.0 !   !END!
133 ! X =       367.661,      174.687,      2513.0,           0.0 !   !END!
134 ! X =       363.389,      175.359,      1950.0,           0.0 !   !END!
135 ! X =       364.093,      175.396,      2471.0,           0.0 !   !END!
136 ! X =       364.797,      175.434,      2499.0,           0.0 !   !END!
137 ! X =       365.501,      175.472,      2511.0,           0.0 !   !END!
138 ! X =       366.204,      175.510,      2503.0,           0.0 !   !END!
139 ! X =       366.908,      175.549,      2574.0,           0.0 !   !END!
140 ! X =       363.340,      176.259,      1950.0,           0.0 !   !END!
141 ! X =       364.044,      176.296,      2464.0,           0.0 !   !END!
142 ! X =       361.884,      177.083,      1950.0,           0.0 !   !END!
143 ! X =       362.588,      177.121,      2202.0,           0.0 !   !END!
144 ! X =       363.292,      177.159,      2399.0,           0.0 !   !END!
145 ! X =       353.392,      177.537,      2194.0,           0.0 !   !END!
146 ! X =       354.799,      177.610,      2350.0,           0.0 !   !END!
147 ! X =       355.503,      177.647,      2248.0,           0.0 !   !END!
148 ! X =       356.207,      177.684,      2091.0,           0.0 !   !END!
149 ! X =       356.910,      177.721,      2015.0,           0.0 !   !END!
150 ! X =       357.614,      177.759,      1994.0,           0.0 !   !END!
151 ! X =       358.318,      177.796,      2071.0,           0.0 !   !END!
152 ! X =       361.836,      177.983,      2098.0,           0.0 !   !END!
153 ! X =       352.641,      178.400,      2243.0,           0.0 !   !END!
154 ! X =       353.345,      178.437,      2056.0,           0.0 !   !END!
155 ! X =       354.048,      178.473,      2214.0,           0.0 !   !END!
156 ! X =       354.752,      178.510,      2341.0,           0.0 !   !END!
157 ! X =       355.456,      178.547,      2090.0,           0.0 !   !END!
158 ! X =       356.159,      178.584,      1784.0,           0.0 !   !END!
159 ! X =       356.863,      178.621,      2011.0,           0.0 !   !END!
160 ! X =       357.566,      178.659,      2015.0,           0.0 !   !END!
161 ! X =       358.270,      178.696,      2165.0,           0.0 !   !END!
162 ! X =       358.974,      178.733,      1841.0,           0.0 !   !END!
163 ! X =       359.677,      178.771,      2217.0,           0.0 !   !END!
164 ! X =       360.381,      178.808,      2084.0,           0.0 !   !END!
165 ! X =       361.084,      178.846,      2133.0,           0.0 !   !END!
166 ! X =       351.187,      179.227,      2180.0,           0.0 !   !END!
167 ! X =       351.891,      179.263,      2201.0,           0.0 !   !END!
168 ! X =       352.594,      179.300,      2316.0,           0.0 !   !END!
169 ! X =       353.298,      179.337,      2067.0,           0.0 !   !END!
170 ! X =       354.001,      179.374,      1972.0,           0.0 !   !END!
171 ! X =       354.705,      179.410,      1793.0,           0.0 !   !END!
172 ! X =       355.408,      179.447,      1783.0,           0.0 !   !END!
173 ! X =       356.112,      179.484,      2011.0,           0.0 !   !END!
174 ! X =       356.815,      179.522,      2121.0,           0.0 !   !END!
175 ! X =       357.519,      179.559,      2438.0,           0.0 !   !END!
176 ! X =       358.222,      179.596,      2419.0,           0.0 !   !END!
177 ! X =       358.926,      179.633,      2368.0,           0.0 !   !END!
178 ! X =       359.629,      179.671,      2261.0,           0.0 !   !END!
179 ! X =       360.333,      179.708,      2278.0,           0.0 !   !END!
180 ! X =       350.437,      180.090,      2017.0,           0.0 !   !END!
181 ! X =       351.140,      180.127,      2072.0,           0.0 !   !END!
182 ! X =       351.844,      180.163,      2157.0,           0.0 !   !END!
183 ! X =       352.547,      180.200,      2063.0,           0.0 !   !END!
184 ! X =       353.251,      180.237,      1766.0,           0.0 !   !END!
185 ! X =       353.954,      180.274,      1892.0,           0.0 !   !END!
186 ! X =       354.657,      180.311,      2093.0,           0.0 !   !END!
187 ! X =       355.361,      180.347,      2209.0,           0.0 !   !END!
188 ! X =       356.064,      180.384,      2316.0,           0.0 !   !END!
189 ! X =       350.390,      180.990,      1951.0,           0.0 !   !END!
190 ! X =       351.093,      181.027,      2063.0,           0.0 !   !END!
191 ! X =       351.797,      181.064,      2087.0,           0.0 !   !END!
192 ! X =       352.500,      181.100,      1744.0,           0.0 !   !END!
193 ! X =       353.204,      181.137,      2070.0,           0.0 !   !END!
194 ! X =       353.907,      181.174,      2316.0,           0.0 !   !END!
195 ! X =       354.610,      181.211,      2237.0,           0.0 !   !END!
196 ! X =       350.343,      181.890,      1900.0,           0.0 !   !END!
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197 ! X =       351.047,      181.927,      1938.0,           0.0 !   !END!
198 ! X =       351.750,      181.964,      1840.0,           0.0 !   !END!
199 ! X =       352.453,      182.000,      1829.0,           0.0 !   !END!
200 ! X =       353.157,      182.037,      2309.0,           0.0 !   !END!
201 ! X =       353.860,      182.074,      2393.0,           0.0 !   !END!
202 ! X =       354.563,      182.111,      2342.0,           0.0 !   !END!
203 ! X =       350.297,      182.791,      1706.0,           0.0 !   !END!
204 ! X =       351.000,      182.827,      1859.0,           0.0 !   !END!
205 ! X =       351.703,      182.864,      2096.0,           0.0 !   !END!
206 ! X =       352.406,      182.900,      2201.0,           0.0 !   !END!
207 ! X =       353.109,      182.937,      2287.0,           0.0 !   !END!
208 ! X =       353.813,      182.974,      2480.0,           0.0 !   !END!
209 ! X =       350.250,      183.691,      1819.0,           0.0 !   !END!
210 ! X =       350.953,      183.727,      1990.0,           0.0 !   !END!
211 ! X =       351.656,      183.764,      2194.0,           0.0 !   !END!
212 ! X =       352.359,      183.800,      2368.0,           0.0 !   !END!
213 ! X =       353.062,      183.837,      2424.0,           0.0 !   !END!
214 ! X =       350.203,      184.591,      1975.0,           0.0 !   !END!
215 ! X =       350.906,      184.627,      2086.0,           0.0 !   !END!
216 ! X =       351.609,      184.664,      2301.0,           0.0 !   !END!
217 ! X =       192.597,      105.182,      1929.0,           0.0 !   !END!
218 ! X =       188.280,      106.867,      1950.0,           0.0 !   !END!
219 ! X =       189.702,      106.907,      1828.0,           0.0 !   !END!
220 ! X =       191.124,      106.946,      1843.0,           0.0 !   !END!
221 ! X =       193.969,      107.027,      1798.0,           0.0 !   !END!
222 ! X =       195.391,      107.067,      1901.0,           0.0 !   !END!
223 ! X =       188.230,      108.672,      1828.0,           0.0 !   !END!
224 ! X =       189.652,      108.711,      1896.0,           0.0 !   !END!
225 ! X =       191.074,      108.751,      1828.0,           0.0 !   !END!
226 ! X =       192.496,      108.791,      1828.0,           0.0 !   !END!
227 ! X =       193.917,      108.831,      1824.0,           0.0 !   !END!
228 ! X =       195.339,      108.871,      1875.0,           0.0 !   !END!
229 ! X =       196.761,      108.912,      1735.0,           0.0 !   !END!
230 ! X =       186.759,      110.437,      1832.0,           0.0 !   !END!
231 ! X =       188.181,      110.476,      1895.0,           0.0 !   !END!
232 ! X =       189.602,      110.515,      1825.0,           0.0 !   !END!
233 ! X =       191.023,      110.555,      1877.0,           0.0 !   !END!
234 ! X =       192.445,      110.595,      1959.0,           0.0 !   !END!
235 ! X =       193.866,      110.635,      2062.0,           0.0 !   !END!
236 ! X =       195.288,      110.675,      1737.0,           0.0 !   !END!
237 ! X =       196.709,      110.716,      1713.0,           0.0 !   !END!
238 ! X =       186.710,      112.241,      1828.0,           0.0 !   !END!
239 ! X =       188.131,      112.280,      1876.0,           0.0 !   !END!
240 ! X =       189.552,      112.319,      1767.0,           0.0 !   !END!
241 ! X =       190.973,      112.359,      1869.0,           0.0 !   !END!
242 ! X =       192.394,      112.399,      1910.0,           0.0 !   !END!
243 ! X =       193.815,      112.439,      1706.0,           0.0 !   !END!
244 ! X =       195.236,      112.479,      1887.0,           0.0 !   !END!
245 ! X =       185.240,      114.006,      1803.0,           0.0 !   !END!
246 ! X =       186.660,      114.045,      1755.0,           0.0 !   !END!
247 ! X =       188.081,      114.084,      1706.0,           0.0 !   !END!
248 ! X =       189.502,      114.123,      1855.0,           0.0 !   !END!
249 ! X =       190.923,      114.163,      1913.0,           0.0 !   !END!
250 ! X =       192.343,      114.203,      1829.0,           0.0 !   !END!
251 ! X =       193.764,      114.243,      1767.0,           0.0 !   !END!
252 ! X =       195.184,      114.283,      1706.0,           0.0 !   !END!
253 ! X =       165.306,      115.300,      1357.0,           0.0 !   !END!
254 ! X =       166.726,      115.334,      1645.0,           0.0 !   !END!
255 ! X =       168.146,      115.369,      1731.0,           0.0 !   !END!
256 ! X =       169.567,      115.404,      1755.0,           0.0 !   !END!
257 ! X =       170.987,      115.440,      1767.0,           0.0 !   !END!
258 ! X =       172.408,      115.475,      1764.0,           0.0 !   !END!
259 ! X =       173.828,      115.511,      1748.0,           0.0 !   !END!
260 ! X =       175.248,      115.548,      1798.0,           0.0 !   !END!
261 ! X =       176.669,      115.584,      1789.0,           0.0 !   !END!
262 ! X =       178.089,      115.621,      1796.0,           0.0 !   !END!
263 ! X =       179.510,      115.658,      1761.0,           0.0 !   !END!
264 ! X =       180.930,      115.696,      1754.0,           0.0 !   !END!
265 ! X =       182.350,      115.734,      1772.0,           0.0 !   !END!
266 ! X =       183.771,      115.772,      1874.0,           0.0 !   !END!
267 ! X =       185.191,      115.810,      1767.0,           0.0 !   !END!
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268 ! X =       186.611,      115.849,      1706.0,           0.0 !   !END!
269 ! X =       188.031,      115.888,      1691.0,           0.0 !   !END!
270 ! X =       189.452,      115.927,      1852.0,           0.0 !   !END!
271 ! X =       190.872,      115.967,      1676.0,           0.0 !   !END!
272 ! X =       192.292,      116.007,      1828.0,           0.0 !   !END!
273 ! X =       193.713,      116.047,      1828.0,           0.0 !   !END!
274 ! X =       195.133,      116.087,      1645.0,           0.0 !   !END!
275 ! X =       161.002,      117.002,      1703.0,           0.0 !   !END!
276 ! X =       162.422,      117.035,      1643.0,           0.0 !   !END!
277 ! X =       163.842,      117.069,      1536.0,           0.0 !   !END!
278 ! X =       165.262,      117.104,      1193.0,           0.0 !   !END!
279 ! X =       166.682,      117.138,      1576.0,           0.0 !   !END!
280 ! X =       168.102,      117.173,      1634.0,           0.0 !   !END!
281 ! X =       169.522,      117.208,      1529.0,           0.0 !   !END!
282 ! X =       170.942,      117.244,      1666.0,           0.0 !   !END!
283 ! X =       172.362,      117.279,      1688.0,           0.0 !   !END!
284 ! X =       173.782,      117.315,      1670.0,           0.0 !   !END!
285 ! X =       175.202,      117.352,      1706.0,           0.0 !   !END!
286 ! X =       176.622,      117.388,      1706.0,           0.0 !   !END!
287 ! X =       178.042,      117.425,      1713.0,           0.0 !   !END!
288 ! X =       179.462,      117.462,      1706.0,           0.0 !   !END!
289 ! X =       180.882,      117.500,      1828.0,           0.0 !   !END!
290 ! X =       182.302,      117.538,      1706.0,           0.0 !   !END!
291 ! X =       183.722,      117.576,      1783.0,           0.0 !   !END!
292 ! X =       185.142,      117.614,      1767.0,           0.0 !   !END!
293 ! X =       186.562,      117.653,      1676.0,           0.0 !   !END!
294 ! X =       187.982,      117.692,      1645.0,           0.0 !   !END!
295 ! X =       189.402,      117.731,      1645.0,           0.0 !   !END!
296 ! X =       190.822,      117.771,      1642.0,           0.0 !   !END!
297 ! X =       192.241,      117.811,      1645.0,           0.0 !   !END!
298 ! X =       193.661,      117.851,      1795.0,           0.0 !   !END!
299 ! X =       195.081,      117.891,      1706.0,           0.0 !   !END!
300 ! X =       160.959,      118.806,      1647.0,           0.0 !   !END!
301 ! X =       162.379,      118.839,      1613.0,           0.0 !   !END!
302 ! X =       163.799,      118.873,      1682.0,           0.0 !   !END!
303 ! X =       165.218,      118.908,      1631.0,           0.0 !   !END!
304 ! X =       166.638,      118.942,      1248.0,           0.0 !   !END!
305 ! X =       168.058,      118.977,      1461.0,           0.0 !   !END!
306 ! X =       169.477,      119.012,      1221.0,           0.0 !   !END!
307 ! X =       170.897,      119.048,      1582.0,           0.0 !   !END!
308 ! X =       172.317,      119.083,      1554.0,           0.0 !   !END!
309 ! X =       173.736,      119.119,      1584.0,           0.0 !   !END!
310 ! X =       175.156,      119.156,      1654.0,           0.0 !   !END!
311 ! X =       176.575,      119.192,      1670.0,           0.0 !   !END!
312 ! X =       177.995,      119.229,      1667.0,           0.0 !   !END!
313 ! X =       179.415,      119.266,      1706.0,           0.0 !   !END!
314 ! X =       180.834,      119.304,      1645.0,           0.0 !   !END!
315 ! X =       182.254,      119.342,      1762.0,           0.0 !   !END!
316 ! X =       183.673,      119.380,      1694.0,           0.0 !   !END!
317 ! X =       185.093,      119.418,      1686.0,           0.0 !   !END!
318 ! X =       186.512,      119.457,      1686.0,           0.0 !   !END!
319 ! X =       187.932,      119.496,      1609.0,           0.0 !   !END!
320 ! X =       189.352,      119.535,      1678.0,           0.0 !   !END!
321 ! X =       190.771,      119.574,      1625.0,           0.0 !   !END!
322 ! X =       192.191,      119.614,      1706.0,           0.0 !   !END!
323 ! X =       193.610,      119.654,      1767.0,           0.0 !   !END!
324 ! X =       195.030,      119.695,      1645.0,           0.0 !   !END!
325 ! X =       163.755,      120.677,      1516.0,           0.0 !   !END!
326 ! X =       165.175,      120.712,      1476.0,           0.0 !   !END!
327 ! X =       166.594,      120.746,      1523.0,           0.0 !   !END!
328 ! X =       168.013,      120.781,      1347.0,           0.0 !   !END!
329 ! X =       169.432,      120.816,      1477.0,           0.0 !   !END!
330 ! X =       170.852,      120.851,      1190.0,           0.0 !   !END!
331 ! X =       172.271,      120.887,      1317.0,           0.0 !   !END!
332 ! X =       173.690,      120.923,      1523.0,           0.0 !   !END!
333 ! X =       175.109,      120.959,      1463.0,           0.0 !   !END!
334 ! X =       176.529,      120.996,      1639.0,           0.0 !   !END!
335 ! X =       177.948,      121.033,      1611.0,           0.0 !   !END!
336 ! X =       179.367,      121.070,      1645.0,           0.0 !   !END!
337 ! X =       180.786,      121.108,      1697.0,           0.0 !   !END!
338 ! X =       182.206,      121.145,      1645.0,           0.0 !   !END!
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339 ! X =       183.625,      121.183,      1645.0,           0.0 !   !END!
340 ! X =       185.044,      121.222,      1626.0,           0.0 !   !END!
341 ! X =       186.463,      121.260,      1584.0,           0.0 !   !END!
342 ! X =       187.882,      121.299,      1584.0,           0.0 !   !END!
343 ! X =       189.302,      121.339,      1584.0,           0.0 !   !END!
344 ! X =       190.721,      121.378,      1584.0,           0.0 !   !END!
345 ! X =       192.140,      121.418,      1584.0,           0.0 !   !END!
346 ! X =       193.559,      121.458,      1601.0,           0.0 !   !END!
347 ! X =       194.978,      121.499,      1647.0,           0.0 !   !END!
348 ! X =       163.712,      122.481,      1584.0,           0.0 !   !END!
349 ! X =       165.131,      122.515,      1588.0,           0.0 !   !END!
350 ! X =       166.550,      122.550,      1524.0,           0.0 !   !END!
351 ! X =       167.969,      122.585,      1555.0,           0.0 !   !END!
352 ! X =       169.388,      122.620,      1639.0,           0.0 !   !END!
353 ! X =       170.806,      122.655,      1536.0,           0.0 !   !END!
354 ! X =       172.225,      122.691,      1279.0,           0.0 !   !END!
355 ! X =       173.644,      122.727,      1371.0,           0.0 !   !END!
356 ! X =       175.063,      122.763,      1498.0,           0.0 !   !END!
357 ! X =       176.482,      122.800,      1463.0,           0.0 !   !END!
358 ! X =       177.901,      122.837,      1595.0,           0.0 !   !END!
359 ! X =       179.320,      122.874,      1645.0,           0.0 !   !END!
360 ! X =       180.739,      122.911,      1675.0,           0.0 !   !END!
361 ! X =       182.157,      122.949,      1584.0,           0.0 !   !END!
362 ! X =       183.576,      122.987,      1584.0,           0.0 !   !END!
363 ! X =       184.995,      123.026,      1584.0,           0.0 !   !END!
364 ! X =       186.414,      123.064,      1584.0,           0.0 !   !END!
365 ! X =       187.833,      123.103,      1533.0,           0.0 !   !END!
366 ! X =       189.251,      123.142,      1523.0,           0.0 !   !END!
367 ! X =       190.670,      123.182,      1578.0,           0.0 !   !END!
368 ! X =       192.089,      123.222,      1604.0,           0.0 !   !END!
369 ! X =       163.669,      124.285,      1628.0,           0.0 !   !END!
370 ! X =       165.087,      124.319,      1585.0,           0.0 !   !END!
371 ! X =       166.506,      124.354,      1584.0,           0.0 !   !END!
372 ! X =       167.924,      124.388,      1582.0,           0.0 !   !END!
373 ! X =       169.343,      124.424,      1641.0,           0.0 !   !END!
374 ! X =       170.761,      124.459,      1607.0,           0.0 !   !END!
375 ! X =       172.180,      124.495,      1547.0,           0.0 !   !END!
376 ! X =       173.598,      124.531,      1474.0,           0.0 !   !END!
377 ! X =       175.017,      124.567,      1524.0,           0.0 !   !END!
378 ! X =       176.435,      124.603,      1463.0,           0.0 !   !END!
379 ! X =       177.854,      124.640,      1463.0,           0.0 !   !END!
380 ! X =       179.272,      124.678,      1584.0,           0.0 !   !END!
381 ! X =       180.691,      124.715,      1586.0,           0.0 !   !END!
382 ! X =       182.109,      124.753,      1584.0,           0.0 !   !END!
383 ! X =       183.528,      124.791,      1584.0,           0.0 !   !END!
384 ! X =       184.946,      124.829,      1575.0,           0.0 !   !END!
385 ! X =       186.365,      124.868,      1530.0,           0.0 !   !END!
386 ! X =       187.783,      124.907,      1524.0,           0.0 !   !END!
387 ! X =       189.201,      124.946,      1523.0,           0.0 !   !END!
388 ! X =       190.620,      124.986,      1581.0,           0.0 !   !END!
389 ! X =       192.038,      125.025,      1584.0,           0.0 !   !END!
390 ! X =       165.043,      126.123,      1701.0,           0.0 !   !END!
391 ! X =       166.462,      126.157,      1645.0,           0.0 !   !END!
392 ! X =       167.880,      126.192,      1634.0,           0.0 !   !END!
393 ! X =       169.298,      126.227,      1608.0,           0.0 !   !END!
394 ! X =       170.716,      126.263,      1645.0,           0.0 !   !END!
395 ! X =       172.134,      126.298,      1584.0,           0.0 !   !END!
396 ! X =       173.552,      126.334,      1287.0,           0.0 !   !END!
397 ! X =       174.970,      126.371,      1230.0,           0.0 !   !END!
398 ! X =       176.389,      126.407,      1497.0,           0.0 !   !END!
399 ! X =       177.807,      126.444,      1478.0,           0.0 !   !END!
400 ! X =       179.225,      126.481,      1562.0,           0.0 !   !END!
401 ! X =       180.643,      126.519,      1535.0,           0.0 !   !END!
402 ! X =       182.061,      126.556,      1525.0,           0.0 !   !END!
403 ! X =       183.479,      126.594,      1523.0,           0.0 !   !END!
404 ! X =       184.897,      126.633,      1524.0,           0.0 !   !END!
405 ! X =       186.315,      126.671,      1524.0,           0.0 !   !END!
406 ! X =       187.733,      126.710,      1520.0,           0.0 !   !END!
407 ! X =       189.151,      126.750,      1500.0,           0.0 !   !END!
408 ! X =       190.569,      126.789,      1523.0,           0.0 !   !END!
409 ! X =       191.987,      126.829,      1570.0,           0.0 !   !END!
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410 ! X =       165.000,      127.927,      1584.0,           0.0 !   !END!
411 ! X =       166.418,      127.961,      1552.0,           0.0 !   !END!
412 ! X =       167.835,      127.996,      1540.0,           0.0 !   !END!
413 ! X =       169.253,      128.031,      1643.0,           0.0 !   !END!
414 ! X =       170.671,      128.066,      1634.0,           0.0 !   !END!
415 ! X =       172.089,      128.102,      1585.0,           0.0 !   !END!
416 ! X =       173.506,      128.138,      1553.0,           0.0 !   !END!
417 ! X =       174.924,      128.174,      1523.0,           0.0 !   !END!
418 ! X =       176.342,      128.211,      1192.0,           0.0 !   !END!
419 ! X =       177.760,      128.248,      1402.0,           0.0 !   !END!
420 ! X =       179.177,      128.285,      1523.0,           0.0 !   !END!
421 ! X =       180.595,      128.322,      1523.0,           0.0 !   !END!
422 ! X =       182.013,      128.360,      1523.0,           0.0 !   !END!
423 ! X =       183.430,      128.398,      1463.0,           0.0 !   !END!
424 ! X =       184.848,      128.436,      1500.0,           0.0 !   !END!
425 ! X =       186.266,      128.475,      1523.0,           0.0 !   !END!
426 ! X =       187.684,      128.514,      1493.0,           0.0 !   !END!
427 ! X =       189.101,      128.553,      1493.0,           0.0 !   !END!
428 ! X =       164.956,      129.730,      1677.0,           0.0 !   !END!
429 ! X =       166.373,      129.765,      1467.0,           0.0 !   !END!
430 ! X =       167.791,      129.799,      1543.0,           0.0 !   !END!
431 ! X =       169.208,      129.834,      1560.0,           0.0 !   !END!
432 ! X =       170.626,      129.870,      1579.0,           0.0 !   !END!
433 ! X =       172.043,      129.905,      1505.0,           0.0 !   !END!
434 ! X =       173.460,      129.941,      1463.0,           0.0 !   !END!
435 ! X =       174.878,      129.978,      1495.0,           0.0 !   !END!
436 ! X =       176.295,      130.014,      1238.0,           0.0 !   !END!
437 ! X =       177.713,      130.051,      1463.0,           0.0 !   !END!
438 ! X =       179.130,      130.088,      1341.0,           0.0 !   !END!
439 ! X =       180.547,      130.126,      1523.0,           0.0 !   !END!
440 ! X =       181.965,      130.163,      1522.0,           0.0 !   !END!
441 ! X =       183.382,      130.201,      1351.0,           0.0 !   !END!
442 ! X =       184.799,      130.240,      1476.0,           0.0 !   !END!
443 ! X =       186.217,      130.278,      1434.0,           0.0 !   !END!
444 ! X =       187.634,      130.317,      1479.0,           0.0 !   !END!
445 ! X =       164.912,      131.534,      1798.0,           0.0 !   !END!
446 ! X =       166.329,      131.568,      1584.0,           0.0 !   !END!
447 ! X =       167.746,      131.603,      1495.0,           0.0 !   !END!
448 ! X =       169.163,      131.638,      1504.0,           0.0 !   !END!
449 ! X =       170.581,      131.673,      1523.0,           0.0 !   !END!
450 ! X =       171.998,      131.709,      1523.0,           0.0 !   !END!
451 ! X =       173.415,      131.745,      1462.0,           0.0 !   !END!
452 ! X =       174.832,      131.781,      1273.0,           0.0 !   !END!
453 ! X =       176.249,      131.818,      1290.0,           0.0 !   !END!
454 ! X =       177.665,      131.855,      1419.0,           0.0 !   !END!
455 ! X =       179.082,      131.892,      1510.0,           0.0 !   !END!
456 ! X =       180.499,      131.929,      1176.0,           0.0 !   !END!
457 ! X =       181.916,      131.967,      1218.0,           0.0 !   !END!
458 ! X =       183.333,      132.005,      1312.0,           0.0 !   !END!
459 ! X =       184.750,      132.043,      1462.0,           0.0 !   !END!
460 ! X =       164.869,      133.337,      1576.0,           0.0 !   !END!
461 ! X =       166.285,      133.372,      1700.0,           0.0 !   !END!
462 ! X =       167.702,      133.406,      1484.0,           0.0 !   !END!
463 ! X =       169.119,      133.441,      1405.0,           0.0 !   !END!
464 ! X =       170.535,      133.477,      1474.0,           0.0 !   !END!
465 ! X =       171.952,      133.512,      1417.0,           0.0 !   !END!
466 ! X =       173.369,      133.548,      1463.0,           0.0 !   !END!
467 ! X =       174.785,      133.585,      1422.0,           0.0 !   !END!
468 ! X =       176.202,      133.621,      1218.0,           0.0 !   !END!
469 ! X =       177.618,      133.658,      1219.0,           0.0 !   !END!
470 ! X =       179.035,      133.695,      1460.0,           0.0 !   !END!
471 ! X =       180.452,      133.732,      1413.0,           0.0 !   !END!
472 ! X =       181.868,      133.770,      1406.0,           0.0 !   !END!
473 ! X =       183.285,      133.808,      1212.0,           0.0 !   !END!
474 ! X =       184.701,      133.846,      1245.0,           0.0 !   !END!
475 ! X =       164.825,      135.140,      1456.0,           0.0 !   !END!
476 ! X =       166.241,      135.175,      1508.0,           0.0 !   !END!
477 ! X =       167.658,      135.210,      1527.0,           0.0 !   !END!
478 ! X =       169.074,      135.245,      1401.0,           0.0 !   !END!
479 ! X =       170.490,      135.280,      1497.0,           0.0 !   !END!
480 ! X =       171.906,      135.316,      1598.0,           0.0 !   !END!
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481 ! X =       173.323,      135.352,      1343.0,           0.0 !   !END!
482 ! X =       174.739,      135.388,      1233.0,           0.0 !   !END!
483 ! X =       176.155,      135.424,      1306.0,           0.0 !   !END!
484 ! X =       177.571,      135.461,      1368.0,           0.0 !   !END!
485 ! X =       178.988,      135.498,      1462.0,           0.0 !   !END!
486 ! X =       180.404,      135.536,      1463.0,           0.0 !   !END!
487 ! X =       181.820,      135.573,      1190.0,           0.0 !   !END!
488 ! X =       183.236,      135.611,      1204.0,           0.0 !   !END!
489 ! X =       184.652,      135.650,      1433.0,           0.0 !   !END!
490 ! X =       166.197,      136.978,      1472.0,           0.0 !   !END!
491 ! X =       167.613,      137.013,      1394.0,           0.0 !   !END!
492 ! X =       169.029,      137.048,      1344.0,           0.0 !   !END!
493 ! X =       170.445,      137.083,      1340.0,           0.0 !   !END!
494 ! X =       171.861,      137.119,      1463.0,           0.0 !   !END!
495 ! X =       173.277,      137.155,      1240.0,           0.0 !   !END!
496 ! X =       174.693,      137.191,      1219.0,           0.0 !   !END!
497 ! X =       176.108,      137.228,      1218.0,           0.0 !   !END!
498 ! X =       177.524,      137.264,      1402.0,           0.0 !   !END!
499 ! X =       178.940,      137.302,      1528.0,           0.0 !   !END!
500 ! X =       180.356,      137.339,      1524.0,           0.0 !   !END!
501 ! X =       181.772,      137.377,      1403.0,           0.0 !   !END!
502 ! X =       183.188,      137.415,      1409.0,           0.0 !   !END!
503 ! X =       184.603,      137.453,      1219.0,           0.0 !   !END!
504 ! X =       186.019,      137.491,      1401.0,           0.0 !   !END!
505 ! X =       170.400,      138.887,      1524.0,           0.0 !   !END!
506 ! X =       171.815,      138.922,      1282.0,           0.0 !   !END!
507 ! X =       173.231,      138.958,      1340.0,           0.0 !   !END!
508 ! X =       174.646,      138.994,      1349.0,           0.0 !   !END!
509 ! X =       176.062,      139.031,      1523.0,           0.0 !   !END!
510 ! X =       177.477,      139.068,      1536.0,           0.0 !   !END!
511 ! X =       178.893,      139.105,      1610.0,           0.0 !   !END!
512 ! X =       180.308,      139.142,      1574.0,           0.0 !   !END!
513 ! X =       181.724,      139.180,      1422.0,           0.0 !   !END!
514 ! X =       183.139,      139.218,      1419.0,           0.0 !   !END!
515 ! X =       184.555,      139.256,      1341.0,           0.0 !   !END!
516 ! X =       185.970,      139.295,      1425.0,           0.0 !   !END!
517 ! X =       171.770,      140.725,      1242.0,           0.0 !   !END!
518 ! X =       173.185,      140.761,      1469.0,           0.0 !   !END!
519 ! X =       174.600,      140.797,      1462.0,           0.0 !   !END!
520 ! X =       176.015,      140.834,      1340.0,           0.0 !   !END!
521 ! X =       177.430,      140.871,      1645.0,           0.0 !   !END!
522 ! X =       178.845,      140.908,      1730.0,           0.0 !   !END!
523 ! X =       180.260,      140.945,      1492.0,           0.0 !   !END!
524 ! X =       181.675,      140.983,      1447.0,           0.0 !   !END!
525 ! X =       183.091,      141.021,      1284.0,           0.0 !   !END!
526 ! X =       184.506,      141.059,      1341.0,           0.0 !   !END!
527 ! X =       185.921,      141.098,      1200.0,           0.0 !   !END!
528 ! X =       187.336,      141.136,      1353.0,           0.0 !   !END!
529 ! X =       188.751,      141.176,      1348.0,           0.0 !   !END!
530 ! X =       170.309,      142.493,      1421.0,           0.0 !   !END!
531 ! X =       171.724,      142.528,      1243.0,           0.0 !   !END!
532 ! X =       173.139,      142.564,      1433.0,           0.0 !   !END!
533 ! X =       174.554,      142.601,      1505.0,           0.0 !   !END!
534 ! X =       175.968,      142.637,      1464.0,           0.0 !   !END!
535 ! X =       177.383,      142.674,      1515.0,           0.0 !   !END!
536 ! X =       178.798,      142.711,      1606.0,           0.0 !   !END!
537 ! X =       180.213,      142.748,      1869.0,           0.0 !   !END!
538 ! X =       181.627,      142.786,      1504.0,           0.0 !   !END!
539 ! X =       183.042,      142.824,      1484.0,           0.0 !   !END!
540 ! X =       184.457,      142.862,      1493.0,           0.0 !   !END!
541 ! X =       185.871,      142.901,      1477.0,           0.0 !   !END!
542 ! X =       187.286,      142.939,      1349.0,           0.0 !   !END!
543 ! X =       188.701,      142.979,      1340.0,           0.0 !   !END!
544 ! X =       170.264,      144.296,      1220.0,           0.0 !   !END!
545 ! X =       171.679,      144.331,      1280.0,           0.0 !   !END!
546 ! X =       173.093,      144.367,      1402.0,           0.0 !   !END!
547 ! X =       174.507,      144.404,      1386.0,           0.0 !   !END!
548 ! X =       175.922,      144.440,      1584.0,           0.0 !   !END!
549 ! X =       177.336,      144.477,      1523.0,           0.0 !   !END!
550 ! X =       178.750,      144.514,      1676.0,           0.0 !   !END!
551 ! X =       180.165,      144.551,      1888.0,           0.0 !   !END!
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552 ! X =       181.579,      144.589,      1523.0,           0.0 !   !END!
553 ! X =       182.993,      144.627,      1461.0,           0.0 !   !END!
554 ! X =       184.408,      144.665,      1462.0,           0.0 !   !END!
555 ! X =       185.822,      144.704,      1355.0,           0.0 !   !END!
556 ! X =       187.236,      144.742,      1191.0,           0.0 !   !END!
557 ! X =       188.651,      144.782,      1279.0,           0.0 !   !END!
558 ! X =       168.805,      146.064,      1331.0,           0.0 !   !END!
559 ! X =       170.219,      146.099,      1219.0,           0.0 !   !END!
560 ! X =       171.633,      146.134,      1239.0,           0.0 !   !END!
561 ! X =       173.047,      146.170,      1218.0,           0.0 !   !END!
562 ! X =       174.461,      146.207,      1279.0,           0.0 !   !END!
563 ! X =       175.875,      146.243,      1461.0,           0.0 !   !END!
564 ! X =       177.289,      146.280,      1690.0,           0.0 !   !END!
565 ! X =       178.703,      146.317,      1859.0,           0.0 !   !END!
566 ! X =       180.117,      146.354,      1558.0,           0.0 !   !END!
567 ! X =       181.531,      146.392,      1463.0,           0.0 !   !END!
568 ! X =       182.945,      146.430,      1461.0,           0.0 !   !END!
569 ! X =       184.359,      146.468,      1345.0,           0.0 !   !END!
570 ! X =       185.773,      146.506,      1280.0,           0.0 !   !END!
571 ! X =       187.187,      146.545,      1188.0,           0.0 !   !END!
572 ! X =       188.601,      146.584,      1340.0,           0.0 !   !END!
573 ! X =       190.014,      146.624,      1341.0,           0.0 !   !END!
574 ! X =       165.933,      147.797,      1219.0,           0.0 !   !END!
575 ! X =       167.347,      147.832,      1281.0,           0.0 !   !END!
576 ! X =       168.760,      147.867,      1219.0,           0.0 !   !END!
577 ! X =       170.174,      147.902,      1331.0,           0.0 !   !END!
578 ! X =       171.588,      147.937,      1390.0,           0.0 !   !END!
579 ! X =       173.001,      147.973,      1361.0,           0.0 !   !END!
580 ! X =       174.415,      148.009,      1320.0,           0.0 !   !END!
581 ! X =       175.828,      148.046,      1381.0,           0.0 !   !END!
582 ! X =       177.242,      148.083,      1462.0,           0.0 !   !END!
583 ! X =       178.656,      148.120,      1889.0,           0.0 !   !END!
584 ! X =       180.069,      148.157,      1727.0,           0.0 !   !END!
585 ! X =       181.483,      148.195,      1463.0,           0.0 !   !END!
586 ! X =       182.896,      148.233,      1381.0,           0.0 !   !END!
587 ! X =       184.310,      148.271,      1333.0,           0.0 !   !END!
588 ! X =       185.723,      148.309,      1219.0,           0.0 !   !END!
589 ! X =       187.137,      148.348,      1279.0,           0.0 !   !END!
590 ! X =       188.551,      148.387,      1279.0,           0.0 !   !END!
591 ! X =       189.964,      148.427,      1215.0,           0.0 !   !END!
592 ! X =       164.476,      149.565,      1280.0,           0.0 !   !END!
593 ! X =       165.889,      149.600,      1236.0,           0.0 !   !END!
594 ! X =       167.302,      149.634,      1276.0,           0.0 !   !END!
595 ! X =       168.715,      149.669,      1283.0,           0.0 !   !END!
596 ! X =       170.129,      149.705,      1284.0,           0.0 !   !END!
597 ! X =       171.542,      149.740,      1340.0,           0.0 !   !END!
598 ! X =       172.955,      149.776,      1401.0,           0.0 !   !END!
599 ! X =       174.368,      149.812,      1446.0,           0.0 !   !END!
600 ! X =       175.782,      149.849,      1459.0,           0.0 !   !END!
601 ! X =       177.195,      149.885,      1757.0,           0.0 !   !END!
602 ! X =       178.608,      149.922,      1827.0,           0.0 !   !END!
603 ! X =       180.021,      149.960,      1462.0,           0.0 !   !END!
604 ! X =       181.435,      149.997,      1419.0,           0.0 !   !END!
605 ! X =       182.848,      150.035,      1402.0,           0.0 !   !END!
606 ! X =       184.261,      150.073,      1342.0,           0.0 !   !END!
607 ! X =       185.674,      150.112,      1280.0,           0.0 !   !END!
608 ! X =       187.087,      150.151,      1280.0,           0.0 !   !END!
609 ! X =       188.500,      150.190,      1341.0,           0.0 !   !END!
610 ! X =       189.914,      150.229,      1280.0,           0.0 !   !END!
611 ! X =       164.432,      151.368,      1249.0,           0.0 !   !END!
612 ! X =       165.845,      151.403,      1195.0,           0.0 !   !END!
613 ! X =       167.258,      151.437,      1279.0,           0.0 !   !END!
614 ! X =       168.671,      151.472,      1285.0,           0.0 !   !END!
615 ! X =       170.084,      151.507,      1237.0,           0.0 !   !END!
616 ! X =       171.496,      151.543,      1340.0,           0.0 !   !END!
617 ! X =       172.909,      151.579,      1345.0,           0.0 !   !END!
618 ! X =       174.322,      151.615,      1402.0,           0.0 !   !END!
619 ! X =       175.735,      151.651,      1776.0,           0.0 !   !END!
620 ! X =       177.148,      151.688,      1828.0,           0.0 !   !END!
621 ! X =       178.561,      151.725,      1828.0,           0.0 !   !END!
622 ! X =       179.974,      151.762,      1828.0,           0.0 !   !END!
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623 ! X =       181.386,      151.800,      1460.0,           0.0 !   !END!
624 ! X =       182.799,      151.838,      1597.0,           0.0 !   !END!
625 ! X =       184.212,      151.876,      1463.0,           0.0 !   !END!
626 ! X =       185.625,      151.915,      1279.0,           0.0 !   !END!
627 ! X =       187.038,      151.953,      1400.0,           0.0 !   !END!
628 ! X =       188.450,      151.993,      1281.0,           0.0 !   !END!
629 ! X =       189.863,      152.032,      1249.0,           0.0 !   !END!
630 ! X =       164.388,      153.171,      1327.0,           0.0 !   !END!
631 ! X =       165.801,      153.205,      1280.0,           0.0 !   !END!
632 ! X =       167.213,      153.240,      1188.0,           0.0 !   !END!
633 ! X =       168.626,      153.275,      1325.0,           0.0 !   !END!
634 ! X =       170.038,      153.310,      1347.0,           0.0 !   !END!
635 ! X =       171.451,      153.346,      1340.0,           0.0 !   !END!
636 ! X =       172.863,      153.382,      1584.0,           0.0 !   !END!
637 ! X =       174.276,      153.418,      1426.0,           0.0 !   !END!
638 ! X =       175.688,      153.454,      1767.0,           0.0 !   !END!
639 ! X =       177.101,      153.491,      1763.0,           0.0 !   !END!
640 ! X =       178.513,      153.528,      1523.0,           0.0 !   !END!
641 ! X =       179.926,      153.565,      1876.0,           0.0 !   !END!
642 ! X =       181.338,      153.603,      1857.0,           0.0 !   !END!
643 ! X =       182.751,      153.641,      1584.0,           0.0 !   !END!
644 ! X =       184.163,      153.679,      1557.0,           0.0 !   !END!
645 ! X =       185.576,      153.717,      1524.0,           0.0 !   !END!
646 ! X =       186.988,      153.756,      1372.0,           0.0 !   !END!
647 ! X =       188.400,      153.795,      1401.0,           0.0 !   !END!
648 ! X =       189.813,      153.834,      1280.0,           0.0 !   !END!
649 ! X =       148.810,      154.615,      1572.0,           0.0 !   !END!
650 ! X =       164.345,      154.974,      1586.0,           0.0 !   !END!
651 ! X =       165.757,      155.008,      1274.0,           0.0 !   !END!
652 ! X =       167.169,      155.043,      1226.0,           0.0 !   !END!
653 ! X =       168.581,      155.078,      1318.0,           0.0 !   !END!
654 ! X =       169.993,      155.113,      1340.0,           0.0 !   !END!
655 ! X =       171.405,      155.148,      1558.0,           0.0 !   !END!
656 ! X =       172.817,      155.184,      1708.0,           0.0 !   !END!
657 ! X =       174.230,      155.220,      1706.0,           0.0 !   !END!
658 ! X =       175.642,      155.257,      1473.0,           0.0 !   !END!
659 ! X =       177.054,      155.293,      1460.0,           0.0 !   !END!
660 ! X =       178.466,      155.330,      1764.0,           0.0 !   !END!
661 ! X =       179.878,      155.368,      1771.0,           0.0 !   !END!
662 ! X =       181.290,      155.405,      1834.0,           0.0 !   !END!
663 ! X =       182.702,      155.443,      1833.0,           0.0 !   !END!
664 ! X =       184.114,      155.481,      1577.0,           0.0 !   !END!
665 ! X =       185.526,      155.520,      1392.0,           0.0 !   !END!
666 ! X =       186.938,      155.559,      1349.0,           0.0 !   !END!
667 ! X =       188.350,      155.598,      1279.0,           0.0 !   !END!
668 ! X =       148.771,      156.418,      1502.0,           0.0 !   !END!
669 ! X =       150.183,      156.449,      1589.0,           0.0 !   !END!
670 ! X =       164.301,      156.776,      1194.0,           0.0 !   !END!
671 ! X =       165.713,      156.811,      1219.0,           0.0 !   !END!
672 ! X =       167.124,      156.845,      1420.0,           0.0 !   !END!
673 ! X =       168.536,      156.880,      1505.0,           0.0 !   !END!
674 ! X =       169.948,      156.915,      1449.0,           0.0 !   !END!
675 ! X =       171.360,      156.951,      1340.0,           0.0 !   !END!
676 ! X =       172.772,      156.987,      1645.0,           0.0 !   !END!
677 ! X =       174.183,      157.023,      1649.0,           0.0 !   !END!
678 ! X =       175.595,      157.059,      1425.0,           0.0 !   !END!
679 ! X =       177.007,      157.096,      1645.0,           0.0 !   !END!
680 ! X =       178.418,      157.133,      1463.0,           0.0 !   !END!
681 ! X =       179.830,      157.170,      1790.0,           0.0 !   !END!
682 ! X =       181.242,      157.208,      1706.0,           0.0 !   !END!
683 ! X =       182.654,      157.246,      1793.0,           0.0 !   !END!
684 ! X =       184.065,      157.284,      1706.0,           0.0 !   !END!
685 ! X =       185.477,      157.322,      1484.0,           0.0 !   !END!
686 ! X =       186.889,      157.361,      1357.0,           0.0 !   !END!
687 ! X =       150.143,      158.252,      1555.0,           0.0 !   !END!
688 ! X =       164.257,      158.579,      1459.0,           0.0 !   !END!
689 ! X =       165.669,      158.613,      1523.0,           0.0 !   !END!
690 ! X =       167.080,      158.648,      1204.0,           0.0 !   !END!
691 ! X =       168.491,      158.683,      1249.0,           0.0 !   !END!
692 ! X =       169.903,      158.718,      1554.0,           0.0 !   !END!
693 ! X =       171.314,      158.753,      1535.0,           0.0 !   !END!
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694 ! X =       172.726,      158.789,      1584.0,           0.0 !   !END!
695 ! X =       174.137,      158.825,      1341.0,           0.0 !   !END!
696 ! X =       175.548,      158.862,      1509.0,           0.0 !   !END!
697 ! X =       176.960,      158.898,      1378.0,           0.0 !   !END!
698 ! X =       178.371,      158.935,      1615.0,           0.0 !   !END!
699 ! X =       179.782,      158.973,      1463.0,           0.0 !   !END!
700 ! X =       181.194,      159.010,      1690.0,           0.0 !   !END!
701 ! X =       182.605,      159.048,      1767.0,           0.0 !   !END!
702 ! X =       184.016,      159.086,      1550.0,           0.0 !   !END!
703 ! X =       185.428,      159.125,      1366.0,           0.0 !   !END!
704 ! X =       151.514,      160.086,      1553.0,           0.0 !   !END!
705 ! X =       167.036,      160.450,      1188.0,           0.0 !   !END!
706 ! X =       168.447,      160.485,      1258.0,           0.0 !   !END!
707 ! X =       169.858,      160.520,      1279.0,           0.0 !   !END!
708 ! X =       171.269,      160.556,      1280.0,           0.0 !   !END!
709 ! X =       172.680,      160.592,      1280.0,           0.0 !   !END!
710 ! X =       174.091,      160.628,      1381.0,           0.0 !   !END!
711 ! X =       175.502,      160.664,      1361.0,           0.0 !   !END!
712 ! X =       176.913,      160.701,      1584.0,           0.0 !   !END!
713 ! X =       178.324,      160.738,      1483.0,           0.0 !   !END!
714 ! X =       179.735,      160.775,      1645.0,           0.0 !   !END!
715 ! X =       181.146,      160.813,      1686.0,           0.0 !   !END!
716 ! X =       182.556,      160.850,      1768.0,           0.0 !   !END!
717 ! X =       183.967,      160.889,      1797.0,           0.0 !   !END!
718 ! X =       185.378,      160.927,      1556.0,           0.0 !   !END!
719 ! X =       165.581,      162.218,      1194.0,           0.0 !   !END!
720 ! X =       166.991,      162.253,      1219.0,           0.0 !   !END!
721 ! X =       168.402,      162.288,      1523.0,           0.0 !   !END!
722 ! X =       185.329,      162.729,      1459.0,           0.0 !   !END!
723 ! X =        93.519,       65.185,      1361.0,           0.0 !   !END!
724 ! X =        94.950,       65.204,      1218.0,           0.0 !   !END!
725 ! X =        92.064,       66.972,      1463.0,           0.0 !   !END!
726 ! X =        93.495,       66.991,      1286.0,           0.0 !   !END!
727 ! X =        92.040,       68.778,      1279.0,           0.0 !   !END!
728 ! X =        90.586,       70.565,      1385.0,           0.0 !   !END!
729 ! X =        86.274,       72.316,      1911.0,           0.0 !   !END!
730 ! X =        87.704,       72.334,      1920.0,           0.0 !   !END!
731 ! X =        89.133,       72.352,      1651.0,           0.0 !   !END!
732 ! X =        90.562,       72.371,      1360.0,           0.0 !   !END!
733 ! X =        86.251,       74.122,      1940.0,           0.0 !   !END!
734 ! X =        87.680,       74.140,      1691.0,           0.0 !   !END!
735 ! X =        89.109,       74.158,      1504.0,           0.0 !   !END!
736 ! X =        86.229,       75.928,      1838.0,           0.0 !   !END!
737 ! X =        87.657,       75.946,      1711.0,           0.0 !   !END!
738 ! X =        89.086,       75.964,      1401.0,           0.0 !   !END!
739 ! X =        84.778,       77.716,      1874.0,           0.0 !   !END!
740 ! X =        86.206,       77.734,      1593.0,           0.0 !   !END!
741 ! X =        87.634,       77.752,      1572.0,           0.0 !   !END!
742 ! X =        89.063,       77.770,      1401.0,           0.0 !   !END!
743 ! X =        81.900,       79.487,      1927.0,           0.0 !   !END!
744 ! X =        83.328,       79.504,      1950.0,           0.0 !   !END!
745 ! X =        84.756,       79.522,      1716.0,           0.0 !   !END!
746 ! X =        86.183,       79.539,      1645.0,           0.0 !   !END!
747 ! X =        87.611,       79.557,      1401.0,           0.0 !   !END!
748 ! X =        81.878,       81.293,      1929.0,           0.0 !   !END!
749 ! X =        83.306,       81.310,      1714.0,           0.0 !   !END!
750 ! X =        84.733,       81.327,      1495.0,           0.0 !   !END!
751 ! X =        86.161,       81.345,      1463.0,           0.0 !   !END!
752 ! X =        87.588,       81.363,      1460.0,           0.0 !   !END!
753 ! X =        80.430,       83.081,      1975.0,           0.0 !   !END!
754 ! X =        81.857,       83.098,      1780.0,           0.0 !   !END!
755 ! X =        83.284,       83.115,      1670.0,           0.0 !   !END!
756 ! X =        84.711,       83.133,      1523.0,           0.0 !   !END!
757 ! X =        86.138,       83.151,      1463.0,           0.0 !   !END!
758 ! X =        78.982,       84.870,      2035.0,           0.0 !   !END!
759 ! X =        80.408,       84.887,      1889.0,           0.0 !   !END!
760 ! X =        81.835,       84.904,      1730.0,           0.0 !   !END!
761 ! X =        83.262,       84.921,      1695.0,           0.0 !   !END!
762 ! X =        84.689,       84.939,      1706.0,           0.0 !   !END!
763 ! X =        86.115,       84.956,      1462.0,           0.0 !   !END!
764 ! X =        77.534,       86.660,      2133.0,           0.0 !   !END!
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765 ! X =        78.961,       86.676,      2011.0,           0.0 !   !END!
766 ! X =        80.387,       86.692,      1828.0,           0.0 !   !END!
767 ! X =        81.814,       86.709,      1841.0,           0.0 !   !END!
768 ! X =        83.240,       86.727,      1744.0,           0.0 !   !END!
769 ! X =        84.666,       86.744,      1645.0,           0.0 !   !END!
770 ! X =        86.093,       86.762,      1522.0,           0.0 !   !END!
771 ! X =        77.514,       88.465,      2072.0,           0.0 !   !END!
772 ! X =        78.940,       88.481,      1869.0,           0.0 !   !END!
773 ! X =        80.366,       88.498,      1767.0,           0.0 !   !END!
774 ! X =        81.792,       88.515,      1706.0,           0.0 !   !END!
775 ! X =        83.218,       88.532,      1720.0,           0.0 !   !END!
776 ! X =        84.644,       88.549,      1523.0,           0.0 !   !END!
777 ! X =        86.070,       88.567,      1584.0,           0.0 !   !END!
778 ! X =        77.494,       90.270,      1950.0,           0.0 !   !END!
779 ! X =        78.919,       90.287,      1830.0,           0.0 !   !END!
780 ! X =        80.345,       90.303,      1767.0,           0.0 !   !END!
781 ! X =        81.770,       90.320,      1730.0,           0.0 !   !END!
782 ! X =        83.196,       90.337,      1518.0,           0.0 !   !END!
783 ! X =        84.622,       90.355,      1523.0,           0.0 !   !END!
784 ! X =        77.473,       92.076,      1954.0,           0.0 !   !END!
785 ! X =        78.898,       92.092,      1847.0,           0.0 !   !END!
786 ! X =        80.324,       92.109,      1767.0,           0.0 !   !END!
787 ! X =        81.749,       92.126,      1531.0,           0.0 !   !END!
788 ! X =        83.174,       92.143,      1584.0,           0.0 !   !END!
789 ! X =        77.453,       93.881,      1889.0,           0.0 !   !END!
790 ! X =        78.878,       93.897,      1828.0,           0.0 !   !END!
791 ! X =        80.302,       93.914,      1683.0,           0.0 !   !END!
792 ! X =        81.727,       93.931,      1584.0,           0.0 !   !END!
793 ! X =        77.432,       95.686,      1889.0,           0.0 !   !END!
794 ! X =        78.857,       95.703,      1828.0,           0.0 !   !END!
795 ! X =        80.281,       95.719,      1584.0,           0.0 !   !END!
796 ! X =        75.988,       97.475,      2035.0,           0.0 !   !END!
797 ! X =        77.412,       97.491,      1925.0,           0.0 !   !END!
798 ! X =        78.836,       97.508,      1646.0,           0.0 !   !END!
799 ! X =        80.260,       97.524,      1641.0,           0.0 !   !END!
800 ! X =        75.968,       99.281,      2049.0,           0.0 !   !END!
801 ! X =        77.391,       99.296,      1921.0,           0.0 !   !END!
802 ! X =        78.815,       99.313,      1646.0,           0.0 !   !END!
803 ! X =        80.239,       99.329,      1706.0,           0.0 !   !END!
804 ! X =        74.524,      101.070,      2054.0,           0.0 !   !END!
805 ! X =        75.948,      101.086,      2100.0,           0.0 !   !END!
806 ! X =        77.371,      101.101,      1767.0,           0.0 !   !END!
807 ! X =        78.794,      101.118,      1706.0,           0.0 !   !END!
808 ! X =        74.505,      102.875,      2190.0,           0.0 !   !END!
809 ! X =        75.928,      102.890,      1916.0,           0.0 !   !END!
810 ! X =        77.351,      102.906,      1748.0,           0.0 !   !END!
811 ! X =        78.774,      102.923,      1766.0,           0.0 !   !END!
812 ! X =        74.485,      104.680,      2103.0,           0.0 !   !END!
813 ! X =        75.908,      104.695,      1768.0,           0.0 !   !END!
814 ! X =        77.330,      104.711,      1706.0,           0.0 !   !END!
815 ! X =        78.753,      104.727,      1744.0,           0.0 !   !END!
816 ! X =        71.621,      106.454,      2022.0,           0.0 !   !END!
817 ! X =        73.043,      106.469,      2182.0,           0.0 !   !END!
818 ! X =        74.465,      106.484,      1861.0,           0.0 !   !END!
819 ! X =        75.888,      106.500,      1710.0,           0.0 !   !END!
820 ! X =        77.310,      106.516,      1692.0,           0.0 !   !END!
821 ! X =        68.758,      108.230,      2119.0,           0.0 !   !END!
822 ! X =        70.180,      108.244,      2195.0,           0.0 !   !END!
823 ! X =        71.602,      108.259,      2237.0,           0.0 !   !END!
824 ! X =        73.024,      108.274,      2020.0,           0.0 !   !END!
825 ! X =        74.446,      108.289,      1767.0,           0.0 !   !END!
826 ! X =        75.867,      108.305,      1706.0,           0.0 !   !END!
827 ! X =        77.289,      108.321,      1663.0,           0.0 !   !END!
828 ! X =        68.740,      110.034,      2072.0,           0.0 !   !END!
829 ! X =        70.161,      110.049,      2059.0,           0.0 !   !END!
830 ! X =        71.583,      110.063,      2133.0,           0.0 !   !END!
831 ! X =        73.004,      110.079,      1887.0,           0.0 !   !END!
832 ! X =        74.426,      110.094,      1724.0,           0.0 !   !END!
833 ! X =        75.847,      110.109,      1749.0,           0.0 !   !END!
834 ! X =        77.269,      110.125,      1657.0,           0.0 !   !END!
835 ! X =        68.722,      111.839,      1950.0,           0.0 !   !END!
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836 ! X =        70.143,      111.853,      2079.0,           0.0 !   !END!
837 ! X =        71.564,      111.868,      1829.0,           0.0 !   !END!
838 ! X =        72.985,      111.883,      1748.0,           0.0 !   !END!
839 ! X =        68.704,      113.643,      2133.0,           0.0 !   !END!
840 ! X =        70.124,      113.658,      2135.0,           0.0 !   !END!
841 ! X =        71.545,      113.673,      1896.0,           0.0 !   !END!
842 ! X =        68.685,      115.448,      1868.0,           0.0 !   !END!
843 ! X =        70.106,      115.462,      1963.0,           0.0 !   !END!
844 ! X =        71.526,      115.477,      1889.0,           0.0 !   !END!
845 ! X =        72.947,      115.492,      1828.0,           0.0 !   !END!
846 ! X =        68.667,      117.252,      2084.0,           0.0 !   !END!
847 ! X =        70.087,      117.267,      2059.0,           0.0 !   !END!
848 ! X =        71.507,      117.282,      1879.0,           0.0 !   !END!
849 ! X =        72.927,      117.297,      1879.0,           0.0 !   !END!
850 ! X =        68.649,      119.057,      1993.0,           0.0 !   !END!
851 ! X =        70.069,      119.071,      2087.0,           0.0 !   !END!
852 ! X =        71.488,      119.086,      2011.0,           0.0 !   !END!
853 ! X =        72.908,      119.101,      1859.0,           0.0 !   !END!
854 ! X =        74.328,      119.116,      1767.0,           0.0 !   !END!
855 ! X =        68.631,      120.861,      1973.0,           0.0 !   !END!
856 ! X =        70.050,      120.875,      2011.0,           0.0 !   !END!
857 ! X =        71.469,      120.890,      2011.0,           0.0 !   !END!
858 ! X =        72.889,      120.905,      1828.0,           0.0 !   !END!
859 ! X =        68.613,      122.665,      1896.0,           0.0 !   !END!
860 ! X =        70.032,      122.680,      1965.0,           0.0 !   !END!
861 ! X =        71.451,      122.694,      1926.0,           0.0 !   !END!
862 ! X =        72.869,      122.709,      1854.0,           0.0 !   !END!
863 ! X =        65.758,      124.441,      1999.0,           0.0 !   !END!
864 ! X =        67.176,      124.455,      1939.0,           0.0 !   !END!
865 ! X =        68.595,      124.469,      1972.0,           0.0 !   !END!
866 ! X =        70.013,      124.484,      1889.0,           0.0 !   !END!
867 ! X =        71.432,      124.499,      1950.0,           0.0 !   !END!
868 ! X =        72.850,      124.514,      1784.0,           0.0 !   !END!
869 ! X =        65.740,      126.245,      1922.0,           0.0 !   !END!
870 ! X =        67.158,      126.259,      1835.0,           0.0 !   !END!
871 ! X =        68.576,      126.273,      2000.0,           0.0 !   !END!
872 ! X =        69.995,      126.288,      1828.0,           0.0 !   !END!
873 ! X =        71.413,      126.303,      1808.0,           0.0 !   !END!
874 ! X =        72.831,      126.318,      1700.0,           0.0 !   !END!
875 ! X =        65.723,      128.050,      1792.0,           0.0 !   !END!
876 ! X =        67.140,      128.063,      2022.0,           0.0 !   !END!
877 ! X =        68.558,      128.077,      1802.0,           0.0 !   !END!
878 ! X =        69.976,      128.092,      1889.0,           0.0 !   !END!
879 ! X =        62.871,      129.827,      2096.0,           0.0 !   !END!
