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Buoyant line and point source (BLP) dispersion model user's guide

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1. INTRODUCTION

1.1 Project Objective

Environmental Research & Technology, Inc. (ERT) was retained by The Aluminum Association, Inc. to develop an air quality dispersion model to simulate the transport and diffusion of emissions from aluminum reduction plants. Aluminum reduction plants are a complex arrangement of emission sources, composed of parallel, low-level, buoyant line sources called potrooms interspersed, typically, by short point sources. Alumina is reduced through electrolysis to aluminum in the potrooms. A reduction facility usually consists of 2 to 20 potroom buildings about 500 meters long. Some of the buoyant emissions from the reduction process escape through a continuous ridge ventilator, which is a few meters wide running the length of the potroom. Most of the emissions, however, are collected by hooding above the reduction cells and are treated and exhausted through nearby stacks. There are typically 2 to 20 point sources, usually low-level, for each potroom primary control system.

Since a buoyant line source has one less degree of freedom than an isolated point source in entraining ambient air, the plume rise will be enhanced. In addition, the line source rise will be dependent on wind direction, line length, the number of parallel lines, and their spacing. Both the line source and the short point sources are subject initially to building downwash effects. The dispersion of effluents from aluminum reduction plants, because of these complexities, is not correctly handled by currently available air quality models. The model developed during this project, the Buoyant Line and Point Source (BLP) model, is in direct response to this need. BLP can simulate the complexities of aluminum reduction plants, but, importantly, also has the flexibility to duplicate point source contributions predicted by the CRSTER model.

1.2 Model Applications

The BLP dispersion model was developed specifically for aluminum reduction plants and, in addition to theoretical considerations, is based on extensive wind tunnel simulations of two reduction plants and an SF_6 field study tracer program at one of the plants. The model has been verified using two years of SO_2 measurements at the second reduction plant. (Refer to the companion document P-7304A for a description of the project and the model verification results.)

The complex source configuration of an aluminum reduction facility dictated that many innovative modeling techniques be developed. The major features of the BLP dispersion model are illustrated in Table 1-1. Plume rise from multiple finite buoyant line sources and the effects of vertical wind shear and building downwash on the plume rise of both line and point sources are the key innovative features.

Line source plume rise is determined analytically and is dependent on line length, wind direction, initial building downwash effects, the number of parallel lines, and line spacing. Plume rise is increased as the line length decreases, the wind direction becomes parallel to the line, and as the number of lines increases. If the building downwash effect is neglected, then as the line length approaches zero, the plume rise relationships reduces to the conventional Briggs formulations.

Because both the line and point sources of an aluminum reduction facility are low-level sources, the wind speeds encountered by the rising plumes are typically much greater than the wind speed at release height. Since current plume rise formulations assume the release height wind speed is constant with height, the resulting plume rise can be greatly overestimated. The BLP model contains an option that analytically determines the reduced plume rise that results when the effects of vertical wind speed shear are considered. Once again, as the wind speed shear approaches zero, the plume rise relationship reduces to the familiar Briggs formulation.

TABLE 1-1

MAJOR FEATURES OF THE BLP MODEL

- UTM or line source oriented (SCS) coordinate system.
- Multiple point source and finite buoyant line source capability.
- Finite buoyant line source plume rise.
- Plume enhancement due to multiple line sources.
- Vertical wind shear in plume rise formulations for both point and line sources.
- Transitional plume rise.
- Incorporation of building downwash in both dispersion and plume rise calculations for point and line sources.
- Terrain adjustment plume path coefficients.
- Time-dependent pollutant decay.
- Source contribution concentrations.
- Flexible post-processing package.

Although the BLP model was specifically developed and verified for aluminum reduction plants, its analytical, theoretically based treatment of buoyant line source plume rise, building downwash, and vertical wind speed shear effects readily lends BLP to similar complex sources where these effects may be important.

1.3 BLP Modeling Package

The BLP modeling package is schematically illustrated in Figure 1-1. The BLP dispersion model accepts processed meteorological data from the CRSTER meteorological preprocessor program. The preprocessor requires hourly surface data and twice daily mixing height data (for further information about the preprocessor program, consult the Handbook for the Single Source (CRSTER) Model (EPA 1977)). For short-term runs up to 24 hours of card-image type user-specified meteorological data may be input. Source, receptor, and program control data are also input by card deck. All BLP concentration output is stored on a disk or tape file for further processing by the BLP post-processing program, POSTBLP. The user inputs POSTBLP program control parameters by card deck. Printouts of the appropriate processed concentration and meteorological data are generated by POSTBLP.

1.4 Summary of Input Data and Program Options

Four types of input data are required for the BLP dispersion model:

- meteorological data,
- source data,
- receptor data, and
- program control parameters.

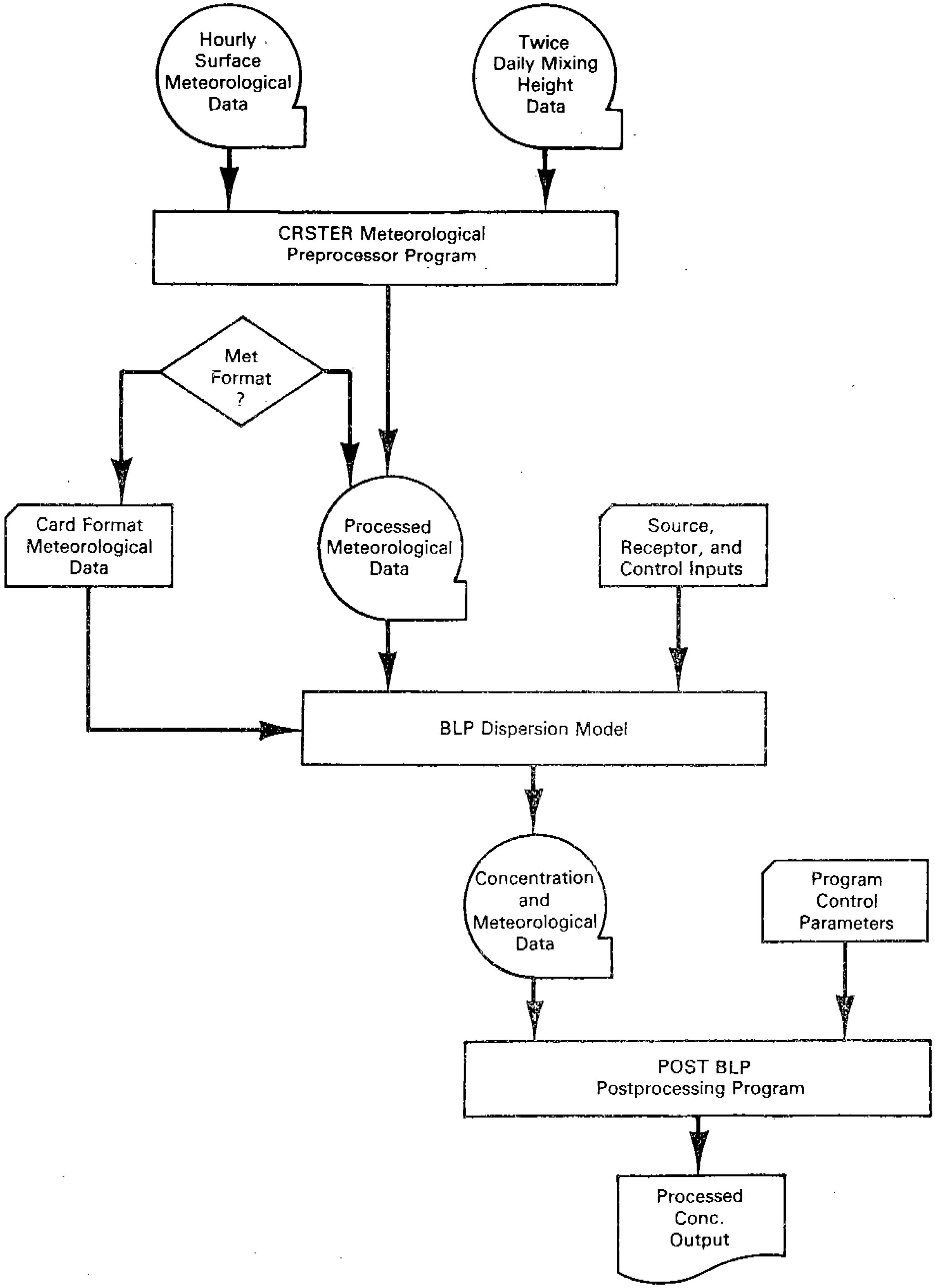

Figure 1-1 BLP Modeling Package

1.4.1 Meteorological Data

The BLP model will accept two types of meteorological data: preprocessor data or user-specified card-image meteorological input. The preprocessor data is generated by the CRSTER meteorological preprocessor program from hourly surface observations and twice daily mixing height data. The preprocessor data includes for each hour:

- PGT stability class,
- wind speed in meters per second,
- wind direction in degrees,
- randomized wind direction in degrees,
- mixing height (urban and rural) in meters, and
- ambient air temperature in degrees Kelvin.

For further information on the output and input requirements of the CRSTER preprocessor program, refer to the Handbook for the Single Source (CRSTER) Model (EPA 1977).

The other possible format of meteorological input data is user-specified hourly card-image type data. Up to 24 hours of meteorological data may be specified in this format and should include hourly values of:

- PGT stability class,
- wind speed in meters per second,
- wind direction in degrees,
- ambient air temperature in degrees Kelvin, and
- mixing height in meters.

1.4.2 Source Data

The BLP program is intended to model both buoyant line and point sources. The required point source data requirements are:

- stack location X and Y coordinates in meters,
- stack base elevation in meters,

- physical stack height in meters,
- pollutant emission rate in grams per second,
- stack inner diameter in meters,
- stack gas exit velocity in meters per second, and
- stack gas temperature in degrees Kelvin.

Up to 50 point sources are allowed.

The required input data for the buoyant line sources consist of a set of averaged parameters for use in the buoyant line sources plume rise calculations and a more detailed set of parameters used in the dispersion calculations. To calculate line source plume rise, it is assumed that there are up to 10 parallel lines of equal length and width equally spaced with identical buoyancy fluxes and release heights. If all these conditions are not satisfied, it may be necessary for the user to calculate appropriately averaged values for the following parameters:

- line length in meters,
- release height in meters,
- line source width in meters,
- building width in meters,
- spacing between buildings in meters, and
- buoyancy parameter in m^4/s^3 (Note: the buoyancy parameter, F', differs from the buoyancy flux defined by Briggs.)

Although the height of an individual plume element is determined from the above averaged information, no restriction is made on the symmetry or spacing of the line sources for the dispersion calculations. The following input parameters, used in the dispersion calculations, are required for <u>each</u> line source:

- X and Y coordinates of start of line in meters,
- X and Y coordinates of end of line in meters,
- building height in meters,

- pollutant emission rate in grams per second, and
- building base elevation in meters.

A maximum of 10 line sources is allowed.

1.4.3 Receptor Data

The user has the option of either specifying the X and Y coordinates and the elevation of each receptor location or generating a rectangular grid of receptors by specifying the endpoints and X and Y spacing of the proposed receptor grid. If the receptors are generated by BLP, the elevations of all receptors are zero. With either option, up to 100 receptors are allowed.

1.4.4 Program Control Parameters

The BLP dispersion model has several optional features that the user may select through the program control parameters. The default values of the program control parameters are discussed in the user's instructions section.

- Coordinate system option--allows the coordinates of all sources and receptors to be specified in Universal Transverse Mercator (UTM) coordinates or in an internal (line source oriented) source coordinate system (SCS).
- Source contribution option--specifies whether the contribution of any particular line or point source is to be separately written to the output file for analysis with the POSTBLP program. (Note: Because of the enhanced plume rise effects of multiple line sources, the source contribution of any single line source implicitly contains the effects of the buoyancy of the other line sources. The addition or removal of line sources will change the contributions of existing line sources.)

- Wind shear option--specifies whether the effect of vertical wind speed shear in determining plume rise from the buoyant point and line sources is to be estimated. The stability-dependent wind speed power law exponents can be changed from the default values by the user.
- Point source downwash option--specifies whether the effects of building downwash are to be estimated for those points within two building heights of any line source. The line sources are assumed to always downwash.
- Transitional plume rise option--specifies whether transitional point source plume rise is to be calculated. Transitional line source plume rise is always calculated.
- Vertical potential temperature gradient option--allows the user to input site-specific vertical potential temperature gradient values for PGT stability classes E and F different from the default values.
- Wind speed power law exponent option--allows the user to change the stability-dependent default power law exponents to more appropriate site-specific values. These exponents are used to calculate wind speed at stack height for use in the dispersion equation and also in the wind shear plume rise formulas. The measurement height of the mean wind speed can also be specified by the user.
- Stability class restriction option--restricts vertical variation of the PGT stability class to a user-specified number of classes per hour. (Note: the CRSTER meteorological preprocessor program may restrict the stability class variation to one class per hour, so if a different variation rate is more appropriate, some modification to the CRSTER preprocessor may also be required.)
- Mixing height option--allows the user to specify whether urban or rural mixing heights are to be used in the dispersion calculations.
- Pollutant decay option--allows for pollutant removal by a linear approximation to a exponential decay process.

- Background concentration option--allows the user to specify a background concentration value.
- Terrain adjustment option--allows the user to specify plume path coefficients for use in plume height calculations.

2. TECHNICAL DESCRIPTION

2.1 Introduction

The source and meteorological data requirements of BLP and a brief summary of the meteorological data generated by the CRSTER meteorological preprocessor program are presented in Section 2.2. A detailed description of the BLP model dispersion equations and assumptions is contained in Section 2.3. Section 2.4 describes the line and point source plume rise equations used in the BLP model. The BLP post-processing program, POSTBLP, is described in Section 2.5.

2.2 Model Input Requirements

2.2.1 Meteorological Inputs

The BLP dispersion model requires hourly values of the following meteorological parameters: PGT stability class, wind speed, wind direction, ambient air temperature, and mixing height. There are two input modes for meteorological data: (1) CRSTER meteorological preprocessor (unformatted) input and (2) card-image type (formatted) meteorological input. Up to 366 days of hourly CRSTER preprocessor data or up to 24 hours of formatted meteorological data can be input to the BLP model.

The stability classification scheme is based on the work of Pasquill (1974), Gifford (1961), and Turner (1964). Six stability categories (Classes A through F) are permitted by BLP. Stability Class G is not allowed; occurrences of stability class G are changed to stability class F by BLP. The CRSTER meteorological preprocessor program calculates hourly values of PGT stability class, and restricts stability class variations to one class per hour. It is possible, however, that the dispersive characteristics of the atmosphere change more rapidly than one class change per hour, especially in the lowest layer of the atmosphere. BLP, therefore, allows the user to specify a maximum stability class variation greater than one class per hour. This option with the CRSTER preprocessor meteorological data requires modification to the CRSTER preprocessor program to remove the one stability class per hour restriction. In formatted card-image input mode, BLP uses the stability classes as specified in the input, with no stability class variation restriction.

The mean wind speed, U_1, at measurement height, Z_1, must be specified hourly. The wind speed variation wind height is assumed to follow a stability dependent power law:

$$U_z = U_1 (Z/Z_1)^P \tag{2-1}$$

where U_z is the wind speed at height Z and P is a stability dependent wind shear exponent. The user may specify site-specific values of the wind shear exponent or use the default values provided (see Table 2-1). The wind speed measurement height, Z_1, can also be specified by the user. A default value of 7 meters is assumed. Because the Gaussian dispersion equation contains a 1/U dependence, a minimum measurement height wind speed of 1 meter per second (m/s) is assumed by the CRSTER preprocessor program.

Wind direction is specified in terms of the direction toward which the wind is blowing. The CRSTER preprocessor program converts the National Weather Service (NWS) wind observations (direction from which the wind is blowing) to the proper format by shifting the direction by 180^o. The NWS observations, reported only in 10^o increments, are randomized by the preprocessor within the 10^o sectors to eliminate wind directional bias.

Hourly ambient air temperatures are used in the point source plume rise equation in the calculation of buoyancy flux (the line source buoyancy parameter for aluminum reduction plants has generally been assumed to be independent of ambient temperature). In preprocessor input mode, a missing temperature value defaults to 293^oK (68^oF). The vertical potential temperature gradients used in the stable plume rise calculations have the default values specfied in Table 2-2. The user may specify more appropriate site-specific values if they are available.

The CRSTER meteorological preprocessor computes hourly mixing heights by interpolation of the twice daily estimated mixing height data. For the details of the interpolation scheme, refer to the

TABLE 2-1

DEFAULT VALUES FOR THE WIND SHEAR EXPONENT, P

PGT Stability Class	P
A	0.10
B	0.15
C	0.20
D	0.25
E	0.30
F	0.30

TABLE 2-2

DEFAULT VALUES FOR THE VERTICAL POTENTIAL TEMPERATURE GRADIENT, $\partial\theta/\theta z$

PGT Stability Class	$\partial\theta/\theta z$ (°K/m)
E	0.020
F	0.035

Handbook for the Single Source (CRSTER) Model (EPA 1977) The preprocessor calculates two mixing heights for each hour: one primarily representative of an urban environment and the other for a rural environment. The user must specify which mixing height (rural or urban) is most appropriate for a particular application of the BLP model.

2.2.2 Source Inputs

The BLP program can be used to model multiple buoyant line and point sources. Table 2-3 summarizes the source data requirements of BLP. For each point source, the stack location, base elevation, physical stack height, inside stack diameter, stack gas exit velocity, stack gas temperature, and pollutant emission rate must be included as input. Up to 50 point sources are allowed. For the line sources, two sets of source parameters must be included. For each line source, the coordinates of the line endpoints, base elevation, release height, and pollutant emission rate are required. A maximum of 10 line sources is allowed. This detailed information is used in the dispersion calculations (see Section 2.3.2). Each line can be a different length, height, and so forth. The plume rise formulation for multiple buoyant finite line sources (described in Section 2.4.2), however, assumes the line sources are equally spaced, with identical heights, widths, buoyancy parameters, and line lengths (see Figure 2-1). These assumptions allow evaluation of the plume rise enhancement effects of multiple line sources. For the plume rise calculations, therefore, a set of averaged line source characteristics must be input. No restriction is placed on the symmetry of the line sources for the dispersion calculation. The averaged parameters determine only the height of individual line source plume elements; for rows of lines with reasonably similar characteristics, the use of averaged parameters is probably not a critical approximation.

All source and receptor locations can be specified as UTM coordinates or in a line-source oriented (SCS) Cartesian coordinate system. The SCS coordinate system has an origin at the endpoint of the first line source, and is oriented with the X-axis parallel to the

TABLE 2-3

REQUIRED SOURCE INPUT DATA

Parameters	Required Point Source Data	Units
X	X coordinate of the stack	m
Y	Y coordinate of the stack	m
E_p	Elevation of the stack base above a reference height (such as sea level)	m
H_s	physical stack height	m
d	stack inner diameter	m
W	stack gas exit velocity	m/s
T_s	stack gas temperature	^oK
Q	pollutant emission rate	g/s

Required Line Sources Data - Dispersion Calculations

Parameters	Definition	Units
X_B	X coordinate of the most westerly end of the line source	m
Y_B	Y coordinate of the most westerly end of the line source	m
X_E	X coordinates of the most easterly end of the line source	m
Y_E	Y coordinate of the most easterly end of the line source	m
H_L	release height of the line source	m
Q_L	pollutant emission rate of the line source	g/s

TABLE 2-3 (Continued)

Required Line Source Data - Plume Rise Calculations

Parameters	Definition	Units
L	average line length	m
H_B	average building height	m
W_m	average line source width	m
W_B	average building width	m
δx	average spacing between buildings	m
F'	average line source buoyancy parameter (Note: the buoyancy parameter, F', differs from the buoyancy flux defined by Briggs by a factor of π - see Equation 2-47)	m^4/s^3

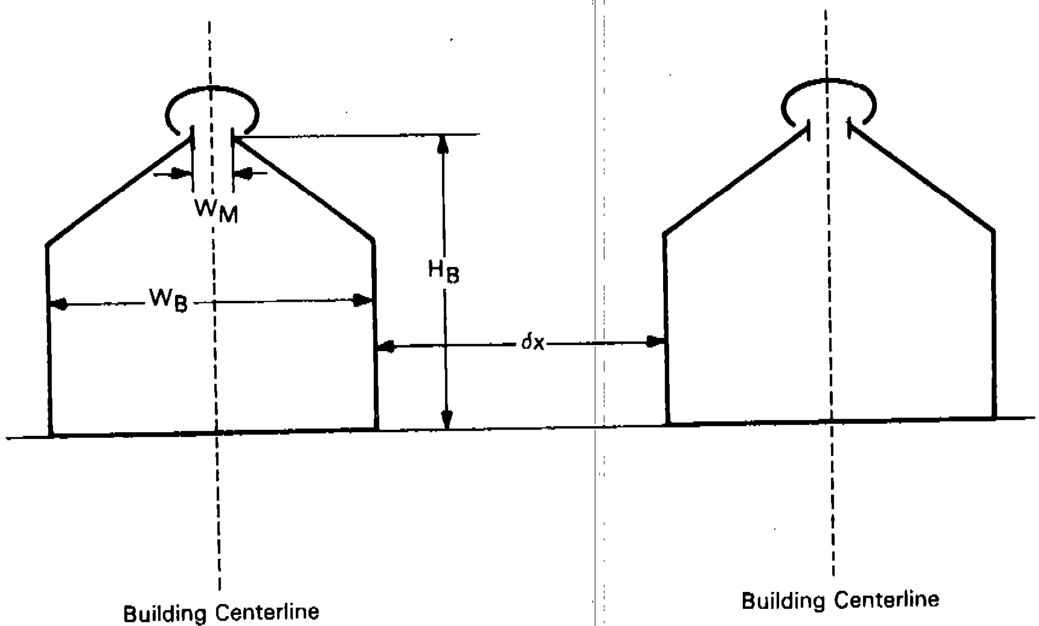

Figure 2-1 Cross-Sectional View of Line Sources

lines. Figure 2-2(a) illustrates the SCS coordinate system. With SCS coordinates, an orientation angle, TCOR, must also be specified. Figure 2-2(b) shows the TCOR variation with different line source orientations.

2.2.3 Receptor Inputs

The BLP model allows the user to either specify a grid of arbitrarily spaced receptor locations or select an option to automatically generate a rectangular grid of receptors, with the boundaries and receptor spacing determined by the user. The location and elevation of each receptor must be specified for arbitrarily located receptors. If the option to generate a rectangular grid is chosen, all receptor elevations are set equal to zero. Figure 2-3 illustrates this receptor generation option. In this example, a grid of 58 receptors, specified in SCS coordinates, are generated. The user must input the SCS coordinates of two points (X_B, Y_B) and (X_E, Y_E), along with the X and Y grid spacing, δX and δY. No receptors are allowed within the "line source rectangle," defined in Figure 2-3 by the dashed lines encompassing the four line sources. It should be noted that because the Pasquill-Gifford Gaussian dispersion parameter curves are defined only for distances greater that 100 meters, the receptor grid should be defined so that no receptor is located within 100 meters of a line or point source.

2.3 Gaussian Modeling Approach

The BLP model calculates ambient air concentrations due to emission from multiple buoyant line and point sources based on the well-known Gaussian plume equation. Adjustments for the effects of limited mixing, and optionally, pollutant decay, downwash, and terrain features are incorporated into the model. For line sources, the point source Gaussian plume equation is numerically integrated over the finite length of the line. The Gaussian dispersion equation and its application to point and line sources are discussed in this section.

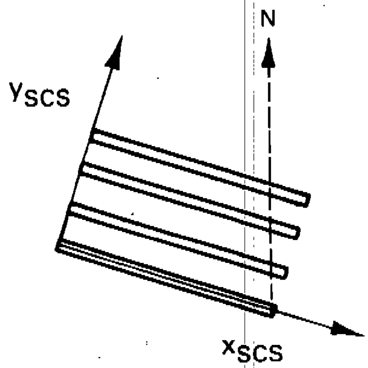

Figure 2-2(a) SCS Coordinate System

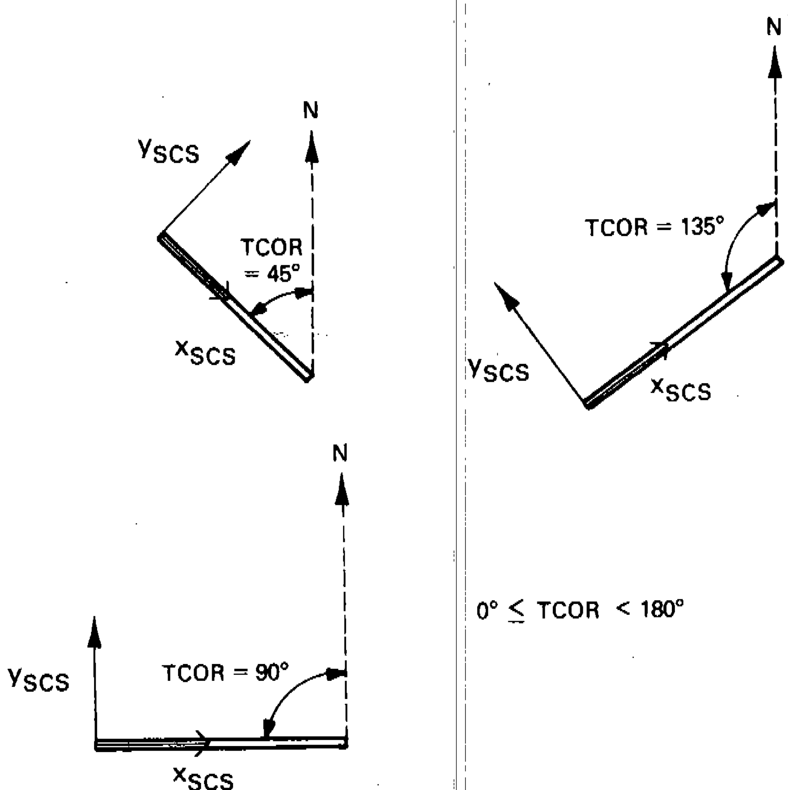

Figure 2-2(b) SCS Orientation Angle, TCOR

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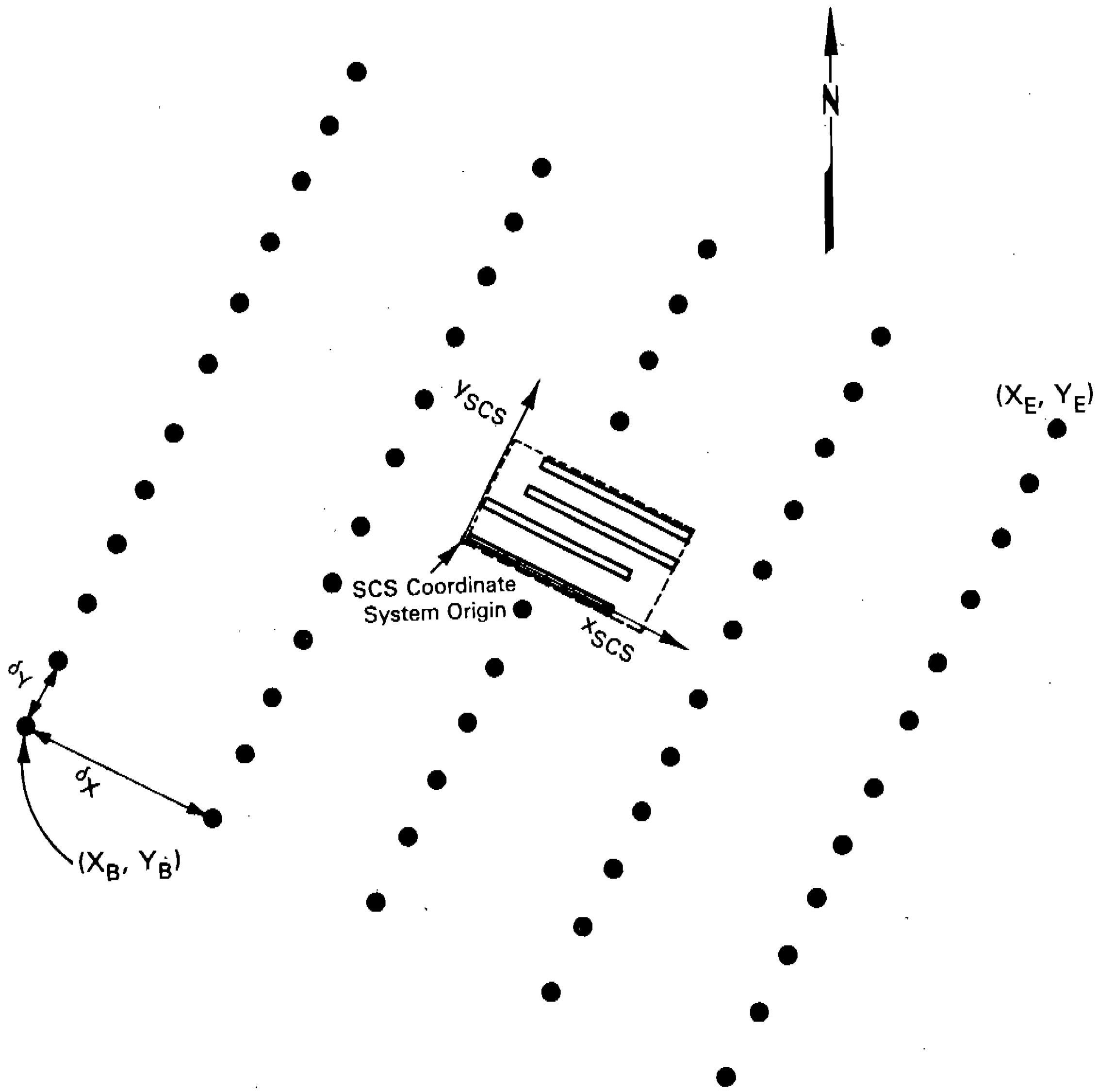

Figure 2-3 Receptor Generation Option

2.3.1 Gaussian Plume Equations for Point Sources

The basic Gaussian plume equation for the concentration, at a ground-level receptor is given by:

$$\chi = \frac{Q}{\pi \sigma_y \sigma_z U_s} \exp -\left[\frac{y^2}{2 \sigma_y^2}\right] \exp -\left[\frac{H^2}{2 \sigma_z^2}\right] \qquad (2\text{-}2)$$

where

- χ is concentration (g/m^3)
- y is crosswind distance (m)
- Q is pollutant emission rate (g/s)
- U_s is mean wind speed (m/s) at stack height
- σ_y is crosswind standard deviation of the concentration distribution (m)
- σ_z is vertical standard deviation of the concentration distribution (m)
- H is effective stack height (m)

The empirical dispersion coefficents, σ_y and σ_z, used in the BLP model are piecewise fits to the stability and distance dependent curves in Turner (1970). The effective stack height, H, is the sum of the physical stack height, H_s, and the plume rise, Δh. The equations used to calculate the plume rise are described in Section 2.4. The mean wind speed used in Equation 2-2 is the stack height wind speed as calculated by the stability dependent power law wind speed profile equation (Equation 2-1).

In the neutral atmospheric boundary layer, the vertical diffusion of a plume is sometimes limited by a stably stratified inversion layer above the mixed layer. The plume is assumed to be reflected at this interface as well as at the ground. The method of image sources is used to model these reflections (Turner 1970). The Gaussian equation for a ground-level receptor, with multiple reflections is:

$$\chi = \frac{Q}{\pi\sigma_y \sigma_z U_s} \exp\left[\frac{-y^2}{2\sigma_y^2}\right]\left\{\sum_{n=-\infty}^{\infty} \exp\left[-\frac{1}{2}\left(\frac{H+2nD}{\sigma_z}\right)^2\right]\right\} \quad (2\text{-}3)$$

where D is the height of the base of the inversion (mixing height).

Equation 2-3 is used only for PGT stability classes A-D. The multiple reflector terms, F_1,

$$F_1 = \sum_{N=-\infty}^{\infty} \exp\left[-\frac{1}{2}\left(\frac{H+2nD}{\sigma_z}\right)^2\right] \quad (2\text{-}4)$$

rapidly converge for small values of $T = (\sigma_z/D)^2$.

For large values of T, however, more terms of the summation are needed. To optimize the computational efficiency of evaluating the infinite series, it is possible to express the series in an equivalent form, which converges rapidly for large values of T, using a Fourier series:

$$F_1 = \frac{\sigma_z}{D}\left(\frac{\pi}{2}\right)^{1/2}\left[1 + \sum_{j=1}^{\infty} 2\cos(j\pi h)\exp(-j^2\pi^2 T/2)\right] \quad (2\text{-}5)$$

where h = H/D. Equation 2-4 converges quickly for small values of T and Equation 2-5 converges quickly for large T. For $T = T^* \approx 0.6$, both equations converge at about the same rate. For $T < T^*$, therefore, Equation 2-4 is used, and for $T > T^*$, Equation 2-5 is used. For these restricted values of T, only a few terms are needed to evaluate the series. Keeping a sufficient number of terms to obtain a high degree of accuracy (about eight decimal places), the equations for F_1, become:

$$F_1 = \begin{cases} \exp\left[-h^2/(2T)\right] \left\{ 1 + \exp\left[-2(1-h)/T\right] + \exp\left[-2(1+h)/T\right] + \exp\left[-4(2-h)\right] + \exp\left[-4(2+h)/T\right] \right\} & T < 0.6 \\ \frac{\sigma z}{D} \left(\frac{\pi}{2}\right)^{1/2} \left\{ 1 + 2\cos(\pi h)\exp\left[-\pi^2 T/2\right] + 2\cos(2\pi h)\exp\left[-2\pi^2 T\right] \right\} & T \geq 0.6 \end{cases} \tag{2-6}$$

to optimize even further, it is possible to compute the exponential terms of Equation 2-6 by:

$$\exp(-a) = \begin{cases} 1-a & a < a_{min} \\ \exp(-a) & a_{min} \leq a \leq a_{max} \\ 0 & a > a_{max} \end{cases} \tag{2-7}$$

where $a_{min} = 0.0512$ and $a_{max} = 9.21$ will give an accurate estimate of the exponential to within about three decimal places.

As the ratio (σ_z/D) becomes larger, the vertical concentration distribution becomes more and more uniform. For values of (σ_z/D) greater than 1.6, the vertical distribution can be assumed to be uniform; Equation 2-8 is then used to calculate concentrations:

$$= \frac{Q}{\sqrt{2\pi}\,\sigma_y\, D\, u} \exp\left[\frac{-y^2}{2\,\sigma_y^2}\right] \tag{2-8}$$

For stable conditions, or for very high mixing heights ($D > 5{,}000$ m), the multiple reflection terms can be ignored, and Equation 2-2 is used. For any stability condition, if the effective height of the plume, H, is greater than the mixed layer height, D, the ground-level concentration is assumed to be zero.

2.3.2 Point Source Building Downwash

Typically, aluminum reduction plants consist of rows of parallel line sources potrooms with point sources (scrubber stacks) located between the lines. In many cases, the scrubber stacks are not sufficiently tall to avoid building downwash. The BLP model, therefore, allows the effects of building downwash to be evaluated for sources within two building heights of the line sources. The point source downwash modeling is based upon an initial dilution of the plume, R_o, caused by the high entrainment rate associated with the building wake region. The initial plume dilution radius is used to calculate an enhanced initial vertical dispersion parameter, σ_{zo}, and possibly an enhanced horizontal dispersion parameter, σ_{yo} as well (depending upon the degree to which the plume downwashes). Dispersion coefficients are then increased using the method of virtual sources. At any downwind distance, X, the virtual distance, X_v, is added to the actual distance (i.e., X) in the computation of the distance dependent dispersion parameters, σ_y and σ_z. The initial virtual distance for σ_{yo} (i.e., X_v (σ_{yo})) is usually not equal to the virtual distance for σ_{zo} (X_v (σ_{zo})), so each is calculated independently. The effect of the initial plume dilution on reducing plume buoyancy is also included in the plume rise modeling (see Section 2.4.1.2).

If point source building downwash effects are not to be considered, the user must request this in the input data (see Section 3). The BLP model will otherwise determine which point sources are within the region of influence of the buildings (within two building heights of any line source). For those point sources, the following four step procedure is followed to evaluate building downwash effects.

1) Evaluate effective stack height due to momentum rise at a downwind distance of two building heights using Equations 2-9 to 2-13.

$$H_e \text{ (momentum)} = H_s + \Delta H_m \qquad (2\text{-}9)$$

$$\Delta H_m = \left(\frac{3\ F_m\ X}{\beta_m^{\ 2}\ U_s^{\ 2}} \right)^{1/2} \qquad (2\text{-}10)$$

$$X = 2H_B \qquad (2\text{-}11)$$

$$F_m = \frac{T_a}{T_s} \quad \frac{w_s^2\ d^2}{4} \qquad (2\text{-}12)$$

$$\beta_m = \frac{1}{3} + \frac{U_s}{w_s} \qquad (2\text{-}13)$$

where

β_m is momentum entrainment coefficient
d is stack diameter (m)
F_m is momentum flux (m^4/s^2)
H_B is building height (m)
H_e is effective stack height (m)
ΔH_m is plume rise due to momentum (m)
T_a is ambient air temperature (^oK)
T_s is stack gas temperature (^oK)
U_s is mean wind speed at stack height (m/s)
w_s is stack gas exit velocity (m/s)
X is downwind distance (m)

2) Determine initial dilution radii, R_{yo} and R_{zo}:

$$A = H_e/H_B \qquad (2\text{-}14)$$

(a) if $A \geq 3.0$, $R_{yo} = 0.0$ (2-15)
$R_{zo} = 0.0$
(no enhancement of σ_y or σ_z)

(b) if $1.2 < A < 3.0$,

$$R_{yo} = 0.0 \tag{2-16}$$
$$R_{zo} = (H_B/2)\,(3-A)$$

(only σ_z is enhanced)

(c) if $A \leq 1.2$,

$$R_{yo} = (H_B/2)\,(6-5A) \tag{2-17}$$

$R_{zo} = (H_B/2)\,(3-A)$ and A = maximum $(1.0, A)$

(both σ_z and σ_y are enhanced).

3) From R_{yo} and R_{zo}, calculate σ_{yo} and σ_{zo}:

$$\sigma_{yo} = \sqrt{\frac{2}{\pi}}\; R_{yo} \qquad \sigma_{zo} = \sqrt{\frac{2}{\pi}}\; R_{zo} \tag{2-18}$$

4) Calculate virtual distances, $X_v\,(\sigma_{yo})$ and $X_v\,(\sigma_{zo})$:

$$X_v\,(\sigma_{yo}) = \left(\frac{\sigma_{yo}}{a_y}\right)^{b_y} \tag{2-19}$$

$$X_v\,(\sigma_{zo}) = \left(\frac{\sigma_{zo}}{a_z}\right)^{b_z} \tag{2-20}$$

where a_y, b_y, a_z, b_z are stability-dependent coefficients (see Tables 2-4, 2-5). The coefficients b_y and b_z are related to $\sigma_z = A_z X^{B_z}$ and $\sigma_y = A_y X^{B_y}$ by $b_z = 1/B_z$ and $b_y = 1/B_y$.

TABLE 2-4

COEFFICIENTS USED TO CALCULATE VIRTUAL DISTANCE, X_v (σ_{yo})

PGT Stability Class	a_y	b_y
A	213.0	1.1148
B	155.0	1.0970
C	103.0	1.0920
D	68.0	1.0760
E	50.0	1.0860
F	33.5	1.0830

TABLE 2-5

COEFFICIENTS USED TO CALCULATE VIRTUAL DISTANCE, X_v (σ_{zo})

PGT Stability Class	σ_{zo}	a_z	b_z
A	$0 < \sigma_{zo} \leq 13.95$	122.80	1.0585
	$13.95 < \sigma_{zo} \leq 21.40$	158.08	0.9486
	$21.40 < \sigma_{zo} \leq 29.30$	170.22	0.9147
	$29.30 < \sigma_{zo} \leq 37.67$	179.52	0.8879
	$37.67 < \sigma_{zo} \leq 47.44$	217.41	0.7909
	$47.44 < \sigma_{zo} \leq 71.16$	258.89	0.7095
	$71.16 < \sigma_{zo} \leq 104.65$	346.75	0.5786
	$104.65 < \sigma_{zo}$	453.85	0.4725
B	$0 < \sigma_{zo} \leq 20.23$	90.673	1.0730
	$20.23 < \sigma_{zo} \leq 40.00$	98.483	1.0170
	$40.00 < \sigma_{zo}$	109.300	0.9115
C	$0 < \sigma_{zo}$	61.141	1.0933
D	$0 < \sigma_{zo} \leq 12.09$	34.459	1.1498
	$12.09 < \sigma_{zo} \leq 32.09$	32.093	1.2336
	$32.09 < \sigma_{zo} \leq 65.12$	32.093	1.5527
	$65.12 < \sigma_{zo} \leq 134.90$	33.504	1.6533
	$134.90 < \sigma_{zo} \leq 251.20$	36.650	1.7671
	$251.20 < \sigma_{zo}$	44.053	1.9539
E	$0 < \sigma_{zo} \leq 3.534$	24.260	1.1953
	$3.534 < \sigma_{zo} \leq 8.698$	23.331	1.2202
	$8.698 < \sigma_{zo} \leq 21.628$	21.628	1.3217
	$21.628 < \sigma_{zo} \leq 33.489$	21.628	1.5854
	$33.489 < \sigma_{zo} \leq 49.767$	22.534	1.7497
	$49.767 < \sigma_{zo} \leq 79.070$	24.703	1.9791
	$79.070 < \sigma_{zo} \leq 109.300$	26.970	2.1407
	$109.300 < \sigma_{zo} \leq 141.860$	35.420	2.6585
	$141.860 < \sigma_{zo}$	47.618	3.3793
F	$0 < \sigma_{zo} \leq 4.093$	15.209	1.2261
	$4.093 < \sigma_{zo} \leq 10.930$	14.457	1.2754
	$10.930 < \sigma_{zo} \leq 13.953$	13.953	1.4606
	$13.953 < \sigma_{zo} \leq 21.627$	13.953	1.5816
	$21.627 < \sigma_{zo} \leq 26.976$	14.823	1.8348
	$26.976 < \sigma_{zo} \leq 40.000$	16.187	2.1510
	$40.000 < \sigma_{zo} \leq 54.890$	17.836	2.4092
	$54.890 < \sigma_{zo} \leq 68.840$	22.651	3.0599
	$68.840 < \sigma_{zo} \leq 83.250$	27.074	3.6448
	$83.250 < \sigma_{zo}$	34.219	4.6049

The point source building downwash model presented above is appropriate only for squat buildings (aluminum reduction plant potlines are always long squat buildings). The height of the plume centerline based on only the momentum plume rise, as suggested by Huber and Snyder (1976), is used to determine if building downwash effects are important. If the ratio of effective stack height to building height, A, is greater than 3, the plume is assumed not to downwash; otherwise, σ_z is enhanced. If A is less than 1.2, σ_y is enhanced as well. The maximum σ_y and σ_z enhancement is:

$$\sigma_{zo} \text{ (maximum)} = 0.80\ H_B \tag{2-21}$$

$$\sigma_{yo} \text{ (maximum)} = 0.40\ H_B \tag{2-22}$$

at $A = H_e/H_B = 1.0$.

