ALOHA™

AREAL LOCATIONS OF HAZARDOUS ATMOSPHERES

User's Manual

FOR THE APPLE® MACINTOSH™

OCTOBER 1992

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U.S. ENVIRONMENTAL PROTECTION AGENCY

Chemical Emergency Preparedness and Prevention Office
Washington, D.C. 20460

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Hazardous Materials Response and Assessment Division
Seattle, Washington 98115

COMPUTER-AIDED MANAGEMENT OF EMERGENCY OPERATIONS

cameo™

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Your feedback is welcome...

...in fact, it's essential to helping us improve both the ALOHA program and the ALOHA manual. Please use the space on the next page to let us know your comments and suggestions (don't be bothered by the fact that we give you only one page for your comments. We actually hope you'll have so many comments that you cover several sheets!) Here are some questions to get you started:

How can we make ALOHA better?

Does ALOHA cover appropriate issues (heavy gas, etc.)?

Which features do you think need improvement? What would you like to see done?

How can we make the manual better?

Are things explained in a way that you can easily understand?

Is the type easy to read?

Is it organized so that you can find pretty much everything?

Does the manual explain how to use ALOHA to its fullest advantage?

Are there some things that the manual could do a better job of explaining—or are there things that we spend too much time on?

Please use the lined page for your comments; simply fold it, tape it, and mail it to us. Thanks!

ALOHA is the best thing that ever happened to me...

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Contents

Chapter 1

Overview

How to Use This Manual

In this chapter...

This manual is divided into five chapters, beginning here in Chapter 1 with a discussion of ALOHA's menus, hardware requirements, and using on-line help. So that you use the model knowledgeably and interpret its output correctly, you should read Chapter 2, **Introduction to Air Modeling**.

Following the discussion of dispersion modeling in Chapter 2, each chapter addresses a specific feature of the model. These chapters explain ALOHA's menus and provide examples to help you move confidently through the menu items. Like the model itself, the manual moves successively through the menubar, **File**, **Edit**, **SiteData**, **SetUp**, and **Display**, and their respective menu items.

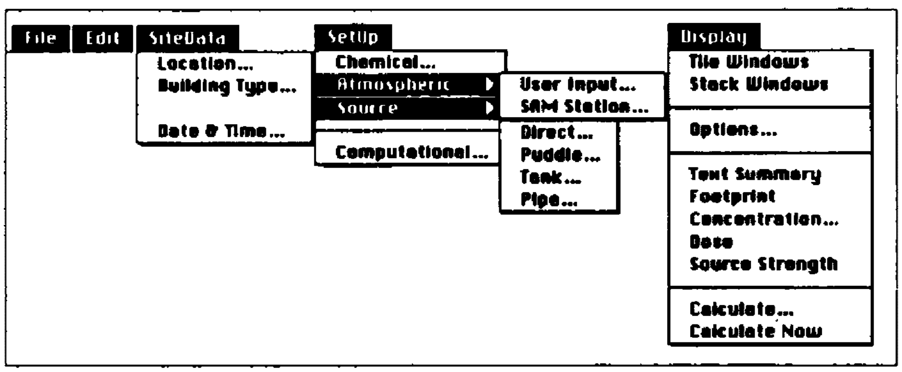


Figure 1-1. Main ALOHA menus.

A glossary of air modeling terms and an index are included at the end of the manual. There are four appendices:

- Examples
- Troubleshooting
- AlohaSpy
- BitPlot

File and Edit menus

You'll benefit most from this manual if you are already familiar with some basic Macintosh and Microsoft Windows™ concepts, such as cutting and pasting, and using the **File** and **Edit** menus, and the **Clipboard**. **PrintAll** is an option that has been added to ALOHA's **File** menu; this permits you to print all of the ALOHA output windows that you have open on your computer screen. (See Chapter 3, **The File and Edit Menus**, for more information.)

SiteData menu

The **SiteData** menu is where you establish the physical location of your spill source. Here, you'll tell ALOHA the **Location** of your spill (in which city did it occur?), the **Building Type** (what are the buildings like in the vicinity of the spill?), and the **Date and Time** of the spill.

SetUp menu

The **SetUp** menu is where you give ALOHA the spill conditions necessary for it to calculate the "footprint," starting with the **Chemical** that is involved. Next, you establish the **Atmospheric** conditions present for your spill. You can enter this information in two different ways: 1) **User Input** (typing it in yourself), or 2) having the data relayed by a portable meteorological station, known as Station for Atmospheric Measurements (**SAM Station**). The next information that you enter is related to the **Source** of the spill: was it from a puddle, tank, or pipe? If you know the amount of vapor entering the air, you may want to choose **Direct**.

Finally, you select **Computational** to choose the type of dispersion computation that you wish ALOHA to use for calculating the spread and duration of the chemical cloud. The options are:

- **Let model decide**, which lets ALOHA choose the type of calculation, based on chemical properties and specifics of the release,
- **Use Gaussian dispersion only**, or
- **Use heavy gas dispersion only**.

Also on this screen, you'll find the option **Define dose**. This option allows you to vary the exponent ALOHA will use in its dose calculation (dose is the accumulated amount of the chemical to which a person is exposed at a particular location).

Display menu

The **Display** menu gives you several different choices for how you'd like to see ALOHA's results displayed. The first two choices deal with how you wish the output displayed on your screen. Under **Options**, you must select a **Level of Concern** concentration for the footprint to be displayed. Would you like the shape of the chemical cloud at ground level (its **Footprint**) plotted on a grid, or displayed with a scale that you set yourself? What **Output Units** (English or metric units of measure) would you like to use with the footprint graph?

Next, you decide what type of output you'd like ALOHA to **Display**:

Text Summary	recaps the options that you've chosen as you move through the ALOHA menus, and summarizes, in text form, the results of ALOHA's calculations. This window is always visible.
Footprint	calculates and displays the shape (when viewed from above) of the chemical cloud at your specified level of concern.
Concentration	calculates the expected indoor and outdoor concentration levels at the specified location. This information is then presented on a graph.
Dose	calculates the expected indoor and outdoor dose levels at the specified location. This information is then presented on a graph.
Source strength	presents a graph indicating the amount of the chemical that is released into the atmosphere over time.
Tile Windows	simultaneously shows you the output from all of the windows that you have open.
Stack Windows	shows you the output, with the windows stacked on top of each other so that only the title bars are visible.
Calculate	allows you to set when you would like output windows updated.
Calculate Now	updates all visible windows.

Sharing Menu

The **Sharing** menu allows you to display an ALOHA footprint on a background map using MARPLOT, the CAMEO mapping module.

Installing ALOHA on your Macintosh

Load only one version of ALOHA; if you load both versions, you can run into problems when you try to use saved ALOHA files.

To install ALOHA, you will need to use only one of the two disks provided (**ALOHA™ math coprocessor version** if your Macintosh has a math coprocessor chip or **ALOHA™** , if it doesn't). An installer contained on each disk automatically copies the files to your hard disk. Data are compressed on the disks and so must be uncompressed into folders on your hard drive. You'll receive two floppy disks with packed, or compressed, ALOHA files:

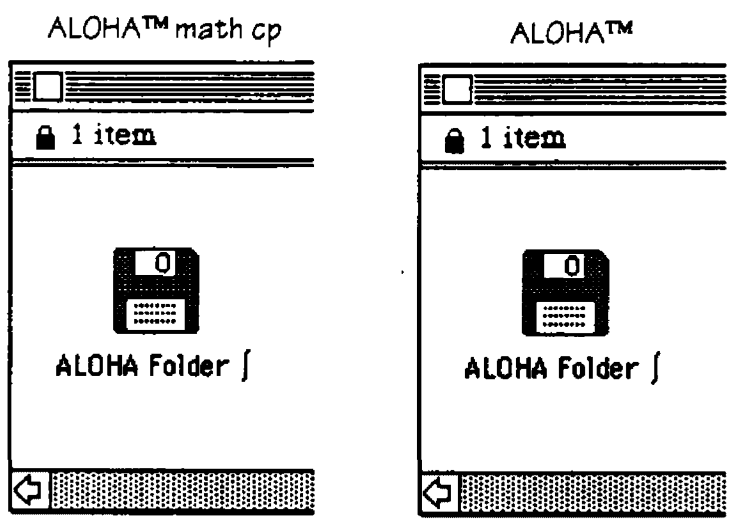
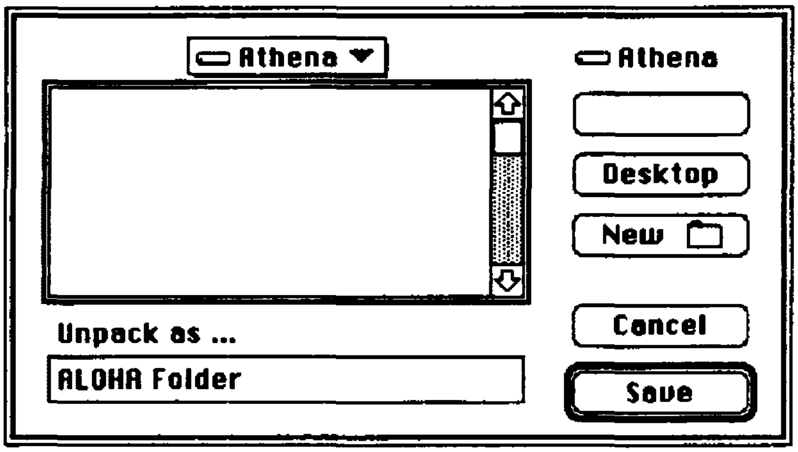


Figure 1-2. Packed ALOHA files.

To begin:

- ❐ Insert the floppy disk with the version of ALOHA that is appropriate for your Macintosh (**ALOHA™ math coprocessor version** if your Macintosh has a math coprocessor chip; **ALOHA™** if it doesn't).
- ❐ Double-click on **ALOHA Folder** ʃ.
- ❐ Click **Drive** until you see your hard drive's name (in the example below, the hard drive is named **Athena**).



- ❐ Click **Save**.
- ❐ You'll see an **Unpacking** timeline that gives you an idea of how long (probably not more than one minute) it takes to extract the files that are compressed onto the disk. Notice that the names of the files currently being unpacked appear above the time-line.
- ❐ When unpacking is completed, choose **Quit** from the **File** menu.

After unpacking, you should have these files in the ALOHA Folder.

ALOHA Folder
ALOHA **ALOHA Helps** **ALOHA Resources** **AlohaSpy** **ChemLib** **ChemManager** **CityLib**

The ALOHA files will be copied into the ALOHA Folder on your Macintosh desktop; don't remove the files from this folder. Your ALOHA folder should contain the files shown at left.

If you stop before you finish unpacking any disk, throw away the ALOHA Folder that has been partially filled with the files unpacked so far. Start over and insert the appropriate ALOHA disk, double-click on **ALOHA Folder** ∫, and repeat the steps above.

Your new folders will include these files:

ALOHA: be sure that you load the correct version of ALOHA for your machine. The coprocessor version of ALOHA will not run on a Macintosh that does not have a math coprocessor chip. You can run the non-coprocessor version of ALOHA on a machine with a math coprocessor chip, but each time you use ALOHA you will be warned that the other version will run faster on your machine.

ALOHA Resources has most of the resource information that is needed to run ALOHA. Don't lock this file.

ALOHA Helps is the database for the on-line help available while you are using ALOHA.

ChemLib contains all of the available physical and toxicological properties used by the air model for over 700 chemicals. If you are using **ChemManager**, unlock this file.

ChemManager allows you to modify or delete chemical data that is already present in the chemical library, or to add other chemicals for which you have the required physical property information. To use ChemManager, you must first unlock **ChemLib**.

CityLib contains the location data used in the SiteData menu. If you add or modify locations while running ALOHA, **CityLib** will be updated automatically. This file should not be locked.

AlohaSpy lets you save the results of an ALOHA model run; a SPY file contains the information from the windows in ALOHA when you saved the file.

A note about memory and speed

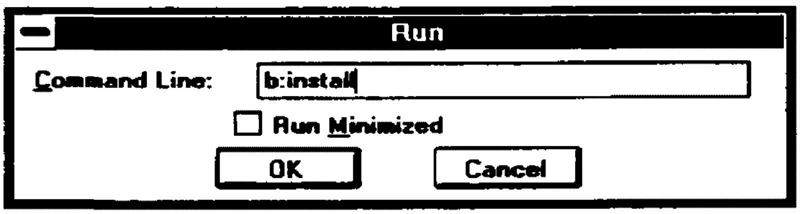
ALOHA runs on an Apple Macintosh with at least one megabyte of random access memory (RAM) and a hard drive. It will run much faster on a Macintosh with a math coprocessor chip. You must also have two megabytes of hard disk space available to load ALOHA. ALOHA will also work on computers that do not have the math coprocessor chip, although it will be slower and, in some cases, significantly so.

ALOHA runs under either the Finder or MultiFinder, unless you are working on a Macintosh with only one megabyte of RAM.

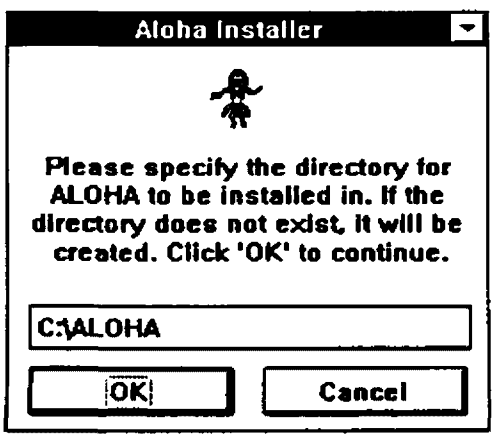
Ask your Apple dealer for information about Macintosh models with and without coprocessor chips.

Installing ALOHA Windows

- ❐ Place the disk containing the ALOHA Installer in either Drive A or B.
- ❐ Choose the **Run** option from the Program Manager's **File** menu.
- ❐ Type **b:install** (or **a:install** if you placed the diskette in Drive A) in the command line box and click **OK**.
- ❐ You'll see the following dialog box:



- ❐ Specify the drive and directory where you wish to install ALOHA, and click **OK**. The default directory is C:\ALOHA; if this is sufficient, just click **OK**. The installer will now decompress files and place them in the specified directory.



- ❒ When the installation is complete, you will be notified. Click OK.

- ❒ The installation process will create a group called **ALOHA** in the program manager, and will place all executable files in that group. You are ready to double-click your way into ALOHA.

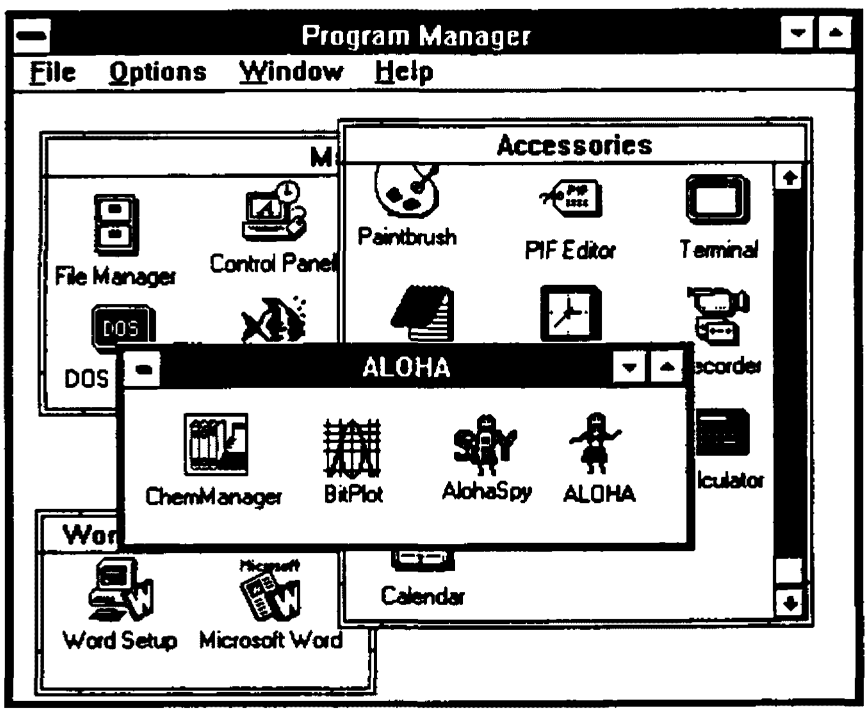


Figure 1-3. Installing ALOHA Windows.

A note about memory and speed

ALOHA runs in Microsoft Windows™, version 3.0 or above. It requires at least one megabyte of Random Access Memory (RAM) and about 2.5 megabytes of space on your hard drive. ALOHA requires a PC using at least an 80286 microprocessor. The model must be run in either Standard or Enhanced mode. ALOHA can be run with or without a math coprocessor; it will run faster if a coprocessor is installed. We recommend that you run ALOHA on a PC using an 80386 microprocessor or above, with a math coprocessor, and with at least two megabytes of RAM.

Getting help

On-line help is available at any time in ALOHA. If you're using ALOHA for the Macintosh, select **About ALOHA™** under the menu to see a brief explanation of each menu item and dialog box in the air model (Figure 1-4). With ALOHA Windows, you select **About ALOHA™** from the Control menu box; for both Macintosh and Windows, you can also click the **Help** button next to the option in question (Figure 1-5). Either of these approaches takes you to the same Help information. Clicking **Help**, as in Figure 1-5, is a short-cut that takes you directly to the topic of concern.

Figure 1-4. Selecting ALOHA Help.

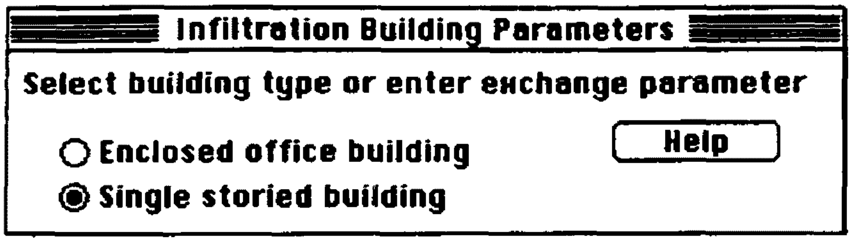


Figure 1-5.
ALOHA Help button.

The Help index you access from **About ALOHA** is arranged alphabetically (Figure 1-6). Under each topic there is a brief discussion of the option, instructions for how to use that option, any pertinent warnings or notes, and the range of allowable inputs if it is a numeric option.

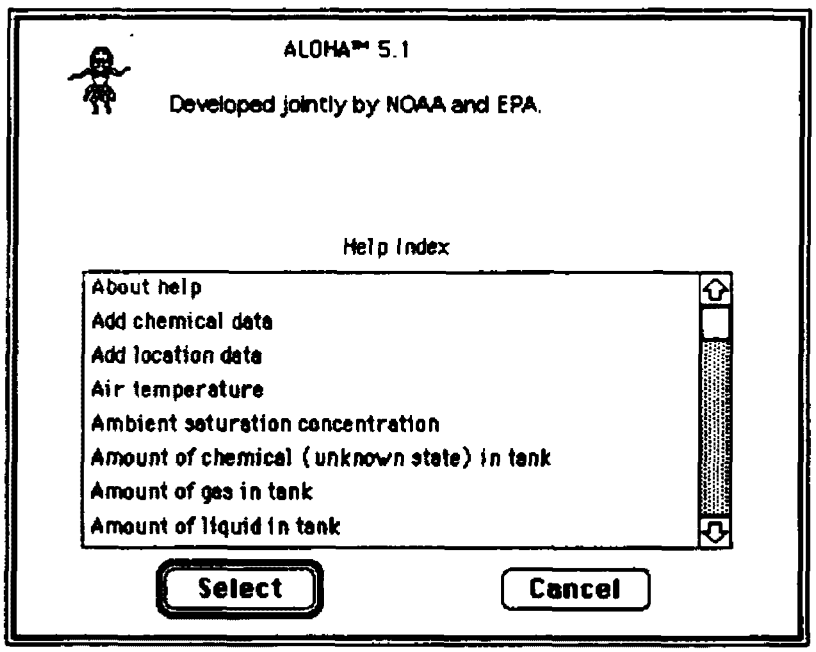
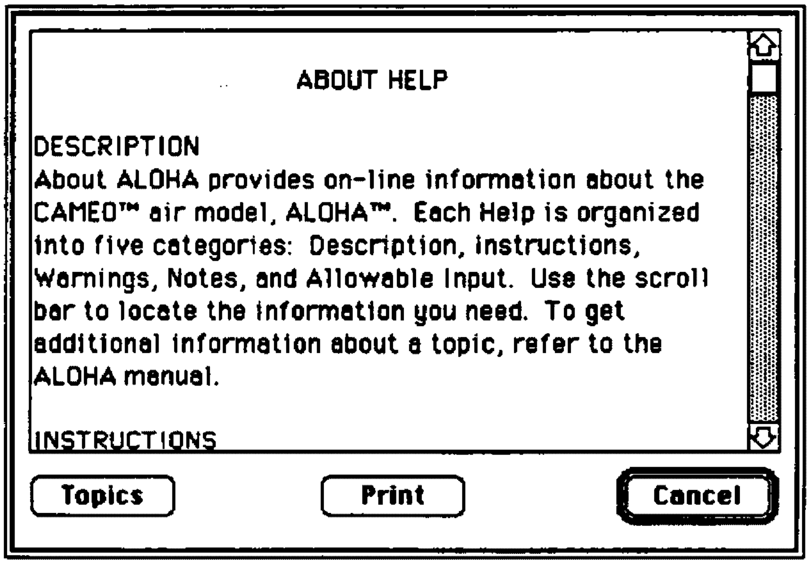


Figure 1-6.
ALOHA Help index.

When you've finished looking at the **Help** screen, click **Topics** to return to the Help index to select another topic, **Print** to print the Help screen, or click **Cancel** to return to the previous screen (Figure 1-7).

Figure 1-7. Sample Help screen.



Chapter 2

Introduction to Air Modeling

In this chapter...

The Areal Locations of Hazardous Atmospheres (ALOHA) model is a tool for estimating the movement and dispersion of gases. The air model estimates pollutant concentrations downwind from the source of a spill, taking into consideration the toxicological and physical characteristics of the spilled material. ALOHA also considers the physical characteristics of the spill site, the atmospheric conditions, and the circumstances of the release. Like many computer applications, it can solve problems rapidly and provides results in a graphic, easy-to-use format. This can be helpful during an emergency response or planning for such a response. **Keep in mind that ALOHA is only a tool whose usefulness depends on your accurate interpretation of the data.**

ALOHA originated as an in-house tool to aid in response situations. In its original format it was based on a very simple approach used in the *Workbook on Atmospheric Dispersion Estimates* (Turner 1974). It has evolved over the years into a tool used for a wide range of response, planning, and academic purposes. However, you must still rely on your own common sense and experience when deciding how to respond to a particular incident. There are some processes that would be useful in a dispersion model that have not been included in ALOHA because of extensive input and computational time requirements (e.g., topography). These model limitations will be discussed in this manual as they come up.

Dispersion modeling

There are a number of different types of air dispersion models, ranging from simple models that do not require a computer, to complex three-dimensional models that require massive amounts of input data and powerful computers. The type of model to be used depends a good deal on the scale of the problem, the level of detail available for input and required for output, the background of the intended user, and the turnaround time needed for an answer.

ALOHA was designed with first responders in mind. The model is most helpful for estimating plume extent and concentration for short-duration chemical accidents. It is not intended for use with accidents involving radioactive chemicals. Nor is ALOHA intended to be used for permitting of stack gas or chronic, low-level ("fugitive") emissions. There are a number of other models available that will address larger scale and/or air quality issues (Turner and Bender 1986).

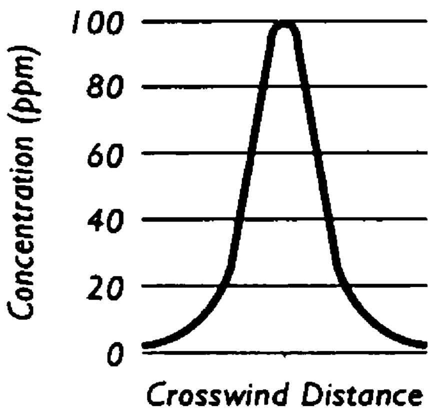
Since the first responder typically does not have a dispersion modeling background, a guiding criterion in ALOHA's development was that the data required for input be easily obtained or estimated on-scene. ALOHA's extensive on-line help can assist you in making appropriate choices.

What is dispersion?

Dispersion is a term used in modeling to include advection (moving) and diffusion (spreading). The cloud of dispersing vapor will generally move in a downwind direction and spread in a crosswind and vertical direction (crosswind is the direction perpendicular to the wind). A heavy gas can also spread upwind to a small extent. There are really two separate dispersion models in ALOHA: Gaussian and heavy gas.

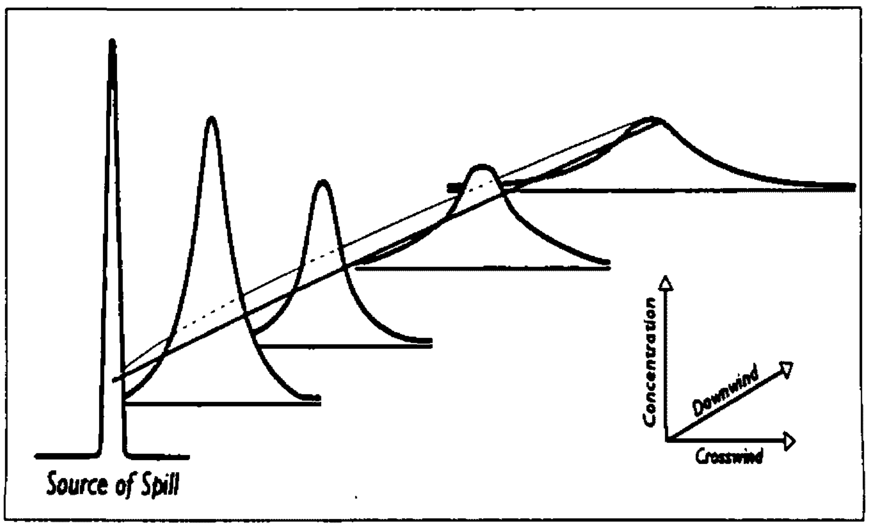
ALOHA uses a Gaussian dispersion model to describe the movement and spreading of a gas that is neutrally buoyant (approximately the same density as air). The Gaussian equation describes the bell-shaped curve that many teachers use in grading. In this curve, there are always a few grades at the high and low ends, but most are in the C range. This curve is used to describe many other phenomena, including how a contaminant will be dispersed in the air from the source of a spill. Figures 2-1 and 2-2 show such a Gaussian distribution produced by ALOHA.

Figure 2-1. Gaussian distribution.



At the source of the spill, the concentration of the pollutant is very large and the Gaussian distribution looks like a spike or a tall column (Figure 2-1). As the pollutant drifts farther downwind, it spreads out and the "bell shape" gets continually wider and flatter (Figure 2-2).

Figure 2-2. Gaussian spread.



The model can produce a diagram that shows the top view of the plume, called the plume's "footprint." This diagram connects all the points of the same concentration (for example, the Immediately Dangerous to Life and Health (IDLH) concentration). The area inside the footprint is the region that is predicted to have ground level concentrations above the limit you set during the model run. Choosing this value (often called the level of concern or LOC) is discussed in the **Options** section of Chapter 5, The Display Menu.

The heavy gas dispersion calculations that are used in ALOHA are those used in the DEGADIS model (Spicer and Havens 1989). This model was selected because of its general acceptance and the extensive testing that was carried out by the authors. In order to speed up the computational procedures and reduce the requirement for input data that would typically not be known in an emergency spill scenario, a few simplifications were introduced into ALOHA-DEGADIS, making it different from the initial model. These simplifications include:

- the initial momentum jet model for elevated sources (OOMS) is not included. ALOHA-DEGADIS assumes that all spills originate at ground level;
- the mathematical approximation procedures used for solving the model's equations are faster, but less accurate than those used in DEGADIS; and
- ALOHA-DEGADIS models sources for which the release rate changes over time as a series of short, steady releases rather than as a number of individual point source puffs.

Throughout the creation of ALOHA-DEGADIS, NOAA worked closely with the original authors of DEGADIS to ensure a faithful representation of DEGADIS model dynamics.

ALOHA-DEGADIS was checked against DEGADIS to ensure that only minor differences existed in results obtained from both models.

Considering the typical inaccuracies common to emergency response, these errors are probably not significant. In cases where technical accuracy is required, you should obtain the original DEGADIS model and use it to investigate the scenarios of interest.

There are some instances, however, when ALOHA's heavy gas calculations may estimate that the footprint is much larger than its actual size. In order to speed calculation of a heavy gas footprint, each spill is treated as a continuous release at the highest release rate estimated for the scenario.

When the source strength is calculated, it is broken into five steps which represent the average rate of release for each segment of time. For the overall footprint estimate, ALOHA's heavy gas calculations use the highest of the five steps, which means that it uses the highest possible rate in its calculations. However, when estimating the dose and concentration curves, the heavy gas calculations use all five varying time-dependent rates.

These differences are particularly noticeable when you're working with large, time-dependent releases, such as those from pressurized tanks. For example, you may find that the concentration curve for a location within the footprint is actually *below* the footprint level of concern. An estimate of source strength or footprint length is "conservative" if it is an overestimate. When release rate changes, ALOHA's heavy gas footprint will always be at least somewhat conservative, and sometimes, too conservative. To get a more accurate picture of the computed concentrations, examine the concentration curves for a few locations within the footprint.

When a gas that is heavier than air is released, it initially diffuses very differently than a neutrally buoyant gas. The heavy gas will first "slump," or sink, because it is heavier than the surrounding air. As the gas cloud moves downwind, gravity makes it spread; this often causes some of the vapor to travel upwind of the source. As the cloud becomes more diluted and its density approaches that of air, it begins behaving like a neutrally buoyant gas. This takes place when the concentration of heavy gas in the surrounding air drops below one percent. For many small spills, this will occur in the first few tens of yards. For large spills, this may happen much further downwind.

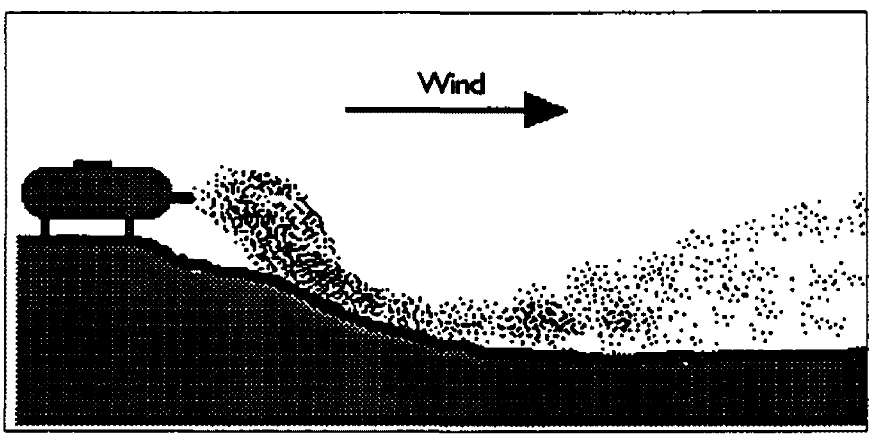


Figure 2-3.
Plume spread as a result of gravity.

The classification of a gas as heavy is not always straightforward. The molecular weight of air is approximately 29 and the density of air is approximately 1.1 kilograms per cubic meter. Gases that have molecular weights greater than that of air will be heavy if enough is released. If the density of the gas is substantially greater than the density of the air, ALOHA considers the gas to be heavy. Gases that are lighter than air under normal conditions, but are being shipped in a cryogenic (low temperature) state, form a heavy gas cloud because they are very cold, and therefore dense, at the time of their release (like anhydrous ammonia, for example).

ALOHA allows you to choose to always use the heavy gas calculations, always use Gaussian calculations, or to let the model decide. Do this by choosing **Computational** from the SetUp menu (see Chapter 4).

There are instances when you may want to specify the calculation method rather than letting the model choose. Such cases include:

DISPERSION CHOICES

- Heavy gas calculations can take longer to complete than Gaussian ones, especially if you are running ALOHA on a computer without a math coprocessor chip. If a very fast turnaround is required, you may wish to run the Gaussian module first and the heavy gas module when time allows.

- In the case of a gas that may be heavy because of how it is stored (e.g., cryogenic), ALOHA will warn you that the selected chemical may flash boil and/or result in two-phase flow. In this case, ALOHA may default to the Gaussian calculation. In such cases, you should re-run ALOHA using the heavy gas calculations, and compare the potential threat zones as represented by the two footprint estimates.

- When used in a planning or training session or when time is not an issue, consider running some scenarios using both the heavy gas and Gaussian modules. This will give you a feel for how the models compare.

Use Caution

Be cautious when interpreting any model's results. **Remember that these results are only as good as the information you gave the model to work with. They reflect the amount of guesswork that went into your input.** Any model requires accurate data from you in order to come up with valid estimates. For example, if you find that you don't know the exact wind speed or temperature, and are instead doing a lot of guessing, the information that you give ALOHA to work with may not represent actual conditions. If this is the case, you can't expect ALOHA's output to reflect what is really going on.

ALOHA's results are only as good as your input.

In addition, ALOHA's calculations become significantly less reliable in certain situations, even though you may be providing accurate input. In particular, pay careful attention to these situations:

CAUTION

- very low wind speeds
- very stable atmospheric conditions
- wind shifts and terrain steering effects
- concentration patchiness, particularly near the spill source.

ALOHA DOESN'T CONSIDER

ALOHA doesn't take into account the effects of:
- fires or chemical reaction by-products
- particulates
- topography

Very low wind speeds
As the wind speed decreases, the wind direction may become very inconsistent. ALOHA warns you in two ways that low wind speeds may lead to problems.

First, ALOHA does not allow you to enter a wind speed that is less than two knots (one meter per second). If you try to use a wind speed of less than two knots, ALOHA tells you that the wind speed is too low and forces you to reset the speed to a minimum of two knots before you can continue.

Second, as the wind speed decreases towards two knots, the "confidence" or "uncertainty" lines drawn around the footprint form a circle (see **Footprint** in Chapter 4, The SetUp Menu), indicating that changes in wind direction may move the chemical cloud in any direction.

Very stable atmospheric conditions
Very stable atmospheric conditions intensify the uncertainties discussed above. Under the most stable atmospheric conditions, there will often be very little wind at all. This situation will usually occur late at night or during the early morning. In these conditions, there is almost no mixing of the pollutant into the surrounding "clean" air; none of this air is entrained, or mixed, into the toxic cloud.

In a very stable atmosphere, the chemical cloud will spread out in the same manner as cream poured into a coffee cup. The cream will dilute and spread slowly into the coffee, but, until you stir it, will take a very long time to mix completely into the coffee. In the same way, a cloud will spread slowly under very stable atmospheric conditions. Terrain features, such as small valleys or depressions, may trap the gas until wind and hence, mixing, is introduced.

These processes may lead to high concentrations of the gas remaining for a long period of time and/or remaining even at large distances from the spill source. The Bhopal, India, accident involving the release of methyl isocyanate is an example of what can happen under very stable atmospheric conditions. Thousands of people died,·some of whom who were quite a distance from the release.

For the first responder, a very stable atmosphere should send up a flag: this is a dangerous situation where models are not very reliable. To counter this situation, think about whether the chemical will behave as a heavy gas; look for physical depressions and topographic features that may trap or steer the dispersing cloud.

Wind shifts and terrain steering effects

ALOHA allows you to enter only one wind speed and direction; this may not accurately describe conditions over the entire affected area. For example, areas with hills or valleys may experience wind shifts where the wind actually flows between the hills or down into the valleys, turning where these features turn. Since ALOHA does not account for shifts in wind direction, the footprint it calculates will not reflect these turns (Figure 2-4).

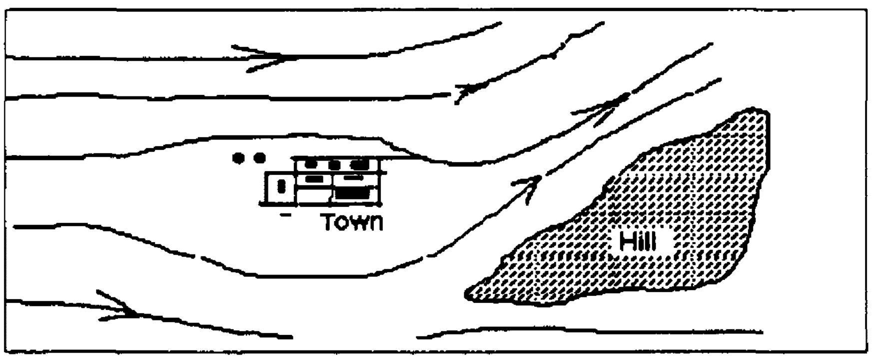
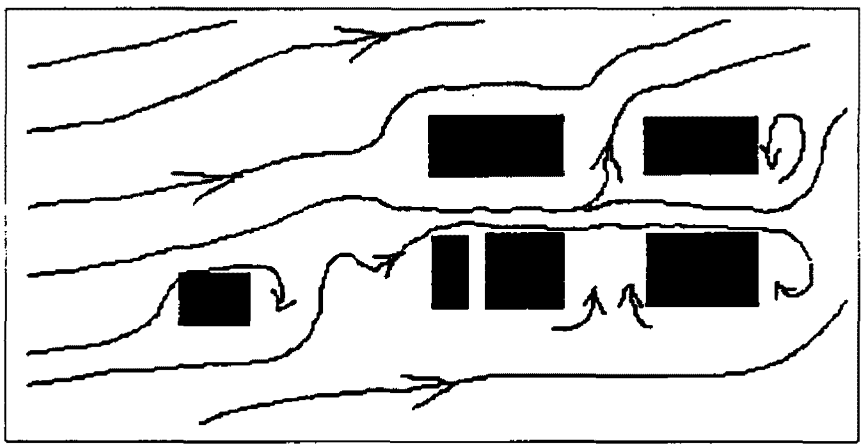


Figure 2-4.
Wind shifts

Recognizing the probability of wind shifts over distance and time, ALOHA has set limits on the duration of a release and size of a footprint. Though ALOHA will not draw any plume longer than 10 km (6.4 miles), as a general rule, you should think that any footprint more than a few miles long may be influenced by variations in the wind direction. Similarly, ALOHA only models the first 60 minutes of a release. After that time, meteorological conditions are likely to have changed.

Another important limitation of the air model is that it does not resolve small-scale variations in the wind caused by obstacles (Figure 2-5).

Figure 2-5.
Small-scale variations in wind direction.



Wind flowing around large obstacles will create eddies and unstable wind shifts; these can significantly change a cloud's shape. For example, in an urban area with high-rise buildings, the wind patterns at ground level are totally controlled by the through streets. These streets may generate a "street canyon" wind pattern. ALOHA's footprint will appear to go right over, or through, obstacles like these. Remember these limitations when you're interpreting model results.

Concentration patchiness

ALOHA doesn't accurately represent variations associated with near-field (close to the spill source) patchiness. In the case of a neutrally buoyant gas (which would be modeled using Gaussian calculations), the vapor cloud will move downwind. Very near the source, however, the cloud can be oriented in quite a different direction.

This kind of movement is familiar to anyone who has tried to toast marshmallows over a campfire (you know—no matter where you sit, the smoke from the fire always seems to come straight towards you). In fact, what you see in a case like this is the effect of individual drifting eddies in the wind, pushing the cloud from side to side (Figure 2-6). These eddies, or small gusts, are also responsible for much of the mixing that makes the cloud spread out. As the pollutant drifts downwind from the spill source, these eddies shift and spread the cloud until it takes on the form of a Gaussian distribution.

Figure 2-6. Concentration patchiness close to the source.

In the case of a heavy gas, concentration patchiness still occurs, though it is combined with the slumping and spreading processes caused by gravity (see page 2-8).

ALOHA does not model...

...fires or chemical reactions

The smoke from a fire rises due to thermal energy, then moves downwind. This rise is based on many factors which are not considered by ALOHA. In addition, ALOHA does not address the by-products resulting from fires or chemical reactions.

WARNING

Be careful that the chemical you select to model reflects the chemical that is actually being released to the air in your scenario. For example, when aluminum phosphide comes in contact with water, it releases phosphine gas. If you wish ALOHA to estimate a footprint associated with aluminum phosphide, you will need to know the reaction rate and how much phosphine is being generated.

...particulates

ALOHA does not include the processes needed to model particulates.

...solutions and mixtures

At this time, the chemical database contains pure compounds only. If you know the chemical properties (e.g., vapor pressure, normal boiling point) for a mixture or solution, you may enter these data and use ALOHA.

...topography

ALOHA does not consider the shape of the ground under the spill or in the area affected by the pollutant. This can be particularly important if a liquid is spilled onto a sloping surface.

Chapter 3

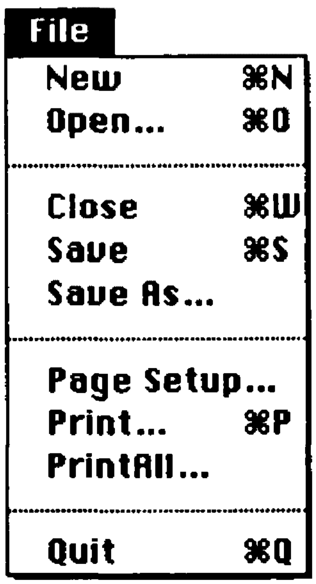
The File and Edit Menus

In this chapter...

Introduction

With several important exceptions, the **File** and **Edit** menus in ALOHA work in the same way as in other applications. These exceptions are described below.

The File Menu



New

allows you to reset ALOHA before beginning a new scenario. When you choose this menu item, you will have the option to save your old scenario before resetting ALOHA.

Open...

allows you to open an ALOHA save file which you previously created using the **Save As...** menu item (see below).

Close

closes ALOHA's front window. You cannot close the Text Summary window.

Save and Save As...

allows you to create and save ALOHA save files and Spy window archive files.

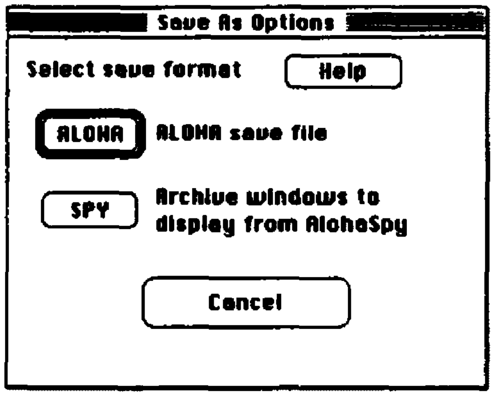


Figure 3-1.
ALOHA Save options.

ALOHA save files

If you have information about chemical storage facilities in your area, you can prepare in advance for a spill response by creating a set of ALOHA save files. You can store some information about the characteristics of a spill in such files, thereby saving time during an actual incident.

Remember, though, that because these files are intended for use in spill response, not all information about a scenario will be saved into an ALOHA save file. Information that is not expected to change from day to day will be saved, including location, chemical of concern, and dimensions of existing storage vessels and containment areas. You'll still need to enter information specific to a particular spill, including weather conditions and size of the spill, when you use an ALOHA save file.

SPY files

You may also archive the results of an ALOHA model run as a SPY file. These files will be useful to you whenever you wish to document your results. A SPY file contains all the information from the windows visible in ALOHA at the time the file was saved. SPY files can be viewed and printed from ALOHA's companion application, AlohaSpy (see Appendix C).

Creating new files

To create an ALOHA save file, choose **Save As...** from the **File** menu, then choose **ALOHA** from the Save As Options dialog, type in a file name, and click **OK**. Now, when you enter new information about the scenario into ALOHA, you can simply choose **Save** to update this file.

Before creating a SPY file, be sure that all windows you'd like to archive are visible. Then choose **Save As...** from the **File** menu, choose **SPY** from the Save As Options dialog, type in a file name, and click **OK**. You can use AlohaSpy to open, view, and print the new SPY file.

Print...

prints the contents of the front ALOHA window.

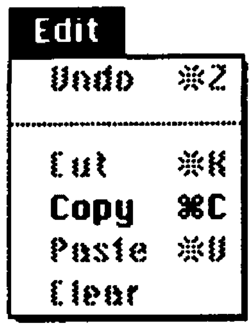
PrintAll...

prints the contents of all visible ALOHA windows.

Quit (or Exit)

ALOHA saves your choice of location upon quitting the application. Remember that if you wish to save the scenario information for later use, select **Save As...** from the **File** menu before quitting.

The Edit Menu



Copy

allows you to copy pictures or selected text from the front window to the clip-board. This allows you to paste selected items into a word processing or graphics application.

Note

The **Undo, Cut, Paste,** and **Clear** menu items are not available in ALOHA.

Chapter 4

The SiteData Menu

In this chapter...

The **SiteData** menu is the first menu in ALOHA where you enter information. There are four items where you can give ALOHA information about your spill situation:

- geographic **location;**
- the **building type** in the area of the spill; and
- **date and time** of the spill.

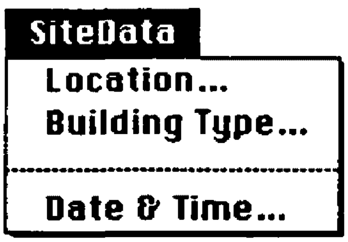


Figure 4-1.
The SiteData menu.

Location

Here, you tell ALOHA the actual geographic location of your spill. Once you have selected **Location,** you can type in the initial letter of the location and move to the first city beginning with that letter, or you can scroll to the location. To choose a location for the incident, double-click on the location you wish, or click on it once and then click the **Select** button. If the city or location you are interested in isn't on the list, you can add it. We explain how to add a city later in this chapter.

ALOHA currently uses location information to calculate:

- the angle of the sun (ALOHA looks at latitude, longitude, and time of day for this calculation), and
- the atmospheric pressure (ALOHA bases this on the location's elevation).

The angle of the sun becomes important when a chemical has formed a puddle on the ground. ALOHA will calculate the amount of energy coming into the puddle from the atmosphere and from the ground. For example, if the sun is high in the sky, the amount of energy coming into the puddle is greater than it would be in the early morning or late afternoon, when the sun is lower. The more energy coming in, the higher the evaporation rate.

The model is not very sensitive to small errors in the location information. If you are in a situation where you must guess at this information, an estimate will be adequate if it is within one degree in latitude and longitude, and a few hundred feet in elevation, of the actual site.

Let's run through an example in which you'll add, modify, and delete two cities, one in the U.S. and one outside the U.S. To begin, choose **Location** from the **SiteData** menu. You see a scrolling index of locations (mostly U.S. cities and towns).

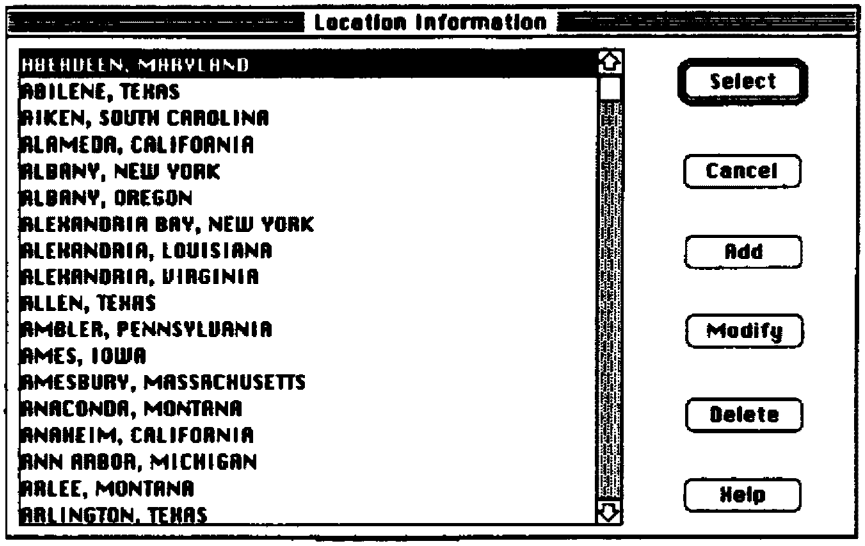


Figure 4-2. Location index.

Adding a U.S. location

Since Jupiter, Florida is not included in this index, click **Add**. Type in the city name, its approximate elevation, and its latitude and longitude (Figure 4-3).

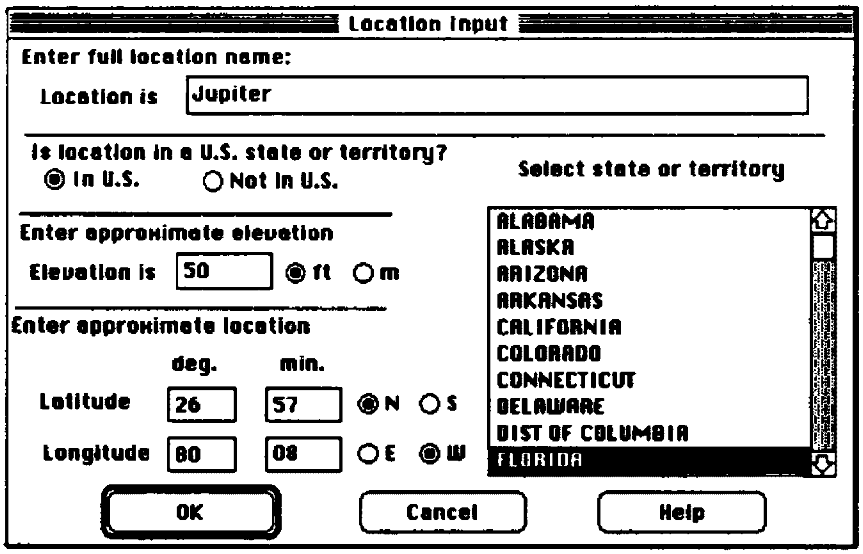


Figure 4-3. Adding a U.S. location.