880 ! X =        64.288,      129.840,      1882.0,           0.0 !   !END!
881 ! X =        65.705,      129.853,      1779.0,           0.0 !   !END!
882 ! X =        67.123,      129.867,      1759.0,           0.0 !   !END!
883 ! X =        68.540,      129.881,      1811.0,           0.0 !   !END!
884 ! X =        69.957,      129.896,      1645.0,           0.0 !   !END!
885 ! X =        62.854,      131.631,      1937.0,           0.0 !   !END!
886 ! X =        64.271,      131.644,      1808.0,           0.0 !   !END!
887 ! X =        65.688,      131.657,      2072.0,           0.0 !   !END!
888 ! X =        67.105,      131.671,      2020.0,           0.0 !   !END!
889 ! X =        68.522,      131.685,      1828.0,           0.0 !   !END!
890 ! X =        69.939,      131.700,      1706.0,           0.0 !   !END!
891 ! X =        61.421,      133.422,      1950.0,           0.0 !   !END!
892 ! X =        62.837,      133.434,      1767.0,           0.0 !   !END!
893 ! X =        64.254,      133.448,      1848.0,           0.0 !   !END!
894 ! X =        65.671,      133.461,      2026.0,           0.0 !   !END!
895 ! X =        67.087,      133.475,      1828.0,           0.0 !   !END!
896 ! X =        68.504,      133.489,      1774.0,           0.0 !   !END!
897 ! X =        69.920,      133.504,      1645.0,           0.0 !   !END!
898 ! X =        58.572,      135.200,      2121.0,           0.0 !   !END!
899 ! X =        59.988,      135.213,      2047.0,           0.0 !   !END!
900 ! X =        61.404,      135.225,      1828.0,           0.0 !   !END!
901 ! X =        62.821,      135.238,      1784.0,           0.0 !   !END!
902 ! X =        64.237,      135.252,      1767.0,           0.0 !   !END!
903 ! X =        65.653,      135.265,      1864.0,           0.0 !   !END!
904 ! X =        67.069,      135.279,      1828.0,           0.0 !   !END!
905 ! X =        68.486,      135.293,      1768.0,           0.0 !   !END!
906 ! X =        69.902,      135.307,      1645.0,           0.0 !   !END!
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907 ! X =        58.556,      137.004,      2012.0,           0.0 !   !END!
908 ! X =        59.972,      137.016,      1822.0,           0.0 !   !END!
909 ! X =        61.388,      137.029,      1707.0,           0.0 !   !END!
910 ! X =        62.804,      137.042,      1821.0,           0.0 !   !END!
911 ! X =        64.220,      137.055,      1713.0,           0.0 !   !END!
912 ! X =        65.636,      137.069,      1773.0,           0.0 !   !END!
913 ! X =        67.052,      137.083,      1615.0,           0.0 !   !END!
914 ! X =        68.467,      137.097,      1609.0,           0.0 !   !END!
915 ! X =        69.883,      137.111,      1638.0,           0.0 !   !END!
916 ! X =        57.125,      138.796,      1919.0,           0.0 !   !END!
917 ! X =        58.541,      138.808,      1839.0,           0.0 !   !END!
918 ! X =        59.956,      138.820,      1712.0,           0.0 !   !END!
919 ! X =        61.372,      138.833,      1874.0,           0.0 !   !END!
920 ! X =        62.787,      138.846,      1828.0,           0.0 !   !END!
921 ! X =        64.203,      138.859,      1830.0,           0.0 !   !END!
922 ! X =        65.618,      138.872,      1772.0,           0.0 !   !END!
923 ! X =        67.034,      138.886,      1840.0,           0.0 !   !END!
924 ! X =        68.449,      138.900,      1710.0,           0.0 !   !END!
925 ! X =        69.865,      138.915,      1585.0,           0.0 !   !END!
926 ! X =        71.280,      138.929,      1645.0,           0.0 !   !END!
927 ! X =        72.696,      138.944,      1583.0,           0.0 !   !END!
928 ! X =        52.865,      140.565,      1948.0,           0.0 !   !END!
929 ! X =        54.280,      140.576,      1937.0,           0.0 !   !END!
930 ! X =        55.695,      140.588,      1889.0,           0.0 !   !END!
931 ! X =        57.110,      140.599,      1831.0,           0.0 !   !END!
932 ! X =        58.525,      140.611,      1932.0,           0.0 !   !END!
933 ! X =        59.940,      140.624,      1959.0,           0.0 !   !END!
934 ! X =        61.355,      140.636,      1828.0,           0.0 !   !END!
935 ! X =        62.771,      140.649,      1708.0,           0.0 !   !END!
936 ! X =        64.186,      140.662,      1867.0,           0.0 !   !END!
937 ! X =        65.601,      140.676,      1895.0,           0.0 !   !END!
938 ! X =        67.016,      140.690,      1791.0,           0.0 !   !END!
939 ! X =        68.431,      140.704,      1646.0,           0.0 !   !END!
940 ! X =        69.846,      140.718,      1576.0,           0.0 !   !END!
941 ! X =        71.261,      140.733,      1582.0,           0.0 !   !END!
942 ! X =        72.677,      140.748,      1533.0,           0.0 !   !END!
943 ! X =        52.850,      142.369,      1971.0,           0.0 !   !END!
944 ! X =        54.265,      142.380,      1948.0,           0.0 !   !END!
945 ! X =        55.680,      142.391,      2194.0,           0.0 !   !END!
946 ! X =        57.095,      142.403,      2106.0,           0.0 !   !END!
947 ! X =        58.510,      142.415,      2043.0,           0.0 !   !END!
948 ! X =        59.924,      142.427,      1889.0,           0.0 !   !END!
949 ! X =        61.339,      142.440,      2011.0,           0.0 !   !END!
950 ! X =        62.754,      142.453,      1967.0,           0.0 !   !END!
951 ! X =        64.169,      142.466,      1848.0,           0.0 !   !END!
952 ! X =        65.583,      142.479,      1793.0,           0.0 !   !END!
953 ! X =        66.998,      142.493,      1669.0,           0.0 !   !END!
954 ! X =        68.413,      142.507,      1584.0,           0.0 !   !END!
955 ! X =        69.828,      142.522,      1584.0,           0.0 !   !END!
956 ! X =        52.836,      144.172,      2262.0,           0.0 !   !END!
957 ! X =        54.251,      144.183,      2214.0,           0.0 !   !END!
958 ! X =        55.665,      144.195,      2190.0,           0.0 !   !END!
959 ! X =        57.080,      144.206,      2072.0,           0.0 !   !END!
960 ! X =        58.494,      144.218,      2044.0,           0.0 !   !END!
961 ! X =        59.909,      144.231,      2130.0,           0.0 !   !END!
962 ! X =        61.323,      144.243,      2072.0,           0.0 !   !END!
963 ! X =        62.737,      144.256,      1950.0,           0.0 !   !END!
964 ! X =        64.152,      144.269,      1767.0,           0.0 !   !END!
965 ! X =        65.566,      144.283,      1722.0,           0.0 !   !END!
966 ! X =        66.980,      144.297,      1637.0,           0.0 !   !END!
967 ! X =        68.395,      144.311,      1646.0,           0.0 !   !END!
968 ! X =        52.822,      145.975,      2241.0,           0.0 !   !END!
969 ! X =        54.236,      145.987,      2194.0,           0.0 !   !END!
970 ! X =        55.651,      145.998,      2194.0,           0.0 !   !END!
971 ! X =        57.065,      146.010,      2148.0,           0.0 !   !END!
972 ! X =        58.479,      146.022,      2172.0,           0.0 !   !END!
973 ! X =        59.893,      146.034,      2045.0,           0.0 !   !END!
974 ! X =        61.307,      146.047,      1917.0,           0.0 !   !END!
975 ! X =        62.721,      146.060,      1787.0,           0.0 !   !END!
976 ! X =        64.135,      146.073,      1767.0,           0.0 !   !END!
977 ! X =        65.549,      146.086,      1695.0,           0.0 !   !END!
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 978 ! X =        66.963,      146.100,      1651.0,           0.0 !   !END!
 979 ! X =        68.377,      146.114,      1661.0,           0.0 !   !END!
 980 ! X =        52.808,      147.779,      2205.0,           0.0 !   !END!
 981 ! X =        54.222,      147.790,      2185.0,           0.0 !   !END!
 982 ! X =        55.636,      147.801,      2133.0,           0.0 !   !END!
 983 ! X =        57.049,      147.813,      2106.0,           0.0 !   !END!
 984 ! X =        58.463,      147.825,      2012.0,           0.0 !   !END!
 985 ! X =        59.877,      147.837,      1950.0,           0.0 !   !END!
 986 ! X =        61.290,      147.850,      1889.0,           0.0 !   !END!
 987 ! X =        62.704,      147.863,      1821.0,           0.0 !   !END!
 988 ! X =        64.118,      147.876,      1706.0,           0.0 !   !END!
 989 ! X =        65.531,      147.890,      1692.0,           0.0 !   !END!
 990 ! X =        66.945,      147.903,      1850.0,           0.0 !   !END!
 991 ! X =        68.359,      147.918,      1757.0,           0.0 !   !END!
 992 ! X =        49.968,      149.561,      2342.0,           0.0 !   !END!
 993 ! X =        51.381,      149.571,      2255.0,           0.0 !   !END!
 994 ! X =        52.794,      149.582,      2187.0,           0.0 !   !END!
 995 ! X =        54.208,      149.593,      2099.0,           0.0 !   !END!
 996 ! X =        55.621,      149.605,      1983.0,           0.0 !   !END!
 997 ! X =        57.034,      149.616,      1889.0,           0.0 !   !END!
 998 ! X =        58.448,      149.628,      1958.0,           0.0 !   !END!
 999 ! X =        59.861,      149.641,      1892.0,           0.0 !   !END!
1000 ! X =        61.274,      149.653,      1828.0,           0.0 !   !END!
1001 ! X =        62.687,      149.666,      1755.0,           0.0 !   !END!
1002 ! X =        64.101,      149.679,      1706.0,           0.0 !   !END!
1003 ! X =        65.514,      149.693,      1773.0,           0.0 !   !END!
1004 ! X =        66.927,      149.707,      1767.0,           0.0 !   !END!
1005 ! X =        49.955,      151.364,      2316.0,           0.0 !   !END!
1006 ! X =        51.367,      151.375,      2255.0,           0.0 !   !END!
1007 ! X =        52.780,      151.385,      2194.0,           0.0 !   !END!
1008 ! X =        54.193,      151.396,      2133.0,           0.0 !   !END!
1009 ! X =        55.606,      151.408,      2068.0,           0.0 !   !END!
1010 ! X =        57.019,      151.420,      1990.0,           0.0 !   !END!
1011 ! X =        58.432,      151.432,      1972.0,           0.0 !   !END!
1012 ! X =        59.845,      151.444,      1892.0,           0.0 !   !END!
1013 ! X =        61.258,      151.457,      1767.0,           0.0 !   !END!
1014 ! X =        62.671,      151.469,      1767.0,           0.0 !   !END!
1015 ! X =        64.084,      151.483,      1758.0,           0.0 !   !END!
1016 ! X =        65.496,      151.496,      1848.0,           0.0 !   !END!
1017 ! X =        47.116,      153.147,      2533.0,           0.0 !   !END!
1018 ! X =        48.529,      153.157,      2441.0,           0.0 !   !END!
1019 ! X =        49.941,      153.167,      2194.0,           0.0 !   !END!
1020 ! X =        51.354,      153.178,      2194.0,           0.0 !   !END!
1021 ! X =        52.766,      153.189,      2194.0,           0.0 !   !END!
1022 ! X =        54.179,      153.200,      2072.0,           0.0 !   !END!
1023 ! X =        55.591,      153.211,      1967.0,           0.0 !   !END!
1024 ! X =        57.004,      153.223,      1876.0,           0.0 !   !END!
1025 ! X =        58.416,      153.235,      1828.0,           0.0 !   !END!
1026 ! X =        59.829,      153.247,      1792.0,           0.0 !   !END!
1027 ! X =        61.242,      153.260,      1889.0,           0.0 !   !END!
1028 ! X =        62.654,      153.273,      1868.0,           0.0 !   !END!
1029 ! X =        64.067,      153.286,      1879.0,           0.0 !   !END!
1030 ! X =        65.479,      153.299,      1804.0,           0.0 !   !END!
1031 ! X =        66.892,      153.313,      1767.0,           0.0 !   !END!
1032 ! X =        48.516,      154.960,      2503.0,           0.0 !   !END!
1033 ! X =        49.928,      154.970,      2304.0,           0.0 !   !END!
1034 ! X =        51.340,      154.981,      2133.0,           0.0 !   !END!
1035 ! X =        52.752,      154.992,      2026.0,           0.0 !   !END!
1036 ! X =        54.165,      155.003,      1950.0,           0.0 !   !END!
1037 ! X =        55.577,      155.014,      1858.0,           0.0 !   !END!
1038 ! X =        56.989,      155.026,      1862.0,           0.0 !   !END!
1039 ! X =        58.401,      155.038,      1944.0,           0.0 !   !END!
1040 ! X =        59.813,      155.050,      1889.0,           0.0 !   !END!
1041 ! X =        61.225,      155.063,      1890.0,           0.0 !   !END!
1042 ! X =        62.637,      155.076,      1835.0,           0.0 !   !END!
1043 ! X =        64.050,      155.089,      1950.0,           0.0 !   !END!
1044 ! X =        65.462,      155.102,      1702.0,           0.0 !   !END!
1045 ! X =        66.874,      155.116,      1665.0,           0.0 !   !END!
1046 ! X =        51.327,      156.784,      2088.0,           0.0 !   !END!
1047 ! X =        52.738,      156.795,      1949.0,           0.0 !   !END!
1048 ! X =        54.150,      156.806,      1938.0,           0.0 !   !END!
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1049 ! X =        55.562,      156.817,      1951.0,           0.0 !   !END!
1050 ! X =        56.974,      156.829,      1950.0,           0.0 !   !END!
1051 ! X =        58.385,      156.841,      1881.0,           0.0 !   !END!
1052 ! X =        59.797,      156.853,      1889.0,           0.0 !   !END!
1053 ! X =        61.209,      156.866,      1895.0,           0.0 !   !END!
1054 ! X =        62.621,      156.879,      1826.0,           0.0 !   !END!
1055 ! X =        64.033,      156.892,      1855.0,           0.0 !   !END!
1056 ! X =        65.444,      156.905,      1851.0,           0.0 !   !END!
1057 ! X =        49.901,      158.576,      2236.0,           0.0 !   !END!
1058 ! X =        51.313,      158.587,      2047.0,           0.0 !   !END!
1059 ! X =        52.724,      158.598,      2020.0,           0.0 !   !END!
1060 ! X =        54.136,      158.609,      2011.0,           0.0 !   !END!
1061 ! X =        55.547,      158.620,      1958.0,           0.0 !   !END!
1062 ! X =        56.959,      158.632,      1951.0,           0.0 !   !END!
1063 ! X =        58.370,      158.644,      1950.0,           0.0 !   !END!
1064 ! X =        59.781,      158.656,      1949.0,           0.0 !   !END!
1065 ! X =        61.193,      158.669,      1987.0,           0.0 !   !END!
1066 ! X =        49.888,      160.379,      2216.0,           0.0 !   !END!
1067 ! X =        51.299,      160.390,      2012.0,           0.0 !   !END!
1068 ! X =        52.710,      160.401,      1935.0,           0.0 !   !END!
1069 ! X =        54.121,      160.412,      1952.0,           0.0 !   !END!
1070 ! X =        55.532,      160.423,      1950.0,           0.0 !   !END!
1071 ! X =        56.943,      160.435,      1828.0,           0.0 !   !END!
1072 ! X =        58.354,      160.447,      1838.0,           0.0 !   !END!
1073 ! X =        59.765,      160.459,      1767.0,           0.0 !   !END!
1074 ! X =        61.176,      160.472,      1764.0,           0.0 !   !END!
1075 ! X =        49.875,      162.182,      2211.0,           0.0 !   !END!
1076 ! X =        51.286,      162.193,      2062.0,           0.0 !   !END!
1077 ! X =        52.696,      162.203,      1949.0,           0.0 !   !END!
1078 ! X =        54.107,      162.215,      1886.0,           0.0 !   !END!
1079 ! X =        55.518,      162.226,      1889.0,           0.0 !   !END!
1080 ! X =        56.928,      162.238,      1852.0,           0.0 !   !END!
1081 ! X =        58.339,      162.250,      1889.0,           0.0 !   !END!
1082 ! X =        59.750,      162.262,      1816.0,           0.0 !   !END!
1083 ! X =        61.160,      162.275,      1767.0,           0.0 !   !END!
1084 ! X =        54.093,      164.017,      1951.0,           0.0 !   !END!
1085 ! X =        55.503,      164.029,      1950.0,           0.0 !   !END!
1086 ! X =       381.134,      308.894,      3290.0,           0.0 !   !END!
1087 ! X =       378.271,      310.531,      3195.0,           0.0 !   !END!
1088 ! X =       379.651,      310.610,      3048.0,           0.0 !   !END!
1089 ! X =       381.031,      310.689,      3239.0,           0.0 !   !END!
1090 ! X =       382.410,      310.769,      3270.0,           0.0 !   !END!
1091 ! X =       378.169,      312.327,      3230.0,           0.0 !   !END!
1092 ! X =       379.548,      312.406,      2873.0,           0.0 !   !END!
1093 ! X =       380.927,      312.485,      3215.0,           0.0 !   !END!
1094 ! X =       382.307,      312.564,      3230.0,           0.0 !   !END!
1095 ! X =       378.066,      314.122,      3089.0,           0.0 !   !END!
1096 ! X =       379.445,      314.201,      2804.0,           0.0 !   !END!
1097 ! X =       380.824,      314.280,      3108.0,           0.0 !   !END!
1098 ! X =       382.203,      314.360,      3217.0,           0.0 !   !END!
1099 ! X =       383.582,      314.439,      3236.0,           0.0 !   !END!
1100 ! X =       376.585,      315.839,      3051.0,           0.0 !   !END!
1101 ! X =       377.964,      315.918,      2845.0,           0.0 !   !END!
1102 ! X =       379.342,      315.997,      2752.0,           0.0 !   !END!
1103 ! X =       380.721,      316.076,      2682.0,           0.0 !   !END!
1104 ! X =       382.100,      316.155,      3062.0,           0.0 !   !END!
1105 ! X =       383.478,      316.235,      2929.0,           0.0 !   !END!
1106 ! X =       384.857,      316.315,      2944.0,           0.0 !   !END!
1107 ! X =       386.235,      316.395,      2898.0,           0.0 !   !END!
1108 ! X =       387.614,      316.476,      3108.0,           0.0 !   !END!
1109 ! X =       388.992,      316.556,      3193.0,           0.0 !   !END!
1110 ! X =       390.371,      316.638,      3230.0,           0.0 !   !END!
1111 ! X =       391.749,      316.719,      2865.0,           0.0 !   !END!
1112 ! X =       393.128,      316.801,      2761.0,           0.0 !   !END!
1113 ! X =       394.506,      316.883,      3159.0,           0.0 !   !END!
1114 ! X =       395.885,      316.965,      2976.0,           0.0 !   !END!
1115 ! X =       397.263,      317.047,      2741.0,           0.0 !   !END!
1116 ! X =       400.020,      317.213,      3445.0,           0.0 !   !END!
1117 ! X =       401.398,      317.297,      3474.0,           0.0 !   !END!
1118 ! X =       369.591,      317.247,      2407.0,           0.0 !   !END!
1119 ! X =       370.969,      317.324,      2542.0,           0.0 !   !END!
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1120 ! X =       372.348,      317.401,      2649.0,           0.0 !   !END!
1121 ! X =       373.726,      317.479,      2634.0,           0.0 !   !END!
1122 ! X =       375.105,      317.557,      2654.0,           0.0 !   !END!
1123 ! X =       376.483,      317.635,      2499.0,           0.0 !   !END!
1124 ! X =       377.861,      317.713,      2640.0,           0.0 !   !END!
1125 ! X =       379.239,      317.792,      3083.0,           0.0 !   !END!
1126 ! X =       380.618,      317.871,      3230.0,           0.0 !   !END!
1127 ! X =       381.996,      317.951,      3108.0,           0.0 !   !END!
1128 ! X =       383.374,      318.030,      3098.0,           0.0 !   !END!
1129 ! X =       384.752,      318.110,      3027.0,           0.0 !   !END!
1130 ! X =       386.131,      318.190,      2865.0,           0.0 !   !END!
1131 ! X =       387.509,      318.271,      3168.0,           0.0 !   !END!
1132 ! X =       388.887,      318.352,      3230.0,           0.0 !   !END!
1133 ! X =       390.265,      318.433,      3112.0,           0.0 !   !END!
1134 ! X =       391.643,      318.514,      2816.0,           0.0 !   !END!
1135 ! X =       393.021,      318.596,      3291.0,           0.0 !   !END!
1136 ! X =       394.399,      318.678,      3319.0,           0.0 !   !END!
1137 ! X =       395.778,      318.760,      3388.0,           0.0 !   !END!
1138 ! X =       397.156,      318.843,      3080.0,           0.0 !   !END!
1139 ! X =       398.534,      318.925,      3001.0,           0.0 !   !END!
1140 ! X =       399.912,      319.008,      3428.0,           0.0 !   !END!
1141 ! X =       401.290,      319.092,      3495.0,           0.0 !   !END!
1142 ! X =       402.668,      319.176,      3413.0,           0.0 !   !END!
1143 ! X =       370.869,      319.119,      3168.0,           0.0 !   !END!
1144 ! X =       372.247,      319.196,      3169.0,           0.0 !   !END!
1145 ! X =       373.625,      319.274,      2833.0,           0.0 !   !END!
1146 ! X =       375.003,      319.352,      2804.0,           0.0 !   !END!
1147 ! X =       376.381,      319.430,      3213.0,           0.0 !   !END!
1148 ! X =       377.759,      319.509,      3169.0,           0.0 !   !END!
1149 ! X =       379.137,      319.587,      2969.0,           0.0 !   !END!
1150 ! X =       380.514,      319.667,      2922.0,           0.0 !   !END!
1151 ! X =       381.892,      319.746,      3068.0,           0.0 !   !END!
1152 ! X =       383.270,      319.825,      3092.0,           0.0 !   !END!
1153 ! X =       384.648,      319.905,      2804.0,           0.0 !   !END!
1154 ! X =       386.026,      319.986,      3169.0,           0.0 !   !END!
1155 ! X =       387.404,      320.066,      3225.0,           0.0 !   !END!
1156 ! X =       388.781,      320.147,      3214.0,           0.0 !   !END!
1157 ! X =       390.159,      320.228,      3217.0,           0.0 !   !END!
1158 ! X =       391.537,      320.309,      3190.0,           0.0 !   !END!
1159 ! X =       392.915,      320.391,      3306.0,           0.0 !   !END!
1160 ! X =       394.292,      320.473,      3351.0,           0.0 !   !END!
1161 ! X =       395.670,      320.555,      3385.0,           0.0 !   !END!
1162 ! X =       397.048,      320.638,      3027.0,           0.0 !   !END!
1163 ! X =       398.426,      320.720,      3322.0,           0.0 !   !END!
1164 ! X =       399.803,      320.803,      3546.0,           0.0 !   !END!
1165 ! X =       401.181,      320.887,      3492.0,           0.0 !   !END!
1166 ! X =       402.558,      320.970,      3413.0,           0.0 !   !END!
1167 ! X =       403.936,      321.054,      3383.0,           0.0 !   !END!
1168 ! X =       372.146,      320.992,      3227.0,           0.0 !   !END!
1169 ! X =       373.524,      321.069,      3048.0,           0.0 !   !END!
1170 ! X =       374.901,      321.147,      2736.0,           0.0 !   !END!
1171 ! X =       376.279,      321.226,      2792.0,           0.0 !   !END!
1172 ! X =       377.656,      321.304,      2804.0,           0.0 !   !END!
1173 ! X =       379.034,      321.383,      3203.0,           0.0 !   !END!
1174 ! X =       380.411,      321.462,      3261.0,           0.0 !   !END!
1175 ! X =       381.789,      321.541,      3233.0,           0.0 !   !END!
1176 ! X =       383.166,      321.621,      3343.0,           0.0 !   !END!
1177 ! X =       384.544,      321.701,      2960.0,           0.0 !   !END!
1178 ! X =       385.921,      321.781,      2804.0,           0.0 !   !END!
1179 ! X =       387.299,      321.861,      2865.0,           0.0 !   !END!
1180 ! X =       388.676,      321.942,      3081.0,           0.0 !   !END!
1181 ! X =       390.053,      322.023,      3306.0,           0.0 !   !END!
1182 ! X =       391.431,      322.104,      3337.0,           0.0 !   !END!
1183 ! X =       392.808,      322.186,      3350.0,           0.0 !   !END!
1184 ! X =       394.186,      322.268,      3411.0,           0.0 !   !END!
1185 ! X =       395.563,      322.350,      3352.0,           0.0 !   !END!
1186 ! X =       396.940,      322.433,      3290.0,           0.0 !   !END!
1187 ! X =       398.318,      322.515,      3473.0,           0.0 !   !END!
1188 ! X =       399.695,      322.598,      3377.0,           0.0 !   !END!
1189 ! X =       401.072,      322.682,      3403.0,           0.0 !   !END!
1190 ! X =       402.449,      322.765,      3210.0,           0.0 !   !END!
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1191 ! X =       372.045,      322.787,      3268.0,           0.0 !   !END!
1192 ! X =       373.422,      322.865,      3286.0,           0.0 !   !END!
1193 ! X =       374.799,      322.943,      3158.0,           0.0 !   !END!
1194 ! X =       376.177,      323.021,      3190.0,           0.0 !   !END!
1195 ! X =       377.554,      323.099,      3230.0,           0.0 !   !END!
1196 ! X =       378.931,      323.178,      3188.0,           0.0 !   !END!
1197 ! X =       380.308,      323.257,      3187.0,           0.0 !   !END!
1198 ! X =       381.685,      323.336,      3327.0,           0.0 !   !END!
1199 ! X =       383.062,      323.416,      3353.0,           0.0 !   !END!
1200 ! X =       384.439,      323.496,      3053.0,           0.0 !   !END!
1201 ! X =       385.817,      323.576,      3238.0,           0.0 !   !END!
1202 ! X =       387.194,      323.656,      3251.0,           0.0 !   !END!
1203 ! X =       388.571,      323.737,      3215.0,           0.0 !   !END!
1204 ! X =       389.948,      323.818,      2926.0,           0.0 !   !END!
1205 ! X =       391.325,      323.899,      3352.0,           0.0 !   !END!
1206 ! X =       392.702,      323.981,      3384.0,           0.0 !   !END!
1207 ! X =       394.079,      324.063,      3450.0,           0.0 !   !END!
1208 ! X =       395.456,      324.145,      3418.0,           0.0 !   !END!
1209 ! X =       396.833,      324.228,      3496.0,           0.0 !   !END!
1210 ! X =       398.209,      324.310,      3413.0,           0.0 !   !END!
1211 ! X =       370.567,      324.505,      3295.0,           0.0 !   !END!
1212 ! X =       371.944,      324.583,      3261.0,           0.0 !   !END!
1213 ! X =       373.321,      324.660,      3229.0,           0.0 !   !END!
1214 ! X =       374.698,      324.738,      3291.0,           0.0 !   !END!
1215 ! X =       376.075,      324.816,      3274.0,           0.0 !   !END!
1216 ! X =       377.451,      324.895,      3261.0,           0.0 !   !END!
1217 ! X =       378.828,      324.973,      3291.0,           0.0 !   !END!
1218 ! X =       380.205,      325.052,      3362.0,           0.0 !   !END!
1219 ! X =       381.582,      325.131,      3291.0,           0.0 !   !END!
1220 ! X =       382.958,      325.211,      3284.0,           0.0 !   !END!
1221 ! X =       384.335,      325.291,      3231.0,           0.0 !   !END!
1222 ! X =       385.712,      325.371,      3352.0,           0.0 !   !END!
1223 ! X =       387.089,      325.451,      3353.0,           0.0 !   !END!
1224 ! X =       388.465,      325.532,      3250.0,           0.0 !   !END!
1225 ! X =       389.842,      325.613,      3247.0,           0.0 !   !END!
1226 ! X =       391.218,      325.694,      3126.0,           0.0 !   !END!
1227 ! X =       392.595,      325.776,      3169.0,           0.0 !   !END!
1228 ! X =       393.972,      325.858,      3304.0,           0.0 !   !END!
1229 ! X =       395.348,      325.940,      3428.0,           0.0 !   !END!
1230 ! X =       396.725,      326.023,      3596.0,           0.0 !   !END!
1231 ! X =       398.101,      326.105,      3460.0,           0.0 !   !END!
1232 ! X =       399.478,      326.188,      3453.0,           0.0 !   !END!
1233 ! X =       400.854,      326.272,      3535.0,           0.0 !   !END!
1234 ! X =       402.231,      326.355,      3277.0,           0.0 !   !END!
1235 ! X =       403.607,      326.439,      3056.0,           0.0 !   !END!
1236 ! X =       370.467,      326.301,      3273.0,           0.0 !   !END!
1237 ! X =       371.843,      326.378,      3029.0,           0.0 !   !END!
1238 ! X =       373.220,      326.455,      3177.0,           0.0 !   !END!
1239 ! X =       374.596,      326.533,      3192.0,           0.0 !   !END!
1240 ! X =       375.972,      326.611,      3229.0,           0.0 !   !END!
1241 ! X =       377.349,      326.690,      3291.0,           0.0 !   !END!
1242 ! X =       378.725,      326.768,      3139.0,           0.0 !   !END!
1243 ! X =       380.102,      326.847,      2885.0,           0.0 !   !END!
1244 ! X =       381.478,      326.927,      2864.0,           0.0 !   !END!
1245 ! X =       382.854,      327.006,      3194.0,           0.0 !   !END!
1246 ! X =       384.231,      327.086,      3230.0,           0.0 !   !END!
1247 ! X =       385.607,      327.166,      3323.0,           0.0 !   !END!
1248 ! X =       386.983,      327.247,      3359.0,           0.0 !   !END!
1249 ! X =       388.360,      327.327,      3336.0,           0.0 !   !END!
1250 ! X =       389.736,      327.408,      3339.0,           0.0 !   !END!
1251 ! X =       391.112,      327.489,      3470.0,           0.0 !   !END!
1252 ! X =       392.489,      327.571,      3384.0,           0.0 !   !END!
1253 ! X =       393.865,      327.653,      3462.0,           0.0 !   !END!
1254 ! X =       395.241,      327.735,      3426.0,           0.0 !   !END!
1255 ! X =       396.617,      327.817,      3596.0,           0.0 !   !END!
1256 ! X =       397.993,      327.900,      3291.0,           0.0 !   !END!
1257 ! X =       399.370,      327.983,      3294.0,           0.0 !   !END!
1258 ! X =       400.746,      328.066,      3099.0,           0.0 !   !END!
1259 ! X =       402.122,      328.150,      2976.0,           0.0 !   !END!
1260 ! X =       403.498,      328.234,      2864.0,           0.0 !   !END!
1261 ! X =       404.874,      328.318,      2865.0,           0.0 !   !END!
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1262 ! X =       406.250,      328.402,      2807.0,           0.0 !   !END!
1263 ! X =       368.990,      328.019,      3169.0,           0.0 !   !END!
1264 ! X =       370.366,      328.096,      3121.0,           0.0 !   !END!
1265 ! X =       371.742,      328.173,      3108.0,           0.0 !   !END!
1266 ! X =       373.118,      328.251,      2843.0,           0.0 !   !END!
1267 ! X =       374.494,      328.328,      3086.0,           0.0 !   !END!
1268 ! X =       375.870,      328.406,      3125.0,           0.0 !   !END!
1269 ! X =       377.246,      328.485,      2770.0,           0.0 !   !END!
1270 ! X =       378.623,      328.563,      2717.0,           0.0 !   !END!
1271 ! X =       379.999,      328.642,      2962.0,           0.0 !   !END!
1272 ! X =       381.375,      328.722,      3268.0,           0.0 !   !END!
1273 ! X =       382.751,      328.801,      3409.0,           0.0 !   !END!
1274 ! X =       384.127,      328.881,      3361.0,           0.0 !   !END!
1275 ! X =       385.502,      328.961,      3355.0,           0.0 !   !END!
1276 ! X =       386.878,      329.041,      3314.0,           0.0 !   !END!
1277 ! X =       388.254,      329.122,      3326.0,           0.0 !   !END!
1278 ! X =       389.630,      329.203,      3371.0,           0.0 !   !END!
1279 ! X =       391.006,      329.284,      3348.0,           0.0 !   !END!
1280 ! X =       392.382,      329.366,      3408.0,           0.0 !   !END!
1281 ! X =       393.758,      329.448,      3208.0,           0.0 !   !END!
1282 ! X =       395.134,      329.530,      3360.0,           0.0 !   !END!
1283 ! X =       396.510,      329.612,      3532.0,           0.0 !   !END!
1284 ! X =       397.885,      329.695,      3372.0,           0.0 !   !END!
1285 ! X =       399.261,      329.778,      3195.0,           0.0 !   !END!
1286 ! X =       400.637,      329.861,      3169.0,           0.0 !   !END!
1287 ! X =       402.013,      329.945,      3159.0,           0.0 !   !END!
1288 ! X =       403.388,      330.028,      3156.0,           0.0 !   !END!
1289 ! X =       404.764,      330.113,      3048.0,           0.0 !   !END!
1290 ! X =       367.514,      329.737,      3010.0,           0.0 !   !END!
1291 ! X =       377.144,      330.280,      2596.0,           0.0 !   !END!
1292 ! X =       378.520,      330.359,      3002.0,           0.0 !   !END!
1293 ! X =       379.895,      330.437,      3397.0,           0.0 !   !END!
1294 ! X =       381.271,      330.517,      3359.0,           0.0 !   !END!
1295 ! X =       382.647,      330.596,      3118.0,           0.0 !   !END!
1296 ! X =       384.022,      330.676,      3291.0,           0.0 !   !END!
1297 ! X =       385.398,      330.756,      3400.0,           0.0 !   !END!
1298 ! X =       386.773,      330.836,      2956.0,           0.0 !   !END!
1299 ! X =       388.149,      330.917,      3035.0,           0.0 !   !END!
1300 ! X =       389.524,      330.998,      3360.0,           0.0 !   !END!
1301 ! X =       390.900,      331.079,      3411.0,           0.0 !   !END!
1302 ! X =       392.275,      331.161,      3004.0,           0.0 !   !END!
1303 ! X =       393.651,      331.243,      3312.0,           0.0 !   !END!
1304 ! X =       395.026,      331.325,      3413.0,           0.0 !   !END!
1305 ! X =       396.402,      331.407,      3534.0,           0.0 !   !END!
1306 ! X =       397.777,      331.490,      3501.0,           0.0 !   !END!
1307 ! X =       399.153,      331.573,      3545.0,           0.0 !   !END!
1308 ! X =       400.528,      331.656,      3657.0,           0.0 !   !END!
1309 ! X =       401.903,      331.739,      3284.0,           0.0 !   !END!
1310 ! X =       403.279,      331.823,      3137.0,           0.0 !   !END!
1311 ! X =       404.654,      331.907,      3120.0,           0.0 !   !END!
1312 ! X =       377.042,      332.075,      2643.0,           0.0 !   !END!
1313 ! X =       378.417,      332.154,      2875.0,           0.0 !   !END!
1314 ! X =       379.792,      332.232,      2920.0,           0.0 !   !END!
1315 ! X =       381.167,      332.312,      2884.0,           0.0 !   !END!
1316 ! X =       382.543,      332.391,      3030.0,           0.0 !   !END!
1317 ! X =       383.918,      332.471,      3418.0,           0.0 !   !END!
1318 ! X =       385.293,      332.551,      3417.0,           0.0 !   !END!
1319 ! X =       386.668,      332.631,      2894.0,           0.0 !   !END!
1320 ! X =       388.043,      332.712,      2987.0,           0.0 !   !END!
1321 ! X =       389.419,      332.793,      3323.0,           0.0 !   !END!
1322 ! X =       390.794,      332.874,      3011.0,           0.0 !   !END!
1323 ! X =       392.169,      332.956,      2980.0,           0.0 !   !END!
1324 ! X =       393.544,      333.037,      3196.0,           0.0 !   !END!
1325 ! X =       394.919,      333.119,      3162.0,           0.0 !   !END!
1326 ! X =       396.294,      333.202,      3430.0,           0.0 !   !END!
1327 ! X =       397.669,      333.284,      3474.0,           0.0 !   !END!
1328 ! X =       399.044,      333.367,      3483.0,           0.0 !   !END!
1329 ! X =       400.419,      333.450,      3484.0,           0.0 !   !END!
1330 ! X =       401.794,      333.534,      3238.0,           0.0 !   !END!
1331 ! X =       403.169,      333.618,      3242.0,           0.0 !   !END!
1332 ! X =       404.544,      333.702,      3306.0,           0.0 !   !END!
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1333 ! X =       376.939,      333.870,      2597.0,           0.0 !   !END!
1334 ! X =       378.314,      333.948,      2714.0,           0.0 !   !END!
1335 ! X =       379.689,      334.027,      2857.0,           0.0 !   !END!
1336 ! X =       381.064,      334.107,      2987.0,           0.0 !   !END!
1337 ! X =       382.439,      334.186,      3161.0,           0.0 !   !END!
1338 ! X =       383.814,      334.266,      3420.0,           0.0 !   !END!
1339 ! X =       385.188,      334.346,      3217.0,           0.0 !   !END!
1340 ! X =       386.563,      334.426,      3047.0,           0.0 !   !END!
1341 ! X =       387.938,      334.507,      2804.0,           0.0 !   !END!
1342 ! X =       389.313,      334.588,      3249.0,           0.0 !   !END!
1343 ! X =       393.437,      334.832,      3071.0,           0.0 !   !END!
1344 ! X =       394.812,      334.914,      3399.0,           0.0 !   !END!
1345 ! X =       396.187,      334.996,      3509.0,           0.0 !   !END!
1346 ! X =       397.561,      335.079,      3437.0,           0.0 !   !END!
1347 ! X =       398.936,      335.162,      3292.0,           0.0 !   !END!
1348 ! X =       400.311,      335.245,      3439.0,           0.0 !   !END!
1349 ! X =       401.685,      335.329,      3474.0,           0.0 !   !END!
1350 ! X =       403.060,      335.412,      3565.0,           0.0 !   !END!
1351 ! X =       404.434,      335.496,      3594.0,           0.0 !   !END!
1352 ! X =       405.809,      335.581,      3622.0,           0.0 !   !END!
1353 ! X =       379.586,      335.822,      3012.0,           0.0 !   !END!
1354 ! X =       380.960,      335.901,      3190.0,           0.0 !   !END!
1355 ! X =       382.335,      335.981,      3353.0,           0.0 !   !END!
1356 ! X =       383.709,      336.061,      3139.0,           0.0 !   !END!
1357 ! X =       385.084,      336.141,      3048.0,           0.0 !   !END!
1358 ! X =       386.458,      336.221,      3028.0,           0.0 !   !END!
1359 ! X =       387.833,      336.301,      2696.0,           0.0 !   !END!
1360 ! X =       389.207,      336.382,      2743.0,           0.0 !   !END!
1361 ! X =       390.581,      336.463,      2912.0,           0.0 !   !END!
1362 ! X =       391.956,      336.545,      3046.0,           0.0 !   !END!
1363 ! X =       393.330,      336.627,      3170.0,           0.0 !   !END!
1364 ! X =       394.705,      336.709,      3342.0,           0.0 !   !END!
1365 ! X =       396.079,      336.791,      3510.0,           0.0 !   !END!
1366 ! X =       397.453,      336.874,      3494.0,           0.0 !   !END!
1367 ! X =       398.827,      336.956,      3231.0,           0.0 !   !END!
1368 ! X =       401.576,      337.123,      3211.0,           0.0 !   !END!
1369 ! X =       402.950,      337.207,      3320.0,           0.0 !   !END!
1370 ! X =       404.324,      337.291,      3454.0,           0.0 !   !END!
1371 ! X =       382.231,      337.776,      3170.0,           0.0 !   !END!
1372 ! X =       383.605,      337.855,      2956.0,           0.0 !   !END!
1373 ! X =       384.979,      337.935,      2851.0,           0.0 !   !END!
1374 ! X =       389.101,      338.177,      2975.0,           0.0 !   !END!
1375 ! X =       390.475,      338.258,      3127.0,           0.0 !   !END!
1376 ! X =       391.849,      338.340,      3182.0,           0.0 !   !END!
1377 ! X =       393.223,      338.421,      3163.0,           0.0 !   !END!
1378 ! X =       394.597,      338.503,      3347.0,           0.0 !   !END!
1379 ! X =       395.971,      338.586,      3536.0,           0.0 !   !END!
1380 ! X =       397.345,      338.668,      3351.0,           0.0 !   !END!
1381 ! X =       398.719,      338.751,      3475.0,           0.0 !   !END!
1382 ! X =       400.093,      338.834,      3475.0,           0.0 !   !END!
1383 ! X =       386.248,      339.810,      2854.0,           0.0 !   !END!
1384 ! X =       387.622,      339.891,      2940.0,           0.0 !   !END!
1385 ! X =       388.995,      339.972,      3083.0,           0.0 !   !END!
1386 ! X =       390.369,      340.053,      3217.0,           0.0 !   !END!
1387 ! X =       391.743,      340.134,      3567.0,           0.0 !   !END!
1388 ! X =       393.116,      340.216,      3530.0,           0.0 !   !END!
1389 ! X =       394.490,      340.298,      3576.0,           0.0 !   !END!
1390 ! X =       395.864,      340.380,      3261.0,           0.0 !   !END!
1391 ! X =       397.237,      340.463,      3239.0,           0.0 !   !END!
1392 ! X =       398.611,      340.545,      3477.0,           0.0 !   !END!
1393 ! X =       399.984,      340.629,      3596.0,           0.0 !   !END!
1394 ! X =       401.358,      340.712,      3245.0,           0.0 !   !END!
1395 ! X =       402.731,      340.796,      3281.0,           0.0 !   !END!
1396 ! X =       386.143,      341.605,      2900.0,           0.0 !   !END!
1397 ! X =       387.516,      341.685,      3057.0,           0.0 !   !END!
1398 ! X =       388.890,      341.766,      3161.0,           0.0 !   !END!
1399 ! X =       390.263,      341.847,      3292.0,           0.0 !   !END!
1400 ! X =       391.636,      341.929,      3139.0,           0.0 !   !END!
1401 ! X =       393.009,      342.010,      3233.0,           0.0 !   !END!
1402 ! X =       394.383,      342.092,      3250.0,           0.0 !   !END!
1403 ! X =       395.756,      342.175,      3170.0,           0.0 !   !END!
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1404 ! X =       397.129,      342.257,      3227.0,           0.0 !   !END!
1405 ! X =       398.502,      342.340,      3486.0,           0.0 !   !END!
1406 ! X =       399.875,      342.423,      3414.0,           0.0 !   !END!
1407 ! X =       401.249,      342.506,      3351.0,           0.0 !   !END!
1408 ! X =       402.622,      342.590,      3415.0,           0.0 !   !END!
1409 ! X =       387.411,      343.480,      3052.0,           0.0 !   !END!
1410 ! X =       388.784,      343.561,      3167.0,           0.0 !   !END!
1411 ! X =       390.157,      343.642,      3236.0,           0.0 !   !END!
1412 ! X =       391.530,      343.723,      3118.0,           0.0 !   !END!
1413 ! X =       392.903,      343.805,      3048.0,           0.0 !   !END!
1414 ! X =       394.275,      343.887,      3170.0,           0.0 !   !END!
1415 ! X =       395.648,      343.969,      2983.0,           0.0 !   !END!
1416 ! X =       397.021,      344.051,      3282.0,           0.0 !   !END!
1417 ! X =       398.394,      344.134,      3597.0,           0.0 !   !END!
1418 ! X =       399.767,      344.217,      3591.0,           0.0 !   !END!
1419 ! X =       401.139,      344.301,      3505.0,           0.0 !   !END!
1420 ! X =       402.512,      344.384,      3506.0,           0.0 !   !END!
1421 ! X =       388.678,      345.355,      3130.0,           0.0 !   !END!
1422 ! X =       390.051,      345.436,      3044.0,           0.0 !   !END!
1423 ! X =       391.423,      345.518,      3014.0,           0.0 !   !END!
1424 ! X =       392.796,      345.599,      2943.0,           0.0 !   !END!
1425 ! X =       394.168,      345.681,      2959.0,           0.0 !   !END!
1426 ! X =       395.541,      345.763,      3210.0,           0.0 !   !END!
1427 ! X =       396.913,      345.846,      3256.0,           0.0 !   !END!
1428 ! X =       398.286,      345.929,      3397.0,           0.0 !   !END!
1429 ! X =       399.658,      346.012,      3378.0,           0.0 !   !END!
1430 ! X =       401.030,      346.095,      3289.0,           0.0 !   !END!
1431 ! X =       402.403,      346.179,      3414.0,           0.0 !   !END!
1432 ! X =       392.689,      347.394,      2878.0,           0.0 !   !END!
1433 ! X =       394.061,      347.475,      3081.0,           0.0 !   !END!
1434 ! X =       395.433,      347.558,      3303.0,           0.0 !   !END!
1435 ! X =       398.177,      347.723,      3323.0,           0.0 !   !END!
1436 ! X =       399.549,      347.806,      3163.0,           0.0 !   !END!
1437 ! X =       400.921,      347.889,      3327.0,           0.0 !   !END!
1438 ! X =       398.069,      349.517,      3142.0,           0.0 !   !END!
1439 ! X =       399.440,      349.600,      3100.0,           0.0 !   !END!
1440 ! X =       400.812,      349.683,      3170.0,           0.0 !   !END!
1441 ! X =       442.406,      100.516,      2809.0,           0.0 !   !END!
1442 ! X =       443.830,      100.608,      3169.0,           0.0 !   !END!
1443 ! X =       440.866,      102.226,      2804.0,           0.0 !   !END!
1444 ! X =       442.289,      102.318,      2854.0,           0.0 !   !END!
1445 ! X =       443.713,      102.410,      3369.0,           0.0 !   !END!
1446 ! X =       445.136,      102.502,      3402.0,           0.0 !   !END!
1447 ! X =       446.559,      102.595,      3344.0,           0.0 !   !END!
1448 ! X =       440.750,      104.027,      2997.0,           0.0 !   !END!
1449 ! X =       442.173,      104.119,      3263.0,           0.0 !   !END!
1450 ! X =       443.596,      104.212,      3413.0,           0.0 !   !END!
1451 ! X =       445.018,      104.304,      3413.0,           0.0 !   !END!
1452 ! X =       446.441,      104.397,      3383.0,           0.0 !   !END!
1453 ! X =       447.864,      104.490,      3281.0,           0.0 !   !END!
1454 ! X =       439.212,      105.738,      3423.0,           0.0 !   !END!
1455 ! X =       440.634,      105.829,      3353.0,           0.0 !   !END!
1456 ! X =       442.056,      105.921,      3048.0,           0.0 !   !END!
1457 ! X =       443.479,      106.013,      3350.0,           0.0 !   !END!
1458 ! X =       447.746,      106.291,      3420.0,           0.0 !   !END!
1459 ! X =       449.168,      106.385,      3657.0,           0.0 !   !END!
1460 ! X =       437.674,      107.448,      3535.0,           0.0 !   !END!
1461 ! X =       439.096,      107.539,      3470.0,           0.0 !   !END!
1462 ! X =       440.518,      107.631,      3352.0,           0.0 !   !END!
1463 ! X =       441.940,      107.723,      3333.0,           0.0 !   !END!
1464 ! X =       443.362,      107.815,      3435.0,           0.0 !   !END!
1465 ! X =       444.784,      107.907,      3611.0,           0.0 !   !END!
1466 ! X =       446.206,      108.000,      3668.0,           0.0 !   !END!
1467 ! X =       447.628,      108.093,      3530.0,           0.0 !   !END!
1468 ! X =       449.050,      108.186,      3662.0,           0.0 !   !END!
1469 ! X =       450.471,      108.280,      3718.0,           0.0 !   !END!
1470 ! X =       436.137,      109.159,      3561.0,           0.0 !   !END!
1471 ! X =       437.558,      109.250,      3596.0,           0.0 !   !END!
1472 ! X =       438.980,      109.341,      3543.0,           0.0 !   !END!
1473 ! X =       440.402,      109.432,      3477.0,           0.0 !   !END!
1474 ! X =       441.823,      109.524,      3466.0,           0.0 !   !END!
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1475 ! X =       443.245,      109.616,      3724.0,           0.0 !   !END!
1476 ! X =       444.666,      109.709,      3598.0,           0.0 !   !END!
1477 ! X =       446.088,      109.801,      3474.0,           0.0 !   !END!
1478 ! X =       447.510,      109.894,      3569.0,           0.0 !   !END!
1479 ! X =       448.931,      109.988,      3657.0,           0.0 !   !END!
1480 ! X =       450.353,      110.081,      3483.0,           0.0 !   !END!
1481 ! X =       437.443,      111.051,      3744.0,           0.0 !   !END!
1482 ! X =       438.864,      111.142,      3902.0,           0.0 !   !END!
1483 ! X =       440.285,      111.234,      3786.0,           0.0 !   !END!
1484 ! X =       441.707,      111.326,      3840.0,           0.0 !   !END!
1485 ! X =       443.128,      111.418,      3596.0,           0.0 !   !END!
1486 ! X =       444.549,      111.510,      3535.0,           0.0 !   !END!
1487 ! X =       445.970,      111.603,      3461.0,           0.0 !   !END!
1488 ! X =       447.392,      111.696,      3352.0,           0.0 !   !END!
1489 ! X =       448.813,      111.789,      3301.0,           0.0 !   !END!
1490 ! X =       450.234,      111.883,      3313.0,           0.0 !   !END!
1491 ! X =       451.655,      111.976,      3559.0,           0.0 !   !END!
1492 ! X =       437.327,      112.853,      3870.0,           0.0 !   !END!
1493 ! X =       438.748,      112.944,      3779.0,           0.0 !   !END!
1494 ! X =       440.169,      113.035,      3583.0,           0.0 !   !END!
1495 ! X =       441.590,      113.127,      3444.0,           0.0 !   !END!
1496 ! X =       443.011,      113.219,      3535.0,           0.0 !   !END!
1497 ! X =       444.432,      113.311,      3657.0,           0.0 !   !END!
1498 ! X =       445.853,      113.404,      3474.0,           0.0 !   !END!
1499 ! X =       447.274,      113.497,      3445.0,           0.0 !   !END!
1500 ! X =       448.694,      113.590,      3303.0,           0.0 !   !END!
1501 ! X =       450.115,      113.684,      3136.0,           0.0 !   !END!
1502 ! X =       411.639,      113.064,      3367.0,           0.0 !   !END!
1503 ! X =       413.060,      113.150,      3569.0,           0.0 !   !END!
1504 ! X =       414.481,      113.236,      3730.0,           0.0 !   !END!
1505 ! X =       435.792,      114.563,      3962.0,           0.0 !   !END!
1506 ! X =       437.212,      114.654,      3810.0,           0.0 !   !END!
1507 ! X =       438.633,      114.745,      3599.0,           0.0 !   !END!
1508 ! X =       440.053,      114.837,      3642.0,           0.0 !   !END!
1509 ! X =       441.474,      114.928,      3657.0,           0.0 !   !END!
1510 ! X =       442.894,      115.020,      3465.0,           0.0 !   !END!
1511 ! X =       444.315,      115.113,      3458.0,           0.0 !   !END!
1512 ! X =       445.735,      115.205,      3392.0,           0.0 !   !END!
1513 ! X =       447.156,      115.298,      3574.0,           0.0 !   !END!
1514 ! X =       448.576,      115.392,      3557.0,           0.0 !   !END!
1515 ! X =       411.530,      114.866,      3294.0,           0.0 !   !END!
1516 ! X =       412.951,      114.951,      3540.0,           0.0 !   !END!
1517 ! X =       414.371,      115.038,      3652.0,           0.0 !   !END!
1518 ! X =       415.792,      115.124,      3805.0,           0.0 !   !END!
1519 ! X =       417.212,      115.211,      3642.0,           0.0 !   !END!
1520 ! X =       418.633,      115.298,      3944.0,           0.0 !   !END!
1521 ! X =       420.053,      115.385,      3855.0,           0.0 !   !END!
1522 ! X =       421.474,      115.473,      3450.0,           0.0 !   !END!
1523 ! X =       422.894,      115.560,      3495.0,           0.0 !   !END!
1524 ! X =       424.314,      115.649,      3677.0,           0.0 !   !END!
1525 ! X =       425.735,      115.737,      3900.0,           0.0 !   !END!
1526 ! X =       429.996,      116.004,      3962.0,           0.0 !   !END!
1527 ! X =       434.256,      116.274,      3712.0,           0.0 !   !END!
1528 ! X =       435.676,      116.365,      3815.0,           0.0 !   !END!
1529 ! X =       437.097,      116.455,      3348.0,           0.0 !   !END!
1530 ! X =       438.517,      116.547,      3962.0,           0.0 !   !END!
1531 ! X =       439.937,      116.638,      3654.0,           0.0 !   !END!
1532 ! X =       445.617,      117.007,      3191.0,           0.0 !   !END!
1533 ! X =       447.037,      117.100,      3309.0,           0.0 !   !END!
1534 ! X =       448.458,      117.193,      3600.0,           0.0 !   !END!
1535 ! X =       411.422,      116.667,      3222.0,           0.0 !   !END!
1536 ! X =       412.842,      116.753,      3328.0,           0.0 !   !END!
1537 ! X =       414.262,      116.839,      3548.0,           0.0 !   !END!
1538 ! X =       415.682,      116.926,      3811.0,           0.0 !   !END!
1539 ! X =       417.102,      117.012,      3474.0,           0.0 !   !END!
1540 ! X =       418.522,      117.099,      3975.0,           0.0 !   !END!
1541 ! X =       419.942,      117.186,      3470.0,           0.0 !   !END!
1542 ! X =       421.362,      117.274,      3363.0,           0.0 !   !END!
1543 ! X =       422.782,      117.362,      3480.0,           0.0 !   !END!
1544 ! X =       424.202,      117.450,      3783.0,           0.0 !   !END!
1545 ! X =       425.622,      117.538,      3799.0,           0.0 !   !END!
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1546 ! X =       427.042,      117.627,      3551.0,           0.0 !   !END!
1547 ! X =       428.462,      117.716,      3454.0,           0.0 !   !END!
1548 ! X =       429.882,      117.806,      3535.0,           0.0 !   !END!
1549 ! X =       431.302,      117.895,      3945.0,           0.0 !   !END!
1550 ! X =       432.722,      117.985,      3539.0,           0.0 !   !END!
1551 ! X =       434.142,      118.075,      3581.0,           0.0 !   !END!
1552 ! X =       435.561,      118.166,      3413.0,           0.0 !   !END!
1553 ! X =       436.981,      118.257,      3291.0,           0.0 !   !END!
1554 ! X =       438.401,      118.348,      3222.0,           0.0 !   !END!
1555 ! X =       439.821,      118.439,      3657.0,           0.0 !   !END!
1556 ! X =       441.241,      118.531,      3585.0,           0.0 !   !END!
1557 ! X =       411.313,      118.469,      3200.0,           0.0 !   !END!
1558 ! X =       412.733,      118.555,      3268.0,           0.0 !   !END!
1559 ! X =       414.153,      118.641,      3456.0,           0.0 !   !END!
1560 ! X =       415.572,      118.727,      3489.0,           0.0 !   !END!
1561 ! X =       416.992,      118.814,      3452.0,           0.0 !   !END!
1562 ! X =       418.412,      118.901,      3625.0,           0.0 !   !END!
1563 ! X =       419.831,      118.988,      3525.0,           0.0 !   !END!
1564 ! X =       421.251,      119.076,      3168.0,           0.0 !   !END!
1565 ! X =       422.671,      119.163,      3484.0,           0.0 !   !END!
1566 ! X =       424.090,      119.251,      3868.0,           0.0 !   !END!
1567 ! X =       425.510,      119.340,      3657.0,           0.0 !   !END!
1568 ! X =       426.929,      119.429,      3596.0,           0.0 !   !END!
1569 ! X =       428.349,      119.518,      3347.0,           0.0 !   !END!
1570 ! X =       429.768,      119.607,      3811.0,           0.0 !   !END!
1571 ! X =       431.188,      119.697,      4104.0,           0.0 !   !END!
1572 ! X =       432.608,      119.786,      4221.0,           0.0 !   !END!
1573 ! X =       434.027,      119.877,      4023.0,           0.0 !   !END!
1574 ! X =       435.446,      119.967,      3884.0,           0.0 !   !END!
1575 ! X =       436.866,      120.058,      3752.0,           0.0 !   !END!
1576 ! X =       438.285,      120.149,      3169.0,           0.0 !   !END!
1577 ! X =       439.705,      120.240,      3474.0,           0.0 !   !END!
1578 ! X =       441.124,      120.332,      3352.0,           0.0 !   !END!
1579 ! X =       411.204,      120.271,      3265.0,           0.0 !   !END!
1580 ! X =       412.624,      120.356,      3289.0,           0.0 !   !END!
1581 ! X =       414.043,      120.442,      3214.0,           0.0 !   !END!
1582 ! X =       415.463,      120.529,      3181.0,           0.0 !   !END!
1583 ! X =       416.882,      120.615,      3395.0,           0.0 !   !END!
1584 ! X =       418.301,      120.702,      3432.0,           0.0 !   !END!
1585 ! X =       419.720,      120.789,      3342.0,           0.0 !   !END!
1586 ! X =       421.140,      120.877,      3067.0,           0.0 !   !END!
1587 ! X =       422.559,      120.965,      3407.0,           0.0 !   !END!
1588 ! X =       423.978,      121.053,      3620.0,           0.0 !   !END!
1589 ! X =       425.397,      121.141,      3450.0,           0.0 !   !END!
1590 ! X =       426.817,      121.230,      3237.0,           0.0 !   !END!
1591 ! X =       428.236,      121.319,      3653.0,           0.0 !   !END!
1592 ! X =       429.655,      121.408,      3834.0,           0.0 !   !END!
1593 ! X =       431.074,      121.498,      3910.0,           0.0 !   !END!
1594 ! X =       432.493,      121.588,      3833.0,           0.0 !   !END!
1595 ! X =       433.912,      121.678,      3477.0,           0.0 !   !END!
1596 ! X =       435.331,      121.768,      3519.0,           0.0 !   !END!
1597 ! X =       436.751,      121.859,      3362.0,           0.0 !   !END!
1598 ! X =       438.170,      121.950,      3345.0,           0.0 !   !END!
1599 ! X =       439.589,      122.041,      3188.0,           0.0 !   !END!
1600 ! X =       441.008,      122.133,      3551.0,           0.0 !   !END!
1601 ! X =       413.934,      122.244,      3166.0,           0.0 !   !END!
1602 ! X =       415.353,      122.330,      3037.0,           0.0 !   !END!
1603 ! X =       416.772,      122.417,      3068.0,           0.0 !   !END!
1604 ! X =       418.191,      122.504,      3174.0,           0.0 !   !END!
1605 ! X =       419.610,      122.591,      2917.0,           0.0 !   !END!
1606 ! X =       421.028,      122.678,      3179.0,           0.0 !   !END!
1607 ! X =       422.447,      122.766,      3391.0,           0.0 !   !END!
1608 ! X =       423.866,      122.854,      3414.0,           0.0 !   !END!
1609 ! X =       428.123,      123.120,      3535.0,           0.0 !   !END!
1610 ! X =       429.541,      123.209,      4032.0,           0.0 !   !END!
1611 ! X =       430.960,      123.299,      3975.0,           0.0 !   !END!
1612 ! X =       432.379,      123.389,      3684.0,           0.0 !   !END!
1613 ! X =       433.798,      123.479,      3670.0,           0.0 !   !END!
1614 ! X =       436.635,      123.660,      3402.0,           0.0 !   !END!
1615 ! X =       439.472,      123.843,      3419.0,           0.0 !   !END!
1616 ! X =       413.824,      124.045,      2902.0,           0.0 !   !END!
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1617 ! X =       415.243,      124.131,      2865.0,           0.0 !   !END!
