

APPENDIX A

**CAVE GULCH - BULLFROG - WALTMAN
NATURAL GAS DEVELOPMENT PROJECT**

TECHNICAL SUPPORT DOCUMENT

CUMULATIVE AIR QUALITY IMPACT ANALYSIS

ADDENDUM

MAY 1997

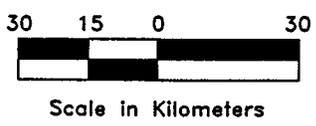
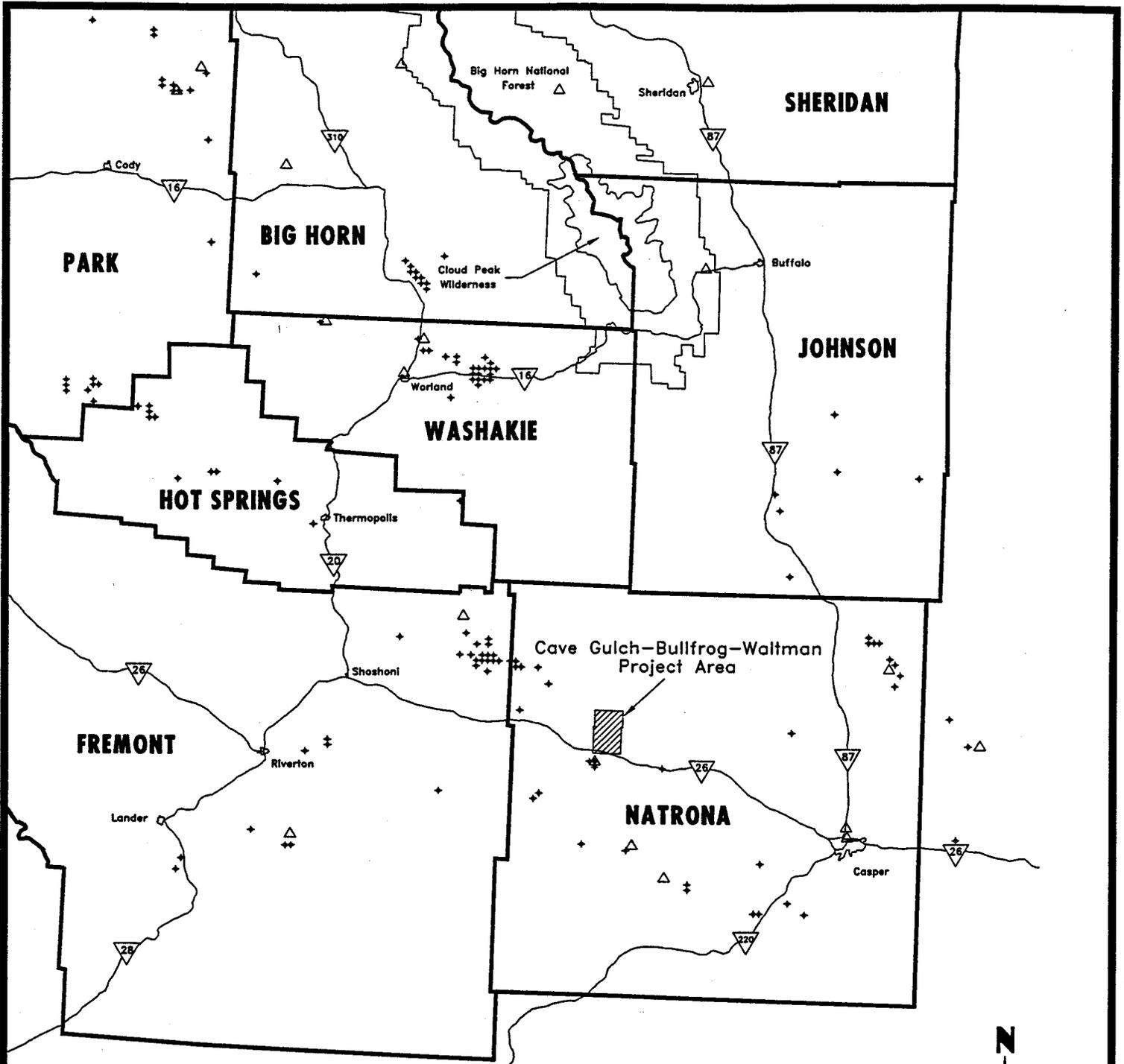
TABLE OF CONTENTS

1.0	INTRODUCTION	A - 2
2.0	EMISSIONS SCENARIOS	A - 4
3.0	AIR QUALITY MODELING	A - 6
3.1	WATERSHED CONCENTRATIONS AND ACID DEPOSITION	A - 6
3.2	VISIBILITY	A - 7
	REFERENCES	A - 9
Figure 1	Cumulative Impacts Study Area	A - 3
Table 1	Maximum Annual Average Production Emissions	A - 4
Table 2	WDEQ Emission Sources Included In Modeling Analysis	A - 5
ATTACHMENT 1	GAS/OIL WELLS INCLUDED IN MODELING ANALYSIS	
ATTACHMENT 2	ACID DEPOSITION SPREADSHEETS	

1.0 INTRODUCTION

A Technical Support Document was prepared that describes the cumulative air quality impacts of natural gas development at the Cave Gulch-Bullfrog-Waltman proposed natural gas development near Waltman Wyoming (BLM, 1997a). The results of the analysis were summarized in the Cave Gulch-Bullfrog-Waltman Natural Gas Development Project, Draft Environmental Impact Statement (DEIS) (BLM, 1997b). Since the DEIS was published new information was obtained that affects the "far field" cumulative air quality study. Based on the new information and on comments received on the DEIS a new cumulative air quality study was performed. This addendum provides a revised "far field" cumulative air quality study for the Cave Gulch - Bullfrog - Waltman development area.