For values of A between 1.0 and 3.0, σ_{zo} is linearly interpolated between 0.80 H_B and zero; σ_{yo} is similarly interpolated between H_B and zero for values of A between 1.0 and 1.2 (personnel communication, Huber 1980). The initial dilution radius, R_{zo} (step 2) is also used in the plume rise calculations (see Section 3).

2.3.3 Decay Mechanism

The BLP model simulates pollutant decay mechanisms with a constant pollutant decay rate, κ. At any receptor i, the travel time from source, j, to the receptor, τ_{ij}, is calculated assuming a constant transport wind $(U_s)_j$.

$$\tau_{ij} = \frac{X_{ij}}{(U_s)_j} \tag{2-23}$$

where X_{ij} is the downwind distance from source j to receptor i. The new source contribution, χ'_{ij}, is:

$$\chi'_{ij} = (1 - \tau_{ij}\kappa)\ \chi_{ij} \tag{2-24}$$

where χ_{ij} is the source contribution predicted with the Gaussian equation assuming no decay. For example, if the decay rate is 10% per hour,

$$\kappa = \frac{0.10}{\text{hr}} \quad \frac{1}{3600\ \text{s/hr}} = 2.78 \times 10^{-5}\ \text{s}^{-1}$$

if τ_{ij} = 0.5 hr = 1800 sec,

$$\chi'_{ij} = 0.95\ \chi_{ij}.$$

The BLP model also allows the user to specify a constant background concentration which is not subject to decay.

2.3.4 Terrain Correction

The effects of terrain elevation on the height of the plume centerline are calculated using stability-dependent plume path coefficients. Table 2-6 contains the default values for the plume path coefficients in the BLP model. For neutral and unstable conditions with the default plume path coefficients, the plume is lifted one-half of the difference between the elevation of the receptor and the elevation of the stack base, with the additional restriction that the plume always be at least half the height above the ground that it would be with no topography. With stable conditions, the default plume path coefficient is 0.3, indicating the plume is lifted only about one-third of the difference between receptor elevation and stack elevation and is restricted to be at least one-third the height above the ground that it would be with no topography. The plume path coefficients can be changed by the user, however, to simulate a constant elevation plume (as with the CRSTER model) by setting the plume path coefficients equal to zero.

TABLE 2-6

DEFAULT VALUES FOR THE PLUME PATH COEFFICIENT

PGT Stability Class	Plume Path Coefficient, T
A	0.5
B	0.5
C	0.5
D	0.5
E	0.3
F	0.3

The terrain adjusted plume centerline height is calculated with Equations 2-25 to 2-26.

$$h_c = (1-T)\ (\text{minimum}\ \{h_s + \Delta h,\ E_R - E_p\}) \tag{2-25}$$

$$H = H_o - h_c \tag{2-26}$$

where

E_R is receptor elevation
E_p is stack base elevation
h_c is plume height correction factor
Δh is plume rise
H is terrain corrected effective stack height
H_o is effective stack height above stack base elevation
T is plume path coefficient

The plume height adjustment is illustrated in Figure 2-4 for T = 0.5.

2.3.5 Plume Width Considerations

To eliminate unnecessary computations, the BLP model calculates concentrations only at downwind receptors within $4\sigma_y$ of the plume centerline. Defining the plume edge to be $4\sigma_y$ from the plume centerline allows virtually all of the source contributions to be evaluated. For a plume with a Gaussian distribution, the concentration at a crosswind distance $4\sigma_y$ from the plume centerline is three hundredths of one percent (0.0003) of the centerline concentration. Figure 2-5 illustrates the plume width-receptor location considerations in calculating concentrations. Concentrations are calculated only for the receptors within the shaded area; the source contributon for any of the other receptors is assumed to be zero.

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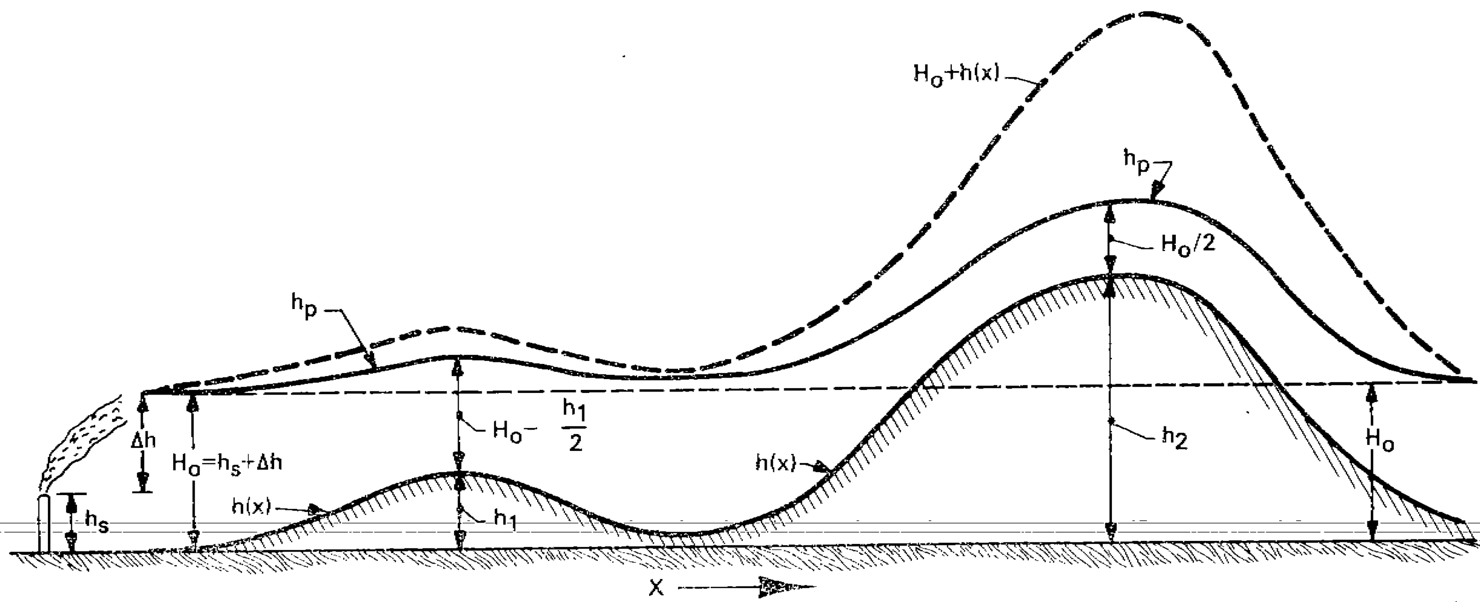

h_s is physical stack height

Δh is plume rise

H_o is effective stack height (physical stack height plus plume rise)

$h(x)$ is terrain height above stack base elevation

h_p is plume centerline height above stack base elevation

Figure 2-4 Terrain Plume Height Adjustment (for T = 0.5)

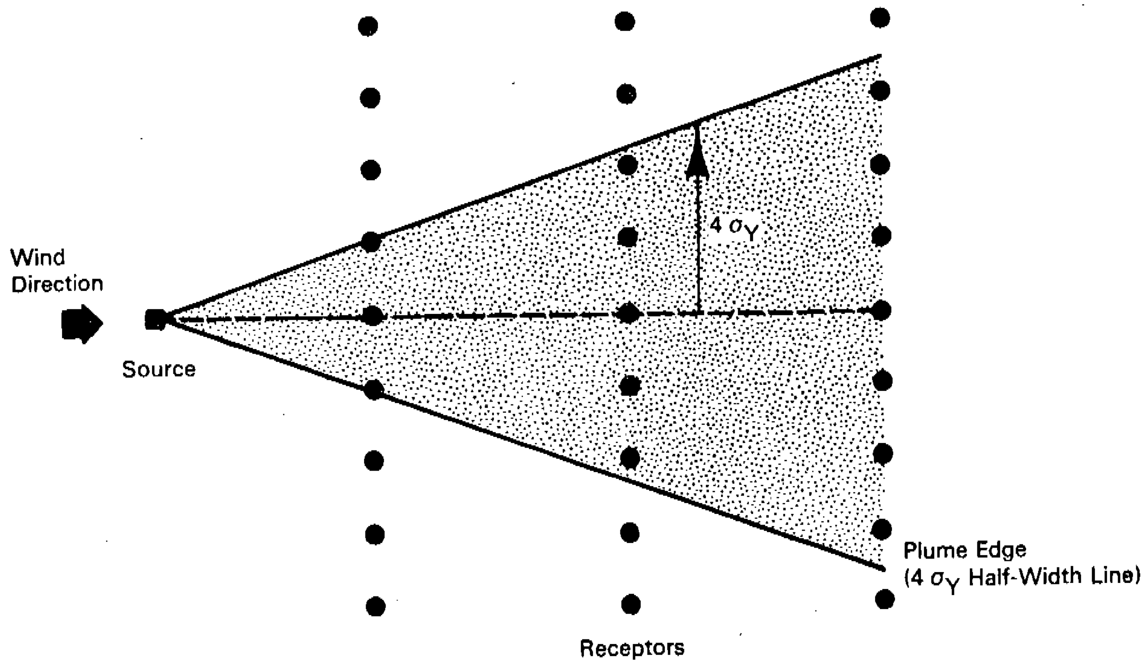

Figure 2-5 Point Source Plume Width - Receptor Location Considerations

2.3.6 Gaussian Plume Equation for Line Sources

To calculate concentrations due to line source emissions, the BLP model numerically integrates the Gaussian point source equation over the finite extent of the line.

The integral of the Gaussian plume equation can be written as:

$$\chi = \frac{(q_\ell)}{U} \int_o^L g \, dl \qquad (2\text{-}27)$$

where

q_ℓ is emission rate per unit length of the line, g s^{-1} m^{-1}

L is line length, m

g is dispersion function, m^{-2}

The dispersion function, g, consists of the lateral and vertical dispersion terms of the Gaussian point source equation (see Equation 2-2 to 2-8). For stable conditions, or if the mixing height is greater than 5,000 m,

$$g = \frac{1}{\pi \sigma_y \sigma_z} \exp\left[\frac{-y^2}{2\sigma_y^2}\right] \exp\left[\frac{-H^2}{2\sigma_z^2}\right] \qquad (2\text{-}28)$$

For unstable or neutral conditions,

$$g = \frac{1}{\pi \sigma_y \sigma_z} \exp\left[\frac{-y^2}{2\sigma_y^2}\right] F_1 \qquad (2\text{-}29)$$

(the function F_1 is given in Equation 2-6), unless the ratio σ_z/D is greater than 1.6,

$$g = \frac{1}{\sqrt{2\pi}\,\sigma_y D} \exp\left[\frac{-y^2}{2\sigma_y^2}\right] \qquad (2\text{-}30)$$

The effective plume height is determined with the line source plume rise equation in Section 2.4.2.

Using the trapezoidal rule to approximate the integral in Equation 2-27, the equation becomes:

$$\chi = \frac{q_\ell \Delta\ell}{U} \left[\frac{1}{2}(g_o + g_N) + \sum_{i=1}^{N-1} g_i\right] \qquad (2\text{-}31)$$

where

N is number of points used to approximate the line
$\Delta\ell$ is L/N

The number of points (or line segments) needed for Equation 2-31 to give a good estimate of the integral depends on atmospheric stability, line length, and the line segment-receptor distance. For each receptor, therefore, Equation 2-31 is initially solved with $N = 3$ and then $N = 5$. The value of N increases with each iteration (see Table 2-7) until all of the following criteria are satisfied:

1) at least one point (line segment) is within one σ_y of the receptor;
2) at least two line segments contribute to the concentration at the receptor (i.e., two line segments are within $4\sigma_y$ of the receptor);
3) two successive iterations yield χ estimates which differ by less than a user's input convergence criterion (default value is 2%) <u>OR</u> the difference between two successive estimates is less than 0.1 $\mu g/m^3$.

TABLE 2-7

ITERATIVE INTEGRATION OF THE GAUSSIAN PLUME EQUATION FOR LINE SOURCES

Number of Line Segments	Number of New Line Segments	Iteration
3	-	1
5	2	2
9	4	3
17	8	4
33	16	5
65	32	6
129	64	7

A minimum of two iterations is always required, that is, the line will be divided into at least five points (line segments). The first criterion is not applied if the receptor is not directly downwind of the line source because the crosswind distance to the nearest part of the line may be greater than σ_y. The concentration at each receptor is obtained by breaking the line source into as many segments as is necessary to satisfy the criteria above. All receptors upwind of the line source, or outside the $4\sigma_y$ plume width are assigned concentration contributions of zero. Receptors 1, 6, and 7 in Figure 2-6 are in this category. The concentration at Receptor 2, which is not directly downwind of any part of the line, but is within the line source plume, is determined by applying Equation 2-31 through as many iterations as is required to satisfy criteria 2 and 3. The first criterion is waived because the receptor is not directly downwind of the line source. The iteration procedure at Receptors 3, 4, and 5 must satisfy all the criteria.

All dispersion calculations are done in a "relative (RCS) coordinate system." The RCS X-axis is aligned parallel to the wind direction; the RCS Y-axis is perpendicular to the wind direction. This allows the downwind and crosswind distances needed in the Gaussian plume equation to be computed as a difference of two numbers. The RCS coordinates of each possible line segment (up to 129 segments per line), point source, and receptor are calculated once per simulated hour. Thus, even if the line source calculations require many iterations at each receptor, the predetermined line segments with the line segment-receptor geometry already calculated are utilized at each receptor. This allows the concentrations at many receptors to be calculated efficiently.

In some cases, seven iterations of the line source calculations may still be insufficient to allow convergence of the integral. This may be due to the following circumstances:

- a receptor is located very close to the line source or
- the line source is very long (such that L/128 is $\gtrsim \sigma_y$ at the receptor).

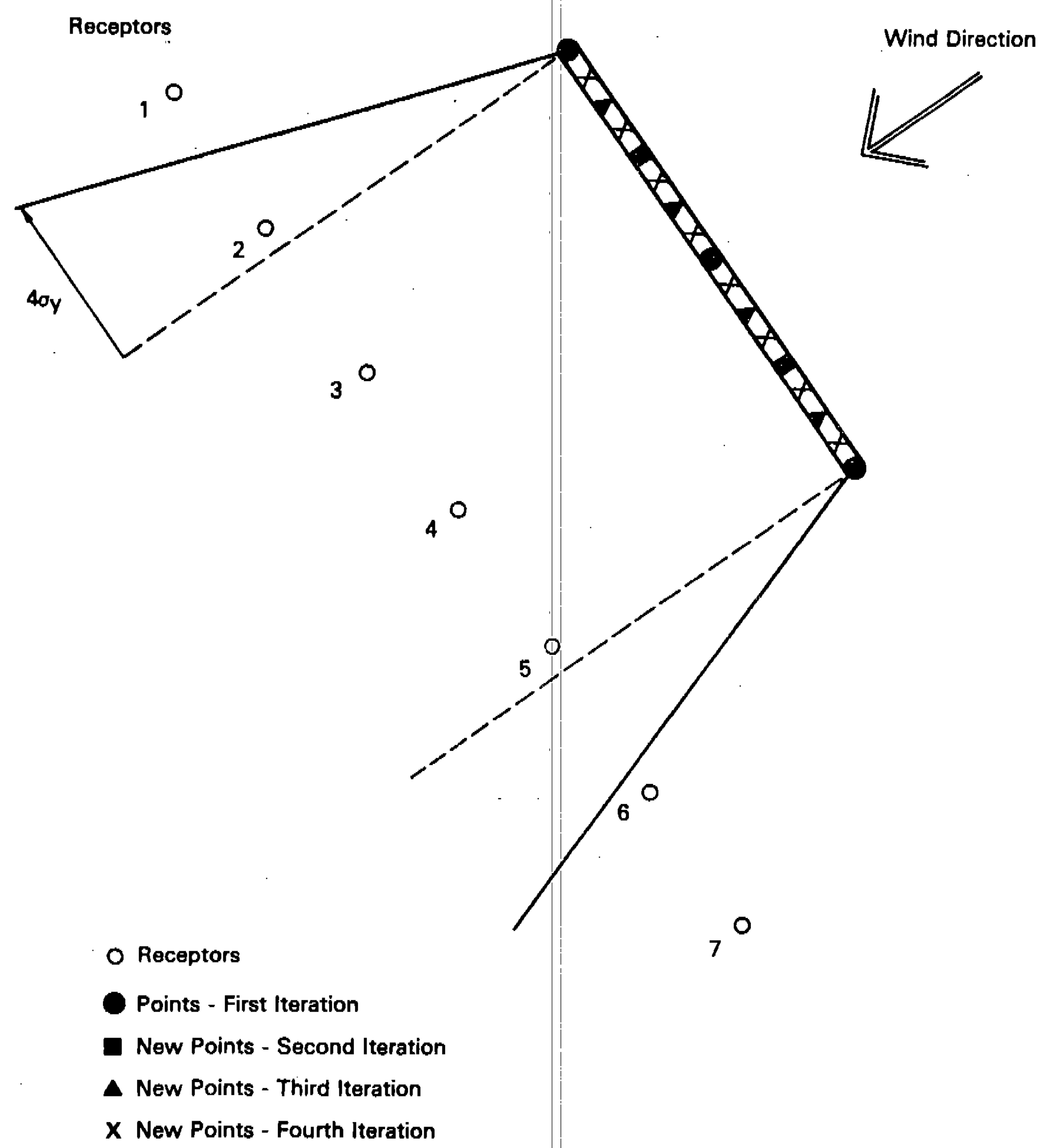

Figure 2-6 Line Source Plume Width - Receptor Location Considerations

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The BLP model will continue to iterate a special high resolution algorithm until convergence is achieved or up to a user specified iteration maximum (default value = 14 iterations). With each iteration over seven, new line segments are generated, but only over the portion of the line source contributing to the concentration at the receptor of interest. If the iteration maximum is reached without convergence, execution will continue using the latest χ value generated. Execution will terminate, however, if the iteration maximum is exceeded more than 100 times and an error message indicating this has occurred will be printed. It should be noted that under most conditions, the execution of this high resolution loop will not be required for proper convergence of the integral--only when a receptor is located very close to the line source (and σ_y values at the receptor are $\leq \Delta\ell$) will it be necessary. Anyway, receptors should not be located within 100 meters of a source because the PGT dispersion curves are defined only for downwind distances greater than 100 meters.

2.4 Plume Rise

Plume rise from tall, buoyant point sources has been extensively studied and is well represented by the equations of Briggs (1969, 1970, 1975). Plume rise from low-level sources, however, can be affected by vertical wind shear and downwash. These effects are generally not important for taller stacks and are not treated by the Briggs equations. The BLP model uses a set of plume rise equations developed to incorporate the effects of vertical wind shear and downwash on plume rise. These equations are consistent with and reduce to the Briggs point source plume rise equations when there is no vertical wind shear or downwash.

Observational studies of rows of point sources (e.g., Briggs 1974) and wind tunnel studies of line sources (Hoydysh et al. 1975, 1979) indicate that the plume rise from closely spaced point sources or line sources is substantially different than that from an isolated point source. Plumes from line sources tend to rise higher when the wind is aligned along the long axis of the line source than when the wind is perpendicular to the line. Also, line source plumes exhibit dependencies on the buoyancy, mean wind speed, and distance different from those of a point source plume. Multiple rows of closely spaced line sources (the typical configuration of aluminum reduction plant line sources) can result in significant plume rise enhancement over that of an isolated line source plume. Roof-level line source releases, however, are susceptible to building downwash, which tends to reduce plume rise. Also, vertical wind shear is often important for these low-level sources. The plume rise relationships used in the study of tall, isolated point sources are not adequate to represent these complex low-level line sources.

A new set of line source plume rise equations has been developed for the BLP model. These equations incorporate the following important effects: multiple-line plume rise enhancement, plume rise wind direction dependence, vertical wind shear, and building downwash. In the limit as the line length approaches zero, the line source plume rise equations reduce to the point source equations; if wind shear and downwash effects are neglected, the line source plume rise equations will reduce to the Briggs point source plume rise equations.

2.4.1 Point Source Plume Rise

Many of the point source emissions from complex industrial facilities, such as aluminum reduction plants, are released in the lowest layer of the atmosphere. These low-level plumes may be subjected to the effects of building downwash and vertical wind shear. Plume rise equations separately incorporating both these effects are presented in Section 2.4.1.1 and 2.4.1.2. Because both shear and downwash may be important in reducing plume rise, the BLP model will use the minimum of the shear plume rise and the downwash plume rise prediction if both the shear and downwash options are chosen.

2.4.1.1 Point Source Plume Rise with Vertical Wind Shear

The power law wind speed profile (Equation 2-1) can be rewritten in terms of a vertical coordinate system with the origin at stack top:

$$U_z = U_s \left[(Z' + Z_s)/Z_s\right]^P \tag{2-32}$$

where

Z_s is stack height
Z' is $Z - Z_s$

The wind speed at stack height U_s can be determined from the measured wind speed with Equation 2-1. For short stacks, a good approximation of Equation 2-32 is:

$$U_s \approx U_s \, (Z'/Z_s)^P \tag{2-33}$$

Integrating the entrainment equation and conservation equations described by Briggs (1970) for a bent-over plume and using the approximate vertical wind speed equation, it is possible to arrive at the following analytic solution for the neutral and unstable plume rise, Z':

$$Z' = \left\{ \frac{\varepsilon^2}{2(3+P)} \left(\frac{F \, Z_s^{3P}}{\beta^2 \, U_s^3} \right) \right\}^{1/\varepsilon} (X')^{2/\varepsilon} \tag{2-34}$$

$$\varepsilon = 3 + 3P \tag{2-35}$$

$$F = \frac{g \, w \, d^2}{4} \; \frac{(T_s - T_a)}{T_s} \tag{2-36}$$

$$X' = \begin{cases} X & X \leq 3.5 \, X^* \\ 3.5 \, X^* & X > 3.5 \, X^* \end{cases} \tag{2-37}$$

$$X^* = \begin{cases} 14 \, F^{5/8} & F \leq 55 \ m^4/s^3 \\ C_3 \, F^{2/5} & F > 55 \ m^4/s^3 \end{cases} \tag{2-38}$$

where

C_3 is a constant (default value 34.49)
β is entrainment parameter (0.6)
F is buoyancy flux (m^4/s^3)
g is acceleration due to gravity ($9.8\ m/s^2$)
w is stack gas exit velocity (m/s)
T_a is ambient air temperature (^oK)
T_s is stack gas temperature (^oK)
d is stack inner diameter (m)

With P = 0 (i.e., constant wind speed with height), the shear plume rise equation reduces to the Briggs expression:

$$Z'_B = \left(\frac{3F}{2\ \beta^2\ U_s^{\ 3}} \right)^{1/3} X^{\ 2/3} \qquad (2\text{-}39)$$

where Z'_B is the Briggs plume rise.

Because the approximate form of the power law wind speed profile equation becomes invalid for $Z'/Z_s \lesssim 1$, the following restriction must be imposed:

$$Z' = \text{minimum} \left\{ Z',\ Z'_B \right\} \qquad (2\text{-}40)$$

For neutral and unstable conditions, terminal plume rise is reached at a downwind distance of 3.5 X* (Briggs 1970). The constant, C_3, in Equation 2-38 has a default value of 34.49 in the BLP model instead of 34.0 (which is assumed in some models) to allow a matching of the two equation for X* at F = 55 m^4/s^3.

Transitional plume rise is an option in the BLP model; if desired, only final plume rise will be calculated.

For stable atmosphere conditions (PGT stability classes E and F), a similar analysis will yield the following plume rise equation for final rise with vertical wind shear:

$$Z' \text{ (final)} = \left\{ \frac{2(3+P) Z_s^P F}{\beta^2 \ U_s \ s} \right\}^{1/(3+P)} \tag{2-41}$$

$$s = \frac{g}{T_a} \frac{\partial \Theta}{\partial Z}$$

where

$\frac{\partial \Theta}{\partial Z}$ is the vertical potential temperature gradient ($^{o}K/m$) and

s is a stability parameter.

If there is no vertical wind shear ($P = 0$), Equation 2-41 reduces to the Briggs stable point source plume rise equation for final rise:

$$Z_B' \text{ (final)} = \left\{ \frac{6F}{\beta^2 \ U_s \ s} \right\}^{1/3} \tag{2-42}$$

Transitional plume rise (i.e., $Z' < Z'$ (final)) as defined by Equation 2-41) is calculated with Equation 2-34 for stable conditions.

2.4.1.2 Point Source Plume Rise with Building Downwash

If an emission source is located in the vicinity of a building, the plume may experience greatly enhanced dispersion in the wake region of the building. The intense turbulence in the building wake region causes the enhanced dispersion and a rapid decrease in the buoyancy of the plume, which will decrease the rise of the plume. As pointed out by Huber and Snyder (1976), however, the turbulence rapidly decays downwind of the building; in the far wake, plume dispersion is determined by the background atmospheric turbulence. In the calculation of plume rise, the initially large entrainment of ambient air into the plume can be represented with an initial "downwash" plume radius, R_o. Thus, the plume buoyancy is immediately decreased, but the subsequent entrainment rate is not modified.

The initial plume dilution is a function of the degree to which the plume downwashes. The downwash dilution radius, R_o, is assumed equal to R_{zo}, used in dispersion coefficient calculation (Equation 2-9 to 2-17). Once R_o is determined, the plume rise including downwash effects, Z_D', is calculated by the following equation:

$$(Z_D')^3 + \frac{3R_o}{\beta}(Z_D')^2 + \frac{3R_o^2}{\beta^2} Z_D' = \frac{3F\, X'^2}{2\beta^2 U_s^3} \qquad (2\text{-}43)$$

This cubic equation is relatively easy to solve for Z_D' by standard mathematical techniques (see subroutine CUBIC).

With stable atmospheric conditions, the <u>maximum</u> stable plume rise is given by:

$$(Z_D')^3 + \frac{3R_o}{\beta}(Z_D')^2 + \frac{3R_o^2}{\beta^2} Z_D' = \frac{6F}{\beta^2\, U_s\, s} \qquad (2\text{-}44)$$

Transitional plume rise for stable conditions is calculated with Equation 2-43. Both Equations 2-43 and 2-44 reduce to the Briggs point source plume rise equations when the downwash radius, R_o, approaches zero.

If both the building downwash and vertical wind shear options have been requested in a BLP run, the plume rise used is the minimum of that given by the shear and downwash plume rise formulations. As noted by Briggs (1970), the stable vertical plume formulation of Morton, Taylor, and Turner (Equation 2-45) is more appropriate than the bent-over plume rise equation with very light winds.

$$Z' \text{ (maximum)} = \frac{5\ F^{1/4}}{s^{3/8}} \qquad (2\text{-}45)$$

Equation 2-45 is used if it yields a lower plume rise estimate than Equation 2-44.

2.4.2 Line Source Plume Rise

The plume from a buoyant line source can be expected to show different behavior than that from an isolated point source. The proximity of adjacent plume elements of a line source plume tends to block entrainment of ambient air. The initial buoyancy, however, is spread over the length of the line instead of being concentrated at one point. Also, the "effective" line length of a line source depends on the wind direction relative to the line, leading to a wind direction dependence of the plume rise. The line source emissions, such as those from aluminum reduction facility potrooms, may experience building downwash. Finally, multiple rows of closely spaced line sources tend to enhance the plume rise. These considerations indicate that a point source plume rise equation is not adequate to represent the plume rise behavior of a line source plume, especially for aluminum reduction facilities where all these factors are important.

2.4.2.1 Line Source Plume Rise with Vertical Wind Shear

The plume rise of a rectangular plume from a finite line source of length L in a neutral atmosphere is:

$$Z' = \left(\frac{F'}{2\,\beta\,L\,U_s^3}\right)^{1/2} X' \qquad (2\text{-}46)$$

$$F' = \frac{g\ L\ W_m\ w\ (T_s - T_a)}{T_s} \qquad (2\text{-}47)$$

where

F' is the average line source buoyancy parameter (m^4/s^3)
g is the acceleration of gravity (9.81 m/s^2)
L is the line source length (m)
W_m is the line source width (m)
w is the exit velocity (m/s)
T_s is the exit temperature (^oK)
T_a is the ambient air temperature (^oK)

(Note: For multiple line sources of comparable buoyancy flux, the buoyancy parameter is calculated for each line source and then averaged to obtain F'.)

Equation 2-46 neglects horizontal entrainment of ambient air at the edges of the plume (i.e., the plume width remains to be L, but the plume's vertical dimension grows). The linear X dependence of the line (versus $X^{2/3}$ for a point source) reflects the decreased ability of the plume to entrain ambient air.

Integrating the rectangular plume equation and analytically incorporating vertical wind speed variation with the approximate power law relationship, Equation 2-33, the following solution is obtained:

$$Z' = \left\{ \left(\frac{\varepsilon_L}{2}\right)^2 \left(\frac{F' \quad Z_s^{\ 3P}}{(2+P) \quad \beta L\ U_s^3} \right) \right\}^{1/\varepsilon_L} X'^{\,2/\varepsilon_L} \qquad (2\text{-}48)$$

where ε_L is 2 + 3P.

With $P = 0$, Equation 2-48 reduces to the line source plume rise without wind shear, Equation 2-44. It is assumed that the distance of final plume rise for PGT stability classes A through D can be obtained with the point source expressions, Equation 2-37 and 2-38, with $F = F'/\pi$.

In the BLP model, the effect of the wind speed variation with height on line source plume rise is estimated by using an "effective" wind speed, U_e, in the generalized line source plume rise equations in Section 2.4.2.2 rather than the stack height wind speed, U_s. (The equations in Section 2.4.2.2 include building downwash, plume rise enhancement, and wind direction dependencies, but do not implicitly incorporate wind shear effects. Wind shear effects which are included in Equation 2-48 are explicitly included in the generalized line source equations by using the "effective" wind speed (which is always greater than or equal to the stack height wind speed) in these equations.) The effective wind speed, U_e, is calculated by matching Equations 2-46 and 2-48 at the final rise distance, X_F. This matching procedure consists of (1) calculating Z' (shear) at $X = X_F$ with Equation 2-48 and (2) solving Equation 2-46 <u>for wind speed</u> using Z' = Z' (shear) and $X = X_F$. This effective wind speed is then used in the generalized line source plume rise equations. Stack height wind speed, however, is used in the Gaussian dispersion equation.

For stable atmospheric conditions, the rectangular plume rise equation (without wind shear) is:

$$Z' = \left(\frac{F'}{\beta L\ U_s\ s}\right)^{1/2} \left\{1-\cos\ \frac{\sqrt{s}\ X}{U_s}\right\}^{1/2} \qquad (2\text{-}49)$$

Final rise is reached at a distance $X = \dfrac{U_s \pi}{\sqrt{s}}$,

so the final plume rise is:

$$Z'\ (\text{final}) = \left(\frac{2\ F'}{\beta L\ U_s\ s}\right)^{1/2} \qquad (2\text{-}50)$$

The appropriate stable rectangular plume equation including vertical wind shear is:

$$Z' \text{ (final)} = \left(\frac{(2+P)\ Z_s^P\ F'}{\beta L\ U_s\ s} \right)^{\frac{1}{2+P}} \qquad (2\text{-}51)$$

The effective wind speed is calculated by matching Equation 2-50 and 2-51 subject to the constraint U_e = minimum (U_e, U_s).

2.4.2.2 Line Source Plume Rise with Downwash and Wind Direction Dependence

Although a linear distance dependence of plume rise from a buoyant line source is reasonable in the near field with perpendicular winds, it would be expected that the plume would eventually approach an $X^{2/3}$ point source dependence as the plume height approaches and exceeds the line length. Figure 2-7 illustrates a rectangular (line source) plume with half-circular (entrained) edges. This edge entrainment is relatively unimportant in the near field, but grows in importance with distance (and plume height). Figure 2-8 illustrates the increasing importance of the entrained edges of the initially rectangular plume. In the near field, the plume height, Z', is small, and because $R = \beta Z' = 0.6\ Z'$, the half-circular plume edges compose a relatively small portion of the plume's cross-sectional area (see Figures 2-8a and b). With increasing distance, however, Z' and therefore R become larger; the ratio R/L increases (see Figure 2-8c, d, e) until eventually the plume cross section begins to look more and more circular. For a short line source or for winds parallel to the line source, the effective length of the line source is small. The ratio R/L may be large even in the near field (Figure 2-8d and e). It is apparent that as the line source length approaches zero, the plume cross section becomes circular (as with a point source). In fact, the line source plume can be visualized as being composed of circular cross-sectional plumes originating from an infinite number of point

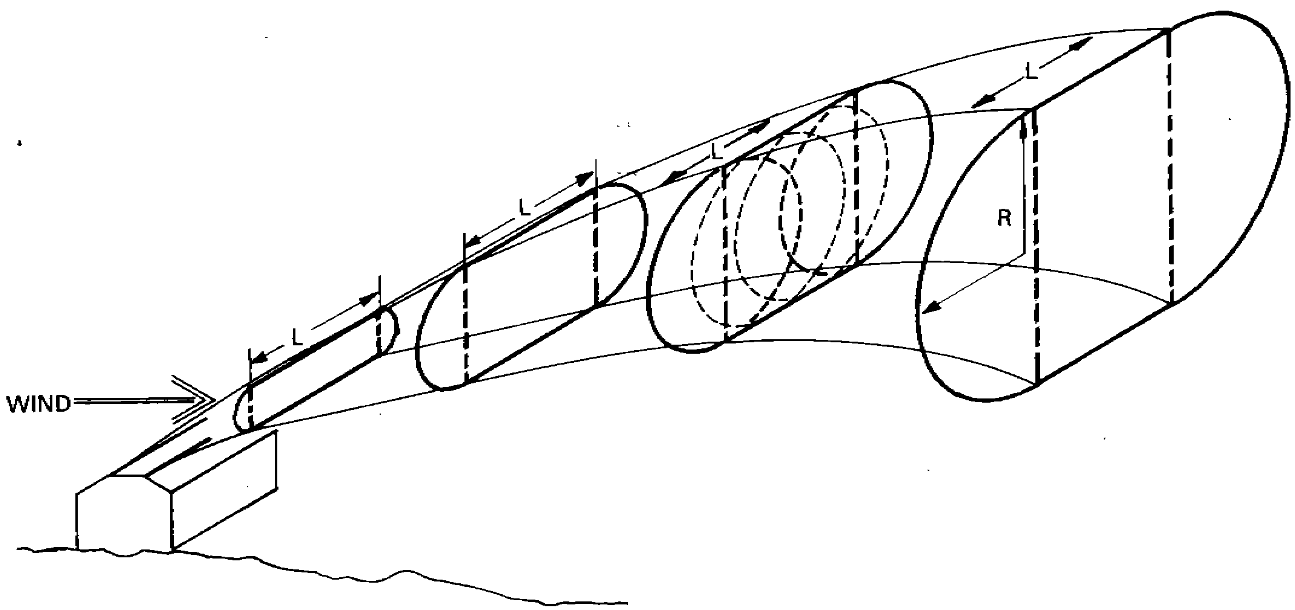


Figure 2-7 Rectangular (Line Source) Plume Rise Half-Circular (Entrained) Edges

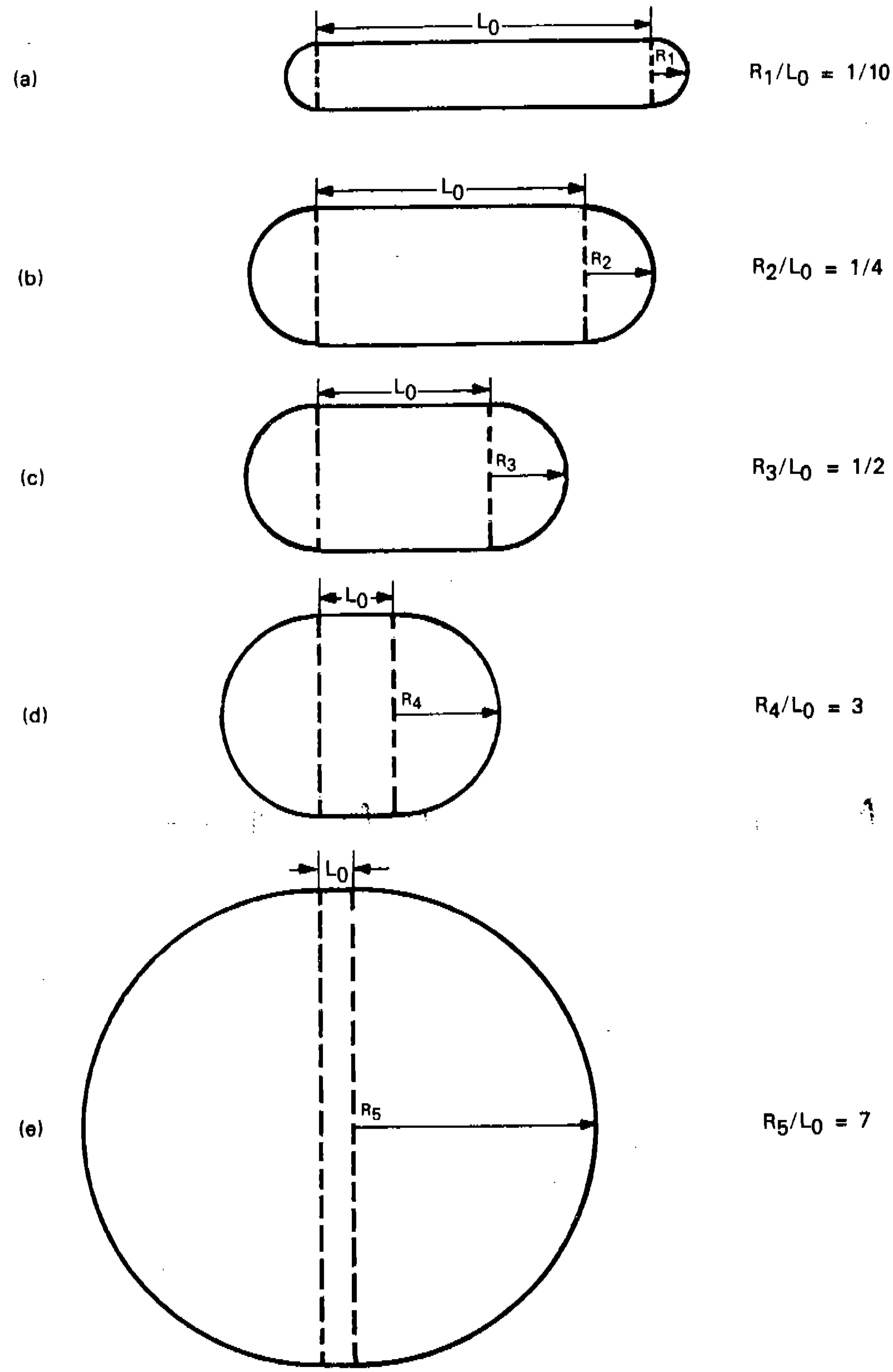


Figure 2-8 Cross Section of Line Source Plume at Various Distances Downwind

sources along the length of the line source (see Figures 2-7 and 2-9). This formulation for the line source plume will result in the approach to the $X^{2/3}$ dependency at large X. The solution of the neutral line source plume rise equation with entrainment at the edges of the plume is:

$$(Z_L')^3 + \frac{3L}{\pi\beta} (Z_L')^2 = \frac{3 F' X^2}{2 \pi \beta^2 U_e^3} \qquad (2\text{-}52)$$

where Z_L' is the line source plume rise and U_e is the effective wind speed (see Section 2.4.2.1). With L = 0, Equation 2-52 reduces to the Briggs point source equation. The line source buoyancy parameter, F', divided by π is the point source buoyancy flux, F, defined by Equation 2-36. If the edge effects are neglected $[(Z_L)^3 \text{ term} \approx 0)]$, the linear X dependence is obtained. Designating the first term of Equation 2-52 as the point source term (because it is responsible for the $X^{2/3}$ component of the equation) and the second term as the line source term (because it is responsible for the X component), it can be seen that the line source term initially dominates the equation, but gradually (depending on L, F', and U_e) the point source term will become increasingly important.