1618 ! X =       416.662,      124.218,      2864.0,           0.0 !   !END!
1619 ! X =       418.080,      124.305,      3040.0,           0.0 !   !END!
1620 ! X =       420.917,      124.480,      3203.0,           0.0 !   !END!
1621 ! X =       422.336,      124.567,      3322.0,           0.0 !   !END!
1622 ! X =       426.591,      124.832,      3599.0,           0.0 !   !END!
1623 ! X =       428.010,      124.921,      3850.0,           0.0 !   !END!
1624 ! X =       429.428,      125.011,      3909.0,           0.0 !   !END!
1625 ! X =       430.846,      125.100,      3683.0,           0.0 !   !END!
1626 ! X =       439.356,      125.643,      3142.0,           0.0 !   !END!
1627 ! X =       440.775,      125.735,      3236.0,           0.0 !   !END!
1628 ! X =       426.101,      222.354,      3403.0,           0.0 !   !END!
1629 ! X =       420.396,      223.800,      3048.0,           0.0 !   !END!
1630 ! X =       421.794,      223.887,      3484.0,           0.0 !   !END!
1631 ! X =       423.191,      223.975,      3671.0,           0.0 !   !END!
1632 ! X =       424.589,      224.063,      3779.0,           0.0 !   !END!
1633 ! X =       425.987,      224.152,      3413.0,           0.0 !   !END!
1634 ! X =       427.385,      224.241,      3914.0,           0.0 !   !END!
1635 ! X =       428.782,      224.330,      3413.0,           0.0 !   !END!
1636 ! X =       431.578,      224.509,      3510.0,           0.0 !   !END!
1637 ! X =       421.681,      225.685,      3146.0,           0.0 !   !END!
1638 ! X =       423.078,      225.773,      3657.0,           0.0 !   !END!
1639 ! X =       424.476,      225.861,      4023.0,           0.0 !   !END!
1640 ! X =       425.873,      225.950,      3779.0,           0.0 !   !END!
1641 ! X =       427.270,      226.038,      3840.0,           0.0 !   !END!
1642 ! X =       428.668,      226.127,      3718.0,           0.0 !   !END!
1643 ! X =       430.065,      226.217,      3462.0,           0.0 !   !END!
1644 ! X =       431.462,      226.307,      3928.0,           0.0 !   !END!
1645 ! X =       418.774,      227.308,      3322.0,           0.0 !   !END!
1646 ! X =       420.171,      227.395,      3759.0,           0.0 !   !END!
1647 ! X =       421.568,      227.483,      3465.0,           0.0 !   !END!
1648 ! X =       422.965,      227.570,      3406.0,           0.0 !   !END!
1649 ! X =       424.362,      227.659,      3596.0,           0.0 !   !END!
1650 ! X =       425.759,      227.747,      3819.0,           0.0 !   !END!
1651 ! X =       427.156,      227.836,      3779.0,           0.0 !   !END!
1652 ! X =       428.553,      227.925,      3703.0,           0.0 !   !END!
1653 ! X =       429.950,      228.014,      3962.0,           0.0 !   !END!
1654 ! X =       431.347,      228.104,      3719.0,           0.0 !   !END!
1655 ! X =       415.868,      228.932,      3622.0,           0.0 !   !END!
1656 ! X =       417.265,      229.018,      3169.0,           0.0 !   !END!
1657 ! X =       418.661,      229.105,      3501.0,           0.0 !   !END!
1658 ! X =       420.058,      229.193,      3664.0,           0.0 !   !END!
1659 ! X =       421.455,      229.280,      3726.0,           0.0 !   !END!
1660 ! X =       422.852,      229.368,      3567.0,           0.0 !   !END!
1661 ! X =       424.248,      229.456,      3580.0,           0.0 !   !END!
1662 ! X =       425.645,      229.545,      3729.0,           0.0 !   !END!
1663 ! X =       427.041,      229.633,      3551.0,           0.0 !   !END!
1664 ! X =       428.438,      229.722,      3857.0,           0.0 !   !END!
1665 ! X =       429.835,      229.812,      3977.0,           0.0 !   !END!
1666 ! X =       431.231,      229.901,      3584.0,           0.0 !   !END!
1667 ! X =       414.360,      230.643,      3282.0,           0.0 !   !END!
1668 ! X =       415.756,      230.729,      3593.0,           0.0 !   !END!
1669 ! X =       417.153,      230.816,      3657.0,           0.0 !   !END!
1670 ! X =       418.549,      230.903,      3606.0,           0.0 !   !END!
1671 ! X =       419.946,      230.990,      3858.0,           0.0 !   !END!
1672 ! X =       421.342,      231.078,      3518.0,           0.0 !   !END!
1673 ! X =       422.738,      231.166,      3266.0,           0.0 !   !END!
1674 ! X =       424.135,      231.254,      3703.0,           0.0 !   !END!
1675 ! X =       425.531,      231.342,      3962.0,           0.0 !   !END!
1676 ! X =       426.927,      231.431,      3230.0,           0.0 !   !END!
1677 ! X =       428.323,      231.520,      3535.0,           0.0 !   !END!
1678 ! X =       431.116,      231.699,      3535.0,           0.0 !   !END!
1679 ! X =       432.512,      231.789,      3474.0,           0.0 !   !END!
1680 ! X =       414.249,      232.440,      3635.0,           0.0 !   !END!
1681 ! X =       415.645,      232.527,      3474.0,           0.0 !   !END!
1682 ! X =       417.041,      232.613,      3751.0,           0.0 !   !END!
1683 ! X =       418.437,      232.700,      3535.0,           0.0 !   !END!
1684 ! X =       419.833,      232.788,      3636.0,           0.0 !   !END!
1685 ! X =       421.229,      232.875,      3861.0,           0.0 !   !END!
1686 ! X =       422.625,      232.963,      3230.0,           0.0 !   !END!
1687 ! X =       424.021,      233.051,      3433.0,           0.0 !   !END!
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1688 ! X =       425.417,      233.139,      3931.0,           0.0 !   !END!
1689 ! X =       426.813,      233.228,      3169.0,           0.0 !   !END!
1690 ! X =       428.209,      233.317,      3607.0,           0.0 !   !END!
1691 ! X =       429.604,      233.406,      3986.0,           0.0 !   !END!
1692 ! X =       431.000,      233.496,      3810.0,           0.0 !   !END!
1693 ! X =       432.396,      233.586,      3352.0,           0.0 !   !END!
1694 ! X =       411.347,      234.066,      3410.0,           0.0 !   !END!
1695 ! X =       412.742,      234.152,      3585.0,           0.0 !   !END!
1696 ! X =       414.138,      234.238,      3442.0,           0.0 !   !END!
1697 ! X =       415.534,      234.324,      3570.0,           0.0 !   !END!
1698 ! X =       416.929,      234.411,      3577.0,           0.0 !   !END!
1699 ! X =       418.325,      234.498,      3922.0,           0.0 !   !END!
1700 ! X =       419.721,      234.585,      3332.0,           0.0 !   !END!
1701 ! X =       421.116,      234.673,      4118.0,           0.0 !   !END!
1702 ! X =       422.512,      234.760,      3352.0,           0.0 !   !END!
1703 ! X =       423.907,      234.848,      3321.0,           0.0 !   !END!
1704 ! X =       425.303,      234.937,      3632.0,           0.0 !   !END!
1705 ! X =       426.698,      235.025,      3291.0,           0.0 !   !END!
1706 ! X =       428.094,      235.114,      3230.0,           0.0 !   !END!
1707 ! X =       429.489,      235.204,      3963.0,           0.0 !   !END!
1708 ! X =       430.885,      235.293,      3596.0,           0.0 !   !END!
1709 ! X =       432.280,      235.383,      3352.0,           0.0 !   !END!
1710 ! X =       407.050,      235.608,      3101.0,           0.0 !   !END!
1711 ! X =       408.446,      235.693,      3286.0,           0.0 !   !END!
1712 ! X =       411.236,      235.864,      3382.0,           0.0 !   !END!
1713 ! X =       412.632,      235.949,      3340.0,           0.0 !   !END!
1714 ! X =       414.027,      236.035,      3217.0,           0.0 !   !END!
1715 ! X =       415.422,      236.122,      3323.0,           0.0 !   !END!
1716 ! X =       416.818,      236.208,      3646.0,           0.0 !   !END!
1717 ! X =       418.213,      236.295,      3962.0,           0.0 !   !END!
1718 ! X =       419.608,      236.382,      3108.0,           0.0 !   !END!
1719 ! X =       421.003,      236.470,      3647.0,           0.0 !   !END!
1720 ! X =       422.398,      236.558,      3511.0,           0.0 !   !END!
1721 ! X =       423.794,      236.646,      3048.0,           0.0 !   !END!
1722 ! X =       425.189,      236.734,      3568.0,           0.0 !   !END!
1723 ! X =       426.584,      236.823,      3405.0,           0.0 !   !END!
1724 ! X =       427.979,      236.912,      2984.0,           0.0 !   !END!
1725 ! X =       429.374,      237.001,      3631.0,           0.0 !   !END!
1726 ! X =       430.769,      237.090,      3429.0,           0.0 !   !END!
1727 ! X =       432.164,      237.180,      3184.0,           0.0 !   !END!
1728 ! X =       398.571,      236.903,      2868.0,           0.0 !   !END!
1729 ! X =       399.966,      236.986,      3187.0,           0.0 !   !END!
1730 ! X =       401.361,      237.069,      2981.0,           0.0 !   !END!
1731 ! X =       402.756,      237.153,      2939.0,           0.0 !   !END!
1732 ! X =       404.151,      237.237,      3352.0,           0.0 !   !END!
1733 ! X =       405.546,      237.321,      3291.0,           0.0 !   !END!
1734 ! X =       406.941,      237.406,      3545.0,           0.0 !   !END!
1735 ! X =       408.336,      237.490,      3650.0,           0.0 !   !END!
1736 ! X =       409.731,      237.576,      3426.0,           0.0 !   !END!
1737 ! X =       411.126,      237.661,      3459.0,           0.0 !   !END!
1738 ! X =       412.521,      237.747,      3485.0,           0.0 !   !END!
1739 ! X =       413.916,      237.833,      3795.0,           0.0 !   !END!
1740 ! X =       415.311,      237.919,      3585.0,           0.0 !   !END!
1741 ! X =       416.706,      238.006,      3455.0,           0.0 !   !END!
1742 ! X =       418.101,      238.092,      3572.0,           0.0 !   !END!
1743 ! X =       419.496,      238.180,      3504.0,           0.0 !   !END!
1744 ! X =       420.890,      238.267,      2989.0,           0.0 !   !END!
1745 ! X =       422.285,      238.355,      3127.0,           0.0 !   !END!
1746 ! X =       423.680,      238.443,      2897.0,           0.0 !   !END!
1747 ! X =       425.075,      238.531,      3278.0,           0.0 !   !END!
1748 ! X =       426.470,      238.620,      3686.0,           0.0 !   !END!
1749 ! X =       427.864,      238.709,      2972.0,           0.0 !   !END!
1750 ! X =       429.259,      238.798,      3088.0,           0.0 !   !END!
1751 ! X =       430.654,      238.887,      3169.0,           0.0 !   !END!
1752 ! X =       397.069,      238.617,      2855.0,           0.0 !   !END!
1753 ! X =       398.464,      238.700,      3280.0,           0.0 !   !END!
1754 ! X =       399.859,      238.783,      3190.0,           0.0 !   !END!
1755 ! X =       401.253,      238.867,      3562.0,           0.0 !   !END!
1756 ! X =       402.648,      238.950,      3413.0,           0.0 !   !END!
1757 ! X =       404.043,      239.034,      3474.0,           0.0 !   !END!
1758 ! X =       405.437,      239.118,      3518.0,           0.0 !   !END!
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1759 ! X =       406.832,      239.203,      3718.0,           0.0 !   !END!
1760 ! X =       408.227,      239.288,      3484.0,           0.0 !   !END!
1761 ! X =       409.621,      239.373,      3697.0,           0.0 !   !END!
1762 ! X =       411.016,      239.458,      3795.0,           0.0 !   !END!
1763 ! X =       412.410,      239.544,      3911.0,           0.0 !   !END!
1764 ! X =       413.805,      239.630,      3406.0,           0.0 !   !END!
1765 ! X =       415.200,      239.716,      3313.0,           0.0 !   !END!
1766 ! X =       416.594,      239.803,      3668.0,           0.0 !   !END!
1767 ! X =       417.989,      239.890,      3793.0,           0.0 !   !END!
1768 ! X =       419.383,      239.977,      3615.0,           0.0 !   !END!
1769 ! X =       420.777,      240.064,      3756.0,           0.0 !   !END!
1770 ! X =       422.172,      240.152,      3403.0,           0.0 !   !END!
1771 ! X =       423.566,      240.240,      2954.0,           0.0 !   !END!
1772 ! X =       424.961,      240.328,      2939.0,           0.0 !   !END!
1773 ! X =       426.355,      240.417,      3569.0,           0.0 !   !END!
1774 ! X =       427.750,      240.506,      3137.0,           0.0 !   !END!
1775 ! X =       429.144,      240.595,      2989.0,           0.0 !   !END!
1776 ! X =       396.963,      240.415,      2929.0,           0.0 !   !END!
1777 ! X =       398.357,      240.498,      2996.0,           0.0 !   !END!
1778 ! X =       399.751,      240.581,      3047.0,           0.0 !   !END!
1779 ! X =       401.146,      240.664,      3169.0,           0.0 !   !END!
1780 ! X =       402.540,      240.748,      3667.0,           0.0 !   !END!
1781 ! X =       403.934,      240.832,      3535.0,           0.0 !   !END!
1782 ! X =       405.329,      240.916,      3171.0,           0.0 !   !END!
1783 ! X =       406.723,      241.000,      3413.0,           0.0 !   !END!
1784 ! X =       408.117,      241.085,      3474.0,           0.0 !   !END!
1785 ! X =       409.511,      241.170,      3901.0,           0.0 !   !END!
1786 ! X =       410.906,      241.256,      3962.0,           0.0 !   !END!
1787 ! X =       412.300,      241.341,      3613.0,           0.0 !   !END!
1788 ! X =       413.694,      241.427,      3735.0,           0.0 !   !END!
1789 ! X =       415.088,      241.514,      3274.0,           0.0 !   !END!
1790 ! X =       416.482,      241.600,      3471.0,           0.0 !   !END!
1791 ! X =       417.876,      241.687,      3840.0,           0.0 !   !END!
1792 ! X =       419.271,      241.774,      3849.0,           0.0 !   !END!
1793 ! X =       420.665,      241.861,      3354.0,           0.0 !   !END!
1794 ! X =       422.059,      241.949,      3787.0,           0.0 !   !END!
1795 ! X =       423.453,      242.037,      3352.0,           0.0 !   !END!
1796 ! X =       396.856,      242.212,      2633.0,           0.0 !   !END!
1797 ! X =       398.250,      242.295,      3009.0,           0.0 !   !END!
1798 ! X =       399.644,      242.378,      3290.0,           0.0 !   !END!
1799 ! X =       401.038,      242.461,      3291.0,           0.0 !   !END!
1800 ! X =       402.432,      242.545,      3596.0,           0.0 !   !END!
1801 ! X =       403.826,      242.629,      3383.0,           0.0 !   !END!
1802 ! X =       405.220,      242.713,      3048.0,           0.0 !   !END!
1803 ! X =       406.614,      242.798,      3047.0,           0.0 !   !END!
1804 ! X =       408.008,      242.882,      3230.0,           0.0 !   !END!
1805 ! X =       409.402,      242.968,      4023.0,           0.0 !   !END!
1806 ! X =       410.795,      243.053,      3760.0,           0.0 !   !END!
1807 ! X =       412.189,      243.139,      3640.0,           0.0 !   !END!
1808 ! X =       413.583,      243.225,      3223.0,           0.0 !   !END!
1809 ! X =       414.977,      243.311,      3212.0,           0.0 !   !END!
1810 ! X =       416.371,      243.397,      3532.0,           0.0 !   !END!
1811 ! X =       417.764,      243.484,      3574.0,           0.0 !   !END!
1812 ! X =       419.158,      243.571,      3933.0,           0.0 !   !END!
1813 ! X =       420.552,      243.659,      3657.0,           0.0 !   !END!
1814 ! X =       421.945,      243.746,      3207.0,           0.0 !   !END!
1815 ! X =       423.339,      243.834,      3461.0,           0.0 !   !END!
1816 ! X =       424.733,      243.923,      2987.0,           0.0 !   !END!
1817 ! X =       398.143,      244.093,      2706.0,           0.0 !   !END!
1818 ! X =       399.537,      244.176,      3320.0,           0.0 !   !END!
1819 ! X =       400.930,      244.259,      3423.0,           0.0 !   !END!
1820 ! X =       402.324,      244.342,      3342.0,           0.0 !   !END!
1821 ! X =       403.718,      244.426,      2991.0,           0.0 !   !END!
1822 ! X =       405.111,      244.511,      2856.0,           0.0 !   !END!
1823 ! X =       406.505,      244.595,      3433.0,           0.0 !   !END!
1824 ! X =       407.898,      244.680,      3616.0,           0.0 !   !END!
1825 ! X =       409.292,      244.765,      3718.0,           0.0 !   !END!
1826 ! X =       410.685,      244.850,      3699.0,           0.0 !   !END!
1827 ! X =       412.079,      244.936,      3718.0,           0.0 !   !END!
1828 ! X =       413.472,      245.022,      3245.0,           0.0 !   !END!
1829 ! X =       414.865,      245.108,      2804.0,           0.0 !   !END!
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1830 ! X =       416.259,      245.194,      3779.0,           0.0 !   !END!
1831 ! X =       417.652,      245.281,      3291.0,           0.0 !   !END!
1832 ! X =       419.046,      245.368,      3764.0,           0.0 !   !END!
1833 ! X =       420.439,      245.456,      3630.0,           0.0 !   !END!
1834 ! X =       421.832,      245.543,      3535.0,           0.0 !   !END!
1835 ! X =       423.225,      245.631,      2899.0,           0.0 !   !END!
1836 ! X =       424.619,      245.719,      3062.0,           0.0 !   !END!
1837 ! X =       426.012,      245.808,      2682.0,           0.0 !   !END!
1838 ! X =       398.036,      245.890,      2560.0,           0.0 !   !END!
1839 ! X =       399.430,      245.973,      2985.0,           0.0 !   !END!
1840 ! X =       400.823,      246.056,      3365.0,           0.0 !   !END!
1841 ! X =       402.216,      246.140,      3105.0,           0.0 !   !END!
1842 ! X =       403.609,      246.224,      2620.0,           0.0 !   !END!
1843 ! X =       405.002,      246.308,      3037.0,           0.0 !   !END!
1844 ! X =       406.396,      246.392,      3689.0,           0.0 !   !END!
1845 ! X =       407.789,      246.477,      3474.0,           0.0 !   !END!
1846 ! X =       409.182,      246.562,      3229.0,           0.0 !   !END!
1847 ! X =       410.575,      246.647,      3718.0,           0.0 !   !END!
1848 ! X =       411.968,      246.733,      3352.0,           0.0 !   !END!
1849 ! X =       413.361,      246.819,      3246.0,           0.0 !   !END!
1850 ! X =       414.754,      246.905,      2743.0,           0.0 !   !END!
1851 ! X =       416.147,      246.991,      3657.0,           0.0 !   !END!
1852 ! X =       417.540,      247.078,      3108.0,           0.0 !   !END!
1853 ! X =       399.322,      247.770,      3286.0,           0.0 !   !END!
1854 ! X =       400.715,      247.853,      3108.0,           0.0 !   !END!
1855 ! X =       402.108,      247.937,      2548.0,           0.0 !   !END!
1856 ! X =       403.501,      248.021,      3118.0,           0.0 !   !END!
1857 ! X =       404.894,      248.105,      3504.0,           0.0 !   !END!
1858 ! X =       406.286,      248.189,      3728.0,           0.0 !   !END!
1859 ! X =       407.679,      248.274,      3352.0,           0.0 !   !END!
1860 ! X =       409.072,      248.359,      3048.0,           0.0 !   !END!
1861 ! X =       410.465,      248.444,      3484.0,           0.0 !   !END!
1862 ! X =       411.857,      248.530,      3443.0,           0.0 !   !END!
1863 ! X =       413.250,      248.616,      3203.0,           0.0 !   !END!
1864 ! X =       414.643,      248.702,      2743.0,           0.0 !   !END!
1865 ! X =       416.035,      248.788,      2712.0,           0.0 !   !END!
1866 ! X =       417.428,      248.875,      2751.0,           0.0 !   !END!
1867 ! X =       399.215,      249.567,      3058.0,           0.0 !   !END!
1868 ! X =       400.608,      249.651,      2575.0,           0.0 !   !END!
1869 ! X =       402.000,      249.734,      2844.0,           0.0 !   !END!
1870 ! X =       403.392,      249.818,      3193.0,           0.0 !   !END!
1871 ! X =       404.785,      249.902,      3494.0,           0.0 !   !END!
1872 ! X =       406.177,      249.986,      3449.0,           0.0 !   !END!
1873 ! X =       407.570,      250.071,      3242.0,           0.0 !   !END!
1874 ! X =       408.962,      250.156,      2864.0,           0.0 !   !END!
1875 ! X =       410.354,      250.241,      3261.0,           0.0 !   !END!
1876 ! X =       411.747,      250.327,      3139.0,           0.0 !   !END!
1877 ! X =       413.139,      250.413,      3261.0,           0.0 !   !END!
1878 ! X =       414.531,      250.499,      3139.0,           0.0 !   !END!
1879 ! X =       415.924,      250.585,      3087.0,           0.0 !   !END!
1880 ! X =       400.500,      251.448,      2619.0,           0.0 !   !END!
1881 ! X =       401.892,      251.531,      2981.0,           0.0 !   !END!
1882 ! X =       403.284,      251.615,      3580.0,           0.0 !   !END!
1883 ! X =       404.676,      251.699,      3665.0,           0.0 !   !END!
1884 ! X =       406.068,      251.784,      3341.0,           0.0 !   !END!
1885 ! X =       407.460,      251.868,      3117.0,           0.0 !   !END!
1886 ! X =       410.244,      252.038,      2748.0,           0.0 !   !END!
1887 ! X =       413.028,      252.210,      2857.0,           0.0 !   !END!
1888 ! X =       414.420,      252.296,      3048.0,           0.0 !   !END!
1889 ! X =       415.812,      252.382,      2682.0,           0.0 !   !END!
1890 ! X =       400.392,      253.245,      2782.0,           0.0 !   !END!
1891 ! X =       401.784,      253.328,      3048.0,           0.0 !   !END!
1892 ! X =       403.176,      253.412,      3272.0,           0.0 !   !END!
1893 ! X =       404.567,      253.496,      3351.0,           0.0 !   !END!
1894 ! X =       405.959,      253.581,      3119.0,           0.0 !   !END!
1895 ! X =       407.351,      253.665,      2942.0,           0.0 !   !END!
1896 ! X =       398.893,      254.959,      2880.0,           0.0 !   !END!
1897 ! X =       400.285,      255.042,      3534.0,           0.0 !   !END!
1898 ! X =       401.676,      255.125,      3739.0,           0.0 !   !END!
1899 ! X =       403.067,      255.209,      3474.0,           0.0 !   !END!
1900 ! X =       404.459,      255.293,      3200.0,           0.0 !   !END!
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1901 ! X =       405.850,      255.377,      3105.0,           0.0 !   !END!
1902 ! X =       398.786,      256.756,      2586.0,           0.0 !   !END!
1903 ! X =       400.177,      256.839,      2965.0,           0.0 !   !END!
1904 ! X =       401.568,      256.922,      3332.0,           0.0 !   !END!
1905 ! X =       402.959,      257.006,      3108.0,           0.0 !   !END!
1906 ! X =       400.070,      258.636,      2444.0,           0.0 !   !END!
1907 ! X =       425.148,       55.983,      2829.0,           0.0 !   !END!
1908 ! X =       426.581,       56.072,      3030.0,           0.0 !   !END!
1909 ! X =       377.758,       55.030,      2891.0,           0.0 !   !END!
1910 ! X =       379.191,       55.109,      2605.0,           0.0 !   !END!
1911 ! X =       423.604,       57.699,      3328.0,           0.0 !   !END!
1912 ! X =       425.036,       57.787,      2926.0,           0.0 !   !END!
1913 ! X =       426.469,       57.876,      3048.0,           0.0 !   !END!
1914 ! X =       377.659,       56.834,      3060.0,           0.0 !   !END!
1915 ! X =       379.091,       56.913,      2649.0,           0.0 !   !END!
1916 ! X =       386.254,       57.311,      2865.0,           0.0 !   !END!
1917 ! X =       420.629,       59.327,      3039.0,           0.0 !   !END!
1918 ! X =       422.061,       59.415,      3555.0,           0.0 !   !END!
1919 ! X =       423.493,       59.503,      3420.0,           0.0 !   !END!
1920 ! X =       424.925,       59.591,      3059.0,           0.0 !   !END!
1921 ! X =       426.357,       59.679,      3314.0,           0.0 !   !END!
1922 ! X =       427.789,       59.768,      3360.0,           0.0 !   !END!
1923 ! X =       429.221,       59.858,      3024.0,           0.0 !   !END!
1924 ! X =       430.653,       59.947,      3081.0,           0.0 !   !END!
1925 ! X =       368.966,       58.173,      2727.0,           0.0 !   !END!
1926 ! X =       376.128,       58.560,      3477.0,           0.0 !   !END!
1927 ! X =       377.560,       58.639,      3137.0,           0.0 !   !END!
1928 ! X =       378.992,       58.718,      2686.0,           0.0 !   !END!
1929 ! X =       389.017,       59.277,      2690.0,           0.0 !   !END!
1930 ! X =       390.449,       59.358,      2902.0,           0.0 !   !END!
1931 ! X =       391.881,       59.440,      3247.0,           0.0 !   !END!
1932 ! X =       421.950,       61.218,      3226.0,           0.0 !   !END!
1933 ! X =       423.382,       61.306,      3474.0,           0.0 !   !END!
1934 ! X =       424.814,       61.395,      3351.0,           0.0 !   !END!
1935 ! X =       426.245,       61.483,      3622.0,           0.0 !   !END!
1936 ! X =       427.677,       61.572,      3269.0,           0.0 !   !END!
1937 ! X =       429.108,       61.661,      3596.0,           0.0 !   !END!
1938 ! X =       430.540,       61.751,      3436.0,           0.0 !   !END!
1939 ! X =       431.972,       61.840,      3210.0,           0.0 !   !END!
1940 ! X =       368.869,       59.977,      3014.0,           0.0 !   !END!
1941 ! X =       370.301,       60.054,      2684.0,           0.0 !   !END!
1942 ! X =       376.029,       60.365,      3407.0,           0.0 !   !END!
1943 ! X =       377.461,       60.443,      3169.0,           0.0 !   !END!
1944 ! X =       378.893,       60.522,      2944.0,           0.0 !   !END!
1945 ! X =       380.324,       60.601,      2534.0,           0.0 !   !END!
1946 ! X =       381.756,       60.680,      2653.0,           0.0 !   !END!
1947 ! X =       387.483,       61.000,      3139.0,           0.0 !   !END!
1948 ! X =       388.915,       61.081,      2721.0,           0.0 !   !END!
1949 ! X =       390.347,       61.162,      2682.0,           0.0 !   !END!
1950 ! X =       391.778,       61.244,      3392.0,           0.0 !   !END!
1951 ! X =       393.210,       61.325,      3449.0,           0.0 !   !END!
1952 ! X =       421.840,       63.022,      3350.0,           0.0 !   !END!
1953 ! X =       423.271,       63.110,      3694.0,           0.0 !   !END!
1954 ! X =       424.702,       63.198,      3665.0,           0.0 !   !END!
1955 ! X =       426.134,       63.287,      3474.0,           0.0 !   !END!
1956 ! X =       427.565,       63.376,      3327.0,           0.0 !   !END!
1957 ! X =       428.996,       63.465,      3657.0,           0.0 !   !END!
1958 ! X =       430.427,       63.554,      3533.0,           0.0 !   !END!
1959 ! X =       431.858,       63.644,      3169.0,           0.0 !   !END!
1960 ! X =       433.290,       63.734,      2832.0,           0.0 !   !END!
1961 ! X =       434.721,       63.824,      2865.0,           0.0 !   !END!
1962 ! X =       436.152,       63.915,      3654.0,           0.0 !   !END!
1963 ! X =       437.583,       64.006,      3243.0,           0.0 !   !END!
1964 ! X =       370.204,       61.858,      3077.0,           0.0 !   !END!
1965 ! X =       371.636,       61.936,      3048.0,           0.0 !   !END!
1966 ! X =       373.067,       62.013,      3379.0,           0.0 !   !END!
1967 ! X =       374.499,       62.091,      3527.0,           0.0 !   !END!
1968 ! X =       375.930,       62.169,      3718.0,           0.0 !   !END!
1969 ! X =       377.362,       62.247,      3588.0,           0.0 !   !END!
1970 ! X =       378.793,       62.326,      3104.0,           0.0 !   !END!
1971 ! X =       380.225,       62.405,      2682.0,           0.0 !   !END!
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1972 ! X =       381.656,       62.484,      2526.0,           0.0 !   !END!
1973 ! X =       388.813,       62.885,      3328.0,           0.0 !   !END!
1974 ! X =       390.244,       62.966,      2521.0,           0.0 !   !END!
1975 ! X =       391.676,       63.048,      2682.0,           0.0 !   !END!
1976 ! X =       393.107,       63.129,      3366.0,           0.0 !   !END!
1977 ! X =       394.538,       63.211,      3459.0,           0.0 !   !END!
1978 ! X =       417.436,       64.564,      3273.0,           0.0 !   !END!
1979 ! X =       418.867,       64.651,      3311.0,           0.0 !   !END!
1980 ! X =       420.298,       64.738,      2836.0,           0.0 !   !END!
1981 ! X =       421.729,       64.826,      3271.0,           0.0 !   !END!
1982 ! X =       423.160,       64.913,      3414.0,           0.0 !   !END!
1983 ! X =       424.591,       65.002,      3469.0,           0.0 !   !END!
1984 ! X =       426.022,       65.090,      3730.0,           0.0 !   !END!
1985 ! X =       427.453,       65.179,      3415.0,           0.0 !   !END!
1986 ! X =       428.883,       65.268,      3279.0,           0.0 !   !END!
1987 ! X =       430.314,       65.358,      3169.0,           0.0 !   !END!
1988 ! X =       431.745,       65.447,      3169.0,           0.0 !   !END!
1989 ! X =       433.176,       65.537,      2681.0,           0.0 !   !END!
1990 ! X =       434.607,       65.628,      3230.0,           0.0 !   !END!
1991 ! X =       436.037,       65.718,      3593.0,           0.0 !   !END!
1992 ! X =       437.468,       65.809,      3587.0,           0.0 !   !END!
1993 ! X =       438.899,       65.900,      3457.0,           0.0 !   !END!
1994 ! X =       440.330,       65.992,      3473.0,           0.0 !   !END!
1995 ! X =       370.107,       63.663,      3210.0,           0.0 !   !END!
1996 ! X =       371.538,       63.740,      3092.0,           0.0 !   !END!
1997 ! X =       372.969,       63.817,      3102.0,           0.0 !   !END!
1998 ! X =       374.401,       63.895,      3468.0,           0.0 !   !END!
1999 ! X =       375.832,       63.973,      3669.0,           0.0 !   !END!
2000 ! X =       377.263,       64.052,      3595.0,           0.0 !   !END!
2001 ! X =       378.694,       64.130,      3337.0,           0.0 !   !END!
2002 ! X =       380.125,       64.209,      2976.0,           0.0 !   !END!
2003 ! X =       381.556,       64.289,      2683.0,           0.0 !   !END!
2004 ! X =       382.987,       64.368,      3062.0,           0.0 !   !END!
2005 ! X =       385.849,       64.528,      3432.0,           0.0 !   !END!
2006 ! X =       387.280,       64.609,      3312.0,           0.0 !   !END!
2007 ! X =       388.711,       64.689,      3134.0,           0.0 !   !END!
2008 ! X =       390.142,       64.770,      2913.0,           0.0 !   !END!
2009 ! X =       391.573,       64.852,      2935.0,           0.0 !   !END!
2010 ! X =       393.004,       64.933,      2797.0,           0.0 !   !END!
2011 ! X =       394.435,       65.015,      3190.0,           0.0 !   !END!
2012 ! X =       395.866,       65.098,      3657.0,           0.0 !   !END!
2013 ! X =       417.327,       66.367,      3315.0,           0.0 !   !END!
2014 ! X =       418.757,       66.454,      3529.0,           0.0 !   !END!
2015 ! X =       420.188,       66.541,      3384.0,           0.0 !   !END!
2016 ! X =       421.618,       66.629,      2986.0,           0.0 !   !END!
2017 ! X =       423.049,       66.717,      3322.0,           0.0 !   !END!
2018 ! X =       424.479,       66.805,      3717.0,           0.0 !   !END!
2019 ! X =       425.910,       66.894,      3656.0,           0.0 !   !END!
2020 ! X =       427.340,       66.982,      3592.0,           0.0 !   !END!
2021 ! X =       428.771,       67.072,      3634.0,           0.0 !   !END!
2022 ! X =       430.201,       67.161,      3076.0,           0.0 !   !END!
2023 ! X =       431.632,       67.251,      2803.0,           0.0 !   !END!
2024 ! X =       433.062,       67.341,      3080.0,           0.0 !   !END!
2025 ! X =       434.493,       67.431,      2921.0,           0.0 !   !END!
2026 ! X =       435.923,       67.522,      3322.0,           0.0 !   !END!
2027 ! X =       437.353,       67.612,      3678.0,           0.0 !   !END!
2028 ! X =       438.784,       67.704,      3454.0,           0.0 !   !END!
2029 ! X =       440.214,       67.795,      3322.0,           0.0 !   !END!
2030 ! X =       441.644,       67.887,      3214.0,           0.0 !   !END!
2031 ! X =       443.075,       67.979,      3291.0,           0.0 !   !END!
2032 ! X =       370.010,       65.467,      3477.0,           0.0 !   !END!
2033 ! X =       371.441,       65.544,      3274.0,           0.0 !   !END!
2034 ! X =       372.872,       65.622,      3543.0,           0.0 !   !END!
2035 ! X =       374.302,       65.699,      3269.0,           0.0 !   !END!
2036 ! X =       375.733,       65.777,      3393.0,           0.0 !   !END!
2037 ! X =       377.164,       65.856,      3699.0,           0.0 !   !END!
2038 ! X =       378.594,       65.934,      3545.0,           0.0 !   !END!
2039 ! X =       380.025,       66.013,      3344.0,           0.0 !   !END!
2040 ! X =       381.456,       66.093,      3078.0,           0.0 !   !END!
2041 ! X =       382.886,       66.172,      2887.0,           0.0 !   !END!
2042 ! X =       384.317,       66.252,      3365.0,           0.0 !   !END!
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2043 ! X =       385.748,       66.332,      3535.0,           0.0 !   !END!
2044 ! X =       387.178,       66.413,      3471.0,           0.0 !   !END!
2045 ! X =       388.609,       66.493,      3230.0,           0.0 !   !END!
2046 ! X =       390.040,       66.574,      3352.0,           0.0 !   !END!
2047 ! X =       391.470,       66.656,      3343.0,           0.0 !   !END!
2048 ! X =       392.901,       66.737,      2891.0,           0.0 !   !END!
2049 ! X =       394.331,       66.819,      2926.0,           0.0 !   !END!
2050 ! X =       395.762,       66.901,      3535.0,           0.0 !   !END!
2051 ! X =       411.496,       67.826,      3010.0,           0.0 !   !END!
2052 ! X =       412.926,       67.911,      3301.0,           0.0 !   !END!
2053 ! X =       414.357,       67.998,      3301.0,           0.0 !   !END!
2054 ! X =       415.787,       68.084,      2929.0,           0.0 !   !END!
2055 ! X =       417.217,       68.171,      3351.0,           0.0 !   !END!
2056 ! X =       418.647,       68.258,      3474.0,           0.0 !   !END!
2057 ! X =       420.078,       68.345,      3718.0,           0.0 !   !END!
2058 ! X =       421.508,       68.432,      3352.0,           0.0 !   !END!
2059 ! X =       422.938,       68.520,      3108.0,           0.0 !   !END!
2060 ! X =       424.368,       68.609,      3448.0,           0.0 !   !END!
2061 ! X =       425.798,       68.697,      3701.0,           0.0 !   !END!
2062 ! X =       427.228,       68.786,      3552.0,           0.0 !   !END!
2063 ! X =       428.658,       68.875,      3222.0,           0.0 !   !END!
2064 ! X =       430.089,       68.964,      3352.0,           0.0 !   !END!
2065 ! X =       431.519,       69.054,      3291.0,           0.0 !   !END!
2066 ! X =       432.949,       69.144,      3571.0,           0.0 !   !END!
2067 ! X =       434.379,       69.234,      3389.0,           0.0 !   !END!
2068 ! X =       435.809,       69.325,      3108.0,           0.0 !   !END!
2069 ! X =       437.239,       69.416,      3647.0,           0.0 !   !END!
2070 ! X =       438.669,       69.507,      3435.0,           0.0 !   !END!
2071 ! X =       440.099,       69.598,      3413.0,           0.0 !   !END!
2072 ! X =       441.528,       69.690,      3261.0,           0.0 !   !END!
2073 ! X =       442.958,       69.782,      3048.0,           0.0 !   !END!
2074 ! X =       369.913,       67.271,      3596.0,           0.0 !   !END!
2075 ! X =       371.343,       67.348,      3531.0,           0.0 !   !END!
2076 ! X =       372.774,       67.426,      3392.0,           0.0 !   !END!
2077 ! X =       374.204,       67.503,      3471.0,           0.0 !   !END!
2078 ! X =       375.634,       67.581,      3514.0,           0.0 !   !END!
2079 ! X =       377.065,       67.660,      3352.0,           0.0 !   !END!
2080 ! X =       378.495,       67.738,      3666.0,           0.0 !   !END!
2081 ! X =       379.925,       67.817,      3901.0,           0.0 !   !END!
2082 ! X =       381.356,       67.897,      3312.0,           0.0 !   !END!
2083 ! X =       382.786,       67.976,      2816.0,           0.0 !   !END!
2084 ! X =       384.216,       68.056,      3352.0,           0.0 !   !END!
2085 ! X =       385.647,       68.136,      3549.0,           0.0 !   !END!
2086 ! X =       387.077,       68.216,      3718.0,           0.0 !   !END!
2087 ! X =       388.507,       68.297,      3352.0,           0.0 !   !END!
2088 ! X =       389.937,       68.378,      3266.0,           0.0 !   !END!
2089 ! X =       391.367,       68.459,      3598.0,           0.0 !   !END!
2090 ! X =       392.797,       68.541,      3078.0,           0.0 !   !END!
2091 ! X =       394.228,       68.623,      2926.0,           0.0 !   !END!
2092 ! X =       395.658,       68.705,      3450.0,           0.0 !   !END!
2093 ! X =       397.088,       68.788,      3364.0,           0.0 !   !END!
2094 ! X =       407.098,       69.374,      3254.0,           0.0 !   !END!
2095 ! X =       412.818,       69.715,      3282.0,           0.0 !   !END!
2096 ! X =       414.248,       69.801,      3469.0,           0.0 !   !END!
2097 ! X =       415.678,       69.887,      3130.0,           0.0 !   !END!
2098 ! X =       417.108,       69.974,      3192.0,           0.0 !   !END!
2099 ! X =       418.537,       70.061,      3059.0,           0.0 !   !END!
2100 ! X =       419.967,       70.148,      3489.0,           0.0 !   !END!
2101 ! X =       421.397,       70.236,      3528.0,           0.0 !   !END!
2102 ! X =       422.827,       70.324,      3455.0,           0.0 !   !END!
2103 ! X =       424.257,       70.412,      3505.0,           0.0 !   !END!
2104 ! X =       425.686,       70.500,      3474.0,           0.0 !   !END!
2105 ! X =       427.116,       70.589,      3548.0,           0.0 !   !END!
2106 ! X =       428.546,       70.678,      3657.0,           0.0 !   !END!
2107 ! X =       429.976,       70.767,      3290.0,           0.0 !   !END!
2108 ! X =       431.405,       70.857,      3535.0,           0.0 !   !END!
2109 ! X =       432.835,       70.947,      3390.0,           0.0 !   !END!
2110 ! X =       434.265,       71.037,      3169.0,           0.0 !   !END!
2111 ! X =       435.694,       71.128,      3352.0,           0.0 !   !END!
2112 ! X =       437.124,       71.219,      3546.0,           0.0 !   !END!
2113 ! X =       438.553,       71.310,      3637.0,           0.0 !   !END!
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2114 ! X =       439.983,       71.401,      3640.0,           0.0 !   !END!
2115 ! X =       441.413,       71.493,      3489.0,           0.0 !   !END!
2116 ! X =       442.842,       71.585,      3230.0,           0.0 !   !END!
2117 ! X =       369.816,       69.075,      3654.0,           0.0 !   !END!
2118 ! X =       371.246,       69.152,      3671.0,           0.0 !   !END!
2119 ! X =       372.676,       69.230,      3568.0,           0.0 !   !END!
2120 ! X =       374.106,       69.307,      3535.0,           0.0 !   !END!
2121 ! X =       375.536,       69.385,      3718.0,           0.0 !   !END!
2122 ! X =       376.966,       69.464,      3779.0,           0.0 !   !END!
2123 ! X =       378.396,       69.542,      3675.0,           0.0 !   !END!
2124 ! X =       379.826,       69.621,      3792.0,           0.0 !   !END!
2125 ! X =       381.256,       69.700,      3525.0,           0.0 !   !END!
2126 ! X =       382.686,       69.780,      2824.0,           0.0 !   !END!
2127 ! X =       384.115,       69.860,      3169.0,           0.0 !   !END!
2128 ! X =       385.545,       69.940,      3612.0,           0.0 !   !END!
2129 ! X =       386.975,       70.020,      3845.0,           0.0 !   !END!
2130 ! X =       388.405,       70.101,      3169.0,           0.0 !   !END!
2131 ! X =       389.835,       70.182,      3406.0,           0.0 !   !END!
2132 ! X =       391.265,       70.263,      3660.0,           0.0 !   !END!
2133 ! X =       392.694,       70.345,      3088.0,           0.0 !   !END!
2134 ! X =       394.124,       70.427,      2926.0,           0.0 !   !END!
2135 ! X =       395.554,       70.509,      3156.0,           0.0 !   !END!
2136 ! X =       396.984,       70.591,      3278.0,           0.0 !   !END!
2137 ! X =       398.413,       70.674,      3481.0,           0.0 !   !END!
2138 ! X =       399.843,       70.757,      3324.0,           0.0 !   !END!
2139 ! X =       401.273,       70.841,      3082.0,           0.0 !   !END!
2140 ! X =       404.132,       71.008,      2648.0,           0.0 !   !END!
2141 ! X =       405.562,       71.093,      2918.0,           0.0 !   !END!
2142 ! X =       406.991,       71.177,      3380.0,           0.0 !   !END!
2143 ! X =       408.421,       71.262,      3216.0,           0.0 !   !END!
2144 ! X =       409.851,       71.347,      3413.0,           0.0 !   !END!
2145 ! X =       411.280,       71.433,      2926.0,           0.0 !   !END!
2146 ! X =       412.710,       71.518,      2957.0,           0.0 !   !END!
2147 ! X =       414.139,       71.604,      3382.0,           0.0 !   !END!
2148 ! X =       415.569,       71.691,      3273.0,           0.0 !   !END!
2149 ! X =       416.998,       71.777,      3139.0,           0.0 !   !END!
2150 ! X =       418.428,       71.864,      3474.0,           0.0 !   !END!
2151 ! X =       419.857,       71.952,      3596.0,           0.0 !   !END!
2152 ! X =       421.287,       72.039,      3413.0,           0.0 !   !END!
2153 ! X =       422.716,       72.127,      3523.0,           0.0 !   !END!
2154 ! X =       424.145,       72.215,      3569.0,           0.0 !   !END!
2155 ! X =       425.575,       72.304,      3656.0,           0.0 !   !END!
2156 ! X =       427.004,       72.392,      3511.0,           0.0 !   !END!
2157 ! X =       428.433,       72.481,      3639.0,           0.0 !   !END!
2158 ! X =       429.863,       72.571,      3800.0,           0.0 !   !END!
2159 ! X =       431.292,       72.660,      3574.0,           0.0 !   !END!
2160 ! X =       432.721,       72.750,      3596.0,           0.0 !   !END!
2161 ! X =       434.151,       72.840,      3474.0,           0.0 !   !END!
2162 ! X =       435.580,       72.931,      3562.0,           0.0 !   !END!
2163 ! X =       437.009,       73.022,      3657.0,           0.0 !   !END!
2164 ! X =       438.438,       73.113,      3571.0,           0.0 !   !END!
2165 ! X =       439.867,       73.204,      3454.0,           0.0 !   !END!
2166 ! X =       441.297,       73.296,      3140.0,           0.0 !   !END!
2167 ! X =       368.289,       70.802,      3717.0,           0.0 !   !END!
2168 ! X =       369.719,       70.879,      3710.0,           0.0 !   !END!
2169 ! X =       371.148,       70.956,      3751.0,           0.0 !   !END!
2170 ! X =       372.578,       71.034,      3713.0,           0.0 !   !END!
2171 ! X =       374.008,       71.111,      3680.0,           0.0 !   !END!
2172 ! X =       375.437,       71.189,      3867.0,           0.0 !   !END!
2173 ! X =       376.867,       71.268,      3901.0,           0.0 !   !END!
2174 ! X =       378.296,       71.346,      3322.0,           0.0 !   !END!
2175 ! X =       379.726,       71.425,      3154.0,           0.0 !   !END!
2176 ! X =       381.155,       71.504,      3220.0,           0.0 !   !END!
2177 ! X =       382.585,       71.584,      2804.0,           0.0 !   !END!
2178 ! X =       384.015,       71.664,      3468.0,           0.0 !   !END!
2179 ! X =       385.444,       71.744,      3881.0,           0.0 !   !END!
2180 ! X =       386.874,       71.824,      3718.0,           0.0 !   !END!
2181 ! X =       388.303,       71.905,      3270.0,           0.0 !   !END!
2182 ! X =       389.732,       71.986,      3779.0,           0.0 !   !END!
2183 ! X =       391.162,       72.067,      3265.0,           0.0 !   !END!
2184 ! X =       392.591,       72.149,      3413.0,           0.0 !   !END!
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2185 ! X =       394.021,       72.230,      3527.0,           0.0 !   !END!
2186 ! X =       395.450,       72.313,      2997.0,           0.0 !   !END!
2187 ! X =       396.879,       72.395,      3291.0,           0.0 !   !END!
2188 ! X =       398.309,       72.478,      3450.0,           0.0 !   !END!
2189 ! X =       399.738,       72.561,      3199.0,           0.0 !   !END!
2190 ! X =       401.167,       72.644,      2926.0,           0.0 !   !END!
2191 ! X =       402.597,       72.728,      2907.0,           0.0 !   !END!
2192 ! X =       404.026,       72.812,      3025.0,           0.0 !   !END!
2193 ! X =       405.455,       72.896,      3465.0,           0.0 !   !END!
2194 ! X =       406.884,       72.981,      3294.0,           0.0 !   !END!
2195 ! X =       408.314,       73.065,      3623.0,           0.0 !   !END!
2196 ! X =       409.743,       73.151,      3535.0,           0.0 !   !END!
2197 ! X =       411.172,       73.236,      3054.0,           0.0 !   !END!
2198 ! X =       412.601,       73.322,      2880.0,           0.0 !   !END!
2199 ! X =       414.030,       73.408,      3318.0,           0.0 !   !END!
2200 ! X =       415.460,       73.494,      3467.0,           0.0 !   !END!
2201 ! X =       416.889,       73.581,      3223.0,           0.0 !   !END!
2202 ! X =       418.318,       73.668,      3379.0,           0.0 !   !END!
2203 ! X =       419.747,       73.755,      3515.0,           0.0 !   !END!
2204 ! X =       421.176,       73.842,      3463.0,           0.0 !   !END!
2205 ! X =       422.605,       73.930,      3413.0,           0.0 !   !END!
2206 ! X =       424.034,       74.018,      3453.0,           0.0 !   !END!
2207 ! X =       425.463,       74.107,      3490.0,           0.0 !   !END!
2208 ! X =       429.750,       74.374,      3698.0,           0.0 !   !END!
2209 ! X =       431.179,       74.463,      3414.0,           0.0 !   !END!
2210 ! X =       432.608,       74.553,      3319.0,           0.0 !   !END!
2211 ! X =       434.037,       74.643,      3291.0,           0.0 !   !END!
2212 ! X =       435.465,       74.734,      3380.0,           0.0 !   !END!
2213 ! X =       436.894,       74.825,      3349.0,           0.0 !   !END!
2214 ! X =       438.323,       74.916,      3717.0,           0.0 !   !END!
2215 ! X =       439.752,       75.007,      3657.0,           0.0 !   !END!
2216 ! X =       361.045,       72.227,      2466.0,           0.0 !   !END!
2217 ! X =       362.475,       72.302,      2751.0,           0.0 !   !END!
2218 ! X =       363.904,       72.378,      3128.0,           0.0 !   !END!
2219 ! X =       365.334,       72.454,      3408.0,           0.0 !   !END!
2220 ! X =       366.763,       72.530,      3592.0,           0.0 !   !END!
2221 ! X =       368.192,       72.606,      3840.0,           0.0 !   !END!
2222 ! X =       369.622,       72.683,      3596.0,           0.0 !   !END!
2223 ! X =       371.051,       72.760,      3437.0,           0.0 !   !END!
2224 ! X =       372.480,       72.838,      3478.0,           0.0 !   !END!
2225 ! X =       373.909,       72.915,      3646.0,           0.0 !   !END!
2226 ! X =       375.339,       72.993,      3835.0,           0.0 !   !END!
2227 ! X =       376.768,       73.071,      3654.0,           0.0 !   !END!
2228 ! X =       378.197,       73.150,      3840.0,           0.0 !   !END!
2229 ! X =       379.626,       73.229,      3233.0,           0.0 !   !END!
2230 ! X =       381.055,       73.308,      2914.0,           0.0 !   !END!
2231 ! X =       382.485,       73.388,      3210.0,           0.0 !   !END!
2232 ! X =       383.914,       73.467,      3815.0,           0.0 !   !END!
2233 ! X =       385.343,       73.547,      3941.0,           0.0 !   !END!
2234 ! X =       386.772,       73.628,      3627.0,           0.0 !   !END!
2235 ! X =       388.201,       73.708,      3519.0,           0.0 !   !END!
2236 ! X =       389.630,       73.789,      3637.0,           0.0 !   !END!
2237 ! X =       391.059,       73.871,      3169.0,           0.0 !   !END!
2238 ! X =       392.488,       73.952,      3557.0,           0.0 !   !END!
2239 ! X =       393.917,       74.034,      3731.0,           0.0 !   !END!
2240 ! X =       395.346,       74.116,      3466.0,           0.0 !   !END!
2241 ! X =       396.775,       74.199,      3048.0,           0.0 !   !END!
2242 ! X =       398.204,       74.281,      3074.0,           0.0 !   !END!
2243 ! X =       399.633,       74.364,      2974.0,           0.0 !   !END!
2244 ! X =       401.062,       74.448,      2976.0,           0.0 !   !END!
2245 ! X =       402.491,       74.531,      3578.0,           0.0 !   !END!
2246 ! X =       403.920,       74.615,      3615.0,           0.0 !   !END!
2247 ! X =       405.349,       74.699,      3410.0,           0.0 !   !END!
2248 ! X =       406.778,       74.784,      3804.0,           0.0 !   !END!
2249 ! X =       408.206,       74.869,      3613.0,           0.0 !   !END!
2250 ! X =       409.635,       74.954,      3359.0,           0.0 !   !END!
2251 ! X =       411.064,       75.039,      3108.0,           0.0 !   !END!
2252 ! X =       412.493,       75.125,      3108.0,           0.0 !   !END!
2253 ! X =       413.922,       75.211,      3088.0,           0.0 !   !END!
2254 ! X =       415.350,       75.297,      3578.0,           0.0 !   !END!
2255 ! X =       416.779,       75.384,      3352.0,           0.0 !   !END!
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2256 ! X =       418.208,       75.471,      3468.0,           0.0 !   !END!
2257 ! X =       419.637,       75.558,      3458.0,           0.0 !   !END!
2258 ! X =       421.065,       75.646,      3235.0,           0.0 !   !END!
2259 ! X =       422.494,       75.733,      3509.0,           0.0 !   !END!
2260 ! X =       428.208,       76.087,      3745.0,           0.0 !   !END!
2261 ! X =       429.637,       76.177,      3576.0,           0.0 !   !END!
2262 ! X =       431.066,       76.266,      3572.0,           0.0 !   !END!
2263 ! X =       432.494,       76.356,      3649.0,           0.0 !   !END!
2264 ! X =       433.923,       76.446,      3596.0,           0.0 !   !END!
2265 ! X =       435.351,       76.537,      3361.0,           0.0 !   !END!
2266 ! X =       436.780,       76.628,      3341.0,           0.0 !   !END!
2267 ! X =       438.208,       76.719,      3718.0,           0.0 !   !END!
2268 ! X =       439.637,       76.810,      3554.0,           0.0 !   !END!
2269 ! X =       359.522,       73.956,      2438.0,           0.0 !   !END!
2270 ! X =       360.951,       74.031,      2962.0,           0.0 !   !END!
2271 ! X =       362.380,       74.106,      2597.0,           0.0 !   !END!
2272 ! X =       366.667,       74.334,      2759.0,           0.0 !   !END!
2273 ! X =       368.096,       74.410,      3083.0,           0.0 !   !END!
2274 ! X =       369.524,       74.487,      2811.0,           0.0 !   !END!
2275 ! X =       370.953,       74.564,      3427.0,           0.0 !   !END!
2276 ! X =       372.382,       74.641,      3840.0,           0.0 !   !END!
2277 ! X =       373.811,       74.719,      3666.0,           0.0 !   !END!
2278 ! X =       375.240,       74.797,      3596.0,           0.0 !   !END!
2279 ! X =       376.669,       74.875,      4023.0,           0.0 !   !END!
2280 ! X =       378.098,       74.954,      3756.0,           0.0 !   !END!
2281 ! X =       379.526,       75.033,      3567.0,           0.0 !   !END!
2282 ! X =       380.955,       75.112,      2945.0,           0.0 !   !END!
2283 ! X =       382.384,       75.191,      3310.0,           0.0 !   !END!
2284 ! X =       383.813,       75.271,      3641.0,           0.0 !   !END!
2285 ! X =       385.242,       75.351,      3843.0,           0.0 !   !END!
2286 ! X =       386.670,       75.431,      3749.0,           0.0 !   !END!
2287 ! X =       388.099,       75.512,      3770.0,           0.0 !   !END!
2288 ! X =       389.528,       75.593,      3627.0,           0.0 !   !END!
2289 ! X =       390.956,       75.674,      3338.0,           0.0 !   !END!
2290 ! X =       392.385,       75.756,      3779.0,           0.0 !   !END!
2291 ! X =       393.814,       75.837,      3718.0,           0.0 !   !END!
2292 ! X =       395.242,       75.920,      3532.0,           0.0 !   !END!
2293 ! X =       396.671,       76.002,      3132.0,           0.0 !   !END!
2294 ! X =       398.100,       76.085,      3168.0,           0.0 !   !END!
2295 ! X =       399.528,       76.168,      3413.0,           0.0 !   !END!
2296 ! X =       400.957,       76.251,      3413.0,           0.0 !   !END!
2297 ! X =       402.385,       76.335,      3230.0,           0.0 !   !END!
2298 ! X =       403.814,       76.419,      3304.0,           0.0 !   !END!
2299 ! X =       405.242,       76.503,      3780.0,           0.0 !   !END!
2300 ! X =       406.671,       76.587,      3648.0,           0.0 !   !END!
2301 ! X =       408.099,       76.672,      3352.0,           0.0 !   !END!
2302 ! X =       409.528,       76.757,      3643.0,           0.0 !   !END!
2303 ! X =       410.956,       76.843,      3718.0,           0.0 !   !END!
2304 ! X =       412.385,       76.928,      3352.0,           0.0 !   !END!
2305 ! X =       413.813,       77.014,      3196.0,           0.0 !   !END!
2306 ! X =       415.241,       77.101,      3461.0,           0.0 !   !END!
2307 ! X =       416.670,       77.187,      3229.0,           0.0 !   !END!
2308 ! X =       418.098,       77.274,      3312.0,           0.0 !   !END!
2309 ! X =       419.526,       77.361,      3064.0,           0.0 !   !END!
2310 ! X =       420.955,       77.449,      3370.0,           0.0 !   !END!
2311 ! X =       428.096,       77.890,      3589.0,           0.0 !   !END!
2312 ! X =       429.524,       77.980,      3581.0,           0.0 !   !END!
2313 ! X =       430.952,       78.069,      3413.0,           0.0 !   !END!
2314 ! X =       432.380,       78.159,      3584.0,           0.0 !   !END!
2315 ! X =       433.809,       78.249,      3694.0,           0.0 !   !END!
2316 ! X =       435.237,       78.340,      3370.0,           0.0 !   !END!
2317 ! X =       436.665,       78.430,      3151.0,           0.0 !   !END!
2318 ! X =       438.093,       78.521,      3321.0,           0.0 !   !END!
2319 ! X =       439.521,       78.613,      3629.0,           0.0 !   !END!
2320 ! X =       359.427,       75.760,      2557.0,           0.0 !   !END!
2321 ! X =       362.284,       75.910,      2959.0,           0.0 !   !END!
2322 ! X =       363.713,       75.986,      3218.0,           0.0 !   !END!
2323 ! X =       365.142,       76.061,      3129.0,           0.0 !   !END!
2324 ! X =       366.570,       76.138,      2776.0,           0.0 !   !END!
2325 ! X =       367.999,       76.214,      2621.0,           0.0 !   !END!
2326 ! X =       369.427,       76.291,      3026.0,           0.0 !   !END!
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2327 ! X =       370.856,       76.368,      3701.0,           0.0 !   !END!
2328 ! X =       372.284,       76.445,      4023.0,           0.0 !   !END!
2329 ! X =       373.713,       76.523,      3946.0,           0.0 !   !END!
2330 ! X =       375.141,       76.601,      4020.0,           0.0 !   !END!
2331 ! X =       376.570,       76.679,      3901.0,           0.0 !   !END!
2332 ! X =       377.998,       76.757,      3630.0,           0.0 !   !END!
2333 ! X =       379.427,       76.836,      3413.0,           0.0 !   !END!
2334 ! X =       380.855,       76.915,      2926.0,           0.0 !   !END!
2335 ! X =       382.284,       76.995,      3474.0,           0.0 !   !END!
2336 ! X =       383.712,       77.075,      3757.0,           0.0 !   !END!
2337 ! X =       385.140,       77.155,      3527.0,           0.0 !   !END!
2338 ! X =       386.569,       77.235,      3676.0,           0.0 !   !END!
2339 ! X =       387.997,       77.316,      3648.0,           0.0 !   !END!
2340 ! X =       389.425,       77.396,      3605.0,           0.0 !   !END!
2341 ! X =       390.854,       77.478,      3706.0,           0.0 !   !END!
2342 ! X =       392.282,       77.559,      3535.0,           0.0 !   !END!
2343 ! X =       393.710,       77.641,      3573.0,           0.0 !   !END!
2344 ! X =       395.138,       77.723,      3559.0,           0.0 !   !END!
2345 ! X =       396.567,       77.805,      3270.0,           0.0 !   !END!
2346 ! X =       397.995,       77.888,      3108.0,           0.0 !   !END!
2347 ! X =       399.423,       77.971,      3413.0,           0.0 !   !END!
2348 ! X =       400.851,       78.054,      3736.0,           0.0 !   !END!
2349 ! X =       402.279,       78.138,      3579.0,           0.0 !   !END!
2350 ! X =       403.708,       78.222,      3779.0,           0.0 !   !END!
2351 ! X =       405.136,       78.306,      3708.0,           0.0 !   !END!
2352 ! X =       406.564,       78.391,      3354.0,           0.0 !   !END!
2353 ! X =       407.992,       78.475,      3352.0,           0.0 !   !END!
2354 ! X =       409.420,       78.560,      3830.0,           0.0 !   !END!