Next, select **Florida** from the scrolling list of U.S. states and trust territories. ALOHA checks that the information you have entered is within the range of reasonable values for Florida. (If you have entered a value that is not in the valid range, ALOHA will tell you which value is out of range; you must correct this value before you can continue). Click **OK.** Provided all of your input was within the acceptable ranges for Florida, you return to the scrolling city index screen.

Jupiter, Florida appears at the top of this screen. If you click **Cancel** at this point, the information you added on Jupiter will disappear and the city name will be removed. To save this information, you must **Select** a location.

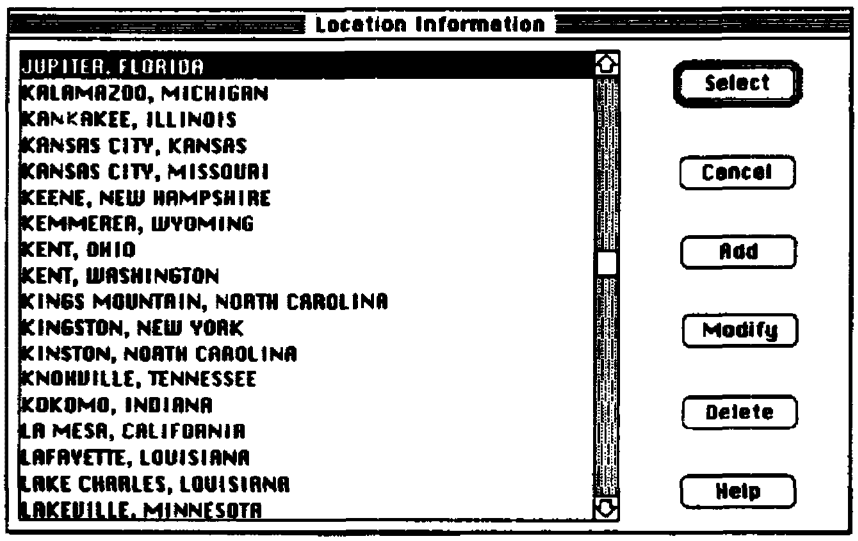


Figure 4-4. Location index with Jupiter, Florida.

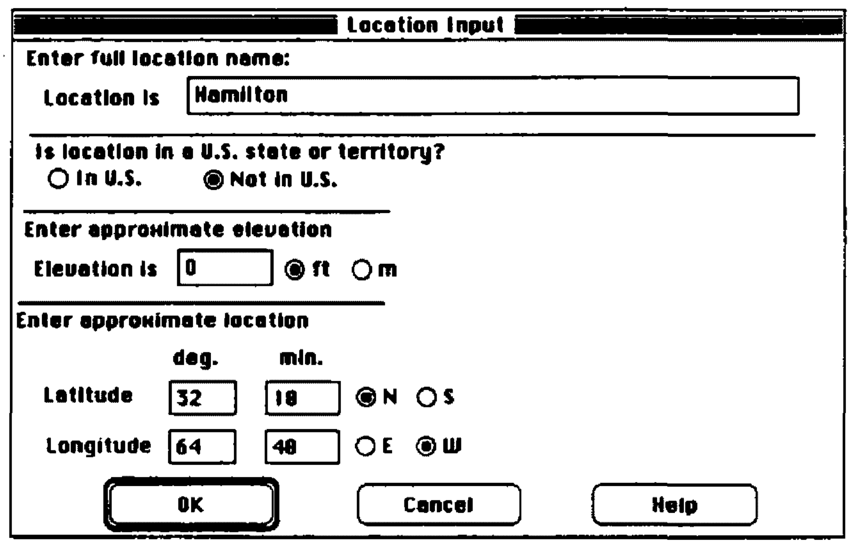
NOTE

If you enter a city in a state with multiple time zones (e.g., Indiana), you may see another set of dialog boxes asking you to select the appropriate time zone.

Adding a location outside the U.S.

We'll use Hamilton, Bermuda as our example here. To add a city or town that is not located in the U.S., click **Add** and type in the name of the location *without* its country (you'll be asked for that next). Click **Not in U.S.** Notice that the scrolling list of U.S. states and territories disappears from the right side of the window (Figure 4-5). Enter the approximate elevation, and latitude and longitude coordinates, and click **OK**.

Figure 4-5.
Adding a non-U.S. city.



You should next see the **Foreign Location Input** dialog box (Figure 4-6). Now, type in the name of the country and the time difference between Greenwich Mean Time (GMT) and the local standard time. The GMT offset must be entered with a negative sign if the time difference is in hours behind GMT. If you don't enter a sign, ALOHA assumes that the time difference is positive. Finally, decide whether the time that you want ALOHA to use in its calculations here is Standard Time or Daylight Savings Time.

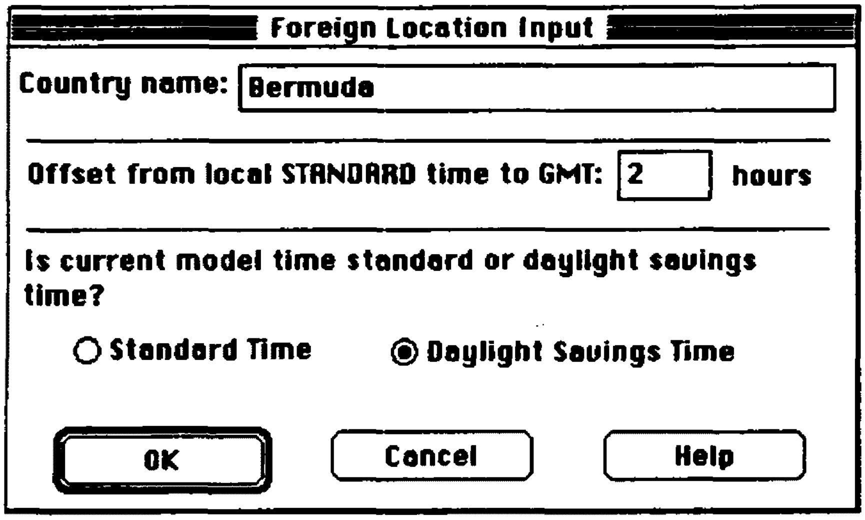


Figure 4-6.
Adding a foreign country.

WARNING

Although ALOHA will automatically switch U.S. cities from Standard to Daylight Savings Time (based on the date), the time change for foreign locations will not be corrected automatically .

When you click OK, you'll see that Hamilton, Bermuda has been added to the location index:

Figure 4-7.
Location index with foreign addition.

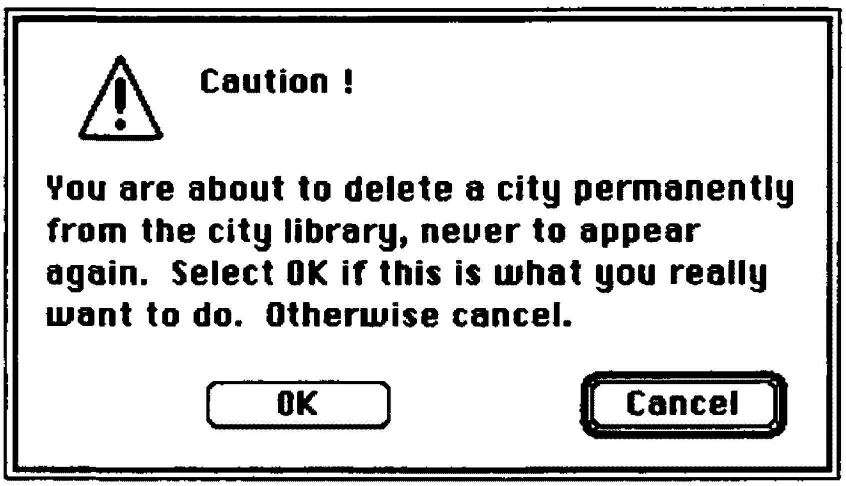
Modifying a location

To change information that you've already entered for a location, click **Modify** on the Location Information screen (Figure 4-4). You will see the information that is currently in CityLib. Select the item that you wish to change and type in the new value.

Deleting a location

To remove a location from the index, select the location on the list, and click **Delete.** ALOHA will ask you if you're sure that you want to remove this location. At this point, you can change your mind by clicking **Cancel**, or proceed with removing the location from the list by clicking **OK**.

Figure 4-8.
City deletion caution.



WARNING

If you've made a mistake and deleted the wrong city, your only option at this point is to click Cancel. If you close the Location dialog box and move on to the next menu item, the city is permanently deleted.

Building Type

You can specify the type of buildings in the area of the spill. ALOHA uses this information, together with data such as the outside wind speed and temperature, to determine the rate at which the chemical will infiltrate the buildings.

If you select a **single** or **double-storied building**, ALOHA will use a default value to calculate the number of air exchanges per hour (Wilson 1987). If you select **Enclosed office building**, ALOHA assumes that the air exchange rate is controlled and sets a default value based on the number of air exchanges an average enclosed building would require to keep the inside air from being "stuffy."

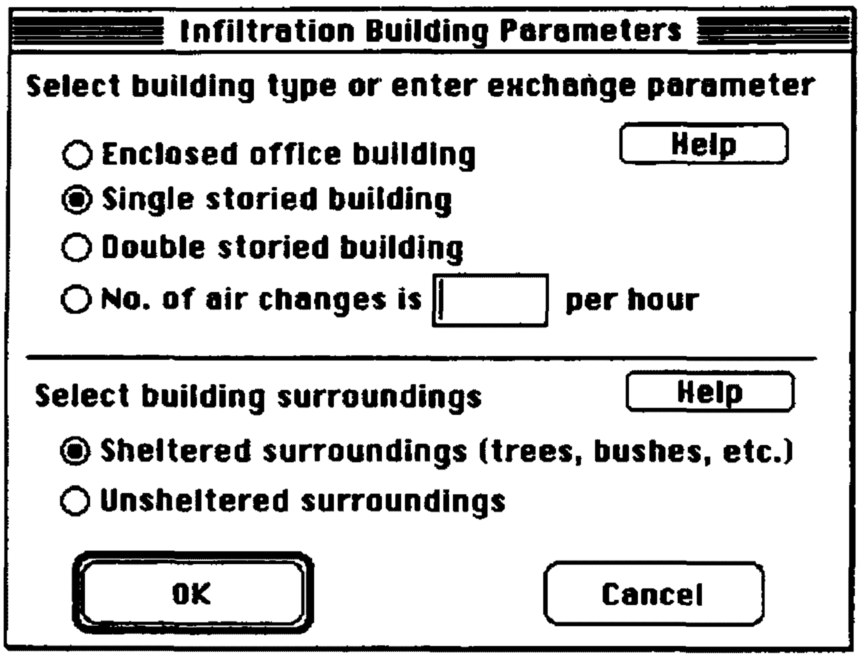


Figure 4-9.
Building parameters.

If you know the number of times per hour that the total air volume within the building is replaced, enter this number next to **No. of air changes**. You can use this to compare the effects of different air exchange rates.

Unless you have specified the number of air changes or have chosen **Enclosed office building**, you will need to tell ALOHA whether the surrounding area is sheltered or unsheltered. Sheltered surroundings will reduce the rate at which the chemical can infiltrate the buildings. Below are some guidelines for choosing sheltered or unsheltered surroundings.

If the buildings...	Click...
...are surrounded by trees or other buildings in the direction from which the chemical cloud will be coming	**Sheltered surroundings**
...are in an open space, with nothing near it	**Unsheltered surroundings**
...if you are unsure	**Unsheltered surroundings.**

Date & Time

Now enter the date and time of the spill. If you don't select **Date & Time**, ALOHA will use the time on your computer's internal clock to run your scenario. If the time on your computer's clock is incorrect, reset the time on the Control Panel. This time may be important as some of the calculations ALOHA will do depend on the time of day.

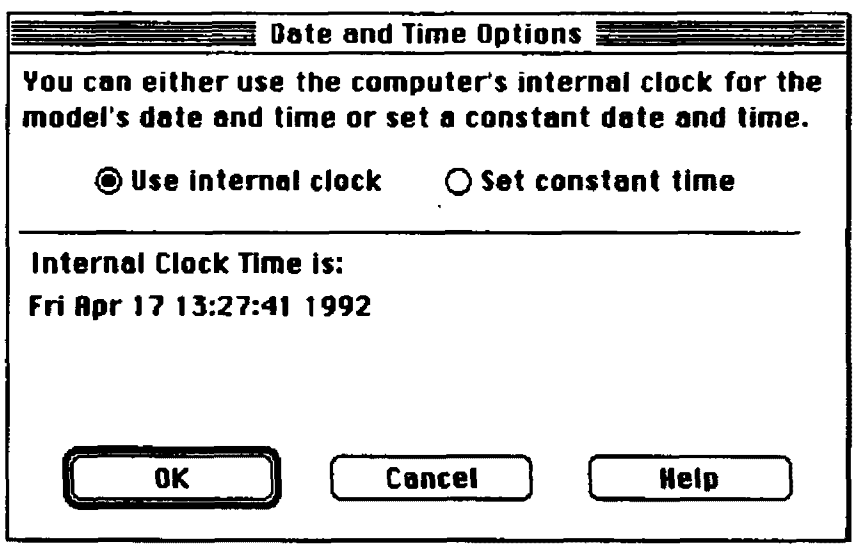


Figure 4-10. Date and time options.

Set constant time lets you specify when you want the scenario to begin. This is useful for contingency planning or training exercises because you can set up scenarios to run at different times of the day and/or year (and therefore under different environmental and atmospheric conditions). The computer's internal clock time will be automatically filled in when you choose this option. You may then change any of the values.

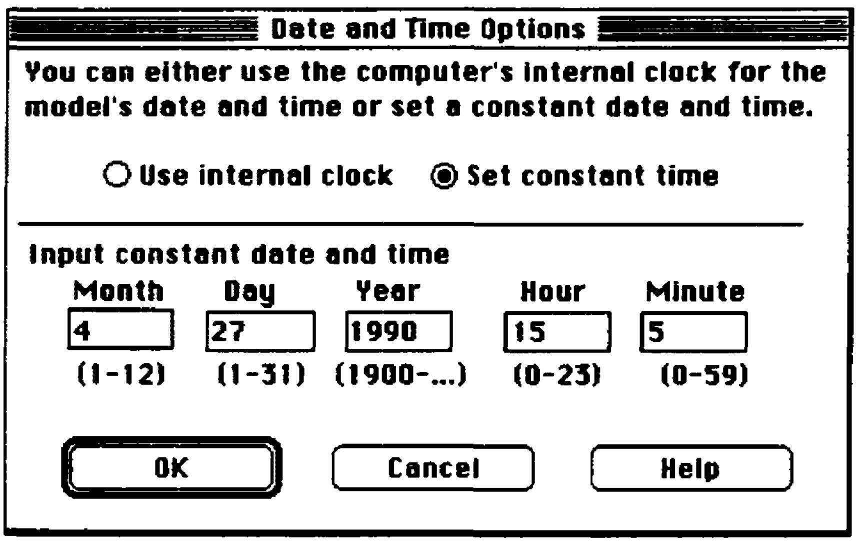


Figure 4-11.
Setting constant time.

Chapter 5

The SetUp Menu

In this chapter...

After you've entered the information under the **SiteData** menu, you need to select a chemical, set the atmospheric conditions, and specify the type of source in your spill scenario. These options are found under the **SetUp** menu. In addition, you can specify the type of computations that you want ALOHA to use to calculate dispersion and dose.

You should select the menu items in descending order. Although you can select the **Chemical** and **Atmospheric** items at any time, the **Source** option cannot be selected until you have filled in the **Chemical** and **Atmospheric** data.

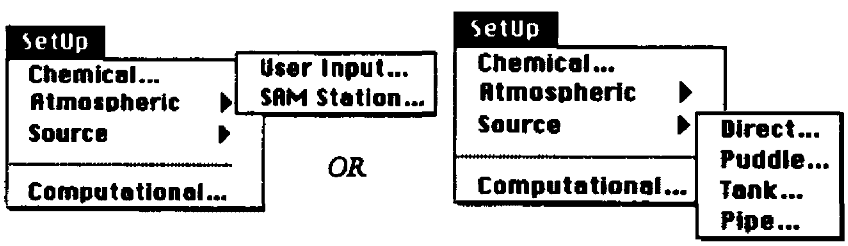


Figure 5-1.
The SetUp menu.

Chemical

Select **Chemical** from the **SetUp** menu to access a scrollable list of the chemicals included in ALOHA's chemical library, ChemLib (Figure 5-2). About 700 pure chemicals are included in the library. No chemical mixtures are included in ALOHA's library, nor are any chemicals with unstable structures, nor any chemicals of such low volatility that they don't represent air dispersion hazards (i.e., solids or liquids with very low vapor pressures). Chemicals may be added to the library or deleted from it, and property information about any chemical may be modified.

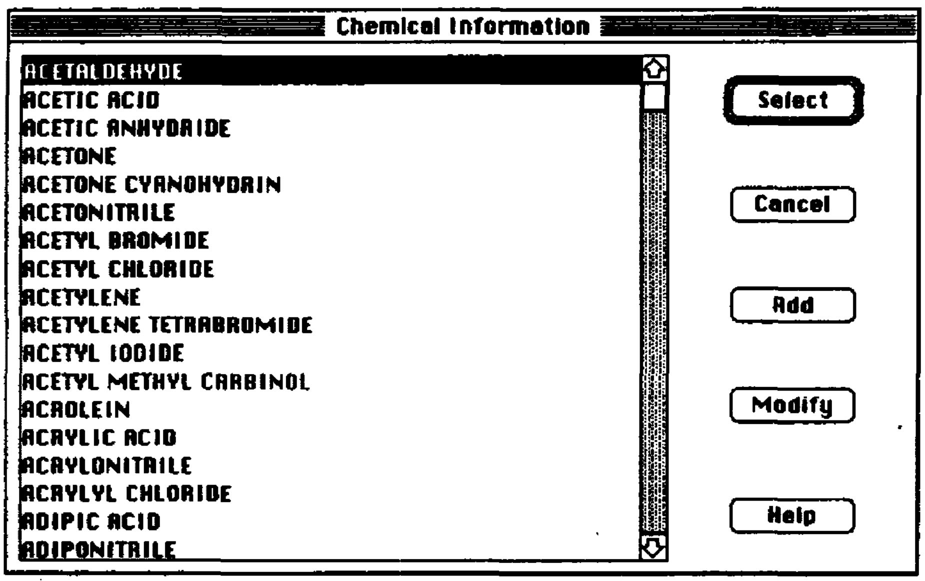


Figure 5-2.
Chemical index.

Selecting a Chemical

Select a chemical by scrolling through the list until you find its name, clicking on the name, and choosing **Select**. You can search rapidly through the list by typing in the first few letters of the chemical name. Once you have selected a chemical, you'll see some of the most important properties of the chemical listed in the Text Summary window (Figure 5-4).

Chemical Data

The chemical library includes information about the physical properties of each ALOHA chemical. The library also includes values for the IDLH (Immediately Dangerous to Life and Health) and TLV-TWA (Threshold Limit Value - Time-Weighted Average) toxic thresholds.

The ALOHA library contains information from two sources. When available, information was obtained from a chemical database compiled by the Design Institute for Physical Properties Data (DIPPR), known as the DIPPR database (Daubert and Danner 1989). Additional property values were obtained from the chemical database included in the Computer-Aided Management of Emergency Operations (CAMEO™) hazardous chemical information system (National Oceanic and Atmospheric Administration 1992).

ALOHA uses information from the library to model the physical behavior of a chemical that you have selected. For example, once ALOHA knows the temperature within a tank, it can use library information to estimate the vapor pressure, density, and other properties of the chemical stored in the tank.

You need only the name of a chemical and its molecular weight to run ALOHA, but you will be able to use only the Direct source option and Gaussian dispersion module. You will need values for additional chemical properties to make source calculations using the Tank, Puddle, or Pipe source options or to make heavy gas calculations. Check Table 5-1 for the properties necessary to use each option.

Refer carefully to Table 5-1 before adding property information about a chemical. ALOHA's chemical library contains a few data fields for properties that the model either estimates itself or does not currently use (we anticipate that these properties may be useful in a future version of ALOHA). Adding values for these properties will have no effect on source or dispersion calculations, and you won't need to add values for them to run any ALOHA calculation.

Table 5-1. Chemical properties needed to use each ALOHA source and dispersion option.

	Gaussian				Heavy Gas			
Property	**Direct**	**Puddle**	**Tank**	**Pipe**	**Direct**	**Puddle**	**Tank**	**Pipe**
Chemical name	❖	❖	❖	❖	❖	❖	❖	❖
Molecular weight	❖	❖	❖	❖	❖	❖	❖	❖
Normal boiling point	○	❖	❖	❖	❖	❖	❖	❖
Critical pressure	○	❖	❖	❖	○	⇨	⇨	⇨
Critical temperature	○	❖	❖	❖	○	⇨	⇨	⇨
Density (gas)					❖	❖	❖	❖
Normal freezing point		❖	❖			❖	❖	
Heat cap. (gas, const. press.)		❖	❖	❖	❖	❖	❖	❖
Heat cap. (liq., const. press.)		❖	❖			❖	❖	
Vapor pressure					❖	⇨	⇨	⇨

❖ **Required properties for entering a new chemical**

○ **Only needed if the source is given in units of volume**

⇨ **Either critical pressure and critical temperature or vapor pressure need to be entered**

These properties are:

- ❒ Critical molar volume
- ❒ Diffusivity (molecular and thermal)
- ❒ Heat of vaporization
- ❒ Density (liquid)
- ❒ Heat capacity (gas at constant volume)
- ❒ Kinematic viscosity (gas and liquid)

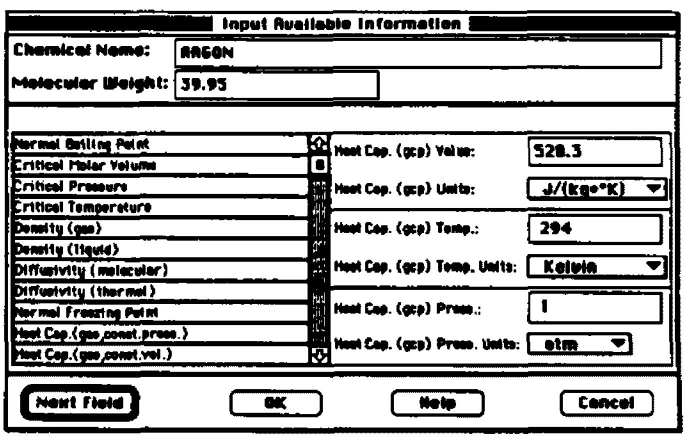
Adding a chemical

You may add a chemical to the library either temporarily (from within ALOHA) or permanently (using ALOHA's companion application, ChemManager). You must know at least the name and molecular weight of each chemical that you add. You may add as many chemicals as you like to the library.

Here's how to add an example chemical, argon, to the library temporarily:

Choose **Chemical** from the **SetUp** menu, then click **Add.** Type "ARGON" in the Chemical Name field. Next, type in 39.95 in the molecular weight field (Figure 5-3). To enter additional property values, click on the name of the property

Figure 5-3.
Adding a chemical.



in the scrolling list (or click on **Next Field** until the property name is highlighted). Enter property values in the appropriate data fields, and choose appropriate units from the corresponding popup menus.

You must add a reference temperature and pressure for all properties which change their value when temperature or pressure change. Click on **Heat Capacity (gas, constant pressure)** and enter the value 520.3 J/kg K at 294 K and 1 atm pressure.

Once you have entered all information about the new chemical, click **OK**. You'll be returned to the chemical index. Click **Select** to select the chemical that you've just added.

Chemicals that you add from within ALOHA will be deleted from the library when you quit from the program. Use ChemManager (see below) to add chemicals permanently to the library.

Review the Text Summary screen for useful information about each chemical you've selected, added, or modified. For example, when only the name and molecular weight of argon have been added to the library, a note will appear on the Text Summary window: "Not enough chemical information to use the Heavy Gas option." This note alerts you that, although

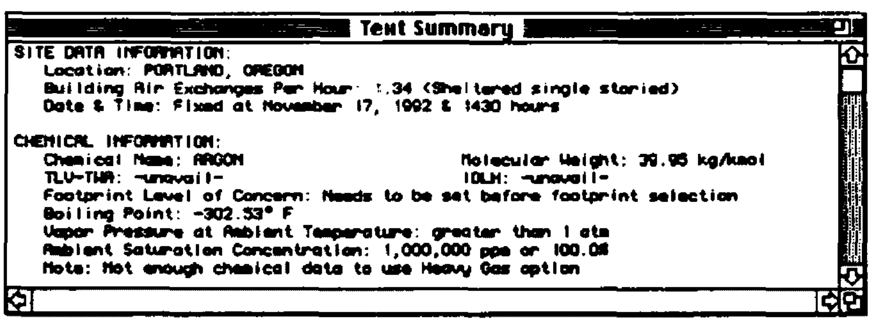


Figure 5-4. Text Summary window.

argon's molecular weight is heavier than 29 kg/kmol, the molecular weight of air, so that it may behave like a heavy gas, ALOHA will have to use Gaussian dispersion calculations (unless you add additional property information).

Also, when you select a chemical which has been identified as a confirmed, potential, or suspected carcinogen, a notation, "Note: Potential or suspected human carcinogen," will appear on the Text Summary screen under the Chemical Information heading.

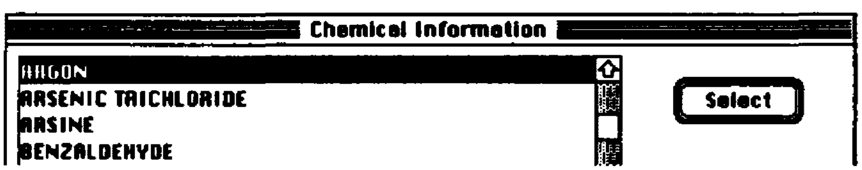
Modifying a chemical

You may modify information about a chemical already in ALOHA's library, or about a chemical that you have previously added. You can make either temporary (from within ALOHA) or permanent (using ChemManager) modifications.

Here's how to temporarily modify information about argon, which you just added to the library. You'll add the properties necessary to run the heavy gas option.

First, choose **Chemical** from the **SetUp** menu. Scroll through the chemical index until you find "ARGON" (or type the letters "AR" for a faster search). Select argon and click on the Modify button.

Figure 5-5.
Chemical index.



Go through the same steps to modify a chemical property value that you used to add values for a new chemical. Click on the name of the property in the scrolling list (or click the

Next Field button until you've highlighted the property name). Enter property values in the appropriate data fields, or modify existing values, and choose appropriate units from the corresponding popup menus.

The first property in the scrolling list is **Normal Boiling Point**. Click on this property name, then enter "87.28" into the empty data field, and choose **Kelvin** from the temperature units menu. Next, click on **Critical Temperature**, and enter the value 150.86 Kelvin. Click on **Critical Pressure**, and enter the value 4,898,100 Pa. Click on **Density (gas)** and enter the value 1.659 kg/m^3 at 294 K and 1 atm pressure.

Not all ALOHA chemical properties can be modified

You cannot modify all property values for ALOHA chemicals already included in the library. Values that you cannot modify, and their units, appear grayed-out. These are values that ALOHA calculates internally, using either values for the chemical's critical properties (molecular weight, boiling point, critical temperature, and critical pressure) or information from the DIPPR database. If you would like to use your own property values for an ALOHA chemical, add the chemical using a slightly different name (such as "CHLORINE-2"), and enter your own values in the new data fields.

Modifications that you've made from within ALOHA will be deleted from the library when you quit from the program. Use ChemManager (see below) to permanently modify the library.

Making permanent changes with ChemManager

You can use ChemManager to make permanent changes to ALOHA's chemical library. To use this application, first quit from ALOHA, then double-click on the ChemManager icon. You'll see a screen very like the one that appears when you choose **Chemical** from ALOHA's **SetUp** menu.

To add a chemical to the library, click **Add**. Then follow the same steps used to temporarily add a chemical from within ALOHA. First, type in the name of the chemical and its molecular weight (you'll absolutely need these two pieces of information). Then add values for all other properties that you'll need to run ALOHA (check Table 5-1 to see which properties are necessary for ALOHA's various source and dispersion options). Be sure to add values for reference temperature and pressure when these are needed (ChemManager will remind you if you don't). When you're finished, click **OK** to make your new chemical a permanent part of ALOHA's library. Click **Cancel** to avoid adding the chemical.

To modify a chemical, select the chemical from the scrolling list of chemical names, then click **Modify**. Follow the same steps used to make temporary modifications from within ALOHA; make modifications to existing information, or add new information to data fields. Remember that you cannot change information in any grayed-out data fields; this information is internally calculated by ALOHA. When you're finished, click **OK** to make your permanent changes to ALOHA's library. Click **Cancel** to avoid making these changes.

To delete a chemical, select the chemical from the scrolling list of chemical names, then click **Delete**. Click **OK** to delete the chemical permanently from ALOHA's library. Click **Cancel** to avoid deleting this chemical.

Remember that when you click **OK** within ChemManager, you're making a permanent change to the ALOHA chemical library. Be sure that you are entering accurate information. To exit ChemManager without making permanent changes to the library, click **Cancel**.

Changes made to ALOHA's chemical library from within ALOHA will not be saved when you exit from ALOHA. Use **ChemManager** to make permanent changes to the library (see below). To save any changes you've made to an ALOHA chemical without making permanent changes to ALOHA's chemical library, choose **Save** from the **File** menu (Figure 5-6), and save this scenario as an ALOHA file (see Appendix C for more on saving files using AlohaSpy). Any modifications you have made to your chemical will be saved in this file, which you can reopen from within ALOHA at any time.

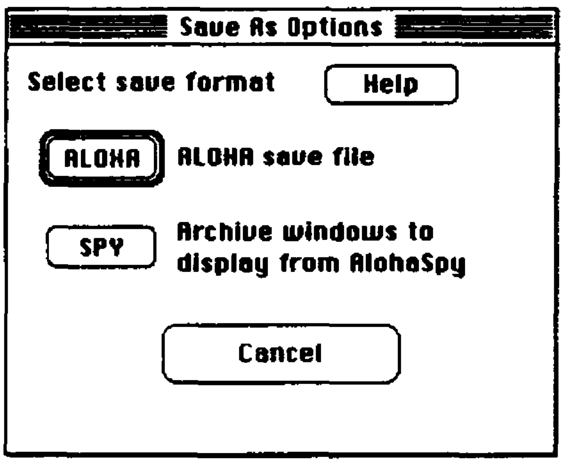


Figure 5-6.
Saving changes.

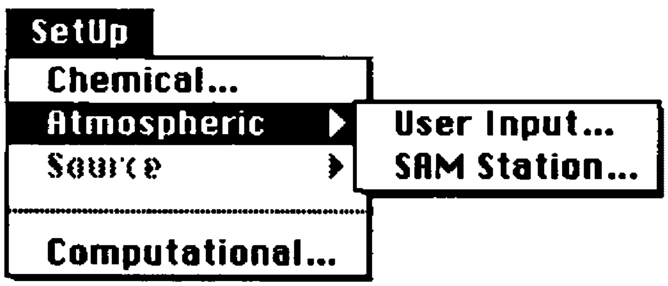
When you reopen an ALOHA file, the model will use the modified chemical properties contained in the file to make source and dispersion calculations. However, if you again select (via the **Chemical** menu item) the chemical that you previously modified, then the changes you made will be replaced by information stored in the chemical library. Choose **Open...** from the **File** menu and reopen your saved ALOHA file whenever you want to run a scenario using the modified chemical information included in the file.

It is important to review the **Text Summary** screen. In our example, a note appears with the chemical information: Not enough chemical data to use Heavy Gas option (Figure 5-4). This tells you that, although the vapors may behave like a heavy gas, the model will have to use the Gaussian calculations. You can also see from the text summary screen that the substance is a gas (the boiling point is well below the air temperature). Argon is a simple asphyxiant; no IDLH or TLV-TWA value has been assigned to it.

Atmospheric

The processes that ALOHA considers to move and disperse a pollutant cloud include atmospheric heating and mechanical stirring, low-level inversions, wind speed and direction, ground roughness, and air temperature. Each of these processes will be discussed in detail below.

Figure 5-7.
Atmospheric menu.



You can enter atmospheric data into ALOHA in two ways:

- **User Input...**, which you use if you know weather and wind conditions, or
- **SAM Station...**, which you use if you want real-time weather data fed directly to ALOHA from a Station for Atmospheric Measurements (SAM).

User Input...

Here, you enter information about the atmospheric environment and the ground roughness at the spill site. This includes:

- ❒ stability class
- ❒ inversion height
- ❒ wind speed and direction
- ❒ air temperature
- ❒ ground roughness
- ❒ cloud cover
- ❒ relative humidity

1. Stability class

There are principally two processes, *heating* and *mechanical stirring,* that can affect mixing in the lower atmosphere.

a) Heating

Heating the atmosphere near the ground leads to the most unstable conditions. Think about what happens to a pan of water that you're heating on the stove. As heat is added to the bottom of the pan, the bottom-heated water rises and mixes as it moves toward the surface. As the heating becomes more intense, so does the mixing.

This same type of heating happens in the atmosphere. On hot summer days, the sun will heat up the ground and warm the lower atmosphere. The lower air rises as it warms, tumbling and mixing as it goes. Remember looking out over a dark parking lot on a hot summer day and seeing the air seem to shimmer? This shimmer is caused by thermal mixing.

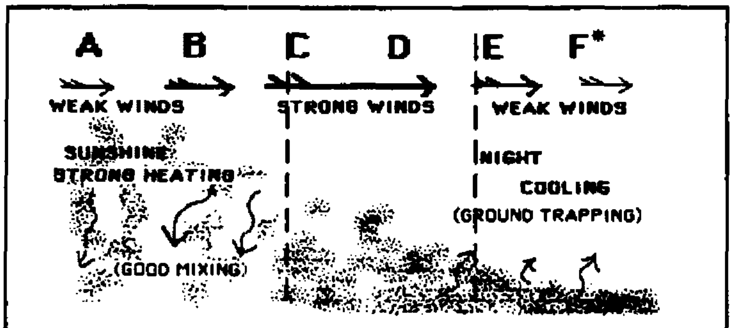
Just as air that is warmed rises if it is warmer than the surrounding air, air that is cooled sinks, or stays trapped in the lower level of the atmosphere. The opposite extreme of intense heating is intense cooling; rapid cooling of the ground leads to the most stable atmospheric conditions. Cooling of the ground causes the lower layer of air to cool and become more dense, making it very stable with little tendency to mix. Clear, calm nights are a prime time for this type of intense cooling to take place; for example, weather conditions where you might expect a quick frost or low ground fog to develop. These very stable conditions make for a very large threat zone (see page 2-11). Very stable air is usually seen in the late night or early morning hours.

b) Mechanical stirring

The second factor affecting stability in the lower atmosphere is mechanical stirring caused by the wind. As the wind blows, the friction caused by the earth slows down the air movement closest to the surface. Air layers near the ground tend to mix and tumble as they glide past each other at different speeds. The stronger the wind, the more effective this stirring mechanism becomes.

Mechanical stirring not only mixes up the air, it also disturbs the temperature layers created by intense heating or cooling. This secondary effect of mechanical mixing causes what may at first seem like a contradiction: it mixes up very stable, cool, ground layers, making conditions less stable. In the same way, it mixes up very unstable warm layers, making conditions more stable. The net effect of stirring mechanisms such as strong winds is that they reduce the possibility of either very stable or very unstable air so that all strong wind cases tend to be in the intermediate (neutral) range of stability.

Meteorologists typically summarize atmospheric stability by specifying the stability class in terms of a letter, ranging from A to F. With A being the most unstable and F the most stable conditions, you will use the same letter code in the air model to specify the relationship of stability class, heating, and wind speed at your spill site (Figure 5-8).



*In the very rare case, stability class F may have stronger winds.

Figure 5-8. Stability class and mixing of a pollutant cloud.

Stability class is the first atmospheric condition that you enter in ALOHA. You choose the single letter that best represents the weather conditions present at your spill site. Using our example from Figure 5-9 and Table 5-2 below, you would choose C or D for your stability class because the wind speed is between 11 and 13 knots. (You can see Table 5-2 while you're running ALOHA by clicking the **Help** button next to **Stability Class** on the Atmospheric Options screen or by looking at the Stability Class topic in the **Help** index.) ALOHA uses stability class information to classify the amount of mixing occurring in the atmosphere. To dilute a cloud of toxic gas, unstable (lots of mixing) conditions give shorter threat distances than would stable (very little mixing) conditions. The cloud is diluted faster when conditions are unstable.

2. Inversion height

Under normal conditions, as you move up in the atmosphere, the air gets cooler. An inversion occurs when cooler air is at the ground and warmer air is above. ALOHA needs to know whether there is a low-level inversion that could trap the pollutant near the ground (Figure 5-10). This type of inversion is different from the inversion that causes smog. That type of inversion is typically thousands of feet above the ground and therefore, much too high to affect a cloud of escaping chemical.

Figure 5-9.
Atmospheric options.

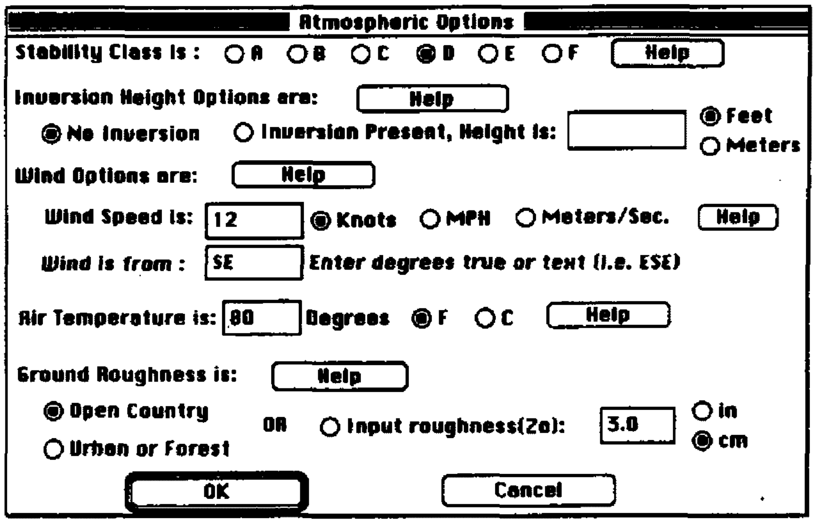


Table 5-2.
Stability class and wind speed.

Surface Wind Speed (knots)	Day: Incoming Solar Radiation			Night*: More than .5 Cloud Cover	Night*: Less than .5 Cloud Cover
	Strong	Moderate	Slight		
<4	A	A-B	B	E	F
4-7	A-B	B	C	E	F
7-11	B	B-C	C	D	E
11-13	C	C-D	D	D	D
>13	C	D	D	D	D

*D for complete overcast conditions during day or night.

(Turner 1974)

ALOHA needs to know about the special situation where the inversion is very near the surface (one hundred feet or less from the ground). A common clue to this situation is a thin layer of patchy ground fog or "sea smoke" over water. These situations are relatively rare, but you should watch for low-level inversions after clear nights with little or no wind.

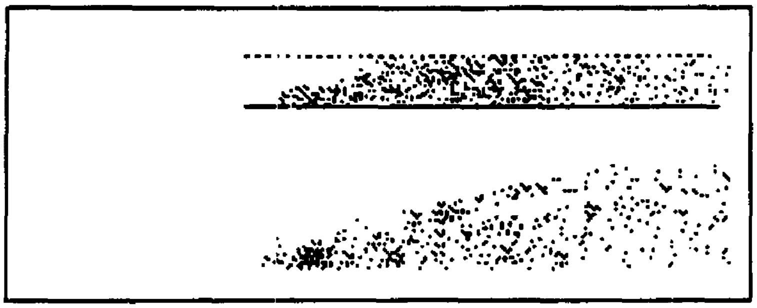


Figure 5-10. Example of pollutant dispersion with and without a low level inversion.

The heavy gas module doesn't account for inversions.

If there is an inversion present and you know its height, click **Inversion Present** and type in the appropriate number, being sure to select **Feet** or **Meters**. If there is an inversion present but you don't know its height, click **Inversion Present** and estimate the height, making sure that the values you choose fall between 10 feet (about three meters) and 5,000 feet (about 1,524 meters). If there isn't an inversion, click **No Inversion.** If the heavy gas computations are used, ALOHA will not factor in the inversion.

3. Wind speed and direction

ALOHA will next need information on **wind speed and direction.** Since many hazardous vapors cannot be seen, imagine a pollutant cloud using your own experience in looking at a smoke stack or campfire. If you've ever done this, you know how the wind's direction and speed will affect the movement of the cloud.

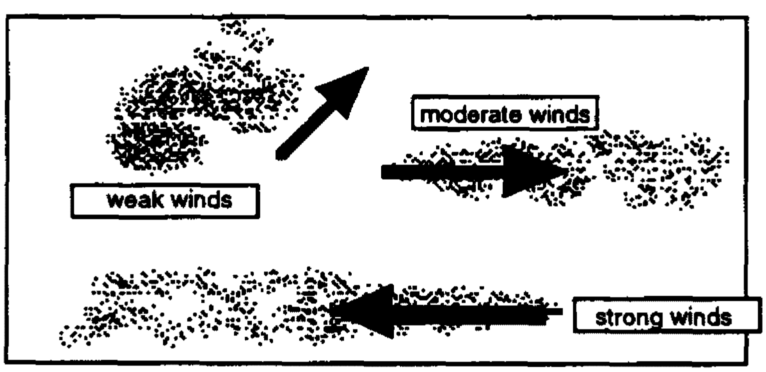


Figure 5-11. Effect of wind speed and direction on plume movement.

Obviously, the wind direction will determine which way a cloud will drift. The wind speed also has a pronounced effect on what the cloud will do. For example, low wind speeds may allow the cloud to meander; high concentrations typically can be found in puffs drifting away from the source. As the wind speed picks up, meandering near the cloud's source decreases, while small-scale mixing in the atmosphere usually increases. The model will make sure that the wind speed and atmospheric stability class you set are consistent.

You can use the table below to help you estimate the wind speed. (Notice that you have the option of miles per hour, knots, or meters per second; be sure to look in the proper column on the table and type in the corresponding value on your computer screen. Since miles per hour and knots are very close, Table 5-3 does not include both measures.)

Table 5-3. How to estimate wind speed.

Meters per second	Knots	International description	Specifications
< 1	< 1	Calm	Calm; smokes rises vertically
<1-2	1-3	Light air	Direction of wind shown by smoke drift but not by wind vanes
2-3	4-6	Light breeze	Wind felt on face; leaves rustle; ordinary vane moved by wind
4-5	7-10	Gentle breeze	Leaves and small twigs in constant motion; wind extends light flag
5-8	11-16	Moderate	Raises dust, loose paper; small branches are moved
8-11	17-21	Fresh	Small trees in leaf begin to sway; crested wavelets form on inland water
11-14	22-27	Strong	Large branches in motion; whistling heard in telegraph wires; umbrellas used with difficulty
14-17	28-33	Near gale	Whole trees in motion; inconvenience felt walking against wind
17-21	34-40	Gale	Breaks twigs off trees; generally impedes progress

In our example we said that the wind was 12 knots; looking in the knots column, this means that we would expect to see small branches moving slightly, with only dust and loose paper blown along the ground.

Now, enter the direction *from* which the wind is blowing. You can enter this using letters (e.g., se, ne, sw) or in degrees true (176°, 210°, etc.).

4. Air temperature

The model uses the air temperature in a number of calculations. This value is used to calculate the evaporation rate from a puddle surface (the higher the temperature, the higher the vapor pressure and the faster the substance evaporates). Elsewhere, especially when you are entering information about the source, you can use air temperature as a value for ground, pipe, or tank temperature if these values are unknown. Because it may be used for so many calculations, you need to enter as accurate an air temperature as possible.

5. Ground roughness

Another process that contributes to mixing is the stirring caused by air moving over "roughness elements" (Figure 5-12). A roughness element is any surface feature that interrupts the flow of air. Depending on the size of the spill, roughness elements may become *obstacles.* For example, a very small spill on the railroad tracks in an urban area will only experience the roughness of the tracks and immediate surroundings. If the nearest buildings are 500 yards away and the cloud doesn't travel that far, the ground roughness may be **open country** (see below). A cloud will generally be narrower and travel further across open country than it will over an urban or forest environment because of the relative lack of roughness elements to create turbulence or curtail the cloud's spread.

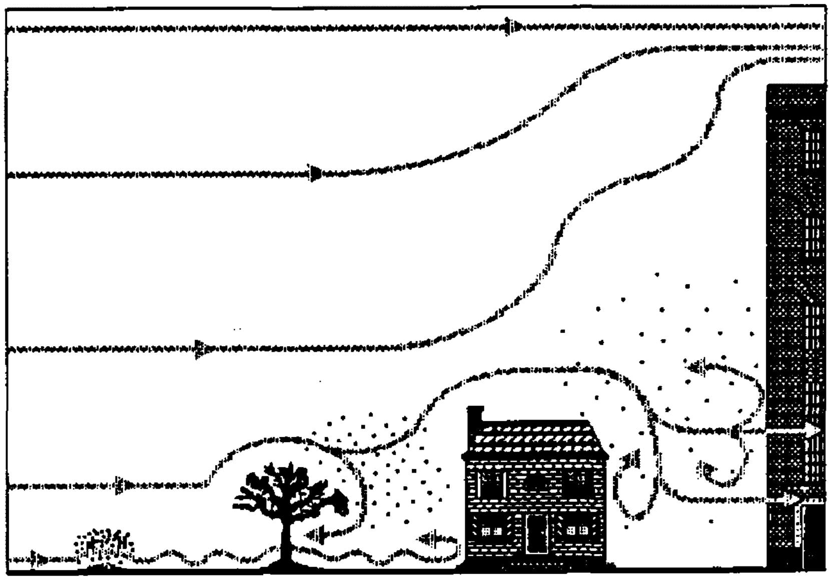


Figure 5-12.
Plume behavior over different types of roughness elements and obstacles.

You must tell ALOHA the ground roughness in the area over which the cloud will be moving. You have three choices: Open Country, Urban or Forest, or you may enter a roughness (Z_0) value.

- **Open Country** means that there are no buildings or other obstacles close by.

- **Urban or Forest** means that there are many obstacles in the area in which your spill has occurred. These obstacles may take the form of skyscrapers, suburban homes, or pine trees. Selecting an **Urban or Forest** ground roughness will lead to more mixing and, hence, a shorter footprint.

Naturally, you can characterize few environments as totally urban or totally open, so make your best guess by deciding which type of ground roughness dominates the area where the spill occurred. For example, if the spill occurred in a downtown area with more tall buildings than open areas or parking lots, you'd choose **Urban or Forest** as your ground roughness. However, if the spill occurred in an area with more open spaces than buildings, you'd choose **Open Country**. If it's not clear which category your spill location falls in, run ALOHA twice, once for each category. In determining the downwind distance to the given Level of Concern, you will find that **Open Country** is a more conservative choice than **Urban or Forest**. That is, if you choose that option, ALOHA will estimate a longer threat distance.

If you want to specify your own roughness length (Z_0), you may find the following table helpful (Brutsaert 1982). As you can see from Table 5-4, choosing roughness length is more complicated than entering the height of the roughness elements.

Table 5-4.
Z_0 equivalences.

Surface Description	Z_0 (cm)
Mud flats, ice	0.001
Smooth tarmac (airport runway)	0.002
Large water surfaces (average)	0.01-0.06
Grass (lawn to 1 cm high)	0.1
Grass (airport)	0.45
Grass (prairie)	0.64
Grass (artificial, 7.5 cm high)	1.0
Grass (thick to 10 cm high)	2.3
Grass (thin to 50 cm)	5.0
Wheat stubble plain (18 cm)	2.44
Grass (with bushes, some trees)	4
1-2 m high vegetation	20
Trees (10-15 m high)	40-70
Savannah scrub (trees, grass, sand)	40
Large city (Tokyo)	165

When ALOHA uses the ground roughness in its calculations, it may readjust the value you have entered to be consistent with the requirements for the Gaussian and heavy gas modules. In the Gaussian case, ALOHA only needs to know the roughness category (**Urban or Forest** or **Open Country**). If you enter a Z_0, ALOHA will categorize your value into one of these two classes.

If the heavy gas calculations are used, ALOHA will assign a value to the **Urban or Forest** or **Open Country** choice. If you have entered a Z_0 ALOHA will use this value, if it falls within the range 0.05 cm to 10 cm. Values greater than or less than these limits will be set to the nearest limiting value.

After you've selected the appropriate atmospheric conditions and ground roughness, and clicked **OK**, ALOHA requests information about the cloud cover and relative humidity in the vicinity of the spill.

6. Cloud cover

ALOHA uses information on cloud cover to help estimate the amount of incoming solar radiation at the time of the spill. With location, air temperature and your other atmospheric selections, this information helps ALOHA to calculate the rate at which the spill will evaporate. ALOHA gives you six options for cloud cover, ranging from complete cover to clear. The sixth option allows you to describe cloud cover in the standard meteorological terminology of tenths. For example, if you called the National Weather Service, they might tell you that cloud cover that day was 5/10, in which case you'd enter 5 as the value.