Observational and wind tunnel studies indicate that the line source plume rise equation should contain a wind direction dependence. For winds aligned parallel to the long axis of a line source, consider the path of a plume element originating from the upwind end of the line source. As the plume element rises and travels along the length of the line, it merges with other buoyant elements. At the downwind edge of the line source, the input of bouyant plume elements stops. Figure 2-9 is a cross section of the plume at the downwind edge of the line source. The plume elements originating from the most upwind section of the line source have risen substantially more than the plume elements near the downwind edge of the line source. The integration of the Gaussian plume equation over the length of the line source consists of breaking the line source into a number of points or line segments; this approach allows different

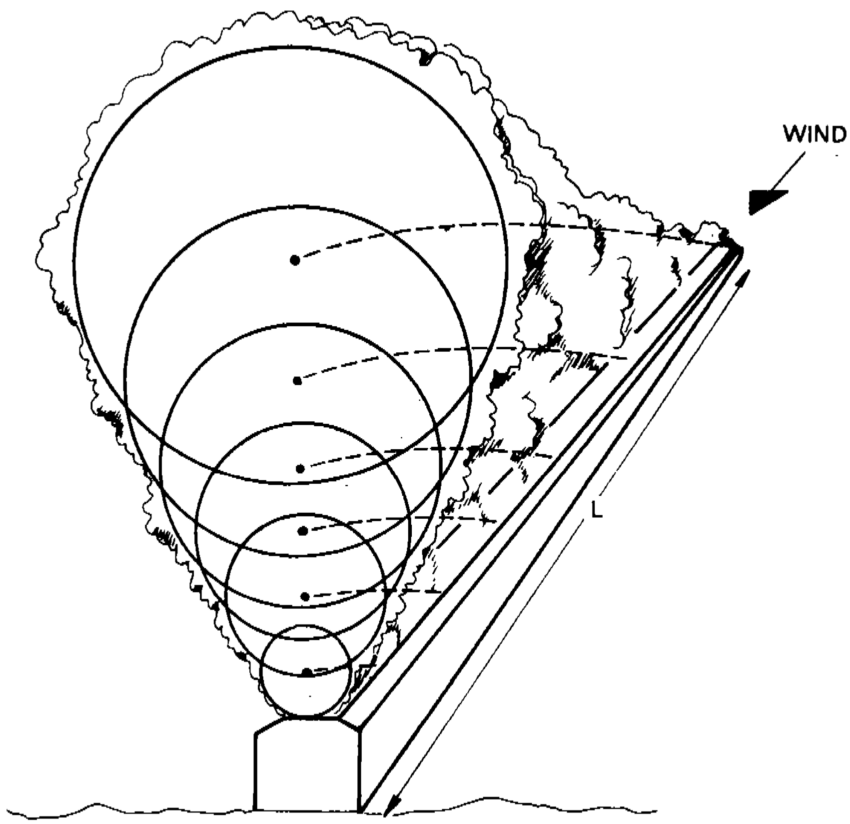


Figure 2-9 Cross Section of Line Source at $X = X_{FB}$ with Parallel Winds

plume elements to have different effective stack heights. If a linear variation in F' along the line is assumed, the value of the buoyancy parameter at any downwind distance, X, is given by:

$$F'(X) = \begin{cases} F' \left(\frac{X}{X_{FB}}\right) & X < X_{FB} \\ F' & X \geq X_{FB} \end{cases} \tag{2-53}$$

where X_{FB} is the distance of the release of the last buoyant plume element (X_{FB} = L for parallel winds and X_{FB} = 0 for perpendicular winds), and F' is the buoyancy parameter for the entire line source, as given by Equation 2-47. Equation 2-52, now predicting the height of the plume element originating from the most upwind end of the line source, becomes:

$$(Z_L')^3 + \left(\frac{3L_e}{\pi\beta}\right)(Z_L')^2 = \begin{cases} \dfrac{F' X^3}{2\pi\beta^2 X_{FB} U_e^3} & X < X_{FB} \\ \dfrac{3F'}{2\pi\beta^2 U_e^3}\left[X_{FB}^2/3 + X^2 - X_{FB} X\right] & X \geq X_{FB} \end{cases} \tag{2-54}$$

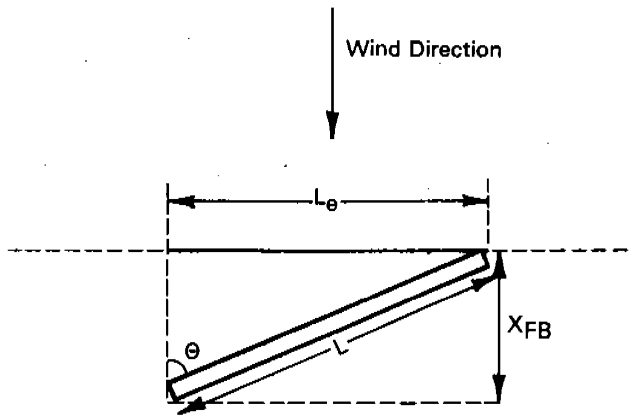
where the effective line length, L_e, replaces L.

For a single line source,

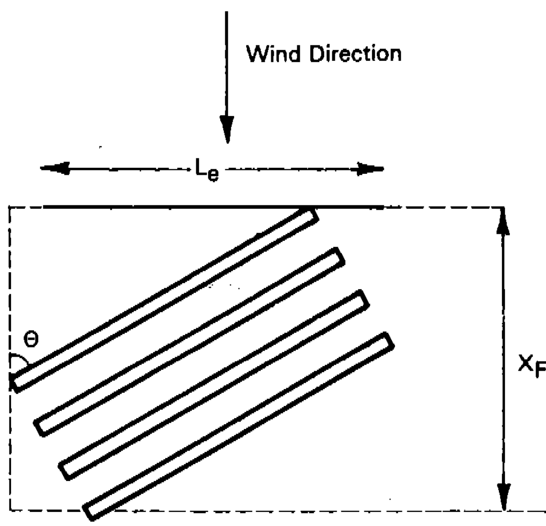
$$L_e = |L \sin\theta| + W_m|\cos\theta| \tag{2-55}$$

$$X_{FB} = |L \cos\theta| + W_m|\sin\theta| \tag{2-56}$$

where θ is the angle between the line source and the wind direction (see Figure 2-10).



(a)



(b)

Figure 2-10 Calculation of the Effective Line Length, L_e, and the Downwind Distance of Full Buoyancy, X_{FB}

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In most cases, the width of the line source, W_m, is much less than the length of the line, so $L_e \approx L \sin\theta$ and $X_{FB} \approx L \cos\theta$. For N line sources of equal length and separated by a distance of δX_m, the buoyancy parameter is the sum of the bouyancy parameters of the individual lines, and the equation for X_{FB} becomes:

$$X_{FB} = L \cos\theta + (N-1)\,\delta X_m \sin\theta \qquad (2\text{-}57)$$

$$F_T' = \sum_{i=1}^{N} (F')_i \qquad (2\text{-}58)$$

The effective line length for multiple line sources is a weighting of L_e for perpendicular winds (i.e., L) and L_e for parallel winds, L_v.

$$L_e = L \sin\theta + L_v \cos\theta \qquad (2\text{-}59)$$

To calculate the effective line length for parallel winds, L_v, the following three step procedure is used.

1) Determine the height at which plumes from adjacent lines interact, Z_I. With $R = \beta Z$, R must be equal to $\delta X_m/2$ for interaction, so $Z_I = \delta X_m/(2\beta)$.
2) Determine the downwind distance, X_I, at which the plumes interact (i.e., X such that $Z_L' = Z_I$), by solving Equation 2-54 for X with $L_e = W_m$ and F_T = buoyancy parameter of one line. First assume $X < X_{FB}$ and solve for X; if this estimate of X is greater than X_{FB}, solve again for X assuming $X \geq X_{FB}$.
3) Calculate the effective line length, L_v, that will yield $Z_L' = Z_I$ at $X' = X_I$ with F_T equal to N times the buoyancy flux of one line, again using Equation 2-54.

The distance of final rise, X_F, for neutral and unstable conditions is calculated by Equations 2-37 and 2-38 with $F = F_T'/\pi$.

Building downwash effects can be incorporated in the line source plume rise equation using the same "downwash radius" approach used in the point source plume rise formulation. The line source emission of aluminum reduction facilities are roof-level releases with negligible momentum rise. The line source plume rise downwash radius, R_o, is determined from Equation 2-17 with A = 1.0 to be:

$$R_o = R_{Zo} = H_B \tag{2-60}$$

With an initial dilution plume radius, the line source plume rise equation becomes:

$$(Z_L')^3 + \frac{3L_e}{\pi\beta}(Z_L')^2 + \left(\frac{3R_o}{\beta}Z_L' + \frac{6R_oL_d}{\pi\beta^2} + \frac{3R_o^2}{\beta^2}\right)Z_L' = \tag{2-61}$$

$$\begin{cases} \dfrac{F_T' \; X^3}{2\pi\beta^2 X_{FB} U_e^3} & X < X_{FB} \\[2ex] \dfrac{3F_T'}{2\pi\beta^2 U_e^3}\left[X_{FB}^2/3 + X^2 - X_{FB}X\right] & X \geq X_{FB} \end{cases}$$

where L_d is an effective downwash length. In the BLP model L_d is:

$$L_d = L_e \sin\theta \tag{2-62}$$

The third term in parentheses of Equation 2-61 containing R_o and L_d is the downwash term.

Equation 2-61 is a simple cubic equation that is solved in the BLP model by subroutine CUBIC. This line source plume rise expression reduces to the Briggs point source plume rise equation when the line length and downwash effects are negligible (i.e., L_e, L_d, and R_o approach zero).

For stable atmospheric conditions, <u>final</u> line source plume rise is calculated with the following equation.

$$(Z_L')^3 + \frac{3L_e}{\pi\beta}(Z_L')^2 + \left\{\frac{3R_o}{\beta} Z_L' + \frac{6R_o L_d}{\pi\beta^2} + \frac{3R_o^2}{\beta^2}\right\} Z_L' = \frac{6 F'_T}{\pi\beta^2 U_e s} \tag{2-63}$$

Transitional plume rise for stable conditions is calculated with Equation 2-61. The stable line source plume rise equations reduces to the Briggs stable plume rise equation for final rise when L_e, L_d, and R_o approach zero.

To save the computation time required to solve the cubic line source plume rise equation many times, the BLP model calculates line source plume rise each simulated hour at six downwind distances: X_{FB}, X_F, and four intermediate distances. The plume rise at distances other than these six distances are interpolated linearly. This allows the plume trajectory to be accurately approximated in a computationally efficient manner. As illustrated in Figure 2-9, the plume element originating from the most upwind end of the line source rises higher than plume elements released at other portions of the line. The plume rise equations in this section predict the height of the plume element originating from the most upwind part of the line source. To find the heights of other plume elements, the BLP model uses a linear interpolation scheme. The entire line source plume rise algorithm is summarized below with the aid of Figure 2-11.

1) Calculate the heights of the plume elements originating from the most upwind portion of the line source (line segment No. 1) at X_{FB}, X_F, and four intermediate distances.
2) Find the height, Z_X^1, of this plume element (plume element No. 1) at a downwind distance X_d by linear interpolation of the results of Step 1.

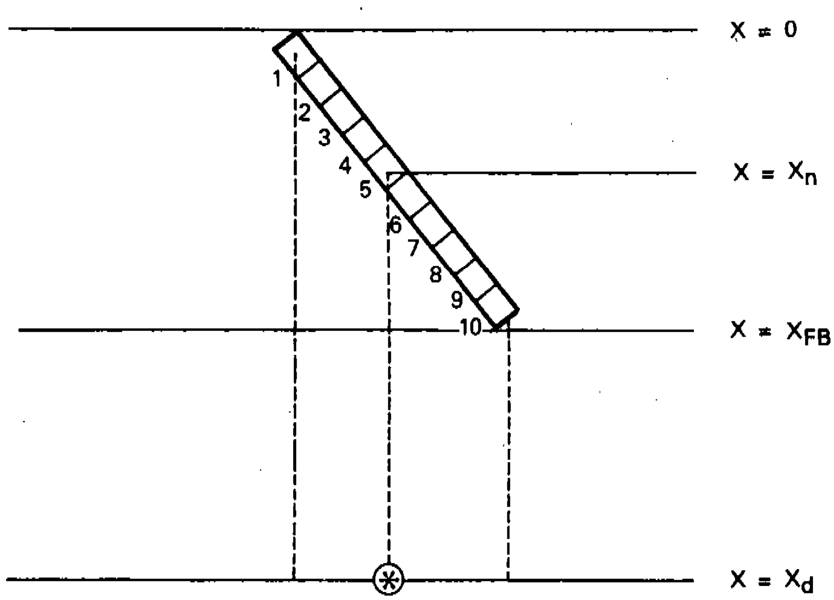

Figure 2-11 Calculation of Plume Rise of Individual Plume Elements of the Line Source Plume

3) Because the height of plume element No. 10 is zero at X_{FB}, the height, $z_{X_{FB}}^{n}$, of plume element No. n at $X = X_{FB}$ can be obtained by interpolation:

$$z_{X_{FB}}^{n} = z_{X_{FB}}^{1} \left[1 - X_n/X_{FB}\right]$$

4) The height, $z_{X_d}^{n}$, of plume element No. n at a downwind distance, X_d, is:

$$z_{X_d}^{n} = z_{X_{FB}}^{n} + \left[z_{X}^{1} - z_{X_{FB}}^{1}\right]$$

2.5 BLP Postprocessing Capabilities (POSTBLP)

As indicated in the BLP modeling package flowchart, Figure 1-1, all analysis of the concentration output of the BLP model is done with the BLP postprocessing program, POSTBLP. The use of a separate program for averaging and analysis operations decreases the computer time and computer memory requirements of the BLP model. Because computer costs are associated with the amount of memory required as well as the computer time used, the use of a separate postprocessing program can be very cost effective.

The capabilities of the POSTBLP program are outlined in Table 2-8. The user has the option of analyzing total concentration data or the source contribution of any single line or point source (or any combination of line and point sources) that have been specified as source contribution sources in the original BLP run. The POSTBLP program will always generate tables of the top fifty 1-, 3-, and 24-hour average concentrations, five highest 1-, 3-, and 24-hour average concentrations at each receptor, and the average concentrations over the length of the BLP run for the concentration data (total or source contribution) selected by the user. The table of the top fifty 1-hour average concentrations include the wind speed, wind direction, stability class, and mixing height for those hours.

TABLE 2-8

MAJOR FEATURES OF THE POSTBLP PROGRAM

- Total concentration or source contribution analysis.
- Monthly and annual frequency distributions for 1-, 3-, and 24-hour average concentrations.
- Tables of 1-, 3-, and 24-hour average concentrations at each receptor.
- Table of the annual (or length of the BLP run) average concentrations at each receptor.
- Five highest 1-, 3-, and 24-hour average concentrations at each receptor.
- Fifty highest 1-, 3-, and 24-hour average concentration over the receptor field.

Optional POSTBLP output consists of monthly and annual frequency distributions for 1-, 3-, and 24-hour average concentrations (total or source contribution) at a user-specified receptor. Also, tables of 1-, 3-, and 24-hour average concentrations at each receptor for any (or every) 24-hour period of the BLP run can be printed.

The BLP model results are stored on a magnetic tape or disk file which can be repeatedly accessed by the POSTBLP program. Multiple runs of the POSTBLP program can be made, first in only a screening mode to scan the concentration output data to determine the time periods and receptors with the highest predicted concentrations; the results at these time periods can be examined more closely with subsequent POSTBLP runs. Typically, the days with the highest total concentrations can be obtained with an initial POSTBLP screening run; the contributions of sources of interest for these days be generated with subsequent POSTBLP runs.

3. USERS INSTRUCTIONS

3.1 BLP Users Instructions

A detailed description of all the card-image input requirements of the BLP model is contained in this section. Figure 3-1 is a flowchart of the main program of the BLP model. All BLP concentration output is written (unformatted) to Logical Unit 20. Unformatted CRSTER preprocessor program meteorological data, if used, is read from Logical Unit 2; otherwise, card-image user input meteorological data, along with all other card-image inputs, are read from Logical Unit 5. Printout of the data entered into the BLP program is obtained through Logical Unit 6. The card-image input deck setup is shown in Figure 3-2. Some of the cards need to be included only if certain options have been requested. A description of all the 12 types of card-image inputs with the default values provided for the program control parameters is presented below.

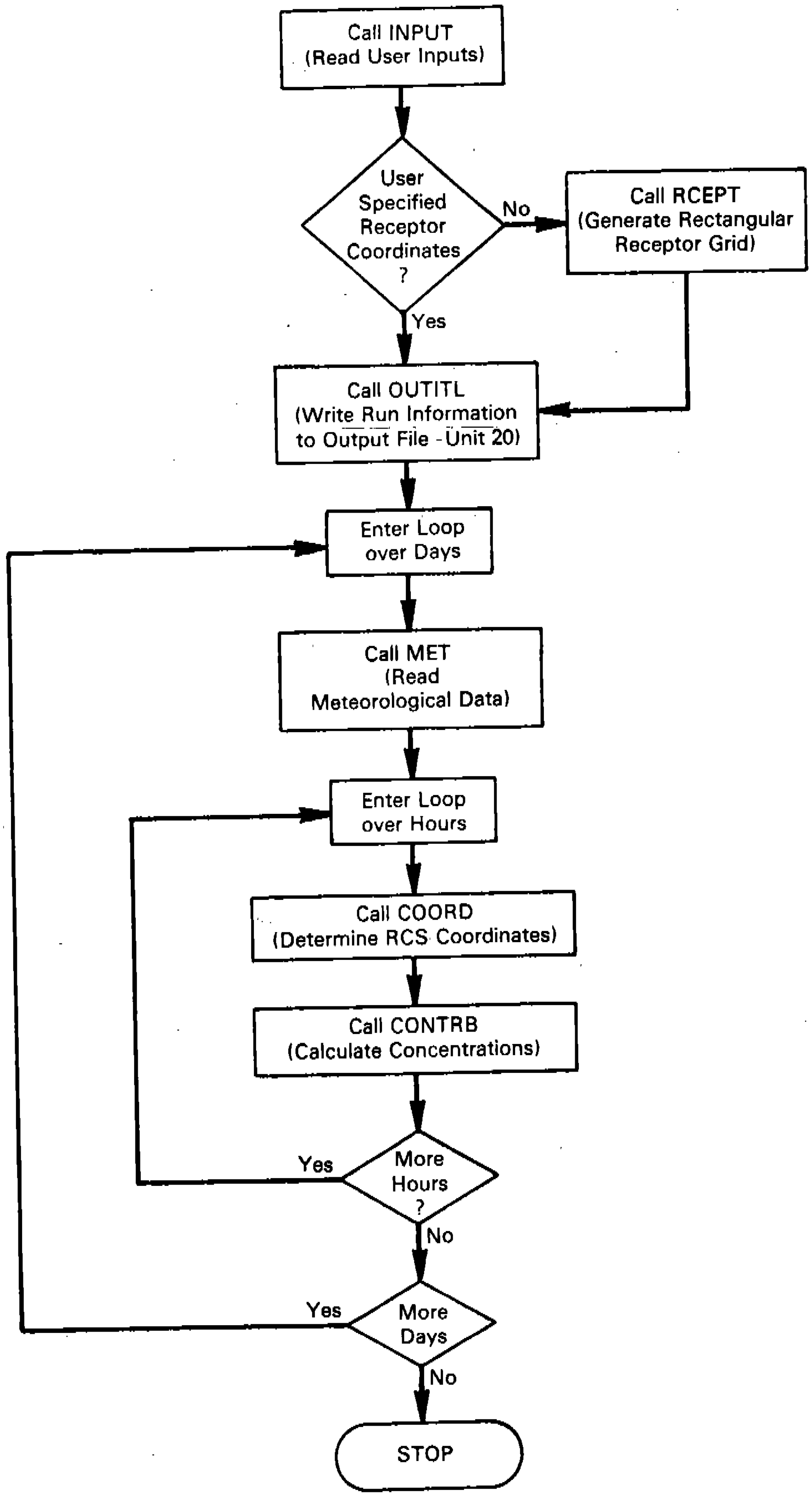

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Figure 3-1 Flow Chart of the BLP Model Main Program

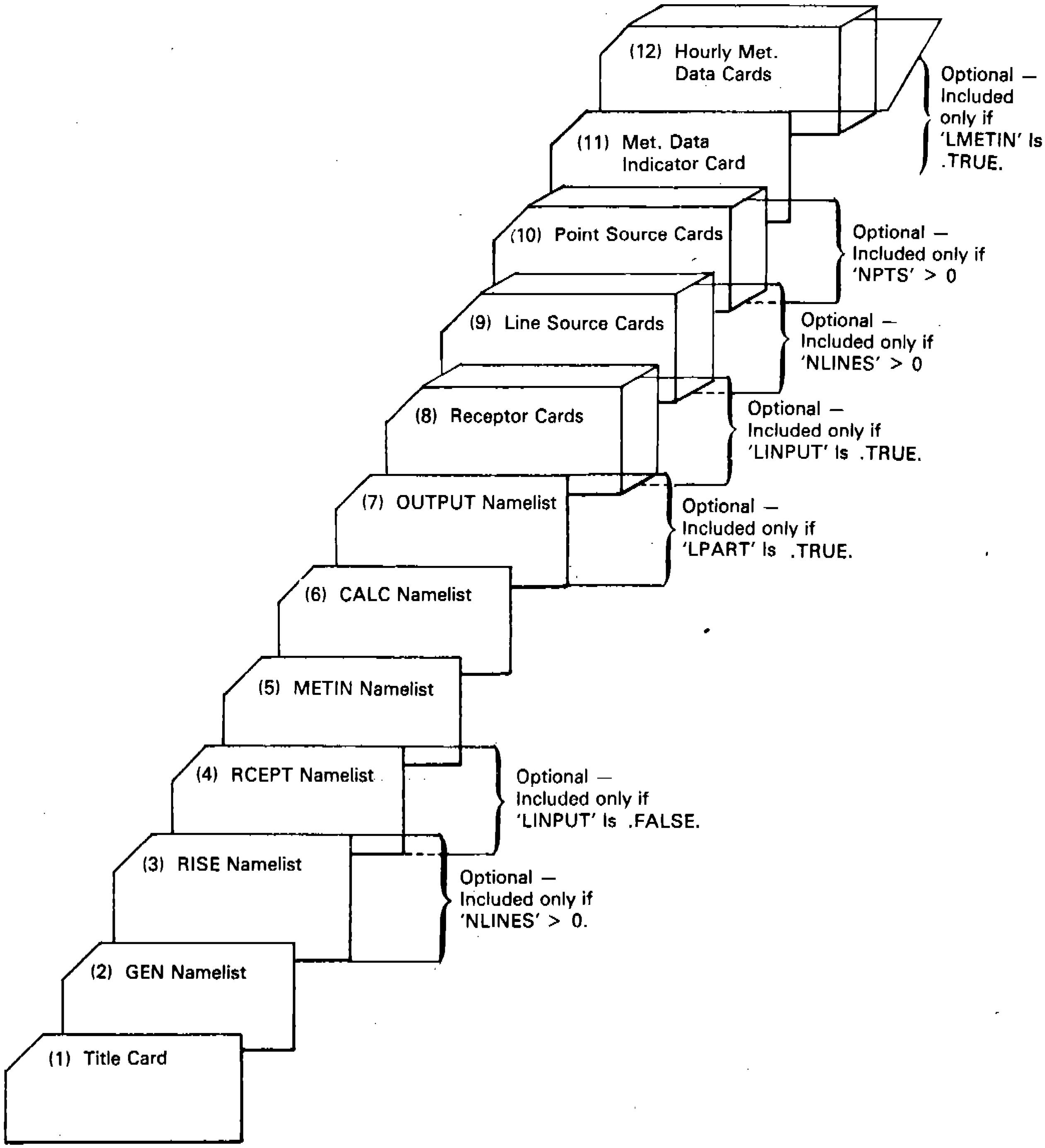

Figure 3-2 Input Deck Setup for BLP Dispersion Model

1) Title Card (up to 80 characters) (always included)

Namelist Inputs

2)	GEN Namelist	(always included)
3)	RISE Namelist	(included only if 'NLINES' > 0)
4)	RCEPT Namelist	(included only if 'LINPUT' is .FALSE.)
5)	METIN Namelist	(always included)
6)	CALC Namelist	(always included)
7)	OUTPUT Namelist	(included only if 'LPART' is .TRUE.)

Formatted Input

8)	One card for each receptor	(included only if 'LINPUT' is .TRUE.)
9)	One card for each line source	(included only if 'NLINES' > 0)
10)	One card for each point source	(included only if 'NPTS' > 0)
11)	One card indicating the number of hours of formatted meteorological data to follow	(included only if 'LMETIN' is .TRUE.)
12)	One card of formatted meteorological data for each hour	(included only if 'LMETIN' is .TRUE.)

Title-Run Identification Card

Columns	Format	Variable	Description
1-80	20A4	TITLE	Any title or run identification information up to 80 characters in length.

Namelist--GEN

GEN assigns values to the number of sources and receptors and initializes control variables.

Variable	Type	Description	Default
NLINES	Integer	Number of line sources. 'NLINES' $\leq$10.	0
NPTS	Integer	Number of point sources. 'NPTS' $\leq$50.	0
NREC	Integer	Number of receptors (input only if 'LINPUT' is .TRUE., otherwise, 'NREC' is calculated by BLP. 'NREC' $\leq$100).	0
LINPUT	Logical	Control variable for receptor input option. If 'LINPUT' is .TRUE., the user will input the X and Y coordinates and elevation of each receptor; if .FALSE., a rectangular receptor grid will be generated by BLP using user input boundary coordinates and X and Y spacings (see RCEPT Namelist).	.FALSE.
LUTMS	Logical	Control variable for the coordinate system used to input all source and receptor coordinates. If 'LUTMS' is .TRUE., all input coordinates are specified in UTM coordinates. If .FALSE., an internal, line source oriented (SCS) coordinate system is assumed.	.FALSE.
LPART	Logical	Control variable for the source contribution option. If 'LPART' is .TRUE., source contributions of user specified sources are included in the output file (see OUTPUT Namelist); otherwise, no source contributions are included.	.FALSE.
LDOWNW	Logical	Control variable for the point source building downwash option. If 'LDOWNW' is .TRUE., the effects of building downwash are evaluated. If .FALSE., point source building downwash effects are not computed.	.TRUE.
LSHEAR	Logical	Control variable for plume rise wind shear option. If 'LSHEAR' is .TRUE., wind shear is included in point and line source plume rise calculations, otherwise, wind shear is not included.	.TRUE.

Variable	Type	Description	Default
LTRANS	Logical	Control variable for the transitional point source plume rise option. If 'LTRANS' is .TRUE., transitional point source plume rise is calculated, otherwise, only final point source plume rise is calculated.	.TRUE.
TCOR	Real	Line source orientation angle. 'TCOR' is the angle (in degrees) between the Y-axis of the UTM coordinate system and the X-axis of the SCS coordinate system - see Figure 2-2 (input only if 'LUTMS' is .FALSE., otherwise, 'TCOR' is calculated by BLP). $0^{\circ} \leq TCOR < 180^{\circ}$.	90.0

Namelist--RISE

This namelist is included only if 'NLINES' >0 (see GEN Namelist). RISE assigns values to the parameters used in the buoyant line source plume rise calculations.

Variable	Type	Description	Default*
L	Real	Average Building Length (m).	-
HB	Real	Average Building Height (m) (see Figure 2-1).	-
WB	Real	Average Building Width (m) (see Figure 2-1).	-
WM	Real	Average Line Source Width (m) (see Figure 2-1).	-
DX	Real	Average Building Separation (m) (see Figure 2-1).	-
FPRIME	Real	Average Buoyancy Parameter (m^4/s^3) (see Equation 2-47).	-

*A dash indicates that no default value is provided.

Namelist--RCEPT

This namelist is included only if 'LINPUT' is .FALSE. (See GEN Namelist). RCEPT defines the rectangular receptor grid to be generated by BLP (see Figure 2-3).

Variable	Type	Description	Default
RXBEG	Real	X-coordinate of lower left corner of receptor grid.	0.0
RYBEG	Real	Y-coordinate of lower left corner of receptor grid.	0.0
RXEND	Real	X-coordinate of upper right corner of receptor grid.	0.0
RYEND	Real	Y-coordinate of upper right corner of receptor grid.	0.0
RDX	Real	Incremental X-spacing of receptors.	0.0
RDY	Real	Incremental Y-spacing of receptors.	0.0

Namelist--METIN

METIN initializes meteorological parameters and assigns values to the array which determines which days are to be modeled.

Variable	Type	Description	Default*
LMETIN	Logical	Meteorological input data control variable. If 'LMETIN' is .TRUE., up to 24 hours of card-image formatted meteorological data is read; if .FALSE., up to 366 days of CRSTER meteorological preprocessor output is read.	.FALSE.
LMETOT	Logical	Meteorological output control parameter-used only if 'LMETIN' is .FALSE. If 'LMETOT' is .TRUE., the hourly meteorology is printed for each day the model is run; if .FALSE., hourly meteorology is not printed. (Note: If 'LMETIN' is .TRUE., hourly meteorology is always printed.)	.FALSE.
IDSURF	Integer	NWS surface station number-used only if 'LMETIN' is .FALSE. 'IDSURF' must be the same as the surface station number input to the CRSTER preprocessor.	-
IYSURF	Integer	Year of record for the surface meteorological data-used only if 'LMETIN' is .FALSE. 'IYSURF' must be the same as the year of the surface data input to the CRSTER preprocessor.	-
IDUPER	Integer	NWS upper air station number-used only if 'LMETIN' is .FALSE. 'IDUPER' must be the same as the upper air station number input to the CRSTER preprocessor.	-
IYUPER	Integer	Year of record for the upper air meteorological data-used only if 'LMETIN' is .FALSE. 'IYUPER' must be the same as the year of the upper air (mixing height) data input to the CRSTER preprocessor.	-
ZMEAS	Real	Measurement height of mean wind speed (m).	7.0
DTHTA(2)	Real Array	Vertical potential temperature gradient for PGT stability classes E and F (Deg. K/m).	0.020, 0.035

Variable	Type	Description	Default*
PEXP (6)	Real Array	Vertical wind speed power law profile exponents for PGT stabilities A-F.	0.10, 0.15, 0.20, 0.25, 0.30, 0.30
IDELS	Integer	Maximum variation in the number of stability classes per hour (used only if 'LMETIN' is .FALSE.). (Note: the CRSTER meteorological preprocessor already may have restricted stability class variations to 1 class/hour.)	5
IRU	Integer	Rural/urban mixing height selector (used only if 'LMETIN' is .FALSE.). 'IRU' is 1 for rural mixing heights and 'IRU' is 2 for urban mixing heights.	1
IDAYS(366)	Integer Array	Array of 366 elements with each element corresponding to a Julian day of the year (used only if 'LMETIN' is .FALSE.). A '1' in element N indicates that Julian day N is to be modeled. A '0' in element N indicates that Julian day N is <u>not</u> to be modeled.	366*0

*A dash indicates that no default is provided.

Namelist--CALC

CALC initializes certain computational, terrain adjustment, decay, and background concentration parameters.

Variable	Type	Description	Default
TERAN (6)	Real Array	Plume path coefficients for PGT stabilities A-F.	0.5, 0.5, 0.5, 0.5 0.3, 0.3
DECFAC	Real	Pollutant decay rate (s^{-1})	0.0
XBACKG	Real	Background concentration ($\mu g/m^3$)	0.0
CONST2	Real	Constant in Briggs stable point source plume rise equation of the form Δh = CONST2*(F/(U*S))$^{1/3}$. (Used only if 'LSHEAR' is .FALSE.)	2.6
CONST3	Real	Constant in Briggs neutral final plume rise distance equation of the form X(final) = CONST3*3.5*F**0.4, where F > 55. m**4/s**3.	34.49
CRIT	Real	Convergence criterion for the line source calculations.	0.02
MAXIT	Integer	Maximum number of iterations allowed in the line source calculations.	14

Namelist--OUTPUT

This namelist is included only if 'LPART' is .TRUE. (See GEN Namelist). OUTPUT defines which sources are to have source contributions included in the output file.

Variable	Type	Description	Default
IPCL (11)	Integer Array	Array of 11 elements with each of the first 10 elements corresponding to a line source. For N≤10, a '1' in element N signifies that the source contribution of line source N is to be written in the output file; A '0' signifies that the source contribution of line source N is not to be written in the output file. The value of element 11 has the same meaning applied to the sum of the source contributions of lines 1 to 'NLINES'.	11*0
IPCP (51)	Integer Array	Array of 51 elements with each of the first 50 elements corresponding to a point source. for N≤50, a '1' in element N signifies that the source contribution of point source N is to be written in the output file; a '0' signifies that the source contribution of point source N is not to be written in the output file. The value of element 51 has the same meaning applied to the sum of the source contributions of points 1 to 'NPTS'.	51*0

The following formatted input follow the Namelist inputs described above.

Receptor Information (included only if 'LINPUT' is .TRUE.). One card must be included for each receptor.

Columns	Format	Variable	Description
1-10	F10.1	XRSCS	X-coordinate of receptor (m).
11-20	F10.1	YRSCS	Y-coordinate of receptor (m).
21-30	F10.1	RELEV	Receptor elevation (m).

Line Source Information-used in dispersion calculations (included only if 'NLINES' > 0). One card must be included for each line source.

Columns	Format	Variable	Description
1-10	F10.1	XLBEG	X-coordinate of beginning of line source (m).
11-20	F10.1	YLBEG	Y-coordinate of beginning of line source (m).
21-30	F10.1	XLEND	X-coordinate of end of line source (m).
31-40	F10.1	YLEND	Y-coordinate of end of line source (m).
41-50	F10.4	HS	Release height of line source (m).
51-60	F10.4	QT	Pollutant emission rate of line source (g/s).
61-70	F10.1	LELEV	Line source base elevation (m).

Point Source Information (including only if 'NPTS' > 0). One card must be included for each point source.

Columns	Format	Variable	Description
1-10	F10.1	XCOORD	X-coordinate of point source (m).
11-20	F10.1	YCOORD	Y-coordinate of point source (m).
21-30	F10.4	PHS	Stack height of point source (m).
31-40	F10.4	PQ	Pollutant emission rate of point source (g/s).
41-50	F10.4	D	Inner stack diameter (m).
51-60	F10.4	W	Exit velocity (m/s).
61-70	F10.4	TSTACK	Stack exit temperature (^oK).
71-80	F10.1	PELEV	Point source base elevation (m).

Formatted Meteorological Input Data (included only if 'LMETIN' is .TRUE.) The formatted meteorological input data consists of one card indicating the number of hours of meteorological data followed by one card for each hour (up to 24 hours).

Columns	Format	Variable	Description
1-2	I2	IHRMAX	Number of hours of formatted meteorological data to follow.

One card with the following format for each of the 'IHRMAX' hours of formatted meteorological data must be included.

Columns	Format	Variable	Description
1	I1	KST	PGT stability class
11-20	F10.2	SPEED	Mean wind speed (m/s)
21-30	F10.2	RANDWD	Wind direction in degrees
31-40	F10.2	TEMP	Ambient air temperature (^{o}K)
41-50	F10.2	HMIX	Mixing height (m)

3.2 POSTBLP User's Instructions

The POSTBLP program is used to process all the BLP concentration output. POSTBLP reads the unformatted BLP output from Logical Unit 20. All POSTBLP output is routed to the line printer (Logical Unit 6). All POSTBLP inputs are specified in Namelist OPTS, which is the only card-image input required by the program. The card-image input is read from Logical Unit 5. A detailed description of Namelist OPTS inputs follows.

Namelist--OPTS

Variable	Type	Description	Default
IJCODE	INTEGER	Coded integer specifying the concentration output (source contribution or summed concentrations) to be processed in this run (not used if 'LSUM' is .TRUE.) If 'IJCODE' is 1 to 10, the concentration output to be processed is the source contribution of line number 'IJCODE'. If 'IJCODE' is 11, the concentration output is the source contribution of the sum of all the line sources. If 'IJCODE' is 101 to 150, the concentration output is the source contribution of point source 'IJCODE'. If 'IJCODE' is 151, the concentration input is the source contribution of the sum of all the point sources. If 'IJCODE' is 999, the concentration output is the total concentration resulting from the sum of all the line and point sources.	999
LECH1	Logical	Control variable for output of 1-hour average concentrations. If 'LECH1' is .TRUE., the 1-hour average concentration at each receptor is printed for each day with '1' indicated in the corresponding element of the 'IECHO' array; if .FALSE., no 1-hour average concentrations are printed.	.FALSE.
LECH3	Logical	Control variable for output of 3-hour average concentrations. If 'LECH1' is .TRUE., the 3-hour average concentration at each receptor is printed for each day with '1' indicated in the corresponding element of the 'IECHO' array; if .FALSE., no 3-hour average concentrations are printed.	.FALSE.
LECH24	Logical	Control variable for output of 24-hour average concentrations. If 'LECH24' is .TRUE., the 24-hour average concentration at each receptor is printed for	.FALSE.

Variable	Type	Description	Default
		each day with a '1' indicated in the corresponding element of the 'IECHO' array, if .FALSE., no 24-hour average concentrations are printed.	
IECHO(366)	Integer	Array of 366 elements with each element corresponding to a Julian day (used only if 'LECH1', or 'LECH3', or 'LECH24' is .TRUE.). IECHO controls output of the 1-, 3-, and 24-hour average concentrations. The concentrations at each receptor will be printed for each Julian day with a '1' in the corresponding element or the 'IECHO' array. For each day with a '0' in the corresponding element, no concentrations will be printed.	366*0
LFRQ1	Logical	Control variable for 1-hour average concentration frequency distributions. If 'LFRQ1' is .TRUE., a frequency distribution of 1-hour averaged concentrations at receptor 'IRECEP' with concentration intervals specified in the 'XINT' array will be produced; otherwise, no distribution will be produced.	.FALSE.
XINT (25)	Real Array	Array containing the concentration intervals used in the 1-hour averaged concentration frequency distribution (used only if 'LFRQ1' is .TRUE.).	25*0.0
NINT	Integer	Number of concentration intervals specified in the 'XINT' array (used only if 'LFRQ1' is .TRUE.). NINT≤25.	0
LFRQ3	Logical	Control variable for 3-hour averaged concentration frequency distributions. If 'LFRQ3' is .TRUE., a frequency distribution of 3-hour average concentration at receptor 'IRECEP' with concentration intervals specified in the 'XINT3' array will be produced; otherwise, no distribution will be printed.	.FALSE.
XINT3(25)	Real Array	Array containing the concentration intervals used in the 3-hour averaged concentration frequency distribution (used only if 'LFRQ3' is .TRUE.).	25*0.0

Variable	Type	Description	Default
NINT3	Integer	Number of concentration intervals specified in the 'XINT3' array (used only if 'LFRQ3' is .TRUE.). NINT3≤25.	0
LFRQ24	Logical	Control variable for 24-hour averaged concentration frequency distributions. If 'LFRQ24' is .TRUE., a frequency distribution of 24-hour averaged concentrations at receptor 'IRECEP' with concentration intervals specified in the 'XINT24' array will be produced; otherwise, no distribution will be produced.	.FALSE.
XINT24(25)	Real	Array containing the concentrations intervals used in the 24-hour averaged concentration frequency distribution (used only if 'LFRQ24' is .TRUE.).	25*0.0
NINT24	Integer	Number of concentration intervals specified in the 'XINT24' array (used only if 'LFRQ24' is .TRUE.). NINT24≤25.	0

Variable	Type	Description	Default
IRECEP	Integer	Number of the receptor used in the frequency distribution calculations (used only if LFRQ1, LFRQ3, or LFRQ34 is .TRUE.).	1
LSUM	Logical	Control variable for source contribution summing option. If 'LSUM' is .TRUE., the source contributions of the sources specified in the array 'ISCODE' are summed; if .FALSE., no source contributions are summed.	.FALSE.
ISCODE(62)	Integer Array	Array containing up to 62 coded integers specifying the source concentrations to be summed (used only if 'LSUM' is .TRUE.). Also see description of 'IJCODE'.	62*0
NSUM	Integer	Number of source contributions specified in 'ISCODE' to be summed (used only if 'LSUM' is .TRUE.). 'NSUM'$\leq$62.	0