2355 ! X =       410.848,       78.646,      3525.0,           0.0 !   !END!
2356 ! X =       412.276,       78.731,      3657.0,           0.0 !   !END!
2357 ! X =       413.704,       78.817,      3636.0,           0.0 !   !END!
2358 ! X =       415.132,       78.904,      3535.0,           0.0 !   !END!
2359 ! X =       416.560,       78.990,      3108.0,           0.0 !   !END!
2360 ! X =       417.988,       79.077,      3240.0,           0.0 !   !END!
2361 ! X =       427.983,       79.693,      3351.0,           0.0 !   !END!
2362 ! X =       429.411,       79.783,      3509.0,           0.0 !   !END!
2363 ! X =       430.839,       79.872,      3544.0,           0.0 !   !END!
2364 ! X =       432.267,       79.962,      3232.0,           0.0 !   !END!
2365 ! X =       433.695,       80.052,      3358.0,           0.0 !   !END!
2366 ! X =       435.122,       80.142,      3588.0,           0.0 !   !END!
2367 ! X =       436.550,       80.233,      3212.0,           0.0 !   !END!
2368 ! X =       437.978,       80.324,      3066.0,           0.0 !   !END!
2369 ! X =       439.406,       80.416,      3462.0,           0.0 !   !END!
2370 ! X =       440.833,       80.507,      3434.0,           0.0 !   !END!
2371 ! X =       362.189,       77.714,      2865.0,           0.0 !   !END!
2372 ! X =       363.617,       77.789,      3452.0,           0.0 !   !END!
2373 ! X =       365.046,       77.865,      3840.0,           0.0 !   !END!
2374 ! X =       366.474,       77.941,      3149.0,           0.0 !   !END!
2375 ! X =       369.330,       78.094,      3114.0,           0.0 !   !END!
2376 ! X =       370.758,       78.171,      3352.0,           0.0 !   !END!
2377 ! X =       372.187,       78.249,      3767.0,           0.0 !   !END!
2378 ! X =       373.615,       78.326,      3626.0,           0.0 !   !END!
2379 ! X =       375.043,       78.404,      3408.0,           0.0 !   !END!
2380 ! X =       376.471,       78.483,      4014.0,           0.0 !   !END!
2381 ! X =       377.899,       78.561,      3840.0,           0.0 !   !END!
2382 ! X =       379.327,       78.640,      3657.0,           0.0 !   !END!
2383 ! X =       380.755,       78.719,      3096.0,           0.0 !   !END!
2384 ! X =       382.183,       78.798,      3373.0,           0.0 !   !END!
2385 ! X =       383.611,       78.878,      3393.0,           0.0 !   !END!
2386 ! X =       385.039,       78.958,      3810.0,           0.0 !   !END!
2387 ! X =       386.467,       79.038,      3627.0,           0.0 !   !END!
2388 ! X =       387.895,       79.119,      3596.0,           0.0 !   !END!
2389 ! X =       389.323,       79.200,      3564.0,           0.0 !   !END!
2390 ! X =       390.751,       79.281,      3793.0,           0.0 !   !END!
2391 ! X =       392.179,       79.363,      3645.0,           0.0 !   !END!
2392 ! X =       393.607,       79.444,      3742.0,           0.0 !   !END!
2393 ! X =       395.035,       79.526,      3581.0,           0.0 !   !END!
2394 ! X =       396.462,       79.609,      3283.0,           0.0 !   !END!
2395 ! X =       397.890,       79.691,      3143.0,           0.0 !   !END!
2396 ! X =       399.318,       79.774,      3413.0,           0.0 !   !END!
2397 ! X =       400.746,       79.858,      3396.0,           0.0 !   !END!
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2398 ! X =       402.174,       79.941,      3718.0,           0.0 !   !END!
2399 ! X =       403.602,       80.025,      3662.0,           0.0 !   !END!
2400 ! X =       405.029,       80.109,      3449.0,           0.0 !   !END!
2401 ! X =       406.457,       80.194,      3192.0,           0.0 !   !END!
2402 ! X =       407.885,       80.278,      3738.0,           0.0 !   !END!
2403 ! X =       409.312,       80.364,      3751.0,           0.0 !   !END!
2404 ! X =       410.740,       80.449,      3442.0,           0.0 !   !END!
2405 ! X =       412.168,       80.534,      3657.0,           0.0 !   !END!
2406 ! X =       413.595,       80.620,      3592.0,           0.0 !   !END!
2407 ! X =       415.023,       80.707,      3449.0,           0.0 !   !END!
2408 ! X =       416.451,       80.793,      3230.0,           0.0 !   !END!
2409 ! X =       417.878,       80.880,      2926.0,           0.0 !   !END!
2410 ! X =       427.871,       81.496,      3108.0,           0.0 !   !END!
2411 ! X =       429.298,       81.585,      3488.0,           0.0 !   !END!
2412 ! X =       430.726,       81.675,      3657.0,           0.0 !   !END!
2413 ! X =       432.153,       81.765,      3640.0,           0.0 !   !END!
2414 ! X =       433.581,       81.855,      3245.0,           0.0 !   !END!
2415 ! X =       435.008,       81.945,      3036.0,           0.0 !   !END!
2416 ! X =       436.435,       82.036,      3279.0,           0.0 !   !END!
2417 ! X =       437.863,       82.127,      2945.0,           0.0 !   !END!
2418 ! X =       439.290,       82.218,      3306.0,           0.0 !   !END!
2419 ! X =       440.717,       82.310,      3231.0,           0.0 !   !END!
2420 ! X =       442.145,       82.402,      3263.0,           0.0 !   !END!
2421 ! X =       362.094,       79.518,      2808.0,           0.0 !   !END!
2422 ! X =       363.522,       79.593,      3535.0,           0.0 !   !END!
2423 ! X =       364.950,       79.669,      3698.0,           0.0 !   !END!
2424 ! X =       366.378,       79.745,      3236.0,           0.0 !   !END!
2425 ! X =       367.805,       79.821,      3092.0,           0.0 !   !END!
2426 ! X =       369.233,       79.898,      2789.0,           0.0 !   !END!
2427 ! X =       370.661,       79.975,      3032.0,           0.0 !   !END!
2428 ! X =       372.089,       80.052,      3295.0,           0.0 !   !END!
2429 ! X =       373.516,       80.130,      3869.0,           0.0 !   !END!
2430 ! X =       374.944,       80.208,      3866.0,           0.0 !   !END!
2431 ! X =       376.372,       80.286,      3991.0,           0.0 !   !END!
2432 ! X =       377.800,       80.365,      3888.0,           0.0 !   !END!
2433 ! X =       379.227,       80.443,      3596.0,           0.0 !   !END!
2434 ! X =       380.655,       80.522,      3875.0,           0.0 !   !END!
2435 ! X =       382.083,       80.602,      3155.0,           0.0 !   !END!
2436 ! X =       383.510,       80.682,      3802.0,           0.0 !   !END!
2437 ! X =       384.938,       80.762,      3708.0,           0.0 !   !END!
2438 ! X =       386.366,       80.842,      3748.0,           0.0 !   !END!
2439 ! X =       387.793,       80.922,      3519.0,           0.0 !   !END!
2440 ! X =       389.221,       81.003,      3413.0,           0.0 !   !END!
2441 ! X =       390.648,       81.084,      3730.0,           0.0 !   !END!
2442 ! X =       392.076,       81.166,      3634.0,           0.0 !   !END!
2443 ! X =       393.503,       81.248,      3789.0,           0.0 !   !END!
2444 ! X =       394.931,       81.330,      3511.0,           0.0 !   !END!
2445 ! X =       396.358,       81.412,      3605.0,           0.0 !   !END!
2446 ! X =       397.786,       81.495,      3291.0,           0.0 !   !END!
2447 ! X =       399.213,       81.578,      3230.0,           0.0 !   !END!
2448 ! X =       400.641,       81.661,      3692.0,           0.0 !   !END!
2449 ! X =       402.068,       81.744,      3579.0,           0.0 !   !END!
2450 ! X =       403.495,       81.828,      3634.0,           0.0 !   !END!
2451 ! X =       404.923,       81.912,      3203.0,           0.0 !   !END!
2452 ! X =       406.350,       81.997,      3514.0,           0.0 !   !END!
2453 ! X =       407.778,       82.082,      3703.0,           0.0 !   !END!
2454 ! X =       409.205,       82.167,      3531.0,           0.0 !   !END!
2455 ! X =       410.632,       82.252,      3272.0,           0.0 !   !END!
2456 ! X =       412.059,       82.338,      3550.0,           0.0 !   !END!
2457 ! X =       413.487,       82.423,      3720.0,           0.0 !   !END!
2458 ! X =       414.914,       82.510,      3618.0,           0.0 !   !END!
2459 ! X =       416.341,       82.596,      3515.0,           0.0 !   !END!
2460 ! X =       417.768,       82.683,      3387.0,           0.0 !   !END!
2461 ! X =       419.196,       82.770,      3136.0,           0.0 !   !END!
2462 ! X =       427.758,       83.299,      3129.0,           0.0 !   !END!
2463 ! X =       429.186,       83.388,      3429.0,           0.0 !   !END!
2464 ! X =       430.613,       83.478,      3472.0,           0.0 !   !END!
2465 ! X =       432.040,       83.567,      3808.0,           0.0 !   !END!
2466 ! X =       433.467,       83.657,      3578.0,           0.0 !   !END!
2467 ! X =       434.894,       83.748,      3365.0,           0.0 !   !END!
2468 ! X =       436.321,       83.839,      3211.0,           0.0 !   !END!
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2469 ! X =       437.748,       83.929,      2966.0,           0.0 !   !END!
2470 ! X =       439.175,       84.021,      3116.0,           0.0 !   !END!
2471 ! X =       440.601,       84.112,      3453.0,           0.0 !   !END!
2472 ! X =       442.028,       84.204,      3101.0,           0.0 !   !END!
2473 ! X =       443.455,       84.296,      3435.0,           0.0 !   !END!
2474 ! X =       363.426,       81.397,      3362.0,           0.0 !   !END!
2475 ! X =       364.854,       81.473,      3443.0,           0.0 !   !END!
2476 ! X =       366.281,       81.549,      3657.0,           0.0 !   !END!
2477 ! X =       367.709,       81.625,      3495.0,           0.0 !   !END!
2478 ! X =       369.136,       81.702,      2783.0,           0.0 !   !END!
2479 ! X =       370.563,       81.779,      2804.0,           0.0 !   !END!
2480 ! X =       371.991,       81.856,      3271.0,           0.0 !   !END!
2481 ! X =       373.418,       81.934,      3284.0,           0.0 !   !END!
2482 ! X =       374.846,       82.011,      3439.0,           0.0 !   !END!
2483 ! X =       376.273,       82.090,      3550.0,           0.0 !   !END!
2484 ! X =       377.700,       82.168,      3778.0,           0.0 !   !END!
2485 ! X =       379.128,       82.247,      3649.0,           0.0 !   !END!
2486 ! X =       380.555,       82.326,      3352.0,           0.0 !   !END!
2487 ! X =       381.982,       82.405,      3372.0,           0.0 !   !END!
2488 ! X =       383.409,       82.485,      3779.0,           0.0 !   !END!
2489 ! X =       384.837,       82.565,      3657.0,           0.0 !   !END!
2490 ! X =       386.264,       82.645,      3525.0,           0.0 !   !END!
2491 ! X =       387.691,       82.726,      3670.0,           0.0 !   !END!
2492 ! X =       389.118,       82.807,      3437.0,           0.0 !   !END!
2493 ! X =       390.546,       82.888,      3464.0,           0.0 !   !END!
2494 ! X =       391.973,       82.969,      3640.0,           0.0 !   !END!
2495 ! X =       393.400,       83.051,      3969.0,           0.0 !   !END!
2496 ! X =       394.827,       83.133,      3699.0,           0.0 !   !END!
2497 ! X =       396.254,       83.215,      3672.0,           0.0 !   !END!
2498 ! X =       397.681,       83.298,      3530.0,           0.0 !   !END!
2499 ! X =       399.108,       83.381,      3230.0,           0.0 !   !END!
2500 ! X =       400.535,       83.464,      3530.0,           0.0 !   !END!
2501 ! X =       401.962,       83.548,      3552.0,           0.0 !   !END!
2502 ! X =       403.389,       83.631,      3596.0,           0.0 !   !END!
2503 ! X =       404.816,       83.715,      3047.0,           0.0 !   !END!
2504 ! X =       406.243,       83.800,      3479.0,           0.0 !   !END!
2505 ! X =       407.670,       83.885,      3490.0,           0.0 !   !END!
2506 ! X =       409.097,       83.970,      3388.0,           0.0 !   !END!
2507 ! X =       410.524,       84.055,      3339.0,           0.0 !   !END!
2508 ! X =       411.951,       84.140,      3641.0,           0.0 !   !END!
2509 ! X =       413.378,       84.226,      3551.0,           0.0 !   !END!
2510 ! X =       414.805,       84.313,      3641.0,           0.0 !   !END!
2511 ! X =       416.232,       84.399,      3687.0,           0.0 !   !END!
2512 ! X =       417.659,       84.486,      3545.0,           0.0 !   !END!
2513 ! X =       434.779,       85.550,      3196.0,           0.0 !   !END!
2514 ! X =       436.206,       85.641,      3113.0,           0.0 !   !END!
2515 ! X =       440.486,       85.915,      3150.0,           0.0 !   !END!
2516 ! X =       441.912,       86.007,      3021.0,           0.0 !   !END!
2517 ! X =       443.339,       86.099,      3352.0,           0.0 !   !END!
2518 ! X =       363.331,       83.200,      3197.0,           0.0 !   !END!
2519 ! X =       364.758,       83.276,      3516.0,           0.0 !   !END!
2520 ! X =       366.185,       83.352,      3680.0,           0.0 !   !END!
2521 ! X =       367.612,       83.429,      3842.0,           0.0 !   !END!
2522 ! X =       369.039,       83.505,      3338.0,           0.0 !   !END!
2523 ! X =       370.466,       83.582,      2812.0,           0.0 !   !END!
2524 ! X =       371.893,       83.659,      3962.0,           0.0 !   !END!
2525 ! X =       373.320,       83.737,      3813.0,           0.0 !   !END!
2526 ! X =       374.747,       83.815,      3787.0,           0.0 !   !END!
2527 ! X =       376.174,       83.893,      3655.0,           0.0 !   !END!
2528 ! X =       377.601,       83.971,      3891.0,           0.0 !   !END!
2529 ! X =       379.028,       84.050,      3995.0,           0.0 !   !END!
2530 ! X =       380.455,       84.129,      3759.0,           0.0 !   !END!
2531 ! X =       381.882,       84.209,      3657.0,           0.0 !   !END!
2532 ! X =       384.735,       84.368,      3733.0,           0.0 !   !END!
2533 ! X =       386.162,       84.448,      3703.0,           0.0 !   !END!
2534 ! X =       387.589,       84.529,      3422.0,           0.0 !   !END!
2535 ! X =       389.016,       84.610,      3353.0,           0.0 !   !END!
2536 ! X =       390.443,       84.691,      3291.0,           0.0 !   !END!
2537 ! X =       391.870,       84.772,      3596.0,           0.0 !   !END!
2538 ! X =       393.296,       84.854,      3667.0,           0.0 !   !END!
2539 ! X =       394.723,       84.936,      3962.0,           0.0 !   !END!
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2540 ! X =       396.150,       85.018,      3810.0,           0.0 !   !END!
2541 ! X =       397.577,       85.101,      3555.0,           0.0 !   !END!
2542 ! X =       399.003,       85.184,      3291.0,           0.0 !   !END!
2543 ! X =       400.430,       85.267,      3277.0,           0.0 !   !END!
2544 ! X =       401.857,       85.351,      3527.0,           0.0 !   !END!
2545 ! X =       403.283,       85.434,      3596.0,           0.0 !   !END!
2546 ! X =       404.710,       85.518,      3138.0,           0.0 !   !END!
2547 ! X =       406.136,       85.603,      3251.0,           0.0 !   !END!
2548 ! X =       407.563,       85.688,      3108.0,           0.0 !   !END!
2549 ! X =       408.990,       85.772,      3291.0,           0.0 !   !END!
2550 ! X =       410.416,       85.858,      3535.0,           0.0 !   !END!
2551 ! X =       411.843,       85.943,      3535.0,           0.0 !   !END!
2552 ! X =       413.269,       86.029,      3435.0,           0.0 !   !END!
2553 ! X =       414.696,       86.115,      3534.0,           0.0 !   !END!
2554 ! X =       436.091,       87.444,      3482.0,           0.0 !   !END!
2555 ! X =       441.796,       87.809,      2786.0,           0.0 !   !END!
2556 ! X =       443.222,       87.901,      3138.0,           0.0 !   !END!
2557 ! X =       366.089,       85.156,      3535.0,           0.0 !   !END!
2558 ! X =       367.515,       85.232,      3771.0,           0.0 !   !END!
2559 ! X =       368.942,       85.309,      3403.0,           0.0 !   !END!
2560 ! X =       371.795,       85.463,      3168.0,           0.0 !   !END!
2561 ! X =       373.222,       85.540,      3313.0,           0.0 !   !END!
2562 ! X =       374.648,       85.618,      3305.0,           0.0 !   !END!
2563 ! X =       376.075,       85.696,      3596.0,           0.0 !   !END!
2564 ! X =       377.502,       85.775,      3586.0,           0.0 !   !END!
2565 ! X =       378.928,       85.854,      3733.0,           0.0 !   !END!
2566 ! X =       380.355,       85.933,      3840.0,           0.0 !   !END!
2567 ! X =       384.634,       86.171,      3613.0,           0.0 !   !END!
2568 ! X =       386.061,       86.252,      3616.0,           0.0 !   !END!
2569 ! X =       387.487,       86.332,      3954.0,           0.0 !   !END!
2570 ! X =       388.914,       86.413,      3782.0,           0.0 !   !END!
2571 ! X =       390.340,       86.494,      3637.0,           0.0 !   !END!
2572 ! X =       391.766,       86.575,      3217.0,           0.0 !   !END!
2573 ! X =       393.193,       86.657,      3352.0,           0.0 !   !END!
2574 ! X =       394.619,       86.739,      3413.0,           0.0 !   !END!
2575 ! X =       396.046,       86.821,      3703.0,           0.0 !   !END!
2576 ! X =       397.472,       86.904,      3686.0,           0.0 !   !END!
2577 ! X =       398.898,       86.987,      3452.0,           0.0 !   !END!
2578 ! X =       400.325,       87.070,      3297.0,           0.0 !   !END!
2579 ! X =       401.751,       87.154,      3042.0,           0.0 !   !END!
2580 ! X =       403.177,       87.237,      3121.0,           0.0 !   !END!
2581 ! X =       404.603,       87.321,      2926.0,           0.0 !   !END!
2582 ! X =       406.030,       87.406,      3272.0,           0.0 !   !END!
2583 ! X =       407.456,       87.490,      3183.0,           0.0 !   !END!
2584 ! X =       408.882,       87.575,      3424.0,           0.0 !   !END!
2585 ! X =       410.308,       87.661,      3479.0,           0.0 !   !END!
2586 ! X =       411.734,       87.746,      3576.0,           0.0 !   !END!
2587 ! X =       413.161,       87.832,      3365.0,           0.0 !   !END!
2588 ! X =       441.680,       89.611,      2864.0,           0.0 !   !END!
2589 ! X =       367.419,       87.035,      3215.0,           0.0 !   !END!
2590 ! X =       368.845,       87.112,      3301.0,           0.0 !   !END!
2591 ! X =       370.271,       87.189,      2742.0,           0.0 !   !END!
2592 ! X =       371.697,       87.266,      3102.0,           0.0 !   !END!
2593 ! X =       373.124,       87.344,      3449.0,           0.0 !   !END!
2594 ! X =       374.550,       87.422,      3376.0,           0.0 !   !END!
2595 ! X =       375.976,       87.500,      3332.0,           0.0 !   !END!
2596 ! X =       377.402,       87.578,      3425.0,           0.0 !   !END!
2597 ! X =       378.828,       87.657,      3840.0,           0.0 !   !END!
2598 ! X =       380.255,       87.736,      3794.0,           0.0 !   !END!
2599 ! X =       385.959,       88.055,      3515.0,           0.0 !   !END!
2600 ! X =       387.385,       88.135,      3442.0,           0.0 !   !END!
2601 ! X =       388.811,       88.216,      3657.0,           0.0 !   !END!
2602 ! X =       390.237,       88.297,      3799.0,           0.0 !   !END!
2603 ! X =       391.663,       88.378,      3683.0,           0.0 !   !END!
2604 ! X =       393.089,       88.460,      3496.0,           0.0 !   !END!
2605 ! X =       394.515,       88.542,      3048.0,           0.0 !   !END!
2606 ! X =       395.941,       88.624,      3267.0,           0.0 !   !END!
2607 ! X =       397.367,       88.707,      3266.0,           0.0 !   !END!
2608 ! X =       398.793,       88.790,      3005.0,           0.0 !   !END!
2609 ! X =       405.923,       89.209,      2878.0,           0.0 !   !END!
2610 ! X =       407.349,       89.293,      2890.0,           0.0 !   !END!
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2611 ! X =       408.774,       89.378,      3145.0,           0.0 !   !END!
2612 ! X =       410.200,       89.463,      3147.0,           0.0 !   !END!
2613 ! X =       411.626,       89.549,      3267.0,           0.0 !   !END!
2614 ! X =       413.052,       89.635,      3361.0,           0.0 !   !END!
2615 ! X =       414.478,       89.721,      3413.0,           0.0 !   !END!
2616 ! X =       371.600,       89.069,      3347.0,           0.0 !   !END!
2617 ! X =       373.025,       89.147,      3643.0,           0.0 !   !END!
2618 ! X =       374.451,       89.225,      3840.0,           0.0 !   !END!
2619 ! X =       375.877,       89.303,      3743.0,           0.0 !   !END!
2620 ! X =       377.303,       89.381,      3702.0,           0.0 !   !END!
2621 ! X =       378.729,       89.460,      3837.0,           0.0 !   !END!
2622 ! X =       380.155,       89.539,      3779.0,           0.0 !   !END!
2623 ! X =       381.580,       89.618,      3535.0,           0.0 !   !END!
2624 ! X =       385.858,       89.858,      3474.0,           0.0 !   !END!
2625 ! X =       390.135,       90.100,      3149.0,           0.0 !   !END!
2626 ! X =       391.560,       90.181,      3383.0,           0.0 !   !END!
2627 ! X =       392.986,       90.263,      3600.0,           0.0 !   !END!
2628 ! X =       394.412,       90.345,      3360.0,           0.0 !   !END!
2629 ! X =       395.837,       90.427,      3237.0,           0.0 !   !END!
2630 ! X =       410.092,       91.266,      3046.0,           0.0 !   !END!
2631 ! X =       411.518,       91.352,      2808.0,           0.0 !   !END!
2632 ! X =       412.943,       91.437,      3048.0,           0.0 !   !END!
2633 ! X =       414.369,       91.523,      3198.0,           0.0 !   !END!
2634 ! X =       415.794,       91.610,      3076.0,           0.0 !   !END!
2635 ! X =       374.353,       91.028,      3960.0,           0.0 !   !END!
2636 ! X =       375.778,       91.106,      3779.0,           0.0 !   !END!
2637 ! X =       377.204,       91.184,      3740.0,           0.0 !   !END!
2638 ! X =       378.629,       91.263,      3753.0,           0.0 !   !END!
2639 ! X =       380.055,       91.342,      3555.0,           0.0 !   !END!
2640 ! X =       381.480,       91.421,      3468.0,           0.0 !   !END!
2641 ! X =       382.905,       91.501,      3520.0,           0.0 !   !END!
2642 ! X =       392.883,       92.066,      3047.0,           0.0 !   !END!
2643 ! X =       394.308,       92.148,      2986.0,           0.0 !   !END!
2644 ! X =       395.733,       92.230,      2926.0,           0.0 !   !END!
2645 ! X =       411.409,       93.154,      3108.0,           0.0 !   !END!
2646 ! X =       412.834,       93.240,      2804.0,           0.0 !   !END!
2647 ! X =       414.259,       93.326,      2951.0,           0.0 !   !END!
2648 ! X =       415.684,       93.412,      2743.0,           0.0 !   !END!
2649 ! X =       378.529,       93.066,      3801.0,           0.0 !   !END!
2650 ! X =       379.954,       93.145,      3647.0,           0.0 !   !END!
2651 ! X =       397.984,      175.500,      2499.0,           0.0 !   !END!
2652 ! X =       395.063,      177.135,      2593.0,           0.0 !   !END!
2653 ! X =       396.470,      177.217,      2711.0,           0.0 !   !END!
2654 ! X =       397.878,      177.300,      2620.0,           0.0 !   !END!
2655 ! X =       399.285,      177.383,      2438.0,           0.0 !   !END!
2656 ! X =       400.693,      177.466,      2794.0,           0.0 !   !END!
2657 ! X =       394.958,      178.934,      2584.0,           0.0 !   !END!
2658 ! X =       396.365,      179.017,      2877.0,           0.0 !   !END!
2659 ! X =       397.772,      179.099,      2969.0,           0.0 !   !END!
2660 ! X =       399.179,      179.182,      2658.0,           0.0 !   !END!
2661 ! X =       400.586,      179.265,      2987.0,           0.0 !   !END!
2662 ! X =       394.853,      180.734,      2787.0,           0.0 !   !END!
2663 ! X =       396.259,      180.816,      3093.0,           0.0 !   !END!
2664 ! X =       397.666,      180.899,      3108.0,           0.0 !   !END!
2665 ! X =       399.073,      180.982,      2745.0,           0.0 !   !END!
2666 ! X =       400.480,      181.065,      2743.0,           0.0 !   !END!
2667 ! X =       394.747,      182.533,      2854.0,           0.0 !   !END!
2668 ! X =       396.154,      182.616,      3180.0,           0.0 !   !END!
2669 ! X =       397.560,      182.698,      2859.0,           0.0 !   !END!
2670 ! X =       398.967,      182.781,      2651.0,           0.0 !   !END!
2671 ! X =       400.373,      182.864,      3116.0,           0.0 !   !END!
2672 ! X =       394.642,      184.333,      3088.0,           0.0 !   !END!
2673 ! X =       396.048,      184.415,      3065.0,           0.0 !   !END!
2674 ! X =       397.454,      184.498,      3108.0,           0.0 !   !END!
2675 ! X =       398.860,      184.581,      2681.0,           0.0 !   !END!
2676 ! X =       400.266,      184.664,      3291.0,           0.0 !   !END!
2677 ! X =       394.537,      186.132,      2926.0,           0.0 !   !END!
2678 ! X =       395.943,      186.214,      3325.0,           0.0 !   !END!
2679 ! X =       397.348,      186.297,      3354.0,           0.0 !   !END!
2680 ! X =       398.754,      186.380,      2987.0,           0.0 !   !END!
2681 ! X =       400.160,      186.463,      3053.0,           0.0 !   !END!
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2682 ! X =       405.782,      186.799,      3291.0,           0.0 !   !END!
2683 ! X =       407.188,      186.883,      3068.0,           0.0 !   !END!
2684 ! X =       408.593,      186.968,      3074.0,           0.0 !   !END!
2685 ! X =       409.999,      187.053,      3073.0,           0.0 !   !END!
2686 ! X =       411.404,      187.139,      2854.0,           0.0 !   !END!
2687 ! X =       412.810,      187.225,      2727.0,           0.0 !   !END!
2688 ! X =       390.216,      187.687,      3045.0,           0.0 !   !END!
2689 ! X =       395.837,      188.014,      3027.0,           0.0 !   !END!
2690 ! X =       397.243,      188.096,      3474.0,           0.0 !   !END!
2691 ! X =       398.648,      188.179,      3108.0,           0.0 !   !END!
2692 ! X =       400.053,      188.262,      2987.0,           0.0 !   !END!
2693 ! X =       401.458,      188.346,      3496.0,           0.0 !   !END!
2694 ! X =       404.269,      188.513,      3329.0,           0.0 !   !END!
2695 ! X =       405.674,      188.598,      3458.0,           0.0 !   !END!
2696 ! X =       407.079,      188.682,      3311.0,           0.0 !   !END!
2697 ! X =       408.484,      188.767,      3072.0,           0.0 !   !END!
2698 ! X =       409.889,      188.852,      3316.0,           0.0 !   !END!
2699 ! X =       411.294,      188.938,      3070.0,           0.0 !   !END!
2700 ! X =       412.700,      189.024,      2966.0,           0.0 !   !END!
2701 ! X =       388.707,      189.405,      3181.0,           0.0 !   !END!
2702 ! X =       390.112,      189.486,      3108.0,           0.0 !   !END!
2703 ! X =       391.517,      189.567,      2926.0,           0.0 !   !END!
2704 ! X =       395.732,      189.813,      2830.0,           0.0 !   !END!
2705 ! X =       397.137,      189.896,      3074.0,           0.0 !   !END!
2706 ! X =       398.542,      189.978,      3230.0,           0.0 !   !END!
2707 ! X =       399.947,      190.062,      3208.0,           0.0 !   !END!
2708 ! X =       401.351,      190.145,      3108.0,           0.0 !   !END!
2709 ! X =       402.756,      190.229,      3555.0,           0.0 !   !END!
2710 ! X =       404.161,      190.313,      3510.0,           0.0 !   !END!
2711 ! X =       405.566,      190.397,      3549.0,           0.0 !   !END!
2712 ! X =       406.971,      190.481,      3474.0,           0.0 !   !END!
2713 ! X =       408.375,      190.566,      3220.0,           0.0 !   !END!
2714 ! X =       409.780,      190.651,      3180.0,           0.0 !   !END!
2715 ! X =       411.185,      190.737,      3077.0,           0.0 !   !END!
2716 ! X =       388.603,      191.204,      3169.0,           0.0 !   !END!
2717 ! X =       390.008,      191.285,      3466.0,           0.0 !   !END!
2718 ! X =       391.413,      191.367,      3032.0,           0.0 !   !END!
2719 ! X =       392.817,      191.448,      3387.0,           0.0 !   !END!
2720 ! X =       394.222,      191.530,      3018.0,           0.0 !   !END!
2721 ! X =       395.626,      191.612,      2631.0,           0.0 !   !END!
2722 ! X =       397.031,      191.695,      2720.0,           0.0 !   !END!
2723 ! X =       398.435,      191.778,      2872.0,           0.0 !   !END!
2724 ! X =       399.840,      191.861,      3108.0,           0.0 !   !END!
2725 ! X =       401.244,      191.944,      3108.0,           0.0 !   !END!
2726 ! X =       402.649,      192.028,      3386.0,           0.0 !   !END!
2727 ! X =       404.053,      192.112,      3718.0,           0.0 !   !END!
2728 ! X =       405.458,      192.196,      3596.0,           0.0 !   !END!
2729 ! X =       406.862,      192.280,      3553.0,           0.0 !   !END!
2730 ! X =       408.267,      192.365,      3596.0,           0.0 !   !END!
2731 ! X =       409.671,      192.450,      3206.0,           0.0 !   !END!
2732 ! X =       411.075,      192.536,      3413.0,           0.0 !   !END!
2733 ! X =       412.480,      192.622,      3303.0,           0.0 !   !END!
2734 ! X =       384.287,      192.762,      2682.0,           0.0 !   !END!
2735 ! X =       388.500,      193.003,      3380.0,           0.0 !   !END!
2736 ! X =       389.904,      193.084,      3391.0,           0.0 !   !END!
2737 ! X =       391.308,      193.166,      3176.0,           0.0 !   !END!
2738 ! X =       392.713,      193.247,      3344.0,           0.0 !   !END!
2739 ! X =       394.117,      193.329,      3160.0,           0.0 !   !END!
2740 ! X =       395.521,      193.411,      2742.0,           0.0 !   !END!
2741 ! X =       396.925,      193.494,      3176.0,           0.0 !   !END!
2742 ! X =       398.329,      193.577,      3243.0,           0.0 !   !END!
2743 ! X =       399.733,      193.660,      3083.0,           0.0 !   !END!
2744 ! X =       401.137,      193.743,      3374.0,           0.0 !   !END!
2745 ! X =       402.541,      193.827,      3425.0,           0.0 !   !END!
2746 ! X =       403.946,      193.911,      3779.0,           0.0 !   !END!
2747 ! X =       405.350,      193.995,      3772.0,           0.0 !   !END!
2748 ! X =       406.754,      194.079,      3629.0,           0.0 !   !END!
2749 ! X =       408.158,      194.164,      3535.0,           0.0 !   !END!
2750 ! X =       409.562,      194.249,      3181.0,           0.0 !   !END!
2751 ! X =       410.966,      194.335,      2804.0,           0.0 !   !END!
2752 ! X =       384.185,      194.561,      2630.0,           0.0 !   !END!
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2753 ! X =       385.588,      194.642,      2975.0,           0.0 !   !END!
2754 ! X =       386.992,      194.722,      3352.0,           0.0 !   !END!
2755 ! X =       388.396,      194.803,      3020.0,           0.0 !   !END!
2756 ! X =       389.800,      194.884,      3108.0,           0.0 !   !END!
2757 ! X =       391.204,      194.965,      3484.0,           0.0 !   !END!
2758 ! X =       392.608,      195.046,      3352.0,           0.0 !   !END!
2759 ! X =       394.012,      195.128,      3108.0,           0.0 !   !END!
2760 ! X =       395.415,      195.211,      2875.0,           0.0 !   !END!
2761 ! X =       396.819,      195.293,      3195.0,           0.0 !   !END!
2762 ! X =       398.223,      195.376,      3211.0,           0.0 !   !END!
2763 ! X =       399.627,      195.459,      3413.0,           0.0 !   !END!
2764 ! X =       401.030,      195.542,      3565.0,           0.0 !   !END!
2765 ! X =       402.434,      195.626,      3645.0,           0.0 !   !END!
2766 ! X =       403.838,      195.710,      3733.0,           0.0 !   !END!
2767 ! X =       405.241,      195.794,      3779.0,           0.0 !   !END!
2768 ! X =       406.645,      195.878,      3762.0,           0.0 !   !END!
2769 ! X =       408.049,      195.963,      3596.0,           0.0 !   !END!
2770 ! X =       409.452,      196.048,      3409.0,           0.0 !   !END!
2771 ! X =       382.678,      196.281,      2672.0,           0.0 !   !END!
2772 ! X =       384.082,      196.361,      3077.0,           0.0 !   !END!
2773 ! X =       385.486,      196.441,      3179.0,           0.0 !   !END!
2774 ! X =       386.889,      196.521,      3372.0,           0.0 !   !END!
2775 ! X =       388.293,      196.602,      3379.0,           0.0 !   !END!
2776 ! X =       389.696,      196.683,      2822.0,           0.0 !   !END!
2777 ! X =       391.100,      196.764,      2901.0,           0.0 !   !END!
2778 ! X =       392.503,      196.846,      3048.0,           0.0 !   !END!
2779 ! X =       393.906,      196.927,      3325.0,           0.0 !   !END!
2780 ! X =       395.310,      197.010,      3048.0,           0.0 !   !END!
2781 ! X =       396.713,      197.092,      2944.0,           0.0 !   !END!
2782 ! X =       398.117,      197.175,      3053.0,           0.0 !   !END!
2783 ! X =       399.520,      197.258,      3116.0,           0.0 !   !END!
2784 ! X =       400.923,      197.341,      3352.0,           0.0 !   !END!
2785 ! X =       402.327,      197.425,      3691.0,           0.0 !   !END!
2786 ! X =       403.730,      197.508,      3605.0,           0.0 !   !END!
2787 ! X =       405.133,      197.593,      3404.0,           0.0 !   !END!
2788 ! X =       406.537,      197.677,      3063.0,           0.0 !   !END!
2789 ! X =       407.940,      197.762,      3184.0,           0.0 !   !END!
2790 ! X =       409.343,      197.847,      3240.0,           0.0 !   !END!
2791 ! X =       379.770,      197.921,      2884.0,           0.0 !   !END!
2792 ! X =       381.173,      198.000,      2621.0,           0.0 !   !END!
2793 ! X =       382.576,      198.080,      2677.0,           0.0 !   !END!
2794 ! X =       383.980,      198.160,      3091.0,           0.0 !   !END!
2795 ! X =       385.383,      198.240,      3155.0,           0.0 !   !END!
2796 ! X =       386.786,      198.320,      2972.0,           0.0 !   !END!
2797 ! X =       388.189,      198.401,      2952.0,           0.0 !   !END!
2798 ! X =       389.592,      198.482,      2805.0,           0.0 !   !END!
2799 ! X =       390.995,      198.563,      2682.0,           0.0 !   !END!
2800 ! X =       392.398,      198.645,      2846.0,           0.0 !   !END!
2801 ! X =       393.801,      198.726,      3143.0,           0.0 !   !END!
2802 ! X =       395.204,      198.809,      2898.0,           0.0 !   !END!
2803 ! X =       396.607,      198.891,      2865.0,           0.0 !   !END!
2804 ! X =       398.010,      198.974,      3043.0,           0.0 !   !END!
2805 ! X =       399.413,      199.057,      3168.0,           0.0 !   !END!
2806 ! X =       400.816,      199.140,      3535.0,           0.0 !   !END!
2807 ! X =       402.219,      199.223,      3657.0,           0.0 !   !END!
2808 ! X =       403.622,      199.307,      3118.0,           0.0 !   !END!
2809 ! X =       405.025,      199.391,      3240.0,           0.0 !   !END!
2810 ! X =       406.428,      199.476,      3256.0,           0.0 !   !END!
2811 ! X =       379.669,      199.720,      2902.0,           0.0 !   !END!
2812 ! X =       381.071,      199.800,      2636.0,           0.0 !   !END!
2813 ! X =       382.474,      199.879,      2609.0,           0.0 !   !END!
2814 ! X =       383.877,      199.959,      2887.0,           0.0 !   !END!
2815 ! X =       385.280,      200.039,      2698.0,           0.0 !   !END!
2816 ! X =       386.683,      200.119,      2857.0,           0.0 !   !END!
2817 ! X =       388.085,      200.200,      2752.0,           0.0 !   !END!
2818 ! X =       389.488,      200.281,      2634.0,           0.0 !   !END!
2819 ! X =       390.891,      200.362,      2612.0,           0.0 !   !END!
2820 ! X =       392.294,      200.444,      2743.0,           0.0 !   !END!
2821 ! X =       393.696,      200.525,      2727.0,           0.0 !   !END!
2822 ! X =       395.099,      200.607,      2865.0,           0.0 !   !END!
2823 ! X =       396.502,      200.690,      2723.0,           0.0 !   !END!
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2824 ! X =       397.904,      200.772,      2884.0,           0.0 !   !END!
2825 ! X =       399.307,      200.855,      3169.0,           0.0 !   !END!
2826 ! X =       400.709,      200.939,      3108.0,           0.0 !   !END!
2827 ! X =       402.112,      201.022,      3352.0,           0.0 !   !END!
2828 ! X =       403.515,      201.106,      3254.0,           0.0 !   !END!
2829 ! X =       404.917,      201.190,      3008.0,           0.0 !   !END!
2830 ! X =       406.320,      201.275,      2987.0,           0.0 !   !END!
2831 ! X =       379.567,      201.520,      3162.0,           0.0 !   !END!
2832 ! X =       383.775,      201.758,      3108.0,           0.0 !   !END!
2833 ! X =       385.177,      201.838,      2969.0,           0.0 !   !END!
2834 ! X =       386.579,      201.918,      2782.0,           0.0 !   !END!
2835 ! X =       387.982,      201.999,      2688.0,           0.0 !   !END!
2836 ! X =       389.384,      202.080,      2632.0,           0.0 !   !END!
2837 ! X =       390.787,      202.161,      2509.0,           0.0 !   !END!
2838 ! X =       392.189,      202.242,      2583.0,           0.0 !   !END!
2839 ! X =       393.591,      202.324,      2703.0,           0.0 !   !END!
2840 ! X =       394.993,      202.406,      2447.0,           0.0 !   !END!
2841 ! X =       396.396,      202.489,      2621.0,           0.0 !   !END!
2842 ! X =       397.798,      202.571,      2725.0,           0.0 !   !END!
2843 ! X =       399.200,      202.654,      2857.0,           0.0 !   !END!
2844 ! X =       400.603,      202.737,      3004.0,           0.0 !   !END!
2845 ! X =       402.005,      202.821,      3362.0,           0.0 !   !END!
2846 ! X =       403.407,      202.905,      3454.0,           0.0 !   !END!
2847 ! X =       404.809,      202.989,      3092.0,           0.0 !   !END!
2848 ! X =       406.211,      203.073,      3081.0,           0.0 !   !END!
2849 ! X =       383.672,      203.557,      2956.0,           0.0 !   !END!
2850 ! X =       385.074,      203.637,      3143.0,           0.0 !   !END!
2851 ! X =       386.476,      203.717,      3500.0,           0.0 !   !END!
2852 ! X =       387.878,      203.798,      3196.0,           0.0 !   !END!
2853 ! X =       389.280,      203.879,      2946.0,           0.0 !   !END!
2854 ! X =       390.682,      203.960,      2561.0,           0.0 !   !END!
2855 ! X =       392.084,      204.041,      2494.0,           0.0 !   !END!
2856 ! X =       393.486,      204.123,      2582.0,           0.0 !   !END!
2857 ! X =       396.290,      204.287,      2437.0,           0.0 !   !END!
2858 ! X =       397.692,      204.370,      2781.0,           0.0 !   !END!
2859 ! X =       399.094,      204.453,      2678.0,           0.0 !   !END!
2860 ! X =       400.496,      204.536,      2923.0,           0.0 !   !END!
2861 ! X =       401.897,      204.620,      3472.0,           0.0 !   !END!
2862 ! X =       403.299,      204.703,      3352.0,           0.0 !   !END!
2863 ! X =       404.701,      204.788,      3169.0,           0.0 !   !END!
2864 ! X =       406.103,      204.872,      3076.0,           0.0 !   !END!
2865 ! X =       407.505,      204.957,      2998.0,           0.0 !   !END!
2866 ! X =       408.906,      205.042,      2967.0,           0.0 !   !END!
2867 ! X =       410.308,      205.127,      2816.0,           0.0 !   !END!
2868 ! X =       384.971,      205.436,      3352.0,           0.0 !   !END!
2869 ! X =       386.373,      205.516,      3743.0,           0.0 !   !END!
2870 ! X =       387.775,      205.597,      3474.0,           0.0 !   !END!
2871 ! X =       389.176,      205.677,      3247.0,           0.0 !   !END!
2872 ! X =       390.578,      205.759,      3076.0,           0.0 !   !END!
2873 ! X =       391.979,      205.840,      2397.0,           0.0 !   !END!
2874 ! X =       394.783,      206.004,      2613.0,           0.0 !   !END!
2875 ! X =       396.184,      206.086,      2530.0,           0.0 !   !END!
2876 ! X =       397.586,      206.169,      2444.0,           0.0 !   !END!
2877 ! X =       398.987,      206.252,      2616.0,           0.0 !   !END!
2878 ! X =       400.389,      206.335,      2618.0,           0.0 !   !END!
2879 ! X =       401.790,      206.418,      2799.0,           0.0 !   !END!
2880 ! X =       403.192,      206.502,      2863.0,           0.0 !   !END!
2881 ! X =       404.593,      206.586,      3133.0,           0.0 !   !END!
2882 ! X =       405.994,      206.670,      3525.0,           0.0 !   !END!
2883 ! X =       407.396,      206.755,      3596.0,           0.0 !   !END!
2884 ! X =       408.797,      206.840,      3352.0,           0.0 !   !END!
2885 ! X =       410.198,      206.925,      3063.0,           0.0 !   !END!
2886 ! X =       411.600,      207.011,      2841.0,           0.0 !   !END!
2887 ! X =       386.270,      207.315,      3535.0,           0.0 !   !END!
2888 ! X =       387.671,      207.395,      3314.0,           0.0 !   !END!
2889 ! X =       389.072,      207.476,      3108.0,           0.0 !   !END!
2890 ! X =       390.474,      207.557,      2621.0,           0.0 !   !END!
2891 ! X =       391.875,      207.639,      2204.0,           0.0 !   !END!
2892 ! X =       393.276,      207.720,      2499.0,           0.0 !   !END!
2893 ! X =       394.677,      207.802,      2408.0,           0.0 !   !END!
2894 ! X =       396.078,      207.885,      2600.0,           0.0 !   !END!
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2895 ! X =       397.479,      207.967,      2803.0,           0.0 !   !END!
2896 ! X =       398.881,      208.050,      2923.0,           0.0 !   !END!
2897 ! X =       400.282,      208.133,      3137.0,           0.0 !   !END!
2898 ! X =       401.683,      208.217,      2990.0,           0.0 !   !END!
2899 ! X =       403.084,      208.301,      2949.0,           0.0 !   !END!
2900 ! X =       404.485,      208.385,      3157.0,           0.0 !   !END!
2901 ! X =       405.886,      208.469,      3227.0,           0.0 !   !END!
2902 ! X =       410.089,      208.724,      3428.0,           0.0 !   !END!
2903 ! X =       387.567,      209.194,      2845.0,           0.0 !   !END!
2904 ! X =       388.968,      209.275,      2621.0,           0.0 !   !END!
2905 ! X =       390.369,      209.356,      2500.0,           0.0 !   !END!
2906 ! X =       391.770,      209.437,      2133.0,           0.0 !   !END!
2907 ! X =       393.171,      209.519,      2499.0,           0.0 !   !END!
2908 ! X =       394.572,      209.601,      2776.0,           0.0 !   !END!
2909 ! X =       395.972,      209.683,      2941.0,           0.0 !   !END!
2910 ! X =       397.373,      209.766,      3446.0,           0.0 !   !END!
2911 ! X =       398.774,      209.849,      3657.0,           0.0 !   !END!
2912 ! X =       222.462,      372.208,      1524.0,           0.0 !   !END!
2913 ! X =       228.286,      372.225,      1585.0,           0.0 !   !END!
2914 ! X =       230.227,      372.231,      1646.0,           0.0 !   !END!
2915 ! X =       216.634,      374.132,      1560.0,           0.0 !   !END!
2916 ! X =       218.575,      374.137,      1526.0,           0.0 !   !END!
2917 ! X =       220.516,      374.143,      1524.0,           0.0 !   !END!
2918 ! X =       222.457,      374.149,      1524.0,           0.0 !   !END!
2919 ! X =       224.398,      374.154,      1531.0,           0.0 !   !END!
2920 ! X =       226.339,      374.160,      1580.0,           0.0 !   !END!
2921 ! X =       228.280,      374.166,      1851.0,           0.0 !   !END!
2922 ! X =       230.221,      374.172,      2256.0,           0.0 !   !END!
2923 ! X =       249.631,      374.235,      2301.0,           0.0 !   !END!
2924 ! X =       251.572,      374.241,      2194.0,           0.0 !   !END!
2925 ! X =       216.628,      376.073,      1761.0,           0.0 !   !END!
2926 ! X =       218.569,      376.078,      1640.0,           0.0 !   !END!
2927 ! X =       220.510,      376.084,      1744.0,           0.0 !   !END!
2928 ! X =       222.451,      376.090,      1536.0,           0.0 !   !END!
2929 ! X =       224.392,      376.095,      1661.0,           0.0 !   !END!
2930 ! X =       226.333,      376.101,      1925.0,           0.0 !   !END!
2931 ! X =       228.274,      376.107,      1984.0,           0.0 !   !END!
2932 ! X =       230.215,      376.113,      2316.0,           0.0 !   !END!
2933 ! X =       243.801,      376.156,      2236.0,           0.0 !   !END!
2934 ! X =       245.742,      376.163,      1957.0,           0.0 !   !END!
2935 ! X =       247.683,      376.169,      1767.0,           0.0 !   !END!
2936 ! X =       249.624,      376.176,      1830.0,           0.0 !   !END!
2937 ! X =       251.565,      376.182,      1711.0,           0.0 !   !END!
2938 ! X =       253.506,      376.189,      1652.0,           0.0 !   !END!
2939 ! X =       255.447,      376.196,      1728.0,           0.0 !   !END!
2940 ! X =       257.388,      376.203,      1686.0,           0.0 !   !END!
2941 ! X =       259.329,      376.209,      1828.0,           0.0 !   !END!
2942 ! X =       261.270,      376.216,      1827.0,           0.0 !   !END!
2943 ! X =       263.211,      376.223,      1961.0,           0.0 !   !END!
2944 ! X =       265.152,      376.230,      2011.0,           0.0 !   !END!
2945 ! X =       267.093,      376.238,      2024.0,           0.0 !   !END!
2946 ! X =       269.034,      376.245,      1952.0,           0.0 !   !END!
2947 ! X =       270.975,      376.252,      1965.0,           0.0 !   !END!
2948 ! X =       272.916,      376.259,      1965.0,           0.0 !   !END!
2949 ! X =       274.857,      376.267,      1839.0,           0.0 !   !END!
2950 ! X =       276.798,      376.274,      1908.0,           0.0 !   !END!
2951 ! X =       278.739,      376.282,      1889.0,           0.0 !   !END!
2952 ! X =       280.680,      376.289,      1889.0,           0.0 !   !END!
2953 ! X =       216.623,      378.014,      1829.0,           0.0 !   !END!
2954 ! X =       218.564,      378.019,      1833.0,           0.0 !   !END!
2955 ! X =       220.505,      378.025,      2009.0,           0.0 !   !END!
2956 ! X =       222.445,      378.031,      2170.0,           0.0 !   !END!
2957 ! X =       224.386,      378.036,      2219.0,           0.0 !   !END!
2958 ! X =       226.327,      378.042,      2134.0,           0.0 !   !END!
2959 ! X =       228.268,      378.048,      1934.0,           0.0 !   !END!
2960 ! X =       230.209,      378.054,      1905.0,           0.0 !   !END!
2961 ! X =       239.913,      378.084,      1890.0,           0.0 !   !END!
2962 ! X =       241.854,      378.091,      1935.0,           0.0 !   !END!
2963 ! X =       243.795,      378.097,      1949.0,           0.0 !   !END!
2964 ! X =       245.736,      378.104,      1755.0,           0.0 !   !END!
2965 ! X =       247.677,      378.110,      1768.0,           0.0 !   !END!
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2966 ! X =       249.618,      378.117,      1645.0,           0.0 !   !END!
2967 ! X =       251.559,      378.123,      1676.0,           0.0 !   !END!
2968 ! X =       253.500,      378.130,      1605.0,           0.0 !   !END!
2969 ! X =       255.440,      378.137,      1585.0,           0.0 !   !END!
2970 ! X =       257.381,      378.143,      1740.0,           0.0 !   !END!
2971 ! X =       259.322,      378.150,      1659.0,           0.0 !   !END!
2972 ! X =       261.263,      378.157,      1950.0,           0.0 !   !END!
2973 ! X =       263.204,      378.164,      1913.0,           0.0 !   !END!
2974 ! X =       265.145,      378.171,      1968.0,           0.0 !   !END!
2975 ! X =       267.086,      378.179,      1653.0,           0.0 !   !END!
2976 ! X =       269.027,      378.186,      1835.0,           0.0 !   !END!
2977 ! X =       270.968,      378.193,      1866.0,           0.0 !   !END!
2978 ! X =       272.909,      378.200,      1847.0,           0.0 !   !END!
2979 ! X =       274.849,      378.208,      2069.0,           0.0 !   !END!
2980 ! X =       276.790,      378.215,      2082.0,           0.0 !   !END!
2981 ! X =       278.731,      378.223,      1795.0,           0.0 !   !END!
2982 ! X =       280.672,      378.230,      1851.0,           0.0 !   !END!
2983 ! X =       282.613,      378.238,      1957.0,           0.0 !   !END!
2984 ! X =       284.554,      378.245,      1920.0,           0.0 !   !END!
2985 ! X =       216.617,      379.955,      1744.0,           0.0 !   !END!
2986 ! X =       218.558,      379.960,      1768.0,           0.0 !   !END!
2987 ! X =       220.499,      379.966,      1768.0,           0.0 !   !END!
2988 ! X =       222.440,      379.971,      1725.0,           0.0 !   !END!
2989 ! X =       224.380,      379.977,      1808.0,           0.0 !   !END!
2990 ! X =       226.321,      379.983,      1753.0,           0.0 !   !END!
2991 ! X =       228.262,      379.989,      1584.0,           0.0 !   !END!
2992 ! X =       230.203,      379.995,      1585.0,           0.0 !   !END!
2993 ! X =       232.144,      380.001,      1898.0,           0.0 !   !END!
2994 ! X =       234.085,      380.007,      2195.0,           0.0 !   !END!
2995 ! X =       236.025,      380.013,      2153.0,           0.0 !   !END!
2996 ! X =       237.966,      380.019,      2316.0,           0.0 !   !END!
2997 ! X =       239.907,      380.025,      1975.0,           0.0 !   !END!
2998 ! X =       241.848,      380.032,      1768.0,           0.0 !   !END!
2999 ! X =       243.789,      380.038,      1793.0,           0.0 !   !END!
3000 ! X =       245.729,      380.044,      1645.0,           0.0 !   !END!
3001 ! X =       247.670,      380.051,      1757.0,           0.0 !   !END!
3002 ! X =       249.611,      380.057,      1828.0,           0.0 !   !END!
3003 ! X =       251.552,      380.064,      1818.0,           0.0 !   !END!
3004 ! X =       253.493,      380.071,      1950.0,           0.0 !   !END!
3005 ! X =       255.434,      380.078,      1950.0,           0.0 !   !END!
3006 ! X =       257.374,      380.084,      2090.0,           0.0 !   !END!
3007 ! X =       259.315,      380.091,      1801.0,           0.0 !   !END!
3008 ! X =       261.256,      380.098,      1626.0,           0.0 !   !END!
3009 ! X =       263.197,      380.105,      1859.0,           0.0 !   !END!
3010 ! X =       265.138,      380.112,      1889.0,           0.0 !   !END!
3011 ! X =       267.079,      380.119,      2133.0,           0.0 !   !END!
3012 ! X =       269.019,      380.127,      2133.0,           0.0 !   !END!
3013 ! X =       270.960,      380.134,      2094.0,           0.0 !   !END!
3014 ! X =       272.901,      380.141,      2090.0,           0.0 !   !END!
3015 ! X =       274.842,      380.148,      2091.0,           0.0 !   !END!
3016 ! X =       276.783,      380.156,      2127.0,           0.0 !   !END!
3017 ! X =       278.724,      380.163,      2073.0,           0.0 !   !END!
3018 ! X =       280.665,      380.171,      2072.0,           0.0 !   !END!
3019 ! X =       228.256,      381.930,      1585.0,           0.0 !   !END!
3020 ! X =       230.197,      381.935,      1566.0,           0.0 !   !END!
3021 ! X =       232.138,      381.941,      1513.0,           0.0 !   !END!
3022 ! X =       234.078,      381.948,      1533.0,           0.0 !   !END!
3023 ! X =       236.019,      381.954,      2156.0,           0.0 !   !END!
3024 ! X =       237.960,      381.960,      2316.0,           0.0 !   !END!
3025 ! X =       239.901,      381.966,      2316.0,           0.0 !   !END!
3026 ! X =       241.842,      381.972,      1829.0,           0.0 !   !END!
3027 ! X =       243.782,      381.979,      1662.0,           0.0 !   !END!
3028 ! X =       245.723,      381.985,      1769.0,           0.0 !   !END!
3029 ! X =       247.664,      381.992,      1586.0,           0.0 !   !END!
3030 ! X =       249.605,      381.998,      1594.0,           0.0 !   !END!
3031 ! X =       251.545,      382.005,      1940.0,           0.0 !   !END!
3032 ! X =       253.486,      382.012,      2125.0,           0.0 !   !END!
3033 ! X =       255.427,      382.018,      2011.0,           0.0 !   !END!
3034 ! X =       257.368,      382.025,      2072.0,           0.0 !   !END!
3035 ! X =       259.308,      382.032,      2133.0,           0.0 !   !END!
3036 ! X =       261.249,      382.039,      2058.0,           0.0 !   !END!
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3037 ! X =       263.190,      382.046,      2015.0,           0.0 !   !END!
3038 ! X =       265.131,      382.053,      2161.0,           0.0 !   !END!
3039 ! X =       267.071,      382.060,      2177.0,           0.0 !   !END!
3040 ! X =       269.012,      382.067,      2194.0,           0.0 !   !END!
3041 ! X =       270.953,      382.075,      2130.0,           0.0 !   !END!
3042 ! X =       274.835,      382.089,      2235.0,           0.0 !   !END!
3043 ! X =       276.775,      382.097,      2194.0,           0.0 !   !END!
3044 ! X =       278.716,      382.104,      2222.0,           0.0 !   !END!
3045 ! X =       280.657,      382.112,      2135.0,           0.0 !   !END!
3046 ! X =       230.191,      383.876,      1646.0,           0.0 !   !END!
3047 ! X =       232.132,      383.882,      1537.0,           0.0 !   !END!
3048 ! X =       234.072,      383.888,      1586.0,           0.0 !   !END!
3049 ! X =       236.013,      383.894,      1829.0,           0.0 !   !END!
3050 ! X =       237.954,      383.901,      2195.0,           0.0 !   !END!
3051 ! X =       239.894,      383.907,      2267.0,           0.0 !   !END!
3052 ! X =       241.835,      383.913,      2121.0,           0.0 !   !END!
3053 ! X =       243.776,      383.919,      1749.0,           0.0 !   !END!
3054 ! X =       245.717,      383.926,      1828.0,           0.0 !   !END!
3055 ! X =       247.657,      383.932,      1929.0,           0.0 !   !END!
3056 ! X =       249.598,      383.939,      1682.0,           0.0 !   !END!
3057 ! X =       251.539,      383.946,      2088.0,           0.0 !   !END!
3058 ! X =       253.479,      383.952,      2133.0,           0.0 !   !END!
3059 ! X =       255.420,      383.959,      2132.0,           0.0 !   !END!
3060 ! X =       257.361,      383.966,      2133.0,           0.0 !   !END!
3061 ! X =       259.301,      383.973,      2194.0,           0.0 !   !END!
3062 ! X =       261.242,      383.980,      2113.0,           0.0 !   !END!
3063 ! X =       263.183,      383.987,      2194.0,           0.0 !   !END!
3064 ! X =       265.124,      383.994,      2194.0,           0.0 !   !END!
3065 ! X =       232.126,      385.823,      1646.0,           0.0 !   !END!
3066 ! X =       234.066,      385.829,      1646.0,           0.0 !   !END!
3067 ! X =       236.007,      385.835,      1646.0,           0.0 !   !END!
3068 ! X =       237.948,      385.841,      1966.0,           0.0 !   !END!
3069 ! X =       239.888,      385.847,      1920.0,           0.0 !   !END!
3070 ! X =       241.829,      385.854,      1986.0,           0.0 !   !END!
3071 ! X =       243.769,      385.860,      2102.0,           0.0 !   !END!
3072 ! X =       245.710,      385.867,      1967.0,           0.0 !   !END!
3073 ! X =       247.651,      385.873,      2133.0,           0.0 !   !END!
3074 ! X =       249.591,      385.880,      2140.0,           0.0 !   !END!
3075 ! X =       251.532,      385.886,      2133.0,           0.0 !   !END!
3076 ! X =       253.473,      385.893,      2194.0,           0.0 !   !END!
3077 ! X =       237.941,      387.782,      1779.0,           0.0 !   !END!
3078 ! X =       239.882,      387.788,      2104.0,           0.0 !   !END!
3079 ! X =       241.823,      387.794,      2369.0,           0.0 !   !END!
3080 ! X =       243.763,      387.801,      2453.0,           0.0 !   !END!
3081 ! X =       245.704,      387.807,      1812.0,           0.0 !   !END!
3082 ! X =       247.644,      387.814,      2115.0,           0.0 !   !END!
3083 ! X =       249.585,      387.820,      2255.0,           0.0 !   !END!
3084 ! X =       251.525,      387.827,      2316.0,           0.0 !   !END!
3085 ! X =       237.935,      389.722,      2155.0,           0.0 !   !END!
3086 ! X =       239.876,      389.729,      2053.0,           0.0 !   !END!
3087 ! X =       241.816,      389.735,      2499.0,           0.0 !   !END!
3088 ! X =       243.757,      389.741,      2287.0,           0.0 !   !END!
3089 ! X =       245.697,      389.748,      2016.0,           0.0 !   !END!
3090 ! X =       247.638,      389.754,      2341.0,           0.0 !   !END!
3091 ! X =       249.578,      389.761,      2256.0,           0.0 !   !END!
