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SCREEN2 Model User's Guide

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PREFACE

The SCREEN2 Model User's Guide is the PC-oriented documentation for the SCREEN2 model. The SCREEN2 model includes several modifications and enhancements to the original SCREEN model, including updates to the code to ensure consistency with the dispersion algorithms in the Industrial Source Complex (ISC2) model (EPA, 1992). The SCREEN2 model has been included in the "Guideline on Air Quality Models (Revised)" as part of Supplement B.

Copies of the SCREEN2 model may be obtained from two sources. They are the National Technical Information Service (NTIS), U.S Department of Commerce, 5285 Port Royal Road, Springfield, VA 22161, telephone (703) 487-4650, and the Support Center for Regulatory Models (SCRAM) Bulletin Board System (BBS). The SCRAM BBS may be accessed at (919) 541-5742.

ACKNOWLEDGEMENTS

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1. INTRODUCTION

1.1 Overview of User's Guide

It will be easier to understand this user's guide and the SCREEN2 model by being familiar with the "Screening Procedures for Estimating the Air Quality Impact of Stationary Sources, Revised" (EPA, 1992a). The SCREEN2 Model User's Guide is PC-oriented instruction and application of this document.

This introduction should answer most general questions about what the SCREEN2 model can (and cannot) do, and explain its relationship to the Screening Procedures Document (SPD) above.

Section 2 provides several examples of how to run the SCREEN2 model and will also help the novice user get started. The point source example provides the most detailed description and should be read before the other examples. Being familiar with personal computers and with the screening procedures will prevent excessive difficulties running SCREEN2 and "experimenting" with it. It runs interactively, and the prompts should be self explanatory.

Section 3 provides background technical information as a reference for those who want to know more about how SCREEN2 makes certain calculations. The discussion in Section 3 is intended to be as brief as possible, with reference to other documents for more detailed descriptions.

1.2 Purpose of SCREEN2

The SCREEN2 model was developed to provide an easy-to-use method of obtaining pollutant concentration estimates based on the new screening procedures document. By taking advantage of the rapid growth in the availability and use of personal computers (PCs), the SCREEN2 model makes screening calculations accessible to a wide range of users.

1.3 What is needed in order to use SCREEN2?

SCREEN2 will run on an IBM-PC compatible personal computer with at least 256K of RAM. You will need at least one 5 1/4 inch double-sided, double-density (360K), a 5 1/4 inch high density (1.2MB), or a 3.5 inch high density (1.4MB) disk drive. The program will run with or without a math coprocessor chip. Execution time will be greatly enhanced with a math coprocessor chip present (about a factor of 5 in runtime) and will also benefit from the use of a hard disk drive. SCREEN2 will write a date and time to the output file, provided that a real time clock is available.

1.4 What will SCREEN2 do?

SCREEN2 runs interactively on the PC, meaning that the program asks the user a series of questions in order to obtain the necessary input data, and to determine which options to exercise. SCREEN2 can perform all of the single source, short-term calculations in the screening procedures document, including estimating maximum ground-level concentrations and the distance to the maximum (Step 4 of Section 4.2, SPD), incorporating the effects of building downwash on the maximum concentrations for both the near wake and far wake regions (Section 4.5.1), estimating concentrations in the cavity recirculation zone (Section 4.5.1), estimating concentrations due to inversion break-up and shoreline fumigation (Section 4.5.3), and determining plume rise for flare releases (Step 1 of Section 4.2). The model can incorporate the effects of simple elevated terrain on maximum concentrations (Section 4.2), and can also estimate 24-hour average concentrations due to plume impaction in complex terrain using the VALLEY model 24-hour screening procedure (Section 4.5.2). Simple area sources can be modeled with SCREEN2 using a finite line segment approach, consistent with the ISCST2 model (Section 4.5.4). The SCREEN2 model can also be used to model the effects of simple volume sources using a virtual point source procedure (Section 4.5.5). The volume source algorithm is described at length in Volume II of the ISC2 model user's guide (EPA, 1992). The SCREEN2 model can also calculate the maximum concentration at any number of user-specified distances in flat or elevated simple terrain (Section 4.3), including distances out to 100km for long-range transport (Section 4.5.7).

1.5 What will SCREEN2 not do?

SCREEN2 can not explicitly determine maximum impacts from multiple sources, except for the procedure to handle multiple nearby stacks by merging emissions into a single "representative" stack (Section 2.2). The user is directed to the MPTER (Pierce, et al, 1980) or ISC2 (EPA, 1992) models on EPA's Support Center for Regulatory Air Models (SCRAM) Bulletin Board System (BBS) to model short-term impacts for multiple sources. With the exception of the 24-hour estimate for complex terrain impacts, the results from SCREEN2 are estimated maximum 1-hour concentrations. To handle longer period averages, the screening procedures document contains recommended adjustment factors to estimate concentrations out to 24 hours from the maximum 1-hour value (Section 4.2, Step 5). For seasonal or annual averages, Section 4.4 of the screening procedures document contains a procedure using hand calculations, but the use of ISCLT2 or another long-term model on the SCRAM BBS is recommended.

1.6 How will SCREEN2 results compare to hand calculations?

The SCREEN2 model is based on the same modeling assumptions that are incorporated into the screening procedures and nomographs, and for many sources the results will be very comparable, with estimated maximum concentrations differing by less than about 5 percent across a range of source characteristics. However, there are a few differences of which the user should be aware. For some sources, particularly taller sources with greater buoyancy, the differences in estimated concentrations will be larger, with the hand calculation exceeding the SCREEN2 model result by as much as 25 percent. These differences are described in more detail below.

The SCREEN2 model can provide estimated concentrations for distances less than 100 meters (down to one meter as in other regulatory models), whereas the nomographs used in the hand calculations are limited to distances greater than or equal to 100 meters. The SCREEN2 model is also not limited to plume heights of 300 meters, whereas the nomographs are. In both cases, caution should be used in interpreting results that are outside the range of the nomographs.

In addition, SCREEN2 examines a full range of meteorological conditions, including all stability classes and wind speeds (see Section 3) to find maximum impacts, whereas to keep the hand calculations tractable only a subset of meteorological conditions (stability classes A, C, and E or F) likely to contribute to the maximum concentration are examined. The use of a full set of meteorological conditions is required in SCREEN2 because maximum concentrations are also given as a function of distance, and because A, C, and E or F stability may not be controlling for sources with building downwash (not included in the hand calculations). SCREEN2 explicitly calculates the effects of multiple reflections of the plume off the elevated inversion and off the ground when calculating concentrations under limited mixing conditions. To account for these reflections, the hand calculation screening procedure (Procedure (a) of Step 4 in Section 4.2, SPD) increases the calculated maximum concentrations for A stability by a factor ranging from 1.0 to 2.0. The factor is intended to be a conservative estimate of the increase due to limited mixing, and may be slightly higher (about 5 to 10 percent) than the increase obtained from SCREEN2 using the multiple reflections, depending on the source. Also, SCREEN2 handles the near neutral/high wind speed case [Procedure (b)] by examining a range of wind speeds for stability class C and selecting the maximum. In contrast, the hand calculations are based on the maximum concentration estimated using stability class C with a calculated critical wind speed and a 10 meter wind speed of 10 m/s. This difference should result in differences in maximum concentrations of less than about 5 percent for those sources where the near neutral/high wind speed case is controlling.

The SCREEN2 model results also include the effects of buoyancy-induced dispersion (BID), which are not accounted for by the hand calculations (except for fumigation). The inclusion of BID in SCREEN2 may either increase or decrease the estimated concentrations, depending on the source and distance. For sources with plume heights below the 300 meter limit of the hand calculations, the effect of BID on estimated maximum concentrations will usually be less than about ± 10 percent. For elevated sources with relatively large buoyancy, the inclusion of BID may be expected to decrease the estimated maximum concentration by as much as 25 percent.

1.7 What changes have been incorporated into SCREEN2?

The SCREEN2 model (dated 92245) includes several modifications relative to the original release of SCREEN (dated 88300). These changes were made in order for the SCREEN2 model to be more consistent with the ISCST2 model (dated 92062), especially for the downwash algorithms. Significant portions of the ISCST2 model code have been incorporated into the SCREEN2 model both to ensure consistency of calculations and to facilitate any future revisions that potentially affect both models.

The following SCREEN2 enhancements were made to ensure that the SCREEN2 model gives conservative concentration estimates relative to the ISCST2 model. These changes include modifications to the iteration procedure used to locate the peak concentration, the addition of wind speeds in 0.5 m/s increments for 10-meter wind speeds less than 5.0 m/s, and the addition of F stability with a 0.035 K/m lapse rate for the urban dispersion option.

The virtual point source algorithm used for area sources in the original SCREEN model has been replaced with a finite line segment approach for consistency with ISCST2 (version 92062). The emission rate input units have been changed to $g/(s\text{-}m^2)$ for consistency with ISCST2, and the distances are now measured from the center of the area source.

A new source type option has been added to SCREEN2 for modeling volume sources. The SCREEN2 volume source algorithm is based on a virtual point source approach, consistent with the ISCST2 model. This option has been added to give the user greater flexibility in modeling various source types, particularly for certain types of air toxic releases.

An option to input volumetric flow rate in lieu of stack gas exit velocity has been incorporated in SCREEN2 for point sources. The flow rate can be input in either English units, Actual Cubic Feet per Minute (ACFM), or metric units (m^3/s).

1.8 How does SCREEN2 differ from PTPLU, PTMAX and PTDIS?

The PT-series of models have been used in the past to obtain results for certain screening procedures in Volume 10R. The SCREEN2 model is designed specifically as a computerized implementation of the revised screening procedures, and is much more complete than the earlier models, as described above. The SCREEN2 model also requires less manual "postprocessing" than the earlier models by listing the maximum concentrations in the output. However, many of the algorithms in SCREEN2 are the same as those contained in PTPLU-2.0. For the same source parameters and for given meteorological conditions, the two models will give comparable results. SCREEN2 also incorporates the option to estimate concentrations at discrete user-specified distances, which was available with PTDIS, but is not included in PTPLU.

2. TUTORIAL

2.1 What is needed?

- IBM-PC compatible with at least 256K bytes of RAM, and a 5 1/4 inch double-sided, double-density or 5 1/4 inch high density, or a 3.5 inch high density disk drive.
- Diskette provided with SCREEN2 software.
- Hard or floppy disk drive (minimum of 550K memory available).
- Math coprocessor chip (optional but recommended).
- Blank diskette for use in making a backup copy of software.

2.2 Setup on the PC

Using the DISKCOPY command of DOS (Disk Operating System) or similar routine, make a backup copy of the SCREEN2 software. Store the original SCREEN2 software diskette in a safe location. The DISKCOPY command will also format the blank disk if needed.

The following set-up instructions assume that the user has a system with a hard disk drive and the "pkunzip" decompression program resident on the hard disk drive. The "pkunzip" program can be obtained via the Support Center for Regulatory Air Models (SCRAM) Bulletin Board System (BBS) by accessing the archivers/dearchivers option under system utilities on the top menu.

Insert the SCREEN2 diskette in floppy drive A: and enter the following command at the DOS prompt from drive C: (either from the root directory or a subdirectory):

```
PKUNZIP A:SCREEN2
```

This command will decompress the six files from the SCREEN2 diskette and place them on the hard disk. The hard disk will now contain the executable file of SCREEN2, called SCREEN2.EXE, as well as the FORTRAN source files, SCREEN2.FOR and MAIN.INC, an example input file, EXAMPLE.DAT, an associated output file EXAMPLE.OUT, and this document, the SCREEN2 Model User's Guide (in WordPerfect 5.1 format), SCREEN2.WPF.

