

Appendix Q

General Conformity Determination

Prepared for:
TransCanada Keystone XL Pipeline, LP
Houston

Keystone XL Pipeline General Conformity Determination

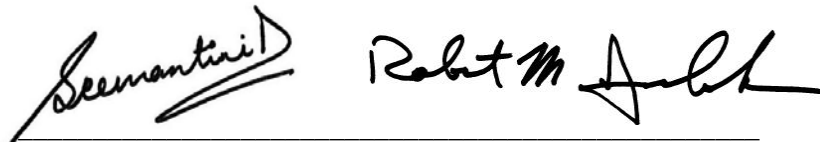
TransCanada
July 2009
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Keystone XL Pipeline General Conformity Determination



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1.0 Introduction

TransCanada Keystone Pipeline, LP (Keystone) is proposing to construct and operate a crude oil pipeline and related facilities from Hardisty, Alberta, Canada, to the Port Arthur and east Houston areas of Texas in the United States (US). The project, known as the Keystone XL Project (Project), will have a nominal capacity to deliver up to 900,000 barrels per day (bpd) of crude oil from an oil supply hub near Hardisty to existing terminals in Nederland near Port Arthur and Moore Junction in Harris County, Texas. The project will consist of three new pipeline segments plus additional pumping capacity on the Cushing Extension Segment of the Keystone Pipeline Project (Keystone Cushing Extension). The Steele City Segment of the Project extends from Hardisty, Alberta southeast to Steele City, Nebraska. The Gulf Coast Segment extends from Cushing, Oklahoma south to Nederland, Texas. The Houston Lateral extends from the Gulf Coast Segment, in Liberty County, Texas southwest to Moore Junction, Harris County, near the Houston Ship Channel (please refer to **Figure 1.1-1**). In total, the Project will consist of approximately 1,707 miles of new, 36-inch-diameter pipeline, consisting of approximately 327 miles in Canada and 1,380 miles within the US. It will interconnect with the northern and southern termini of the previously approved 298-mile-long, 36-inch-diameter Keystone Cushing Extension. The Project is planned to be placed into service in phases. The Gulf Coast Segment is planned to be in-service in 2011. The Steele City Segment and the Houston Lateral are planned to be in-service in 2012.

The Department of State (DOS) has determined that actions by TransCanada Keystone Pipeline, LP (Keystone) regarding the proposed Keystone XL Project (Project) would be subject to the requirements of the Federal Clean Air Act General Conformity Rule for the Houston-Galveston-Brazoria (HGB) severe ozone nonattainment area and the Beaumont-Port Arthur (BPA) moderate ozone nonattainment area. The DOS requested documentation pertaining to estimated Project emissions of ozone precursors i.e., oxides of nitrogen (NO_x) and volatile organic compounds (VOC) in the HGB and BPA ozone nonattainment areas to determine if emissions of these pollutants are above the de minimis thresholds or would be “regionally significant” and thus subject to the General Conformity Rule. Annual emissions from both construction and operational activities were estimated for comparison with the de minimis thresholds and regional significance levels. A project’s emissions are considered to be regionally significant if the emissions exceed 10 percent of a nonattainment area’s emissions inventory for that area.

2.0 Regulatory Background – General Conformity

Section 176(c) of the Federal Clean Air Act states that Federal agencies cannot engage, support, or provide financial assistance for licensing, permitting, or approving any project that could cause or contribute to the severity and/or number of violations of National Ambient Air Quality Standards (NAAQS) or could inhibit the expeditious attainment of these standards. Pursuant to statutory requirements of section 176(c), the USEPA promulgated implementing regulations in Parts 51 (Subpart W) and 93 (Subpart B - "Determining Conformity of General Federal Actions to State or Federal Implementation Plans.") of Title 40 of the Code of Federal Regulations. These regulations, commonly referred to as the General Conformity Rule, apply to all Federal actions except for those related to transportation plans, programs, and projects under Title 23 U.S. Code or the Federal Transit Act, which are subject to Transportation Conformity.

The General Conformity Rule defines a Federal action as any activity engaged in by a department, agency, or instrumentality of the Federal government or any activity that a department, agency, or instrumentality of the Federal government supports in any way, provides financial assistance for, licenses, permits, or approves. The General Conformity Rule applies only to Federal actions in locations designated as maintenance or nonattainment areas for any criteria air pollutant under 40 CFR § 81, "Designation of Areas for Air Quality Planning Purposes."

A Federal action is subject to the General Conformity Rule if it is not classified as an exempt activity, as listed in 40 CFR § 93 Subpart B, and if the total direct and indirect emissions of a pollutant (or its precursors), for which the area is classified as a nonattainment or a maintenance area, equal or exceed either:

1. the emission thresholds established in the General Conformity regulations, or
2. 10 percent of the total emissions budget for the entire nonattainment area.

De minimis thresholds for each ozone nonattainment precursor are based on the severity of the non-attainment classification. For the HGB severe ozone nonattainment areas, the de minimis threshold for the ozone precursors, i.e., volatile organic compounds (VOC) and oxides of nitrogen (NO_x), is 25 tons per year (tpy) for each pollutant. For the BPA moderate ozone nonattainment area, the de minimis threshold for the ozone precursors VOC and NO_x is 100 tpy for each.

If the projected construction and operational emissions are less than both these thresholds, then the Federal action is presumed to conform to the State Implementation Plan (SIP) or Nonattainment Plan. In the State of Texas, Rule 30 TAC 101.30, "Conformity of General Federal Actions to State Implementation Plans" incorporates Federal General Conformity regulations by reference.

3.0 General Conformity Applicability

3.1 Houston-Galveston-Brazoria Severe Ozone Nonattainment Area

3.1.1 Construction Activities

Project-related construction activities, such as the installation of intermediate pumping stations and pipelines, would require Federal actions (e.g., licenses, permits, and/or approvals from Federal agencies) that could be applicable to the General Conformity Rule. The Gulf Coast Segment (GCS) of the Project will enter Liberty County (and the HGB severe ozone nonattainment area) at Mile Post (MP) 413.4. The Houston Lateral (a lateral segment branching off the Gulf Coast Segment) extends from the GCS at Pump Station 41 to Moore Junction in Harris County, TX. Construction of the GCS Segment (part of Spread 5 and 6 that is located in the HGB nonattainment area) as well as pump station PS-41 is scheduled to occur from May 1, 2011 through August 30, 2011. Construction of the Houston Lateral is scheduled to begin on May 1, 2012 and continue through September 30, 2012. Since Liberty, Chambers, and Harris Counties are part of the HGB severe ozone nonattainment area, direct and indirect emissions associated with federal actions taken for Project construction and operation activities in Liberty, Chambers, and Harris Counties were analyzed to determine applicability of the General Conformity Rule. Emissions of ozone precursor compounds, oxides of nitrogen (NO_x) and volatile organic compounds (VOC) were analyzed in this conformity determination.

Project-related construction that would occur in Liberty, Chambers, and Harris Counties includes pipeline installation and pumping station (PS-41) construction. The activities associated with construction are further separated by equipment types (on-road and non-road), open burning emissions, fugitive dust and personnel commute. **Table 3-1** compares Project-related construction emissions in Liberty, Chambers, and Harris Counties, with General Conformity Rule de minimis thresholds and 10 percent regional emission levels. The detailed Project construction emission calculations are provided in **Appendix A** of this attachment. The emissions calculations reflect the latest project schedule information.

Table 3-1 Estimated Project-related Construction Emissions in Liberty, Chambers, and Harris Counties (HGB Nonattainment Area) Compared to General Conformity Thresholds

Pollutant	Year	Estimated Project Construction Emissions (tons/year)	General Conformity Threshold (tons/year) ⁽¹⁾	10% of Regional Emissions Budget (tons/year) ⁽²⁾
NO _x	2011 ⁽³⁾	39.7	25	40,848
VOC	2011 ⁽³⁾	9.0	25	39,013
NO _x	2012	64.4	25	40,848
VOC	2012	23.9	25	39,013

¹ 40 CFR 93.153 (amended July 17, 2006)

² Year 2002 tons per year emissions (Houston-Galveston-Brazoria Eight-Hour Ozone Non-Attainment Area Revisions to the State Implementation Plan for the Control of Ozone Air Pollution, Appendix F).

³ NO_x and VOC emissions for the year 2011 include emissions from construction of the main Gulf Coast segment and PS-41.

As shown in **Table 3-1**, construction-related emissions represent less than 10 percent of the regional emissions budget. Therefore, the second criterion of comparing the projected emissions of NO_x and VOC to the significance thresholds (25 tons per year for a severe ozone nonattainment area) given in the General Conformity regulations was evaluated.

Based on an evaluation of the direct and indirect emissions associated with construction of the project, the estimated emissions of NO_x are projected to exceed the general conformity threshold of 25 tons per year by 14.7 tons per year for NO_x for the year 2011. The estimated emissions are projected to exceed the general conformity threshold of 25 tons per year by 39.4 tons per year for NO_x for the year 2012. Construction-related emissions of VOC for both construction years are below the threshold of 25 tons.

Therefore, a General Conformity Determination is required.

3.1.2 Operational Activities

Pipelines themselves have no operational emissions. The only facility that is a part of this project, has operational emissions, and is located in the HGB nonattainment area is an intermediate pumping station, Pumping Station No. 41 (PS-41) which will begin operation in the year 2012. Emission sources at PS-41 include a crude sump and fugitive sources such as valves, pumps and flanges. **Table 3-2** shows the estimated NO_x and VOC operational emissions for the PS-41 pumping station

Table 3-2 Estimated Project-related Operational Emissions in Liberty, Chambers, and Harris Counties (HGB ozone nonattainment area) Compared to General Conformity Thresholds

Project	Pollutant	Estimated Project Operational Emissions (tons/year)	General Conformity Threshold (tons/year) ⁽¹⁾	10% of Regional Emissions Budget (tons/year) ⁽²⁾
PS-41	NO _x	-	25	40,848
	VOC	0.1	25	39,013

¹ 40 CFR 93.153 (amended July 17, 2006)

² Year 2002 tons per year emissions (Houston-Galveston-Brazoria Eight-Hour Ozone Non- Attainment Area Revisions to the State Implementation Plan for the Control of Ozone Air Pollution, Appendix F).

Since the operational emissions of NO_x and VOC are well below the 25 tpy threshold, the General Conformity Rule does not apply to operational activities.

3.2 Beaumont-Port Arthur Moderate Ozone Nonattainment Area

3.2.1 Construction Activities

Project-related construction activities, such as the installation of intermediate pumping stations and pipelines, would require Federal actions (e.g., licenses, permits, and/or approvals from Federal agencies) that could be applicable to the General Conformity Rule. The pipeline will enter Liberty County (in the HGB severe ozone nonattainment area) MP 413.4 before entering Hardin County at MP 437.3 and Jefferson County at MP 449.6. Since both Hardin and Jefferson Counties are located in the Beaumont-Port Arthur (BPA) moderate ozone nonattainment area, direct and indirect emissions associated with Federal actions taken for Project construction in the counties were analyzed to determine applicability to the General Conformity Rule. As such,

construction related emissions of ozone precursor compounds, oxides of nitrogen (NO_x) and volatile organic compounds (VOC) were analyzed in this conformity determination.

Project-related construction that would occur in Jefferson and Hardin Counties includes pipeline installation. The activities associated with construction are further separated by equipment types (on-road and non-road), open burning emissions, fugitive dust and personnel commute. **Table 3-3** compares Project-related construction emissions in Jefferson and Hardin Counties, with General Conformity Rule de minimis thresholds and 10 percent regional emission levels. The detailed Project construction emission calculations are provided in **Appendix A** of this attachment. The emissions calculations reflect current project schedule information.

Table 3-3 Estimated Project-related Construction Emissions in Jefferson and Hardin Counties (BPA ozone nonattainment area) Compared to General Conformity Thresholds

Pollutant	Year	Estimated Project Construction Emissions (tons/year)	General Conformity Threshold (tons/year) ⁽¹⁾	10% of Regional Emissions Budget (tons/year) ⁽²⁾
NO _x	2011	68.2	100	70,544
VOC	2011	22.3	100	117,818

¹ 40 CFR 93.153 (amended July 17, 2006)

² Year 2002 tons per year emissions (Beaumont-Port Arthur Eight-Hour Ozone Redesignation and Maintenance Plan SIP Revision, Appendix B: Texas 2002 Periodic Emissions Inventory Area, Nonroad Mobile, and Biogenic Sources).

As shown in **Table 3-3**, construction-related emissions represent less than 10 percent of the regional emissions budget. Therefore, the second criterion of comparing the projected emissions of NO_x and VOC to the significance thresholds (100 tons per year for a moderate ozone nonattainment area) given in the General Conformity regulations was evaluated.

Based on an evaluation of the direct and indirect emissions associated with construction of the project, the estimated emissions of NO_x and VOC are below the General Conformity significance threshold of 100 tons per year for a moderate ozone nonattainment area. Hence, the conformity determination is complete for the portion of the pipeline that would be located in the BPA nonattainment area and the proposed construction activity is presumed to conform to the SIP.

3.2.2 Operational Activities

Pipelines themselves have very little operational emissions. Most come in the form of fugitive emissions from valves and flanges at pump stations. Moreover, there are no crude terminals located along this portion of the Gulf Coast Segment of the Project. Accordingly, the General Conformity Rule does not apply to operational activities.

4.0 General Conformity Determination

4.1 Houston-Galveston-Brazoria Severe Ozone Nonattainment Area

The Houston-Galveston-Brazoria eight county area was re-classified as a severe non-attainment for the 8-hour ozone standard in 2008. The TCEQ developed an air quality nonattainment plan as required by USEPA to ensure that these counties would reduce emissions and work towards achieving future attainment. The most recent revision of the nonattainment plan was adopted as part of the Texas SIP on May 23, 2007. The Project can demonstrate conformity with the nonattainment plan by meeting one or more of the following requirements:

- Demonstrate that the total direct and indirect emissions are specifically identified and accounted for in the applicable SIP;
- Document that the total direct and indirect emissions from the action along with all other emissions in the area will not exceed the SIP emissions budget;
- Obtain a written statement from the State to revise the SIP to include the emissions from the action;
- Document that any on-road motor vehicle emissions are included in the current regional emission analysis for the area's transportation plan or transportation improvement program;
- Fully offset the total direct and indirect emissions by reducing emissions of the same pollutant or precursor in the same nonattainment or nonattainment area; or
- Where appropriate, in accordance with 40 CFR 51.858(4), conduct air quality modeling that can demonstrate that the emissions will not cause or contribute to new violations of the standards, or increase the frequency or severity of any existing violations of the standards.

For the construction of the main pipeline and PS-41 within the HGB severe nonattainment area, NO_x emissions are projected to exceed the 25 tpy threshold by 14.7 tpy in 2011. For the construction of the Houston Lateral, NO_x emissions are projected to exceed the 25 tpy threshold by 39.4 tpy in 2012.

The emissions calculations for non-road mobile sources are conservatively based on Tier 2 engine standards as adopted by EPA. In addition to this engine standard, several actions as part of the Texas SIP could be used to mitigate emissions during the construction phase of the Project:

- Utilize construction contractors that participate in the Texas Emission Reduction Plan (TERP) grant program or require contractors to apply for TERP grant funds,
- Give preference through the bidding process to "Green/Clean" Contractors,;
- Require construction contracts to use diesel fuels that meet the Texas Low Emission Diesel (TxLED) standards,
- Require construction contractors to use Best Management Practices in relation to air quality.

In determining whether a Project is in conformity with the state implementation plan (SIP), the emissions from the project are compared to the allowable emissions inventory to determine if the expected emissions increase

can be accommodated in the SIP emissions budget. According to the email communication between Ms. Seemantini Deshpande of AECOM and Mr. Koy Howard of TCEQ (**Appendix A-5**), TCEQ has reviewed the May 23, 2007 revision of the Houston/Galveston Area SIP for Eight-Hour Ozone (entitled “HGB 1997 Eight-Hour Ozone Nonattainment Area RFP SIP Revision”) and determined the 2011 and 2012 compliance year emission inventories for Construction Emissions category. Estimated Project construction emissions were compared to the SIP emissions budget for 2011 and 2012 for NO_x and VOC by TCEQ and were determined to be well under the emissions budget allotted for this category. Therefore, the expected increase in emissions due to construction activities is accounted for in the SIP emissions budget and the proposed activity within the HGB nonattainment area is presumed to conform to the SIP.

5.0 Finding of Conformity

As discussed in Section 4, the two phases of the Project will meet the requirements of the General Conformity Rule through a combination of mitigation measures and accommodation of the construction related emissions in the SIP budget. The Project will not exceed the total budgeted emissions in the applicable SIP.

Appendix A

Emission Calculations

CONSTRUCTION EMISSIONS
Keystone XL Pipeline
HGB Severe Ozone Nonattainment Area
Main Pipeline

	2011 Construction Emissions: Main Pipeline in the HGB Nonattainment Area (tons)																
	HC	CO	NOx	SO2	TSP	PM10	PM2.5	CO2e	Benzene	Toluene	Xylenes	Propylene	Acrolein	PAHs	1,3-Butadiene	Formaldehyde	Acetaldehyde
CONSTRUCTION NONROAD	2.55	23.02	34.76	1.45	1.45	1.45	1.45	4863.969715	4.58E-02	2.01E-02	1.40E-02	1.27E-01	4.54E-03	8.24E-03	1.92E-03	5.79E-02	3.76E-02
CONSTRUCTION ONROAD	0.75	13.51	2.20	0.01	0.08	0.08	0.08	941.68	2.24E-02				4.55E-04		2.69E-03	8.70E-03	6.56E-03
OPEN BURNING	5.00	68.11	1.16	-	10.92	7.79	6.62	1,611.41									
FUGITIVE DUST					86.76	43.38	6.51										
PAVED ROAD DUST					6.87	1.08	0.11										
TOTAL	8.30	104.64	38.12	1.46	106.08	53.78	14.77	7,417.06	6.81E-02	2.01E-02	1.40E-02	1.27E-01	4.99E-03	8.24E-03	4.61E-03	6.66E-02	4.42E-02
Since the project is proposed to be located in an ozone nonattainment area, the pollutants of interest are HC (VOC) and NOx.																	

Equipment	Daily Hours operated	Number of eqpmt Per Station	Units		Units		Units		2011 TOTAL Hours	Eqpmt Horsepwr	Fuel Type	Criteria Pollutants					TAF Assignm ent ^{2,b}	Load Factor ³	TAF ^{2,b}				
			Pre-welding days (18 days)	Days of Operation Per Unit	Welding days (72 days)	Days of Operation Per Unit	Clean-up days (18 days)	Days of Operation Per Unit				EFss (g/hp-hr) ^{1,a}				BSFC			HC	CO	NOx		
												hrs/eqpmt/day	lb/hp-hr	HC	CO							NOx	PM
D-7 Dozer	8	2	12	12	12	31	7	42	6,470	240	Diesel	0.367	0.3085	0.7475	4	0.13	Hi	0.59	1.01	1.05	1.53	0.95	
D-8 Dozer	8	0	13	12	22	31	18	42	12,762	310	Diesel	0.367	0.1669	0.8425	4.355	0.13	Hi	0.59	1.01	1.05	1.53	0.95	
D-8 Ripper	0	0	0	0	0	26	0	30	0	310	Diesel	0.367	0.1669	0.8425	4.355	0.13	Hi	0.59	1.01	1.05	1.53	0.95	
D-5 Tow	8	0	0	12	2	31	2	42	1,172	120	Diesel	0.367	0.3384	0.8667	4.1	0.18	None	0.43	1.00	1.00	1.00	1.00	
D-7 Tow	8	0	0	12	1	31	1	42	586	240	Diesel	0.367	0.3085	0.7475	4	0.13	None	0.43	1.00	1.00	1.00	1.00	
D-6 Tack	8	0	3	12	3	31	3	42	2,040	200	Diesel	0.367	0.3085	0.7475	4	0.13	None	0.43	1.00	1.00	1.00	1.00	
CAT 225	8	2	0	12	7	31	4	42	3,088	150	Diesel	0.367	0.3384	0.8667	4.1	0.18	Hi	0.59	1.01	1.05	1.53	0.95	
CAT 235	8	0	0	12	26	31	15	42	11,518	250	Diesel	0.367	0.3085	0.7475	4	0.13	Hi	0.59	1.01	1.05	1.53	0.95	
CAT 235 w/ Hammer	0	0	0	0	0	26	0	30	0	260	Diesel	0.367	0.3085	0.7475	4	0.13	Hi	0.59	1.01	1.05	1.53	0.95	
Bending Machine 22-36	8	0	0	12	1	31	0	42	248	159	Diesel	0.367	0.3384	0.8667	4.1	0.18	None	0.43	1.00	1.00	1.00	1.00	
Crane LS-98A (35 ton)	0	2	0	0	0	26	0	30	0	230	Diesel	0.367	0.3085	0.7475	4	0.13	None	0.43	1.00	1.00	1.00	1.00	
Farm Tractor	8	1	2	12	2	31	2	42	1,360	60	Diesel	0.408	0.3672	2.3655	4.7	0.24	Hi	0.59	1.01	1.05	1.53	0.95	
Frontend Loader 977	8	1	2	12	2	31	2	42	1,360	190	Diesel	0.367	0.3085	0.7475	4	0.13	Hi	0.59	1.01	1.05	1.53	0.95	
Motor Grader 14G	8	1	2	12	2	31	2	42	1,360	200	Diesel	0.367	0.3085	0.7475	4	0.13	Hi	0.59	1.01	1.05	1.53	0.95	
Sideboom 571	8	0	0	12	1	31	0	42	248	200	Diesel	0.367	0.3085	0.7475	4	0.13	Hi	0.59	1.01	1.05	1.53	0.95	
Sideboom 572	8	0	0	12	1	31	1	42	586	230	Diesel	0.367	0.3085	0.7475	4	0.13	Hi	0.59	1.01	1.05	1.53	0.95	
Sideboom 583	8	0	0	12	22	31	4	42	6,808	310	Diesel	0.367	0.1669	0.8425	4.355	0.13	Hi	0.59	1.01	1.05	1.53	0.95	
Sideboom 594	8	0	0	12	4	31	4	42	2,344	410	Diesel	0.367	0.1669	0.8425	4.355	0.13	Hi	0.59	1.01	1.05	1.53	0.95	
Air Compressor 1750 cfm	8	1	0	12	3	31	1	42	1,082	50	Gasoline	0.484	0.27	11.94	0.69	0.06	None	0.69	1.00	1.00	1.00	1.00	
Pump - 3"	8	1	0	12	1	31	1	42	586	20	Gasoline	0.868	5.5	387.02	4.5	0.06	None	0.69	1.00	1.00	1.00	1.00	
Pump - 6"	8	1	0	12	9	31	9	42	5,274	40	Gasoline	0.484	0.27	11.94	0.69	0.06	None	0.69	1.00	1.00	1.00	1.00	
Emergency Engines	8	4	0	12	9	31	2	42	2,908	10	Gasoline	0.868	5.5	387.02	4.5	0.06	None	0.68	1.00	1.00	1.00	1.00	
TOTAL (Tons)																							

NOTES:

Notes 1 through 9 apply to diesel engines.