3092 ! X =       251.519,      389.767,      2398.0,           0.0 !   !END!
3093 ! X =       243.750,      391.682,      2207.0,           0.0 !   !END!
3094 ! X =       245.691,      391.688,      2255.0,           0.0 !   !END!
3095 ! X =       247.631,      391.695,      1763.0,           0.0 !   !END!
3096 ! X =       249.572,      391.701,      2353.0,           0.0 !   !END!
3097 ! X =       251.512,      391.708,      2211.0,           0.0 !   !END!
3098 ! X =       247.625,      393.635,      2133.0,           0.0 !   !END!
3099 ! X =       249.565,      393.642,      2134.0,           0.0 !   !END!
3100 ! X =       251.505,      393.648,      2167.0,           0.0 !   !END!
3101 ! X =       253.446,      393.655,      2255.0,           0.0 !   !END!
3102 ! X =       247.618,      395.575,      2142.0,           0.0 !   !END!
3103 ! X =       249.558,      395.582,      2033.0,           0.0 !   !END!
3104 ! X =       251.499,      395.589,      2234.0,           0.0 !   !END!
3105 ! X =       253.439,      395.595,      2448.0,           0.0 !   !END!
3106 ! X =       247.612,      397.516,      2179.0,           0.0 !   !END!
3107 ! X =       249.552,      397.522,      1791.0,           0.0 !   !END!
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3108 ! X =       251.492,      397.529,      1890.0,           0.0 !   !END!
3109 ! X =       253.432,      397.536,      2133.0,           0.0 !   !END!
3110 ! X =       249.545,      399.463,      2082.0,           0.0 !   !END!
3111 ! X =       251.485,      399.469,      2112.0,           0.0 !   !END!
3112 ! X =       253.426,      399.476,      2075.0,           0.0 !   !END!
3113 ! X =       249.539,      401.403,      2146.0,           0.0 !   !END!
3114 ! X =       251.479,      401.409,      1925.0,           0.0 !   !END!
3115 ! X =       253.419,      401.416,      1936.0,           0.0 !   !END!
3116 ! X =       249.532,      403.343,      2038.0,           0.0 !   !END!
3117 ! X =       251.472,      403.349,      1816.0,           0.0 !   !END!
3118 ! X =       253.412,      403.356,      1745.0,           0.0 !   !END!
3119 ! X =       251.465,      405.289,      1685.0,           0.0 !   !END!
3120 ! X =       253.405,      405.296,      1663.0,           0.0 !   !END!
3121 ! X =       251.459,      407.229,      1652.0,           0.0 !   !END!
3122 ! X =       253.399,      407.236,      1718.0,           0.0 !   !END!
3123 ! X =       251.648,      408.491,      1621.0,           0.0 !   !END!
3124 ! X =       251.642,      410.431,      1623.0,           0.0 !   !END!
3125 ! X =       249.696,      412.267,      1631.0,           0.0 !   !END!
3126 ! X =       251.635,      412.371,      1658.0,           0.0 !   !END!
3127 ! X =       245.810,      414.194,      1626.0,           0.0 !   !END!
3128 ! X =       247.749,      414.200,      1653.0,           0.0 !   !END!
3129 ! X =       249.689,      414.207,      1645.0,           0.0 !   !END!
3130 ! X =       241.924,      416.120,      1657.0,           0.0 !   !END!
3131 ! X =       243.863,      416.127,      1624.0,           0.0 !   !END!
3132 ! X =       245.803,      416.133,      1683.0,           0.0 !   !END!
3133 ! X =       239.978,      417.957,      1677.0,           0.0 !   !END!
3134 ! X =       241.917,      418.060,      1692.0,           0.0 !   !END!
3135 ! X =       243.857,      418.066,      1721.0,           0.0 !   !END!
3136 ! X =       239.972,      419.896,      1723.0,           0.0 !   !END!
3137 ! X =       239.869,      421.835,      1808.0,           0.0 !   !END!
3138 ! X =       275.932,      219.913,      1957.0,           0.0 !   !END!
3139 ! X =       277.878,      219.920,      1985.0,           0.0 !   !END!
3140 ! X =       277.871,      221.866,      1848.0,           0.0 !   !END!
3141 ! X =       279.817,      221.874,      1837.0,           0.0 !   !END!
3142 ! X =       273.972,      223.798,      1950.0,           0.0 !   !END!
3143 ! X =       275.918,      223.805,      1892.0,           0.0 !   !END!
3144 ! X =       277.864,      223.812,      1860.0,           0.0 !   !END!
3145 ! X =       279.810,      223.819,      1706.0,           0.0 !   !END!
3146 ! X =       273.965,      225.744,      1950.0,           0.0 !   !END!
3147 ! X =       275.910,      225.751,      1828.0,           0.0 !   !END!
3148 ! X =       277.856,      225.758,      1706.0,           0.0 !   !END!
3149 ! X =       272.012,      227.682,      1966.0,           0.0 !   !END!
3150 ! X =       273.957,      227.689,      1848.0,           0.0 !   !END!
3151 ! X =       275.903,      227.697,      1793.0,           0.0 !   !END!
3152 ! X =       277.849,      227.704,      1447.0,           0.0 !   !END!
3153 ! X =       272.005,      229.628,      1950.0,           0.0 !   !END!
3154 ! X =       273.950,      229.635,      1584.0,           0.0 !   !END!
3155 ! X =       275.896,      229.642,      1463.0,           0.0 !   !END!
3156 ! X =       271.997,      231.574,      1767.0,           0.0 !   !END!
3157 ! X =       273.943,      231.581,      1558.0,           0.0 !   !END!
3158 ! X =       270.045,      233.512,      1587.0,           0.0 !   !END!
3159 ! X =       271.990,      233.519,      1435.0,           0.0 !   !END!
3160 ! X =       187.805,      417.519,      2320.0,           0.0 !   !END!
3161 ! X =       189.744,      417.524,      2438.0,           0.0 !   !END!
3162 ! X =       185.861,      419.454,      2258.0,           0.0 !   !END!
3163 ! X =       187.800,      419.459,      2372.0,           0.0 !   !END!
3164 ! X =       189.740,      419.463,      2124.0,           0.0 !   !END!
3165 ! X =       191.679,      419.468,      2067.0,           0.0 !   !END!
3166 ! X =       193.619,      419.473,      2310.0,           0.0 !   !END!
3167 ! X =       195.558,      419.478,      2197.0,           0.0 !   !END!
3168 ! X =       197.498,      419.482,      2255.0,           0.0 !   !END!
3169 ! X =       199.437,      419.487,      2259.0,           0.0 !   !END!
3170 ! X =       203.316,      419.497,      2262.0,           0.0 !   !END!
3171 ! X =       183.917,      421.389,      2377.0,           0.0 !   !END!
3172 ! X =       185.856,      421.393,      2395.0,           0.0 !   !END!
3173 ! X =       187.796,      421.398,      2441.0,           0.0 !   !END!
3174 ! X =       189.735,      421.403,      2379.0,           0.0 !   !END!
3175 ! X =       191.674,      421.407,      2317.0,           0.0 !   !END!
3176 ! X =       193.614,      421.412,      2164.0,           0.0 !   !END!
3177 ! X =       195.553,      421.417,      2148.0,           0.0 !   !END!
3178 ! X =       197.493,      421.422,      2256.0,           0.0 !   !END!
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3179 ! X =       199.432,      421.427,      2140.0,           0.0 !   !END!
3180 ! X =       201.372,      421.432,      2134.0,           0.0 !   !END!
3181 ! X =       203.311,      421.437,      2124.0,           0.0 !   !END!
3182 ! X =       205.250,      421.442,      2090.0,           0.0 !   !END!
3183 ! X =       207.190,      421.447,      2012.0,           0.0 !   !END!
3184 ! X =       185.852,      423.333,      2161.0,           0.0 !   !END!
3185 ! X =       187.791,      423.337,      2195.0,           0.0 !   !END!
3186 ! X =       189.730,      423.342,      1978.0,           0.0 !   !END!
3187 ! X =       191.670,      423.347,      1867.0,           0.0 !   !END!
3188 ! X =       193.609,      423.352,      2256.0,           0.0 !   !END!
3189 ! X =       195.548,      423.356,      2267.0,           0.0 !   !END!
3190 ! X =       197.488,      423.361,      2195.0,           0.0 !   !END!
3191 ! X =       199.427,      423.366,      1841.0,           0.0 !   !END!
3192 ! X =       201.367,      423.371,      1961.0,           0.0 !   !END!
3193 ! X =       203.306,      423.376,      1854.0,           0.0 !   !END!
3194 ! X =       205.245,      423.381,      1951.0,           0.0 !   !END!
3195 ! X =       207.185,      423.387,      1890.0,           0.0 !   !END!
3196 ! X =       209.124,      423.392,      1866.0,           0.0 !   !END!
3197 ! X =       211.063,      423.397,      1762.0,           0.0 !   !END!
3198 ! X =       213.003,      423.403,      2011.0,           0.0 !   !END!
3199 ! X =       214.942,      423.408,      1977.0,           0.0 !   !END!
3200 ! X =       222.700,      423.431,      1886.0,           0.0 !   !END!
3201 ! X =       181.968,      425.263,      2152.0,           0.0 !   !END!
3202 ! X =       183.908,      425.268,      1941.0,           0.0 !   !END!
3203 ! X =       185.847,      425.272,      2135.0,           0.0 !   !END!
3204 ! X =       187.786,      425.277,      1876.0,           0.0 !   !END!
3205 ! X =       189.726,      425.281,      1872.0,           0.0 !   !END!
3206 ! X =       191.665,      425.286,      2027.0,           0.0 !   !END!
3207 ! X =       193.604,      425.291,      2092.0,           0.0 !   !END!
3208 ! X =       195.544,      425.296,      2272.0,           0.0 !   !END!
3209 ! X =       197.483,      425.301,      2256.0,           0.0 !   !END!
3210 ! X =       199.422,      425.306,      2143.0,           0.0 !   !END!
3211 ! X =       201.362,      425.311,      1903.0,           0.0 !   !END!
3212 ! X =       203.301,      425.316,      1841.0,           0.0 !   !END!
3213 ! X =       205.240,      425.321,      1892.0,           0.0 !   !END!
3214 ! X =       207.179,      425.326,      1841.0,           0.0 !   !END!
3215 ! X =       209.119,      425.331,      1957.0,           0.0 !   !END!
3216 ! X =       211.058,      425.337,      1964.0,           0.0 !   !END!
3217 ! X =       212.997,      425.342,      1887.0,           0.0 !   !END!
3218 ! X =       214.937,      425.347,      1838.0,           0.0 !   !END!
3219 ! X =       216.876,      425.353,      1773.0,           0.0 !   !END!
3220 ! X =       218.815,      425.359,      1900.0,           0.0 !   !END!
3221 ! X =       220.755,      425.364,      1830.0,           0.0 !   !END!
3222 ! X =       185.843,      427.211,      2013.0,           0.0 !   !END!
3223 ! X =       187.782,      427.216,      2107.0,           0.0 !   !END!
3224 ! X =       189.721,      427.221,      1841.0,           0.0 !   !END!
3225 ! X =       191.660,      427.225,      2018.0,           0.0 !   !END!
3226 ! X =       193.599,      427.230,      1951.0,           0.0 !   !END!
3227 ! X =       195.539,      427.235,      2047.0,           0.0 !   !END!
3228 ! X =       197.478,      427.240,      2256.0,           0.0 !   !END!
3229 ! X =       199.417,      427.245,      2156.0,           0.0 !   !END!
3230 ! X =       201.356,      427.250,      2195.0,           0.0 !   !END!
3231 ! X =       203.296,      427.255,      1951.0,           0.0 !   !END!
3232 ! X =       205.235,      427.260,      2012.0,           0.0 !   !END!
3233 ! X =       207.174,      427.265,      1890.0,           0.0 !   !END!
3234 ! X =       209.113,      427.271,      1950.0,           0.0 !   !END!
3235 ! X =       211.053,      427.276,      2001.0,           0.0 !   !END!
3236 ! X =       189.716,      429.160,      1998.0,           0.0 !   !END!
3237 ! X =       191.656,      429.165,      2134.0,           0.0 !   !END!
3238 ! X =       193.595,      429.169,      1846.0,           0.0 !   !END!
3239 ! X =       195.534,      429.174,      1841.0,           0.0 !   !END!
3240 ! X =       197.473,      429.179,      1865.0,           0.0 !   !END!
3241 ! X =       199.412,      429.184,      1907.0,           0.0 !   !END!
3242 ! X =       201.351,      429.189,      1995.0,           0.0 !   !END!
3243 ! X =       203.291,      429.194,      2072.0,           0.0 !   !END!
3244 ! X =       205.230,      429.199,      2134.0,           0.0 !   !END!
3245 ! X =       207.169,      429.205,      2072.0,           0.0 !   !END!
3246 ! X =       189.712,      431.099,      1878.0,           0.0 !   !END!
3247 ! X =       191.651,      431.104,      1841.0,           0.0 !   !END!
3248 ! X =       193.590,      431.109,      1841.0,           0.0 !   !END!
3249 ! X =       195.529,      431.113,      1841.0,           0.0 !   !END!
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3250 ! X =       197.468,      431.118,      1841.0,           0.0 !   !END!
3251 ! X =       199.407,      431.123,      1850.0,           0.0 !   !END!
3252 ! X =       201.346,      431.128,      1889.0,           0.0 !   !END!
3253 ! X =       203.286,      431.133,      1898.0,           0.0 !   !END!
3254 ! X =       189.707,      433.038,      1841.0,           0.0 !   !END!
3255 ! X =       191.646,      433.043,      1862.0,           0.0 !   !END!
3256 ! X =       193.585,      433.048,      1841.0,           0.0 !   !END!
3257 ! X =       195.524,      433.053,      1841.0,           0.0 !   !END!
3258 ! X =       197.463,      433.057,      1841.0,           0.0 !   !END!
3259 ! X =       199.402,      433.062,      1866.0,           0.0 !   !END!
3260 ! X =       201.341,      433.067,      1892.0,           0.0 !   !END!
3261 ! X =       203.280,      433.073,      1895.0,           0.0 !   !END!
3262 ! X =       187.763,      434.973,      1951.0,           0.0 !   !END!
3263 ! X =       189.702,      434.977,      2011.0,           0.0 !   !END!
3264 ! X =       191.641,      434.982,      2011.0,           0.0 !   !END!
3265 ! X =       193.580,      434.987,      1909.0,           0.0 !   !END!
3266 ! X =       195.519,      434.992,      1841.0,           0.0 !   !END!
3267 ! X =       197.458,      434.996,      1841.0,           0.0 !   !END!
3268 ! X =       199.397,      435.001,      1860.0,           0.0 !   !END!
3269 ! X =       193.576,      436.926,      1890.0,           0.0 !   !END!
3270 ! X =       195.514,      436.931,      1866.0,           0.0 !   !END!
3271 ! X =       197.453,      436.935,      1908.0,           0.0 !   !END!
3272 ! X =       199.392,      436.940,      2044.0,           0.0 !   !END!
3273 ! X =       193.571,      438.865,      1862.0,           0.0 !   !END!
3274 ! X =       195.510,      438.869,      1841.0,           0.0 !   !END!
3275 ! X =       197.449,      438.874,      1890.0,           0.0 !   !END!
3276 ! X =       191.627,      440.799,      1889.0,           0.0 !   !END!
3277 ! X =       193.566,      440.803,      1856.0,           0.0 !   !END!
3278 ! X =       195.505,      440.808,      1844.0,           0.0 !   !END!
3279 ! X =       197.444,      440.813,      1841.0,           0.0 !   !END!
3280 ! X =       199.382,      440.818,      1936.0,           0.0 !   !END!
3281 ! X =       193.561,      442.742,      1880.0,           0.0 !   !END!
3282 ! X =       195.500,      442.747,      1858.0,           0.0 !   !END!
3283 ! X =       197.439,      442.752,      1841.0,           0.0 !   !END!
3284 ! X =       199.377,      442.757,      1889.0,           0.0 !   !END!
3285 ! X =       190.614,      337.854,      1441.0,           0.0 !   !END!
3286 ! X =       192.556,      337.858,      1424.0,           0.0 !   !END!
3287 ! X =       192.552,      339.800,      1440.0,           0.0 !   !END!
3288 ! X =       194.494,      339.902,      1439.0,           0.0 !   !END!
3289 ! X =       196.436,      339.907,      1425.0,           0.0 !   !END!
3290 ! X =       192.450,      341.742,      1462.0,           0.0 !   !END!
3291 ! X =       194.392,      341.844,      1424.0,           0.0 !   !END!
3292 ! X =       194.387,      343.786,      1464.0,           0.0 !   !END!
3293 ! X =       196.329,      343.791,      1438.0,           0.0 !   !END!
3294 ! X =       198.271,      343.796,      1461.0,           0.0 !   !END!
3295 ! X =       194.382,      345.728,      1463.0,           0.0 !   !END!
3296 ! X =       196.324,      345.733,      1456.0,           0.0 !   !END!
3297 ! X =       198.266,      345.738,      1462.0,           0.0 !   !END!
3298 ! X =       194.377,      347.670,      1463.0,           0.0 !   !END!
3299 ! X =       196.319,      347.675,      1448.0,           0.0 !   !END!
3300 ! X =       401.769,      216.911,      2659.0,           0.0 !   !END!
3301 ! X =       403.715,      216.923,      2853.0,           0.0 !   !END!
3302 ! X =       405.662,      216.934,      3094.0,           0.0 !   !END!
3303 ! X =       407.608,      216.945,      3918.0,           0.0 !   !END!
3304 ! X =       397.865,      218.835,      3390.0,           0.0 !   !END!
3305 ! X =       399.812,      218.846,      2648.0,           0.0 !   !END!
3306 ! X =       401.758,      218.858,      2550.0,           0.0 !   !END!
3307 ! X =       403.704,      218.869,      2804.0,           0.0 !   !END!
3308 ! X =       405.650,      218.880,      3130.0,           0.0 !   !END!
3309 ! X =       407.596,      218.892,      3657.0,           0.0 !   !END!
3310 ! X =       397.854,      220.781,      3040.0,           0.0 !   !END!
3311 ! X =       399.800,      220.793,      2357.0,           0.0 !   !END!
3312 ! X =       401.746,      220.804,      2561.0,           0.0 !   !END!
3313 ! X =       403.693,      220.815,      2653.0,           0.0 !   !END!
3314 ! X =       405.639,      220.827,      2874.0,           0.0 !   !END!
3315 ! X =       407.585,      220.838,      3373.0,           0.0 !   !END!
3316 ! X =       397.843,      222.728,      2487.0,           0.0 !   !END!
3317 ! X =       399.789,      222.739,      2568.0,           0.0 !   !END!
3318 ! X =       401.735,      222.750,      2436.0,           0.0 !   !END!
3319 ! X =       403.681,      222.761,      2849.0,           0.0 !   !END!
3320 ! X =       405.627,      222.773,      2641.0,           0.0 !   !END!
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3321 ! X =       407.574,      222.784,      3277.0,           0.0 !   !END!
3322 ! X =       397.832,      224.674,      2691.0,           0.0 !   !END!
3323 ! X =       399.778,      224.685,      2905.0,           0.0 !   !END!
3324 ! X =       401.724,      224.696,      2539.0,           0.0 !   !END!
3325 ! X =       403.670,      224.707,      2962.0,           0.0 !   !END!
3326 ! X =       405.616,      224.719,      3400.0,           0.0 !   !END!
3327 ! X =       407.562,      224.730,      3108.0,           0.0 !   !END!
3328 ! X =       393.929,      226.597,      2659.0,           0.0 !   !END!
3329 ! X =       395.875,      226.609,      2814.0,           0.0 !   !END!
3330 ! X =       397.821,      226.620,      3207.0,           0.0 !   !END!
3331 ! X =       399.767,      226.631,      3309.0,           0.0 !   !END!
3332 ! X =       401.713,      226.642,      2723.0,           0.0 !   !END!
3333 ! X =       403.659,      226.653,      3386.0,           0.0 !   !END!
3334 ! X =       405.605,      226.665,      3840.0,           0.0 !   !END!
3335 ! X =       407.551,      226.676,      3765.0,           0.0 !   !END!
3336 ! X =       393.918,      228.543,      3240.0,           0.0 !   !END!
3337 ! X =       395.864,      228.554,      3366.0,           0.0 !   !END!
3338 ! X =       397.810,      228.566,      3577.0,           0.0 !   !END!
3339 ! X =       399.756,      228.577,      3058.0,           0.0 !   !END!
3340 ! X =       401.701,      228.588,      2865.0,           0.0 !   !END!
3341 ! X =       403.647,      228.599,      3352.0,           0.0 !   !END!
3342 ! X =       405.593,      228.611,      3367.0,           0.0 !   !END!
3343 ! X =       407.539,      228.622,      3745.0,           0.0 !   !END!
3344 ! X =       391.961,      230.478,      2894.0,           0.0 !   !END!
3345 ! X =       393.907,      230.489,      3762.0,           0.0 !   !END!
3346 ! X =       395.853,      230.500,      3352.0,           0.0 !   !END!
3347 ! X =       397.798,      230.512,      3256.0,           0.0 !   !END!
3348 ! X =       399.744,      230.523,      3522.0,           0.0 !   !END!
3349 ! X =       401.690,      230.534,      3365.0,           0.0 !   !END!
3350 ! X =       405.582,      230.557,      3901.0,           0.0 !   !END!
3351 ! X =       391.950,      232.424,      3352.0,           0.0 !   !END!
3352 ! X =       393.896,      232.435,      3791.0,           0.0 !   !END!
3353 ! X =       395.842,      232.446,      3000.0,           0.0 !   !END!
3354 ! X =       397.787,      232.457,      3196.0,           0.0 !   !END!
3355 ! X =       399.733,      232.469,      3073.0,           0.0 !   !END!
3356 ! X =       401.679,      232.480,      2913.0,           0.0 !   !END!
3357 ! X =       393.885,      234.381,      3183.0,           0.0 !   !END!
3358 ! X =       395.830,      234.392,      2753.0,           0.0 !   !END!
3359 ! X =       397.776,      234.403,      2491.0,           0.0 !   !END!
3360 ! X =       102.106,      388.763,      2872.0,           0.0 !   !END!
3361 ! X =       104.046,      388.765,      2743.0,           0.0 !   !END!
3362 ! X =       105.987,      388.767,      3353.0,           0.0 !   !END!
3363 ! X =       107.927,      388.768,      3467.0,           0.0 !   !END!
3364 ! X =       109.868,      388.770,      3170.0,           0.0 !   !END!
3365 ! X =       111.808,      388.772,      3170.0,           0.0 !   !END!
3366 ! X =       113.748,      388.775,      3121.0,           0.0 !   !END!
3367 ! X =       115.689,      388.777,      3096.0,           0.0 !   !END!
3368 ! X =       117.629,      388.779,      3022.0,           0.0 !   !END!
3369 ! X =       121.510,      388.784,      3146.0,           0.0 !   !END!
3370 ! X =       129.271,      388.794,      3012.0,           0.0 !   !END!
3371 ! X =       131.212,      388.796,      2926.0,           0.0 !   !END!
3372 ! X =       133.152,      388.799,      2499.0,           0.0 !   !END!
3373 ! X =        90.462,      390.694,      3270.0,           0.0 !   !END!
3374 ! X =        92.403,      390.695,      3170.0,           0.0 !   !END!
3375 ! X =        94.343,      390.697,      3160.0,           0.0 !   !END!
3376 ! X =        96.283,      390.698,      3052.0,           0.0 !   !END!
3377 ! X =        98.224,      390.700,      2987.0,           0.0 !   !END!
3378 ! X =       100.164,      390.702,      3002.0,           0.0 !   !END!
3379 ! X =       102.104,      390.703,      3048.0,           0.0 !   !END!
3380 ! X =       104.045,      390.705,      2885.0,           0.0 !   !END!
3381 ! X =       105.985,      390.707,      3360.0,           0.0 !   !END!
3382 ! X =       107.925,      390.709,      3160.0,           0.0 !   !END!
3383 ! X =       109.866,      390.711,      3456.0,           0.0 !   !END!
3384 ! X =       111.806,      390.713,      3251.0,           0.0 !   !END!
3385 ! X =       113.746,      390.715,      3170.0,           0.0 !   !END!
3386 ! X =       115.686,      390.717,      2991.0,           0.0 !   !END!
3387 ! X =       117.627,      390.719,      2613.0,           0.0 !   !END!
3388 ! X =       119.567,      390.722,      3292.0,           0.0 !   !END!
3389 ! X =       121.507,      390.724,      3331.0,           0.0 !   !END!
3390 ! X =       123.448,      390.726,      3180.0,           0.0 !   !END!
3391 ! X =       127.328,      390.732,      3048.0,           0.0 !   !END!
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3392 ! X =       129.269,      390.734,      2621.0,           0.0 !   !END!
3393 ! X =       131.209,      390.737,      2743.0,           0.0 !   !END!
3394 ! X =       133.149,      390.740,      2804.0,           0.0 !   !END!
3395 ! X =        90.461,      392.634,      3048.0,           0.0 !   !END!
3396 ! X =        92.401,      392.636,      2987.0,           0.0 !   !END!
3397 ! X =        94.341,      392.637,      3170.0,           0.0 !   !END!
3398 ! X =        96.282,      392.639,      3111.0,           0.0 !   !END!
3399 ! X =        98.222,      392.640,      3075.0,           0.0 !   !END!
3400 ! X =       100.162,      392.642,      3164.0,           0.0 !   !END!
3401 ! X =       102.102,      392.644,      3130.0,           0.0 !   !END!
3402 ! X =       104.043,      392.645,      2804.0,           0.0 !   !END!
3403 ! X =       105.983,      392.647,      3073.0,           0.0 !   !END!
3404 ! X =       107.923,      392.649,      3132.0,           0.0 !   !END!
3405 ! X =       109.863,      392.651,      3579.0,           0.0 !   !END!
3406 ! X =       111.804,      392.653,      3395.0,           0.0 !   !END!
3407 ! X =       113.744,      392.655,      3293.0,           0.0 !   !END!
3408 ! X =       115.684,      392.657,      2932.0,           0.0 !   !END!
3409 ! X =       117.625,      392.660,      3231.0,           0.0 !   !END!
3410 ! X =       119.565,      392.662,      3424.0,           0.0 !   !END!
3411 ! X =       121.505,      392.664,      3494.0,           0.0 !   !END!
3412 ! X =       123.445,      392.667,      3414.0,           0.0 !   !END!
3413 ! X =       125.386,      392.669,      3143.0,           0.0 !   !END!
3414 ! X =       127.326,      392.672,      2743.0,           0.0 !   !END!
3415 ! X =       129.266,      392.674,      3272.0,           0.0 !   !END!
3416 ! X =       131.206,      392.677,      3269.0,           0.0 !   !END!
3417 ! X =       133.147,      392.680,      3089.0,           0.0 !   !END!
3418 ! X =        92.400,      394.576,      3048.0,           0.0 !   !END!
3419 ! X =        94.340,      394.577,      3148.0,           0.0 !   !END!
3420 ! X =        96.280,      394.579,      3109.0,           0.0 !   !END!
3421 ! X =        98.220,      394.581,      3207.0,           0.0 !   !END!
3422 ! X =       100.160,      394.582,      3414.0,           0.0 !   !END!
3423 ! X =       102.101,      394.584,      3075.0,           0.0 !   !END!
3424 ! X =       104.041,      394.586,      2834.0,           0.0 !   !END!
3425 ! X =       105.981,      394.588,      3293.0,           0.0 !   !END!
3426 ! X =       107.921,      394.589,      3230.0,           0.0 !   !END!
3427 ! X =       109.861,      394.591,      3552.0,           0.0 !   !END!
3428 ! X =       111.802,      394.593,      3249.0,           0.0 !   !END!
3429 ! X =       113.742,      394.596,      3110.0,           0.0 !   !END!
3430 ! X =       115.682,      394.598,      2743.0,           0.0 !   !END!
3431 ! X =       117.622,      394.600,      3357.0,           0.0 !   !END!
3432 ! X =       119.562,      394.602,      3353.0,           0.0 !   !END!
3433 ! X =       121.503,      394.605,      3407.0,           0.0 !   !END!
3434 ! X =       123.443,      394.607,      3255.0,           0.0 !   !END!
3435 ! X =       125.383,      394.610,      3093.0,           0.0 !   !END!
3436 ! X =       127.323,      394.612,      3048.0,           0.0 !   !END!
3437 ! X =       129.264,      394.615,      3505.0,           0.0 !   !END!
3438 ! X =       131.204,      394.617,      3172.0,           0.0 !   !END!
3439 ! X =       133.144,      394.620,      3338.0,           0.0 !   !END!
3440 ! X =       135.084,      394.623,      3537.0,           0.0 !   !END!
3441 ! X =       137.024,      394.626,      3294.0,           0.0 !   !END!
3442 ! X =       138.965,      394.629,      3475.0,           0.0 !   !END!
3443 ! X =       140.905,      394.632,      3303.0,           0.0 !   !END!
3444 ! X =       142.845,      394.635,      3206.0,           0.0 !   !END!
3445 ! X =        92.398,      396.516,      2977.0,           0.0 !   !END!
3446 ! X =        94.338,      396.518,      2987.0,           0.0 !   !END!
3447 ! X =        96.278,      396.519,      3115.0,           0.0 !   !END!
3448 ! X =        98.219,      396.521,      3475.0,           0.0 !   !END!
3449 ! X =       100.159,      396.522,      3536.0,           0.0 !   !END!
3450 ! X =       102.099,      396.524,      3176.0,           0.0 !   !END!
3451 ! X =       104.039,      396.526,      2914.0,           0.0 !   !END!
3452 ! X =       105.979,      396.528,      3455.0,           0.0 !   !END!
3453 ! X =       107.919,      396.530,      3331.0,           0.0 !   !END!
3454 ! X =       109.859,      396.532,      3397.0,           0.0 !   !END!
3455 ! X =       111.800,      396.534,      3342.0,           0.0 !   !END!
3456 ! X =       113.740,      396.536,      3208.0,           0.0 !   !END!
3457 ! X =       115.680,      396.538,      2908.0,           0.0 !   !END!
3458 ! X =       117.620,      396.540,      3230.0,           0.0 !   !END!
3459 ! X =       119.560,      396.542,      3638.0,           0.0 !   !END!
3460 ! X =       121.500,      396.545,      3475.0,           0.0 !   !END!
3461 ! X =       123.440,      396.547,      3405.0,           0.0 !   !END!
3462 ! X =       125.381,      396.550,      3031.0,           0.0 !   !END!
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3463 ! X =       127.321,      396.552,      3414.0,           0.0 !   !END!
3464 ! X =       129.261,      396.555,      3573.0,           0.0 !   !END!
3465 ! X =       131.201,      396.558,      3232.0,           0.0 !   !END!
3466 ! X =       133.141,      396.560,      3255.0,           0.0 !   !END!
3467 ! X =       135.081,      396.563,      3532.0,           0.0 !   !END!
3468 ! X =       137.021,      396.566,      3623.0,           0.0 !   !END!
3469 ! X =       138.962,      396.569,      3353.0,           0.0 !   !END!
3470 ! X =       140.902,      396.572,      3209.0,           0.0 !   !END!
3471 ! X =       142.842,      396.575,      3247.0,           0.0 !   !END!
3472 ! X =       144.782,      396.578,      2920.0,           0.0 !   !END!
3473 ! X =        92.397,      398.456,      3078.0,           0.0 !   !END!
3474 ! X =        94.337,      398.458,      3319.0,           0.0 !   !END!
3475 ! X =        96.277,      398.459,      3200.0,           0.0 !   !END!
3476 ! X =        98.217,      398.461,      3457.0,           0.0 !   !END!
3477 ! X =       100.157,      398.463,      3231.0,           0.0 !   !END!
3478 ! X =       102.097,      398.464,      3054.0,           0.0 !   !END!
3479 ! X =       104.037,      398.466,      3110.0,           0.0 !   !END!
3480 ! X =       105.977,      398.468,      3278.0,           0.0 !   !END!
3481 ! X =       107.917,      398.470,      3463.0,           0.0 !   !END!
3482 ! X =       109.857,      398.472,      3470.0,           0.0 !   !END!
3483 ! X =       111.797,      398.474,      3234.0,           0.0 !   !END!
3484 ! X =       113.738,      398.476,      3265.0,           0.0 !   !END!
3485 ! X =       115.678,      398.478,      3170.0,           0.0 !   !END!
3486 ! X =       117.618,      398.480,      3231.0,           0.0 !   !END!
3487 ! X =       119.558,      398.483,      3658.0,           0.0 !   !END!
3488 ! X =       121.498,      398.485,      3354.0,           0.0 !   !END!
3489 ! X =       123.438,      398.487,      3274.0,           0.0 !   !END!
3490 ! X =       125.378,      398.490,      2982.0,           0.0 !   !END!
3491 ! X =       127.318,      398.492,      3353.0,           0.0 !   !END!
3492 ! X =       129.258,      398.495,      3658.0,           0.0 !   !END!
3493 ! X =       131.198,      398.498,      3300.0,           0.0 !   !END!
3494 ! X =       133.138,      398.501,      3292.0,           0.0 !   !END!
3495 ! X =       135.079,      398.503,      3906.0,           0.0 !   !END!
3496 ! X =       137.019,      398.506,      3444.0,           0.0 !   !END!
3497 ! X =       138.959,      398.509,      3292.0,           0.0 !   !END!
3498 ! X =       140.899,      398.512,      3261.0,           0.0 !   !END!
3499 ! X =       142.839,      398.515,      3414.0,           0.0 !   !END!
3500 ! X =       144.779,      398.518,      3028.0,           0.0 !   !END!
3501 ! X =       146.719,      398.522,      2670.0,           0.0 !   !END!
3502 ! X =        92.395,      400.396,      3211.0,           0.0 !   !END!
3503 ! X =        94.335,      400.398,      3495.0,           0.0 !   !END!
3504 ! X =        96.275,      400.399,      3430.0,           0.0 !   !END!
3505 ! X =        98.215,      400.401,      3593.0,           0.0 !   !END!
3506 ! X =       100.155,      400.403,      3213.0,           0.0 !   !END!
3507 ! X =       102.095,      400.404,      3216.0,           0.0 !   !END!
3508 ! X =       104.035,      400.406,      3275.0,           0.0 !   !END!
3509 ! X =       105.975,      400.408,      3176.0,           0.0 !   !END!
3510 ! X =       107.915,      400.410,      3416.0,           0.0 !   !END!
3511 ! X =       109.855,      400.412,      3475.0,           0.0 !   !END!
3512 ! X =       111.795,      400.414,      3434.0,           0.0 !   !END!
3513 ! X =       113.735,      400.416,      3206.0,           0.0 !   !END!
3514 ! X =       115.675,      400.418,      3241.0,           0.0 !   !END!
3515 ! X =       117.615,      400.420,      3292.0,           0.0 !   !END!
3516 ! X =       119.555,      400.423,      3558.0,           0.0 !   !END!
3517 ! X =       121.495,      400.425,      3414.0,           0.0 !   !END!
3518 ! X =       123.435,      400.427,      3253.0,           0.0 !   !END!
3519 ! X =       125.376,      400.430,      3414.0,           0.0 !   !END!
3520 ! X =       127.316,      400.433,      3219.0,           0.0 !   !END!
3521 ! X =       129.256,      400.435,      3539.0,           0.0 !   !END!
3522 ! X =       131.196,      400.438,      3734.0,           0.0 !   !END!
3523 ! X =       133.136,      400.441,      3369.0,           0.0 !   !END!
3524 ! X =       135.076,      400.443,      3582.0,           0.0 !   !END!
3525 ! X =       137.016,      400.446,      3768.0,           0.0 !   !END!
3526 ! X =       138.956,      400.449,      3541.0,           0.0 !   !END!
3527 ! X =       140.896,      400.452,      3260.0,           0.0 !   !END!
3528 ! X =       142.836,      400.455,      3303.0,           0.0 !   !END!
3529 ! X =       144.776,      400.459,      3145.0,           0.0 !   !END!
3530 ! X =       146.716,      400.462,      2743.0,           0.0 !   !END!
3531 ! X =       148.656,      400.465,      3147.0,           0.0 !   !END!
3532 ! X =       150.596,      400.468,      3242.0,           0.0 !   !END!
3533 ! X =       152.536,      400.472,      3438.0,           0.0 !   !END!
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3534 ! X =        92.394,      402.337,      3655.0,           0.0 !   !END!
3535 ! X =        94.334,      402.338,      3293.0,           0.0 !   !END!
3536 ! X =        96.274,      402.339,      3151.0,           0.0 !   !END!
3537 ! X =        98.214,      402.341,      3542.0,           0.0 !   !END!
3538 ! X =       100.153,      402.343,      3295.0,           0.0 !   !END!
3539 ! X =       102.093,      402.344,      3310.0,           0.0 !   !END!
3540 ! X =       104.033,      402.346,      3392.0,           0.0 !   !END!
3541 ! X =       105.973,      402.348,      3414.0,           0.0 !   !END!
3542 ! X =       107.913,      402.350,      3491.0,           0.0 !   !END!
3543 ! X =       109.853,      402.352,      3349.0,           0.0 !   !END!
3544 ! X =       111.793,      402.354,      3250.0,           0.0 !   !END!
3545 ! X =       113.733,      402.356,      3299.0,           0.0 !   !END!
3546 ! X =       115.673,      402.358,      3356.0,           0.0 !   !END!
3547 ! X =       117.613,      402.360,      3281.0,           0.0 !   !END!
3548 ! X =       119.553,      402.363,      3743.0,           0.0 !   !END!
3549 ! X =       121.493,      402.365,      3477.0,           0.0 !   !END!
3550 ! X =       123.433,      402.367,      3376.0,           0.0 !   !END!
3551 ! X =       125.373,      402.370,      3489.0,           0.0 !   !END!
3552 ! X =       127.313,      402.373,      3113.0,           0.0 !   !END!
3553 ! X =       129.253,      402.375,      3351.0,           0.0 !   !END!
3554 ! X =       131.193,      402.378,      3666.0,           0.0 !   !END!
3555 ! X =       133.133,      402.381,      3536.0,           0.0 !   !END!
3556 ! X =       135.073,      402.383,      3851.0,           0.0 !   !END!
3557 ! X =       137.013,      402.386,      3415.0,           0.0 !   !END!
3558 ! X =       138.953,      402.389,      3597.0,           0.0 !   !END!
3559 ! X =       140.893,      402.392,      3321.0,           0.0 !   !END!
3560 ! X =       142.833,      402.395,      3096.0,           0.0 !   !END!
3561 ! X =       144.773,      402.399,      2933.0,           0.0 !   !END!
3562 ! X =       146.713,      402.402,      3076.0,           0.0 !   !END!
3563 ! X =       148.653,      402.405,      3405.0,           0.0 !   !END!
3564 ! X =       150.593,      402.409,      3667.0,           0.0 !   !END!
3565 ! X =       152.533,      402.412,      3536.0,           0.0 !   !END!
3566 ! X =        92.392,      404.276,      3256.0,           0.0 !   !END!
3567 ! X =        94.332,      404.278,      3475.0,           0.0 !   !END!
3568 ! X =        96.272,      404.279,      2957.0,           0.0 !   !END!
3569 ! X =        98.212,      404.281,      3729.0,           0.0 !   !END!
3570 ! X =       100.152,      404.283,      3627.0,           0.0 !   !END!
3571 ! X =       102.092,      404.284,      3582.0,           0.0 !   !END!
3572 ! X =       104.032,      404.286,      3619.0,           0.0 !   !END!
3573 ! X =       105.971,      404.288,      3353.0,           0.0 !   !END!
3574 ! X =       107.911,      404.290,      3491.0,           0.0 !   !END!
3575 ! X =       109.851,      404.292,      3392.0,           0.0 !   !END!
3576 ! X =       111.791,      404.294,      3658.0,           0.0 !   !END!
3577 ! X =       113.731,      404.296,      3447.0,           0.0 !   !END!
3578 ! X =       115.671,      404.298,      3461.0,           0.0 !   !END!
3579 ! X =       117.611,      404.300,      3366.0,           0.0 !   !END!
3580 ! X =       119.551,      404.303,      3377.0,           0.0 !   !END!
3581 ! X =       121.491,      404.305,      3658.0,           0.0 !   !END!
3582 ! X =       123.431,      404.307,      3447.0,           0.0 !   !END!
3583 ! X =       125.370,      404.310,      3475.0,           0.0 !   !END!
3584 ! X =       127.310,      404.312,      3353.0,           0.0 !   !END!
3585 ! X =       129.250,      404.315,      3452.0,           0.0 !   !END!
3586 ! X =       131.190,      404.318,      3658.0,           0.0 !   !END!
3587 ! X =       133.130,      404.321,      3719.0,           0.0 !   !END!
3588 ! X =       135.070,      404.323,      3414.0,           0.0 !   !END!
3589 ! X =       137.010,      404.326,      3353.0,           0.0 !   !END!
3590 ! X =       138.950,      404.329,      3266.0,           0.0 !   !END!
3591 ! X =       140.890,      404.332,      3219.0,           0.0 !   !END!
3592 ! X =       142.830,      404.335,      3335.0,           0.0 !   !END!
3593 ! X =       144.770,      404.338,      2865.0,           0.0 !   !END!
3594 ! X =       146.709,      404.342,      3232.0,           0.0 !   !END!
3595 ! X =       148.649,      404.345,      3567.0,           0.0 !   !END!
3596 ! X =        92.391,      406.216,      3453.0,           0.0 !   !END!
3597 ! X =        94.331,      406.218,      3456.0,           0.0 !   !END!
3598 ! X =        96.270,      406.219,      2866.0,           0.0 !   !END!
3599 ! X =        98.210,      406.221,      3137.0,           0.0 !   !END!
3600 ! X =       100.150,      406.223,      3780.0,           0.0 !   !END!
3601 ! X =       102.090,      406.224,      3251.0,           0.0 !   !END!
3602 ! X =       104.030,      406.226,      3251.0,           0.0 !   !END!
3603 ! X =       105.970,      406.228,      3631.0,           0.0 !   !END!
3604 ! X =       107.909,      406.230,      3279.0,           0.0 !   !END!
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3605 ! X =       109.849,      406.232,      3658.0,           0.0 !   !END!
3606 ! X =       111.789,      406.234,      3453.0,           0.0 !   !END!
3607 ! X =       113.729,      406.236,      3877.0,           0.0 !   !END!
3608 ! X =       115.669,      406.238,      3513.0,           0.0 !   !END!
3609 ! X =       117.609,      406.240,      3541.0,           0.0 !   !END!
3610 ! X =       119.548,      406.243,      3759.0,           0.0 !   !END!
3611 ! X =       121.488,      406.245,      3523.0,           0.0 !   !END!
3612 ! X =       123.428,      406.247,      3595.0,           0.0 !   !END!
3613 ! X =       125.368,      406.250,      3548.0,           0.0 !   !END!
3614 ! X =       127.308,      406.252,      3353.0,           0.0 !   !END!
3615 ! X =       129.248,      406.255,      3704.0,           0.0 !   !END!
3616 ! X =       131.187,      406.258,      3840.0,           0.0 !   !END!
3617 ! X =       133.127,      406.260,      3475.0,           0.0 !   !END!
3618 ! X =       135.067,      406.263,      3557.0,           0.0 !   !END!
3619 ! X =       137.007,      406.266,      3769.0,           0.0 !   !END!
3620 ! X =       138.947,      406.269,      3427.0,           0.0 !   !END!
3621 ! X =       140.887,      406.272,      3328.0,           0.0 !   !END!
3622 ! X =       142.827,      406.275,      3219.0,           0.0 !   !END!
3623 ! X =       144.766,      406.278,      2987.0,           0.0 !   !END!
3624 ! X =       146.706,      406.282,      3229.0,           0.0 !   !END!
3625 ! X =       148.646,      406.285,      3597.0,           0.0 !   !END!
3626 ! X =        92.389,      408.156,      3170.0,           0.0 !   !END!
3627 ! X =        94.329,      408.158,      3130.0,           0.0 !   !END!
3628 ! X =        96.269,      408.159,      2794.0,           0.0 !   !END!
3629 ! X =       100.148,      408.162,      3292.0,           0.0 !   !END!
3630 ! X =       102.088,      408.164,      3231.0,           0.0 !   !END!
3631 ! X =       104.028,      408.166,      3185.0,           0.0 !   !END!
3632 ! X =       105.968,      408.168,      3536.0,           0.0 !   !END!
3633 ! X =       107.907,      408.170,      3299.0,           0.0 !   !END!
3634 ! X =       109.847,      408.172,      3827.0,           0.0 !   !END!
3635 ! X =       111.787,      408.174,      3414.0,           0.0 !   !END!
3636 ! X =       113.727,      408.176,      3279.0,           0.0 !   !END!
3637 ! X =       115.667,      408.178,      3477.0,           0.0 !   !END!
3638 ! X =       117.606,      408.180,      3454.0,           0.0 !   !END!
3639 ! X =       119.546,      408.182,      3323.0,           0.0 !   !END!
3640 ! X =       121.486,      408.185,      3901.0,           0.0 !   !END!
3641 ! X =       123.426,      408.187,      3620.0,           0.0 !   !END!
3642 ! X =       125.365,      408.190,      3540.0,           0.0 !   !END!
3643 ! X =       127.305,      408.192,      3555.0,           0.0 !   !END!
3644 ! X =       129.245,      408.195,      3581.0,           0.0 !   !END!
3645 ! X =       131.185,      408.198,      3811.0,           0.0 !   !END!
3646 ! X =       133.125,      408.200,      3424.0,           0.0 !   !END!
3647 ! X =       135.064,      408.203,      3358.0,           0.0 !   !END!
3648 ! X =       137.004,      408.206,      3292.0,           0.0 !   !END!
3649 ! X =       138.944,      408.209,      3216.0,           0.0 !   !END!
3650 ! X =       140.884,      408.212,      3123.0,           0.0 !   !END!
3651 ! X =       142.823,      408.215,      3088.0,           0.0 !   !END!
3652 ! X =       144.763,      408.218,      3205.0,           0.0 !   !END!
3653 ! X =       146.703,      408.222,      3245.0,           0.0 !   !END!
3654 ! X =       148.643,      408.225,      3538.0,           0.0 !   !END!
3655 ! X =       100.147,      410.102,      3324.0,           0.0 !   !END!
3656 ! X =       102.086,      410.104,      2972.0,           0.0 !   !END!
3657 ! X =       104.026,      410.106,      3048.0,           0.0 !   !END!
3658 ! X =       105.966,      410.108,      3430.0,           0.0 !   !END!
3659 ! X =       107.905,      410.109,      3369.0,           0.0 !   !END!
3660 ! X =       109.845,      410.111,      3658.0,           0.0 !   !END!
3661 ! X =       111.785,      410.113,      3355.0,           0.0 !   !END!
3662 ! X =       113.725,      410.116,      3163.0,           0.0 !   !END!
3663 ! X =       115.664,      410.118,      3840.0,           0.0 !   !END!
3664 ! X =       117.604,      410.120,      3373.0,           0.0 !   !END!
3665 ! X =       119.544,      410.122,      3408.0,           0.0 !   !END!
3666 ! X =       121.483,      410.125,      3415.0,           0.0 !   !END!
3667 ! X =       123.423,      410.127,      3698.0,           0.0 !   !END!
3668 ! X =       125.363,      410.130,      3414.0,           0.0 !   !END!
3669 ! X =       127.303,      410.132,      3541.0,           0.0 !   !END!
3670 ! X =       129.242,      410.135,      3464.0,           0.0 !   !END!
3671 ! X =       131.182,      410.137,      3719.0,           0.0 !   !END!
3672 ! X =       133.122,      410.140,      3861.0,           0.0 !   !END!
3673 ! X =       135.062,      410.143,      3686.0,           0.0 !   !END!
3674 ! X =       137.001,      410.146,      3461.0,           0.0 !   !END!
3675 ! X =       138.941,      410.149,      3274.0,           0.0 !   !END!
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3676 ! X =       140.881,      410.152,      3320.0,           0.0 !   !END!
3677 ! X =       142.820,      410.155,      3301.0,           0.0 !   !END!
3678 ! X =       144.760,      410.158,      3287.0,           0.0 !   !END!
3679 ! X =       146.700,      410.161,      3353.0,           0.0 !   !END!
3680 ! X =       148.639,      410.165,      3305.0,           0.0 !   !END!
3681 ! X =       150.579,      410.168,      3403.0,           0.0 !   !END!
3682 ! X =       104.024,      412.045,      3224.0,           0.0 !   !END!
3683 ! X =       105.964,      412.047,      3255.0,           0.0 !   !END!
3684 ! X =       107.903,      412.049,      3271.0,           0.0 !   !END!
3685 ! X =       109.843,      412.051,      3585.0,           0.0 !   !END!
3686 ! X =       111.783,      412.053,      3475.0,           0.0 !   !END!
3687 ! X =       113.722,      412.055,      3139.0,           0.0 !   !END!
3688 ! X =       115.662,      412.057,      3353.0,           0.0 !   !END!
3689 ! X =       117.602,      412.060,      3292.0,           0.0 !   !END!
3690 ! X =       119.541,      412.062,      3486.0,           0.0 !   !END!
3691 ! X =       121.481,      412.064,      3547.0,           0.0 !   !END!
3692 ! X =       123.421,      412.067,      3296.0,           0.0 !   !END!
3693 ! X =       125.360,      412.069,      3564.0,           0.0 !   !END!
3694 ! X =       127.300,      412.072,      3588.0,           0.0 !   !END!
3695 ! X =       129.240,      412.074,      3335.0,           0.0 !   !END!
3696 ! X =       131.179,      412.077,      3658.0,           0.0 !   !END!
3697 ! X =       133.119,      412.080,      3657.0,           0.0 !   !END!
3698 ! X =       135.059,      412.083,      3673.0,           0.0 !   !END!
3699 ! X =       136.998,      412.086,      3491.0,           0.0 !   !END!
3700 ! X =       138.938,      412.089,      3641.0,           0.0 !   !END!
3701 ! X =       140.878,      412.092,      3462.0,           0.0 !   !END!
3702 ! X =       142.817,      412.095,      3410.0,           0.0 !   !END!
3703 ! X =       144.757,      412.098,      3531.0,           0.0 !   !END!
3704 ! X =       146.697,      412.101,      3719.0,           0.0 !   !END!
3705 ! X =       148.636,      412.104,      3468.0,           0.0 !   !END!
3706 ! X =       150.576,      412.108,      3840.0,           0.0 !   !END!
3707 ! X =       152.515,      412.111,      3600.0,           0.0 !   !END!
3708 ! X =       105.962,      413.987,      3229.0,           0.0 !   !END!
3709 ! X =       107.902,      413.989,      3028.0,           0.0 !   !END!
3710 ! X =       109.841,      413.991,      3475.0,           0.0 !   !END!
3711 ! X =       111.781,      413.993,      3454.0,           0.0 !   !END!
3712 ! X =       113.720,      413.995,      3234.0,           0.0 !   !END!
3713 ! X =       115.660,      413.997,      3020.0,           0.0 !   !END!
3714 ! X =       117.599,      413.999,      3414.0,           0.0 !   !END!
3715 ! X =       119.539,      414.002,      3310.0,           0.0 !   !END!
3716 ! X =       121.479,      414.004,      3437.0,           0.0 !   !END!
3717 ! X =       123.418,      414.006,      3170.0,           0.0 !   !END!
3718 ! X =       125.358,      414.009,      3566.0,           0.0 !   !END!
3719 ! X =       127.297,      414.011,      3597.0,           0.0 !   !END!
3720 ! X =       129.237,      414.014,      3249.0,           0.0 !   !END!
3721 ! X =       131.177,      414.017,      3613.0,           0.0 !   !END!
3722 ! X =       133.116,      414.020,      3536.0,           0.0 !   !END!
3723 ! X =       135.056,      414.022,      3597.0,           0.0 !   !END!
3724 ! X =       136.995,      414.025,      3840.0,           0.0 !   !END!
3725 ! X =       138.935,      414.028,      3779.0,           0.0 !   !END!
3726 ! X =       140.875,      414.031,      3719.0,           0.0 !   !END!
3727 ! X =       142.814,      414.034,      3509.0,           0.0 !   !END!
3728 ! X =       144.754,      414.038,      3353.0,           0.0 !   !END!
3729 ! X =       146.693,      414.041,      3534.0,           0.0 !   !END!
3730 ! X =       148.633,      414.044,      3304.0,           0.0 !   !END!
3731 ! X =       150.572,      414.048,      3280.0,           0.0 !   !END!
3732 ! X =       152.512,      414.051,      3168.0,           0.0 !   !END!
3733 ! X =       154.452,      414.055,      3372.0,           0.0 !   !END!
3734 ! X =       156.391,      414.058,      3461.0,           0.0 !   !END!
3735 ! X =       115.658,      415.937,      3103.0,           0.0 !   !END!
3736 ! X =       117.597,      415.939,      2944.0,           0.0 !   !END!
3737 ! X =       119.537,      415.941,      3436.0,           0.0 !   !END!
3738 ! X =       121.476,      415.944,      3475.0,           0.0 !   !END!
3739 ! X =       123.416,      415.946,      3149.0,           0.0 !   !END!
3740 ! X =       125.355,      415.949,      3354.0,           0.0 !   !END!
3741 ! X =       127.295,      415.951,      3461.0,           0.0 !   !END!
3742 ! X =       129.234,      415.954,      3231.0,           0.0 !   !END!
3743 ! X =       131.174,      415.956,      3445.0,           0.0 !   !END!
3744 ! X =       133.113,      415.959,      3676.0,           0.0 !   !END!
3745 ! X =       135.053,      415.962,      3320.0,           0.0 !   !END!
3746 ! X =       136.993,      415.965,      3231.0,           0.0 !   !END!
```

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3747 ! X =       138.932,      415.968,      3543.0,           0.0 !   !END!
3748 ! X =       140.872,      415.971,      3299.0,           0.0 !   !END!
3749 ! X =       142.811,      415.974,      3244.0,           0.0 !   !END!
3750 ! X =       144.751,      415.977,      3475.0,           0.0 !   !END!
3751 ! X =       146.690,      415.980,      3501.0,           0.0 !   !END!
3752 ! X =       148.630,      415.984,      3540.0,           0.0 !   !END!
3753 ! X =       150.569,      415.987,      3370.0,           0.0 !   !END!
3754 ! X =       152.509,      415.991,      3171.0,           0.0 !   !END!
3755 ! X =       154.448,      415.994,      3232.0,           0.0 !   !END!
3756 ! X =       156.388,      415.998,      3296.0,           0.0 !   !END!
3757 ! X =       119.534,      417.881,      3420.0,           0.0 !   !END!
3758 ! X =       121.474,      417.883,      3292.0,           0.0 !   !END!
3759 ! X =       123.413,      417.886,      3204.0,           0.0 !   !END!
3760 ! X =       125.353,      417.888,      3106.0,           0.0 !   !END!
3761 ! X =       127.292,      417.891,      3254.0,           0.0 !   !END!
3762 ! X =       129.232,      417.893,      3226.0,           0.0 !   !END!
3763 ! X =       131.171,      417.896,      3209.0,           0.0 !   !END!
3764 ! X =       133.111,      417.899,      3277.0,           0.0 !   !END!
3765 ! X =       135.050,      417.902,      3380.0,           0.0 !   !END!
3766 ! X =       136.990,      417.904,      3216.0,           0.0 !   !END!
3767 ! X =       138.929,      417.907,      3268.0,           0.0 !   !END!
3768 ! X =       140.869,      417.910,      3313.0,           0.0 !   !END!
3769 ! X =       142.808,      417.914,      3168.0,           0.0 !   !END!
3770 ! X =       144.747,      417.917,      3434.0,           0.0 !   !END!
3771 ! X =       146.687,      417.920,      3390.0,           0.0 !   !END!
3772 ! X =       148.626,      417.923,      3231.0,           0.0 !   !END!
3773 ! X =       150.566,      417.927,      3170.0,           0.0 !   !END!
3774 ! X =       152.505,      417.930,      3171.0,           0.0 !   !END!
3775 ! X =       154.445,      417.934,      3109.0,           0.0 !   !END!
3776 ! X =       119.532,      419.820,      3187.0,           0.0 !   !END!
3777 ! X =       121.471,      419.823,      3139.0,           0.0 !   !END!
3778 ! X =       123.411,      419.825,      3227.0,           0.0 !   !END!
3779 ! X =       125.350,      419.828,      3048.0,           0.0 !   !END!
3780 ! X =       127.290,      419.830,      3043.0,           0.0 !   !END!
3781 ! X =       129.229,      419.833,      3257.0,           0.0 !   !END!
3782 ! X =       131.168,      419.835,      3061.0,           0.0 !   !END!
3783 ! X =       133.108,      419.838,      3163.0,           0.0 !   !END!
3784 ! X =       135.047,      419.841,      3214.0,           0.0 !   !END!
3785 ! X =       136.987,      419.844,      3235.0,           0.0 !   !END!
3786 ! X =       138.926,      419.847,      3075.0,           0.0 !   !END!
3787 ! X =       142.805,      419.853,      3100.0,           0.0 !   !END!
3788 ! X =       144.744,      419.856,      3234.0,           0.0 !   !END!
3789 ! X =       146.684,      419.860,      3281.0,           0.0 !   !END!
3790 ! X =       148.623,      419.863,      3176.0,           0.0 !   !END!
3791 ! X =       152.502,      419.870,      3048.0,           0.0 !   !END!
3792 ! X =       121.469,      421.762,      3048.0,           0.0 !   !END!
3793 ! X =       123.408,      421.764,      3105.0,           0.0 !   !END!
3794 ! X =       125.348,      421.767,      3179.0,           0.0 !   !END!
3795 ! X =       127.287,      421.770,      2970.0,           0.0 !   !END!
3796 ! X =       129.226,      421.772,      3116.0,           0.0 !   !END!
3797 ! X =       133.105,      421.778,      2927.0,           0.0 !   !END!
3798 ! X =       135.044,      421.780,      3036.0,           0.0 !   !END!
3799 ! X =       136.984,      421.783,      3084.0,           0.0 !   !END!
3800 ! X =       142.802,      421.792,      2997.0,           0.0 !   !END!
3801 ! X =       144.741,      421.796,      3045.0,           0.0 !   !END!
3802 ! X =       146.680,      421.799,      3060.0,           0.0 !   !END!
3803 ! X =       148.620,      421.802,      3124.0,           0.0 !   !END!
3804 ! X =       123.406,      423.704,      3048.0,           0.0 !   !END!
3805 ! X =       125.345,      423.706,      3063.0,           0.0 !   !END!
3806 ! X =       142.799,      423.732,      2926.0,           0.0 !   !END!
3807 ! X =       144.738,      423.735,      2837.0,           0.0 !   !END!
3808 ! X =        90.467,      384.872,      3170.0,           0.0 !   !END!
3809 ! X =        92.407,      384.874,      3300.0,           0.0 !   !END!
3810 ! X =        90.465,      386.813,      3062.0,           0.0 !   !END!
3811 ! X =        92.406,      386.814,      3167.0,           0.0 !   !END!
3812 ! X =        94.346,      386.816,      3216.0,           0.0 !   !END!
3813 ! X =       102.108,      386.822,      2961.0,           0.0 !   !END!
3814 ! X =        90.464,      388.754,      3142.0,           0.0 !   !END!
3815 ! X =        92.404,      388.755,      3292.0,           0.0 !   !END!
3816 ! X =        94.344,      388.756,      3228.0,           0.0 !   !END!
3817 ! X =        96.285,      388.758,      3113.0,           0.0 !   !END!
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3818 ! X =        98.225,      388.759,      3044.0,           0.0 !   !END!
3819 ! X =       100.166,      388.761,      2950.0,           0.0 !   !END!
3820 ! X =       102.106,      388.763,      2872.0,           0.0 !   !END!
3821 ! X =        90.462,      390.694,      3270.0,           0.0 !   !END!
3822 ! X =        92.403,      390.695,      3170.0,           0.0 !   !END!
3823 ! X =        94.343,      390.697,      3160.0,           0.0 !   !END!
3824 ! X =        96.283,      390.698,      3052.0,           0.0 !   !END!
3825 ! X =        98.224,      390.700,      2987.0,           0.0 !   !END!
3826 ! X =       100.164,      390.702,      3002.0,           0.0 !   !END!
3827 ! X =       102.104,      390.703,      3048.0,           0.0 !   !END!
```