2.3 Executing the Model

The SCREEN2 model is written as an interactive program for the PC, as described earlier. Therefore, SCREEN2 is normally executed by simply typing SCREEN2 from any drive and directory that contains the SCREEN2.EXE file, and responding to the prompts provided by the program. However, a mechanism has been provided to accommodate the fact that for some applications of SCREEN2 the user might want to perform several runs for the same source changing only one or a few input parameters. This mechanism takes advantage of the fact that the Disk Operating System (DOS) on PCs allows for the redirection of input that is normally provided via the keyboard to be read from a file instead. As an example, to run the sample problem provided on the disk one would type:

SCREEN2 <EXAMPLE.DAT

at the DOS prompt. The SCREEN2 model will then read the responses to its prompts from the EXAMPLE.DAT file rather than from the keyboard. The output from this run will be stored in a file called SCREEN.OUT, which can then be compared with the EXAMPLE.OUT file provided on the program disk. The file containing the redirected input data may be given any valid DOS pathname. To facilitate the creation of the input file for the SCREEN2 model, SCREEN2 has been programmed to write out all inputs provided to a file called SCREEN.DAT during execution. Therefore, at the completion of a run, if the user types

SCREEN2 <SCREEN.DAT

the last run will be duplicated exactly. Alternatively, the SCREEN.DAT file may be edited as an ASCII file using a text or line editor, and selected input parameters changed before rerunning the model. Since the original SCREEN.DAT file will be overwritten each time the model is run, it is advisable to save the modified inputs under a different file name.

Some cautions are needed regarding the use of redirected input with SCREEN2. Because of the way some input errors are handled by SCREEN2, the SCREEN.DAT file may contain some of the errors from the original input. While SCREEN.DAT should still reproduce the correct results, it will be easier to work with the file if the original input does not contain any errors. More importantly, since the inputs requested by SCREEN2 depend on the options selected, it is not advisable to edit the SCREEN.DAT file and try to change the options selected. An experienced user may be able to do this, especially with the help of the input flow charts provided later in this section, but it may be easier simply to rerun SCREEN2 with the new options.

2.4 Point Source Example

When running SCREEN2 for a point source, or for flare releases and area sources discussed below, the user is first asked to provide a one line title (up to 79 characters) that will appear on the output file. The user will then be asked to identify the source type, and should enter P for a point source, F for a flare release, A for an area source, or V for a volume source (the model will identify either upper or lower case letters and will repeat the prompt until a valid response is given).

For a point source, the user will be asked to provide the following inputs:

Point Source Inputs

Emission rate (g/s)
Stack height (m)
Stack inside diameter (m)
Stack gas exit velocity (m/s) or
  flow rate (ACFM or m^3/s)
Stack gas temperature (K)
Ambient temperature (K) (use default of 293K if
  not known)
Receptor height above ground (may be used to
  define flagpole receptors) (m)
Urban/rural option (U = urban, R = rural)

The SCREEN2 model uses free format to read the numerical input data, with the exception of the exit velocity/flow rate option. The default choice for this input is stack gas exit velocity, which SCREEN2 will read as free format. However, if the user precedes the input with the characters VF= in columns 1-3, then SCREEN2 will interpret the input as flow rate in actual cubic feet per minute (ACFM). Alternatively, if the user inputs the characters VM= in columns 1-3, then SCREEN2 will interpret the input as flow rate in m^3/s. The user can input either upper or lower case characters for VF and VM. The flow rate values are then converted to exit velocity in m/s for use in the plume rise equations, based on the diameter of the stack.

SCREEN2 allows for the selection of urban or rural dispersion coefficients. The urban dispersion option is selected by entering a 'U' (lower or upper case) in column 1, while the rural dispersion option is selected by entering an 'R' (upper or lower case) in column 1. For compatibility with the previous version of the model, SCREEN2 also allows for an input of '1' to select the urban option, or a '2' to select the rural option. Determination of the applicability of urban or rural dispersion is based upon land use or population density. For determination by land use, (1) circumscribe a 3km radius circle, A_o, about the source using the meteorological land use typing scheme and (2) if land use types I1, I2, C1, R2, and R3 account for 50 percent or more of A_o, select the urban option, otherwise use the rural option. Using the population density criteria, (1) compute the average population density, "p", per square kilometer with A_o as defined above and (2) if "p" is greater than 750 people/km², use the urban option, otherwise select the rural option. Of the two methods, the land use procedure is considered more definitive. This guidance is extracted from Section 8.2.8 of the "Guideline On Air Quality Models (Revised)" (EPA, 1986).

Figure 1 presents the order of options within the SCREEN2 model for point sources and is annotated with the corresponding sections from the screening procedures document. In order to obtain results from SCREEN2 corresponding to the procedures in Step 4 of Section 4.2, the user should select the full meteorology option, the automated distance array option, and, if applicable for the source, the simple elevated terrain option. The simple elevated terrain option would be used if the terrain rises above the stack base elevation but is less than the height of the physical stack. These, as well as the other options in Figure 1, are explained in more detail below. A flagpole receptor is defined as any receptor which is located above local ground level, e.g., to represent the roof or balcony of a building.

2.4.1 Building Downwash Option

Following the basic input of source characteristics SCREEN2 will first ask if building downwash is to be considered, and if so, asks for the building height, minimum horizontal dimension, and maximum horizontal dimension in meters. The downwash screening procedure assumes that the building can be approximated by a simple rectangular box. Wake effects are included in any calculations made using the automated distance array or discrete distance options (described below). Cavity calculations are made for two building orientations - first with the minimum horizontal building dimension alongwind, and second with the maximum horizontal dimension alongwind. The cavity calculations are summarized at the end of the distance-dependent calculations. Refer to Section 3.6 for more details on the building downwash cavity and wake screening procedure.

2.4.2 Complex Terrain Option

The complex terrain option of SCREEN2 allows the user to estimate impacts for cases where terrain elevations exceed stack height. If the user selects this option, then SCREEN2 will calculate and print out a final stable plume height and distance to final rise for the VALLEY model 24-hour screening technique. This technique assumes stability class F (E for urban) and a stack height wind speed of 2.5 m/s. For complex terrain, maximum impacts are expected to occur for plume impaction on the elevated terrain under stable conditions. The user is therefore instructed to enter minimum distances and terrain heights for which impaction is likely, given the plume height calculated, and taking into account complex terrain closer than the distance to final rise. If the plume is at or below the terrain height for the distance entered, then SCREEN2 will make a 24-hour concentration estimate using the VALLEY screening technique. If the terrain is above stack height but below plume centerline height for the distance entered, then SCREEN2 will make a VALLEY 24-hour estimate (assuming E or F and 2.5 m/s), and also estimate the maximum concentration across a full range of meteorological conditions using simple terrain procedures with terrain "chopped off" at physical stack height. The higher of the two estimates is selected as controlling for that distance and terrain height (both estimates are printed out for comparison). The simple terrain estimate is adjusted to represent a 24-hour average by multiplying by a factor of 0.4, while the VALLEY 24-hour estimate incorporates the 0.25 factor used in the VALLEY model. Calculations continue for each terrain height/distance combination entered until a terrain height of zero is entered. The user will then have the option to continue with simple terrain calculations or to exit the program. It should be noted that SCREEN2 will not consider building downwash effects in either the VALLEY or the simple terrain component of the complex terrain screening procedure, even if the building downwash option is selected. SCREEN2 also uses a receptor height above ground of 0.0m (i.e. no flagpole receptors) in the complex terrain option even if a non-zero value is entered. The original receptor height is saved for later calculations. Refer to Section 3 for more details on the complex terrain screening procedure.

2.4.3 Simple Elevated or Flat Terrain Option

The user is given the option in SCREEN2 of modeling either simple elevated terrain, where terrain heights exceed stack base but are below stack height, or simple flat terrain, where terrain heights are assumed not to exceed stack base elevation. If the user elects not to use the option for simple terrain screening with terrain above stack base, then flat terrain is assumed and the terrain height is assigned a value of zero. If the simple elevated terrain option is used, SCREEN2 will prompt the user to enter a terrain height above stack base. If terrain heights above physical stack height are entered by the user for this option, they are chopped off at the physical stack height.

The simple elevated terrain screening procedure assumes that the plume elevation above sea level is not affected by the elevated terrain. Concentration estimates are made by reducing the calculated plume height by the user-supplied terrain height above stack base. Neither the plume height nor terrain height are allowed to go below zero. The user can model simple elevated terrain using either or both of the distance options described below, i.e., the automated distance array or the discrete distance option. When the simple elevated terrain calculations for each distance option are completed, the user will have the option of continuing simple terrain calculations for that option with a new terrain height. (For flat terrain the user will not be given the option to continue with a new terrain height). For conservatism and to discourage the user from modeling terrain heights that decrease with distance, the new terrain height for the automated distances cannot be lower than the previous height for that run. The user is still given considerable flexibility to model the effects of elevated terrain below stack height across a wide range of situations.

For relatively uniform elevated terrain, or as a "first cut" conservative estimate of terrain effects, the user should input the maximum terrain elevation (above stack base) within 50 km of the source, and exercise the automated distance array option out to 50 km. For isolated terrain features a separate calculation can be made using the discrete distance option for the distance to the terrain feature, with the terrain height input as the maximum height of the feature above stack base. Where terrain heights vary with distance from the source, then the SCREEN2 model can be run on each of several concentric rings using the minimum and maximum distance inputs of the automated distance option to define each ring, and using the maximum terrain elevation above stack base within each ring for terrain height input. As noted above, the terrain heights are not allowed to decrease with distance in SCREEN2. If terrain decreasing with distance (in all directions) can be justified for a particular source, then the distance rings would have to be modeled using separate SCREEN2 runs, and the results combined. The overall maximum concentration would then be the controlling value. The optimum ring sizes will depend on how the terrain heights vary with distance, but as a "first cut" it is suggested that ring sizes of about 5 km be used (i.e., 0-5km, 5-10km, etc.). The application of SCREEN2 to evaluating the effects of elevated terrain should be done in consultation with the permitting agency.

2.4.4 Choice of Meteorology

For simple elevated or flat terrain screening, the user will be given the option of selecting from three choices of meteorology: (1) full meteorology (all stability classes and wind speeds); (2) specifying a single stability class; or (3) specifying a single stability class and wind speed. Generally, the full meteorology option should be selected. The other two options were originally included for testing purposes only, but may be useful when particular meteorological conditions are of concern. Refer to Section 3 for more details on the determination of worst case meteorological conditions by SCREEN2.

2.4.5 Automated Distance Array Option

The automated distance array option of SCREEN2 gives the user the option of using a pre-selected array of 50 distances ranging from 100m out to 50 km. Increments of 100m are used out to 3,000m, with 500m increments from 3,000m to 10 km, 5 km increments from 10 km to 30 km, and 10 km increments out to 50 km. When using the automated distance array, SCREEN2 prompts the user for a minimum and maximum distance to use, which should be input in free format, i.e., separated by a comma or a space. SCREEN2 then calculates the maximum concentration across a range of meteorological conditions for the minimum distance given (≥ 1 meter), and then for each distance in the array larger than the minimum and less than or equal to the maximum. Thus, the user can input the minimum site boundary distance as the minimum distance for calculation and obtain a concentration estimate at the site boundary and beyond, while ignoring distances less than the site boundary.

If the automated distance array is used, then the SCREEN2 model will use an iteration routine to determine the maximum value and associated distance to the nearest meter. If the minimum and maximum distances entered do not encompass the true maximum concentration, then the maximum value calculated by SCREEN2 may not be the true maximum. Therefore, it is recommended that the maximum distance be set sufficiently large initially to ensure that the maximum concentration is found. This distance will depend on the source, and some "trial and error" may be necessary, however, the user can input a distance of 50,000m to examine the entire array. The iteration routine stops after 50 iterations and prints out a message if the maximum is not found. Also, since there may be several local maxima in the concentration distribution associated with different wind speeds, it is possible that SCREEN2 will not identify the overall maximum in its iteration. This is not likely to be a frequent occurrence, but will be more likely for stability classes C and D due to the larger number of wind speeds examined.