Note 1: Brake-specific fuel consumption and Zero hour steady state EF (EFss; g/hp-hr) assumed to be Tier 2 engines, from Table A2 of "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

Engine Size (HP)	HC	CO	NOx	PM	BSFC	M. Life
1	11	0.5508	4.1127	4.3	0.5	2500
12	16	0.438	2.161	4.4399	0.2665	2500
17	25	0.438	2.161	4.4399	0.2665	2500
26	50	0.2789	1.5323	4.7279	0.3389	4667
51	100	0.3672	2.3655	4.7	0.24	4667
101	175	0.3384	0.8667	4.1	0.18	4667
176	300	0.3085	0.7475	4	0.1316	7000
301	600	0.1669	0.8425	4.3551	0.1316	7000
601	750	0.1669	1.3272	4.1	0.1316	7000
751	2500	0.1669	0.7642	4.1	0.1316	7000

Note 2: Transient Adjustment Factors and TAF assignment and TAF from Table A3 of "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

Note 3: Load factor from Appendix A of "Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling", April 2004, EPA-420-P-04-005.

Note 4: Median life is taken from Table 1 of "Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling", April 2004, EPA-420-P-04-005.

Note 5: Age factor and Deterioration factors calculated using Equation 4 from "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

Age Factor = LF * cumulative hours / median life (Age factor is assumed to be greater than one, i.e. the equipment is approximately at the end of its useful life).

Deterioration Factor = 1 + (A * Age Factor^b), where b = 1 for diesel engines and A is taken from Table A4 from source

Note 6: Adjusted Emission Factors for HC, NOx, and CO are calculated using Equation 1 (Table A4) from, "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009. Relative Deterioration factors for Tier II engines was used.

Adjusted EF = EFss * TAF * DF

Note 7: SO2 calculated from Equation 7 from "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

SO2=BSFC*453.6*(1-soxncv)-HC)*0.01*soxdsl*2

where: soxncv = 0.02247 and soxdsl = 0.05

Note 8: Adjusted Emission Factor for particulate matter is calculated using Equations 2 and 5 from "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

Adjusted EF = EFss * TAF * DF - Spm adj

Spm adj = BSFC*453.6*7.0*soxncv*0.01*(soxbas-soxdsl)

where: soxbas = 0.33

Note 9: Construction is proposed to occur between March 2012 and December 2012 approximately. Annual Emissions are calculated using the following calculation

(Emission factor (g/hp-hr) * horsepower * hours operated * load factor) / (2000 lb/ton * 453.6 g/lb)

Notes a through d apply to gasoline engines.

Note a: Fuel Type Gasoline only: Brake specific fuel consumption and emission factors (EFss; g/hp-hr) assumed to be Phase 2 side-valved for < 25hp from Table 5 and Table 6 for > 25hp of "Exhaust Emission Factors for Nonroad Engine Modeling: Spark-Ignition", December 2005, EPA420-R-05-019

Note b: Fuel Type Gasoline only: Transient Adjustment Factors assumed to be Phase 2 for >25 Hp (for <25Hp TAFs emission factors are based on unadjusted steady-state test results) from Table 20 of "Exhaust Emission Factors for Nonroad Engine Modeling: Spark-Ignition", December 2005, EPA420-R-05-019.

Note c: Fuel Type Gasoline only: Deterioration Factors from Table 2 (Phase 2-Side valved) for <25 Hp of "Nonroad Spark-Ignition Engine Emission Deterioration Factors", December 2005, EPA420-R-05-023.

Fuel Type Gasoline only: Deterioration Factors from Table 7 for >25 Hp of "Nonroad Spark-Ignition Engine Emission Deterioration Factors", December 2005, EPA420-R-05-023.

Note d: Fuel Type Gasoline only: SO2 calculated from Sulfur Dioxide Emission Factor calculations from "Exhaust Emission Factors for Nonroad Engine Modeling: Spark-Ignition", December 2005, EPA420-R-05-019.

SO2=BSFC*453.6*(1-soxncv)-HC)*0.01*soxdsl*2

where: soxncv = 0.03 and soxdsl = 0.0339

Line Construction: Criteria Emissions from Non-Road Engines

Equipment	BSFC _{adj}		Median	Age Factor ⁵	"A" ⁵				Deterioration factor ^{5,c}				Adjusted EF (g/hp-hr) ⁶					2011 Emissions (tons) ⁹				
	PM		Life ⁴		HC	CO	NOx	PM	HC	CO	NOx	PM	HC	CO	NOx	SO2 ^{7,d}	PM ⁸	HC	CO	NOx	SO2	PM
			Hours																			
D-7 Dozer	1.23	0.3707	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.335	1.259	3.834	0.164	0.164	0.34	1.27	3.87	0.17	0.17
D-8 Dozer	1.23	0.3707	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.181	1.419	4.175	0.164	0.164	0.47	3.65	10.74	0.42	0.42
D-8 Ripper	1.23	0.3707	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.181	1.419	4.175	0.164	0.164	0.00	0.00	0.00	0.00	0.00
D-5 Tow	1.00	0.3670	4667	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.350	0.954	4.137	0.162	0.192	0.02	0.06	0.28	0.01	0.01
D-7 Tow	1.00	0.3670	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.319	0.823	4.036	0.162	0.121	0.02	0.05	0.27	0.01	0.01
D-6 Tack	1.00	0.3670	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.319	0.823	4.036	0.162	0.121	0.06	0.16	0.78	0.03	0.02
CAT 225	1.23	0.3707	4667	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.367	1.460	3.930	0.164	0.252	0.11	0.44	1.18	0.05	0.08
CAT 235	1.23	0.3707	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.335	1.259	3.834	0.164	0.164	0.63	2.36	7.18	0.31	0.31
CAT 235 w/ Hammer	1.23	0.3707	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.335	1.259	3.834	0.164	0.164	0.00	0.00	0.00	0.00	0.00
Bending Machine 22-36	1.00	0.3670	4667	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.350	0.954	4.137	0.162	0.192	0.01	0.02	0.08	0.00	0.00
Crane LS-98A (35 ton)	1.00	0.3670	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.319	0.823	4.036	0.162	0.121	0.00	0.00	0.00	0.00	0.00
Farm Tractor	1.23	0.4121	4667	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.399	3.985	4.505	0.182	0.353	0.02	0.21	0.24	0.01	0.02
Frontend Loader 977	1.23	0.3707	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.335	1.259	3.834	0.164	0.164	0.06	0.21	0.64	0.03	0.03
Motor Grader 14G	1.23	0.3707	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.335	1.259	3.834	0.164	0.164	0.06	0.22	0.68	0.03	0.03
Sideboom 571	1.23	0.3707	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.335	1.259	3.834	0.164	0.164	0.01	0.04	0.12	0.01	0.01
Sideboom 572	1.23	0.3707	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.335	1.259	3.834	0.164	0.164	0.03	0.11	0.34	0.01	0.01
Sideboom 583	1.23	0.3707	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.181	1.419	4.175	0.164	0.164	0.25	1.95	5.73	0.23	0.23
Sideboom 594	1.23	0.3707	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.181	1.419	4.175	0.164	0.164	0.11	0.89	2.61	0.10	0.10
Air Compressor 1750 cfm	1.00	0.4840	4667	> 1	-	-	-	-	0.640	0.360	0.150	0.260	0.173	4.298	0.104	0.144	0.016	0.01	0.14	0.00	0.00	0.00
Pump - 3"	1.00	0.8680	2500	> 1	-	-	-	-	1.935	0.887	0.000	1.935	10.643	343.29	0.000	0.252	0.116	0.09	3.06	0.00	0.00	0.00
Pump - 6"	1.00	0.4840	4667	> 1	-	-	-	-	0.640	0.360	0.150	0.260	0.173	4.298	0.104	0.144	0.016	0.03	0.69	0.02	0.02	0.00
Emergency Engines	1.00	0.8680	2500	> 1	-	-	-	-	1.935	0.887	0.000	1.935	10.643	343.287	0.000	0.252	0.116	0.23	7.48	0.00	0.01	0.00
TOTAL (Tons)																		2.55	23.02	34.76	1.45	1.45

Main Pipeline Construction: GHG Emissions from Non-Road Engines

Equipment	Daily Hours operated	2011 TOTAL Hours	Equipment HP	Fuel Type	BSFC	TAF Assignment	Load Factor ²	TAF ¹	BSFC _{adj}	Greenhouse Gases				2011 Emissions (Tons)				
										CO ₂	CH ₄		N ₂ O	CO ₂	CH ₄	N ₂ O	CO ₂ e ⁵	
											g/hp-hr ³	⁴						lb/hp-hr
D-7 Dozer	8	6,470	240	Diesel	0.367	Hi	0.59	1.01	0.3707	535.27	0.58	6.72E-05	0.26	3.01E-05	540.57	0.05	0.02	548.92
D-8 Dozer	8	12,762	310	Diesel	0.367	Hi	0.59	1.01	0.3707	535.76	0.58	6.72E-05	0.26	3.01E-05	1,378.52	0.13	0.06	1,399.79
D-8 Ripper	0	0	310	Diesel	0.367	Hi	0.59	1.01	0.3707	535.76	0.58	6.72E-05	0.26	3.01E-05	0.00	0.00	0.00	0.00
D-5 Tow	8	1,172	120	Diesel	0.367	None	0.43	1	0.3670	529.92	0.58	6.66E-05	0.26	2.98E-05	35.33	0.00	0.00	36.07
D-7 Tow	8	586	240	Diesel	0.367	None	0.43	1	0.3670	530.01	0.58	6.66E-05	0.26	2.98E-05	35.33	0.00	0.00	36.08
D-6 Tack	8	2,040	200	Diesel	0.367	None	0.43	1	0.3670	530.01	0.58	6.66E-05	0.26	2.98E-05	102.50	0.01	0.01	104.67
CAT 225	8	3,088	150	Diesel	0.367	Hi	0.59	1.01	0.3707	535.17	0.58	6.72E-05	0.26	3.01E-05	161.22	0.02	0.01	163.71
CAT 235	8	11,518	250	Diesel	0.367	Hi	0.59	1.01	0.3707	535.27	0.58	6.72E-05	0.26	3.01E-05	1,002.42	0.10	0.04	1,017.91
CAT 235 w/ Hammer	0	0	260	Diesel	0.367	Hi	0.59	1.01	0.3707	535.27	0.58	6.72E-05	0.26	3.01E-05	0.00	0.00	0.00	0.00
Bending Machine 22-36	8	248	159	Diesel	0.367	None	0.43	1	0.3670	529.92	0.58	6.66E-05	0.26	2.98E-05	9.90	0.00	0.00	10.11
Crane LS-98A (35 ton)	0	0	230	Diesel	0.367	None	0.43	1	0.3670	530.01	0.58	6.66E-05	0.26	2.98E-05	0.00	0.00	0.00	0.00
Farm Tractor	8	1,360	60	Diesel	0.408	Hi	0.59	1.01	0.4121	594.99	0.58	7.47E-05	0.26	3.35E-05	31.58	0.00	0.00	32.06
Frontend Loader 977	8	1,360	190	Diesel	0.367	Hi	0.59	1.01	0.3707	535.27	0.58	6.72E-05	0.26	3.01E-05	89.96	0.01	0.00	91.34
Motor Grader 14G	8	1,360	200	Diesel	0.367	Hi	0.59	1.01	0.3707	535.27	0.58	6.72E-05	0.26	3.01E-05	94.69	0.01	0.00	96.15
Sideboom 571	8	248	200	Diesel	0.367	Hi	0.59	1.01	0.3707	535.27	0.58	6.72E-05	0.26	3.01E-05	17.27	0.00	0.00	17.53
Sideboom 572	8	586	230	Diesel	0.367	Hi	0.59	1.01	0.3707	535.27	0.58	6.72E-05	0.26	3.01E-05	46.92	0.00	0.00	47.64
Sideboom 583	8	6,808	310	Diesel	0.367	Hi	0.59	1.01	0.3707	535.76	0.58	6.72E-05	0.26	3.01E-05	735.38	0.07	0.03	746.73
Sideboom 594	8	2,344	410	Diesel	0.367	Hi	0.59	1.01	0.3707	535.76	0.58	6.72E-05	0.26	3.01E-05	334.87	0.03	0.01	340.04
Air Compressor 1750 cfm	8	1,082	50	Gasoline	0.484	None	0.56	1	0.4840	699.77	0.50	7.57E-05	0.22	3.33E-05	23.37	0.00	0.00	23.69
Pump - 3"	8	586	20	Gasoline	0.868	None	0.69	1	0.8680	1222.00	0.50	1.36E-04	0.22	5.97E-05	10.89	0.00	0.00	11.02
Pump - 6"	8	5,274	40	Gasoline	0.484	None	0.69	1	0.4840	699.77	0.50	7.57E-05	0.22	3.33E-05	112.28	0.01	0.00	113.54
Emergency Engines	8	2,908	10	Gasoline	0.868	None	0.68	1	0.8680	1222.00	0.50	1.36E-04	0.22	5.97E-05	26.64	0.00	0.00	26.95
TOTAL (Tons)															4,789.63	0.46	0.21	4,863.97

NOTES:

- Note 1: Transient Adjustment Factors and TAF assignment and from Table A3 of "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.
- Note 2: Load factor from Appendix A of "Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling", April 2004, EPA-420-P-04-005.
- Note 3: Carbon dioxide is calculated using Equation 6 from "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.
 $CO_2e = ((BSFC * 453.6) - HC) * 0.87 * (44/12)$
 HC is the hydrocarbon emission factor from criteria pollutant calculation.
 0.87 is the mass fraction of carbon mass in diesel and
 44/12 is the molecular weight ratio of CO₂ to carbon
- Note 4: Emission Factors from Table 13.6 of The Climate Registry General Reporting Protocol Version 1.0, tons calculated using 7.05 lb/gal from AP-42 Appendix A and adjusted BSFC
- Note 5: Carbon dioxide equivalents calculated using IPCC Second Assessment Report (SAR) Global Warming Potentials CO₂ = 1, CH₄ = 21, N₂O = 310.
 $CO_2e = CO_2 + (CH_4 * 21) + (N_2O * 310)$

Main Pipeline Construction: HAP Emissions from Non-Road Engines

Equipment	Daily Hours operated	Number of eqpt.	2011 TOTAL Hours hrs	Equipment Horsepower hp	Fuel Type	BSFC lb/hp-hr	TAF Assignment ¹	Load Factor ²	BSFC TAF ¹	BSFC _{adj}	HAP Emission Factors (lb/MMBtu) ³					
	hrs/eqpt/day										Benzene	Toluene	Xylenes	Propylene	Acrolein	PAHs
D-7 Dozer	8	2	6,470	240	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
D-8 Dozer	8	0	12,762	310	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
D-8 Ripper	0	0	0	310	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
D-5 Tow	8	0	1,172	120	Diesel	0.367	None	0.43	1	0.3670	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
D-7 Tow	8	0	586	240	Diesel	0.367	None	0.43	1	0.3670	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
D-6 Tack	8	0	2,040	200	Diesel	0.367	None	0.43	1	0.3670	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
CAT 225	8	2	3,088	150	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
CAT 235	8	0	11,518	250	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
CAT 235 w/ Hammer	0	0	0	260	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Bending Machine 22-36	8	0	248	159	Diesel	0.367	None	0.43	1	0.3670	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Crane LS-98A (35 ton)	0	2	0	230	Diesel	0.367	None	0.43	1	0.3670	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Farm Tractor	8	1	1,360	60	Diesel	0.408	Hi	0.59	1.01	0.4121	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Frontend Loader 977	8	1	1,360	190	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Motor Grader 14G	8	1	1,360	200	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Sideboom 571	8	0	248	200	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Sideboom 572	8	0	586	230	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Sideboom 583	8	0	6,808	310	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Sideboom 594	8	0	2,344	410	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Air Compressor 1750 cfm	8	1	1,082	50	Gasoline	0.484	None	0.56	1	0.4840	N/A	N/A	N/A	N/A	N/A	N/A
Pump - 3"	8	1	586	20	Gasoline	0.868	None	0.69	1	0.8680	N/A	N/A	N/A	N/A	N/A	N/A
Pump - 6"	8	1	5,274	40	Gasoline	0.484	None	0.69	1	0.4840	N/A	N/A	N/A	N/A	N/A	N/A
Emergency Engines	8	4	2,908	10	Gasoline	0.868	None	0.68	1	0.8680	N/A	N/A	N/A	N/A	N/A	N/A
TOTAL (Tons)																

NOTES:

- Note 1: Transient Adjustment Factors and TAF assignment and from Table A3 of "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.
- Note 2: Load factor from Appendix A of "Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling", April 2004, EPA-420-P-04-005. TAF Assignment of Hi/Lo is based on the Load Factor.
- Note 3: Emission factors (lb/MMBtu) from AP-42 Section 3.3, Table 3.3-2. Note that HAP emission factors for gasoline fired engines are not available.
- Note 4: Tons are calculated using 7.05 lb/gal from AP-42 Appendix A and 5.825 MMBtu/barrel from Table 13.1 of The Climate Registry General Reporting Protocol version 1.0

Main Pipeline Construction: HAP Emissions from Non-Road Engines

Equipment	HAP Emission Factors (lb/MMBtu) ³			2011 HAP Emissions (Tons) ⁴								
	1,3-Butadiene	Formaldehyde	Acetaldehyde	Benzene	Toluene	Xylenes	Propylene	Acrolein	PAHs	1,3-Butadiene	Formaldehyde	Acetaldehyde
D-7 Dozer	3.91E-05	1.18E-03	7.67E-04	5.28E-03	2.32E-03	1.61E-03	1.46E-02	5.24E-04	9.51E-04	2.21E-04	6.68E-03	4.34E-03
D-8 Dozer	3.91E-05	1.18E-03	7.67E-04	1.35E-02	5.90E-03	4.11E-03	3.72E-02	1.33E-03	2.42E-03	5.64E-04	1.70E-02	1.11E-02
D-8 Ripper	3.91E-05	1.18E-03	7.67E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D-5 Tow	3.91E-05	1.18E-03	7.67E-04	4.74E-04	2.08E-04	1.45E-04	1.31E-03	4.70E-05	8.53E-05	1.99E-05	5.99E-04	3.89E-04
D-7 Tow	3.91E-05	1.18E-03	7.67E-04	4.74E-04	2.08E-04	1.45E-04	1.31E-03	4.70E-05	8.53E-05	1.99E-05	5.99E-04	3.89E-04
D-6 Tack	3.91E-05	1.18E-03	7.67E-04	1.37E-03	6.02E-04	4.20E-04	3.80E-03	1.36E-04	2.47E-04	5.76E-05	1.74E-03	1.13E-03
CAT 225	3.91E-05	1.18E-03	7.67E-04	1.58E-03	6.91E-04	4.81E-04	4.36E-03	1.56E-04	2.84E-04	6.60E-05	1.99E-03	1.30E-03
CAT 235	3.91E-05	1.18E-03	7.67E-04	9.80E-03	4.29E-03	2.99E-03	2.71E-02	9.71E-04	1.76E-03	4.10E-04	1.24E-02	8.05E-03
CAT 235 w/ Hammer	3.91E-05	1.18E-03	7.67E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bending Machine 22-36	3.91E-05	1.18E-03	7.67E-04	1.33E-04	5.82E-05	4.06E-05	3.67E-04	1.32E-05	2.39E-05	5.57E-06	1.68E-04	1.09E-04
Crane LS-98A (35 ton)	3.91E-05	1.18E-03	7.67E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Farm Tractor	3.91E-05	1.18E-03	7.67E-04	3.09E-04	1.35E-04	9.43E-05	8.53E-04	3.06E-05	5.56E-05	1.29E-05	3.90E-04	2.54E-04
Frontend Loader 977	3.91E-05	1.18E-03	7.67E-04	8.79E-04	3.85E-04	2.69E-04	2.43E-03	8.71E-05	1.58E-04	3.68E-05	1.11E-03	7.23E-04
Motor Grader 14G	3.91E-05	1.18E-03	7.67E-04	9.25E-04	4.06E-04	2.83E-04	2.56E-03	9.17E-05	1.67E-04	3.88E-05	1.17E-03	7.61E-04
Sideboom 571	3.91E-05	1.18E-03	7.67E-04	1.69E-04	7.40E-05	5.15E-05	4.67E-04	1.67E-05	3.04E-05	7.07E-06	2.13E-04	1.39E-04
Sideboom 572	3.91E-05	1.18E-03	7.67E-04	4.58E-04	2.01E-04	1.40E-04	1.27E-03	4.55E-05	8.26E-05	1.92E-05	5.80E-04	3.77E-04
Sideboom 583	3.91E-05	1.18E-03	7.67E-04	7.18E-03	3.15E-03	2.19E-03	1.99E-02	7.12E-04	1.29E-03	3.01E-04	9.08E-03	5.90E-03
Sideboom 594	3.91E-05	1.18E-03	7.67E-04	3.27E-03	1.43E-03	9.99E-04	9.04E-03	3.24E-04	5.89E-04	1.37E-04	4.13E-03	2.69E-03
Air Compressor 1750 cfm	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pump - 3"	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pump - 6"	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Emergency Engines	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
TOTAL (Tons)				4.58E-02	2.01E-02	1.40E-02	1.27E-01	4.54E-03	8.24E-03	1.92E-03	5.79E-02	3.76E-02

Main Pipeline Construction: Criteria and GHG Emissions from On-Road Vehicles

Equipment	Daily Hours operated hr/eqpt/day	Number		Days of Operation	Units per station		Days of Operation	Units per station		Vehicle Class ¹	2011 Miles traveled ²	Fuel Type	Criteria Pollutants				
		eqpt	#		Pre-welding days (18 days)	Welding days (49 days)		Clean-up days (39 days)	Emission Factor (g/VMT) ³								
									VOC				CO	NOx	SO ₂	PM	
Automobile	2	50	20	12	50	31	20	42	LDGV	131,500	Diesel	0.627	12.7	0.588	0.0068	0.0249	
Bus	3	7	2	12	7	31	1	42	URBANBUS	21,206	Diesel	0.257	2.121	10.677	0.0218	0.226	
Pickup 4x4	5	100	20	12	100	31	20	42	LDGV	522,500	Diesel	0.627	12.7	0.588	0.0068	0.0249	
Welding Rig	10	30	0	12	30	31	5	42	LDGV	285,313	Diesel	0.627	12.7	0.588	0.0068	0.0249	
Winch Truck	8	3	3	12	3	31	0	42	HDDV3	25,650	Diesel	0.16	0.541	2.319	0.0082	0.0848	
Dump Truck	8	1	1	12	1	31	1	42	HDDV3	17,000	Diesel	0.16	0.541	2.319	0.0082	0.0848	
Flatbed Truck	9	8	1	12	8	31	2	42	HDDV3	77,456	Diesel	0.16	0.541	2.319	0.0082	0.0848	
Fuel Truck	10	2	1	12	2	31	2	42	HDDV3	39,563	Diesel	0.16	0.541	2.319	0.0082	0.0848	
Grease Truck	10	1	1	12	1	31	1	42	HDDV3	21,250	Diesel	0.16	0.541	2.319	0.0082	0.0848	
Mechanic Rig	10	1	1	12	1	31	1	42	HDDV2B	21,250	Diesel	0.149	0.508	2.182	0.0074	0.0966	
Skid Truck	10	1	1	12	1	31	0	42	HDDV3	10,688	Diesel	0.16	0.541	2.319	0.0082	0.0848	
Stringing Tr. & Tr.	10	15	0	12	15	31	0	42	HDDV3	116,250	Diesel	0.16	0.541	2.319	0.0082	0.0848	
Truck & Float	10	9	0	12	9	31	5	42	HDDV3	122,563	Diesel	0.16	0.541	2.319	0.0082	0.0848	
Truck & Lowboy	10	5	5	12	5	31	2	42	HDDV3	74,563	Diesel	0.16	0.541	2.319	0.0082	0.0848	
TOTAL (Tons)																	

NOTES:

Note 1: Vehicle Classes were taken from Mobile6.2 based on estimated gross weight of the vehicle.

Note 2: Vehicle miles traveled are based on an assumed

25 mi/hr on average/ vehicle based on arterial roads.

Note 3: Emission factors from Mobile6.2.