The revised air quality study includes analyses of potential acid deposition and visibility degradation at the Cloud Peak Wilderness Area. For acid deposition the pollutants of concern are NO_x and SO_2 , and for visibility degradation the pollutants of concern are PM_{10} , NO_x and SO_2 . The estimated pollutant emissions from the proposed Cave Gulch - Bullfrog - Waltman well field plus emissions from other potential sources in the cumulative study area were included in the analysis. A map showing the cumulative study area and the locations of all the emissions sources that were analyzed in this analysis is provided in Figure 1.



- + Gas/Oil Well Locations
- △ WDEQ Recently Permitted Source Emissions

Figure 1

Cave Gulch-Bullfrog-Waltman Cumulative Impact Study Area

TRC	DATE :	PROJECT	FILE ID	REV #
	5/27/97	20861	Cave	2

2.0 EMISSIONS SCENARIOS

The cumulative air quality study includes pollutant emissions from three groups of sources.

- The maximum potential annual average production emissions from the Cave Gulch - Bullfrog - Waltman well field when all 202 (42 existing and 160 proposed) wells are in production with compression operating at maximum capacity (15,000 hp), (BLM, 1997a). These emissions are summarized in Table 1.

**TABLE 1
MAXIMUM ANNUAL AVERAGE PRODUCTION EMISSIONS**

POLLUTANT	EMISSIONS (Tons per Year)
PM ₁₀	< 0.1
NO _x	303
SO ₂	< 0.1

- Emission sources in north central Wyoming (Natrona, Fremont, Washakie, Hot Springs, Big Horn, Johnson, and Sheridan counties) that might have additive air quality effects with the Cave Gulch - Bullfrog - Waltman well field were identified. The most recent two years of Wyoming DEQ permitting records were examined to identify other sources which have been permitted in north central Wyoming but have not been constructed, or have not yet begun operation. The emission sources considered have undergone new source review (NSR) by WDEQ, but may not yet be operating. Thus, these sources could be part of the cumulative impacts but would not be included in background pollutant estimates. The identified sources are summarized in Table 2 along with their respective emission rates.

**TABLE 2
WDEQ EMISSION SOURCES INCLUDED IN MODELING ANALYSIS**

SOURCE	NO _x Emissions (tons/year)	SO ₂ Emissions (tons/year)
Colloid Environmental Tech., Lowell Plant - Big Horn Co.	152.7	98.6
Texaco Garland Compressor Engine - Big Horn Co.	10.6	0.9
Texaco 3 Oil Heaters - Big Horn Co.	2.4	53.5
Texaco Glycol Dehydrator - Big Horn Co.	0.0	0.7
WyoBen Sage Creek Bentonite Plant - Big Horn Co.	94.2	54.3
WyoBen Stucco Bentonite Plant - Big Horn Co.	94.2	54.3
AMOCO Big Sand Draw - Fremont Co.	21.2	0.0
Colorado Interstate Gas, Bridger Comp. Station - Fremont Co.	18.4	0.0
Moltz Construction Company - Johnson Co.	14.5	1.0
Dept of Energy, Naval Petroleum Reserve - Natrona Co.	0.8	0.0
Equitable Resources - Natrona Co.	77.0	0.0
Forest Oil Company - Natrona Co.	11.0	0.0
Intoil, Inc. - Natrona Co.	9.9	0.0
Kaycee Bentonite Ore Dryer, Natrona Co.	10.5	0.0
Rissler & McMurry Co. - Natrona Co.	11.1	0.7
Western Gas Resources, Sand Dunes Plant - Natrona Co.	11.6	0.0
Larry's Inc. - Asphalt Plant - Sheridan Co.	0.0	2.7
Veterans Administration Medical Center - Sheridan Co.	50.5	95.0
Devon Energy Company - Washakie Co.	85.0	0.0
McGarwin - Moberly Construction - Washakie Co.	7.9	0.0

Source: TRC, 1997.

- Gas/oil wells that have been issued Wyoming Oil and Gas Conservation Commission Permits from January 1996 - April 1, 1997 (WO&GCC, 1997), and proposed wells in the Madden Deep Unit (BLM, 1997c), Wallace Creek (BLM, 1997d), and Cooper Reservoir (BLM, 1997d), well field development areas. These wells are listed in Attachment 1. The pollutant emissions from each of the wells was estimated as 0.44 tons per year of NO_x (from well site dehydrator/separator heaters).