2.4.6 Discrete Distance Option

The discrete distance option of SCREEN2 allows the user to input specific distances. Any number of distances (≥ 1 meter) can be input by the user and the maximum concentration for each distance will be calculated. The user will always be given this option whether or not the automated distance array option is used. The option is terminated by entering a distance of zero (0). SCREEN2 will accept distances out to 100 km for long-range transport estimates with the discrete distance option. However, for distances greater than 50 km, SCREEN2 sets the minimum 10 meter wind speed at 2 m/s to avoid unrealistic transport times.

2.4.7 Fumigation Option

Once the distance-dependent calculations are completed, SCREEN2 will give the user the option of estimating maximum concentrations and distance to the maximum associated with inversion break-up fumigation, and shoreline fumigation. The option for fumigation calculations is applicable only for rural inland sites with stack heights greater than or equal to 10 meters (within 3,000m onshore from a large body of water.) The fumigation algorithm also ignores any potential effects of elevated terrain.

Once all calculations are completed, SCREEN2 summarizes the maximum concentrations for each of the calculation procedures considered. Before execution is stopped, whether it is after complex terrain calculations are completed or at the end of the simple terrain calculations, the user is given the option of printing a hardcopy of the results. Whether or not a hardcopy is printed, the results of the session, including all input data and concentration estimates, are stored in a file called SCREEN.OUT. This file is opened by the model each time it is run. If a file named SCREEN.OUT already exists, then its contents will be overwritten and lost. Thus, if you wish to save results of a particular run, then change the name of the output file using the DOS RENAME command, e.g., type 'REN SCREEN.OUT SAMPLE1.OUT', or print the file using the option at the end of the program. If SCREEN.OUT is later printed using the DOS PRINT command, the FORTRAN carriage controls will not be observed. (Instructions are included in Section 4 for simple modifications to the SCREEN2 code that allow the user to specify an output filename for each run.)

Figure 2 shows an example using the complex terrain screen only. Figure 3 shows an example for an urban point source which uses the building downwash option. In the DWASH column of the output, 'NO' indicates that no downwash is included, 'HS' means that Huber-Snyder downwash is included, 'SS' means that Schulman-Scire downwash is included, and 'NA' means that downwash is not applicable since the downwind distance is less than $3L_b$. A blank in the DWASH column means that no calculation was made for that distance because the concentration was so small.

Figure 4 presents a flow chart of all the inputs and various options of SCREEN2 for point sources. Also illustrated are all of the outputs from SCREEN2. If a cell on the flow chart does not contain the words "Enter" or "Print out", then it is an internal test or process of the program, and is included to show the flow of the program.

2.5 Flare Release Example

By answering "F" or "f" to the question on source type the user selects the flare release option. This option is similar to the point source described above except for the inputs needed to calculate plume rise. The inputs for flare releases are as follows:

Flare Release Inputs

Emission rate (g/s)
Flare stack height (m)
Total heat release rate (cal/s)
Receptor height above ground (m)
Urban/rural option (U = urban, R = rural)

The SCREEN2 model calculates plume rise for flares based on an effective buoyancy flux parameter. An ambient temperature of 293K is assumed in this calculation and therefore none is input by the user. It is assumed that 55 percent of the total heat is lost due to radiation. Plume rise is calculated from the top of the flame, assuming that the flame is bent 45 degrees from the vertical. SCREEN2 calculates and prints out the effective release height for the flare. SCREEN2 provides the same options for flares as described earlier for point sources, including building downwash, complex and/or simple terrain, fumigation, and the automated and/or discrete distances. The order of these options and the user prompts are the same as described for the point source example.

While building downwash is included as an option for flare releases, it should be noted that SCREEN2 assumes an effective stack gas exit velocity (v_s) of 20 m/s and an effective stack gas exit temperature (T_s) of 1,273K, and calculates an effective stack diameter based on the heat release rate. These effective stack parameters are somewhat arbitrary, but the resulting buoyancy flux estimate is expected to give reasonable final plume rise estimates for flares. However, since building downwash estimates depend on transitional momentum plume rise and transitional buoyant plume rise calculations, the selection of effective stack parameters could influence the estimates. Therefore, building downwash estimates should be used with extra caution for flare releases. If more realistic stack parameters can be determined, then the estimate could alternatively be made with the point source option of SCREEN2. In doing so, care should be taken to account for the vertical height of the flame in specifying the release height (see Section 3). Figure 5 shows an example for a flare release, and Figure 6 shows a flow chart of the flare release inputs, options, and output.

2.6 Area Source Example

The third source type option in SCREEN2 is for area sources. The area source algorithm in SCREEN2 is based on a finite line segment approach consistent with ISCST2 (dated 92062), and assumes that the area source can be approximated by a simple square area. The inputs requested for area sources are as follows:

Area Source Inputs

Emission rate [g/(s-m^2)]
Source release height (m)
Length of side of the square area (m)
Receptor height above ground (m)
Urban/rural option (U = urban, R = rural)

Note that the emission rate for area sources is input as an emission rate per unit area in units of g/(s-m^2). These units are consistent with the ISCST2 model (version 92062), but differ from the original SCREEN model which used input units of g/s for a total emission rate for the area.

The user has the same options for handling distances and the same choices of meteorology as described above for point sources, but no complex terrain, elevated simple terrain, building downwash, or fumigation calculations are made for area sources. Distances are measured from the center of the square area. Since this algorithm cannot estimate concentrations within the area source, the model will give a concentration of zero for distances less than XINIT/$\sqrt{\pi}$, where XINIT is the width of the area. Figure 7 shows an example of SCREEN2 for an area source, using both the automated and discrete distance options. Figure 8 provides a flow chart of inputs, options, and outputs for area sources.

2.7 Volume Source Example

The fourth source type option in SCREEN2 is for volume sources. The volume source algorithm is based on a virtual point source approach, consistent with the ISCST2 model (version 92062), and may be used for non-buoyant sources whose emissions occupy some initial volume. The inputs requested for volume sources are as follows:

Volume Source Inputs

Emission rate (g/s)
Source release height (m)
Initial lateral dimension of volume (m)
Initial vertical dimension of volume (m)
Receptor height above ground (m)
Urban/rural option (U = urban, R = rural)

The user must determine the initial dimensions of the volume source plume before exercising the SCREEN2 model volume source. Table 1 provides guidance on determining these inputs. Since the volume source algorithm cannot estimate concentrations within the volume source, the model will give a concentration of zero for distances (measured from the center of the volume) of less than 2.15 σ_{yo}. Figure 9 shows an example of SCREEN2 for a volume source, and Figure 10 provides a flow chart of inputs, options, and outputs for volume sources.

TABLE 1.
Summary of Suggested Procedures for Estimating Initial Lateral Dimensions (σ_{yo}) and Initial Vertical Dimensions (σ_{zo}) for Volume Sources

Description of Source	Initial Dimension
(a) Initial Lateral Dimensions (σ_{yo})	
Single Volume Source	σ_{yo} = length of side divided by 4.3
(b) Initial Vertical Dimensions (σ_{zo})	
Surface-Based Source ($h_e \sim 0$)	σ_{zo} = vertical dimension of source divided by 2.15
Elevated Source ($h_e > 0$) on or Adjacent to a Building	σ_{zo} = building height divided by 2.15
Elevated Source ($h_e > 0$) not on or Adjacent to a Building	σ_{zo} = vertical dimension of source divided by 4.3

Order of Options in SCREEN2	Corresponding Section in Screening Procedures Document
Input Source Characteristics	
Building Downwash Option	Section 4 5 1
Complex Terrain Option	Section 4.5 2
Simple Elevated or Flat Terrain Option*	Section 4.2
Choice of Meteorology*	Section 4 2, Step 4
Automated Distance Array Option*	Section 4.2, Step 4
Discrete Distance Option*	Section 4.3 for Distances < 50km Section 4.5.7 for Distances > 50km
Fumigation Option (Rural Only)	Section 4.5.3

*These options also apply to Area Sources, Section 4 5 4

Figure 1. Point Source Options in SCREEN2

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*** SCREEN2 MODEL RUN ***
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POINT SOURCE EXAMPLE WITH COMPLEX TERRAIN

COMPLEX TERRAIN INPUTS:

SOURCE TYPE	=	POINT
EMISSION RATE (G/S)	=	100.000
STACK HT (M)	=	100.0000
STACK DIAMETER (M)	=	2.5000
STACK VELOCITY (M/S)	=	25.0000
STACK GAS TEMP (K)	=	450.0000
AMBIENT AIR TEMP (K)	=	293.0000
RECEPTOR HEIGHT (M)	=	.0000
URBAN/RURAL OPTION	=	RURAL

BUOY. FLUX = 133.643 M**4/S**3; MOM. FLUX = 635.851 M**4/S**2.

FINAL STABLE PLUME HEIGHT (M) = 192.9
DISTANCE TO FINAL RISE (M) = 151.3

			VALLEY 24-HR CALCS		**SIMPLE TERRAIN 24-HR CALCS**				
TERR HT (M)	DIST (M)	MAX 24-HR CONC (UG/M**3)	CONC (UG/M**3)	PLUME HT ABOVE STK BASE (M)	CONC (UG/M**3)	PLUME HT ABOVE STK HGT (M)	SC	U10M (M/S)	USTK (M/S)
150.	1000.	243.4	243.4	192.9	161.1	32.9	4	15.0	21.2
200.	2000.	284.3	284.3	192.9	.0000	.0	0	.0	.0
200.	5000.	91.39	91.39	192.9	.0000	.0	0	.0	.0
200.	10000.	37.36	37.36	192.9	.0000	.0	0	.0	.0

****
*** SUMMARY OF SCREEN MODEL RESULTS ***
****

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
COMPLEX TERRAIN	284.3	2000.	200. (24-HR CONC)

****
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
****

Figure 2. SCREEN2 Point Source Example for Complex Terrain

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*** SCREEN2 MODEL RUN ***
*** VERSION DATED 92245 ***

POINT SOURCE EXAMPLE WITH BUILDING DOWNWASH

```
SIMPLE TERRAIN INPUTS:
   SOURCE TYPE            =       POINT
   EMISSION RATE (G/S)    =     100.000
   STACK HEIGHT (M)       =    100.0000
   STK INSIDE DIAM (M)    =      2.0000
   STK EXIT VELOCITY (M/S)=     15.0000
   STK GAS EXIT TEMP (K)  =    450.0000
   AMBIENT AIR TEMP (K)   =    293.0000
   RECEPTOR HEIGHT (M)    =       .0000
   URBAN/RURAL OPTION     =       URBAN
   BUILDING HEIGHT (M)    =     80.0000
   MIN HORIZ BLDG DIM (M) =     80.0000
   MAX HORIZ BLDG DIM (M) =    100.0000


BUOY. FLUX =   51.319 M**4/S**3;  MOM. FLUX =  146.500 M**4/S**2.

*** FULL METEOROLOGY ***

**********************************
*** SCREEN AUTOMATED DISTANCES ***
**********************************

*** TERRAIN HEIGHT OF    0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

  DIST     CONC              U10M   USTK  MIX HT   PLUME   SIGMA   SIGMA
   (M)   (UG/M**3)   STAB   (M/S)  (M/S)    (M)   HT (M)   Y (M)   Z (M)  DWASH
 ------- ----------  ----   -----  -----  ------  ------  ------  ------  -----
   100.   .0000        0      .0     .0      .0     .00     .00     .00    NA
   200.   .0000        0      .0     .0      .0     .00     .00     .00    NA
   300.   631.6        1     1.5    2.1   480.0  125.11   90.71   82.09    SS
   400.   517.4        1     1.5    2.1   480.0  140.59  118.85  113.59    SS
   500.   494.6        6     1.0    2.0 10000.0  113.08   50.21   50.05    SS
   600.   578.0        6     1.0    2.0 10000.0  113.08   59.27   54.62    SS
   700.   638.4        6     1.0    2.0 10000.0  113.08   68.06   59.18    SS
   800.   715.3        6     1.0    2.0 10000.0  113.08   76.59   65.44    SS
   900.   699.4        6     1.0    2.0 10000.0  113.08   84.89   68.33    SS
  1000.   681.9        6     1.0    2.0 10000.0  113.08   92.97   71.13    SS

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND    100. M:
   800.   715.3        6     1.0    2.0 10000.0  113.08   76.59   65.44    SS

 DWASH=   MEANS NO CALC MADE (CONC = 0.0)
 DWASH=NO MEANS NO BUILDING DOWNWASH USED
 DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
 DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
 DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB
```