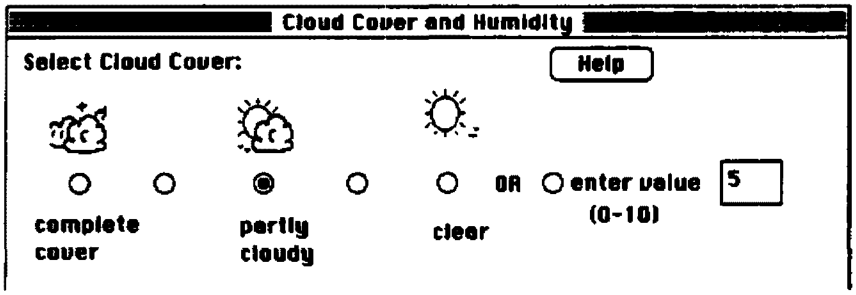


Figure 5-13.
Cloud cover options.

7. Humidity

Relative humidity is another measure that ALOHA uses to help calculate the rate at which the spill will evaporate into the atmosphere. As with cloud cover, ALOHA gives you six options for relative humidity, ranging from wet to dry. The sixth option allows you to describe humidity in the standard meteorological terminology of percentage. For example, if you called the National Weather Service, they might tell you that there was 50% humidity that day.

Note that, as you've entered more information, the **Text**

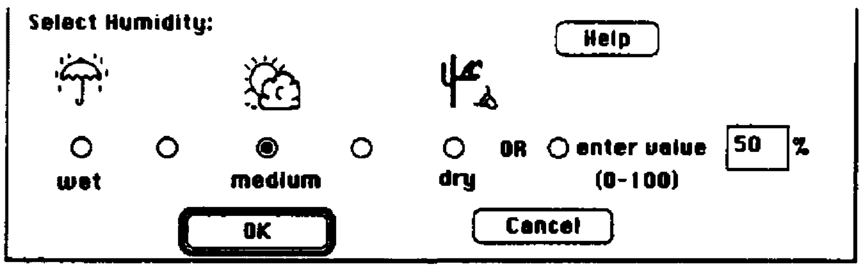
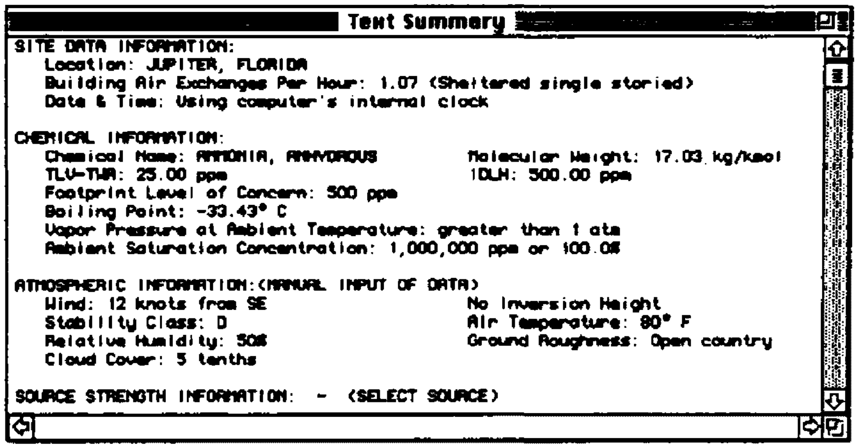


Figure 5-14.
Humidity options.

Summary window has continued to be updated (Figure 5-15). The window now includes information on the site, chemical, and atmospheric conditions for the spill scenario.

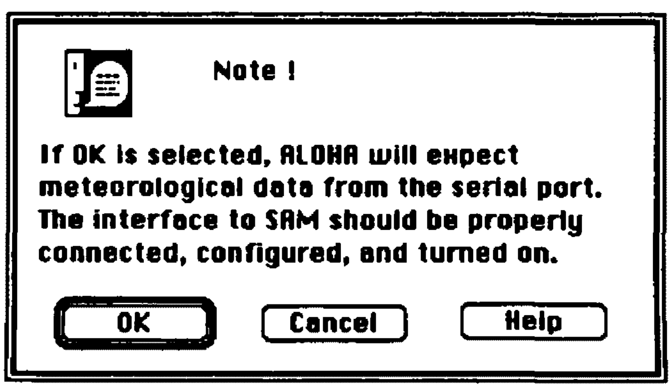
Figure 5-15.
Text summary.



SAM Station...

Several companies manufacture Stations for Atmospheric Measurement (SAM) for use with ALOHA. For a list of current manufacturers, please call NOAA at (206)526-6317. Before using a SAM not specifically designed for ALOHA, be sure that the data format is compatible with ALOHA, as described below. Choose **SAM Station...** to enter atmospheric information that you receive over a VHF radio frequency or through a direct connection between your computer and a SAM (Figure 5-16). Set up the SAM in the area where conditions need to be monitored. The SAM will feed real-time weather data to the computer and ALOHA will interpret and use this information in its pollutant dispersion calculations.

Figure 5-16.
SAM selection note.



WARNING

A SAM transmits updated meteorological conditions every 30 seconds. If ALOHA has finished the previous dispersion calculations and has drawn a footprint, the new SAM data will be used to update the dispersion calculations and draw a new footprint. If, on the other hand, ALOHA is still in the process of calculating the dispersion when SAM data are received, the new data will be ignored. Not until the footprint has been drawn will ALOHA again begin acknowledging the SAM data and resume the process of calculating a new footprint. Remember that the SAM can only update the data that it collects. You will need to update the inversion, cloud cover, and humidity conditions if these change during the incident.

When you select **SAM Station,** ALOHA assumes that you are hooked into a SAM unit and are prepared to receive weather data through it (Figure 5-16). ALOHA will alert you if it doesn't receive data from the SAM after several minutes.

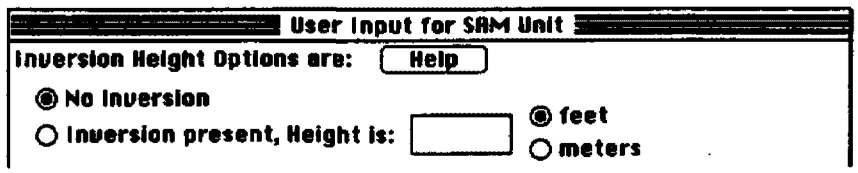
Windows users will need to specify the serial port to which the SAM unit is connected.

After you click **OK**, ALOHA asks you for additional information about atmospheric conditions in the vicinity of the SAM that cannot be measured by the station.

I. Inversion Height Options

Click **No inversion** if there is no inversion present. If an inversion is present, click **Inversion present** and type in its height. Make sure that you choose whichever unit of measure is appropriate. (For more on inversion height, see pages 5-14 to 5-15.)

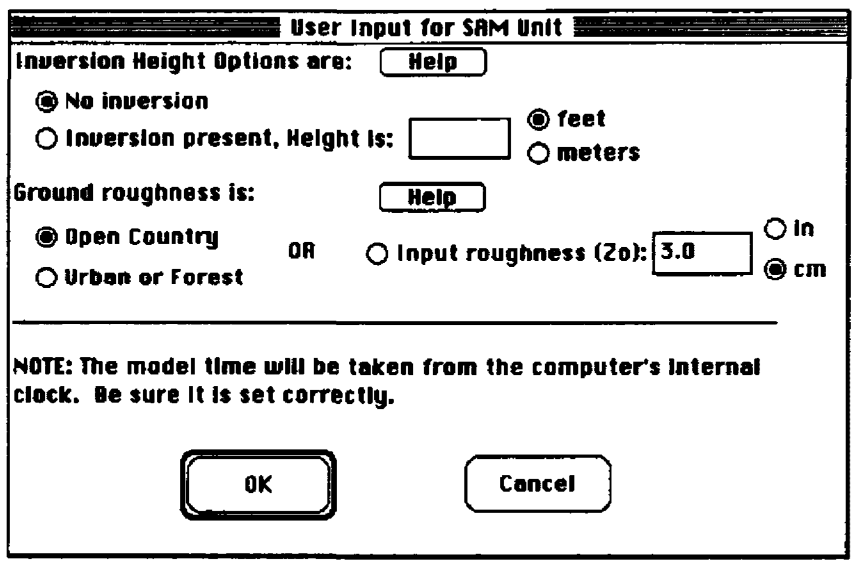
Figure 5-17.
Inversion height options.



2. *Ground Roughness*

Next, select the appropriate **Ground roughness** category. (See previous discussion of ground roughness.)

Figure 5-18.
Ground roughness and time options.



Make sure that your computer's internal clock is set to the appropriate time for your spill; your SAM will run using this time and ALOHA will use this time, along with the wind speed and direction, to calculate the appropriate stability class. After you click **OK**, ALOHA requests cloud cover and humidity information for the location where your spill occurred. (See previous discuss of cloud cover and humidity.)

If you save a scenario as an ALOHA file while the met station is turned on, ALOHA won't automatically start receiving data when you reopen the file. You must again select **Atmospheric** and choose either **User Input** or **SAM Station.**

SAM Options

After you click OK on the Cloud Cover and Humidity screen, notice that a new menu item, **SAM Options**, appears to the right of the Display menu. You can **Archive** the data received through SAM as ASCII characters in a text file, look at **Raw** or **Processed** data, or look at a **Wind Rose** displaying the last ten wind vectors that ALOHA received from your SAM. You do not have to use any of these options for ALOHA to use the SAM data; they are truly "optional."

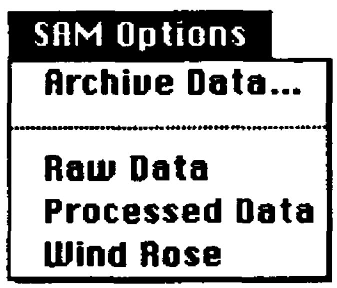


Figure 5-19.
SAM Options menu.

Met station sensors are scanned every two seconds; the mean wind speed, direction, and temperature are based on five-minute running averages of the scanned sensors. Be aware that the data received through these sensors are specific only to the area where you have set up your SAM. Wind speed and direction for other areas covered by the dispersing cloud may not be reflected (see **Wind shifts** on pages 2-10 to 2-11). Further, since ALOHA can only receive data from one SAM at a time, footprint calculations may be invalid if they are based on a SAM located some distance from the spill source, and there is a lot of variation in the terrain in between.

1. Archive Data

You can save your processed meteorological data as a tab-delimited text file for later referral. Choose **Archive Data** from the **SAM Options** menu, name the file in the dialog box, and click **Save**. You can later open this file in a word processing application. Since data may not be received every 30 seconds if ALOHA is doing time-intensive calculations, the archived data will include the time of each transmission. This time is taken from the computer's internal clock; please be sure this time is accurate. You may change the time using the Control Panel on the Macintosh or the Control menu box on the IBM.

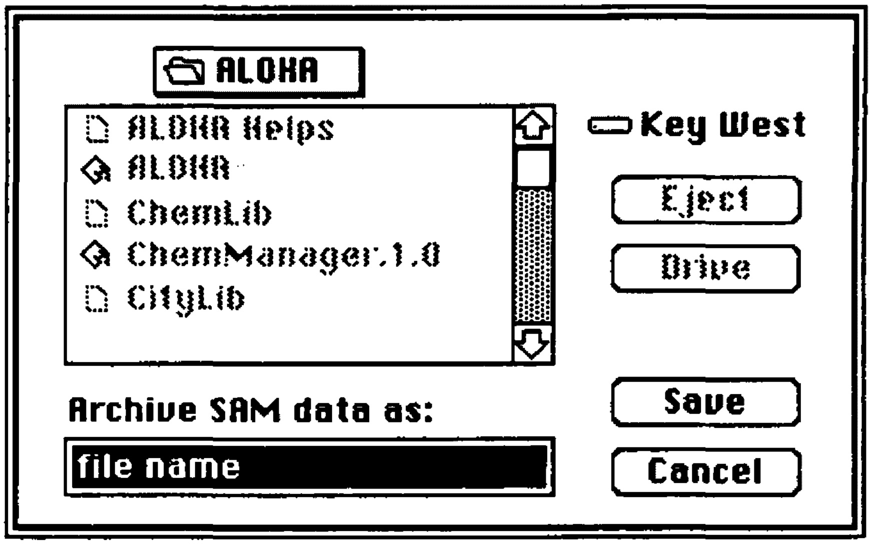


Figure 5-20.
Archive SAM data.

ALOHA places no limit on the amount of data you may archive. The only limit will be the amount of space available on your hard drive (or floppy disk).

2. *Raw Data*

This option allows you to view the string of data that the met station is sending to your computer. The data, separated by commas, are printed on a single line on your screen in the following format:

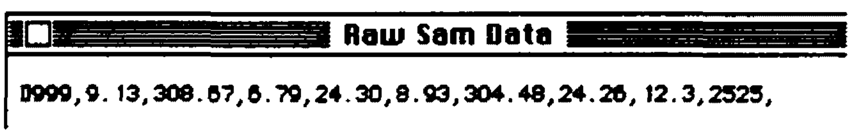


Figure 5-21.
Raw SAM data.

- met station identification number
- mean wind speed (meters per second)
- mean wind direction (in degrees true)
- standard deviation of wind direction (in degrees)
- mean temperature (in degrees Celsius)
- instantaneous wind speed (meters per second)
- instantaneous wind direction (degrees)
- instantaneous temperature (again, in °C)
- battery voltage of the field unit
- the sum of the ASCII code of all the data sent (ALOHA uses this number to trap bad or incomplete transmissions).

3. Processed Data

Here, you see SAM data after ALOHA has processed and interpreted it (Figure 5-22).

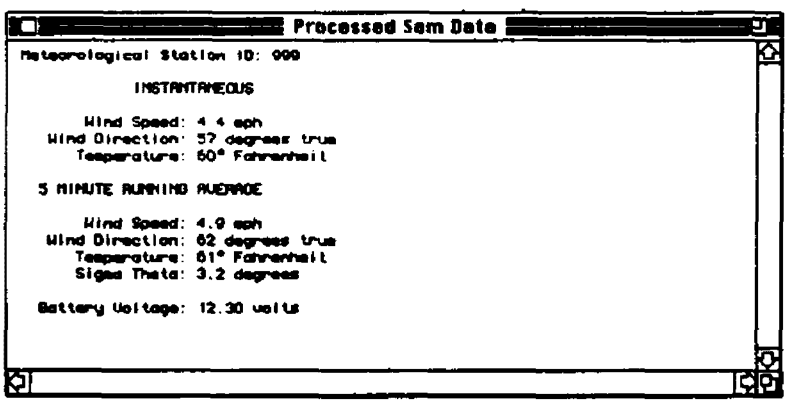


Figure 5-22. Processed SAM data.

The **Meteorological Station ID** is the identification code of the SAM that is sending data to your computer (this ID is assigned by the manufacturer). **Battery voltage** is the voltage of the battery on the SAM unit.

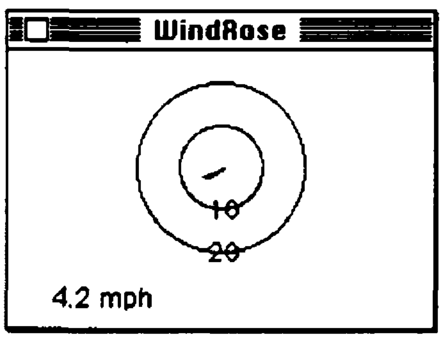
Sigma Theta corresponds to how the wind direction has been changing over the last five minutes. ALOHA uses this value to help determine the stability class. If the value for **Sigma**

Theta is -1.00, SAM has not been transmitting for five minutes. ALOHA will not allow you to set the source or draw any footprints until SAM has been running for at least five minutes.

4. Wind Rose

Selecting **Wind Rose** displays a diagram that summarizes the direction and speed of the wind at a SAM's location. This window shows up to the last ten wind observations received. Each observation appears as a line, called a vector, that indicates the wind direction by the angle at which each line is drawn, and the wind speed, by the length of the line. Each vector represents a five-minute running average, rather than an instantaneous measurement.

Figure 5-23.
SAM wind rose.



The wind rose helps you to visualize how much the wind has been shifting. For example, in low wind conditions on a hot, sunny day, you would expect fairly unstable atmospheric conditions. The wind rose would show vectors that are widely scattered. Conversely, under stable conditions, the wind rose will show very little scatter; some of the vectors may even be lying on top of one another. The last wind speed received is displayed in the lower left corner. The vector representing the last wind observation is drawn on the diagram with a darker line. Notice that the vectors are drawn from the center of the circle towards the direction TO which the wind (and any cloud of chemical) is blowing. Both processed and raw data will show the direction FROM which the wind is coming. The wind rose will continue to be updated until you disconnect your SAM or close the window.

Source...

The **Source** options let you tell ALOHA the amount and/or circumstances of the chemical release.

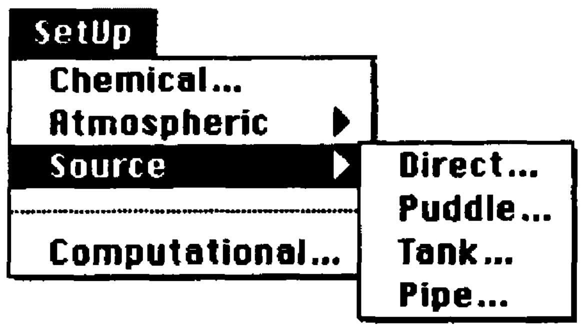


Figure 5-24.
Source options.

ALOHA can estimate the duration of chemical releases lasting from a minimum of 60 seconds to a maximum of 60 minutes. After sixty minutes, atmospheric conditions are likely to have changed. Remember, ALOHA uses constant atmospheric conditions. If the circumstances of the release lead to a spill that would last longer than 60 minutes, you will see that the concentration, source strength, and dose curves are truncated at 60 minutes. The text summary screen will say **"Release Duration: ALOHA limited the duration to 1 hour."** The 60-minute cutoff is a maximum; if conditions change dramatically before an hour has passed, ALOHA's output will not be valid. When this happens, reset the atmospheric and source input and let ALOHA calculate a new footprint.

ALOHA reports two release rates. The *maximum computed release rate* is the fastest release rate possible for your scenario. It may be very fast in the case of a pressurized tank release. The *maximum average release rate* is averaged over at lest one minute. It will be considerably slower than the maximum computed rate in the case of a pressurized release. ALOHA uses a series of average rates to make its dispersion calculations.

After you click **OK**, the source is calculated and you will be returned to the Text summary screen. **Review the information you have entered as it appears on this screen.** The source strength information calculated by ALOHA includes an estimate of how long the release will last, the total amount released, and both the maximum computed and average release rates. If a pressurized liquid was stored in the tank, ALOHA will indicate that the release was a two-phase flow. In such cases, liquid, as a fine aerosol mist, and gas are released rapidly and simultaneously from the tank. Two-phase mixtures are denser than the gas phase of the chemical, and often disperse as a heavy gas.

Choose the **Source** option that most closely resembles the spill scenario.

Choose...	If...
❒ **Direct**	...you can estimate the amount entering the atmosphere,
❒ **Puddle**	...you can estimate the size of the puddle on the ground,
❒ **Tank**	...the substance is being released from a tank, or
❒ **Pipe**	...a gas is escaping from a broken or punctured pipe.

Direct

Choose **Direct** to enter your own estimate of how fast the pollutant is entering (or has entered) the atmosphere. Was the spill instantaneous (the entire amount escaped into the atmosphere in the first 60 seconds) or continuous (the contents are entering the atmosphere over time)? This estimate must be for the amount of pollutant *entering the atmosphere as a gas*. This may not equal the amount spilled, particularly if the substance spilled is a liquid (in such a case, you'd need to estimate its evaporation rate).

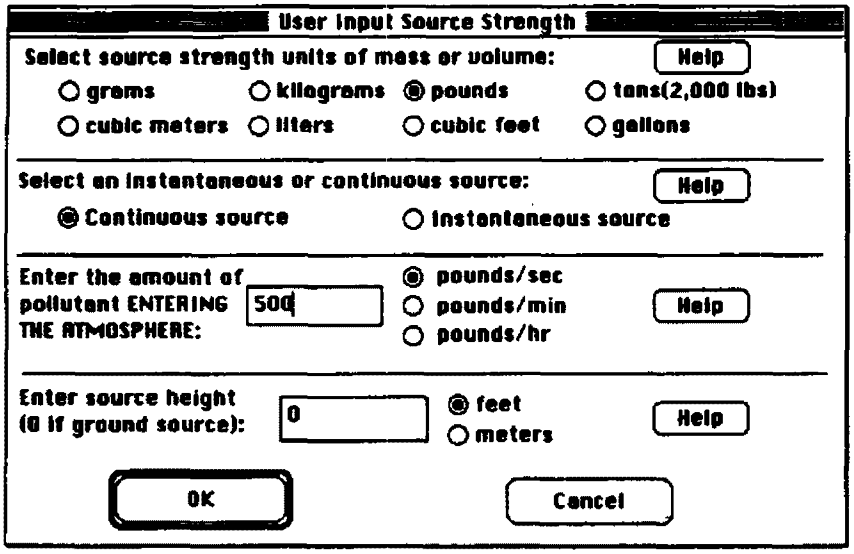


Figure 5-25. Direct input of source strength.

If the spill is above ground level, you may also enter the source height. This allows you to model neutral gas releases from elevated pipes or other above-ground sources. If you don't enter a source height, ALOHA assumes that the spill is at ground level, and sets the source height to zero.

However, entering an elevated source height doesn't cause ALOHA to evaluate releases of heated gases accurately. This is because plumes of heated gas, like those from smokestacks or fires, usually rise before traveling downwind, and ALOHA's calculations do not account for downward movement of a gas released at an elevated height if it is much heavier than air. Therefore, ALOHA won't let you try to model an elevated source when the chemical is a heavy gas. If you enter a non-zero source height for such a case, ALOHA warns you that heavy gas calculations can only be made for ground-level releases. (A ground-level release is a more conservative choice than an elevated release: ALOHA will predict a longer footprint for a ground-level release.)

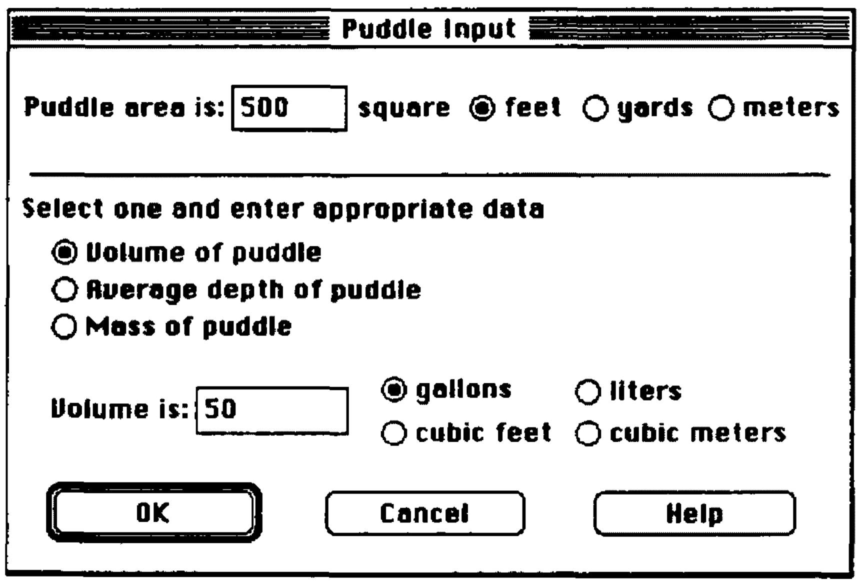
Heavy gas calculations can only be made for ground-level releases

Puddle

If the spill is a liquid that has formed a puddle on the ground, select **Puddle**, unless the source of the puddle is a tank that is still leaking (in which case you should select **Tank**).

When you select **Puddle**, the first pieces of information that you must give ALOHA are how large an area the puddle covers, and how much of the chemical is contained in the puddle (Figure 5-26).

Figure 5-26.
Puddle input.



- ❐ Visually estimate the amount of ground the puddle covers (remember, for a square or rectangle shape, area = length times width; for a circle, area = 3.14 times the square of the radius).

- ❐ Estimate the amount of chemical contained in the puddle by typing in either the volume or mass of the chemical in the puddle. Otherwise, estimate the average depth of the puddle and ALOHA will calculate its mass.

ALOHA now knows the puddle's surface area and the amount of the chemical available for evaporation. The evaporation rate will depend on these factors, as well as:

- *incoming solar radiation* (affected by location, time, cloud cover);
- *heat transfer with air* (affected by air temperature, humidity, initial puddle temperature); and
- *heat transfer with ground* (affected by ground temperature, ground type, initial puddle temperature).

The ground conditions influence the amount of heat transferred between the ground and the puddle (for example, the warmer the ground, the warmer the puddle; hence, there will be a higher vapor pressure, resulting in a higher evaporation rate).

Choose ground type by selecting **default**, **concrete**, **sandy**, or **moist**. (ALOHA doesn't assume any of the chemical is absorbed into the ground, but uses ground type information to help calculate energy transfer.) In most cases, concrete will be the most conservative choice (it leads to the highest heat transfer). The **default** selection is equivalent to unwetted ground not covered by rock or concrete. This choice will usually lead to evaporation rates that are somewhat slower than those resulting from **concrete**, but faster than if you chose **sandy**.

You must next select a ground temperature; the air temperature will be automatically filled in as an estimate of **Ground temperature**. You may use this as a default value or you may enter the ground temperature, if you know it. There may be a large difference between air and ground temperatures in some situations, such as in a parking lot on a hot day late in the afternoon, or on a street during the early morning hours following a very cold night. Be sure to estimate air and ground temperatures carefully in such situations.

The last piece of information ALOHA will need here is the initial puddle temperature. You may again elect to use either the air or ground temperature, or you may enter an initial puddle temperature, if you know it.

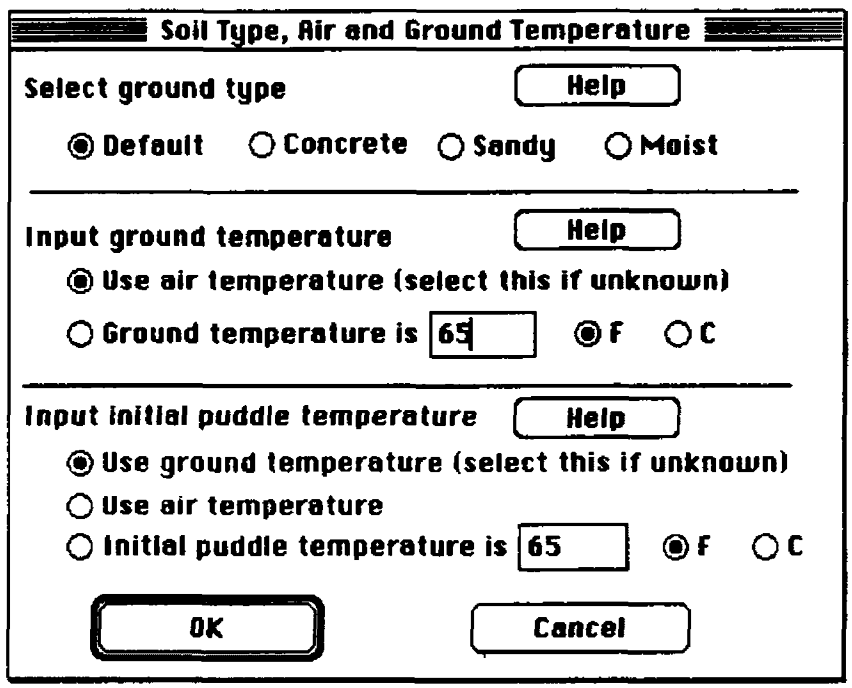


Figure 5-27. Ground type, temperature, and initial puddle temperature.

After you click OK, ALOHA will calculate the source, and you'll be returned to the Text Summary screen.

WARNING

ALOHA doesn't take into account any changes in atmospheric conditions—such as changes in wind speed or air temperature— when calculating the rate of evaporation from a puddle. This is especially important to remember because wind speed and air temperature are very important influences on evaporation rate. If these conditions change while ALOHA is calculating the evaporation rate, you'll need to enter the new values and re-run ALOHA.

Puddle or tank?

Puddles may also be formed by leaks from tanks. If a tank is the source of the puddle, choosing **Tank** allows the puddle area to grow while the tank continues to leak.

Tank...

If the source of the spill was a tank rupture or tank valve leak, choose **Tank**. ALOHA will need to know what the tank looks like, how big it is, how much of a chemical, either liquid or gas, could be stored in the tank, and the storage temperature and/or pressure.

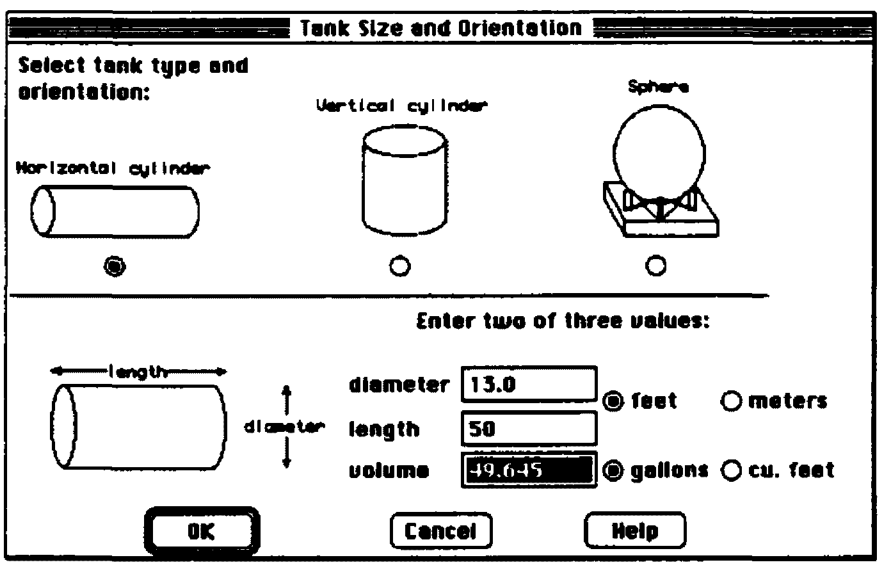


Figure 5-28. Tank size and orientation.

Tank size and orientation

ALOHA considers three type of tanks: a horizontal cylinder, a vertically oriented cylinder, or a sphere. As you choose the tank type and orientation, the bottom of the tank input screen will change to reflect whatever additional information is needed to help ALOHA determine the total volume of the tank.

If, for example, you select a cylinder, the model will request that two of the following three values be entered: diameter, length, or volume. If you select a sphere, ALOHA needs to know either the diameter of the container or the volume of the tank. The model will fill in the calculated values for the other input boxes as you enter the requested information.

Chemical state

Next, tell ALOHA the nature of the material in the tank and the temperature at which it is stored. You may tell ALOHA that the tank contains liquid, the tank contains gas only, or you don't know.

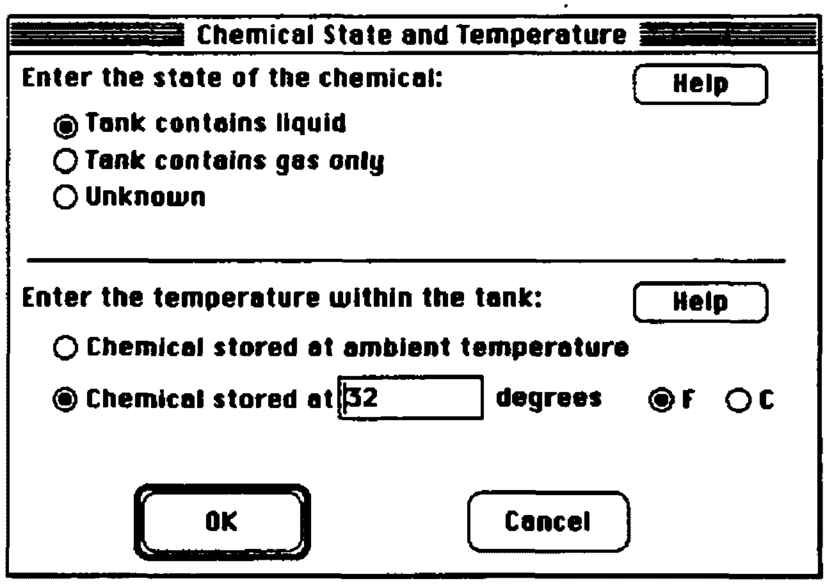


Figure 5-29. State and temperature of chemical in tank.

Liquid in a tank

If you choose liquid, ALOHA will determine how much of the chemical is in the tank once you have entered the mass or volume of the chemical, the percentage of the tank that is filled, or the liquid level in the tank. Remember that you have already specified the size of the tank, so the model already knows the maximum amount that may be in the tank (Figure 5-30). ALOHA won't allow you to overfill the tank!

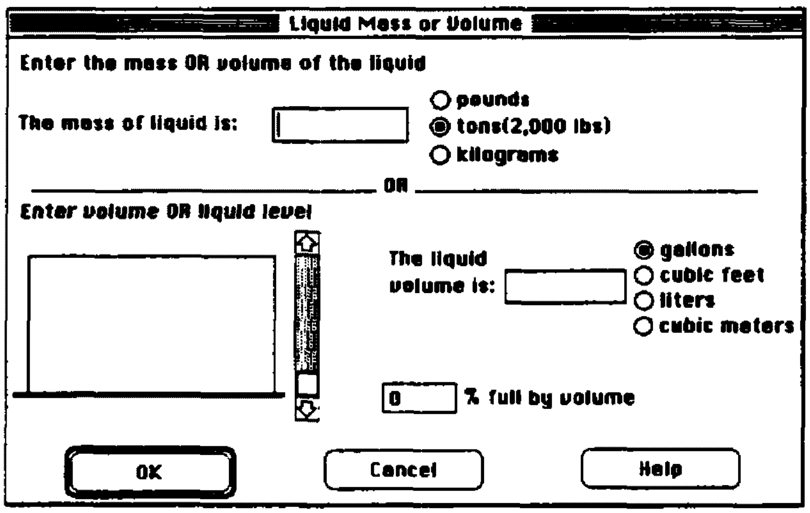


Figure 5-30. Liquid in tank.

Gas in a tank

If you choose gas, ALOHA will determine how much is in the tank by asking you to enter the tank pressure or amount of gas directly.

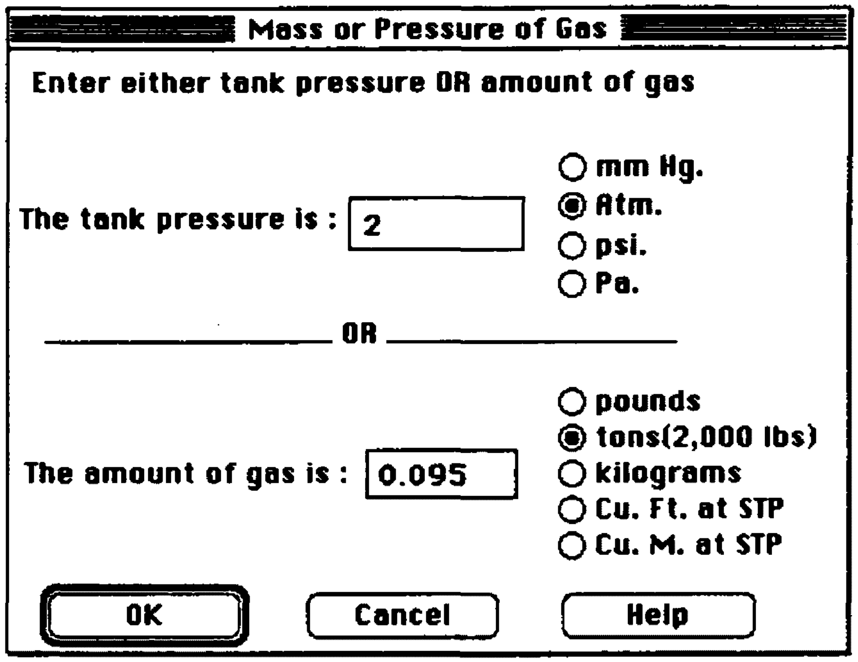


Figure 5-31. Tank pressure/ amount of gas in a tank.

Unknown in a tank

If you choose unknown, ALOHA will ask you to enter the mass of the chemical in the tank. The model will then calculate the state of the chemical based on tank volume, temperature, and mass of the chemical in the tank (Figure 5-32).

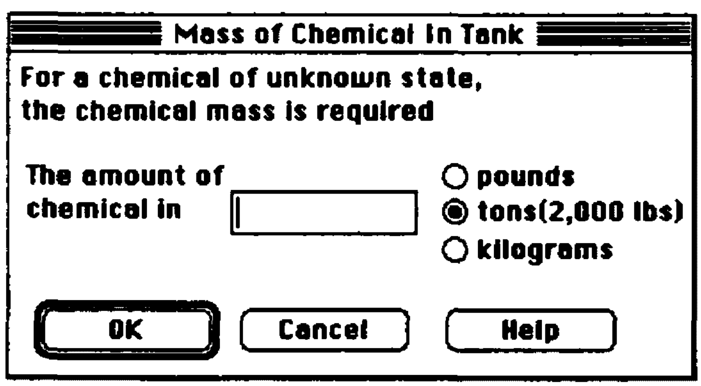


Figure 5-32. Mass of unknown chemical in tank.

Area and type of leak

Now ALOHA will ask you about the opening from which the pollutant is escaping. You must decide if the opening is best described as a hole or a short pipe/valve leak, and what shape best describes the opening (Figure 5-33).

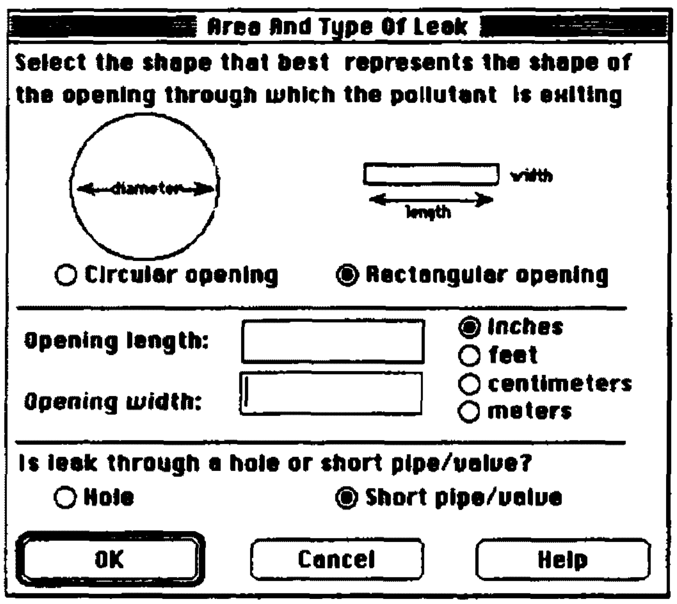
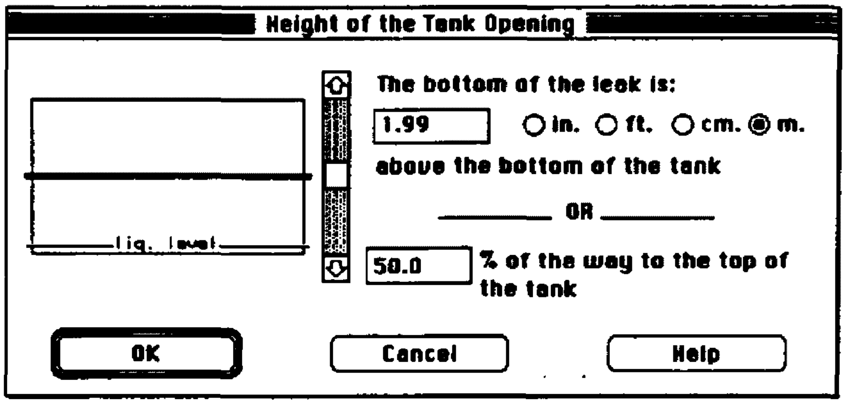


Figure 5-33.
Area and type of leak.

If you specify that the opening is rectangular in shape, ALOHA will ask you for the length and width of the hole. If you specify a circular leak, you will need to provide a diameter. The last piece of information that you must give ALOHA about how the chemical is leaking out of the tank is whether the leak is through a hole or a short pipe/valve. A hole is any kind of break directly into the tank (e.g., a puncture or crack).

If there is any liquid in the tank, you must next tell ALOHA where the leak occurs on the tank (Figure 5-34).

Figure 5-34.
Height of leak in tank.



You may tell ALOHA where the leak is in one of three ways:

- move the scroll bar up to the approximate height of the bottom of the leak (notice that the liquid level is shown),
- specify the distance from the bottom of the tank to the bottom of the leak, or
- specify the height of the leak as a percentage of the total tank height (e.g., 0% means that the hole is at the bottom of the tank; 90% means that the hole is 90% of the way to the top of the tank).

If the leak is a gas, you will be returned to the Text Summary screen when you click OK. You will see a summary of the information that you entered on the tank, and the source strength results calculated by ALOHA (Figure 5-35).

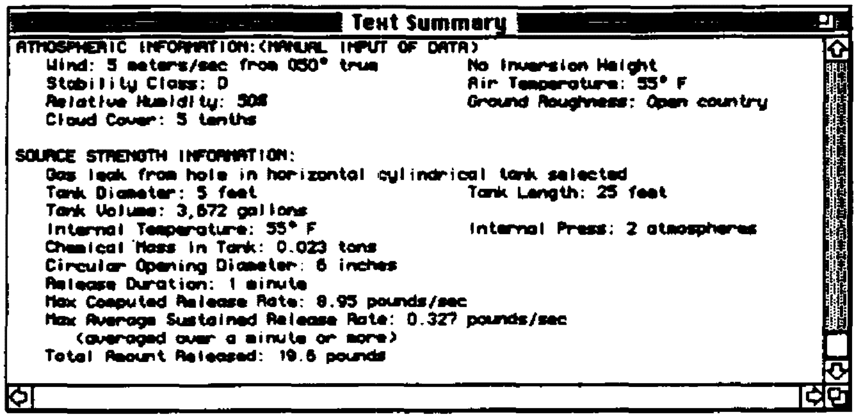


Figure 5-35.
Text summary of gas leak from tank.

If the chemical is stored as a non-pressurized liquid, a puddle may be formed, so ALOHA will ask you for information about the ground. This information is similar to the information requested in the **Puddle** option. There are, however, two differences.

First, ALOHA will have calculated the initial puddle temperature, based on the temperature of the tank and flow considerations, so you will not have to enter this information. Second, you must let the model know whether the puddle is diked.

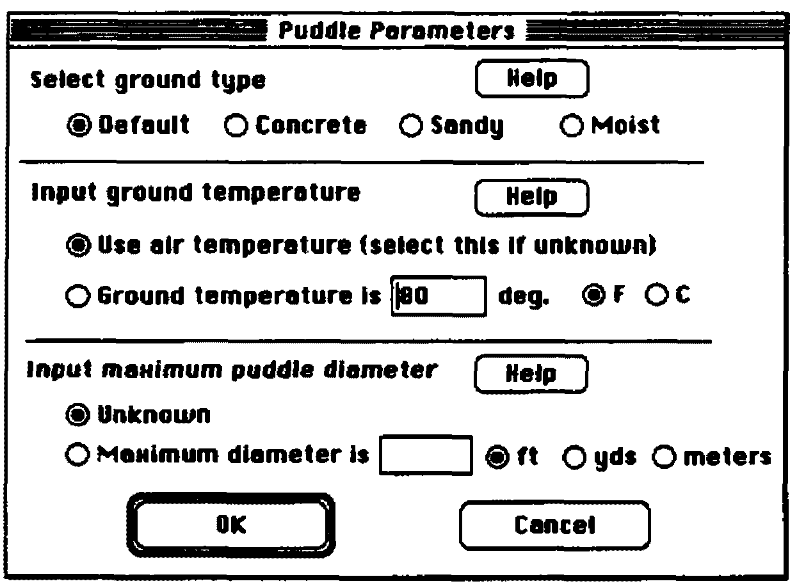


Figure 5-36.
Puddle input.

ALOHA will ask you to enter the maximum puddle diameter. If there are no barriers to prevent the liquid from flowing, select **unknown.** If there is a barrier to liquid flow (e.g., a containment or diked area), then enter the approximate diameter of that barrier as the maximum puddle diameter. Remember to select the appropriate units, and click **OK**.

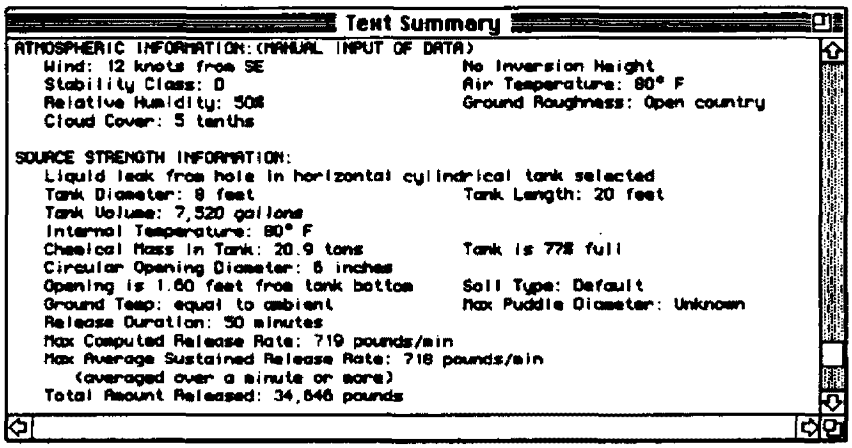


Figure 5-37. Text summary of liquid release from tank.

Now you can select **Source** from the **Display** menu to see a plot of the source strength over time.

Pipe...

If the chemical is spilled from a leaking gas pipe, choose **Pipe....** (ALOHA does not allow for liquid pipe leaks.) Here, you tell ALOHA the *inside* diameter of the pipe, the pipe's length, whether the pipe is connected to a tank (**infinite tank source**) or shutoff valve (**closed off**), and the pipe's roughness.

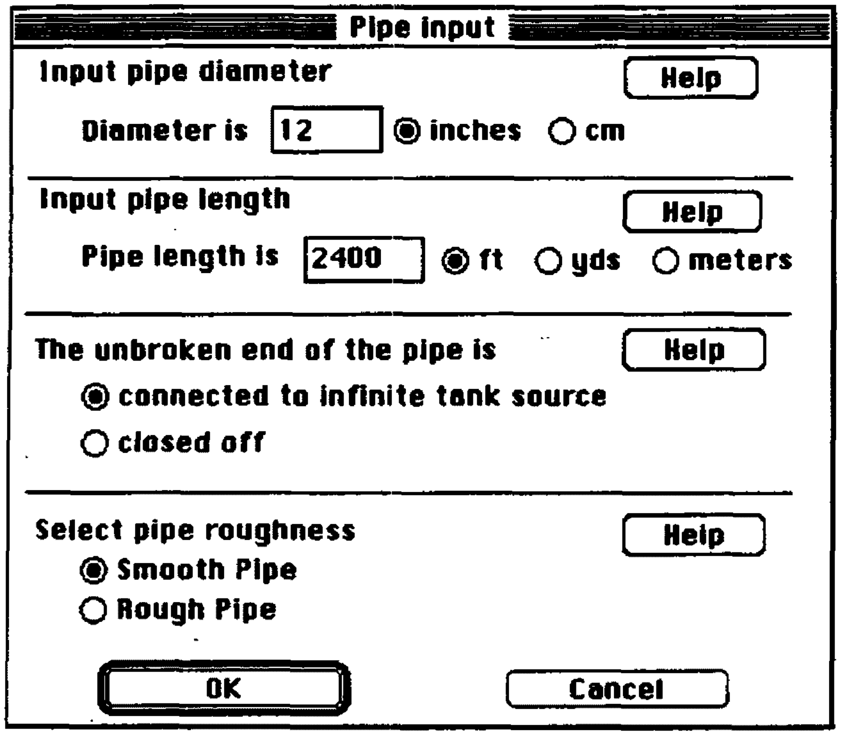


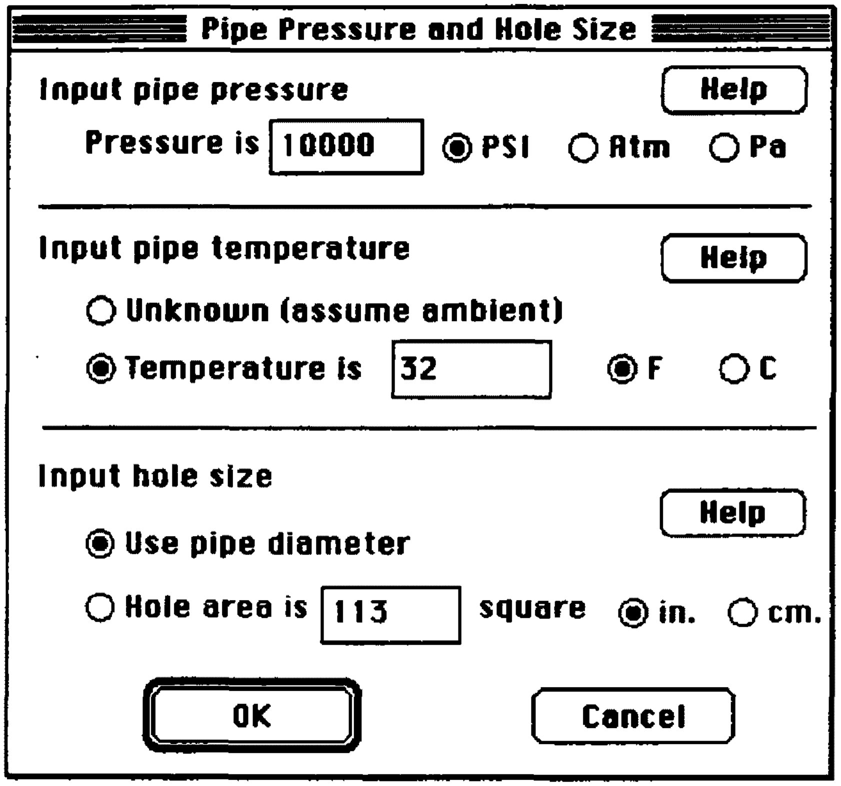
Figure 5-38.
Pipe input.

