DEPARTMENT OF ENERGY
National Nuclear Security Administration
Los Alamos Site Office
Los Alamos, New Mexico 87544

Mr. John Kieling
Permits Management Program
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303

Subject: Transmittal of the Los Alamos National Laboratory (LANL) Technical Area (TA) 16 Burn Ground Air Pathway Assessment Report, Revision 0

Dear Mr. Kieling:

The purpose of this letter is to transmit the National Nuclear Security Administration (NNSA) and the Los Alamos National Security, LLC (LANS) TA-16 Burn Ground Air Pathway Assessment Report describing results from air modeling conducted for the two open burn Resource Conservation and Recovery Act (RCRA) treatment units at TA-16. This report includes dispersion and deposition modeling information, modeling results, and the impacts analysis based on the modeling results. The revised modeling protocol document and a response to a notice of deficiency (NOD) associated with the protocol document were transmitted to your office on May 31, 2007. These documents clarified information on input parameters for the modeling, further explained some technical issues for the air dispersion pathway analysis, analyzed the effects of plume rise, and committed to conducting and updating ground level deposition analysis.

As detailed in the letter transmitting the modeling protocol and NOD response, it was agreed that LANL would transmit the model report during the first public comment period for the draft renewed LANL Hazardous Waste Facility Permit to be issued in August 2007. An unofficial copy of this report was also transmitted to Rebecca Kay of your office via email on Friday August 24, 2007. If you should have any questions or concerns regarding this submittal, please feel free to contact me at (505) 667-5794 or Jack Ellvinger, LANS, at (505) 667-0633.

Sincerely,

Gene Turner
Environmental Permitting Manager

cc: See page 2

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Author(s): Water Quality and RCRA Group
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Form 836 (7/06)

1.0 Introduction

The Technical Area 16 (TA-16) Burn Ground consists of two units operating under Resource Conservation and Recovery Act (RCRA) interim status:

- the TA-16-399 Burn Tray, which is used to treat bulk dry high explosives (HE) and
- the TA-16-388 Flash Pad, which is used primarily to treat wet HE, combustibles, or other HE-contaminated materials using an external heat source (propane) but can also be used to treat HE.

When Revision 4.0 of the Los Alamos National Laboratory (LANL) TA-16 Part B Permit Renewal Application (LANL, 2003) was submitted to the New Mexico Environment Department (NMED), open burning impacts from the treatment of RCRA wastes were subject to an air permit issued under the NMED's Open Burning Regulation within New Mexico Administrative Code, Title 20, Chapter 2, Part 60 (20.2.60 NMAC). The TA-16 RCRA application referenced the air permit as the means of assessing and regulating air emissions impacts. In 2003, the Open Burning regulation changed to exclude all burning activities covered under RCRA and the Open Burning permit for the TA-16 Burn Ground was withdrawn. This air quality impacts analysis has been developed to support the Technical Area 16 Part B Permit Renewal Application (LANL, 2003) in the absence of an air permit. To provide conservative impacts estimates, this analysis assumes higher quantities of waste treated and more frequent burns than actually occur, and worst-case emission factors. The waste quantities are approximately ten times the amount of waste that is currently burned. These higher levels will not be treated, but provide a conservative analysis. The air quality impacts analysis based on ultra-conservative parameters is presented in Section 2.

LANL previously submitted a deposition modeling analysis based on an actual year's burn activity as part of the TA-16 Part B Permit Renewal Application (LANL, 2003). The deposition modeling has been rerun with the same worst-case assumptions used for the air dispersion modeling, to provide an equally conservative deposition impacts analysis. The deposition modeling analysis is described in Section 3. An analysis of potential solvent releases, as requested by NMED and described in the TA-16 Air Pathway Assessment Protocol, Revision 1.0 (LANL, 2007), is contained in Section 4.

Both the air quality impacts and deposition analyses were conducted using the CALPUFF (Scire et. al., 2000) modeling package. The rationale for choosing CALPUFF is described in the protocol document (LANL, 2007), submitted to NMED on May 31, 2007.

1.1 Protocol Variances

The air and deposition impacts analyses were conducted in accordance with the protocol except for two minor changes. The 1995 meteorological data were not available in a format that could be processed by CALMET, the meteorological model associated with CALPUFF. Meteorological data from 1999 were available in a CALMET-processed file and were used. Also, the TA-16 Burn Ground Units are too small an area for CALPUFF to model as an area source, so they were modeled as point sources.

2.0 Air Quality Modeling

The first step in performing the air quality modeling was to determine which unit/waste combinations had the worst case impacts. These results are discussed in Section 2.1. The second step was to use the worst-case unit/waste conditions to calculate air quality impacts, which are discussed in Section 2.2. Parameters not specifically addressed within this report are discussed in the modeling protocol (LANL, 2007), submitted March 31, 2007.

2.1 Unit/Waste-Specific Modeling Scenarios

The two units, TA-16-388 and TA-16-399, treat different amounts and types of waste which affect the amount of pollutants emitted as well as the plume rise and dispersion from each unit. The first step in the modeling was to determine which units/wastes created the worst case on-site and off-site impacts for each averaging period. The modeling protocol proposed to evaluate the impacts of burning 1000 pounds (lb) of HE at TA-16-399, 250 lb of HE at TA-16-388, and propane-assisted burning of less energetic HE-contaminated materials at TA-16-388. The first two scenarios were refined by evaluating both an HE that burned rapidly at high temperatures and an HE that burned less rapidly and at lower temperatures to provide an upper and lower bound for vertical plume velocity. These are referred to in the protocol and report as a “maximum lofting” and “minimum lofting” scenarios. The modeling runs confirmed that the minimum lofting HE had the highest impacts on-site and at some nearby off-site locations but that overall the maximum lofting HE had the highest impacts at more distant off-site receptors. Figures 2-1 through 2-4 show the effect of maximum and minimum lofting on air concentrations.

For the HE-only burns, Composition B (COMPB), which is 60 percent by weight (wt. %) cyclonite (RDX) and 40 wt. % trinitrotoluene (TNT), was used to represent a high energy release (high heat of combustion and burn rate) waste to maximize plume rise. PBX 9501 (95 wt% Cyclotetramethylenetetranitramine (HMX) and 5 wt. % inert binder) was used as a lower energy release waste to minimize plume rise. These explosives were selected because experimental data on their burning characteristics was available to calculate vertical velocity. Similar data is not available for the pure explosives such as TNT. For the propane-assisted scenario with less energetic wastes (e.g., HE-contaminated materials, PBX 9502), the energy releases were calculated assuming that the heat released was only from the propane used at TA-16-388 to improve burning; it does not take credit for the energy and additional plume rise caused by the burning waste material.

All modeling runs assumed the following:

- Each burn occurs in < 1 hour (hr) to provide the most conservative short-term impacts.
- Burns are separated by at least 1 hour of preparation time.
- Two burns a day would be conducted 5 days a week. In fact, TA-16 Burn Ground typically burns waste once or twice a week.

- Specific burn times were randomly sampled from an annual set of hourly meteorology data to begin during daytime hours and allow at least 1 hr of preparation time between burns. Burn times were restricted to hours with winds $\leq$ 15 miles per hr, similar to actual conditions when burning occurs. This resulted in 508 hours of meteorological data used in the analysis.
- A 20 kilometer (km) by 20 km receptor grid was centered on the Burn Ground, with receptors spaced at 100 meter (m) intervals. Additional discrete receptors at public areas such as residential areas, hospitals, and Bandelier National Monument were included.
- Receptor elevations were determined from Digital Elevation Model (DEM) data imported into the model.
- A standard 1 gram per second (g/s) emission rate was used to obtain the conversion factor that is applied to pollutant-specific emission rates in Section 2.2.

Section 4.3 of the modeling protocol (LANL, 2007) describes the source-specific information required to calculate vertical velocity:

$$w_s = \frac{H_c R}{P_a\, c_p A_s (T_s - T_a)}$$

where

w_s is the vertical velocity (m/s),
H_c is the heat of combustion for a given material (HE or propane) type in Joules per kilogram (J/kg)
R is the burn rate (kg/s)
P_a is the density of ambient air in kilograms per cubic meter (kg/m^3)
c_p is the constant-pressure heat capacity of air in Joules per kilogram-Kelvin (J/kg-K)
A_s is the source area in square meters (m^2)
T_s is the exit gas temperature in Kelvin (K)
T_a is the ambient air temperature in (K)

The assumptions used to calculate vertical velocity and the values for each variable follow. The vertical velocities calculated using these variables are shown in Table 2-1.

- H_c is unique to the type of material burned. The heats of combustion for the HE used in this analysis were obtained from Gibbs and Popolato (1980) for pure HE and adjusted for inert constituents.
  - 8.87 million J/kg (MJ/kg) was used for PBX 9501
  - 11.58 MJ/kg was used for COMPB
  - The heat content of propane was assumed to be 1 million British Thermal Units (MBtu) per 15.7 gallons (gal) (Glover, 1998).

- R can be expressed as M_b/t_b, where M_b is the amount of material burned in a given time period and t_b is the burn time for specific materials determined from the referenced literature.
  - For the HE burning scenarios, the maximum allowable HE unit limits were used for M_b:
    - 1000 lb (453.6 kg) per burn for TA-16-399
    - 250 lb (113.4 kg) per burn for TA-16-388
  - The values for t_b vary by the type of material being burned.
    - For PBX 9501, used in the minimum lofting HE scenarios for both units the burn time used was 8 minutes (28,800 s) (Hatler, 1982) based on measurements for burning solids.
    - For COMPB, the HE used for the maximum lofting HE scenarios for both units, the burn time used was estimated to be 1.5 minutes (5400 s). This was based on data for chips of COMPB (Hatler, 1982) adjusted to reflect the slower burn time for a solid composition. Other data in this reference for PBX 9501 or PBX 9502 show that solids burn 2 to 4 times longer than the same HE burned as chips. The COMPB burn time was adjusted accordingly.
  - Specific M_b and t_s were not necessary for propane because the propane-only scenario for TA-16-388 assumed a burn rate of 1 gal per minute (gal/min) based on operational observations.

- Dry air density at 7200 feet (ft) (P_a = 0.913 kg/m^3) was calculated using the ideal gas law to adjust air density at standard conditions (Stull, 1988) to 7200 ft (T_a).

- The heat capacity of air (c_p = 1004.67 J/kg/K) was obtained from Stull (1988).

- Air temperatures (T_a) of 35 degrees Fahrenheit (^{o}F) were used to calculate the minimum vertical velocities and 85 ºF was used to calculate the maximum vertical velocities for both units.

- T_s values were obtained from experimental data (Hatler, 1982).
  - Based on direct thermocouple measurements, 993 K was used for PBX 9501.
  - Temperature measurements were only available for COMPB chips so the COMPB T_s was estimated to be 1840 K. The estimation was based on PBX 9501 and PBX 9502 solid HE temperature measurements applied to the COMP chip data in a manner similar to the description above for t_b.

- A_s is based on the size of the tray used to treat M_b:

  - TA-16-388, 4 ft × 8 ft = 32 square feet (ft^2) = 2.97 m^2
  - TA-16-399, 4 ft x 16 ft = 64 ft^2 = 5.95 m^2

Other source-specific variables required by CALPUFF, but not required for calculating vertical velocity, are the effective radius (r_{eff}) and release height. The r_{eff} (r_{eff} = *square root(A/π)*) for TA-16-388 is 0.97 m^2 and for TA-16-399 it is 1.38 m^2. The release height

is defined as the height of the base of the burn tray + r_{eff} : 1.47 m for TA-16-388 (using a base tray height of 0.5 m) and 2.38 m for TA-16-399 (using a tray base height of 1 m). Finally, data specific to the unit location are required: UTM Zone 13 coordinates and the ground elevation in m above mean sea level (m MSL), which are shown in Table 2-2.

As requested by NMED, LANL is providing an electronic copy of model run input and output along with the program files as part of this report. Source-specific information is described above and the model runs provide model flag settings and other general information.

2.2 Air Quality Impacts Calculations

CALPUFF estimates air quality impacts in micrograms per cubic meter (µg/m^3) for a 1 g/s emission rate. From these estimates, a conversion factor (CF) in µg/m^3 per g/s of a pollutant emitted is calculated for each screening level averaging period. However, to determine which unit has the highest impacts at various locations for the short-term averaging periods, the CF must be weighted by the maximum amount of waste that can be burned at each unit: 250 lb at TA-16-388 and 1000 lb at TA-16-399. The annual averaging period assumes that 20,000 lb of waste and 15,000 gal of propane are burned at the most conservative unit and the burn size is not considered in calculating impacts. Because the fuel amount burned at TA-16-399 is four times higher than at TA-16-388, the TA-16-399 conversion factors were multiplied by 4 and compared to the TA-16-388 conversion factors. Table 2-3 shows the averaging period and location for the worst-case CFs. Ambient air impacts were calculated using the unit-specific amount of fuel burned, and the emission factors described in the modeling protocol (LANL, 2007). In accordance with the protocol, the calculated impacts have been compared to the following screening levels in Tables 2-7 through 2-10:

- The NMED and the Environmental Protection Agency's (EPA's) ambient air quality standards (AAQS). (Tables 2-8 and 2-10)
- The EPA Region 9 Preliminary Remediation Goals (PRGs) (EPA, 2004). (Tables 2-9 and 2-10)
- The acute (1 hr) inhalation exposures (AIEC) for toxic air pollutants from the Companion Database to EPA's Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities (EPA, 2005). (Tables 2-7 and 2-8)

CFs were applied to the amounts of waste burned during a specific averaging period. For example, the highest hourly on-site impacts resulted from burning HE at TA-16-388.