3.0 AIR QUALITY MODELING

The air quality modeling study was performed following the procedures described in the Technical Support Document (BLM 1997a). The ISCST3 model combined with 1991Casper/Lander meteorology data were used to estimate pollutant impacts at the Cloud Peak Wilderness Area.

In the cumulative impact investigation two separate modeling analyses were performed:

- Modeling of Cave Gulch - Bullfrog - Waltman well field development emissions plus other newly permitted but not yet operating source emissions in the cumulative impact study area (see Figure 1) to estimate atmospheric deposition and water quality changes at the Florence Lake watershed.
- Modeling of Cave Gulch - Bullfrog - Waltman well field development emissions plus other "nearby" newly permitted but not yet operating source emissions to estimate visibility impacts at the Cloud Peak Wilderness Area.

3.1 WATERSHED CONCENTRATIONS AND ACID DEPOSITION

Potential acid deposition and water quality changes at Florence Lake were analyzed. For this analysis proposed emission sources from the Cave Gulch - Bullfrog - Waltman well field shown in Table 1 and other sources identified in Table 2 and Attachment 1, were modeled with the ISCST3 model. Annual average concentrations of SO₂ and NO₂ at Florence Lake were computed and used to estimate acid deposition, change in acid neutralizing capacity (ANC) and change in pH.

The predicted (modeled) annual average SO₂ and NO₂ concentrations at Florence Lake are 0.003 and 0.007 μg/m³, respectively. These SO₂ and NO₂ concentrations were used, along with Florence Lake ANC values, to calculate the flux of nitrogen and sulfur deposition (kg/ha-yr) to the lake as a function of predicted concentrations and deposition velocities. The nitrogen and sulfur fluxes were then used to compute the potential change in pH and in ANC at Florence Lake. The nitrogen and sulfur deposition flux is then used, along with ANC and representative precipitation values, to compute the potential change in ANC. These computations are shown in Attachment 2.

The potential change in ANC at Florence Lake is 0.5 percent. A limit of 10 percent change in ANC reduction has been adopted by the USDA-Forest Service for lakes with ANC over 25 ueq/l. The maximum predicted change in pH is 0.002, well within the allowable range of 0.1 pH units defined USDA-Forest Service.

3.2 VISIBILITY

Visibility degradation at the Cloud Peak Wilderness area was analyzed following the procedures described in the previous air quality impacts analysis (BLM, 1997a). Specifically, the ISCST3 model was used to estimate the maximum 24-hour average pollutant impacts at receptors along the Cloud Peak Wilderness Area boundary. The maximum 24-hour concentrations were then used in the deciview calculation to estimate visibility degradation.

For this analysis the Cave Gulch - Bullfrog - Waltman production emissions (Table 1) along with emissions from "nearby" proposed sources were modeled. For estimating visibility degradation "nearby" proposed sources whose pollutant plumes have the potential to combine with pollutant plumes from the Cave Gulch - Bullfrog - Waltman sources were identified. These nearby sources included the proposed well field development at Wallace Creek, Cooper Reservoir, and the Madden Deep Unit, along with newly permitted but not operating source emissions from Intoil Inc., Equitable Resources, and Colorado Interstate Gas (see Table 2). NO_x emissions from these sources along with potential particulate emissions from disturbed area wind erosion were the only pollutants considered in the analysis. Sulfur emissions and particulate emissions are insignificant from these sources.

The procedure used for estimating regional haze is then summarized below:

- The maximum 24-hour NO₂ and PM₁₀ concentrations were computed, and the day with the maximum predicted combined impact of NO₂ and PM₁₀ was identified.
- NO₂ concentrations were converted to ammonium nitrate by multiplying by the ratio of the molecular weights (1.742) and 100 percent conversion (i.e.; assuming there is excess ambient ammonium present in the atmosphere).

- The extinction coefficient due to impacts from the well fields was computed using the formula:

$$b_{\text{ext,source}} = 0.003 f(\text{rh}) [\text{NO}_2] (1.742) + 0.003 f(\text{rh}) [\text{PM}_{10}]$$

where $[\text{NO}_2]$ and $[\text{PM}_{10}]$ are the calculated daily concentrations, and $f(\text{rh})$ (a factor for relative humidity) was assumed a reasonable "worst case" 11.5 for 95 percent relative humidity.

- The background extinction coefficient was determined using pristine conditions, a standard range value (SVR) of 374 km, as provided by the USDA-Forest Service (Blett, 1996). The theoretical maximum possible visibility is 391 km SVR:

$$b_{\text{ext,back}} = 3.912 / \text{SVR}$$

- The maximum daily deciview change was computed from the incremental extinction coefficient due to the well field emissions and the extinction coefficient from seasonal background visibility using the following equation:

$$dv = \ln (1 + (b_{\text{ext,source}} / b_{\text{ext,back}})) \times 10$$

where:

$b_{\text{ext,source}}$ = extinction coefficient from source impacts, and
 $b_{\text{ext,back}}$ = extinction coefficient from background seasonal SVR

Results of this analysis indicated that the maximum predicted deciview is 0.5. Therefore, it is unlikely that well field emissions would cause significant regional haze impacts at the Cloud Peak Wilderness Area.