Note 4: Emission Factors from Table 13.4 of The Climate Registry General Reporting Protocol Version 1.1 applicable to "Diesel Heavy Duty Vehicles" all model year vehicles.

Note that Efs applicable to light duty gasoline vehicles was used for the vehicle category "automobiles" (MY 2000).

Note 5: Carbon dioxide equivalents calculated using IPCC Second Assessment Report (SAR) Global Warming Potentials CO₂ = 1, CH₄ = 21, N₂O = 310.

$$CO_2e = CO_2 + (CH_4 * 21) + (N_2O * 310)$$

Main Pipeline Construction: Criteria and GHG Emissions from On-Road Vehicles

Equipment	Greenhouse Gasses			2011 Emissions (Tons)								
	Ef (g/mile)			Criteria Pollutants					Greenhouse Gasses			
	CO ₂ ³	CH ₄ ⁴	N ₂ O ⁴	VOC	CO	NOx	SO ₂	PM	CO ₂	CH ₄	N ₂ O	CO ₂ e ⁵
Automobile	368.1	0.0273	0.0178	0.0909	1.8409	0.0852	0.0010	0.00	53.36	3.96E-03	2.58E-03	54.24
Bus	2342.9	0.0051	0.0048	0.0060	0.0496	0.2496	0.0005	0.01	54.77	1.19E-04	1.12E-04	54.80
Pickup 4x4	368.1	0.0273	0.0178	0.3611	7.3147	0.3387	0.0039	0.01	212.01	1.57E-02	1.03E-02	215.52
Welding Rig	368.1	0.0273	0.0178	0.1972	3.9942	0.1849	0.0021	0.01	115.77	8.59E-03	5.60E-03	117.68
Winch Truck	875.4	0.0051	0.0048	0.0045	0.0153	0.0656	0.0002	0.00	24.75	1.44E-04	1.36E-04	24.80
Dump Truck	875.4	0.0051	0.0048	0.0030	0.0101	0.0435	0.0002	0.00	16.40	9.56E-05	8.99E-05	16.43
Flatbed Truck	875.4	0.0051	0.0048	0.0137	0.0462	0.1980	0.0007	0.01	74.74	4.35E-04	4.10E-04	74.88
Fuel Truck	875.4	0.0051	0.0048	0.0070	0.0236	0.1011	0.0004	0.00	38.18	2.22E-04	2.09E-04	38.25
Grease Truck	875.4	0.0051	0.0048	0.0037	0.0127	0.0543	0.0002	0.00	20.51	1.19E-04	1.12E-04	20.54
Mechanic Rig	789.4	0.0051	0.0048	0.0035	0.0119	0.0511	0.0002	0.00	18.49	1.19E-04	1.12E-04	18.53
Skid Truck	875.4	0.0051	0.0048	0.0019	0.0064	0.0273	0.0001	0.00	10.31	6.01E-05	5.65E-05	10.33
Stringing Tr.& Tr.	875.4	0.0051	0.0048	0.0205	0.0693	0.2972	0.0011	0.01	112.18	6.54E-04	6.15E-04	112.38
Truck & Float	875.4	0.0051	0.0048	0.0216	0.0731	0.3133	0.0011	0.01	118.27	6.89E-04	6.48E-04	118.48
Truck & Lowboy	875.4	0.0051	0.0048	0.0132	0.0445	0.1906	0.0007	0.01	71.95	4.19E-04	3.95E-04	72.08
TOTAL (Tons)				0.748	13.512	2.200	0.012	0.081	941.68	3.13E-02	2.13E-02	948.95

Main Pipeline Construction: HAP Emissions from On-Road Vehicles

Equipment	Daily Hours operated	Vehicle Class ¹	2011 Miles traveled/year ²	Fuel Type	Hazardous Air Pollutants				
	hr/eqpt/day		miles/yr		Emission Factor (mg/VMT) ³				
					Acetaldehyde	Acrolein	Benzene	1,3-butadiene	Formaldehyde
Automobile	2	LDGV	131,500	Diesel	4.04	0.24	16.45	2.04	4.51
Bus	3	URBANBUS	21,206	Diesel	7.75	0.94	2.83	1.64	21.05
Pickup 4x4	5	LDGV	522,500	Diesel	4.04	0.24	16.45	2.04	4.51
Welding Rig	10	LDGV	285,313	Diesel	4.04	0.24	16.45	2.04	4.51
Winch Truck	8	HDDV3	25,650	Diesel	3.78	0.32	9.09	0.94	6.11
Dump Truck	8	HDDV3	17,000	Diesel	3.78	0.32	9.09	0.94	6.11
Flatbed Truck	9	HDDV3	77,456	Diesel	3.78	0.32	9.09	0.94	6.11
Fuel Truck	10	HDDV3	39,563	Diesel	3.78	0.32	9.09	0.94	6.11
Grease Truck	10	HDDV3	21,250	Diesel	3.78	0.32	9.09	0.94	6.11
Mechanic Rig	10	HDDV2B	21,250	Diesel	3.74	0.29	9.34	0.89	5.92
Skid Truck	10	HDDV3	10,688	Diesel	3.78	0.32	9.09	0.94	6.11
Stringing Tr. & Tr.	10	HDDV3	116,250	Diesel	3.78	0.32	9.09	0.94	6.11
Truck & Float	10	HDDV3	122,563	Diesel	3.78	0.32	9.09	0.94	6.11
Truck & Lowboy	10	HDDV3	74,563	Diesel	3.78	0.32	9.09	0.94	6.11
TOTAL (Tons)									

NOTES:

Note 1: Vehicle Classes were taken from Mobile6.2 based on estimated gross weight of the vehicle.

Note 2: Vehicle miles traveled are based on an assumed 25 mi/hr on average/ vehicle based on arterial roads.

Note 3: HAP Emission factors taken from Mobile6.2

Main Pipeline Construction: HAP Emissions from On-Road Vehicles

Equipment	Hazardous Air Pollutants				
	2010 Emissions (Tons)				
	Acetaldehyde	Acrolein	Benzene	1,3-butadiene	Formaldehyde
Automobile	5.86E-04	3.48E-05	2.38E-03	2.96E-04	6.54E-04
Bus	1.81E-04	2.20E-05	6.62E-05	3.83E-05	4.92E-04
Pickup 4x4	2.33E-03	1.38E-04	9.47E-03	1.17E-03	2.60E-03
Welding Rig	1.27E-03	7.55E-05	5.17E-03	6.42E-04	1.42E-03
Winch Truck	1.07E-04	9.05E-06	2.57E-04	2.66E-05	1.73E-04
Dump Truck	7.08E-05	6.00E-06	1.70E-04	1.76E-05	1.14E-04
Flatbed Truck	3.23E-04	2.73E-05	7.76E-04	8.03E-05	5.22E-04
Fuel Truck	1.65E-04	1.40E-05	3.96E-04	4.10E-05	2.66E-04
Grease Truck	8.85E-05	7.50E-06	2.13E-04	2.20E-05	1.43E-04
Mechanic Rig	8.76E-05	6.79E-06	2.19E-04	2.08E-05	1.39E-04
Skid Truck	4.45E-05	3.77E-06	1.07E-04	1.11E-05	7.20E-05
Stringing Tr. & Tr.	4.84E-04	4.10E-05	1.16E-03	1.20E-04	7.83E-04
Truck & Float	5.11E-04	4.32E-05	1.23E-03	1.27E-04	8.25E-04
Truck & Lowboy	3.11E-04	2.63E-05	7.47E-04	7.73E-05	5.02E-04
TOTAL (Tons)	0.0066	0.0005	0.0224	0.0027	0.0087

Main Pipeline Construction: Emissions from Slash/Brush Burning

Volume and Area of Prescribed Burning		
1 cu. Yd.	=	0.00062 acre-foot
333251 cu. yd.	=	206.62 acre-foot
Area disturbed/ burned	=	207 acre

Vegetation Type Distribution		
Tree Tops/Stump:	=	50% ^(a)
Hay/Gass	=	50% ^(a)

Fuel Load Emission Factor		
Hay/grass	=	1.0 ton/acre ^(b)
Tree Tops and Stumps	=	9.0 ton/acre ^(c)

Weight of Wood/Hay Burned		
Hay/grass	=	0.00 tons
Tree Tops and Stumps	=	929.77 tons

Note: Hay/grass will not be burned during construction

Emission factors for wildfire, prescribed burning and slash burns calculated under dry conditions for each fuel component ^(d)										
Fuel Component	Emission factor (lb/ton)									
	% of total Vegetation	CO	CH ₄	NMHC	PM	PM _{2.5}	PM ₁₀	CO ₂	NO _x	NH ₃
Litter, Wood 0-1"	25%	52	3	6	15	8	9	3483	2.5	0.5
Wood 1-3"	25%	111	6	9	20	12	14	3373	2.5	1.1
Wood 3+"	25%	174	9	12	26	16	19	3263	2.5	1.7
Herb, Shrub	25%	249	12	16	33	21	25	3116	2.5	2.6

Emission from prescribed wood burning									
Fuel Component	Emissions (tons)								
	CO	CH ₄	NMHC	PM	PM _{2.5}	PM ₁₀	CO ₂	NO _x	NH ₃
Litter, Wood 0-1"	6.04	0.35	0.70	1.74	0.93	1.05	404.80	0.29	0.06
Wood 1-3"	12.90	0.70	1.05	2.32	1.39	1.63	392.01	0.29	0.13
Wood 3+"	20.22	1.05	1.39	3.02	1.86	2.21	379.23	0.29	0.20
Herb, Shrub	28.94	1.39	1.86	3.84	2.44	2.91	362.15	0.29	0.30
TOTAL	68.11	3.49	5.00	10.92	6.62	7.79	1538.19	1.16	0.69

Emission factors for crop residue burning ^(e)									
Crop Residue	Emission factor (lb/ton)								
	CO	CH ₄	NMHC	PM	PM _{2.5}	PM ₁₀	CO ₂ ^(f)	NO _x	NH ₃
Hay/Grasses	204.3	6.3	32.7	17.6	17.4	16.9	-	5.1	6.7

Emissions from crop residue burning									
Crop Residue	Emissions (tons)								
	CO	CH ₄	NMHC	PM	PM _{2.5}	PM ₁₀	CO ₂	NO _x	NH ₃
Hay/Grasses	0.00	0.00	0.00	0.00	0.00	0.00	-	0.00	0.00

Emissions from prescribed burning and crop residue burning									
	CO	CH ₄	NMHC	PM	PM _{2.5}	PM ₁₀	CO ₂	NO _x	NH ₃
TOTAL	68.11	3.49	5.00	10.92	6.62	7.79	1,538.19	1.16	0.69

NOTES:

(a) Taken from http://www.tpwd.state.tx.us/publications/pwdpubs/media/pwd_mp_e0100_1070n_08.pdf.

(b) Taken from Table 5 of Dennis A., Fraser, M., Anderson, S., Allen, D., 2002. Air pollutant emissions associated with forest, grassland, and agricultural burning in Texas. Atmospheric Environment, 36, pp. 3779-3792.

(c) Fuel loading value of tree tops and stumps taken from AP-42 Table 13.1-1. Value applicable to southern region (Region 8) were used.

(d) Taken from Table 2 and 3 of Dennis A., Fraser, M., Anderson, S., Allen, D., 2002. Air pollutant emissions associated with forest, grassland, and agricultural burning in Texas. Atmospheric Environment, 36, pp. 3779-3792.

(e) Taken from Table 6 of Dennis A., Fraser, M., Anderson, S., Allen, D., 2002. Air pollutant emissions associated with forest, grassland, and agricultural burning in Texas. Atmospheric Environment, 36, pp. 3779-3792.

(f) Emission factor of CO₂ for hay/grass burning was not available.

PM EMISSIONS FROM LAND DISTURBED: Pipeline Construction in HGB Nonattainment Area

2011 Activities	
Area Name:	Pipeline
Area of Land Disturbance over the total months of construction (acres):	72.3
Months of Construction Activity (May-August 2011) ⁽¹⁾ :	4
	total tons ⁽²⁾ tons/month
PM2.5	6.5 1.6
PM10	43.4 10.8
PM30	86.8 21.7

Factor	Heavy Construction Operations			Notes
	PM2.5	PM10	PM30	
tons/acre/month	0.09	0.60	1.20	(3)
From AP-42, Section 13.2.3 Heavy Construction Operations:				
For construction activity operations:				
E = 1.2 tons/acre/month of activity				

NOTES:

(1) Construction is projected to occur over 4 months.

(2) Total tons is for entire construction duration, which is expected to be over an 4 month period. PM2.5 is particulate matter less than 2.5 microns. PM10 is particulate matter less than 10 microns. PM30 is particulate matter less than 30 microns.

(3) From AP-42 Section 13.2.3.3. Note that a factor of 1.2 ton/acre/month is conservatively high for TSP since it assumes that construction occurs over 30 days of the month which is not true in this case. Particle size multiplier (k) of 0.5 and 0.075 were used to determine the fraction of PM10 and PM2.5, respectively (taken from AP-42 Section 13.2.5.3).

PERSONNEL COMMUTE-PM EMISSIONS FROM PAVED ROADS: Main
Pipeline Construction

Total Number of miles for 2011	1,486,750	miles for 2011	(1)
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Emissions = VMT roundtrip/trip * 'X' trips for the construction period / 2000

All Paved Roads			
Emissions (ton/year)	PM2.5	PM10	PM30 (TSP)
2011	0.11	1.08	6.87

All Paved Roads				Notes
Emission Factor	PM2.5	PM10	PM30	
lb/VMT	0.0001	0.0015	0.0092	(2)

From AP-42, Section 13.2.1 Paved Roads:

For all paved roads:

$$E = \{ [k * ((sL/2)^{0.65} * ((W/3)^{1.5}) - C) * (1 - P/4N)] \}$$

where

E = size specific emission factor (lb/VMT)

k = particulate size multiplier

sL = road surface silt loading (g/m²)

W = mean vehicle weight (tons)

C = emission factor for 1980's vehicle fleet exhaust, brake wear, and tire wear.

P = number of wet days with at least 0.254 mm (0.01 in) of precipitation during the averaging period, and

N = number of days in the averaging period

Parameter	All Paved Roads 2010			Notes
	PM2.5	PM10	PM30	
k	0.004	0.016	0.082	(3)
sL	0.2	0.2	0.2	(4)
W	2.1	2.1	2.1	(5)
C	0.00036	0.00047	0.00047	(6)

NOTES:

(1) Number of personnel is assumed to be a constant during the entire construction schedule.

(2) Derived from equation, based on lb/VMT, P=120 from Figure 13.2.1-2, N=365

(3) From AP-42 Table 13.2-1.1 in lb/VMT.

(4) Silt content taken from AP-42 Table 13.2.1-3 for 500-5,000 ADT ubiquitous baseline.

(5) Average worker vehicle weight based on average car or light duty truck sold in the US last year 4,144 pounds from EPA. 4,144 pounds = 2.07 tons

(6) From AP-42 Table 13.2-1.2 in lb/VMT.

CONSTRUCTION EMISSIONS
Keystone XL Pipeline
HGB Severe Ozone Nonattainment Area
Pumping Station No. 41

2011 Construction Emissions: PS-41 in the HGB Nonattainment Area (tons)																	
	HC	CO	NOx	SO2	TSP	PM10	PM2.5	CO2e	Benzene	Toluene	Xylenes	Propylene	Acrolein	PAHs	1,3-Butadiene	Formaldehyde	Acetaldehyde..
CONSTRUCTION <u>NONROAD</u>	.								1.74E-03	7.62E-04	5.31E-04	4.80E-03	1.72E-04	3.13E-04	7.28E-05	2.20E-03	1.43E-03
CONSTRUCTION <u>ONROAD</u>	0.19	3.59	0.31	0.00	0.01	0.01	0.01	156.94	5.17E-03				8.69E-05		6.29E-04	1.64E-03	1.36E-03
OPEN BURNING	0.24	3.30	0.06	-	0.53	0.38	0.32	77.99									
FUGITIVE DUST					12.00	6.00	0.90										
PAVED ROAD DUST					1.43	0.23	0.02										
TOTAL	#NAME?	#NAME?	#NAME?	#NAME?	#NAME?	#NAME?	#NAME?	#NAME?	6.91E-03	7.62E-04	5.31E-04	4.80E-03	2.59E-04	3.13E-04	7.02E-04	3.84E-03	2.79E-03
Since the project is proposed to be located in an ozone nonattainment area, the pollutants of interest are HC (VOC) and NOx.																	

PS-41 Construction: Criteria Emissions from Non-Road Engines

Equipment	Daily Hours operated hrs/eqpt/day	Number of eqpt Per Station	Units per Station	Days of Operation Per Unit	Units per Station	Days of Operation Per Unit	Units per Station	Days of Operation Per Unit	2011 TOTAL Hours	Eqpt Horsepwr hp	Fuel Type	BSFC ^{1,a} lb/hp-hr	Criteria Pollutants EFss (g/hp-hr) ^{1,a}				TAF Assignm ent ^{2,b}	Load Factor ³
			Pre-welding days (18 days)		Welding days (72 days)		Clean-up days (18 days)						HC	CO	NOx	PM		
													hrs					
D-7 Dozer	8	2	2	9	0		1	9	216	240	Diesel	0.367	0.3085	0.7475	4	0.13	Hi	0.59
D-8 Dozer	0	0	0		0		0		0	310	Diesel	0.367	0.1669	0.8425	4.355	0.13	Hi	0.59
D-8 Ripper	0	0	0		0		0		0	310	Diesel	0.367	0.1669	0.8425	4.355	0.13	Hi	0.59
D-5 Tow	0	0	0		0		0		0	120	Diesel	0.367	0.3384	0.8667	4.1	0.18	None	0.43
D-7 Tow	0	0	0		0		0		0	240	Diesel	0.367	0.3085	0.7475	4	0.13	None	0.43
D-6 Tack	0	0	0		0		0		0	200	Diesel	0.367	0.3085	0.7475	4	0.13	None	0.43
CAT 225	8	2	0		2	72	2	18	1,440	150	Diesel	0.367	0.3384	0.8667	4.1	0.18	Hi	0.59
CAT 235	0	0	0		0		0		0	250	Diesel	0.367	0.3085	0.7475	4	0.13	Hi	0.59
CAT 235 w/ Hammer	0	0	0		0		0		0	260	Diesel	0.367	0.3085	0.7475	4	0.13	Hi	0.59
Bending Machine 22-36	0	0	0		0		0		0	159	Diesel	0.367	0.3384	0.8667	4.1	0.18	None	0.43
Crane LS-98A (35 ton)	10	2	0		2	36	1	9	810	230	Diesel	0.367	0.3085	0.7475	4	0.13	None	0.43
Farm Tractor	8	1	1	18	1	36	1	18	576	60	Diesel	0.408	0.3672	2.3655	4.7	0.24	Hi	0.59
Frontend Loader 977	8	1	1	2	1	5	1	2	72	190	Diesel	0.367	0.3085	0.7475	4	0.13	Hi	0.59
Motor Grader 14G	8	1	1	2	0	5	1	2	32	200	Diesel	0.367	0.3085	0.7475	4	0.13	Hi	0.59
Sideboom 571	0	0	0		0		0		0	200	Diesel	0.367	0.3085	0.7475	4	0.13	Hi	0.59
Sideboom 572	0	0	0		0		0		0	230	Diesel	0.367	0.3085	0.7475	4	0.13	Hi	0.59
Sideboom 583	0	0	0		0		0		0	310	Diesel	0.367	0.1669	0.8425	4.355	0.13	Hi	0.59
Sideboom 594	0	0	0		0		0		0	410	Diesel	0.367	0.1669	0.8425	4.355	0.13	Hi	0.59
Air Compressor 1750 cfm	8	1	0		1	36	1	9	360	50	Gasoline	0.484	0.27	11.94	0.69	0.06	None	0.56
Pump - 3"	8	1	0		1	36	1	36	576	20	Gasoline	0.868	5.5	387.02	4.5	0.06	None	0.69
Pump - 6"	8	1	0		1	36	1	36	576	40	Gasoline	0.484	0.27	11.94	0.69	0.06	None	0.69
Emergency Engines	8	4	0		2	36	2	36	1,152	10	Gasoline	0.868	5.5	387.02	4.5	0.06	None	0.68
TOTAL (Tons)																		

NOTES:

Notes 1 through 9 apply to diesel engines.

Note 1: Brake-specific fuel consumption and Zero hour steady state EF (EFss; g/hp-hr) assumed to be Tier 2 engines, from Table A2 of "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling- Compression-Ignition", April 2004, EPA-420-P-04-009.

Engine Size (HP)	HC	CO	NOx	PM	BSFC	M. Life	
1	11	0.5508	4.1127	4.3	0.5	0.408	2500
12	16	0.438	2.161	4.4399	0.2665	0.408	2500
17	25	0.438	2.161	4.4399	0.2665	0.408	2500
26	50	0.2789	1.5323	4.7279	0.3389	0.408	4667
51	100	0.3672	2.3655	4.7	0.24	0.408	4667
101	175	0.3384	0.8667	4.1	0.18	0.367	4667
176	300	0.3085	0.7475	4	0.1316	0.367	7000
301	600	0.1669	0.8425	4.3551	0.1316	0.367	7000
601	750	0.1669	1.3272	4.1	0.1316	0.367	7000
751	2500	0.1669	0.7642	4.1	0.1316	0.367	7000

Note 2: Transient Adjustment Factors and TAF assignment and TAF from Table A3 of "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

Note 3: Load factor from Appendix A of "Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling", April 2004, EPA-420-P-04-005.

Note 4: Median life is taken from Table 1 of "Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling", April 2004, EPA-420-P-04-005.

Note 5: Age factor and Deterioration factors calculated using Equation 4 from "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

Age Factor = LF * cumulative hours / median life (Age factor is assumed to be greater than one, i.e. the equipment is approximately at the end of its useful life).

Deterioration Factor = 1 + (A * Age Factor^b), where b = 1 for diesel engines and A is taken from Table A4 from source

Note 6: Adjusted Emission Factors for HC, NOx, and CO are calculated using Equation 1 (Table A4) from, "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009. Relative Deterioration factors for Tier II engines was used.

Adjusted EF = Efss * TAF * DF

Note 7: SO2 calculated from Equation 7 from "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

SO2=BSFC*453.6*(1-soxcnv)-HC)*0.01*soxdsl*2

where: soxcnv = 0.02247 and soxdsl = 0.05

Note 8: Adjusted Emission Factor for particulate matter is calculated using Equations 2 and 5 from "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

Adjusted EF = Efss * TAF * DF - Spm adj

Spm adj = BSFC*453.6*7.0*soxcnv*0.01*(soxbas-soxdsl)

where: soxbas = 0.33

Note 9: Construction is proposed to occur between March 2012 and December 2012 approximately. Annual Emissions are calculated using the following calculation

(Emission factor (g/hp-hr) * horsepower * hours operated * load factor) / (2000 lb/ton * 453.6 g/lb)

Notes a through d apply to gasoline engines.

Note a: Fuel Type Gasoline only: Brake specific fuel consumption and emission factors (EFss; g/hp-hr) assumed to be Phase 2 side-valved for < 25hp from Table 5 and Table 6 for > 25hp of "Exhaust Emission Factors for Nonroad Engine Modeling: Spark-Ignition", December 2005, EPA420-R-05-019

Note b: Fuel Type Galosine only: Transient Adjsutment Factors assumed to be Phase 2 for >25 Hp (for <25Hp TAFs emission factors are based on unadjusted steady-state test results) from Table 20 of "Exhaust Emission Factors for Nonroad Engine Modeling: Spark-Ignition", December 2005, EPA420-R-05-019.