The impacts were calculated as follows:

$$\frac{\boldsymbol{EF}\ \text{g pollutant}}{\text{g waste}} \times \frac{454\ \text{g waste}}{\text{lb waste}} \times \frac{250\ \text{lb waste}}{\text{hr}} \times \frac{1\ \text{hr}}{3600\ \text{s}} \times \frac{\boldsymbol{CF}\ \mu\text{g pollutant/m}^3}{\text{g pollutant/s}} = \frac{\boldsymbol{I}\ \mu\text{g pollutant}}{\text{m}^3}$$

where:

EF = emission factors from Table 3-6 in the modeling protocol
CF = conversion factors from g/s of pollutant emitted to µg/m^3 concentrations of the pollutant in air for a 1-hr averaging period
I = calculated air pollutant concentration in µg/m^3

When the averaging periods for the screening levels span 3-hrs, 8-hrs and 24-hrs, two burns are assumed because that would be the maximum amount of waste that could be burned during these time periods. However, the equation doesn't change because the amount of fuel doubles (2 burns = 500 lb of HE) in the numerator and the number of seconds (2 hr = 7200 s) doubles in the denominator, thereby cancelling each other. In addition, propane emissions were not added for the example above or scenarios where burning of HE alone caused the highest impacts (e.g. off-site cases). However, annual impacts assessments assume that 15,000 gal of propane are used and 20,000 lb of burnable waste (HE and combustible wastes) are treated annually. Annual emissions were averaged over 508 hours, the number of meteorological hours modeled, to provide a more conservative estimate than averaging over 520 hours.

Because the types and quantities of wastes treated vary from year-to-year, the impacts analysis used only the worst-case emissions factors (EFs) from Table 3-6 of the modeling protocol (LANL, 2007) for all wastes. This avoids the need to estimate the quantities of each type of waste stream for the next 10 years and results in a conservative air impacts analysis. The EFs from Table 3-5 of the modeling protocol (LANL, 2007) were used for propane. Tables 2-4 and 2-5 calculate the short-term emissions for TA-16-388 and TA-16-399, respectively. Table 2-6 provides the calculated emissions for the annual averaging period.

Tables 2-7 through 2-10 compare the calculated worst-case on- and off-site impacts to the applicable screening levels. Note that not all of the tables have the same contaminants. Some contaminants with AIECs do not have PRGs, and vice versa. The AAQS are evaluated only for off-site impacts, in accordance with the EPA's Draft Final Open Burning/Open Detonation Permitting Guidelines (EPA, 2002) and NMED's air quality requirements. Receptors other than the worst-case on- and off-site impact receptors have lower CFs (see Table 2-3) than the worst-case CFs; therefore, the impacts to these other receptors are lower than the worst-case impacts. Other receptor impacts are lower than the worst-case impact in a ratio of the other receptor's CF divided by the worst-case impact CF for each averaging period.

Table 2-7 compares the calculated worst-case on-site emissions impacts to EPA's AIECs. No screening levels are exceeded and only acrolein approaches the short-term level. The acrolein emission factor was derived from the open burning of fuel oil (e.g., a fuel spill), which was used as a very conservative representative of burning oils and solvents. Oils and solvents are a small waste stream treated rarely at the TA-16 Burn Ground and none of the other waste streams at the Burn Ground have acrolein emission factors. Therefore, acrolein is not an environmental concern.

The short-term off-site impacts are compared to EPA's AIECs and short-term AAQS in Table 2-8. All impacts are below the screening levels. To obtain the final impacts, background values from the New Mexico Air Quality Bureau Air Dispersion Modeling Guidelines (NMED, 2007) were added, as appropriate, to the calculated impacts from the TA-16 Burn Ground.

Table 2-9 compares the annual on-site impacts with EPA's PRGs. As described in the modeling protocol (LANL, 2007), a risk assessment is required if the impacts exceed 0.1 times the PRGs. This conservative analysis shows no exceedences of 0.1 times the PRGs

and no risk assessment is required. The annual off-site impacts are compared with EPA's PRGs and long-term AAQS in Table 2-10. No screening levels are exceeded and the impacts are less than the screening levels, with the exception of Particulate Matter. The estimated impact for Particulate Matter is 26.6 µg/m^3 and the standard is 60 µg/ m^3. The calculated impact from the TA-16 Burn Ground activities is 5.72 E-03. The remaining 26.6 µg/m^3 is the assumed background level in accordance with the NMED's 2007 Modeling Guidelines (NMED, 2007). Therefore, the TA-16 Burn Ground had negligible additive impacts. Based on this analysis, screening levels were not exceeded at any receptor, including the maximum on- and off-site receptors. Therefore, additional analyses are not warranted.

Table 2-1. Vertical Velocities for Unit/Waste Scenarios

TA-16-388	
Maximum Lofting (250 lb COMPB)	3.49 m/s
Minimum Lofting (250 lb PBX 9501)	0.45 m/s
TA-16-399	
Maximum Lofting (1000 lb COMPB)	7.0 m/s
Minimum Lofting (1000 lb PBX 9501)	0.89 m/s

lb = pound(s)
COMPB = Composition B composed of 60 percent by weight (wt. %) cyclonite (RDX) and 40 wt. % trinitrotoluene (TNT)
PBX 9501 = plastic bonded explosive composed of 95 wt. % Cyclotetramethylenetetranitramine (HMX) and 5 wt. % inert binder
m/s = meters per second
gal/min = gallon(s) per minute

Table 2-2. Location-Specific Information

Unit	UTM X-Coordinate	UTM Y-Coordinate	Elevation (m MSL)
TA-16-388 Flash Pad	379720.1133	3967617.404	2286.3
TA-16-399 Burn Tray	379783.1419	3967735.864	2275.03

UTM = Universal Transverse Mercator (UTM)
m MSL = meters above mean sea level

Table 2-3. Unit/Waste Scenarios Creating Maximum Impacts by Averaging Periods

Receptor	Air Impacts Conversion Factors (µg/m^3 per g/s)									
	1 hr	Scenario[1]	3 hr	Scenario	8 hr	Scenario	24 hr	Scenario	Annual	Scenario
Sombrillo Nursing Care	1.09E-01	TA-16-399 HE Max	3.62E-02	TA-16-399 HE Max	1.36E-02	TA-16-399 HE Max	5.03E-03	TA-16-399 HE Min	3.05E-04	TA-16-388 HE Min
Los Alamos Middle School	2.24E-01	TA-16-399 HE Min	8.50E-02	TA-16-399 HE Max	4.80E-02	TA-16-399 HE Min	1.60E-02	TA-16-399 HE Min	5.24E-04	TA-16-399 HE Min
Tsankawi Ruins	4.31E-02	TA-16-399 HE Max	1.54E-02	TA-16-399 HE Max	6.33E-03	TA-16-399 HE Min	2.11E-03	TA-16-399 HE Min	6.70E-05	TA-16-388 HE Min
Bandelier Visitor Center	7.56E-02	TA-16-399 HE Max	2.99E-02	TA-16-399 HE Max	1.41E-02	TA-16-399 HE Max	4.68E-03	TA-16-399 HE Max	7.69E-05	TA-16-388 HE Min
San Ildefonso Pueblo	2.37E-01	TA-16-399 HE Max	1.42E-01	TA-16-399 HE Max	5.36E-02	TA-16-399 HE Max	1.79E-02	TA-16-399 HE Max	3.66E-04	TA-16-388 HE Min
Los Alamos County Hospital	9.90E-01	TA-16-399 HE Min	3.55E-01	TA-16-399 HE Min	1.33E-01	TA-16-399 HE Min	4.49E-02	TA-16-399 HE Min	1.86E-03	TA-16-399 HE Min
Royal Crest Trailer Park	2.80E-01	TA-16-399 HE Max	1.17E-01	TA-16-399 HE Max	4.38E-02	TA-16-399 HE Max	1.46E-02	TA-16-399 HE Max	7.49E-04	TA-16-388 HE Min
Ponderosa Campground	1.92E+00	TA-16-399 HE Min	6.93E-01	TA-16-399 HE Min	2.60E-01	TA-16-399 HE Min	8.76E-02	TA-16-399 HE Min	1.94E-03	TA-16-388 HE Min
HE Max On Site	1.49E+02	TA-16-388 HE Min	4.95E+01	TA-16-388 HE Min	3.41E+01	TA-16-388 HE Min	1.14E+01	TA-16-388 HE Min	1.48E+00	TA-16-388 HE Min
Max Off Site	2.87E+00	TA-16-399 HE Min	9.57E-01	TA-16-399 HE Min	4.19E-01	TA-16-399 HE Min	1.40E-01	TA-16-399 HE Min	5.76E-03	TA-16-388 HE Min

[1] TA-16-388 or TA-16-399 HE Max is based on the explosives Maximum Lofting scenarios. TA-16-388 or TA-16-399 HE Min is based on the Minimum Lofting scenarios. For the short-term impacts, if TA-16-388 is the maximum scenario, impact calculations use 250 lb of waste per burn. If TA-16-399 is the maximum scenario, impact calculations use 1000 lb of waste per burn. TA-16-388 propane was never the most conservative weighted conversion factor. For the annual impacts, 20,000 pounds of wastes and 15,000 pounds of HE were assumed to be burned at the most conservative impact unit.

Table 2-4. Contaminant-Specific Emissions for Short-Term Averaging Times at TA-16-388

Contaminant	Total Waste Burned Over Averaging Period (lb) [1]	Waste Burned (g/s)	Calculated Contaminant Emissions (g/s) [2]
Acenaphthene	250	3.15E+01	3.15E-04
Acetaldehyde	250	3.15E+01	1.99E-03
Acetone	250	3.15E+01	1.10E-03
Acetophenone	250	3.15E+01	5.49E-06
Acrolein	250	3.15E+01	1.23E-03
Aluminum	250	3.15E+01	2.25E-05
Anthracene	250	3.15E+01	4.73E-04
Barium	250	3.15E+01	1.32E-05
Benzaldehyde	250	3.15E+01	3.28E-03
Benzene	250	3.15E+01	3.22E-02
Benzo(a)anthracene	250	3.15E+01	1.58E-04
Benzo(a)pyrene	250	3.15E+01	1.58E-04
Benzo(b,k)fluoranthene	250	3.15E+01	2.21E-04
Benzyl alcohol	250	3.15E+01	1.25E-03
Butadiene [1-3-]	250	3.15E+01	4.22E-05
Butyl benzyl phthalate	250	3.15E+01	3.85E-06
Carbon monoxide - 1 hr	250	3.15E+01	2.84E+00
Carbon monoxide - 8 hr	500	3.15E+01	2.84E+00
Carbon tetrachloride	250	3.15E+01	2.17E-06
Chloromethane (methyl chloride)	250	3.15E+01	8.95E-06
Chromium (total)	250	3.15E+01	1.25E-05
Chrysene	250	3.15E+01	2.84E-04
Crotonaldehyde	250	3.15E+01	1.89E-04
Cyclohexane	250	3.15E+01	8.42E-04
Dibenzo(a,h)anthracene	250	3.15E+01	6.31E-06
Dibutyl phthalate	250	3.15E+01	1.04E-05
Dichloroethylene [1,1-]	250	3.15E+01	6.78E-06
Diethyl phthalate	250	3.15E+01	2.21E-06
Dimethyl phthalate	250	3.15E+01	5.93E-06
Dioctyl phthalate	250	3.15E+01	2.90E-05
Dioxin (2,3,7,8-TCDD)	250	3.15E+01	4.70E-11
Ethylbenzene	250	3.15E+01	1.73E-03
Ethyl chloride	250	3.15E+01	2.17E-06
Fluoranthene	250	3.15E+01	6.31E-04
Fluorene	250	3.15E+01	3.15E-05
Formaldehyde	250	3.15E+01	9.55E-03
Furan	250	3.15E+01	4.73E-06
Hexane	250	3.15E+01	5.04E-04
Hydrogen chloride	250	3.15E+01	3.14E-02
Indeno[1,2,3-cd]pyrene	250	3.15E+01	1.58E-04
Methylcyclohexane	250	3.15E+01	4.92E-03
Methylene chloride	250	3.15E+01	2.35E-05
Methyl ethyl ketone (2-Butanone)	250	3.15E+01	4.10E-04

Table 2-4. Contaminant-Specific Emissions for Short-Term Averaging Times at TA-16-388 (continued)

Contaminant	Total Waste Burned Over Averaging Period (lb) [1]	Waste Burned (g/s)	Calculated Contaminant Emissions (g/s) [2]
Methyl isobutyl ketone	250	3.15E+01	3.47E-04
Naphthalene	250	3.15E+01	5.11E-03
Nitrogen dioxide - 24 hr	500	2.63E+00	1.97E-01
Particulate matter (PM-10) - 24 hr	500	3.15E+01	6.31E+00
Particulate matter (TSP) - 24 hr	500	3.15E+01	6.31E+00
Phenanthrene	250	3.15E+01	2.26E-04
Phenol	250	3.15E+01	4.92E-04
Pyrene	250	3.15E+01	6.31E-05
Styrene	250	3.15E+01	1.57E-03
Sulfur dioxide - 3 hr	500	3.15E+01	7.88E-02
Sulfur dioxide - 24 hr	500	3.15E+01	7.88E-02
Toluene	250	3.15E+01	3.85E-03
Trichloroethane [1,1,1-]	250	3.15E+01	1.08E-06
Trimethylbenzene [1,2,4-]	250	3.15E+01	7.66E-03
Trimethylbenzene [1,3,5-]	250	3.15E+01	1.76E-02
Vinyl chloride	250	3.15E+01	7.03E-06
Xylene (Total)	250	3.15E+01	1.82E-02
Zinc	250	3.15E+01	1.97E-03

[1] Unless noted in the contaminant column, averaging times are 1 hour (hr) and include only one burn at the unit. In the case of the 3-hr, 8-hr, and 24-hr averaging times, two burns are included in the emissions analysis.