REFERENCES

- BLM, 1997a. Cave Gulch - Bullfrog - Waltman Natural Gas Development Project Draft Cumulative Air Quality Impact Analysis Technical Support Document. U.S. Department of the Interior, Bureau of Land Management, Wyoming State Office, Casper District, February 1997.
- BLM, 1997b. Cave Gulch - Bullfrog - Waltman Natural Gas Development Project Draft Environmental Impact Statement. U.S. Department of the Interior, Bureau of Land Management, Wyoming State Office, Casper District, February 1997.
- BLM, 1997c. Facsimile letter from Kate Padilla, U.S. Department of the Interior, Bureau of Land Management, Wyoming State Office, Casper District, Development Plans for Madden Deep Unit, April 1997.
- BLM, 1997d. Facsimile letter from Kate Padilla, U.S. Department of the Interior, Bureau of Land Management, Wyoming State Office, Casper District, Development Plans for Wallace Creek and Cooper Reservoir, May 1997.
- TRC, 1997. Review of Wyoming Department of Environmental Quality Stationary Source files for new or modified emissions sources (1995-1996), Cheyenne, WY, May, 1997.
- WO&GCC, 1997. DIALWYO, Data Base, Wyoming Oil & Gas Conservation Commission, Casper, WY, May, 1997.

ATTACHMENT 1

GAS/OIL WELLS INCLUDED IN MODELING ANALYSIS

API No.	Number	Operator	Qtr	Sec	Twp	Rng	Completion Date
1321582	4C-23	ALPAR RESOURCE	NE SE	23	36	94	Comp Rec = 07/15/96
2522757	27-34	AMERADA HESS C	SE SE	27	33	86	Comp Rec = 09/03/96
1321042	122	AMOCO PRODUCTI	NW NE	9	33	96	Comp Rec = 04/25/96
2907122	80	AMOCO PRODUCTI	SW SW	29	58	99	Comp Rec = 03/15/96
2522766	1	ANSCHUTZ EXPLOI	SW SW	29	32	84	Comp Rec = 03/31/97
320952	32-47	ATLANTIC OIL &	SW NE	36	51	92	Comp Rec = 08/14/96
320935	31-47	ATLANTIC OIL &T	NE NW	36	51	92	Comp Rec = 06/25/96
4320793	18	BASS ENTERPRISO	NW NW	6	46	91	Comp Rec = 11/12/96
4320774	234	BASS ENTERPRISO	NW NW	19	47	90	Comp Rec = 02/05/96
4320771	240	BASS ENTERPRISO	SW SE	7	47	90	Comp Rec = 02/05/96
4320772	241	BASS ENTERPRISO	SE NW	17	47	90	Comp Rec = 02/05/96
4320775	242	BASS ENTERPRISO	SE NW	8	47	90	Comp Rec = 02/29/96
4320784	243	BASS ENTERPRISO	SE SE	8	47	90	Comp Rec = 07/18/96
4320785	244	BASS ENTERPRISO	SW SE	8	47	90	Comp Rec = 07/18/96
4320798	245	BASS ENTERPRISO	NE SE	14	47	91	Comp Rec = 01/22/97
4320795	246	BASS ENTERPRISO	SW NE	13	47	91	Comp Rec = 01/22/97
4320796	247	BASS ENTERPRISO	SE NW	13	47	91	Comp Rec = 01/22/97
4320797	248	BASS ENTERPRISO	NE NE	23	47	91	Comp Rec = 01/27/97
4320801	249	BASS ENTERPRISO	NE NW	24	47	91	Comp Rec = 01/27/97
4320799	250	BASS ENTERPRISO	NE NE	14	47	91	Comp Rec = 01/27/97
4320805	251	BASS ENTERPRISO	SE NE	23	47	91	Comp Rec = 02/03/97
4320777	252	BASS ENTERPRISO	SW SW	8	47	90	Comp Rec = 06/24/96
4320778	253	BASS ENTERPRISO	NW NE	17	47	90	Comp Rec = 06/24/96
4320779	254	BASS ENTERPRISO	NE NE	17	47	90	Comp Rec = 07/18/96
4320780	255	BASS ENTERPRISO	SE NE	17	47	90	Comp Rec = 08/16/96
4320781	256	BASS ENTERPRISO	SW NW	20	47	90	Comp Rec = 06/24/96
4320782	257	BASS ENTERPRISO	SE NW	20	47	90	Comp Rec = 07/18/96
4320800	258	BASS ENTERPRISO	SW SE	11	47	91	Comp Rec = 01/22/97
4320802	259	BASS ENTERPRISO	SW SE	11	47	91	Comp Rec = 01/22/97
4320803	260	BASS ENTERPRISO	NW SE	11	47	91	Comp Rec = 11/12/96
4320786	261	BASS ENTERPRISO	NW SW	9	47	90	Comp Rec = 08/16/96
4320787	262	BASS ENTERPRISO	SE SW	5	47	91	Comp Rec = 08/20/96
4320788	263	BASS ENTERPRISO	SW SE	32	48	91	Comp Rec = 09/19/96
4320792	29-1	BASS ENTERPRISO	NW SW	25	47	91	Comp Rec = 11/12/96
4320794	4-36	BASS ENTERPRISO	NE SW	36	48	92	Comp Rec = 10/21/96
4320783	8X	BASS ENTERPRISO	NW SE	12	47	91	Comp Rec = 06/07/96
1321191	1-16	BHP PETROLEUM	SE NW	16	38	90	Comp Rec = 07/11/96
1321755	2-6	BISSELL OIL CO	SE SW	6	32	98	Comp Rec = 08/20/96
1921015	1-26	BLACK OIL COMP	NW NW	25	44	82	Comp Rec = 02/21/96
1321688	30	BROWN TOM INC	SE NW	21	37	89	Comp Rec = 01/22/96
1321766	1-1	BUFFALO OPERAT	SE SE	1	34	92	Comp Rec = 01/21/97
2522754	1-4	BURR OIL & GAS	SE NW	4	32	82	Comp Rec = 01/08/96
2522794	2-4	BURR OIL & GAS	NE NW	4	32	82	Comp Rec = 11/14/96
2522798	3-4	BURR OIL & GAS	SW NE	4	32	82	Comp Rec = 11/14/96
2522812	8-22	C & S OPERATIN	SE NW	8	31	81	Comp Rec = 11/07/96
1321758	2	CHEVRON USA IN	SW SE	3	38	90	Comp Rec = 08/16/96