The pipe length must be at least 200 times the diameter of the pipe. After telling ALOHA the size of the pipe, you must specify what the unbroken end of the pipe is connected to. The pipe may be connected to an infinite tank source (that is, ALOHA will assume that the temperature and pressure in the tank remain constant), or may be closed off on the unbroken end (for example, by a shutoff valve). Note that ALOHA does not handle pipes that break in the middle, leading to two pipe sources (one on either side of the break).

Pipe roughness refers to the texture of the inside of the pipe; rough texture causes turbulence, which reduces the flow rate of the gas in the pipe. A gas will flow more slowly through an older, corroded (rough) pipe than through a newer (smooth) pipe.

Next, tell ALOHA the pressure and temperature inside the pipe. You may enter a value for the size of the hole in a broken pipe if the pipe is closed off at its unbroken end. If, instead, the pipe is connected to a large reservoir, ALOHA will assume that the hole diameter equals the pipe diameter.

Figure 5-39. Pipe pressure/ hole size.



When you click OK, the source will be calculated and you'll be returned to the Text Summary screen.

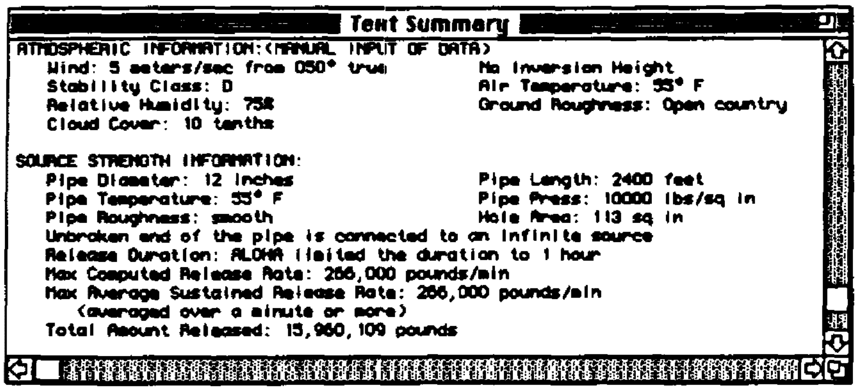


Figure 5-40.
Text summary of gas release from pipe.

Computational...

Choose **Computational** to specify which type of calculations you want ALOHA to use for estimating the dispersion. You may choose to let ALOHA decide whether to use the heavy gas or Gaussian calculations, or you may force the model to use one or the other. This option also allows you to specify a dose exponent.

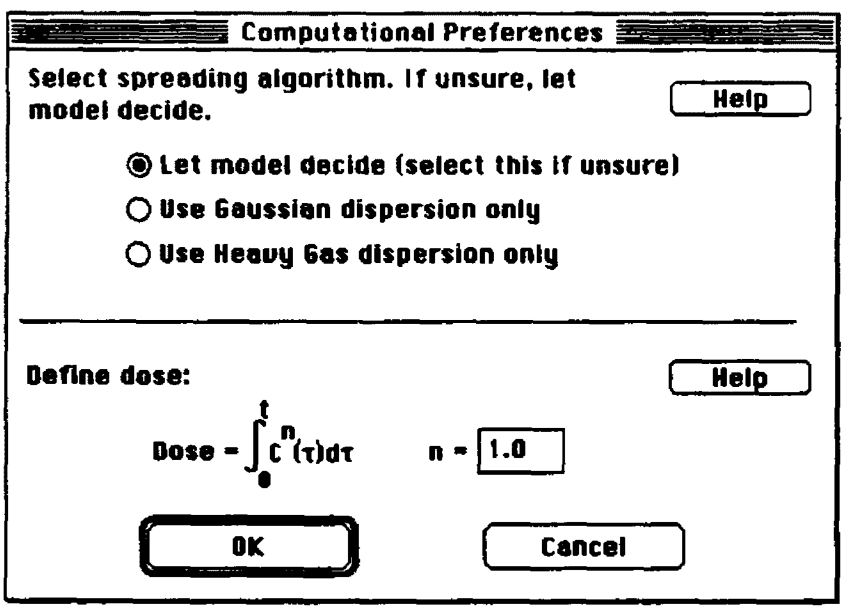


Figure 5-41.
Options for footprint calculations.

Let model decide

When you choose **Let model decide** and are running one of the **Tank**, **Puddle**, or **Pipe** source options, ALOHA will identify chemicals that will behave as heavy gases. This is true even if a chemical's molecular weight is less than 29 kg/kmol (the "molecular weight" of air). However, if you chose **Direct** as your source option, ALOHA may not have enough information about the release to determine whether a heavy gas is formed when the molecular weight of the chemical is less than 29 kg/kmol. In these cases, it will default to the Gaussian calculations.

Use Gaussian dispersion only

When you choose **Use Gaussian dispersion only**, ALOHA will calculate the spread of the chemical cloud using the Gaussian distribution discussed in Chapter 2. The Gaussian calculations may be quicker than the heavy gas calculations, particularly if you are using a computer without a math coprocessor. In a response situation, you may elect to use the Gaussian dispersion option to obtain an initial footprint estimate. You may then recompute the footprint using **Let model choose** when time allows.

A general rule is that for unstable atmospheres (stability classes A and B), the heavy gas calculations will predict longer footprints; in stable atmospheres (stability classes E and F), the Gaussian footprints will be longer. Under neutral (C and D) conditions, the computations will be approximately the same.

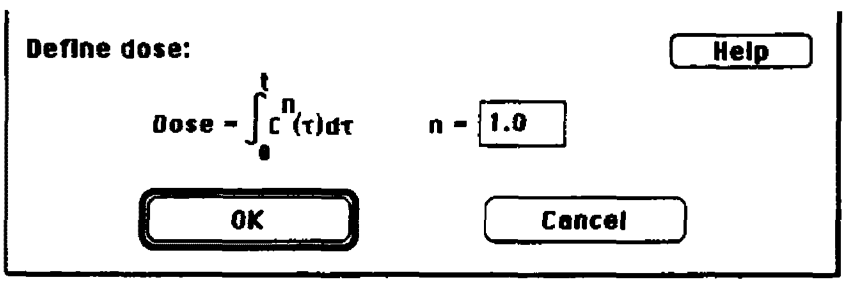
Use Heavy Gas dispersion only

When you choose **Use Heavy Gas dispersion only**, ALOHA will calculate the spread of the pollutant using the heavy gas computations discussed in Chapter 2. These calculations may be slower than the Gaussian calculations, particularly if you are using a computer without a math coprocessor . There are some instances, such as when a chemical has been stored at a low temperature or under high pressure, when a chemical with a molecular weight less than that of air may behave like a heavy gas. ALOHA will warn you in some of the situations where this may happen. If you think this may be true of a chemical, choose **Use Heavy Gas dispersion only**.

Some chemicals with molecular weights less than that of air may behave like heavy gases.

Define dose

Scientists disagree about the definition of "dose." ALOHA defines dose using the equation shown when you choose **Computational**. In this equation, C represents the concentration of the chemical in the air, t represents the time period over which the dose is calculated, and n is the exponent related to response (see below). When n is 1.0, you would read this equation as:



dose = concentration of the chemical multiplied by the time period it is present

For example,

dose = concentration of the chemical (250 ppm) multiplied by time (four minutes)

In our example, people at this location have been exposed to a total dose of 1,000 ppm-min.

The default value for *n* is 1. You should retain this value unless you are consulting with a specialist who understands the dose formula and knows the appropriate exponent to be used in the formula for the chemical in question.

Seeing the calculated footprint

After selecting a computational preference, click **OK**. You are now ready to move on to the **Display** menu, where you will specify how you would like your data displayed.

Chapter 6

The Display Menu

In this chapter...

Once you've entered information about your scenario under the SetUp menu, you can use the options on the Display menu to look at various types of output. Output options are:

- text summary
- dispersion footprint
- graph of concentration over time at a given point (both in- and outdoors)
- graph of dose over time at a given point (both in- and outdoors)
- source strength (release rate over time).

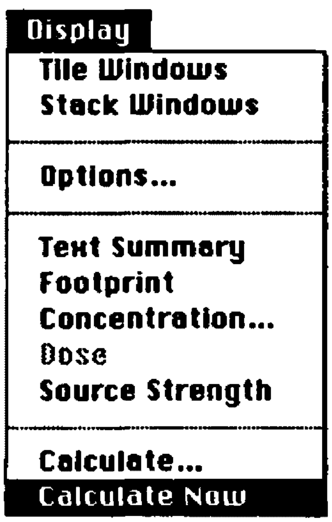


Figure 6-1.
The Display menu.

When windows displaying this information are visible, you may organize them by selecting **Tile Windows** or **Stack Windows.**

Tile and Stack Windows

The **Tile** and **Stack Windows** options allow you to organize the information windows on your computer screen. **Tile Windows** displays the windows side by side, or one above the other; **Stack Windows** overlaps the windows one on top of the other, so that only the front window is visible; the title bars of the remaining windows are stacked behind. These windows can be expanded to fill your screen. Each of the windows may be sized or moved.

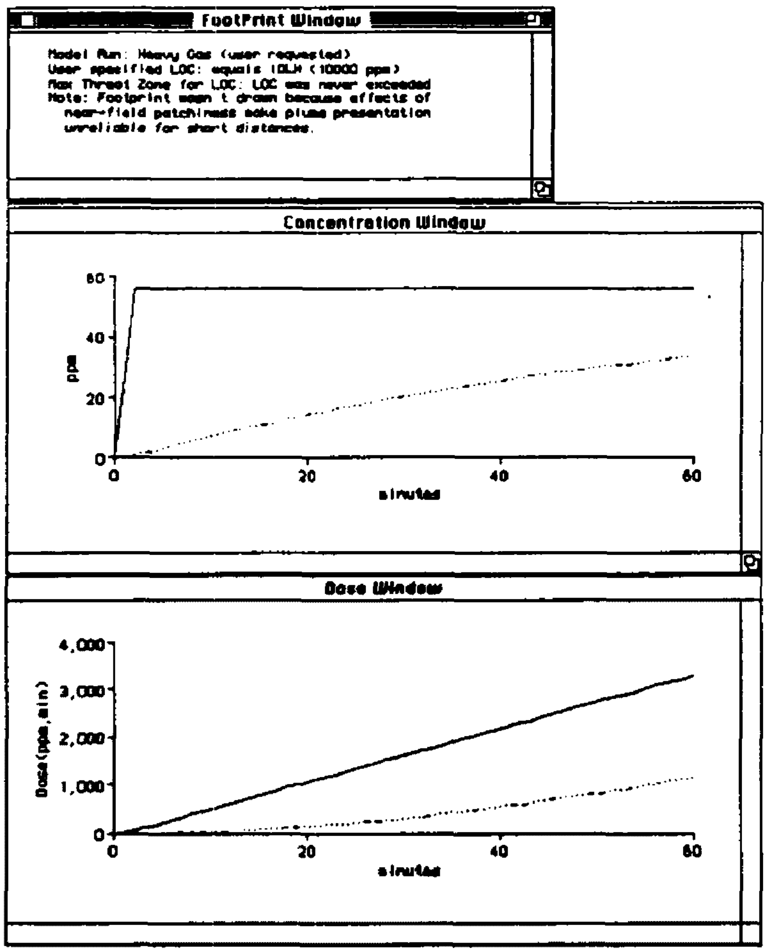
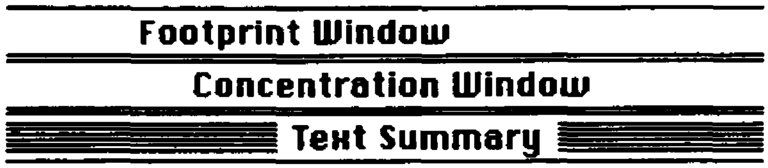


Figure 6-2.
Tile windows.

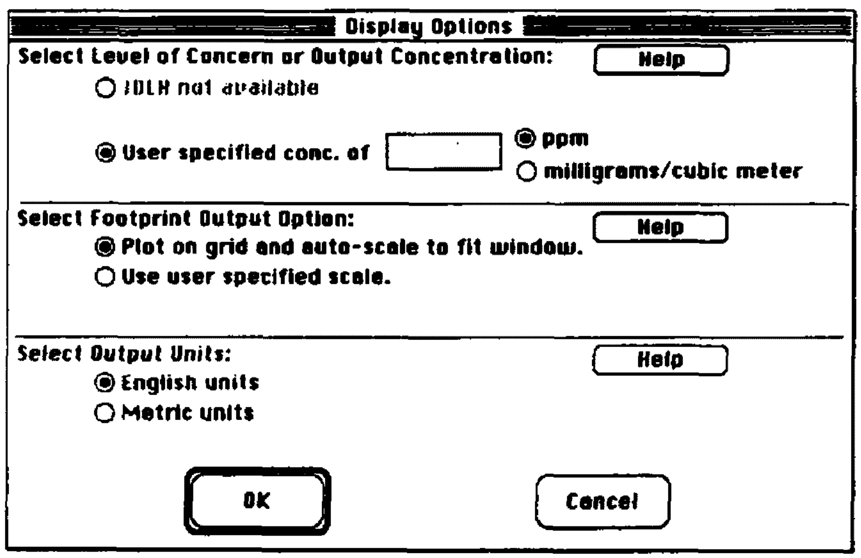
Figure 6-3.
Stack windows



Options...

You can ask ALOHA to calculate the shape of the footprint based on a given level of concern. You then specify how the footprint should be displayed.

Figure 6-4.
Display options.



Level of Concern

You must choose a level of concern before ALOHA can plot a footprint. The footprint will encompass the area within which, at some time during the hour after a spill begins, ground-level concentrations will reach or exceed your specified level of concern. There are two choices for specifying a level of concern. **IDLH Concentration** is the maximum concentration from which a healthy person could escape within 30 minutes without escape-impairing symptoms or irreversible health effects (NIOSH 1990).

WARNING

The IDLH was not designed to be an appropriate measure of exposure levels for the general population. It doesn't take into account the greater sensitivity of children and the elderly. Although it is the most commonly used toxic threshold, it should be used with great care.

Hence, you should be cautious when using this value for any type of evacuation decision. Make sure that you don't use this estimate to evaluate the relative toxicity of different chemicals, as a definitive way to identify safe or hazardous conditions, or without reference to length of exposure.

When you select a chemical for your scenario, ALOHA automatically checks to see if the IDLH value is available from the chemical library. If it is, ALOHA will set the default level of concern to this value. If it is not available, **IDLH Concentration** will be grayed-out and you will not be able to select this option.

A preferred way to determine the level of concern to be used as an action criterion is through contingency planning. In this way, communities can set predetermined levels of concern for chemicals or classes of chemicals common to their region. If such a value exists for the chemical you are using, enter that value next to **User specified conc.**, making sure to click ppm or milligrams/cubic meter as appropriate. You may also use **User specified conc.** to obtain footprint estimates for a variety of levels of concern.

Footprint options

Once you've chosen the level of concern that you want ALOHA to use for calculating the potential threat zone, decide how you want to view this information. If you click **Plot on grid,** ALOHA will draw the footprint on a grid and scale the drawing to fit on your computer screen.

Chapter 6

The Display Menu

In this chapter...

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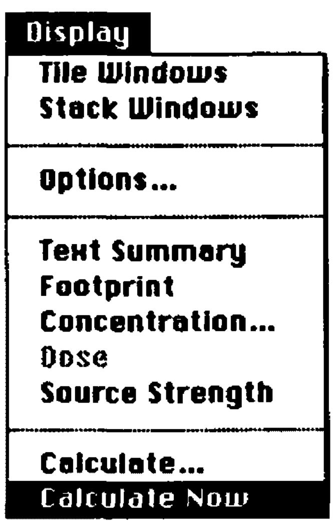
- dispersion footprint
- graph of concentration over time at a given point (both in- and outdoors)
- graph of dose over time at a given point (both in- and outdoors)
- source strength (release rate over time).



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The Display menu.

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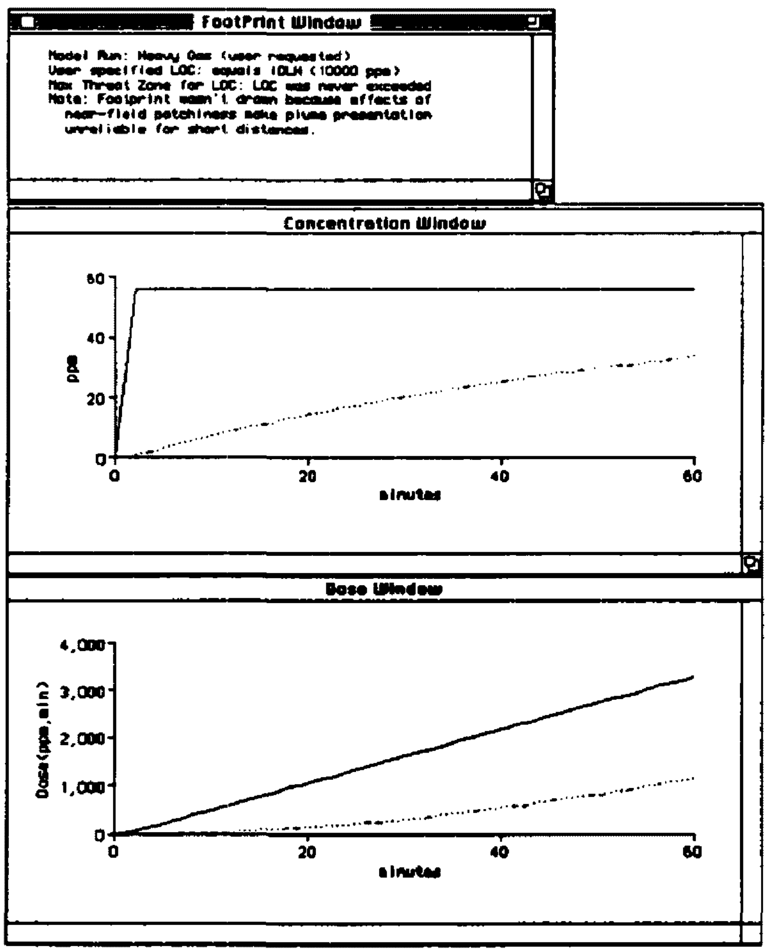
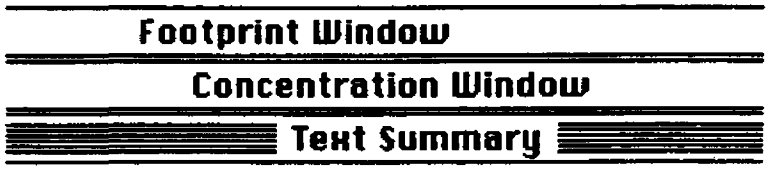


Figure 6-2.
Tile windows.

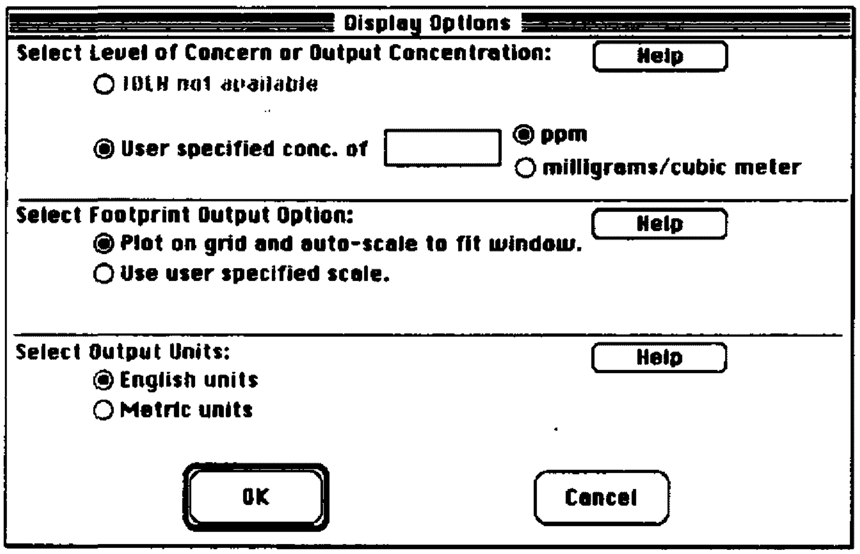
Figure 6-3.
Stack windows



Options...

You can ask ALOHA to calculate the shape of the footprint based on a given level of concern. You then specify how the footprint should be displayed.

Figure 6-4.
Display options.



Level of Concern

You must choose a level of concern before ALOHA can plot a footprint. The footprint will encompass the area within which, at some time during the hour after a spill begins, ground-level concentrations will reach or exceed your specified level of concern. There are two choices for specifying a level of concern. **IDLH Concentration** is the maximum concentration from which a healthy person could escape within 30 minutes without escape-impairing symptoms or irreversible health effects (NIOSH 1990).

WARNING

The IDLH was not designed to be an appropriate measure of exposure levels for the general population. It doesn't take into account the greater sensitivity of children and the elderly. Although it is the most commonly used toxic threshold, it should be used with great care.

Hence, you should be cautious when using this value for any type of evacuation decision. Make sure that you don't use this estimate to evaluate the relative toxicity of different chemicals, as a definitive way to identify safe or hazardous conditions, or without reference to length of exposure.

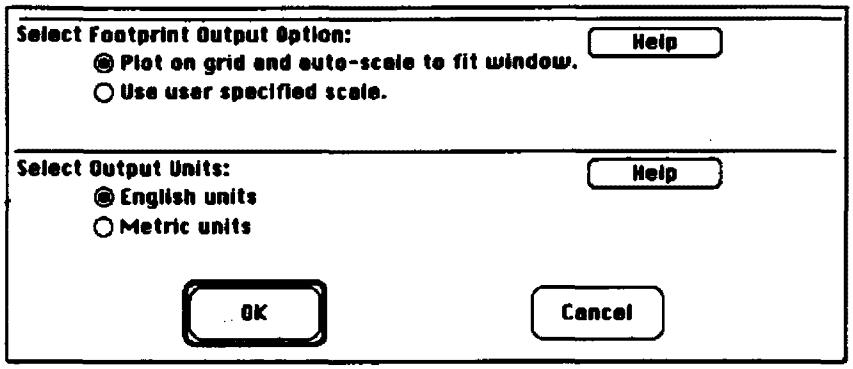
When you select a chemical for your scenario, ALOHA automatically checks to see if the IDLH value is available from the chemical library. If it is, ALOHA will set the default level of concern to this value. If it is not available, **IDLH Concentration** will be grayed-out and you will not be able to select this option.

A preferred way to determine the level of concern to be used as an action criterion is through contingency planning. In this way, communities can set predetermined levels of concern for chemicals or classes of chemicals common to their region. If such a value exists for the chemical you are using, enter that value next to **User specified conc.**, making sure to click ppm or milligrams/cubic meter as appropriate. You may also use **User specified conc.** to obtain footprint estimates for a variety of levels of concern.

Footprint options

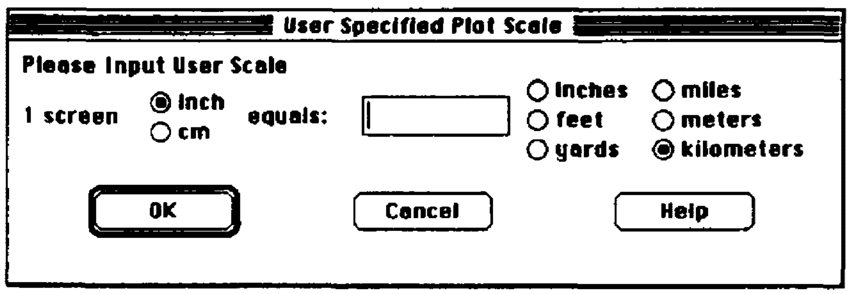
Once you've chosen the level of concern that you want ALOHA to use for calculating the potential threat zone, decide how you want to view this information. If you click **Plot on grid,** ALOHA will draw the footprint on a grid and scale the drawing to fit on your computer screen.

Figure 6-5. Footprint display options.



If you select **User specified scale,** when you click **OK,** ALOHA will ask what scale you wish to use. **User specified scale** is useful if you want to print the footprint on a transparency and overlay it on a map of known scale.

Figure 6-6. Specifying a scale for footprint plot.



Select Output Units

ALOHA will use the units that you select to represent the footprint distance and source rate information. The units that you select will not affect the meteorological, chemical, and source information that you entered using the **SetUp** menu (i.e., your inputs will remain in the units that you used and will appear on the Text Summary screen as such).

Text Summary

Choose the **Text Summary** menu item to make the Text Summary window the current front window. This window displays the options you've chosen as you've moved through the ALOHA menus. It also summarizes, in text form, the results of ALOHA's calculations, such as the length of the footprint and type of dispersion calculation used. When you first open ALOHA, you'll see short messages in the Text Summary window. These indicate that you haven't yet told ALOHA the location, chemical, or atmospheric conditions for your scenario.

Pay careful attention to this screen: make sure that your input is accurately reflected and note warnings or messages.

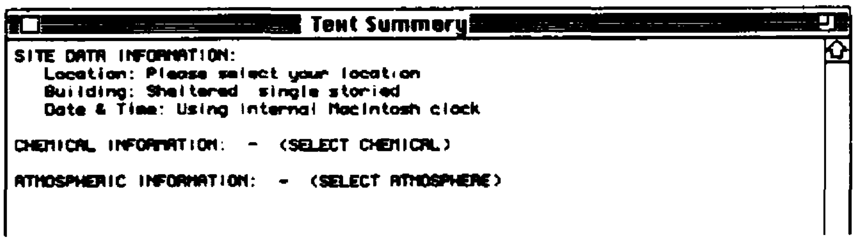


Figure 6-7.
Text summary window.

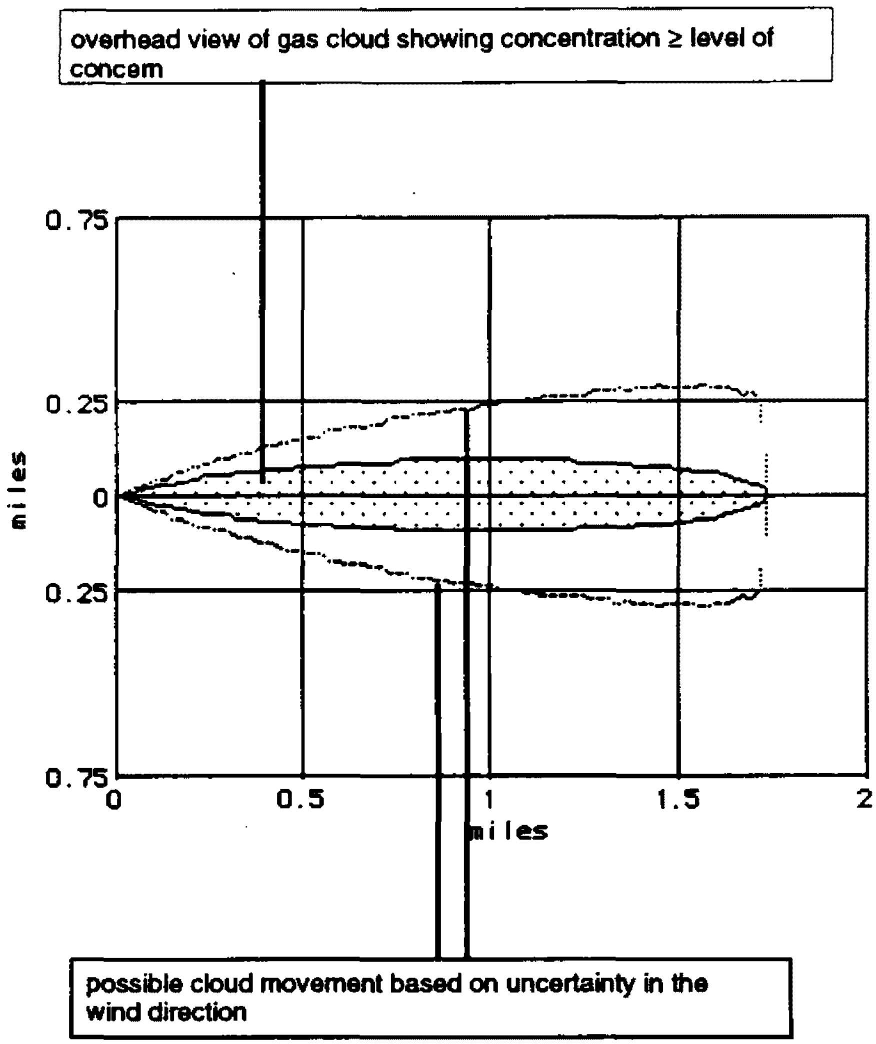
Whenever you choose a menu item, enter information, and click **OK**, your choices are summarized in the Text Summary window. For example, when you choose a chemical, its name will appear next to CHEMICAL INFORMATION; when you enter atmospheric information, that information will appear under ATMOSPHERIC INFORMATION, and so on. In the example above, only a **Building** type and **Date & Time** have been specified.

Footprint

When viewed from above, ground-level concentrations of a dispersing chemical reach or exceed your specified level of concern within an area that forms a "footprint." This shape represents the spread of the gas cloud to the level of concern.

Dashed lines are drawn on either side of the footprint. These lines reflect the uncertainty in the wind direction based on the stability class that you (or the SAM station) have chosen. The wind usually will not remain constant from any one direction; the lower the wind speed, the more likely it is that the wind direction will vary, and thus, the wider the uncertainty lines become. These "uncertainty lines" give you an indication of how confident you can be of the direction of the dispersing cloud.

Figure 6-8.
ALOHA footprint.



You can never be 100% certain that the wind direction will fall within the uncertainty limits unless you draw a circle (to indicate that it's possible for the wind to come from any direction). The outer lines drawn by ALOHA are based on a 95% confidence factor. This means that, 19 out of 20 times, the wind will be from a direction that will keep the cloud of pollutant between these lines. At very low wind speeds, you will notice that these lines will form a circle.

Be aware that, whenever source strength changes during a release or a release is very brief, a heavy gas footprint may overestimate the threat zone. This overestimate can be substantial when source strength changes rapidly and drastically. This happens because ALOHA makes simplified calculations in order to produce a footprint plot in the short time available during an emergency response. Except in cases when release rate is constant, the model warns you of this by placing brief messages both on the heavy gas footprint plot (where you'll see the messages, "May be overestimate" and "Check concentration") and in the Text Summary window.

When source strength is not constant for an hour, treat a heavy gas footprint as an initial screening estimate. When you see ALOHA's warning messages, check concentrations, both at locations of concern and at a few points along the footprint centerline. This will give you a better idea of what ground-level concentrations may actually be downwind of the source. Unlike the footprint calculations, ALOHA's heavy gas concentration calculations are not simplified. Note that, in some cases, concentrations may be lower than your level of concern well within the footprint.

Concentration

Besides examining ALOHA's footprint plot to see how far a dispersing chemical cloud may spread, you may want to find out about the concentration of chemical to which people at a particular location within the affected area may be exposed. This location could be a hospital, school, or large office building, as examples.

ALOHA displays a **Concentration vs. Time** graph showing predicted concentrations for the first hour following the start of a release, at a location that you have specified. You'll see two curves on the graph. The solid (red on a color monitor) curve represents the outdoor, ground-level concentration. The dashed (blue on a color monitor) curve represents concentration within a building of the type you selected using the **Building Type...** menu item in the **SiteData** menu.

In reality, concentration of a dispersing chemical at a specific point can fluctuate widely. The concentration values presented by ALOHA represent concentration values that have been averaged for five minutes.

An example of a concentration graph is shown below. This graph shows concentrations downwind of an evaporating puddle of acrolein. You can see that outdoor concentration started to increase immediately after the spill began. Inside sheltered, single-story buildings (the type selected for this scenario) it took much longer for indoor concentration to increase. Comparing indoor and outdoor curves on a **Concentration vs. Time** graph can be helpful in determining the relative threats associated with remaining indoors versus leaving the area through a dispersing pollutant cloud.

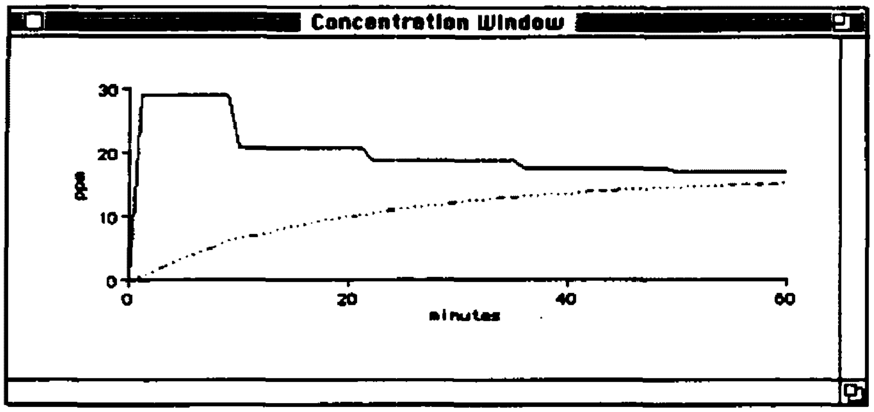


Figure 6-9. Concentration vs. Time graph for an evaporating puddle.

Designating a Location

You may choose either of the following ways to designate a location for which you would like to see predicted concentration. (You'll first need to have chosen a chemical and entered information under the source option.)

Choose Concentration from the Display menu.

Then type in the coordinates of a location either in terms of its east-west and north-south distances or its downwind and crosswind distances from the source. Once you have indicated a location and clicked OK, ALOHA will automatically calculate and display a concentration graph for that point.

Choosing coordinates

Your choice of coordinates will have important effects on the information that ALOHA will present to you if the wind direction changes (whether you're using a SAM station, or you manually entered a new value).

Using fixed (east-west and north-south) coordinates

Choose this method if you wish to know the concentration expected at a specific geographical location. This could be, for example, a school 100 yards to the west and 400 yards to the north of the spill location. This is the best method to choose if you wish to monitor expected concentration at the school, and you are using a SAM station to track wind speed and direction in ALOHA. If the wind shifts direction, the concentration graph displayed by ALOHA may change, depending on whether or not the shift in wind direction moves the cloud closer to the school or farther away from it.

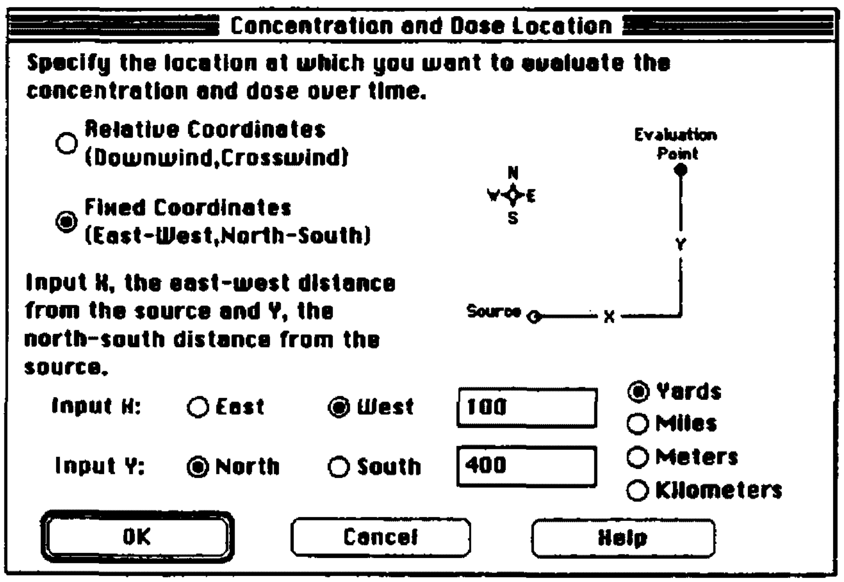


Figure 6-10. Entering fixed coordinates for a location of concern.

Using relative (downwind and crosswind) coordinates

Choose this method when you wish to know the concentration expected at a position that can best be described in terms of its downwind and crosswind distance from the spill source. For example, suppose that you have estimated the straight-line distance between the site of a spill and a nearby hospital to be a quarter-mile. At the moment, the wind is not blowing the chemical cloud directly towards the hospital, but the wind is variable in direction.

You wish to know the concentration you could expect if the wind were to shift and carry the cloud of escaping chemical directly towards the hospital. You can find this out by using ALOHA to obtain a concentration graph for a location a quarter-mile downwind, with a crosswind distance of 0 miles.

When you use relative coordinates, ALOHA will remember the location of the point that you have specified in terms of its downwind and crosswind distance to the source. Therefore, the geographic location of the point that you have specified to ALOHA will move when the wind direction changes.

IMPORTANT

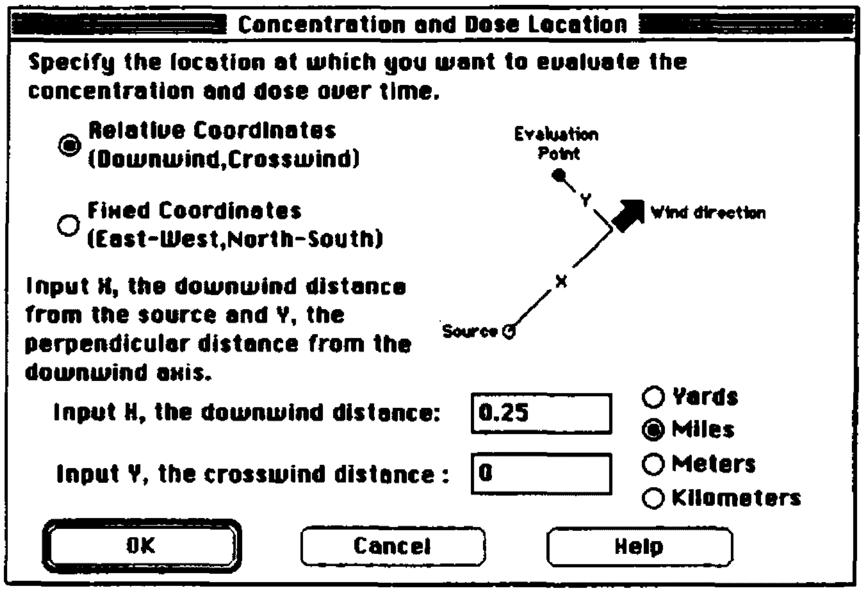


Figure 6-11.
Entering wind-relative coordinates for a location of concern.

2 In the Footprint window, double-click on the location of concern

You are not restricted to choosing a point within the footprint. ALOHA will display a concentration graph for the point that you have indicated.

ALOHA will use relative (downwind and crosswind) coordinates to remember your site's position. Remember that the geographic location of the point that you have specified to ALOHA will move when the wind direction changes.

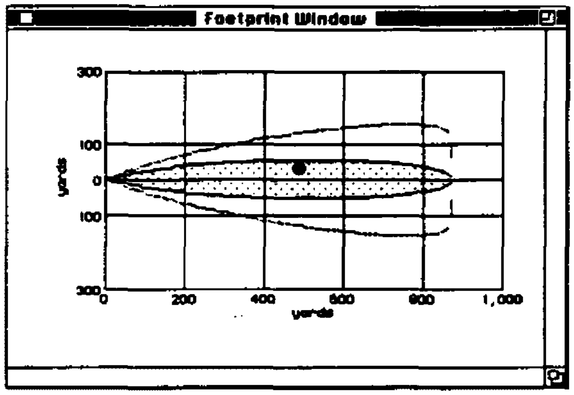


Figure 6-12. Footprint plot showing a selected concentration location. The cross-hair symbol marks the point where concentration has been evaluated.

Dose

There is no general agreement among toxicologists about the proper definition of the term "dose." ALOHA defines dose as the concentration of pollutant to which people are exposed, taken to a power, multiplied by the period of time that it is present. The exact equation used in ALOHA is

$$dose = \int_0^t C^n(\tau)d\tau$$

where C is the concentration computed by ALOHA, *t* is the period of exposure, and *n* is the dose exponent. Toxicologists adjust the exponent n to account for the differing toxic effects of hazardous chemicals. When *n* is 1.0, dose is equivalent to what many people call "exposure."

WARNING: Dose information is difficult to interpret because the effects of most toxic chemicals on people are poorly understood. If you don't know the appropriate dose exponent to use for a particular chemical, or if you can't consult with a specialist who can advise you on the correct exponent to use and help you to interpret ALOHA's results, avoid using ALOHA's dose calculations. Instead, use information from ALOHA's footprint and concentration plots and your own knowledge of a chemical to make response decisions.

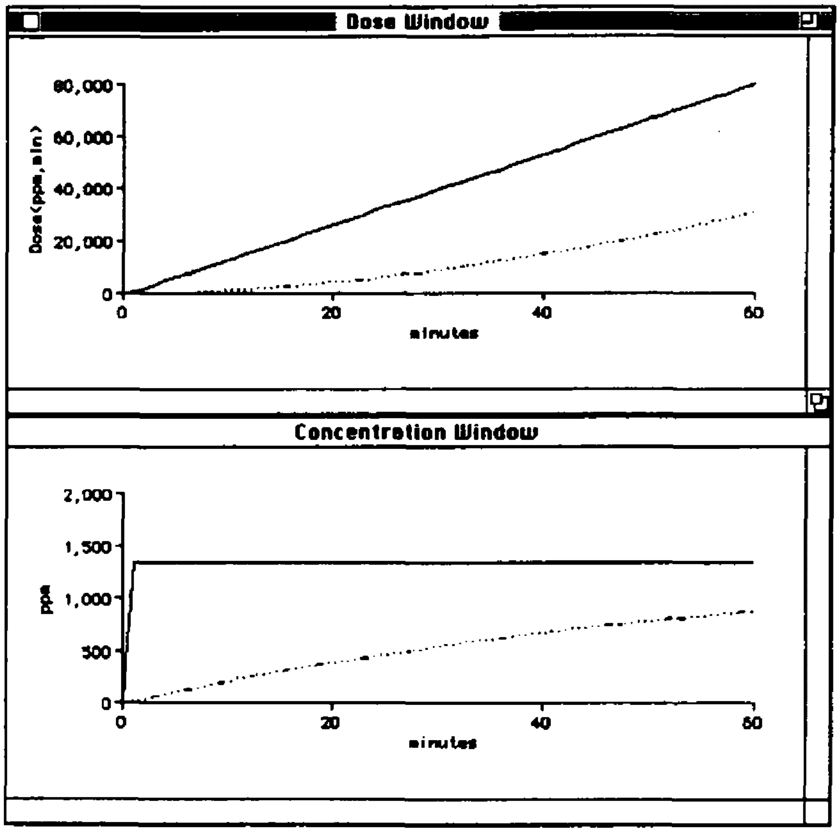
Using the dose exponent

You can adjust ALOHA's dose exponent, *n*, by choosing **Computational** from the **SetUp** menu. ALOHA will calculate dose by multiplying concentration, taken to the n-th power, by the exposure time. For example, if you set *n* to 1.0 and the concentration is predicted to remain at a constant 100 ppm for 5 min at a particular location, ALOHA will predict that people there will be exposed to a dose of 500 ppm-min. If you change the exponent to 2.0, ALOHA will calculate dose as concentration squared and multiplied by exposure time. For the example above, ALOHA would predict dose to be 50,000 ppm^2-min. (Note that the units of dose change when the exponent changes.)

Obtaining a dose graph

Once ALOHA has made concentration calculations for a location that you have specified, you may choose **Dose** from the **Display** menu to see a **Dose vs. Time** graph for the same location. This graph will display indoor and outdoor dose predicted for the first hour after a release begins. On the graph, outdoor dose is shown as a solid (red on a color monitor) curve, and indoor dose as a dashed (blue on a color monitor) curve. In the Text Summary window, you'll see values for maximum indoor and outdoor dose at the end of ALOHA's one-hour scenario representation.

Figure 6-13.
Dose and concentration vs. time graphs for a time-dependent release.



Source Strength

You may choose **Source Strength** from the Display menu to get an idea of how rapidly (or slowly) a spilled chemical is escaping into the atmosphere. When you choose this menu item, ALOHA will display a graph showing the rate of release of your chemical (the "source strength") predicted for the first hour after a spill begins.

ALOHA produces two main types of source strength estimates, depending on the type of release that you have chosen. Source strength graphs for the two types of estimates differ in appearance.

Release rate for a **Direct** source, whether it's instantaneous or continuous, will remain constant for the duration of the release. ALOHA expects an instantaneous release to last for 1 minute, and a continuous release to last for one hour. Graphs of either type of **Direct** release look like the plot shown below.

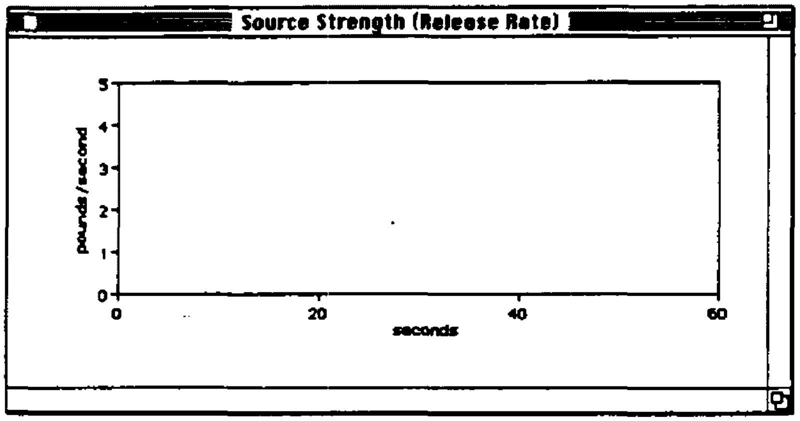


Figure 6-14.
Source strength graph for an instantaneous Direct release.

Source strength predicted by the Puddle, Tank, or Pipe source options may change over time.

For example, take the rate of release of a pressurized gas from a tank rupture. Initially, the chemical escapes rapidly through the rupture. As the tank pressure drops, the rate of release slows. If you model such a release using ALOHA, you'll see a curve that descends in steps on the source strength graph.

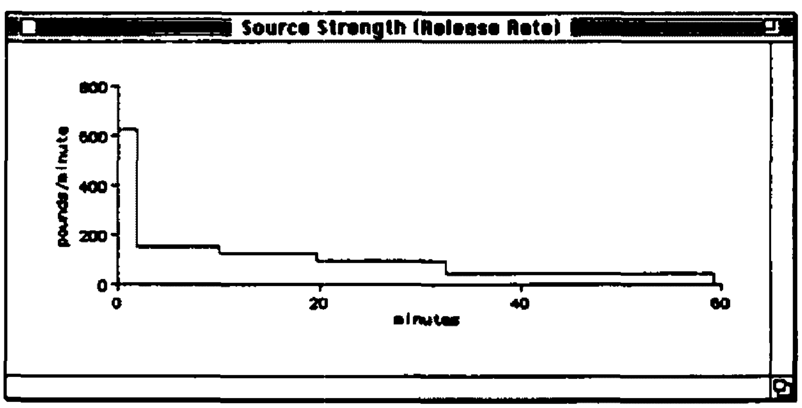


Figure 6-15.
Source strength graph for a pressurized tank release.

Source strength averaging

ALOHA calculates source strength as a series of up to 150 steps. These values must be averaged into fewer steps so that dispersion and concentration calculations can be made rapidly. The averaged source strengths form a series of up to five steps, each of at least one minute duration. The highest release rate from each of the two series is reported on the Text Summary window. The highest release rate from the first series is the maximum computed release rate. The highest release rate from the averaged series is the maximum averaged release rate. The series of averaged steps is shown on the Source Strength graph, since this is the information used to calculate the footprint.

Calculate

You can choose how often you would like the data in the windows in ALOHA updated. This is necessary because some of ALOHA's calculations, such as those for heavy gas, may take a few minutes. You have three options for deciding when to update ALOHA output windows:

- ❐ **Automatically update all visible windows**
- ❐ **Automatically update only front window**
- ❐ **Manual update of all visible windows**

In all cases, ALOHA will not update any windows until new data are available. The first two options are self-explanatory; the last option means no window will be updated until you select **Calculate Now** from the **Display** menu. All visible windows will then be updated.

To make multiple changes before asking ALOHA to recalculate...	Choose "Manual update of all visible windows"	**ALOHA will only update its windows when you choose Calculate Now from the Display menu. Otherwise, all visible windows will be grayed-out to remind you that their data has not yet been recomputed.**
To have your data continuously updated regardless of the time it takes...	Choose "Automatically update all visible windows"	**Whenever you add data, all of the windows will be updated to reflect your additions. However, any data you are receiving from the SAM station during this update will be lost.**
To have only ALOHA's most recent calculations updated...	Choose "Automatically update only front window"	**All of the other windows will be grayed-out, but you can click on one of the back windows to bring it forward to be recalculated (you can only choose the window from the Display menu).**

Figure 6-16.
Calculate options.