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a

Data for each receptor are treated as a separate input subgroup and therefore must end with an input group terminator.

b

Receptor height above ground is optional. If no value is entered, the receptor is placed on the ground.

CUMULATIVE EMISSIONS SOURCES

AC 1.0 CUMULATIVE EMISSIONS

The following five sources of emissions were gathered for the cumulative analysis: Sources permitted by the State of Utah after June 30, 2004.

- Utah sources whose emissions have increased since June 30, 2004.
- Sources permitted by the State of Colorado after June 30, 2004.
- Colorado sources whose emissions have increased since June 30, 2004.
- NEPA projects in Utah and Colorado that have been approved or drafts have been issued.
- Tribal permitted sources in Utah.

The Colorado data was received from the Utah Department of Health and Environment, Air Pollution Control Division (David Thayer 3-12-2008 and 3-26-2008 via email) and the Utah Department of Environmental Quality, Air Quality Division (Teri Weiss 3-18-2008 via email). Additionally, the State of Utah provided the new permit approvals on CDROM. The NEPA projects were mostly gathered from the West Tavaputs cumulative far-field air quality analysis and updated with newer projects. The data was filtered according to the following criteria:

- All sources outside of the domain were eliminated.
- All sources with emissions less than one ton/year were not included.
- Sources with decrease in emissions from 2004 to the most current year of emissions (2005 and 2006) were eliminated.

Stack parameters were generally included by the State agencies. In cases where the stack parameters were not included, the stack parameters were estimated based on the type of equipment listed in the permit files. **Tables AC-1** through **AC-5** list the emission sources used in the analysis.

Table AC-1 Utah Point Source Emission Increases Since 2004 and New Permitted Sources.

Facility	Model Number	LCC X	LCC Y	Stk Ht (m)	Elevation (m)	Stk Dia (m)	Exit Vel (m/s)	Exit Temp (K)	SO2 (tons/yr)	NOx (tons/yr)	PM10 (tons/yr)	PM2.5 (tons/yr)
Pacificcorp Carbon Power Plant	UT1	92.518	293.422	61	1866	3.14	0.394	410.78	0.00	0.00	0.00	16.70
PACIFICCORP Hunter Power Plant	UT2	78.765	232.76	182.9	1724	7.32	0.277	321.89	0.00	0.00	0.00	13.10
PACIFICCORP Huntington Power Plant	UT3	75.015	255.889	182.9	1960	7.32	0.302	336.33	3020	0.00	3020	0.00
QUESTAR Kastler/Marushack Compressor Station	UT4	225.37	433.333	14	2006	0.60	34.815	671.89	0.00	66.4	66.4	0.00
S&P 'Wellington Asphalt Plant	UT5	104.313	273.314	3	1645	1.22	0.097	327.44	3.49	8.84	12.33	0.00
Sunnyside Cogeneration Facility	UT6	132.937	275.028	76.2	1994	2.59	0.464	422.04	0.00	0.00	0.00	13.60
UTELITE Corp Shale Processing	UT7	46.917	403.75	25.6	1893	1.07	0.211	402.44	12.70	14.80	27.50	0.00

Table AC-2 NEPA Area Sources for Cumulative Analysis

Project	Model ID	Elevation (m)	SO_2 (tons/year)	NO_X (tons/year)	PM_{10} (tons/year)	$PM_{2.5}$ (tons/year)	Model Area (m^2)
Dominion/Mak J Little Canyon Unit/Hill Creek Unit/Big Pack Unit EA	RFD1	1,716.3	1.95	371.71	626.01	110.38	113,325,151
Kerr-Mcgee Bonanza EA	RFD2	1,495.0	2.60	169.68	257.97	43.22	44,188,650
Kerr-Mcgee Love Unit EA	RFD3	1,595.4	4.37	373.66	407.17	69.75	45,291,748
Inland (Newfield) Castle Peak/Eight Mile Flat EIS	RFD4	1,858.2	36.62	2642	153	45.77	208,062,444
QEP Greater Deadman Bench EIS	RFD5	1,421.5	13.29	1,276.62	1,003.96	179.15	525,359,216
EOG Chapita Wells-Stagecoach EIS	RFD6	1,483.6	2.38	239.20	522.93	90.94	103,101,914
ENCANA North Chapita Development EA	RFD7	1,473.1	3.60	335.32	274.72	47.09	48,952,512
Enduring Resources West Bonanza EA	RFD8	1,637.6	0.88	139.13	158.14	31.74	97,978,272
RDG Development EIS	RFD9	1,890.1	0.00	25.73	1.43	1.43	332,430,592
EOG Resources North Alger Natural Gas Expansion Project	RFD10	1,613.3	0.50	34.16	9.73	1.64	8,291,360
Figure Four EA Natural Gas Project	RFD11	2,514.0	101.98	494.13	529.78	91.20	82,907,485
EGL Resources Oil Shale EA	RFD13	2,109.0	152.29	63.18	11.15	2.27	648,025
Spaulding Peak EA	RFD14	2,823.0	0.20	23.73	64.21	10.61	36,965,140
Hells Gulch #2 PHASE I	RFD15	2,330.0	6.79	109.20	311.65	46.62	13,875,850
Gant Gulch EA	RFD17	2,328.0	3.40	206.79	199.05	34.46	14,067,030
Orchard Unit EA	RFD18	1,700.0	2.90	172.40	167.01	28.90	32,651,563
Grass Mesa EA	RFD19	2,447.0	4.31	269.06	149.75	28.48	49,098,252
Castle Springs EA	RFD20	1,951.0	3.40	218.43	178.51	31.77	19,856,988
West Brundage Canyon Oil And Gas Field Development EA	RFD21	2,448.4	2.57	110.98	68.13	14.57	42,850,674
Roosevelt Unit EA	RFD22	1,680.1	0.90	55.15	53.94	9.32	15,026,317
Tabby Canyon EA	RFD23	2,480.2	0.80	35.53	54.24	11.93	6,704,105

Table AC-2 NEPA Area Sources for Cumulative Analysis

Project	Model ID	Elevation (m)	SO_2 (tons/year)	NO_X (tons/year)	PM_{10} (tons/year)	$PM_{2.5}$ (tons/year)	Model Area (m^2)
North Hill Creek Field Development EA	RFD24	2,237.0	0.00	434.63	7.19	6.41	176,677,200
Sowers Canyon EA	RFD25	2,140.9	0.60	108.51	169.75	29.98	91,956,282
EOG Exploratory Well EA	RFD26	2,631.1	0.40	11.28	11.84	0.60	346,928,850

Table AC-3. Utah Tribal Emissions

Model ID	Tribal Source Name	LCCX	LCCY	Stack Height (m)	Elevation (m)	Stack Diameter (m)	Exhaust Velocity (m/s)	Temp (K)	SO_2 (tons/yr)	NO_x (tons/yr)	PM_{10} (tons/yr)	$PM_{2.5}$ (tons/yr)
TRTV1	Kerr McGee Cottonwood Wash	201.71	326.343	6	1510	0.91	30	755	0	89.4	2	0
TRTV2	Kerr McGee Ouray	204.789	332.643	6	1431	0.91	30	755	0	70.1	1	0
TRTV3	Canyon Gas Mesa Tap	192.366	323.37	6	1495.2	0.91	30	755	0	3.3	0	0
TRTV4	Deseret Power Bonanza	222.176	334.763	60.2	1531.3	2.744	17	432	0	49	55	0
TRTV5	Questar Island	187.877	320.824	5	1524	0.4	30	700	0	242	1	0
TRTV6	Questar Chapita	211.336	329.536	6	1467	0.91	40	900	0	90	0	0
TRTV7	Questar Riverbend	183.124	319.121	5	1584.4	0.4	30	700	0	84	0	0
TRTV8	Questar Wonsits	205.07	330.825	6	1474.9	0.91	30	755	0	5.9	0	0
TRTV9	Questar Fidlar	209.037	329.526	6	1450.8	0.91	30	755	0	14	0	0
TRTV10	Questar Flatrock	188.282	276.992	6	2253	0.91	40	900	0	9.0	0	0
TRTV11	Wind River Resources North Hill Creek	193.187	274.929	5	2273.2	0.4	30	700	0	40	1	0
TRM1	Houston Exploration Rock hHuse 32-2	217.735	315.775	6	1585.6	0.91	30	755	0	7.6	0	0
TRM2	Slate River Resources Willow Creek Compressor Station #1	200.716	292.807	5	1828.6	0.4	30	700	0	126	0	0
TRM3	Ute/FNR LLC NOSR2	183.241	290.874	6	1962	0.91	40	900	0	27	0	0
TRM4	Rosewood Evacuation Creek	240.275	305.386	6	1760	0.3	15	500	0	2.1	0	0
TRM5	Newfield Exploration Sundance	172.112	327.755	6	1539	0.91	40	900	0	18	0	0

Table AC-3. Utah Tribal Emissions

Model ID	Tribal Source Name	LCCX	LCCY	Stack Height (m)	Elevation (m)	Stack Diameter (m)	Exhaust Velocity (m/s)	Temp (K)	SO_2 (tons/yr)	NO_x (tons/yr)	PM_{10} (tons/yr)	$PM_{2.5}$ (tons/yr)
	Compressor Station											
TRM6	Questar Old Squaws Crossing Compressor Station	184.44	315.941	6	1622	0.91	40	900	0	51	0	0
TRM7	Kerr-McGee North Compressor Station	198.826	329.109	6	1469.9	0.91	40	900	0	18	0	0
TRM8	Kerr-McGee East Bench Compressor Station	208.573	315.297	6	1694.7	0.91	40	900	0	44	0	0
TRM9	Kerr-McGee East Compressor Station	214.578	321.751	6	1579.8	0.91	40	900	0	21	0	0
TRM10	Kerr-Mcgee Archie Bench Compressor Station	213.007	321.686	6	1535.8	0.91	40	900	0.00	13.2	13.2	0.00
TRM11	Kerr-Mcgee South Central Compressor Station	208.236	324.681	6	1525.1	0.91	40	900	0.00	39.8	39.8	0.00
TRM12	Kerr-Mcgee South East Compressor Station	202.471	330.174	6	1470.2	0.91	40	900	0.00	38.9	38.9	0.00
TRM13	Kerr-Mcgee North East Compressor Station	202.473	331.351	6	1465.2	0.91	40	900	0.00	38.9	38.9	0.00
TRM14	Kerr-Mcgee Bonanza Central Compressor Station	217.64	323.399	6	1603.2	0.91	40	900	0.00	61.4	61.4	0.00
TRM15	Kerr-Mcgee Flat Mesa 2-7	216.131	321.772	6	1625.6	0.91	40	900	0.00	19.5	19.5	0.00

Table AC-3. Utah Tribal Emissions

Model ID	Tribal Source Name	LCCX	LCCY	Stack Height (m)	Elevation (m)	Stack Diameter (m)	Exhaust Velocity (m/s)	Temp (K)	SO_2 (tons/yr)	NO_x (tons/yr)	PM_{10} (tons/yr)	$PM_{2.5}$ (tons/yr)
	Compressor Station											
TRM16	Kerr-Mcgee Nbu #4 Ctb	212.315	327.753	6	1498.8	0.91	30	755	0.00	15.9	15.9	0.00
TRM17	Kerr-Mcgee East Junior Compressor Station	214.495	324.908	6	1513.8	0.91	40	900	0.00	36.7	36.7	0.00
TRM18	Kerr-Mcgee Bonanza East Compressor Station	222.391	322.028	6	1660.7	0.91	40	900	0.00	19.5	19.5	0.00
TRM19	Kerr-Mcgee Nbu #347 Swd Disposal	212.519	321.519	6	1549	0.91	30	755	0.00	37.5	37.5	0.00
TRM20	Pioneer Natural Resources Usa, Inc. Wolf Point Compressor Station	208.16	268.831	6.1	2282	0.305	30	755	0.00	39.3	39.3	0.00

Table AC-4 Utah Area Sources for Cumulative Analysis

Project	Model ID	Elevation (m)	SO_2 (tons/year)	NO_X (tons/year)	PM_{10} (tons/year)	$PM_{2.5}$ (tons/year)	Model Area (m^2)
OIL WELLS	UTOIL1	2393	0.00	50.80	0.00	0.00	89,435,624
OIL WELLS	UTOIL2	2062.8	0.00	54.85	0.00	0.00	96,909,500
OIL WELLS	UTOIL3	1649	0.00	46.59	0.00	0.00	129,065,376
GAS WELLS	UTGAS1	2119	0.00	5.14	0.00	0.00	2,006,781,480
GAS WELLS	UTGAS2	1597	0.00	5.61	0.00	0.00	187,763,706
GAS WELLS	UTGAS3	1740.9	0.00	9.15	0.00	0.00	384,633,117
GAS WELLS	UTGAS4	1523.6	0.00	21.61	0.00	0.00	218,921,616

Table AC-5. Colorado Point Sources (Increases from 2004 and New Permits)

Facility	Model Number	LCC X	LCC Y	Stk Ht (m)	Elevation (m)	Stk Dia (m)	Exit Vel (m/s)	Exit Temp (K)	SO2 (tons/yr)	NOx (tons/yr)	PM10 (tons/yr)	PM2.5 (tons/yr)
Gunnison Energy - Spaulding Peak CS TOTAL	CO1	340.004	222.003	7.6	2513	0.357	27.097	700	0.03	28.9	0.55	0.55
Mid-America Pipeline CO Dove CR STA TOTAL	CO6	258.678	93.626	7	2106	0.457	80.62	765	0.03	16.4	2.10	2.10
Canyon Gas Resources - Rifle C.S. TOTAL	CO7	346.045	280.626	6.1	1625	0.366	23.957	811	0.06	52.7	0.93	0.93
Lafarge West, Inc. - Powers Pit TOTAL	CO8	399.924	271.206	6	1903	0.91	40	900	0.20	14.0	1.00	1.00
William Production RMT - Rifle Station TOTAL	CO9	346.028	280.638	4.6	1626	0.152	54.437	533	0.00	2.80	0.00	0.00
Bill Barrett Corp - Mamm Creek CS TOTAL	CO10	356.329	276.987	6	1777	0.357	35.479	894	0.00	20.9	0.00	0.00
Williams Production RMT - Starkey Gulch TOTAL	CO11	321.076	273.892	7	1730	0.305	49.682	730	0.02	24.5	0.40	0.40
OXY USA WTP LP -Cascade Creek Compressor TOTAL	CO13	311.054	280.828	5	2605	0.4	30	744	0.06	59.9	0.99	0.99
Williams Production RMT CO. - Sharrard TOTAL	CO14	340.661	277.94	6.1	1620	0.305	49.682	730	0.04	11.6	0.61	0.61
ENCANA - East Mamm Creek CS TOTAL	CO15	355.102	276.322	15.2	1795	0.411	51.511	727	0.22	85.5	3.68	3.68
Williams Prod. RMT CORP. -	CO17	323.017	274.57	7	1650	0.457	17.526	690	0.29	150	4.25	4.25

Table AC-5. Colorado Point Sources (Increases from 2004 and New Permits)

Facility	Model Number	LCC X	LCC Y	Stk Ht (m)	Elevation (m)	Stk Dia (m)	Exit Vel (m/s)	Exit Temp (K)	SO2 (tons/yr)	NOx (tons/yr)	PM10 (tons/yr)	PM2.5 (tons/yr)
Parachute TOTAL												
ENCANA Oil & Gas - Hunter Mesa TOTAL	CO18	355.828	274.412	7.6	1858	4.953	22.403	722	0.22	31.5	0.21	0.21
ENCANA Gathering - Mamm Creek Conditioni TOTAL	CO19	345.627	280.142	6.1	1617	0.457	67.452	900	2.49	22.6	1.66	1.66
Williams Prod RMT - Riley CS TOTAL	CO20	323.655	273.837	6.7	1629	0.305	49.682	730	0.11	71.7	1.89	1.89
Williams Prod RMT Anvil Points CS TOTAL	CO21	338.707	278.227	8.5	1707	0.305	49.682	730	0.15	72.0	1.93	1.93
Williams Prod RMT CO. - Cottonwood Point TOTAL	CO22	333.775	275.199	6.1	1624	0.305	49.682	730	0.14	133	2.27	2.27
ENCANA (West) - Logan Wash Amine Plant TOTAL	CO23	310.85	264.804	6	1618	0.91	1	500	0.00	6.30	0.00	0.00
ENCANA (West) - Divide Creek 31 TOTAL	CO24	369.622	265.003	1.8	2762	0.061	30.48	436	0.00	4.30	0.01	0.00
Williams Production RMT - Rulison CS TOTAL	CO25	321.152	275.678	6.1	1696	0.305	57.973	730	0.12	94.60	2.02	0.00
Williams Prod RMT-South Grand Valey CS TOTAL	CO26	326.098	268.932	6.7	2496	0.357	26.609	711	0.02	17.5	0.29	0.00
ENCANA (West) - Divide Creek 25-2C TOTAL	CO28	364.758	270.012	2.7	1979	0.091	30	833	1.05	7.84	1.08	1.08
OXY USA WTP LP - Conn Creek Gas TOTAL	CO29	311.254	273.717	10.4	1864	0.305	30	900	0.11	92.2	1.78	1.78
Noble Energy, Inc.	CO30	327.473	262.198	1.5	1819	0.305	40	723	0.00	28.1	0.02	0.00

Table AC-5. Colorado Point Sources (Increases from 2004 and New Permits)

Facility	Model Number	LCC X	LCC Y	Stk Ht (m)	Elevation (m)	Stk Dia (m)	Exit Vel (m/s)	Exit Temp (K)	SO2 (tons/yr)	NOx (tons/yr)	PM10 (tons/yr)	PM2.5 (tons/yr)
- Hyrup Prod Facility TOTAL												
Windsor Energy - Castle Springs Central TOTAL	CO31	367.195	273.074	6	2166	0.91	30	755	0.02	27.8	0.28	0.28
Williams Production RMT-Heath CS TOTAL	CO32	341.534	276.823	6.1	1637	0.305	40	730	0.05	44.2	0.76	0.76
Antero Resources II, Park B Pad TOTAL	CO33	356.769	282.223	36	1636	0.314	45.171	730	0.01	2.69	0.18	0.18
Laramie Energy-Brush Creek Processing P TOTAL	CO38	347.039	254.824	6.1	2330	0.439	14.143	516	0.01	9.56	0.18	0.18
Suncor Energy (U.S.A.), INC. TOTAL	CO39	280.665	231.192	4	1377	0.3	30	755	0.00	1.10	0.00	0.00
Canyon Gas Resources - Premier Debeque TOTAL	CO40	312.596	257.341	3.7	1552	0.152	13.167	844	0.00	24.3	0.06	0.06
Slate River Resources - Badger WGP TOTAL	CO41	256.925	254.987	6	1485	0.91	40	900	0.02	13.3	0.33	0.33
Laramie Energy - Plateau Processing Plan TOTAL	CO42	338.792	248.735	6.1	1904	0.323	56.236	762	0.04	82.0	0.59	0.59
LARAMIE ENERGY, LLC - Hell's Gulch TOTAL	CO43	363.982	257.285	6	2373	0.91	40	726	0.01	12.3	0.21	0.00
QUESTAR Gas Management Company TOTAL	CO45	298.734	431.469	6.1	2038	0.61	30	866	0.00	13.3	0.00	0.00

Table AC-5. Colorado Point Sources (Increases from 2004 and New Permits)

Facility	Model Number	LCC X	LCC Y	Stk Ht (m)	Elevation (m)	Stk Dia (m)	Exit Vel (m/s)	Exit Temp (K)	SO2 (tons/yr)	NOx (tons/yr)	PM10 (tons/yr)	PM2.5 (tons/yr)
QUESTAR Gas MGMT CO W Hiawatha Comp Sta TOTAL	CO46	268.704	433.654	6.1	2097	0.61	30	866	0.02	19.4	0.41	0.41
QUESTAR Pipeline CO State Line Comp Sta TOTAL	CO47	318.511	436.118	4.6	1960	0.457	73.823	727	0.00	2.43	0.28	0.28
KOCH Exploration CO LLC - Walker 3-1 TOTAL	CO48	341.381	394.649	4.6	2120	0.101	30	811	0.01	20.8	1.68	1.68
KOCH Exploration CO LLC - Walker 3-2 TOTAL	CO49	341.153	394.843	2.1	2137	0.101	30	833	1.71	25.8	1.83	1.83
KOCH Exploration CO LLC - Walker 3-4 TOTAL	CO50	341.574	394.456	2.1	2092	0.101	30	833	1.71	25.8	1.83	1.83
KOCH Exploration CO, LLC - Walker 3-3 TOTAL	CO51	341.607	394.765	2.1	2129	0.101	30	833	1.71	25.8	1.83	1.83
Cedar Ridge LLC - CF&8 CORP. #1 TOTAL	CO52	378.652	439.734	4.3	2081	0.91	40	900	0.01	7.60	0.10	0.10
Cedar Ridge LLC - Robidoux 23-13 CBM #1 TOTAL	CO53	378.691	440.019	6	2028	0.91	30	755	0.01	27.9	0.14	0.14
Western Gas Resources - Garfield CS TOTAL	CO54	334.968	421.91	8.5	2113	0.381	32.888	904	0.07	65.1	1.11	1.11
Western Gas Resources - Federal 1-14-28 TOTAL	CO56	337.626	416.202	3.4	2098	0.091	97.536	836	0.00	2.00	0.07	0.07
KOCH Exploration CO., LLC - Culverwell TOTAL	CO57	340.764	394.819	2.1	2095	0.101	30	833	2.07	31.2	2.22	2.22
KOCH Exploration	CO58	341.175	394.453	2.4	2082	0.076	30	755	1.71	25.8	1.83	1.83

Table AC-5. Colorado Point Sources (Increases from 2004 and New Permits)

Facility	Model Number	LCC X	LCC Y	Stk Ht (m)	Elevation (m)	Stk Dia (m)	Exit Vel (m/s)	Exit Temp (K)	SO2 (tons/yr)	NOx (tons/yr)	PM10 (tons/yr)	PM2.5 (tons/yr)
- Walker 3-5 TOTAL												
Rocky Mountain NG CO - Naturita Creek TOTAL	CO60	319.745	132.479	1.2	2114	0.076	29.505	755	0.01	8.32	0.19	0.19
TransColorado Gas Trans - Redvale CS TOTAL	CO61	301.226	131.143	7.6	1940	0.457	96.683	755	0.04	17.8	0.80	0.80
Chevron USA - Wilson Creek Gas Plt TOTAL	CO63	335.095	351.714	4.6	2414	0.204	32.827	755	0.00	4.21	0.00	0.00
Canyon Gas Resources - N. Douglas Creek TOTAL	CO64	265.783	322.425	6.7	1728	0.366	19.903	727	0.03	28.9	0.43	0.43
Colorado Interstate Gas CO Greasewood TOTAL	CO65	313.932	319.542	5.5	2230	0.305	19.629	578	0.03	16.3	1.20	1.20
EXXON MOBIL Corporation - Piceance Creek TOTAL	CO66	313.792	318.174	7	2287	0.201	36.424	911	0.04	2.76	0.62	0.62
South-Tex Treaters, INC. - Meeker Plant TOTAL	CO67	312.803	340.635	7.3	1808	0.351	62.24	916	0.01	10.0	0.55	0.55
Canyon Gas Resources, INC. - Rangely NGL TOTAL	CO68	245.237	343.662	4.6	1693	0.152	5	700	0.00	4.60	0.00	0.00
ENCANA (West) - Bull Fork TOTAL	CO69	307.422	296.602	7.6	2275	0.305	46.726	900	0.03	19.4	0.46	0.46
Williams Prod RMT - Greasewood CS	CO70	314.161	318.099	8.5	2286	0.305	49.682	730	0.09	88.4	1.51	1.51

Table AC-5. Colorado Point Sources (Increases from 2004 and New Permits)

Facility	Model Number	LCC X	LCC Y	Stk Ht (m)	Elevation (m)	Stk Dia (m)	Exit Vel (m/s)	Exit Temp (K)	SO2 (tons/yr)	NOx (tons/yr)	PM10 (tons/yr)	PM2.5 (tons/yr)
TOTAL												
ENCANA (West) - LHDU 2194 TOTAL	CO71	253.345	310.171	6.1	2134	0.244	36.576	811	0.00	18.3	0.03	0.00
ENCANA (West) - LHDU 2111 TOTAL	CO72	253.726	310.604	6.1	2157	0.244	36.576	811	0.00	18.3	0.03	0.00
Williams Production RMT - Ryan Gulch Gas TOTAL	CO73	302.101	317.914	7.6	1911	0.305	46.421	738	0.05	45.5	0.77	0.77
ROC Gas Company TOTAL	CO74	289.836	312.473	9.1	2184	0.204	45.446	900	0.14	106	1.64	1.64
Enterprise Gas Proc - Meeker Gas Plant TOTAL	CO76	302.707	324.393	21.3	2008	1.737	22.86	811	0.36	90.1	15.50	15.50
ENCANA - Andy's Mesa TOTAL	CO78	285.127	117.092	5.8	1971	0.305	43.525	727	0.04	42.0	0.62	0.62
ENCANA Oil & Gas - Hamilton Creek Booste TOTAL	CO79	300.931	126.437	6.7	2014	0.335	43.647	644	0.04	35.8	0.69	0.69
Cabot Oil & Gas - Fossil Federal #4-20 TOTAL	CO80	282.871	118.625	4.6	2003	0.152	25.908	783	0.00	3.60	0.07	0.07
ENCANA (West) - Hamilton Creek CS TOTAL	CO81	299.406	124.999	6.7	2088	0.335	31.699	700	0.14	99.0	2.13	2.13

Table AC-6 Utah Area Sources for Cumulative Analysis

Facility	Model ID	Elevation (m)	SO2 (tons/yr)	NOx (tons/yr)	PM10 (tons/yr)	PM2.5 (tons/yr)	Model Area (m2)
DIAMOND LAZY L. RANCH - JANET PIT TOTAL	CO2	1649	0.00	0.00	1.22	0.37	22,500
ALTERNATIVE MINING METHODS, LLC TOTAL	CO3	1561	0.00	0.00	1.28	0.38	22,500
S&S TRUCKING & EXCAVATION - RED SHALE TOTAL	CO4	2230	0.00	0.00	4.21	1.26	22,500
OLDCASTLE SW GROUP - ANDERSON PIT TOTAL	CO5	1513	0.00	0.00	9.97	2.99	22,500
FLAG RESOURCES, INC TOTAL	CO12	1653	0.00	0.00	6.43	1.93	22,500
LAFARGE WEST - MAMM CREEK PIT TOTAL	CO16	1627	0.00	0.00	3.40	1.02	22,500
OLDCASTLE DBA UNITED CO - CHAMBERS PIT TOTAL	CO27	1621	0.00	0.00	3.60	1.08	22,500
ENCANA OIL & GAS - WEST FORK SHALE PIT TOTAL	CO34	2495	0.00	0.00	8.75	2.63	22,500
VARRA COMPANIES - PIT 118 TOTAL	CO35	2360	0.00	0.00	5.37	1.61	22,500
QUIKRETE GRAND JUNCTION TOTAL	CO36	1392	0.00	0.00	17.62	5.29	22,500
COORSTEK GRAND JUNCTION TOTAL	CO37	1388	0.00	34.87	6.33	1.89	22,500
NATCO GROUP INC. TOTAL	CO44	1380	0.00	0.00	4.11	1.23	22,500
PLAINS MARKETING LP - BUCK PEAK STATION TOTAL	CO55	1963	0.00	0.00	4.95	4.95	22,500
WESTERN FUELS CO LLC NEW HORIZON MINE TOTAL	CO59	1753	0.00	14.80	54.65	16.40	22,500

Table AC-6 Utah Area Sources for Cumulative Analysis

Facility	Model ID	Elevation (m)	SO2 (tons/yr)	NOx (tons/yr)	PM10 (tons/yr)	PM2.5 (tons/yr)	Model Area (m2)
HALDORSON AND SONS GRAVEL MINE TOTAL	CO62	1769	0.00	0.00	4.34	1.30	22,500
SAM F. LOVE - P&S GRAVEL PIT TOTAL	CO75	1783	0.00	0.00	13.43	4.03	22,500
HAYDEN GULCH TERMINAL INC TOTAL	CO77	2241	0.00	0.00	71.03	21.31	22,500
GAS WELLS	COGAS1	1727	0.00	8.76	0.00	0.00	451,536,930
GAS WELLS	COGAS2	2172	0.00	6.71	0.00	0.00	387,673,695
GAS WELLS	COGAS3	2530	0.00	7.08	0.00	0.00	243,233,910
GAS/OIL WELLS	COG_O4	1792	0.00	27.75	0.00	0.00	695,541,465
GAS WELLS	COGAS5	2356	0.00	8.51	0.00	0.00	305,940,283
GAS WELLS	COGAS6	2145	0.00	9.44	0.00	0.00	568,588,086

Table AC-7 NEPA Point Source Emission Increases

Facility	Model Number	LCC X	LCC Y	Stk Ht (m)	Elevation (m)	Stk Dia (m)	Exit Vel (m/s)	Exit Temp (K)	SO2 (tons/yr)	NOx (tons/yr)	PM10 (tons/yr)	PM2.5 (tons/yr)
Bull Mountain Natural Gas Pipeline EIS	RFD16	381.857	237.905	15.2	2330	0.457	72.542	713.6	0.00	117	0.00	0.00
Deseret Power Bonanza WCFU Expansion	RFD27	222.176	334.763	60.2	1531.3	2.744	16.677	431.6	348	557	208	0.00
Petrocanada Cottonwood EA	RFD28	147.986	289.839	9.1	2395.7	0.305	25	811	0.00	14.5	0.00	0.00

Ozone Impact Assessment

for

West Tavaputs Plateau

Environmental Impact Statement

Prepared for: Bureau of Land Management
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1.0 Introduction

Bill Barrett Corporation (BBC) proposes to develop the hydrocarbon resources underlying oil and gas leases that it owns, at least in part, within the West Tavaputs Plateau Project Area (WTP) in Carbon County, Utah. BBC plans to explore and develop all potentially productive subsurface formations underlying the land in the project area. Further, BBC is the designated operator or owns contractual leasehold rights for approximately 85 percent of the lands within the Greater Natural Buttes (GNB) boundary. The oil and gas leases were issued by the Bureau of Land Management (BLM), the State of Utah, and private owners.

Exploration and development of federal oil and gas mineral leases by private industry are an integral part of BLM's oil and gas program as administered under the Mineral Leasing Act of 1920 as amended, the Mining and Minerals Policy Act of 1970, the Federal Land Policy and Management Act of 1976 (FLPMA), the National Materials and Minerals Policy, Research and Development Act of 1980, and the Federal Onshore Oil and Gas Leasing Reform Act of 1987. Mineral leasing decisions made by the BLM result in a contractual commitment from the United States to allow for exploration, development, and operations in accordance with stipulations and restrictions incorporated in a lease. Lease rights include the right to occupy and use as much of the surface as is reasonably necessary to explore, develop, operate, produce and remove for sale the subsurface hydrocarbon resources.

Oil and gas exploration and development in the GNB project area is governed by the Book Cliffs Resource Management Plan (1985) and the decisions made in applicable project-specific BLM National Environmental Policy Act (NEPA) documents. The BLM's Vernal Field Office manages the affected public lands in accordance with the FLPMA, which mandates that the BLM consider multiple uses for the lands it administers. FLPMA requires the BLM to consider the land's inherent natural resources as well as its mineral resources when making land management decisions. The BLM's responsibility extends to environmental protection, public health, and safety associated with oil and gas operations on public lands.

BBC recognizes that the State of Utah has authority over various aspects of oil and gas development in portions of the project area. The decision that results from its project-specific NEPA document will pertain to those areas in the WTP project area where there are federal surface and/or federal minerals. Each aspect of all project operations will be conducted in compliance with applicable federal, state, tribal, and local rules and regulations.

1.1 Project Description

The WTP Project Area currently contains 71 active producing wells, with accompanying production related facilities, roads, and pipelines. An additional 30 wells approved under the WTP Drilling Program EA (UT-070-2004-28) are proposed for development. Total gas compression and treatment capacity is currently 16,000 horsepower (hp) within the WTP at the existing Dry Canyon facility.

The proposed wells will be drilled to all potentially productive formations in the WTP Project Area: the Wasatch, North Horn, Mesa Verde, Dakota, Cedar Mountain, Navajo, and Wingate

Formations, and other formations found to be productive. The majority of the wells will be spaced at one well per 80 acres or less. However, geologic characteristics that are currently poorly defined and which will be better defined through future drilling, will dictate the well density necessary to effectively drain the natural gas within the WTP Project Area.

Each geologic formation in the WTP Project Area has unique permeability, which requires variable well densities for effective drainage of the gas reservoirs. Some of the economically productive geological formations can be effectively drained by down hole well densities of one well per 160 acres, most by well densities of one well per 80 acres, and others are likely to require well densities of up to one well per 40 acres (Wasatch and Mesa Verde formations). In general, deeper formations require lower down hole well density. Therefore, the number of wells per well pad vary dramatically, depending on the required down hole well density as well as topographic considerations. Well pads are to have from one to eight well bores. Some formations can be produced by a single well per 80 acres. Other formations may require well densities of one well per 40 acres as they are adjacent to topographically inaccessible lands or have multiple productive horizons; thus, they can be developed using well pads with up to eight wells per pad. Therefore, it is assumed for the EIS analysis that 807 wells are to be drilled from a minimum of 538 well pads.

BBC proposes the following primary components for development under the Proposed Action:

- Up to 807 natural gas wells from up to 538 pads over an 8 year development period, 33 year life of project (LOP);
- Up to 9 drilling rigs operating year round;
- Up to 3,656 acres short-term surface disturbance (wells, access roads, pipelines, compressor stations); and
- Approximately 24,000 compression horsepower would be added to the existing system, for a total of 40,000 horsepower (hp) within the WTP Project Area.

In addition to the Proposed Action, the following four alternatives are considered in the NEPA analysis:

- Alternative B – No Action (81 wells from 54 pads, 17,600 hp additional compression for 33,600 hp total compression, 3 rigs year round for 2 years, 27 year LOP)
- Alternative C – Transportation Reduction (807 wells from 538 pads, 40,000 hp total compression, 2-6 rigs year round for 15 years, 40 year LOP)
- Alternative D – Conservation Alternative (558 wells from 348 pads, 20,800 hp additional compression for a total of 36,800 horsepower compression, 7 rigs seasonally for 21 years, 46 year LOP)
- Alternative E – BLM Preferred Alternative (807 wells from 494 pads, 40,000 hp total compression, year-round drilling, 7 rigs per year for 9 years provided surface disturbance and air quality thresholds are not exceeded)

After construction of well pads and roads, drilling and completion of a well, and interconnection to the pipeline system, each well pad will consist of a wellhead, a three-phase separator (to separate gas, produced water, and hydrocarbon condensate), and a condensate tank. Approximately 25% of wells will require individual dehydrators and gas powered pump jacks. The gas will be moved to central production facilities (CPF) that will include multiple compressor engines, a central separator, and central glycol dehydration units. After processing, the gas will be transported to a sales pipeline for further distribution.

Emissions to the atmosphere from the proposed project will consist of the criteria pollutants nitrogen oxides (NO_x), carbon monoxide (CO), particulates (PM_{10} and $PM_{2.5}$), sulfur dioxide (SO_2), and volatile organic compounds (VOC), and various hazardous air pollutants (HAP). These pollutants will be emitted from the following activities and sources:

- Well pad and road construction: equipment producing fugitive dust while moving and leveling earth;
- Drilling: vehicles generating fugitive dust on access roads, and drill rig engine exhaust;
- Completion: vehicles generating fugitive dust on access roads, fracturing pump engine and generator emissions, and flaring emissions;
- Vehicle tailpipe emissions associated with all development phases;
- Well production operations: three-phase separator emissions, flashing and breathing emissions from a condensate tank, and pump jack engine emissions;
- Central production facility: compressor engines and central glycol dehydration unit emissions; and
- VOC emissions from pneumatic devises including methanol injection pumps, heat trace pumps, and two liquid level controllers at each well.

The ozone modeling will evaluate the incremental effect of two alternatives, the Proposed Action and Alternative E, the BLM Preferred Alternative. This approach will be used because both the Proposed Action and Alternative E would have the same level of development. However, under Alternative E, mitigation in the form of pollutant control devises will be required. Emission controls will be utilized on all condensate storage batteries with VOC emissions greater than 5 tons/year. The emission controls will likely consist of vapor recovery, thermal oxidation or other available technologies. At a minimum, the applied control technology must be capable of reducing emissions by 95 percent. Also, drill rig engines meeting the Tier II emissions standards will be required to reduce nitrogen dioxide (NOx) emissions. With this mitigation, the primary ozone precursors, NOx and especially VOC, will be reduced substantially. A comparison of emissions from each alternative is shown in **Table 1-1**. It is anticipated that ozone impacts will be less under Alternative E.

Table 1-1. WTP Emissions Comparison						
Pollutant (tons/year)	Proposed Action			Alternative E (Agency Preferred)		
	Development	Production	Total	Development	Production	Total
NO_x	570.2	702.8	1,273	272	690	963
CO	681.7	835.7	1,517	475	822	1,297
VOC	106.3	12,017	12,124	81.3	6,929	7,010
SO_2	12.5	0.69	13.1	9.92	0.58	10.50
PM_{10}	7,256.7	1,683	8,939	5,097	823	5,920
$PM_{2.5}$	1,129.3	288.2	1,417	767	156	923

1.2 Modeling Approach

For more than a decade, EPA has been developing the Models-3 Community Multiscale Air Quality (CMAQ) modeling system with the overarching aim of producing a 'One-Atmosphere' air quality modeling system capable of addressing ozone, particulate matter (PM), visibility and acid deposition within a common platform (Byun and Ching, 1999, Pleim et al., 2003, Byun and Schere, 2006). The original justification for the Models-3 development emerged from the challenges posed by the 1990 Clean Air Act Amendments and EPA's desire to develop an advanced modeling framework for 'holistic' environmental modeling utilizing state-of-science representations of atmospheric processes in a high performance computing environment. EPA completed the initial stage of development with Models-3 and released CMAQ in mid-1999 as the initial operating science model under the Models-3 framework. The most recent rendition is CMAQ version 4.6, publicly released October 2006.

CMAQ consists of a core Chemical Transport Model (CTM) and several pre-processors including the Meteorological-Chemistry Interface Processor (MCIP), initial and boundary conditions processors (ICON and BCON) and a photolysis rates processor (JPROC). EPA continues to improve and develop new modules for the CMAQ model and typically provides a new release each year. In the past, EPA has also provided patches for CMAQ as errors are discovered and corrected. More recently, EPA has funded the Community Modeling and Analysis Systems (CMAS) center to support the coordination, update and distribution of the Models-3 system. Byun and Schere (2006) describe the newest features implemented in the previously released CMAQ version 4.5.

2.0 CMAQ Modeling

The CMAQ modeling system is used for assessing the potential ozone impacts of the WTP project in the surrounding area. The CMAQ modeling consists of five different model simulations:

- Run 1 is the *2002 base case* year simulation using actual emissions and is also used in the model performance evaluation.;
- Run 2 is the *2002 baseline* year, which uses typical emissions instead of actual emissions, and is used for comparison with the future case design value calculations. The only difference between the *base case* and *baseline* runs are that the *base case* run uses Continuous Emissions Monitor (CEM) data for point sources whereas the *baseline* run has point sources operating at more typical levels;.
- Run 3 is a *future baseline* year, which is 2018 – the year the West Tavaputs project will be complete,
- Run 4 is the 2018 simulation that includes the anticipated emissions from the Proposed Action WTP project; and
- Run 5 is the 2018 simulation that includes the anticipated emissions from Alternative E of the WTP project.

The two alternatives for the "WTP project-only" impacts are estimated by determining the difference between Runs 3 and 4 for the Proposed Action and between Runs 3 and 5 for Alternative E.

2.1 Episode Selection

The year 2002 is used for the CMAQ ozone modeling for the West Tavaputs Plateau study. This selection is appropriate primarily because of data availability for 2002. The Western Regional Air Partnership (WRAP) (http://www.wrapair.org) used 2002 as the base year for their regional haze planning and has put significant effort into preparing the meteorological simulation and emissions data that are necessary for carrying out a detailed CMAQ simulation on a reasonable timeframe. Although 2002 was a particularly hot year with significant fire activity, it is an appropriate year for modeling given the uncertainty of future fires.

2.2 Modeling Domains

This section summarizes the model domain definitions for the WTP ozone modeling, including the domain coverage, resolution, map projection, and nesting schemes for the high resolution sub-domain.

2.2.1 Horizontal Modeling Domain

Figure 2-1 displays the 36/12 km modeling domains that are used in the CMAQ/SMOKE air quality/emissions modeling. The 36 km continental United States (U.S.) horizontal domain for CMAQ air quality and SMOKE emissions modeling are identical to what is used by several Regional Planning Organizations (RPOs) for their regional haze modeling (e.g., WRAP, CENRAP and VISTAS). This 36 km modeling domain covers the continental U.S. as well as large portions of Mexico and Canada. The CMAQ 12 km modeling domain is shown in **Figure**

2-2 and covers eastern Utah, western Colorado and portions of Wyoming, Arizona and New Mexico.

The CMAQ air quality and SMOKE emissions modeling 36/12 km modeling domains are aligned within the MM5 domains. The larger MM5 modeling domains provide a buffer around the CMAQ/emissions modeling domains by at least 6 grid cells in each direction. These grids are based on a Lambert Conformal Projection (LCP) using the same projection as adopted by the RPOs. The LCP parameters are listed in **Table 2-1**.

There is a possibility of boundary "noise" effects resulting from boundary conditions coming into dynamic balance with MM5's algorithms. The WRAP 12km MM5 domain, with the 12km CMAQ domain in red, is presented in **Figure 2-3**. The larger MM5 domain is designed to sequester such errors from the air quality simulation. The buffer region used in the current study exceeds the EPA suggestion of at least 5 grid cell buffers at each boundary.

Table 2-2 lists the number of rows and columns (i.e., the number of grid cells in the east-west and north-south direction) and the definition of the X and Y origin (i.e., the southwest corner) for the 36/12 km domains used in the CMAQ and the SMOKE models for the current study.

2.2.2 Vertical Modeling Structure

The CMAQ vertical structure is primarily defined by the vertical grid used in the MM5 modeling. The MM5 model employs a terrain-following coordinate system defined by pressure, using multiple layers that extend from the surface to 100 millibars (mb), which is approximately 15 km above ground level (AGL). A layer-averaging scheme is adopted for CMAQ simulations to reduce the air quality computational time. The effects of layer averaging were evaluated by WRAP and VISTAS and found to have a relatively minor effect on the model performance metrics when both 34 layer and 19 layer CMAQ model simulations were compared to ambient monitoring data (Morris et al., 2004a). For the West Tavaputs Plateau ozone modeling, 19 vertical layers are used. **Table 2-3** lists the mapping from the MM5 vertical layer structure to the CMAQ vertical layers. This MM5 structure was taken from the WRAP, VISTAS and CENRAP RPO configuration and the same CMAQ structure is also being used in the RPO modeling. Note that the MM5 and CMAQ models both use a terrain following "sigma" coordinate system so over elevated terrain the model heights will be compressed.

2.3 Model Input Preparation Procedures

2.3.1 Meteorological Inputs

This and the following subsections describe the procedures used in developing the meteorological, emissions, and air quality inputs to the CMAQ model for the West Tavaputs Plateau ozone modeling study on the 36/12 km grids. The development of the CMAQ meteorological and emissions inputs are discussed together with the science options recommended for the CMAQ model. The procedures for developing the initial and boundary conditions and photolysis rates are also discussed along with the model application procedures.

The procedures set forth here are consistent with EPA guidance (e.g., EPA, 1991; 1999; 2005a; 2007), other recent 8-hour ozone modeling studies conducted for various State and local agencies using these or other state-of-science modeling tools (e.g., Tesche et al., 2003; Morris et al., 2004a,b; Tesche et al., 2005a), as well as the methods used by EPA in support of the recent Clean Air Interstate Rule (EPA, 2005b) and the Clean Air Mercury Rule (EPA, 2005c).

The WRAP 2002 36/12km MM5 simulation (Kemball-Cook et al., 2004) was used to provide meteorological inputs to the CMAQ and SMOKE models. The WRAP simulations were based on an extensive review of available MM5 physical and dynamical options and have been the basis of many subsequent MM5 applications in the region. The WRAP did a fairly extensive study to determine the optimal configuration for the MM5 modeling system. One of the choices they made was to use the Betts-Miller Cumulus Parameterization. Betts-Miller was developed to parameterize tropical convection. However, using Betts-Miller improved the precipitation skill of the model.

2.3.2 Emission Inputs

In order to simulate ozone, it was necessary to develop emissions estimates for all other emission sources (i.e. industrial, electric generation, motor vehicle, biogenic) in addition to the emissions from the West Tavaputs Plateau project. The foundation datasets for the emissions development were based on the WRAP 2002 and 2018 emissions databases and were processed into CMAQ-ready files using SMOKE 2.2 for both the 36km and 12km grids. SMOKE 2.2 was used because several of the WRAP-developed emissions files are not directly compatible with the newest version of SMOKE (i.e., version 2.4). Further, this project would not have benefited from the enhancements in SMOKE v.2.4. Details on the emissions input preparation are presented in Section 3.

2.3.3 CMAQ Science and Input Configurations

This section describes the model configuration and science options to be used in the WTP ozone modeling effort. **Table 2-4** summarizes the CMAQ configuration that was used in the study. The latest version of CMAQ (Version 4.6) was used in the WTP ozone modeling.

As indicated in the CMAQ model setup defined in **Table 2-4**, two grids were employed. CMAQ was initially run for the 2002 base case on the 36 km continental U.S. grid for calendar year 2002. CMAQ was then run for the 2002 base case on the 12 km grid utilizing the initial and boundary conditions from the 36 km CMAQ simulation.

CMAQ inputs were as follows:

> Meteorological Inputs: The MM5-derived meteorological fields were prepared for CMAQ using MCIP 3.3.
>
> Initial/Boundary Conditions (IC/BC's): The IC/BC's for the 36-km continental U.S. simulation were based on the latest available information. Currently, the RPOs use IC/BC's for the same domain based on a 2002 GEOS-CHEM global chemistry model

simulation. Boundary and initial conditions for the 12-km nest will be generated from the 36-km CMAQ nest using the CMAQ ICON and BCON processors.

Photolysis Rates: The modeling team prepared the photolysis inputs as well as the albedo/haze/ozone/snow inputs for CMAQ based on Total Ozone Mapping Spectrometer (TOMS) data using the CMAQ JPROC processor.

Spin-Up Initialization: The model was run in quarters using a nominal 15-day spin-up from the previous quarter for the 36-km grid and a nominal 4 day spin-up from the previous quarter for the 12-km grid.

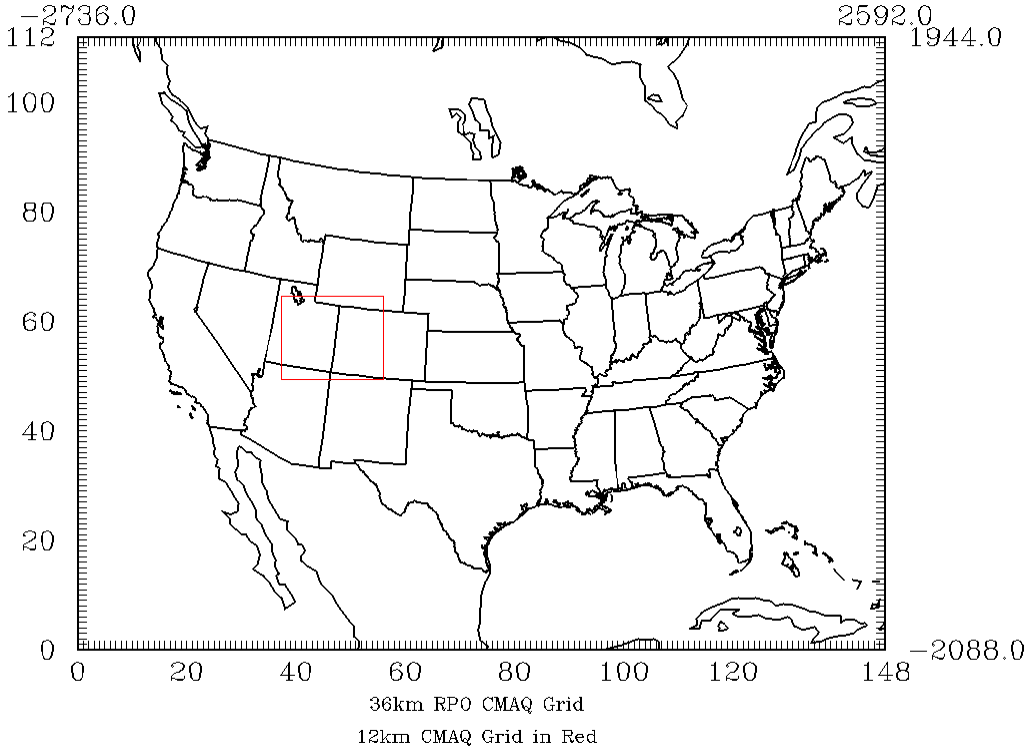


Figure 2-1. 36- and 12-km CMAQ Domains for West Tavaputs Plateau Study. The 12-km domain is highlighted in red and is expanded in Figure 2-2.

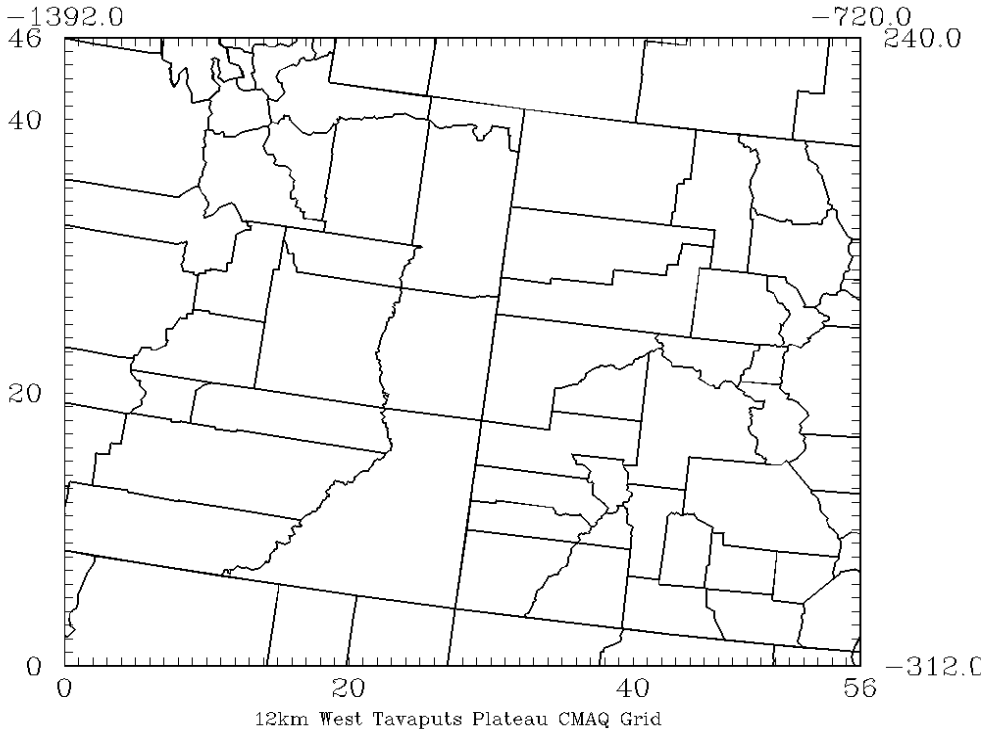


Figure 2-2. 12-km CMAQ Domain for West Tavaputs Plateau Study

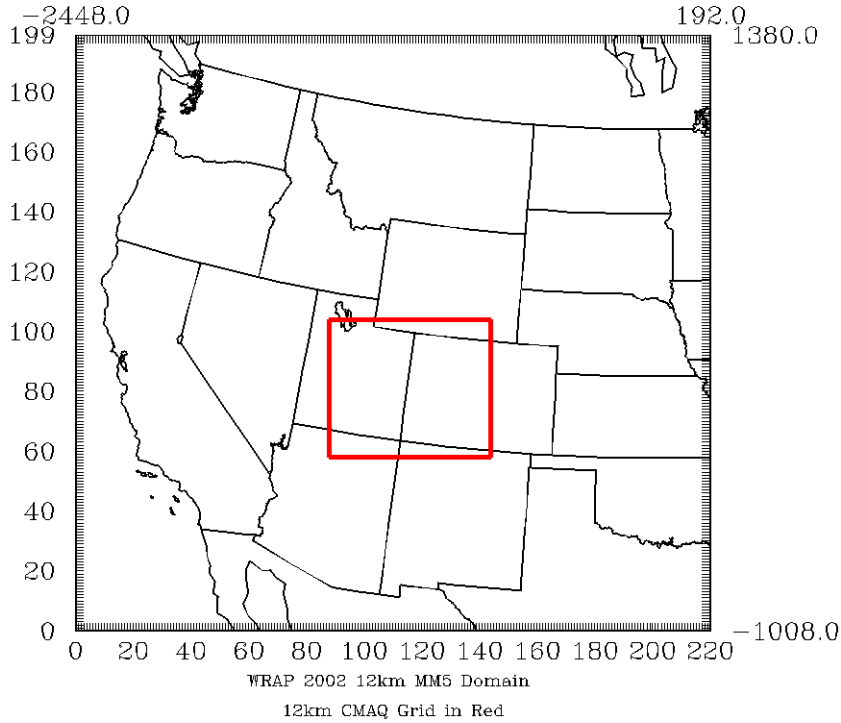


Figure 2-3. 12-km WRAP MM5 Domain with 12-km CMAQ Domain for West Tavaputs Plateau Study

Table 2-1. Lambert Conformal Projection (LCP) Definition for the West Tavaputs Plateau Modeling Grid	
Parameter	**Value**
Projection	Lambert-Conformal
1st True Latitude	33 degrees N
2nd True Latitude	45 degrees N
Central Longitude	-97 degrees W
Central Latitude	40 degrees N

Table 2-2. Grid Definitions for SMOKE and CMAQ				
Grid Resolution	**east-west grid cells**	**north-south grid cells**	**X-origin (km)**	**Y-origin (km)**
36 km grid	148	112	-2736.0	-2088.0
12 km grid	53	47	-1368.0	-288.0

Table 2-3. Vertical Layer Definition for MM5 Simulations (left most columns), and Approach for Reducing CMAQ Layers by Collapsing Multiple MM5 Layers (right columns)

MM5					CMAQ			
Layer	**Sigma**	**Pres (mb)**	**Height (m)**	**Depth (m)**	**Layer**	**Pres (mb)**	**Height (m)**	**Depth (m)**
34 (top)	0.000	100	18123	2856	19	100	18123	9160
33	0.050	145	15267	2097				
32	0.100	190	13170	1659				
31	0.150	235	11510	1374				
30	0.200	280	10136	1173				
39	0.250	325	8963	1024	18	325	8963	3492
28	0.300	370	7938	909				
27	0.350	415	7030	817				
26	0.400	460	6213	742				
25	0.450	505	5471	680	17	505	5471	1890
24	0.500	550	4791	627				
23	0.550	595	4163	582				
22	0.600	640	3581	543	16	640	3581	1053
21	0.650	685	3038	509				
20	0.700	730	2528	386	15	730	2528	664
19	0.740	766	2142	278				
18	0.770	793	1864	269	14	793	1864	443
17	0.800	820	1596	174				
16	0.820	838	1421	171	13	838	1421	338
15	0.840	856	1251	167				
14	0.860	874	1083	164	12	874	1083	163
13	0.880	892	920	161	11	892	920	161
12	0.900	910	759	79	10	910	759	158
11	0.910	919	680	78				
10	0.920	928	601	78	9	928	601	155
9	0.930	937	524	77				
8	0.940	946	447	76	8	946	447	76
7	0.950	955	371	75	7	955	371	76
6	0.960	964	295	75	6	964	295	75
5	0.970	973	220	74	5	973	220	74
4	0.980	982	146	37	4	982	146	37
3	0.985	987	109	37	3	987	109	37
2	0.990	991	73	36	2	991	73	36
1	0.995	996	36	36	1	996	36	36
0 (ground)	1.000	1000	0	0	0	0	0	0

Table 2-4. CMAQ (version 4.6) Model Configuration		
Science Options	**Configuration**	**Details/Comments**
Model Code	CMAQ (version 4.6)	Pleim et al., (2003)
Horizontal Grid Mesh	36/12 km	36 km covering continental U.S; 12 km covering Eastern UT and Western CO
36 km grid	148 x 112 cells	RPO National Grid
12 km grid	53 x 47 cells	
Vertical Grid Mesh	19 Layers	First 8 layers synchronized with MM5
Grid Interaction	One-way nesting	
Initial Conditions	15 days full spin-up	Separately run 4 quarters of 2002
Boundary Conditions	GEOS-CHEM annual run	2002 GEOS-CHEM run.
Emissions		
Baseline Emissions Processing	See SMOKE (Ver 2.2) model configuration	MM5 Meteorology input to SMOKE, CMAQ
Dust Transport Fraction	Applied in emissions before SMOKE	
NH3 Inventory Adjustment	Applied in emissions before SMOKE	
Sub-grid-scale Plumes	No Plume-in-Grid (PinG)	
Chemistry		
Gas Phase Chemistry	CBM-IV	with Isoprene updates
Aerosol Chemistry	AE3/ISORROPIA	
Secondary Organic Aerosols	Secondary Organic Aerosol Model (SORGAM)	Schell et al., (2001)
Aerosol Mass Conservation Patch	Yes	
Cloud Chemistry	RADM-type aqueous chemistry	Includes subgrid cloud processes
N2O5 Reaction Probability	0.01 – 0.001	
Horizontal Transport		
Eddy Diffusivity Scheme	K-theory with K_h grid size dependence	Multiscale Smagorinsky (1963) approach
Vertical Transport		
Eddy Diffusivity Scheme	K-theory	
Diffusivity Lower Limit	Kzmin = 0.1	
Planetary Boundary Layer	No Patch [1]	
Deposition Scheme	M3dry	Directly linked to Pleim-Xiu Land Surface Model parameters

Table 2-4. CMAQ (version 4.6) Model Configuration		
Science Options	**Configuration**	**Details/Comments**
Numerics		
Gas Phase Chemistry Solver	Euler Backward Iterative (EBI) solver	Hertel et al (1993) EPI solver ~ 2x faster than MEBI
Horizontal Advection Scheme	Piecewise Parabolic Method (PPM) scheme	
Other		
Meteorological Processor	MCIP ver 3-3	
Simulation Periods	Annual 2002	
Integration Time Step	Internally Computed	15 minute coupling time step
Time zone	GMT	
Platform	Dual Processor/Dual Core AMD Opteron	
Run-Time (expected)	7-10 days	Platform Dependent

[1]PATCH means applying a mosaic scheme based on land-use, which is not normally done for CMAQ. The terminology is not the same as used for a software fix.