API No.	Number	Operator	Qtr	Sec	Twp	Rng	Completion Date
2506903	11-141	COALEUM CORPOR	NW NE	11	39	79	Comp Rec = 06/13/96
2510123	18ANW	COALEUM CORPOR	NW NW	7	39	78	Comp Rec = 06/26/96
2521758	7-75	COALEUM CORPOR	SW NE	7	39	78	Comp Rec = 06/11/96
1321678	1	CONOCO INC	SE SE	14	39	93	Comp Rec = 08/29/96
905950	17	CONOCO INC	NW NW	9	33	76	Comp Rec = 04/18/96
1720980	7-12-36	CONTINENTAL OP	SW NE	36	43	94	Comp Rec = 03/14/97
1720978	7-4-36	CONTINENTAL OP	SW NW	36	43	94	Comp Rec = 03/14/97
320917	1	CRABTREE OIL &	SE SE	16	56	96	Comp Rec = 11/20/96
4305414	11-T	DEVON ENERGY C	NE SW	28	48	92	Comp Rec = 08/30/96
4305400	30-F4	DEVON ENERGY C	SW SE	28	48	92	Comp Rec = 01/17/97
4305704	35-F4	DEVON ENERGY C	C NW	28	48	92	Comp Rec = 12/02/96
320934	61-G33	DEVON ENERGY C	SW NE	33	49	93	Comp Rec = 03/10/97
4320776	71-I29	DEVON ENERGY C	NE SE	29	48	92	Comp Rec = 08/12/96
4320804	77-J18	DEVON ENERGY C	C SE	18	48	92	Comp Rec = 01/23/97
320933	37-11-4	DIVERSIFIED OP	NE SW	16	54	96	Comp Rec = 02/12/97
2522821	3-32	DUSTY MAC RESO	NE NW	32	32	84	Comp Rec = 10/21/96
320379	17-15	EASTERN MINERA	SW SE	17	51	96	Comp Rec = 05/06/96
1921019	4-M81-I	EOG (NEW MEXIC	SW SW	8	44	77	Comp Rec = 01/22/97
1921017	7-D8	EOG (NEW MEXIC	NW NW	8	44	77	Comp Rec = 09/09/96
1920988	1	FLAHIVE OIL &	NE SW	7	43	81	Comp Rec = 11/21/96
1720934	1	FLAHIVE OIL &	SE NW	10	43	91	Comp Rec = 06/26/96
2510783	23-SH7	FLUOR DANIEL I	SW NW	11	38	78	Comp Rec = 11/14/96
2510732	301	FLUOR DANIEL I	NW NW	34	39	78	Comp Rec = 11/14/96
2510261	306	FLUOR DANIEL I	NE SW	28	39	78	Comp Rec = 11/14/96
2510935	32MX22	FLUOR DANIEL I	NE NW	22	38	78	Comp Rec = 11/14/96
1321719	4-28H	FLYING J OIL &	NW NW	28	33	95	Comp Rec = 11/04/96
1306045	1-X	GRYNBERG JACK	SW SW	31	36	94	Comp Rec = 08/09/96
2506870	11-140	HUNT OIL COMPA	SE NE	11	39	79	Comp Rec = 06/18/96
2509452	11-75W	HUNT OIL COMPA	SE NW	11	39	79	Comp Rec = 06/20/96
2509501	12-160	HUNT OIL COMPA	SE NE	12	39	79	Comp Rec = 07/12/96
2506917	12-41W	HUNT OIL COMPA	NW NE	12	39	79	Comp Rec = 06/20/96
2506807	12-79	HUNT OIL COMPA	NE SE	12	39	79	Comp Rec = 07/12/96
2506967	2-100	HUNT OIL COMPA	SE SE	2	39	79	Comp Rec = 06/13/96
2506984	2-104	HUNT OIL COMPA	SE SE	2	39	79	Comp Rec = 06/13/96
2506982	2-121	HUNT OIL COMPA	SW SE	2	39	79	Comp Rec = 08/06/96
2522767	7	HUNT OIL COMPA	NW NW	10	35	85	Comp Rec = 03/28/96
2506855	7-151	HUNT OIL COMPA	SE NW	7	39	78	Comp Rec = 06/26/96
2506909	7-153	HUNT OIL COMPA	NE NW	7	39	78	Comp Rec = 06/11/96
	NEW1	INTOIL		3	35	87	
	NEW2	INTOIL		3	35	87	
	NEW3	INTOIL		3	35	87	
	NEW4	INTOIL		3	35	87	
	NEW5	INTOIL		3	35	87	
	NEW6	INTOIL		3	35	87	
	NEW7	INTOIL		3	35	87	
	NEW8	INTOIL		3	35	87	