[2] Emissions factors used to calculate these emissions can be found in the modeling protocol (LANL, 2007).

hr = hour
g/s = grams per second
lb = pounds
PM-10 = particulate matter less than 10 micrometers
TSP = total suspended particulate

Table 2-5. Contaminant-Specific Emissions for Short-Term Averaging Times at TA-16-399

Contaminant	Total Waste Burned Over Averaging Period (lb) [1]	Waste Burned (g/s)	Calculated Contaminant Emissions (g/s) [2]
Acenaphthene	1.00E+03	1.26E+02	1.26E-03
Acetaldehyde	1.00E+03	1.26E+02	7.95E-03
Acetone	1.00E+03	1.26E+02	4.41E-03
Acetophenone	1.00E+03	1.26E+02	2.19E-05
Acrolein	1.00E+03	1.26E+02	4.92E-03
Aluminum	1.00E+03	1.26E+02	8.99E-05
Anthracene	1.00E+03	1.26E+02	1.89E-03
Barium	1.00E+03	1.26E+02	5.30E-05
Benzaldehyde	1.00E+03	1.26E+02	1.31E-02
Benzene-	1.00E+03	1.26E+02	1.29E-01
Benzo(a)anthracene	1.00E+03	1.26E+02	6.31E-04
Benzo(a)pyrene	1.00E+03	1.26E+02	6.31E-04
Benzo(b,k)fluoranthene	1.00E+03	1.26E+02	8.83E-04
Benzyl alcohol	1.00E+03	1.26E+02	4.99E-03
Butadiene [1-3-]	1.00E+03	1.26E+02	1.69E-04
Butyl benzyl phthalate	1.00E+03	1.26E+02	1.54E-05
Carbon monoxide - 1 hr	1.00E+03	1.26E+02	1.14E+01
Carbon monoxide - 8 hr	2.00E+03	1.26E+02	1.14E+01
Carbon tetrachloride	2.00E+03	1.26E+02	8.69E-06
Chloromethane (methyl chloride)	1.00E+03	1.26E+02	3.58E-05
Chromium (total)	1.00E+03	1.26E+02	5.01E-05
Chrysene	1.00E+03	1.26E+02	1.14E-03
Crotonaldehyde	1.00E+03	1.26E+02	7.57E-04
Cyclohexane	1.00E+03	1.26E+02	3.37E-03
Dibenzo(a,h)anthracene	1.00E+03	1.26E+02	2.52E-05
Dibutyl phthalate	1.00E+03	1.26E+02	4.16E-05
Dichloroethylene [1,1-]	1.00E+03	1.26E+02	2.71E-05
Diethyl phthalate	1.00E+03	1.26E+02	8.83E-06
Dimethyl phthalate	1.00E+03	1.26E+02	2.37E-05
Dioctyl phthalate	1.00E+03	1.26E+02	1.16E-04
Dioxin (2,3,7,8-TCDD)	1.00E+03	1.26E+02	1.88E-10
Ethylbenzene	1.00E+03	1.26E+02	6.92E-03
Ethyl chloride	1.00E+03	1.26E+02	8.69E-06
Fluoranthene	1.00E+03	1.26E+02	2.52E-03
Fluorene	1.00E+03	1.26E+02	1.26E-04
Formaldehyde	1.00E+03	1.26E+02	3.82E-02
Furan	1.00E+03	1.26E+02	1.89E-05
Hexane	1.00E+03	1.26E+02	2.02E-03
Hydrogen chloride	1.00E+03	1.26E+02	1.26E-01
Indeno[1,2,3-cd]pyrene	1.00E+03	1.26E+02	6.31E-04
Methylcyclohexane	1.00E+03	1.26E+02	1.97E-02
Methylene chloride	1.00E+03	1.26E+02	9.41E-05
Methyl ethyl ketone (2-Butanone)	1.00E+03	1.26E+02	1.64E-03
Methyl isobutyl ketone	1.00E+03	1.26E+02	1.39E-03
Naphthalene	1.00E+03	1.26E+02	2.04E-02
Nitrogen dioxide - 24 hr	2.00E+03	1.26E+02	9.46E+00

Table 2-5. Contaminant-Specific Emissions for Short-Term Averaging Times at TA-16-399 (continued)

Contaminant	Total Waste Burned Over Averaging Period (lb) [1]	Waste Burned (g/s)	Calculated Contaminant Emissions (g/s) [2]
Particulate matter (PM-10) - 24 hr	2.00E+03	1.26E+02	2.52E+01
Particulate matter (TSP) - 24 hr	1.00E+03	1.26E+02	2.52E+01
Phenanthrene	1.00E+03	1.26E+02	9.04E-04
Phenol	1.00E+03	1.26E+02	1.97E-03
Pyrene	1.00E+03	1.26E+02	2.52E-04
Styrene	1.00E+03	1.26E+02	6.29E-03
Sulfur dioxide - 3 hr	2.00E+03	1.26E+02	3.15E-01
Sulfur dioxide - 24 hr	2.00E+03	1.26E+02	3.15E-01
Toluene	1.00E+03	1.26E+02	1.54E-02
Trichloroethane [1,1,1-]	1.00E+03	1.26E+02	4.34E-06
Trimethylbenzene [1,2,4-]	1.00E+03	1.26E+02	3.06E-02
Trimethylbenzene [1,3,5-]	1.00E+03	1.26E+02	7.02E-02
Vinyl chloride	1.00E+03	1.26E+02	2.81E-05
Xylene (Total)	1.00E+03	1.26E+02	7.28E-02
Zinc	1.00E+03	1.26E+02	7.89E-03

[1] Unless noted in the contaminant column, averaging times are 1 hour (hr) and include only one burn at the unit. In the case of the 3-hr, 8-hr, and 24-hr averaging times, two burns are included in the emissions analysis.

[2] Emissions factors used to calculate these emissions can be found in the modeling protocol (LANL, 2007).

hr = hour
g/s = grams per second
lb = pounds
PM-10 = particulate matter less than 10 micrometers
TSP = total suspended particulate

Table 2-6. Contaminant-Specific Emissions for the Annual Averaging Period [1]

Contaminant	Amount Waste Burned (lb/yr)	Amount Waste Burned (g/s)	Calculated Waste Emissions [2] (g/s)	Amount Propane Burned [3] (gal/yr)	Calculated Propane Emissions (lb/yr)	Propane Emissions (g/s)	Total Calculated Emissions [2, 3] (g/s)
Acenaphthene	2.00E+04	4.97E+00	4.97E-05				4.97E-05
Acetaldehyde	2.00E+04	4.97E+00	3.13E-04				3.13E-04
Acetone	2.00E+04	4.97E+00	1.74E-04				1.74E-04
Acetophenone	2.00E+04	4.97E+00	8.64E-07				8.64E-07
Acrolein	2.00E+04	4.97E+00	1.94E-04				1.94E-04
Aluminum	2.00E+04	4.97E+00	3.54E-06				3.54E-06
Anthracene	2.00E+04	4.97E+00	7.45E-05				7.45E-05
Barium	2.00E+04	4.97E+00	2.09E-06				2.09E-06
Benzaldehyde	2.00E+04	4.97E+00	5.16E-04				5.16E-04
Benzene	2.00E+04	4.97E+00	5.07E-03				5.07E-03
Benzo(a)anthracene	2.00E+04	4.97E+00	2.48E-05				2.48E-05
Benzo(a)pyrene	2.00E+04	4.97E+00	2.48E-05				2.48E-05
Benzo(b,k)fluoranthene	2.00E+04	4.97E+00	3.48E-05				3.48E-05
Benzyl alcohol	2.00E+04	4.97E+00	1.97E-04				1.97E-04
Butadiene [1-3-]	2.00E+04	4.97E+00	6.65E-06				6.65E-06
Butyl benzyl phthalate	2.00E+04	4.97E+00	6.06E-07				6.06E-07
Carbon monoxide	2.00E+04	4.97E+00	4.47E-01	1.50E+04	2.85E+01	3.33E-02	4.80E-01
Carbon tetrachloride	2.00E+04	4.97E+00	3.42E-07				3.42E-07
Chloromethane (methyl chloride)	2.00E+04	4.97E+00	1.41E-06				1.41E-06
Chromium (total)	2.00E+04	4.97E+00	1.97E-06				1.97E-06
Chrysene	2.00E+04	4.97E+00	4.47E-05				4.47E-05
Crotonaldehyde	2.00E+04	4.97E+00	2.98E-05				2.98E-05
Cyclohexane	2.00E+04	4.97E+00	1.33E-04				1.33E-04
Dibenzo(a,h)anthracene	2.00E+04	4.97E+00	9.93E-07				9.93E-07
Dibutyl phthalate	2.00E+04	4.97E+00	1.64E-06				1.64E-06
Dichloroethylene [1,1-]	2.00E+04	4.97E+00	1.07E-06				1.07E-06
Diethyl phthalate	2.00E+04	4.97E+00	3.48E-07				3.48E-07
Dimethyl phthalate	2.00E+04	4.97E+00	9.33E-07				9.33E-07
Dioctyl phthalate	2.00E+04	4.97E+00	4.56E-06				4.56E-06
Dioxin (2,3,7,8-TCDD)	2.00E+04	4.97E+00	7.40E-12				7.40E-12
Ethylbenzene	2.00E+04	4.97E+00	2.73E-04				2.73E-04

Table 2-6. Contaminant-Specific Emissions for the Annual Averaging Period [1] (continued)

Contaminant	Amount Waste Burned (lb/yr)	Amount Waste Burned (g/s)	Calculated Waste Emissions [2] (g/s)	Amount Propane Burned [3] (gal/yr)	Calculated Propane Emissions (lb/yr)	Propane Emissions (g/s)	Total Calculated Emissions [2, 3] (g/s)
Ethyl chloride	2.00E+04	4.97E+00	3.42E-07				3.42E-07
Fluoranthene	2.00E+04	4.97E+00	9.93E-05				9.93E-05
Fluorene	2.00E+04	4.97E+00	4.97E-06				4.97E-06
Formaldehyde	2.00E+04	4.97E+00	1.50E-03				1.50E-03
Furan	2.00E+04	4.97E+00	7.45E-07				7.45E-07
Hexane	2.00E+04	4.97E+00	7.94E-05				7.94E-05
Hydrogen chloride	2.00E+04	4.97E+00	4.95E-03				4.95E-03
Indeno[1,2,3-cd]pyrene	2.00E+04	4.97E+00	2.48E-05				2.48E-05
Methylcyclohexane	2.00E+04	4.97E+00	7.75E-04				7.75E-04
Methylene chloride	2.00E+04	4.97E+00	3.70E-06				3.70E-06
Methyl ethyl ketone (2-Butanone)	2.00E+04	4.97E+00	6.45E-05				6.45E-05
Methyl isobutyl ketone	2.00E+04	4.97E+00	5.46E-05				5.46E-05
Naphthalene	2.00E+04	4.97E+00	8.04E-04				8.04E-04
Nitrogen dioxide	2.00E+04	4.97E+00	3.72E-01	1.50E+04	2.10E+02	5.21E-02	4.25E-01
Particulate matter (TSP)	2.00E+04	4.97E+00	9.93E-01	1.50E+04	6.00E+00	1.49E-03	9.94E-01
Phenanthrene	2.00E+04	4.97E+00	3.56E-05				3.56E-05
Phenol	2.00E+04	4.97E+00	7.75E-05				7.75E-05
Pyrene	2.00E+04	4.97E+00	9.93E-06				9.93E-06
Styrene	2.00E+04	4.97E+00	2.48E-04				2.48E-04
Sulfur dioxide	2.00E+04	4.97E+00	1.24E-02	1.50E+04	2.70E-01	6.70E-05	1.25E-02
Toluene	2.00E+04	4.97E+00	6.06E-04				6.06E-04
Trichloroethane [1,1,1-]	2.00E+04	4.97E+00	1.71E-07				1.71E-07
Trimethylbenzene [1,2,4-]	2.00E+04	4.97E+00	1.21E-03				1.21E-03
Trimethylbenzene [1,3,5-]	2.00E+04	4.97E+00	2.77E-03				2.77E-03
Vinyl chloride	2.00E+04	4.97E+00	1.11E-06				1.11E-06
Xylene (Total)	2.00E+04	4.97E+00	2.86E-03				2.86E-03
Zinc	2.00E+04	4.97E+00	3.11E-04				3.11E-04

[1] Annual averaging period assumes that 15,000 gallons of propane are burned a year and 20,000 pounds of burnable waste (high explosives and combustible wastes).
[2] Emissions factors used to calculate these emissions can be found in the modeling protocol (LANL, 2007).
[3] Propane emissions were not added for scenarios where burning of high explosives alone caused the highest impacts.
lb/yr = pounds per year
g/s = grams per second