Note c: Fuel Type Gasoline only: Deterioration Factors from Table 2 (Phase 2-Side valved) for <25 Hp of "Nonroad Spark-Ignition Engine Emission Deterioration Factors", December 2005, EPA420-R-05-023.

Fuel Type Gasoline only: Deterioration Factors from Table 7 for >25 Hp of "Nonroad Spark-Ignition Engine Emission Deterioration Factors", December 2005, EPA420-R-05-023.

Note d: Fuel Type Gasoline only: SO2 calculated from Sulfur Dioxide Emission Factor calculations from "Exhaust Emission Factors for Nonroad Engine Modeling: Spark-Ignition", December 2005, EPA420-R-05-019.

SO2=BSFC*453.6*(1-soxcnv)-HC)*0.01*soxdsl*2

where: soxcnv = 0.03 and soxdsl = 0.0339

PS-41 Construction: GHG Emissions from Non-Road Engines

Equipment	Daily Hours operated hrs/eqp/day	2011 TOTAL Hours hrs	Equipment HP hp	Fuel Type	BSFC lb/hp-hr	TAF Assignment	Load Factor ²	TAF ¹ BSFC	BSFC _{adj}	Greenhouse Gases					2011 Emissions (Tons)				
										CO ₂		CH ₄		N ₂ O		CO ₂	CH ₄	N ₂ O	CO ₂ e ⁵
										g/hp-hr ³	⁴	lb/hp-hr	Ef (g/gal) ⁴	lb/hp-hr					
D-7 Dozer	8	216	240	Diesel	0.367	Hi	0.59	1.01	0.3707	535.27	0.58	6.72E-05	0.26	3.01E-05	18.05	0.00	0.00	18.33	
D-8 Dozer	0	0	310	Diesel	0.367	Hi	0.59	1.01	0.3707	535.76	0.58	6.72E-05	0.26	3.01E-05	0.00	0.00	0.00	0.00	
D-8 Ripper	0	0	310	Diesel	0.367	Hi	0.59	1.01	0.3707	535.76	0.58	6.72E-05	0.26	3.01E-05	0.00	0.00	0.00	0.00	
D-5 Tow	0	0	120	Diesel	0.367	None	0.43	1	0.3670	529.92	0.58	6.66E-05	0.26	2.98E-05	0.00	0.00	0.00	0.00	
D-7 Tow	0	0	240	Diesel	0.367	None	0.43	1	0.3670	530.01	0.58	6.66E-05	0.26	2.98E-05	0.00	0.00	0.00	0.00	
D-6 Tack	0	0	200	Diesel	0.367	None	0.43	1	0.3670	530.01	0.58	6.66E-05	0.26	2.98E-05	0.00	0.00	0.00	0.00	
CAT 225	8	1,440	150	Diesel	0.367	Hi	0.59	1.01	0.3707	535.17	0.58	6.72E-05	0.26	3.01E-05	75.18	0.01	0.00	76.34	
CAT 235	0	0	250	Diesel	0.367	Hi	0.59	1.01	0.3707	535.27	0.58	6.72E-05	0.26	3.01E-05	0.00	0.00	0.00	0.00	
CAT 235 w/ Hammer	0	0	260	Diesel	0.367	Hi	0.59	1.01	0.3707	535.27	0.58	6.72E-05	0.26	3.01E-05	0.00	0.00	0.00	0.00	
Bending Machine 22-36	0	0	159	Diesel	0.367	None	0.43	1	0.3670	529.92	0.58	6.66E-05	0.26	2.98E-05	0.00	0.00	0.00	0.00	
Crane LS-98A (35 ton)	10	810	230	Diesel	0.367	None	0.43	1	0.3670	530.01	0.58	6.66E-05	0.26	2.98E-05	46.80	0.01	0.00	47.80	
Farm Tractor	8	576	60	Diesel	0.408	Hi	0.59	1.01	0.4121	594.99	0.58	7.47E-05	0.26	3.35E-05	13.37	0.00	0.00	13.58	
Frontend Loader 977	8	72	190	Diesel	0.367	Hi	0.59	1.01	0.3707	535.27	0.58	6.72E-05	0.26	3.01E-05	4.76	0.00	0.00	4.84	
Motor Grader 14G	8	32	200	Diesel	0.367	Hi	0.59	1.01	0.3707	535.27	0.58	6.72E-05	0.26	3.01E-05	2.23	0.00	0.00	2.26	
Sideboom 571	0	0	200	Diesel	0.367	Hi	0.59	1.01	0.3707	535.27	0.58	6.72E-05	0.26	3.01E-05	0.00	0.00	0.00	0.00	
Sideboom 572	0	0	230	Diesel	0.367	Hi	0.59	1.01	0.3707	535.27	0.58	6.72E-05	0.26	3.01E-05	0.00	0.00	0.00	0.00	
Sideboom 583	0	0	310	Diesel	0.367	Hi	0.59	1.01	0.3707	535.76	0.58	6.72E-05	0.26	3.01E-05	0.00	0.00	0.00	0.00	
Sideboom 594	0	0	410	Diesel	0.367	Hi	0.59	1.01	0.3707	535.76	0.58	6.72E-05	0.26	3.01E-05	0.00	0.00	0.00	0.00	
Air Compressor 1750 cfm	8	360	50	Gasoline	0.484	None	0.56	1	0.4840	699.77	0.50	7.57E-05	0.22	3.33E-05	7.78	0.00	0.00	7.88	
Pump - 3"	8	576	20	Gasoline	0.868	None	0.69	1	0.8680	1222.00	0.50	1.36E-04	0.22	5.97E-05	10.71	0.00	0.00	10.83	
Pump - 6"	8	576	40	Gasoline	0.484	None	0.69	1	0.4840	699.77	0.50	7.57E-05	0.22	3.33E-05	12.26	0.00	0.00	12.40	
Emergency Engines	8	1,152	10	Gasoline	0.868	None	0.68	1	0.8680	1222.00	0.50	1.36E-04	0.22	5.97E-05	10.55	0.00	0.00	10.68	
TOTAL (Tons)															201.69	0.02	0.01	204.93	

NOTES:

Note 1: Transient Adjustment Factors and TAF assignment and from Table A3 of "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

Note 2: Load factor from Appendix A of "Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling", April 2004, EPA-420-P-04-005.

Note 3: Carbon dioxide is calculated using Equation 6 from "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

$$CO_2 = (BSFC * 453.6 - HC) * 0.87 * (44/12)$$

HC is the hydrocarbon emission factor from criteria pollutant calculation.

0.87 is the mass fraction of carbon mass in diesel and

44/12 is the molecular weight ratio of CO₂ to carbon

Note 4: Emission Factors from Table 13.6 of The Climate Registry General Reporting Protocol Version 1.0, tons calculated using 7.05 lb/gal from AP-42 Appendix A and adjusted BSFC

Note 5: Carbon dioxide equivalents calculated using IPCC Second Assessment Report (SAR) Global Warming Potentials CO₂ = 1, CH₄ = 21, N₂O = 310.

$$CO_2e = CO_2 + (CH_4 * 21) + (N_2O * 310)$$

PS-41 Construction: HAP Emissions from Non-Road Engines

Equipment	Daily Hours operated hrs/eqpt/day	Number of eqpt.	2011 TOTAL Hours hrs	Equipment Horsepower hp	Fuel Type	BSFC lb/hp-hr	TAF Assignment ¹	Load Factor ²	BSFC TAF ¹	BSFC _{adj}	HAP Emission Factors (lb/MMBtu) ³					
											Benzene	Toluene	Xylenes	Propylene	Acrolein	PAHs
D-7 Dozer	8	2	216	240	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
D-8 Dozer	0	0	0	310	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
D-8 Ripper	0	0	0	310	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
D-5 Tow	0	0	0	120	Diesel	0.367	None	0.43	1	0.3670	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
D-7 Tow	0	0	0	240	Diesel	0.367	None	0.43	1	0.3670	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
D-6 Tack	0	0	0	200	Diesel	0.367	None	0.43	1	0.3670	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
CAT 225	8	2	1,440	150	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
CAT 235	0	0	0	250	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
CAT 235 w/ Hammer	0	0	0	260	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Bending Machine 22-36	0	0	0	159	Diesel	0.367	None	0.43	1	0.3670	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Crane LS-98A (35 ton)	10	2	810	230	Diesel	0.367	None	0.43	1	0.3670	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Farm Tractor	8	1	576	60	Diesel	0.408	Hi	0.59	1.01	0.4121	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Frontend Loader 977	8	1	72	190	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Motor Grader 14G	8	1	32	200	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Sideboom 571	0	0	0	200	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Sideboom 572	0	0	0	230	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Sideboom 583	0	0	0	310	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Sideboom 594	0	0	0	410	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Air Compressor 1750 cfm	8	1	360	50	Gasoline	0.484	None	0.56	1	0.4840	N/A	N/A	N/A	N/A	N/A	N/A
Pump - 3"	8	1	576	20	Gasoline	0.868	None	0.69	1	0.8680	N/A	N/A	N/A	N/A	N/A	N/A
Pump - 6"	8	1	576	40	Gasoline	0.484	None	0.69	1	0.4840	N/A	N/A	N/A	N/A	N/A	N/A
Emergency Engines	8	4	1,152	10	Gasoline	0.868	None	0.68	1	0.8680	N/A	N/A	N/A	N/A	N/A	N/A
TOTAL (Tons)																

NOTES:

- Note 1: Transient Adjustment Factors and TAF assignment and from Table A3 of "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.
 Note 2: Load factor from Appendix A of "Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling", April 2004, EPA-420-P-04-005. TAF Assignment of Hi/Lo is based on the Load Factor.
 Note 3: Emission factors (lb/MMBtu) from AP-42 Section 3.3, Table 3.3-2. Note that HAP emission factors for gasoline fired engines are not available.
 Note 4: Tons are calculated using 7.05 lb/gal from AP-42 Appendix A and 5.825 MMBtu/barrel from Table 13.1 of The Climate Registry General Reporting Protocol version 1.0

PS-41 Construction: HAP Emissions from Non-Road Engines

Equipment	HAP Emission Factors (lb/MMBtu) ³			2011 HAP Emissions (Tons) ⁴								
	1,3-Butadiene	Formaldehyde	Acetaldehyde	Benzene	Toluene	Xylenes	Propylene	Acrolein	PAHs	1,3-Butadiene	Formaldehyde	Acetaldehyde
D-7 Dozer	3.91E-05	1.18E-03	7.67E-04	1.76E-04	7.73E-05	5.39E-05	4.88E-04	1.75E-05	3.18E-05	7.39E-06	2.23E-04	1.45E-04
D-8 Dozer	3.91E-05	1.18E-03	7.67E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D-8 Ripper	3.91E-05	1.18E-03	7.67E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D-5 Tow	3.91E-05	1.18E-03	7.67E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D-7 Tow	3.91E-05	1.18E-03	7.67E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D-6 Tack	3.91E-05	1.18E-03	7.67E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CAT 225	3.91E-05	1.18E-03	7.67E-04	7.35E-04	3.22E-04	2.24E-04	2.03E-03	7.28E-05	1.32E-04	3.08E-05	9.29E-04	6.04E-04
CAT 235	3.91E-05	1.18E-03	7.67E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CAT 235 w/ Hammer	3.91E-05	1.18E-03	7.67E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bending Machine 22-36	3.91E-05	1.18E-03	7.67E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane LS-98A (35 ton)	3.91E-05	1.18E-03	7.67E-04	6.27E-04	2.75E-04	1.92E-04	1.74E-03	6.22E-05	1.13E-04	2.63E-05	7.94E-04	5.16E-04
Farm Tractor	3.91E-05	1.18E-03	7.67E-04	1.31E-04	5.73E-05	3.99E-05	3.61E-04	1.30E-05	2.35E-05	5.48E-06	1.65E-04	1.07E-04
Frontend Loader 977	3.91E-05	1.18E-03	7.67E-04	4.65E-05	2.04E-05	1.42E-05	1.29E-04	4.61E-06	8.38E-06	1.95E-06	5.89E-05	3.83E-05
Motor Grader 14G	3.91E-05	1.18E-03	7.67E-04	2.18E-05	9.54E-06	6.65E-06	6.02E-05	2.16E-06	3.92E-06	9.12E-07	2.75E-05	1.79E-05
Sideboom 571	3.91E-05	1.18E-03	7.67E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sideboom 572	3.91E-05	1.18E-03	7.67E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sideboom 583	3.91E-05	1.18E-03	7.67E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sideboom 594	3.91E-05	1.18E-03	7.67E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Air Compressor 1750 cfm	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pump - 3"	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pump - 6"	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Emergency Engines	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
TOTAL (Tons)				1.74E-03	7.62E-04	5.31E-04	4.80E-03	1.72E-04	3.13E-04	7.28E-05	2.20E-03	1.43E-03

PS-41 Construction: Criteria and GHG Emissions from On-Road Vehicles

Equipment	Daily Hours operated hr/eqpt/day	Number		Days of Operation	Units per station		Days of Operation	Units per station		Vehicle Class ¹	2011 Miles traveled ²	Fuel Type	Criteria Pollutants				
		eqpt	Pre-welding days (18 days)		Welding days (49 days)	Clean-up days (39 days)		Emission Factor (g/VMT) ³									
								#	VOC				CO	NOx	SO ₂	PM	
Automobile	2	10	10	18	10	72	5	18	LDGV	49,500	Diesel	0.627	12.7	0.588	0.0068	0.0249	
Bus	0	0	0		0		0		URBANBUS	0	Diesel	0.257	2.121	10.677	0.0218	0.226	
Pickup 4x4	5	10	10	18	10	72	5	18	LDGV	123,750	Diesel	0.627	12.7	0.588	0.0068	0.0249	
Welding Rig	10	4	0		4	72	4	9	LDGV	81,000	Diesel	0.627	12.7	0.588	0.0068	0.0249	
Winch Truck	0	0	0		0		0		HDDV3	0	Diesel	0.16	0.541	2.319	0.0082	0.0848	
Dump Truck	8	2	2	10	1	20	2	18	HDDV3	15,200	Diesel	0.16	0.541	2.319	0.0082	0.0848	
Flatbed Truck	9	1	1	9	1	72	1	18	HDDV3	22,275	Diesel	0.16	0.541	2.319	0.0082	0.0848	
Fuel Truck	0	0	0		0		0		HDDV3	0	Diesel	0.16	0.541	2.319	0.0082	0.0848	
Grease Truck	0	0	0		0		0		HDDV3	0	Diesel	0.16	0.541	2.319	0.0082	0.0848	
Mechanic Rig	0	0	0		0		0		HDDV2B	0	Diesel	0.149	0.508	2.182	0.0074	0.0966	
Skid Truck	0	0	0		0		0		HDDV3	0	Diesel	0.16	0.541	2.319	0.0082	0.0848	
Stringing Tr. & Tr.	0	0	0		0		0		HDDV3	0	Diesel	0.16	0.541	2.319	0.0082	0.0848	
Truck & Float	10	1	1	9	1	36	1	9	HDDV3	13,500	Diesel	0.16	0.541	2.319	0.0082	0.0848	
Truck & Lowboy	10	1	1	9	1	5	1	5	HDDV3	4,750	Diesel	0.16	0.541	2.319	0.0082	0.0848	
TOTAL (Tons)																	

NOTES:

Note 1: Vehicle Classes were taken from Mobile6.2 based on estimated gross weight of the vehicle.

Note 2: Vehicle miles traveled are based on an assumed

25

mi/hr on average/ vehicle based on arterial roads.

Note 3: Emission factors from Mobile6.2.

Note 4: Emission Factors from Table 13.4 of The Climate Registry General Reporting Protocol Version 1.1 applicable to "Diesel Heavy Duty Vehicles" all model year vehicles.

Note that Efs applicable to light duty gasoline vehicles was used for the vehicle category "automobiles" (MY 2000).

Note 5: Carbon dioxide equivalents calculated using IPCC Second Assessment Report (SAR) Global Warming Potentials CO₂ = 1, CH₄ = 21, N₂O = 310.

$$CO_2e = CO_2 + (CH_4 * 21) + (N_2O * 310)$$

PS-41 Construction: Criteria and GHG Emissions from On-Road Vehicles

Equipment	Greenhouse Gasses			2011 Emissions (Tons)								
	Ef (g/mile)			Criteria Pollutants					Greenhouse Gasses			
	CO ₂ ³	CH ₄ ⁴	N ₂ O ⁴	VOC	CO	NOx	SO ₂	PM	CO ₂	CH ₄	N ₂ O	CO ₂ e ⁵
Automobile	368.1	0.0273	0.0178	0.0342	0.6930	0.0321	0.0004	0.00	20.09	1.49E-03	9.71E-04	20.42
Bus	2342.9	0.0051	0.0048	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00E+00	0.00E+00	0.00
Pickup 4x4	368.1	0.0273	0.0178	0.0855	1.7324	0.0802	0.0009	0.00	50.21	3.72E-03	2.43E-03	51.04
Welding Rig	368.1	0.0273	0.0178	0.0560	1.1339	0.0525	0.0006	0.00	32.87	2.44E-03	1.59E-03	33.41
Winch Truck	875.4	0.0051	0.0048	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00E+00	0.00E+00	0.00
Dump Truck	875.4	0.0051	0.0048	0.0027	0.0091	0.0389	0.0001	0.00	14.67	8.55E-05	8.04E-05	14.69
Flatbed Truck	875.4	0.0051	0.0048	0.0039	0.0133	0.0569	0.0002	0.00	21.49	1.25E-04	1.18E-04	21.53
Fuel Truck	875.4	0.0051	0.0048	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00E+00	0.00E+00	0.00
Grease Truck	875.4	0.0051	0.0048	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00E+00	0.00E+00	0.00
Mechanic Rig	789.4	0.0051	0.0048	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00E+00	0.00E+00	0.00
Skid Truck	875.4	0.0051	0.0048	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00E+00	0.00E+00	0.00
Stringing Tr.& Tr.	875.4	0.0051	0.0048	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00E+00	0.00E+00	0.00
Truck & Float	875.4	0.0051	0.0048	0.0024	0.0081	0.0345	0.0001	0.00	13.03	7.59E-05	7.14E-05	13.05
Truck & Lowboy	875.4	0.0051	0.0048	0.0008	0.0028	0.0121	0.0000	0.00	4.58	2.67E-05	2.51E-05	4.59
TOTAL (Tons)				0.186	3.593	0.307	0.002	0.012	156.94	7.96E-03	5.28E-03	158.74

PS-41 Construction: HAP Emissions from On-Road Vehicles

Equipment	Daily Hours operated	Vehicle Class ¹	2011 Miles traveled/year ²	Fuel Type	Hazardous Air Pollutants				
	hr/eqpt/day		miles/yr		Emission Factor (mg/VMT) ³				
					Acetaldehyde	Acrolein	Benzene	1,3-butadiene	Formaldehyde
Automobile	2	LDGV	49,500	Diesel	4.04	0.24	16.45	2.04	4.51
Bus	0	URBANBUS	0	Diesel	7.75	0.94	2.83	1.64	21.05
Pickup 4x4	5	LDGV	123,750	Diesel	4.04	0.24	16.45	2.04	4.51
Welding Rig	10	LDGV	81,000	Diesel	4.04	0.24	16.45	2.04	4.51
Winch Truck	0	HDDV3	0	Diesel	3.78	0.32	9.09	0.94	6.11
Dump Truck	8	HDDV3	15,200	Diesel	3.78	0.32	9.09	0.94	6.11
Flatbed Truck	9	HDDV3	22,275	Diesel	3.78	0.32	9.09	0.94	6.11
Fuel Truck	0	HDDV3	0	Diesel	3.78	0.32	9.09	0.94	6.11
Grease Truck	0	HDDV3	0	Diesel	3.78	0.32	9.09	0.94	6.11
Mechanic Rig	0	HDDV2B	0	Diesel	3.74	0.29	9.34	0.89	5.92
Skid Truck	0	HDDV3	0	Diesel	3.78	0.32	9.09	0.94	6.11
Stringing Tr. & Tr.	0	HDDV3	0	Diesel	3.78	0.32	9.09	0.94	6.11
Truck & Float	10	HDDV3	13,500	Diesel	3.78	0.32	9.09	0.94	6.11
Truck & Lowboy	10	HDDV3	4,750	Diesel	3.78	0.32	9.09	0.94	6.11
TOTAL (Tons)									

NOTES:

Note 1: Vehicle Classes were taken from Mobile6.2 based on estimated gross weight of the vehicle.

Note 2: Vehicle miles traveled are based on an assumed 25 mi/hr on average/ vehicle based on arterial roads.

Note 3: HAP Emission factors taken from Mobile6.2

PS-41 Construction: HAP Emissions from On-Road Vehicles

Equipment	Hazardous Air Pollutants				
	2010 Emissions (Tons)				
	Acetaldehyde	Acrolein	Benzene	1,3-butadiene	Formaldehyde
Automobile	2.20E-04	1.31E-05	8.98E-04	1.11E-04	2.46E-04
Bus	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pickup 4x4	5.51E-04	3.27E-05	2.24E-03	2.78E-04	6.15E-04
Welding Rig	3.61E-04	2.14E-05	1.47E-03	1.82E-04	4.03E-04
Winch Truck	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dump Truck	6.33E-05	5.36E-06	1.52E-04	1.57E-05	1.02E-04
Flatbed Truck	9.28E-05	7.86E-06	2.23E-04	2.31E-05	1.50E-04
Fuel Truck	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Grease Truck	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mechanic Rig	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Skid Truck	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Stringing Tr. & Tr.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Truck & Float	5.63E-05	4.76E-06	1.35E-04	1.40E-05	9.09E-05
Truck & Lowboy	1.98E-05	1.68E-06	4.76E-05	4.92E-06	3.20E-05
TOTAL (Tons)	0.0014	0.0001	0.0052	0.0006	0.0016

PS-41 Construction: Emissions from Slash/Brush Burning

Volume and Area of Prescribed Burning		
Area disturbed/ burned	=	10 acre

Vegetation Type Distribution		
Tree Tops/Stump:	=	50% ^(a)
Hay/Gass	=	50% ^(a)

Fuel Load Emission Factor		
Hay/grass	=	1.0 ton/acre ^(b)
Tree Tops and Stumps	=	9.0 ton/acre ^(c)

Weight of Wood/Hay Burned		
Hay/grass	=	0.00 tons
Tree Tops and Stumps	=	45.00 tons

Note: Hay/grass will not be burned during construction.

Emission factors for wildfire, prescribed burning and slash burns calculated under dry conditions for each fuel component ^(d)										
Fuel Component	Emission factor (lb/ton)									
	% of total Vegetation	CO	CH ₄	NMHC	PM	PM _{2.5}	PM ₁₀	CO ₂	NO _x	NH ₃
Litter, Wood 0-1"	25%	52	3	6	15	8	9	3483	2.5	0.5
Wood 1-3"	25%	111	6	9	20	12	14	3373	2.5	1.1
Wood 3+"	25%	174	9	12	26	16	19	3263	2.5	1.7
Herb, Shrub	25%	249	12	16	33	21	25	3116	2.5	2.6

Emission from prescribed wood burning									
Fuel Component	Emissions (tons)								
	CO	CH ₄	NMHC	PM	PM _{2.5}	PM ₁₀	CO ₂	NO _x	NH ₃
Litter, Wood 0-1"	0.29	0.02	0.03	0.08	0.05	0.05	19.59	0.01	0.00
Wood 1-3"	0.62	0.03	0.05	0.11	0.07	0.08	18.97	0.01	0.01
Wood 3+"	0.98	0.05	0.07	0.15	0.09	0.11	18.35	0.01	0.01
Herb, Shrub	1.40	0.07	0.09	0.19	0.12	0.14	17.53	0.01	0.01
TOTAL	3.30	0.17	0.24	0.53	0.32	0.38	74.45	0.06	0.03

Emission factors for crop residue burning ^(e)									
Crop Residue	Emission factor (lb/ton)								
	CO	CH ₄	NMHC	PM	PM _{2.5}	PM ₁₀	CO ₂ ^(f)	NO _x	NH ₃
Hay/Grasses	204.3	6.3	32.7	17.6	17.4	16.9	-	5.1	6.7

Emissions from crop residue burning									
Crop Residue	Emissions (tons)								
	CO	CH ₄	NMHC	PM	PM _{2.5}	PM ₁₀	CO ₂	NO _x	NH ₃
Hay/Grasses	0.00	0.00	0.00	0.00	0.00	0.00	-	0.00	0.00

Emissions from prescribed burning and crop residue burning									
	CO	CH ₄	NMHC	PM	PM _{2.5}	PM ₁₀	CO ₂	NO _x	NH ₃
TOTAL	3.30	0.17	0.24	0.53	0.32	0.38	74.45	0.06	0.03

NOTES:

(a) Taken from http://www.tpwd.state.tx.us/publications/pwdpubs/media/pwd_mp_e0100_1070n_08.pdf.