Figure 3. SCREEN2 Point Source Example with Building Downwash (Page 1 of 2)

```
 *** CAVITY CALCULATION - 1 ***        *** CAVITY CALCULATION - 2 ***
  CONC (UG/M**3)      =   3168.         CONC (UG/M**3)      =   1691.
  CRIT WS @10M (M/S) =    3.32         CRIT WS @10M (M/S) =    7.77
  CRIT WS @ HS (M/S) =    5.26         CRIT WS @ HS (M/S) =   12.32
  DILUTION WS (M/S)  =    2.63         DILUTION WS (M/S)  =    6.16
  CAVITY HT (M)      =  114.88         CAVITY HT (M)      =  105.20
  CAVITY LENGTH (M)  =  142.41         CAVITY LENGTH (M)  =  101.30
  ALONGWIND DIM (M)  =   80.00         ALONGWIND DIM (M)  =  100.00

     ***************************************
     *** SUMMARY OF SCREEN MODEL RESULTS ***
     ***************************************

 CALCULATION        MAX CONC      DIST TO   TERRAIN
  PROCEDURE        (UG/M**3)      MAX (M)    HT (M)
 --------------    -----------    -------   -------
SIMPLE TERRAIN      715.3           800.        0.

BUILDING CAVITY-1   3168.           142.       --   (DIST = CAVITY LENGTH)
BUILDING CAVITY-2   1691.           101.       --   (DIST = CAVITY LENGTH)


***************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
***************************************************
```

Figure 3. SCREEN2 Point Source Example with Building Downwash (Page 2 of 2)

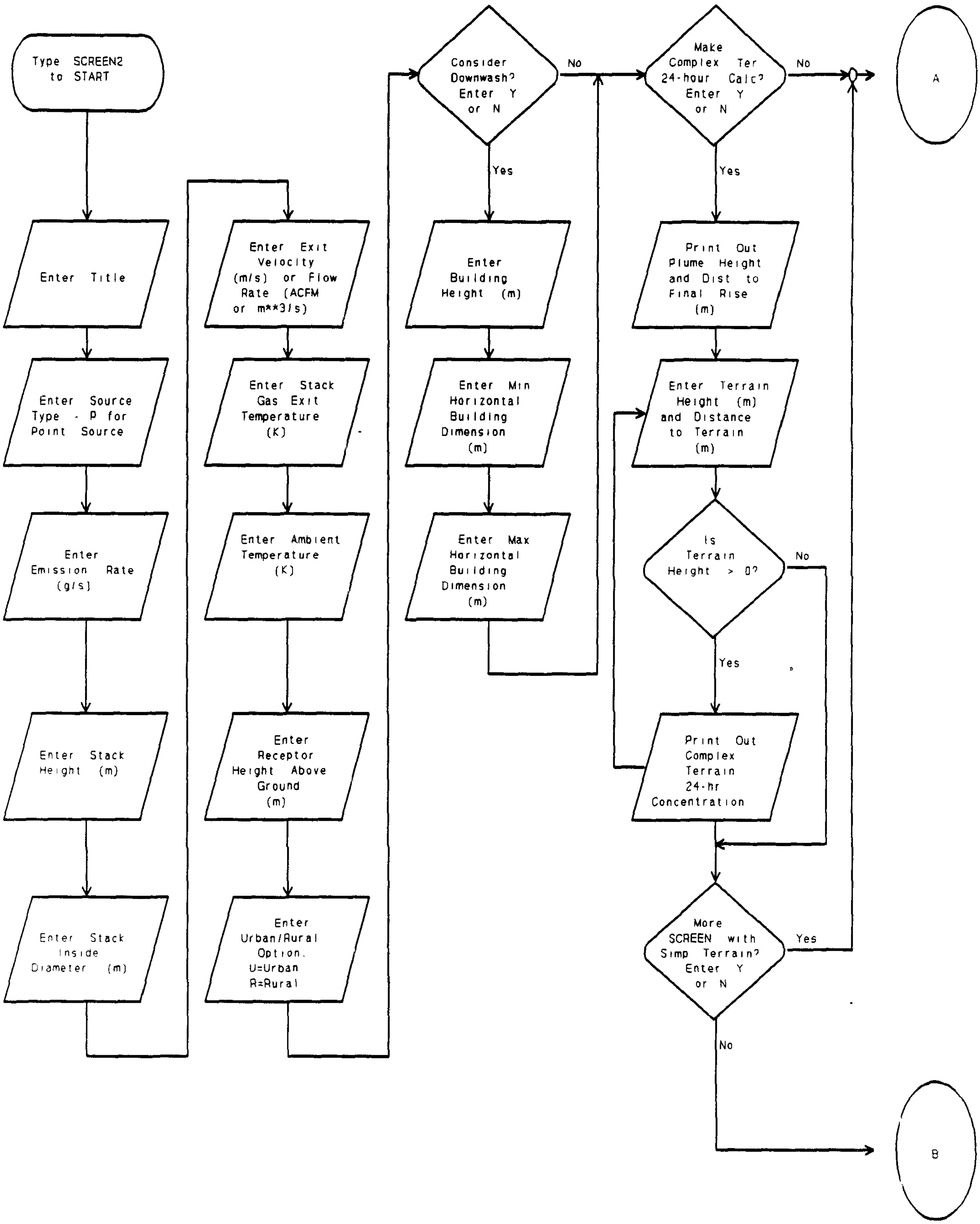

Figure 4. Flow Chart of Inputs and Outputs for SCREEN2 Point Source (Page 1 of 2)

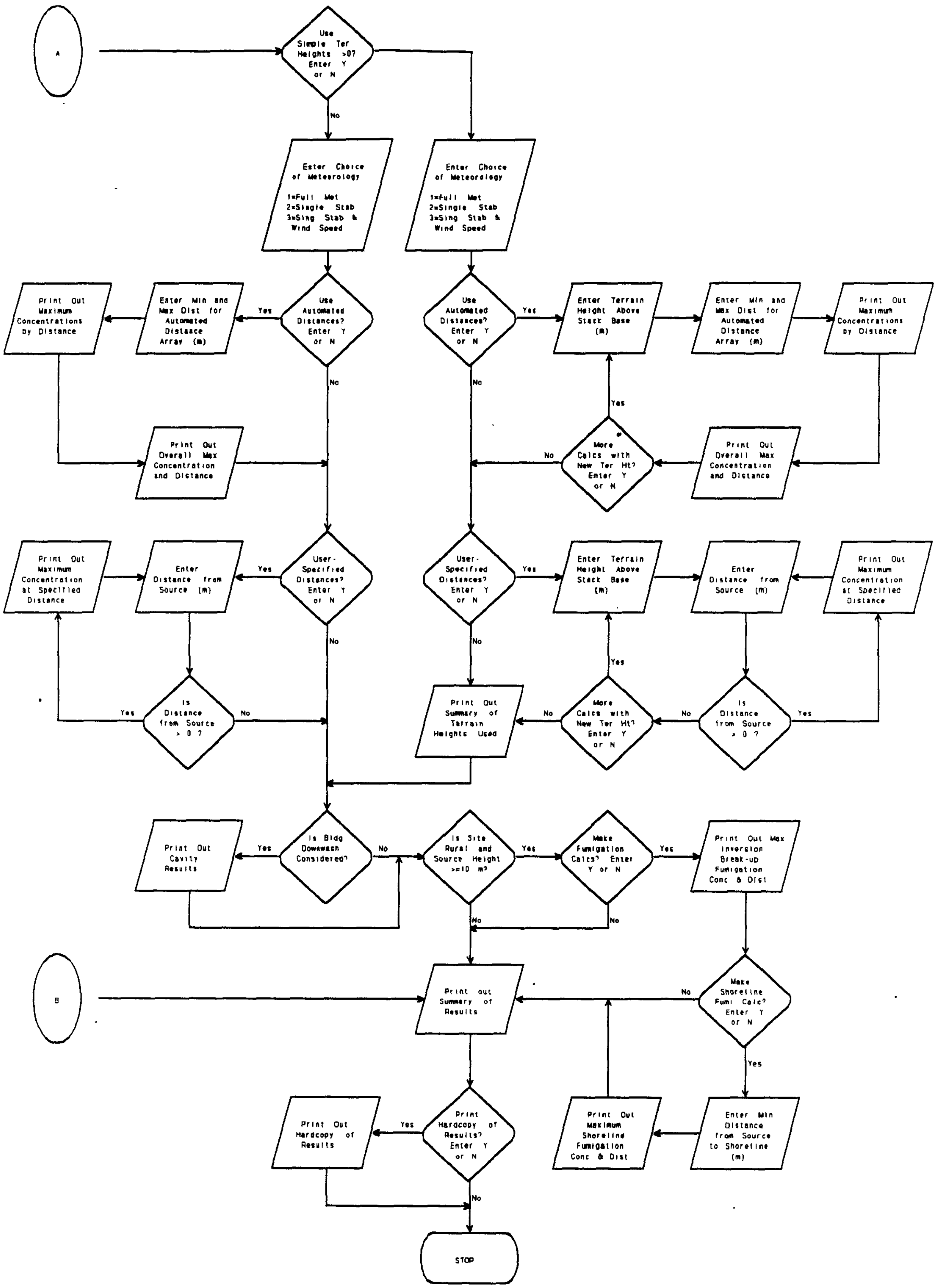

Figure 4. Flow Chart of Inputs and Outputs for SCREEN2 Point Source (Page 2 of 2)

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```
 ***  SCREEN2 MODEL RUN  ***
 *** VERSION DATED 92245 ***

FLARE RELEASE EXAMPLE

SIMPLE TERRAIN INPUTS:
   SOURCE TYPE              =        FLARE
   EMISSION RATE (G/S)      =      1000.00
   FLARE STACK HEIGHT (M)   =     100.0000
   TOT HEAT RLS (CAL/S)     =      .100000E+08
   RECEPTOR HEIGHT (M)      =        .0000
   URBAN/RURAL OPTION       =        RURAL
   EFF RELEASE HEIGHT (M)   =     110.1150
   BUILDING HEIGHT (M)      =        .0000
   MIN HORIZ BLDG DIM (M)   =        .0000
   MAX HORIZ BLDG DIM (M)   =        .0000


BUOY. FLUX =  165.803 M**4/S**3;  MOM. FLUX =  101.103 M**4/S**2.