API No.	Number	Operator	Qtr	Sec	Twp	Rng	Completion Date
	NEW9	INTOIL		3	35	87	
	NEW10	INTOIL		3	35	87	
	10	INTOIL	SW SE	3	35	87	
	11	INTOIL	NE NE	4	35	87	
	12	INTOIL	NW NE	10	35	87	
	13	INTOIL	NW NW	10	35	87	
	14	INTOIL	SW SE	4	35	87	
	7A	INTOIL	SW SW	3	35	87	
	9	INTOIL	NE NW	3	35	87	
	NEW11	INTOIL		3	35	87	
2522631	6	INTOIL INC	SE NW	10	35	87	Comp Rec = 01/18/96
2522719	8	INTOIL INC	SE NE	4	35	87	Comp Rec = 01/18/96
320938	11-33	KCS MOUNTAIN R	NW NW	33	50	92	Comp Rec = 07/23/96
320941	12-18P	KCS MOUNTAIN R	SW NW	18	50	92	Comp Rec = 10/14/96
320945	12-20P	KCS MOUNTAIN R	SW NW	20	50	92	Comp Rec = 11/04/96
1720953	13-11	KCS MOUNTAIN R	NW SW	11	46	99	Comp Rec = 10/14/96
320955	21-19P	KCS MOUNTAIN R	NE NW	19	50	92	Comp Rec = 02/05/97
320960	21-29L	KCS MOUNTAIN R	NE NW	29	50	92	Comp Rec = 02/20/97
320940	21-29P	KCS MOUNTAIN R	NE NW	29	50	92	Comp Rec = 09/23/96
320953	22-12P	KCS MOUNTAIN R	SE NW	12	50	93	Comp Rec = 11/04/96
320976	23-12P	KCS MOUNTAIN R	NE SW	12	50	93	Comp Rec = 02/05/97
320946	23-18P	KCS MOUNTAIN R	NE SW	18	50	92	Comp Rec = 11/12/96
320841	24-20	KCS MOUNTAIN R	SE SW	20	50	92	Comp Rec = 10/14/96
320966	32-18P	KCS MOUNTAIN R	SW NE	18	50	92	Comp Rec = 02/05/97
320928	34-12P	KCS MOUNTAIN R	SW SE	12	50	93	Comp Rec = 07/12/96
320937	34-18P	KCS MOUNTAIN R	SW SE	18	50	92	Comp Rec = 07/12/96
320975	34-2	KCS MOUNTAIN R	SW SE	2	50	93	Comp Rec = 02/05/97
320958	34-28P	KCS MOUNTAIN R	SW SE	28	50	92	Comp Rec = 02/05/97
2521648	4-2	KCS MOUNTAIN R	SE NW	4	36	81	Comp Rec = 10/14/96
320948	41-13P	KCS MOUNTAIN R	NE NE	13	50	93	Comp Rec = 10/14/96
320947	41-19P	KCS MOUNTAIN R	NE NE	19	50	92	Comp Rec = 10/08/96
320968	43-13P	KCS MOUNTAIN R	NE SE	13	50	93	Comp Rec = 02/05/97
320929	43-19P	KCS MOUNTAIN R	NE SE	19	50	92	Comp Rec = 10/14/96
922914	21-14	KERR-MCGEE COR	NE NW	14	36	76	Comp Rec = 01/18/96
	4-36	LL&E		36	39	91	
	1-7	LL&E	SE NE	7	38	90	
	1-6	LL&E		6	38	89	
	1-9	LL&E		9	38	89	
	1-3	LL&E	NE SW	3	38	90	
	9	LL&E	NE SW	3	38	90	
	1-29	LL&E		29	38	88	
	1-2	LL&E	NW SE	2	38	90	
	1-32	LL&E		32	39	90	
	2-8	LL&E		8	38	89	
	1-6	LL&E		6	38	90	
	5-3	LL&E	NE SE	3	38	90	