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APPENDIX A

FORTRAN SOURCE LISTING OF BLP

```
C
C*************************************************************************
C
C       BLP -- MULTIPLE BUOYANT LINE AND POINT SOURCE
C       DISPERSION MODEL
C
C       BLP   VERSION 1.1  LEVEL 800702      MAIN
C
C       DEVELOPED BY:
C
C       JOE SCIRE AND LLOYD SCHULMAN
C       ENVIRONMENTAL RESEARCH AND TECHNOLOGY
C       696 VIRGINIA ROAD
C       CONCORD, MASSACHUSETTS  01742
C
C*************************************************************************
C
      REAL TITLE(20)
      REAL L,LEFF,LD,LELEV
      INTEGER*2 IDAYS
      LOGICAL RINPUT,LSHEAR,RDOWNW
      LOGICAL LMETIN,LMETOT,LTRANS
      COMMON/SOURCE/NLINES,XLBEG(10),XLEND(10),DEL(10),YSCS(10),QT(10),
     1 HS(10),XRCS(10,129),YRCS(10,129),TCOR,LELEV(10),
     2 NPTS,XPSCS(50),YPSCS(50),PQ(50),PHS(50),XPRCS(50),YPRCS(50),
     3 ISTACK(50),APTS(50),BPTS(50),VEXIT(50),PELEV(50),IDOWNW(50)
      COMMON/RCEPT/RXBEG,RYBEG,RXEND,RYEND,RDX,RDY,XRSCS(100),
     1 YRSCS(100),XRRCS(100),YRRCS(100),RELEV(100),NREC
      COMMON/PR/L,HB,WB,WM,FPRIME,FP,XMATCH,DX,AVFACT,TWOHB,N,LSHEAR,
     1 LTRANS
      COMMON/PRLS/XFB,LEFF,LD,R0,XFINAL,XFS
      COMMON/RINTP/XDIST(7),DH(7)
      COMMON/METD/ZMEAS,WS,WD,ISTAB,TDEGK,DPBL,THETA,S,P,IYR,JDAY,IHOUR
      COMMON/METD24/KST(24),SPEED(24),RANDWD(24),HMIX(24),TEMP(24),
     1 DTHTA(2),PEXP(6),IDELS,IDSURF,IYSURF,IDUPER,IYUPER,TERAN(6),
     2 IRU,IHRMAX,LMETIN,LMETOT,IDAYS(366)
      COMMON/PBLDAT/TWOPBL,PBL1P6
      COMMON/OUTPT/IPCL(11),IPCP(51)
      COMMON/PARM/CRIT,TER1,DECFAC,XBACKG,CONST2,CONST3,MAXIT
      COMMON/QA/VERSON,LEVEL
      DATA PI/3.1415927/
C
C       IDENTIFY VERSION AND LEVEL NUMBERS OF BLP -- MAIN PROGRAM
C
      VERSON=1.1
      LEVEL=800702
C
C       READ INPUTS
C
      CALL INPUT(RINPUT,RDOWNW,TITLE)
      IF(.NOT.RINPUT)CALL RECEPT
C
C       WRITE RUN INFORMATION TO RECORD #1 OF OUTPUT FILE (20)
C
      CALL OUTITL(TITLE,NREC,NPTS,NLINES,IPCL,IPCP,IYR,IDAYS)
      IF(NLINES.LT.1)GO TO 21
      DO 20 I=1,NLINES
20    DEL(I)=XLEND(I)-XLBEG(I)
21    CONTINUE
      IF(NPTS.LE.0)GO TO 520
C
C       IF THE POINT SOURCE DOWNWASH OPTION IS REQUESTED,
C       DEFINE THE RECTANGLE OF INFLUENCE (IN SCS COORDINATES)
```

```
C     FOR THE DOWNWASH CALCULATIONS
C
      IF(.NOT.RDOWNW)GO TO 520
      THREHB=3.*HB
      TWOHB=2.*HB
      HALFWB=WB/2.
      XAMIN=-TWOHB
      XAMAX=L+TWOHB
      YAMIN=-HALFWB-TWOHB
      YAMAX=(NLINES-1)*(DX+WB)+HALFWB+TWOHB
C     FOR THOSE POINTS WITHIN THE REGION OF BUILDING DOWNWASH
C     EFFECTS AND WITH STACK HEIGHTS < 3*HB, SET
C     IDOWNW (POINT #) = 1
      DO 505 I=1,NPTS
      IF(PHS(I).GE.THREHB)GO TO 505
      IF(XPSCS(I).LT.XAMIN.OR.XPSCS(I).GT.XAMAX)GO TO 505
      IF(YPSCS(I).LT.YAMIN.OR.YPSCS(I).GT.YAMAX)GO TO 505
      IDOWNW(I)=1
505   CONTINUE
520   CONTINUE
      IF(LMETIN)GO TO 1212
C     READ STATION CODES AND YEAR OF METEOROLOGICAL DATA
      READ(2)IDS,IYS,IDU,IYU
      IF(IDS.EQ.IDSURF.AND.IYS.EQ.IYSURF.AND.IDU.EQ.IDUPER.AND.
     1 IYU.EQ.IYUPER)GO TO 1212
      WRITE(6,1211)IDSURF,IYSURF,IDS,IYS,IDUPER,IYUPER,IDU,IYU
1211  FORMAT('1','REQUESTED STATION ID OR YEAR DOES NOT MATCH ',
     1 'THAT READ FROM THE MET. DATA FILE -- RUN TERMINATED'/
     2 '0',2X,'REQUESTED SURFACE DATA: ID = ',I4,3X,'YEAR = ',I4/
     3 10X,'MET. DATA READS: ID = ',I4,3X,'YEAR = ',I4/
     4 '0','REQUESTED UPPER AIR DATA: ID = ',I4,3X,'YEAR = ',I4/
     5 10X,'MET. DATA FILE READS: ID = ',3X,'YEAR = ',I4)
      STOP
1212  CONTINUE
C     CALCULATE DISTANCE (FROM XFB) TO FINAL NEUTRAL PLUME RISE
C     ASSUMING PLUMES INTERACT BEFORE REACHING TERMINAL RISE
      FBRG=N*FPRIME/PI
      IF(FBRG.GT.55.)GO TO 10
C     THE CONSTANT 49 = 3.5*14.
      XFINAL=49.*FBRG**0.625
      GO TO 15
10    XFINAL=3.5*CONST3*FBRG**0.4
15    CONTINUE
      XMATCH=XFINAL
C
C     ENTER MAIN LOOP
C
      ISTART=1
      DO 135 I=1,366
      II=367-I
      IF(IDAYS(II).NE.1)GO TO 135
      LASTDY=II
      GO TO 137
135   CONTINUE
      WRITE(6,136)
136   FORMAT(///'0','EXECUTION TERMINATING -- NO ELEMENTS OF ',
     1 'IDAYS ARRAY ARE EQUAL TO ONE')
      STOP
137   CONTINUE
      IF(LMETIN)LASTDY=1
      WRITE(6,1401)
1401  FORMAT('1')
      DO 1002 IDAY=ISTART,LASTDY
```

```
      JDAY=IDAY
C     READ METEOROLOGICAL DATA
      CALL MET
      IF(IDAYS(IDAY).NE.1)GO TO 1002
C
      DO 1000 IHR=1,IHRMAX
C
      IHOUR=IHR
      ISTAB=KST(IHR)
      TER1=1.-TERAN(ISTAB)
      P=PEXP(ISTAB)
      TDEGK=TEMP(IHR)
      IF(ISTAB.GT.4)S=9.80616*DTHTA(ISTAB-4)/TDEGK
      WS=SPEED(IHR)
      WD=RANDWD(IHR)
C     CONVERT WD (FROM PREPROCESSOR) TO WD IN THE REGULAR
C     METEOROLOGICAL SENSE (I.E., 0=NORTH WIND,90=EAST WIND,
C     180=SOUTH WIND,270=WEST WIND)
      WD1=WD+180.
      WD1=AMOD(WD1,360.)
      THETA=360.-(WD1+TCOR)
      IF(THETA.LT.0.0)THETA=360.+THETA
      THETA=AMOD(THETA,360.)
      DPBL=HMIX(IHR)
      TWOPBL=2.*DPBL
      PBL1P6=1.6*DPBL
      CALL COORD(THETA,ISTAB)
      CALL CONTRB
 1000 CONTINUE
 1002 CONTINUE
      WRITE(6,1005)JDAY
 1005 FORMAT(/////'0',30X,'LAST DAY PROCESSED = ',I3)
      STOP
      END
      SUBROUTINE INPUT(RINPUT,RDOWNW,TITLE)
C      BLP    VERSION 1.1   LEVEL 800212       INPUT
      REAL*8 RXBEG,RYBEG,RXEND,RYEND,XBASE,YBASE,XCOORD,YCOORD
      REAL*8 XLBEG,XLEND,YLBEG,YLEND
      REAL YLBEG1(10),YLEND1(10)
      REAL L,LELEV
      REAL TITLE(20)
      INTEGER*2 IDAYS,NDYS
      LOGICAL RINPUT,LINPUT,LUTMS,LPART,LSHEAR,RDOWNW,LDOWNW,LFALSE
      LOGICAL LMETOT,LMETIN,LTRANS
C
C     COMMON BLOCKS
C
      COMMON/SOURCE/NLINES,XLBEG1(10),XLEND1(10),DEL(10),YSCS(10),
     1 GT(10),HS(10),XRCS(10,129),YRCS(10,129),TCOR,LELEV(10),
     2 NPTS,XPSCS(50),YPSCS(50),PQ(50),PHS(50),XPRCS(50),YPRCS(50),
     3 ISTACK(50),APTS(50),BPTS(50),VEXIT(50),PELEV(50),IDOWNW(50)
      COMMON/RCEPT/RXBEG1,RYBEG1,RXEND1,RYEND1,RDX,RDY,XRSCS(100),
     1 YRSCS(100),XRRCS(100),YRRCS(100),RELEV(100),NREC
      COMMON/PR/L,HB,WB,WM,FPRIME,FP,XMATCH,DX,AVFACT,TWOHB,N,LSHEAR,
     1 LTRANS
      COMMON/OUTPT/IPCL(11),IPCP(51)
      COMMON/PARM/CRIT,TER1,DECFAC,XBACKG,CONST2,CONST3,MAXIT
      COMMON/METD24/KST(24),SPEED(24),RANDWD(24),HMIX(24),TEMP(24),
     1 DTHTA(2),PEXP(6),IDELS,IDSURF,IYSURF,IDUPER,IYUPER,TERAN(6),
     2 IRU,IHRMAX,LMETIN,LMETOT,IDAYS(366)
      COMMON/METD/ZMEAS,WS,WD,ISTAB,TDEGK,DPBL,THETA,S,P,IYR,JDAY,IHOUR
      COMMON/QA/VERSON,LEVEL
C
```

```
C     NAMELIST STATEMENTS
C
      NAMELIST/GEN/NLINES,NPTS,NREC,LINPUT,LUTMS,LPART,LDOWNW,LSHEAR,
     1 LTRANS,TCOR
      NAMELIST/RISE/L,HB,WB,WM,FPRIME,DX
      NAMELIST/METIN/ZMEAS,DTHTA,PEXP,IDSURF,IYSURF,IDUPER,IYUPER,
     1 IDELS,IRU,IDAYS,LMETIN,LMETOT
      NAMELIST/CALC/CRIT,TERAN,DECFAC,XBACKG,CONST2,CONST3,MAXIT
      NAMELIST/OUTPUT/IPCL,IPCP
      NAMELIST/RCEPT/RXBEG,RYBEG,RXEND,RYEND,RDX,RDY
C
      DATA LINPUT/.FALSE./,LUTMS/.FALSE./,LPART/.FALSE./
      DATA LDOWNW/.TRUE./,LFALSE/.FALSE./
      DATA ALPYES/'YES'/,ALP1/'NO'/
      DATA ALP2/'NO'/,ALP3/'NO'/,ALP4/'NO'/,ALP5/'NO'/
      DATA PI/3.1415927/,RAD/0.017453293/
      DATA MAXL/10/,MAXP/50/,MAXR/100/
      DATA TEN6/1.E6/
C
C     READ TITLE CARD
C
      READ(5,7)TITLE
7     FORMAT(20A4)
      WRITE(6,1400)VERSON,LEVEL
1400  FORMAT('1',11X,'BLP -- MULTIPLE BUOYANT LINE AND POINT ',
     1 'SOURCE DISPERSION MODEL      VERSION ',F4.1,3X,'LEVEL ',I6/
     2 '0',13('**********'))
      WRITE(6,8)TITLE
8     FORMAT(/'0',20A4)
C
C     READ NUMBER OF SOURCES AND FORMAT OF INPUTS (GEN NAMELIST)
C
      READ(5,GEN)
      WRITE(6,GEN)
      N=NLINES
      RINPUT=LINPUT
      IF(NLINES.LE.0)LDOWNW=LFALSE
      RDOWNW=LDOWNW
      IF(NLINES.GT.MAXL)GO TO 700
      IF(NPTS.GT.MAXP)GO TO 702
      IF(NREC.GT.MAXR)GO TO 704
C
C     READ PARAMETERS USED IN LINE SOURCE PLUME RISE
C     CALCULATIONS (RISE NAMELIST)
C
      IF(NLINES.LT.1)GO TO 49
      READ(5,RISE)
      WRITE(6,RISE)
C
C     READ RECEPTOR INFORMATION (RCEPT NAMELIST)
C
C     IF LINPUT (RINPUT) = .TRUE., INPUT COORDINATES OF EACH RECEPTOR
C     OTHERWISE, INPUT RECEPTOR GRID BOUDARIES AND SPACING AND A
C     RECTANGULAR RECEPTOR GRID WILL BE GENERATED (UP TO 100 RECEPTORS)
49    CONTINUE
      IF(RINPUT)GO TO 25
      READ(5,RCEPT)
      WRITE(6,RCEPT)
      XBASE=0.0
      YBASE=0.0
      IF(.NOT.LUTMS)GO TO 61
      XBASE=RXBEG
      YBASE=RYBEG
```

```
 61    CONTINUE
       RXBEG1=RXBEG-XBASE
       RYBEG1=RYBEG-YBASE
       RXEND1=RXEND-XBASE
       RYEND1=RYEND-YBASE
 25    CONTINUE
C
C      READ MET. DATA PARAMETERS (METIN NAMELIST)
C
       READ(5,METIN)
       WRITE(6,METIN)
       IF(IYSURF.EQ.IYUPER)GO TO 55
       WRITE(6,56)IYSURF,IYUPER
 56    FORMAT('1','RUN TERMINATED -- YEAR REQUESTED FOR SURFACE AND ',
      1 'UPPER AIR MET. DATA DO NOT MATCH'/'0','IYSURF = ',I4,
      2 5X,'IYUPER = ',I4)
       STOP
 55    CONTINUE
       IYR=IYSURF
       IF(LMETIN)IDAYS(1)=1
       IF(MOD(IYSURF,4).NE.0)IDAYS(366)=0
C
C      READ DECAY RATE, TERRAIN CORRECTION FACTOR, CONVERGENCE
C      CRITERION, ITERATION LIMIT (CALC NAMELIST)
C
       READ(5,CALC)
       WRITE(6,CALC)
C
C      READ WHICH SOURCES (IF ANY) TO HAVE PARTIAL
C      CONCENTRATION OUTPUT (OUTPUT NAMELIST)
C
       IF(.NOT.LPART)GO TO 118
       READ(5,OUTPUT)
       WRITE(6,OUTPUT)
 118   CONTINUE
C
C      READ COORDINATES OF USER SPECIFIED RECEPTORS
C
       IF(.NOT.RINPUT)GO TO 40
       IF(LUTMS)GO TO 36
C      READ RECEPTOR COORDINATES IN SCS UNITS
       DO 27 I=1,NREC
 27    READ(5,28)XRSCS(I),YRSCS(I),RELEV(I)
 28    FORMAT(3F10.1)
       XBASE=0.0
       YBASE=0.0
       GO TO 40
C      READ RECEPTOR COORDINATES IN UTM UNITS
 36    READ(5,28)XBASE,YBASE,RELEV(1)
       XRSCS(1)=0.0
       YRSCS(1)=0.0
       IF(NREC.LE.1)GO TO 40
       DO 37 I=2,NREC
       READ(5,28)XCOORD,YCOORD,RELEV(I)
       XRSCS(I)=XCOORD-XBASE
       YRSCS(I)=YCOORD-YBASE
 37    CONTINUE
 40    CONTINUE
C
C      READ LINE SOURCE PARAMETERS USED IN DISPERSION CALCULATIONS
C
       IF(NLINES.LT.1)GO TO 59
       DO 46 I=1,NLINES
```

```
      READ(5,48)XLBEG,YLBEG,XLEND,YLEND,HS(I),QT(I),LELEV(I)
48    FORMAT(4F10.1,2F10.4,F10.1)
C     CHANGE EMISSION RATE TO MICROGRAMS/SECOND
      QT(I)=QT(I)*TEN6
      IF(XLBEG.GT.XLEND)GO TO 706
      XLBEG1(I)=XLBEG-XBASE
      YLBEG1(I)=YLBEG-YBASE
      XLEND1(I)=XLEND-XBASE
      YLEND1(I)=YLEND-YBASE
      YSCS(I)=YLBEG1(I)
46    CONTINUE
59    CONTINUE
C
C     READ POINT SOURCE INFORMATION
C
      IF(NPTS.LT.1)GO TO 22
      DO 15 I=1,NPTS
      READ(5,14)XCOORD,YCOORD,PHS(I),PQ(I),D,W,TSTACK(I),PELEV(I)
14    FORMAT(2F10.1,5F10.4,F10.1)
C     CHANGE EMISSION RATE TO MICROGRAMS/SECOND
      PQ(I)=PQ(I)*TEN6
      XPSCS(I)=XCOORD-XBASE
      YPSCS(I)=YCOORD-YBASE
C     CONSTANT 2.45154 = G/4. (9.80616/4.)
      APTS(I)=2.45154*D*D*W/TSTACK(I)
C     WHEN MULTIPLIED BY THE AMBIENT TEMPERATURE, BPTS GIVES 3. * FM
C     CONSTANT 0.75 = 3./(2.*2.)
      BPTS(I)=0.75*W*W*D*D/TSTACK(I)
      VEXIT(I)=W
15    CONTINUE
22    CONTINUE
C
C     WRITE INPUT PARAMETERS
C
      WRITE(6,1400)VERSON,LEVEL
      WRITE(6,8)TITLE
      NDYS=0
      DO 135 I=1,366
135   NDYS=NDYS+IDAYS(I)
      WRITE(6,136)NDYS,IDAYS
136   FORMAT(//'0','TOTAL NUMBER OF DAYS INCLUDED IN THIS RUN: ',I3//
     1 1X,'(0=NOT INCLUDED,1=INCLUDED)'//
     2 3('0',10(10I1,3X)/),'0',6(10I1,3X),6I1)
      NT=NPTS+NLINES
      WRITE(6,112)NT,NLINES,NPTS
112   FORMAT(//'0','TOTAL NUMBER OF SOURCES: ',I3//12X,'LINE SOURCES: ',
     1 I3/11X,'POINT SOURCES: ',I3)
      IF(LPART)ALP1=ALPYES
      WRITE(6,113)ALP1
113   FORMAT(/'0','PARTIAL CONCENTRATIONS REQUESTED FOR ANY LINE OR ',
     1 'POINT SOURCES ? ',A3)
      IF(LDOWNW)ALP2=ALPYES
      WRITE(6,1110)ALP2
1110  FORMAT('0','POINT SOURCE BUILDING DOWNWASH OPTION REQUESTED ? ',
     1 A3)
      IF(LSHEAR)ALP3=ALPYES
      WRITE(6,1111)ALP3
1111  FORMAT('0','VERTICAL WIND SHEAR (IN PLUME RISE) REQUESTED ? ',A3)
      IF(LTRANS)ALP5=ALPYES
      WRITE(6,1212)ALP5
1212  FORMAT('0','TRANSITIONAL POINT SOURCE PLUME RISE REQUESTED ? ',A3)
      IF(LMETOT)ALP4=ALPYES
      WRITE(6,1112)ALP4
```

```
1112  FORMAT('0','OUTPUT OF METEOROLOGICAL DATA REQUESTED ? ',A3)
C
C      WRITE THE LINE SOURCE PLUME RISE PARAMETERS
C
      IF(NLINES.LT.1)GO TO 122
      DXM=DX+WB
      WRITE(6,50)HB,WB,L,DX,DXM,WM,FPRIME
50    FORMAT(//'0','PARAMETERS USED IN THE LINE SOURCE PLUME RISE ',
     1 'CALCULATIONS'/
     1 '0','BUILDING DIMENSIONS:  HEIGHT = ',F7.2,1X,'(M)'/
     2 24X,'WIDTH = ',F7.2,1X,'(M)'/
     3 23X,'LENGTH = ',F7.2,1X,'(M)'/
     4 '0',9X,'BUILDING SEPARATION = ',F7.2,1X,'(M)'/
     5 '0',6X,'LINE SOURCE SEPARATION = ',F7.2,1X,'(M)'/
     6 '0',11X,'LINE SOURCE WIDTH = ',F7.2,1X,'(M)'/
     7 '0','BUOYANCY FLUX PER LINE (FPRIME) = ',F7.1,1X,'(M**4/S**3)')
122   CONTINUE
C
C      WRITE THE METEOROLOGICAL PARAMETERS
C
      WRITE(6,1400)VERSON,LEVEL
      WRITE(6,1120)
1120  FORMAT(/'0','METEOROLOGICAL PARAMETERS')
      WRITE(6,1121)ZMEAS,PEXP,DTHTA
1121  FORMAT(/'0','MEAN WIND SPEED MEASUREMENT HEIGHT = ',F4.1,' (M)'/
     1 '0','WIND SPEED POWER LAW EXPONENTS (STABILITIES 1-6) =  ',
     2 6(F4.2,2X)/'0','VERTICAL POTENTIAL TEMPERATURE GRADIENT =  ',
     3 F5.3,1X,'DEG K/M  (STABILITY 5)',5X,F5.3,1X,'DEG K/M  ',
     4 '(STABILITY 6)')
      IF(LMETIN)WRITE(6,1122)
1122  FORMAT('0','METEOROLOGICAL DATA -- FORMATTED USER INPUT')
      IF(.NOT.LMETIN)WRITE(6,1123)IOFLS,IRU,IDSURF,IYSURF,IDUPER,IYUPER
1123  FORMAT('0','METEOROLOGICAL DATA -- PREPROCESSOR FORMAT'/
     1 '0','STABILITY CLASS VARIATION RESTRICTED TO ',I1,' CLASSES/',
     2 'HOUR'/'0',1X,'MIXING HEIGHTS USED: ',I1,2X,'(1=RURAL,2=URBAN)'/
     3 '    SURFACE STATION ID: ',I5,5X,'YEAR: ',I2/
     4 1X,'UPPER AIR STATION ID: ',I5,5X,'YEAR: ',I2)
C
C      WRITE THE COMPUTATIONAL PARAMETERS
C
      WRITE(6,1130)CRIT,MAXIT
1130  FORMAT(///'0','COMPUTATIONAL PARAMETERS'//'0','CONVERGENCE ',
     1 'THRESHOLD FOR LINE SOURCE CALCULATIONS = ',F6.3,1X,
     2 '(MICROGRAMS/M**3)'/
     3 '0','MAXIMUM NUMBER OF ITERATIONS IN LINE SOURCE CALCULATIONS = '
     4,I2)
      IF(.NOT.LSHEAR)WRITE(6,1131)CONST2
1131  FORMAT('0','STABLE POINT SOURCE PLUME RISE CONSTANT (CONST2) = ',
     1 F4.2)
      WRITE(6,11131)CONST3
11131 FORMAT('0','FINAL NEUTRAL PLUME RISE CONSTANT (CONST3) = ',
     1 F5.2)
      WRITE(6,1132)XBACKG,DECFAC,TERAN
1132  FORMAT('0','BACKGROUND CONCENTRATION = ',F8.2,1X,'(MICROGRAMS/',
     1 'M**3)'/'0','POLLUTANT DECAY FACTOR = ',E12.5,1X,' (1/SEC)'/
     2 '0','TERRAIN ADJUSTMENT FACTORS (STABILITIES 1-6) =  ',
     3 6(F4.2,2X))
C
C      WRITE THE RECEPTOR INFORMATION
C
      WRITE(6,1400)VERSON,LEVEL
      IF(RINPUT)GO TO 85
      WRITE(6,114)
```

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114   FORMAT(/'0','RECEPTOR LOCATIONS GENERATED FROM USER DEFINED ',
     1 'RECEPTOR RECTANGLE')
      WRITE(6,70)RXBEG,RYEND,RXEND,RYEND,RXBEG,RYBEG,RXEND,RYBEG,RDX,RDY
70    FORMAT(//'0',10X,'RECEPTOR NETWORK DEFINED BY THE FOLLOWING ',
     1 'RECTANGLE'/
     2 '0',10X,'(',F10.1,',',F10.1,')',5X,'(',F10.1,',',F10.1,')'/
     3 '0',10X,'(',F10.1,',',F10.1,')',5X,'(',F10.1,',',F10.1,')'/
     4 '0',10X,'X GRID SPACING = ',F7.2/
     5 '0',10X,'Y GRID SPACING = ',F7.2)
      GO TO 99
85    WRITE(6,115)NREC
115   FORMAT(/'0','ALL RECEPTOR LOCATIONS SPECIFIED BY THE USER -- ',
     1 'TOTAL NUMBER OF RECEPTOR: ',I3)
      WRITE(6,89)NREC
89    FORMAT(//'0',10X,'RECEPTOR NETWORK (USER INPUT)'/
     1 '0','NUMBER OF RECEPTORS: ',I4///1X,'RECEPTOR NUMBER',10X,
     2 'X',14X,'Y',10X,'ELEVATION'/25X,'(M)',12X,'(M)',12X,'(M)'/)
      DO 92 I=1,NREC
      XCOORD=XRSCS(I)+XBASE
      YCOORD=YRSCS(I)+YBASE
92    WRITE(6,93)I,XCOORD,YCOORD,RELEV(I)
93    FORMAT(7X,I3,11X,F10.1,5X,F10.1,2X,F10.1)
99    CONTINUE
      IF(.NOT.LUTMS)WRITE(6,116)TCOR
116   FORMAT('0','SOURCE AND RECEPTOR LOCATIONS SPECIFIED IN SCS ',
     1 'COORDINATES -- TCOR = ',F6.2,' DEGREES')
      IF(LUTMS)WRITE(6,117)
117   FORMAT('0','SOURCE AND RECEPTOR LOCATIONS SPECIFIED IN UTM ',
     1 'COORDINATES')
C
C     WRITE THE LINE SOURCE  PARAMETERS
C
      IF(NLINES.LT.1)GO TO 1133
      WRITE(6,1400)VERSON,LEVEL
      WRITE(6,60)NLINES
60    FORMAT(/'0','LINE SOURCE PARAMETERS'///'0','NUMBER OF LINES: ',I4
     1 //1X,'LINE NUMBER',4X,'X START',6X,'Y START',9X,'X END',9X,
     2 'Y END',11X,'Q',10X,'HEIGHT',5X,'PARTIAL CHI OUTPUT',
     2 3X,'ELEVATION'/
     3 18X,'(M)',10X,'(M)',12X,'(M)',11X,'(M)',8X,'(GM/SEC)',9X,
     4 '(M)',8X,'(0=NO,1=YES)',10X,'(M)')
      DO 65 I=1,NLINES
      XLBEG=XLBEG1(I)+XBASE
      YLBEG=YLBEG1(I)+YBASE
      XLEND=XLEND1(I)+XBASE
      YLEND=YLEND1(I)+YBASE
      QGMS=QT(I)/TEN6
65    WRITE(6,62)I,XLBEG,YLBEG,XLEND,YLEND,QGMS,HS(I),IPCL(I),LELEV(I)
62    FORMAT(4X,I3,7X,4(F10.1,4X),2X,F7.2,6X,F7.2,13X,I1,8X,F10.1)
      WRITE(6,212)
212   FORMAT(//'0','SOURCE CONTRIBUTIONS FROM THE FOLLOWING ',
     1 'LINE SOURCES ARE AVAILABLE: '/'0','(0=NOT AVAILABLE; ',
     2 '1=AVAILABLE)'/'0','LINE SOURCE NUMBER',5X,'AVAILABILITY')
      DO 219 I=1,NLINES
      WRITE(6,215)I,IPCL(I)
215   FORMAT('0',7X,I2,19X,I1)
219   CONTINUE
      WRITE(6,216)NLINES,IPCL(11)
216   FORMAT('0',5X,'1 - ',I2,17X,I1)
1133  CONTINUE
C
C     WRITE THE POINT SOURCE PARAMETERS
C
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      IF(NPTS.LT.1)GO TO 127
      WRITE(6,1400)VERSON,LEVEL
      WRITE(6,160)NPTS
 160  FORMAT(/'0','POINT SOURCE PARAMETERS'///'0','NUMBER OF POINTS: ',
     1 I4//1X,'POINT NUMBER',8X,'X',14X,'Y',11X,'Q',10X,'HEIGHT',4X,
     2 'VOL. FLUX',5X,'STACK TEMP.',5X,'PARTIAL CHI OUTPUT',
     2 3X,'ELEVATION'/
     3 20X,'(M)',12X,'(M)',6X,'(GM/SEC)',9X,'(M)',5X,'(M**3/SEC)',
     4 6X,'(DEG K)',9X,'(0=NO,1=YES)',10X,'(M)')
      DO 132 I=1,NPTS
      XCOORD=XPSCS(I)+XBASE
      YCOORD=YPSCS(I)+YBASE
      VFLUX=APTS(I)*TSTACK(I)*PI/9.8
      QGMS=PQ(I)/TEN6
 132  WRITE(6,133)I,XCOORD,YCOORD,QGMS,PHS(I),VFLUX,TSTACK(I),IPCP(I),
     1 PELEV(I)
 133  FORMAT(5X,I3,8X,F10.1,5X,F10.1,4X,F7.2,6X,F7.2,4X,F10.0,7X,
     1 F5.1,16X,I1,8X,F10.1)
      WRITE(6,222)
 222  FORMAT(//'0','SOURCE CONTRIBUTIONS FROM THE FOLLOWING ',
     1 'POINT SOURCES ARE AVAILABLE: '/'0','(0=NOT AVAILABLE; ',
     2 '1=AVAILABLE)'/'0','POINT SOURCE NUMBER',5X,'AVAILABILITY')
      DO 239 I=1,NPTS
      WRITE(6,235)I,IPCP(I)
 235  FORMAT('0',8X,I2,19X,I1)
 239  CONTINUE
      WRITE(6,236)NPTS,IPCP(51)
 236  FORMAT('0',6X,'1 - ',I2,17X,I1)
 127  CONTINUE
C
C     CALCULATE SCS COORDINATES FROM UTM COORDINATES
C
      IF(.NOT.LUTMS)RETURN
      IF(NLINES.LE.0)RETURN
      XOR=XLBEG1(1)
      YOR=YLBEG1(1)
      DX=XLEND1(1)-XOR
      DY=YLEND1(1)-YOR
      ANGRAD=ATAN2(DY,DX)
      TCOR=90.+ANGRAD/RAD
      SINT=SIN(ANGRAD)
      COST=COS(ANGRAD)
      WRITE(6,189)
 189  FORMAT('1')
C
C     TRANSLATE ORIGIN AND ROTATE COORDINATES
C
C     LINE SOURCE COORDINATES
      DO 260 I=1,NLINES
      XLBEG1(I)=XLBEG1(I)-XOR
      XLEND1(I)=XLEND1(I)-XOR
      YLBEG1(I)=YLBEG1(I)-YOR
      YLEND1(I)=YLEND1(I)-YOR
      YLBEG1(I)=-XLBEG1(I)*SINT+YLBEG1(I)*COST
      XLBEG1(I)=(XLBEG1(I)+YLBEG1(I)*SINT)/COST
      YSCS(I)=-XLEND1(I)*SINT+YLEND1(I)*COST
      XLEND1(I)=(XLEND1(I)+YSCS(I)*SINT)/COST
 260  CONTINUE
C     POINT SOURCE COORDINATES
      IF(NPTS.LT.1)GO TO 275
      DO 270 I=1,NPTS
      XPSCS(I)=XPSCS(I)-XOR
      YPSCS(I)=YPSCS(I)-YOR
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      YRSCS(I)=-XPSCS(I)*SINT+YPSCS(I)*COST
      XPSCS(I)=(XPSCS(I)+YPSCS(I)*SINT)/COST
270   CONTINUE
275   CONTINUE
C     RECEPTOR COORDINATES
      IF(LINPUT)GO TO 290
      RXBEG1=RXBEG1-XOR
      RXEND1=RXEND1-XOR
      RYBEG1=RYBEG1-YOR
      RYEND1=RYEND1-YOR
      RYBEG1=-RXBEG1*SINT+RYBEG1*COST
      RXBEG1=(RXBEG1+RYBEG1*SINT)/COST
      RYEND1=-RXEND1*SINT+RYEND1*COST
      RXEND1=(RXEND1+RYEND1*SINT)/COST
      GO TO 299
290   DO 295 I=1,NREC
      XRSCS(I)=XRSCS(I)-XOR
      YRSCS(I)=YRSCS(I)-YOR
      YRSCS(I)=-XRSCS(I)*SINT+YRSCS(I)*COST
      XRSCS(I)=(XRSCS(I)+YRSCS(I)*SINT)/COST
295   CONTINUE
299   CONTINUE
      RETURN
700   WRITE(6,701)NLINES,MAXL
701   FORMAT('1','NUMBER OF LINE SOURCES INPUT EXCEEDS MAXIMUM NUMBER ',
     1 'ALLOWED'/'0','NUMBER OF LINE SOURCES INPUT (NLINES): ',I5/
     2 '0','MAXIMUM NUMBER OF LINE SOURCES ALLOWED: ',I5)
      STOP
702   WRITE(6,703)NPTS,MAXP
703   FORMAT('1','NUMBER OF POINT SOURCES INPUT EXCEEDS MAXIMUM ',
     1 'NUMBER ALLOWED'/'0','NUMBER OF POINT SOURCES INPUT (NPTS): ',I5/
     2 '0','MAXIMUM NUMBER OF POINT SOURCES ALLOWED: ',I5)
      STOP
704   WRITE(6,705)NREC,MAXR
705   FORMAT('1','NUMBER OF RECEPTORS INPUT EXCEEDS MAXIMUM NUMBER ',
     1 'ALLOWED'/'0','NUMBER OF RECEPTORS INPUT (NREC): ',I5/
     2 '0','MAXIMUM NUMBER OF RECEPTORS ALLOWED: ',I5)
      STOP
706   WRITE(6,707)XLBEG,XLEND
707   FORMAT('1','ENTER COORDINATES OF THE LINE SOURCE ENDPOINTS FROM ',
     1 'WEST TO EAST -- '/1X,'I.E., XLBEG MUST BE LESS THAN OR EQUAL ',
     2 'TO XLEND'/'0','XLBEG INPUT AS ',F10.1/'0','XLEND INPUT AS ',
     3 F10.1)
      STOP
      END
      SUBROUTINE RECEPT
C       BLP   VERSION 1.1  LEVEL 800702      RECEPT
      REAL LELEV
      COMMON/SOURCE/NLINES,XLBEG(10),XLEND(10),DEL(10),YSCS(10),QT(10),
     1 HS(10),XRCS(10,129),YRCS(10,129),TCOR,LELEV(10),
     2 NPTS,XPSCS(50),YPSCS(50),PQ(50),PHS(50),XPRCS(50),YPRCS(50),
     3 TSTACK(50),APTS(50),BPTS(50),VEXIT(50),PELEV(50),IDOWNW(50)
      COMMON/RCEPT/RXBEG,RYBEG,RXEND,RYEND,RDX,RDY,XRSCS(100),
     1 YRSCS(100),XRRCS(100),YRRCS(100),RELEV(100),NREC
      COMMON/QA/VERSON,LEVEL
      IF(NLINES.LE.0)GO TO 151
      YLMAX=YSCS(1)
      YLMIN=YSCS(NLINES)
      XLMAX=XLEND(1)
      XLMIN=XLBEG(1)
      DO 5 I=1,NLINES
      XLMIN=AMIN1(XLMIN,XLBEG(I))
      XLMAX=AMAX1(XLMAX,XLEND(I))
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      YLMIN=AMIN1(YLMIN,YSCS(I))
      YLMAX=AMAX1(YLMAX,YSCS(I))
    5 CONTINUE
C     DEFINE THE SOURCE RECTANGLE
      WRITE(6,105)XLMIN,YLMAX,XLMAX,YLMAX,XLMIN,YLMIN,XLMAX,YLMIN
  105 FORMAT('0','THE SOURCE RECTANGLE IS DEFINED BY THE FOLLOWING ',
     1 'POINTS:'
     2 /'0','(',F10.2,',',F10.2,')',10X,'(',F10.2,',',F10.2,')'
     3 /'0','(',F10.2,',',F10.2,')',10X,'(',F10.2,',',F10.2,')')
      GO TO 161
C     IF THERE ARE NO LINE SOURCES, SOURCE RECTANGLE IS
C     UNDEFINED -- ASSIGN VALUES TO XLMIN,XLMAX,YLMIN,YLMAX
C     SUCH THAT NO RESTRICTION IS PLACED ON THE LOCATIONS OF
C     RECEPTORS
  151 CONTINUE
      XLMIN=1.E10
      XLMAX=-1.E10
      YLMIN=1.E10
      YLMAX=-1.E10
  161 CONTINUE
      NRINX=(RXEND-RXBEG)/RDX+1
      NRINY=(RYEND-RYBEG)/RDY+1
C     NTHTOT IS THE NUMBER OF RECEPTORS BEFORE ELIMINATING
C     THOSE IN THE SOURCE RECTANGLE
      NTHTOT=NRINX*NRINY
      NREC=0
      DO 10 I=1,NRINX
      RXSAVE=RXBEG+(I-1)*RDX
      DO 10 J=1,NRINY
      RYSAVE=RYBEG+(J-1)*RDY
C     IF A RECEPTOR IS OUTSIDE THE SOURCE RECTANGLE, RECORD ITS
C     X AND Y COORDINATES, OTHERWISE, IGNORE IT
      IF(RYSAVE.GT.YLMAX.OR.RYSAVE.LT.YLMIN)GO TO 9
      IF(RXSAVE.GT.XLMAX.OR.RXSAVE.LT.XLMIN)GO TO 9
      GO TO 10
    9 NREC=NREC+1
      IF(NREC.GT.100)GO TO 200
      XRSCS(NREC)=RXSAVE
      YRSCS(NREC)=RYSAVE
   10 CONTINUE
      WRITE(6,1400)VERSON,LEVEL
 1400 FORMAT('1',11X,'BLP -- MULTIPLE BUOYANT LINE AND POINT ',
     1 'SOURCE DISPERSION MODEL      VERSION ',F4.1,3X,'LEVEL ',I6/
     2 '0',13('**********'))
      WRITE(6,26)
   26 FORMAT(//'0','RECEPTOR NO.',11X,'LOCATION',19X,'RECEPTOR NO.',11X,
     1 'LOCATION'/16X,'X',16X,'Y',32X,'X',16X,'Y')
      IH=NREC/2
      DO 30 I=1,IH
      IP=IH+I
      WRITE(6,29)I,XRSCS(I),YRSCS(I),IP,XRSCS(IP),YRSCS(IP)
   29 FORMAT(3X,I3,10X,F6.0,10X,F6.0,13X,I3,10X,F6.0,10X,F6.0)
   30 CONTINUE
      IEVEN=MOD(NREC,2)
      IF(IEVEN.NE.0)WRITE(6,33)NREC,XRSCS(NREC),YRSCS(NREC)
   33 FORMAT(51X,I3,10X,F6.0,10X,F6.0)
      WRITE(6,35)NTHTOT,NREC
   35 FORMAT(////1X,'NUMBER OF POSSIBLE RECEPTOR LOCATIONS = ',I5/
     1 '0','NUMBER OF ACTUAL RECEPTOR LOCATIONS = ',I5)
      RETURN
  200 WRITE(6,205)RXBEG,RYBEG,RXEND,RYEND,RDX,RDY
  205 FORMAT('0','TOO MANY RECEPTOR LOCATIONS REQUESTED.'/'0',
     1 'RECEPTORS AT: (',E13.6,',',E13.6,')',2X,'TO  (',E13.6,',',
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     2 E13.6,10X,'WITH (DX,DY) = (',E13.6,',',E13.6,')')
      STOP
      END
      SUBROUTINE OUTITL(TITLE,NREC,NPTS,NLINES,IPCL,IPCP,IYR,IDAYS)
C      BLP    VERSION 1.1  LEVEL 800212       OUTITL
      REAL TITLE(20)
      INTEGER IPCL(11),IPCP(51)
      INTEGER*2 IDAYS(366)
C
C     THIS SUBROUTINE WRITES THE TITLE CARD AND OTHER RUN
C     INFORMATION TO RECORD #1 OF THE OUTPUT FILE (UNIT 20)
C
      WRITE(20)TITLE,NREC,NPTS,NLINES,IPCL,IPCP,IYR,IDAYS
      RETURN
      END
      SUBROUTINE MET
C      BLP    VERSION 1.1  LEVEL 800212       MET
      LOGICAL LMETIN,LMETOT
      INTEGER IDM(12,2)/0,31,60,91,121,152,182,213,244,274,305,335,
     1 0,31,59,90,120,151,181,212,243,273,304,334/
      INTEGER*2 IDAYS
      DIMENSION REPWD(24),HLH(2,24)
      COMMON/METD24/KST(24),SPEED(24),RANDWD(24),HMIX(24),TEMP(24),
     1 DTHTA(2),PEXP(6),IDELS,IDSURF,IYSURF,IDUPER,IYUPER,TERAN(6),
     2 IRU,IHRMAX,LMETIN,LMETOT,IDAYS(366)
      COMMON/QA/VERSON,LEVEL
      DATA KSTOLD/5/
C
C     READ PROCESSED UNFORMATTED METEOROLOGICAL DATA
C
      IF(LMETIN)GO TO 185
      READ(2)IYR,IMO,DAY,KST,SPEED,TEMP,REPWD,RANDWD,HLH
      IDAY=DAY+0.01
C
C     CALCULATE JULIAN DAY
C
C     ILEAP=1 FOR A LEAP YEAR
C     ILEAP=2 FOR A NON-LEAP YEAR
C
      ILEAP=2
      IF(MOD(IYR,4).EQ.0)ILEAP=1
      IDAY=IDM(IMO,ILEAP)+IDAY
C     IRU=1 FOR RURAL MIXING HEIGHTS, IRU=2 FOR URBAN MIXING HEIGHTS
      DO 5 I=1,24
      HMIX(I)=HLH(IRU,I)
5     CONTINUE
C
C     ALLOW ONLY STABILITIES 1 TO 6 AND
C     RESTRICT STABILITY VARIATION TO 'IDELS' CLASSES/HOUR
C
      DO 75 I=1,24
      ISTAB=KST(I)
      ISTAB=MINO(ISTAB,6)
      IDSTAB=ISTAB-KSTOLD
      IF(IABS(IDSTAB).GT.IDELS)ISTAB=KSTOLD+ISIGN(IDELS,IDSTAB)
      KSTOLD=ISTAB
      KST(I)=ISTAB
C     IF AMBIENT TEMPERATURE IS MISSING, ASSUME T=293.0 DEG. K
      IF(TEMP(I).LE.0.0)TEMP(I)=293.
75    CONTINUE
C
C     IF LMETOT = .TRUE., WRITE HOURLY METEOROLOGY
C
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      IF(.NOT.LMETOT)RETURN
      IF(IDAYS(IDAY).NE.1)RETURN
      WRITE(6,12)IYR,IMO,DAY,(NH,NH=1,24),KST,SPEED,TEMP,REFWD,RANDWD,
     1 (HLH(1,N),N=1,24),(HLH(2,N2),N2=1,24)
12    FORMAT('0','IYR = ',I2,3X,'IMO = ',I2,3X,'DAY = ',F4.0/
     1 4X,'HR=',3X,I4,23I5/
     1 4X,'ISTAB=',I4,23I5/4X,'WS=  ',24F5.1/4X,'TEMP=',24F5.0/
     2 4X,'WD-A=',24F5.0/4X,'WD-R=',24F5.0/4X,'H-RURAL=',12F6.0/
     3 12X,12F6.0/4X,'H-URBAN=',12F6.0/12X,12F6.0)
      RETURN
185   CONTINUE
C
C     READ UP TO 24 HOURS OF FORMATTED METEOROLOGICAL DATA
C     FROM UNIT 5
C
      READ(5,110)IHRMAX
110   FORMAT(I2)
      IF(IHRMAX.LE.24.AND.IHRMAX.GE.1)GO TO 161
      WRITE(6,159)IHRMAX
159   FORMAT(/////10X,'EXECUTION TERMINATING -- IHRMAX MUST ',
     1 'BE SPECIFIED BY THE USER TO BE '/'0',9X,'BETWEEN ',
     2 '1 AND 24 WHEN THE FORMATTED METEOROLOGICAL USER INPUT '/
     3 '0',9X,'OPTION IS REQUESTED  --  (IHRMAX = ',
     4 I5,')')
      STOP
161   CONTINUE
      WRITE(6,1400)VERSON,LEVEL
1400  FORMAT(1X,11X,'BLP -- MULTIPLE BUOYANT LINE AND POINT ',
     1 'SOURCE DISPERSION MODEL     VERSION ',F4.1,3X,'LEVEL ',I6/
     2 '0',13('**********'))
      WRITE(6,171)
171   FORMAT(/'0',20X,'USER INPUT FORMATTED METEOROLOGICAL DATA'//
     1 '0',5X,'HOUR',3X,'STABILITY',3X,'WIND SPEED',3X,'WIND ',
     2 'DIRECTION',3X,'TEMPERATURE',3X,'MIXING HEIGHT'/
     3 15X,'CLASS',8X,'(M/S)',8X,'(DEGREES)',6X,'(DEG. K)',9X,
     4 '(M)')
      DO 100 I=1,IHRMAX
      READ(5,112)KST(I),SPEED(I),RANDWD(I),TEMP(I),HMIX(I)
112   FORMAT(I1,9X,F10.2,F10.2,F10.2,F10.2)
      WRITE(6,114)I,KST(I),SPEED(I),RANDWD(I),TEMP(I),HMIX(I)
114   FORMAT('0',6X,I2,8X,I1,9X,F5.2,10X,F5.1,11X,F5.1,9X,F5.0)
100   CONTINUE
      RETURN
      END
      SUBROUTINE COORD(THETA,ISTAB)
C      BLP   VERSION 1.1  LEVEL 800212     COORD
      DIMENSION XSCS(10,129)
      REAL L,LELEV
      REAL ICHK(4)/90.,180.,270.,360./
      INTEGER IL(4)/4*1/,ISEG(4)/1,129,129,1/
      COMMON/SOURCE/NLINES,XLBEG(10),XLEND(10),DEL(10),YSCS(10),QT(10),
     1 HS(10),XRCS(10,129),YRCS(10,129),TCOR,LELEV(10),
     2 NPTS,XPSCS(50),YPSCS(50),PQ(50),PHS(50),XPRCS(50),YPRCS(50),
     3 TSTACK(50),APTS(50),BPTS(50),VEXIT(50),PELEV(50),IDOWNW(50)
      COMMON/RCEPT/RXBEG,RYBEG,RXEND,RYEND,RDX,RDY,XRSCS(100),
     1 YRSCS(100),XRRCS(100),YRRCS(100),RELEV(100),NREC
      EQUIVALENCE (XRCS(1,1),XSCS(1,1))
      DATA RAD/57.29578/
      TRAD=THETA/RAD
      COST=COS(TRAD)
      SINT=SIN(TRAD)
      IF(NLINES.LT.1)GO TO 250
C
```