(b) Taken from Table 5 of Dennis A., Fraser, M., Anderson, S., Allen, D., 2002. Air pollutant emissions associated with forest, grassland, and agricultural burning in Texas. Atmospheric Environment, 36, pp. 3779-3792.

(c) Fuel loading value of tree tops and stumps taken from AP-42 Table 13.1-1. Value applicable to southern region (Region 8) were used.

(d) Taken from Table 2 and 3 of Dennis A., Fraser, M., Anderson, S., Allen, D., 2002. Air pollutant emissions associated with forest, grassland, and agricultural burning in Texas. Atmospheric Environment, 36, pp. 3779-3792.

(e) Taken from Table 6 of Dennis A., Fraser, M., Anderson, S., Allen, D., 2002. Air pollutant emissions associated with forest, grassland, and agricultural burning in Texas. Atmospheric Environment, 36, pp. 3779-3792.

(f) Emission factor of CO₂ for hay/grass burning was not available.

PM EMISSIONS FROM LAND DISTURBED: Pipeline and PS-41 Construction

2011 Activities		
Area Name:	Pipeline	
Area of Land Disturbance over the total months of construction (acres):	10	
Months of Construction Activity (May-August 2011) ⁽¹⁾ :	4	
	total tons ⁽²⁾	tons/month
PM2.5	0.9	0.2
PM10	6.0	1.5
PM30	12.0	3.0

Factor	Heavy Construction Operations			Notes
	PM2.5	PM10	PM30	
tons/acre/month	0.09	0.60	1.20	(3)
From AP-42, Section 13.2.3 Heavy Construction Operations:				
For construction activity operations:				
E = 1.2 tons/acre/month of activity				

NOTES:

(1) Construction is projected to occur over 4 months.

(2) Total tons is for entire construction duration, which is expected to be over an 4 month period. PM2.5 is particulate matter less than 2.5 microns. PM10 is particulate matter less than 10 microns. PM30 is particulate matter less than 30 microns.

(3) From AP-42 Section 13.2.3.3. Note that a factor of 1.2 ton/acre/month is conservatively high for TSP since it assumes that construction occurs over 30 days of the month which is not true in this case. Particle size multiplier (k) of 0.5 and 0.075 were used to determine the fraction of PM10 and PM2.5, respectively (taken from AP-42 Section 13.2.5.3).

PERSONNEL COMMUTE-PM EMISSIONS FROM PAVED ROADS:PS-41
Construction

Total Number of miles for 2011	309,975 miles for 2011	(1)
--------------------------------	------------------------	-----

Emissions = VMT roundtrip/trip * 'X' trips for the construction period / 2000

All Paved Roads			
Emissions (ton/year)	PM2.5	PM10	PM30 (TSP)
2011	0.02	0.23	1.43

All Paved Roads				Notes
Emission Factor	PM2.5	PM10	PM30	
lb/VMT	0.0001	0.0015	0.0092	(2)

From AP-42, Section 13.2.1 Paved Roads:

For all paved roads:

$$E = \{ [k * ((sL/2)^{0.65} * ((W/3)^{1.5}) - C) * (1 - P/4N)] \}$$

where

E = size specific emission factor (lb/VMT)

k = particulate size multiplier

sL = road surface silt loading (g/m²)

W = mean vehicle weight (tons)

C = emission factor for 1980's vehicle fleet exhaust, brake wear, and tire wear.

P = number of wet days with at least 0.254 mm (0.01 in) of precipitation during the averaging period, and

N = number of days in the averaging period

Parameter	All Paved Roads 2010			Notes
	PM2.5	PM10	PM30	
k	0.004	0.016	0.082	(3)
sL	0.2	0.2	0.2	(4)
W	2.1	2.1	2.1	(5)
C	0.00036	0.00047	0.00047	(6)

NOTES:

(1) Number of personnel is assumed to be a constant during the entire construction schedule.

(2) Derived from equation, based on lb/VMT, P=120 from Figure 13.2.1-2, N=365

(3) From AP-42 Table 13.2-1.1 in lb/VMT.

(4) Silt content taken from AP-42 Table 13.2.1-3 for 500-5,000 ADT ubiquitous baseline.

(5) Average worker vehicle weight based on average car or light duty truck sold in the US last year 4,144 pounds from EPA. 4,144 pounds = 2.07 tons

(6) From AP-42 Table 13.2-1.2 in lb/VMT.

OPERATIONAL EMISSIONS

Keystone XL Pipeline

HGB Severe Ozone Nonattainment Area

Pumping Station No. 41

Annual Operational Emissions: Pumping Station - 41 (tons per year)											
	HC	CO	NOx	SO2	TSP	PM10	PM2.5	CO2e	Benzene	Toluene	Xylenes
TOTAL	9.81E-02	-	-	-	-	-	-	0.55	1.57E-02	2.62E-02	3.67E-02
Since the project is proposed to be located in an ozone nonattainment area, the pollutants of interest are HC (VOC) and NOx.											

PUMPING STATION No. 41: CRITERIA POLLUTANT EMISSIONS

Pumping Station 41: Annual VOC Emissions from Crude Sump

Tank No.	Working Capacity		Height	Diameter	Product	Annual Turnovers	Throughput ^(a)	Working Losses	Breathing Losses	Total Losses	
	bbl	gal	ft	ft			gal/yr	lb/year	lb/year	lb/year	ton/yr
Sump 1	60	2,500	14	6	Crude Oil	12	30,000	143.82	0.00	143.82	7.19E-02
TOTAL										143.82	0.072

Pumping Station - 41: Fugitive Emissions

Service	Components	Emission Factor ^{(a), (b)}	VOC Emissions	
	#	(lb/hr)/component	lb/hr	ton/year
Valves	13	1.85E-05	0.00024	0.001
Pumps	5	1.13E-03	0.006	0.025
Flanges and Connectors	109	8.60E-07	0.000	0.000
Total			0.006	0.03

Notes:

(a) Emission factors taken from TCEQ's "Equipment Leak Fugitives" document, May 2000. Emission factors pertaining to Oil and Gas Production Operations for Heavy Oil <20° API were used.

(b) Factors give the total organic compound emission rate. Assume that all TOCs are VOCs to be conservative.

PUMPING STATION 41: GHG EMISSIONS

GHG (CH4) Emissions from Fugitive Emissions at Pumping Station- 41

Freeport Pumping Station: Fugitive Emissions

Service	Components	Emission Factor ^{(a), (b)}	TOC Emissions		CH4 Emissions	CO2e Emissions
	#	(lb/hr)/component	lb/hr	ton/year	ton/year	ton/year
Valves	13	2.E-05	0.00024	0.001	0.001	0.022
Pumps	5	1.E-03	0.006	0.025	0.025	0.520
Flanges and Connectors	109	9.E-07	0.0001	0.00041	0.00041	0.009
Total			0.006	0.03	0.03	0.55

Notes:

(a) Operators of crude oil pipeline facilities which handle weathered or dead crude may use the Oil and Gas Heavy Oil (< 20° API gravity) factors to estimate fugitive emissions.

(b) Factors give the total organic compound emission rate. It is conservatively assumed that all of the TOC is CH4 to estimate the GHG emissions. CH4 emissions are represented as CO2e emissions by multiplying them with a GWP of 21.

CONSTRUCTION EMISSIONS
Keystone XL Pipeline
HGB Severe Ozone Nonattainment Area
Houston Lateral Segment

	2011 Construction Emissions: PS-41 in the HGB Nonattainment Area (tons)																
	HC	CO	NOx	SO2	TSP	PM10	PM2.5	CO2e	Benzene	Toluene	Xylenes	Propylene	Acrolein	PAHs	1,3-Butadiene	Formaldehyde	Acetaldehyde
CONSTRUCTION NONROAD									7.40E-02	3.25E-02	2.26E-02	2.05E-01	7.34E-03	1.33E-02	3.10E-03	9.36E-02	6.09E-02
CONSTRUCTION ONROAD	1.33	24.14	3.87	0.02	0.14	0.14	0.14	1671.85	3.97E-02				8.05E-03		4.97E-03	1.54E-02	1.16E-02
OPEN BURNING	18.42	250.96	4.28	-	40.26	28.69	24.41	5937.82									
FUGITIVE DUST					774.00	387.00	58.05										
PAVED ROAD DUST					12.15	1.91	0.19										
TOTAL	19.75	275.10	8.15	0.02	826.55	417.74	82.79	7609.67	1.14E-01	3.25E-02	2.26E-02	2.05E-01	1.54E-02	1.33E-02	8.07E-03	1.09E-01	7.25E-02
	Since the project is proposed to be located in an ozone nonattainment area, the pollutants of interest are HC (VOC) and NOx.																

Houston Lateral Pipeline Construction: Criteria Emissions from Non-Road Engines

Equipment	Daily Hours operated hrs/eqpt/day	Units per spread			2012 TOTAL Hours	Eqpt Horsepower	Fuel Type	BSFC 1,a lb/hp-hr	Criteria Pollutants EFss (g/hp-hr) 1,a				TAF Assignment 2,b	Load Factor 3	TAF 2,b						
		Pre-welding days (21 days)	Welding days (61 days)	Clean-up days (49 days)					hrs	hp	HC	CO			NOx	PM	BSFC	HC	CO	NOx	PM
		D-7 Dozer	8	12					12	7	10,616	240			Diesel	0.367	#NAME?	#NAME?	#####	#####	Hi
D-8 Dozer	8	13	22	18	19,976	310	Diesel	0.367	#NAME?	#NAME?	#####	#####	Hi	0.59	1.01	1.05	1.53	0.95	1.23		
D-8 Ripper	0	0	0	0	0	310	Diesel	0.367	#NAME?	#NAME?	#####	#####	Hi	0.59	1.01	1.05	1.53	0.95	1.23		
D-5 Tow	8	0	2	2	1,760	120	Diesel	0.367	#NAME?	#NAME?	#####	#####	None	0.43	1.00	1.00	1.00	1.00	1.00		
D-7 Tow	8	0	1	1	880	240	Diesel	0.367	#NAME?	#NAME?	#####	#####	None	0.43	1.00	1.00	1.00	1.00	1.00		
D-6 Tack	8	3	3	3	3,144	200	Diesel	0.367	#NAME?	#NAME?	#####	#####	None	0.43	1.00	1.00	1.00	1.00	1.00		
CAT 225	8	0	7	4	4,984	150	Diesel	0.367	#NAME?	#NAME?	#####	#####	Hi	0.59	1.01	1.05	1.53	0.95	1.23		
CAT 235	8	0	26	15	18,568	250	Diesel	0.367	#NAME?	#NAME?	#####	#####	Hi	0.59	1.01	1.05	1.53	0.95	1.23		
CAT 235 w/ Hammer	0	0	0	0	0	260	Diesel	0.367	#NAME?	#NAME?	#####	#####	Hi	0.59	1.01	1.05	1.53	0.95	1.23		
Bending Machine 22-36	8	0	1	0	488	159	Diesel	0.367	#NAME?	#NAME?	#####	#####	None	0.43	1.00	1.00	1.00	1.00	1.00		
Crane LS-98A (35 ton)	0	0	0	0	0	230	Diesel	0.367	#NAME?	#NAME?	#####	#####	None	0.43	1.00	1.00	1.00	1.00	1.00		
Farm Tractor	8	2	2	2	2,096	60	Diesel	0.408	#NAME?	#NAME?	#####	#####	Hi	0.59	1.01	1.05	1.53	0.95	1.23		
Frontend Loader 977	8	2	2	2	2,096	190	Diesel	0.367	#NAME?	#NAME?	#####	#####	Hi	0.59	1.01	1.05	1.53	0.95	1.23		
Motor Grader 14G	8	2	2	2	2,096	200	Diesel	0.367	#NAME?	#NAME?	#####	#####	Hi	0.59	1.01	1.05	1.53	0.95	1.23		
Sideboom 571	8	0	1	0	488	200	Diesel	0.367	#NAME?	#NAME?	#####	#####	Hi	0.59	1.01	1.05	1.53	0.95	1.23		
Sideboom 572	8	0	1	1	880	230	Diesel	0.367	#NAME?	#NAME?	#####	#####	Hi	0.59	1.01	1.05	1.53	0.95	1.23		
Sideboom 583	8	0	22	4	12,304	310	Diesel	0.367	#NAME?	#NAME?	#####	#####	Hi	0.59	1.01	1.05	1.53	0.95	1.23		
Sideboom 594	8	0	4	4	3,520	410	Diesel	0.367	#NAME?	#NAME?	#####	#####	Hi	0.59	1.01	1.05	1.53	0.95	1.23		
Air Compressor 1750 cfm	8	0	3	1	1,856	50	Gasoline	0.484	0.27	11.94	0.69	0.06	None	0.56	1.00	1.00	1.00	1.00	1.00		
Pump - 3"	8	0	1	1	880	20	Gasoline	0.868	5.5	387.02	4.5	0.06	None	0.69	1.00	1.00	1.00	1.00	1.00		
Pump - 6"	8	0	9	9	7,920	40	Gasoline	0.484	0.27	11.94	0.69	0.06	None	0.69	1.00	1.00	1.00	1.00	1.00		
Emergency Engines	8	0	9	2	5,176	10	Gasoline	0.868	5.5	387.02	4.5	0.06	None	0.68	1.00	1.00	1.00	1.00	1.00		
TOTAL (Tons)																					

NOTES:

Notes 1 through 9 apply to diesel engines.

Note 1: Brake-specific fuel consumption and Zero hour steady state EF (EFss; g/hp-hr) assumed to be Tier 2 engines, from Table A2 of "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

Engine Size (HP)	HC	CO	NOx	PM	BSFC	M. Life
11	0.5508	4.1127	4.3	0.5	0.408	2500
16	0.438	2.161	4.4399	0.2665	0.408	2500
25	0.438	2.161	4.4399	0.2665	0.408	2500
50	0.2789	1.5323	4.7279	0.3389	0.408	4667
100	0.3672	2.3655	4.7	0.24	0.408	4667
175	0.3384	0.8667	4.1	0.18	0.367	4667
300	0.3085	0.7475	4	0.1316	0.367	7000
600	0.1669	0.8425	4.3551	0.1316	0.367	7000
750	0.1669	1.3272	4.1	0.1316	0.367	7000
2500	0.1669	0.7642	4.1	0.1316	0.367	7000

Note 2: Transient Adjustment Factors and TAF assignment and TAF from Table A3 of "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

Note 3: Load factor from Appendix A of "Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling", April 2004, EPA-420-P-04-005.

Note 4: Median life is taken from Table 1 of "Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling", April 2004, EPA-420-P-04-005.

Note 5: Age factor and Deterioration factors calculated using Equation 4 from "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

Age Factor = LF * cumulative hours / median life (Age factor is assumed to be greater than one, i.e. the equipment is approximately at the end of its useful life).

Deterioration Factor = 1 + (A * Age Factor^b), where b = 1 for diesel engines and A is taken from Table A4 from source

Note 6: Adjusted Emission Factors for HC, NOx, and CO are calculated using Equation 1 (Table A4) from, "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009. Relative Deterioration factors for Tier II engines was used.

Adjusted EF = EFss * TAF * DF

Note 7: SO2 calculated from Equation 7 from "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

SO2=BSFC*453.6*(1-soxcnv)-HC)*0.01*soxdsI*2

where: soxcnv = 0.02247 and soxdsI = 0.05

Note 8: Adjusted Emission Factor for particulate matter is calculated using Equations 2 and 5 from "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

Adjusted EF = EFss * TAF * DF * Spm adj

Spm adj = BSFC*453.6*7.0*soxcnv*0.01*(soxbas-soxdsI)

where: soxbas = 0.33

Note 9: Construction is proposed to occur between March 2012 and December 2012 approximately. Annual Emissions are calculated using the following calculation

(Emission factor (g/hp-hr) * horsepower * hours operated * load factor) / (2000 lb/ton * 453.6 g/lb)

Notes a through d apply to gasoline engines.

Note a: Fuel Type Gasoline only: Brake specific fuel consumption and emission factors (EFss; g/hp-hr) assumed to be Phase 2 side-valved for < 25hp from Table 5 and Table 6 for > 25hp of "Exhaust Emission Factors for Nonroad Engine Modeling: Spark-Ignition", December 2005, EPA420-R-05-019

Note b: Fuel Type Gasoline only: Transient Adjustment Factors assumed to be Phase 2 for >25 Hp (for <25Hp TAFs emission factors are based on unadjusted steady-state test results) from Table 20 of "Exhaust Emission Factors for Nonroad Engine Modeling: Spark-Ignition", December 2005, EPA420-R-05-019.

Note c: Fuel Type Gasoline only: Deterioration Factors from Table 2 class 2 for <25 Hp of "Nonroad Spark-Ignition Engine Emission Deterioration Factors", December 2005, EPA420-R-05-023.

Fuel Type Gasoline only: Deterioration Factors from Table 7 for >25 Hp of "Nonroad Spark-Ignition Engine Emission Deterioration Factors", December 2005, EPA420-R-05-023.

Note d: Fuel Type Gasoline only: SO2 calculated from Sulfur Dioxide Emission Factor calculations from "Exhaust Emission Factors for Nonroad Engine Modeling: Spark-Ignition", December 2005, EPA420-R-05-019.

SO2=BSFC*453.6*(1-soxcnv)-HC)*0.01*soxdsI*2

where: soxcnv = 0.03 and soxdsI = 0.0339

Houston Lateral Pipeline Construction: Criteria Emissions from Non-Road Engines

Equipment	BSFC _{adj}	Median Life ⁴ Hours	Age Factor	"A" ⁵				Deterioration factor ^{5,c}				Adjusted EF (g/hp-hr) ⁶					2012 Emissions (tons) ⁹				
				HC	CO	NOx	PM	HC	CO	NOx	PM	HC	CO	NOx	SO ₂ ^{7,d}	PM ⁸	HC	CO	NOx	SO ₂	PM
				D-7 Dozer	0.3707	#NAME?	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	#####	#####	#####	#####	#####	#####
D-8 Dozer	0.3707	#NAME?	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	#####	#####	#####	#####	#####	#####	#####	#####	#####	#NAME?
D-8 Ripper	0.3707	#NAME?	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	#####	#####	#####	#####	#####	#####	#####	#####	#####	#NAME?
D-5 Tow	0.3670	#NAME?	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	#####	#####	#####	#####	#####	#####	#####	#####	#####	#NAME?
D-7 Tow	0.3670	#NAME?	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	#####	#####	#####	#####	#####	#####	#####	#####	#####	#NAME?
D-6 Tack	0.3670	#NAME?	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	#####	#####	#####	#####	#####	#####	#####	#####	#####	#NAME?
CAT 225	0.3707	#NAME?	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	#####	#####	#####	#####	#####	#####	#####	#####	#####	#NAME?
CAT 235	0.3707	#NAME?	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	#####	#####	#####	#####	#####	#####	#####	#####	#####	#NAME?
CAT 235 w/ Hammer	0.3707	#NAME?	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	#####	#####	#####	#####	#####	#####	#####	#####	#####	#NAME?
Bending Machine 22-36	0.3670	#NAME?	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	#####	#####	#####	#####	#####	#####	#####	#####	#####	#NAME?
Crane LS-98A (35 ton)	0.3670	#NAME?	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	#####	#####	#####	#####	#####	#####	#####	#####	#####	#NAME?
Farm Tractor	0.4121	#NAME?	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	#####	#####	#####	#####	#####	#####	#####	#####	#####	#NAME?
Frontend Loader 977	0.3707	#NAME?	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	#####	#####	#####	#####	#####	#####	#####	#####	#####	#NAME?
Motor Grader 14G	0.3707	#NAME?	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	#####	#####	#####	#####	#####	#####	#####	#####	#####	#NAME?
Sideboom 571	0.3707	#NAME?	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	#####	#####	#####	#####	#####	#####	#####	#####	#####	#NAME?
Sideboom 572	0.3707	#NAME?	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	#####	#####	#####	#####	#####	#####	#####	#####	#####	#NAME?
Sideboom 583	0.3707	#NAME?	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	#####	#####	#####	#####	#####	#####	#####	#####	#####	#NAME?
Sideboom 594	0.3707	#NAME?	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	#####	#####	#####	#####	#####	#####	#####	#####	#####	#NAME?
Air Compressor 1750 cfm	0.4840	#NAME?	> 1	-	-	-	-	0.640	0.360	0.150	0.260	0.173	4.298	0.104	0.144	0.016	0.01	0.25	0.01	0.01	0.00
Pump - 3"	0.8680	#NAME?	> 1	-	-	-	-	1.935	0.887	0.000	1.935	10.643	343.29	0.000	0.252	0.116	0.14	4.60	0.00	0.00	0.00
Pump - 6"	0.4840	#NAME?	> 1	-	-	-	-	0.640	0.360	0.150	0.260	0.173	4.298	0.104	0.144	0.016	0.04	1.04	0.02	0.03	0.00
Emergency Engines	0.8680	#NAME?	> 1	-	-	-	-	1.935	0.887	0.000	1.935	10.643	343.29	0.000	0.252	0.116	0.41	13.32	0.00	0.01	0.00
TOTAL (Tons)																	#####	#####	#####	#####	#NAME?