Calculate Now

You can only select Calculate Now if you've done two things: 1) chosen **Manual update of all visible windows** in the **Calculate Options** dialog box, and 2) changed some of your information under the **SetUp** menu. The windows remain grayed-out, indicating that they do not reflect current conditions. When you choose **Calculate Now**, the output will be recalculated and the visible windows will be updated.

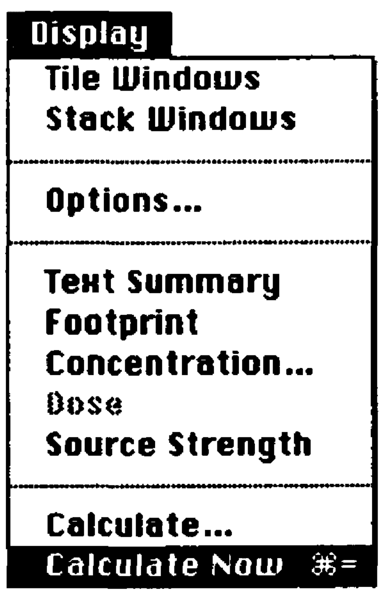


Figure 6-17.
Calculate Now option.

Chapter 7

The Sharing Menu

In this chapter...

Introduction

ALOHA can communicate and share information with other programs. Both in Windows and on a Macintosh, ALOHA can share information with mapping applications so that a current ALOHA footprint can be plotted on a map.

Sharing Information in Windows

When you're running ALOHA in Windows, you can choose between two applications to plot an ALOHA footprint on an electronic map of your city or community. ALOHA can share information with two mapping programs, BitPlot and MARPLOT-DOS. The program you choose depends on the type of map that you have.

BitPlot

BitPlot is a Windows application that is installed in your ALOHA directory when you install ALOHA. It uses maps which are in the Windows device-independent bitmap (.bmp) format. If BitPlot is present in your ALOHA directory, ALOHA will display a **Sharing** menu for BitPlot.

Figure 7-1.
ALOHA Windows Sharing menu.

Select **Go to Map** from this menu to launch BitPlot or to bring it forward if it is already running. A step-by-step example describing how to use ALOHA and BitPlot together is included as Example 5 in Appendix A. Refer to the appendix describing BitPlot in this manual, or to BitPlot's on-line help topics, for additional information.

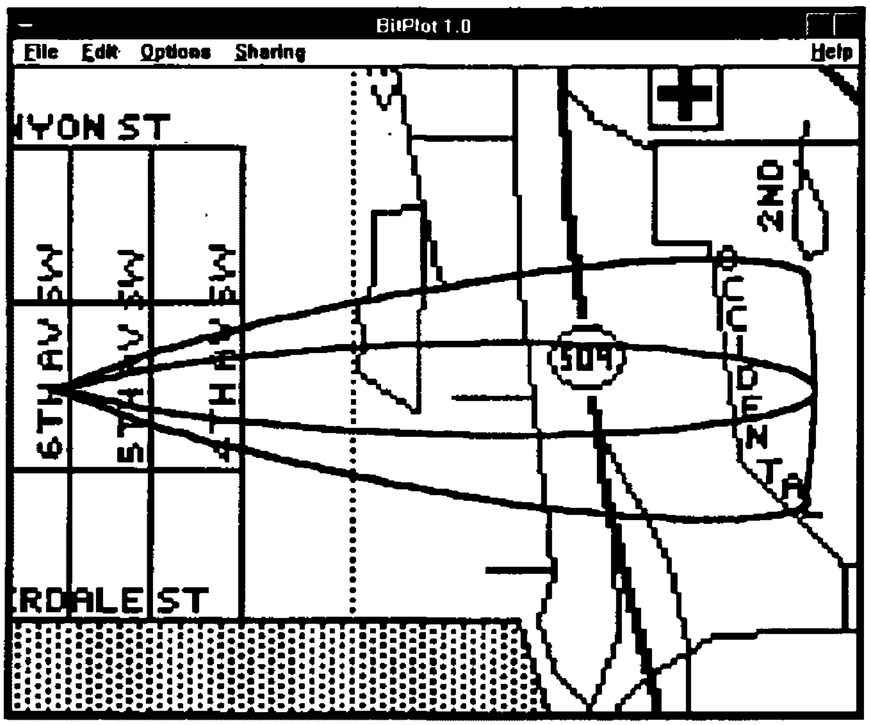


Figure 7-2.
An ALOHA footprint plotted on a map in BitPlot.

MARPLOT-DOS

MARPLOT-DOS is the mapping module of the CAMEO-DOS package. To see your ALOHA footprint on a MARPLOT map, you must run ALOHA and MARPLOT simultaneously in Windows. See your MARPLOT documentation for additional information.

MARPLOT was designed to use special maps generated from TIGER (Topologically Integrated Geographic Encoding and Referencing) files, prepared by the U.S. Census Bureau. TIGER files are computer-readable geographic data bases for all U.S. states, territories, and possessions. They include digital descriptions of features such as political boundaries, water bodies, transportation routes, and address ranges for street segments. MARPLOT-readable maps incorporating this TIGER information are available from the National Safety Council (1-800-621-7619, extension 6900) and other sources. MARPLOT cannot directly read TIGER files; however, you may use MARPLOT to generate maps from TIGER files.

Sharing Information on a Macintosh

When you're running ALOHA on a Macintosh, you can use MARPLOT-Macintosh to plot an ALOHA footprint on an electronic map of your city or community.

The Sharing menu

The programs that comprise the CAMEO package for the Macintosh work together by means of the **Sharing** menu. Any program that can communicate with ALOHA may install a hierarchical menu under ALOHA's **Sharing** menu. In the example below, MARPLOT has installed a menu in ALOHA's **Sharing** menu. In return, ALOHA installs a menu under the **Sharing** menu in MARPLOT.

These menus will appear every time the two applications are run simultaneously. A menu installed by another application into the ALOHA **Sharing** menu belongs to the installing application. Refer to the documentation from that program for a description of how those menu items operate.

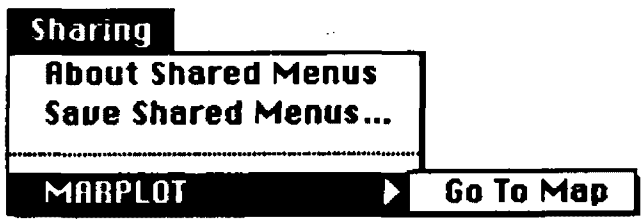


Figure 7-3.
ALOHA's Sharing menu, including a menu installed by the application 'MARPLOT'.

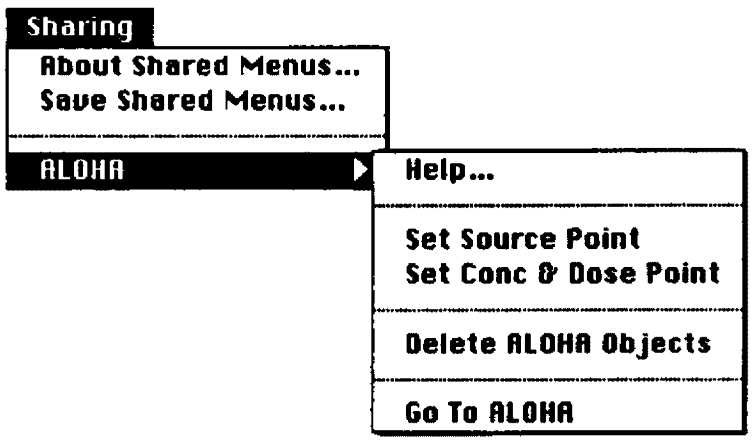
Before you quit ALOHA, you may wish to save the menus that other applications have placed under ALOHA's **Sharing** menu. Do this by choosing **Save Shared Menus** and selecting those menus which you wish to be saved. These menus will automatically be placed under the **Sharing** menu the next time ALOHA is run. When you use a saved menu that belongs to an application that isn't currently running, ALOHA starts that application so that it can carry out the specified action.

MARPLOT-Macintosh

On a Macintosh, ALOHA relies on MARPLOT-Macintosh, the mapping module of the CAMEO-Macintosh package, to display a footprint generated by ALOHA on a map. You must be using either MultiFinder in System 6 or System 7 to use MARPLOT with ALOHA. Like MARPLOT-DOS, it uses special maps generated from TIGER files. MARPLOT-Macintosh cannot read TIGER files directly, and cannot be used to generate maps from TIGER files. Obtain MARPLOT-readable maps generated from TIGER files from the National Safety Council. MARPLOT also can use standard Macintosh PICT format files as background maps.

In order to plot an ALOHA footprint on a background map, you'll need to run ALOHA and MARPLOT simultaneously. ALOHA will install a menu in MARPLOT's **Sharing** menu which will allow you to display an ALOHA footprint on a MARPLOT map. Choose from among the following items contained in the MARPLOT menu:

Figure 7-4. ALOHA menu items installed in MARPLOT's Sharing menu.



Help...

Choose this item to see a help text describing ALOHA's menu items in MARPLOT. When you're finished, click Cancel to be returned to MARPLOT.

Set Source Point

Before choosing this item, click on the location of the spill on your MARPLOT map. Then choose **Set Source Point** to tell ALOHA the source location. ALOHA will place a symbol at that location. The footprint, confidence lines, and concentration/dose point will automatically be placed on the map when the necessary information is available in ALOHA.

Set Conc & Dose Point

Before choosing this item, click the location on your MARPLOT map for which you'd like to see concentration and/or dose information. Then choose **Set Conc & Dose Point** to tell ALOHA the concentration/dose location. ALOHA will place a symbol at that location, then come forward to make concentration calculations and display the results.

Delete ALOHA objects

Choose this item to remove all objects placed on the map by ALOHA. ALOHA will then stop updating the map every time it generates new information.

ALOHA will use fixed (east-west, north-south) coordinates to remember the point's position.

Go to ALOHA

Choose this item to bring ALOHA forward.

A step-by-step example describing how to use ALOHA and MARPLOT together is included in Appendix A. See your MARPLOT documentation, and MARPLOT's on-line help topics for additional information.

Appendix A

Examples

...a tank source

...direct input (heavy gas)

...a pipe source

...ALOHA, MARPLOT, and a PICT map

...BitPlot and ALOHA

...ALOHA and a MARPLOT map

Note:

Here are six examples which are designed to help you understand ALOHA for both the Macintosh and Windows platforms. You may get slightly different answers if you use a computer without a coprocessor.

Example 1

A Tank Source

In a small industrial park outside of Baton Rouge, Louisiana, a 500-gallon, four-foot diameter vertical tank contains liquid benzene. On August 20, 1990 at 10:30 pm local time, a security guard discovers that liquid is leaking out of the tank through a six-inch circular hole that is 10 inches from the bottom of the tank. He also notices that the liquid appears to be flowing into a grassy field west of the industrial park. The security guard thinks the tank had just been filled that evening.

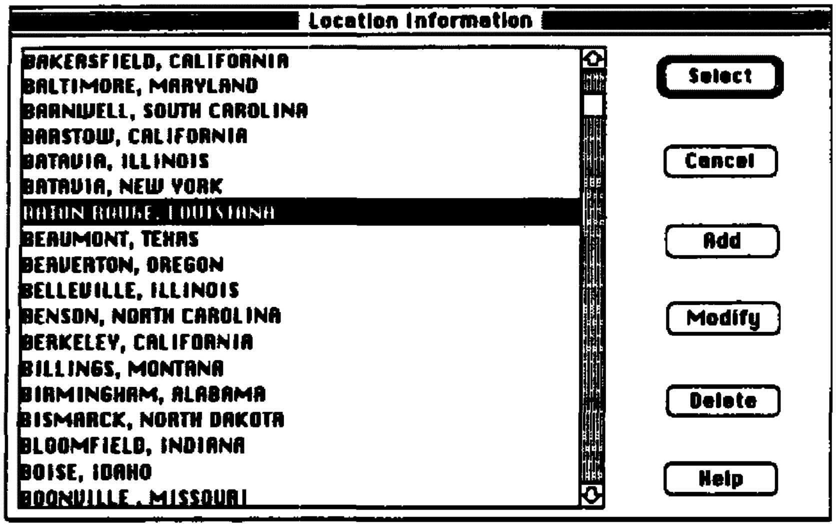
The on-scene weather is partly cloudy, 80°F, with wind from the east at 7 knots. There is more than 50% cloud cover and the humidity is greater than 75%. There is no inversion.

The local emergency planning committee (LEPC) has indicated that the level of concern (LOC) for this product is 10 ppm. Using this scenario, we'll determine the downwind distance to this LOC.

First...

1 Double-click on ALOHA and, after reading the ALOHA caveats, click **OK**.

2 Choose **Location** from the **SiteData** menu.



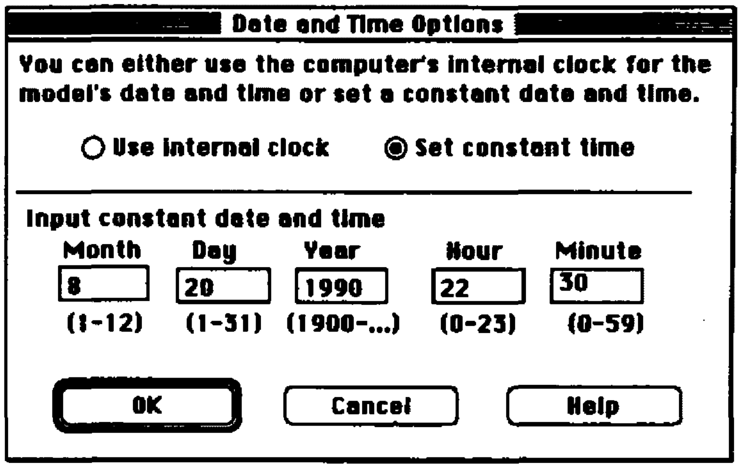
3 Use the scroll bar or type the character "B" to find the city. Once you have located Baton Rouge, Louisiana, double-click on it or click once and click **Select**.

Second...

For this case, we will not enter information about the building type because buildings are not described in the scenario.

1 Choose **Date & Time...** from the **SiteData** menu.

2 Select **Set constant time** and enter the month, day, year, hour and minute for this scenario. You may tab to each of the fields to enter the date. Remember, the hour must be entered as a military time.

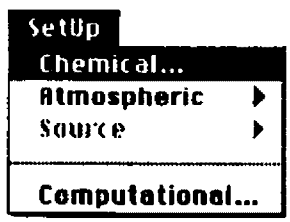


3 Click OK.

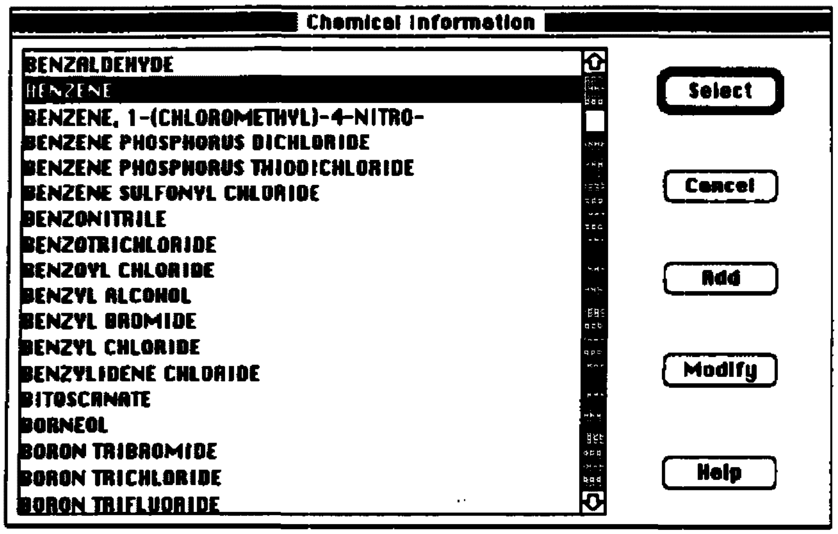
The next menu for data input is the **SetUp** menu.

Third...

1 Select **Chemical...** from the **SetUp** menu.

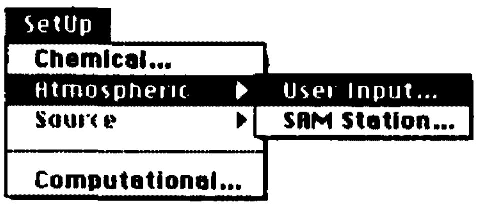


2 Use the scroll bar or type the character "B" to find the chemical. Once you have found benzene, either double-click on the chemical or select the chemical and click **Select**.

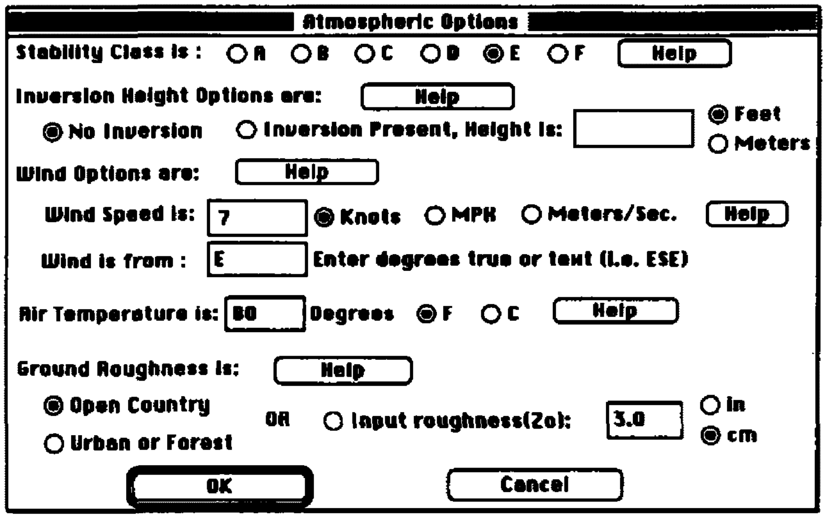


Fourth...

1 Select **User Input...** from the **Atmospheric** submenu under the **SetUp** menu.

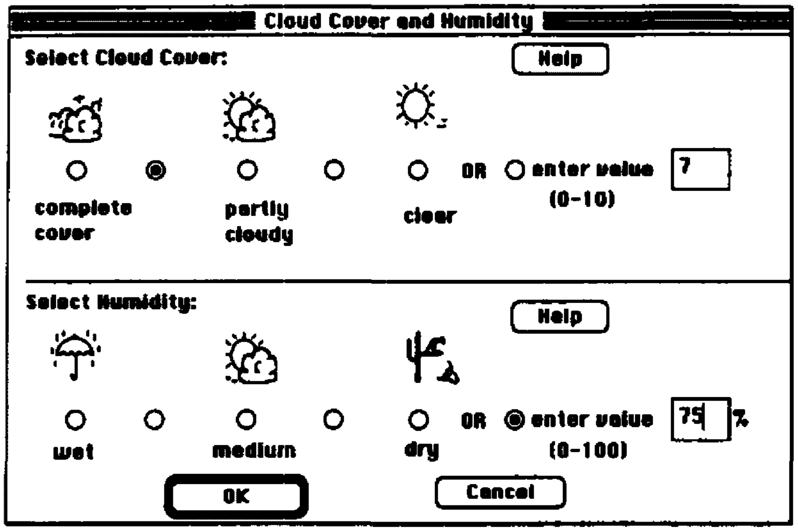


2 Click the button for stability class E because the spill occurs at night, the winds are between 4 and 7 knots, and the cloud cover is greater than 50%. To help you make this choice, click **Help** and look at the table. Nothing in the scenario indicates the presence of an inversion, therefore, the default setting, **No Inversion**, should not be changed.



3 After selecting the stability class, enter the wind speed and click the button next to knots. Enter either E or 90 for the wind direction. Remember, the direction entered is the direction **from** which the wind is blowing. Enter 80 for the air temperature and select the units button for degrees F.

4 Select the button for **Open Country** for the ground roughness because the leaking chemical is flowing into a nearby grassy field that is west of the industrial park. The wind direction is from the east and the general area that we would expect the benzene cloud to move is over the grassy field. If the wind direction had been from the west, that is blowing towards the industrial park, the **Urban or Forest** button should have been selected.



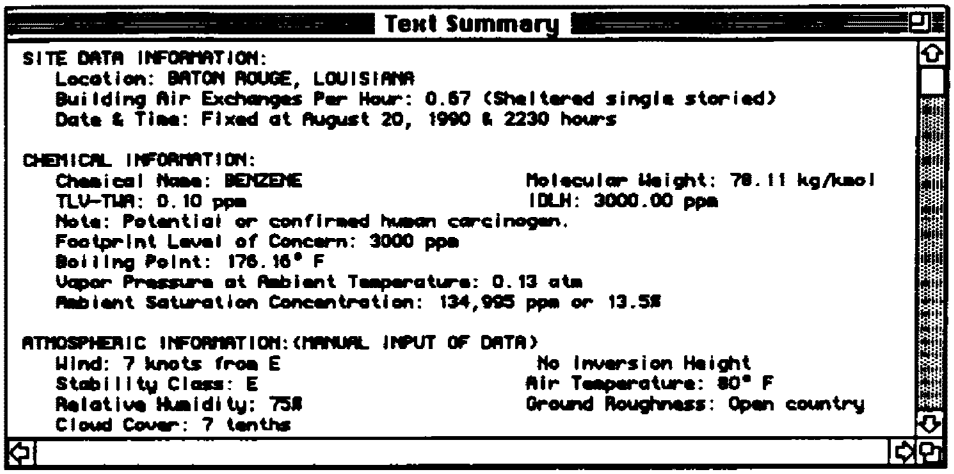
5 Click **OK** when you've filled in all of the data.

6 The scenario describes the cloud cover as partly cloudy (greater than 50%) and not completely overcast, so click the button between **complete cover** and **partly cloudy**.

7 Click the **enter value** button and enter 75 for the humidity.

8 Click **OK**.

The information that you have entered into ALOHA will appear on the text summary screen. Remember that, for this scenario, we are not considering the infiltration rate into buildings so you should ignore the building exchange rate.


Text Summary

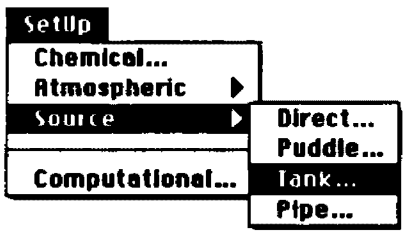
SITE DATA INFORMATION:
Location: BATON ROUGE, LOUISIANA
Building Air Exchanges Per Hour: 0.67 (Sheltered single storied)
Date & Time: Fixed at August 20, 1990 & 2230 hours

CHEMICAL INFORMATION:
Chemical Name: BENZENE
Molecular Weight: 78.11 kg/kmol
TLV-TWA: 0.10 ppm
IDLH: 3000.00 ppm
Note: Potential or confirmed human carcinogen.
Footprint Level of Concern: 3000 ppm
Boiling Point: 176.16° F
Vapor Pressure at Ambient Temperature: 0.13 atm
Ambient Saturation Concentration: 134,995 ppm or 13.5%

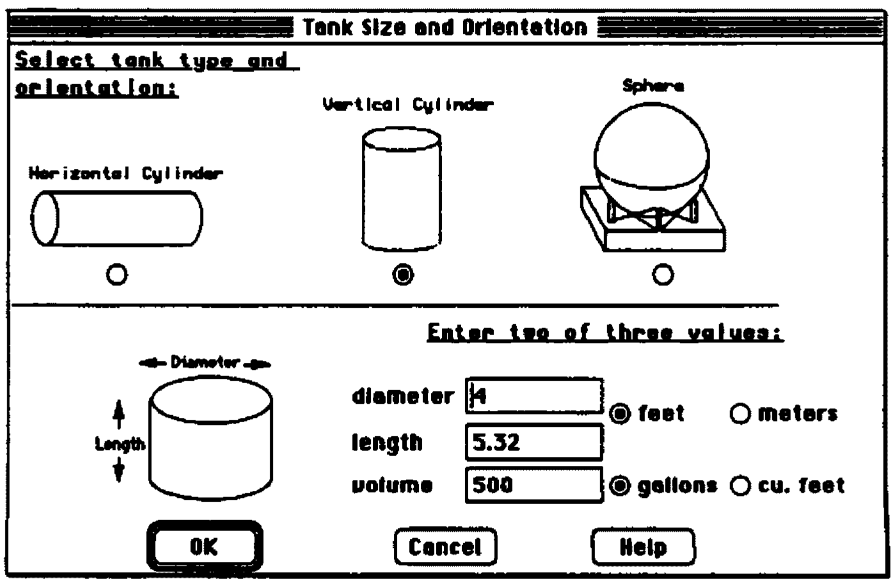
ATMOSPHERIC INFORMATION:(MANUAL INPUT OF DATA)
Wind: 7 knots from E
No Inversion Height
Stability Class: E
Air Temperature: 80° F
Relative Humidity: 75%
Ground Roughness: Open country
Cloud Cover: 7 tenths

Fifth...

1 Select **Tank...** from the **Source** submenu in the **SetUp** menu.



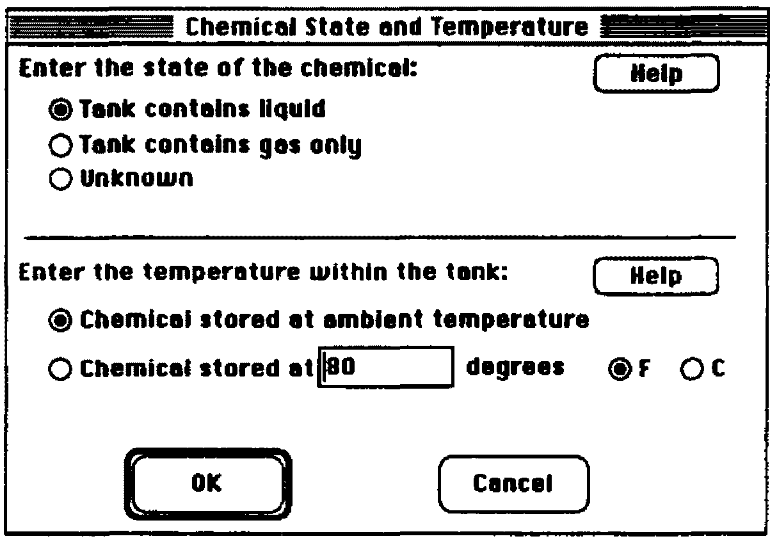
2 Click Vertical Cylinder.



3 Enter 500 gallons for the **volume** and 4 feet for the **diameter** of the tank. Be sure to select the correct buttons for the units. Once the volume and diameter are entered, the correct **length** is automatically calculated.

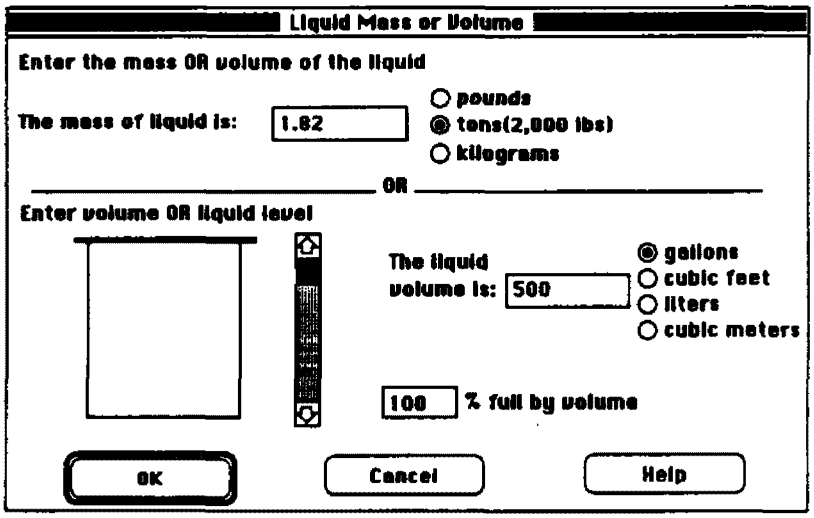
4 Click **OK**.

5 The scenario described the product stored in the tank as a liquid. Since we would expect benzene to be a liquid at ambient temperature (notice on the summary screen that it has a boiling point of 176.16°F), we have no reason to suspect that the chemical is stored at a temperature other than ambient. Click **Tank contains liquid** and **Chemical stored at ambient temperature.**



6 Click **OK**.

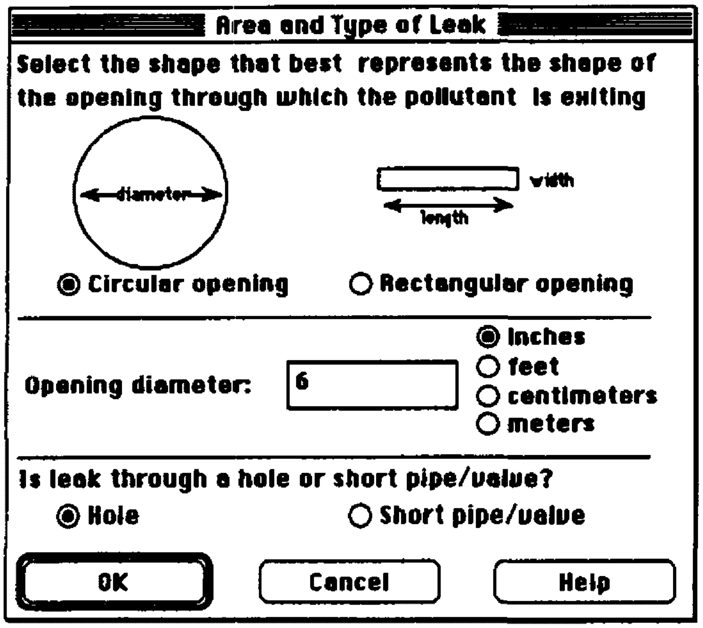
7 The security guard thinks the tank was filled in the evening, so the most conservative estimate we can make is that the tank is 100% full and contains 500 gallons of product. Either enter the liquid volume directly, 500, and select gallons for the units, enter 100% full by volume, or scroll the bar to the top for the liquid level. After the liquid volume is entered, the mass of the liquid is automatically calculated.



8 Click OK.

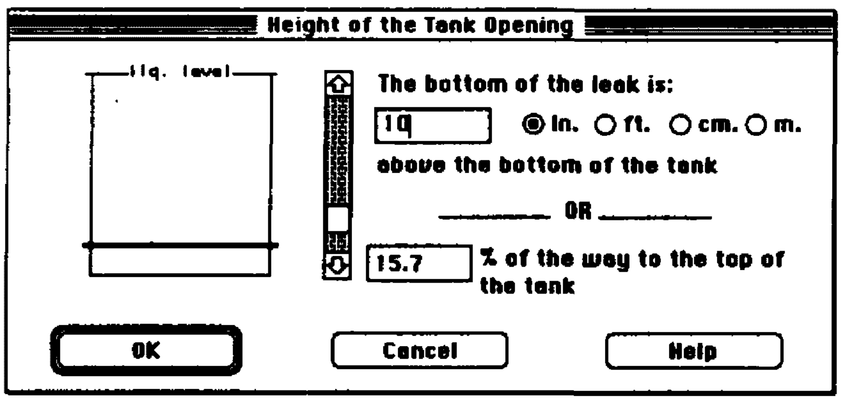
9 Click **Circular opening**, enter 6 for the hole diameter, and select inches.

10 Click Hole.



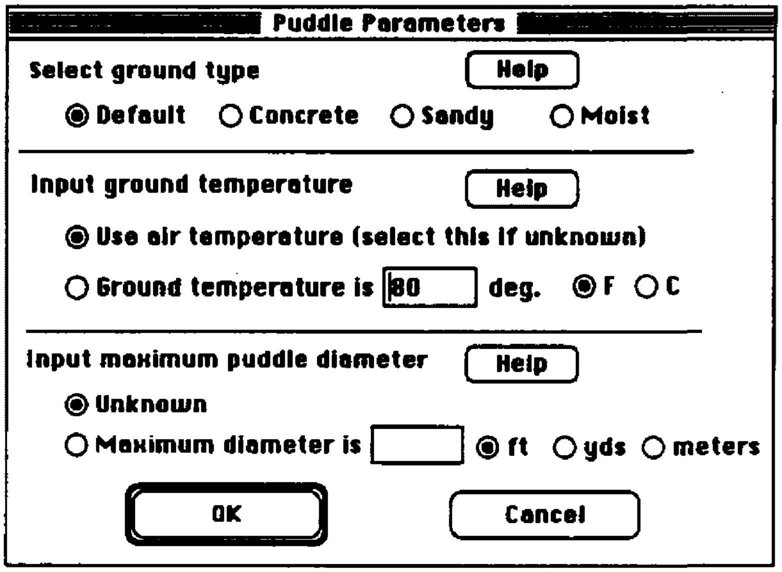
11 Click OK.

12 Enter 10 and select inches for the height that the bottom of the hole is from the bottom of the tank. ALOHA will automatically calculate the percent from the top of the tank.



13 Click OK.

14 The product is flowing into a grassy field, but grass is not one of the choices. For this scenario, clicking **Default** for ground type is probably the best choice. You may wish to compare results using other ground types.

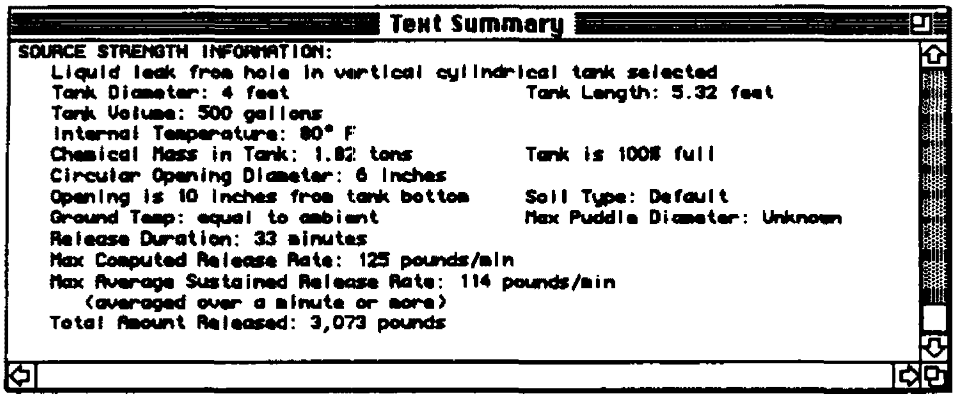


15 The scenario does not give the ground temperature so the best choice is to click **Use air temperature.**

16 Because the product is flowing into a field, it is probably not contained by a dike. For input maximum puddle diameter, click **Unknown**.

17 Click **OK**.

The source strength information that you have entered into ALOHA should appear on the Text Summary screen. This screen contains a lot of information about the release. For example, you know that the release of vapor into the atmosphere is estimated to last for approximately 33 minutes and the maximum amount of vapor released at any one time is estimated at 125 pounds/minute (maximum computed release rate). In the case of the puddle, we would expect the maximum release rate to correspond to the time when the puddle surface is the greatest.

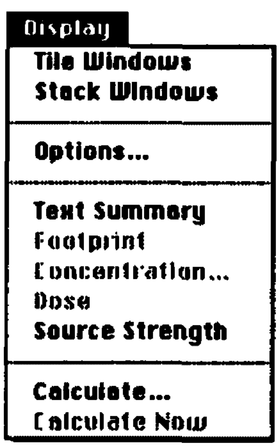


When ALOHA does its calculations, it averages the release rate over five steps (these five steps are seen in the source strength graph). The maximum average sustained release rate reported on the text summary screen corresponds to this maximum average step on the source strength graph. In some cases (particularly pressurized releases which have very high release rates for the first few seconds), these two maximum release rates may be significantly different.

Sixth...

We can see the source strength graph at this point by selecting **Source Strength** from the **Display** menu.

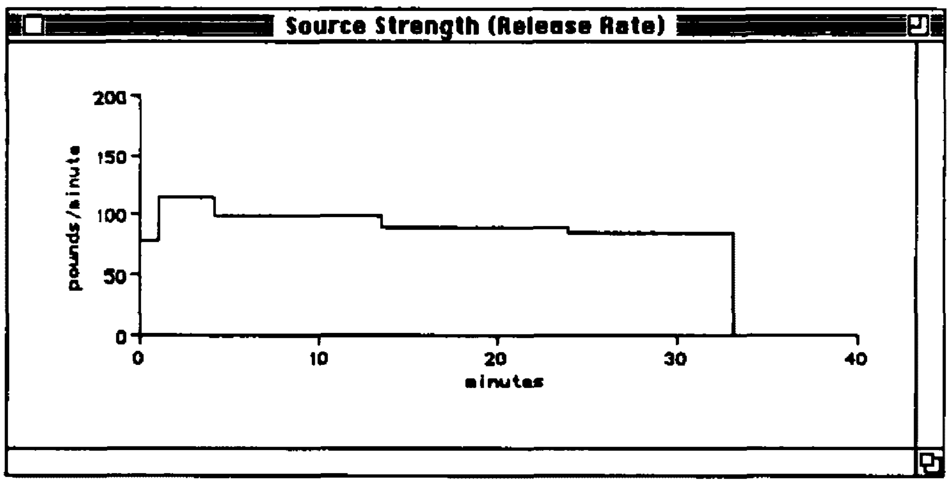
- Select **Source Strength...** from the **Display** menu.



Let's think about the release rate implications of our scenario and try and determine where the model may not be accurately representing what is actually occurring. We have a tank that has formed a puddle; the puddle is undiked so it can grow quite large and thin. This would lead to a large evaporation rate for a short period of time. What would happen if the puddle were constrained by small depressions in the grass?

The puddle would not be able to spread out as far because the liquid flowing away from the tank would fill up the depressions in the grass. The puddle would then be smaller and deeper. This would make the evaporation rate lower and it would take much longer for the puddle to completely evaporate.

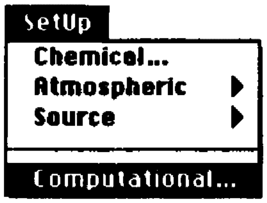
The release rate calculated by ALOHA in our scenario assumes that the puddle gets large; therefore, ALOHA would predict the most conservative (worst-case) downwind distance to the level of concern and, in this instance, the duration of the release rate may be underestimated.



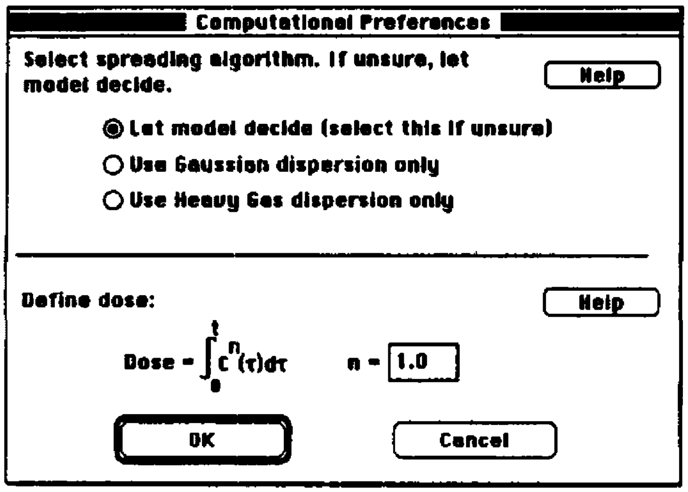
If the terrain contains any features (e.g., ditch or ground depression) that may constrain the puddle from spreading, we can try to estimate the effective diked area and enter this as the maximum puddle area. In this scenario, no other information was given.

Seventh...

1 Select **Computational...** from the **SetUp** menu.



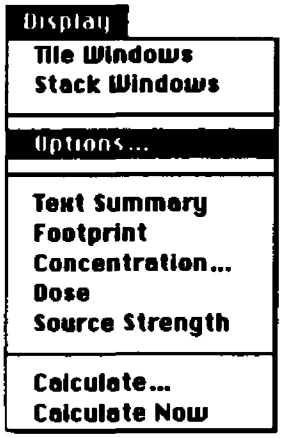
2 Click **Let model decide (select this if you're unsure).**



3 Click OK.

Eighth...

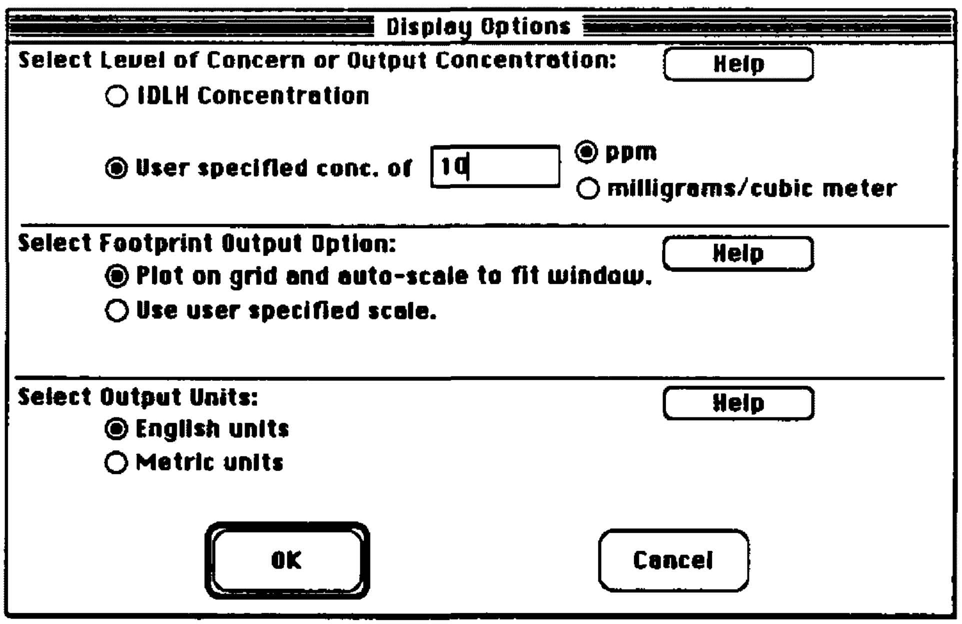
1 Select **Options...** from the **Display** menu.



2 The scenario describes the level of concern as 10 ppm. Click the button for **User specified concentration** and enter 10. For the units, click the button for **ppm**.

3 Click **Plot on grid and auto-scale to fit window**.

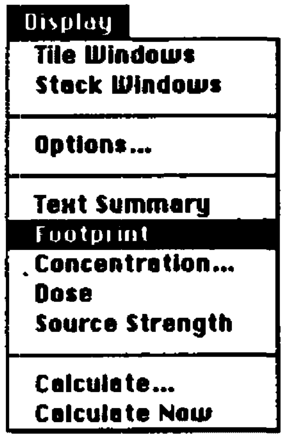
4 Click the **Output Units** button for **English units**.



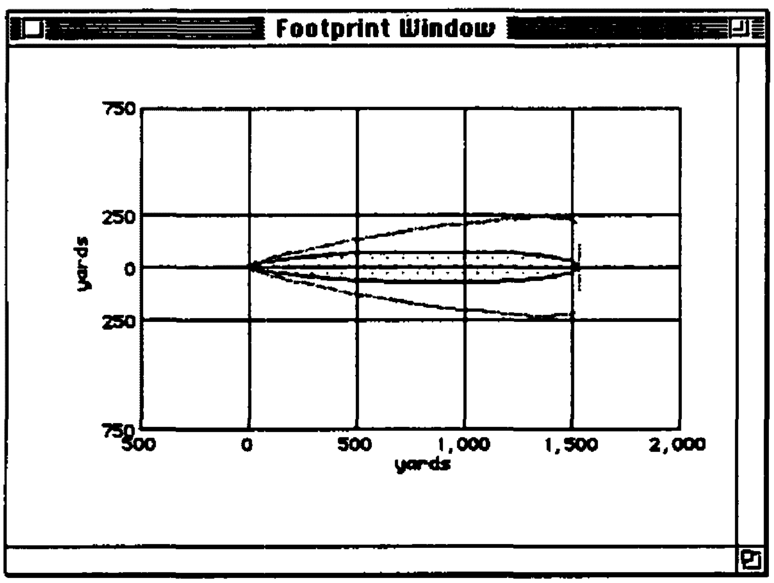
5 Click **OK**.

Ninth...

- Select **Footprint** from the **Display** menu.



Once you select **Footprint**, a bar graph should briefly appear on the screen. The bar graph will indicate how much time the model needs to finish calculating the footprint. It will also indicate which module is being used for the calculations. For this scenario, the Gaussian module was used.



Notice that ALOHA opted to use the Gaussian calculation even though the molecular weight of benzene is greater than air. This is one of the instances when the concentration of benzene in the air is not enough to make the air/benzene density much greater than that of pure air. From the Text Summary screen, we can see that the maximum concentration of benzene that could be in the air at 80°F is 134,995 ppm; or a maximum of 13.5% of the air/benzene mixture directly above the puddle is benzene (ambient saturation concentration).

After a few moments, the screen will display the footprint for the vapor cloud. The solid line around the footprint indicates the level of concern of 10 ppm. The dashed lines reflect the uncertainty in the wind direction for the atmospheric stability class E. This means that in a five-minute period, we could expect the benzene cloud to rotate within the area drawn by the dashed lines or "uncertainty lines." The dashed lines represent a "certainty" level of 95%; or, 19 out of 20 times the footprint will be within these lines.

A verbal summary of the footprint information should appear at the bottom of ALOHA's text summary screen. For this scenario, the downwind maximum threat zone for the level of concern of 10 ppm is 1,538 yards.

```
Text Summary
SITE DATA INFORMATION:
   Location: BATON ROUGE, LOUISIANA
   Building Air Exchanges Per Hour: 0.67 (Sheltered single storied)
   Date & Time: Fixed at August 20, 1990 & 2230 hours

CHEMICAL INFORMATION:
   Chemical Name: BENZENE                   Molecular Weight: 78.11 kg/kmol
   TLV-TWA: 0.10 ppm                        IDLH: 3000.00 ppm
   Note: Potential or confirmed human carcinogen.
   Footprint Level of Concern: 10 ppm
   Boiling Point: 176.16° F
   Vapor Pressure at Ambient Temperature: 0.13 atm
   Ambient Saturation Concentration: 134,995 ppm or 13.5%

ATMOSPHERIC INFORMATION:(MANUAL INPUT OF DATA)
   Wind: 7 knots from E                      No Inversion Height
   Stability Class: E                       Air Temperature: 80° F
   Relative Humidity: 75%                   Ground Roughness: Open country
   Cloud Cover: 7 tenths

SOURCE STRENGTH INFORMATION:
   Liquid leak from hole in vertical cylindrical tank selected
   Tank Diameter: 4 feet                    Tank Length: 5.32 feet
   Tank Volume: 500 gallons
   Internal Temperature: 80° F
   Chemical Mass in Tank: 1.82 tons         Tank is 100% full
   Circular Opening Diameter: 6 inches
   Opening is 10 inches from tank bottom    Soil Type: Default
   Ground Temp: equal to ambient            Max Puddle Diameter: Unknown
   Release Duration: 33 minutes
   Max Computed Release Rate: 125 pounds/min
   Max Average Sustained Release Rate: 114 pounds/min
      (averaged over a minute or more)
   Total Amount Released: 3,073 pounds

FOOTPRINT INFORMATION:
   Dispersion Module: Gaussian
   User specified LOC: 10 ppm
   Max Threat Zone for LOC:  1538 yards
   Max Threat Zone for IDLH: 34 yards
```

Example 2

Direct Input (Heavy Gas)

A paper mill located at a highly industrialized area in Columbia, South Carolina stores large amounts of liquid chlorine. On May 15, 1990 at 13:00, a reckless forklift operator breaks open a pipe. About 2,000 gallons of liquid chlorine are sprayed out in a fine mist and immediately evaporate. The chlorine is normally stored at a temperature of -30°F. The paper mill's single-storied office building is located about 100 yards directly downwind of the accident. The building has been recently landscaped with bushes and trees. Since the weather for the past few days has been rather cool, most people in the building have kept their windows closed.

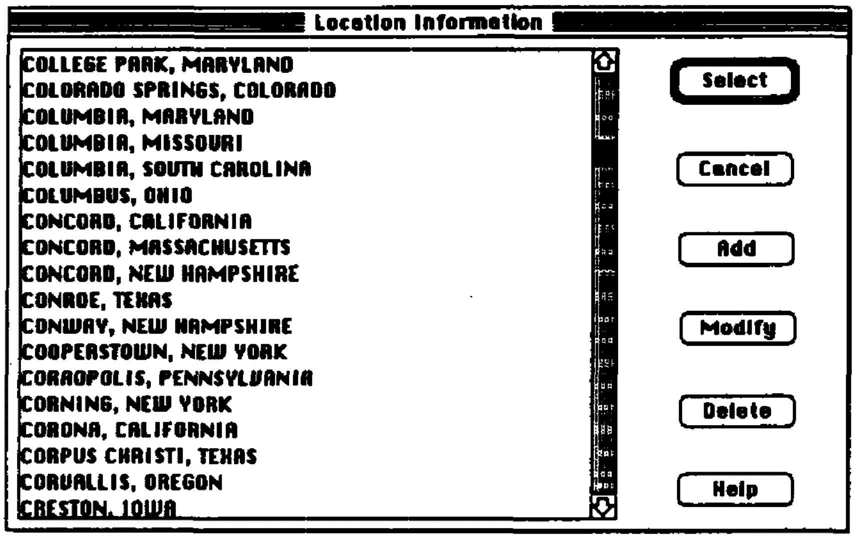
At the time of the spill, the sky was completely overcast, the air temperature was 70° F and the wind was from 360° at 10 knots. The relative humidity was 67%. We will use ALOHA to help determine the indoor concentrations of chlorine for the paper mill's office building.