Table 2-6. Contaminant-Specific Emissions for the Annual Averaging Period [1] (continued)

gal/yr = gallons per year
PM-10 = particulate matter less than 10 micrometers
TSP = total suspended particulate

Table 2-7. Short-Term On-Site Impacts [1]

Contaminant	Calculated Emissions[2] (g/s)	On-site Conversion Factor ($\mu g/m^3$ per g/s)	On-Site Impacts [3] ($\mu g/m^3$)	Acute Limits [4] ($\mu g/m^3$)
Acenaphthene	3.15E-04	1.5E+02	4.70E-02	1.3E+03
Acetaldehyde	1.99E-03	1.5E+02	2.96E-01	8.1E+04
Acetone	1.10E-03	1.5E+02	1.64E-01	4.8E+05
Acetophenone	5.49E-06	1.5E+02	8.17E-04	3.0E+04
Acrolein	1.23E-03	1.5E+02	1.83E-01	1.9E-01
Anthracene	4.73E-04	1.5E+02	7.05E-02	6.0E+03
Barium	1.32E-05	1.5E+02	1.97E-03	1.5E+03
Benzaldehyde	3.28E-03	1.5E+02	4.89E-01	1.5E+04
Benzene	3.22E-02	1.5E+02	4.80E+00	1.3E+03
Benzo[a]anthracene	1.58E-04	1.5E+02	2.35E-02	3.0E+02
Benzo[a]pyrene	1.58E-04	1.5E+02	2.35E-02	6.0E+02
Benzo[b&k]fluoanthene	2.21E-04	1.5E+02	3.29E-02	6.0E+02
Benzyl alcohol	1.25E-03	1.5E+02	1.86E-01	6.0E+04
Butyl benzyl phthalate	3.85E-06	1.5E+02	5.73E-04	1.5E+04
Carbon tetrachloride	2.17E-06	1.5E+02	3.24E-04	1.9E+03
Chloromethane (methyl chloride)	8.95E-06	1.5E+02	1.33E-03	2.0E+05
Chromium	1.25E-05	1.5E+02	1.86E-03	1.5E+03
Chrysene	2.84E-04	1.5E+02	4.23E-02	6.0E+02
Dibenzo[ah]anthracene	6.31E-06	1.5E+02	9.40E-04	3.0E+04
Dibutyl phthalate	1.04E-05	1.5E+02	1.55E-03	1.5E+04
Dichloroethylene [1,1-]	6.78E-06	1.5E+02	1.01E-03	7.5E+04
Diethyl phthalate	2.21E-06	1.5E+02	3.29E-04	1.5E+04
Dimethyl phthalate	5.93E-06	1.5E+02	8.83E-04	1.5E+04
Dioctyl phthalate	2.90E-05	1.5E+02	4.32E-03	5.0E+04
Dioxin	4.70E-11	1.5E+02	7.00E-09	1.3E+00
Ethylbenzene	1.73E-03	1.5E+02	2.58E-01	5.0E+05
Fluoranthene	6.31E-04	1.5E+02	9.40E-02	1.5E+01
Fluorene	3.15E-05	1.5E+02	4.70E-03	1.2E+04
Formaldehyde	9.55E-03	1.5E+02	1.42E+00	9.4E+01
Furan	4.73E-06	1.5E+02	7.05E-04	8.0E-02
Hydrogen chloride	3.14E-02	1.5E+02	4.68E+00	2.1E+03
Indeno[1,2,3-cd]pyrene	1.58E-04	1.5E+02	2.35E-02	5.0E+02
Methylene chloride	2.35E-05	1.5E+02	3.50E-03	1.4E+04
Methyl ethyl ketone	4.10E-04	1.5E+02	6.11E-02	1.3E+04
Methyl isobutyl ketone	3.47E-04	1.5E+02	5.17E-02	3.0E+05
Naphthalene	5.11E-03	1.5E+02	7.61E-01	7.5E+04
Phenanthrene	2.26E-04	1.5E+02	3.37E-02	1.0E+03
Phenol	4.92E-04	1.5E+02	7.33E-02	5.8E+03
Pyrene	6.31E-05	1.5E+02	9.40E-03	1.5E+04
Styrene	1.57E-03	1.5E+02	2.34E-01	2.1E+04
Toluene	3.85E-03	1.5E+02	5.73E-01	3.7E+04

Table 2-7. Short-Term On-Site Impacts (continued)

Contaminant	Calculated Emissions[2] (g/s)	On-site Conversion Factor ($\mu g/m^3$ per g/s)	On-Site Impacts [3] ($\mu g/m^3$)	Acute Limits [4] ($\mu g/m^3$)
Trichloroethane [1,1,1-]	1.08E-06	1.5E+02	1.62E-04	6.8E+04
Trimethylbenzene [1,3,5-]	1.76E-02	1.5E+02	2.62E+00	1.3E+05
Vinyl chloride	7.03E-06	1.5E+02	1.05E-03	1.8E+05
Xylenes	1.82E-02	1.5E+02	2.71E+00	2.2E+04
Zinc	1.97E-03	1.5E+02	2.94E-01	3.0E+04

[1] Assumes 250 pounds per hour burned, converted to grams per second (31.5 g/s)
[2] See Table 2-4 for the method of calculating these emissions
[3] Background included, as appropriate (NMED, 2007)
[4] Screening limits are from acute limits (1 hr) inhalation exposures (AIEC) for toxic air pollutants (EPA, 2005)
g/s = grams per second
$\mu g/m^3$ = micrograms per cubic meter

Table 2-8. Short-Term Off-Site Impacts

Contaminant	Calculated Emissions [1] (g/s)	Off-site Conversion Factor ($\mu g/m^3$ per g/s)	Off-Site Impacts [2] ($\mu g/m^3$)	Acute Limits [3] ($\mu g/m^3$)
Acenaphthene	1.26E-03	2.87E+00	3.62E-03	1.3E+03
Acetaldehyde	7.95E-03	2.87E+00	2.28E-02	8.1E+04
Acetone	4.41E-03	2.87E+00	1.27E-02	4.8E+05
Acetophenone	2.19E-05	2.87E+00	6.30E-05	3.0E+04
Acrolein	4.92E-03	2.87E+00	1.41E-02	1.9E-01
Anthracene	1.89E-03	2.87E+00	5.43E-03	6.0E+03
Barium	5.30E-05	2.87E+00	1.52E-04	1.5E+03
Benzaldehyde	1.31E-02	2.87E+00	3.76E-02	1.5E+04
Benzene	1.29E-01	2.87E+00	3.70E-01	1.3E+03
Benzo[a]anthracene	6.31E-04	2.87E+00	1.81E-03	3.0E+02
Benzo[a]pyrene	6.31E-04	2.87E+00	1.81E-03	6.0E+02
Benzo[b&k]fluoanthene	8.83E-04	2.87E+00	2.53E-03	6.0E+02
Benzyl alcohol	4.99E-03	2.87E+00	1.43E-02	6.0E+04
Butyl benzyl phthalate	1.54E-05	2.87E+00	4.42E-05	1.5E+04
Carbon Monoxide	1.14E+01	4.19E-01	4.76E+00	7.9E+03 [4]
Carbon Monoxide	1.14E+01	2.87E+00	3.26E+01	1.2E+04 [5]
Carbon tetrachloride	8.69E-06	2.87E+00	2.49E-05	1.9E+03
Chloromethane	3.58E-05	2.87E+00	1.03E-04	2.0E+05
Chromium	5.01E-05	2.87E+00	1.44E-04	1.5E+03
Chrysene	1.14E-03	2.87E+00	3.26E-03	6.0E+02
Dibenzo[ah]anthracene	2.52E-05	2.87E+00	7.24E-05	3.0E+04
Dibutyl phthalate	4.16E-05	2.87E+00	1.19E-04	1.5E+04
Dichloroethylene [1,1-]	2.71E-05	2.87E+00	7.78E-05	7.5E+04
Diethyl phthalate	8.83E-06	2.87E+00	2.53E-05	1.5E+04
Dimethyl phthalate	2.37E-05	2.87E+00	6.80E-05	1.5E+04
Dioctyl phthalate	1.16E-04	2.87E+00	3.33E-04	5.0E+04
Dioxin	1.88E-10	2.87E+00	5.39E-10	1.3E+00
Ethylbenzene	6.92E-03	2.87E+00	1.99E-02	5.0E+05
Fluoranthene	2.52E-03	2.87E+00	7.24E-03	1.5E+01
Fluorene	1.26E-04	2.87E+00	3.62E-04	1.2E+04
Formaldehyde	3.82E-02	2.87E+00	1.10E-01	9.4E+01
Furan	1.89E-05	2.87E+00	5.43E-05	7.5E-02
Hydrogen chloride	1.26E-01	2.87E+00	3.61E-01	2.1E+03
Indeno[1,2,3-cd]pyrene	6.31E-04	2.87E+00	1.81E-03	5.0E+02
Methylene chloride	9.41E-05	2.87E+00	2.70E-04	1.4E+04
Methyl ethyl ketone	1.64E-03	2.87E+00	4.71E-03	1.3E+04
Methyl isobutyl ketone	1.39E-03	2.87E+00	3.98E-03	3.0E+05
Naphthalene	2.04E-02	2.87E+00	5.86E-02	7.5E+04
Nitrogen dioxide	9.46E+00	1.40E-01	1.32E+00	1.5E+02 [6]
Particulate matter (PM-10)	2.52E+01	1.40E-01	2.35E+01	1.5E+02 [6]
Particulate matter (TSP)	2.52E+01	1.40E-01	3.01E+01	1.5E+02 [6]
Phenanthrene	9.04E-04	2.87E+00	2.60E-03	1.0E+03

Table 2-8. Short-Term Off-Site Impacts (continued)

Contaminant	Calculated Emissions [1] (g/s)	Off-site Conversion Factor ($\mu g/m^3$ per g/s)	Off-Site Impacts [2] ($\mu g/m^3$)	Acute Limits [3] ($\mu g/m^3$)
Phenol	1.97E-03	2.87E+00	5.65E-03	5.8E+03
Pyrene	2.52E-04	2.87E+00	7.24E-04	1.5E+04
Styrene	6.29E-03	2.87E+00	1.81E-02	2.1E+04
Sulfur Dioxide	3.15E-01	9.57E-01	3.02E-01	1.1E+03 [7]
Sulfur Dioxide	3.15E-01	1.40E-01	4.41E-02	2.1E+02 [6]
Toluene	1.54E-02	2.87E+00	4.42E-02	3.7E+04
Trichloroethane [1,1,1-]	4.34E-06	2.87E+00	1.25E-05	6.8E+04
Trimethylbenzene [1,3,5-]	7.02E-02	2.87E+00	2.02E-01	1.3E+05
Vinyl chloride	2.81E-05	2.87E+00	8.07E-05	1.8E+05
Xylenes	7.28E-02	2.87E+00	2.09E-01	2.2E+04
Zinc	7.89E-03	2.87E+00	2.27E-02	3.0E+04

[1] Calculated using 1000 pounds per hour of waste burned, converted to 126 grams/second (g/s). See Table 2-5 for the method of calculating emissions
[2] Background included, as appropriate (NMED, 2007)
[3] Except where noted, screening limits are from acute limits (1 hr) inhalation exposures (AIEC) for toxic air pollutants (EPA, 2005).
[4] Acute limits for these contaminants are from the Environmental Protection Agency's (EPA's) Ambient Air Quality Standards (AAQS) for a 8 hour averaging period.
[5] Acute limit for this contaminant is from the EPA's AAQS for a 1 hour averaging period.
[6] Acute limit for this contaminant is from the EPA's AAQS for a 24 hour averaging period.
[7] Acute limit for this contaminant is from the EPA's AAQS for a 3 hour averaging period.

g/s = grams per second
$\mu g/m^3$ = micrograms per cubic meter
PM-10 = particulate matter less than 10 micrometers
TSP= total suspended particulate