```
C     CALCULATE SOURCE COORDINATES FOR EACH SOURCE LINE SEGMENT
C
      DO 25 I=1,NLINES
      DXX=DEL(I)/128.
      XSCS(I,1)=XLBEG(I)
      DO 25 J=2,129
      XSCS(I,J)=XSCS(I,J-1)+DXX
25    CONTINUE
      IL(3)=NLINES
      IL(4)=NLINES
C
C     CALCULATE XN, YN (ORIGINS OF TRANSLATED COORDINATE SYSTEM
C     IN TERMS OF THE SCS COORDINATES
C
      DO 5 I=1,4
      IF(THETA.GE.TCHK(I))GO TO 5
      ISAVE=I
      ILINE=IL(I)
      ISEGN=ISEG(I)
      XN=XSCS(ILINE,ISEGN)
      YN=YSCS(ILINE)
      GO TO 6
5     CONTINUE
6     CONTINUE
C
C     TRANSLATE COORDINATES
C
C     TRANSLATE LINE SOURCE SEGMENT COORDINATES
      DO 10 I=1,NLINES
      DO 10 J=1,129
      XRCS(I,J)=XSCS(I,J)-XN
      YRCS(I,J)=YSCS(I)-YN
10    CONTINUE
C     TRANSLATE POINT SOURCE COORDINATES
      DO 11 I=1,NPTS
      XPRCS(I)=XPSCS(I)-XN
      YPRCS(I)=YPSCS(I)-YN
11    CONTINUE
C     TRANSLATE RECEPTOR COORDINATES
      DO 12 I=1,NREC
      XRRCS(I)=XRSCS(I)-XN
      YRRCS(I)=YRSCS(I)-YN
12    CONTINUE
C
C     ROTATE COORDINATE SYSTEM
C
C     ROTATE LINE SOURCE SEGMENT COORDINATES
      DO 20 I=1,NLINES
      DO 20 J=1,129
      XSAVE=XRCS(I,J)
      YSAVE=YRCS(I,J)
      XRCS(I,J)=XSAVE*COST+YSAVE*SINT
      YRCS(I,J)=YSAVE*COST-XSAVE*SINT
20    CONTINUE
      IF(NPTS.LT.1)GO TO 260
C     ROTATE POINT SOURCE COORDINATES
      DO 21 I=1,NPTS
      XSAVE=XPRCS(I)
      YSAVE=YPRCS(I)
      XPRCS(I)=XSAVE*COST+YSAVE*SINT
      YPRCS(I)=YSAVE*COST-XSAVE*SINT
21    CONTINUE
260   CONTINUE
```

```
C     ROTATE RECEPTOR COORDINATES
      DO 22 I=1,NREC
      XSAVE=XRRCS(I)
      YSAVE=YRRCS(I)
      XRRCS(I)=XSAVE*COST+YSAVE*SINT
      YRRCS(I)=YSAVE*COST-XSAVE*SINT
22    CONTINUE
      RETURN
250   CONTINUE
C
C     WITH NO LINE SOURCES, JUST ROTATE THE POINT SOURCE AND
C     RECEPTOR COORDINATES
C
      IF(NPTS.LT.1)GO TO 360
C     ROTATE POINT SOURCE COORDINATES
      DO 321 I=1,NPTS
      XSAVE=XPSCS(I)
      YSAVE=YPSCS(I)
      XPRCS(I)=XSAVE*COST+YSAVE*SINT
      YPRCS(I)=YSAVE*COST-XSAVE*SINT
321   CONTINUE
360   CONTINUE
C     ROTATE RECEPTOR COORDINATES
      DO 322 I=1,NREC
      XSAVE=XRSCS(I)
      YSAVE=YRSCS(I)
      XRRCS(I)=XSAVE*COST+YSAVE*SINT
      YRRCS(I)=YSAVE*COST-XSAVE*SINT
322   CONTINUE
      RETURN
      END
      SUBROUTINE CONTRB
C      BLP    VERSION 1.1  LEVEL 800702       CONTRB
      REAL CHI(100),PARTCH(100),CHIL(100),FTSAVE(129)
      REAL L,LEFF,LD,LELEV
      INTEGER NSEGA(7)/3,5,9,17,33,65,129/
      LOGICAL LSHEAR,LTRANS
      COMMON/PRLS/XFB,LEFF,LD,R0,XFINAL,XFS
      COMMON/SOURCE/NLINES,XLBEG(10),XLEND(10),DEL(10),YSCS(10),QT(10),
     1 HS(10),XRCS(10,129),YRCS(10,129),ICOR,LELEV(10),
     2 NPTS,XPSCS(50),YPSCS(50),PQ(50),PHS(50),XPRCS(50),YPRCS(50),
     3 ISTACK(50),APTS(50),BPTS(50),VEXIT(50),PELEV(50),IDOWNW(50)
      COMMON/RCEPT/RXBEG,RYBEG,RXEND,RYEND,RDX,RDY,XRSCS(100),
     1 YRSCS(100),XRRCS(100),YRRCS(100),RELEV(100),NREC
      COMMON/WINTP/XDIST(7),DH(7)
      COMMON/METD/ZMEAS,WS,WD,ISTAB,TDEGK,DPBL,THETA,S,P,TYP,JDAY,IHOUR
      COMMON/PR/L,HB,WB,WM,FPRIME,FP,XMATCH,DX,AVFACT,TWGHB,N,LSHEAR,
     1 LTRANS
      COMMON/PBLDAT/IWOPBL,PBLIB6
      COMMON/OUTPT/IPCL(11),IPCP(51)
      COMMON/PARM/CRIT,IENT,DECFAC,XBACKG,CONST2,CONST3,MAXIT
      DATA PI/3.1415927/,SRT2DP/0.7978846/,IAPBL/0/,JTICT/0/
      DO 5 I=1,NREC
      CHIL(I)=0.0
5     CHI(I)=0.0
      IF(NLINES.LT.1)GO TO 2000
      ITHETA=THETA+0.5
      WSST=WS*(HB/ZMEAS)**P
C     SET EFFECTIVE WIND SPEED USED IN PLUME RISE
C     CALCULATIONS, U, TO STACK HEIGHT WIND SPEED, WSST --
C     IF USING WIND SHEAR OPTION IN PLUME RISE, U WILL BE
C     CALCULATED IN SUBROUTINE WSC
      U=WSST
```

```
      IF(LSHEAR)CALL WSC(ISTAB,WSST,U,S,P)
      CALL LENG(THETA,U)
C
C     CALCULATE DISTANCE TO FINAL RISE
C
      IF(ISTAB.LE.4)GO TO 6
C     CALCULATE DISTANCE TO FINAL RISE FOR STABLE CONDITIONS
      UNSRT=16.*U*U/S-XFB*XFB/3.
      IF(UNSRT.LE.0.0)GO TO 105
      XFS=0.5*(XFB+SQRT(UNSRT))
      GO TO 106
105   XFS=(12.*XFB*U*U/S)**0.3333333
106   IF(XFS.GT.XFB)GO TO 7
      DO 18 I=2,7
18    XDIST(I)=XFS
      GO TO 10
6     XFS=XFB+XFINAL
7     CONTINUE
C     FIND 5 INTERMEDIATE DOWNWIND DISTANCES (IN ADDITION TO XFB)
C     AT WHICH PLUME RISE WILL BE CALCULATED
      DO 9 I=2,7
      RI=FLOAT(I)
      XDIST(I)=XFS-(XFS-XFB)*(7.-RI)/5.
9     CONTINUE
10    CONTINUE
      CALL RISE(U,THETA,ISTAB,S)
C
C     CALCULATE PARTIAL CONCENTRATIONS DUE TO THE LINE SOURCES
C
C     LOOP OVER LINES
C
      DO 1000 LNUM=1,NLINES
      DLMIN=DEL(LNUM)/128.
      ZB=LELEV(LNUM)
      ZLINE=HS(LNUM)
      WSST=WS*(ZLINE/ZMEAS)**P
      CUQ=QT(LNUM)/((NSEGA(1)-1)*WSST)
C     SRT2DP = SQRT(2./PI)
      SZ0=R0*SRT2DP
      ZV=1000.*XVZ(SZ0,ISTAB)
      SY0=SZ0/2.
      YV=1000.*XVY(SY0,ISTAB)
      XB=XRCS(LNUM,1)
      YB=YRCS(LNUM,1)
      XE=XRCS(LNUM,129)
      YE=YRCS(LNUM,129)
      XMAXL=AMAX1(XB,XE)
      XMINL=AMIN1(XB,XE)
      YMAXL=AMAX1(YB,YE)
      YMINL=AMIN1(YB,YE)
      DXEL=XE-XB
      DYEL=YE-YB
C
C     LOOP OVER RECEPTORS
C
      DO 500 I=1,NREC
      SUM=0.0
      PARTCH(I)=0.0
      NSEG=0
      NCONTR=0
      XRECEP=XRRCS(I)
      THT=RELEV(I)-ZB
C
```

```
C       IF RECEPTOR IS UPWIND OF THE LINE, CHI = 0.0
C
        IF(XRECEP.LE.XMINL)GO TO 500
        YRECEP=YRRCS(I)
C       INSIG KEEPS TRACK OF WHETHER ANY LINE SEGMENT IS WITHIN
C       ONE SIGMA Y OF THE CURRENT RECEPTOR (0=NO,1=YES)
        INSIG=0
C       DEFINE REGION OF INFLUENCE
C       MAX DISTANCE FROM ANY SOURCE SEGMENT TO CURRENT RECEPTOR
C       IS EQUAL TO (XRECEP-XMINL)
        XRMXKM=(XRECEP-XMINL)/1000.
        CALL SIGMAY(XRMXKM,ISTAB,SYC)
        YLOW=YMINL-4.*SYC
        YHIGH=YMAXL+4.*SYC
        IF(YRECEP.LT.YLOW.OR.YRECEP.GT.YHIGH)GO TO 500
        YLOW=YLOW+DLMIN
        YHIGH=YHIGH-DLMIN
        IF(YRECEP.LT.YLOW.OR.YRECEP.GT.YHIGH)GO TO 500
C       CHECK IF RECEPTOR IS DIRECTLY DOWNWIND OF
C       THE LINE (IDW=0=NO,IDW=1=YES)
        IDW=1
        IF(YRECEP.LT.YMINL.OR.YRECEP.GT.YMAXL)IDW=0
C       CHECK IF RECEPTOR IS ON THE DOWNWIND SIDE OF THE LINE
        IF(XRECEP.GE.XMAXL)GO TO 477
        IF(MOD(ITHETA,90).EQ.0)GO TO 477
        EM=DYEL/DXEL
        B=YE-EM*XE
        IF(XRECEP.LT.(YRECEP-B)/EM)NCONTR=999
477     CONTINUE
        NSEG0=NSEGA(I)
        NNEW=NSEG0
        ITER=0
        INDL=1
        IDELTA=128/(NSEG0-1)
498     CONTINUE
        NSEG=NSEG+NNEW
C
C       LOOP OVER LINE SEGMENTS
C
        DO 499 ISEG=1,NNEW
        FTSAVE(INDL)=0.0
C       IF CURRENT RECEPTOR IS UPWIND OF A SOURCE SEGMENT, THEN
C       THIS SOURCE SEGMENT DOES NOT CONTRIBUTE
        IF(XRCS(LNUM,INDL).GE.XRECEP)GO TO 495
        DOWNX=XRECEP-XRCS(LNUM,INDL)
        CROSSY=YRECEP-YRCS(LNUM,INDL)
        VIRTXZ=DOWNX+ZV
        VIRTXY=DOWNX+YV
        VXYKM=VIRTXY/1000.
        VXZKM=VIRTXZ/1000.
        CALL DBTSIG(VXZKM,VXYKM,ISTAB,SIGY,SIGZ)
C
C       IF CROSSWIND DISTANCE > 4 * SIGY, THEN THIS SOURCE SEGMENT
C       DOES NOT CONTRIBUTE
        IF(4.*SIGY.LT.ABS(CROSSY))GO TO 495
        IF(ABS(CROSSY).LT.SIGY)INOSIG=1
        CALL ZRISE(LNUM,INDL,I,Z)
C
C       INCLUDE TERRAIN CORRECTION IN DETERMINING THE PLUME HEIGHT
C
        HNT=Z+ZLINE
C       TER1=(1.-TERAN(ISTAB)); THT=RELEV(I)-LELEV(LNUM)
        TERRAN=TER1*AMIN1(HNT,THT)
```

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      H=HNT-TERRAN
      IF(H.GT.DPBL)GO TO 495
C
C     SOLVE THE GAUSSIAN POINT SOURCE EQUATION
C
      CALL GAUSS(CROSSY,SIGY,SIGZ,H,FT)
C     INCLUDE DECAY IN DETERMINING CHI
      DELTAT=DOWNX/WSST
      FT=FT*(1.-DELTAT*DECFAC)
      FTSAVE(INDL)=FT
      NCONTR=NCONTR+1
495   INDL=INDL+IDELTA
499   CONTINUE
C
C     FIRST TIME THROUGH LOOP, CALCULATE THE FIRST CHI ESTIMATE
C
      IF(NNEW.NE.NSEG0)GO TO 714
      INDL=1
      NSEGM1=NSEG0-1
      SUM=(FTSAVE(1)+FTSAVE(129))/2.
      DO 712 ISEG2=2,NSEGM1
      INDL=INDL+IDELTA
      SUM=SUM+FTSAVE(INDL)
712   CONTINUE
C     IF RECEPTOR IS WITHIN REGION OF INFLUENCE BUT NOT DIRECTLY
C     DOWNWIND OF ANY PART OF THE LINE, AND SUM=0.0, CHI=0.0
      IF(SUM.LE.0.0.AND.IDW.NE.1)GO TO 500
C
C     CALCULATE THE REFINED CHI ESTIMATE
C
713   CONTINUE
      ITER=ITER+1
      IDIV=MIN0(ITER,2)
      IDELTA=IDELTA/IDIV
      INDL=1+IDELTA/2
C     INDL IS THE SUBSCRIPT OF THE FIRST NEW LINE SEGMENT
C     (SAVE AS INDLSV)
      INDLSV=INDL
      NNEW=NSEGM1**ITER+0.1
C     IF MORE THAN 129 LINE SEGMENTS (I.E., 64 NEW SEGMENTS)
C     ARE REQUIRED, CONTINUE TO INCREASE THE NUMBER OF
C     SEGMENTS BUT ONLY OVER THE SECTION OF THE LINE
C     WHICH IS CONTRIBUTING
      IF(NNEW.GT.64)GO TO 759
      GO TO 498
714   CONTINUE
C     SUBSCRIPT OF THE FIRST NEW LINE SEGMENT IS INDLSV
C     SUBSCRIPT OF THE LAST NEW LINE SEGMENT IS INDLLN
      INDLLN=129-IDELTA/2
C     SUM THE FIRST AND LAST NEW LINE SEGMENTS
      SUM2=FTSAVE(INDLSV)+FTSAVE(INDLLN)
C     IF THERE ARE ONLY 2 NEW LINE SEGMENTS, SKIP THIS LOOP
      IF(NNEW.LE.2)GO TO 717
      INDL=INDLSV
      I2=NNEW-1
C
C     FIND THE SUM OF ALL THE NEW LINE SEGMENTS
C
      DO 715 ISEG3=2,I2
      INDL=INDL+IDELTA
      SUM2=SUM2+FTSAVE(INDL)
715   CONTINUE
717   CONTINUE
```

```
C
C     COMPARE THE NEW ESTIMATE WITH THE PREVIOUS ESTIMATE
C
      SUM2=SUM/2.+SUM2/(2.**ITER)
C     AT LEAST ONE LINE SEGMENT MUST BE WITHIN ONE SIGMA Y OF
C     THE LINE (IF THE RECEPTOR IS DIRECTLY DOWNWIND OF ANY PART
C     OF THE LINE)
      IF(IDW.EQ.1.AND.IWOSIG.NE.1)GO TO 758
      DIFF=ABS(SUM2-SUM)
      IF(DIFF*CUQ.LT.0.1)GO TO 720
      CORR=DIFF/SUM2
      IF(CORR.LT.CRIT)GO TO 720
758   CONTINUE
      SUM=SUM2
      GO TO 713
C     IF 129 SOURCE SEGMENTS NOT SUFFICIENT, CONTINUE
C     TO INCREASE NUMBER OF SEGMENTS, BUT ONLY OVER THE
C     SECTION OF LINE WHICH IS CONTRIBUTING
759   CONTINUE
      CALL SORT(FTSAVE,IBMIN,IBMAX,IWPBL)
      IF(IWPBL.NE.999)GO TO 4949
      IWPBL=0
      PARTCH(I)=0.0
      GO TO 500
4949  CONTINUE
      IBMAX1=IBMAX-1
      IH=0
      IGMAX=1
939   CONTINUE
      SUM2=0.0
      XGMAX1=IGMAX+1
      DO 940 IG=IBMIN,IBMAX1
C     XCLN = X COORDINATE (RCS) OF CURRENT (NEWEST) LINE SEGMENT
C     YCLN = Y COORDINATE (RCS) OF CURRENT (NEWEST) LINE SEGMENT
      XSEG1=XRCS(LNUM,IG)
      XDIFF=XRCS(LNUM,IG+1)-XSEG1
      YSEG1=YRCS(LNUM,IG)
      YDIFF=YRCS(LNUM,IG+1)-YSEG1
      DO 940 IGSUB=1,IGMAX
      WEIGHT=FLOAT(IGSUB)/XGMAX1
      XCLN=XSEG1+WEIGHT*XDIFF
      YCLN=YSEG1+WEIGHT*YDIFF
      DOWNX=XRECEP-XCLN
      CROSSY=YRECEP-YCLN
      VIRTXZ=DOWNX+ZV
      VIRTXY=DOWNX+YV
      VXYKM=VIRTXY/1000.
      VXZKM=VIRTXZ/1000.
      CALL DBTSIG(VXZKM,VXYKM,ISTAB,SIGY,SIGZ)
      CALL ZRISE(LNUM,IG,I,Z)
C     INCLUDE TERRAIN CORRECTION IN DETERMINING THE PLUME HEIGHT
      HNT=Z+ZLINE
C     TER1=(1.-TERAN(ISTAB)); THT=RELEV(I)-LELEV(LNUM)
      TERRAN=TER1*AMIN1(HNT,THT)
      H=HNT-TERRAN
      CALL GAUSS(CROSSY,SIGY,SIGZ,H,FT)
C     INCLUDE DECAY IN DETERMINING CHI
      DELTAT=DOWNX/WSST
      FT=FT*(1.-DELTAT*DECFAC)
      SUM2=SUM2+FT
      NCONTR=NCONTR+1
940   CONTINUE
C     COMPARE THE NEW ESTIMATE WITH THE PREVIOUS ESTIMATE
```

```
      SUM2=SUM/2.+SUM2/(2.**ITER)
      DIFF=ABS(SUM2-SUM)
      IF(DIFF*CUQ.LT.0.1)GO TO 720
      CORR=DIFF/SUM2
      IF(CORR.LT.CRIT)GO TO 720
      SUM=SUM2
      ITER=ITER+1
      IF(ITER.GE.MAXIT)GO TO 599
      IH=IH+1
      IGMAX=2**IH
      GO TO 939
720   CONTINUE
      SUM=SUM2
C     TEST TO MAKE SURE AT LEAST TWO LINE SEGMENTS CONTRIBUTED
C     TO THE CHI ESTIMATE
C     (UNLESS RECEPTOR IS ON THE UPWIND SIDE OF THE LINE WITH
C     SOME SOURCE SEGMENTS DOWNWIND AND SOME SOURCE SEGMENTS
C     UPWIND -- IN THAT CASE JUST USE THE TEST FOR CONVERGENCE)
      IF(NCONTR.LT.2)GO TO 713
C     CALCULATE CONCENTRATION (IN MICROGRAMS)
C     USE STACK HEIGHT WIND SPEED FOR DILUTION
      PARTCH(I)=CUQ*SUM
      CHIL(I)=CHIL(I)+PARTCH(I)
      GO TO 500
599   WRITE(6,600)MAXIT,I,LNUM,CORR,CRIT,ITER,IHOUR,IDAY,IYR
600   FORMAT(//'0','TOO MANY ITERATIONS IN LINE SOURCE CALCULATIONS',
     1 ' -- MAXIT = ',I2/1X,'RECEPTOR ',I3,
     1 ' PROBABLY TOO CLOSE TO LINE ',I2/
     2 1X,'CORR = ',F6.2/1X,'CRIT = ',F6.2/1X,'ITER = ',I3/
     3 1X,'(IHOUR,IDAY,IYR) = ','(',I2,',',I3,',',I2,')')
      JITCT=JITCT+1
      IF(JITCT.GT.100)GO TO 6491
      SUM=SUM2
      PARTCH(I)=CUQ*SUM
      CHIL(I)=CHIL(I)+PARTCH(I)
      GO TO 500
6491  WRITE(6,6492)
6492  FORMAT(//'0','TOO MANY EXCEEDENCES OF LINE SOURCE ',
     1 'ITERATION MAXIMUM -- EXECUTION TERMINATING')
      STOP
500   CONTINUE
      IF(IPCL(LNUM).EQ.1)CALL OUTPUT(LNUM,PARTCH,NREC)
1000  CONTINUE
      IF(IPCL(11).EQ.1)CALL OUTPUT(11,CHIL,NREC)
C
C     CALCULATE PARTIAL CONCENTRATIONS DUE TO THE POINT SOURCES
C
C     LOOP OVER POINTS
C
2000  IF(NPTS.LT.1)GO TO 9999
      IF(ISTAB.GT.4)SQRTS=SQRT(S)
      DO 2100 NUMPT=1,NPTS
      ZB=PELEV(NUMPT)
      XSTACK=XPRCS(NUMPT)
      YSTACK=YPRCS(NUMPT)
      ZSTACK=PHS(NUMPT)
      WSST=WS*(ZSTACK/ZMEAS)**P
      CUQ=PQ(NUMPT)/WSST
      BUOYFX=APTS(NUMPT)*(TSTACK(NUMPT)-TDEGK)
      IF(ISTAB.GT.4)GO TO 7150
C     CALCULATE DISTANCE TO FINAL RISE
      IF(BUOYFX.GT.55.)GO TO 7010
C     THE CONSTANT 49. = 3.5*14.
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      XSMT=49.*BUOYFX**0.625
      GO TO 7015
 7010 XSMT=3.5*CONST3*BUOYFX**0.4
      GO TO 7015
 7150 XSMT=3.14159*WSST/SQRTS
 7015 CONTINUE
C
C     IF THE POINT SOURCE BUILDING DOWNWASH OPTION IS REQUESTED,
C     DETERMINE THE EFFECTS (IF ANY) OF BUILDING DOWNWASH
C
      ZV=0.0
      YV=0.0
      IF(IDOWNW(NUMPT).NE.1)GO TO 512
C     CALCULATE THE MOMENTUM RISE AT A DOWNWIND DISTANCE OF 2.*HB
C     FM3 = 3.*FM (I.E., 3.*VERTICAL MOMENTUM FLUX TERM)
      FM3=HPTS(NUMPT)*TDFGK
      BETAM=0.3333333+WSST/VEXIT(NUMPT)
      IF(ISTAB.GT.4)GO TO 509
      EFFHT=ZSTACK+(FM3*TWOHB/(BETAM*BETAM*WSST*WSST))**0.3333333
      GO TO 511
  509 EFFHT=ZSTACK+(FM3*SIN(SQRTS*TWOHB/WSST)/
     1 (BETAM*BETAM*WSST*SQRTS))**0.3333333
  511 CONTINUE
      RATIO=EFFHT/HB
      RATIO=AMAX1(RATIO,1.0)
C     IF RATIO GE 3.0, SIGY AND SIGZ ARE NOT MODIFIED
C     IF RATIO LT 3.0 AND GT 1.2, ONLY SIGZ IS MODIFIED
C     IF RATIO LE 1.2, BOTH SIGY AND SIGZ ARE MODIFIED
      IF(RATIO.GE.3.0)GO TO 512
      ROZ=HB*(1.5-RATIO/2.)
      SZ0=SRT2DP*ROZ
      ZV=1000.*XVZ(SZ0,ISTAB)
      A=5.0*ROZ
      B=8.3333333*ROZ*ROZ
      IF(RATIO.GT.1.2)GO TO 512
      ROY=HB*(6.-5.*RATIO)/2.
      SY0=SRT2DP*ROY
      YV=1000.*XVY(SY0,ISTAB)
  512 CONTINUE
C
C     LOOP OVER RECEPTORS
C
      DO 2050 I=1,NREC
      PARTCH(I)=0.0
      DOWNX=XRRCS(I)-XSTACK
      IF(DOWNX.LE.0.0)GO TO 2050
      CROSSY=YRRCS(I)-YSTACK
      VIRTXZ=DOWNX+ZV
      VIRTXY=DOWNX+YV
      VXZKM=VIRTXZ/1000.
      VXYKM=VIRTXY/1000.
      CALL DBTSIG(VXZKM,VXYKM,ISTAB,SIGY,SIGZ)
      IF(4.*SIGY.LT.ABS(CROSSY))GO TO 2050
      IF(IDOWNW(NUMPT).NE.1)GO TO 1517
      ZSAVE=9999.
C
C     IF THE SHEAR AND DOWNWASH OPTIONS ARE BOTH REQUESTED,
C     USE THE MINIMUM OF Z(SHEAR) AND Z(DOWNWASH)
C
      IF(LSHEAR)CALL PTRISE(BUOYFX,ZSTACK,XSMT,DOWNX,WSST,ZSAVE,LSHEAR,
     1 LTRANS)
      IF(ISTAB.GT.4)GO TO 1515
 1514 CONTINUE
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      EXR=AMIN1(DOWNX,XSMT)
      IF(.NOT.LTRANS)EXR=XSMT
      C=-4.16666667*BUOYFX*EXR*EXR/WSST**3
      GO TO 1516
 1515 IF(DOWNX.LT.2.*SQRT(WSST/S))GO TO 1514
      C=-16.666667*BUOYFX/(WSST*S)
 1516 CONTINUE
      CALL CUBIC(A,B,C,Z)
      Z=AMIN1(Z,ZSAVE)
      GO TO 1518
 1517 CONTINUE
      CALL PTRISE(BUOYFX,ZSTACK,XSMT,DOWNX,WSST,Z,LSHEAR,LTRANS)
 1518 CONTINUE
      HNT=Z+ZSTACK
      THT=RELEV(I)-ZB
C     TER1=(1.-TERAN(ISTAB))
      TERRAN=TER1*AMIN1(HNT,THT)
      H=HNT-TERRAN
      IF(H.GT.DPBL)GO TO 2050
      CALL GAUSS(CROSSY,SIGY,SIGZ,H,FT)
C     INCLUDE DECAY IN DETERMINING CHI
      DELTAT=DOWNX/WSST
      FT=FT*(1.-DELTAT*DECFAC)
      PARTCH(I)=CQQ*FT
      CHI(I)=CHI(I)+PARTCH(I)
 2050 CONTINUE
      ICODE=100+NUMPT
      IF(IPCP(NUMPT).EQ.1)CALL OUTPUT(ICODE,PARTCH,NREC)
 2100 CONTINUE
      IF(IPCP(51).EQ.1)CALL OUTPUT(151,CHI,NREC)
 9999 CONTINUE
      DO 9050 I=1,NREC
      CHI(I)=CHI(I)+CHIL(I)+XBACKG
 9050 CONTINUE
      CALL OUTPUT(999,CHI,NREC)
      RETURN
      END
      SUBROUTINE GAUSS(CROSSY,SIGY,SIGZ,H,FT)
C      BLP    VERSION 1.1   LEVEL 800212      GAUSS
      COMMON/METD/ZMEAS,WS,WD,ISTAB,TDEGK,DPBL,THETA,S,P,IYR,JDAY,IHOUR
      COMMON/PBLDAT/TWOPBL,PBL1P6
      DATA TMIN/0.0512/,TMAX/9.21/
      TD1=3.1415927*SIGY*SIGZ
      YPSIG=CROSSY/SIGY
      EXPYP=0.5*YPSIG*YPSIG
C     PREVENT UNDERFLOWS
      IF(EXPYP.GT.50.)GO TO 495
      F=EXP(-EXPYP)
      GO TO 496
  495 F=0.0
      GO TO 443
  496 CONTINUE
C     IF SIGZ GT 1.6*DPBL, ASSUME A UNIFORM VERTICAL DISTRIBUTION
      IF(SIGZ.GT.PBL1P6)GO TO 460
C     IF MIXING HEIGHT (DPBL) GE 5000 M OR FOR STABLE CONDITIONS,
C     NEGLECT THE REFLECTION TERMS
      IF(ISTAB.GE.5.OR.DPBL.GT.5000.)GO TO 451
C     CALCULATE MULTIPLE EDDY REFLECTIONS TERMS
C     USING A FOURIER SERIES METHOD -- SEE ERT MEMO CS 093
      F1=1
      T=(SIGZ/DPBL)**2
      H2=H/DPBL
      IF(T.GE.0.6)GO TO 500
```

```
      ARG=2.*(1.-H2)/T
      IF(ARG.GE.TMAX)GO TO 400
      IF(ARG.LT.TMIN)F1=F1+1.-ARG
      IF(ARG.GE.TMIN)F1=F1+EXP(-ARG)
      ARG=2.*(1.+H2)/T
      IF(ARG.GE.TMAX)GO TO 400
      F1=F1+EXP(-ARG)
      ARG=4.*(2.-H2)/T
      IF(ARG.GE.TMAX)GO TO 400
      F1=F1+EXP(-ARG)
      ARG=4.*(2.+H2)/T
      IF(ARG.LT.TMAX)F1=F1+EXP(-ARG)
400   ARG=-0.5*H2*H2/T
      IF(ARG.LT.-90.)F1=0.0
C     CONSTANT 0.797885 = SQRT(2./PI)
      IF(ARG.GE.-90.)F1=0.797885*F1*FXP(ARG)/SIGZ
      IF(F1.LT.1.E-30)F1=0.0
      GO TO 1500
C     CONSTANT 4.934802 = PI*PI/2.
500   ARG=4.934802*T
      IF(ARG.GE.TMAX)GO TO 900
      F1=F1+2.*EXP(-ARG)*COS(3.141593*H2)
C     CONSTANT 19.739209 = 2.*PI*PI
      ARG=19.739209*T
      IF(ARG.LT.TMAX)F1=F1+2.*EXP(-ARG)*COS(6.283185*H2)
900   F1=F1/DPBL
      IF(F1.LT.1.E-30)F1=0.0
1500  CONTINUE
C     THE CONSTANT 1.25331414 = SQRT(PI/2.)
      F1=1.25331414*SIGZ*F1
      GO TO 445
451   CONTINUE
      HPSIG=H/SIGZ
      EXPHP=0.5*HPSIG*HPSIG
      IF(EXPHP.GT.50)GO TO 443
      F1=EXP(-EXPHP)
      GO TO 445
443   F1=0.0
445   CONTINUE
C     FIND PRODUCT OF EXPONENTIAL TERMS DIVIDED BY (PI*SIGY*SIGZ)
      FT=F*F1/TD1
      GO TO 470
460   CONTINUE
C     VERTICAL DISTRIBUTION ASSUMED UNIFORM
C     THE CONSTANT 2.5066283 = SQRT(2.*PI)
      FT=F/(2.5066283*SIGY*DPBL)
470   RETURN
      END
      SUBROUTINE SORT(FTSAVE,IBMIN,IBMAX,IWPBL)
C      BLP   VERSION 1.1  LEVEL 800212      SORT
      REAL FTSAVE(129)
      ISAFE=0
      IB=0
      IF(FTSAVE(129).NE.0.0)IB=129
      IF(FTSAVE(1).NE.0.0)IB=1
      IF(IB.NE.0)GO TO 970
      DO 950 ILEVEL=1,7
      NEACHL=2**(ILEVEL-1)
      INCR=2**(8-ILEVEL)
      INDEX=1+INCR/2
      DO 945 NC=1,NEACHL
      IF(FTSAVE(INDEX).EQ.0.0)GO TO 944
      IB=INDEX
```

```
      GO TO 970
944   INDEX=INDEX+INCR
945   CONTINUE
950   CONTINUE
      IF(IB.NE.0)GO TO 970
      IWPBL=999
      RETURN
970   IBMIN=IB-1
      IBMAX=IB+1
      IBMIN=AMAX0(IBMIN,1)
      IBMAX=AMIN0(IBMAX,129)
975   CONTINUE
      INCRM=0
      INCRP=0
      IF(FTSAVE(IBMIN).NE.0.0)INCRM=1
      IF(IBMIN.EQ.1)INCRM=0
      IF(FTSAVE(IBMAX).NE.0.0)INCRP=1
      IF(IBMAX.EQ.129)INCRP=0
      IBMIN=IBMIN-INCRM
      IBMAX=IBMAX+INCRP
      IF(INCRM.EQ.0.AND.INCRP.EQ.0)GO TO 980
      ISAFE=ISAFE+1
      IF(ISAFE.GT.129)GO TO 980
      GO TO 975
980   CONTINUE
      RETURN
      END
      SUBROUTINE OUTPUT(ICODE,CHIS,NREC)
C      BLP   VERSION 1.1  LEVEL 800212      OUTPUT
      REAL CHIS(NREC)
      COMMON/METO/ZMEAS,WS,WD,ISTAB,TDEGK,DPBL,THETA,S,P,IYR,JDAY,IHOUR
C
C     THIS SUBROUTINE OUTPUTS ALL CHI ARRAYS TO TAPE (OR DISK)
C
C     ICODE IDENTIFIES THE CHI ARRAY TO FOLLOW:
C
C     ICODE = 1 TO 10 IMPLIES THE CHI ARRAY IS THE PARTIAL
C     CONTRIBUTION OF LINE NUMBER "ICODE" AT EACH RECEPTOR
C
C     ICODE = 11 IMPLIES THE CHI ARRAY IS THE PARTIAL
C     CONTRIBUTION OF ALL THE LINES AT EACH RECEPTOR
C
C     ICODE = 101 TO 150 IMPLIES THE CHI ARRAY IS THE PARTIAL
C     CONTRIBUTION OF POINT SOURCE NUMBER "ICODE - 100" AT
C     EACH RECEPTOR
C
C     ICODE = 151 IMPLIES THE CHI ARRAY IS THE PARTIAL
C     CONTRIBUTION OF ALL THE POINT SOURCES AT EACH RECEPTOR
C
C     ICODE = 999 IMPLIES THE CHI ARRAY IS THE TOTAL
C     CONCENTRATION SUMMED OVER ALL THE POINT AND LINE SOURCES AT
C     EACH RECEPTOR
      IDAYHR=JDAY*100+IHOUR
C     ROUND THE WS (NEAREST TENTHS OF M/S) AND
C     THE DPBL (NEAREST METER)
      IWS=(WS+0.05)*10
      IDPBL=DPBL+0.5
      IWD=WD
      ICD=IWS*10000+ISTAB*1000+ICODE
      IMET2=IWD*10000+IDPBL
      WRITE(20)IDAYHR,ICD,IMET2,CHIS
      RETURN
      END
```

```
      SUBROUTINE PTRISE(BUOYFX,ZSTACK,XSMT,DOWNX,WSST,Z,LSHEAR,LTRANS)
C      BLP    VERSION 1.1  LEVEL 800212        PTRISE
      REAL LELEV
      LOGICAL LSHEAR,LTRANS
      COMMON/METD//ZMEAS,WS,WD,ISTAB,TDEGK,DPBL,THETA,S,P,IYR,JDAY,IHOUR
      COMMON/PARM/CRIT,TER1,DECFAC,XBACKG,CONST2,CONST3,MAXIT
C
C     THIS SUBROUTINE CALCULATES POINT SOURCE PLUME RISE
C     WITH AN OPTIONAL VERTICAL WIND SPEED SHEAR CORRECTION FOR
C     BOTH NEUTRAL AND STABLE PLUME RISE
C
C     A VALUE OF 0.6 IS ASSUMED FOR THE ENTRAINMENT
C     PARAMETER (BETA)
C
      X=DOWNX
      IF(.NOT.LSHEAR)GO TO 145
C     CONSTANT 2.777778 = 1./(BETA*BETA) WITH BETA=0.6
      CS=2.777778*BUOYFX
      CS2=ZSTACK**P
      EP=3.*(1.+P)
      P3=3.+P
      TP3=2.*P3
145   CONTINUE
      X=AMIN1(X,XSMT)
      IF(.NOT.LTRANS)X=XSMT
      IF(ISTAB.GT.4)GO TO 150
      IF(.NOT.LSHEAR)GO TO 170
C
C     NEUTRAL-UNSTABLE PLUME RISE WITH SHEAR
C
16    CONTINUE
C     BETA (ENTRAINMENT PARAMETER) IS ASSUMED TO BE 0.6
      A1=CS*X*X/WSST**3
C     CONSTANT 0.8735805 = (2./3.)**(1./3.)
      RMULT=0.8735805*(EP*EP*CS2**3/(TP3*A1**P))**(1./EP)
      RMULT=AMIN1(RMULT,1.0)
      Z=RMULT*(1.5*A1)**0.333333
      IF(ISTAB.LE.4)GO TO 39
      Z=AMIN1(Z,(6./CSV1)**0.333333)
      Z=AMIN1(Z,5.0*BUOYFX**0.25/S**0.375)
39    CONTINUE
      RETURN
C
C     NEUTRAL-UNSTABLE PLUME RISE -- NO SHEAR
C
170   CONTINUE
      Z=1.6*(BUOYFX*X*X)**0.333333/WSST
      IF(ISTAB.GT.4)Z=AMIN1(Z,ZB)
      RETURN
C
C     STABLE PLUME RISE -- NO SHEAR
C
175   CONTINUE
      ZMTT=5.0*BUOYFX**0.25/S**0.375
C     CONST2 HAS A DEFAULT VALUE OF 2.6 (BRIGGS, 1975)
      ZB=CONST2*(BUOYFX/(WSST*S))**0.333333
      ZB=AMIN1(ZB,ZMTT)
      IF(X.LT.XSMT)GO TO 170
      Z=ZB
      RETURN
C
C     STABLE PLUME RISE WITH SHEAR
C
```

```
150   CONTINUE
      IF(.NOT.LSHEAR)GO TO 175
      XPFS=SQRT((TP3*CS2*CS/(WSST*S))**(EP/P3)*TP3*WSST**3/(EP*EP*CS2**3
     1 *CS))
      CSV1=WSST*S/CS
      IF(X.LT.XPFS)GO TO 16
C     CONSTANT 0.5503212 = (1./6.)**(1./3.)
      RMULT=0.5503212*CSV1**(P/(3.*P3))*(TP3*CS2)**(1./P3)
      RMULT=AMIN1(RMULT,1.0)
      Z=RMULT*(6./CSV1)**0.333333
      Z=AMIN1(Z,5.0*BUOYFX**0.25/S**0.375)
      RETURN
      END
      SUBROUTINE CUBIC(A,B,C,Z)
C      BLP   VERSION 1.1  LEVEL 800212      CUBIC
C
C     SOLVES FOR ONE ROOT OF THE CUBIC EQUATION:
C     Z**3 + A*Z**2 + B*Z + C = 0
C
      DATA ONE/1.0/
      A3=A/3.
      AP=B-A*A3
      BP=2.*A3**3-A3*B+C
      AP3=AP/3.
      BP2=BP/2.
      TROOT=BP2*BP2+AP3*AP3*AP3
      IF(TROOT.LE.0.0)GO TO 50
      TR=SQRT(TROOT)
      APP=(-BP2+TR)**0.333333
      BSV=-BP2-TR
      SGN=SIGN(ONE,BSV)
      BPP=SGN*(ABS(BSV))**0.333333
      Z=APP+BPP-A3
      RETURN
50    CM=2.*SQRT(-AP3)
      ALPHA=ARCOS(BP/(AP3*CM))/3.
      Z=CM*COS(ALPHA)-A3
      RETURN
      END
      SUBROUTINE WSC(ISTAB,UM,U,S,P)
C      BLP   VERSION 1.1  LEVEL 800212      WSC
      REAL L
      LOGICAL LSHEAR,LTRANS
      COMMON/PR/L,HB,WB,WM,FPRIME,EP,XMATCH,DX,AVFACT,TWOHB,N,LSHEAR,
     1 LTRANS
C     CALCULATES AN EFFECTIVE U USING THE LINE SOURCE PLUME
C     RISE EQUATION (LINE SOURCE TERM ONLY)
C     MATCHED AT X = XF (FINAL RISE)
      IF(ISTAB.GT.4)GO TO 50
C
C     NEUTRAL (OR UNSTABLE) CONDITIONS
C
      P3=3.*P
      EP=2.+P3
      EPI=1./EP
C     CONSTANT 2.4=4.*BETA WITH BETA=0.6
      T1=(EP*EP*N*FPRIME*HB**P3/(2.4*(2.+P)*L*UM**3))**EPI
      Z=T1*XMATCH**(2.*EPI)
C     CONSTANT 1.2 = 2.*BETA WITH BETA=0.6
      U=(N*FPRIME/(1.2*L)*(XMATCH/Z)**2)**0.333333
      U=AMAX1(U,UM)
      RETURN
50    CONTINUE
```

```
C
C     STABLE CONDITIONS
C
      P2=2.+P
C     CONSTANT 0.6 = BETA
      Z=(P2*HB**P*N*FPRIME/(0.6*L*UM*S))**(1./P2)
C     CONSTANT 3.3333333 = 2./BETA WITH BETA=0.6
      U=3.3333333*N*FPRIME/(L*S*Z*Z)
      U=AMAX1(U,UM)
      RETURN
      END
      SUBROUTINE LENG(THETA,U)
C      BLP   VERSION 1.1  LEVEL 800212     LENG
      REAL L,LEFF,LD,LEFF1,LEFFV
      LOGICAL LSHEAR,LTRANS
      COMMON/PR/L,HB,WB,WM,FPRIME,FP,XMATCH,DX,AVFACT,TWOHB,N,LSHEAR,
     1 LTRANS
      COMMON/PRLS/XFB,LEFF,LD,R0,XFINAL,XFS
      DATA PI/3.1415927/,RAD/0.0174533/
C
C     THIS SUBROUTINE CALCULATES XFB,LEFF,LD,R0
C
C     FPRIME IS THE BUOYANCY FLUX OF ONE LINE; FP IS THE EFFECTIVE
C     BUOYANCY FLUX OF N LINES
      FP=N*FPRIME
      TRAD=THETA*RAD
      SINT=ABS(SIN(TRAD))
      COST=ABS(COS(TRAD))
C     CALCULATE DISTANCE OF FULL BUOYANCY (XFB)
      DXM=DX+WB
      XFB=L*COST+(N-1)*DXM*SINT
C     CALCULATE EFFECTIVE LINE SOURCE LENGTH (LEFF) AND
C     EFFECTIVE DOWNWASH LINE LENGTH (LD)
      LEFF1=L*SINT
      IF(N.EQ.1)GO TO 112
C     CONSTANT 0.8333333 = 1./(2.*BETA) WITH BETA=0.6
      ZI=0.8333333*DXM
C     CONSTANT 2.2619467 = 2.*PI*BETA*BETA WITH BETA=0.6
C     CONSTANT 1.5915494 = 3./(PI*BETA) WITH BETA=0.6
      T1=(2.2619467*U**3/FPRIME)*ZI*ZI*(ZI+1.5915494*WM)
      XI=(T1*L)**0.333333
      IF(XI.LE.L)GO TO 55
      XI=L/2.+SQRT(12.*T1-3.*L*L)/6.
C     CONSTANT 1.2 = 2.*BETA WITH BETA=0.6
C     CONSTANT 0.6283185 = PI*BETA/3. WITH BETA=0.6
      LEFFV=FP*(L*L/3.+XI*(XI-L))/(1.2*U**3*ZI*ZI)-0.6283185*ZI
      GO TO 110
55    CONTINUE
C     CONSTANT 3.6 = 6.*BETA WITH BETA=0.6
C     CONSTANT 0.6283185 = PI*BETA/3. WITH BETA=0.6
      LEFFV=FP/(3.6*L*ZI*ZI)*(XI/U)**3-0.6283185*ZI
110   LEFF=LEFF1+LEFFV*COST
      LD=LEFF*SINT
C     CALCULATE DOWNWASHED EDGE RADIUS
      R0=AMIN1(HB,LD)/AVFACT
      RETURN
C     IF N = 1, NO INTERACTION AT ANY X, I.E.,
C     LEFFV = WM; FP = FPRIME; XFB = L * COST + WM * SINT
112   LEFFV=WM
      FP=FPRIME
      XFB=XFB+WM*SINT
      GO TO 110
      END
```

```
      SUBROUTINE RISE(U,THETA,ISTAB,S)
C      BLP   VERSION 1.1  LEVEL 800212          RISE
      REAL L,LEFF,LD
      LOGICAL LSHEAR,LTRANS
      COMMON/PR/L,HB,WB,WM,FPRIME,FP,XMATCH,DX,AVFACT,TWOHB,N,LSHEAR,
     1 LTRANS
      COMMON/PRLS/XFB,LEFF,LD,R0,XFINAL,XFS
      COMMON/RINTP/XDIST(7),DH(7)
C
C     THIS SUBROUTINE CALCULATES LINE SOURCE PLUME RISE
C     USING AN OPTIONAL VERTICAL WIND SHEAR CORRECTED 'EFFECTIVE' WIND
C     SPEED FOR BOTH NEUTRAL AND STABLE CONDITIONS
C
C     CONSTANT 1.5915494 = 3./(PI*BETA) WITH BETA=0.6
C     CONSTANT 5.0 = 3./BETA WITH BETA=0.6
      A=1.5915494*LEFF+5.*R0
C     CONSTANT 5.3051648 = 6./(PI*BETA*BETA) WITH BETA=0.6
C     CONSTANT 8.3333333 = 3./(BETA*BETA) WITH BETA=0.6
      B=R0*(5.3051648*LD+8.333333*R0)
      DO 1000 I=2,7
      X=XDIST(I)
      IF(ISTAB.LE.4)GO TO 90
C     WITH STABLE CONDITIONS, USE NEUTRAL RISE EQUATION
C     FOR TRANSITIONAL RISE CALCULATIONS, BUT CALCULATE
C     FINAL RISE BASED ON THE FINAL STABLE RISE EQUATION
      IF(X.LT.XFS)GO TO 90
C     CALCULATE FINAL (STABLE) PLUME RISE
C     CONSTANT 5.3051648 = 6./(PI*BETA*BETA) WITH BETA=0.6
92    C=-5.3051648*FP/(U*S)
      GO TO 8
90    CONTINUE
      IF(X.LE.XFB)GO TO 80
7     CONTINUE
C     CONSTANT 1.3262912 = 3./(2.*PI*BETA*BETA) WITH BETA=0.6
      C=-1.3262912*FP*(XFB*XFB/3.+X*X-XFB*X)/U**3
8     CONTINUE
      CALL CUBIC(A,B,C,Z)
12    CONTINUE
      DH(I)=Z
      GO TO 1000
C     CONSTANT 0.4420971 = 1./(2.*PI*BETA*BETA) WITH BETA=0.6
80    C=-0.4420971*(FP/XFB)*(X/U)**3
      GO TO 8
1000  CONTINUE
      RETURN
      END
      SUBROUTINE ZRISE(IL,IS,IR,Z)
C      BLP   VERSION 1.1  LEVEL 800212          ZRISE
      REAL LEFF,LD,LELEV
      COMMON/RCEPT/RXBEG,RYBEG,RXEND,RYEND,RDX,RDY,XRSCS(100),
     1 YRSCS(100),XRRCS(100),YRRCS(100),RELEV(100),NRFC
      COMMON/SOURCE/NLINES,XLBEG(10),XLEND(10),DEL(10),YSCS(10),QT(10),
     1 HS(10),XRCS(10,129),YRCS(10,129),TCOR,LELEV(10),
     2 NPTS,XPSCS(50),YPSCS(50),PQ(50),PHS(50),XPRCS(50),YPRCS(50),
     3 ISTACK(50),APTS(50),BPTS(50),VEXIT(50),PELEV(50),IDOWNW(50)
      COMMON/PRLS/XFB,LEFF,LD,R0,XFINAL,XFS
      COMMON/RINTP/XDIST(7),DH(7)
C
C     Z1 IS THE PLUME HEIGHT OF THE HIGHEST PLUME SEGMENT AT X = XFB
C     (EXCEPT IN THE SPECIAL CASE OF STABLE CONDITIONS WITH
C     THE DISTANCE TO FINAL RISE (XFS) LESS THAN XFB -- IN
C     THAT CASE, Z1 IS THE HEIGHT OF THE HIGHEST PLUME ELEMENT
C     AT X=XFS)
```

```
C     XI IS THE DISTANCE OF THE CURRENT LINE SEGMENT TO XFB
C
      Z1=DH(2)
      XFXFB=XDIST(2)
      XI=XFXFB-XRCS(IL,IS)
      ZXFB=Z1*(1.-(XFXFB-XI)/XFXFB)
C     Z2 IS THE PLUME HEIGHT OF THE HIGHEST SEGMENT AT X
      CALL INTRSE(XRRCS(IR),Z2)
      DELTAZ=Z2-Z1
      Z=ZXFB+DELTAZ
      RETURN
      END
      SUBROUTINE INTRSE(X,Z)
C      BLP   VERSION 1.1  LEVEL 800212     INTRSE
      REAL LEFF,LD
      COMMON/PRLS/XFB,LEFF,LD,R0,XFINAL,XFS
      COMMON/RINTP/XDIST(7),DH(7)
C
C     THIS SUBROUTINE INTERPOLATES THE PLUME RISE OF THE TOP (HIGHEST)
C     PLUME ELEMENT AT ANY DISTANCE X USING THE CALCULATED
C     PLUME RISE AT SEVEN POINTS (XDIST(1-7))
C
      IF (X.GT.XDIST(7))GO TO 55
      DO 10 I=2,6
      IF(X.GT.XDIST(I))GO TO 10
      INDEX=I
      GO TO 11
10    CONTINUE
      INDEX=5
11    CONTINUE
      INDEX1=INDEX-1
      Z=DH(INDEX)-(DH(INDEX)-DH(INDEX1))*(XDIST(INDEX)-X)/
     1 (XDIST(INDEX)-XDIST(INDEX1))
      RETURN
55    CONTINUE
C     PLUME REACHES FINAL RISE
      Z=DH(7)
      RETURN
      END
      SUBROUTINE DBTSIG (X,XY,KST,SY,SZ)
C      BLP   VERSION 1.1  LEVEL 800212     DBTSIG
      DIMENSION XA(7),XB(2),XD(5),XE(8),XF(9),AA(8),BA(8),AB(3),BB(3),
     1 AD(6),BD(6),AE(9),BE(9),AF(10),BF(10)
      DATA XA/.5,.4,.3,.25,.2,.15,.1/
      DATA XB/.4,.2/
      DATA XD /30.,10.,3.,1.,.3/
      DATA XE /40.,20.,10.,4.,2.,1.,.3,.1/
      DATA XF /60.,30.,15.,7.,3.,2.,1.,.7,.2/
      DATA AA /453.85,346.75,258.89,217.41,179.52,170.22,158.08,122.8/
      DATA BA /2.1166,1.7283,1.4094,1.2644,1.1262,1.0932,1.0542,.9447/
      DATA AB /109.30,98.483,90.673/
      DATA BB /1.0971,0.98332,0.93198/
      DATA AD /44.053,36.650,33.504,32.093,32.093,34.459/
      DATA BD /0.51179,0.56589,0.60486,0.64403,0.81066,0.86974/
      DATA AE /47.618,35.420,26.970,24.703,22.534,21.628,21.628,23.331,
     1 24.26/
      DATA BE /0.29592,0.37615,0.46713,0.50527,0.57154,0.63077,0.75660,
     1 0.81956,0.8366/
      DATA AF /34.219,27.074,22.651,17.836,16.187,14.823,13.953,13.953,
     1 14.457,15.209/
      DATA BF /0.21716,0.27436,0.32681,0.41507,0.46490,0.54503,0.63227,
     1 0.68465,0.78407,0.81558/
      GO TO (10,20,30,40,50,60),KST
```

```
C          STABILITY A (10)
   10 TH = (24.167 - 2.5334*ALOG(XY))/57.2958
      IF (X.GT.3.11) GO TO 69
      DO 11 ID = 1,7
      IF(X.GE.XA(ID)) GO TO 12
   11 CONTINUE
      ID = 8
   12 SZ = AA(ID) * X ** BA(ID)
      GO TO 71
C          STABILITY B (20)
   20 TH = (18.333 - 1.8096*ALOG(XY))/57.2958
      IF(X.GT.35.) GO TO 69
      DO 21 ID = 1,2
      IF (X.GE.XB(ID)) GO TO 22
   21 CONTINUE
      ID = 3
   22 SZ = AB(ID) * X ** BB(ID)
      GO TO 70
C          STABILITY C (30)
   30 TH = (12.5 - 1.0857*ALOG(XY))/57.2958
      SZ = 61.141 *X ** 0.91465
      GO TO 70
C          STABILITY D (40)
   40 TH = (8.3333-0.72382*ALOG(XY))/57.2958
      DO 41 ID = 1,5
      IF (X.GE.XD(ID)) GO TO 42
   41 CONTINUE
      ID = 6
   42 SZ = AD(ID) * X ** BD(ID)
      GO TO 70
C          STABILITY E (50)
   50 TH = (6.25 - 0.54287*ALOG(XY))/57.2958
      DO 51 ID = 1,8
      IF (X.GE.XE(ID)) GO TO 52
   51 CONTINUE
      ID = 9
   52 SZ = AE(ID) * X ** BE(ID)
      GO TO 70
C          STABILITY F (60)
   60 TH = (4.1667 - 0.36191*ALOG(XY))/57.2958
      DO 61 ID = 1,9
      IF (X.GE.XF(ID)) GO TO 62
   61 CONTINUE
      ID = 10
   62 SZ = AF(ID) * X ** BF(ID)
      GO TO 70
   69 SZ = 5000.
      GO TO 71
   70 IF (SZ.GT.5000.) SZ = 5000.
   71 SY = 1000. * XY * SIN(TH)/(2.15 * COS(TH))
      RETURN
      END
      SUBROUTINE SIGMAY(XKM,KST,SY)
C      BLP   VERSION 1.1  LEVEL 800212      SIGMAY
C
C     THIS SUBROUTINE CALCULATES SIGMA Y
C
      GO TO (10,20,30,40,50,60),KST
10    TH=(24.167-2.5334*ALOG(XKM))/57.2958
      GO TO 70
20    TH=(18.333-1.8096*ALOG(XKM))/57.2958
      GO TO 70
30    TH=(12.5-1.0857*ALOG(XKM))/57.2958
```

```
      GO TO 70
40    TH=(8.3333-0.72385*ALOG(XKM))/57.2958
      GO TO 70
50    TH=(6.25-0.54287*ALOG(XKM))/57.2958
      GO TO 70
60    TH=(4.1667-0.36191*ALOG(XKM))/57.2958
70    SY=1000.*XKM*SIN(TH)/(2.15*COS(TH))
      RETURN
      END
      FUNCTION XVZ (SZO,KST)
C      BLP    VERSION 1.1  LEVEL 800212      XVZ
      DIMENSION SA(7),SB(2),SD(5),SE(8),SF(9),AA(8),AB(3),AD(6),AE(9),
     * AF(10),CA(8),CB(3),CD(6),CE(9),CF(10)
      DATA SA /13.95,21.40,29.3,37.67,47.44,71.16,104.65/
      DATA SB /20.23,40./
      DATA SD /12.09,32.09,65.12,134.9,251.2/
      DATA SE /3.534,8.698,21.628,33.489,49.767,79.07,109.3,141.86/
      DATA SF /4.093,10.93,13.953,21.627,26.976,40.,54.89,68.84,83.25/
      DATA AA /122.8,158.08,170.22,179.52,217.41,258.89,346.75,453.85/
      DATA AB /90.673,98.483,109.3/
      DATA AD /34.459,32.093,32.093,33.504,36.650,44.053/
      DATA AE /24.26,23.331,21.628,21.628,22.534,24.703,26.97,35.42,
     * 47.618/
      DATA AF /15.209,14.457,13.953,13.953,14.823,16.187,17.836,22.651,
     * 27.074,34.219/
      DATA CA /1.0585,.9486,.9147,.8879,.7909,.7095,.5786,.4725/
      DATA CB /1.073,1.017,.9115/
      DATA CD /1.1498,1.2336,1.5527,1.6533,1.7671,1.9539/
      DATA CE /1.1953,1.2202,1.3217,1.5854,1.7497,1.9791,2.1407,2.6585,
     * 3.3793/
      DATA CF /1.2261,1.2754,1.4606,1.5816,1.8348,2.151,2.4092,3.0599,
     * 3.6448,4.6049/
      GO TO (10,20,30,40,50,60),KST
C        STABILITY A(10)
10    DO 11 ID = 1,7
      IF(SZO.LE.SA(ID)) GO TO 12
11    CONTINUE
      ID = 8
12    XVZ =(SZO/AA(ID))**CA(ID)
      RETURN
C        STABILITY B (20)
20    DO 21 ID = 1,2
      IF (SZO.LE.SB(ID)) GO TO 22
21    CONTINUE
      ID = 3
22    XVZ = (SZO/AB(ID))**CB(ID)
      RETURN
C        STABILITY C (30)
30    XVZ = (SZO/61.141)**1.0933
      RETURN
C        STABILITY D (40)
40    DO 41 ID = 1,5
      IF(SZO.LE.SD(ID)) GO TO 42
41    CONTINUE
      ID = 6
42    XVZ = (SZO/AD(ID))**CD(ID)
      RETURN
C        STABILITY E (50)
50    DO 51 ID = 1,8
      IF (SZO.LE.SE(ID)) GO TO 52
51    CONTINUE
      ID = 9
52    XVZ = (SZO/AE(ID))**CE(ID)
```

```
      RETURN
C         STABILITY F(60)
60    DO 61 ID = 1,9
      IF(SZO.LE.SF(ID)) GO TO 62
61    CONTINUE
      ID = 10
62    XVZ = (SZO/AF(ID))**CF(ID)
      RETURN
      END
      FUNCTION XVY (SYO,KST)
C      BLP   VERSION 1.1  LEVEL 800212       XVY
      GO TO (1,2,3,4,5,6),KST
1     XVY = (SYO/213.)**1.1148
      RETURN
2     XVY = (SYO/155.)**1.097
      RETURN
3     XVY = (SYO/103.)**1.092
      RETURN
4     XVY = (SYO/68.)**1.076
      RETURN
5     XVY = (SYO/50.)**1.086
      RETURN
6     XVY = (SYO/33.5)**1.083
      RETURN
      END
      BLOCK DATA
C      BLP   VERSION 1.1  LEVEL 800212       BLOCK DATA
      REAL L,LELEV
      INTEGER*2 IDAYS
      LOGICAL LSHEAR,LMETIN,LMETOT,LTRANS
      COMMON/PR/L,HB,WB,WM,FPRIME,FP,XMATCH,DX,AVFACT,TWOHB,N,LSHEAR,
     1 LTRANS
      COMMON/METD/ZMEAS,WS,WD,ISTAB,TDEGK,DPBL,THETA,S,P,IYR,JDAY,IHOUR
      COMMON/SOURCE/NLINES,XLBEG(10),XLEND(10),DEL(10),YSCS(10),QT(10),
     1 HS(10),XRCS(10,129),YRCS(10,129),TCOR,LELEV(10),
     2 NPTS,XPSCS(50),YPSCS(50),PQ(50),PHS(50),XPRCS(50),YPRCS(50),
     3 TSTACK(50),APTS(50),BPTS(50),VEXIT(50),PELEV(50),IDOWNW(50)
      COMMON/RCEPT/RXBEG,RYBEG,RXEND,RYEND,RDX,RDY,XRSCS(100),
     1 YRSCS(100),XRRCS(100),YRRCS(100),RELEV(100),NREC
      COMMON/RINTP/XDIST(7),DH(7)
      COMMON/OUTPT/IPCL(11),IPCP(51)
      COMMON/PARM/CRIT,TER1,DECFAC,XBACKG,CONST2,CONST3,MAXIT
      COMMON/MET24/KST(24),SPEED(24),RANDWD(24),HMIX(24),TEMP(24),
     1 DTHTA(2),PEXP(6),IDELS,IDSURF,IYSURF,IDUPER,IYUPER,TERAN(6),
     2 IRU,IHRMAX,LMETIN,LMETOT,IDAYS(366)
      DATA AVFACT/1.0/
      DATA NLINES/0/,NPTS/0/,NREC/0/,TCOR/90.0/
      DATA ZMEAS/7.0/,DTHTA/0.02,0.035/,IDELS/5/,IDAYS/366*0/
      DATA IRU/1/,IHRMAX/24/
      DATA LSHEAR/.TRUE./,LMETIN/.FALSE./,LMETOT/.FALSE./,LTRANS/.TRUE./
      DATA PEXP/0.10,0.15,0.20,0.25,0.30,0.30/
      DATA IYSURF/0/,IYUPER/0/
      DATA CRIT/0.02/,DECFAC/0.0/,XBACKG/0.0/,CONST2/2.6/,CONST3/34.49/,
     1 TERAN/0.5,0.5,0.5,0.5,0.30,0.30/,MAXIT/14/
      DATA IPCL/11*0/,IPCP/51*0/
      DATA RXBEG/0.0/,RYBEG/0.0/,RXEND/0.0/,RYEND/0.0/,RDX/0.0/,RDY/0.0/
      DATA XRSCS/100*0.0/,YRSCS/100*0.0/,RELEV/100*0.0/
      DATA XLBEG/10*0.0/,XLEND/10*0.0/,YSCS/10*0.0/,
     1 HS/10*0.0/,QT/10*0.0/,LELEV/10*0.0/
      DATA XPSCS/50*0.0/,YPSCS/50*0.0/,PHS/50*0.0/,PQ/50*0.0/,
     1 APTS/50*0.0/,TSTACK/50*0.0/,PELEV/50*0.0/,IDOWNW/50*0/
      END
```