First...

1 Double-click on ALOHA and, after reading the ALOHA caveats, click **OK**

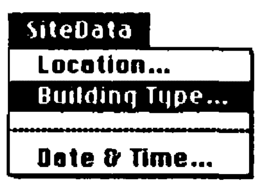
2 Choose **Location** from the **SiteData** menu.

3 Use the scroll bar or type the character "C" to find the city. Once you have found Columbia, South Carolina, either double-click on the city or select the city and click **Select**.

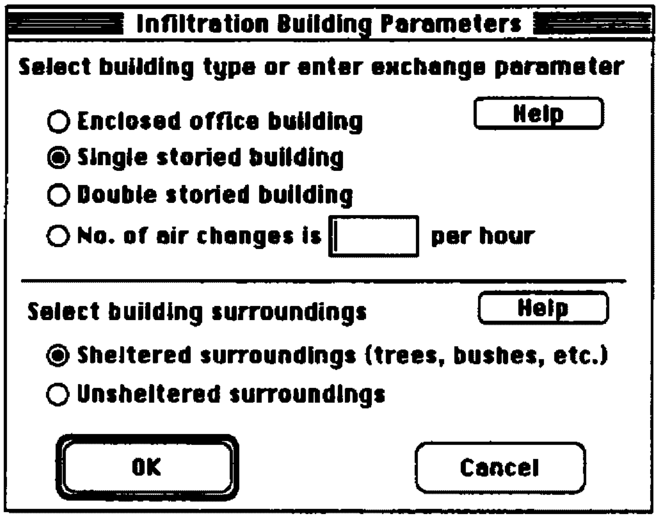


Second...

1 Choose **Building Type...** from the **SiteData** menu.



2 The scenario describes the office building as being single-storied. Since the building has windows that open, we might suspect that the air exchange rate is not controlled and the choice of single-storied building would be most appropriate. Because the building is landscaped, you should select **Sheltered surroundings.**

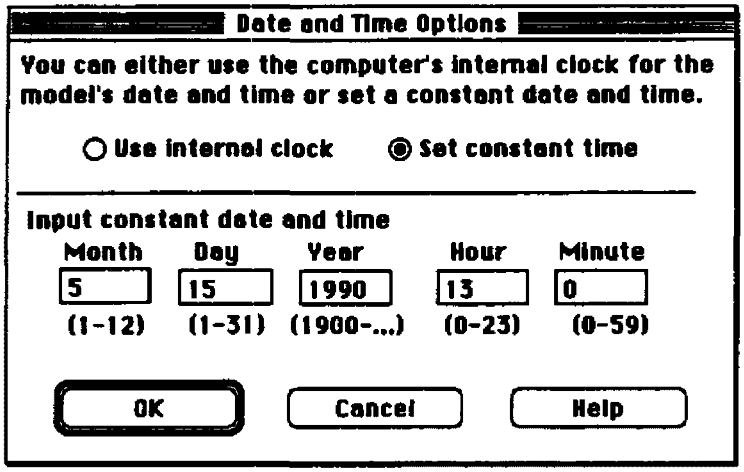


3 Click OK.

Third...

1 Choose Date & Time... from the **SiteData** menu.

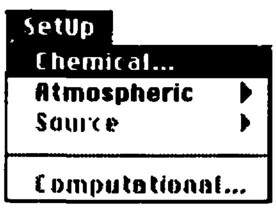
2 Select **Set constant time** and enter the month, day, year, hour and minute for this scenario. You may tab to each of the fields to enter the date and time.



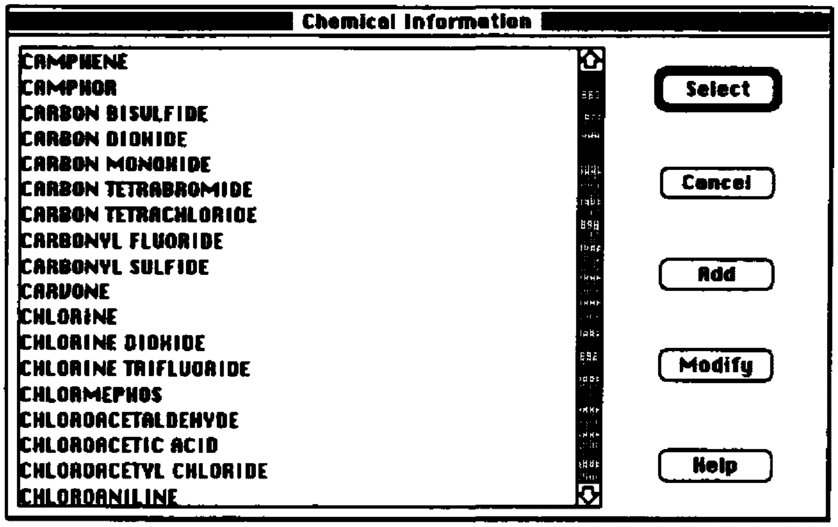
3 Click OK.

Fourth...

1 Select **Chemical...** from the **SetUp** menu.

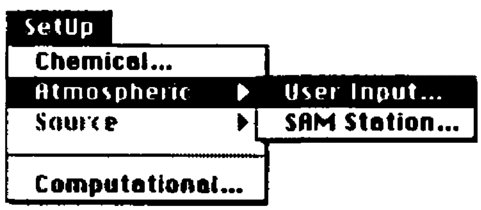


2 Use the scroll bar or type the character "C" to find the chemical. Once you have found chlorine, either double-click on the chemical or select the chemical and click **Select**.



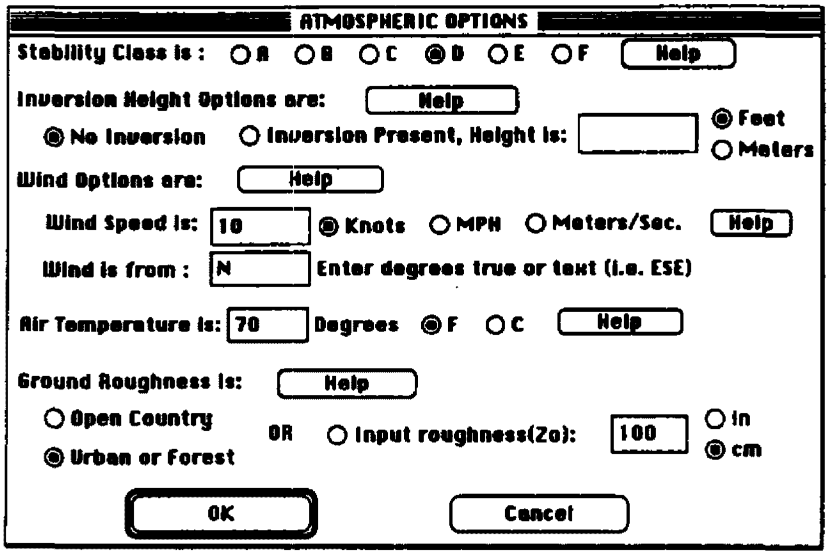
Fifth...

1 Select **User Input...** from the **Atmospheric** submenu in the **SetUp** menu.



2 Determining the stability class for this scenario is relatively easy.

When the sky is completely overcast, the stability class is always D regardless of the wind speed and time of day. Click **Help** if you need assistance in making this choice. Click the button for stability class D.

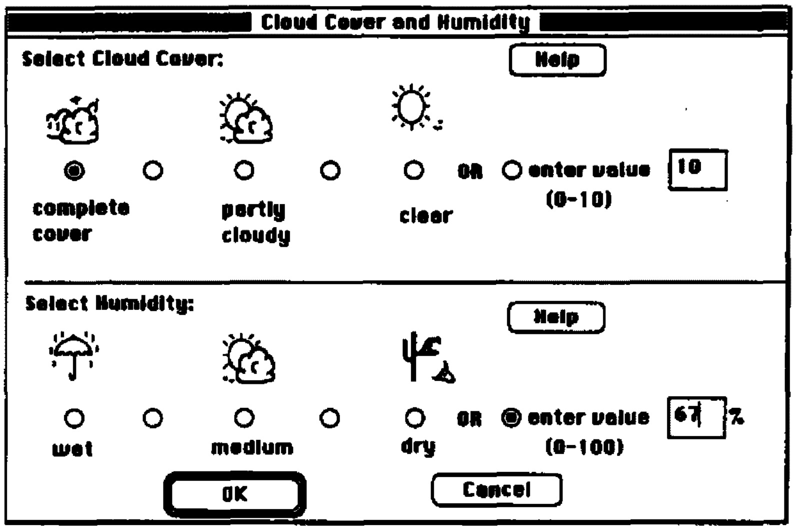


3 After selecting the stability class, enter the wind speed and select the units button for knots. Enter either N or 360 for the wind direction. The air temperature is 70 and the selected units should be degrees F. Nothing in the scenario indicates the presence of an inversion, therefore, the default setting, **No Inversion**, should not be changed.

4 The button for **Urban or Forest** should be selected for the ground roughness as the spill is in a highly industrialized area, that is, an area that contains many buildings and obstacles.

5 Click **OK** when you've filled in all of the data.

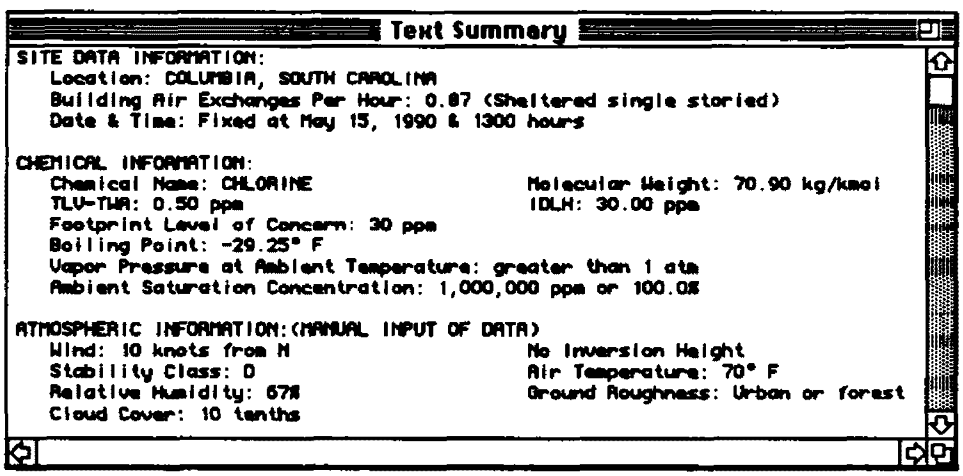
6 The scenario describes the cloud cover as completely overcast, so click the button under the complete cloud cover icon.



7 Select the **enter value** button and enter 67 for the humidity.

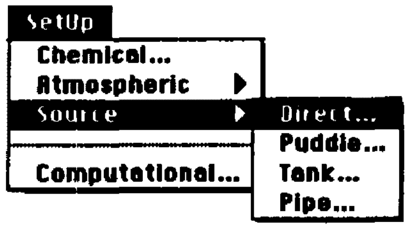
8 Click OK.

The information that you have entered into ALOHA should appear on the text summary screen. Under the heading SITE DATA INFORMATION, you see the air exchange rate ALOHA will use in its calculations.

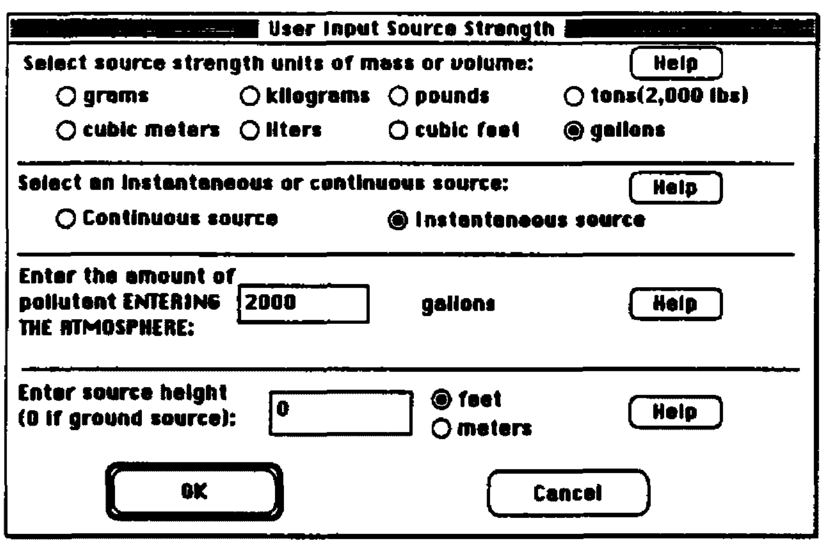


Sixth...

1 Select **Direct...** from the **Source** submenu in the **SetUp** menu.



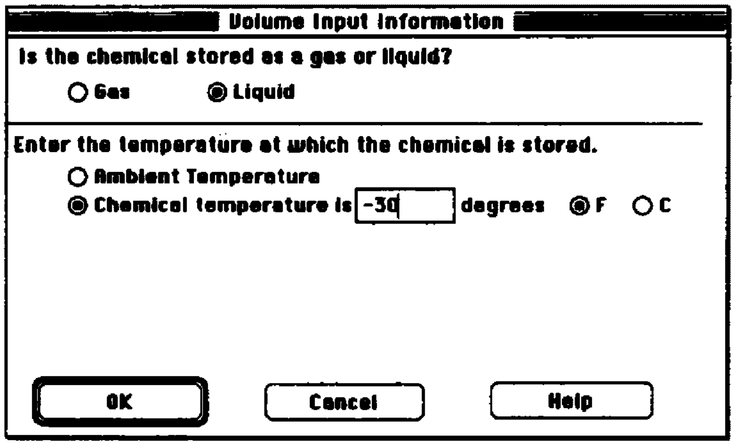
2 The scenario describes the pipe breaking and spraying 2000 gallons of chlorine instantly into the atmosphere. ALOHA assumes that an instantaneous release is one that occurs in 60 seconds. For this scenario, however, it would probably take a little more than 60 seconds for all of the product to be released into the atmosphere. We can still use an instantaneous source since we do not have any more information, but the model's estimates may be conservative as a result. Click the buttons for **gallons** and **instantaneous source**.



3 Enter 2000 for the amount of pollutant entering the atmosphere. Do not change the default of ground-level for **source height**.

4 Click OK.

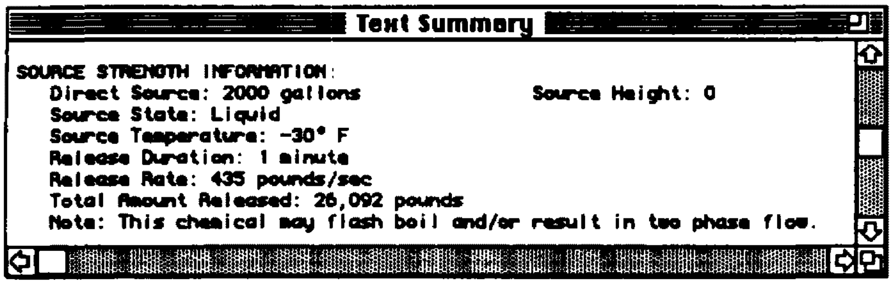
5 The chlorine was refrigerated at -30°F and stored as a liquid. The text summary screen indicates that the boiling point for chlorine is -29.25°F, so it is barely in the liquid stage. Click **Liquid** and **Chemical temperature**. Enter -30 for chemical temperature. Be sure to select the correct units.



6 Click OK.

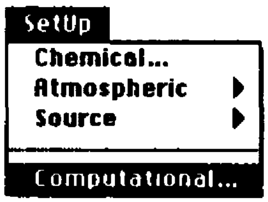
7 An alert box warning you that the chemical may flash boil and/or result in two-phase flow will appear on the screen. If you are unsure what this means, click **Help**. Otherwise, click **OK**.

The source strength information that you have entered into ALOHA should appear on the Text Summary screen. The Text Summary screen will also remind you that the chemical may flash boil and/or result in two-phase flow.

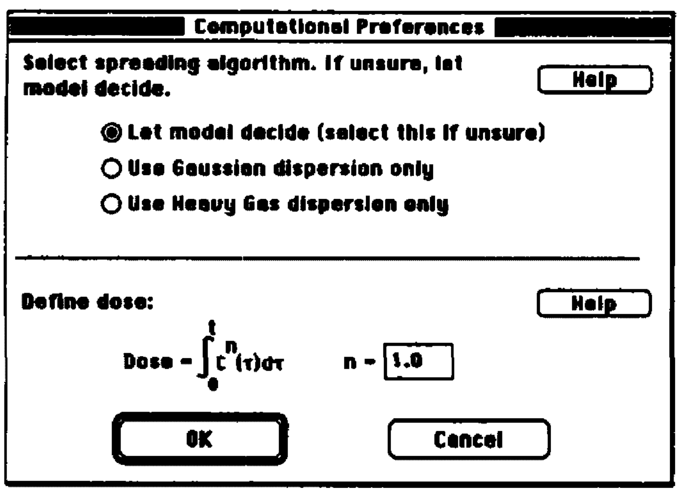


Seventh...

1 Select **Computational...** from the **SetUp** menu.



2 The scenario describes the chlorine as being stored at very cold temperatures; the chlorine will behave as a heavy gas. Click **Let Model Decide.** ALOHA will be able to determine that the appropriate dispersion calculations will be for a heavy gas.

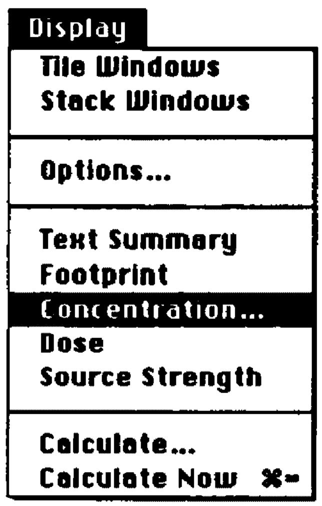


3 Do not change the default for **Define dose**. Don't use this option unless you have some technical expertise or guidance to do so.

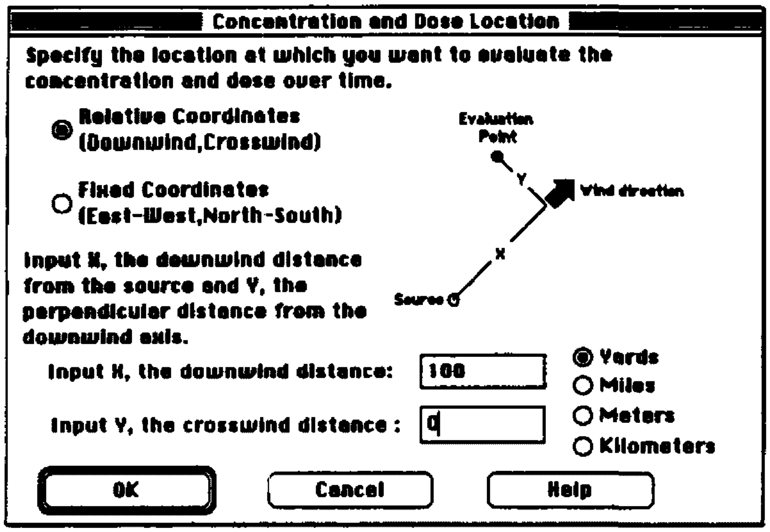
4 Click **OK**.

Eighth...

1 Select **Concentration** from the **Display** menu.



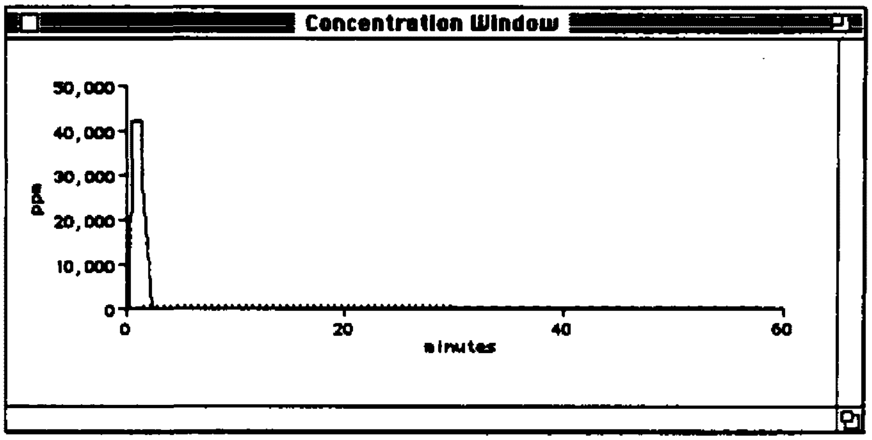
2 The scenario describes the paper mill's office building as being about 100 yards *directly* downwind of the spill. Enter the downwind distance of 100 yards and the crosswind distance of 0 yards. Be sure to select the correct units.



3 Click OK.

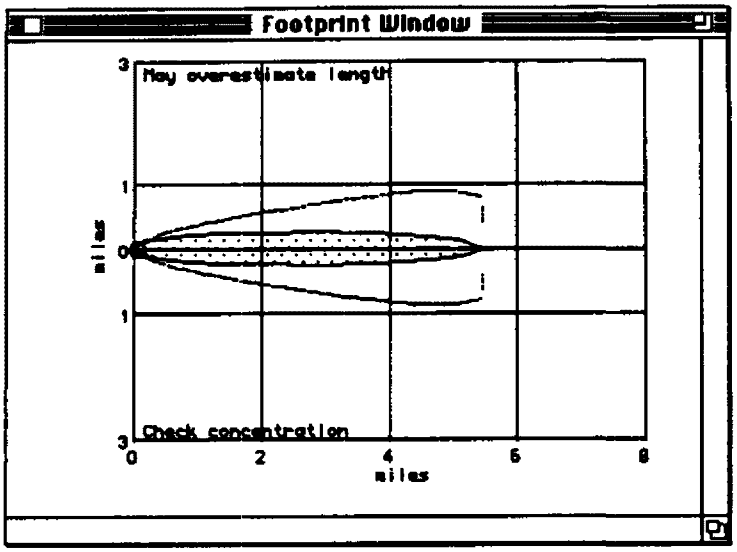
4 Once you have clicked OK, a bar graph should appear on the screen. The bar graph will indicate how much time the model needs to finish calculating the graphs. It will also indicate whether Gaussian or heavy gas calculations are being used. For this scenario, the heavy gas calculations were used and, if you are using a Mac Plus (or other Mac without a math coprocessor), it may take a few minutes for ALOHA to do the calculations.

After ALOHA has completed its calculations, the Concentration window will appear. The dotted line indicates the estimated concentrations inside the office building. The solid line is the estimated concentration outside of the office building (on a color monitor these will appear blue and red, respectively).



You can see from the concentration window that the chlorine cloud passes by the office building within the first few minutes. After that, the outdoor concentration drops back to zero. The indoor concentration is very difficult to determine from this graph; however, the Text Summary screen will display the maximum values.

Here is ALOHA's footprint for this scenario.




```
Text Summary
SITE DATA INFORMATION:
   Location: COLUMBIA, SOUTH CAROLINA
   Building Air Exchanges Per Hour: 0.87 (Sheltered single storied)
   Date & Time: Fixed at May 15, 1990 & 1300 hours

CHEMICAL INFORMATION:
   Chemical Name: CHLORINE                  Molecular Weight: 70.90 kg/kmol
   TLV-TWA: 0.50 ppm                        IDLH: 30.00 ppm
   Footprint Level of Concern: 30 ppm
   Boiling Point: -29.25° F
   Vapor Pressure at Ambient Temperature: greater than 1 atm
   Ambient Saturation Concentration: 1,000,000 ppm or 100.0%

ATMOSPHERIC INFORMATION:(MANUAL INPUT OF DATA)
   Wind: 10 knots from N                     No Inversion Height
   Stability Class: D                       Air Temperature: 70° F
   Relative Humidity: 57%                   Ground Roughness: Urban or forest
   Cloud Cover: 10 tenths

SOURCE STRENGTH INFORMATION:
   Direct Source: 2000 gallons              Source Height: 0
   Source State: Liquid
   Source Temperature: -30° F
   Release Duration: 1 minute
   Release Rate: 435 pounds/sec
   Total Amount Released: 26,092 pounds
   Note: This chemical may flash boil and/or result in two phase flow.

FOOTPRINT INFORMATION:
   Model Run: Heavy Gas
   User specified LOC: equals IDLH (30 ppm)
   Max Threat Zone for LOC: 5.5 miles
   Note: The Heavy Gas footprint is an initial screening.
     For short releases it may be an overestimation.
     Be sure to check concentration information at specific locations.

TIME DEPENDENT INFORMATION:
   Concentration Estimates at the point:
   Downwind:        100 yards
   Off Centerline: 0 yards
   Max Concentration:
      Outdoor: 42,100 ppm
      Indoor:  788 ppm
   Note: Indoor graph is shown with a dotted line.
```

Example 3

A Pipe Source

At a rural road construction site near Portland, Oregon, a heavy equipment operator accidentally cuts open a methane pipe on November 17, 1990 at 1430. The pipe runs 1,000 feet to the emergency shutoff valve but the valve has been left open. The inside diameter of the smooth pipe is 8 inches. The methane in the pipe is at ambient temperature and the pressure is 100 PSI.

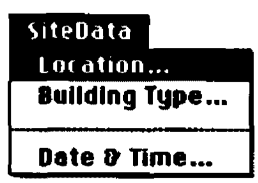
The on-scene weather is completely overcast skies, with an air temperature of 44°F and 78% relative humidity. The wind is from the SE at 15 knots.

Although methane is relatively non-toxic, the lower explosive limit (LEL) is about 5% or 50000 ppm. We will use ALOHA to help determine the downwind distance for the explosive atmospheric concentration.

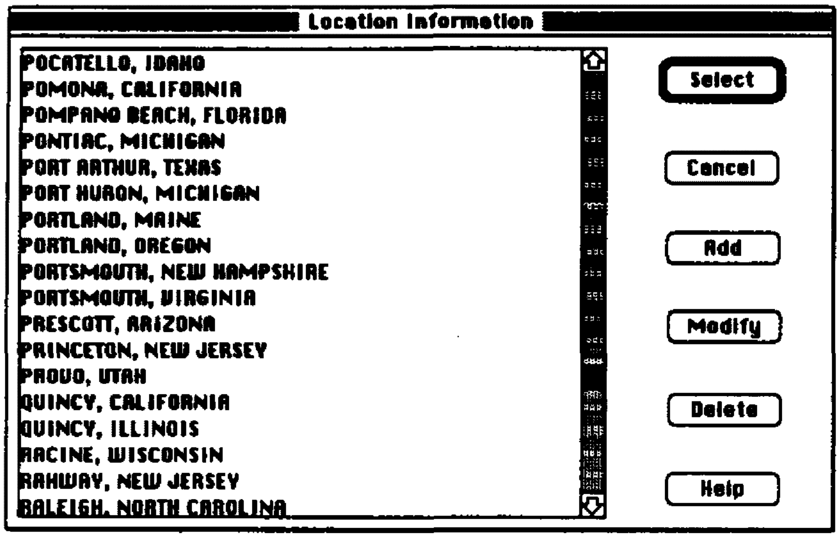
First...

1 Double-click on ALOHA and, after reading the ALOHA caveats, click **OK**

2 Choose **Location** from the **SiteData** menu.



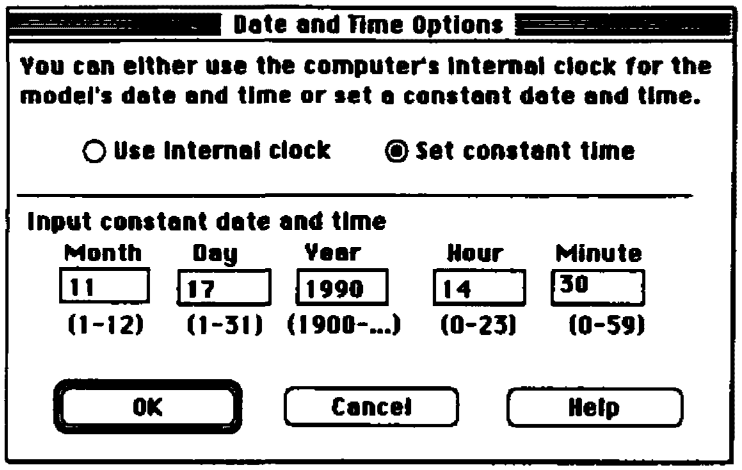
3 Use the scroll bar or type the character "P" to find the city. Once you have found Portland, Oregon, either double-click on the city or select the city and click **Select**.



Second...

1 Choose **Date & Time...** from the **SiteData** menu

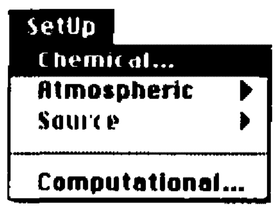
2 Select **Set constant time** and enter the month, day, year, hour and minute for this scenario. You may tab to each of the fields to enter the date. Don't forget to enter the hour as a military time.



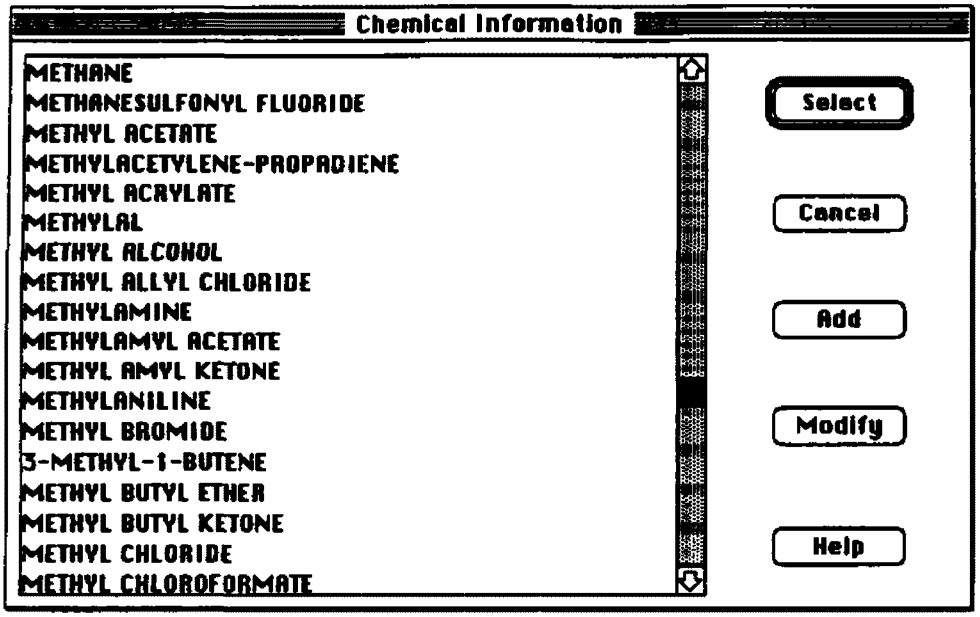
3 Click **OK**.

Third...

1 Select **Chemical...** from the **SetUp** menu.

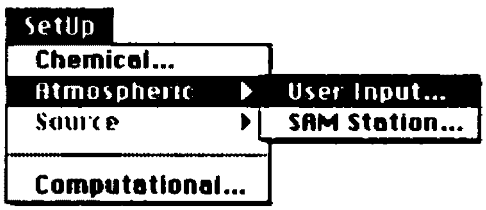


2 Use the scroll bar or type the character "M" to find the chemical. Once you have found methane, either double-click on the chemical or select the chemical and click **Select**.

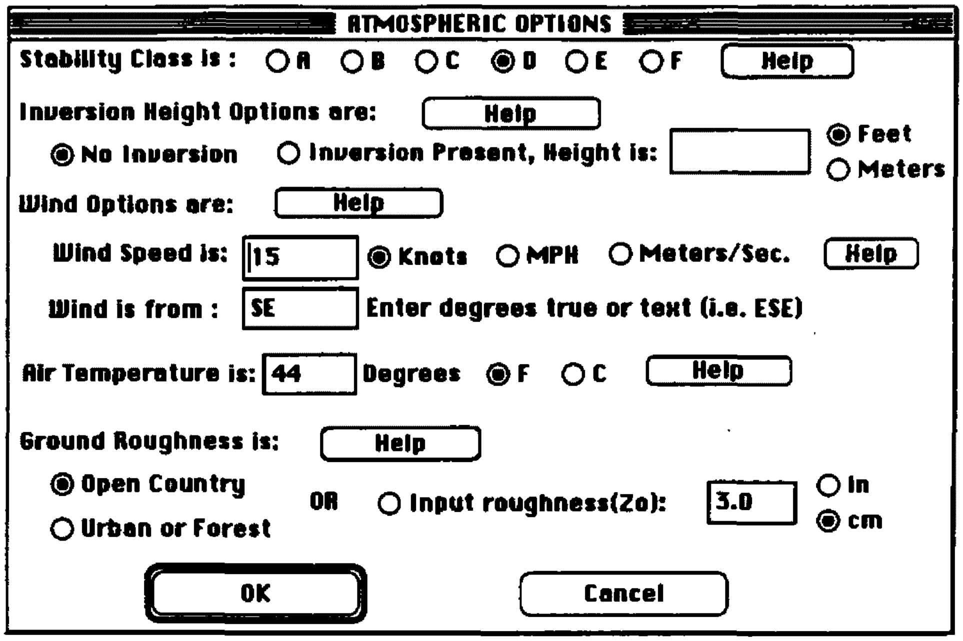


Fourth...

1 Select **User Input...** from the **Atmospheric** submenu in the **SetUp** menu.



2 Click the button for stability class D because the sky is completely overcast. Remember, stability class D is always selected if the sky is completely overcast regardless of the wind speed and the time of day. Since the scenario does not mention anything about an inversion, the default setting, **No Inversion,** should not be changed.

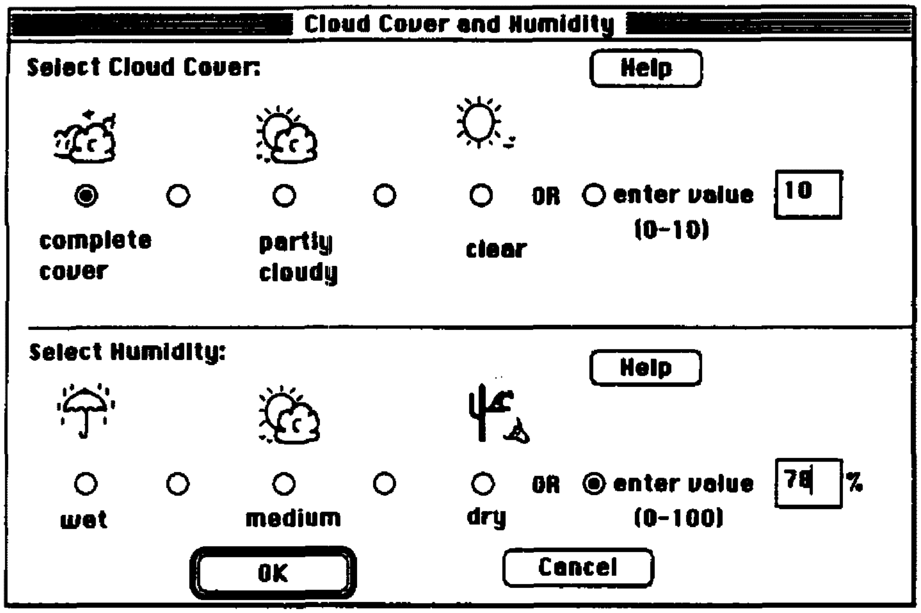


3 After selecting the stability class, enter the wind speed and select knots. Enter SE for the wind direction. Don't forget that the wind direction is entered as the direction **from** which the wind is blowing. Enter 44 for the air temperature. Be sure to select the correct units (Degrees F).

4 Click **Open Country** because the spill occurs at a rural road construction site. Since the scenario does not describe the location of the accident in great detail, it may be a good idea to run the model a second time with **Urban or Forest** selected as well.

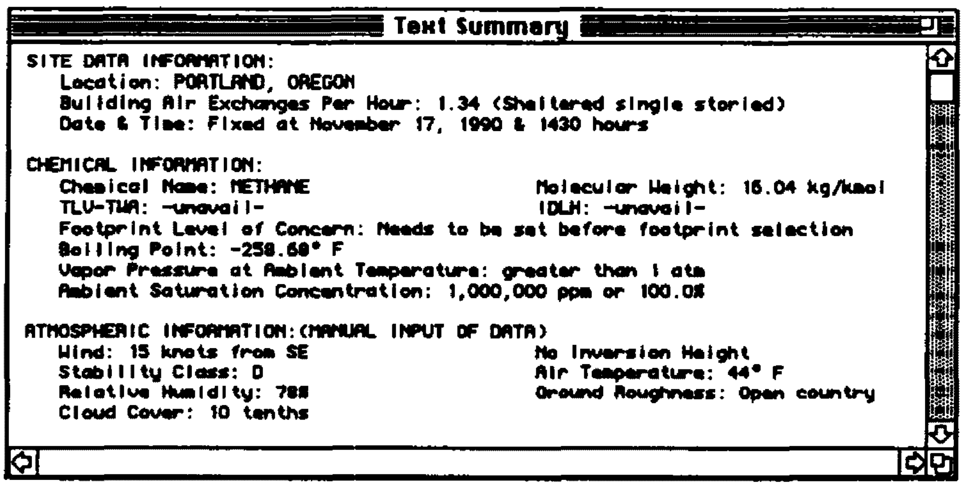
5 Click OK when you've filled in all of the data.

6 Click the button for the **complete cover** and enter 78 for humidity.



7 Click OK.

The information that you have entered into ALOHA should appear on the Text Summary screen. For this scenario, we are not considering the infiltration rate into buildings; you should ignore the building exchange rate as it will not be used.


Text Summary

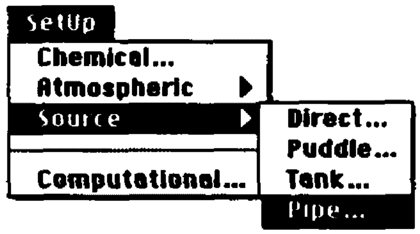
SITE DATA INFORMATION:
Location: PORTLAND, OREGON
Building Air Exchanges Per Hour: 1.34 (Sheltered single storied)
Date & Time: Fixed at November 17, 1990 & 1430 hours

CHEMICAL INFORMATION:
Chemical Name: METHANE　Molecular Weight: 16.04 kg/kmol
TLV-TWA: -unavail-　IDLH: -unavail-
Footprint Level of Concern: Needs to be set before footprint selection
Boiling Point: -258.68° F
Vapor Pressure at Ambient Temperature: greater than 1 atm
Ambient Saturation Concentration: 1,000,000 ppm or 100.0%

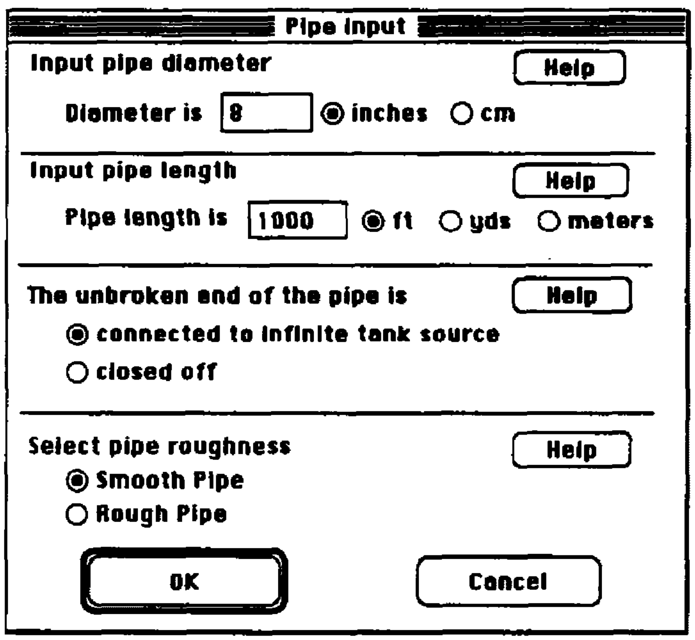
ATMOSPHERIC INFORMATION:(MANUAL INPUT OF DATA)
Wind: 15 knots from SE　No Inversion Height
Stability Class: D　Air Temperature: 44° F
Relative Humidity: 78%　Ground Roughness: Open country
Cloud Cover: 10 tenths

Fifth...

1 Select **Pipe...** from the **Source** submenu in the **SetUp** menu.



2 Enter **8** for the pipe diameter and select for units, **inches**. Enter **1000** for the pipe length, selecting **feet** for units.



3 In the scenario, the pipe is connected to a safety valve but the valve has been left open. This means that the pipe will continually release methane. We do not know how much methane will be supplied to the pipe, but we do know that the pipe is supplied by a very large source, that is, this source is much larger than the amount of methane in 1,000 feet of pipe. Since the source is very large, we can say the pipe is attached to

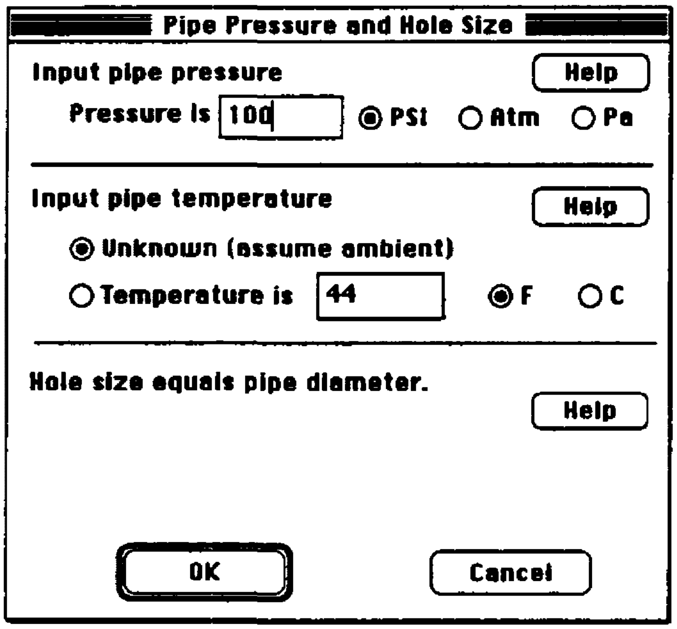
an infinite source. The best choice for this scenario is to click the button for **connected to infinite tank source.**

If the safety valve for the pipe had been closed, we would have then selected the button for **closed off.**

4 The scenario described the inside of the pipe as being smooth, so you should click **Smooth Pipe**.

5 Click **OK**.

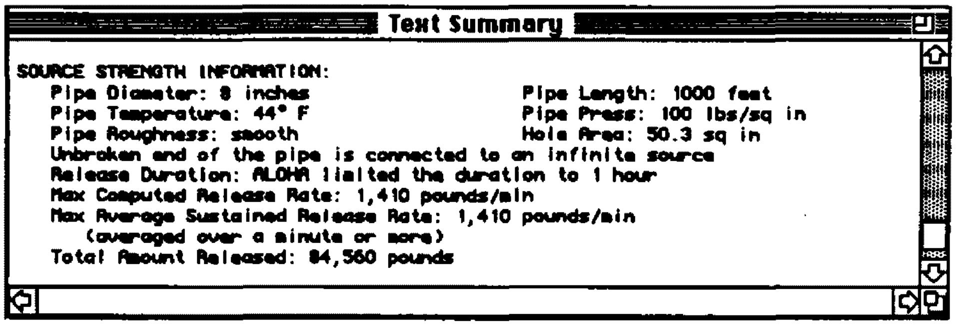
6 Enter 100 for the pipe pressure and select for the units, PSI.



7 In this scenario, the temperature of the pipe is given as ambient, so click **Unknown (assume ambient)**.

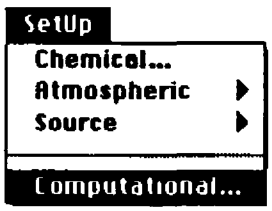
8 Click **OK**.

The information that you have entered into ALOHA should appear on the Text Summary screen. Remember, for this scenario we are not considering the infiltration rate into buildings; you should ignore the building exchange rate as it will not be used.

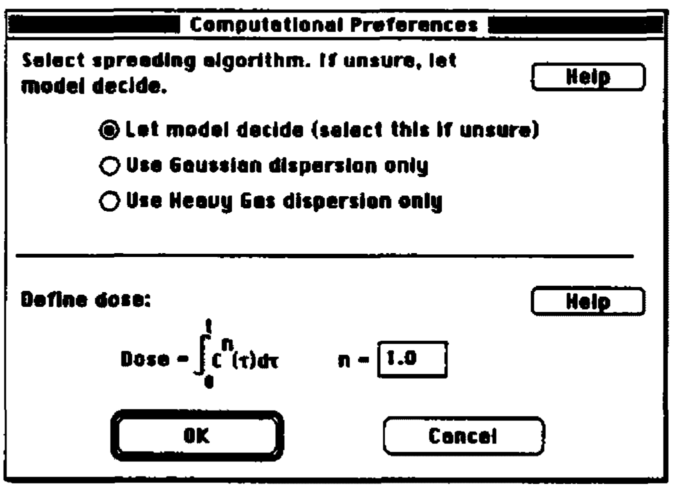


Sixth...

1 Select **Computational...** from the **SetUp** menu.



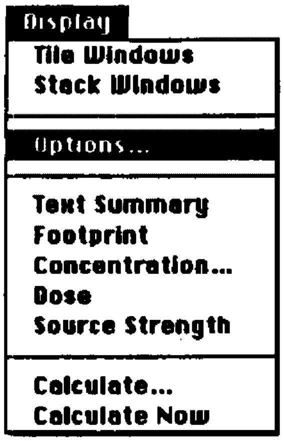
2 Select **Let model decide** (select this if you're unsure).



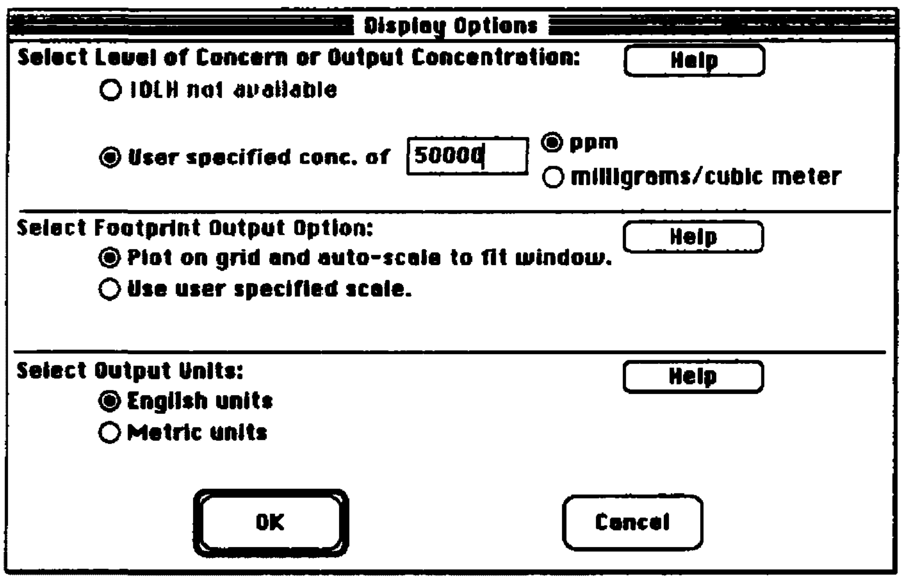
3 Click **OK**.

Seventh...

1 Select **Options...** from the **Display** menu.



2 The scenario describes the level of concern as 50000 ppm. Click **User specified concentration** and enter 50000. For the units, click **ppm**.

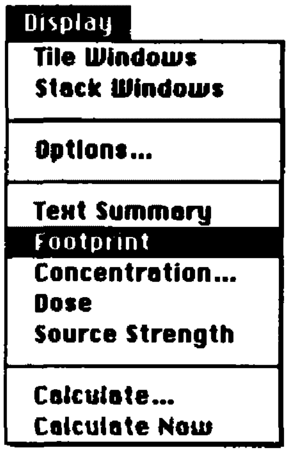


3 Select **Plot on grid and auto-scale to fit window** and **English units**.

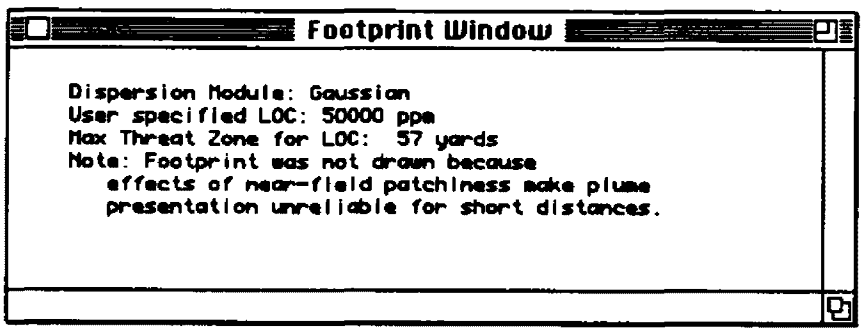
4 Click **OK**.

Eighth...

I Select **Footprint** from the **Display** menu.



The footprint that ALOHA gives us is too short to plot (approximately 60 yards). This near the source, concentration patchiness could be significant (see the **Use Caution** section of Chapter 2, Introduction to Air Modeling). When using this information, we can see that the explosive threat is likely to be on the order of one hundred yards. We would also suspect that the direction of cloud travel is fairly consistent since the wind speed is 15 knots. However, for this short a threat distance and considering near-field patchiness, it is prudent to consider a circular danger zone in the one hundred-yard range (again, see Chapter 2).