Table 2-9. Annual On-Site Impacts

Contaminant	Calculated Emissions [1] (g/s)	On-site Conversion Factor ($\mu g/m^3$ per g/s)	Annual Impact [2] ($\mu g/m^3$)	Screening Level [3] ($\mu g/m^3$)
Acenaphthene	4.97E-05	1.48E+00	7.35E-05	2.2E+02
Acetaldehyde	3.13E-04	1.48E+00	4.63E-04	8.7E-01
Acetone	1.74E-04	1.48E+00	2.57E-04	3.3E+03
Acrolein	1.94E-04	1.48E+00	2.87E-04	2.1E-02
Aluminum	3.54E-06	1.48E+00	5.24E-06	5.1E+00
Anthracene	7.45E-05	1.48E+00	1.10E-04	1.1E+03
Barium	2.09E-06	1.48E+00	3.09E-06	5.2E-01
Benzaldehyde	5.16E-04	1.48E+00	7.64E-04	3.7E+02
Benzene	5.07E-03	1.48E+00	7.51E-03	2.5E-01
Benzo(a)anthracene	2.48E-05	1.48E+00	3.67E-05	9.2E-03
Benzo(a)pyrene	2.48E-05	1.48E+00	3.67E-05	9.2E-04
Benzo(b,k)fluoranthene	3.48E-05	1.48E+00	5.14E-05	2.6E-02
Benzyl alcohol	1.97E-04	1.48E+00	2.91E-04	1.1E+03
Butadiene [1-3-]	6.65E-06	1.48E+00	9.85E-06	1.1E-02
Butyl benzyl phthalate	6.06E-07	1.48E+00	8.96E-07	7.3E+02
Carbon tetrachloride	3.42E-07	1.48E+00	5.06E-07	1.3E-01
Chloromethane (methyl chloride)	1.41E-06	1.48E+00	2.09E-06	9.5E+01
Chromium (total)	1.97E-06	1.48E+00	2.92E-06	1.6E-04
Chrysene	4.47E-05	1.48E+00	6.61E-05	1.7E-01
Crotonaldehyde	2.98E-05	1.48E+00	4.41E-05	3.5E-03
Cyclohexane	1.33E-04	1.48E+00	1.96E-04	6.2E+03
Dibenzo(a,h)anthracene	9.93E-07	1.48E+00	1.47E-06	9.2E-04
Dibutyl phthalate	1.64E-06	1.48E+00	2.42E-06	3.7E+02
Dichloroethylene [1,1-]	1.07E-06	1.48E+00	1.58E-06	2.1E+02
Diethyl phthalate	3.48E-07	1.48E+00	5.14E-07	2.9E+03
Dimethyl phthalate	9.33E-07	1.48E+00	1.38E-06	3.7E+04
Dioctyl phthalate	4.56E-06	1.48E+00	6.75E-06	1.5E+02
Dioxin (2,3,7,8-TCDD)	7.40E-12	1.48E+00	1.09E-11	4.5E-08
Ethylbenzene	2.73E-04	1.48E+00	4.03E-04	1.1E+03
Ethyl chloride	3.42E-07	1.48E+00	5.06E-07	2.3E+00
Fluoranthene	9.93E-05	1.48E+00	1.47E-04	1.5E+02
Fluorene	4.97E-06	1.48E+00	7.35E-06	1.5E+02
Formaldehyde	1.50E-03	1.48E+00	2.23E-03	1.5E-01
Furan	7.45E-07	1.48E+00	1.10E-06	3.7E+00
Hexane	7.94E-05	1.48E+00	1.18E-04	2.1E+02
Hydrogen chloride	4.95E-03	1.48E+00	7.33E-03	2.1E+01
Indeno[1,2,3-cd]pyrene	2.48E-05	1.48E+00	3.67E-05	9.2E-03
Methylcyclohexane	7.75E-04	1.48E+00	1.15E-03	3.1E+03
Methylene chloride	3.70E-06	1.48E+00	5.48E-06	4.1E+00
Methyl ethyl ketone (2-Butanone)	6.45E-05	1.48E+00	9.55E-05	5.1E+03
Methyl isobutyl ketone	5.46E-05	1.48E+00	8.08E-05	3.1E+03
Naphthalene	8.04E-04	1.48E+00	1.19E-03	5.6E-02
Phenol	7.75E-05	1.48E+00	1.15E-04	1.1E+03
Pyrene	9.93E-06	1.48E+00	1.47E-05	1.1E+02

Table 2-9. Annual On-Site Impacts (continued)

Contaminant	Calculated Emissions [1] (g/s)	On-site Conversion Factor ($\mu g/m^3$ per g/s)	Annual Impact [2] ($\mu g/m^3$)	Screening Level [3] ($\mu g/m^3$)
Styrene	2.48E-04	1.48E+00	3.67E-04	1.1E+03
Toluene	6.10E-04	1.48E+00	9.03E-04	4.0E+02
Trichloroethane [1,1,1-]	1.72E-07	1.48E+00	2.55E-07	2.3E+03
Trimethylbenzene [1,2,4-]	1.22E-03	1.48E+00	1.80E-03	6.2E+00
Trimethylbenzene [1,3,5-]	2.79E-03	1.48E+00	4.12E-03	6.2E+00
Vinyl chloride	1.12E-06	1.48E+00	1.65E-06	1.1E-01
Xylene (Total)	2.89E-03	1.48E+00	4.27E-03	1.1E+02

[1] Calculated assuming the amount of waste burned is 20,000 and 15,000 gal of propane. See Table 2-6 for the method of calculating emissions
[2] Background included, as appropriate (NMED, 2007)
[3] Source for annual screening levels are from Environmental Protection Agency's Region 9 Preliminary Remediation Goals (PRGs), (EPA, 2004), as described in the modeling report (LANL, 2007).

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

Table 2-10. Annual Off-Site Impacts

Contaminant	Calculated Emissions [1] (g/s)	Off-site Conversion Factor (µg/m^3 per g/s)	Annual Impact [2] (µg/m^3)	Screening Level [3] (µg/m^3)
Acenaphthene	4.97E-05	5.76E-03	2.86E-07	2.2E+02
Acetaldehyde	3.13E-04	5.76E-03	1.80E-06	8.7E-01
Acetone	1.74E-04	5.76E-03	1.00E-06	3.3E+03
Acrolein	1.94E-04	5.76E-03	1.12E-06	2.1E-02
Aluminum	3.54E-06	5.76E-03	2.04E-08	5.1E+00
Anthracene	7.45E-05	5.76E-03	4.29E-07	1.1E+03
Barium	2.09E-06	5.76E-03	1.20E-08	5.2E-01
Benzaldehyde	5.16E-04	5.76E-03	2.97E-06	3.7E+02
Benzene	5.07E-03	5.76E-03	2.92E-05	2.5E-01
Benzo(a)anthracene	2.48E-05	5.76E-03	1.43E-07	9.2E-03
Benzo(a)pyrene	2.48E-05	5.76E-03	1.43E-07	9.2E-04
Benzo(b,k)fluoranthene	3.48E-05	5.76E-03	2.00E-07	2.6E-02
Benzyl alcohol	1.97E-04	5.76E-03	1.13E-06	1.1E+03
Butadiene [1-3-]	6.65E-06	5.76E-03	3.83E-08	1.1E-02
Butyl benzyl phthalate	6.06E-07	5.76E-03	3.49E-09	7.3E+02
Carbon tetrachloride	3.42E-07	5.76E-03	1.97E-09	1.3E-01
Chloromethane (methyl chloride)	1.41E-06	5.76E-03	8.12E-09	9.5E+01
Chromium (total)	1.97E-06	5.76E-03	1.14E-08	1.6E-04
Chrysene	4.47E-05	5.76E-03	2.57E-07	1.7E-01
Crotonaldehyde	2.98E-05	5.76E-03	1.72E-07	3.5E-03
Cyclohexane	1.33E-04	5.76E-03	7.64E-07	6.2E+03
Dibenzo(a,h)anthracene	9.93E-07	5.76E-03	5.72E-09	9.2E-04
Dibutyl phthalate	1.64E-06	5.76E-03	9.44E-09	3.7E+02
Dichloroethylene [1,1-]	1.07E-06	5.76E-03	6.15E-09	2.1E+02
Diethyl phthalate	3.48E-07	5.76E-03	2.00E-09	2.9E+03
Dimethyl phthalate	9.33E-07	5.76E-03	5.38E-09	3.7E+04
Dioctyl phthalate	4.56E-06	5.76E-03	2.63E-08	1.5E+02
Dioxin (2,3,7,8-TCDD)	7.40E-12	5.76E-03	4.26E-14	4.5E-08
Ethylbenzene	2.73E-04	5.76E-03	1.57E-06	1.1E+03
Ethyl chloride	3.42E-07	5.76E-03	1.97E-09	2.3E+00
Fluoranthene	9.93E-05	5.76E-03	5.72E-07	1.5E+02
Fluorene	4.97E-06	5.76E-03	2.86E-08	1.5E+02
Formaldehyde	1.50E-03	5.76E-03	8.67E-06	1.5E-01
Furan	7.45E-07	5.76E-03	4.29E-09	3.7E+00
Hexane	7.94E-05	5.76E-03	4.58E-07	2.1E+02
Hydrogen chloride	4.95E-03	5.76E-03	2.85E-05	2.1E+01
Indeno[1,2,3-cd]pyrene	2.48E-05	5.76E-03	1.43E-07	9.2E-03
Methylcyclohexane	7.75E-04	5.76E-03	4.46E-06	3.1E+03
Methylene chloride	3.70E-06	5.76E-03	2.13E-08	4.1E+00
Methyl ethyl ketone (2-Butanone)	6.45E-05	5.76E-03	3.72E-07	5.1E+03
Methyl isobutyl ketone	5.46E-05	5.76E-03	3.15E-07	3.1E+03
Naphthalene	8.04E-04	5.76E-03	4.63E-06	5.6E-02

Table 2-10. Annual Off-Site Impacts (continued)

Contaminant	Calculated Emissions [1] (g/s)	Off-site Conversion Factor (µg/m^3 per g/s)	Annual Impact [2] (µg/m^3)	Screening Level [3] (µg/m^3)
Nitrogen dioxide	3.98E-01 [5]	5.76E-03	2.29E-03	7.5E+01 [4]
Particulate matter (TSP)	9.94E-01 [5]	5.76E-03	2.66E+01	6.0E+01 [4]
Phenol	7.75E-05	5.76E-03	4.46E-07	1.1E+03
Pyrene	9.93E-06	5.76E-03	5.72E-08	1.1E+02
Styrene	2.48E-04	5.76E-03	1.43E-06	1.1E+03
Sulfur dioxide	1.25E-02 [5]	5.76E-03	7.22E-05	4.2E+01 [4]
Toluene	6.10E-04	5.76E-03	3.51E-06	4.0E+02
Trichloroethane [1,1,1-]	1.72E-07	5.76E-03	9.91E-10	2.3E+03
Trimethylbenzene [1,2,4-]	1.22E-03	5.76E-03	7.00E-06	6.2E+00
Trimethylbenzene [1,3,5-]	2.79E-03	5.76E-03	1.60E-05	6.2E+00
Vinyl chloride	1.12E-06	5.76E-03	6.42E-09	1.1E-01
Xylene (Total)	2.89E-03	5.76E-03	1.66E-05	1.1E+02

1 Calculated assuming the amount of waste burned is 20,000 and 15,000 gallons of propane. See Table 2-6 for the method of calculating emissions
2 Background included, as appropriate (NMED, 2007)
3 Except as noted, source for annual screening levels are from Environmental Protection Agency's Region 9 Preliminary Remediation Goals (PRGs), (EPA, 2004), as described in the modeling report (LANL, 2007).
4 Source for this annual screening level is the Environmental Protection Agency's (EPA's) Ambient Air Quality Standards (AAQS).
5 Calculated emissions include the addition of propane emissions, see Table 2-6.

g/s = grams per second
µg/m^3 = micrograms per cubic meter
TSP= total suspended particulate

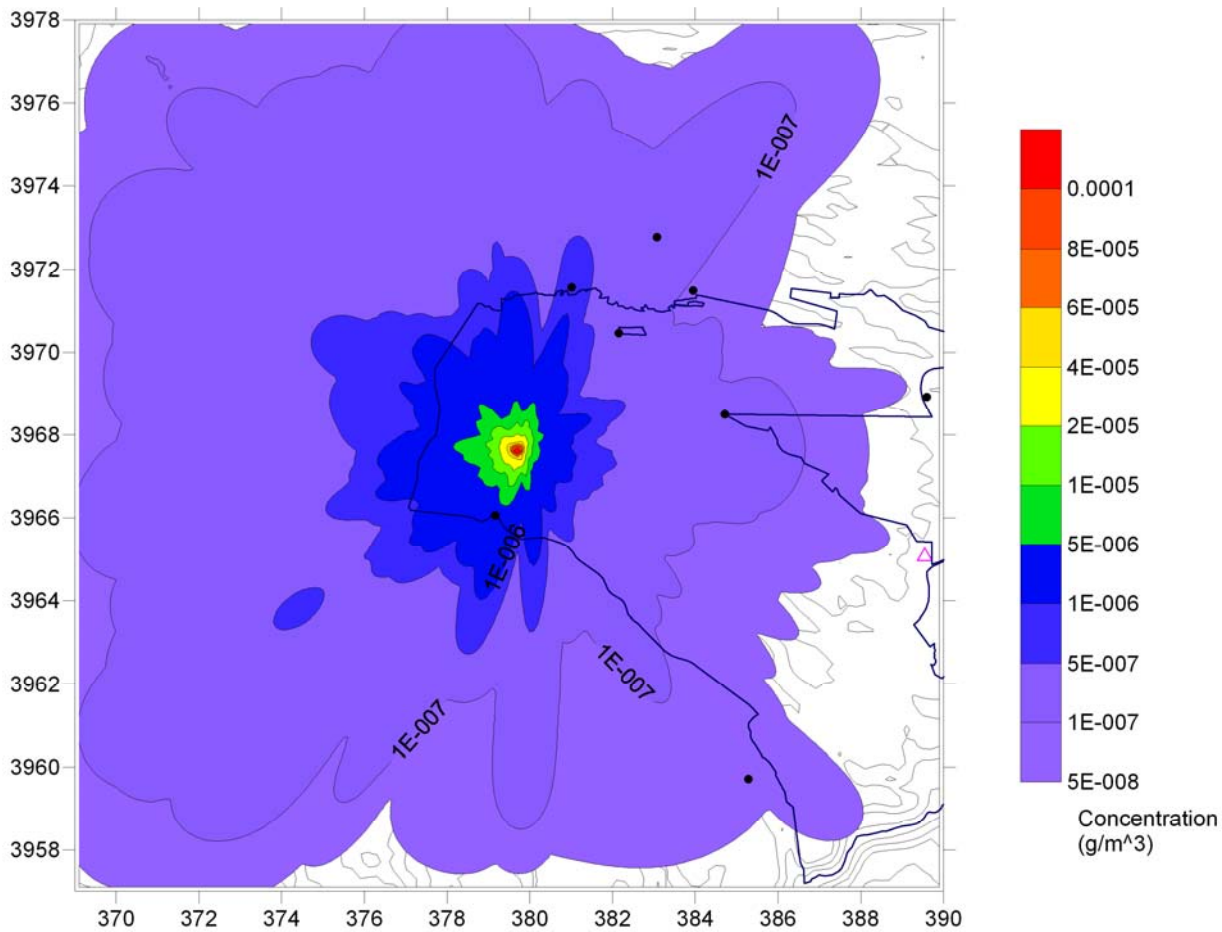

Figure 2-1. Peak 1-hour average air concentrations for the TA-16-388 minimum lofting case study for a 1 gram per second release rate.