API No.	Number	Operator	Qtr	Sec	Twp	Rng	Completion Date
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	24	LL&E	SW SW	34	39	90	
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	26	LL&E	NE NE	3	38	90	
	8	LL&E		3	38	90	
	1-21	LL&E		21	39	90	
	1-14	LL&E		11	39	91	
	1-34	LL&E	SE NW	34	39	91	
	2-34	LL&E		34	39	91	
	1-19	L&E		19	39	90	
	1-5	LL&E		5	38	89	
	1-16	LL&E		16	39	90	
320871	1	LOEMWAL INC	SW SW	19	50	92	Comp Rec = 05/29/96
1321243	1-5	LOUISIANA LANDC	NW SW	5	38	90	Comp Rec = 08/12/96
2522195	1-43-C	M-3 INDUSTRIES	NE SE	1	34	89	Comp Rec = 02/18/97
1707285	W-2	MANX OIL CORPO	NW SW	7	44	96	Comp Rec = 10/17/96
1707286	W-3	MANX OIL CORPO	SW NE	12	44	97	Comp Rec = 10/17/96
4320744	1	MARATHON OIL C	NE SE	5	47	90	Comp Rec = 03/01/96
320913	1	MARATHON OIL C	SW SW	36	56	97	Comp Rec = 02/05/96
1720967	11-39	MARATHON OIL C	NW SE	18	46	98	Comp Rec = 02/05/97
1720972	113	MARATHON OIL C	SW SW	20	46	98	Comp Rec = 01/29/97
320907	27	MARATHON OIL C	SE SE	33	56	97	Comp Rec = 01/29/97
1706523	43	MARATHON OIL C	NE SW	7	46	98	Comp Rec = 01/17/97
4320254	5-H	MARATHON OIL C	SE SE	31	48	90	Comp Rec = 02/08/96
306357	52	MARATHON OIL C	SE SE	19	56	97	Comp Rec = 01/11/96
1720111	54	MARATHON OIL C	NW SW	24	44	95	Comp Rec = 05/23/96
2920669	5H	MARATHON OIL C	SW NW	15	47	101	Comp Rec = 12/20/96
4320541	6	MARATHON OIL C	NE SE	31	48	90	Comp Rec = 02/22/96
2921752	6	MARATHON OIL C	SE NE	27	47	101	Comp Rec = 12/04/96
4320557	7	MARATHON OIL C	NE SE	31	48	90	Comp Rec = 02/23/96
2921751	7	MARATHON OIL C	NW SW	22	47	101	Comp Rec = 01/29/97
1720965	8	MARATHON OIL C	SW NE	19	46	98	Comp Rec = 01/22/97
320912	97	MARATHON OIL C	SW NW	30	56	97	Comp Rec = 01/26/96
1308108	32-5	MERCURY EXPLOR	NE SW	13	32	99	Comp Rec = 10/11/96
1308109	44-5	MERCURY EXPLOR	NE SW	13	32	99	Comp Rec = 10/11/96
1308107	59-3	MERCURY EXPLOR	SE SW	13	32	99	Comp Rec = 10/11/96
1308110	61-5	MERCURY EXPLOR	SE SW	13	32	99	Comp Rec = 10/11/96
1720945	135	MERIT ENERGY C	SE NW	13	44	98	Comp Rec = 10/30/96
2522405	1	MONCRIEF W A J	SW NE	12	38	89	Comp Rec = 02/20/96
2522755	30-1	MONCRIEF W A J	SW NE	30	37	86	Comp Rec = 03/26/96
2522795	22-23	MOUNTAIN PETRO	SE NW	23	31	81	Comp Rec = 06/10/96
1720956	32-20	NATURAL GAS PRY	SW NE	20	46	98	Comp Rec = 10/14/96
2522644	41-11	NATURAL GAS PRY	NE NE	11	34	89	Comp Rec = 10/14/96
2521796	7-94	PACIFIC ENTERPN	NW NW	7	39	78	Comp Rec = 07/12/96
1321729	4-A	PETROLEUM RESO	NE SE	26	36	94	Comp Rec = 03/18/96
306532	1	PHOENIX PRODUC	SE SW	6	57	97	Comp Rec = 05/09/96