APPENDIX B

POSTBLP FORTRAN SOURCE LISTING

```
C
C***********************************************************************
C
C      POSTBLP -- MULTIPLE BUOYANT LINE AND POINT SOURCE
C                 DISPERSION MODEL (BLP) POST-PROCESSOR
C
C      POSTBLP   VERSION 1.1  LEVEL 800702      MAIN
C
C      DEVELOPED BY:
C
C      JOE SCIRE AND LLOYD SCHULMAN
C      ENVIRONMENTAL RESEARCH AND TECHNOLOGY
C      696 VIRGINIA ROAD
C      CONCORD, MASSACHUSETTS  01742
C
C***********************************************************************
C
      REAL CHIS(100),CHI3(100),CHI24(100),CHIANN(100)
      REAL T50C1(50),T5RC1(100,5)
      REAL T50C3(50),T5RC3(100,5)
      REAL T50C24(50),T5RC24(100,5)
      REAL TITLE(20)
      INTEGER I50C1(50),J50C1(50),K50C1(50)
      INTEGER I5RC1(100,5)
      INTEGER I50C3(50),I5RC3(100,5)
      INTEGER I50C24(50),I5RC24(100,5)
      INTEGER IPCL(11),IPCP(51)
      INTEGER KDAY(5),KHR(5)
      INTEGER IDM(12,2),IEM(12)
      INTEGER*2 IDAYS(366),NDYS,IECHO(366)
      INTEGER*2 INTM,INTY,INTM3,INTY3,INTM24,INTY24,IRECEP
      INTEGER*2 ISCODE
      LOGICAL LFRQ1,LFRQ3,LFRQ24
      LOGICAL LECH1,LECH3,LECH24
      LOGICAL LSUM
      LOGICAL LEND/.FALSE./
      LOGICAL LFRQ/.FALSE./,LTRUE/.TRUE./
      EQUIVALENCE (CHILOW,T50C1(50)),(CHIL3,T50C3(50))
      EQUIVALENCE (CHIL24,T50C24(50))
      COMMON/ACODE/IYR,IDAY,IHOUR,ICODE,ISTAB,WS,IWD,IDPBL
      COMMON/BCODE/ICD,IMET2,ICD1,ICD3,IDAYHR
      COMMON/FRDIST/XINT(25),XINT3(25),XINT24(25),NINT,NINT3,NINT24,
     1 INTM(25,12),INTY(25),INTM3(25,12),INTY3(25),INTM24(25,12),
     2 INTY24(25),IRECEP
      COMMON/CHIPRT/NIA,NSUM,ISCODE(62),LSUM,IJCODE
      NAMELIST/OPTS/XINT,XINT3,XINT24,NINT,NINT3,NINT24,
     1 LFRQ1,LFRQ3,LFRQ24,IRECEP,IECHO,LECH1,LECH3,LECH24,
     2 NSUM,ISCODE,LSUM,IJCODE
      DATA T50C1/50*0.0/,T5RC1/500*0.0/
      DATA I50C1/50*0/,J50C1/50*0/,K50C1/50*0/
      DATA T50C3/50*0.0/,T5RC3/500*0.0/
      DATA I50C3/50*0/,I5RC3/500*0/
      DATA T50C24/50*0.0/,T5RC24/500*0.0/
      DATA I50C24/50*0/,I5RC24/500*0/
      DATA CHIANN/100*0.0/,IDANN/0/
      DATA IDM/31,60,91,121,152,182,213,244,274,305,335,366,
     1 31,59,90,120,151,181,212,243,273,304,334,365/
      DATA IECHO/366*0/,IEM/12*0/
      DATA LFRQ1/.FALSE./,LFRQ3/.FALSE./,LFRQ24/.FALSE./
      DATA LECH1/.FALSE./,LECH3/.FALSE./,LECH24/.FALSE./
      DATA ALPYES/'YES'/,ALP1/'NO'/,ALP2/'NO'/,ALP3/'NO'/
      DATA ALP4/'NO'/,ALP5/'NO'/,ALP6/'NO'/
      DATA ALPAR/'('/
```

```
C
C      IDENTIFY VERSION AND LEVEL NUMBERS OF BLP POSTPROCESSOR
C
      VERSON=1.1
      LEVEL=800702
      WRITE(6,1400)VERSON,LEVEL
 1400 FORMAT('1',40X,'BLP POSTPROCESSOR   VERSION ',F4.1,3X,'LEVEL ',I6/
     1 '0',13('**********'))
C
C      READ BLP POSTPROCESSOR USER INPUTS
C
      READ(5,OPTS)
      WRITE(6,1402)
 1402 FORMAT(///)
      WRITE(6,OPTS)
      WRITE(6,1400)VERSON,LEVEL
C
C      READ TITLE CARD AND OTHER GENERAL INFORMATION
C      ON RECORD #1 OF THE OUTPUT FILE (20)
C
      READ(20)TITLE,NREC,NPTS,NLINES,IPCL,IPCP,IYR,IDAYS
      WRITE(6,8)TITLE,IYR
    8 FORMAT(/'0',20A4,5X,'YEAR: ',I2)
C      ILEAP = 1 (LEAP YEAR); ILEAP = 2 (NON-LEAP YEAR)
      ILEAP=2
      IF(MOD(IYR,4).EQ.0)ILEAP=1
      NPH=MIN0(NREC,50)
      NR2=NREC/2
      NPL=0
      DO 121 I=1,11
  121 NPL=NPL+IPCL(I)
      NPP=0
      DO 122 I=1,51
  122 NPP=NPP+IPCP(I)
C      NTA IS THE NUMBER OF RECORDS FOR EACH HOUR
      NTA=1+NPL+NPP
      NDYS=0
      DO 135 I=1,366
  135 NDYS=NDYS+IDAYS(I)
      WRITE(6,136)NDYS,IDAYS
  136 FORMAT(//'0','TOTAL NUMBER OF DAYS INCLUDED IN THIS RUN: ',I3//
     1 1X,'(0=NOT INCLUDED; 1=INCLUDED)'//
     2 3('0',10(10I1,3X)/),'0',6(10I1,3X),6I1)
      NT=NPTS+NLINES
      WRITE(6,112)NT,NLINES,NPTS,NREC
  112 FORMAT(//'0','TOTAL NUMBER OF SOURCES: ',I3//12X,'LINE SOURCES: ',
     1I3/11X,'POINT SOURCES: ',I3///1X,'TOTAL NUMBER OF RECEPTORS: ',I3)
      IF(NLINES.LE.0)GO TO 57
      WRITE(6,212)
  212 FORMAT(//'0','SOURCE CONTRIBUTIONS FROM THE FOLLOWING LINE ',
     1 'SOURCES ARE AVAILABLE: '/'0','(0=NOT AVAILABLE; 1=AVAILABLE)'/
     2 '0','LINE SOURCE NUMBER',5X,'AVAILABILITY')
      DO 219 I=1,NLINES
      WRITE(6,215)I,IPCL(I)
  215 FORMAT('0',7X,I2,19X,I1)
  219 CONTINUE
      WRITE(6,216)NLINES,IPCL(11)
  216 FORMAT('0',5X,'1 - ',I2,17X,I1)
   57 CONTINUE
      IF(NPTS.LE.0)GO TO 58
      WRITE(6,1400)VERSON,LEVEL
      WRITE(6,222)
  222 FORMAT(//'0','SOURCE CONTRIBUTIONS FROM THE FOLLOWING ',
```

```
     1 'POINT SOURCES ARE AVAILABLE: '/'0','(0=NOT AVAILABLE; ',
     2 '1=AVAILABLE)'/'0','POINT SOURCE NUMBER',5X,'AVAILABILITY')
      DO 239 I=1,NPTS
      WRITE(6,235)I,IPCP(I)
235   FORMAT('0',8X,I2,19X,I1)
239   CONTINUE
      WRITE(6,236)NPTS,IPCP(51)
236   FORMAT('0',6X,'1 - ',I2,17X,I1)
58    CONTINUE
      WRITE(6,1400)VERSON,LEVEL
      IF(.NOT.LSUM)WRITE(6,2000)IJCODE
2000  FORMAT(//'0',9X,'IJCODE = ',I3)
      IF(.NOT.LSUM)WRITE(6,2001)
2001  FORMAT('0','(IJCODE SPECIFIES THE BLP CONCENTRATION ',
     1 'OUTPUT DATA USED IN THIS RUN OF POSTBLP.'/2X,'THE ',
     1 'CONCENTRATION DATA ASSOCIATED WITH IJCODE IS AS FOLLOWS: '/
     2 '0',9X,'IJCODE',
     2 18X,'CONCENTRATION DATA'/'0',10X,'1-10',5X,'SOURCE CONTRIBUTION '
     3,'- LINE SOURCE NUMBER "IJCODE"'/12X,'11',6X,'SOURCE ',
     4 'CONTRIBUTION - ALL LINE SOURCES'/10X,'101-150',3X,'SOURCE ',
     5 'CONTRIBUTION - POINT SOURCE NUMBER "IJCODE - 100"'/
     6 11X,'151',6X,'SOURCE CONTRIBUTION - ALL POINT SOURCES'/
     7 11X,'999',6X,'TOTAL CONCENTRATION)')
      IF(LSUM)WRITE(6,2012)NSUM,(ALPAR,NXX,ISCODE(NXX),NXX=1,NSUM)
2012  FORMAT(//'0','THE BLP CONCENTRATION DATA USED IN THIS RUN OF ',
     1 'POSTBLP IS THE SUM OF THE FOLLOWING ',I3,' SETS'/2X,'OF ',
     2 'SOURCE CONTRIBUTION DATA: '/'0','ISCODE = ',
     3 9(A1,I1,')',I3,3X),6(/9X,10(A1,I2,')',I3,2X)))
      IF(LSUM)WRITE(6,2013)
2013  FORMAT(/9X,'WHERE THE CONCENTRATION DATA ASSOCIATED WITH EACH ',
     1 'ISCODE IS IDENTIFIED AS FOLLOWS: '/'0',9X,'ISCODE',
     2 18X,'CONCENTRATION DATA'/'0',10X,'1-10',5X,'SOURCE CONTRIBUTION '
     3,'- LINE SOURCE NUMBER "ISCODE"'/12X,'11',6X,'SOURCE ',
     4 'CONTRIBUTION - ALL LINE SOURCES'/10X,'101-150',3X,'SOURCE ',
     5 'CONTRIBUTION - POINT SOURCE NUMBER "ISCODE - 100"'/
     6 11X,'151',6X,'SOURCE CONTRIBUTION - ALL POINT SOURCES'/
     7 11X,'999',6X,'TOTAL CONCENTRATION)')
      IF(LFRQ1)ALP1=ALPYES
      IF(LFRQ3)ALP2=ALPYES
      IF(LFRQ24)ALP3=ALPYES
      WRITE(6,2005)ALP1,ALP2,ALP3
2005  FORMAT(////'0','FREQUENCY DISTRIBUTIONS REQUESTED IN THIS',
     1 ' POSTBLP RUN: '/'0',4X,'1-HOUR AVERAGES ? ',A3/5X,
     2 '3-HOUR AVERAGES ? ',A3/4X,'24-HOUR AVERAGES ? ',A3)
      IF(LFRQ1.OR.LFRQ3.OR.LFRQ24)LFRQ=LTRUE
      IF(LFRQ)WRITE(6,2010)IRECEP
2010  FORMAT('0','FREQUENCY DISTRIBUTION(S) FOR RECEPTOR NUMBER ',
     1 I3)
      WRITE(6,1400)VERSON,LEVEL
      IF(LECH1)ALP4=ALPYES
      IF(LECH3)ALP5=ALPYES
      IF(LECH24)ALP6=ALPYES
      WRITE(6,2015)IECHO
2015  FORMAT(//'0','CONCENTRATIONS AT EACH RECEPTOR ARE PRINTED ',
     1 'FOR THE FOLLOWING DAYS: '/'0','(0=NOT PRINTED; 1=PRINTED)'
     2 //3('0',10(10I1,3X)/),'0',6(10I1,3X),6I1)
      WRITE(6,2016)ALP4,ALP5,ALP6
2016  FORMAT(/'0','AND FOR THE FOLLOWING AVERAGING TIMES: '/
     1 '0',4X,'1-HOUR AVERAGES ? ',A3/5X,'3-HOUR AVERAGES ? ',A3/
     2 4X,'24-HOUR AVERAGES ? ',A3)
      IMOLST=1
      IMO=1
      DO 1000 JDAY=1,366
```

```
      IF(IDAYS(JDAY).NE.1)GO TO 1000
      IF(JDAY.LE.IDM(IMOLST,ILEAP))GO TO 285
      IMOLST=IMOLST+1
      DO 282 IJ=IMOLST,12
      IF(JDAY.LE.IDM(IMOLST,ILEAP))GO TO 283
      IMOLST=IMOLST+1
282   CONTINUE
283   IMO=IMOLST
285   CONTINUE
      IFM(IMO)=1
      MPERID=0
      DO 900 JHR=1,24
      CALL GETDAT(NREC,CHIS,LEND)
      IF(LEND)GO TO 1001
C
C     ONE HOUR AVERAGES
C
      IF(LFRQ1)CALL FREQ(CHIS,IMO,1)
      IF(LECH1.AND.IECHO(JDAY).EQ.1)CALL OUTDAT(CHIS,IYR,IDAY,JHR,1,
     1 NREC,NR2)
C
C     FIND THE TOP 50 ONE HOUR CONCENTRATIONS
C
      DO 310 J=1,NREC
C     CHILOW HAS BEEN EQUIVALENCED TO T50C1(50)
      IF(CHIS(J).LE.CHILOW)GO TO 310
      CHIV=CHIS(J)
      ICD2=ICD1*1000+J
C     T50C1 IS THE ARRAY OF THE TOP 50 HOURLY CONCENTRATIONS
C     I50C1 IS A CORRESPONDING ARRAY CONTAINING THE WS, STAB., AND
C     RECEPTOR NUMBER
C     J50C1 IS ANOTHER ARRAY CONTAINING THE WIND DIR. AND OPRL
C     INSERT THE NEW VALUE IN THE ARRAY OF TOP 50 VALUES (T50C1) AND
C     INCREMENT THE APPROPRIATE PORTION OF THE ARRAY UP BY ONE
C     DO THE SAME FOR THE ARRAYS I50C1 AND J50C1
      IP=24
      MAG=24
      DO 350 I=1,3
      MAG=MAG/2
      ISGN=1
      IF(CHIV.GT.T50C1(IP))ISGN=-1
      IP=IP+ISGN*MAG
350   CONTINUE
      IL=IP-2
      IH=IP+3
      DO 360 I=IL,IH
      IF(CHIV.LT.T50C1(I))GO TO 360
      IRPLAC=I
      GO TO 361
360   CONTINUE
      IRPLAC=50
      IF(CHIV.GE.T50C1(49))IRPLAC=49
361   CONTINUE
      INDEX=50-IRPLAC
      IF(INDEX.EQ.0)GO TO 375
      DO 370 I=1,INDEX
      II=50-I
      T50C1(II+1)=T50C1(II)
      I50C1(II+1)=I50C1(II)
      J50C1(II+1)=J50C1(II)
      K50C1(II+1)=K50C1(II)
370   CONTINUE
375   CONTINUE
```

```
      T50C1(IRPLAC)=CHIV
      I50C1(IRPLAC)=ICD2
      J50C1(IRPLAC)=IMET2
      K50C1(IRPLAC)=IDAYHR
310   CONTINUE
C
C     FIND THE 5 HIGHEST HOURLY CONCENTRATIONS AT EACH RECEPTOR
C
      DO 410 J=1,NREC
      IF(CHIS(J).LE.T5RC1(J,5))GO TO 410
      CHIV=CHIS(J)
      DO 415 I=1,4
      IF(CHIV.LT.T5RC1(J,I))GO TO 415
      IRPLAC=I
      GO TO 420
415   CONTINUE
      IRPLAC=5
420   CONTINUE
      INDEX=5-IRPLAC
      IF(INDEX.EQ.0)GO TO 435
      DO 430 I=1,INDEX
      II=5-I
      T5RC1(J,II+1)=T5RC1(J,II)
      I5RC1(J,II+1)=I5RC1(J,II)
430   CONTINUE
435   CONTINUE
      T5RC1(J,IRPLAC)=CHIV
      I5RC1(J,IRPLAC)=IDAYHR
410   CONTINUE
C
C     3-HOUR AVERAGES
C
      IF(MOD(JHR,3).EQ.1)GO TO 502
      DO 501 NR=1,NREC
501   CHI3(NR)=CHI3(NR)+CHIS(NR)
      GO TO 504
502   CONTINUE
      MPERID=MPERID+1
      DO 503 NR=1,NREC
503   CHI3(NR)=CHIS(NR)
      GO TO 599
504   CONTINUE
      IF(MOD(JHR,3).NE.0)GO TO 599
      DO 505 NR=1,NREC
505   CHI3(NR)=CHI3(NR)/3.
      ICD4=IDAY*10+MPERID
      IF(LFRQ3)CALL FREQ(CHI3,IMO,3)
      IF(LECH3.AND.IECHO(JDAY).EQ.1)CALL OUTDAT(CHI3,IYR,IDAY,MPERID,3,
     1 NREC,NP2)
C
C     FIND THE TOP 50 3-HOUR AVERAGE CONCENTRATIONS
C
      DO 510 J=1,NREC
C     CHIL3 HAS BEEN EQUIVALENCED TO T50C3(50)
      IF(CHI3(J).LE.CHIL3)GO TO 510
      CHIV=CHI3(J)
      IPDATE=ICD4*1000+J
      IP=24
      MAG=24
      DO 550 I=1,3
      MAG=MAG/2
      ISGN=1
      IF(CHIV.GT.T50C3(IP))ISGN=-1
```

```
      IP=IP+ISGN*MAG
550   CONTINUE
      IL=IP-2
      IH=IP+3
      DO 560 I=IL,IH
      IF(CHIV.LT.T50C3(I))GO TO 560
      IRPLAC=I
      GO TO 561
560   CONTINUE
      IRPLAC=50
      IF(CHIV.GE.T50C3(49))IRPLAC=49
561   CONTINUE
      INDEX=50-IRPLAC
      IF(INDEX.EQ.0)GO TO 575
      DO 570 I=1,INDEX
      II=50-I
      T50C3(II+1)=T50C3(II)
      I50C3(II+1)=I50C3(II)
570   CONTINUE
575   CONTINUE
      T50C3(IRPLAC)=CHIV
      I50C3(IRPLAC)=IPDATE
510   CONTINUE
C
C     FIND THE 5 HIGHEST 3-HOUR AVERAGE CONCENTRATIONS AT EACH RECEPTOR
C
      DO 590 J=1,NREC
      IF(CHI3(J).LE.T5RC3(J,5))GO TO 590
      CHIV=CHI3(J)
      DO 515 I=1,4
      IF(CHIV.LT.T5RC3(J,I))GO TO 515
      IRPLAC=I
      GO TO 520
515   CONTINUE
      IRPLAC=5
520   CONTINUE
      INDEX=5-IRPLAC
      IF(INDEX.EQ.0)GO TO 535
      DO 530 I=1,INDEX
      II=5-I
      T5RC3(J,II+1)=T5RC3(J,II)
      I5RC3(J,II+1)=I5RC3(J,II)
530   CONTINUE
535   CONTINUE
      T5RC3(J,IRPLAC)=CHIV
      I5RC3(J,IRPLAC)=ICD4
590   CONTINUE
599   CONTINUE
C
C     24-HOUR AVERAGES
C
      IF(JHR.NE.1)GO TO 605
      DO 602 NR=1,NREC
602   CHI24(NR)=CHIS(NR)
      GO TO 699
605   CONTINUE
      DO 604 NR=1,NREC
604   CHI24(NR)=CHI24(NR)+CHIS(NR)
      IF(JHR.NE.24)GO TO 699
      DO 606 NR=1,NREC
606   CHI24(NR)=CHI24(NR)/24.
      IF(LFRQ24)CALL FREQ(CHI24,IMO,24)
      IF(LECH24.AND.IECHO(JDAY).EQ.1)CALL OUTDAT(CHI24,IYR,IDAY,0,24,
```

```
     1 NREC,NR2)
C
C     FIND THE TOP 50 24-HOUR AVERAGE CONCENTRATIONS
C
      DO 610 J=1,NREC
C     CHIL24 HAS BEEN EQUIVALENCED TO T50C24(50)
      IF(CHI24(J).LE.CHIL24)GO TO 610
      CHIV=CHI24(J)
      IPDAY=IDAY*1000+J
      IP=24
      MAG=24
      DO 650 I=1,3
      MAG=MAG/2
      ISGN=1
      IF(CHIV.GT.T50C24(IP))ISGN=-1
      IP=IP+ISGN*MAG
  650 CONTINUE
      IL=IP-2
      IH=IP+3
      DO 660 I=IL,IH
      IF(CHIV.LT.T50C24(I))GO TO 660
      IRPLAC=I
      GO TO 651
  660 CONTINUE
      IRPLAC=50
      IF(CHIV.GE.T50C24(49))IRPLAC=49
  651 CONTINUE
      INDEX=50-IRPLAC
      IF(INDEX.EQ.0)GO TO 675
      DO 670 I=1,INDEX
      II=50-I
      T50C24(II+1)=T50C24(II)
      I50C24(II+1)=I50C24(II)
  670 CONTINUE
  675 CONTINUE
      T50C24(IRPLAC)=CHIV
      I50C24(IRPLAC)=IPDAY
  610 CONTINUE
C
C     FIND THE 5 HIGHEST 24-HOUR AVERAGE CONCENTRATIONS AT EACH RECEPTOR
C
      DO 690 J=1,NREC
      IF(CHI24(J).LE.T5RC24(J,5))GO TO 690
      CHIV=CHI24(J)
      DO 615 I=1,4
      IF(CHIV.LT.T5RC24(J,I))GO TO 615
      IRPLAC=I
      GO TO 620
  615 CONTINUE
      IRPLAC=5
  620 CONTINUE
      INDEX=5-IRPLAC
      IF(INDEX.EQ.0)GO TO 635
      DO 630 I=1,INDEX
      II=5-I
      T5RC24(J,II+1)=T5RC24(J,II)
      I5RC24(J,II+1)=I5RC24(J,II)
  630 CONTINUE
  635 CONTINUE
      T5RC24(J,IRPLAC)=CHIV
      I5RC24(J,IRPLAC)=IDAY
  690 CONTINUE
  699 CONTINUE
```

```
C
C     ANNUAL AVERAGES
C
      DO 705 J=1,NREC
705   CHIANN(J)=CHIANN(J)+CHIS(J)
      IDANN=IDANN+1
900   CONTINUE
1000  CONTINUE
1001  CONTINUE
C
C     WRITE THE ANNUAL AVERAGE CONCENTRATIONS AT EACH RECEPTOR
C
      XHRS=IDANN
      XDAYS=XHRS/24.
      WRITE(6,1020)XDAYS,IDANN
1020  FORMAT('1',35X,F5.1,' DAY (',I4,' HR) AVERAGE CONCENTRATIONS ',
     1 'AT EACH RECEPTOR')
      IF(NREC.EQ.1)GO TO 1030
      WRITE(6,1021)XDAYS,XDAYS
1021  FORMAT(/'0',14X,'RECEPTOR',5X,F5.1,' DAY AVERAGE CONCENTRATION',
     1 15X,'RECEPTOR',5X,F5.1,' DAY AVERAGE CONCENTRATION'/
     2 39X,'(UG/M**3)',50X,'(UG/M**3)')
      DO 1025 I=1,NR2
      I2=NR2+I
      CHI1=CHIANN(I)/XHRS
      CHI2=CHIANN(I2)/XHRS
      WRITE(6,1024)I,CHI1,I2,CHI2
1024  FORMAT(17X,I3,18X,F9.1,29X,I3,18X,F9.1)
1025  CONTINUE
      IF(MOD(NREC,2).EQ.0)GO TO 1040
      WRITE(6,1026)NREC,CHIANN(NREC)
1026  FORMAT(76X,I3,18X,F9.1)
      GO TO 1040
1030  CONTINUE
      WRITE(6,1031)XDAYS
1031  FORMAT(/'0',44X,'RECEPTOR',5X,F5.1,' DAY AVERAGE ',
     1 'CONCENTRATION'/69X,'(UG/M**3)')
      CHI1=CHIANN(1)/XHRS
      WRITE(6,1046)NREC,CHI1
1046  FORMAT(47X,I3,18X,F9.1)
1040  CONTINUE
C
C     WRITE THE TOP 5 1-HOUR AVERAGE CONCENTRATIONS AT EACH RECEPTOR
C
      WRITE(6,1120)
1120  FORMAT('1',38X,'5 HIGHEST 1-HOUR AVERAGE CONCENTRATIONS AT ',
     1 'EACH RECEPTOR'/'0',16X,'RECEPTOR',5X,'HIGHEST',15X,
     2 '2ND HIGHEST',10X,'3RD HIGHEST',10X,'4TH HIGHEST',10X,
     3 '5TH HIGHEST'/
     4 29X,'(UG/M**3)',15X,3('(UG/M**3)',12X),'(UG/M**3)')
      DO 1126 I=1,NPH
      DO 1124 NN=1,5
      JDAYHR=I5RC1(I,NN)
      KDAY(NN)=JDAYHR/100
      KHR(NN)=JDAYHR-KDAY(NN)*100
1124  CONTINUE
      WRITE(6,1125)I,(TSRC1(I,N),KDAY(N),KHR(N),N=1,5)
1125  FORMAT(19X,I3,4X,5(F9.1,1X,'(',I3,',',I2,')',3X))
1126  CONTINUE
      IF(NREC.LE.50)GO TO 1140
      WRITE(6,1120)
      DO 1136 I=51,NREC
      DO 1134 NN=1,5
```

```
      JDAYHR=ISRC1(I,NN)
      KDAY(NN)=JDAYHR/100
      KHR(NN)=JDAYHR-KDAY(NN)*100
 1134 CONTINUE
      WRITE(6,1125)I,(ISRC1(I,N),KDAY(N),KHR(N),N=1,5)
 1136 CONTINUE
 1140 CONTINUE
C
C     WRITE THE TOP 5 3-HOUR AVERAGE CONCENTRATIONS AT EACH RECEPTOR
C
      WRITE(6,1220)
 1220 FORMAT('1',38X,'5 HIGHEST 3-HOUR AVERAGE CONCENTRATIONS AT ',
     1 'EACH RECEPTOR'/'0',16X,'RECEPTOR',5X,'HIGHEST',14X,
     2 '2ND HIGHEST',9X,'3RD HIGHEST',9X,'4TH HIGHEST',9X,'5TH HIGHEST'/
     3 29X,'(UG/M**3)',14X,3('(UG/M**3)',11X),'(UG/M**3)')
      DO 1226 I=1,NPH
      DO 1224 NN=1,5
      JPDATE=ISRC3(I,NN)
      KDAY(NN)=JPDATE/10
C     MPERID IS STORED IN THE KHR ARRAY
      KHR(NN)=JPDATE-KDAY(NN)*10
 1224 CONTINUE
      WRITE(6,1225)I,(TSRC3(I,N),KDAY(N),KHR(N),N=1,5)
 1225 FORMAT(19X,I3,4X,5(F9.1,1X,'(',I3,',',I1,')',3X))
 1226 CONTINUE
      IF(NREC.LE.50)GO TO 1240
      WRITE(6,1220)
      DO 1236 I=51,NREC
      DO 1234 NN=1,5
      JPDATE=ISRC3(I,NN)
      KDAY(NN)=JPDATE/10
      KHR(NN)=JPDATE-KDAY(NN)*10
 1234 CONTINUE
      WRITE(6,1225)I,(TSRC3(I,N),KDAY(N),KHR(N),N=1,5)
 1236 CONTINUE
 1240 CONTINUE
C
C     WRITE THE TOP 5 24-HOUR AVERAGE CONCENTRATIONS AT EACH RECEPTOR
C
      WRITE(6,1320)
 1320 FORMAT('1',37X,'5 HIGHEST 24-HOUR AVERAGE CONCENTRATIONS AT ',
     1 'EACH RECEPTOR'/'0',16X,'RECEPTOR',5X,'HIGHEST',14X,
     2 '2ND HIGHEST',9X,'3RD HIGHEST',9X,'4TH HIGHEST',9X,'5TH HIGHEST'/
     3 29X,'(UG/M**3)',14X,3('(UG/M**3)',11X),'(UG/M**3)')
      DO 1326 I=1,NPH
      WRITE(6,1325)I,(TSRC24(I,N),ISRC24(I,N),N=1,5)
 1325 FORMAT(19X,I3,4X,5(F9.1,1X,'(',I3,')',5X))
 1326 CONTINUE
      IF(NREC.LE.50)GO TO 1340
      WRITE(6,1320)
      DO 1336 I=51,NREC
      WRITE(6,1325)I,(TSRC24(I,N),ISRC24(I,N),N=1,5)
 1336 CONTINUE
 1340 CONTINUE
C
C     WRITE THE TOP 50 1-HOUR CONCENTRATIONS
C
      WRITE(6,1100)
 1100 FORMAT('1',40X,'TOP 50 1-HOUR AVERAGE CONCENTRATIONS')
      WRITE(6,1101)
 1101 FORMAT(/'0',10X,'DAY',3X,'HOUR',3X,'WIND SPEED',3X,'WIND DIRECTION
     1',3X,'STABILITY',3X,'MIXING HEIGHT',3X,'RECEPTOR',4X,'1-HOUR ',
     2 'CONCENTRATION'/26X,'(M/S)',9X,'(DEGREES)',19X,'(METERS)',
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     3 22X,'(UG/M**3)')
      DO 1110 I=1,50
      JCD2=I50C1(I)
      JMET2=J50C1(I)
      JDAYHR=K50C1(I)
      JWS=JCD2/10000
      JSTAB=JCD2/1000-10*JWS
      JRECEP=JCD2-JSTAB*1000-JWS*10000
      XWS=FLOAT(JWS)/10.
      JWD=JMET2/10000
      JDPBL=JMET2-10000*JWD
      JDAY=JDAYHR/100
      JHR=JDAYHR-JDAY*100
      WRITE(6,1105)JDAY,JHR,XWS,JWD,JSTAB,JDPBL,JRECEP,I50C1(I)
 1105 FORMAT(11X,I3,4X,I2,6X,F4.1,13X,I3,12X,I1,10X,I5,10X,I3,10X,F9.1)
 1110 CONTINUE
C
C     WRITE THE TOP 50 3-HOUR CONCENTRATIONS
C
      WRITE(6,1200)
 1200 FORMAT('1',48X,'TOP 50 3-HOUR AVERAGE CONCENTRATIONS')
      WRITE(6,1201)
 1201 FORMAT(/'0',40X,'DAY',3X,'TIME PERIOD',3X,'RECEPTOR',3X,
     1 '3-HOUR CONCENTRATION'/75X,'(UG/M**3)')
      DO 1210 I=1,50
      JPDATE=I50C3(I)
      JDAY=JPDATE/10000
      JTIME=JPDATE/1000-JDAY*10
      JRECEP=JPDATE-JDAY*10000-JTIME*1000
      WRITE(6,1215)JDAY,JTIME,JRECEP,I50C3(I)
 1215 FORMAT(41X,I3,8X,I1,10X,I3,8X,F9.1)
 1210 CONTINUE
C
C     WRITE THE TOP 50 24-HOUR CONCENTRATIONS
C
      WRITE(6,1300)
 1300 FORMAT('1',41X,'TOP 50 24-HOUR AVERAGE CONCENTRATIONS')
      WRITE(6,1301)
 1301 FORMAT(/'0',40X,'DAY',3X,'RECEPTOR',3X,'24-HOUR ',
     1 'CONCENTRATION'/63X,'(UG/M**3)')
      DO 1310 I=1,50
      JPDAY=I50C24(I)
      JDAY=JPDAY/1000
      JRECEP=JPDAY-JDAY*1000
      WRITE(6,1315)JDAY,JRECEP,I50C24(I)
 1315 FORMAT(41X,I3,5X,I3,8X,F9.1)
 1310 CONTINUE
C
C     WRITE THE MONTHLY FREQUENCY DISTRIBUTIONS
C
      IF(.NOT.LFRQ1)GO TO 1491
C     WRITE THE MONTHLY SUMMARIES FOR THE 1-HOUR AVERAGES
      DO 1490 IJ=1,12
      IF(IFM(IJ).NE.1)GO TO 1490
      WRITE(6,1480)IRECEP,IJ
 1480 FORMAT('1',15X,'RECEPTOR: ',I3,6X,'FREQUENCY DISTRIBUTION FOR ',
     1 'MONTH: ',I2,6X,
     1 '1-HOUR AVERAGE CONCENTRATIONS (UG/M**3)'///
     2 '0',24X,'INTERVAL NO.',38X,'HOURS',5X,'PERCENT',5X,'CUMULATIVE')
      IF(IJ.EQ.1)GO TO 1420
      XHRM=24.*(IDM(IJ,ILEAP)-IDM(IJ-1,ILEAP))
      GO TO 1425
 1420 XHRM=744.
```

```
1425  CONTINUE
      CALL FROOUT(NINT,IJ,XHRM,INTM,XINT)
1490  CONTINUE
1491  CONTINUE
      IF(.NOT.LFRQ3)GO TO 1591
C     WRITE THE MONTHLY SUMMARIES FOR THE 3-HOUR AVERAGES
      DO 1590 IJ=1,12
      IF(IFM(IJ).NE.1)GO TO 1590
      WRITE(6,1580)IRECEP,IJ
1580  FORMAT('1',15X,'RECEPTOR: ',I3,6X,'FREQUENCY DISTRIBUTION FOR ',
     1 'MONTH: ',I2,6X,
     1 '3-HOUR AVERAGE CONCENTRATIONS (UG/M**3)'///
     2'0',24X,'INTERVAL NO.',37X,'PERIODS',4X,'PERCENT',5X,'CUMULATIVE')
      IF(IJ.EQ.1)GO TO 1520
      XHRM=8.*(IDM(IJ,ILEAP)-IDM(IJ-1,ILEAP))
      GO TO 1525
1520  XHRM=248.
1525  CONTINUE
      CALL FROOUT(NINT3,IJ,XHRM,INTM3,XINT3)
1590  CONTINUE
1591  CONTINUE
C     WRITE THE MONTHLY SUMMARIES FOR THE 24-HOUR AVERAGES
      IF(.NOT.LFRQ24)GO TO 1691
C     WRITE THE MONTHLY SUMMARIES FOR THE 24-HOUR AVERAGES
      DO 1690 IJ=1,12
      IF(IFM(IJ).NE.1)GO TO 1690
      WRITE(6,1680)IRECEP,IJ
1680  FORMAT('1',15X,'RECEPTOR: ',I3,6X,'FREQUENCY DISTRIBUTION FOR ',
     1 'MONTH: ',I2,6X,
     1 '24-HOUR AVERAGE CONCENTRATIONS (UG/M**3)'///
     2 '0',24X,'INTERVAL NO.',39X,'DAYS',5X,'PERCENT',5X,'CUMULATIVE')
      IF(IJ.EQ.1)GO TO 1620
      XHRM=IDM(IJ,ILEAP)-IDM(IJ-1,ILEAP)
      GO TO 1625
1620  XHRM=31.
1625  CONTINUE
      CALL FROOUT(NINT24,IJ,XHRM,INTM24,XINT24)
1690  CONTINUE
1691  CONTINUE
C
C     WRITE THE ANNUAL FREQUENCY DISTRIBUTIONS
C
      XHRSY=8760.
      IF(ILEAP.EQ.1)XHRSY=8784.
      IF(.NOT.LFRQ1)GO TO 1791
C     WRITE THE ANNUAL SUMMARY FOR THE 1-HOUR AVERAGES
      WRITE(6,1780)IRECEP,IYR
1780  FORMAT('1',15X,'RECEPTOR: ',I3,6X,'FREQUENCY DISTRIBUTION FOR ',
     1 'YEAR: ',I2,6X,
     1 '1-HOUR AVERAGE CONCENTRATIONS (UG/M**3)'///
     2 '0',24X,'INTERVAL NO.',38X,'HOURS',5X,'PERCENT',5X,'CUMULATIVE')
      CALL FROOUT(NINT,1,XHRSY,INTY,XINT)
1791  CONTINUE
      IF(.NOT.LFRQ3)GO TO 1891
C     WRITE THE ANNUAL SUMMARY FOR THE 3-HOUR AVERAGES
      WRITE(6,1880)IRECEP,IYR
1880  FORMAT('1',15X,'RECEPTOR: ',I3,6X,'FREQUENCY DISTRIBUTION FOR ',
     1 'YEAR: ',I2,6X,
     1 '3-HOUR AVERAGE CONCENTRATIONS (UG/M**3)'///
     2'0',24X,'INTERVAL NO.',37X,'PERIODS',4X,'PERCENT',5X,'CUMULATIVE')
      X3=XHRSY/3.
      CALL FROOUT(NINT3,1,X3,INTY3,XINT3)
1891  CONTINUE
```