Houston Lateral Pipeline Construction: GHG Emissions from Non-Road Engines

Equipment	Daily Hours operated hrs/eqpt/day	2012 TOTAL Hours hrs	Equipment HP hp	Fuel Type	BSFC lb/hp-hr	TAF Assignment	Load Factor ²	TAF ¹ BSFC	BSFC _{adj}	Greenhouse Gases					2012 Emissions (Tons)				
										CO ₂		CH ₄		N ₂ O		CO ₂	CH ₄	N ₂ O	CO ₂ e ⁵
										g/hp-hr ³	⁴	lb/hp-hr	Ef (g/gal) ⁴	lb/hp-hr					
D-7 Dozer	8	10,616	240	Diesel	0.367	Hi	0.59	1.01	0.3707	#NAME?	0.58	6.72E-05	0.26	3.01E-05	#NAME?	0.09	0.04	#NAME?	
D-8 Dozer	8	19,976	310	Diesel	0.367	Hi	0.59	1.01	0.3707	#NAME?	0.58	6.72E-05	0.26	3.01E-05	#NAME?	0.21	0.09	#NAME?	
D-8 Ripper	0	0	310	Diesel	0.367	Hi	0.59	1.01	0.3707	#NAME?	0.58	6.72E-05	0.26	3.01E-05	#NAME?	0.00	0.00	#NAME?	
D-5 Tow	8	1,760	120	Diesel	0.367	None	0.43	1	0.3670	#NAME?	0.58	6.66E-05	0.26	2.98E-05	#NAME?	0.01	0.00	#NAME?	
D-7 Tow	8	880	240	Diesel	0.367	None	0.43	1	0.3670	#NAME?	0.58	6.66E-05	0.26	2.98E-05	#NAME?	0.01	0.00	#NAME?	
D-6 Tack	8	3,144	200	Diesel	0.367	None	0.43	1	0.3670	#NAME?	0.58	6.66E-05	0.26	2.98E-05	#NAME?	0.02	0.01	#NAME?	
CAT 225	8	4,984	150	Diesel	0.367	Hi	0.59	1.01	0.3707	#NAME?	0.58	6.72E-05	0.26	3.01E-05	#NAME?	0.03	0.01	#NAME?	
CAT 235	8	18,568	250	Diesel	0.367	Hi	0.59	1.01	0.3707	#NAME?	0.58	6.72E-05	0.26	3.01E-05	#NAME?	0.16	0.07	#NAME?	
CAT 235 w/ Hammer	0	0	260	Diesel	0.367	Hi	0.59	1.01	0.3707	#NAME?	0.58	6.72E-05	0.26	3.01E-05	#NAME?	0.00	0.00	#NAME?	
Bending Machine 22-36	8	488	159	Diesel	0.367	None	0.43	1	0.3670	#NAME?	0.58	6.66E-05	0.26	2.98E-05	#NAME?	0.00	0.00	#NAME?	
Crane LS-98A (35 ton)	0	0	230	Diesel	0.367	None	0.43	1	0.3670	#NAME?	0.58	6.66E-05	0.26	2.98E-05	#NAME?	0.00	0.00	#NAME?	
Farm Tractor	8	2,096	60	Diesel	0.408	Hi	0.59	1.01	0.4121	#NAME?	0.58	7.47E-05	0.26	3.35E-05	#NAME?	0.00	0.00	#NAME?	
Frontend Loader 977	8	2,096	190	Diesel	0.367	Hi	0.59	1.01	0.3707	#NAME?	0.58	6.72E-05	0.26	3.01E-05	#NAME?	0.01	0.01	#NAME?	
Motor Grader 14G	8	2,096	200	Diesel	0.367	Hi	0.59	1.01	0.3707	#NAME?	0.58	6.72E-05	0.26	3.01E-05	#NAME?	0.01	0.01	#NAME?	
Sideboom 571	8	488	200	Diesel	0.367	Hi	0.59	1.01	0.3707	#NAME?	0.58	6.72E-05	0.26	3.01E-05	#NAME?	0.00	0.00	#NAME?	
Sideboom 572	8	880	230	Diesel	0.367	Hi	0.59	1.01	0.3707	#NAME?	0.58	6.72E-05	0.26	3.01E-05	#NAME?	0.01	0.00	#NAME?	
Sideboom 583	8	12,304	310	Diesel	0.367	Hi	0.59	1.01	0.3707	#NAME?	0.58	6.72E-05	0.26	3.01E-05	#NAME?	0.13	0.06	#NAME?	
Sideboom 594	8	3,520	410	Diesel	0.367	Hi	0.59	1.01	0.3707	#NAME?	0.58	6.72E-05	0.26	3.01E-05	#NAME?	0.05	0.02	#NAME?	
Air Compressor 1750 cfm	8	1,856	50	Gasoline	0.484	None	0.56	1	0.4840	699.77	0.50	7.57E-05	0.22	3.33E-05	40.09	0.00	0.00	40.64	
Pump - 3"	8	880	20	Gasoline	0.868	None	0.69	1	0.8680	1222.00	0.50	1.36E-04	0.22	5.97E-05	16.36	0.00	0.00	16.55	
Pump - 6"	8	7,920	40	Gasoline	0.484	None	0.69	1	0.4840	699.77	0.50	7.57E-05	0.22	3.33E-05	168.62	0.01	0.01	170.50	
Emergency Engines	8	5,176	10	Gasoline	0.868	None	0.68	1	0.8680	1222.00	0.50	1.36E-04	0.22	5.97E-05	47.41	0.00	0.00	47.96	
TOTAL (Tons)															#NAME?	0.75	0.34	#NAME?	

NOTES:

Note 1: Transient Adjustment Factors and TAF assignment and from Table A3 of "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

Note 2: Load factor from Appendix A of "Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling", April 2004, EPA-420-P-04-005.

Note 3: Carbon dioxide is calculated using Equation 6 from "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

$$CO_2 = (BSFC * 453.6) - HC * 0.87 * (44/12)$$

HC is the hydrocarbon emission factor from criteria pollutant calculation,

0.87 is the mass fraction of carbon mass in diesel and

44/12 is the molecular weight ratio of CO₂ to carbon

Note 4: Emission Factors from Table 13.6 of The Climate Registry General Reporting Protocol Version 1.0, tons calculated using 7.05 lb/gal from AP-42 Appendix A and adjusted BSFC

Note 5: Carbon dioxide equivalents calculated using IPCC Second Assessment Report (SAR) Global Warming Potentials CO₂ = 1, CH₄ = 21, N₂O = 310.

$$CO_2e = CO_2 + (CH_4 * 21) + (N_2O * 310)$$

Houston Lateral Pipeline Construction: HAP Emissions from Non-Road Engines

Equipment	Daily Hours operated hrs/eqpt/day	2012 TOTAL Hours hrs	Equipment Horsepower hp	Fuel Type	BSFC lb/hp-hr	TAF Assignment ¹	Load Factor ²	BSFC TAF ¹	BSFC _{adj}	HAP Emission Factors (lb/MMBtu) ³					
										Benzene	Toluene	Xylenes	Propylene	Acrolein	PAHs
D-7 Dozer	8	10,616	240	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
D-8 Dozer	8	19,976	310	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
D-8 Ripper	0	0	310	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
D-5 Tow	8	1,760	120	Diesel	0.367	None	0.43	1	0.3670	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
D-7 Tow	8	880	240	Diesel	0.367	None	0.43	1	0.3670	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
D-6 Tack	8	3,144	200	Diesel	0.367	None	0.43	1	0.3670	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
CAT 225	8	4,984	150	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
CAT 235	8	18,568	250	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
CAT 235 w/ Hammer	0	0	260	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Bending Machine 22-36	8	488	159	Diesel	0.367	None	0.43	1	0.3670	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Crane LS-98A (35 ton)	0	0	230	Diesel	0.367	None	0.43	1	0.3670	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Farm Tractor	8	2,096	60	Diesel	0.408	Hi	0.59	1.01	0.4121	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Frontend Loader 977	8	2,096	190	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Motor Grader 14G	8	2,096	200	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Sideboom 571	8	488	200	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Sideboom 572	8	880	230	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Sideboom 583	8	12,304	310	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Sideboom 594	8	3,520	410	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Air Compressor 1750 cfm	8	1,856	50	Gasoline	0.484	None	0.56	1	0.4840	N/A	N/A	N/A	N/A	N/A	N/A
Pump - 3"	8	880	20	Gasoline	0.868	None	0.69	1	0.8680	N/A	N/A	N/A	N/A	N/A	N/A
Pump - 6"	8	7,920	40	Gasoline	0.484	None	0.69	1	0.4840	N/A	N/A	N/A	N/A	N/A	N/A
Emergency Engines	8	5,176	10	Gasoline	0.868	None	0.68	1	0.8680	N/A	N/A	N/A	N/A	N/A	N/A
TOTAL (Tons)															

NOTES:

Note 1: Transient Adjustment Factors and TAF assignment and from Table A3 of "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

Note 2: Load factor from Appendix A of "Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling", April 2004, EPA-420-P-04-005. TAF Assignment of Hi/Lo is based on the Load Factor.

Note 3: Emission factors (lb/MMBtu) from AP-42 Section 3.3, Table 3.3-2. Note that HAP emission factors for gasoline fired engines are not available.

Note 4: Tons are calculated using 7.05 lb/gal from AP-42 Appendix A and 5.825 MMBtu/barrel from Table 13.1 of The Climate Registry Genral Reporting Protocol version 1.0

Houston Lateral Pipeline Construction: HAP Emissions from Non-Road Engines

Equipment	HAP Emission Factors (lb/MMBtu) ³			2012 HAP Emissions (Tons) ⁴								
	1,3-Butadiene	Formaldehyde	Acetaldehyde	Benzene	Toluene	Xylenes	Propylene	Acrolein	PAHs	1,3-Butadiene	Formaldehyde	Acetaldehyde
D-7 Dozer	3.91E-05	1.18E-03	7.67E-04	8.67E-03	3.80E-03	2.65E-03	2.40E-02	8.59E-04	1.56E-03	3.63E-04	1.10E-02	7.12E-03
D-8 Dozer	3.91E-05	1.18E-03	7.67E-04	2.11E-02	9.23E-03	6.43E-03	5.83E-02	2.09E-03	3.79E-03	8.83E-04	2.66E-02	1.73E-02
D-8 Ripper	3.91E-05	1.18E-03	7.67E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D-5 Tow	3.91E-05	1.18E-03	7.67E-04	7.11E-04	3.12E-04	2.17E-04	1.97E-03	7.05E-05	1.28E-04	2.98E-05	9.00E-04	5.85E-04
D-7 Tow	3.91E-05	1.18E-03	7.67E-04	7.11E-04	3.12E-04	2.17E-04	1.97E-03	7.05E-05	1.28E-04	2.98E-05	9.00E-04	5.85E-04
D-6 Tack	3.91E-05	1.18E-03	7.67E-04	2.12E-03	9.28E-04	6.47E-04	5.86E-03	2.10E-04	3.81E-04	8.88E-05	2.68E-03	1.74E-03
CAT 225	3.91E-05	1.18E-03	7.67E-04	2.54E-03	1.11E-03	7.77E-04	7.03E-03	2.52E-04	4.58E-04	1.07E-04	3.22E-03	2.09E-03
CAT 235	3.91E-05	1.18E-03	7.67E-04	1.58E-02	6.92E-03	4.82E-03	4.37E-02	1.57E-03	2.84E-03	6.62E-04	2.00E-02	1.30E-02
CAT 235 w/ Hammer	3.91E-05	1.18E-03	7.67E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bending Machine 22-36	3.91E-05	1.18E-03	7.67E-04	2.61E-04	1.15E-04	7.98E-05	7.23E-04	2.59E-05	4.71E-05	1.10E-05	3.31E-04	2.15E-04
Crane LS-98A (35 ton)	3.91E-05	1.18E-03	7.67E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Farm Tractor	3.91E-05	1.18E-03	7.67E-04	4.76E-04	2.08E-04	1.45E-04	1.32E-03	4.72E-05	8.56E-05	1.99E-05	6.01E-04	3.91E-04
Frontend Loader 977	3.91E-05	1.18E-03	7.67E-04	1.35E-03	5.94E-04	4.14E-04	3.75E-03	1.34E-04	2.44E-04	5.68E-05	1.71E-03	1.11E-03
Motor Grader 14G	3.91E-05	1.18E-03	7.67E-04	1.43E-03	6.25E-04	4.36E-04	3.94E-03	1.41E-04	2.57E-04	5.98E-05	1.80E-03	1.17E-03
Sideboom 571	3.91E-05	1.18E-03	7.67E-04	3.32E-04	1.46E-04	1.01E-04	9.18E-04	3.29E-05	5.98E-05	1.39E-05	4.20E-04	2.73E-04
Sideboom 572	3.91E-05	1.18E-03	7.67E-04	6.89E-04	3.02E-04	2.10E-04	1.90E-03	6.83E-05	1.24E-04	2.89E-05	8.71E-04	5.66E-04
Sideboom 583	3.91E-05	1.18E-03	7.67E-04	1.30E-02	5.69E-03	3.96E-03	3.59E-02	1.29E-03	2.34E-03	5.44E-04	1.64E-02	1.07E-02
Sideboom 594	3.91E-05	1.18E-03	7.67E-04	4.91E-03	2.15E-03	1.50E-03	1.36E-02	4.87E-04	8.84E-04	2.06E-04	6.21E-03	4.04E-03
Air Compressor 1750 cfm	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pump - 3"	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pump - 6"	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Emergency Engines	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
TOTAL (Tons)				7.40E-02	3.25E-02	2.26E-02	2.05E-01	7.34E-03	1.33E-02	3.10E-03	9.36E-02	6.09E-02

Houston Lateral Pipeline Construction: Criteria and GHG Emissions from On-Road Vehicles

Equipment	Daily Hours operated hrs/eqpt/day	Number eqpt #	Units per spread	Units per spread	Units per spread	Vehicle Class ¹	2012 Miles traveled ²	Fuel Type	Criteria Pollutants				
			Pre-welding days (21 days)	Welding days (61 days)	Clean-up days (49 days)				Emission Factor (g/VMT) ³				
									VOC	CO	NOx	SO ₂	PM
Automobile	2	50	20	50	20	LDGV	222,500	Diesel	0.627	12.7	0.588	0.0068	0.0249
Bus	3	7	2	7	1	URBANBUS	38,850	Diesel	0.257	2.121	10.677	0.0218	0.226
Pickup 4x4	5	100	20	100	20	LDGV	937,500	Diesel	0.627	12.7	0.588	0.0068	0.0249
Welding Rig	10	30	0	30	5	LDGV	518,750	Diesel	0.627	12.7	0.588	0.0068	0.0249
Winch Truck	8	3	3	3		HDDV3	49,200	Diesel	0.16	0.541	2.319	0.0082	0.0848
Dump Truck	8	1	1	1	1	HDDV3	26,200	Diesel	0.16	0.541	2.319	0.0082	0.0848
Flatbed Truck	9	8	1	8	2	HDDV3	136,575	Diesel	0.16	0.541	2.319	0.0082	0.0848
Fuel Truck	10	2	1	2	2	HDDV3	60,250	Diesel	0.16	0.541	2.319	0.0082	0.0848
Grease Truck	10	1	1	1	1	HDDV3	32,750	Diesel	0.16	0.541	2.319	0.0082	0.0848
Mechanic Rig	10	1	1	1	1	HDDV2B	32,750	Diesel	0.149	0.508	2.182	0.0074	0.0966
Skid Truck	10	1	1	1	0	HDDV3	20,500	Diesel	0.16	0.541	2.319	0.0082	0.0848
Stringing Tr. & Tr.	10	15	0	15	0	HDDV3	228,750	Diesel	0.16	0.541	2.319	0.0082	0.0848
Tuck. & Float	10	9	0	9	5	HDDV3	198,500	Diesel	0.16	0.541	2.319	0.0082	0.0848
Truck & Lowboy	10	5	5	5	2	HDDV3	127,000	Diesel	0.16	0.541	2.319	0.0082	0.0848
TOTAL (Tons)													

NOTES:

Note 1: Vehicle Classes were taken from Mobile6.2 based on estimated gross weight of the vehicle.

Note 2: Vehicle miles traveled are based on an assumed 25 mi/hr on average/ vehicle based on arterial roads.

Note 3: Emission factors from Mobile6.2.

Note 4: Emission Factors from Table 13.4 of The Climate Registry General Reporting Protocol Version 1.1 applicable to "Diesel Heavy Duty Vehicles" all model year vehicles.

Note that Efs applicable to light duty gasoline vehicles was used for the vehicle category "automobiles" (MY 2000).

Note 5: Carbon dioxide equivalents calculated using IPCC Second Assessment Report (SAR) Global Warming Potentials CO₂ = 1, CH₄ = 21, N₂O = 310.

$$CO_2e = CO_2 + (CH_4 * 21) + (N_2O * 310)$$

Houston Lateral Pipeline Construction: Criteria and GHG Emissions from On-Road Vehicles

Equipment	Greenhouse Gasses			2012 Emissions (Tons)								
	Ef (g/mile)			Criteria Pollutants					Greenhouse Gasses			
	CO ₂ ³	CH ₄ ⁴	N ₂ O ⁴	VOC	CO	NOx	SO ₂	PM	CO ₂	CH ₄	N ₂ O	CO ₂ e ⁵
Automobile	368.1	0.0273	0.0178	0.1538	3.1149	0.1442	0.0017	0.01	90.28	6.70E-03	4.37E-03	91.78
Bus	2342.9	0.0051	0.0048	0.0110	0.0908	0.4572	0.0009	0.01	100.33	2.18E-04	2.06E-04	100.40
Pickup 4x4	368.1	0.0273	0.0178	0.6480	13.1244	0.6076	0.0070	0.03	380.40	2.82E-02	1.84E-02	386.70
Welding Rig	368.1	0.0273	0.0178	0.3585	7.2622	0.3362	0.0039	0.01	210.49	1.56E-02	1.02E-02	213.97
Winch Truck	875.4	0.0051	0.0048	0.0087	0.0293	0.1258	0.0004	0.00	47.48	2.77E-04	2.60E-04	47.56
Dump Truck	875.4	0.0051	0.0048	0.0046	0.0156	0.0670	0.0002	0.00	25.28	1.47E-04	1.39E-04	25.33
Flatbed Truck	875.4	0.0051	0.0048	0.0241	0.0814	0.3491	0.0012	0.01	131.79	7.68E-04	7.23E-04	132.03
Fuel Truck	875.4	0.0051	0.0048	0.0106	0.0359	0.1540	0.0005	0.01	58.14	3.39E-04	3.19E-04	58.25
Grease Truck	875.4	0.0051	0.0048	0.0058	0.0195	0.0837	0.0003	0.00	31.60	1.84E-04	1.73E-04	31.66
Mechanic Rig	789.4	0.0051	0.0048	0.0054	0.0183	0.0788	0.0003	0.00	28.50	1.84E-04	1.73E-04	28.56
Skid Truck	875.4	0.0051	0.0048	0.0036	0.0122	0.0524	0.0002	0.00	19.78	1.15E-04	1.08E-04	19.82
Stringing Tr. & Tr.	875.4	0.0051	0.0048	0.0403	0.1364	0.5847	0.0021	0.02	220.74	1.29E-03	1.21E-03	221.14
Tuck. & Float	875.4	0.0051	0.0048	0.0350	0.1184	0.5074	0.0018	0.02	191.55	1.12E-03	1.05E-03	191.89
Truck & Lowboy	875.4	0.0051	0.0048	0.0224	0.0757	0.3246	0.0011	0.01	122.55	7.14E-04	6.72E-04	122.77
TOTAL (Tons)				1.332	24.135	3.873	0.022	0.141	1658.91	5.59E-02	3.80E-02	1671.85

Houston Lateral Pipeline Construction: HAP Emissions from On-Road Vehicles

Equipment	Daily Hours operated	Number eqpt	Vehicle Class ¹	2012 Miles traveled ²	Fuel Type	Hazardous Air Pollutants				
	hrs/eqpt/day	#		miles/yr		Emission Factor (mg/VMT) ³				
						Acetaldehyde	Acrolein	Benzene	1,3-butadiene	Formaldehyde
Automobile	2	50	LDGV	222,500	Diesel	4.04	0.24	16.45	2.04	4.51
Bus	3	7	URBANBUS	38,850	Diesel	7.75	0.94	2.83	1.64	21.05
Pickup 4x4	5	100	LDGV	937,500	Diesel	4.04	0.24	16.45	2.04	4.51
Welding Rig	10	30	LDGV	518,750	Diesel	4.04	0.24	16.45	2.04	4.51
Winch Truck	8	3	HDDV3	49,200	Diesel	3.78	0.32	9.09	0.94	6.11
Dump Truck	8	1	HDDV3	26,200	Diesel	3.78	0.32	9.09	0.94	6.11
Flatbed Truck	9	8	HDDV3	136,575	Diesel	3.78	0.32	9.09	0.94	6.11
Fuel Truck	10	2	HDDV3	60,250	Diesel	3.78	0.32	9.09	0.94	6.11
Grease Truck	10	1	HDDV3	32,750	Diesel	3.78	0.32	9.09	0.94	6.11
Mechanic Rig	10	1	HDDV2B	32,750	Diesel	3.74	0.29	9.34	0.89	5.92
Skid Truck	10	1	HDDV3	20,500	Diesel	3.78	0.32	9.09	0.94	6.11
Stringing Tr. & Tr.	10	15	HDDV3	228,750	Diesel	3.78	0.32	9.09	0.94	6.11
Tuck. & Float	10	9	HDDV3	198,500	Diesel	3.78	0.32	9.09	0.94	6.11
Truck & Lowboy	10	5	HDDV3	127,000	Diesel	3.78	0.32	9.09	0.94	6.11
TOTAL (Tons)										

NOTES:

Note 1: Vehicle Classes were taken from Mobile6.2 based on estimated gross weight of the vehicle.

Note 2: Vehicle miles traveled are based on an assumed 25 mi/hr on average/ vehicle based on arterial roads.

Note 3: HAP Emission factors taken from Mobile6.2

Houston Lateral Pipeline Construction: HAP Emissions from On-Road Vehicles

Equipment	Hazardous Air Pollutants				
	2012 Emissions (Tons)				
	Acetaldehyde	Acrolein	Benzene	1,3-butadiene	Formaldehyde
Automobile	9.91E-04	5.89E-05	4.03E-03	5.00E-04	1.11E-03
Bus	3.32E-04	4.03E-05	1.21E-04	7.02E-05	9.01E-04
Pickup 4x4	4.17E-03	2.48E-04	1.70E-02	2.11E-03	4.66E-03
Welding Rig	2.31E-03	1.37E-04	9.41E-03	1.17E-03	2.58E-03
Winch Truck	2.05E-04	1.74E-05	4.93E-04	5.10E-05	3.31E-04
Dump Truck	1.09E-04	9.24E-06	2.63E-04	2.71E-05	1.76E-04
Flatbed Truck	5.69E-04	4.82E-05	1.37E-03	1.42E-04	9.20E-04
Fuel Truck	2.51E-04	2.13E-05	6.04E-04	6.24E-05	4.06E-04
Grease Truck	1.36E-04	1.16E-05	3.28E-04	3.39E-05	2.21E-04
Mechanic Rig	1.35E-04	1.05E-05	3.37E-04	3.21E-05	2.14E-04
Skid Truck	8.54E-05	7.23E-06	2.05E-04	2.12E-05	1.38E-04
Stringing Tr. & Tr.	9.53E-04	8.07E-05	2.29E-03	2.37E-04	1.54E-03
Tuck. & Float	8.27E-04	7.00E-05	1.99E-03	2.06E-04	1.34E-03
Truck & Lowboy	5.29E-04	4.48E-05	1.27E-03	1.32E-04	8.55E-04
TOTAL (Tons)	0.0116	0.0008	0.0397	0.0048	0.0154

Houston Lateral Pipeline Construction: Emissions from Slash/Brush Burning

Volume and Area of Prescribed Burning		
1 cu. Yd.	=	0.00062 acre-foot
1227985 cu. yd.	=	761.35 acre-foot
Area disturbed/ burned	=	761.35 acre

Vegetation Type Distribution		
Tree Tops/Stumps	=	50% ^(a)
Hay/Gass	=	50% ^(a)

Fuel Load Emission Factor		
Hay/grass	=	1.0 ton/acre ^(b)
Tree Tops and Stumps	=	9.0 ton/acre ^(c)

Weight of Wood/Hay Burned		
Hay/grass	=	0.00 tons
Tree Tops and Stumps	=	3,426.08 tons

Note: Hay/grass will not be burned during construction.