Example 4

...Using ALOHA, MARPLOT, and a PICT map

At 11:15 am on February 14, 1992, the Seattle, Washington Police find several 12-quart plastic containers labeled "anhydrous hydrazine" in the middle of a vacant, concrete parking lot. The lot is at the intersection of 5th Avenue South and South Donovan Street. The police officers report that some of the product has been spilled, and that there is a strong odor directly downwind of the containers. The fire department is then notified of a potential chemical spill.

When the fire department arrives, they find one police officer complaining of eye and nose irritation. Using a pair of binoculars, the Assistant Chief assesses the spill site. The chief sees that a 40 square foot puddle has formed around the containers. Three of the containers appear to be open and lying on their sides.

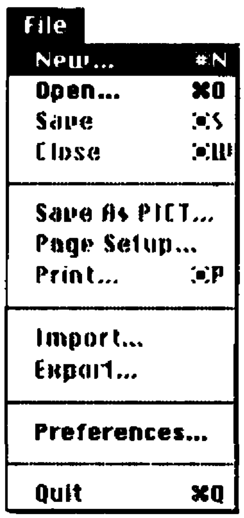
The firefighters report the following on-scene weather observations: the air temperature is 45° F, the sky is almost completely covered with clouds, the winds are from the west at 15 mph and the relative humidity is 70%.

A representative from a state environmental agency suggests running the air model with a level of concern of 0.03 ppm. Assuming that the contents of three containers have spilled, what is the extent of the footprint for this concentration? What area on a map does this footprint cover?

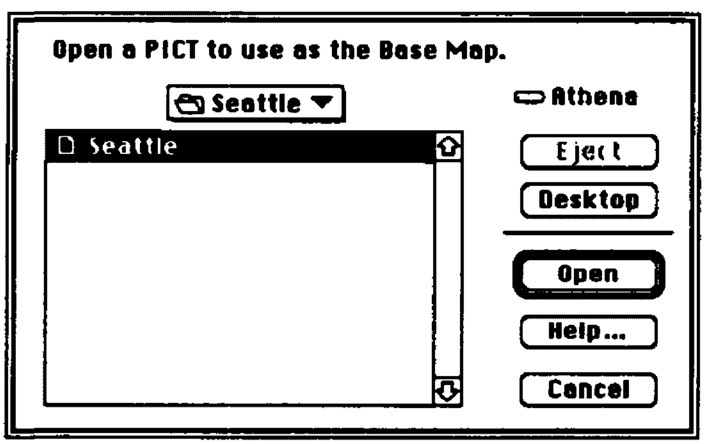
First...

1 Before obtaining estimates of source strength and dispersion from ALOHA, you'll begin by preparing and loading a map of Seattle in MARPLOT. You should find a folder titled "Seattle" in your MARPLOT folder. This contains a PICT file, rather than a MARPLOT map derived from TIGER data. Be sure that this file is in a folder by itself. Then double-click on the MARPLOT icon to launch the application.

2 Choose **New** from the **File** menu.

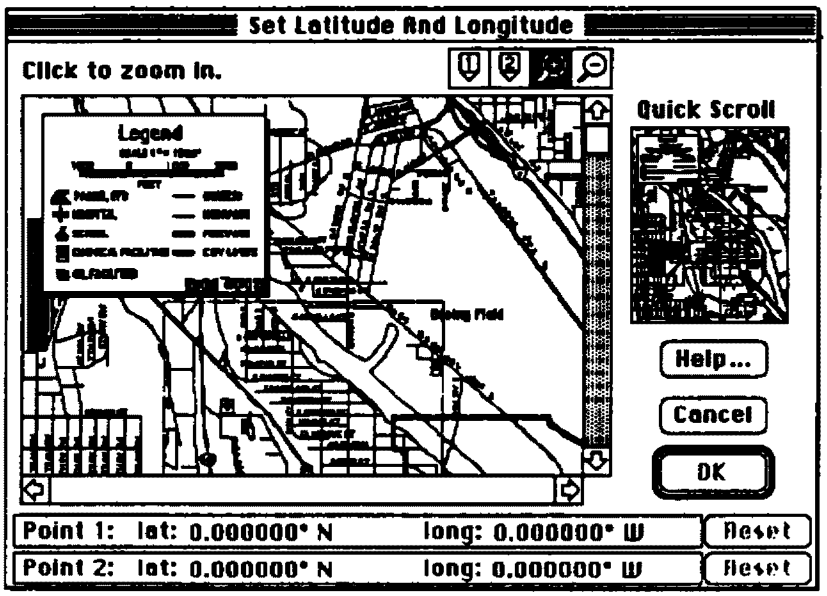


3 Choose **Seattle** and click **Open**.

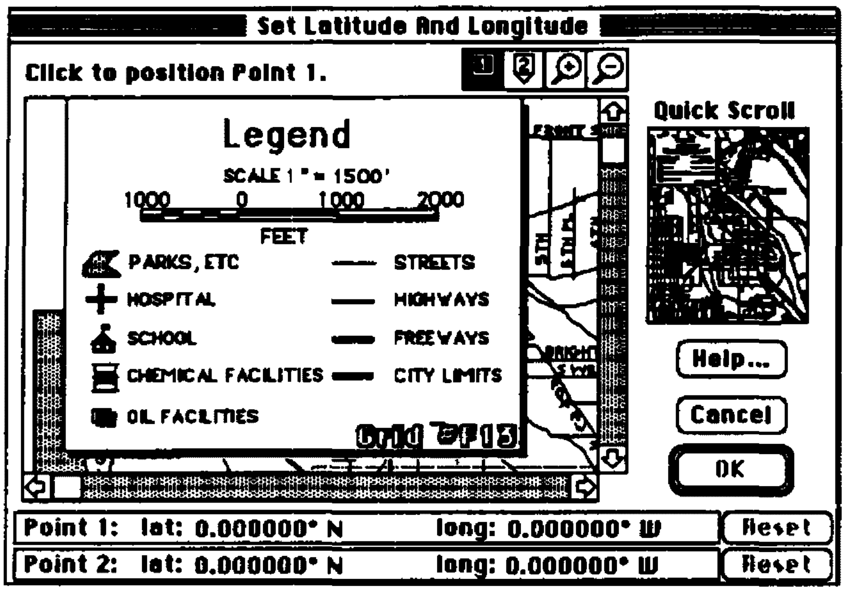


4 You'll need to indicate the position of two points on the map to MARPLOT, so that the program knows where on the earth the mapped area lies, and how large an area the map encompasses. You'll do this by choosing two points on the map scale bar, and telling MARPLOT the location of these two points.

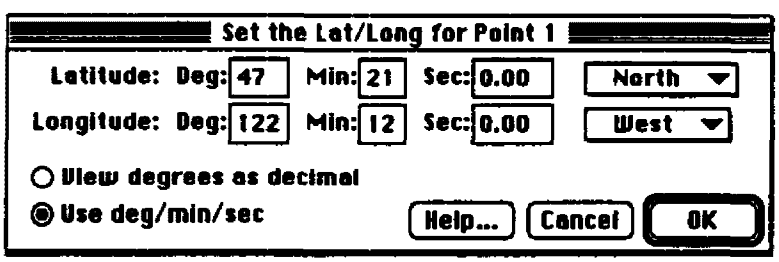
First, click on the zoom in tool , from the row of four tools above the top right corner of the map.



5 Click once within the map legend to zoom in. Then click on [icon]. You'll use this tool to position Point 1. Your screen should now look like the one below.



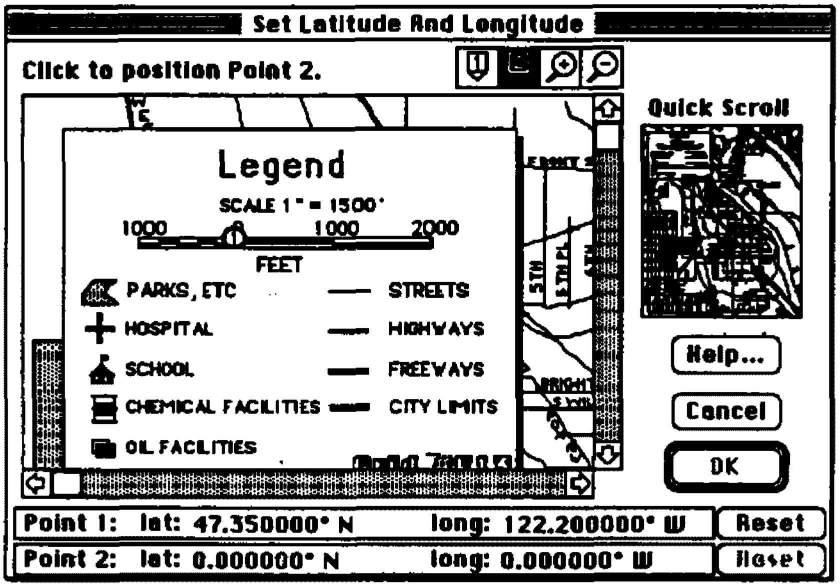
6 Go to the scale bar of the map, and click on the bar at the '0 feet' mark. You'll see the following dialog box. For Point 1, you'll enter the geographic coordinates of Seattle Click on the **Use deg/min/sec** button. Then enter Seattle's coordinates: 47° 21' N and 122° 12' W. Click **OK**.



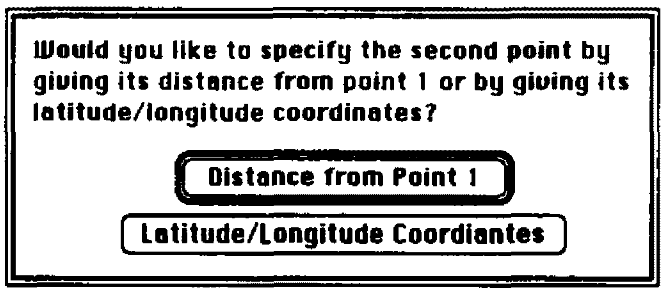
NOTE *To find the coordinates of Seattle or any other city in ALOHA's city library, go to ALOHA, choose Location from the SiteData menu, click on the city's name within the scrolling city list, then click on the Modify button to see*

ALOHA's values for the coordinates of the city.

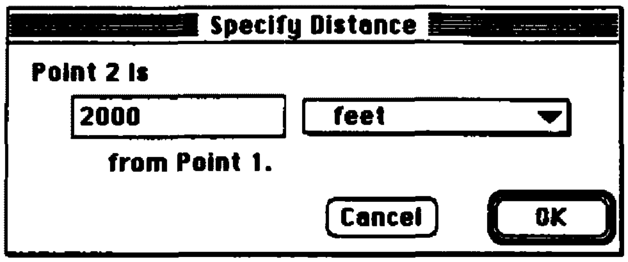
7 Now set the position of Point 2. Click on the map scale bar at the "2000 feet" mark.



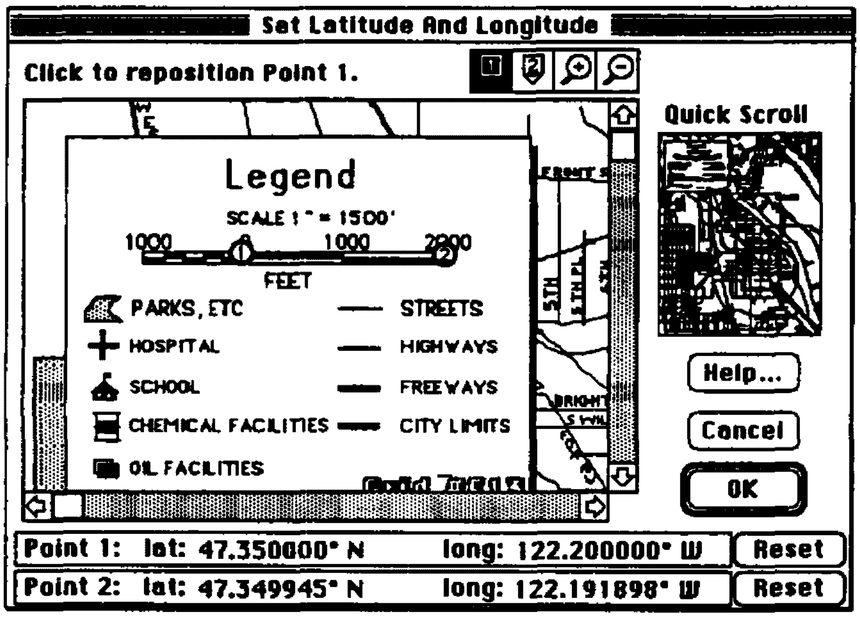
8 Click the **Distance from Point 1** button.



9 Enter "2000" in the distance field, and choose 'feet' from the pop-up units menu. Click **OK**.

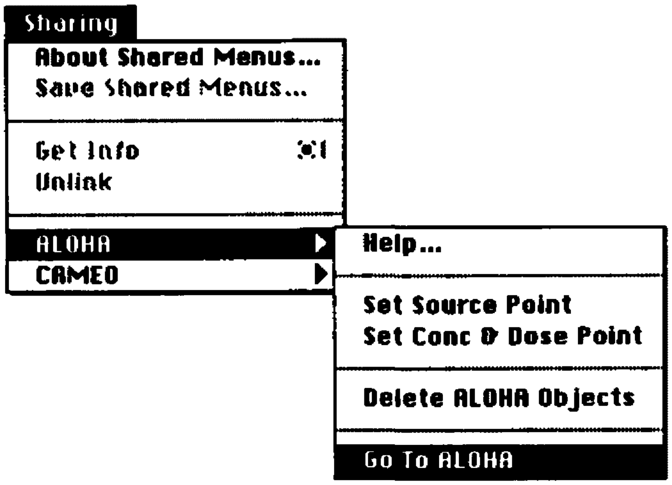


10 Your screen should look like the one below. Note the ① and ② marking the locations of Points 1 and 2 on the map scale bar. If you need to reposition either point, click on the corresponding **Reset** button, or click on the map again with either the ① (if you wish to reposition Point 1) or ② (if you wish to reposition Point 2) tool.



11 Once you're satisfied, click OK. The Seattle map should appear in the MARPLOT window.

12 Now that you've loaded the Seattle map, you're ready to run ALOHA. Choose **Go to ALOHA** from the **ALOHA** submenu in MARPLOT's **Sharing** menu. This will launch ALOHA and bring it forward.

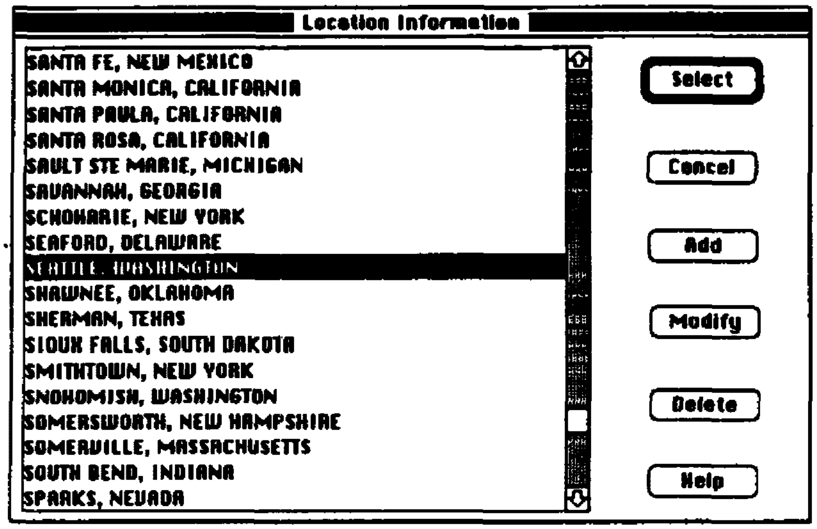


Second...

1 After reading the ALOHA caveats, click OK.

2 Choose Location from the SiteData menu.

3 Use the scroll bar or quickly type the characters "SE" to find Seattle, Washington in the scrolling list. Once you have located Seattle, double-click on it or click once, then click Select.

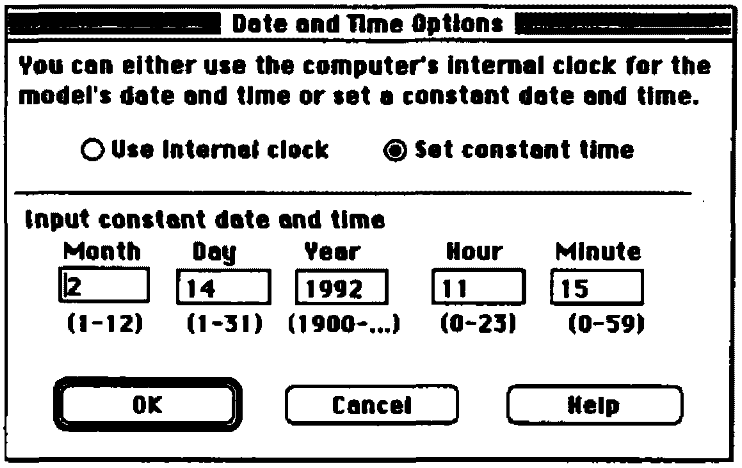


Third...

We'll ignore **Building Type** during this scenario.

1 Choose **Date & Time...** from the **SiteData** menu.

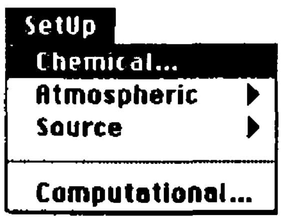
2 Select **Set constant time** and enter the month, day, year, hour and minute for this scenario.



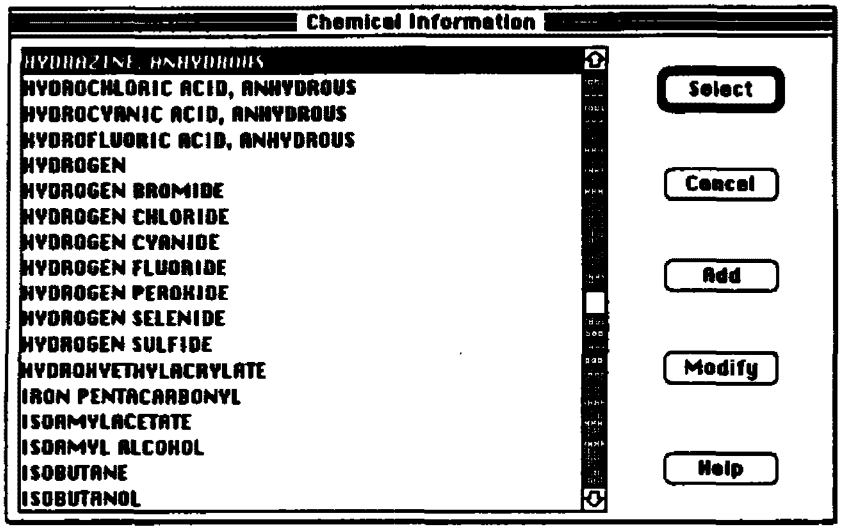
3 Click OK.

Fourth...

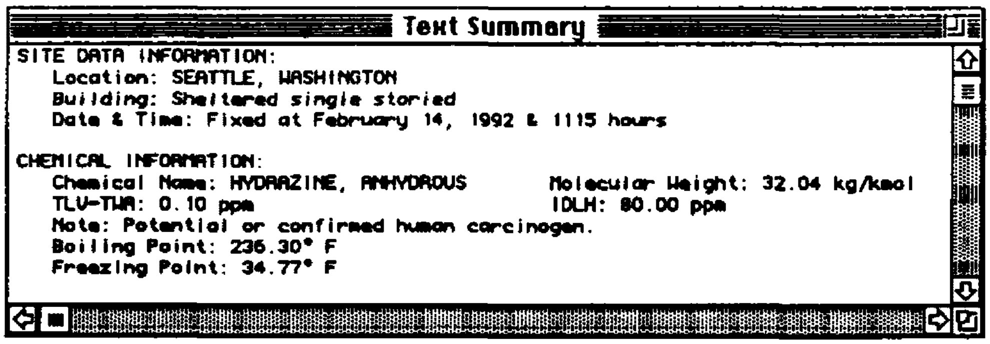
1 Select **Chemical...** from the **SetUp** menu.



2 Use the scroll bar or quickly type the characters "HY" to find "hydrazine, anhydrous." Double-click on this name or click once on it, then click **Select**.

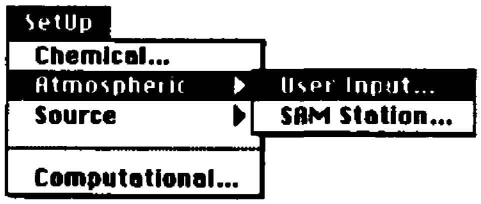


Check the Text Summary window to review information about the properties and toxicology of hydrazine. ALOHA alerts you that this chemical is a potential or confirmed human carcinogen. Boiling point of hydrazine is well above air temperature, so it's a liquid.

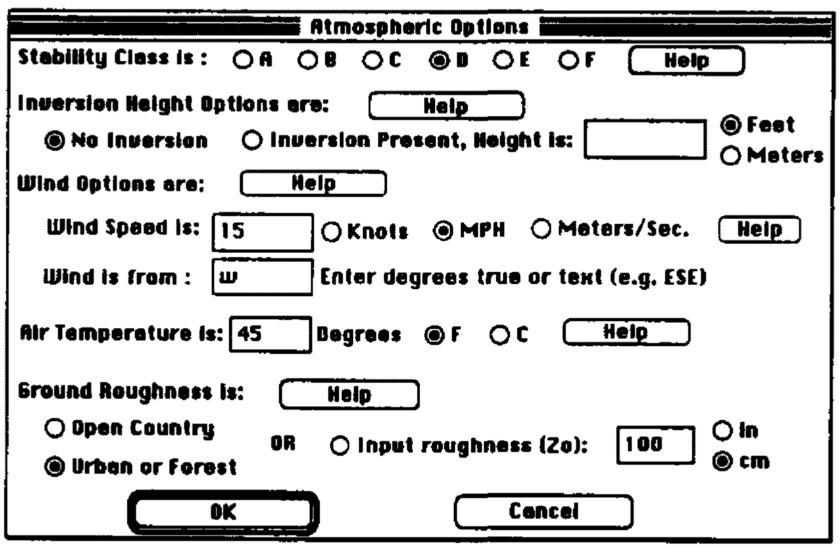


Fifth...

1 Select **User Input...** from the **Atmospheric** submenu in the **SetUp** menu.



2 The wind speed is about 15 mph and it's almost completely cloudy. By clicking on the stability class Help button (in the upper right corner of this screen), you can see that the best choice for stability class is D. Click on the button for stability class D.



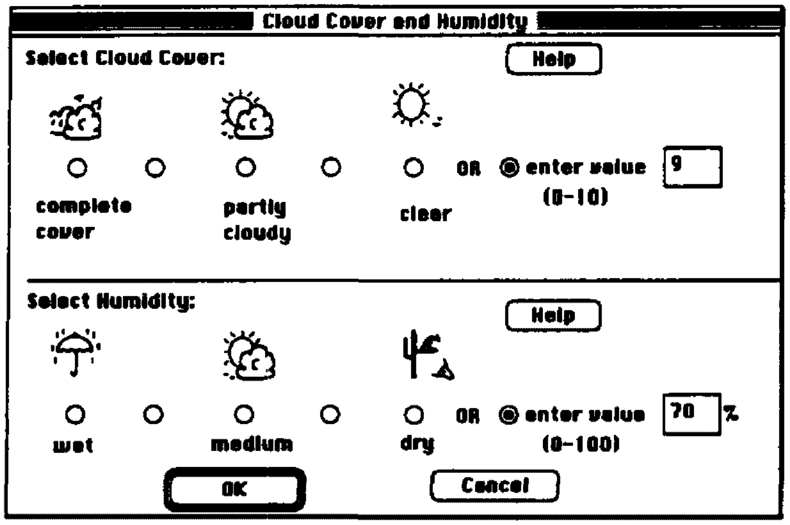
3 There's no inversion, so the default setting, **No inversion**, should not be changed.

4 Enter "15" as your value for wind speed, then click on the **mph** units button. Enter either "W" or "270" to indicate that the wind is from the west.

5 Type in 45 as the air temperature, and click **F**.

6 This spill is in an urban, industrialized area, with many buildings and obstacles. Click on the **Urban or forest** button.

7 Once you've made these selections, click OK.

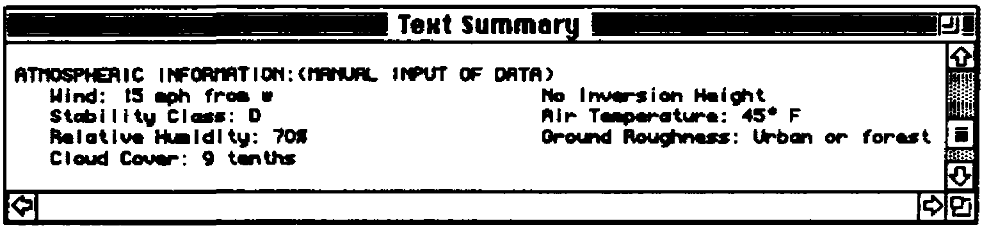


8 The sky is almost completely cloudy. Type "9" in the cloud cover data field.

9 Relative humidity is 70%. Type "70" in the humidity data field.

10 Click OK.

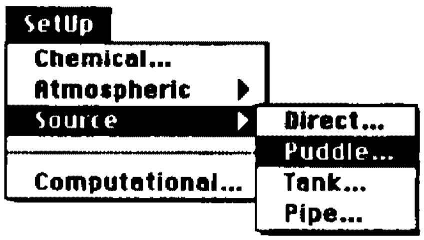
11 Check the Text Summary screen to be sure that you've entered these data correctly.



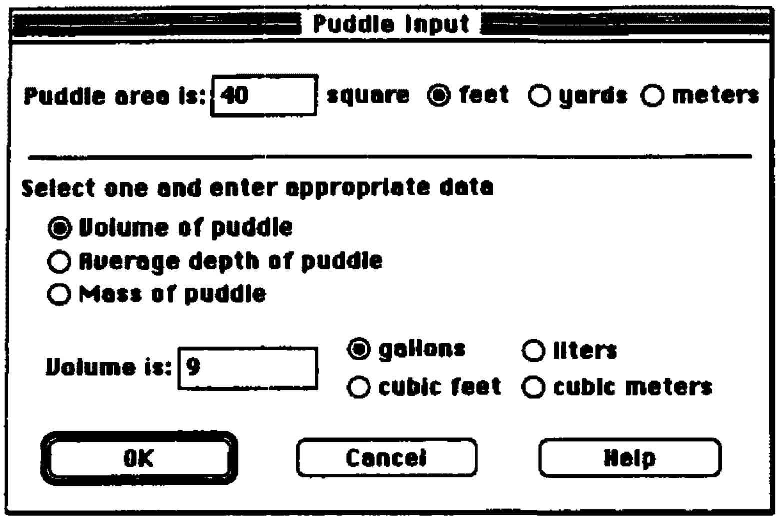
Sixth...

The containers of hydrazine have leaked to form a pool of liquid on the concrete parking lot. ALOHA's Puddle source option is therefore the most appropriate one for this scenario.

1 Choose **Puddle** from the **Source** submenu in the **SetUp** menu.

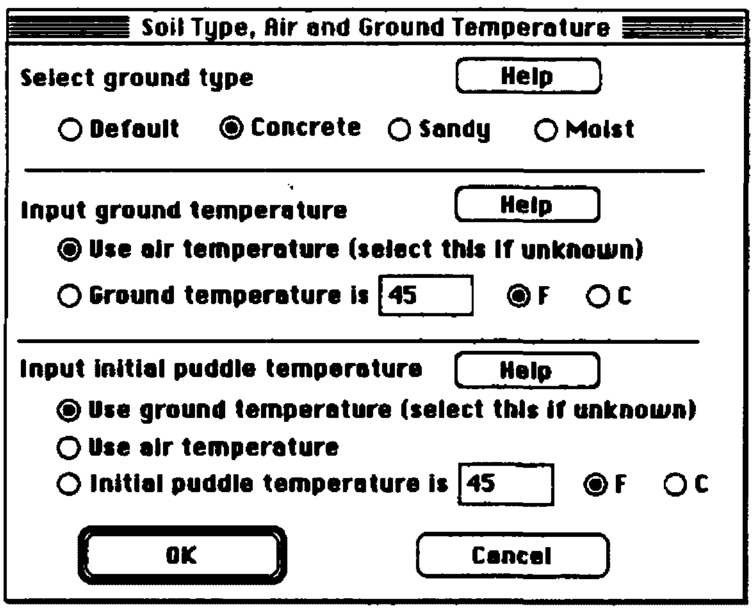


2 Type "40" in the puddle area data field, and click the square **feet** units button.



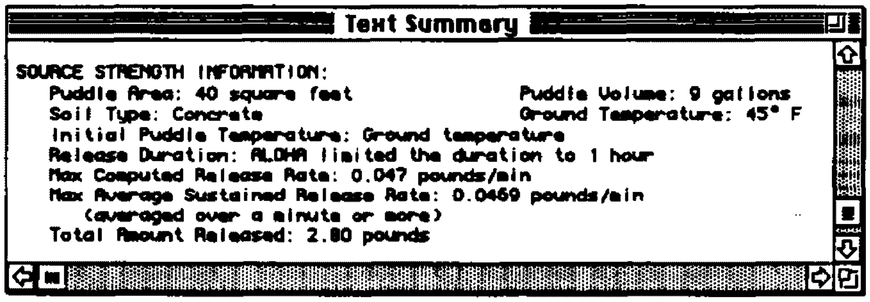
3 Three 12-quart containers have leaked hydrazine. There are four quarts in a gallon, so 9 gallons of hydrazine have spilled into the puddle. Click on the button for **Volume of puddle**, then type "9" in the puddle volume data field. Click **gallons**, then click OK.

4 The puddle has formed on a concrete parking lot, so click Concrete.



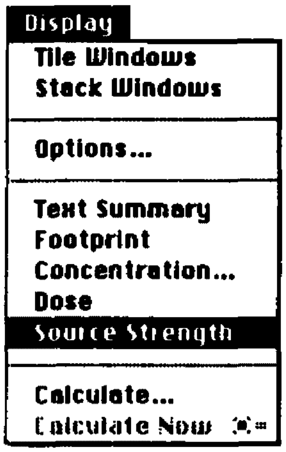
5 No estimate of ground or puddle temperature is available, so leave both equal to air temperature, the default value. Click **OK**.

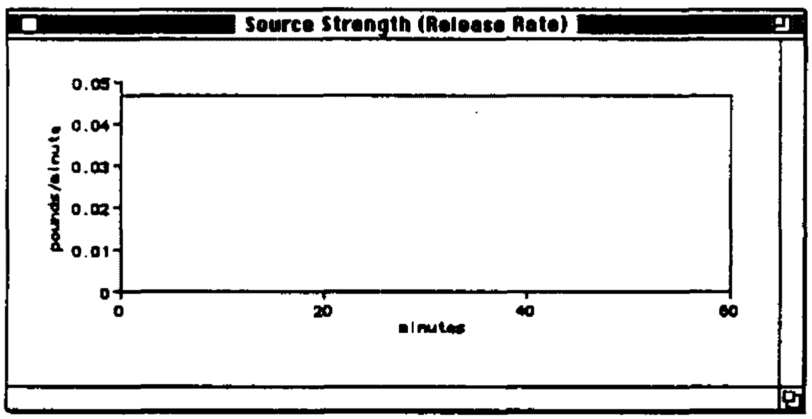
Check the Text Summary screen to be sure that you've entered the source strength data correctly, and to review ALOHA's estimates of maximum and averaged release rates and other information about the release. ALOHA expects the release to last more than one hour, and predicts that 2.8 pounds of hydrazine will have evaporated during the first hour of the spill.



Seventh...

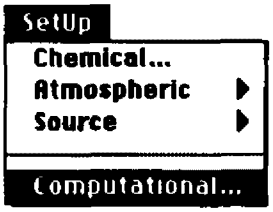
- Choose **Source Strength...** from the **Display** menu to view ALOHA's graph of source strength, or release rate, for the first hour of the spill. ALOHA does not expect evaporation rate to change during this hour. The model expects the puddle to be cooled as it evaporates, but warmed by its environment at the same time, so that its temperature (and hence its evaporation rate) remain unchanged.



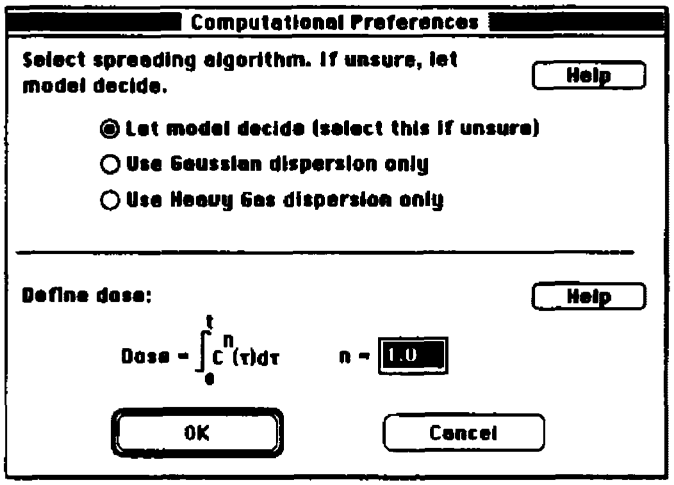


Eighth...

1 Choose **Computational** from the **SetUp** menu.

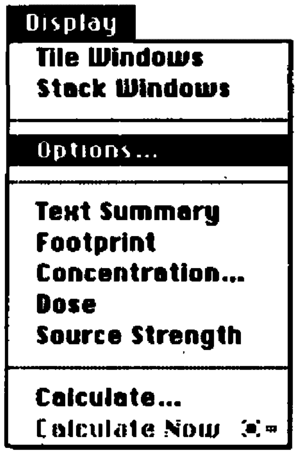


2 Check to be sure that **Let model decide** is selected (This is the default setting). Click on this button if it is not selected, then click **OK**



Ninth...

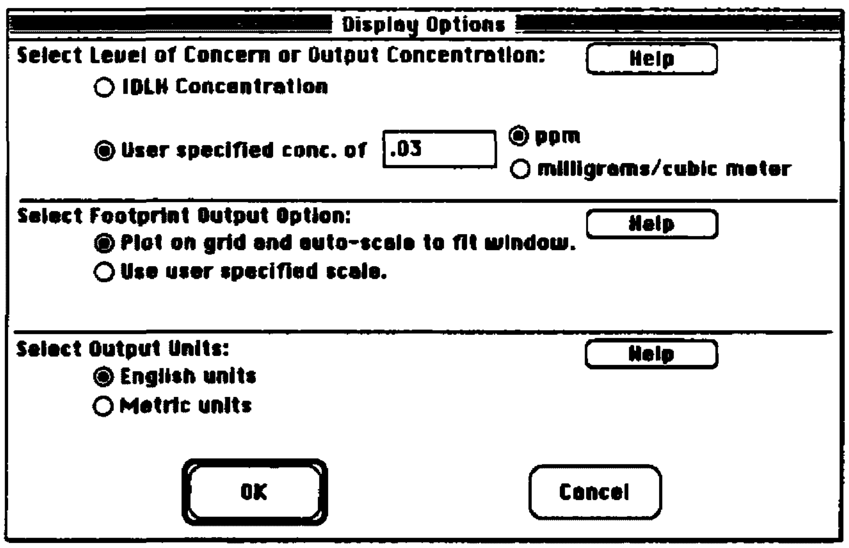
1 Select **Options...** from the **Display** menu.



2 The state official suggested a level of concern of 0.03 ppm. Click **User-specified conc.** and enter "0.03." Click **ppm**.

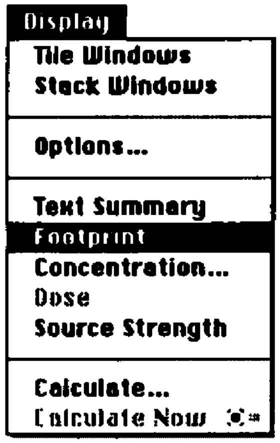
3 Check to ensure that **Plot on grid and autoscale to fit window** is selected.

4 Click **English units**, then click **OK**.

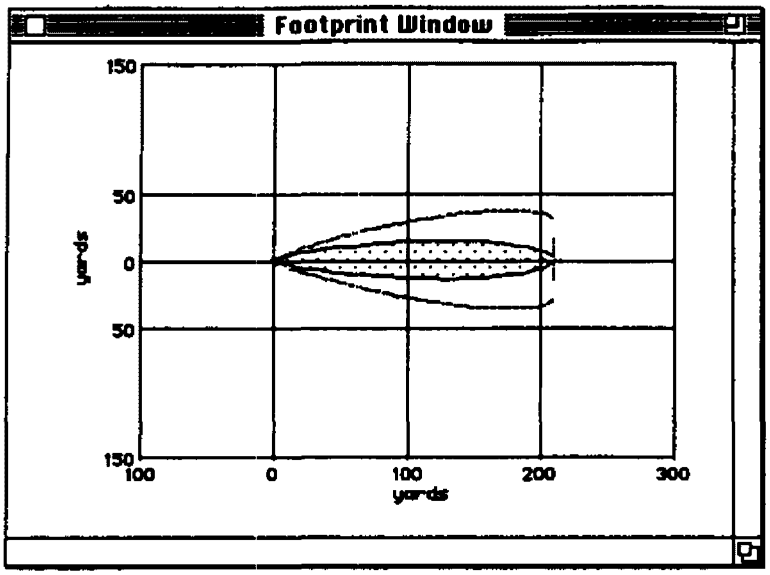


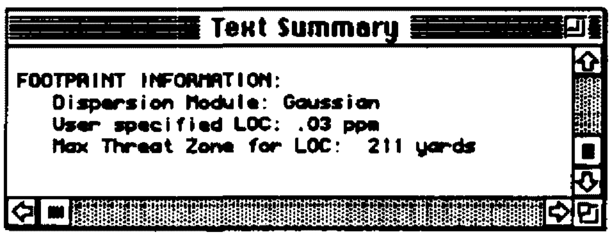
Tenth...

- Choose **Footprint** from the **Display** menu.



ALOHA will display a diagram of the footprint for this hydrazine release. Check the Text Summary window to see the maximum downwind distance that the footprint may extend (the Maximum Threat Zone). ALOHA expects the footprint to extend downwind for about 211 yards. Although the molecular weight of hydrazine is about 32 kg/kmol, and is heavier than that of air (which is about 29 kg/kmol), ALOHA chose the Gaussian dispersion model instead of the Heavy Gas model. That's because the model expects the hydrazine to evaporate so slowly that it does not form the dense blanket of gas typical of a heavy gas release.





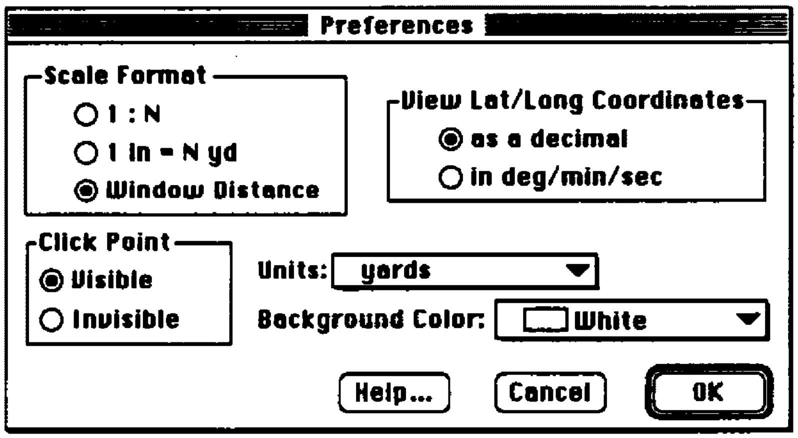
Eleventh...

1 You're ready to use MARPLOT to plot this ALOHA footprint on the map of Seattle. Select **Go to Map** from the **MARPLOT** submenu under ALOHA's **Sharing** menu to bring MARPLOT forward. The Seattle map should still be displayed in MARPLOT's window.

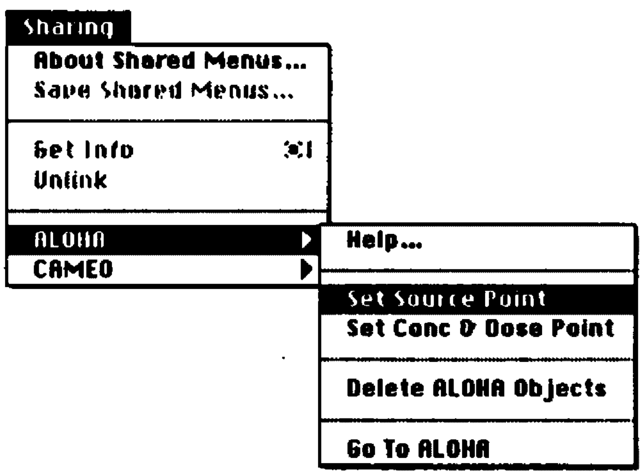
2 Click on the zoom in tool, , in the tool palette to the left of the map, then click once in the middle of the map to zoom in so that you can read street names. Search near the middle of the map for the intersection of 5th Avenue South and South Donovan Street.

3 Once you've identified this intersection, choose  from the tool palette. Click once on the intersection. MARPLOT will place a visible crosshair mark, or "click point" at this location.

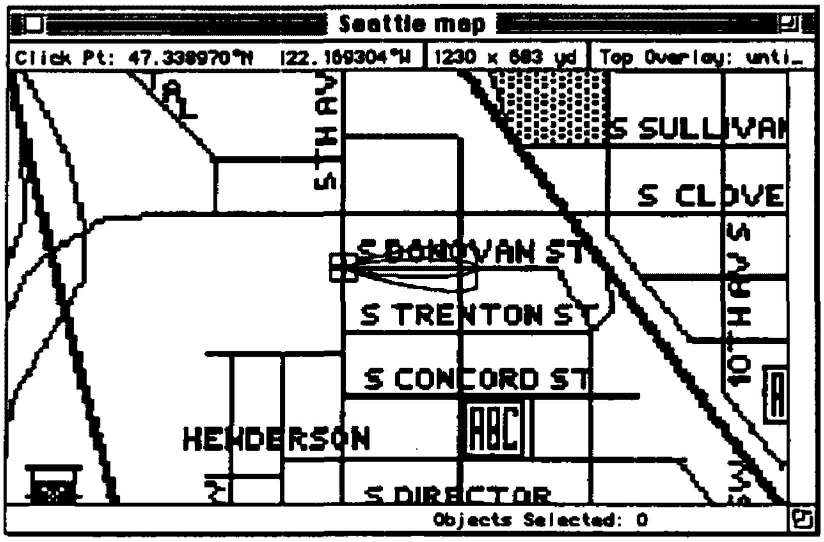
Note **If you don't see a crosshair click point mark at the point where you clicked, choose "Preferences" from the File menu, make the click point Visible, then click OK.**



4 Choose Set Source Point from the ALOHA submenu in MARPLOT's **Sharing** menu. An ALOHA footprint should automatically appear on the MARPLOT map (this may take a few seconds).



5 Choose the zoom in tool to zoom in more closely, if you like. The footprint should look like the one below.



You can see from this footprint plot that ground-level concentrations of hydrazine may be high enough to be of concern for the area along S. Donovan Street between 5th and 7th Avenues S. The confidence lines drawn on either side of the footprint delineate the area within which the cloud of hydrazine is 95% likely to remain, if the wind shifts it about during the release. You can see that hydrazine concentrations aren't predicted to reach your level of concern more than half a block north or south from Donovan Street.

Remember, though, that ALOHA was designed to give you "ballpark" estimates of source strength and dispersion. It cannot give you completely accurate predictions for a real release, because no model can account for every uncertainty. For example, if the wind shifted direction or changed speed, the footprint might be longer or shorter, or oriented in a different direction. Likewise, you had to guess the exact amount of hydrazine in the puddle. In real response situations, ALOHA gives you a "best guess" rather than an exact answer.

Example 5

...Using BitPlot with ALOHA in Windows

The Seattle, Washington Fire Department responds to a freight train derailment on August 25, 1992 at 10:15 am. The police dispatcher reports that the derailment has occurred about 3 miles south of the downtown area next to the intersection of 16th Ave. South and East Marginal Way. When the firefighters arrive on-scene, they find several tank cars off the tracks and on their sides. There is no fire, but one tank car is damaged, and a large volume of fine mist and vapor can be seen spraying out of a crack in the tank bottom. The entry team members cannot get very close to the tank, but they estimate that this crack is about 36 inches long and 1/2-inch wide.

The train's crew is unharmed and immediately hands the train's consist to a police officer. From the consist, the entry team finds that this tank car was carrying 19,789 gallons of liquid methyl chloride and that the tank car capacity is 24,750 gallons. They estimate the tank diameter to be about 10 feet.

The firefighters report the following on-scene weather observations: there are some high cirrus clouds visible and they estimate that the coverage is about 20%. The winds are from the northeast at about 10 mph. The humidity is about 50% and the air temperature is 75° F.

The fire chief notes that residential neighborhoods to the southwest of the derailment are in the path of the dispersing chemical cloud. Most of the homes are single-storied structures surrounded by shrubs and trees. The closest residence is about 600 yards downwind from the derailment, at the intersection of Southern Street and 12th Ave. S.

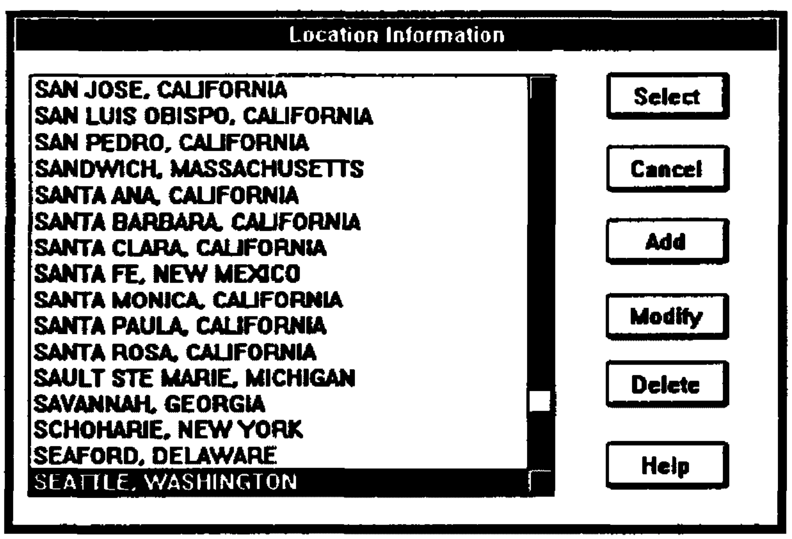
A toxicologist recommends 100 ppm as an appropriate level of concern. What is the downwind distance to this concentration? What is the estimated maximum indoor concentration for the house closest to the derailed rail car? What is the expected maximum outdoor concentration at that point?

First...

1 Double-click on ALOHA and, after reading the ALOHA caveats, click **OK**.

2 Choose **Location** from the **SiteData** menu.

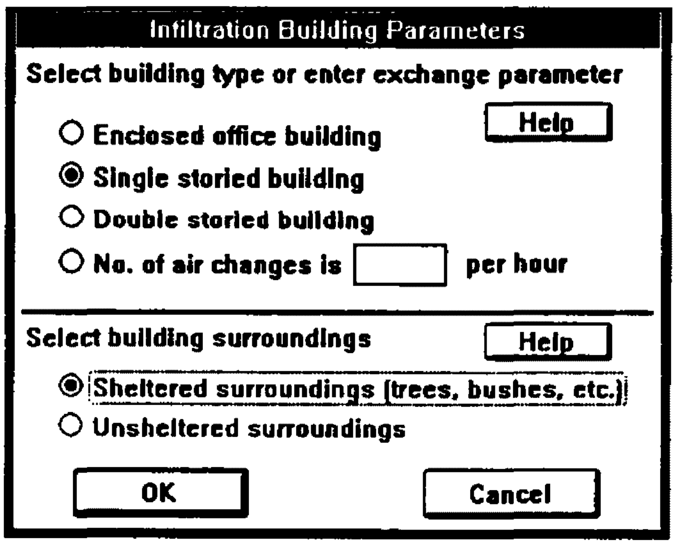
3 Use the scroll bar or quickly type the characters "SE" to find Seattle, Washington in the scrolling list. Once you have located Seattle, double-click on it or click once and click **Select**.



Second...

1 Choose **Building Type...** from the **SiteData** menu.

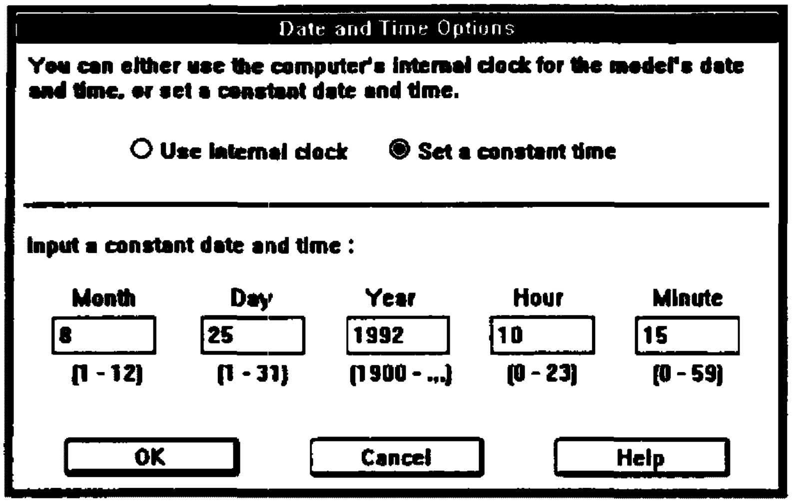
2 The residences are mostly single storied buildings, so click on the **Single storied building** button. Because the buildings are surrounded by trees and other buildings, you should select **Sheltered surroundings.** Click **OK.**



Third...