3.0 CMAQ Emissions Input Procedures

The emissions inventories utilized for the West Tavaputs Plateau Study were based on several sources. The ozone modeling required CMAQ-ready emissions estimates for 2002 and an additional future modeling year. 2018 was selected as the future year modeling inventory because it coincided with the WRAP inventory and was the year when the West Tavaputs field development was projected to be complete.

At the time of this study, the WRAP Phase II oil and gas emission inventory were the best publically available baseline data for oil and gas activities in the Uinta Basin. The selected emissions inventories were supplemented with project-related emissions data for each of the two alternatives that were analyzed. The oil and gas-related emissions data were converted into SMOKE-ready input files, and maintained as an individual processing stream to allow easy update of the oil and gas emissions data, detailed QA, and reporting.

The non-oil and gas emissions used for the WTP ozone analysis are the WRAP 2002 Plan2d emissions inventory, and the WRAP 2018 PRP18a emissions inventory. These inventories cover the following major emissions source categories in the WRAP states:

- Point sources,
- Area sources,
- Non-road mobile sources, and
- On-road mobile sources,
- Biogenic sources
- Fire sources

Overviews and detailed technical descriptions of the WRAP emissions inventory development can be found at:

http://wrapair.org/forums/ssjf/pivot.html - Stationary area and point sources
http://wrapair.org/forums/ef/UMSI/index.html - On-road and off-road mobile sources

WRAP has inventoried the oil and gas related emissions as a separate category. The most current inventory for the oil and gas emissions at the time of the project execution were the WRAP Phase II oil and gas inventories for 2002 and 2018. These emissions were included in the modeling as separate source categories. The overviews and detailed technical descriptions of the WRAP oil and gas emissions inventory development can be found at:

http://wrapair.org/forums/ogwg/Phases_I_and_II_Inventories.html - Oil and Gas sources

A complete description of the process used to project the WRAP 2002 point and area source emissions to the year 2018 are documented (ERS 2006). The following is a summary of the steps followed to project the WRAP 2002 emissions inventory to the year 2018.

1) 2002 Emissions Inventory. This information was taken from the revised 2002 WRAP point and area source inventory.

2) Adjustments:

- Emissions for new facilities that have come on-line since 2002

- Corrections for facilities that retired in 2003 or 2004 and will not return to operation in the future

- Other (i.e., ratios to correct certain PM10 and PM2.5 emission factors/SCCs for combustion of natural gas)

3) Control Factors:

Emission reductions due to known (i.e., on-the-books) controls, consent decrees reductions, SIP control measures, and other relevant regulations that have gone into effect since 2002, or will go into effect before the end of 2018. These controls do not include impacts from any future control scenarios that have yet to be determined.

4) Growth Factors:

SCC-specific growth factors developed from EGAS projection factor model; special analysis of EGU growth relative to unit capacity threshold.

5) Retirement and Replacement rates:

Effects of retirement estimated using annual retirement rates based on expected equipment lifetimes. Retired equipment replaced by lower-emitting new equipment. Unit lifetimes examined for natural gas-fired EGUs; no retirements for coal-fired EGUs.

6) Permit Limits:

Used in the cases where the projected emissions may have inadvertently exceeded an enforceable emission limit (i.e., emissions were adjusted downward to the permit limit, as applicable).

3.1 Development of CMAQ Ready Emissions Inventories

Emissions inventory development for CMAQ ozone and haze modeling addressed several source categories including: (a) stationary point sources, (b) area sources, (c) on-road mobile sources, (d) non-road mobile sources, (e) biogenic sources and (f) fire sources. For this analysis, CMAQ ready emissions input files were created using SMOKE 2.2 for the 2002 and 2018 annual periods over the 36 and 12-km grids.

CMAQ requires emission input files containing hourly emission estimates, distributed both vertically and horizontally in the modeling domain. For ozone modeling alone, hourly emissions are required for NO, NO_2, CO, several classes of VOCs and other chemicals as available. The

VOC classes used depend upon the chemical mechanism selected, which for the current study was CB-IV with updates to the isoprene chemistry.

CMAQ was also configured to provide particulate matter (PM) estimates, as well as visibility and deposition results. Thus, additional PM precursor species were needed as emissions inputs, which included SO_2, NH_3, SO_4, NO_3, EC, OMC, other primary $PM_{2.5}$ and coarse PM ($PM_{2.5-10}$).

3.2 Set-up of SMOKE Over the WTP Domain

SMOKE was configured to generate point, area, non-road, highway, and biogenic source emissions. In addition, certain subcategories, such as fires and electricity generator units (EGU) were maintained in separate source category files in order to allow maximum flexibility in producing alternate emissions modeling strategies. Domain specific oil and gas-related emissions were also maintained as a separate source category. With the exception of biogenic and highway mobile source emissions, that were generated using the BEIS3 and MOBILE6 modules in SMOKE, respectively, pre-computed annual emissions were processed using the month, day, and hour-specific temporal profiles of the SMOKE model.

Producing 365 day-specific input files for all source categories places a burden on available computing facilities, data management systems, and would adversely affect the project schedule. Selecting representative model days for some or all of the source categories reduces the processing and file handling requirements to a more manageable level, and in most cases, does not compromise the accuracy of the emissions files. Other current or recent projects undertaken by EPA, WRAP and LADCO have used representative weekday/Saturday/Sunday emissions estimates for all source categories except biogenics either for each month or each season to model.

In an attempt to better represent the level of temporal and spatial detail available for each source category, a more detailed strategy was adopted. Biogenic emissions were modeled for each episode day, using the daily meteorology. Point sources, including CEM and fire emissions, were modeled for each episode day to take advantage of the available day-specific emissions and meteorology. All sources were treated by SMOKE as potentially elevated. No plume-in-grid sources were modeled. Wildfire emissions were handled as point sources. In the past, wildfire emissions were often handled as area source releases. However, since wildfires do have plume rise, techniques have been developed using plume rise calculations to place emissions into appropriate vertical layers. This technique was used in the WRAP and VISTAS CMAQ modeling.

Area sources, including non-road mobile and dust emissions, which do not utilize meteorological data, were temporally allocated by monthly, daily and hourly profiles that are contained in SMOKE. Review of these temporal profiles indicated that maximum temporal definition was achieved by selecting representative Thursday, Friday, Saturday, Sunday, and Monday profiles for each month. Though motor vehicle emissions are influenced by meteorological variability, the processing requirements for daily motor vehicle emissions were prohibitive under the project schedule. Instead, a single week per month was selected to model emissions from on-road mobile sources. This week was selected from mid-month, to best represent the average

temperature ranges for the month, and also adjusted to exclude holidays that would have required atypical processing. The area source modeling dates were also selected from these weeks to simplify data handling procedures. The selected weeks for area source and on-road mobile source emissions modeling were as follows:

2002 On-Road Mobile Sources Represented by the Following Weeks:

January 13-19	February 10-16
March 10-16	April14-20
May 12-18	June 9-15
July 14-20	August 11-17
September 15-21	October 13-19
November 10-16	December 15-21

3.3 Development of Point Source Emissions

Stack parameter data may be incorrect, especially in some of the current regional modeling inventories. Therefore, careful QA is required to assure that the point source emissions are properly located both horizontally and vertically on the modeling grid. To screen for simple, but potentially serious inventory errors such as these, the study team has modified procedures originally developed by EPA to quality assure, augment, and where necessary, revise the stack parameters to examine the accuracy of the point source emissions, as well as standardize procedures to identify and correct stack data errors. SMOKE has a number of built-in QA procedures designed to catch missing or out-of-range stack parameters. These procedures were invoked in the processing of the point source data.

Point source emissions were separated into EGU and non-EGU categories. The non-EGU category did not have any day or hour-specific emissions. All non-EGU point source emissions were temporally allocated to month, day, and hours using annual emissions and source category code (SCC) based allocation factors. These factors were based on the cross-reference and profile data supplied with the SMOKE 2.2 and were supplemented with relevant data that were developed during the WRAP and VISTAS modeling projects.

To temporally allocate the EGU point sources, the heat input data were derived from the 2002 Continuous Emissions Monitoring (CEM) datasets, and were used to develop facility-level temporal distributions. The day-specific and facility-specific temporal profiles were used in conjunction with the emissions data to estimate hourly EGU emissions by facility.

All point sources were spatially allocated in the domain based on the stationary source geographic coordinates. If a point source was missing its latitude/longitude coordinates, the source was placed in the center of its respective county.

3.4 Development of Area and Non-Road Source Emissions

All area and non-road source emissions were temporally allocated to month, day, and hour using annual emissions and source category code (SCC) based allocation factors. These factors were based on the cross-reference and profile data supplied with the SMOKE 2.2 and supplemented

with relevant data developed during the WRAP and VISTAS studies. Area and non-road sources were spatially allocated in the domain based on SCC-based spatial surrogate allocation factors. If an area or non-road source SCC did not have an existing cross-reference profile assigned to it, the county-level emissions were allocated by population density in the respective county.

A crustal PM transport factor was applied to fugitive dust emission sources that were identified in U.S. EPA modeling to have only a portion of its mass transported from the source of the emissions generation. The EPA's studies indicated that 60 to 90 percent of PM emissions from fugitive dust sources are rapidly deposited to near-source locales; hence, do not participate in the physicochemical processes on the spatial scales that are typically used in air quality modeling simulations. For this reason, the county-specific fugitive dust emissions transport factors were applied to these sources to adjust PM emissions prior to the SMOKE modeling.

3.5 Development of On-Road Mobile Source Emissions

The MOBILE6 module of SMOKE was used to develop the base year on-road mobile source emissions estimates for CO, NOx, PM, and VOC emissions. The MOBILE6 parameters, vehicle fleet descriptions, and VMT estimates were combined with gridded, episode-specific temperature data to calculate the gridded, hourly emission estimates. Of note, whereas the on-network emissions estimates were spatially allocated based on link location and subsequently summed to the grid cell level, the off-network emissions estimates were spatially allocated based on a combination of the FHWA version 2.0 highway networks and population. For the WTP 36/12 km modeling, no link based data were used. The MOBILE6 emissions factors were based on episode-specific temperatures predicted by the meteorological model. Further, the MOBILE6 emissions factors model accounted for the following:

- Hourly and daily minimum/maximum temperatures;
- Facility speeds;
- Locale-specific inspection and maintenance (I/M) control programs, if any;
- Adjustments for running losses;
- Splitting of evaporative and exhaust emissions into separate source categories;
- VMT, fleet turnover, and changes in fuel composition and Reid vapor pressure (RVP).

The primary input to MOBILE6 was the MOBILE shell file. The MOBILE shell contained the various options (e.g., type of inspection and maintenance program in effect, type of oxygenated fuel program in effect, alternative vehicle mix profiles, RVP of in-use fuel, operating mode) that direct the calculation of the MOBILE6 emissions factors.

3.6 Development of Biogenic Source Emissions

A revised version of a commonly used biogenic emissions model, the Biogenic Emissions Inventory System (BEIS), has been developed and tested by EPA over two separate modeling domains/episodes. This version of the model (BEIS-3, v0.9) contains several changes over BEIS-2, including the following:

- Vegetation input data -- are now based on a 1-km Biogenic Emissions Landuse Database (BELD3) vegetation data base,
- Emission factors – many updates including some recent NARSTO modifications,
- Environmental algorithm -- includes a sunlit/shaded leaf solar radiation model.

A series of sensitivity modeling simulations has been completed and concluded that the more recent BEIS-3 methodology will impact base case model ozone predictions in most parts of the U.S. The preliminary tests have also shown that the newer biogenic emissions **do not** appear to have a large effect on: 1) the control signal response, 2) relative reduction factors resulting from a projected emissions change, or 3) overall regional model performance in the eastern U.S.

For the current study, BEIS-3 version 0.9 as currently incorporated in SMOKE was used. This version was used since it is consistent with the WRAP emissions inventory, which means 1) soil NO emissions were prepared without the input of specific soil moisture and precipitation data and 2) biogenic methanol emissions were not modeled explicitly. Otherwise, the modeling was identical to a BEIS-3 (v1.0) application.

The BELD-3 land use data on a Lambert conformal grid at 1-km resolution have already been developed and were used to estimate biogenic emissions in this study. The BEIS model also required as input hourly, gridded temperature and solar radiation data to estimate biogenic emissions, and these data were derived from the MM5 predictions.

3.7 Wildfires and Prescribed Burns

Wildfire and prescribed burn emissions were handled separately from the standard area source input files. The study team had nation-wide fire emissions for the 2002 year, developed for WRAP and VISTAS. Spatial and temporal distributions of the fire emissions were calculated based on this information rather than relying on standard distribution profiles. Also, the study team calculated the vertical distribution of the fire emissions, based on fire size and biomass involvement. SMOKE 2.2 can model fire plume rise if provided with the following variables:

PTOP – Top of the fire plume profile (meters above ground level)
PBOT – Bottom of the fire plume profile (meters above ground level)
Lay1 – The percent of the emissions entrained in the first modeling layer

The WRAP Fire Emissions Joint Forum Emissions Inventory Report (FEJF,2002) documented an approach to estimate these plume descriptors. In this method, the fires were assigned to one of 5 size categories, based on the total burn acreage, and the biomass fuel loading. These categories were then used to calculate representative hourly plume profiles. These profiles were used by SMOKE 2.2 to distribute the vertical emissions for the fires.

3.8 Products of the Emissions Inventory Development Process

In addition to the CMAQ-ready input files generated for each hour of the days modeled in the annual run, a number of quality assurance (QA) files were prepared and used to check for gross errors in the emissions inputs. Importing the model-ready emissions into the Package for

Analysis and Visualization of Environmental Data (PAVE) and looking at both the spatial and temporal distribution of the emissions provided insight into the quality and accuracy of the emissions inputs. PAVE allowed for the following quality assurance checks on the emissions estimated using SMOKE 2.2:

- Visualizing the model-ready emissions with the scale of the plots set to a very low value, areas where emissions were omitted from the raw inventory and erroneously located emissions (such as area source industrial emission in water cells) were corrected.
- Normalizing the emissions by population for each state illustrated where the inventories may have been deficient and provided a reality check of the inventories vis-à-vis a spatial evaluation of the population weighted emissions estimates.
- Spot checked vertical allocation of point source emissions estimates.

State inventory summaries were prepared prior to the emissions processing to compare against SMOKE output report totals generated after each major step of the emissions generation process.

To check the vertical allocation of the emissions estimates, reports were created by source, hour, and layer for randomly selected states in the domain.

Quantitative QA analyses often reveal significant deficiencies in the input data or the model setup. Sometimes it is necessary to tailor these procedures to track down the source of each problem. As such, the basic quantitative QA steps that were performed in an attempt to reveal the underlying problems with the inventories or processing are described. Some of the reports that may be generated to review the processed emissions estimates include the following:

- State and county totals from inventory for each source category
- State and county totals after spatial allocation for each source category
- State and county totals by day after temporal allocation for each source category for representative days
- State and county totals by model species after chemical speciation for each source category
- State and county model-ready totals (after spatial allocation, temporal allocation, and chemical speciation) for each source category and for all source categories combined
- If elevated source selection is chosen by user, the report indicating which sources have been selected as elevated and plume-in-grid will be included.
- Totals by source category code (SCC) from the inventory for area, mobile, and point sources
- Totals by state and SCC from the inventory for area, mobile, and point sources
- Totals by county and SCC from the inventory for area, mobile, and point sources
- Totals by SCC and spatial surrogates code for area and mobile sources
- Totals by speciation profile code for area, mobile, and point sources
- Totals by speciation profile code and SCC for area, mobile, and point sources
- Totals by monthly temporal profile code for area, mobile, and point sources

- Totals by monthly temporal profile code and SCC for area, mobile, and point sources
- Totals by weekly temporal profile code for area, mobile, and point sources
- Totals by weekly temporal profile code and SCC for area, mobile, and point sources
- Totals by diurnal temporal profile code for area, mobile, and point sources
- Totals by diurnal temporal profile code and SCC for area, mobile, and point sources

3.9 Project Emissions

Study-specific emission inventories, described in Section 1.1, were developed for the WTP for the Proposed Action (Alternative A) and the Agency Preferred Alternative (Alternative E). These inventories included the construction and operations emissions. The emissions were calculated for the last year of construction and the year when the WTP is expected to be fully developed – 2018. Because the WTP project is expected to be fully developed in 2018, use of the WRAP 2018 inventory was possible thus allowing for the inclusion of the most precise emissions estimates for the future year.

4.0 2002 Base Case Modeling Results

In order to gain confidence that the CMAQ base case simulation for 2002 is operating well enough to be a useful tool in assessing future ozone impacts, the modeling system is evaluated against available ambient data. The two monitoring networks with available observational data are the AIRS and CASTNET monitoring networks. However, with the closest monitoring station to the WTP project approximately 120 km away, there is a dearth of observational data that is in the immediate vicinity of the proposed project. The available monitoring stations are listed in Table 4-1 and graphically shown in Figure 4-1. Particular emphasis is placed on the Canyonlands monitor since that is the closest rural monitor to the West Tavaputs Plateau project area.

4.1 Comparison of Modeled Versus Observed Peak 2002 Ozone Concentrations

A monitor's 8-hour ozone design value is expressed as the three-year average of the fourth highest daily maximum ozone concentration at a monitor. For example, the monitor's 8-hour ozone design value for 2002 is the average of the fourth highest 8-hour observed concentration in 2000, the fourth highest 8-hour observed concentration in 2001, and the fourth highest 8-hour observed concentration in 2002. Consequently, the model's ability to predict the highest ozone concentrations at an ozone monitor is of particular concern, and the focus of the evaluation is typically on the fourth highest 8-hour ozone concentrations.

Table 4-2 displays the first through fourth highest model estimated and observed daily maximum 8-hour ozone concentrations during the 2002 modeling year at ozone monitors in the 12 km modeling domain. In comparing the model estimated (cells shaded white in Table 4-2) and peak observed (cells shaded yellow in Table 4-2) values, CMAQ consistently overestimates 8-hour peak observed concentrations at the CASTNET sites. Further, except for a couple of instances, CMAQ predicts peak concentrations to occur in April and May at the CASTNET sites while the observed peaks occurred in June through September. For example, at the Canyonlands CASTNET site (i.e., UT-CAN407 in Tables 4-2 through 4-4), CMAQ estimated the fourth highest 8-hour ozone concentration to be 90 ppb on May 22 where the observed fourth highest 8-hour ozone value was 74 ppb on June 16.

For the urban monitoring sites, the trend for CMAQ to over predict observed ozone concentrations continues all but two stations – 490352004 and 490353006, where CMAQ under predicts observed ozone concentrations for the four highest ozone values, and at stations 490110001 and 490350003 where CMAQ under predicts the third and fourth highest observed ozone values. In addition, CMAQ has mixed ability to accurately predict the date where the highest ozone concentrations are observed.

The ozone season in Utah runs from June 1 through September 30. To examine the performance of the CMAQ model during the ozone season, the four highest observed and predicted ozone values were extracted from this time period. Table 4-3 presents the first through fourth highest daily maximum 8-hour ozone concentrations in the 2002 base case simulation during the ozone season (cells shaded white in Table 4-3), and the four highest observed daily 8-hour maximum ozone concentrations during the 2002 ozone season (cells shaded yellow in Table 4-3). As with

the analysis where all ozone values were examined, the outcome is very similar with the following exceptions:

- Though CMAQ continues to under predict the highest observed 8-hour ozone concentration at station 490352004, CMAQ over predicts the second through fourth highest observed ozone concentration when considering only ozone season days; and

- For station 490495008, CMAQ consistently under predicts the four highest observed 8-hour concentrations when considering only the ozone season days.

When only the fourth highest observed and predicted 8-hour ozone values are considered from Table 4-3, the agreement between the observations and model estimates are much closer when only days from the ozone season are considered. Further, CMAQ does better at predicting the date of the fourth highest ozone event generally coming within in one month of the event, with the exception of station 490370101, when only days in the ozone season are considered. For example, at the Canyonlands CASTNET monitor (i.e., UT-CAN407) the observed fourth highest daily 8-hour maximum ozone concentration was 74.1 ppb and the fourth highest modeled daily 8-hour maximum ozone concentration was 76.2 ppb with the peaks occurring within 8 days of each other in June.

4.2 Statistical and Graphical Ozone Model Performance Evaluation

The 2002 base case CMAQ simulation is compared against available observed ozone concentrations in the 12 km domain to assess model performance both graphically and statistically. The graphical summaries are presented with the goal of providing a qualitative assessment of CMAQ's ability to replicate observed ozone concentrations. The graphical summaries provide a quick, visual means of qualitatively assessing model performance. The statistical summaries are presented with the goal of providing a quantitative assessment of model performance.

Figures 4-2 through 4-5 show the ability of CMAQ to predict observed 8-hour ozone concentrations for the first quarter (Figure 4-2), second quarter (Figure 4-3), third quarter (Figure 4-4), and fourth quarter (Figure 4-5) of 2002. Figure 4-6 shows the ability of CMAQ to predict 8-hour observed ozone concentrations through the 2002 ozone season (01-June through 30-September). For these comparisons, the "best," "cell," and "weighted" predictions are compared to the observed concentrations. The "best" comparison refers to the CMAQ 8-hour ozone prediction that is closest to the observed value within nine grid cells centered on the monitoring station. The "cell" comparison refers to the CMAQ 8-hour ozone prediction that that falls in the grid cell where the ozone monitor is located. The "weighted" comparison refers to the distance-weighted average to the location of the ozone monitor of the CMAQ 8-hour ozone predictions that are centered about the nine grid cells of the ozone monitor. Periods where no observations are plotted indicate times when the ozone monitor was down and no observations were available.

The model tends to overestimate ozone at Canyonlands throughout much of February through May. In May, the highest model estimate at Canyonlands is over 100 ppb. The observations during this time are in the low 60 ppb. During the June through September ozone season, Figure 4-6, the model has much more skill replicating daily peak 8-hour ozone concentrations and

overall episodic trends, but the model tends to predict lower nighttime concentrations than observed though much of July and August.

Correlation diagrams of daily maximum 8-hour ozone concentrations at all monitors in the domain for the first through fourth quarters and the ozone season for 2002 are presented in Figures 4-7 through 4-11, respectively. In the first (Figure 4-7), second (Figure 4-8), and fourth (Figure 4-10) quarters, the model tends to overestimate ozone concentrations. In the third quarter of 2002, Figure 4-9), CMAQ does better at estimating daily maximum 8-hour ozone concentrations. As much of the ozone season falls in the third quarter, CMAQ performance during the ozone season (Figure 4-11) is also relatively good.

Comparisons of domain average 8-hour average ozone observations and model estimates at observation locations are presented for the first through fourth quarters and the ozone season for 2002 in Figures 4-12 through 4-16, respectively. As was seen in the correlation diagrams, the model tends to overestimate ozone concentrations in the first (Figure 4-12), second (Figure 4-13), and third (Figure 4-15) quarters of 2002, but CMAQ does comparatively well at replicating the observations in the third (Figure 4-14) quarter of 2002, which includes periods of oscillating high and low episodes in mid-August through mid-September. Although the CMAQ model is in many cases overestimating the mean ozone concentrations, the model does have skill in estimating the episodic nature of high ozone concentrations. The model tends to estimate periods of ozone build-up, followed by clean-out periods.

Statistical model performance goals and criteria are used as a reference point to help interpret the CMAQ model performance. However, they are not to be used as a pass/fail test. This is consistent with EPA's latest modeling guidance for 8-hour ozone, $PM_{2.5}$ and regional haze modeling that lists no performance goals, but instead lists several studies' past model performance metrics as a benchmark for comparison (EPA, 2007). This is in contrast to EPA's original 1-hour ozone modeling guidance that listed specific modeling metrics and performance goals that should be met (EPA, 1991). For ozone modeling, EPA established performance goals for 1-hour ozone Mean Normalized Bias (MNB) and Mean Normalized Gross Error (MNGE) of less than or equal to ±15% and less than or equal to 35%, respectively (EPA, 1991).

Table 4-4 presents the mean normalized bias (MNB) and mean normalized gross error (MNGE) statistical metrics by month. EPA recommends using a threshold of 60 ppb for computing the MNB and MNGE. However, this guidance was developed for ozone model performance in urban areas during high ozone periods, not for examining largely rural annual model performance. For this reason a threshold of 40 ppb was used in the calculation. The column labeled "N" in Table 4-4 is the number of station-hours where the ozone concentration was greater than 40 ppb and were used in to compute the MNB and MNGE statistical metrics. The MNB performance goal of less than or equal to ±15% is met in seven of the twelve months, the annual period, and for the ozone season. The MNGE performance goal of less than or equal to 35% is met for all months, the annual period, and the ozone season. The worst model performance was during May when the model had nearly equal MNB and MNGE of greater than 30%, signifying the model was systematically overestimating ozone concentrations. For the June through September ozone season the model MNB is 5.22% and MNGE is 15.72, well within the EPA performance goals.

4.3 Ozone Model Performance Summary

Though the model tends to have an overestimation bias, the CAMx 2002 12km base case simulation reproduces the observed ozone to within EPA's performance goals.,. Care must be taken interpreting the fourth highest absolute model estimates since the limited observations suggest that the model may be overestimating during these periods. It appears to be more appropriate to use the model results in a relative sense per EPA guidance than to use the model in an absolute sense. It also appears to be more appropriate to use the ozone season values to help eliminate the suspect high ozone periods in May, particularly if the fourth highest ozone concentration is used. Though there is a limited database against which to conduct an extensive operational CMAQ model performance evaluation, the model performance results suggest that the existing CMAQ air quality simulation framework is adequate to perform an assessment of the potential ozone impacts of the West Tavaputs Plateau project emissions.

Table 4-1. AIRS/AQS and CASTNET Surface Stations Used for Model Performance Evaluation.

AIRSID	State	County	Network
080677001	CO	La Plata	AIRS
080677003	CO	La Plata	AIRS
080830101	CO	Montezuma	AIRS
490030003	UT	Box Elder	AIRS
490110001	UT	Davis	AIRS
490350003	UT	Salt Lake	AIRS
490352004	UT	Salt Lake	AIRS
490353006	UT	Salt Lake	AIRS
490353007	UT	Salt Lake	AIRS
490353008	UT	Salt Lake	AIRS
490370101	UT	San Juan	AIRS
490490002	UT	Utah	AIRS
490495008	UT	Utah	AIRS
490495010	UT	Utah	AIRS
490570007	UT	Weber	AIRS
490571003	UT	Weber	AIRS
CAN407	UT		CASTNET
CNT169	WY		CASTNET
GTH161	CO		CASTNET
MEV405	CO		CASTNET

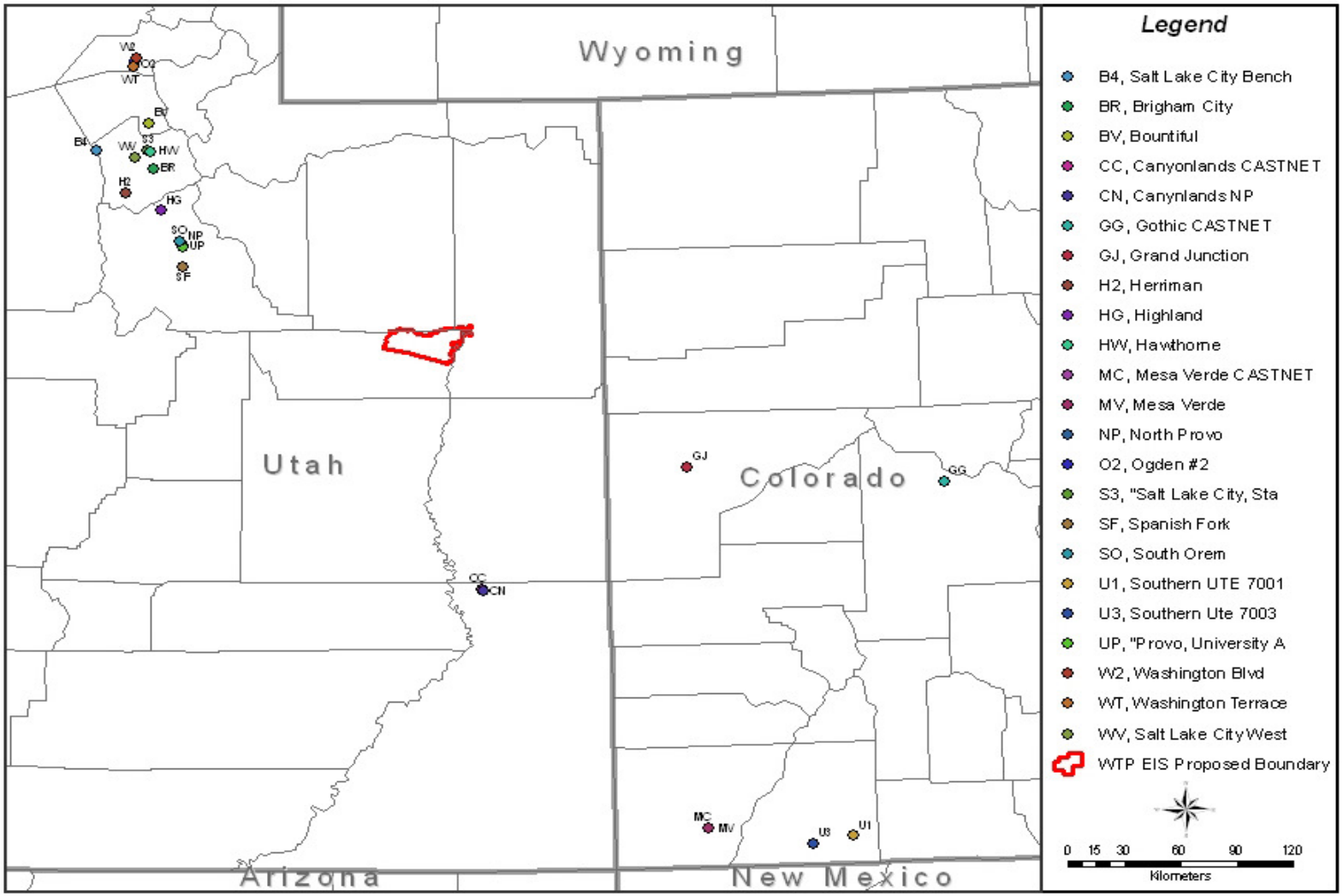


Figure 4-1. CASTNET/AQS Surface Stations.

Table 4-2. Highest daily maximum 8-hr average ozone (ppb) at monitors in 12 km study domain in 2002. Cells shaded in blue are from the CASTNET monitoring network. Table cells shaded white are CMAQ 8-hour ozone 2002 base case predictions, and table cells shaded yellow are 8-hour 2002 observed ozone values.

	Highest		Second		Third		Fourth	
Monitor	Date	Value	Date	Value	Date	Value	Date	Value
UT-CAN407	20020501	104.80	20020423	91.32	20020508	90.46	20020522	90.21
	20020902	75.50	20020607	74.67	20020608	74.17	20020616	74.17
WY-CNT169	20020523	94.13	20020507	91.31	20020609	89.76	20020621	88.46
	20020626	79.13	20020627	79.00	20020708	76.66	20020625	76.54
CO-GTH161	20020502	107.76	20020501	107.51	20020522	97.64	20020521	96.82
	20020616	74.50	20020416	74.18	20020507	72.78	20020505	72.19
CO-MEV405	20020423	96.12	20020521	93.97	20020502	93.45	20020605	93.14
	20020619	78.00	20020620	73.83	20020617	70.88	20020618	70.88
80677001	20020423	101.24	20020605	96.84	20020522	96.56	20020422	95.23
	20020617	61.75	20020606	61.25	20020608	61.00	20020605	60.88
80677003	20020423	98.99	20020605	98.33	20020522	95.12	20020525	92.71
	20020617	59.83	20020619	58.25	20020618	57.13	20020416	55.50
80830101	20020423	96.12	20020521	93.97	20020502	93.45	20020605	93.14
	20020619	77.50	20020620	74.38	20020617	70.88	20020618	70.88
350451005	20020605	91.42	20020521	90.11	20020423	88.24	20020517	87.24
	20020617	80.38	20020607	77.14	20020608	76.75	20020605	75.75
490110001	20020711	101.07	20020710	99.36	20020705	84.15	20020625	83.24
	20020819	93.86	20020714	91.38	20020625	89.63	20020702	89.25
490350003	20020711	89.69	20020710	84.18	20020615	81.57	20020526	79.54
	20020712	86.25	20020710	84.13	20020713	83.50	20020714	82.50
490352004	20020711	98.70	20020710	91.76	20020614	91.32	20020621	85.31
	20020626	100.13	20020712	89.38	20020713	87.63	20020711	83.75
490353006	20020711	92.86	20020710	88.25	20020714	82.96	20020615	81.11
	20020710	94.57	20020625	91.63	20020714	86.38	20020712	84.88
490353007	20020711	100.45	20020710	94.38	20020614	86.86	20020615	83.14
	20020711	82.25	20020616	81.13	20020710	80.88	20020713	79.50
490353008	20020711	93.70	20020710	90.93	20020615	81.95	20020512	80.21
	20020616	83.00	20020711	82.38	20020614	80.25	20020701	78.13
490370101	20020501	104.80	20020423	91.32	20020508	90.46	20020522	90.21
	20020902	75.57	20020607	74.43	20020616	74.29	20020903	74.14
490490002	20020604	88.47	20020702	85.78	20020709	84.60	20020512	81.87
	20020702	82.50	20020710	81.75	20020709	79.88	20020615	77.75
490495008	20020711	82.88	20020512	81.70	20020604	81.18	20020526	80.42
	20020702	85.14	20020712	82.63	20020710	82.50	20020701	82.25
490495010	20020604	90.08	20020527	88.26	20020709	83.89	20020526	82.38
	20020709	81.50	20020702	81.38	20020620	78.38	20020615	77.75

Table 4-3. Highest daily maximum 8-hr average ozone (ppb) at monitors in 12 km study domain for the 2002 ozone season (01-June through 30-September). Cells shaded in blue are from the CASTNET monitoring network. Table cells shaded white are CMAQ 8-hour ozone 2002 base case predictions, and table cells shaded yellow are 8-hour observed ozone values.

	Highest		Second		Third		Fourth	
Monitor	Date	Value	Date	Value	Date	Value	Date	Value
UT-CAN407	20020604	81.33	20020605	79.44	20020603	77.69	20020608	76.25
	20020902	75.50	20020607	74.67	20020608	74.17	20020616	74.17
WY-CNT169	20020609	89.76	20020621	88.46	20020608	85.97	20020624	84.77
	20020626	79.13	20020627	79.00	20020708	76.66	20020625	76.54
CO-GTH161	20020605	89.47	20020621	87.43	20020611	86.16	20020624	84.95
	20020616	74.50	20020608	71.78	20020617	70.59	20020618	70.13
CO-MEV405	20020605	93.14	20020624	86.64	20020617	84.66	20020730	83.36
	20020619	78.00	20020620	73.83	20020617	70.88	20020618	70.88
80677001	20020605	96.84	20020619	88.71	20020623	86.86	20020616	85.96
	20020617	61.75	20020606	61.25	20020608	61.00	20020605	60.88
80677003	20020605	98.33	20020619	90.52	20020623	85.20	20020624	84.64
	20020617	59.83	20020619	58.25	20020618	57.13	20020719	53.88
80830101	20020605	93.14	20020624	86.64	20020617	84.66	20020730	83.36
	20020619	77.50	20020620	74.38	20020617	70.88	20020618	70.88
350451005	20020605	91.42	20020712	86.73	20020724	85.07	20020713	84.33
	20020617	80.38	20020607	77.14	20020608	76.75	20020605	75.75
490110001	20020711	101.07	20020710	99.36	20020705	84.15	20020625	83.24
	20020819	93.86	20020714	91.38	20020625	89.63	20020702	89.25
490350003	20020711	89.69	20020710	84.18	20020615	81.57	20020714	79.30
	20020712	86.25	20020710	84.13	20020713	83.50	20020714	82.50
490352004	20020711	98.70	20020710	91.76	20020614	91.32	20020621	85.31
	20020626	100.13	20020712	89.38	20020713	87.63	20020711	83.75
490353006	20020711	92.86	20020710	88.25	20020714	82.96	20020615	81.11
	20020710	94.57	20020625	91.63	20020714	86.38	20020712	84.88
490353007	20020711	100.45	20020710	94.38	20020614	86.86	20020615	83.14
	20020711	82.25	20020616	81.13	20020710	80.88	20020713	79.50
490353008	20020711	93.70	20020710	90.93	20020615	81.95	20020614	76.81
	20020616	83.00	20020711	82.38	20020614	80.25	20020701	78.13
490370101	20020604	81.33	20020605	79.44	20020603	77.69	20020608	76.25
	20020902	75.57	20020607	74.43	20020616	74.29	20020903	74.14
490490002	20020604	88.47	20020702	85.78	20020709	84.60	20020713	80.98
	20020702	82.50	20020710	81.75	20020709	79.88	20020615	77.75
490495008	20020711	82.88	20020604	81.18	20020710	80.30	20020615	75.60
	20020702	85.14	20020712	82.63	20020710	82.50	20020701	82.25
490495010	20020604	90.08	20020709	83.89	20020713	79.74	20020617	77.72
	20020709	81.50	20020702	81.38	20020620	78.38	20020615	77.75

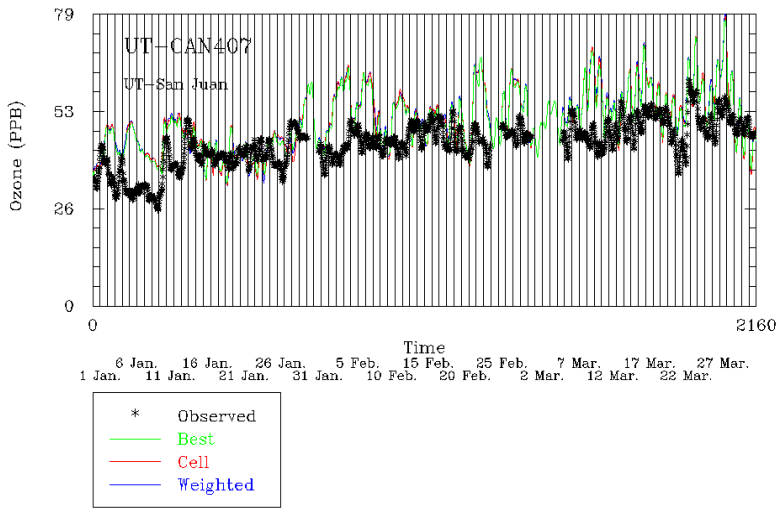


Figure 4-2. Comparison of Model Estimated and Observed Ozone Concentrations (ppb) at the Canyonlands CASTNET Site for Q1 2002.

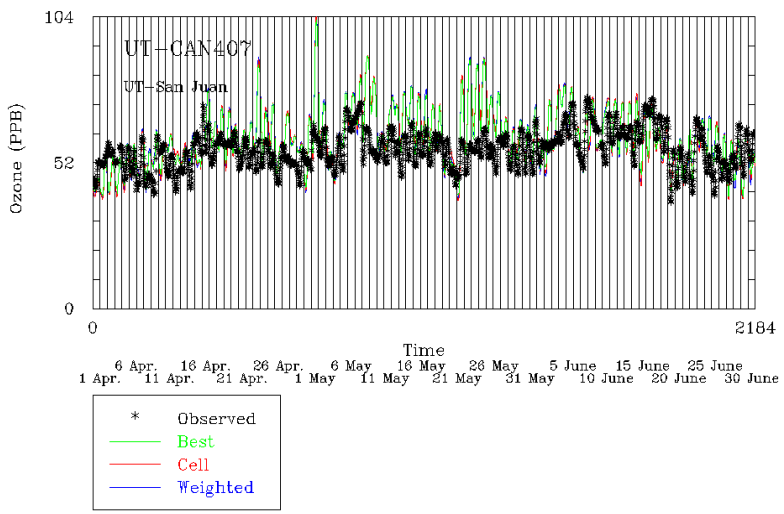


Figure 4-3. Comparison of Model Estimated and Observed Ozone Concentrations (ppb) at the Canyonlands CASTNET Site for Q2 2002.

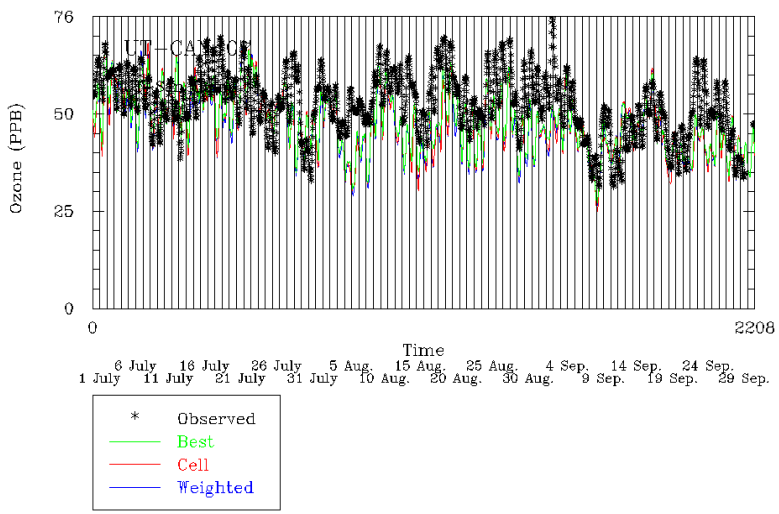


Figure 4-4. Comparison of Model Estimated and Observed Ozone Concentrations (ppb) at the Canyonlands CASTNET Site for Q3 2002.

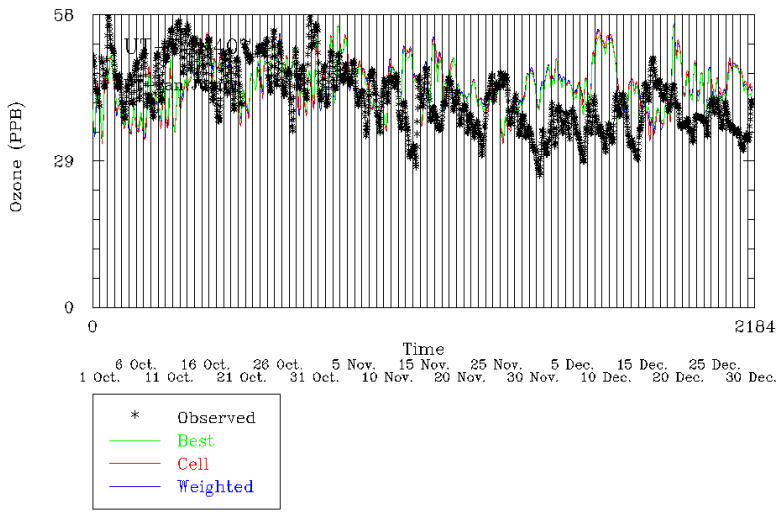


Figure 4-5. Comparison of Model Estimated and Observed Ozone Concentrations (ppb) at the Canyonlands CASTNET Site for Q4 2002.

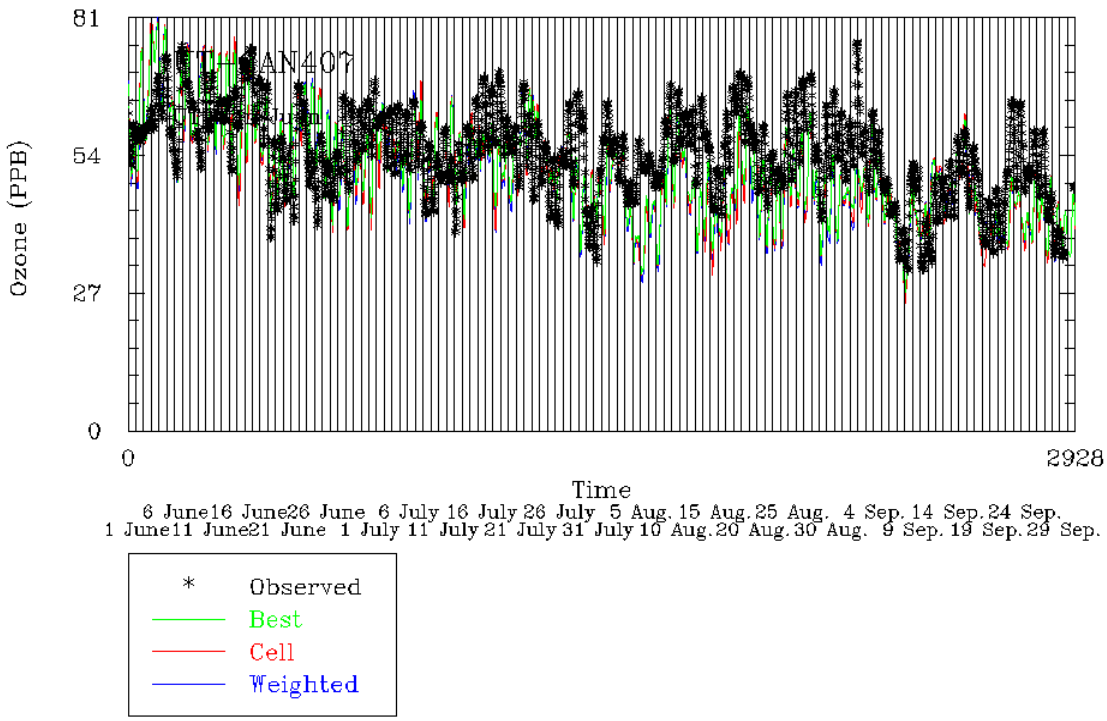


Figure 4-6. Comparison of Model Estimated and Observed Ozone Concentrations (ppb) at the Canyonlands CASTNET Site for Ozone Season 2002.

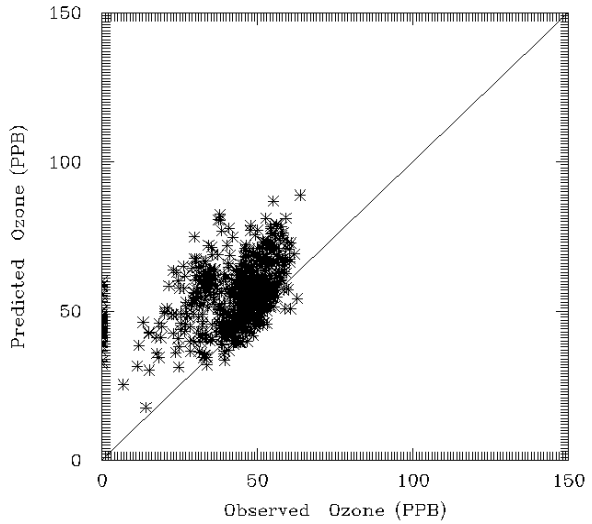


Figure 4-7. Comparison of Modeled and Observed Daily Maximum 8-hour Ozone (ppb) for Q1 2002.

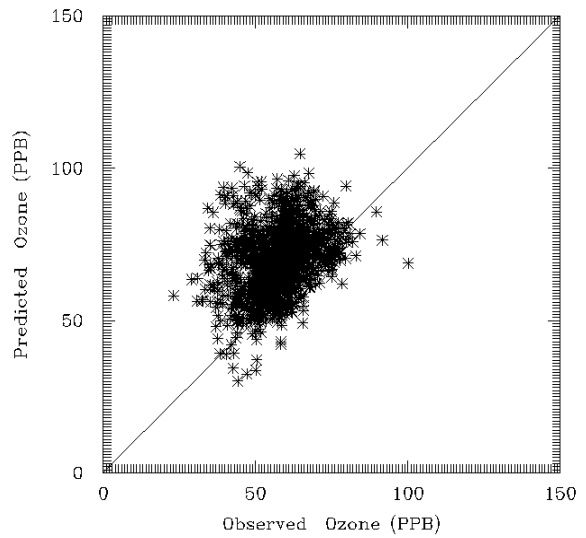


Figure 4-8. Comparison of Modeled and Observed Daily Maximum 8-hour Ozone (ppb) for Q2 2002.

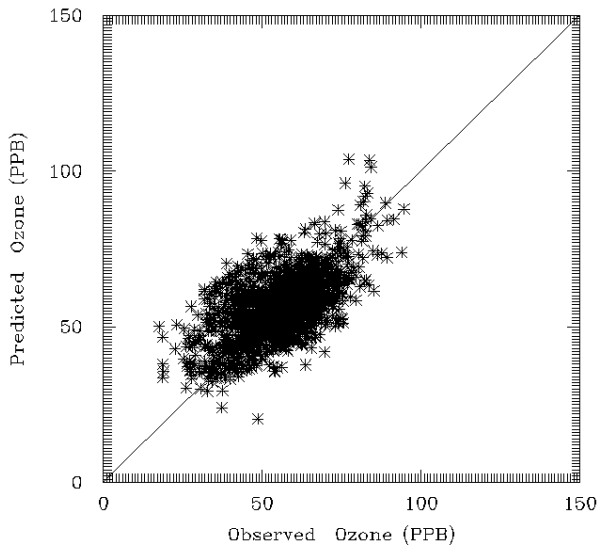


Figure 4-9. Comparison of Modeled and Observed Daily Maximum 8-hour Ozone (ppb) for Q3 2002.

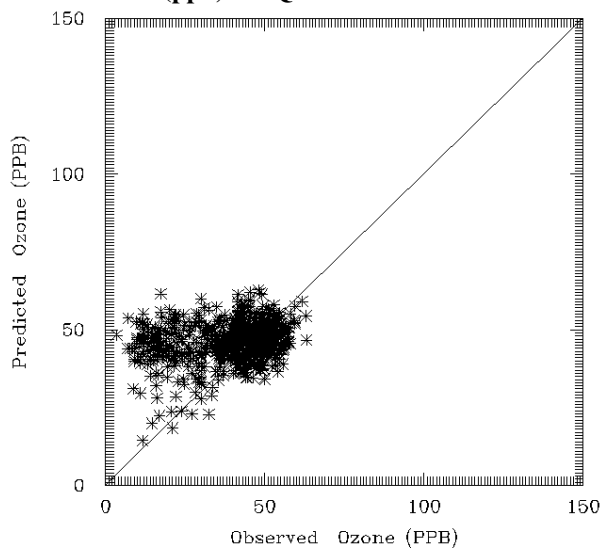


Figure 4-10. Comparison of Modeled and Observed Daily Maximum 8-hour Ozone (ppb) for Q4 2002.

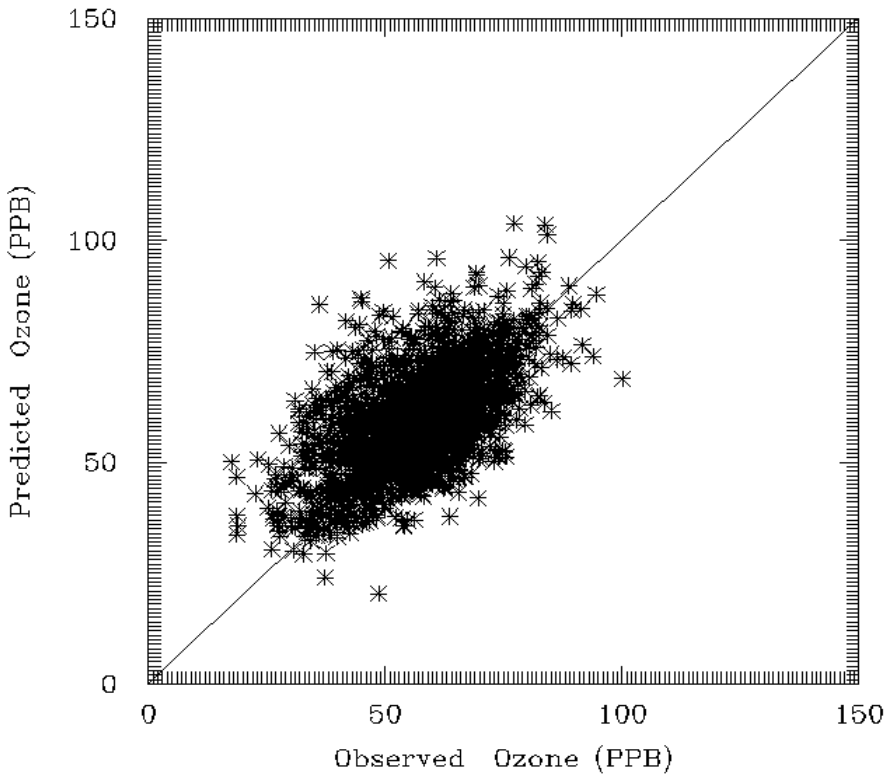


Figure 4-11. Comparison of Modeled and Observed Daily Maximum 8-hour Ozone (ppb) for Ozone Season 2002.

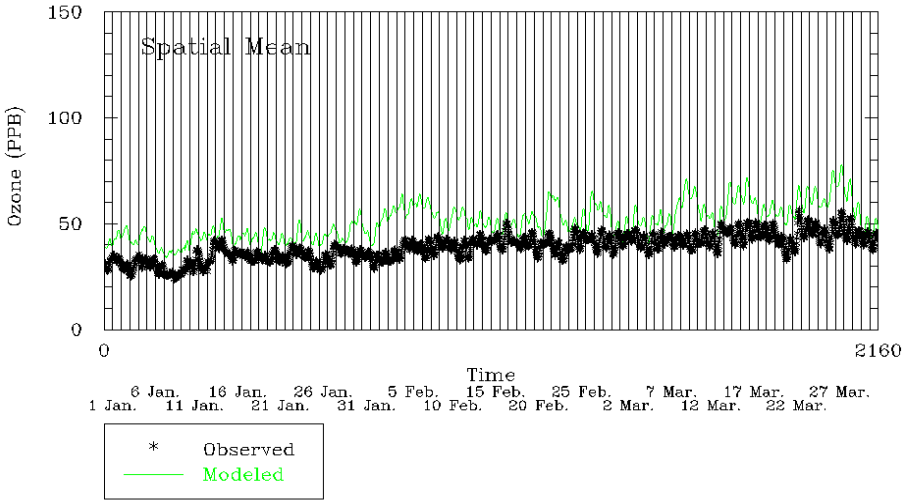


Figure 4-12. Spatial Mean Observed and Model Estimated Ozone Concentration (ppb) for Q1 2002.

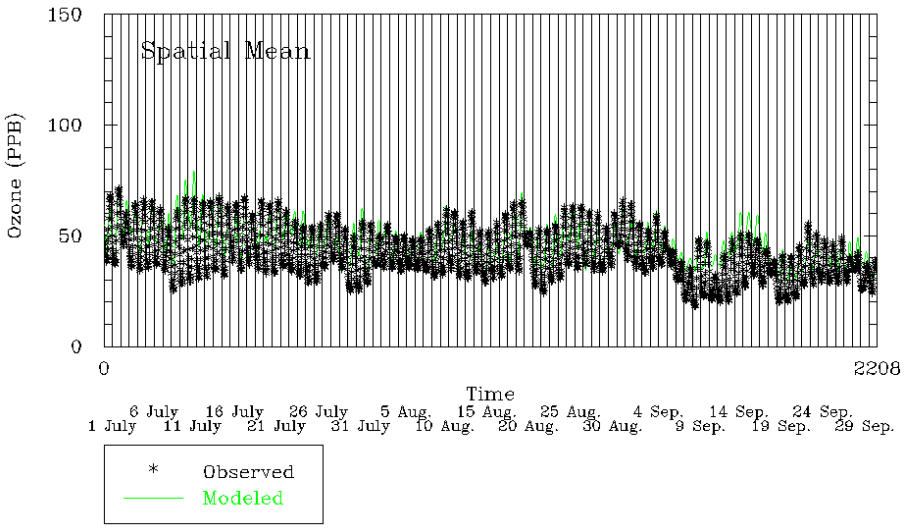


Figure 4-13. Spatial Mean Observed and Model Estimated Ozone Concentration (ppb) for Q3 2002.