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      IF(.NOT.LFRQ24)GO TO 1991
C     WRITE THE ANNUAL SUMMARY FOR THE 24-HOUR AVERAGES
      WRITE(6,1980)IRECFP,IYR
1980  FORMAT('1',15X,'RECEPTOR: ',I3,6X,'FREQUENCY DISTRIBUTION FOR ',
     1 'YEAR: ',I2,6X,
     1 '24-HOUR AVERAGE CONCENTRATIONS (UG/M**3)'///
     2 '0',24X,'INTERVAL NO.',39X,'DAYS',5X,'PERCENT',5X,'CUMULATIVE')
      X24=XHRSY/24.
      CALL FRQOUT(NINT24,1,X24,INTY24,XINT24)
1991  CONTINUE
      STOP
      END
      SUBROUTINE GETDAT(NREC,CHIS,LEND)
C      POSTBLP    VERSION 1.1  LEVEL 800212      GETDAT
      REAL CHIA(100)
      REAL CHIS(NREC)
      INTEGER*2 ISCODE
      LOGICAL LSUM
      LOGICAL LEND,LTRUE
      COMMON/ACODE/IYR,IDAY,IHOUR,ICODE,ISTAB,WS,IWD,IDPBL
      COMMON/BCODE/ICD,IMET2,ICD1,ICD3,IDAYHR
      COMMON/CHIPRT/NTA,NSUM,ISCODE(62),LSUM,IJCODE
      DATA LTRUE/.TRUE./
      IF(.NOT.LSUM)GO TO 50
      INDEX=1
C     NTA IS THE NUMBER OF RECORDS PER HOUR
      DO 10 I=1,NTA
      READ(20,END=999)IDAYHR,ICD,IMET2,CHIS
      ICD1=ICD/1000
      ICODE=ICD-1000*ICD1
      IF(ICODE.NE.ISCODE(INDEX))GO TO 10
      INDEX=INDEX+1
      IF(INDEX.NE.2)GO TO 8
      DO 7 J=1,NREC
7     CHIA(J)=CHIS(J)
      GO TO 10
8     DO 9 J=1,NREC
9     CHIA(J)=CHIA(J)+CHIS(J)
10    CONTINUE
      IF(INDEX.EQ.NSUM+1)GO TO 15
      WRITE(6,12)NSUM,INDEX,ISCODE
12    FORMAT(/////'0','EXECUTION TERMINATING -- ERROR IN SPECIFICATION '
     1 ,'OF NSUM OR ISCODE'/'0','NSUM = ',I5,5X,'INDEX = ',I5,5X,
     2 6(/'0',10(I5,2X))/'0',2(I5,2X))
      STOP
15    CONTINUE
      DO 17 J=1,NREC
17    CHIS(J)=CHIA(J)
      GO TO 60
50    CONTINUE
      DO 55 I=1,NTA
      READ(20,END=999)IDAYHR,ICD,IMET2,CHIS
      ICD1=ICD/1000
      ICODE=ICD-1000*ICD1
      IF(ICODE.NE.IJCODE)GO TO 55
      NTA2=NTA-I
      IF(NTA2.EQ.0)GO TO 60
      DO 54 J=1,NTA2
      READ(20)
54    CONTINUE
      GO TO 60
55    CONTINUE
      WRITE(6,56)IJCODE
```

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56    FORMAT(/////'0','EXECUTION TERMINATING -- ERROR IN ',
     1 'THE SPECIFICATION OF IJCODE'/'0','IJCODE = ',I5)
      STOP
60    CONTINUE
C
C     DECODE IDAYHR
C
      IDAY=IDAYHR/100
      IHOUR=IDAYHR-IDAY*100
C
C     DECODE ICD
C
      IWS=ICD1/10
      WS=FLOAT(IWS)/10.
      ISTAB=ICD1-10*IWS
      ICD3=IDAYHR*10+ISTAB
C
C     DECODE IMET2
C
      IWD=IMET2/10000
      IDPBL=IMET2-IWD*10000
      RETURN
999   LEND=LTRUE
      RETURN
      END
      SUBROUTINE OUTDAT(CHI,IYR,IDAY,ITM,IAVG,NREC,NR2)
C       POSTBLP   VERSION 1.1  LEVEL 800212      OUTDAT
      REAL CHI(100)
      IF(NREC.LT.40)GO TO 1000
      IF(IAVG.EQ.1)WRITE(6,100)IYR,IDAY,ITM,IAVG
100   FORMAT('1',24X,'YEAR: ',I2,3X,'DAY: ',I3,3X,'HOUR: ',I2,10X,
     1 I2,' HOUR AVERAGE CONCENTRATIONS AT EACH RECEPTOR')
      IF(IAVG.EQ.3)WRITE(6,101)IYR,IDAY,ITM,IAVG
101   FORMAT('1',23X,'YEAR: ',I2,3X,'DAY: ',I3,3X,'PERIOD: ',I2,10X,
     1 I2,' HOUR AVERAGE CONCENTRATIONS AT EACH RECEPTOR')
      IF(IAVG.EQ.24)WRITE(6,102)IYR,IDAY,IAVG
102   FORMAT('1',28X,'YEAR: ',I2,3X,'DAY: ',I3,12X,
     1 I2,' HOUR AVERAGE CONCENTRATIONS AT EACH RECEPTOR')
120   CONTINUE
      WRITE(6,121)IAVG,IAVG
121   FORMAT('0',14X,'RECEPTOR',9X,I2,' HR AVERAGE CONCENTRATION',
     1 15X,'RECEPTOR',9X,I2,' HR AVERAGE CONCENTRATION'/
     2 39X,'(UG/M**3)',50X,'(UG/M**3)')
      DO 125 I=1,NR2
      I2=NR2+I
      WRITE(6,124)I,CHI(I),I2,CHI(I2)
124   FORMAT(17X,I3,18X,F9.1,29X,I3,18X,F9.1)
125   CONTINUE
      IF(MOD(NREC,2).EQ.0)RETURN
      WRITE(6,126)NREC,CHI(NREC)
126   FORMAT(76X,I3,18X,F9.1)
      RETURN
1000  CONTINUE
      IF(IAVG.EQ.1)WRITE(6,200)IYR,IDAY,ITM,IAVG
200   FORMAT(//'0',24X,'YEAR: ',I2,3X,'DAY: ',I3,3X,'HOUR: ',I2,10X,
     1 I2,' HOUR AVERAGE CONCENTRATIONS AT EACH RECEPTOR')
      IF(IAVG.EQ.3)WRITE(6,201)IYR,IDAY,ITM,IAVG
201   FORMAT(//'0',23X,'YEAR: ',I2,3X,'DAY: ',I3,3X,'PERIOD: ',I2,10X,
     1 I2,' HOUR AVERAGE CONCENTRATIONS AT EACH RECEPTOR')
      IF(IAVG.EQ.24)WRITE(6,202)IYR,IDAY,IAVG
202   FORMAT(//'0',28X,'YEAR: ',I2,3X,'DAY: ',I3,12X,
     1 I2,' HOUR AVERAGE CONCENTRATIONS AT EACH RECEPTOR')
      IF(NREC.NE.1)GO TO 120
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      WRITE(6,131)IAVG
131   FORMAT('0',44X,'RECEPTOR',9X,I2,' HR AVERAGE CONCENTRATION'/
     1 69X,'(UG/M**3)')
      WRITE(6,146)NREC,CHI(1)
146   FORMAT(47X,I3,18X,F9.1)
      RETURN
      END
      SUBROUTINE FREQ(CHI,IMO,IAVG)
C      POSTBLP   VERSION 1.1  LEVEL 800212      FREQ
      REAL CHI(100)
      INTEGER*2 INTM,INTY,INTM3,INTY3,INTM24,INTY24,IRECEP
      COMMON/FRDIST/XINT(25),XINT3(25),XINT24(25),NINT,NINT3,NINT24,
     1 INTM(25,12),INTY(25),INTM3(25,12),INTY3(25),INTM24(25,12),
     2 INTY24(25),IRECEP
      XCHI=CHI(IRECEP)
      IF(IAVG.NE.1)GO TO 50
      DO 10 J=2,NINT
      IF(XCHI.GE.XINT(J))GO TO 10
      JM1=J-1
      INTM(JM1,IMO)=INTM(JM1,IMO)+1
      INTY(JM1)=INTY(JM1)+1
      GO TO 15
10    CONTINUE
      INTM(NINT,IMO)=INTM(NINT,IMO)+1
      INTY(NINT)=INTY(NINT)+1
15    CONTINUE
      RETURN
50    CONTINUE
      IF(IAVG.NE.3)GO TO 100
      DO 60 J=2,NINT3
      IF(XCHI.GE.XINT3(J))GO TO 60
      JM1=J-1
      INTM3(JM1,IMO)=INTM3(JM1,IMO)+1
      INTY3(JM1)=INTY3(JM1)+1
      GO TO 65
60    CONTINUE
      INTM3(NINT3,IMO)=INTM3(NINT3,IMO)+1
      INTY3(NINT3)=INTY3(NINT3)+1
65    CONTINUE
      RETURN
100   CONTINUE
      IF(IAVG.NE.24)RETURN
      DO 110 J=2,NINT24
      IF(XCHI.GE.XINT24(J))GO TO 110
      JM1=J-1
      INTM24(JM1,IMO)=INTM24(JM1,IMO)+1
      INTY24(JM1)=INTY24(JM1)+1
      GO TO 115
110   CONTINUE
      INTM24(NINT24,IMO)=INTM24(NINT24,IMO)+1
      INTY24(NINT24)=INTY24(NINT24)+1
115   CONTINUE
      RETURN
      END
      SUBROUTINE FROOUT(NLEVEL,IMO,XHRS,INT,XINT)
C      POSTBLP   VERSION 1.1  LEVEL 800212      FROOUT
      REAL XINT(25)
      INTEGER*2 INT(25,12)
      NLM1=NLEVEL-1
      PCNT=100./XHRS
      PERCNT=PCNT*INT(1,IMO)
      CP=PERCNT
      WRITE(6,1481)XINT(2),INT(1,IMO),PERCNT,CP
```

```
1481  FORMAT(31X,'1',21X,'CHI LT ',F9.1,6X,I4,6X,F6.2,7X,F6.2)
      DO 1485 I=2,NLM1
      PERCNT=PCNT*INT(I,IMO)
      CP=CP+PERCNT
      WRITE(6,1484)I,XINT(I),XINT(I+1),INT(I,IMO),PERCNT,CP
1484  FORMAT(29X,I3,7X,F9.1,2X,'LE CHI LT ',F9.1,6X,I4,6X,F6.2,7X,F6.2)
1485  CONTINUE
      PERCNT=PCNT*INT(NLEVEL,IMO)
      CP=CP+PERCNT
      WRITE(6,1489)NLEVEL,XINT(NLEVEL),INT(NLEVEL,IMO),PERCNT,CP
1489  FORMAT(29X,I3,7X,F9.1,2X,'LE CHI',19X,I4,6X,F6.2,7X,F6.2)
      RETURN
      END
      BLOCK DATA
C      POSTBLP   VERSION 1.1  LEVEL 800212     BLOCK DATA
      INTEGER*2 INTM,INTY,INTM3,INTY3,INTM24,INTY24,IRECEP
      INTEGER*2 ISCODE
      LOGICAL LSUM
      COMMON/FRDIST/XINT(25),XINT3(25),XINT24(25),NINT,NINT3,NINT24,
     1 INTM(25,12),INTY(25),INTM3(25,12),INTY3(25),INTM24(25,12),
     2 INTY24(25),IRECEP
      COMMON/CHIPRT/NTA,NSUM,ISCODE(62),LSUM,IJCODE
      DATA XINT/25*0.0/,XINT3/25*0.0/,XINT24/25*0.0/
      DATA NINT/0/,NINT3/0/,NINT24/0/
      DATA INTM/300*0/,INTY/25*0/,INTM3/300*0/,INTY3/25*0/,
     1 INTM24/300*0/,INTY24/25*0/
      DATA IRECEP/1/
      DATA NSUM/0/,ISCODE/62*0/,IJCODE/999/
      DATA LSUM/.FALSE./
      END
```

APPENDIX C
BLP TEST CASE

INPUT DATA

```
BLP USER'S GUIDE TEST CASE
 &GEN NLINES=4,NPTS=2,LPART=.TRUE.,TCOR=90.0,&END
 &RISE L=500.,HB=15.,WB=20.,WM=2.5,DX=30.0,FPRIME=300.,&END
 &RCEPT RXBEG=-1000.,RYBEG=-1000.,RXEND=1500.,RYEND=1000.,RDX=500.,
 RDY=1000.,&END
 &METIN LMETIN=.TRUE.,ZMEAS=10.0,&END
 &CALC XBACKG=15.0,DECFAC=4.167E-5,&END
 &OUTPUT IPCL=1,1,1,1,6*0,1,IPCP=1,1,48*0,1,&END
0.0        0.0        500.       0.0        15.        25.5       0.0
0.0        50.0       500.       50.0       15.        25.5       0.0
0.0        100.0      500.       100.0      15.        30.0       0.0
0.0        150.0      500.       150.0      15.        30.0       0.0
166.7      75.0       15.0       75.0       3.5        12.0       340.0      0.0
333.3      75.0       25.0       80.0       4.0        15.0       350.0      0.0
24
6          1.5        201.       263.       251.
6          2.1        176.       261.       251.
6          2.1        214.       262.       251.
6          2.1        223.       262.       251.
6          3.1        233.       261.       251.
6          2.6        232.       261.       251.
5          3.1        235.       261.       251.
4          3.6        213.       261.       267.
4          4.1        197.       263.       371.
4          5.8        221.       265.       475.
4          8.5        234.       265.       579.
4          10.2       226.       266.       683.
3          2.1        3.         267.       787.
2          2.1        349.       268.       891.
1          1.0        312.       269.       891.
2          3.1        324.       270.       891.
3          1.5        11.        270.       891.
6          1.5        7.         269.       825.
6          2.1        24.        267.       703.
6          1.5        17.        267.       582.
6          2.1        220.       265.       460.
6          1.5        222.       265.       338.
6          3.1        230.       264.       216.
5          4.1        220.       265.       94.
```

OUTPUT DATA

```
BLP -- BUOYANT LINE AND POINT SOURCE DISPERSION MODEL      VERSION  1.1   LEVEL 800702
*******************************************************************************************************************

BLP USER'S GUIDE TEST CASE
&GEN
NLINES=          4,NPTS=          2,NREC=          0,LINPUT=F,LUTMS=F,LPART=T,LDOWNW=T,LSHEAR=T,LTRANS=T,TCOR=  90.0000000
&END
&RISE
L=  500.000000    ,HB=  15.0000000    ,WB=  20.0000000    ,WM=  2.50000000    ,FPRIME=  300.000000    ,DX=  30.0000000
&END
&RCEPT
RXBEG= -1000.0000000000000    ,RYBEG= -1000.0000000000000    ,RXEND=  1500.0000000000000    ,RYEND=  1000.0000000000000    ,
RDX=  500.000000    ,RDY=  1000.00000
&END
&METIN
ZMEAS=  10.0000000    ,DTHTA=  .199999996E-01,  .350000001E-01,PEXP=  .100000024    ,  .149999976    ,  .199999988    ,
  .250000000    ,  .300000012    ,  .300000012    ,IDSURF=          0,IYSURF=          0,IDUPER=          0,IYUPER=          0,
IDELS=          5,IRG=          1,IDAYS=    0,    0,    0,    0,    0,    0,    0,    0,
  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,
  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,
  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,
  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,
  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,
  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,
  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,
  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,
  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,
  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,
  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,
  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,
  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,
  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,
  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,
  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,
  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,
  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,
  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,LMETIN=T,LMETOT=F
&END
&CALC
CRIT=  .199999996E-01,TERAN=  .500000000    ,  .500000000    ,  .500000000    ,  .500000000    ,  .300000012    ,  .300000012    ,
DECFAC=  .416700059E-04,XBACKG=  15.0000000    ,CONST2=  2.60000038    ,CONST3=  34.4900055    ,MAXIT=          14
&END
&OUTPUT
IPCL=          1,          1,          1,          1,          0,          0,          0,          0,          0,          0,
          1,IPCP=          1,          1,          0,          0,          0,          0,          0,          0,          0,
          0,          0,          0,          0,          0,          0,          0,          0,          0,          0,          0,
          0,          0,          0,          0,          0,          0,          0,          0,          0,          0,          0,
          0,          0,          0,          0,          0,          0,          0,          0,          0,          0,          0,
          0,          0,          0,          0,          0,          0,          0,          0,          1
&END
```

```
BLP -- MULTIPLE BUOYANT LINE AND POINT SOURCE DISPERSION MODEL     VERSION  1.1   LEVEL 800702
*****************************************************************************************************************

BLP USER'S GUIDE TEST CASE


TOTAL NUMBER OF DAYS INCLUDED IN THIS RUN:   1

(0=NOT INCLUDED,1=INCLUDED)
                                                                                                    0000000000
1000000000  0000000000  0000000000  0000000000  0000000000  0000000000  0000000000  0000000000  0000000000  0000000000
0000000000  0000000000  0000000000  0000000000  0000000000  0000000000  0000000000  0000000000  0000000000  0000000000
0000000000  0000000000  0000000000  0000000000  0000000000  0000000000  0000000000  0000000000  0000000000
0000000000  0000000000  0000000000  0000000000  0000000000  0000000000  000000


TOTAL NUMBER OF SOURCES:   6

          LINE SOURCES:   4
         POINT SOURCES:   2

PARTIAL CONCENTRATIONS REQUESTED FOR ANY LINE OR POINT SOURCES ? YES

POINT SOURCE BUILDING DOWNWASH OPTION REQUESTED ? YES

VERTICAL WIND SHEAR (IN PLUME RISE) REQUESTED ? YES

TRANSITIONAL POINT SOURCE PLUME RISE REQUESTED ? YES

OUTPUT OF METEOROLOGICAL DATA REQUESTED ? NO


PARAMETERS USED IN THE LINE SOURCE PLUME RISE CALCULATIONS

BUILDING DIMENSIONS:  HEIGHT =   15.00 (M)
                       WIDTH =   20.00 (M)
                      LENGTH =  500.00 (M)

         BUILDING SEPARATION =   50.00 (M)

      LINE SOURCE SEPARATION =   50.00 (M)

           LINE SOURCE WIDTH =    2.50 (M)

BUOYANCY FLUX PER LINE (FPRIME) =   400.0 (M**4/S**3)
```

BLP -- MULTIPLE BUOYANT LINE AND POINT SOURCE DISPERSION MODEL   VERSION 1.1   LEVEL 800702

****

METEOROLOGICAL PARAMETERS

MEAN WIND SPEED MEASUREMENT HEIGHT = 10.0 (M)

WIND SPEED POWER LAW EXPONENTS (STABILITIES 1-6) = 0.10 0.15 0.20 0.25 0.30 0.30

VERTICAL POTENTIAL TEMPERATURE GRADIENT = 0.020 DEG K/M (STABILITY 5)   0.035 DEG K/M (STABILITY 6)

METEOROLOGICAL DATA -- FORMATTED USER INPUT

COMPUTATIONAL PARAMETERS

CONVERGENCE THRESHOLD FOR LINE SOURCE CALCULATIONS = 0.020 (MICROGRAMS/M**3)

MAXIMUM NUMBER OF ITERATIONS IN LINE SOURCE CALCULATIONS = 14

FINAL NEUTRAL PLUME RISE CONSTANT (CONST3) = 34.49

BACKGROUND CONCENTRATION =   15.00 (MICROGRAMS/M**3)

POLLUTANT DECAY FACTOR = 0.41670E-04 (1/SEC)

TERRAIN ADJUSTMENT FACTORS (STABILITIES 1-6) = 0.50 0.50 0.50 0.50 0.30 0.30

```
MLP -- MULTIPLE BUOYANT LINE AND POINT SOURCE DISPERSION MODEL     VERSION  1.1   LEVEL 800702
****************************************************************************************************

RECEPTOR LOCATIONS GENERATED FROM USER DEFINED RECEPTOR RECTANGLE

     RECEPTOR NETWORK DEFINED BY THE FOLLOWING RECTANGLE
     (   -1000.0,    1000.0)     (    1500.0,    1000.0)
     (   -1000.0,   -1000.0)     (    1500.0,   -1000.0)
     X GRID SPACING =  500.00
     Y GRID SPACING = 1000.00
SOURCE AND RECEPTOR LOCATIONS SPECIFIED IN SCS COORDINATES -- TCOR =  90.00 DEGREES
```

BLP -- MULTIPLE BUOYANT LINE AND POINT SOURCE DISPERSION MODEL VERSION 1.1 LEVEL 800702

****

LINE SOURCE PARAMETERS

NUMBER OF LINES: 4

LINE NUMBER	X START (M)	Y START (M)	X END (M)	Y END (M)	Q (GM/SEC)	HEIGHT (M)	PARTIAL CHI OUTPUT (0=NO,1=YES)	ELEVATION (M)
1	0.0	0.0	500.0	0.0	25.50	15.00	1	0.0
2	0.0	50.0	500.0	50.0	25.50	15.00	1	0.0
3	0.0	100.0	500.0	100.0	30.00	15.00	1	0.0
4	0.0	150.0	500.0	150.0	30.00	15.00	1	0.0

SOURCE CONTRIBUTIONS FROM THE FOLLOWING LINE SOURCES ARE AVAILABLE:

(0=NOT AVAILABLE; 1=AVAILABLE)

LINE SOURCE NUMBER	AVAILABILITY
1	1
2	1
3	1
4	1
1 - 4	1

BLP -- MULTIPLE BUOYANT LINE AND POINT SOURCE DISPERSION MODEL   VERSION 1.1   LEVEL 800702

****

POINT SOURCE PARAMETERS

NUMBER OF POINTS: 2

POINT NUMBER	X (M)	Y (M)	Q (GM/SEC)	HEIGHT (M)	VOL. FLUX (M**3/SEC)	STACK TEMP. (DEG K)	PARTIAL CHI OUTPUT (0=NO,1=YES)	ELEVATION (M)
1	166.7	75.0	75.00	15.00	116.	340.0	1	0.0
2	333.3	75.0	80.00	25.00	189.	350.0	1	0.0

SOURCE CONTRIBUTIONS FROM THE FOLLOWING POINT SOURCES ARE AVAILABLE:

(0=NOT AVAILABLE; 1=AVAILABLE)

POINT SOURCE NUMBER	AVAILABILITY
1	1
2	1
1 - 2	1

THE SOURCE RECTANGLE IS DEFINED BY THE FOLLOWING POINTS:

(0.0 , 150.00)   (500.00, 150.00)

(0.0 , 0.0)   (500.00, 0.0)

****

RECEPTOR NO.	LOCATION X	LOCATION Y	RECEPTOR NO.	LOCATION X	LOCATION Y
1	-1000.	-1000.	9	500.	-1000.
2	-1000.	0.	10	500.	1000.
3	-1000.	1000.	11	1000.	-1000.
4	-500.	-1000.	12	1000.	0.
5	-500.	0.	13	1000.	1000.
6	-500.	1000.	14	1500.	-1000.
7	0.	-1000.	15	1500.	0.
8	0.	1000.	16	1500.	1000.

NUMBER OF POSSIBLE RECEPTOR LOCATIONS = 18

NUMBER OF ACTUAL RECEPTOR LOCATIONS = 16

BLP -- MULTIPLE BUOYANT LINE AND POINT SOURCE DISPERSION MODEL VERSION 1.1 LEVEL 800702

****

USER INPUT FORMATTED METEOROLOGICAL DATA

HOUR	STABILITY CLASS	WIND SPEED (M/S)	WIND DIRECTION (DEGREES)	TEMPERATURE (DEG. K)	MIXING HEIGHT (M)
1	6	1.50	201.0	263.0	251.
2	6	2.10	176.0	261.0	251.
3	6	2.10	214.0	262.0	251.
4	6	2.10	223.0	262.0	251.
5	6	3.10	233.0	261.0	251.
6	6	2.60	232.0	261.0	251.
7	5	3.10	235.0	261.0	251.
8	4	3.60	213.0	261.0	267.
9	4	4.10	197.0	263.0	371.
10	4	5.80	221.0	265.0	475.
11	4	6.50	234.0	265.0	579.
12	4	10.20	226.0	266.0	683.
13	3	2.10	5.0	267.0	787.
14	2	2.10	349.0	268.0	891.
15	1	1.00	312.0	269.0	891.
16	2	3.10	324.0	270.0	891.
17	3	1.50	11.0	270.0	891.
18	6	1.50	7.0	269.0	825.
19	6	2.10	24.0	267.0	703.
20	6	1.50	17.0	267.0	582.
21	6	2.10	220.0	265.0	460.
22	6	1.50	222.0	265.0	338.
23	6	3.10	230.0	264.0	216.
24	5	4.10	220.0	265.0	94.