API No.	Number	Operator	Qtr	Sec	Tw	Rng	Completion Date
320923	21	PHOENIX PRODUC	SW NE	7	57	97	Comp Rec = 06/27/96
1921014	1-2	SANCHEZ-O'BRIE	SW NE	2	44	80	Comp Rec = 03/25/96
320433	15-1	SCHNEIDER OIL	NE SW	15	50	95	Comp Rec = 01/05/96
2522809	16-20	STOVALL OIL CO	NE NE	20	31	82	Comp Rec = 07/24/96
2522775	21-4	STOVALL OIL CO	SW NW	21	31	82	Comp Rec = 04/26/96
2522815	21-6	STOVALL OIL CO	SE NW	21	31	82	Comp Rec = 09/09/96
320950	11	TEXACO EXPLORA	SW SW	28	56	97	Comp Rec = 10/17/96
320780	13	TEXACO EXPLORA	NE NW	33	56	97	Comp Rec = 01/16/96
306135	2	TEXACO EXPLORA	NW SW	34	56	97	Comp Rec = 02/23/96
320715	4	TEXACO EXPLORA	SW NW	33	56	97	Comp Rec = 12/10/96
320792	5	TEXACO EXPLORA	C NW	33	56	97	Comp Rec = 07/11/96
320951	6	TEXACO EXPLORA	SW SW	34	56	97	Comp Rec = 10/03/96
320739	8	TEXACO EXPLORA	SW SW	34	56	97	Comp Rec = 03/20/97
1321104	1-27	TRUE OIL COMPA	NW SE	27	33	95	Comp Rec = 04/25/96
2522603	1	WESCO OPERATIN	NW SW	20	33	87	Comp Rec = 03/20/97
2522604	P-1	WESCO OPERATIN	NW SW	20	33	87	Comp Rec = 03/20/97
2522605	P-2	WESCO OPERATIN	NW SW	20	33	87	Comp Rec = 03/20/97
2522606	P-3	WESCO OPERATIN	NW SW	20	33	87	Comp Rec = 03/20/97
2522607	P-4	WESCO OPERATIN	NE SW	20	33	87	Comp Rec = 03/20/97
2921744	11-22	WESTPORT OIL &C	NW NW	22	47	100	Comp Rec = 08/23/96
1905246	14	WESTPORT OIL &C	NE NW	9	41	81	Comp Rec = 03/27/97
2921757	17-28	WESTPORT OIL &C	NE SE	29	47	100	Comp Rec = 11/08/96
1720964	21-4	WESTPORT OIL &C	NW NW	4	46	100	Comp Rec = 02/03/97
2921745	31-21	WESTPORT OIL &C	NW NE	21	47	100	Comp Rec = 11/08/96
1720963	32-4	WESTPORT OIL &C	NW NW	4	46	100	Comp Rec = 03/14/97
2921748	44-16	WESTPORT OIL &C	SW SE	16	47	100	Comp Rec = 11/18/96
1921026	55H	WESTPORT OIL &C	NE NW	9	41	81	Comp Rec = 03/27/97
1921024	69	WESTPORT OIL &C	SE SW	9	41	81	Comp Rec = 12/12/96
1920497	1-14	WEXPRO COMPANY	SW NW	14	46	80	Comp Rec = 10/07/96
922917	2	YATES PETROLEU	NW SE	20	37	76	Comp Rec = 01/16/96

ATTACHMENT 2
ACID DEPOSITION SPREADSHEETS

**COMPUTATION OF TOTAL DEPOSITION
FROM ANNUAL NO2 AND SO2 CONCENTRATIONS**

WILDERNESS LOCATION: Florence Lake

POLLUTANT OF CONCERN:	NO2	SO2
ANN. CONCENTRATION (ug/m3):	0.0074	0.0029
DEPOSITION VELOCITY (m/s):	0.007	0.024
DEP (total-to-dry dep):	2	2
R (elemental ratio):	0.3	0.5

EQUATION: $D = (X)(Vd)(R)(DEP)(Fc)$

where:

- D = Deposition Flux, kg/ha-yr
- X = Pollutant Concentration, ug/m3
- Vd = Deposition Velocity, m/sec
(From Sehmel, 1984, Table 12.5)
- R = Ratio of elemental composition
= 32/64 = 0.5 for SO2
= 14/46 = 0.3 for NO2
- DEP = Total to dry deposition ratio
= 2.0 for SO2 and NO2
- Fc = units correction (315.4)

	N	S
COMPUTED DEPOSITION (kg/ha-yr):	0.0104	0.0216

COMPUTATION OF pH AND ALKALINITY CHANGE FROM ANNUAL DEPOSITION FLUX

WILDERNESS LOCATION: Florence Lake

INPUT DATA

ANC (A) in ueq/l	37.6
S deposition (kg/ha-yr)	0.0216
N deposition (kg/ha-yr)	0.0104
C deposition (kg/ha-yr)	0
ppt (d) in inches	48

INTERMEDIATE VALUES

Hs =	0.000135 eq/m2	
Hn =	0.000075 eq/m2	
Hc =	0 eq/m2	
A =	0.000038 eq/l	
d =	1.22 meters	

COMPUTATION OF pH CHANGE

part 1	=		-4.4248
part 2	=		-4.4268
DELTA pH	=		0.0020

COMPUTATION OF ALKALINITY CHANGE (%)

part 1	=		0.000038
part 2	=		0.000000

DELTA ANC (%)	=		0.46
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EQUATIONS

$$\text{delta pH} = \log(A) - \log\{A - [(Hs + Hn + Hc/d)/1000]\}$$

$$\% \text{ alkalinity change} = \{(Hs + Hn + Hc/d)/1000\} / [A] \times 100$$

where

A = alkalinity, eq/l
d = annual ppt, meters
Hs = Ds/(10*Rs*32) for SO2, eq/m2
Hn = Dn/(10*Rn*46) for NO2, eq/m2
Hc = Dc/(10*Rc*60) for COS, eq/m2
Ds = sulfur deposition (from SO2), kg/ha
Dn = nitrogen deposition, kg/ha
Dc = sulfur deposition (from COS), kg/ha
Rs = sulfur/total weight of SO2 (32/64=) 0.5
Rc = sulfur/total weight of COS (32/60=) 0.5
Rn = nitrogen/total weight of NO2 (14/64=) 0.3

FROM Fox, D.G., "A Suggested Methodology for an Acid Deposition Screening Technique Applicable Within 200 Km of Isolated Sources," Preliminary Draft, 1983.