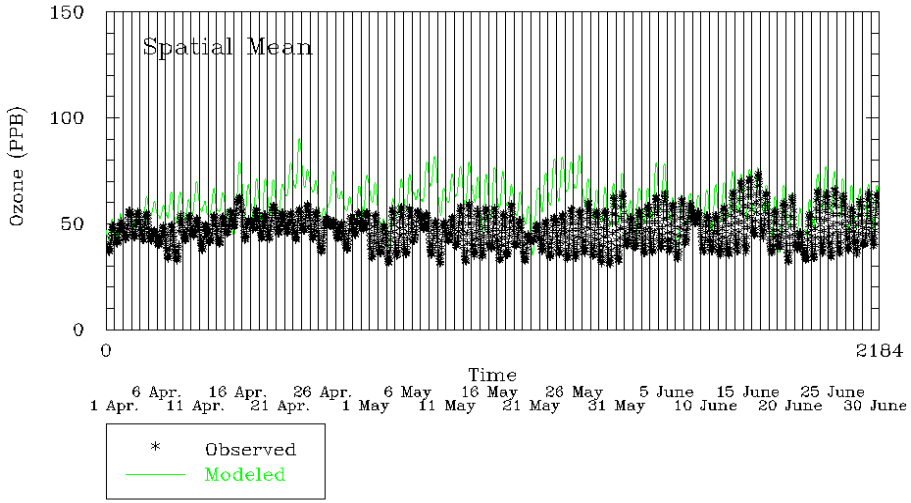


Figure 4-14. Spatial Mean Observed and Model Estimated Ozone Concentration (ppb) for Q2 2002.

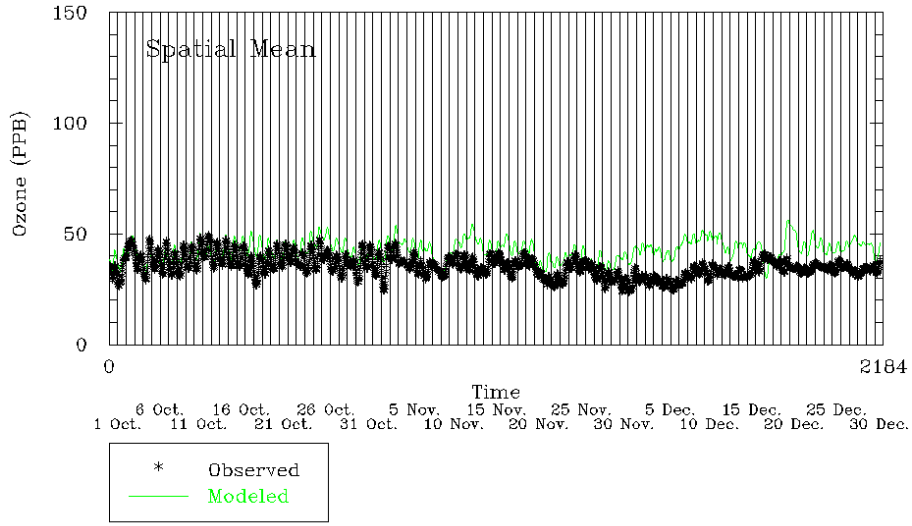


Figure 4-15. Spatial Mean Observed and Model Estimated Ozone Concentration (ppb) for Q4 2002.

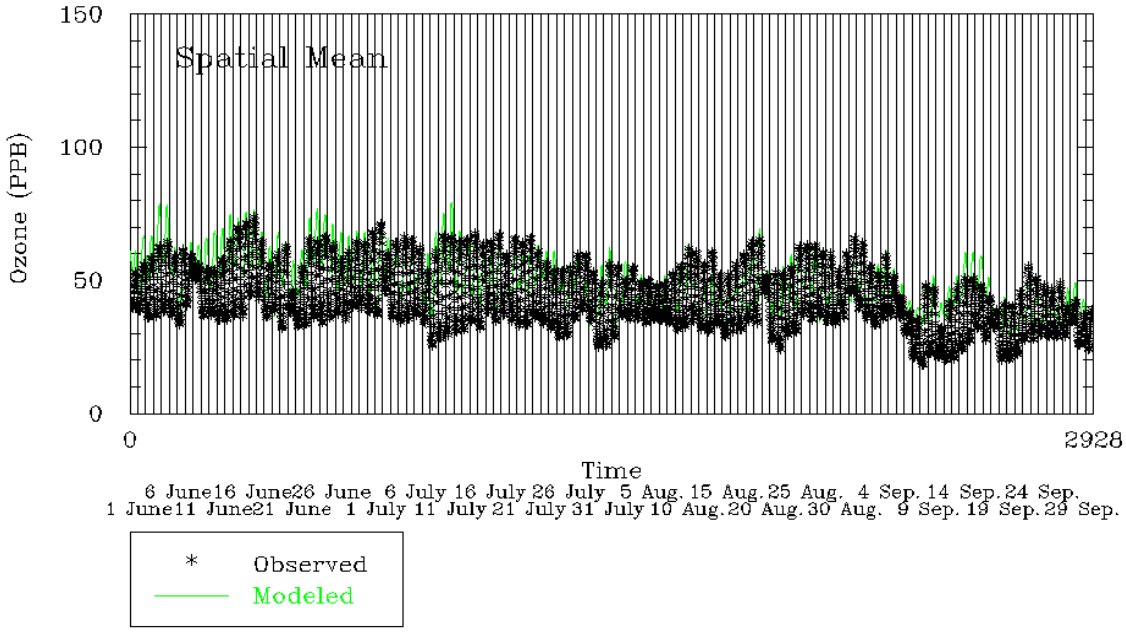


Figure 4-16. Spatial Mean Observed and Model Estimated Ozone Concentration (ppb) for Ozone Season 2002.

Table 4-4. Mean normalized bias (MNB) and mean normalized gross error (MNGE) by month for all stations in the 12km domain.

Month	MNB	MNGE	N
Jan '02	6.02	10.50	2646
Feb '02	19.61	20.45	3732
Mar '02	19.60	21.18	4667
Apr '02	17.59	20.81	4819
May '02	30.46	31.78	8423
Jun '02	15.21	19.26	8869
Jul '02	4.90	15.06	8488
Aug '02	-3.08	14.02	7982
Sep '02	1.21	13.21	4925
Oct '02	-4.69	10.48	3574
Nov '02	0.14	9.36	2512
Dec '02	8.41	14.84	1805
Annual	10.87	18.17	62442
Ozone Season	5.22	15.72	30264

5.0 CMAQ Ozone Impact Assessment

This section presents the ozone impacts of the 2018 No Action, 2018 Proposed Action, and 2018 Alternative E cases using both the EPA guidance relative approach (EPA, 2007) and an absolute impact approach.

5.1 Results Using EPA Guidance Ozone Projection Approach

EPA guidance for projecting future 8-hour ozone concentrations recommends using the photochemical grid model in a relative sense to scale current observed 8-hour ozone design values (EPA, 2007).

The EPA metrics for determining attainment of the ozone standard are based on the modeled ozone concentrations at a monitor location. For this analysis, the study area has very few available ozone measurements, so it is desirable to examine the ozone impacts both at the monitors, and also at areas removed from monitors. This section treats each in-turn.

5.1.1 EPA Guidance 8-Hour Ozone Projection Procedures

EPA guidance for projecting future 8-hour ozone concentrations recommends using the photochemical grid model in a relative sense to scale current observed 8-hour design values (EPA, 2007). A design value is defined as a three-year average of the fourth highest daily maximum 8-hour ozone concentrations at a monitor. Model scaling factors called relative response factors (RRFs) are used to scale the observed design values in order to predict future year design values. RRFs are the ratio of the future year (or the control case) to the current-year modeled 8-hour ozone concentrations near a monitor site. EPA has defined "near the monitor" to be approximately 15 km from the monitor location. The future-year design value (DVf) is obtained from the current-year design value (DVc) using the relation:

$$DVf = DVc \times RRF$$

The RRFs are calculated for all days in which the current-year modeled 8-hour ozone value is above a threshold. EPA recommends a threshold between 70 and 85 ppb. This is done so that the model response to future changes in emissions is considered only on high ozone days of comparable conditions to the days used to produce the DVc.

To perform the 8-hour projections, EPA has developed the Modeled Attainment Test Software (MATS) (http://www.epa.gov/scram000/modelingapps_mats.html) tool that uses modeling results, 8-hour ozone design values and follows EPA guidance (EPA,2007) to project 8-hour ozone concentrations that reflect the change in emissions from the base case to an alternative emissions scenario.

The EPA modeling guidance procedures (EPA, 2007) recommends using a DVc based on a three-year average of 8-hour ozone design values centered on the modeling year. For the 2002 modeling year, this means the DVc would be the weighted average of the fourth highest 8-hour

ozone concentration at a monitor from 2000, 2001, 2002, 2003 and 2004 using weights of 1, 2, 3, 2, and 1, respectively. For example, if the fourth highest observed ozone concentrations in each of the years 2000 through 2004 are 101 ppb, 75 ppb, 95 ppb, 83 ppb, and 70 ppb respectively, the DVc is computed as follows:

$$DVc = (1*101 + 2*75 + 3*95 + 2*83 + 1*70) / (1 + 2 + 3 + 2 + 1) = 85.8 \text{ ppb}$$

To develop RRFs, EPA guidance recommends using current and future year modeling results for all days in which the current year daily maximum 8-hour ozone concentration near the monitor exceeds a threshold value. Using the 12-km grid, the maximum modeled daily maximum 8-hour ozone concentration in a 3 by 3 array of grid cells centered on the monitor is used. EPA recommends using an 8-hour ozone threshold concentration of 85 ppb and recommends that RRFs be based on a minimum of 5 days, although greater than 10 days is preferred.

The 8-hour ozone projections are performed three times. The first projection is performed using the 2002 typical simulation and the future year No Action. Projections will be then be run comparing the Proposed Action and Alternative E cases to the 2002 typical simulation. As was discussed previously, a 2002 base case simulation is constructed to determine if CMAQ model performance is sufficiently adequate to conduct a 2018 future year impact assessment. As it was determined that CMAQ can be used for a 2018 future year impact assessment, a 2002 typical is constructed. The 2002 typical CMAQ simulation differs from the 2002 CMAQ actual base case simulation in the emissions that are used. For the 2002 CMAQ base case simulation, the most representative set of emissions estimates, consisting of actual hourly point source NOx emissions from EGUs are used in the air quality modeling. In the 2002 typical simulation, the emissions from EGUs, averaged over a three to four year period to prevent upset conditions or extended offline time from biasing the data, are used in the air quality modeling simulations. Three different 2018 future year emissions inventories are constructed to represent the alternatives actions that may occur: (1) the "No Action" case; (2) the "Proposed Action" case; and (3) the "Alternative E" case. CMAQ is run for each case and three sets of future design values are estimated for each of the three cases. The project impacts are the differences in the future design values between the Proposed Action and the Alternative E simulations and the No Action simulation.

5.1.2 Impact Assessment at Monitors

Monitor station 2002 design values (DVc), 2018 future year design values (DVf) and the RRF for the 2018 No Action, 2018 Proposed Action and 2018 Alternative E for all stations in the domain analyzed over the entire 2018 period are presented in Table 5-1. EPA Guidance (EPA, 2007) suggests truncating ozone concentrations to the PPB level when performing attainment testing. However, for this analysis the results are presented to the tenth of a PPB to better resolve potential project impacts.

Table 5-1 shows that in 2018, all monitors in the study area predicted to be in attainment of the 75 ppb ozone standard. The only monitors where either the Proposed Action or Alternative E impact a monitors' 2018 design value at the tenth ppb level are the Centennial CASTNET monitor in Wyoming (CNT169) where the DVf is 69.2 ppb for "No Action" increasing to 69.3

ppb for both the Proposed Action and Alternative E, and the Brigham City AIRS monitor in Utah (49035003) where the DVf is 64.8 ppb for "No Action" increasing to 64.9 ppb for both the Proposed Action and Alternative E.

Monitor station 2002 design values (DVc), 2018 future year design values (DVf) and the RRF for the 2018 No Action, 2018 Proposed Action and 2018 Alternative E for all stations in the domain analyzed over just the 2018 ozone season are presented in Table 5-2. As with the analysis of 2018 future year design values over the entire 2018 period, all monitors are predicted to attain the 75 ppb ozone standard under 2018 No Action case with no detrimental impacts predicted under the Proposed Action or Alternative E.

5.1.3 Impact Assessment Removed from Monitors

To assess the project impacts in areas removed from monitor locations, EPA guidance calls for an unmonitored area analysis. For this application, the MATS unmonitored area analysis is used to prepare spatial fields of the projected future year ozone design values throughout the 12km domain. EPA does not determine attainment of the 8-hour standard based on the unmonitored area analysis. Rather the unmonitored analysis is used as more of a weight of evidence analysis (EPA,2007).

The MATS unmonitored area analysis results for the annual period are presented in Figure 5-1. Figure 5-1a presents the results for the 2018 No Action, Figure 5-1b shows the results for the 2018 Proposed Action, and Figure 5-1c presents the results for the 2018 Alternative E. For all three cases, the maximum concentrations are less than 75 ppb in the project area (i.e., the box outlined in black in Figure 5-1a, b, and c shows no area where CMAQ predicts that the 8-hour ozone concentration exceeds 75 ppb). The only region that exceeds 75 ppb is a region in Moffat County in extreme northwestern Colorado. Much of the reason for this locally high area is a nuance of the MATS unmonitored area analysis. MATS uses the average of the five highest daily maximum ozone concentrations to determine ozone gradients, then applies those gradients to the interpolated base year design values. This area in Moffat County was affected by the Bear and Pinyon Ridge fires from June 22 through July 2 and the Halo fire from August 26 through 30 so had very high model estimated ozone concentration, and steep ozone gradients between the monitors and the fire impact areas.

Differences between the unmonitored area analyses for the different simulations are presented in Figure 5-2. Regions where ozone decreases are presented in blue and grey colors and regions where ozone increases show in colors of greens, orange, and red. Figure 5-2a shows the difference between the Proposed Action and No action alternatives and indicates that the WTP Proposed Action project emissions suppress ozone formation, due to NO emissions titrating available ozone, in the project area by a maximum of up to 0.6 ppb, and increase ozone away from the project area by a maximum of less than 0.3 ppb. Figure 5-2b shows the difference between Alternative E and No Action cases and indicates that the lower NOx emissions in Alternative E are predicted to suppress ozone formation somewhat less in the project area generating a maximum decrease in ozone up to 0.3 ppb. Further, fewer areas are impacted by ozone increases due to implementation of Alternative E. The differences between Alternative E and the Proposed Action are presented in Figure 5-2c. The impact of the emission decrease from

the Proposed Action to Alternative E increases ozone a maximum of less than 0.3 ppb in the project area, and decreases ozone a maximum of less than 0.3 ppb away from the study area.

The MATS unmonitored area analysis results for the 2018 ozone season are presented in Figure 5-3a (No Action), 5-3b (Proposed Action), and 5-3c (Alternative E), where all three cases show very similar predicted outcomes. For the 2018 ozone season analysis, the highest regions are again in Moffat County, Colorado, and a local high in San Miguel County, Colorado. The local high in San Miguel County was again symptomatic of fires, namely the West Beaver fire from June 25 through 30 and the Burn Canyon fire from July 12 through 22. Near the project area and to the east and southeast, the ozone concentrations are estimated to be between 75 and 80 ppb, in excess of the 75 ppb ozone NAAQS.

Differences between the 2018 future year design values among the cases are presented in Figure 5-4. Figure 5-4a shows the predicted 8-hour ozone concentration differences between the Proposed Action and No Action cases. Figure 5-4b shows the differences between the Alternative E and No Action cases. And Figure 5-4c shows the differences between Alternative E and Proposed Action. As was seen for the 2018 annual analysis, the project emissions locally suppress ozone formation, but increase ozone farther afield. Also, there is little predicted difference between implementing the Proposed Action or Alternative E.

5.2 Ozone Projections Using Absolute Modeling Results

As was stated previously, the EPA preferred approach for use of photochemical models to assess ozone attainment is to use air quality model results in a relative sense. However, another approach is to use the model in an absolute sense. As was presented in Chapter 4, CMAQ tends to overestimate rural ozone in May (i.e., May is the month when CMAQ predicts many of the fourth highest ozone to occur). The limited rural observations show that during May, observed ozone is quite low. As was presented in Section 3, the CMAQ model is having performance problems during this period. For this reason, the annual fourth highest absolute model estimates for the entire year are highly suspect.

The fourth highest daily maximum predicted 8-hour ozone concentrations for all of 2018 are presented in Figure 5-5. Figure 5-5a shows the predicted results for the 2018 No Action case. Figure 5-5b shows the predicted results for the 2018 Proposed Action. And Figure 5-5c shows the predicted results for 2018 Alternative E. These absolute model concentrations show broad regions over the new 75 ppb ozone standard with concentrations exceeding 90 ppb over the Rocky Mountains.

To examine the proposed WTP project impacts on the fourth-highest daily maximum 8-hour ozone concentrations for the 2018 annual period, difference plots are presented in Figure 5-6. Regions of ozone decreases are presented in blue and grey colors, and regions of ozone increases are presented in the green, orange, and red colors.

Figure 5-6a shows the difference between the Proposed Action and No Action cases. The Proposed Action emissions are predicted to locally decrease emissions near the proposed WTP project and are simulated to increase ozone a maximum of less than 0.6 ppb primarily to the

east/northeast of the proposed WTP project area. Figure 5-6b shows the difference between Alternative E and No Action cases, with the Alternative E outcome very similar to the Proposed Action. The difference between Alternative E and the Proposed Action are presented in Figure 5-6c again showing that there is almost no difference between implementation of the Proposed Action and Alternative E.

Figure 5-7 presents the fourth-highest daily maximum predicted 8-hour ozone concentrations during the 2018 ozone season. The absolute ozone concentrations are predicted to exceed 75 ppb in the study area and the surrounding areas with little difference in the outcomes whether No Action is taken (Figure 5-7a), the Proposed Action is implemented (Figure 5-7b), or Alternative E is implemented (Figure 5-7c).

Figure 5-8 presents the differences in the fourth-highest daily maximum predicted 8-hour ozone concentrations between the different simulations for the 2018 ozone season. Figure 5-8a shows the difference between the Proposed Action and No Action. With implementation of the Proposed Action there is predicted to be a decrease in ozone concentrations on the order of greater than 1.0 ppb just to the east-northeast of the proposed WTP project. Other areas particularly further afield to the northeast of the proposed project area show small predicted increases in ozone concentrations. Figure 5-8b shows the difference between Alternative E and No Action, with the predicted outcome similar to that of the Proposed Action and No Action case. Figure 5-8c shows that there small differences are predicted to arise in ozone concentration in a small number of locales due to whether the Proposed Action or Alternative E is taken.

5.3 Ozone Impact Assessment Summary

The project impacts for the 2018 No Action, 2018 Proposed Action, and 2018 Alternative E were examined using both the EPA recommended relative approach and an absolute approach. Using the relative approach at the monitors, the criteria used by EPA to show attainment of the NAAQS, indicates that all three future cases are predicted to attain the 75 ppb ozone standard in the proposed WTP project area. Using the full 2018 annual ozone simulation, the areas removed from the monitors also are predicted to show attainment of the 75 ppb ozone NAAQS. However, when the analysis is restricted to just the June through September ozone season, the period when the model is performing the best, several areas in the proposed WTP project area are simulated to exceed the 75 ppb ozone standard for all three future year simulations: No Action, Proposed Action, or Alternative E. In the area simulated to exceed the 75 ppb ozone NAAQS, the proposed WTP project emissions are simulated to improve the air quality locally by 0.1 to 0.3 ppb, and negatively impact air quality by 0.1 to 0.6 ppb, depending on the analysis period or project alternative analyzed. The impact of the emission changes from the Proposed Action to Alternative E results in maximum positive and negative impacts of 0.1 ppb.

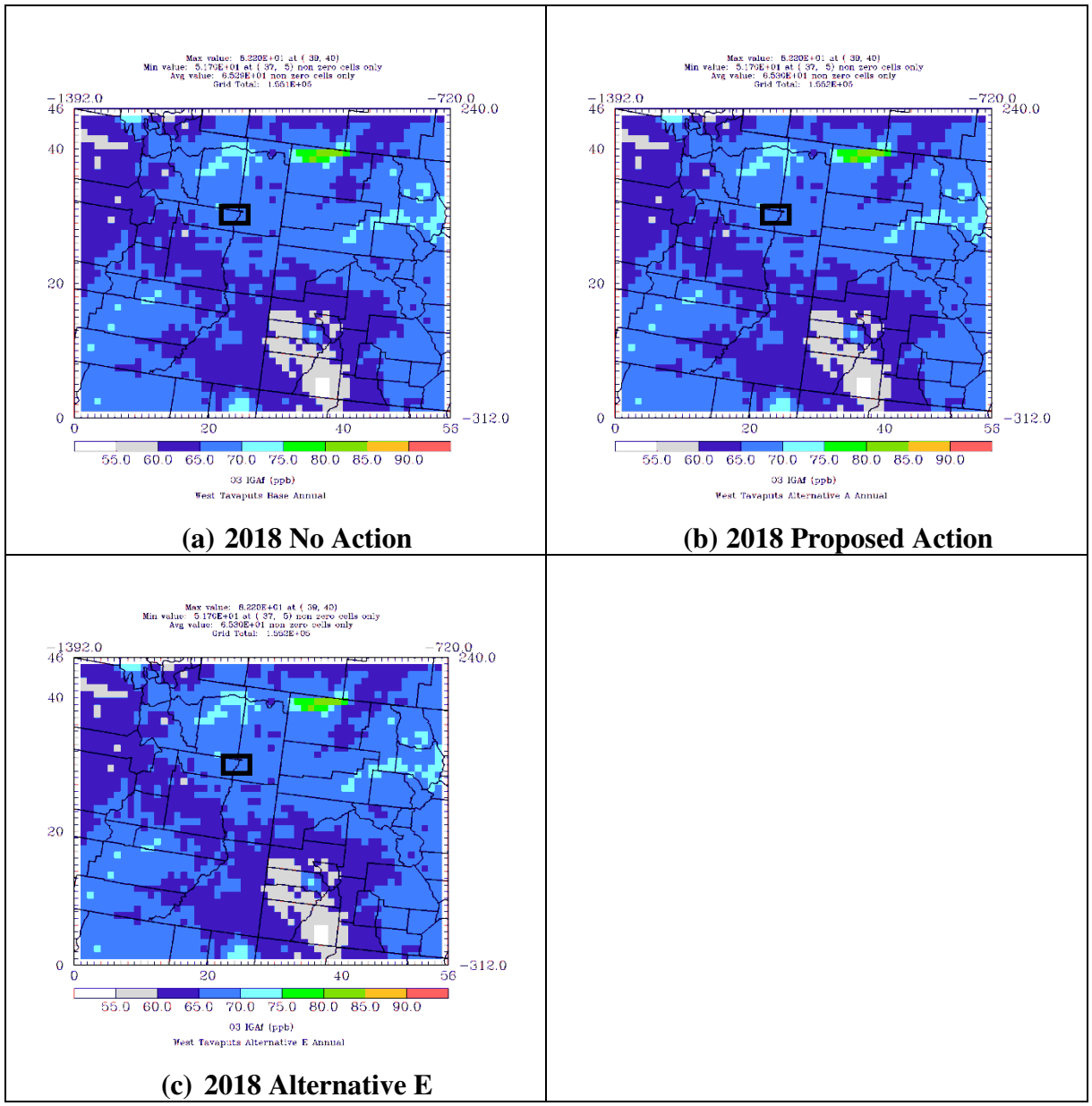
Using the absolute impact approach, broad areas are shown to not attain the 75 ppb fourth-highest ozone standard in the 2018 No Action, or either of the project impact simulations whether the analysis is restricted to just looking at the ozone season, or is expanded to the whole year. On an absolute basis the project emissions are simulated to decrease ozone concentrations locally by over 1 ppb and increase ozone concentrations less than 0.6 ppb, depending on the analysis period or project alternative.

Table 5-1. Annual monitor station 2002 8-hour ozone design values (DVc) and future year design values (DVf) for 2018 "No Action" case, 2018 Proposed Action, and 2018 Alternative E for AIRS and CASTNET monitors in the 12km modeling domain.

State	Name	Mon. ID	2002	2018 "No Action"		2018 Proposed Action		2018 Alternative E	
			DVc	DVf	rrf	DVf	rrf	DVf	rrf
AZ	CC	40058001	73.7	66.5	0.9027	66.5	0.9027	66.5	0.9027
AZ	GC	GRC474	73.7	66.5	0.9027	66.5	0.9027	66.5	0.9027
CO	GG	GTH161	70.7	65.2	0.9233	65.2	0.9234	65.2	0.9234
CO	MC	MEV405	68.0	60.4	0.8885	60.4	0.8885	60.4	0.8885
CO	MV	80830101	68.0	60.4	0.8885	60.4	0.8885	60.4	0.8885
CO	R2	ROM206	76.0	68.6	0.9027	68.6	0.9027	68.6	0.9027
CO	R4	ROM406	80.3	72.4	0.9027	72.4	0.9027	72.4	0.9027
CO	RA	80690007	80.3	72.4	0.9027	72.4	0.9027	72.4	0.9027
CO	U1	80677001	58.0	53.1	0.9171	53.1	0.9171	53.1	0.9171
CO	U3	80677003	56.0	51.2	0.9152	51.2	0.9152	51.2	0.9152
NM	BL	350450009	74.0	67.6	0.9141	67.6	0.9141	67.6	0.9141
NM	SJ	350451005	74.3	66.6	0.8972	66.6	0.8973	66.6	0.8972
UT	B4	490352004	79.7	62.5	0.7853	62.5	0.7854	62.5	0.7854
UT	BR	490350003	78.3	64.8	0.8288	64.9	0.8290	64.9	0.8289
UT	BV	490110004	81.0	60.5	0.7472	60.5	0.7473	60.5	0.7472
UT	CC	CAN407	71.3	65.3	0.9171	65.3	0.9172	65.3	0.9172
UT	CN	490370101	71.0	65.1	0.9171	65.1	0.9172	65.1	0.9172
UT	H2	490353007	76.7	66.4	0.8665	66.4	0.8667	66.4	0.8666
UT	HG	490495008	77.7	65.6	0.8453	65.6	0.8454	65.6	0.8454
UT	HV	490571003	79.3	58.3	0.7362	58.3	0.7363	58.3	0.7363
UT	NP	490490002	73.0	58.7	0.8042	58.7	0.8043	58.7	0.8043
UT	SF	490495010	75.0	61.2	0.8169	61.2	0.8171	61.2	0.8171
UT	W2	490353006	78.3	61.1	0.7804	61.1	0.7805	61.1	0.7805
UT	W2	490570007	76.3	56.1	0.7362	56.1	0.7363	56.1	0.7363
UT	WV	490353007	78.3	62.1	0.7937	62.1	0.7938	62.1	0.7938
WY	CN	CNT169	75.0	69.2	0.9239	69.3	0.9240	69.3	0.9240

Table 5-2. Ozone season monitor station 2002 8-hour ozone design values (DVc) and future year design values (DVf) for 2018 "No Action", 2018 Proposed Action, and 2018 Alternative E for AIRS and CASTNET monitors in the 12km modeling domain.

State	Name	Mon. ID	2002	2018 "No Action"		2018 Proposed Action		2018 Alternative E	
			DVc	DVf	rrf	DVf	rrf	DVf	rrf
AZ	CC	40058001	73.7	70.0	0.9498	70.0	0.9498	70.0	0.9498
AZ	GC	GRC474	73.7	70.0	0.9498	70.0	0.9498	70.0	0.9498
CO	GG	GTH161	70.7	69.5	0.9841	69.5	0.9842	69.5	0.9842
CO	MC	MEV405	68.0	63.5	0.9348	63.5	0.9349	63.5	0.9349
CO	MV	80830101	68.0	63.5	0.9348	63.5	0.9349	63.5	0.9349
CO	R2	ROM206	76.0	69.9	0.9198	69.9	0.9198	69.9	0.9198
CO	R4	ROM406	80.3	73.8	0.9198	73.8	0.9198	73.8	0.9198
CO	RA	80690007	80.3	73.8	0.9198	73.8	0.9198	73.8	0.9198
CO	U1	80677001	58.0	55.3	0.9538	55.3	0.9538	55.3	0.9538
CO	U3	80677003	56.0	53.1	0.9496	53.1	0.9496	53.1	0.9496
NM	BL	350450009	74.0	71.1	0.9613	71.1	0.9613	71.1	0.9613
NM	SJ	350451005	74.3	72.3	0.9743	72.3	0.9743	72.3	0.9743
UT	B4	490352004	79.7	67.3	0.8452	67.3	0.8453	67.3	0.8453
UT	BR	490350003	78.3	68.3	0.8730	68.3	0.8731	68.3	0.8731
UT	BV	490110004	81.0	66.6	0.8228	66.6	0.8229	66.6	0.8229
UT	CC	CAN407	71.3	68.6	0.9623	68.6	0.9627	68.6	0.9626
UT	CN	490370101	71.0	68.3	0.9623	68.3	0.9627	68.3	0.9626
UT	H2	490353007	76.7	70.1	0.9143	70.1	0.9144	70.1	0.9144
UT	HG	490495008	77.7	68.0	0.8758	68.0	0.8759	68.0	0.8759
UT	HV	490571003	79.3	60.9	0.7684	60.9	0.7686	60.9	0.7686
UT	NP	490490002	73.0	63.2	0.8664	63.2	0.8665	63.2	0.8665
UT	SF	490495010	75.0	64.6	0.8624	64.6	0.8625	64.6	0.8625
UT	W2	490353006	78.3	65.0	0.8308	65.0	0.8309	65.0	0.8308
UT	W2	490570007	76.3	58.6	0.7684	58.6	0.7686	58.6	0.7686
UT	WV	490353007	78.3	67.2	0.8595	67.3	0.8596	67.3	0.8596
WY	CN	CNT169	75.0	73.0	0.9745	73.0	0.9746	73.0	0.9746



(a) 2018 No Action

(b) 2018 Proposed Action

(c) 2018 Alternative E

Figure 5-1. Spatial field of projected annual 2018 8-hour ozone design values for (a) 2018 No Action, (b) 2018 Proposed Action, and (c) 2018 Alternative E. Approximate location of WTP project is located in box outlined in black.

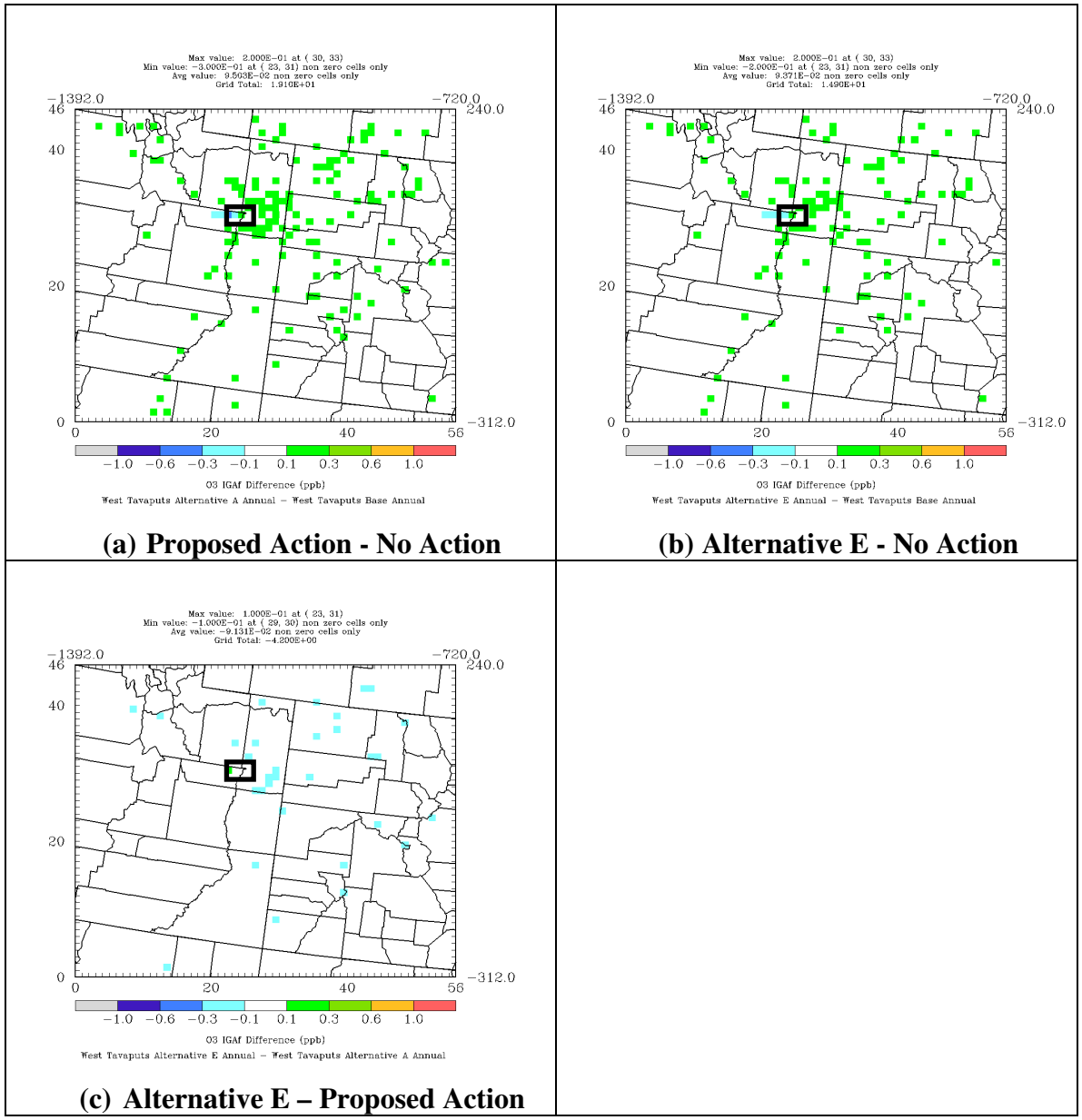
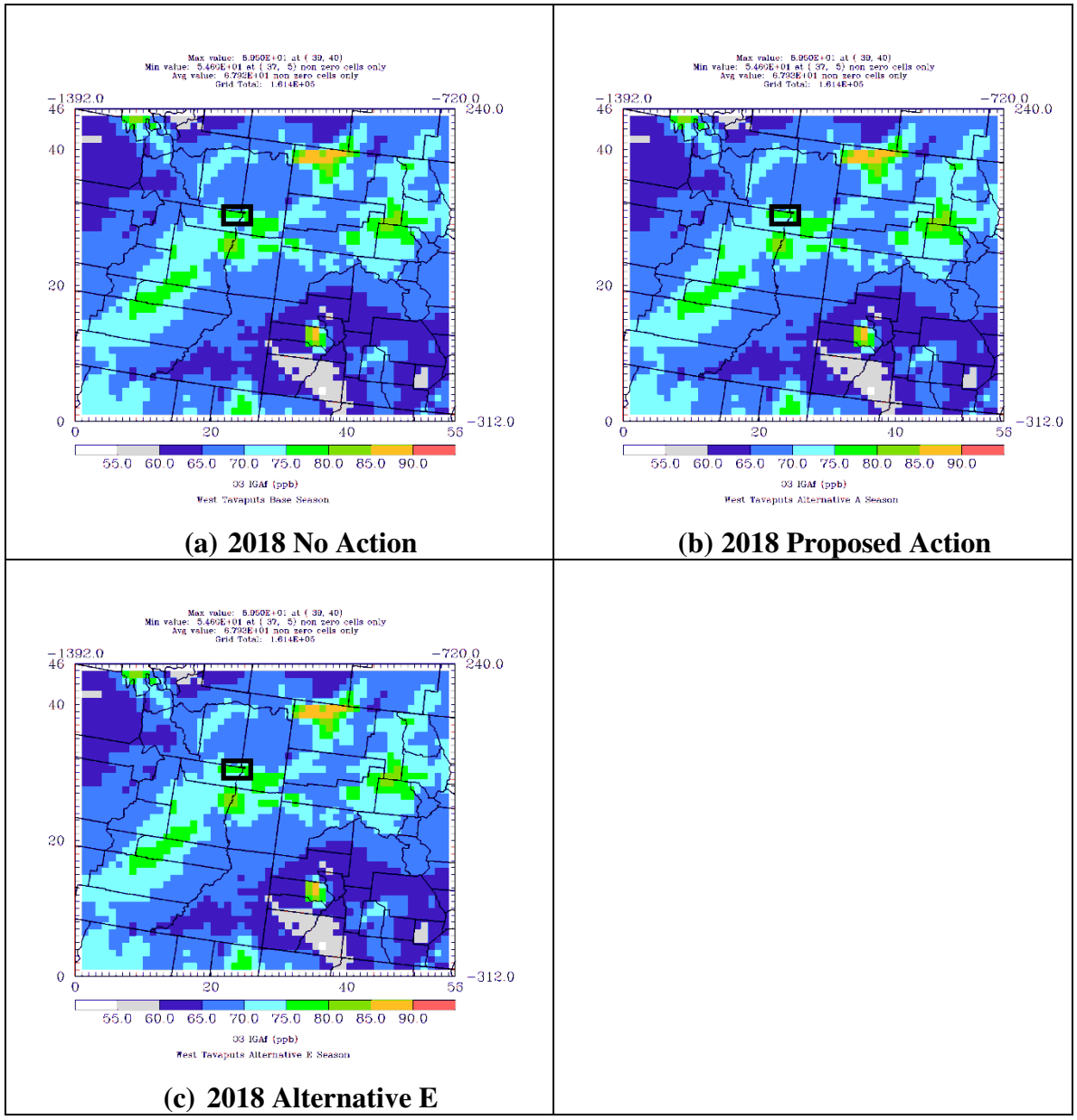


Figure 5-2. Spatial field of projected annual 2018 8-hour ozone design value differences for (a) Proposed Action minus No Action, (b) Alternative E minus No Action, and (c) Alternative E minus Proposed Action. Approximate location of WTP project is located in box outlined in black.



(a) 2018 No Action

(b) 2018 Proposed Action

(c) 2018 Alternative E

Figure 5-3. Spatial field of projected ozone season 2018 8-hour ozone design values for (a) 2018 No Action, (b) 2018 Proposed Action, and (c) 2018 Alternative E. Approximate location of WTP project is located in box outlined in black.

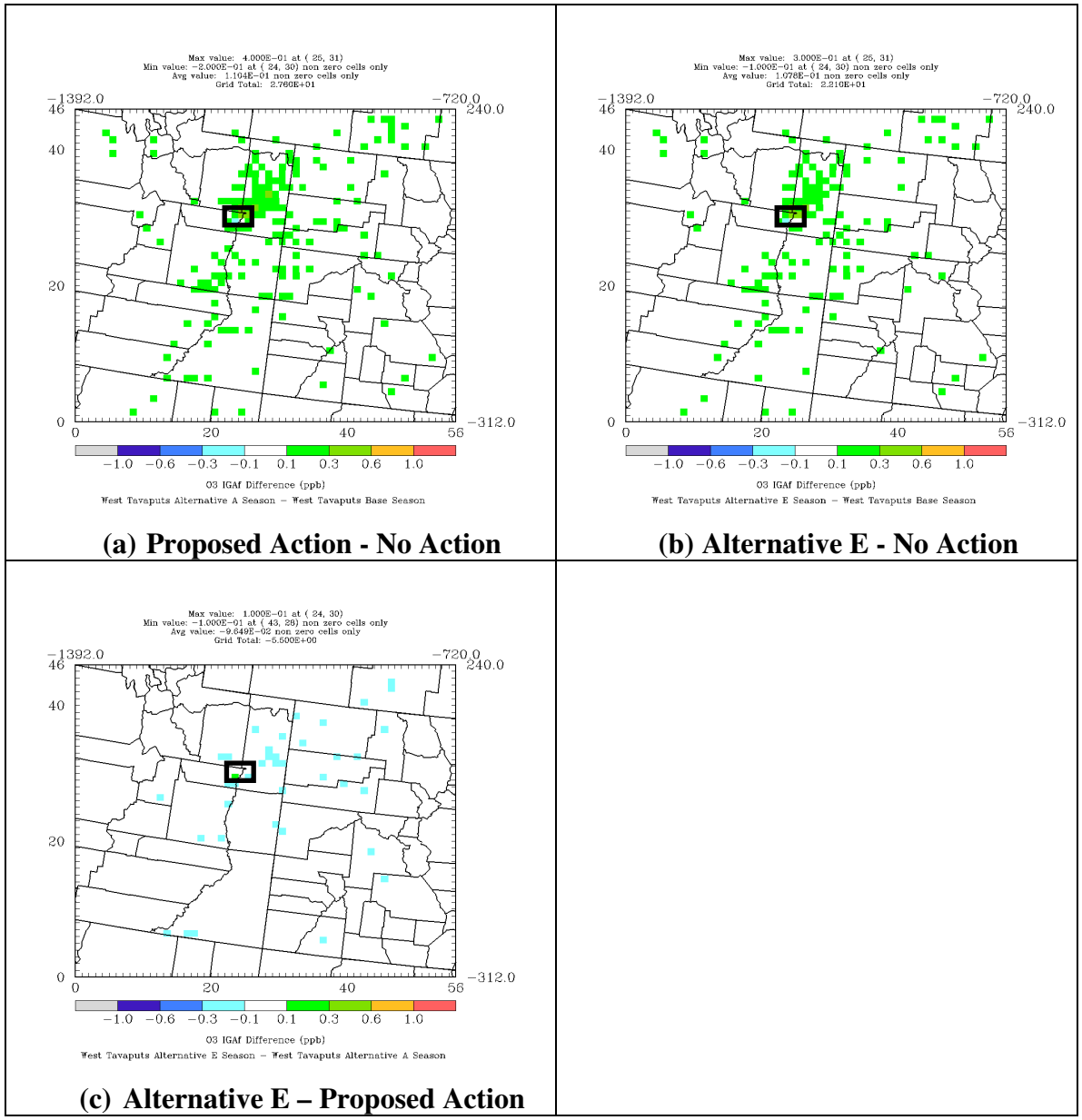


Figure 5-4. Spatial field of projected ozone season 2018 8-hour ozone design value differences for (a) Proposed Action minus No Action, (b) Alternative E minus No Action, and (c) Alternative E minus Proposed Action. Approximate location of WTP project is located in box outlined in black.

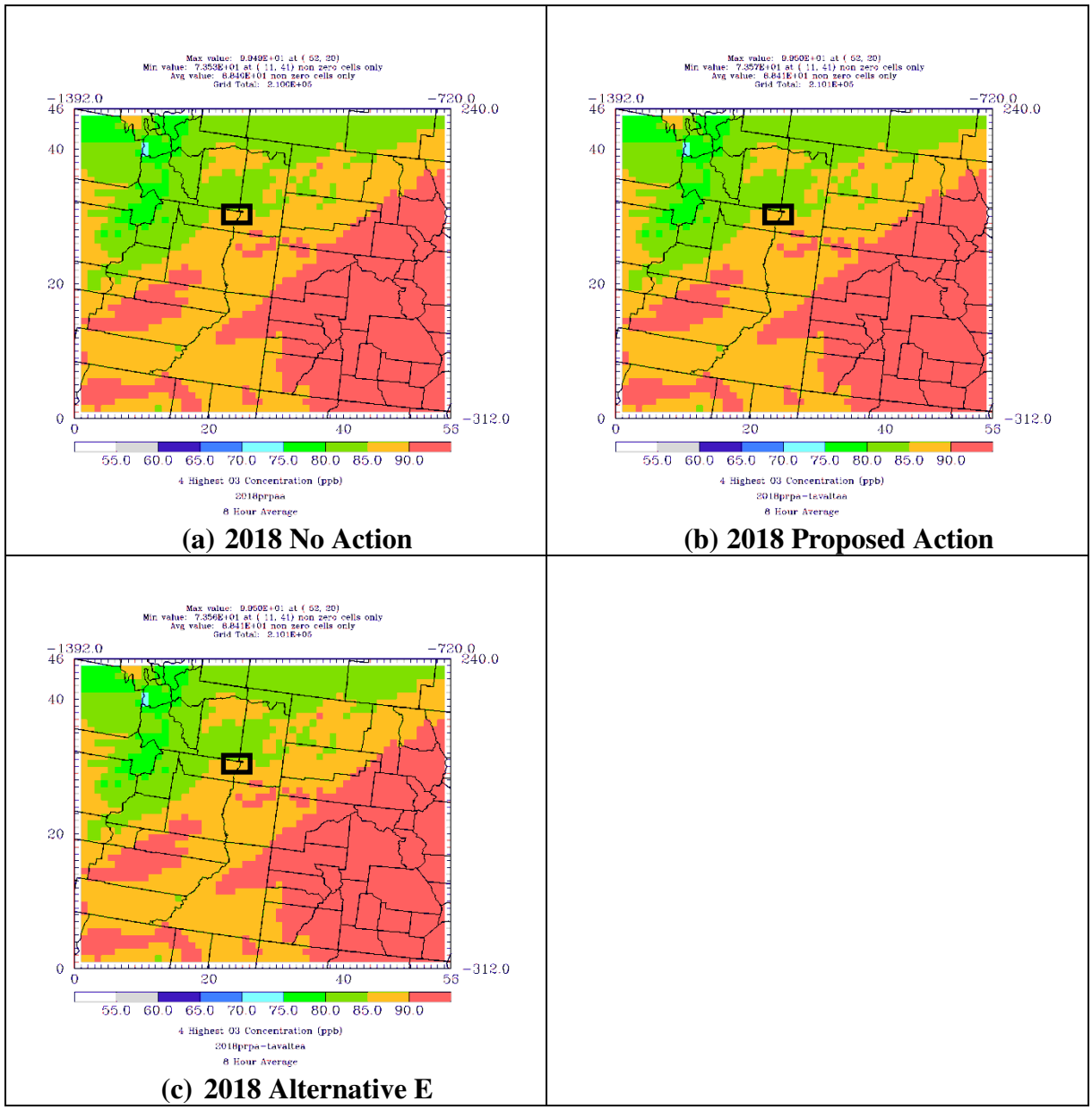


Figure 5-5. Fourth highest annual daily maximum predicted 8-hour ozone concentration (ppb) for (a) 2018 No Action, (b) 2018 Proposed Action, and (c) 2018 Alternative E. Approximate location of WTP project is located in box outlined in black.

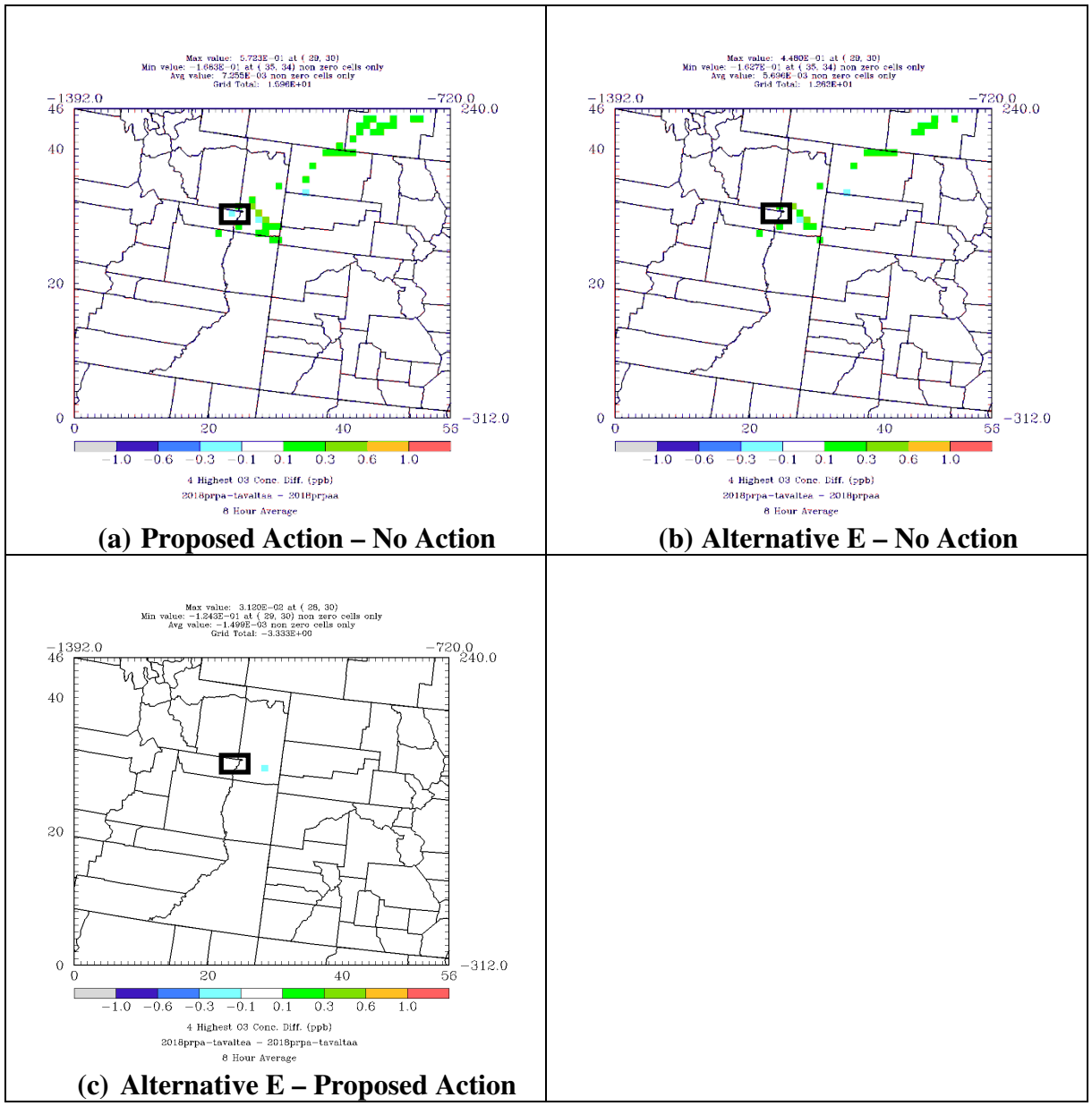


Figure 5-6. Difference in fourth highest annual daily maximum predicted 8-hour ozone concentration (ppb) for (a) Proposed Action minus No Action, (b) Alternative E minus No Action, and (c) Alternative E minus Proposed Action. Approximate location of WTP project is located in box outlined in black.

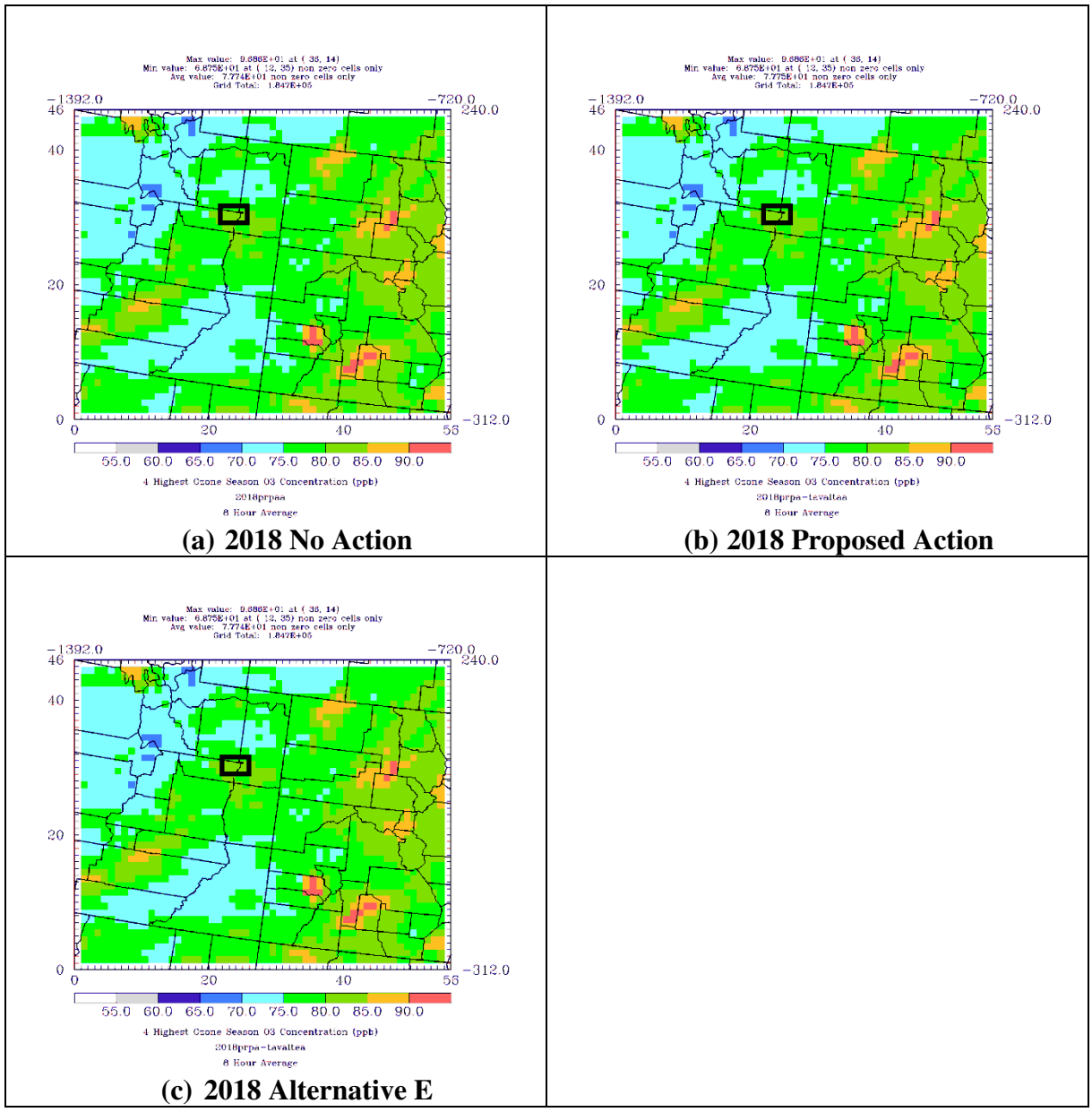
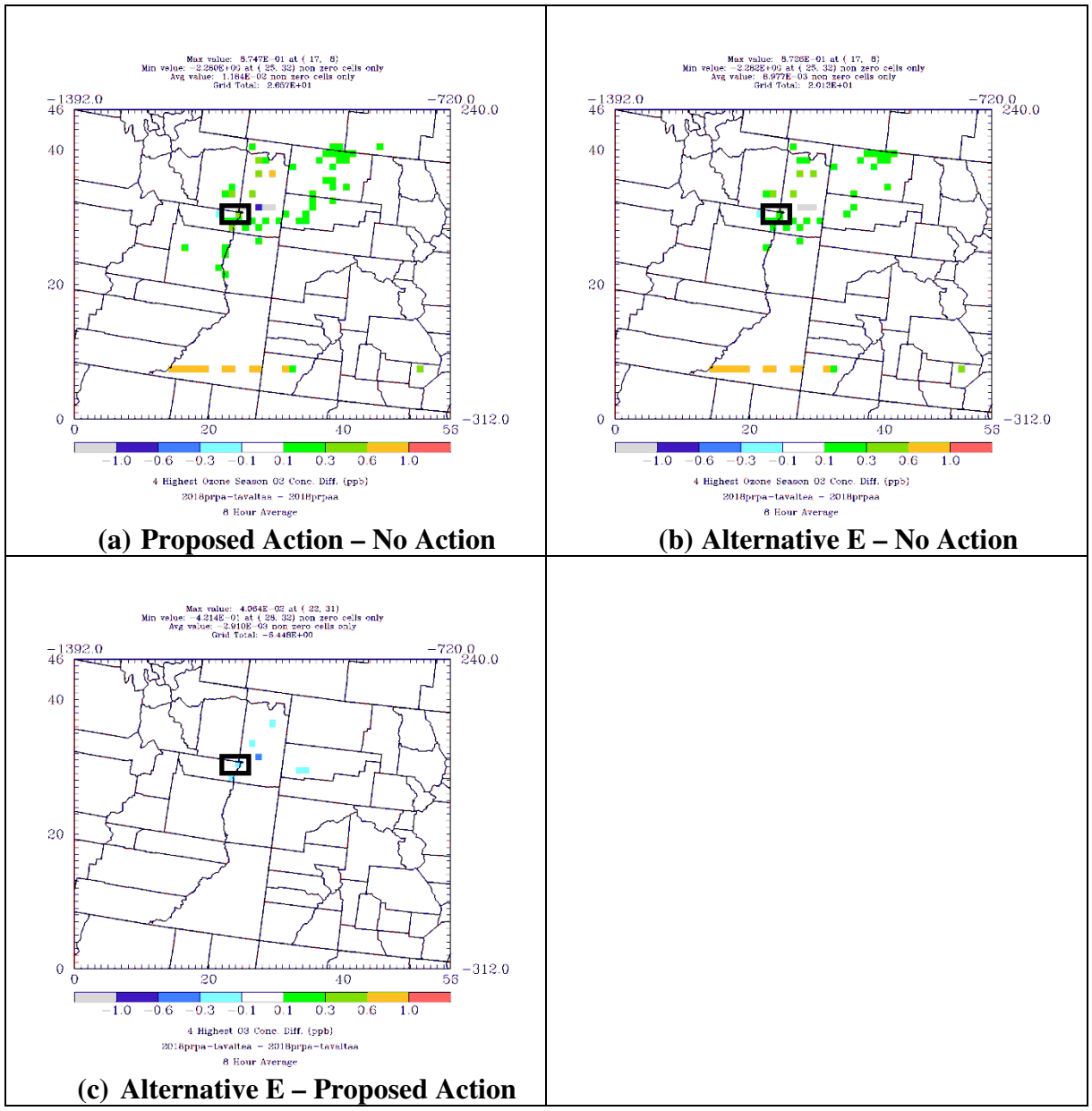


Figure 5-7. Fourth highest ozone season daily maximum predicted 8-hour ozone concentration (ppb) for (a) 2018 No Action, (b) 2018 Proposed Action, and (c) 2018 Alternative E. Approximate location of WTP project is located in box outlined in black.



(a) Proposed Action – No Action

(b) Alternative E – No Action

(c) Alternative E – Proposed Action

Figure 5-8. Difference in fourth highest ozone season daily maximum predicted 8-hour ozone concentration (ppb) for (a) Proposed Action minus No Action, (b) Alternative E minus No Action, and (c) Alternative E minus Proposed Action. Approximate location of WTP project is located in box outlined in black.

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