Emission factors for wildfire, prescribed burning and slash burns calculated under dry conditions for each fuel component ^(d)										
Fuel Component	Emission factor (lb/ton)									
	% of total Vegetation	CO	CH ₄	NMHC	PM	PM _{2.5}	PM ₁₀	CO ₂	NO _x	NH ₃
Litter, Wood 0-1"	25%	52	3	6	15	8	9	3483	2.5	0.5
Wood 1-3"	25%	111	6	9	20	12	14	3373	2.5	1.1
Wood 3+"	25%	174	9	12	26	16	19	3263	2.5	1.7
Herb, Shrub	25%	249	12	16	33	21	25	3116	2.5	2.6

Emission from prescribed wood burning									
Fuel Component	Emissions (tons)								
	CO	CH ₄	NMHC	PM	PM _{2.5}	PM ₁₀	CO ₂	NO _x	NH ₃
Litter, Wood 0-1"	22.27	1.28	2.57	6.42	3.43	3.85	1491.63	1.07	0.21
Wood 1-3"	47.54	2.57	3.85	8.57	5.14	6.00	1444.52	1.07	0.47
Wood 3+"	74.52	3.85	5.14	11.13	6.85	8.14	1397.41	1.07	0.73
Herb, Shrub	106.64	5.14	6.85	14.13	8.99	10.71	1334.46	1.07	1.11
TOTAL	250.96	12.85	18.42	40.26	24.41	28.69	5668.02	4.28	2.53

Emission factors for crop residue burning ^(e)									
Crop Residue	Emission factor (lb/ton)								
	CO	CH ₄	NMHC	PM	PM _{2.5}	PM ₁₀	CO ₂ ^(f)	NO _x	NH ₃
Hay/Grasses	204.3	6.3	32.7	17.6	17.4	16.9	-	5.1	6.7

Emissions from crop residue burning									
Crop Residue	Emissions (tons)								
	CO	CH ₄	NMHC	PM	PM _{2.5}	PM ₁₀	CO ₂	NO _x	NH ₃
Hay/Grasses	0.00	0.00	0.00	0.00	0.00	0.00	-	0.00	0.00

Emissions from prescribed burning and crop residue burning									
	CO	CH ₄	NMHC	PM	PM _{2.5}	PM ₁₀	CO ₂	NO _x	NH ₃
TOTAL	250.96	12.85	18.42	40.26	24.41	28.69	5,668.02	4.28	2.53

NOTES:

(a) Taken from http://www.tpwd.state.tx.us/publications/pwdpubs/media/pwd_mp_e0100_1070n_08.pdf.

(b) Taken from Table 5 of Dennis A., Fraser, M., Anderson, S., Allen, D., 2002. Air pollutant emissions associated with forest, grassland, and agricultural burning in Texas. Atmospheric Environment, 36, pp. 3779-3792.

(c) Fuel loading value of tree tops and stumps taken from AP-42 Table 13.1-1. Value applicable to southern region (Region 8) were used.

(d) Taken from Table 2 and 3 of Dennis A., Fraser, M., Anderson, S., Allen, D., 2002. Air pollutant emissions associated with forest, grassland, and agricultural burning in Texas. Atmospheric Environment, 36, pp. 3779-3792.

(e) Taken from Table 6 of Dennis A., Fraser, M., Anderson, S., Allen, D., 2002. Air pollutant emissions associated with forest, grassland, and agricultural burning in Texas. Atmospheric Environment, 36, pp. 3779-3792.

(f) Emission factor of CO₂ for hay/grass burning was not available.

PM EMISSIONS FROM LAND DISTURBED: Houston Lateral Pipeline Construction

2012 Activities		
Area Name:	Pipeline	
Area of Land Disturbance over the total months of construction (acres):	645	
Months of Construction Activity (May-September 2012) ⁽¹⁾ :	5	
	total tons ⁽²⁾	tons/month
PM2.5	58.1	11.6
PM10	387.0	77.4
PM30	774.0	154.8

Factor	Heavy Construction Operations			Notes
	PM2.5	PM10	PM30	
tons/acre/month	0.09	0.60	1.20	(3)
From AP-42, Section 13.2.3 Heavy Construction Operations:				
For construction activity operations:				
E = 1.2 tons/acre/month of activity				

NOTES:

(1) Construction is projected to occur over 5 months.

(2) Total tons is for entire construction duration, which is expected to be over an 5 month period. PM2.5 is particulate matter less than 2.5 microns. PM10 is particulate matter less than 10 microns. PM30 is particulate matter less than 30 microns.

(3) From AP-42 Section 13.2.3.3. Note that a factor of 1.2 ton/acre/month is conservatively high for TSP since it assumes that construction occurs over 30 days of the month which is not true in this case. Particle size multiplier (k) of 0.5 and 0.075 were used to determine the fraction of PM10 and PM2.5, respectively (taken from AP-42 Section 13.2.5.3).

PERSONNEL COMMUTE-PM EMISSIONS FROM PAVED ROADS: Houston
Lateral Pipeline Construction

Number of Roundtrips for 2012	2,630,075 Miles for 2012	(1)
-------------------------------	--------------------------	-----

Emissions = VMT roundtrip/trip * 'X' miles for the construction period / 2000

All Paved Roads			
Emissions (ton/year)	PM2.5	PM10	PM30 (TSP)
2012	0.19	1.91	12.15

All Paved Roads				Notes
Emission Factor	PM2.5	PM10	PM30	
lb/VMT	0.0001	0.0015	0.0092	(2)

From AP-42, Section 13.2.1 Paved Roads:

For all paved roads:

$$E = \{ [k * ((sL/2)^{0.65}) * ((W/3)^{1.5}) - C] * (1 - P/4N) \}$$

where

E = size specific emission factor (lb/VMT)

k = particulate size multiplier

sL = road surface silt loading (g/m²)

W = mean vehicle weight (tons)

C = emission factor for 1980's vehicle fleet exhaust, brake wear, and tire wear.

P = number of wet days with at least 0.254 mm (0.01 in) of precipitation during the averaging period, and

N = number of days in the averaging period

Parameter	All Paved Roads 2010			Notes
	PM2.5	PM10	PM30	
k	0.004	0.016	0.082	(3)
sL	0.2	0.2	0.2	(4)
W	2.1	2.1	2.1	(5)
C	0.00036	0.00047	0.00047	(6)

NOTES:

(1) Number of personnel is assumed to be a constant during the entire construction schedule.

(2) Derived from equation, based on lb/VMT, P=120 from Figure 13.2.1-2, N=365

(3) From AP-42 Table 13.2-1.1 in lb/VMT.

(4) Silt content taken from AP-42 Table 13.2.1-3 for 500-5,000 ADT ubiquitous baseline.

(5) Average worker vehicle weight based on average car or light duty truck sold in the US last year 4,144 pounds from EPA. 4,144 pounds = 2.07 tons

(6) From AP-42 Table 13.2-1.2 in lb/VMT.

CONSTRUCTION EMISSIONS
Keystone XL Pipeline
BPA Marginal Ozone Nonattainment Area
Gulf Coast Main Segment

2011 Construction Emissions: Pipeline Construction in BPA Nonattainment Area (tons)																	
	HC	CO	NOx	SO2	TSP	PM10	PM2.5	CO2e	Benzene	Toluene	Xylenes	Propylene	Acrolein	PAHs	1,3-Butadiene	Formaldehyde	Acetaldehyde
CONSTRUCTION NONROAD	#NAME?	#NAME?	#NAME?	#NAME?	#NAME?	#NAME?	#NAME?	#NAME?	7.97E-02	3.49E-02	2.43E-02	2.20E-01	7.90E-03	1.44E-02	3.34E-03	1.01E-01	6.55E-02
CONSTRUCTION ONROAD	1.30	23.53	3.80	0.02	0.14	0.14	0.14	1,627.23	3.88E-02				7.88E-04		4.68E-03	1.51E-02	1.14E-02
OPEN BURNING	16.54	225.40	3.85	-	36.16	25.77	21.92	5,333.10									
FUGITIVE DUST					679.32	339.66	50.95										
PAVED ROAD DUST					11.90	1.87	0.18										
TOTAL	#NAME?	#NAME?	#NAME?	#NAME?	#NAME?	#NAME?	#NAME?	#NAME?	1.19E-01	3.49E-02	2.43E-02	2.20E-01	8.69E-03	1.44E-02	8.02E-03	1.16E-01	7.69E-02
Since the project is proposed to be located in an ozone nonattainment area, the pollutants of interest are HC (VOC) and NOx.																	

Main Pipeline Line Construction: Criteria Emissions from Non-Road Engines

Equipment	Daily Hours operated hrs/eqpt/day	Number of eqpt Per Station	Units		Units		Units		2011 TOTAL Hours	Eqpt Horsepwr hp	Fuel Type	BSFC ^{1,a} lb/hp-hr	Criteria Pollutants EFss (g/hp-hr) ^{1,a}				TAF Assignm ent ^{2,b}	Load Factor ³
			Pre-welding days (18 days)	Days of Operation Per Unit	Welding days (72 days)	Days of Operation Per Unit	Clean-up days (18 days)	Days of Operation Per Unit					HC	CO	NOx	PM		
D-7 Dozer	8	2	12	12	12	31	7	42	6,470	240	Diesel	0.367	0.3085	0.7475	4	0.13	Hi	0.59
D-8 Dozer	8	0	13	12	22	31	18	42	12,762	310	Diesel	0.367	0.1669	0.8425	4.355	0.13	Hi	0.59
D-8 Ripper	0	0	0	0	0	26	0	30	0	310	Diesel	0.367	0.1669	0.8425	4.355	0.13	Hi	0.59
D-5 Tow	8	0	0	12	2	31	2	42	1,172	120	Diesel	0.367	0.3384	0.8667	4.1	0.18	None	0.43
D-7 Tow	8	0	0	12	1	31	1	42	586	240	Diesel	0.367	0.3085	0.7475	4	0.13	None	0.43
D-6 Tack	8	0	3	12	3	31	3	42	2,040	200	Diesel	0.367	0.3085	0.7475	4	0.13	None	0.43
CAT 225	8	2	0	12	7	31	4	42	3,088	150	Diesel	0.367	0.3384	0.8667	4.1	0.18	Hi	0.59
CAT 235	8	0	0	12	26	31	15	42	11,518	250	Diesel	0.367	0.3085	0.7475	4	0.13	Hi	0.59
CAT 235 w/ Hammer	0	0	0	0	0	26	0	30	0	260	Diesel	0.367	0.3085	0.7475	4	0.13	Hi	0.59
Bending Machine 22-36	8	0	0	12	1	31	0	42	248	159	Diesel	0.367	0.3384	0.8667	4.1	0.18	None	0.43
Crane LS-98A (35 ton)	0	2	0	0	0	26	0	30	0	230	Diesel	0.367	0.3085	0.7475	4	0.13	None	0.43
Farm Tractor	8	1	2	12	2	31	2	42	1,360	60	Diesel	0.408	0.3672	2.3655	4.7	0.24	Hi	0.59
Frontend Loader 977	8	1	2	12	2	31	2	42	1,360	190	Diesel	0.367	0.3085	0.7475	4	0.13	Hi	0.59
Motor Grader 14G	8	1	2	12	2	31	2	42	1,360	200	Diesel	0.367	0.3085	0.7475	4	0.13	Hi	0.59
Sideboom 571	8	0	0	12	1	31	0	42	248	200	Diesel	0.367	0.3085	0.7475	4	0.13	Hi	0.59
Sideboom 572	8	0	0	12	1	31	1	42	586	230	Diesel	0.367	0.3085	0.7475	4	0.13	Hi	0.59
Sideboom 583	8	0	0	12	22	31	4	42	6,808	310	Diesel	0.367	0.1669	0.8425	4.355	0.13	Hi	0.59
Sideboom 594	8	0	0	12	4	31	4	42	2,344	410	Diesel	0.367	0.1669	0.8425	4.355	0.13	Hi	0.59
Air Compressor 1750 cfm	8	1	0	12	3	31	1	42	1,082	50	Gasoline	0.484	0.27	11.94	0.69	0.06	None	0.56
Pump - 3"	8	1	0	12	1	31	1	42	586	20	Gasoline	0.868	5.5	387.02	4.5	0.06	None	0.69
Pump - 6"	8	1	0	12	9	31	9	42	5,274	40	Gasoline	0.484	0.27	11.94	0.69	0.06	None	0.69
Emergency Engines	8	4	0	12	9	31	2	42	2,908	10	Gasoline	0.868	5.5	387.02	4.5	0.06	None	0.68
TOTAL (Tons)																		

NOTES:

Notes 1 through 9 apply to diesel engines.

Note 1: Brake-specific fuel consumption and Zero hour steady state EF (EFss; g/hp-hr) assumed to be Tier 2 engines, from Table A2 of "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling- Compression-Ignition", April 2004, EPA-420-P-04-009.

Engine Size (HP)	HC	CO	NOx	PM	BSFC	M. Life	
1	11	0.5508	4.1127	4.3	0.5	0.408	2500
12	16	0.438	2.161	4.4399	0.2665	0.408	2500
17	25	0.438	2.161	4.4399	0.2665	0.408	2500
26	50	0.2789	1.5323	4.7279	0.3389	0.408	4667
51	100	0.3672	2.3655	4.7	0.24	0.408	4667
101	175	0.3384	0.8667	4.1	0.18	0.367	4667
176	300	0.3085	0.7475	4	0.1316	0.367	7000
301	600	0.1669	0.8425	4.3551	0.1316	0.367	7000
601	750	0.1669	1.3272	4.1	0.1316	0.367	7000
751	2500	0.1669	0.7642	4.1	0.1316	0.367	7000

Note 2: Transient Adjustment Factors and TAF assignment and TAF from Table A3 of "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

Note 3: Load factor from Appendix A of "Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling", April 2004, EPA-420-P-04-005.

Note 4: Median life is taken from Table 1 of "Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling", April 2004, EPA-420-P-04-005.

Note 5: Age factor and Deterioration factors calculated using Equation 4 from "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

Age Factor = LF * cumulative hours / median life (Age factor is assumed to be greater than one, i.e. the equipment is approximately at the end of its useful life).

Deterioration Factor = 1 + (A * Age Factor^b), where b = 1 for diesel engines and A is taken from Table A4 from source

Note 6: Adjusted Emission Factors for HC, NOx, and CO are calculated using Equation 1 (Table A4) from, "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009. Relative Deterioration factors for Tier II engines was used.

Adjusted EF = Efss * TAF * DF

Note 7: SO2 calculated from Equation 7 from "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

SO2=BSFC*453.6*(1-soxcnv)-HC)*0.01*soxdsl*2

where: soxcnv = 0.02247 and soxdsl = 0.05

Note 8: Adjusted Emission Factor for particulate matter is calculated using Equations 2 and 5 from "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

Adjusted EF = Efss * TAF * DF - Spm adj

Spm adj = BSFC*453.6*7.0*soxcnv*0.01*(soxbas-soxdsl)

where: soxbas = 0.33

Note 9: Construction is proposed to occur between March 2012 and December 2012 approximately. Annual Emissions are calculated using the following calculation

(Emission factor (g/hp-hr) * horsepower * hours operated * load factor) / (2000 lb/ton * 453.6 g/lb)

Notes a through d apply to gasoline engines.

Note a: Fuel Type Gasoline only: Brake specific fuel consumption and emission factors (EFss; g/hp-hr) assumed to be Phase 2 side-valved for < 25hp from Table 5 and Table 6 for > 25hp of "Exhaust Emission Factors for Nonroad Engine Modeling: Spark-Ignition", December 2005, EPA420-R-05-019

Note b: Fuel Type Gasoline only: Transient Adjustment Factors assumed to be Phase 2 for >25 Hp (for <25Hp TAFs emission factors are based on unadjusted steady-state test results) from Table 20 of "Exhaust Emission Factors for Nonroad Engine Modeling: Spark-Ignition", December 2005, EPA420-R-05-019.

Note c: Fuel Type Gasoline only: Deterioration Factors from Table 2 (Phase 2-Side valved) for <25 Hp of "Nonroad Spark-Ignition Engine Emission Deterioration Factors", December 2005, EPA420-R-05-023.

Fuel Type Gasoline only: Deterioration Factors from Table 7 for >25 Hp of "Nonroad Spark-Ignition Engine Emission Deterioration Factors", December 2005, EPA420-R-05-023.

Note d: Fuel Type Gasoline only: SO2 calculated from Sulfur Dioxide Emission Factor calculations from "Exhaust Emission Factors for Nonroad Engine Modeling: Spark-Ignition", December 2005, EPA420-R-05-019.

SO2=BSFC*453.6*(1-soxcnv)-HC)*0.01*soxdsl*2

where: soxcnv = 0.03 and soxdsl = 0.0339

Main Pipeline Construction: GHG Emissions from Non-Road Engines

Equipment	Daily Hours operated hrs/eqp/day	2011 TOTAL Hours hrs	Equipment HP hp	Fuel Type	BSFC lb/hp-hr	TAF Assignment	Load Factor ²	TAF ¹ BSFC	BSFC _{adj}	Greenhouse Gases					2011 Emissions (Tons)				
										CO ₂		CH ₄		N ₂ O		CO ₂	CH ₄	N ₂ O	CO ₂ e ⁵
										g/hp-hr ³	⁴	lb/hp-hr	Ef (g/gal) ⁴	lb/hp-hr					
D-7 Dozer	8	6,470	240	Diesel	0.367	Hi	0.59	1.01	0.3707	535.27	0.58	6.72E-05	0.26	3.01E-05	540.57	0.05	0.02	548.92	
D-8 Dozer	8	12,762	310	Diesel	0.367	Hi	0.59	1.01	0.3707	535.76	0.58	6.72E-05	0.26	3.01E-05	1,378.52	0.13	0.06	1,399.79	
D-8 Ripper	0	0	310	Diesel	0.367	Hi	0.59	1.01	0.3707	535.76	0.58	6.72E-05	0.26	3.01E-05	0.00	0.00	0.00	0.00	
D-5 Tow	8	1,172	120	Diesel	0.367	None	0.43	1	0.3670	529.92	0.58	6.66E-05	0.26	2.98E-05	35.33	0.00	0.00	36.07	
D-7 Tow	8	586	240	Diesel	0.367	None	0.43	1	0.3670	530.01	0.58	6.66E-05	0.26	2.98E-05	35.33	0.00	0.00	36.08	
D-6 Tack	8	2,040	200	Diesel	0.367	None	0.43	1	0.3670	530.01	0.58	6.66E-05	0.26	2.98E-05	102.50	0.01	0.01	104.67	
CAT 225	8	3,088	150	Diesel	0.367	Hi	0.59	1.01	0.3707	535.17	0.58	6.72E-05	0.26	3.01E-05	161.22	0.02	0.01	163.71	
CAT 235	8	11,518	250	Diesel	0.367	Hi	0.59	1.01	0.3707	535.27	0.58	6.72E-05	0.26	3.01E-05	1,002.42	0.10	0.04	1,017.91	
CAT 235 w/ Hammer	0	0	260	Diesel	0.367	Hi	0.59	1.01	0.3707	535.27	0.58	6.72E-05	0.26	3.01E-05	0.00	0.00	0.00	0.00	
Bending Machine 22-36	8	248	159	Diesel	0.367	None	0.43	1	0.3670	529.92	0.58	6.66E-05	0.26	2.98E-05	9.90	0.00	0.00	10.11	
Crane LS-98A (35 ton)	0	0	230	Diesel	0.367	None	0.43	1	0.3670	530.01	0.58	6.66E-05	0.26	2.98E-05	0.00	0.00	0.00	0.00	
Farm Tractor	8	1,360	60	Diesel	0.408	Hi	0.59	1.01	0.4121	594.99	0.58	7.47E-05	0.26	3.35E-05	31.58	0.00	0.00	32.06	
Frontend Loader 977	8	1,360	190	Diesel	0.367	Hi	0.59	1.01	0.3707	535.27	0.58	6.72E-05	0.26	3.01E-05	89.96	0.01	0.00	91.34	
Motor Grader 14G	8	1,360	200	Diesel	0.367	Hi	0.59	1.01	0.3707	535.27	0.58	6.72E-05	0.26	3.01E-05	94.69	0.01	0.00	96.15	
Sideboom 571	8	248	200	Diesel	0.367	Hi	0.59	1.01	0.3707	535.27	0.58	6.72E-05	0.26	3.01E-05	17.27	0.00	0.00	17.53	
Sideboom 572	8	586	230	Diesel	0.367	Hi	0.59	1.01	0.3707	535.27	0.58	6.72E-05	0.26	3.01E-05	46.92	0.00	0.00	47.64	
Sideboom 583	8	6,808	310	Diesel	0.367	Hi	0.59	1.01	0.3707	535.76	0.58	6.72E-05	0.26	3.01E-05	735.38	0.07	0.03	746.73	
Sideboom 594	8	2,344	410	Diesel	0.367	Hi	0.59	1.01	0.3707	535.76	0.58	6.72E-05	0.26	3.01E-05	334.87	0.03	0.01	340.04	
Air Compressor 1750 cfm	8	1,082	50	Gasoline	0.484	None	0.56	1	0.4840	699.77	0.50	7.57E-05	0.22	3.33E-05	23.37	0.00	0.00	23.69	
Pump - 3"	8	586	20	Gasoline	0.868	None	0.69	1	0.8680	1222.00	0.50	1.36E-04	0.22	5.97E-05	10.89	0.00	0.00	11.02	
Pump - 6"	8	5,274	40	Gasoline	0.484	None	0.69	1	0.4840	699.77	0.50	7.57E-05	0.22	3.33E-05	112.28	0.01	0.00	113.54	
Emergency Engines	8	2,908	10	Gasoline	0.868	None	0.68	1	0.8680	1222.00	0.50	1.36E-04	0.22	5.97E-05	26.64	0.00	0.00	26.95	
TOTAL (Tons)															4,789.63	0.46	0.21	4,863.97	

NOTES:

Note 1: Transient Adjustment Factors and TAF assignment and from Table A3 of "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

Note 2: Load factor from Appendix A of "Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling", April 2004, EPA-420-P-04-005.

Note 3: Carbon dioxide is calculated using Equation 6 from "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

$$CO_2 = ((BSFC * 453.6) - HC) * 0.87 * (44/12)$$

HC is the hydrocarbon emission factor from criteria pollutant calculation.