LAST DAY PROCESSED = 1

APPENDIX D
POSTBLP TEST CASES

INPUT DATA FOR POSTBLP

TEST CASE NO. 1

```
&OPTS IJCODE=999,LECH3=.TRUE.,LECH24=.TRUE.,IECHO=1,365*0,&END
```

OUTPUT DATA FOR POSTBLP

TEST CASE NO. 1

GLP POSTPROCESSOR   VERSION 1.1   LEVEL 800702

```
*****************************************************************************************************************

&OPTS
XINT=  .0          ,  .0          ,  .0          ,  .0          ,  .0          ,  .0          ,  .0          ,
  .0          ,  .0          ,  .0          ,  .0          ,  .0          ,  .0          ,  .0          ,
  .0          ,  .0          ,  .0          ,  .0          ,  .0          ,  .0          ,  .0          ,
  .0          ,  .0          ,  .0          ,  .0          ,XINT3=  .0   ,  .0          ,  .0          ,
  .0          ,  .0          ,  .0          ,  .0          ,  .0          ,  .0          ,  .0          ,
  .0          ,  .0          ,  .0          ,  .0          ,  .0          ,  .0          ,  .0          ,
  .0          ,  .0          ,  .0          ,  .0          ,  .0          ,  .0          ,  .0          ,
  .0          ,XINT24=  .0   ,  .0          ,  .0          ,  .0          ,  .0          ,  .0          ,
  .0          ,  .0          ,  .0          ,  .0          ,  .0          ,  .0          ,  .0          ,
  .0          ,  .0          ,  .0          ,  .0          ,  .0          ,  .0          ,  .0          ,
  .0          ,  .0          ,  .0          ,  .0          ,  .0          ,NINT=        0,NINT3=       0,NINT24=
        0,LFRQ1=F,LFRQ3=F,LFRQ24=F,IRECEP=       1,IECHO=     1,    0,    0,    0,    0,    0,    0,    0,    0,
    0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
    0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
    0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
    0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
    0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
    0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
    0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
    0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
    0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
    0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
    0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
    0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
    0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
    0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
    0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
    0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
    0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
    0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
    0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
    0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,LECH1=F,LECH3=T,LECH24=T,NSUM=
        0,ISCODE=    0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
    0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
    0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
    0,   0,   0,   0,   0,   0,   0,   0,   0,   0,LSUM=F,IJCODE=      999
&END
```

```
                         HLP POSTPROCESSOR   VERSION  1.1   LEVEL 800702

****************************************************************************************************

HLP USER'S GUIDE TEST CASE                                                   YEAR:  0


TOTAL NUMBER OF DAYS INCLUDED IN THIS RUN:    1

(0=NOT INCLUDED; 1=INCLUDED)

1000000000  0000000000  0000000000  0000000000  0000000000  0000000000  0000000000  0000000000  0000000000  0000000000
0000000000  0000000000  0000000000  0000000000  0000000000  0000000000  0000000000  0000000000  0000000000  0000000000
0000000000  0000000000  0000000000  0000000000  0000000000  0000000000  0000000000  0000000000  0000000000  0000000000
0000000000  0000000000  0000000000  0000000000  0000000000  0000000000  000000


TOTAL NUMBER OF SOURCES:   6

        LINE SOURCES:   4
       POINT SOURCES:   2


TOTAL NUMBER OF RECEPTORS:  16


SOURCE CONTRIBUTIONS FROM THE FOLLOWING LINE SOURCES ARE AVAILABLE:

(0=NOT AVAILABLE; 1=AVAILABLE)

LINE SOURCE NUMBER     AVAILABILITY

        1                   1

        2                   1

        3                   1

        4                   1

      1 -  4                1
```

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                    PCP POSTPROCESSOR    VERSION  1.1    LEVEL 800702
*****************************************************************************************************************************

SOURCE CONTRIBUTIONS FROM THE FOLLOWING POINT SOURCES ARE AVAILABLE:
(0=NOT AVAILABLE; 1=AVAILABLE)
POINT SOURCE NUMBER      AVAILABILITY
         1                    1
         2                    1
      1 -  2                  1
```

```
****************************************************************************************************************************

    IJCODE = 999

(IJCODE SPECIFIES THE BLP CONCENTRATION OUTPUT DATA USED IN THIS RUN OF POSTBLP.
 THE CONCENTRATION DATA ASSOCIATED WITH IJCODE IS AS FOLLOWS:

    IJCODE                    CONCENTRATION DATA

     1-10      SOURCE CONTRIBUTION - LINE SOURCE NUMBER "IJCODE"
      11       SOURCE CONTRIBUTION - ALL LINE SOURCES
    101-150    SOURCE CONTRIBUTION - POINT SOURCE NUMBER "IJCODE - 100"
     151       SOURCE CONTRIBUTION - ALL POINT SOURCES
     999       TOTAL CONCENTRATION)


FREQUENCY DISTRIBUTIONS REQUESTED IN THIS POSTBLP RUN:

    1-HOUR AVERAGES ? NO
    3-HOUR AVERAGES ? NO
   24-HOUR AVERAGES ? NO
```

ELP POSTPROCESSOR VERSION 1.1 LEVEL 800702

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CONCENTRATIONS AT EACH RECEPTOR ARE PRINTED FOR THE FOLLOWING DAYS:

(0=NOT PRINTED; 1=PRINTED)

1000000000 0000000000 0000000000 0000000000 0000000000 0000000000 0000000000 0000000000 0000000000 0000000000

0000000000 0000000000 0000000000 0000000000 0000000000 0000000000 0000000000 0000000000 0000000000 0000000000

0000000000 0000000000 0000000000 0000000000 0000000000 0000000000 0000000000 0000000000 0000000000 0000000000

0000000000 0000000000 0000000000 0000000000 0000000000 0000000000 000000

AND FOR THE FOLLOWING AVERAGING TIMES:

1-HOUR AVERAGES ? NO
3-HOUR AVERAGES ? YES
24-HOUR AVERAGES ? YES

YEAR: 0 DAY: 1 PERIOD: 1 3 HOUR AVERAGE CONCENTRATIONS AT EACH RECEPTOR

RECEPTOR	3 HR AVERAGE CONCENTRATION (UG/M**3)	RECEPTOR	3 HR AVERAGE CONCENTRATION (UG/M**3)
1	15.1	9	342.6
2	15.0	10	15.0
3	15.0	11	15.0
4	802.3	12	15.0
5	15.0	13	15.0
6	15.0	14	15.0
7	535.7	15	15.0
8	15.0	16	15.0

YEAR: 0 DAY: 1 PERIOD: 2 3 HOUR AVERAGE CONCENTRATIONS AT EACH RECEPTOR

RECEPTOR	3 HR AVERAGE CONCENTRATION (UG/M**3)	RECEPTOR	3 HR AVERAGE CONCENTRATION (UG/M**3)
1	1390.3	9	15.0
2	15.0	10	15.0
3	15.0	11	15.0
4	229.9	12	15.0
5	15.0	13	15.0
6	15.0	14	15.0
7	15.0	15	15.0
8	15.0	16	15.0

YEAR: 0 DAY: 1 PERIOD: 3 3 HOUR AVERAGE CONCENTRATIONS AT EACH RECEPTOR

RECEPTOR	3 HR AVERAGE CONCENTRATION (UG/M**3)	RECEPTOR	3 HR AVERAGE CONCENTRATION (UG/M**3)
1	[illegible]	9	15.0

2	15.0	10	15.0
3	15.0	11	15.0
4	54.6	12	15.0
5	15.0	13	15.0
6	15.0	14	15.0
7	53.7	15	15.0
8	15.0	16	15.0

YEAR: 0 DAY: 1 PERIOD: 4 — 3 HOUR AVERAGE CONCENTRATIONS AT EACH RECEPTOR

RECEPTOR	3 HR AVERAGE CONCENTRATION (UG/M**3)	RECEPTOR	3 HR AVERAGE CONCENTRATION (UG/M**3)
1	297.2	9	15.0
2	15.0	10	15.0
3	15.0	11	15.0
4	90.2	12	15.0
5	15.0	13	15.0
6	15.0	14	15.0
7	15.0	15	15.0
8	15.0	16	15.0

YEAR: 0 DAY: 1 PERIOD: 5 — 3 HOUR AVERAGE CONCENTRATIONS AT EACH RECEPTOR

RECEPTOR	3 HR AVERAGE CONCENTRATION (UG/M**3)	RECEPTOR	3 HR AVERAGE CONCENTRATION (UG/M**3)
1	15.0	9	15.0
2	15.0	10	33.6
3	115.5	11	15.0
4	15.0	12	15.0
5	15.0	13	15.0
6	119.9	14	15.0
7	15.0	15	15.0
8	121.0	16	15.0

YEAR: 0 DAY: 1 PERIOD: 6 — 3 HOUR AVERAGE CONCENTRATIONS AT EACH RECEPTOR

RECEPTOR	3 HR AVERAGE CONCENTRATION (UG/M**3)	RECEPTOR	3 HR AVERAGE CONCENTRATION (UG/M**3)
1	15.0	9	15.0
2	15.0	10	715.8
3	32.4	11	15.0
4	15.0	12	15.0
5	15.0	13	15.0
6	160.2	14	15.0
7	15.0	15	15.0
8	40.3	16	15.0

YEAR: 0 DAY: 1 PERIOD: 7 — 3 HOUR AVERAGE CONCENTRATIONS AT EACH RECEPTOR

RECEPTOR	3 HR AVERAGE CONCENTRATION (UG/M**3)	RECEPTOR	3 HR AVERAGE CONCENTRATION (UG/M**3)
1	160.0	9	15.0
2	15.0	10	1120.0
3	15.0	11	15.0
4	[illegible]	12	15.0

5	15.0	13	44.3
6	15.0	14	15.0
7	15.0	15	15.0
8	15.0	16	15.0

YEAR: 0 DAY: 1 PERIOD: 8 3 HOUR AVERAGE CONCENTRATIONS AT EACH RECEPTOR

RECEPTOR	3 HR AVERAGE CONCENTRATION (UG/M**3)	RECEPTOR	3 HR AVERAGE CONCENTRATION (UG/M**3)
1	1260.1	9	15.0
2	15.0	10	15.0
3	15.0	11	15.0
4	586.9	12	15.0
5	15.0	13	15.0
6	15.0	14	15.0
7	15.0	15	15.0
8	15.0	16	15.0

YEAR: 0 DAY: 1 24 HOUR AVERAGE CONCENTRATIONS AT EACH RECEPTOR

RECEPTOR	24 HR AVERAGE CONCENTRATION (UG/M**3)	RECEPTOR	24 HR AVERAGE CONCENTRATION (UG/M**3)
1	414.0	9	55.9
2	15.0	10	243.1
3	29.7	11	15.0
4	277.9	12	15.0
5	15.0	13	18.7
6	46.3	14	15.0
7	84.7	15	15.0
8	31.4	16	15.0

1.0 DAY (24 HR) AVERAGE CONCENTRATIONS AT EACH RECEPTOR

RECEPTOR	1.0 DAY AVERAGE CONCENTRATION (UG/M**3)	RECEPTOR	1.0 DAY AVERAGE CONCENTRATION (UG/M**3)
1	414.0	9	55.9
2	15.0	10	243.1
3	29.7	11	15.0
4	277.9	12	15.0
5	15.0	13	18.7
6	46.3	14	15.0
7	84.7	15	15.0
8	31.4	16	15.0

5 HIGHEST 1-HOUR AVERAGE CONCENTRATIONS AT EACH RECEPTOR

RECEPTOR	HIGHEST (UG/M**3)	2ND HIGHEST (UG/M**3)	3RD HIGHEST (UG/M**3)	4TH HIGHEST (UG/M**3)	5TH HIGHEST (UG/M**3)
1	2024.0 (1,22)	1842.7 (1, 4)	1556.5 (1,23)	1386.9 (1, 6)	941.4 (1, 5)
2	15.0 (1, 5)	15.0 (1, 4)	15.0 (1, 3)	15.0 (1, 2)	15.0 (1, 1)
3	316.4 (1,15)	67.3 (1,16)	15.0 (1, 5)	15.0 (1, 4)	15.0 (1, 3)
4	2208.9 (1, 3)	1317.2 (1,21)	1162.6 (1,22)	659.6 (1, 4)	581.2 (1,24)
5	15.0 (1,15)	15.0 (1, 5)	15.0 (1, 4)	15.0 (1, 3)	15.0 (1, 2)
6	450.5 (1,16)	324.5 (1,15)	20.5 (1,14)	15.0 (1, 5)	15.0 (1, 4)
7	1542.1 (1, 1)	129.0 (1, 9)	43.9 (1, 2)	17.1 (1, 8)	15.1 (1, 3)
8	299.1 (1,14)	89.3 (1,16)	33.4 (1,13)	30.4 (1,15)	16.3 (1,18)
9	997.7 (1, 2)	15.0 (1, 5)	15.0 (1, 4)	15.0 (1, 3)	15.0 (1, 1)
10	2187.8 (1,20)	2113.7 (1,18)	1157.2 (1,19)	49.3 (1,13)	36.7 (1,14)
11	15.0 (1, 5)	15.0 (1, 4)	15.0 (1, 3)	15.0 (1, 2)	15.0 (1, 1)
12	15.0 (1, 5)	15.0 (1, 4)	15.0 (1, 3)	15.0 (1, 2)	15.0 (1, 1)
13	102.9 (1,19)	15.0 (1,17)	15.0 (1, 5)	15.0 (1, 4)	15.0 (1, 3)
14	15.0 (1, 5)	15.0 (1, 4)	15.0 (1, 3)	15.0 (1, 2)	15.0 (1, 1)
15	15.0 (1, 5)	15.0 (1, 4)	15.0 (1, 3)	15.0 (1, 2)	15.0 (1, 1)
16	15.0 (1, 5)	15.0 (1, 4)	15.0 (1, 3)	15.0 (1, 2)	15.0 (1, 1)

5 HIGHEST 3-HOUR AVERAGE CONCENTRATIONS AT EACH RECEPTOR

RECEPTOR	HIGHEST (UG/M**3)	2ND HIGHEST (UG/M**3)	3RD HIGHEST (UG/M**3)	4TH HIGHEST (UG/M**3)	5TH HIGHEST (UG/M**3)
1	1590.3 (1,2)	1260.1 (1,8)	297.2 (1,4)	160.8 (1,7)	158.2 (1,3)
2	15.0 (1,5)	15.0 (1,4)	15.0 (1,3)	15.0 (1,2)	15.0 (1,1)
3	115.5 (1,5)	32.4 (1,6)	15.0 (1,4)	15.0 (1,3)	15.0 (1,2)
4	602.3 (1,1)	586.9 (1,8)	449.1 (1,7)	229.9 (1,2)	90.2 (1,4)
5	15.0 (1,5)	15.0 (1,4)	15.0 (1,3)	15.0 (1,2)	15.0 (1,1)
6	160.2 (1,6)	119.9 (1,5)	15.0 (1,4)	15.0 (1,3)	15.0 (1,2)
7	533.7 (1,1)	53.7 (1,3)	15.0 (1,4)	15.0 (1,5)	15.0 (1,2)
8	121.0 (1,5)	40.3 (1,6)	15.0 (1,4)	15.0 (1,3)	15.0 (1,2)
9	342.6 (1,1)	15.0 (1,5)	15.0 (1,4)	15.0 (1,3)	15.0 (1,2)
10	1120.0 (1,7)	715.8 (1,6)	33.6 (1,5)	15.0 (1,4)	15.0 (1,3)
11	15.0 (1,5)	15.0 (1,4)	15.0 (1,3)	15.0 (1,2)	15.0 (1,1)
12	15.0 (1,5)	15.0 (1,4)	15.0 (1,3)	15.0 (1,2)	15.0 (1,1)
13	44.3 (1,7)	15.0 (1,6)	15.0 (1,5)	15.0 (1,4)	15.0 (1,3)
14	15.0 (1,5)	15.0 (1,4)	15.0 (1,3)	15.0 (1,2)	15.0 (1,1)
15	15.0 (1,5)	15.0 (1,4)	15.0 (1,3)	15.0 (1,2)	15.0 (1,1)
16	15.0 (1,5)	15.0 (1,4)	15.0 (1,3)	15.0 (1,2)	15.0 (1,1)

5 HIGHEST 24-HOUR AVERAGE CONCENTRATIONS AT EACH RECEPTOR

RECEPTOR	HIGHEST (UG/M**3)	2ND HIGHEST (UG/M**3)	3RD HIGHEST (UG/M**3)	4TH HIGHEST (UG/M**3)	5TH HIGHEST (UG/M**3)
1	414.0 (1)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)
2	15.0 (1)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)
3	29.7 (1)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)
4	277.9 (1)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)
5	15.0 (1)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)
6	46.5 (1)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)
7	84.7 (1)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)
8	51.4 (1)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)
9	55.9 (1)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)
10	243.1 (1)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)
11	15.0 (1)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)
12	15.0 (1)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)
13	18.7 (1)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)
14	15.0 (1)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)
15	15.0 (1)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)
16	15.0 (1)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)

TOP 50 1-HOUR AVERAGE CONCENTRATIONS

DAY	HOUR	WIND SPEED (M/S)	WIND DIRECTION (DEGREES)	STABILITY	MIXING HEIGHT (METERS)	RECEPTOR	1-HOUR CONCENTRATION (UG/M**3)
1	3	2.1	214	6	251	4	2208.9
1	20	1.5	17	6	582	10	2187.8
1	16	1.5	7	6	825	10	2113.7
1	22	1.5	222	6	338	1	2024.0
1	4	2.1	223	6	251	1	1842.7
1	23	3.1	230	6	216	1	1556.5
1	1	1.5	201	6	251	7	1542.1
1	6	2.6	232	6	251	1	1386.9
1	21	2.1	220	6	460	4	1317.2
1	22	1.5	222	6	338	4	1162.6
1	19	2.1	24	6	703	10	1157.2
1	2	2.1	176	6	251	9	997.7
1	5	3.1	233	6	251	1	941.4
1	4	2.1	223	6	251	4	659.6
1	24	4.1	220	5	94	4	581.2
1	12	10.2	226	4	683	1	524.5
1	21	2.1	220	6	460	1	452.4
1	16	3.1	324	2	891	6	450.5
1	7	3.1	235	5	251	1	444.3
1	15	1.0	312	1	891	6	324.3
1	15	1.0	312	1	891	3	316.4
1	14	2.1	349	2	891	8	299.1
1	11	8.5	234	4	579	1	259.6
1	24	4.1	220	5	94	1	199.9
1	1	1.5	201	6	251	4	182.9
1	10	5.8	221	4	475	4	163.2
1	9	4.1	197	4	371	7	129.0
1	10	5.8	221	4	475	1	107.6
1	19	2.1	24	6	703	13	102.9
1	12	10.2	226	4	683	4	91.3
1	16	3.1	324	2	891	8	89.3
1	8	3.6	213	4	267	4	71.2
1	16	3.1	324	2	891	3	67.3
1	13	2.1	3	3	787	10	49.3
1	2	2.1	176	6	251	7	43.9
1	14	2.1	349	2	891	10	36.7
1	13	2.1	3	3	787	8	33.4
1	15	1.0	312	1	891	8	30.4
1	14	2.1	349	2	891	6	20.5
1	17	1.5	11	3	891	10	18.8
1	9	4.1	197	4	371	4	17.4
1	8	3.6	213	4	267	7	17.1
1	23	3.1	230	6	216	4	16.8
1	18	1.5	7	6	825	8	16.3
1	11	8.5	234	4	579	4	16.1
1	17	1.5	11	3	891	8	15.3
1	8	3.6	213	4	267	1	15.3
1	3	2.1	214	6	251	1	15.2
1	7	3.1	235	5	251	4	15.1
1	6	2.6	232	6	251	4	15.1

TOP 50 3-HOUR AVERAGE CONCENTRATIONS

DAY	TIME PERIOD	RECEPTOR	3-HOUR CONCENTRATION (UG/M**3)
1	2	1	1390.3
1	8	1	1260.1
1	7	10	1120.0
1	1	4	802.3
1	6	10	715.8
1	8	4	586.9
1	1	7	533.7
1	7	4	449.1
1	1	9	342.6
1	4	1	297.2
1	2	4	229.9
1	7	1	160.8
1	6	6	160.2
1	3	1	158.2
1	5	8	121.0
1	5	6	119.9
1	5	3	115.5
1	4	4	90.2
1	3	7	53.7
1	7	13	44.3
1	6	8	40.3
1	3	4	34.6
1	5	10	33.6
1	6	3	32.4
1	1	1	15.1
1	5	5	15.0
1	4	7	15.0
1	6	13	15.0
1	1	6	15.0
1	1	5	15.0
1	1	12	15.0
1	1	11	15.0
1	1	10	15.0
1	1	3	15.0
1	1	8	15.0
1	2	2	15.0
1	1	2	15.0
1	1	16	15.0
1	1	15	15.0
1	1	14	15.0
1	2	8	15.0
1	2	7	15.0
1	2	6	15.0
1	2	5	15.0
1	1	13	15.0
1	2	3	15.0
1	2	14	15.0
1	2	13	15.0
1	2	12	15.0
1	2	11	15.0

TOP 50 24-HOUR AVERAGE CONCENTRATIONS

DAY	RECEPTOR	24-HOUR CONCENTRATION (UG/M**3)
1	1	414.0
1	4	277.9
1	10	243.1
1	7	84.7
1	9	55.9
1	6	46.3
1	8	31.4
1	3	29.7
1	13	18.7
1	5	15.0
1	12	15.0
1	11	15.0
1	16	15.0
1	15	15.0
1	14	15.0
1	2	15.0
0	0	0.0
0	0	0.0
0	0	0.0
0	0	0.0
0	0	0.0
0	0	0.0
0	0	0.0
0	0	0.0
0	0	0.0
0	0	0.0
0	0	0.0
0	0	0.0
0	0	0.0
0	0	0.0
0	0	0.0
0	0	0.0
0	0	0.0
0	0	0.0
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0	0	0.0
0	0	0.0
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0	0	0.0
0	0	0.0
0	0	0.0
0	0	0.0
0	0	0.0
0	0	0.0
0	0	0.0
0	0	0.0
0	0	0.0
0	0	0.0
0	0	0.0

INPUT DATA FOR POSTBLP

TEST CASE NO. 2

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&OPTS LECHS=.TRUE.,LECH24=.TRUE.,IECHO=1,365*0,
LSUM=.TRUE.,NSUM=6,ISCODE=1,2,3,4,101,102,56*0,&END
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OUTPUT DATA FOR POSTBLP

TEST CASE NO. 2

```
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&KOPIS
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  .0        ,  .0        ,  .0        ,  .0        ,  .0        ,  .0        ,  .0        ,
  .0        ,  .0        ,  .0        ,  .0        ,  .0        ,  .0        ,  .0        ,
  .0        ,  .0        ,  .0        ,  .0        ,XINI3=  .0  ,  .0        ,  .0        ,
  .0        ,  .0        ,  .0        ,  .0        ,  .0        ,  .0        ,  .0        ,
  .0        ,  .0        ,  .0        ,  .0        ,  .0        ,  .0        ,  .0        ,
  .0        ,  .0        ,  .0        ,  .0        ,  .0        ,  .0        ,  .0        ,
  .0        ,XINI24=  .0 ,  .0        ,  .0        ,  .0        ,  .0        ,  .0        ,
  .0        ,  .0        ,  .0        ,  .0        ,  .0        ,  .0        ,  .0        ,
  .0        ,  .0        ,  .0        ,  .0        ,  .0        ,  .0        ,  .0        ,
  .0        ,  .0        ,  .0        ,  .0        ,  .0        ,  .0        ,  .0        ,
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    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,
    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,
    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,
    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,
    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,
    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,
    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,
    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,
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    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,
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    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,
    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,
    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,
    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,
    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,0,LECH1=F,LECH3=T,LECH24=T,NSUM=
        6,ISCODE=     1,     2,     3,     4,   101,   102,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,
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    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,
    0,    0,    0,    0,    0,    0,    0,    0,    0,0,LSUM=1,IJCODE=       999
&END
```

```
*******************************************************************************************************************

RLP USER'S GUIDE TEST CASE                                                              YEAR:  0

TOTAL NUMBER OF DAYS INCLUDED IN THIS RUN:    1

(0=NOT INCLUDED; 1=INCLUDED)

1000000000  0000000000  0000000000  0000000000  0000000000  0000000000  0000000000  0000000000  0000000000  0000000000
0000000000  0000000000  0000000000  0000000000  0000000000  0000000000  0000000000  0000000000  0000000000  0000000000
0000000000  0000000000  0000000000  0000000000  0000000000  0000000000  0000000000  0000000000  0000000000  0000000000
0000000000  0000000000  0000000000  0000000000  0000000000  0000000000  000000

TOTAL NUMBER OF SOURCES:    6

          LINE SOURCES:    4
         POINT SOURCES:    2

TOTAL NUMBER OF RECEPTORS:  16

SOURCE CONTRIBUTIONS FROM THE FOLLOWING LINE SOURCES ARE AVAILABLE:

(0=NOT AVAILABLE; 1=AVAILABLE)

LINE SOURCE NUMBER     AVAILABILITY

        1                    1
        2                    1
        3                    1
        4                    1
      1 - 4                  1
```

MLP POSTPROCESSOR   VERSION 1.1   LEVEL 800702

****

SOURCE CONTRIBUTIONS FROM THE FOLLOWING POINT SOURCES ARE AVAILABLE:

(0=NOT AVAILABLE; 1=AVAILABLE)

POINT SOURCE NUMBER	AVAILABILITY
1	1
2	1
1 - 2	1

```
RLP POSTPROCESSOR    VERSION  1.1   LEVEL 800702
***************************************************************************************************************************

THE RLP CONCENTRATION DATA USED IN THIS RUN OF POSTRLP IS THE SUM OF THE FOLLOWING   6 SETS
 OF SOURCE CONTRIBUTION DATA:

ISCODE = (1)  1   (2)  2   (3)  3   (4)  4   (5)101   (6)102

        WHERE THE CONCENTRATION DATA ASSOCIATED WITH EACH ISCODE IS IDENTIFIED AS FOLLOWS:

        ISCODE                 CONCENTRATION DATA

         1-10       SOURCE CONTRIBUTION - LINE SOURCE NUMBER "ISCODE"
          11        SOURCE CONTRIBUTION - ALL LINE SOURCES
        101-150     SOURCE CONTRIBUTION - POINT SOURCE NUMBER "ISCODE - 100"
         151        SOURCE CONTRIBUTION - ALL POINT SOURCES
         999        TOTAL CONCENTRATION)


FREQUENCY DISTRIBUTIONS REQUESTED IN THIS POSTRLP RUN:

    1-HOUR AVERAGES ? NO
    3-HOUR AVERAGES ? NO
   24-HOUR AVERAGES ? NO
```

PEP POSTPROCESSOR VERSION 1.1 LEVEL 800702

****

CONCENTRATIONS AT EACH RECEPTOR ARE PRINTED FOR THE FOLLOWING DAYS:

(0=NOT PRINTED; 1=PRINTED)

```
1000000000  0000000000  0000000000  0000000000  0000000000  0000000000  0000000000  0000000000  0000000000  0000000000
0000000000  0000000000  0000000000  0000000000  0000000000  0000000000  0000000000  0000000000  0000000000  0000000000
0000000000  0000000000  0000000000  0000000000  0000000000  0000000000  0000000000  0000000000  0000000000  0000000000
0000000000  0000000000  0000000000  0000000000  0000000000  0000000000  000000
```

AND FOR THE FOLLOWING AVERAGING TIMES:

1-HOUR AVERAGES ? NO
3-HOUR AVERAGES ? YES
24-HOUR AVERAGES ? YES

YEAR: 0 DAY: 1 PERIOD: 1

3 HOUR AVERAGE CONCENTRATIONS AT EACH RECEPTOR

RECEPTOR	3 HR AVERAGE CONCENTRATION (UG/M**3)	RECEPTOR	3 HR AVERAGE CONCENTRATION (UG/M**3)
1	0.1	9	327.6
2	0.0	10	0.0
3	0.0	11	0.0
4	787.3	12	0.0
5	0.0	13	0.0
6	0.0	14	0.0
7	316.7	15	0.0
8	0.0	16	0.0

YEAR: 0 DAY: 1 PERIOD: 2

3 HOUR AVERAGE CONCENTRATIONS AT EACH RECEPTOR

RECEPTOR	3 HR AVERAGE CONCENTRATION (UG/M**3)	RECEPTOR	3 HR AVERAGE CONCENTRATION (UG/M**3)
1	1375.3	9	0.0
2	0.0	10	0.0
3	0.0	11	0.0
4	214.9	12	0.0
5	0.0	13	0.0
6	0.0	14	0.0
7	0.0	15	0.0
8	0.0	16	0.0

YEAR: 0 DAY: 1 PERIOD: 3

3 HOUR AVERAGE CONCENTRATIONS AT EACH RECEPTOR

RECEPTOR	3 HR AVERAGE CONCENTRATION (UG/M**3)	RECEPTOR	3 HR AVERAGE CONCENTRATION (UG/M**3)
1	195.[illegible]	9	0.0

2	0.0
3	[illegible]
4	19.6
5	0.0
6	0.0
7	[illegible]
8	0.0

10	0.0
11	0.0
12	0.0
13	0.0
14	0.0
15	0.0
16	0.0

YEAR: 0 DAY: 1 PERIOD: 4

RECEPTOR	3 HR AVERAGE CONCENTRATION (UG/M**3)
1	262.2
2	0.0
3	0.0
4	75.2
5	0.0
6	0.0
7	0.0
8	0.0

3 HOUR AVERAGE CONCENTRATIONS AT EACH RECEPTOR

RECEPTOR	3 HR AVERAGE CONCENTRATION (UG/M**3)
9	0.0
10	0.0
11	0.0
12	0.0
13	0.0
14	0.0
15	0.0
16	0.0

YEAR: 0 DAY: 1 PERIOD: 5

RECEPTOR	3 HR AVERAGE CONCENTRATION (UG/M**3)
1	0.0
2	0.0
3	100.5
4	0.0
5	0.0
6	109.9
7	0.0
8	106.0

3 HOUR AVERAGE CONCENTRATIONS AT EACH RECEPTOR

RECEPTOR	3 HR AVERAGE CONCENTRATION (UG/M**3)
9	0.0
10	18.6
11	0.0
12	0.0
13	0.0
14	0.0
15	0.0
16	0.0

YEAR: 0 DAY: 1 PERIOD: 6

RECEPTOR	3 HR AVERAGE CONCENTRATION (UG/M**3)
1	0.0
2	0.0
3	17.4
4	0.0
5	0.0
6	145.2
7	0.0
8	25.3

3 HOUR AVERAGE CONCENTRATIONS AT EACH RECEPTOR

RECEPTOR	3 HR AVERAGE CONCENTRATION (UG/M**3)
9	0.0
10	700.8
11	0.0
12	0.0
13	0.0
14	0.0
15	0.0
16	0.0

YEAR: 0 DAY: 1 PERIOD: 7

RECEPTOR	3 HR AVERAGE CONCENTRATION (UG/M**3)
1	115.8
2	0.0
3	0.0
4	[illegible]

3 HOUR AVERAGE CONCENTRATIONS AT EACH RECEPTOR

RECEPTOR	3 HR AVERAGE CONCENTRATION (UG/M**3)
9	0.0
10	1105.0
11	0.0
12	0.0

5	0.0	13	29.3
6	0.0	14	0.0
7	0.0	15	0.0
8	0.0	16	0.0

YEAR: 0 DAY: 1 PERIOD: 8

3 HOUR AVERAGE CONCENTRATIONS AT EACH RECEPTOR

RECEPTOR	3 HR AVERAGE CONCENTRATION (UG/M**3)	RECEPTOR	3 HR AVERAGE CONCENTRATION (UG/M**3)
1	1245.1	9	0.0
2	0.0	10	0.0
3	0.0	11	0.0
4	571.9	12	0.0
5	0.0	13	0.0
6	0.0	14	0.0
7	0.0	15	0.0
8	0.0	16	0.0

YEAR: 0 DAY: 1

24 HOUR AVERAGE CONCENTRATIONS AT EACH RECEPTOR

RECEPTOR	24 HR AVERAGE CONCENTRATION (UG/M**3)	RECEPTOR	24 HR AVERAGE CONCENTRATION (UG/M**3)
1	399.0	9	40.9
2	0.0	10	228.1
3	14.7	11	0.0
4	262.9	12	0.0
5	0.0	13	3.7
6	31.3	14	0.0
7	69.7	15	0.0
8	16.4	16	0.0

1.0 DAY (24 HR) AVERAGE CONCENTRATIONS AT EACH RECEPTOR

RECEPTOR	1.0 DAY AVERAGE CONCENTRATION (UG/M**3)	RECEPTOR	1.0 DAY AVERAGE CONCENTRATION (UG/M**3)
1	399.0	9	40.9
2	0.0	10	228.1
3	14.7	11	0.0
4	262.9	12	0.0
5	0.0	13	3.7
6	31.3	14	0.0
7	69.7	15	0.0
8	16.4	16	0.0

5 HIGHEST 1-HOUR AVERAGE CONCENTRATIONS AT EACH RECEPTOR

RECEPTOR	HIGHEST (UG/M**3)	2ND HIGHEST (UG/M**3)	3RD HIGHEST (UG/M**3)	4TH HIGHEST (UG/M**3)	5TH HIGHEST (UG/M**3)
1	2069.0 (1,22)	1627.7 (1, 4)	1541.5 (1,23)	1371.9 (1, 6)	926.4 (1, 5)
2	0.0 (0, 0)	0.0 (0, 0)	0.0 (0, 0)	0.0 (0, 0)	0.0 (0, 0)
3	301.4 (1,15)	52.5 (1,16)	0.0 (0, 0)	0.0 (0, 0)	0.0 (0, 0)
4	2195.9 (1, 5)	1302.2 (1,21)	1147.6 (1,22)	644.6 (1, 4)	566.2 (1,24)
5	0.0 (1,15)	0.0 (0, 0)	0.0 (0, 0)	0.0 (0, 0)	0.0 (0, 0)
6	435.5 (1,16)	309.3 (1,15)	5.5 (1,14)	0.0 (0, 0)	0.0 (0, 0)
7	1527.1 (1, 1)	114.0 (1, 9)	28.9 (1, 2)	2.1 (1, 8)	0.1 (1, 3)
8	234.1 (1,14)	74.3 (1,16)	16.4 (1,13)	15.4 (1,15)	1.3 (1,18)
9	982.7 (1, 2)	0.0 (0, 0)	0.0 (0, 0)	0.0 (0, 0)	0.0 (0, 0)
10	2172.8 (1,20)	2098.7 (1,18)	1142.2 (1,19)	34.3 (1,13)	21.7 (1,14)
11	0.0 (0, 0)	0.0 (0, 0)	0.0 (0, 0)	0.0 (0, 0)	0.0 (0, 0)
12	0.0 (0, 0)	0.0 (0, 0)	0.0 (0, 0)	0.0 (0, 0)	0.0 (0, 0)
13	67.9 (1,19)	0.0 (1,17)	0.0 (0, 0)	0.0 (0, 0)	0.0 (0, 0)
14	0.0 (0, 0)	0.0 (0, 0)	0.0 (0, 0)	0.0 (0, 0)	0.0 (0, 0)
15	0.0 (0, 0)	0.0 (0, 0)	0.0 (0, 0)	0.0 (0, 0)	0.0 (0, 0)
16	0.0 (0, 0)	0.0 (0, 0)	0.0 (0, 0)	0.0 (0, 0)	0.0 (0, 0)

5 HIGHEST 3-HOUR AVERAGE CONCENTRATIONS AT EACH RECEPTOR

RECEPTOR	HIGHEST (UG/M**3)	2ND HIGHEST (UG/M**3)	3RD HIGHEST (UG/M**3)	4TH HIGHEST (UG/M**3)	5TH HIGHEST (UG/M**3)
1	1575.3 (1,2)	1245.1 (1,8)	282.2 (1,4)	145.8 (1,7)	143.2 (1,3)
2	0.0 (0,0)	0.0 (0,0)	0.0 (0,0)	0.0 (0,0)	0.0 (0,0)
3	[illegible] (1,5)	17.4 (1,6)	0.0 (0,0)	0.0 (0,0)	0.0 (0,0)
4	787.3 (1,1)	571.9 (1,8)	434.1 (1,7)	214.9 (1,2)	75.2 (1,4)
5	0.9 (1,5)	0.0 (0,0)	0.0 (0,0)	0.0 (0,0)	0.0 (0,0)
6	145.2 (1,6)	104.9 (1,5)	0.0 (0,0)	0.0 (0,0)	0.0 (0,0)
7	513.7 (1,1)	38.7 (1,5)	0.0 (1,4)	0.0 (0,0)	0.0 (0,0)
8	106.0 (1,5)	25.3 (1,6)	0.0 (0,0)	0.0 (0,0)	0.0 (0,0)
9	327.6 (1,1)	0.0 (0,0)	0.0 (0,0)	0.0 (0,0)	0.0 (0,0)
10	1105.0 (1,7)	700.8 (1,6)	18.6 (1,5)	0.0 (0,0)	0.0 (0,0)
11	0.0 (0,0)	0.0 (0,0)	0.0 (0,0)	0.0 (0,0)	0.0 (0,0)
12	0.0 (0,0)	0.0 (0,0)	0.0 (0,0)	0.0 (0,0)	0.0 (0,0)
13	29.5 (1,7)	0.9 (1,6)	0.0 (0,0)	0.0 (0,0)	0.0 (0,0)
14	0.0 (0,0)	0.0 (0,0)	0.0 (0,0)	0.0 (0,0)	0.0 (0,0)
15	0.0 (0,0)	0.0 (0,0)	0.0 (0,0)	0.0 (0,0)	0.0 (0,0)
16	0.0 (0,0)	0.0 (0,0)	0.0 (0,0)	0.0 (0,0)	0.0 (0,0)

5 HIGHEST 24-HOUR AVERAGE CONCENTRATIONS AT EACH RECEPTOR

RECEPTOR	HIGHEST (UG/M**3)	2ND HIGHEST (UG/M**3)	3RD HIGHEST (UG/M**3)	4TH HIGHEST (UG/M**3)	5TH HIGHEST (UG/M**3)
1	599.0 (1)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)
2	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)
3	14.7 (1)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)
4	262.9 (1)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)
5	0.0 (1)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)
6	31.3 (1)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)
7	69.7 (1)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)
8	16.4 (1)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)
9	40.9 (1)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)
10	220.1 (1)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)
11	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)
12	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)
13	3.7 (1)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)
14	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)
15	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)
16	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)

TOP 50 1-HOUR AVERAGE CONCENTRATIONS

DAY	HOUR	WIND SPEED (M/S)	WIND DIRECTION (DEGREES)	STABILITY	MIXING HEIGHT (METERS)	RECEPTOR	1-HOUR CONCENTRATION (UG/M**3)
1	3	2.1	214	6	251	4	2193.9
1	20	1.5	17	6	582	10	2172.8
1	16	1.5	7	6	825	10	2098.7
1	22	1.5	222	6	338	1	2009.0
1	4	2.1	223	6	251	1	1827.7
1	23	3.1	230	6	216	1	1541.5
1	1	1.5	201	6	251	7	1527.1
1	6	2.6	232	6	251	1	1371.9
1	21	2.1	220	6	460	4	1302.2
1	22	1.5	222	6	338	4	1147.6
1	19	2.1	24	6	703	10	1142.2
1	2	2.1	176	6	251	9	982.7
1	5	3.1	233	6	251	1	926.4
1	4	2.1	223	6	251	4	644.6
1	24	4.1	220	5	94	4	566.2
1	12	10.2	226	4	683	1	509.5
1	21	2.1	220	6	460	1	437.4
1	16	3.1	324	2	891	6	435.5
1	7	3.1	255	5	251	1	429.3
1	15	1.0	312	1	891	6	309.3
1	15	1.0	312	1	891	3	301.4
1	14	2.1	344	2	891	8	284.1
1	11	8.5	234	4	579	1	244.6
1	24	4.1	220	5	94	1	184.9
1	1	1.5	201	6	251	4	167.9
1	10	5.8	221	4	475	4	148.2
1	9	4.1	197	4	371	7	114.0
1	10	5.8	221	4	475	1	92.6
1	19	2.1	24	6	703	13	87.9
1	12	10.2	226	4	683	4	76.3
1	16	3.1	324	2	891	8	74.3
1	8	3.6	213	4	267	4	56.2
1	16	3.1	324	2	891	3	52.3
1	13	2.1	3	3	787	10	34.3
1	2	2.1	176	6	251	7	28.9
1	14	2.1	349	2	891	10	21.7
1	13	2.1	3	3	767	8	18.4
1	15	1.0	312	1	891	8	15.4
1	14	2.1	349	2	891	6	5.5
1	17	1.5	11	3	891	10	3.8
1	9	4.1	197	4	371	4	2.4
1	6	3.6	213	4	267	7	2.1
1	23	3.1	230	6	216	4	1.8
1	16	1.5	7	6	825	8	1.3
1	11	8.5	234	4	579	4	1.1
1	17	1.5	11	3	891	8	0.3
1	8	3.6	213	4	267	1	0.3
1	3	2.1	214	6	251	1	0.2
1	7	3.1	255	5	251	4	0.1
1	6	2.6	232	6	251	4	0.1

TOP 50 3-HOUR AVERAGE CONCENTRATIONS

DAY	TIME PERIOD	RECEPTOR	3-HOUR CONCENTRATION (UG/M**3)
1	2	1	1375.3
1	8	1	1245.1
1	7	10	1105.0
1	1	4	787.3
1	6	10	700.8
1	8	4	571.9
1	1	7	518.7
1	7	4	434.1
1	1	9	327.6
1	4	1	282.2
1	2	4	214.9
1	7	1	145.8
1	6	6	145.2
1	3	1	143.2
1	5	8	106.0
1	5	6	104.9
1	5	5	100.5
1	4	4	75.2
1	3	7	38.7
1	7	13	29.3
1	6	8	25.3
1	3	4	19.6
1	5	10	18.6
1	6	5	17.4
1	1	1	0.1
1	5	5	0.0
1	4	7	0.0
1	6	13	0.0
0	0	0	0.0
0	0	0	0.0
0	0	0	0.0
0	0	0	0.0
0	0	0	0.0
0	0	0	0.0
0	0	0	0.0
0	0	0	0.0
0	0	0	0.0
0	0	0	0.0
0	0	0	0.0
0	0	0	0.0
0	0	0	0.0
0	0	0	0.0
0	0	0	0.0
0	0	0	0.0
0	0	0	0.0
0	0	0	0.0
0	0	0	0.0
0	0	0	0.0
0	0	0	0.0
0	0	0	0.0

TOP 50 24-HOUR AVERAGE CONCENTRATIONS

DAY	RECEPTOR	24-HOUR CONCENTRATION (UG/M**3)
1	1	399.0
1	4	262.9
1	10	228.1
1	7	69.7
1	9	40.9
1	6	31.3
1	8	16.4
1	3	14.7
1	13	3.7
1	5	0.0
0	0	0.0
0	0	0.0
0	0	0.0
0	0	0.0
0	0	0.0
0	0	0.0
0	0	0.0
0	0	0.0
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0	0	0.0
0	0	0.0