*** FULL METEOROLOGY ***

**********************************
*** SCREEN AUTOMATED DISTANCES ***
**********************************

*** TERRAIN HEIGHT OF    0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***
```

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
250.	.7733E-04	5	1.0	2.3	10000.0	233.54	38.05	36.05	NO
300.	.2501E-03	1	3.0	3.5	960.0	344.28	78.46	57.07	NO
400.	1.283	1	3.0	3.5	960.0	344.28	100.36	80.87	NO
500.	66.54	1	3.0	3.5	960.0	344.28	121.51	113.75	NO
600.	407.0	1	3.0	3.5	960.0	344.28	142.09	161.96	NO
700.	741.2	1	3.0	3.5	960.0	344.28	162.21	220.50	NO
800.	944.9	1	1.5	1.8	579.5	578.45	210.37	308.17	NO
900.	1303.	1	1.5	1.8	579.5	578.45	231.47	386.36	NO
1000.	1449.	1	1.5	1.8	579.5	578.45	247.92	473.16	NO
1100.	1448.	1	1.5	1.8	579.5	578.45	263.50	571.19	NO
1200.	1387.	1	1.5	1.8	579.5	578.45	279.21	680.86	NO
1300.	1315.	1	1.5	1.8	579.5	578.45	295.03	802.07	NO
1400.	1248.	1	1.5	1.8	579.5	578.45	310.90	934.77	NO
1500.	1187.	1	1.5	1.8	579.5	578.45	326.80	1078.93	NO
1600.	1132.	1	1.5	1.8	579.5	578.45	342.72	1234.58	NO
1700.	1082.	1	1.5	1.8	579.5	578.45	358.64	1401.74	NO
1800.	1036.	1	1.5	1.8	579.5	578.45	374.55	1580.46	NO
1900.	993.9	1	1.5	1.8	579.5	578.45	390.43	1770.78	NO
2000.	957.5	1	1.0	1.2	813.6	812.62	432.95	1978.42	NO

```
MAXIMUM 1-HR CONCENTRATION AT OR BEYOND   250. M:
  1046.    1461.        1     1.5    1.8    579.5  578.45  254.91  515.82     NO

 DWASH=   MEANS NO CALC MADE (CONC = 0.0)
 DWASH=NO MEANS NO BUILDING DOWNWASH USED
 DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
 DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
 DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB
```

Figure 5. SCREEN2 Flare Release Example (Page 1 of 2)

```
****************************************
*** SUMMARY OF SCREEN MODEL RESULTS ***
****************************************

 CALCULATION          MAX CONC    DIST TO   TERRAIN
  PROCEDURE          (UG/M**3)    MAX (M)    HT (M)
--------------      -----------   -------   -------
SIMPLE TERRAIN        1461.        1046.        0.

***************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
***************************************************
```

Figure 5. SCREEN2 Flare Release Example (Page 2 of 2)

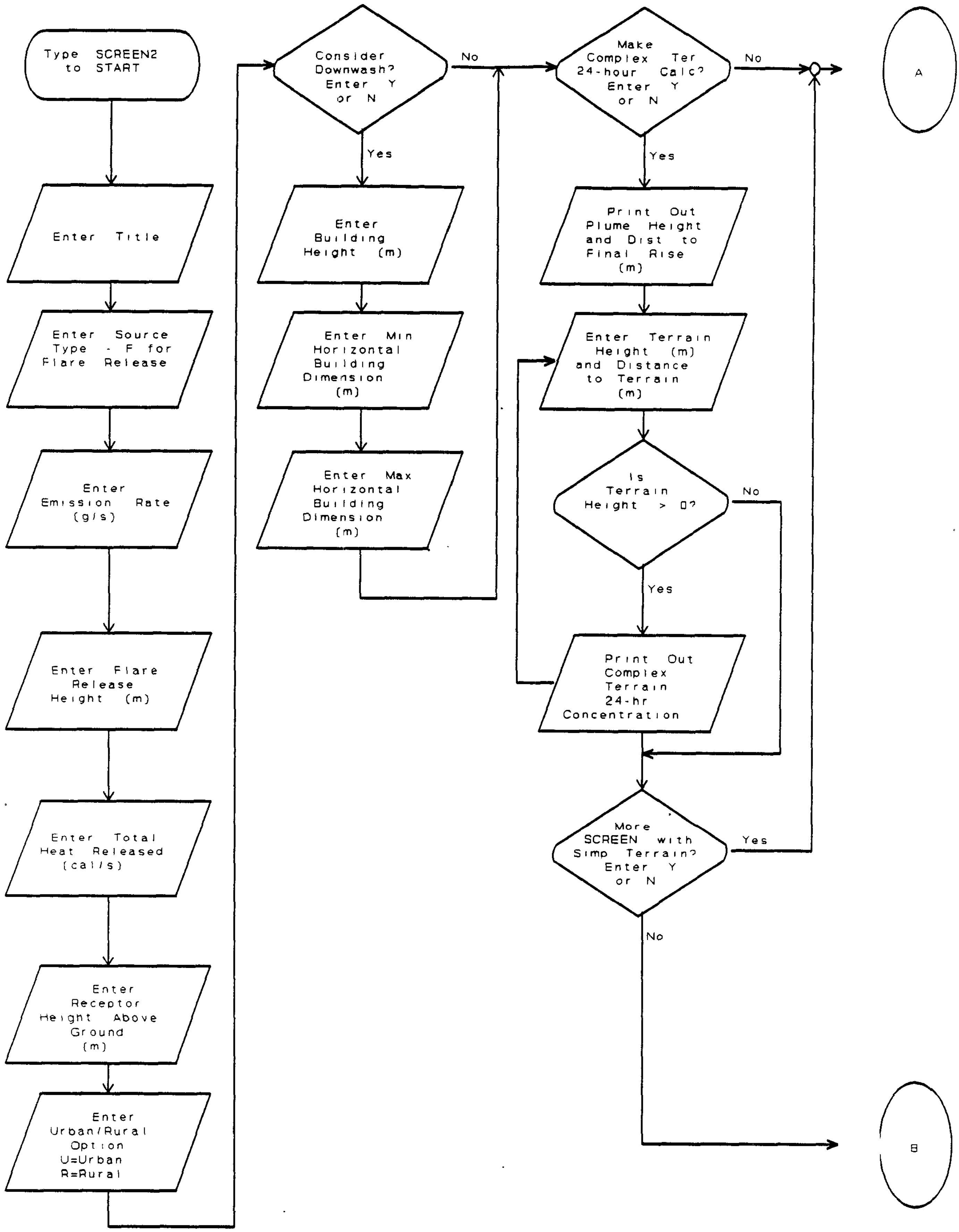

Figure 6. Flow Chart of Inputs and Outputs for SCREEN2 Flare Release (Page 1 of 2)

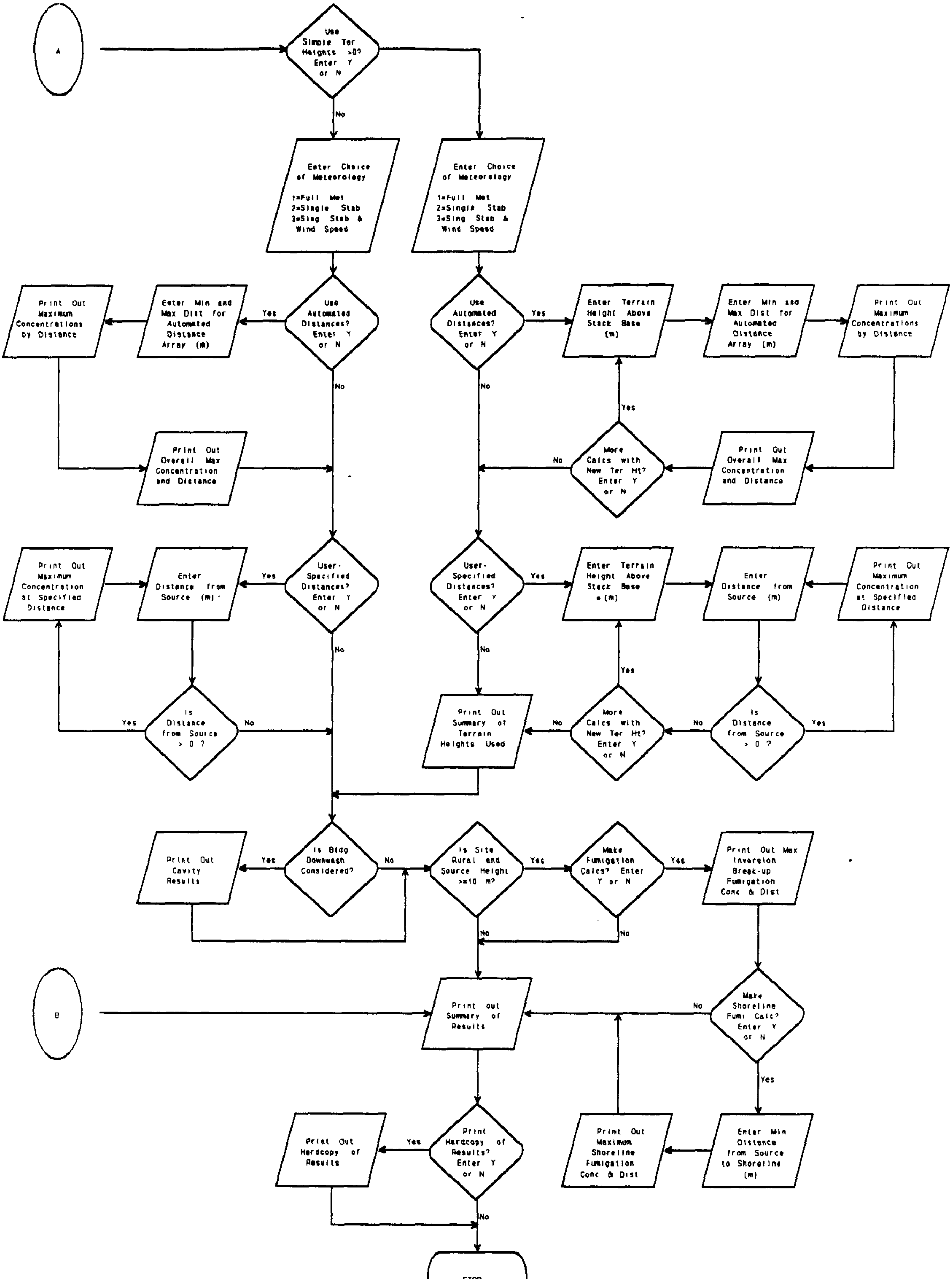

Figure 6. Flow Chart of Inputs and Outputs for SCREEN2 Flare Release (Page 2 of 2)

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*** SCREEN2 MODEL RUN ***
*** VERSION DATED 92245 ***

AREA SOURCE EXAMPLE

SIMPLE TERRAIN INPUTS:

SOURCE TYPE	=	AREA
EMISSION RATE (G/(S-M**2))	=	.250000E-02
SOURCE HEIGHT (M)	=	5.0000
LENGTH OF SIDE (M)	=	200.0000
RECEPTOR HEIGHT (M)	=	.0000
URBAN/RURAL OPTION	=	URBAN

BUOY. FLUX = .000 M**4/S**3; MOM. FLUX = .000 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
150.	.2070E+05	5	1.0	1.0	10000.0	5.00	4.06	16.29	NO
200.	.1780E+05	5	1.0	1.0	10000.0	5.00	9.42	19.21	NO
300.	.1406E+05	5	1.0	1.0	10000.0	5.00	19.86	24.63	NO
400.	.1176E+05	5	1.0	1.0	10000.0	5.00	29.92	29.62	NO
500.	.1017E+05	5	1.0	1.0	10000.0	5.00	39.63	34.25	NO
600.	8894.	5	1.0	1.0	10000.0	5.00	49.02	38.58	NO
700.	7804.	5	1.0	1.0	10000.0	5.00	58.12	42.64	NO
800.	6867.	5	1.0	1.0	10000.0	5.00	66.95	46.49	NO
900.	6068.	5	1.0	1.0	10000.0	5.00	75.51	50.14	NO
1000.	5394.	5	1.0	1.0	10000.0	5.00	83.84	53.62	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 150. M:

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
150.	.2070E+05	5	1.0	1.0	10000.0	5.00	4.06	16.29	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

Figure 7. SCREEN2 Area Source Example (Page 1 of 2)

```
**********************************
*** SCREEN DISCRETE DISTANCES ***
**********************************

*** TERRAIN HEIGHT OF    0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

  DIST     CONC              U10M   USTK  MIX HT    PLUME   SIGMA    SIGMA
   (M)   (UG/M**3)   STAB   (M/S)  (M/S)    (M)    HT (M)   Y (M)    Z (M)  DWASH
-------  ----------  ----   -----  -----  ------   ------  ------   ------  -----
  5000.   718.6        5     1.0     1.0 10000.0    5.00   312.74   138.53    NO
 10000.   321.3        5     1.0     1.0 10000.0    5.00   488.59   200.92    NO
 20000.   150.6        5     1.0     1.0 10000.0    5.00   731.03   288.01    NO
 50000.   71.45        4     1.0     1.0   320.0    5.00  1743.68  1751.62    NO

 DWASH=   MEANS NO CALC MADE (CONC = 0.0)
 DWASH=NO MEANS NO BUILDING DOWNWASH USED
 DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
 DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
 DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

      ***************************************
      *** SUMMARY OF SCREEN MODEL RESULTS ***
      ***************************************

 CALCULATION          MAX CONC     DIST TO    TERRAIN
  PROCEDURE          (UG/M**3)     MAX (M)     HT (M)
--------------     -----------    -------    -------
SIMPLE TERRAIN       .2070E+05       150.          0.