Blue line = LANL boundary
Black-dot = receptor
Black lines = background elevation contours
g/m^3 = grams per cubic meter

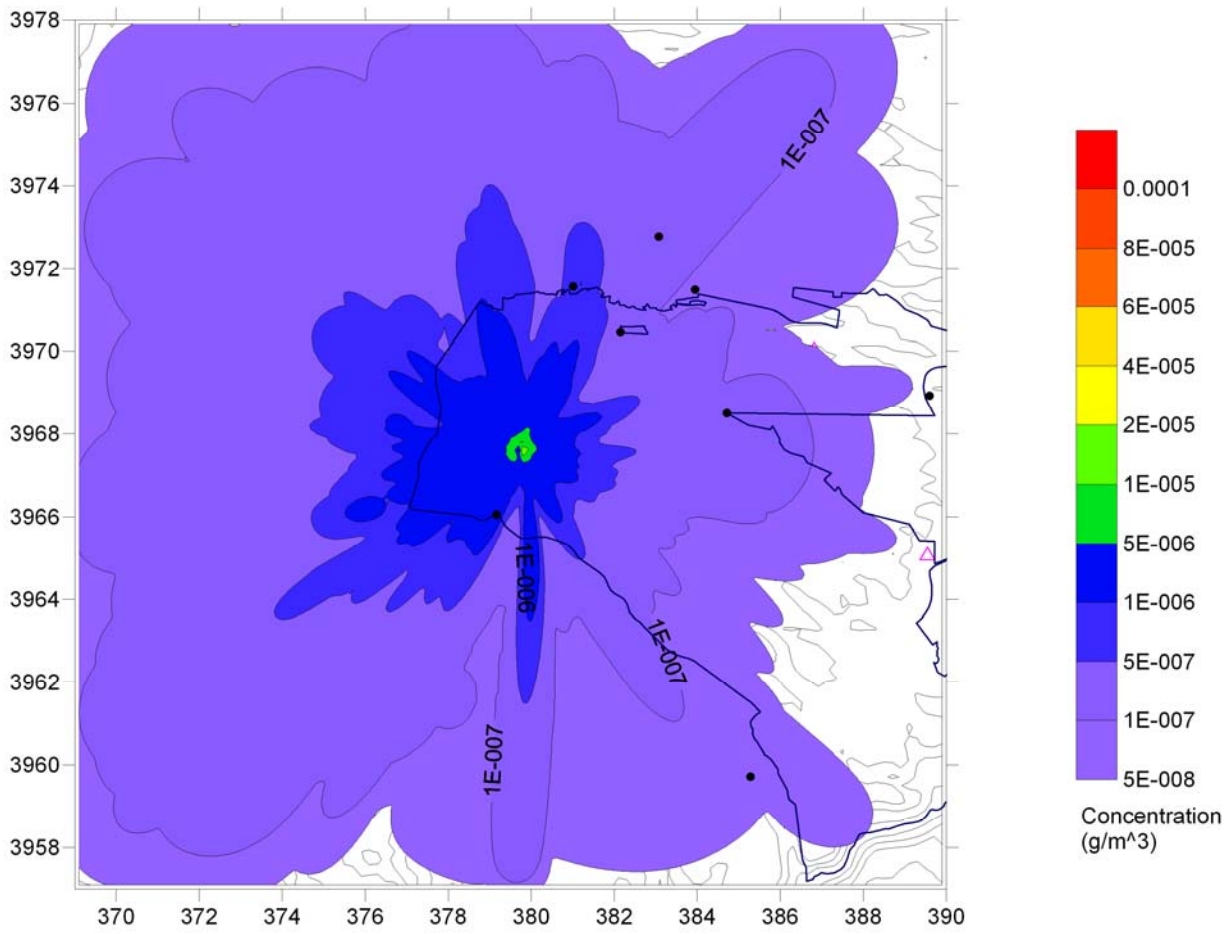

Figure 2-2. Peak 1-hour average air concentrations for the TA-16-388 maximum lofting case study with a 1 gram per second release rate.

Blue line = LANL boundary
Black-dot = receptor
Black lines = background elevation contours
Pink triangle = meteorological stations
g/m^3 = grams per cubic meter

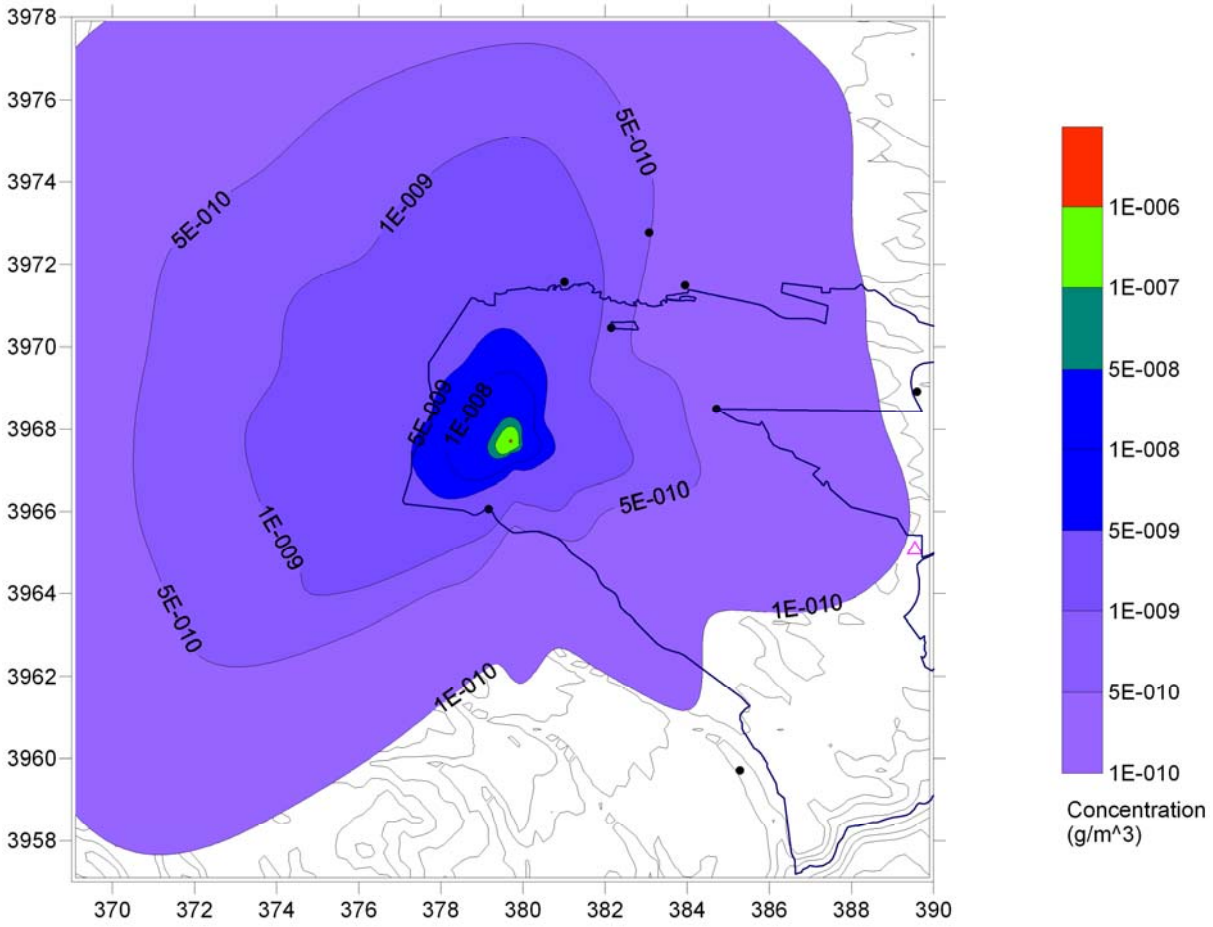

Figure 2-3. Peak annual average air concentration for the TA-16-388 minimum lofting case study with a 1 gram per second release rate.

Blue line = LANL boundary
Black-dot = receptor
Black lines = background elevation contours
Pink triangle = meteorological stations
g/m^3 = grams per cubic meter

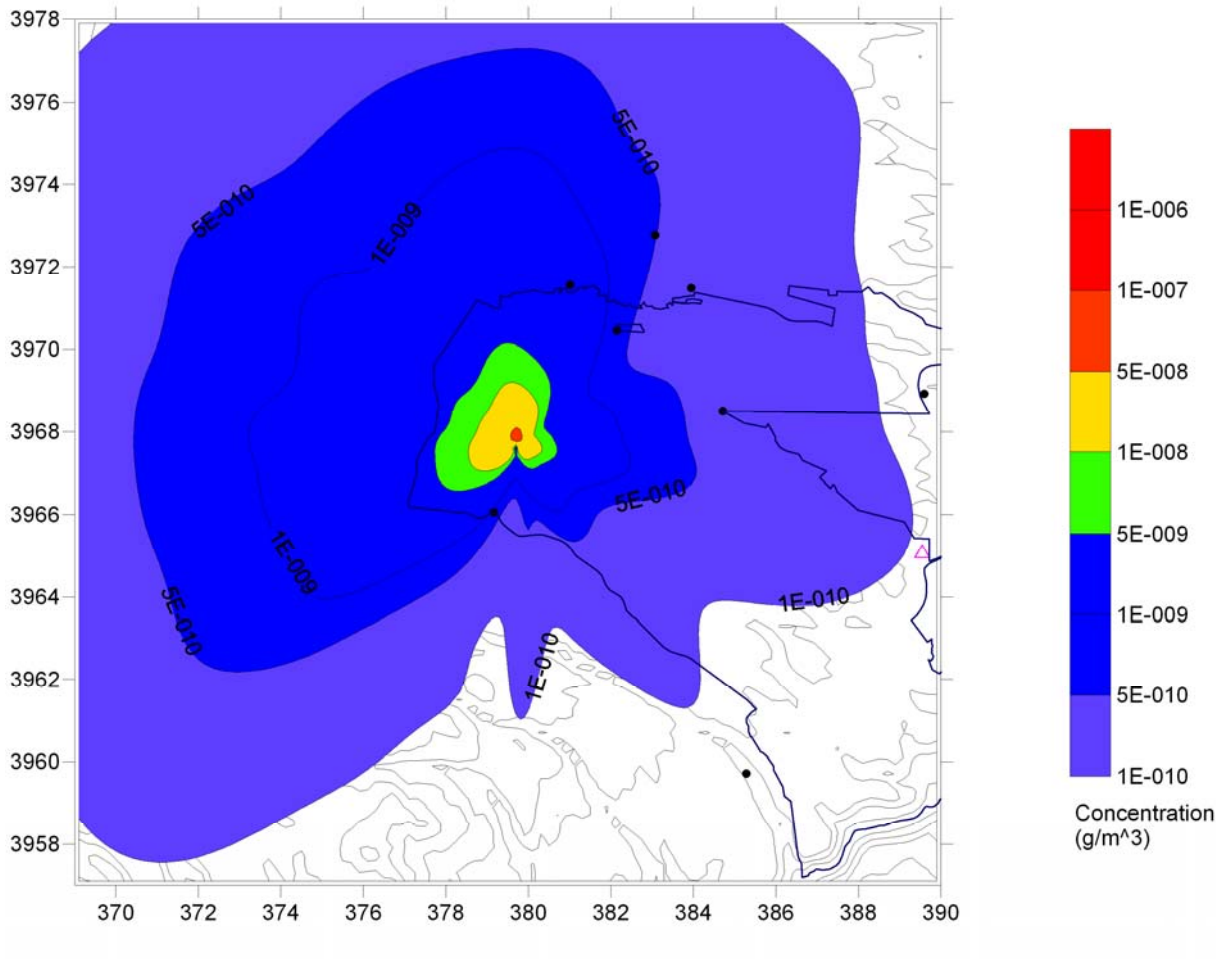

Figure 2-4. Peak annual-average air concentration for the TA-16-388 maximum lofting case study with a 1 gram per second release rate.

Blue line = LANL boundary
Black-dot = receptor
Black lines = background elevation contours
Pink triangle = meteorological stations
g/m^3 = grams per cubic meter

3.0 Deposition Modeling Results

Deposition modeling was performed using the same worst-case unit/waste scenarios (see Section 2) used to model air quality impacts. CALPUFF's deposition option uses the same air concentrations calculated for air quality impacts then "deposits" the pollutants on surfaces using pollutant-specific deposition rates. The pollutant-specific deposition parameters are complex and, because LANL-specific information is not available, the model parameter defaults were used. CALPUFF provides a library of information for particulate matter, sulfur dioxide, various oxides of nitrogen, nitric acid, odor, toluene, xylene, and pinenes. To best reflect the types of pollutants that may be emitted from the TA-16 Burn Ground, the CALPUFF parameters for particulate matter represented total suspended particulate and PM_{10}; oxides of nitrogen represented inorganic gaseous pollutants such as carbon monoxide and nitrogen dioxide; and toluene represented emissions of gaseous hydrocarbons.