0.87 is the mass fraction of carbon mass in diesel and

44/12 is the molecular weight ratio of CO₂ to carbon

Note 4: Emission Factors from Table 13.6 of The Climate Registry General Reporting Protocol Version 1.0, tons calculated using 7.05 lb/gal from AP-42 Appendix A and adjusted BSFC

Note 5: Carbon dioxide equivalents calculated using IPCC Second Assessment Report (SAR) Global Warming Potentials CO₂ = 1, CH₄ = 21, N₂O = 310.

$$CO_2e = CO_2 + (CH_4 * 21) + (N_2O * 310)$$

Pipeline Construction: HAP Emissions from Non-Road Engines

Equipment	Daily Hours operated hrs/eqpt/day	TOTAL HOURS hrs	Equipment Horsepower hp	Fuel Type	BSFC lb/hp-hr	TAF Assignment ¹	Load Factor ²	BSFC TAF ¹	BSFC _{adj}	HAP Emission Factors (lb/MMBtu) ³					
										Benzene	Toluene	Xylenes	Propylene	Acrolein	PAHs
D-7 Dozer	8	11,262	240	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
D-8 Dozer	8	22,022	310	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
D-8 Ripper	8	0	310	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
D-5 Tow	8	2,010	120	Diesel	0.367	None	0.43	1	0.3670	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
D-7 Tow	8	1,005	240	Diesel	0.367	None	0.43	1	0.3670	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
D-6 Tack	8	3,502	200	Diesel	0.367	None	0.43	1	0.3670	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
CAT 225	8	5,387	150	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
CAT 235	8	20,088	250	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
CAT 235 w/ Hammer	8	0	260	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Bending Machine 22-36	8	456	159	Diesel	0.367	None	0.43	1	0.3670	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Crane LS-98A (35 ton)	8	0	230	Diesel	0.367	None	0.43	1	0.3670	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Farm Tractor	8	2,334	60	Diesel	0.408	Hi	0.59	1.01	0.4121	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Frontend Loader 977	8	2,334	190	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Motor Grader 14G	8	2,334	200	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Sideboom 571	8	456	200	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Sideboom 572	8	1,005	230	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Sideboom 583	8	12,227	310	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Sideboom 594	8	4,019	410	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Air Compressor 1750 cfm	8	4,653	50	Gasoline	0.484	None	0.56	1	0.4840	N/A	N/A	N/A	N/A	N/A	N/A
Pump - 3"	8	1,005	20	Gasoline	0.868	None	0.69	1	0.8680	N/A	N/A	N/A	N/A	N/A	N/A
Pump - 6"	8	9,043	40	Gasoline	0.484	None	0.69	1	0.4840	N/A	N/A	N/A	N/A	N/A	N/A
Emergency Engines	8	5,202	10	Gasoline	0.868	None	0.68	1	0.8680	N/A	N/A	N/A	N/A	N/A	N/A
TOTAL (Tons)															

NOTES:

- Note 1: Transient Adjustment Factors and TAF assignment and from Table A3 of "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.
 Note 2: Load factor from Appendix A of "Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling", April 2004, EPA-420-P-04-005. TAF Assignment of Hi/Lo is based on the Load Factor.
 Note 3: Emission factors (lb/MMBtu) from AP-42 Section 3.3, Table 3.3-2. Note that HAP emission factors for gasoline fired engines are not available.
 Note 4: Tons are calculated using 7.05 lb/gal from AP-42 Appendix A and 5.825 MMBtu/barrel from Table 13.1 of The Climate Registry Genral Reporting Protocol version 1.0

Pipeline Construction: HAP Emissions from Non-Road Engines

Equipment	HAP Emission Factors (lb/MMBtu) ³			2011 HAP Emissions (Tons) ⁴								
	1,3-Butadiene	Formaldehyde	Acetaldehyde	Benzene	Toluene	Xylenes	Propylene	Acrolein	PAHs	1,3-Butadiene	Formaldehyde	Acetaldehyde
D-7 Dozer	3.91E-05	1.18E-03	7.67E-04	9.19E-03	4.03E-03	2.81E-03	2.54E-02	9.12E-04	1.66E-03	3.85E-04	1.16E-02	7.56E-03
D-8 Dozer	3.91E-05	1.18E-03	7.67E-04	2.32E-02	1.02E-02	7.09E-03	6.42E-02	2.30E-03	4.18E-03	9.73E-04	2.94E-02	1.91E-02
D-8 Ripper	3.91E-05	1.18E-03	7.67E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D-5 Tow	3.91E-05	1.18E-03	7.67E-04	8.12E-04	3.56E-04	2.48E-04	2.25E-03	8.05E-05	1.46E-04	3.40E-05	1.03E-03	6.68E-04
D-7 Tow	3.91E-05	1.18E-03	7.67E-04	8.12E-04	3.56E-04	2.48E-04	2.25E-03	8.05E-05	1.46E-04	3.40E-05	1.03E-03	6.68E-04
D-6 Tack	3.91E-05	1.18E-03	7.67E-04	2.36E-03	1.03E-03	7.21E-04	6.52E-03	2.34E-04	4.25E-04	9.88E-05	2.98E-03	1.94E-03
CAT 225	3.91E-05	1.18E-03	7.67E-04	2.75E-03	1.21E-03	8.40E-04	7.60E-03	2.73E-04	4.95E-04	1.15E-04	3.48E-03	2.26E-03
CAT 235	3.91E-05	1.18E-03	7.67E-04	1.71E-02	7.49E-03	5.22E-03	4.72E-02	1.69E-03	3.08E-03	7.16E-04	2.16E-02	1.40E-02
CAT 235 w/ Hammer	3.91E-05	1.18E-03	7.67E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bending Machine 22-36	3.91E-05	1.18E-03	7.67E-04	2.44E-04	1.07E-04	7.46E-05	6.75E-04	2.42E-05	4.40E-05	1.02E-05	3.09E-04	2.01E-04
Crane LS-98A (35 ton)	3.91E-05	1.18E-03	7.67E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Farm Tractor	3.91E-05	1.18E-03	7.67E-04	5.30E-04	2.32E-04	1.62E-04	1.46E-03	5.25E-05	9.54E-05	2.22E-05	6.70E-04	4.35E-04
Frontend Loader 977	3.91E-05	1.18E-03	7.67E-04	1.51E-03	6.61E-04	4.61E-04	4.17E-03	1.50E-04	2.72E-04	6.32E-05	1.91E-03	1.24E-03
Motor Grader 14G	3.91E-05	1.18E-03	7.67E-04	1.59E-03	6.96E-04	4.85E-04	4.39E-03	1.57E-04	2.86E-04	6.66E-05	2.01E-03	1.31E-03
Sideboom 571	3.91E-05	1.18E-03	7.67E-04	3.10E-04	1.36E-04	9.48E-05	8.58E-04	3.08E-05	5.59E-05	1.30E-05	3.92E-04	2.55E-04
Sideboom 572	3.91E-05	1.18E-03	7.67E-04	7.86E-04	3.45E-04	2.40E-04	2.17E-03	7.79E-05	1.42E-04	3.29E-05	9.94E-04	6.46E-04
Sideboom 583	3.91E-05	1.18E-03	7.67E-04	1.29E-02	5.65E-03	3.94E-03	3.57E-02	1.28E-03	2.32E-03	5.40E-04	1.63E-02	1.06E-02
Sideboom 594	3.91E-05	1.18E-03	7.67E-04	5.61E-03	2.46E-03	1.71E-03	1.55E-02	5.56E-04	1.01E-03	2.35E-04	7.09E-03	4.61E-03
Air Compressor 1750 cfm	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pump - 3"	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pump - 6"	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Emergency Engines	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
TOTAL (Tons)				7.97E-02	3.49E-02	2.43E-02	2.20E-01	7.90E-03	1.44E-02	3.34E-03	1.01E-01	6.55E-02

Pipeline Construction: Criteria and GHG Emissions from On-Road Vehicles

Equipment	Daily Hours operated hr/eqpt/day	Units per spread	Days for 2 BPA Counties (Jefferson + Hardin)	Units per spread	Days for 2 BPA Counties (Jefferson + Hardin)	Units per spread	Days for 2 BPA Counties (Jefferson + Hardin)	Vehicle Class ¹	2011 Miles traveled ²	Fuel Type	Emissions	
		Pre-welding days (21 days)		Welding days (61 days)		Clean-up days (49 days)					VOC	CO
Automobile	2	20	20	50	57	20	60	LDGV	222,300	Diesel	0.627	12.7
Bus	3	2	20	7	57	1	60	URBANBUS	37,433	Diesel	0.257	2.121
Pickup 4x4	5	20	20	100	57	20	60	LDGV	912,000	Diesel	0.627	12.7
Welding Rig	10	0	20	30	57	5	60	LDGV	501,875	Diesel	0.627	12.7
Winch Truck	8	3	20	3	57		60	HDDV3	46,380	Diesel	0.16	0.541
Dump Truck	8	1	20	1	57	1	60	HDDV3	27,360	Diesel	0.16	0.541
Flatbed Truck	9	1	20	8	57	2	60	HDDV3	133,943	Diesel	0.16	0.541
Fuel Truck	10	1	20	2	57	2	60	HDDV3	63,325	Diesel	0.16	0.541
Grease Truck	10	1	20	1	57	1	60	HDDV3	34,200	Diesel	0.16	0.541
Mechanic Rig	10	1	20	1	57	1	60	HDDV2B	34,200	Diesel	0.149	0.508
Skid Truck	10	1	20	1	57	0	60	HDDV3	19,325	Diesel	0.16	0.541
Stringing Tr. & Tr.	10	0	20	15	57	0	60	HDDV3	213,750	Diesel	0.16	0.541
Tuck. & Float	10	0	20	9	57	5	60	HDDV3	202,625	Diesel	0.16	0.541
Truck & Lowboy	10	5	20	5	57	2	60	HDDV3	126,375	Diesel	0.16	0.541
TOTAL (Tons)												

NOTES:

Note 1: Vehicle Classes were taken from Mobile6.2 based on estimated gross weight of the vehicle.

Note 2: Vehicle miles traveled are based on an assumed 25 mi/hr on average/ vehicle based on arterial roads.

Note 3: Emission factors from Mobile6.2.

Note 4: Emission Factors from Table 13.4 of The Climate Registry General Reporting Protocol Version 1.1 applicable to "Diesel Heavy Duty Vehicles" all model year vehicles.

Note that Efs applicable to light duty gasoline vehicles was used for the vehicle category "automobiles" (MY 2000).

Note 5: Carbon dioxide equivalents calculated using IPCC Second Assessment Report (SAR) Global Warming Potentials CO2 = 1, CH4 = 21, N2O = 310.

$$CO2e = CO2 + (CH4 * 21) + (N2O * 310)$$

Pipeline Construction: Criteria and GHG Emissions from On-Road Vehicles

Equipment	Criteria Pollutants			Greenhouse Gasses			2011 Emissions (Tons)								
	Emission Factor (g/VMT) ³			Ef (g/mile)			Criteria Pollutants					Greenhouse Gasses			
	NOx	SO ₂	PM	CO ₂ ³	CH ₄ ⁴	N ₂ O ⁴	VOC	CO	NOx	SO ₂	PM	CO ₂	CH ₄	N ₂ O	CO ₂ e ⁵
Automobile	0.588	0.0068	0.0249	368.1	0.0273	0.0178	0.1536	3.1121	0.1441	0.0017	0.01	90.20	6.69E-03	4.36E-03	91.69
Bus	10.677	0.0218	0.226	2342.9	0.0051	0.0048	0.0106	0.0875	0.4406	0.0009	0.01	96.67	2.10E-04	1.98E-04	96.74
Pickup 4x4	0.588	0.0068	0.0249	368.1	0.0273	0.0178	0.6303	12.7674	0.5911	0.0068	0.03	370.05	2.74E-02	1.79E-02	376.18
Welding Rig	0.588	0.0068	0.0249	368.1	0.0273	0.0178	0.3469	7.0259	0.3253	0.0038	0.01	203.64	1.51E-02	9.85E-03	207.01
Winch Truck	2.319	0.0082	0.0848	875.4	0.0051	0.0048	0.0082	0.0277	0.1186	0.0004	0.00	44.76	2.61E-04	2.45E-04	44.84
Dump Truck	2.319	0.0082	0.0848	875.4	0.0051	0.0048	0.0048	0.0163	0.0699	0.0002	0.00	26.40	1.54E-04	1.45E-04	26.45
Flatbed Truck	2.319	0.0082	0.0848	875.4	0.0051	0.0048	0.0236	0.0799	0.3424	0.0012	0.01	129.25	7.53E-04	7.09E-04	129.49
Fuel Truck	2.319	0.0082	0.0848	875.4	0.0051	0.0048	0.0112	0.0378	0.1619	0.0006	0.01	61.11	3.56E-04	3.35E-04	61.22
Grease Truck	2.319	0.0082	0.0848	875.4	0.0051	0.0048	0.0060	0.0204	0.0874	0.0003	0.00	33.00	1.92E-04	1.81E-04	33.06
Mechanic Rig	2.182	0.0074	0.0966	789.4	0.0051	0.0048	0.0056	0.0192	0.0823	0.0003	0.00	29.76	1.92E-04	1.81E-04	29.82
Skid Truck	2.319	0.0082	0.0848	875.4	0.0051	0.0048	0.0034	0.0115	0.0494	0.0002	0.00	18.65	1.09E-04	1.02E-04	18.68
Stringing Tr. & Tr.	2.319	0.0082	0.0848	875.4	0.0051	0.0048	0.0377	0.1275	0.5464	0.0019	0.02	206.26	1.20E-03	1.13E-03	206.64
Tuck. & Float	2.319	0.0082	0.0848	875.4	0.0051	0.0048	0.0357	0.1208	0.5180	0.0018	0.02	195.53	1.14E-03	1.07E-03	195.88
Truck & Lowboy	2.319	0.0082	0.0848	875.4	0.0051	0.0048	0.0223	0.0754	0.3230	0.0011	0.01	121.95	7.10E-04	6.69E-04	122.17
TOTAL (Tons)							1.300	23.529	3.800	0.021	0.139	1627.23	5.45E-02	3.71E-02	#####

Pipeline Construction: HAP Emissions from On-Road Vehicles

Equipment	Daily Hours operated	Vehicle Class ¹	2011 Miles traveled/year ²	Fuel Type	Hazardous Air Pollutants				
	hr/eqpt/day		miles/yr		Emission Factor (mg/VMT) ³				
					Acetaldehyde	Acrolein	Benzene	1,3-butadiene	Formaldehyde
Automobile	2	LDGV	222,300	Diesel	4.04	0.24	16.45	2.04	4.51
Bus	3	URBANBUS	37,433	Diesel	7.75	0.94	2.83	1.64	21.05
Pickup 4x4	5	LDGV	912,000	Diesel	4.04	0.24	16.45	2.04	4.51
Welding Rig	10	LDGV	501,875	Diesel	4.04	0.24	16.45	2.04	4.51
Winch Truck	8	HDDV3	46,380	Diesel	3.78	0.32	9.09	0.94	6.11
Dump Truck	8	HDDV3	27,360	Diesel	3.78	0.32	9.09	0.94	6.11
Flatbed Truck	9	HDDV3	133,943	Diesel	3.78	0.32	9.09	0.94	6.11
Fuel Truck	10	HDDV3	63,325	Diesel	3.78	0.32	9.09	0.94	6.11
Grease Truck	10	HDDV3	34,200	Diesel	3.78	0.32	9.09	0.94	6.11
Mechanic Rig	10	HDDV2B	34,200	Diesel	3.74	0.29	9.34	0.89	5.92
Skid Truck	10	HDDV3	19,325	Diesel	3.78	0.32	9.09	0.94	6.11
Stringing Tr. & Tr.	10	HDDV3	213,750	Diesel	3.78	0.32	9.09	0.94	6.11
Tuck. & Float	10	HDDV3	202,625	Diesel	3.78	0.32	9.09	0.94	6.11
Truck & Lowboy	10	HDDV3	126,375	Diesel	3.78	0.32	9.09	0.94	6.11
TOTAL (Tons)									

NOTES:

Note 1: Vehicle Classes were taken from Mobile6.2 based on estimated gross weight of the vehicle.

Note 2: Vehicle miles traveled are based on an assumed 25 mi/hr on average/ vehicle based on arterial roads.

Note 3: HAP Emission factors taken from Mobile6.2

Pipeline Construction: HAP Emissions from On-Road Vehicles

Equipment	Hazardous Air Pollutants				
	2011 Emissions (Tons)				
	Acetaldehyde	Acrolein	Benzene	1,3-butadiene	Formaldehyde
Automobile	9.90E-04	5.88E-05	4.03E-03	5.00E-04	1.11E-03
Bus	3.20E-04	3.88E-05	1.17E-04	6.77E-05	8.69E-04
Pickup 4x4	4.06E-03	2.41E-04	1.65E-02	2.05E-03	4.53E-03
Welding Rig	2.23E-03	1.33E-04	9.10E-03	1.13E-03	2.49E-03
Winch Truck	1.93E-04	1.64E-05	4.65E-04	4.81E-05	3.12E-04
Dump Truck	1.14E-04	9.65E-06	2.74E-04	2.83E-05	1.84E-04
Flatbed Truck	5.58E-04	4.72E-05	1.34E-03	1.39E-04	9.02E-04
Fuel Truck	2.64E-04	2.23E-05	6.35E-04	6.56E-05	4.26E-04
Grease Truck	1.43E-04	1.21E-05	3.43E-04	3.54E-05	2.30E-04
Mechanic Rig	1.41E-04	1.09E-05	3.52E-04	3.36E-05	2.23E-04
Skid Truck	8.05E-05	6.82E-06	1.94E-04	2.00E-05	1.30E-04
Stringing Tr. & Tr.	8.91E-04	7.54E-05	2.14E-03	2.21E-04	1.44E-03
Tuck. & Float	8.44E-04	7.15E-05	2.03E-03	2.10E-04	1.36E-03
Truck & Lowboy	5.27E-04	4.46E-05	1.27E-03	1.31E-04	8.51E-04
TOTAL (Tons)	0.0114	0.0008	0.0388	0.0047	0.0151

Pipeline Construction: Emissions from Slash/Brush Burning

Volume and Area of Prescribed Burning		
1 cu. Yd.	=	0.00062 acre-foot
1654385 cu. yd.	=	1025.72 acre-foot
Area disturbed/ burned	=	683.81 acre

Vegetation Type Distribution		
Tree Tops/Stumps	=	50% ^(a)
Hay/Gass	=	50% ^(a)

Fuel Load Emission Factor		
Hay/grass	=	1.0 ton/acre ^(b)
Tree Tops and Stumps	=	9.0 ton/acre ^(c)

Weight of Wood/Hay Burned		
Hay/grass	=	0.00 tons
Tree Tops and Stumps	=	3,077.16 tons

Note: Hay/grass will not be burned during construction.

Emission factors for wildfire, prescribed burning and slash burns calculated under dry conditions for each fuel component ^(d)										
Fuel Component	Emission factor (lb/ton)									
	% of total Vegetation	CO	CH ₄	NMHC	PM	PM _{2.5}	PM ₁₀	CO ₂	NO _x	NH ₃
Litter, Wood 0-1"	25%	52	3	6	15	8	9	3483	2.5	0.5
Wood 1-3"	25%	111	6	9	20	12	14	3373	2.5	1.1
Wood 3+"	25%	174	9	12	26	16	19	3263	2.5	1.7
Herb, Shrub	25%	249	12	16	33	21	25	3116	2.5	2.6

Emission from prescribed wood burning									
Fuel Component	Emissions (tons)								
	CO	CH ₄	NMHC	PM	PM _{2.5}	PM ₁₀	CO ₂	NO _x	NH ₃
Litter, Wood 0-1"	20.00	1.15	2.31	5.77	3.08	3.46	1339.72	0.96	0.19
Wood 1-3"	42.70	2.31	3.46	7.69	4.62	5.39	1297.41	0.96	0.42
Wood 3+"	66.93	3.46	4.62	10.00	6.15	7.31	1255.10	0.96	0.65
Herb, Shrub	95.78	4.62	6.15	12.69	8.08	9.62	1198.55	0.96	1.00
TOTAL	225.40	11.54	16.54	36.16	21.92	25.77	5090.77	3.85	2.27

Emission factors for crop residue burning ^(e)									
Crop Residue	Emission factor (lb/ton)								
	CO	CH ₄	NMHC	PM	PM _{2.5}	PM ₁₀	CO ₂ ^(f)	NO _x	NH ₃
Hay/Grasses	204.3	6.3	32.7	17.6	17.4	16.9	-	5.1	6.7

Emissions from crop residue burning									
Crop Residue	Emissions (tons)								
	CO	CH ₄	NMHC	PM	PM _{2.5}	PM ₁₀	CO ₂	NO _x	NH ₃
Hay/Grasses	0.00	0.00	0.00	0.00	0.00	0.00	-	0.00	0.00

Emissions from prescribed burning and crop residue burning									
	CO	CH ₄	NMHC	PM	PM _{2.5}	PM ₁₀	CO ₂	NO _x	NH ₃
TOTAL	225.40	11.54	16.54	36.16	21.92	25.77	5,090.77	3.85	2.27

NOTES:

(a) Taken from http://www.tpwd.state.tx.us/publications/pwdpubs/media/pwd_mp_e0100_1070n_08.pdf.

(b) Taken from Table 5 of Dennis A., Fraser, M., Anderson, S., Allen, D., 2002. Air pollutant emissions associated with forest, grassland, and agricultural burning in Texas. Atmospheric Environment, 36, pp. 3779-3792.

(c) Fuel loading value of tree tops and stumps taken from AP-42 Table 13.1-1. Value applicable to southern region (Region 8) were used.

(d) Taken from Table 2 and 3 of Dennis A., Fraser, M., Anderson, S., Allen, D., 2002. Air pollutant emissions associated with forest, grassland, and agricultural burning in Texas. Atmospheric Environment, 36, pp. 3779-3792.

(e) Taken from Table 6 of Dennis A., Fraser, M., Anderson, S., Allen, D., 2002. Air pollutant emissions associated with forest, grassland, and agricultural burning in Texas. Atmospheric Environment, 36, pp. 3779-3792.

(f) Emission factor of CO₂ for hay/grass burning was not available.

PM EMISSIONS FROM LAND DISTURBED: Pipeline

2011 Activities		
Area Name:	Pipeline	
Area of Land Disturbance over the total months of construction (acres):	566.1	
Months of Construction Activity (May-September 2011) ⁽¹⁾ :	5	
	total tons ⁽²⁾	tons/month
PM2.5	50.9	10.2
PM10	339.7	67.9
PM30	679.3	135.9

Factor	Heavy Construction Operations			Notes
	PM2.5	PM10	PM30	
tons/acre/month	0.09	0.60	1.20	(3)
From AP-42, Section 13.2.3 Heavy Construction Operations:				
For construction activity operations:				
E = 1.2 tons/acre/month of activity				

NOTES:

(1) Construction is projected to occur over 5 months.

(2) Total tons is for entire construction duration, which is expected to be over an 5 month period. PM2.5 is particulate matter less than 2.5 microns. PM10 is particulate matter less than 10 microns. PM30 is particulate matter less than 30 microns.

(3) From AP-42 Section 13.2.3.3. Note that a factor of 1.2 ton/acre/month is conservatively high for TSP since it assumes that construction occurs over 30 days of the month which is not true in this case. Particle size multiplier (k) of 0.5 and 0.075 were used to determine the fraction of PM10 and PM2.5, respectively (taken from AP-42 Section 13.2.5.3).

PERSONNEL COMMUTE-PM EMISSIONS FROM PAVED ROADS: Pipeline

Worker Vehicle Emissions

Number of Roundtrips for 2011	2,575,090 miles for 2011	(1)
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Emissions = VMT roundtrip/trip * 'X' trips for the construction period / 2000

All Paved Roads			
Emissions (ton/year)	PM2.5	PM10	PM30 (TSP)
2011	0.18	1.87	11.90

All Paved Roads				Notes
Emission Factor	PM2.5	PM10	PM30	
lb/VMT	0.0001	0.0015	0.0092	(2)

From AP-42, Section 13.2.1 Paved Roads:

For all paved roads:

$$E = \{ [k * ((sL/2)^{0.65}) * (W/3)^{1.5}] - C \} * (1 - P/4N)$$

where

E = size specific emission factor (lb/VMT)

k = particulate size multiplier

sL = road surface silt loading (g/m²)

W = mean vehicle weight (tons)

C = emission factor for 1980's vehicle fleet exhaust, brake wear, and tire wear.

P = number of wet days with at least 0.254 mm (0.01 in) of precipitation during the averaging period, and

N = number of days in the averaging period

Parameter	All Paved Roads 2011			Notes
	PM2.5	PM10	PM30	
k	0.004	0.016	0.082	(3)
sL	0.2	0.2	0.2	(4)
W	2.1	2.1	2.1	(5)
C	0.00036	0.00047	0.00047	(6)

NOTES:

(1) Number of personnel is assumed to be a constant during the entire construction schedule.

(2) Derived from equation, based on lb/VMT, P=120 from Figure 13.2.1-2, N=365

(3) From AP-42 Table 13.2-1.1 in lb/VMT.

(4) Silt content taken from AP-42 Table 13.2.1-3 for 500-5,000 ADT ubiquitous baseline.

(5) Average worker vehicle weight based on average car or light duty truck sold in the US last year 4,144 pounds from EPA. 4,144 pounds = 2.07 tons

(6) From AP-42 Table 13.2-1.2 in lb/VMT.