***************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
***************************************************
```

Figure 7. SCREEN2 Area Source Example (Page 2 of 2)

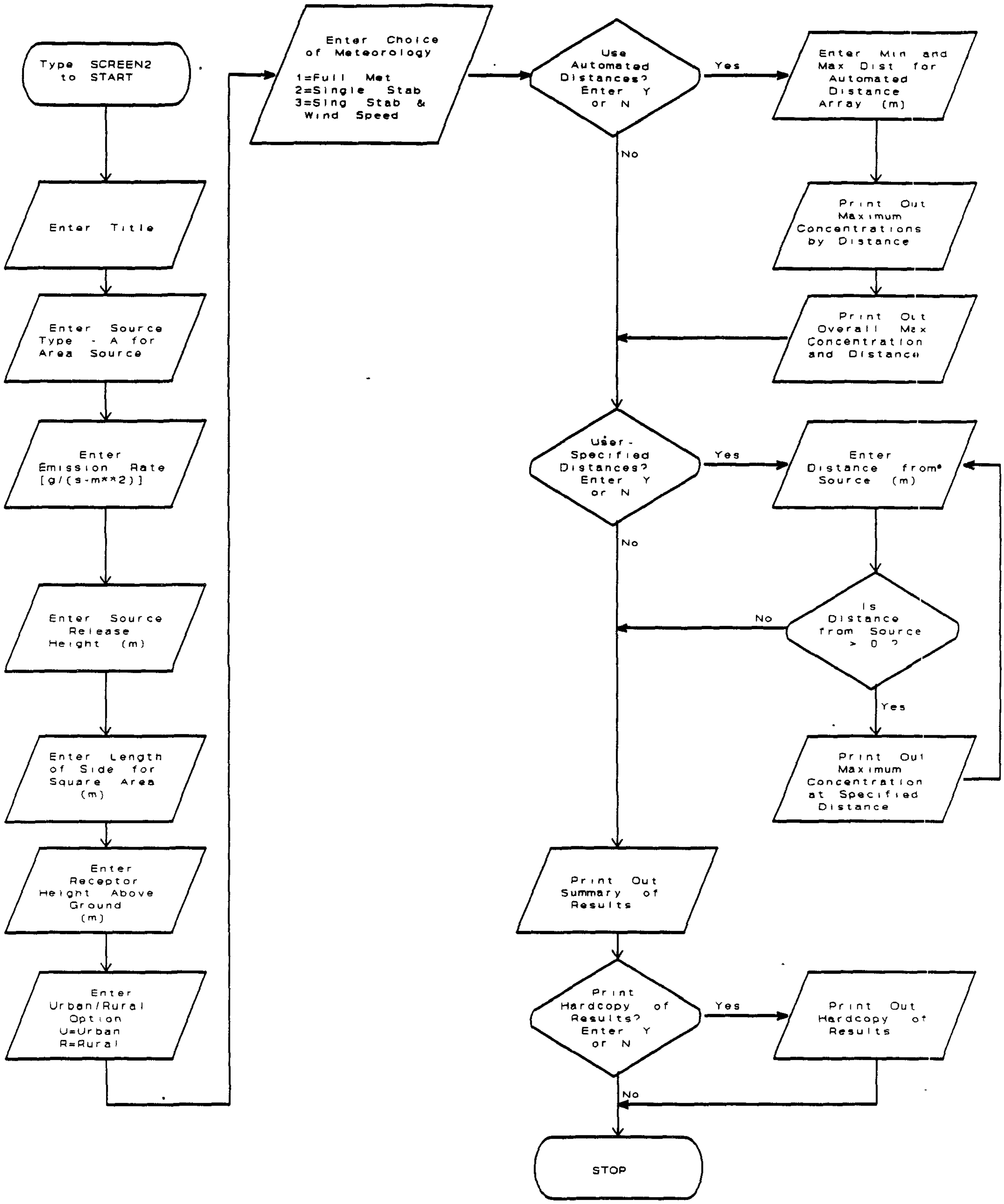

Figure 8. Flow Chart of Inputs and Outputs for SCREEN2 Area Source

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*** SCREEN2 MODEL RUN ***
*** VERSION DATED 92245 ***

VOLUME SOURCE EXAMPLE

SIMPLE TERRAIN INPUTS:

SOURCE TYPE	=	VOLUME
EMISSION RATE (G/S)	=	1.00000
SOURCE HEIGHT (M)	=	10.0000
INIT. LATERAL DIMEN (M)	=	50.0000
INIT. VERTICAL DIMEN (M)	=	20.0000
RECEPTOR HEIGHT (M)	=	.0000
URBAN/RURAL OPTION	=	RURAL

BUOY. FLUX = .000 M**4/S**3; MOM. FLUX = .000 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	.0000	0	.0	.0	.0	.00	.00	.00	
200.	239.5	6	1.0	1.0	10000.0	10.00	55.68	21.40	NO
300.	224.1	6	1.0	1.0	10000.0	10.00	58.61	21.82	NO
400.	209.1	6	1.0	1.0	10000.0	10.00	61.51	22.40	NO
500.	195.7	6	1.0	1.0	10000.0	10.00	64.41	22.96	NO
600.	183.8	6	1.0	1.0	10000.0	10.00	67.28	23.52	NO
700.	173.0	6	1.0	1.0	10000.0	10.00	70.15	24.06	NO
800.	163.2	6	1.0	1.0	10000.0	10.00	73.00	24.60	NO
900.	154.4	6	1.0	1.0	10000.0	10.00	75.84	25.12	NO
1000.	146.3	6	1.0	1.0	10000.0	10.00	78.66	25.64	NO
MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 100. M:									
109.	257.5	6	1.0	1.0	10000.0	10.00	53.04	20.78	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

****
*** SUMMARY OF SCREEN MODEL RESULTS ***
****

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	257.5	109.	0.

****
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
****

Figure 9. SCREEN2 Volume Source Example

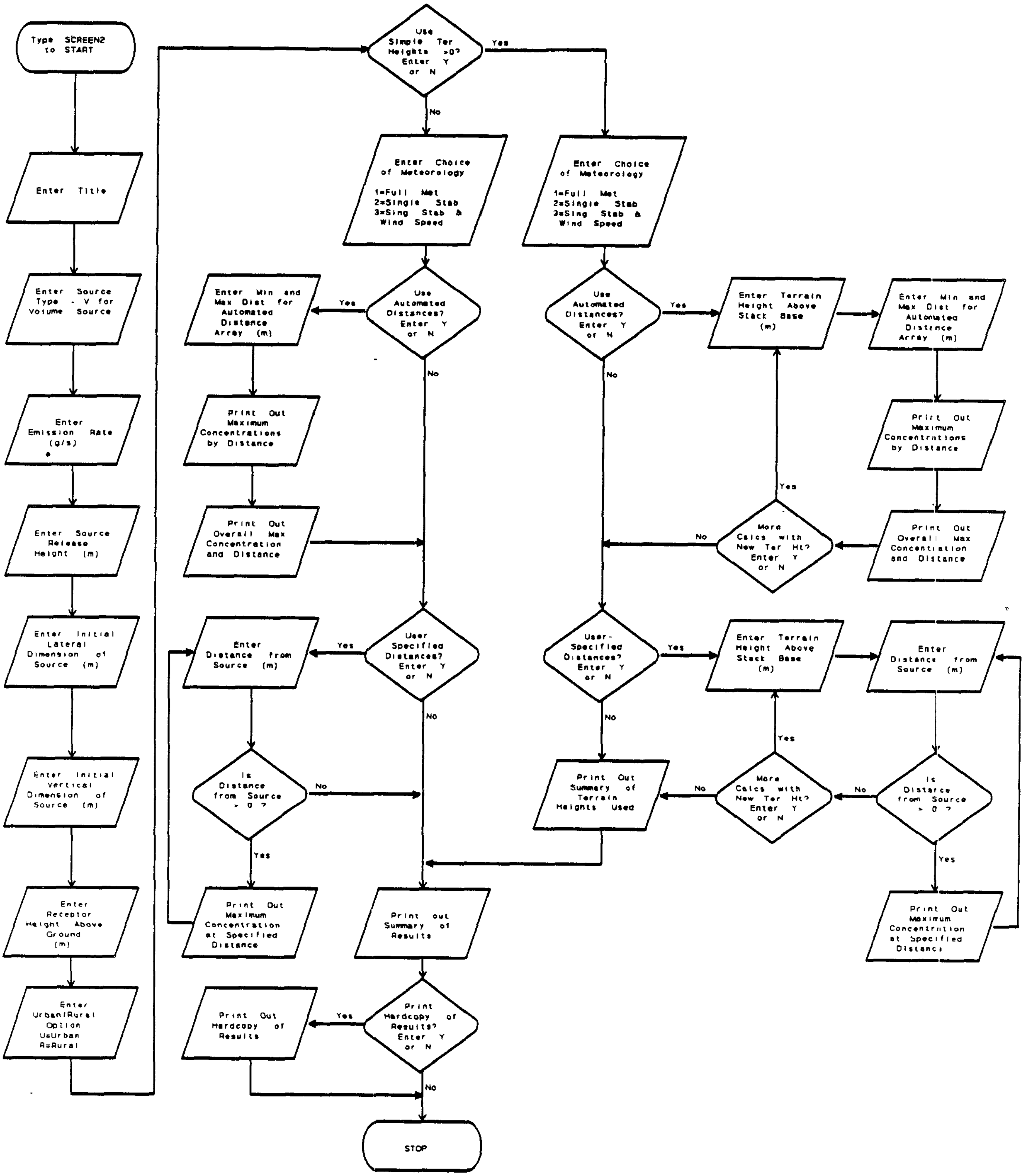

Figure 10. Flow Chart of Inputs and Outputs for SCREEN2 Volume Source

3. TECHNICAL DESCRIPTION

Most of the techniques used in the SCREEN2 model are based on assumptions and methods common to other EPA dispersion models. For the sake of brevity, lengthy technical descriptions that are available elsewhere are not duplicated here. This discussion will concentrate on how those methods are incorporated into SCREEN2 and on describing those techniques that are unique to SCREEN2.

3.1 Basic Concepts of Dispersion Modeling

SCREEN2 uses a Gaussian plume model that incorporates source-related factors and meteorological factors to estimate pollutant concentration from continuous sources. It is assumed that the pollutant does not undergo any chemical reactions, and that no other removal processes, such as wet or dry deposition, act on the plume during its transport from the source. The Gaussian model equations and the interactions of the source-related and meteorological factors are described in Volume II of the ISC2 user's guide (EPA, 1992), and in the Workbook of Atmospheric Dispersion Estimates (Turner, 1970).

The basic equation for determining ground-level concentrations under the plume centerline is:

$$
\begin{aligned}
X = Q/(2\pi u_s \sigma_y \sigma_z) \{ & \exp[-\tfrac{1}{2}((z_r-h_e)/\sigma_z)^2] \\
& + \exp[-\tfrac{1}{2}((z_r+h_e)/\sigma_z)^2] \\
& + \sum_{N=1}^{k} [\exp[-\tfrac{1}{2}((z_r-h_e-2Nz_i)/\sigma_z)^2] \\
& + \exp[-\tfrac{1}{2}((z_r+h_e-2Nz_i)/\sigma_z)^2] \\
& + \exp[-\tfrac{1}{2}((z_r-h_e+2Nz_i)/\sigma_z)^2] \\
& + \exp[-\tfrac{1}{2}((z_r+h_e+2Nz_i)/\sigma_z)^2]] \}
\end{aligned} \qquad (1)
$$

where

X = concentration (g/m^3)
Q = emission rate (g/s)
π = 3.141593
u_s = stack height wind speed (m/s)
σ_y = lateral dispersion parameter (m)
σ_z = vertical dispersion parameter (m)
z_r = receptor height above ground (m)
h_e = plume centerline height (m)
z_i = mixing height (m)
k = summation limit for multiple reflections of plume off of the ground and elevated inversion, usually ≤4.

Note that for stable conditions and/or mixing heights greater than or equal to 10,000m, unlimited mixing is assumed and the summation term is assumed to be zero.

Equation 1 is used to model the plume impacts from point sources, flare releases, and volume releases in SCREEN2. The SCREEN2 volume source option uses a virtual point source approach, as described in Volume II (Section 1.2.2) of the ISC2 model user's guide (EPA, 1992). The user inputs the initial lateral and vertical dimensions of the volume source, as described in Section 2.7 above.

The SCREEN2 model uses a finite line segment algorithm for modeling impacts from area sources, as described in Volume II (Section 1.2.3) of the ISC2 model user's guide (EPA, 1992). The area source is assumed to be a square shape, and the model cannot be used to estimate concentrations within the area.

3.2 Worst Case Meteorological Conditions

SCREEN2 examines a range of stability classes and wind speeds to identify the "worst case" meteorological conditions, i.e., the combination of wind speed and stability that results in the maximum ground level concentrations. The wind speed and stability class combinations used by SCREEN2 are given in Table 2. The 10-meter wind speeds given in Table 2 are adjusted to stack height by SCREEN2 using the wind profile power law exponents given in Table 3-1 of the screening procedures document. For release heights of less than 10 meters, the wind speeds listed in Table 2 are used without adjustment. For distances greater than 50 km (available with the discrete distance option), SCREEN2 sets 2 m/s as the lower limit for the 10-meter wind speed to avoid unrealistic transport times. Table 2 includes some cases that may not be considered standard stability class/wind speed combinations, namely E with winds less than 2 m/s, and F with winds greater than 3 m/s. The combinations of E and winds of 1 - 1.5 m/s are often excluded because the algorithm developed by Turner (1964) to determine stability class from routine National Weather Service (NWS) observations excludes cases of E stability for wind speeds less than 4 knots (2 m/s). These combinations are included in SCREEN2 because they are valid combinations that could appear in a data set using on-site meteorological data with another stability class method. A wind speed of 6 knots (the highest speed for F stability in Turner's scheme) measured at a typical NWS anemometer height of 20 feet (6.1 meters) corresponds to a 10 meter wind speed of 4 m/s under F stability. Therefore the combination of F and 4 m/s has been included.

Table 2. Wind Speed and Stability Class Combinations Used by the SCREEN2 Model

Stability Class	10-m Wind Speed (m/s) 1	1.5	2	2.5	3	3.5	4	4.5	5	8	10	15	20
A	*	*	*	*	*								
B	*	*	*	*	*	*	*	*	*				
C	*	*	*	*	*	*	*	*	*	*	*		
D	*	*	*	*	*	*	*	*	*	*	*	*	*
E	*	*	*	*	*	*	*	*	*				
F	*	*	*	*	*	*	*						

The user has three choices of meteorological data to examine. The first choice, which should be used in most applications, is to use "Full Meteorology" which examines all six stability classes (five for urban sources) and their associated wind speeds. Using full meteorology with the automated distance array (described in Section 2), SCREEN2 prints out the maximum concentration for each distance, and the overall maximum and associated distance. The overall maximum concentration from SCREEN2 represents the controlling 1-hour value corresponding to the result from Procedures (a) - (c) in Step 4 of Section 4.2. Full meteorology is used instead of the A, C, and E or F subset used by the hand calculations because SCREEN2 provides maximum concentrations as a function of distance, and stability classes A, C and E or F may not be controlling for all distances. The use of A, C, and E or F may also not give the maximum concentration when building downwash is considered. The second choice is to input a single stability class (1 = A, 2 = B, ..., 6 = F). SCREEN2 will examine a range of wind speeds for that stability class only. Using this option the user is able to determine the maximum concentrations associated with each of the individual procedures, (a) - (c), in Step 4 of Section 4.2. The third choice is to specify a single stability class and wind speed. The last two choices were originally put into SCREEN2 to facilitate testing only, but they may be useful if particular meteorological conditions are of concern. However, they are not recommended for routine uses of SCREEN2.

The mixing height used in SCREEN2 for neutral and unstable conditions (classes A-D) is based on an estimate of the mechanically driven mixing height. The mechanical mixing height, z_m (m), is calculated (Randerson, 1984) as

$$z_m = 0.3\ u^*/f \qquad (2)$$

where: $u*$ = friction velocity (m/s)
f = Coriolis parameter (9.374×10^{-5} s^{-1} at 40° latitude)

Using a log-linear profile of the wind speed, and assuming a surface roughness length of about 0.3m, $u*$ is estimated from the 10-meter wind speed, u_{10}, as

$$u* = 0.1\ u_{10} \tag{3}$$

Substituting for $u*$ in Equation 2 we have

$$z_m = 320\ u_{10}. \tag{4}$$

The mechanical mixing height is taken to be the minimum daytime mixing height. To be conservative for limited mixing calculations, if the value of z_m from Equation 3 is less than the plume height, h_e, then the mixing height used in calculating the concentration is set equal to $h_e + 1$. For stable conditions, the mixing height is set equal to 10,000m to represent unlimited mixing.

3.3 Plume Rise for Point Sources

The use of the methods of Briggs to estimate plume rise are discussed in detail in Section 1.1.4 of Volume II of the ISC2 user's guide (EPA, 1992). These methods are also incorporated in the SCREEN2 model.

Stack tip downwash is estimated following Briggs (1973, p.4) for all sources except those employing the Schulman-Scire downwash algorithm. Buoyancy flux for non-flare point sources is calculated from

$$F_b = g v_s d_s^2 (T_s - T_a)/(4T_s), \tag{5}$$

which is described in Section 4 of the screening procedures document and is equivalent to Briggs' (1975, p. 63) Equation 12.

Buoyancy flux for flare releases is estimated from

$$F_b = 1.66 \times 10^{-5} \times H, \tag{6}$$

where H is the total heat release rate of the flare (cal/s). This formula was derived from Equation 4.20 of Briggs (1969), assuming T_a = 293K, p = 1205 g/m, c_p = 0.24 cal/gK, and that the sensible heat release rate, Q_H = (0.45) H. The sensible heat rate is based on the assumption that 55 percent of the total heat released is lost due to radiation (Leahey and Davies, 1984). The buoyancy flux for flares is calculated in SCREEN2 by assuming effective stack parameters of v_s = 20 m/s, T_s = 1,273K, and solving for an effective stack diameter, $d_s = 9.88 \times 10^{-4} (Q_H)^{0.5}$.

The momentum flux, which is used in estimating plume rise for building downwash effects, is calculated from,

$$F_m = v_s^2 d_s^2 T_a / (4T_s) . \qquad (7)$$

The ISC2 user's guide (EPA, 1992) describes the equations used to estimate buoyant plume rise and momentum plume rise for both unstable/neutral and stable conditions. Also described are transitional plume rise and how to estimate the distance to final rise. Final plume rise is used in SCREEN2 for all cases with the exception of the complex terrain screening procedure and for building downwash effects.

The buoyant line source plume rise formulas that are used for the Schulman-Scire downwash scheme are described in Section 1.1.4.11 of Volume II of the ISC2 user's guide (EPA, 1992). These formulas apply to sources where $h_s \leq H_b + 0.5L_b$. For sources subject to downwash but not meeting this criterion, the downwash algorithms of Huber and Snyder (EPA, 1992) are used, which employ the Briggs plume rise formulas referenced above.

3.4 Dispersion Parameters

The formulas used for calculating vertical (σ_z) and lateral (σ_y) dispersion parameters for rural and urban sites are described in Section 1.1.5 of Volume II of the ISC2 user's guide (EPA, 1992).

3.5 Buoyancy Induced Dispersion

Throughout the SCREEN2 model, with the exception of the Schulman-Scire downwash algorithm, the dispersion parameters, σ_y and σ_z, are adjusted to account for the effects of buoyancy induced dispersion as follows:

$$\sigma_{ye} = (\sigma_y^2 + (\Delta h/3.5)^2)^{0.5} \qquad (8)$$

$$\sigma_{ze} = (\sigma_z^2 + (\Delta h/3.5)^2)^{0.5}$$

where Δh is the distance-dependent plume rise. (Note that for inversion break-up and shoreline fumigation, distances are always beyond the distance to final rise, and therefore Δh = final plume rise).

3.6 Building Downwash

3.6.1 Cavity Recirculation Region