CALPUFF derives annual deposition fluxes (DF) in g of pollutant deposited per m^2 of soil per second (g/m^2 s) for each g/s of pollutant released. Illustrations of the deposition fluxes are located in Figures 3-1 and 3-2 for the TA-16-388 minimum and maximum lofting scenarios. Table 3-1 shows the deposition fluxes for particles, hydrocarbons, and inorganic gases for the worst-case on-site and off-site impacts scenarios. However, the screening levels used are in milligrams of pollutant deposited per kilogram of soil (mg/kg) so the deposition fluxes must be converted to unit soil input concentrations as follows:

$$SC = \frac{DF\ (g\ pollutant)}{(m^2\ soil * s)} * \frac{1}{D\ (m\ soil)} * \frac{(m^3\ soil)}{BD\ (kg\ soil)} * \frac{1000\ mg\ pollutant}{g\ pollutant}$$

Where:

SC = Soil input concentration rate (mg pollutant/kg soil * s) per g/s pollutant emission rate

DF = the annual deposition flux in g/m^2 s per g/s pollutant emission rate

D = depth of the soil mixing layer = 2 cm = 0.02 m (EPA, 2005)

BD = bulk soil density = 1.5 g/cm^3 = 1500 kg/m^3 (EPA, 2005)

Table 3-1 shows the worst-case DFs and Table 3-2 shows the calculated SCs. The SC rates are multiplied by pollutant emissions rates to calculate deposition. The contaminant-specific annual emissions rates are the same as those used for the chronic air quality impacts analysis (Table 2-6). These emission rates assume that 20,000 lb/yr of burnable wastes (this does not include non-combustibles associated with the waste, such as scrap metal or soil) are treated annually and 15,000 gal of propane is used as supplemental fuel annually. Annual deposition was multiplied by 10 to estimate a 10-year impact, which provides an incremental change over the lifetime of the permit. The 10-year deposition quantities are then compared to deposition screening levels. In accordance with the modeling protocol, the screening levels used were:

- The NMED Human Health Industrial/Occupational Soil Screening Levels (SSLs) (NMED, 2006)

- The EPA Region 6 Human Health Medium-Specific Screening Levels (EPA, 2007), contaminants which are not on the NMED SSL table. EPA guidance uses a 10^{-6} cancer risk level and NMED uses a 10^{-5} cancer risk level for chemical carcinogens. To equalize the deposition pollutant assessment, EPA carcinogen screening levels are multiplied by 10 to reflect the 10^{-5} cancer risk.
- The LANL Ecological Screening Levels (ESLs).

Table 3-3 shows the worst-case pollutant-specific annual deposition and 10-yr deposition and the screening levels. Based on Table 3-3, screening levels would not be approached until orders of magnitude more material was burned than estimated. This confirms that the air pathway will not create unacceptable soil contamination.

Table 3-1. Deposition Fluxes

Pollutant Type	Deposition Rate[1]	
	Worst-Case On-Site	Worst-Case Off-Site
Particulate matter	9.68E-09	1.70E-11
Volatile organic gases	1.19E-08	2.55E-11
Inorganic gases	9.45E-09	2.10E-11

[1] Units are grams of pollutant deposited per square meter of soil per second for a standard gram per second pollutant emissions rate

Table 3-2. Soil Input Concentrations

Pollutant Type	Soil Input Concentration[1]	
	Worst-Case On-Site	Worst- Case Off-Site
Particulate matter	3.22E-07	5.66E-10
Volatile organic gases	3.98E-07	8.50E-10
Inorganic gases	3.15E-07	6.99E-10

[1] Units are milligrams of pollutant deposited per kilogram of soil for a standard gram per second pollutant emissions rate

Table 3-3. Worst-Case On-Site 10-year Deposition

Contaminant	Emissions (g/s)	Conversion Factor Source [1]	Worst-Case On-site Conversion Factor [2]	Annual Deposition (mg/kg)	10-year Deposition (mg/kg)	ESL[3] (mg/kg)	SSL[4] (mg/kg)
Acenaphthene	4.97E-05	HC	3.98E-07	1.98E-11	1.98E-10	2.50E-01	3.35E+04
Acetaldehyde	3.13E-04	HC	3.98E-07	1.24E-10	1.24E-09		3.84 E+02
Acetone	1.74E-04	HC	3.98E-07	6.92E-11	6.92E-10	1.20E+00	1.00E+05
Acrolein	1.94E-04	HC	3.98E-07	7.71E-11	7.71E-10		7.52 E-01
Aluminum	3.54E-06	PM	3.22E-07	1.14E-12	1.14E-11		1.00E+05
Anthracene	7.45E-05	HC	3.98E-07	2.96E-11	2.96E-10	2.10E+02	1.00E+05
Barium	2.09E-06	PM	3.22E-07	6.71E-13	6.71E-12	1.10E+02	1.00E+05
Benzaldehyde	5.16E-04	HC	3.98E-07	2.06E-10	2.06E-09		6.80E+04
Benzene	5.07E-03	HC	3.98E-07	2.02E-09	2.02E-08	2.40E+01	2.58E+01
Benzo(a)anthracene	2.48E-05	HC	3.98E-07	9.88E-12	9.88E-11	3.00E+00	2.34E+01
Benzo(a)pyrene	2.48E-05	HC	3.98E-07	9.88E-12	9.88E-11	9.60E+00	2.34E+00
Benzo(b,k)fluoranthene	3.48E-05	HC	3.98E-07	1.38E-11	1.38E-10	1.80E+01	2.34E+01
Benzyl alcohol	1.97E-04	HC	3.98E-07	7.83E-11	7.83E-10		1.00E+05
Butadiene [1-3-]	6.65E-06	HC	3.98E-07	2.65E-12	2.65E-11		2.38E+00
Butyl benzyl phthalate	6.06E-07	HC	3.98E-07	2.41E-13	2.41E-12	9.00E+01	2.40E+02
Carbon tetrachloride	3.42E-07	HC	3.98E-07	1.36E-13	1.36E-12		8.64E+00
Chloromethane	1.41E-06	HC	3.98E-07	5.61E-13	5.61E-12		5.34E+01
Chromium (total)	1.97E-06	PM	3.22E-07	6.35E-13	6.35E-12	2.30E+00	5.00E+03
Chrysene	4.47E-05	HC	3.98E-07	1.78E-11	1.78E-10	2.40E+00	2.31E+03
Crotonaldehyde	2.98E-05	HC	3.98E-07	1.19E-11	1.19E-10		1.70E-01
Cyclohexane	1.33E-04	HC	3.98E-07	5.28E-11	5.28E-10		1.40E+02
Dibenzo(a,h)anthracene	9.93E-07	HC	3.98E-07	3.95E-13	3.95E-12	1.20E+01	2.34E+00
Dibutyl phthalate	1.64E-06	HC	3.98E-07	6.52E-13	6.52E-12	1.10E-02	6.84E+04
Dichloroethylene [1,1-]	1.07E-06	HC	3.98E-07	4.25E-13	4.25E-12	1.10E+01	7.77E+02
Diethyl phthalate	3.48E-07	HC	3.98E-07	1.38E-13	1.38E-12		1.00E+05

Table 3-3. Worst-Case On-Site 10-year Deposition (continued)

Contaminant	Emissions (g/s)	Conversion Factor Source [1]	Worst-Case On-site Conversion Factor [2]	Annual Deposition (mg/kg)	10-year Deposition (mg/kg)	ESL[3] (mg/kg)	SSL[4] (mg/kg)
Dimethyl phthalate	9.33E-07	HC	3.98E-07	3.72E-13	3.72E-12	1.00E+01	1.00E+05
Dioctyl phthalate	4.56E-06	HC	3.98E-07	1.82E-12	1.82E-11	1.10E+00	
Dioxin (2,3,7,8-TCDD)	7.40E-12	HC	3.98E-07	2.94E-18	2.94E-17	2.90E-07	1.80E-04
Ethylbenzene	2.73E-04	HC	3.98E-07	1.08E-10	1.08E-09		1.28E+02
Ethyl chloride	3.42E-07	HC	3.98E-07	1.36E-13	1.36E-12		1.54E+02
Fluoranthene	9.93E-05	HC	3.98E-07	3.95E-11	3.95E-10	2.20E+01	2.44E+04
Fluorene	4.97E-06	HC	3.98E-07	1.98E-12	1.98E-11	4.10E+00	2.65E+04
Formaldehyde	1.50E-03	HC	3.98E-07	5.99E-10	5.99E-09		4.20E+02
Furan	7.45E-07	HC	3.98E-07	2.96E-13	2.96E-12		2.12E+01
Hexane	7.94E-05	HC	3.98E-07	3.16E-11	3.16E-10		3.80E+01
Hydrogen chloride	4.95E-03	INORG	3.15E-07	1.56E-09	1.56E-08		1.00 E+05
Indeno[1,2,3-cd]pyrene	2.48E-05	HC	3.98E-07	9.88E-12	9.88E-11	6.20E+01	2.34E+01
Methylcyclohexane	7.75E-04	HC	3.98E-07	3.08E-10	3.08E-09		7.89E+01
Methylene chloride	3.70E-06	HC	3.98E-07	1.47E-12	1.47E-11	2.60E+00	4.90E+02
Methyl ethyl ketone (2-Butanone)	6.45E-05	HC	3.98E-07	2.57E-11	2.57E-10	3.60E+02	4.87E+04
Methyl isobutyl ketone	5.46E-05	HC	3.98E-07	2.17E-11	2.17E-10		7.01E+03
Naphthalene	8.04E-04	HC	3.98E-07	3.20E-10	3.20E-09	3.40E-01	3.00E+02
Nitrogen dioxide	6.18E-01	INORG	3.15E-07	1.95E-07	1.95E-06		1.00E+05
Phenanthrene	3.56E-05	HC	3.98E-07	1.42E-11	1.42E-10	1.00E+01	2.05E+04
Phenol	7.75E-05	HC	3.98E-07	3.08E-11	3.08E-10	7.90E-01	1.00E+05
Pyrene	9.93E-06	HC	3.98E-07	3.95E-12	3.95E-11	1.80E+01	3.09E+04
Styrene	2.48E-04	HC	3.98E-07	9.86E-11	9.86E-10		1.00E+02
Toluene	6.06E-04	HC	3.98E-07	2.41E-10	2.41E-09	2.30E+01	2.52E+02
Trichloroethane[1,1,1-]	1.71E-07	HC	3.98E-07	6.80E-14	6.80E-13	2.60E+02	5.63E+02
Trimethylbenzene [1,2,4-]	1.21E-03	HC	3.98E-07	4.80E-10	4.80E-09		2.13E+02
1,3,5-Trimethylbenzene	2.77E-03	HC	3.98E-07	1.10E-09	1.10E-08		6.92E+01
Vinyl chloride	1.11E-06	HC	3.98E-07	4.41E-13	4.41E-12		1.40E+01

Table 3-3. Worst-Case On-Site 10-year Deposition (continued)

Contaminant	Emissions (g/s)	Conversion Factor Source [1]	Worst-Case On-site Conversion Factor [2]	Annual Deposition (mg/kg)	10-year Deposition (mg/kg)	ESL[3] (mg/kg)	SSL[4] (mg/kg)
Xylene (Total)	2.86E-03	HC	3.98E-07	1.14E-09	1.14E-08	1.40E+00	8.20E+01
Zinc	3.11E-04	PM	3.22E-07	1.00E-10	1.00E-09	1.00E+01	1.00E+05

[1] The source of the conversion factor (CF) is either the Table 3-2 particulate matter (PM) deposition rate, the inorganic gases (INORG) deposition rate, based on oxides of nitrogen, or the hydrocarbon (HC) depositon rate, based on toluene.
[2] The units of the CF are milligrams of pollutant deposited per kilogram of soil (mg/kg) per gram per second pollutant emission rate.
[3] ESL = The LANL Ecological Screening Levels
[4] SSL = The NMED Human Health Industrial/Occupational Soil Screening Levels (SSLs) (NMED, 2006) or the EPA Region 6 Human Health Medium-Specific Screening Levels (EPA, 2007), which are used for contaminants not appearing on the NMED SSL table