The cavity calculations are a revision of the procedure described in the Regional Workshops on Air Quality Modeling Summary Report, Appendix C (EPA, 1983), and are based largely on results published by Hosker (1984).

If non-zero building dimensions are input to SCREEN2 for either point or flare releases, then cavity calculations will be made as follows. The cavity height, h_c (m), is estimated based on the following equation from Hosker (1984):

$$h_c = h_b\ (1.0 + 1.6 \exp\ (-1.3L/h_b)), \qquad (9)$$

where: h_b = building height (m)
L = alongwind dimension of the building (m).

Using the plume height based on momentum rise at two building heights downwind, including stack tip downwash, a critical (i.e., minimum) stack height wind speed is calculated that will just put the plume into the cavity (defined by plume centerline height = cavity height). The critical wind speed is then adjusted from stack height to 10-meter using a power law with an exponent of 0.2 to represent neutral conditions (no attempt is made to differentiate between urban or rural sites or different stability classes). If the critical wind speed (adjusted to 10-meters) is less than or equal to 20 m/s, then a cavity concentration is calculated, otherwise the cavity concentration is assumed to be zero. Concentrations within the cavity, X_c, are estimated by the following approximation (Hosker, 1984):

$$X_c = Q/(1.5\ A_p\ u) \qquad (10)$$

where: Q = emission rate (g/s)
$A_p = H_b \cdot W$ = cross-sectional area of the building normal to the wind (m^2)
W = crosswind dimension of the building (m)
u = wind speed (m/s).

For u, a value of one-half the <u>stack height</u> critical wind speed is used, but not greater than 10 m/s and not less than 1 m/s. Thus, the calculation of X_c is linked to the determination of a critical wind speed. The concentration, X_c, is assumed to be uniform within the cavity.

The cavity length, x_r, measured from the lee side of the building, is estimated by the following (Hosker, 1984):

(1) for short buildings ($L/h_b \le 2$),

$$x_r = \frac{(A)\ (W)}{1.0 + B(W/h_b)} \qquad (11)$$

(2) for long buildings ($L/h_b \ge 2$),

$$x_r = \frac{1.75\ (W)}{1.0 + 0.25(W/h_b)} \qquad (12)$$

where: h_b = building height (m)
L = alongwind building dimension (m)
W = crosswind building dimension (m)
$A = -2.0 + 3.7\ (L/h_b)^{-1/3}$, and
$B = -0.15 + 0.305\ (L/h_b)^{-1/3}$.

The equations above for cavity height, concentration and cavity length are all sensitive to building orientation through the terms L, W and A_p. Therefore, the entire cavity procedure is performed for two orientations, first with the minimum horizontal dimension alongwind and second with the maximum horizontal dimension alongwind. For screening purposes, this is thought to give reasonable bounds on the cavity estimates. However, the higher concentration that potentially effects ambient air should be used as the controlling value for the cavity procedure. The cavity heights estimated by Equation (9) for tall narrow buildings can exceed the GEP height. In these situations use of Equation (9) to calculate cavity concentrations may not be accurate and use of other techniques should be investigated.

3.6.2 Wake Region

The calculations for the building wake region are based on the ISC2 model (EPA, 1992). The wake effects are divided into two regions, one referred to as the "near wake" extending from $3L_b$ to $10L_b$ (L_b is the lesser of the building height, h_b, and maximum projected width), and the other as the "far wake" for distances greater than $10L_b$. For the SCREEN2 model, the maximum projected width is calculated from the input minimum and maximum horizontal dimensions as $(L^2 + W^2)^{0.5}$. The remainder of the building wake calculations in SCREEN2 are based on the ISC2 user's guide (EPA, 1992).

It should be noted that, unlike the cavity calculation, the comparison of plume height (due to momentum rise at two building heights) to wake height to determine if wake effects apply does not include stack tip downwash. This is done for consistency with the ISC2 model.

3.7 Fumigation

3.7.1 Inversion Break-up Fumigation

The inversion break-up screening calculations are based on procedures described in the Workbook of Atmospheric Dispersion Estimates (Turner, 1970). The distance to maximum fumigation is based on an estimate of the time required for the mixing layer to develop from the top of the stack to the top of the plume, using Equation 5.5 of Turner (1970):

$$x_{max} = u\ t_m$$
$$= (u\ p_a\ c_p/R)\ (\Delta\theta/\Delta z)\ (h_i - h_s)\ [(h_i + h_s)/2] \qquad (13)$$

where:

x_{max} = downwind distance to maximum concentration (m)
t_m = time required for mixing layer to develop from top of stack to top of plume(s)
u = wind speed (2.5 m/s assumed)
p_a = ambient air density (1205 g/m^3 at 20°C)
c_p = specific heat of the air at constant pressure (0.24 cal/gK)
R = net rate of sensible heating of an air column by solar radiation (about 67 cal/m^2/s)
$\Delta\theta/\Delta z$ = vertical potential temperature gradient (assume 0.035 K/m for F stability)
h_i = height of the top of the plume (m) = $h_e + 2\sigma_{ze}$ (h_e = plume centerline height)
h_s = physical stack height (m).
σ_{ze} = vertical dispersion parameter incorporating buoyancy induced dispersion (m)

The values of u and $\Delta\theta/\Delta z$ are based on assumed conditions of stability class F and stack height wind speed of 2.5 m/s for the stable layer above the inversion. The value of h_i incorporates the effect of buoyancy induced dispersion on σ_z, however, elevated terrain effects are ignored. The equation above is solved by iteration, starting from an initial guess of x_{max} = 5,000m.

The maximum ground-level concentration due to inversion break-up fumigation, X_f, is calculated from Equation 5.2 of Turner (1970).

$$X_f = Q/[(2\pi)^{0.5}u(\sigma_{ye}+h_e/8)(h_e+2\sigma_{ze})] \qquad (14)$$

where Q is the emission rate (g/s), and other terms are defined above. The dispersion parameters, σ_{ye} and σ_{ze}, incorporate the effects of buoyancy induced dispersion. If the distance to the maximum fumigation is less than 2000m, then SCREEN2 sets X_f = 0 since for such short distances the fumigation concentration is not likely to exceed the unstable/limited mixing concentration estimated by the simple terrain screening procedure.

3.7.2 Shoreline Fumigation

For rural sources within 3000m of a large body of water, maximum shoreline fumigation concentrations can be estimated by SCREEN2. A stable onshore flow is assumed with stability class F ($\Delta\theta/\Delta z$ = 0.035 K/m) and stack height wind speed of 2.5 m/s. Similar to the inversion break-up fumigation case, the maximum ground-level shoreline fumigation concentration is assumed to occur where the top of the stable plume intersects the top of the well-mixed thermal internal boundary layer (TIBL).

An evaluation of coastal fumigation models (EPA, 1987) has shown that the TIBL height as a function of distance inland is well-represented in rural areas with relatively flat terrain by an equation of the form:

$$h_T = A\ [x]^{0.5} \tag{15}$$

where: h_T = height of the TIBL (m)
A = TIBL factor containing physics needed for TIBL parameterization (including heat flux) ($m^{1/2}$)
x = inland distance from shoreline (m).

Studies (e.g. Misra and Onlock, 1982) have shown that the TIBL factor, A, ranges from about 2 to 6. For screening purposes, A is conservatively set equal to 6, since this will minimize the distance to plume/TIBL intersection, and therefore tend to maximize the concentration estimate.

As with the inversion break-up case, the distance to maximum ground-level concentration is determined by iteration. The equation used for the shoreline fumigation case is:

$$x_{max} = [(h_e + 2\sigma_{ze})/6]^2 - x_s \tag{16}$$

where: x_{max} = downwind distance to maximum concentration (m)
x_s = shortest distance from source to shoreline (m)
h_e = plume centerline height (m)
σ_{ze} = vertical dispersion parameter incorporating buoyancy induced dispersion (m)

Plume height is based on the assumed F stability and 2.5 m/s wind speed, and the dispersion parameter (σ_{ze}) incorporates the effects of buoyancy induced dispersion. If x_{max} is less than 200m, then no shoreline fumigation calculation is made, since the plume may still be influenced by transitional rise and its interaction with the TIBL is more difficult to model.

The maximum ground-level concentration due to shoreline fumigation, X_f, is also calculated from Turner's (1970) Equation 5.2:

$$X_f = Q/[(2\pi)^{0.5}u(\sigma_{ye}+h_e/8)(h_e+2\sigma_{ze})] \tag{14}$$

with σ_{ye} and σ_{ze} incorporating the effects of buoyancy induced dispersion.

Even though the calculation of x_{max} above accounts for the distance from the source to the shoreline in x_s, extra caution should be used in interpreting results as the value of x_s increases. The use of A=6 in Equations 15 and 16 may not be conservative in these cases since there will be an increased chance that the plume will be calculated as being below the TIBL height, and therefore no fumigation concentration estimated.

Whereas a smaller value of A could put the plume above the TIBL with a potentially high fumigation concentration. Also, this screening procedure considers only TIBLs that begin formation at the shoreline, and neglects TIBLs that begin to form offshore.

3.8 Complex Terrain 24-hour Screen

The SCREEN2 model also contains the option to calculate maximum 24-hour concentrations for terrain elevations above stack height. A final plume height and distance to final rise are calculated based on the VALLEY model screening technique (Burt, 1977) assuming conditions of F stability (E for urban) and a stack height wind speed of 2.5 m/s. Stack tip downwash is incorporated in the plume rise calculation.

The user then inputs a terrain height and a distance (m) for the nearest terrain feature likely to experience plume impaction, taking into account complex terrain closer than the distance to final rise. If the plume height is at or below the terrain height for the distance entered, then SCREEN2 will make a 24-hour average concentration estimate using the VALLEY screening technique. If the terrain is above stack height but below plume centerline height, then SCREEN2 will make a VALLEY 24-hour estimate (assuming F or E and 2.5 m/s), and also estimate the maximum concentration across a full range of meteorological conditions using simple terrain procedures with terrain "chopped off" at physical stack height, and select the higher estimate. Calculations continue until a terrain height of zero is entered. For the VALLEY model concentration SCREEN2 will calculate a sector-averaged ground-level concentration with the plume centerline height (h_c) as the larger of 10.0m or the difference between plume height and terrain height. The equation used is

$$X = \frac{2.032\ Q}{\sigma_{ze}\ u\ x} \exp\left[-0.5(h_c/\sigma_{ze})^2\right]. \qquad (17)$$

Note that for screening purposes, concentrations are not attenuated for terrain heights above plume height. The dispersion parameter, σ_{ze}, incorporates the effects of buoyancy induced dispersion (BID). For the simple terrain calculation SCREEN2 examines concentrations for the full range of meteorological conditions and selects the highest ground level concentration. Plume heights are reduced by the chopped off terrain height for the simple terrain calculation. To adjust the concentrations to 24-hour averages, the VALLEY screening value is multiplied by 0.25, as done in the VALLEY model, and the simple terrain value is multiplied by the 0.4 factor used in Step 5 of Section 4.2.

4. NOTE TO PROGRAMMERS

The SCREEN2 model was compiled on an IBM PC/AT compatible microcomputer using the Microsoft FORTRAN Compiler, Version 5.1. It was compiled with the emulator library, meaning that the executable file (SCREEN2.EXE) will run with or without a math coprocessor chip. A minimum of 256 KB of RAM is required to execute the model. Provided in a compressed file on the diskette are the executable file, SCREEN2.EXE, the FORTRAN source code files, SCREEN2.FOR and MAIN.INC, a sample input file, EXAMPLE.DAT, an associated output file, EXAMPLE.OUT, and this document, the SCREEN2 Model User's Guide (in WordPerfect 5.1 format), SCREEN2.WPF. Also included on the diskette is a READ.ME file with instructions on extracting SCREEN2.

The SCREEN2 model provided was compiled with the following Microsoft FORTRAN compile command:

```
FL /FPi SCREEN2.FOR
```

where the /FPi compile option specifies the emulator library and causes floating point operations to be processed using in-line instructions rather than library CALLs (used for faster execution). SCREEN2 uses the FORTRAN default unit number of 5 (five) for reading input from the keyboard and 6 (six) for writing to the screen. The unit number for the disk output file, SCREEN.OUT, is set internally to 9, and the unit number for writing inputs to the data file, SCREEN.DAT, is set to 7. These unit numbers are assigned to the variables IRD, IPRT, IOUT, and IDAT, respectively, and are initialized in BLOCK DATA at the end of the SCREEN2.FOR source file. The Microsoft version of SCREEN2 also uses the GETDAT and GETTIM system routines for retrieving the date and time. These routines require the variables to be INTEGER*2, and they may differ on other compilers.

The following simple change can be made to the SCREEN2 source file, SCREEN2.FOR, in order to create a version that will accept a user-specified output filename, instead of automatically writing to the file SCREEN.OUT. An ASCII text editor or a wordprocessor that has an ASCII or nondocument mode may be used to edit the source file. Delete the letter C from Column 1 on lines 199 to 202. They should read as follows:

```
      WRITE(IPRT,*) ' '
94    WRITE(IPRT,*) 'ENTER NAME FOR OUTPUT FILE'
      READ(IRD,95) OUTFIL
95    FORMAT(A12)
```

With this change, if the user-specified filename already exists, it will be overwritten. If desired, the OPEN statement on line 204 may also be changed to read as follows:

```
      OPEN(IOUT,FILE=OUTFIL,STATUS='NEW',ERR=94)
```

With this additional change, the program will continue to prompt for the input filename until a filename that doesn't already exist is entered by the user. Before recompiling, make any other changes that may be necessary for the particular compiler being used. It should be noted that without optimization, the source file may be too large to compile as a single unit. In this case, the SCREEN2.FOR file may need to be split up into separate modules that can be compiled separately and then linked together.

The SCREEN2 model code has also been successfully compiled with the Lahey F77/EM-32 Fortran compiler, with the following compile command:

```
F77L3 SCREEN2.FOR /NO /NW /D1LAHEY
```

where the /NO option suppresses the printing of compile options, /NW suppresses certain warning messages, and /D1LAHEY defines LAHEY for implementing the conditional compile block of Lahey-specific statements for retrieving the system date and time for the output file. Follow the instructions with the Lahey compiler for linking the model to create an executable file.

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15. SUPPLEMENTARY NOTES

16. ABSTRACT

This document presents current EPA guidance on the use of the SCREEN2 screening model. The SCREEN2 model is supported by the "SCREEN2 Model User's Guide," which previously was Appendix A of "Screening Procedures for Estimating the Air Quality Impact of Stationary Sources - Draft for Public Comment". SCREEN2 is a PC-driven, Gaussian atmospheric dispersion model which calculates maximum 1-hour, downwind concentrations of non-reactive pollutants. Major changes in this version of SCREEN2 are the finite line segment method for area sources, addition of wind speeds in the wind speed-stability matrix for calculating concentrations, and the inclusion of a single volume source option. The structure of the computer code was modified to aid in any future revisions to SCREEN2.

17. KEY WORDS AND DOCUMENT ANALYSIS

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