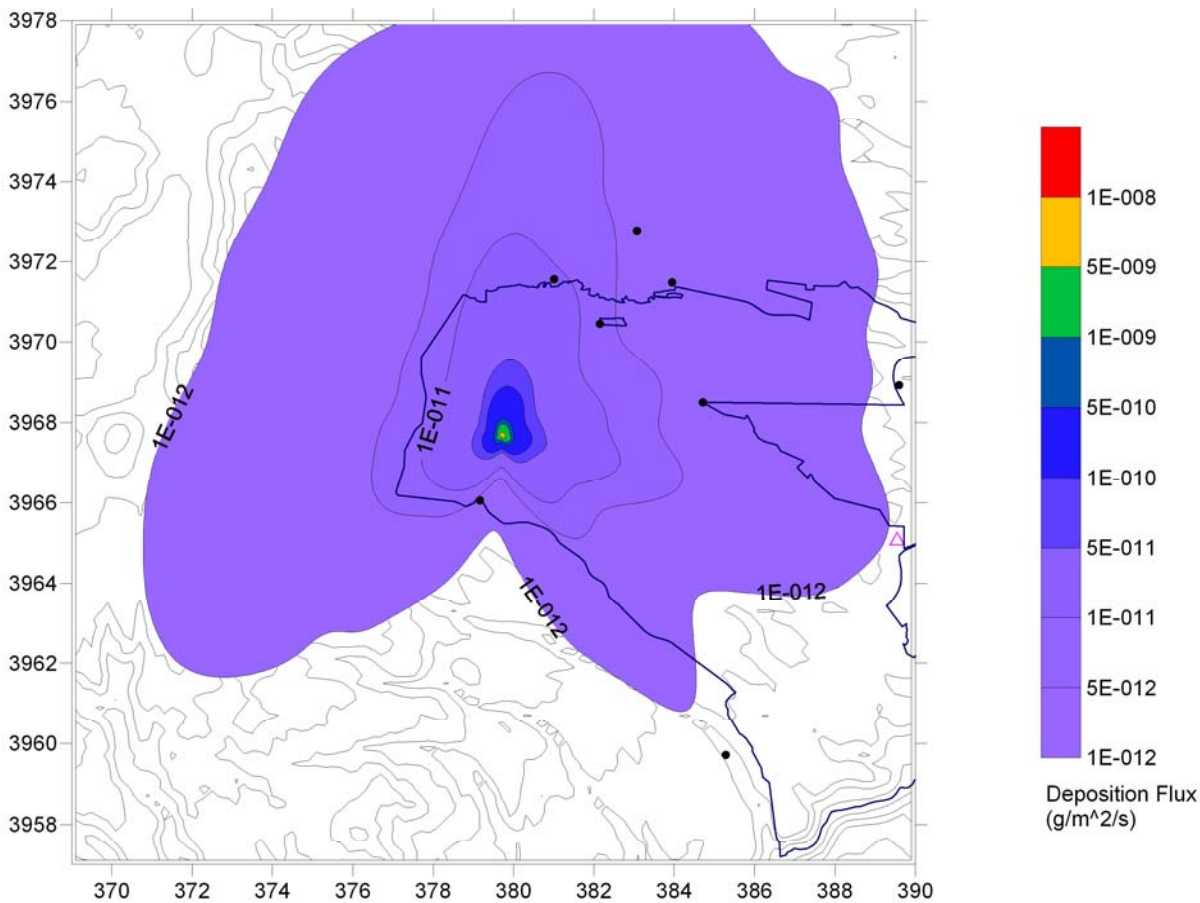

Figure 3-1. Peak annual average deposition flux for the TA-16-388 minimum lofting case with a 1 gram per second release rate.

Blue line = LANL boundary
Black-dot = receptor
Black lines = background elevation contours
g/m^2-s = grams per square meter seconds

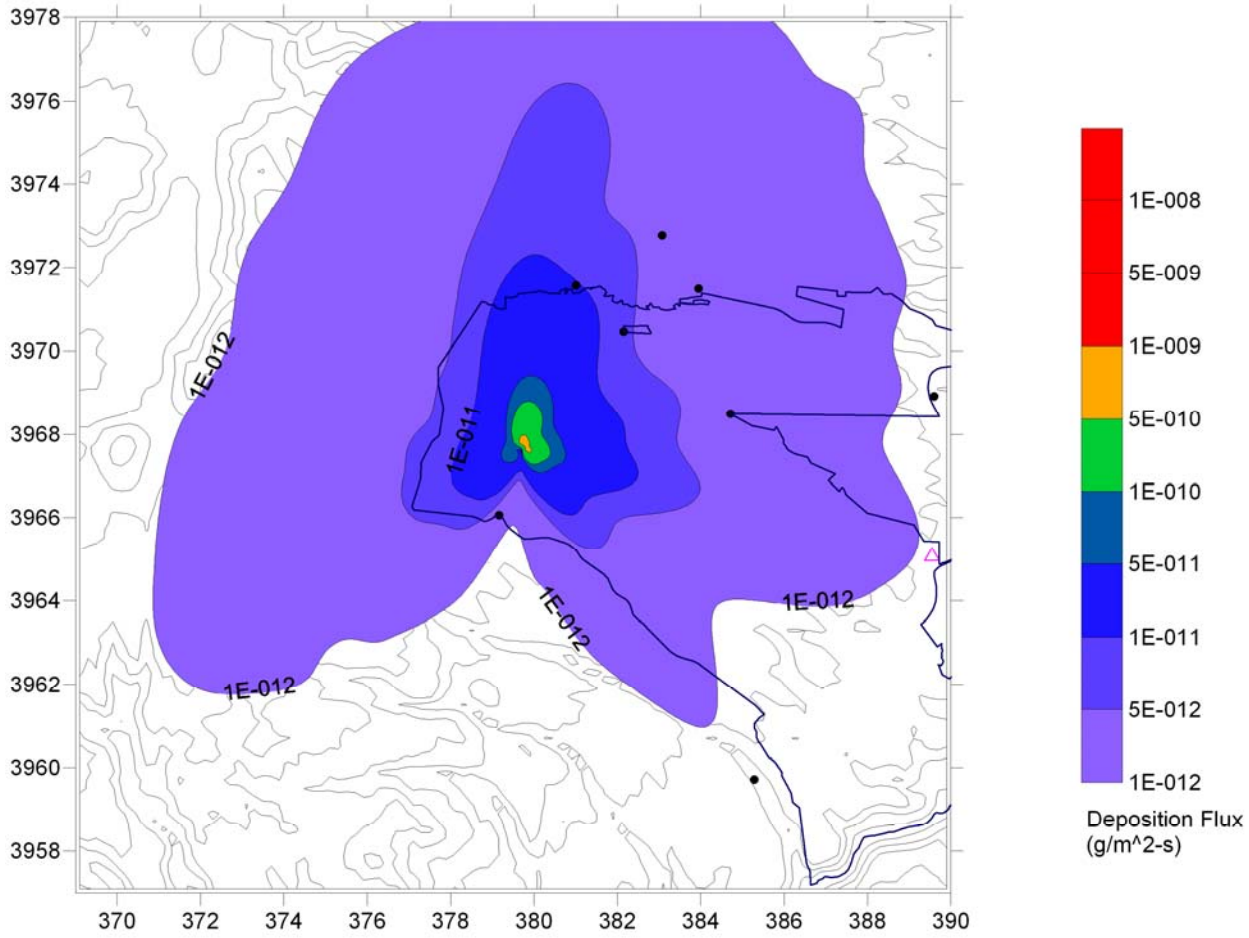

Figure 3-2. Peak annual average deposition flux for the TA-16-388 maximum lofting case with a 1 gram per second release rate.

Blue line = LANL boundary
Black-dot = receptor
Black lines = background elevation contours
g/m^2-s = grams per square meter seconds

4.0 Regulated Solvent Impacts Analysis

Specific individual solvents burned at the TA-16 Burn Ground cannot be modeled as described in Section 2 because there are no solvent-specific emission factors for open burning of solvents. Emission factors for the open burning of spilled fuel oil were used to conservatively estimate the products of combustion that result from burning solvents.

Solvents treated at TA-16 are produced mainly from research and development processes, which may change frequently. Therefore, the types and amounts of solvents cannot be estimated. Solvent emissions calculated in the past were snapshots of a single year's activities and cannot be extrapolated to other years with certainty. Over the past several years, alternatives have been implemented to reduce the amount of HE-contaminated solvents that require treatment. As a result, no bulk solvents have been treated for several years and <300 gallons of dimethylsulfoxide (DMSO) were treated in 2006. Small amounts of a few solvents are present at trace levels on combustibles treated at the TA-16 Burn Ground.

To put into perspective the acceptable releases of regulated solvents that can be treated at the TA-16 Burn Ground, LANL used the worst-case hourly and annual CFs to back-calculate acceptable release impacts and compared the impacts to the air quality screening levels described in Section 2 of this document. The solvents analyzed were those listed in the most recent version of the LANL General Part A Permit Application (LANL, 2006). Many of these are F-listed and are not expected to be treated at the TA-16 Burn Ground, but are included to provide a worst-case analysis.

The screening levels for acute (1-hr) and chronic (annual) exposures and the CFs calculated by CALPUFF can be used to estimate the amount of a pollutant that could be released from the TA-16 Burn Ground operations before the screening level is reached. Note that the amount released is not the same as the amount burned because burning destroys most of the material. Below is an example using benzene as the pollutant, with a screening level of 1300 µg/m^3, and the hourly worst-case CF of 1.49 E+02 µg/m^3 of pollutant per g/s of solvent burned. Assuming a 95% destruction efficiency:

$$\frac{1300\ \mu g/m^3}{} \times \frac{g/sec}{1.49E{+}02\ \mu g/m3} \times \frac{3600\ sec}{hr} \times \frac{1\ lb}{454\ g} \times \frac{100\ lb\ burned}{5\ lb\ released} = 1384\ lb/hr$$

Therefore, 1384 lb/hr of benzene could be burned before the acute screening level was exceeded. Since only 250 lb of waste can be burned per hour at TA-16-388, the screening level will not be exceeded.

Table 4-1 shows the hourly and annual contaminant-specific screening levels, the CFs, and the calculated quantities of bulk solvents that could be treated (assuming a 95 % destruction efficiency) before the screening levels were reached. These quantities were calculated using the on-site CFs. If calculated with the off-site CFs, the calculated quantities would be even larger.

Table 4-1. Short-Term and Annual Solvents Impacts Estimation [1]

Contaminant	Acute Screening Limit [2] ($\mu g/m^3$)	On-site 1 Hour Conversion Factor ($\mu g/m^3$ per g/s)	1-Hour Solvent Limits [3] (lb/hr)	Chronic Screening Level [4] ($\mu g/m^3$)	On-site Annual Conversion Factor ($\mu g/m^3$ per g/s)	Annual Solvent Limits (lb/yr)
Acetone	4.75E+05	1.49E+02	5.06E+05	3.29E+03	1.48E+00	1.79E+08
Benzene	1.30E+03	1.49E+02	1.38E+03	2.50E-01	1.48E+00	1.36E+04
Carbon disulfide	6.20E+03	1.49E+02	6.60E+03	7.50E+02	1.48E+00	4.08E+07
Carbon tetrachloride	1.90E+03	1.49E+02	2.02E+03	1.30E-01	1.48E+00	7.08E+03
Chlorobenzene	1.25E+05	1.49E+02	1.33E+05	6.20E+01	1.48E+00	3.37E+06
Chloroform	1.50E+02	1.49E+02	1.60E+02	3.50E-01	1.48E+00	1.91E+04
Cresols	2.00E+04	1.49E+02	2.13E+04	NA[5]	NA	NA
Dichlorobenzene, o-	3.00E+05	1.49E+02	3.19E+05	2.10E+02	1.48E+00	1.14E+07
Dichloroethane [1,2-]	2.02E+05	1.49E+02	2.15E+05	5.10E+00	1.48E+00	2.78E+05
Dichloroethylene [1,1-]	7.50E+04	1.49E+02	7.98E+04	2.10E+02	1.48E+00	1.14E+07
Dichlorodifluoromethane	1.50E+07	1.49E+02	1.60E+07	NA	NA	NA
Ethyl benzene	5.00E+05	1.49E+02	5.32E+05	1.10E+03	1.48E+00	5.99E+07
Methanol	2.80E+04	1.49E+02	2.98E+04	NA	NA	NA
Methyl ethyl ketone	1.30E+04	1.49E+02	1.38E+04	5.10E-03	1.48E+00	2.78E+02
Methyl isobutyl ketone	3.00E+05	1.49E+02	3.19E+05	3.10E+03	1.48E+00	1.69E+08
Methylene chloride	1.40E+04	1.49E+02	1.49E+04	3.10E+03	1.48E+00	1.69E+08
Nitrobenzene	1.50E+04	1.49E+02	1.60E+04	2.10E+00	1.48E+00	1.14E+05
Pyridine	5.00E+04	1.49E+02	5.32E+04	3.70E+00	1.48E+00	2.01E+05
Tetrachloroethylene	2.00E+04	1.49E+02	2.13E+04	3.20E-01	1.48E+00	1.74E+04
Toluene	3.70E+04	1.49E+02	3.94E+04	4.00E+02	1.48E+00	2.18E+07
Trichloroethane, 1,1,1-	6.80E+04	1.49E+02	7.24E+04	2.30E+03	1.48E+00	1.25E+08
Trichloroethane, 1,1,2-	5.00E+04	1.49E+02	5.32E+04	1.50E+01	1.48E+00	8.17E+05
Trichloroethylene	6.98E+05	1.49E+02	7.43E+05	9.60E-01	1.48E+00	5.23E+04
Trichlorofluoromethane	2.50E+06	1.49E+02	2.66E+06	7.30E+02	1.48E+00	3.97E+07
Xylenes	2.20E+04	1.49E+02	2.34E+04	1.10E+02	1.48E+00	5.99E+06

1 Quantities calculated assume 95% destruction of the solvent while burning.
2 Screening limits are from acute limits (1 hour) inhalation exposure (AIEC) for toxic air pollutants (EPA, 2005)

[3] Calculated solvent limits illustrate the amount of solvent that could be burned before the respective screening limit was reached
[4] Annual screening limits are from the Environmental Protection Agency's Region 9 Preliminary Remediation Goals (PRGs), (EPA, 2004)
[5] NA indicates that there is no screening limit for the contaminant
g/s = grams per second
$\mu g/m^3$ = micrograms per cubic meter
lb/yr = pounds per year

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Richard S. Watkins
Associate Director
Associate Directorate Environment, Safety, Health, & Quality
Los Alamos National Laboratory
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