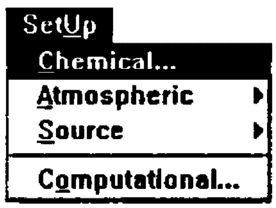
1 Choose **Date & Time...** from the **SiteData** menu.

2 Select **Set constant time** and enter the month, day, year, hour and minute for this scenario. Click **OK**

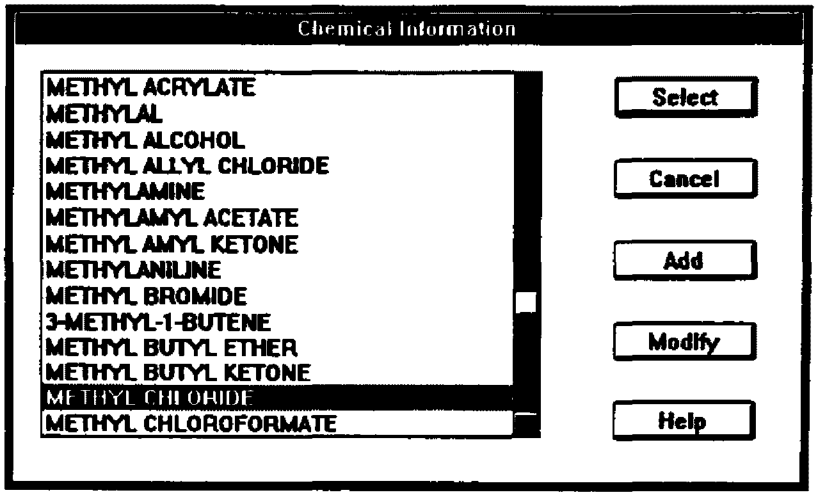


Fourth...

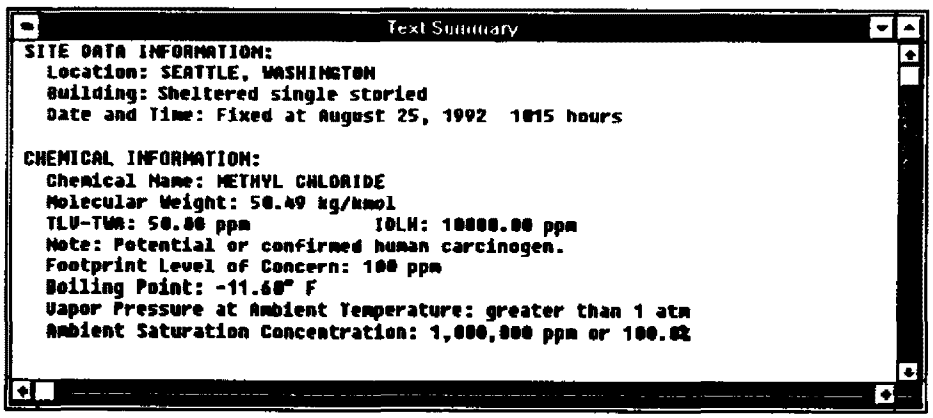
1 Select **Chemical...** from the **SetUp** menu.



2 Use the scroll bar or quickly type the characters 'ME' to find methyl chloride. Double-click on "METHYL CHLORIDE" or click once on this name, then click **Select**.

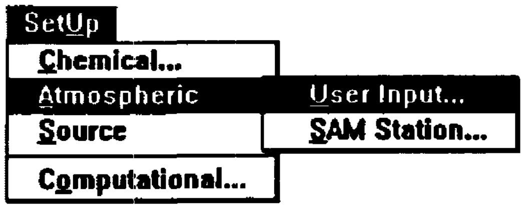


Check the Text Summary window to review information about the properties and toxicology of methyl chloride. ALOHA alerts you that this chemical is a potential or confirmed human carcinogen. Its boiling point is well below ambient air temperature; this indicates that the chemical was stored in the tank car as a pressurized liquid.

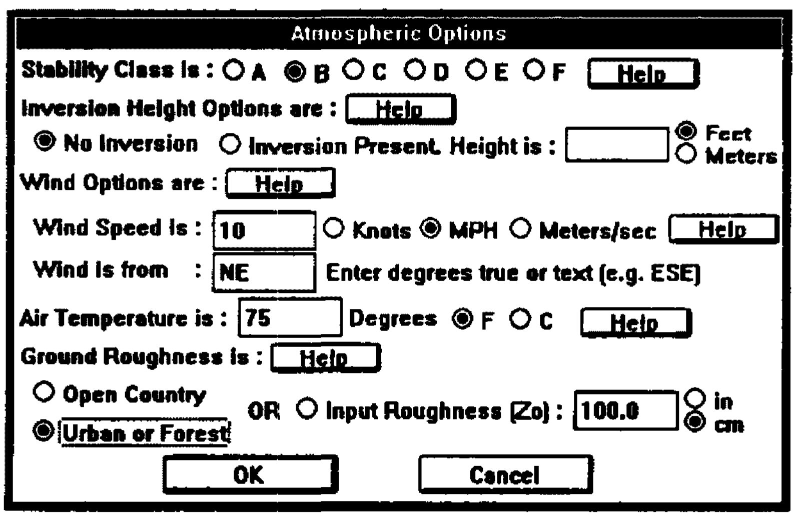


Fifth...

1 Select **User Input...** from the **Atmospheric** submenu in the **SetUp** menu.



2 The firefighters estimated the wind speed to be 10 mph, with about 20% of the sky obscured by clouds. By clicking on the stability class **Help** button (at the upper right corner of the screen), you can see that for this combination of strong solar radiation and 10 mph winds, the best choice for stability class is B. Click on the button for stability class B.



3 There's no inversion, so ensure that the default setting, **No inversion**, is selected.

4 Enter "10" as your value for wind speed, then click on the **mph** units button. Enter either 'NE' or '45' to indicate that the wind is from the northeast.

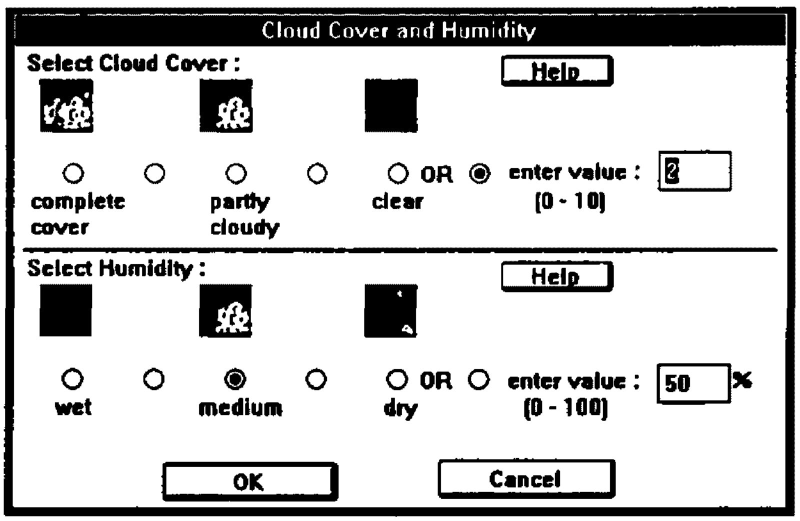
5 Type "75" as the air temperature, and click F.

6 This spill is in an urban, industrialized area, with many buildings and other obstacles. Click on the **Urban or forest** button.

7 Once you've made these selections, click **OK**.

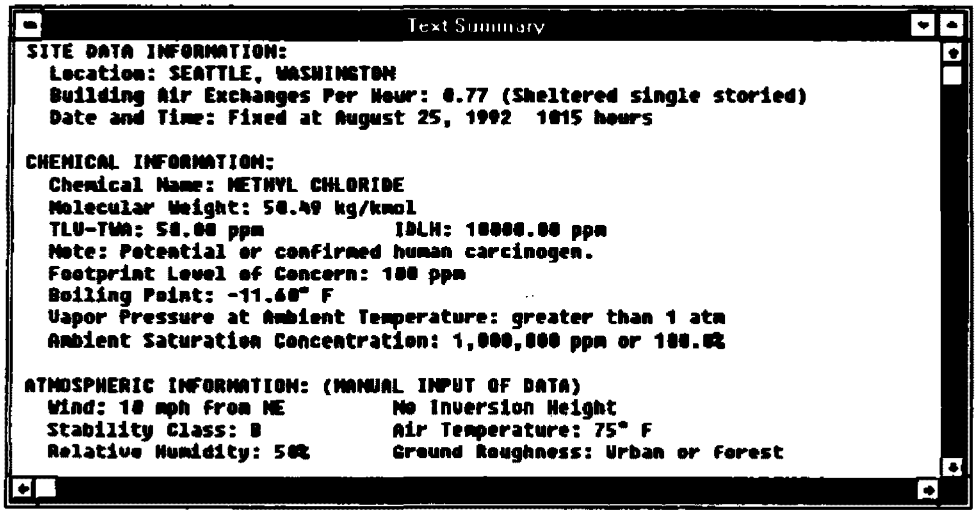
8 The sky is described as about 20%, or 2/10 cloudy. Type "2" in the cloud cover data field.

9 Relative humidity is 50%, so ensure that this button is selected (it's the default value).



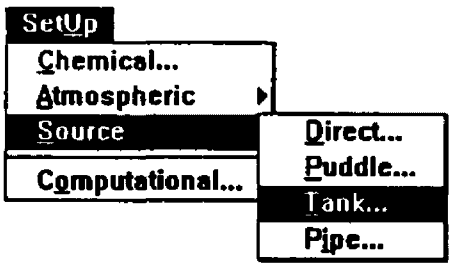
10 Click OK.

Check the Text Summary screen to be sure that you've entered these data correctly. Under the heading, "Site Data Information," you can see the air exchange rate that ALOHA has calculated for the residences near the spill site.



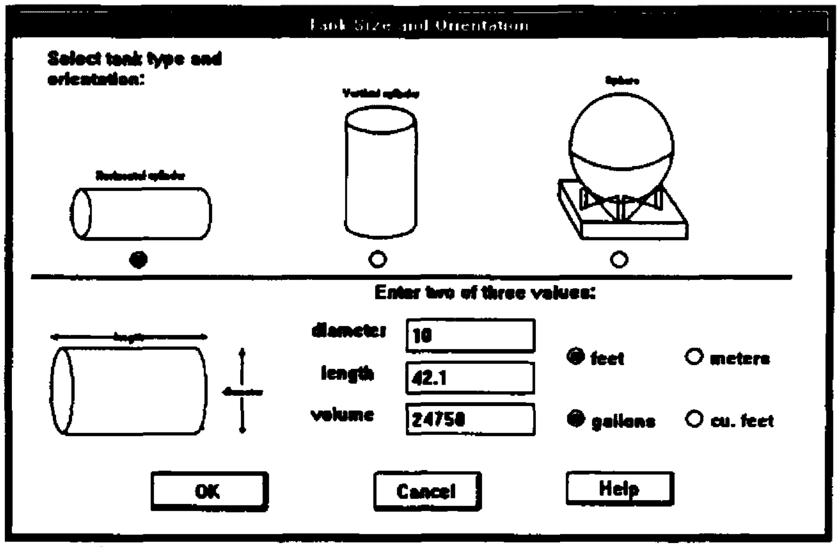
Sixth...

1 Select **Tank...** from the **Source** submenu in the **SetUp** menu.

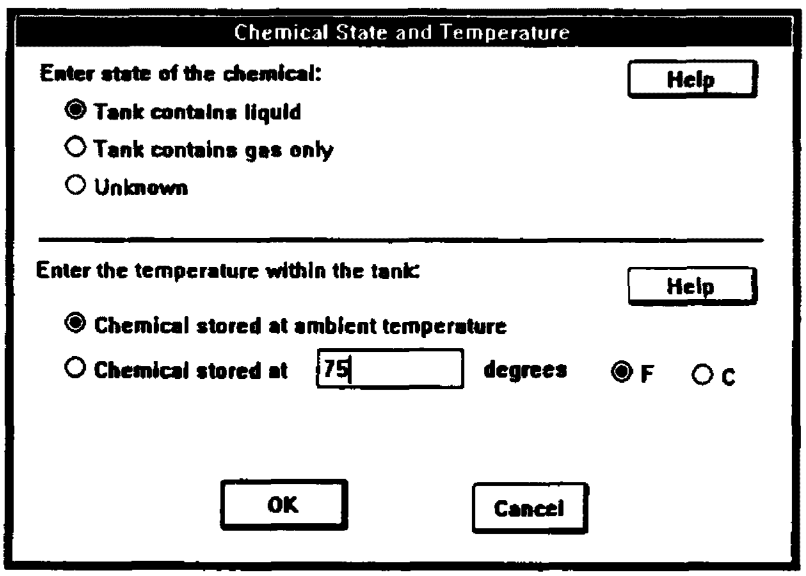


2 **Click Horizontal Cylinder.**

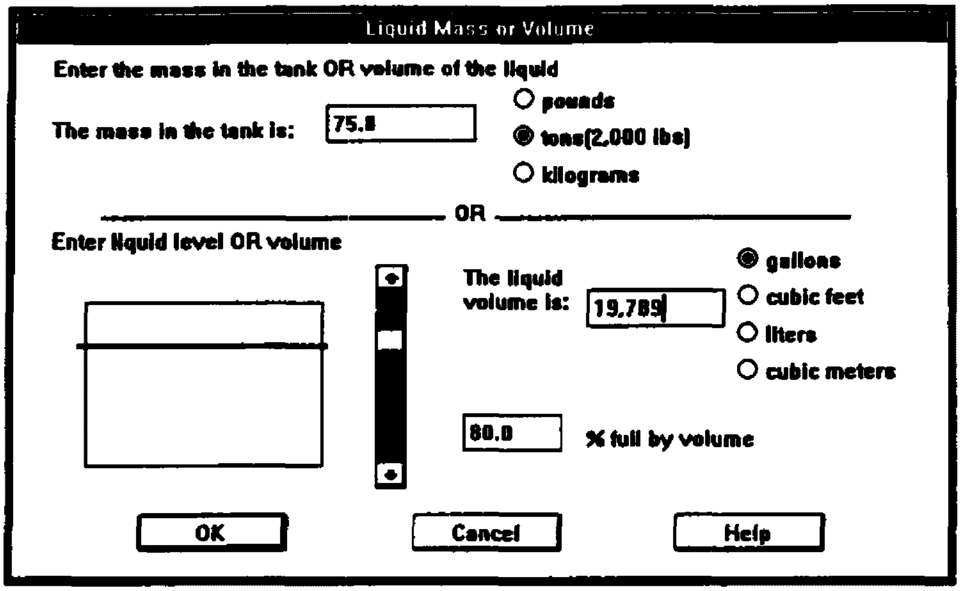
3 The tank car is 10 ft in diameter and has a capacity of 24,750 gallons. Enter "10" for diameter, don't enter a value for length, then enter "24,750" for volume. Click **feet** for diameter and **gallons** for volume. ALOHA will calculate and display the correct length automatically. Click **OK.**



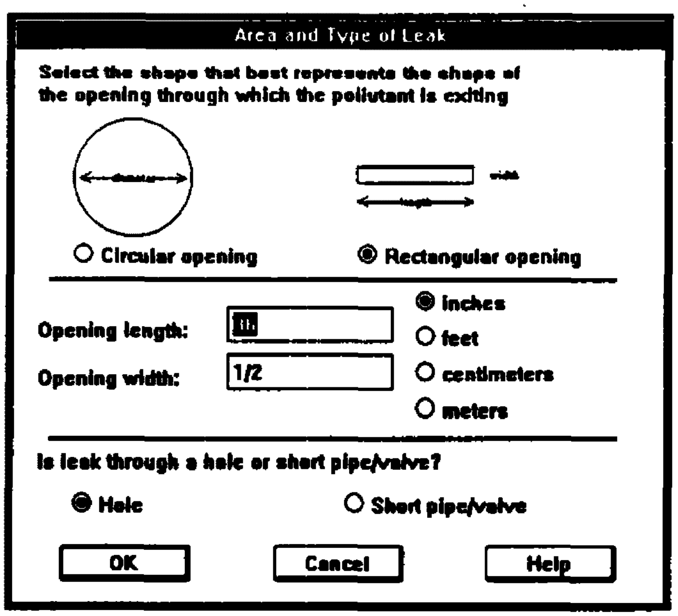
4 The methyl chloride is stored as a liquid. The tank temperature wasn't reported, so air temperature is the best guess. Click the buttons for **Tank contains liquid** and **Chemical stored at ambient temperature**. Click **OK**.



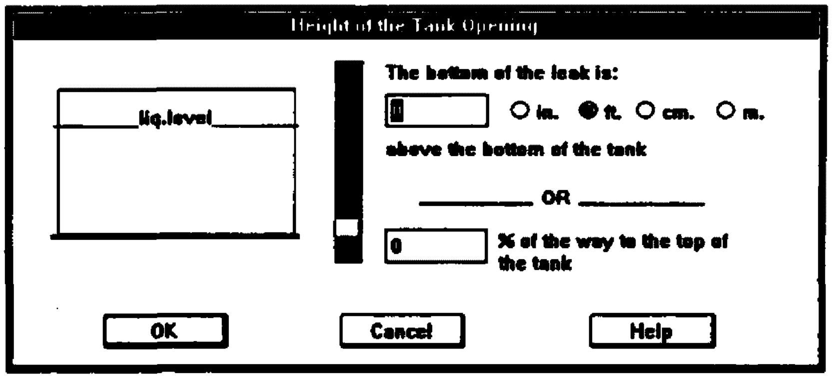
5 After the heading **The liquid volume is:**, type in the responders' estimate of the amount of methyl chloride in the tank car. Click on the **gallons** button. Click **OK**.



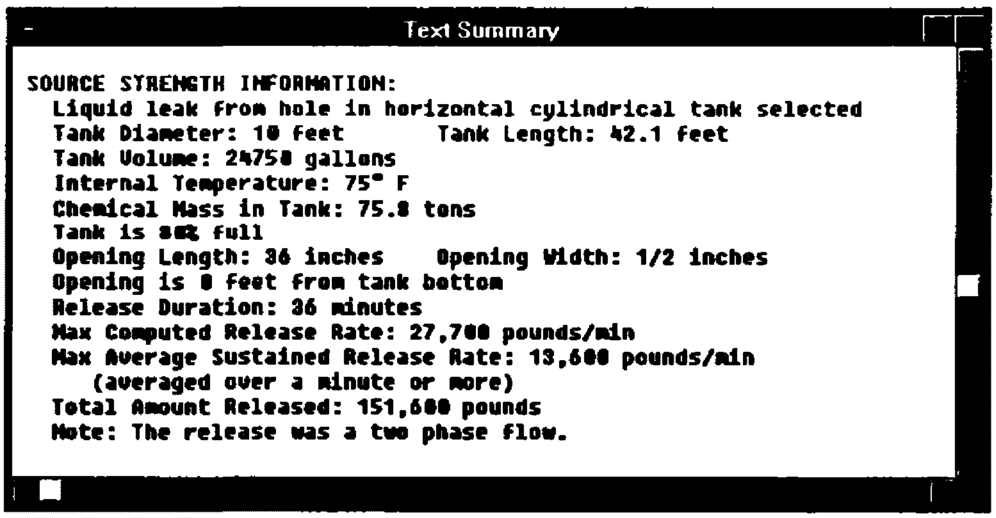
6 Click **Rectangular opening** and enter "36" for the opening length and "1/2" for the opening width. Click **inches** . "Hole" is the default leak type; ensure that this button is selected. Click **OK**.



7 The hole is at the bottom of the tank car. This is the default setting, so just click **OK**.

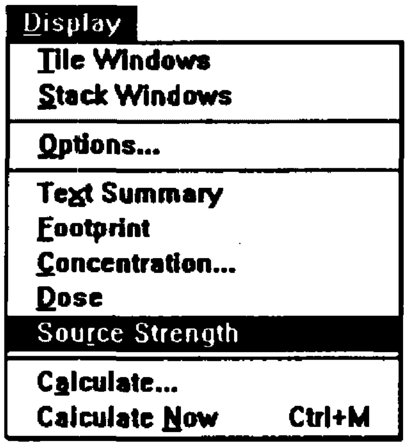


Check the Text Summary screen to be sure that you've entered the source strength data correctly, and to review ALOHA's estimates of maximum and averaged release rates and other information about the release. ALOHA expects the release to last about 36 minutes. Because the methyl chloride was stored as a pressurized liquid, ALOHA expects it to escape from the tank as a two-phase flow of aerosol (a fine mist of liquid droplets) and vapor.

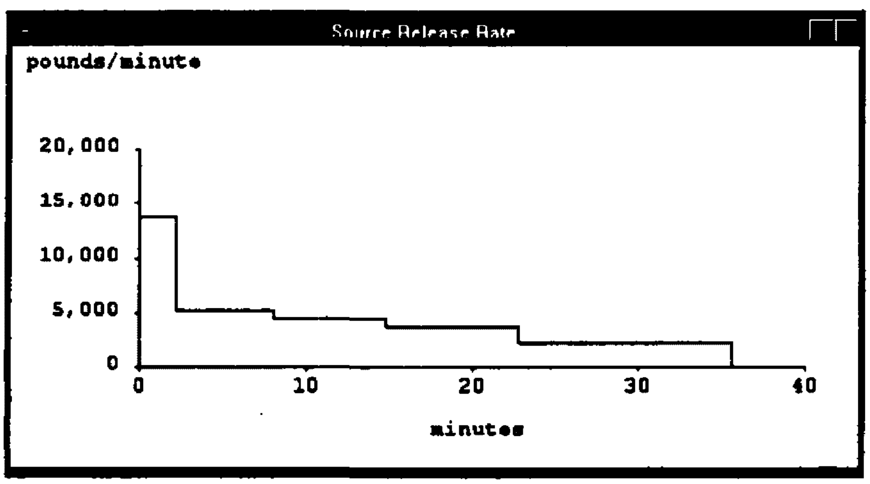


Seventh...

- Choose **Source Strength...** from the Display menu to review ALOHA's graph of source strength, or release rate, over the duration of the spill.

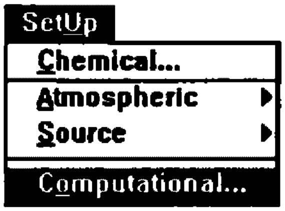


You can see from the source strength graph that ALOHA expects the release rate to be highest at the beginning of the release, when the pressure in the tank is greatest, and then to decline as chemical escapes and pressure drops. The maximum computed release rate shown on the Text Summary screen, 27,700 pounds/min, would have occurred just as the tank began to leak.

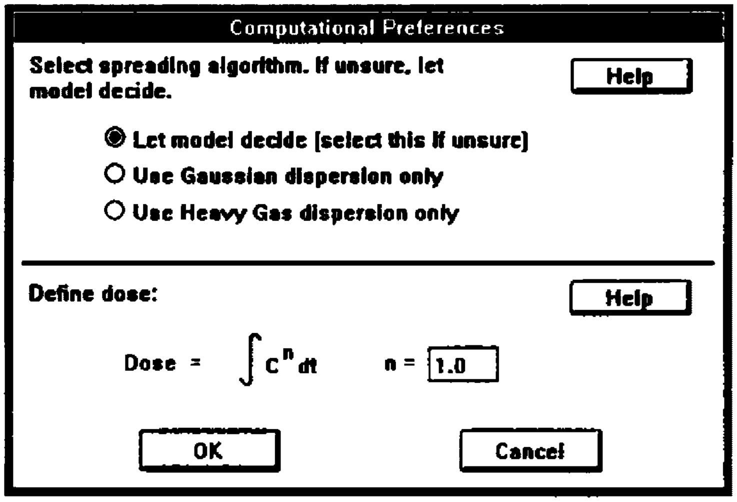


Eighth...

1 Choose **Computational** from the **SetUp** menu.

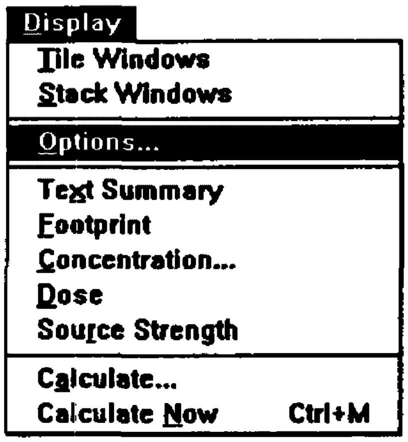


2 Check to be sure that **Let model decide** is selected (Unless you specify otherwise, ALOHA will default to this setting). Click on this button if it is not. Click **OK**.



Ninth...

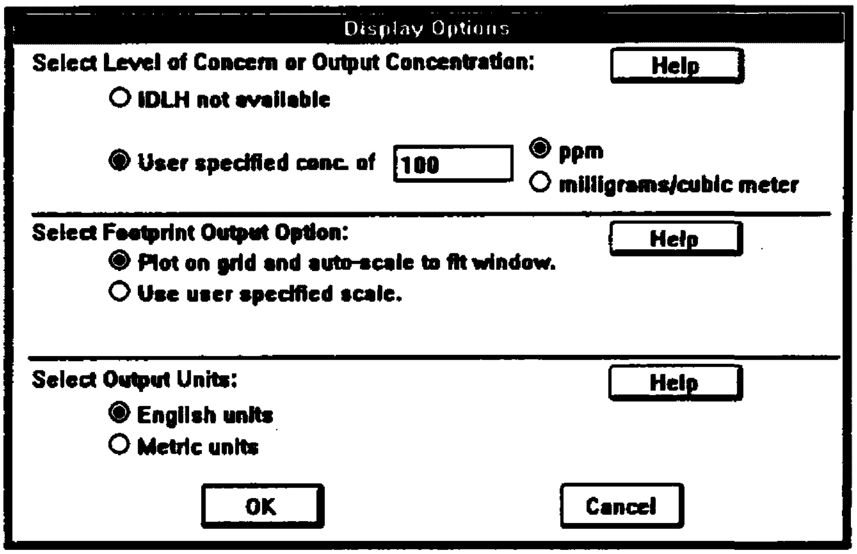
1) Select **Options...** from the **Display** menu.



2 The toxicologist has recommended that you use the TLV-STEL value for methyl chloride, 100 ppm, as your level of concern (The TLV-STEL is a 15-minute workplace exposure limit). Since ALOHA's chemical library doesn't include a value for TLV-STEL, click **User-specified conc.** and enter "100." Be sure to click **ppm**.

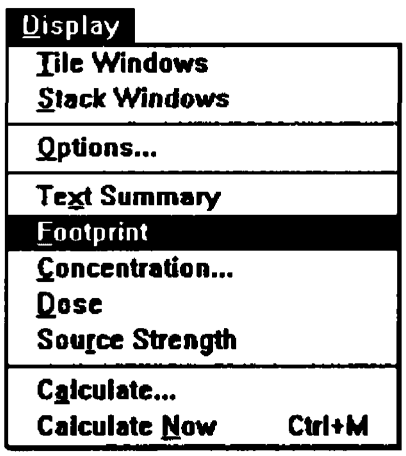
3 Check to ensure that **Plot on grid and autoscale to fit window** is selected. Click on this button if it is not.

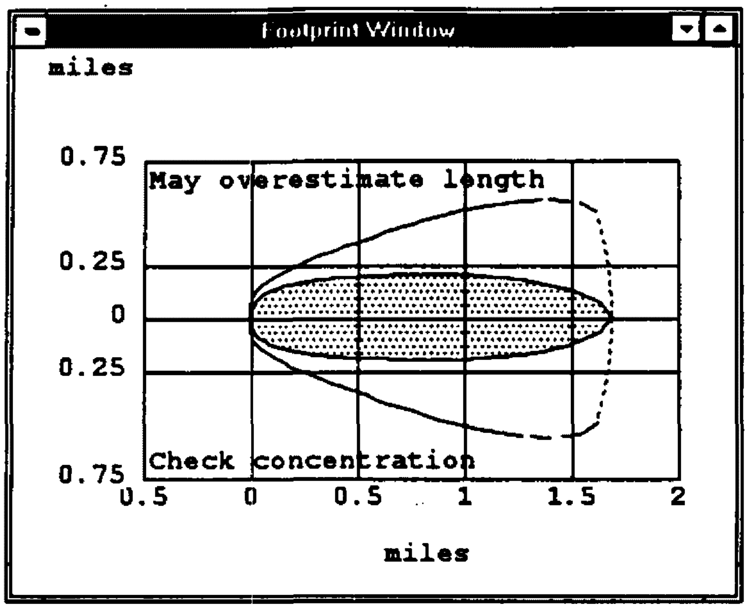
4 Click the **English units** button. Then click **OK**



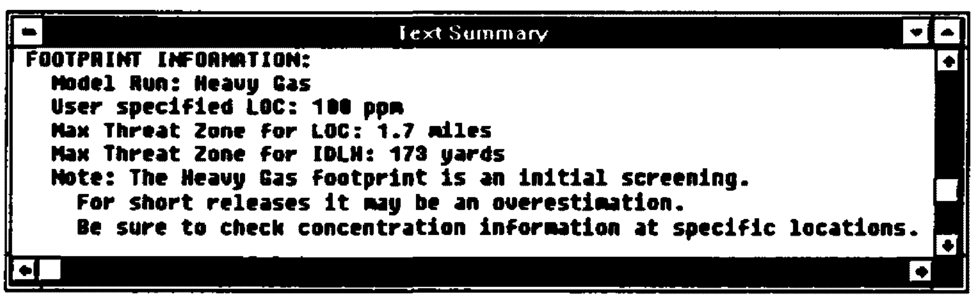
Tenth...

1 Choose **Footprint** from the **Display** menu.





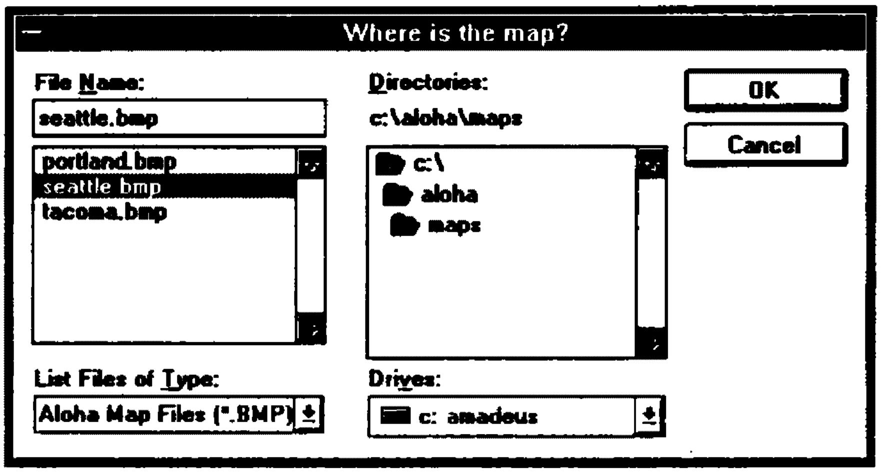
ALOHA will display a diagram of the footprint for this methyl chloride release. Check the Text Summary window to see the maximum downwind distance that the footprint may extend (called the Maximum Threat Zone). You'll also see that ALOHA chose to use the Heavy Gas model to make its calculations, and that the model reminds you that a Heavy Gas footprint represents an initial screening. ALOHA must simplify its Heavy Gas calculations so that a footprint can be completed and displayed in a short time. For pressurized releases such as this one, such a footprint can be an overestimate. In a moment, you'll check concentration at a location downwind of the source for a more accurate estimate (concentration calculations are not simplified).



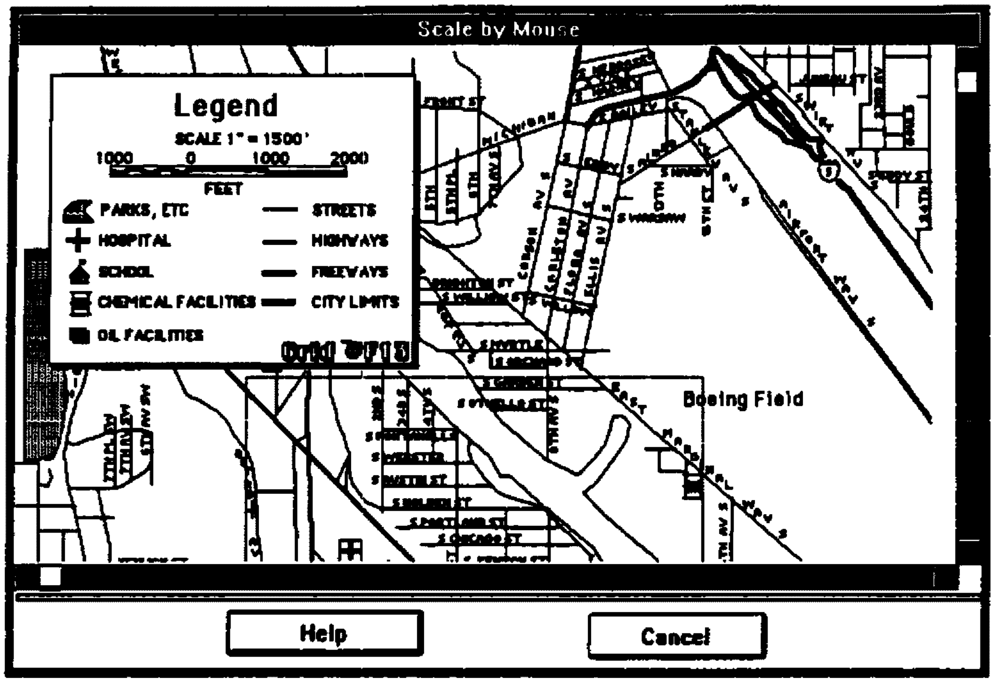
Eleventh...

1 You're ready to use BitPlot to plot this ALOHA footprint on a map of Seattle. Select **Go to Map** from the **BitPlot** submenu under ALOHA's **Sharing** menu to launch BitPlot or to bring it forward if it is already running.

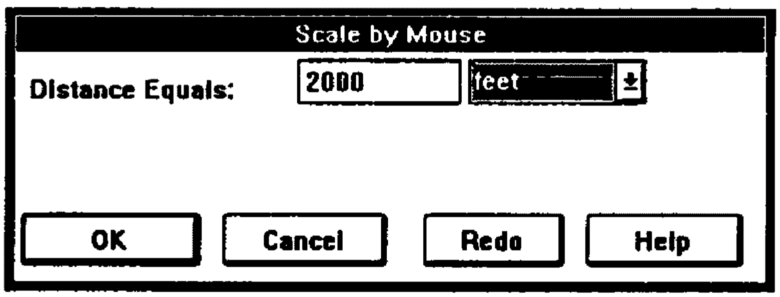
2 Go to the Maps directory in the ALOHA folder and click on the Seattle map. Click **OK**.



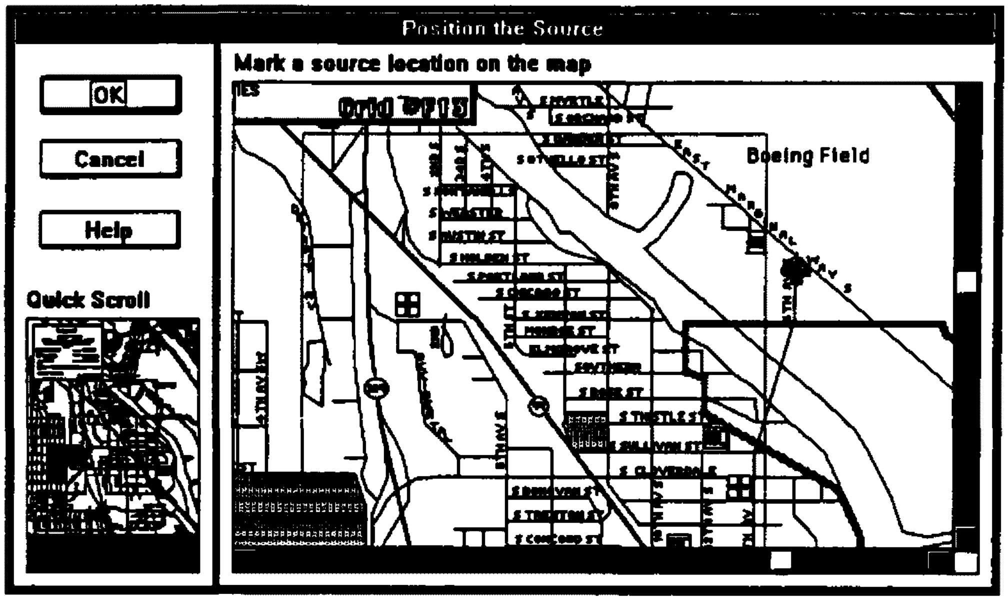
3 Next, you'll need to enter your map scale. You will see the Seattle map displayed on your screen inside a scrolling window. Move the crosshair cursor to the 0 feet point on the scale bar inside the map legend, and click your mouse button at that point. Then move the crosshair to the 2000 feet point on the scale bar and click the mouse button again.



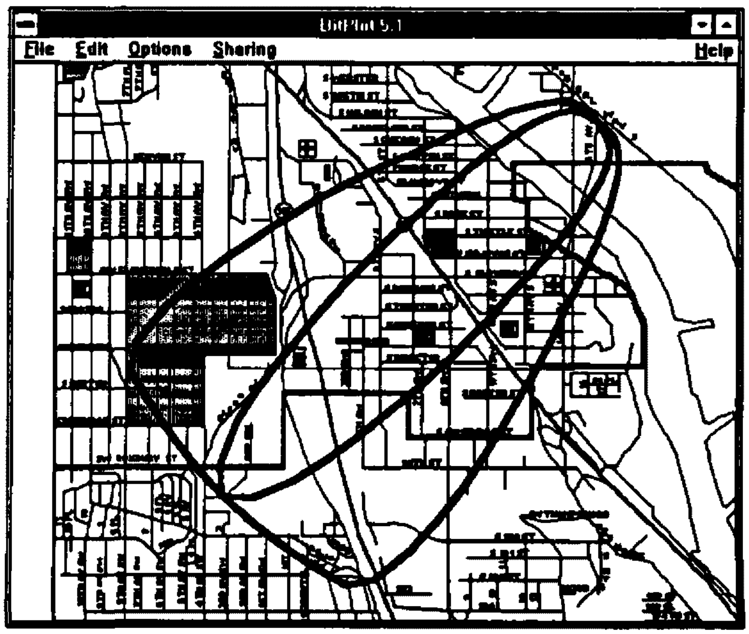
4 Enter "2000," the distance between the two points. Click on the popup units menu and choose feet for distance units. Click **OK** when you're finished.



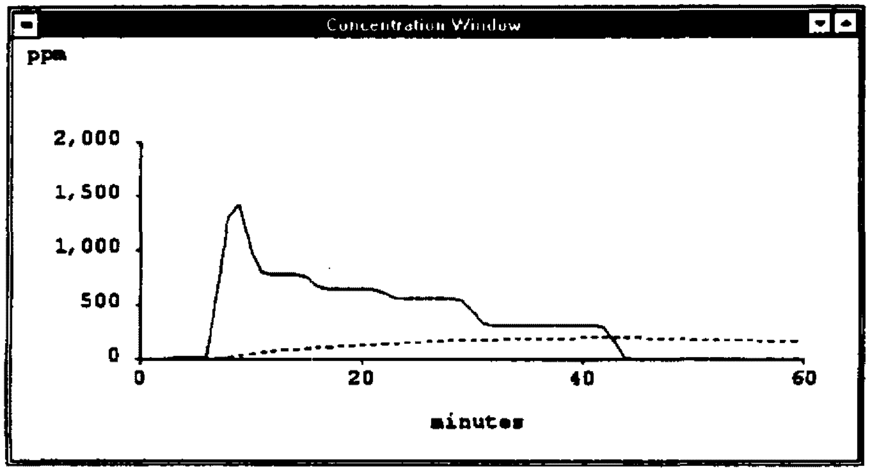
5 Next, you'll need to indicate the location of the spill. Scroll the map down until you can see the intersection of East Marginal Way and 16th Avenue South. The train tracks cross 16th Avenue on the south side of this intersection; this is the location of the leaking tank car. Click once on this point. You should see a red cross marking this point. If you didn't click in just the right spot the first time, just click again. When you're satisfied, click **OK**.



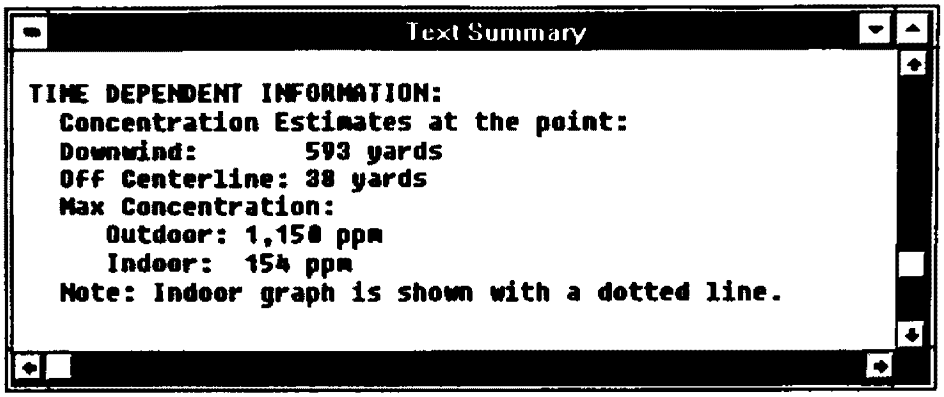
6 Once you have positioned the source, BitPlot will display the ALOHA footprint on the map. On this footprint plot, the innermost oval represents the Maximum Threat Zone, the area where ground-level concentrations of methyl chloride are most likely to exceed 100 ppm, your level of concern. On either side of this oval, you can see confidence lines. These delineate the area within which ALOHA is 95% sure the chemical cloud will remain, if the wind shifts it about during the release.



7 Next, to find out the concentrations expected inside and outside the nearest residence, you'll need to indicate the building location so that ALOHA can calculate and display a Concentration vs. Time graph. The closest homes are located near the intersection of Southern Street and 12th Avenue South, across the river and southwest of the spill location. Double-click on this intersection. ALOHA will come forward automatically, and will display a Concentration graph for your location.



You can also view estimates of maximum indoor and outdoor concentrations in ALOHA's Text Summary window. ALOHA predicted that people at the residence nearest the spill may be exposed to a maximum outdoor concentration of about 1400 ppm, within 20 minutes of the start of the release, and a maximum indoor concentration of about 150 ppm at the end of the first hour.



8 When you've finished viewing the graph and Text Summary, choose **Go to map** from the hierarchical **BitPlot** menu item under ALOHA's **Sharing** menu to return to BitPlot.

Don't be concerned if the numbers that you see on your screen don't exactly match the ones shown here. ALOHA's estimates are affected by exactly where on the map you click. ALOHA was designed to give you "ballpark" estimates of source strength and dispersion. It cannot give you completely accurate predictions for a real release, because no model can account for every uncertainty. For example, if the wind shifted direction or changed speed, concentrations at the location you selected could be higher or lower than ALOHA's estimates. Likewise, you had to guess the temperature of the methyl chloride in the tank, and the firefighters had to guess the dimensions of the hole in the tank. If you or the firefighters were wrong, ALOHA's estimate of release rate was inaccurate. In real response situations, ALOHA gives you a "best guess," rather than an exact answer.

Example 6

Using ALOHA and a MARPLOT map

On June 4, 1992, a train traveling on the Southern Railway near Manassas, Virginia, collided with a stalled truck at U. S. Highway 29 (also numbered 211). During the hour from 15:00 to 16:00, 4,000 pounds of chlorine gas were released from a derailed tank car. The land between the tank car and the intersection of Gallerher Road with U. S. Highway 29 is flat with no obstructions. Two workmen repairing potholes at this intersection were overcome by fumes and treated at a local hospital for chlorine gas inhalation. At the time of the release, winds were out of the ENE at about 12 knots, one-third of the sky was covered by clouds, the humidity was about 80% and the air temperature was 72° F.

Given this information, what is the concentration of chlorine that the workmen may have been exposed to?

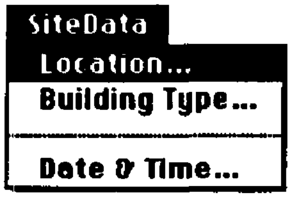
You'll evaluate this scenario first by using ALOHA to obtain a source strength estimate and a footprint, then by plotting the footprint on a MARPLOT map in order to obtain a concentration estimate for the location where the workmen were injured.

First...

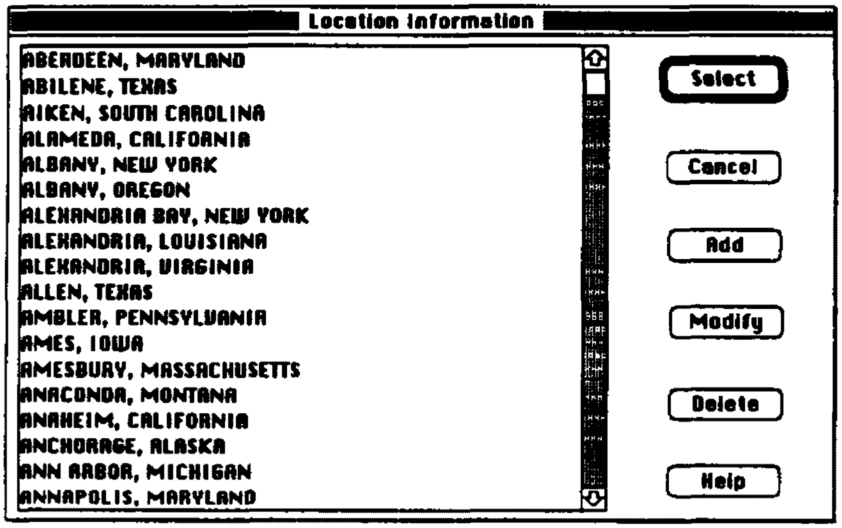
1 Double-click on the ALOHA icon to launch the application.

2 After reading the ALOHA caveats, click **OK**.

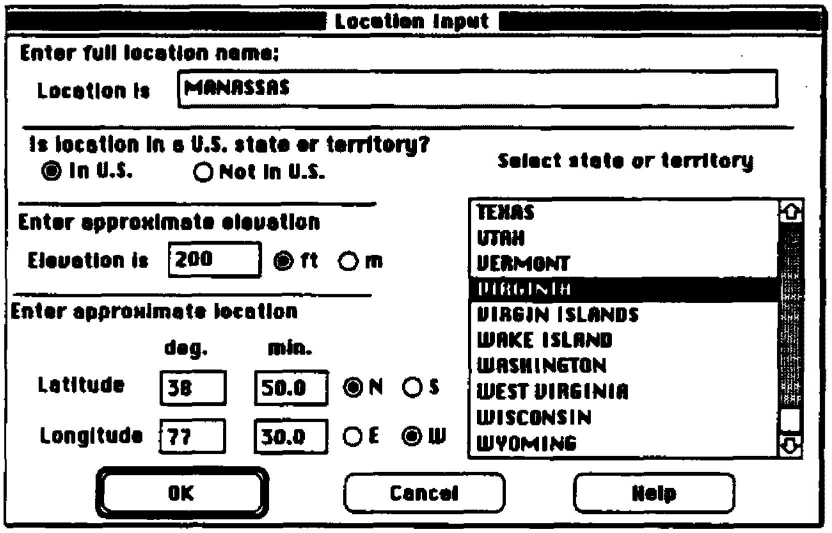
3 You'll need to add Manassas, Virginia to ALOHA's city library. Choose **Location** from the **SiteData** menu.



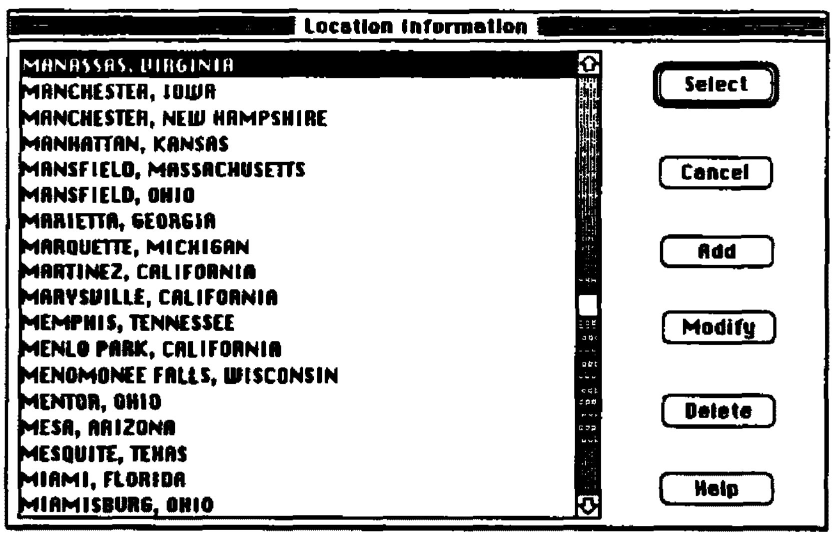
4 Click **Add**.



5 Type "Manassas" in the location name field. Click **In U. S.** Enter "200," the approximate elevation of Manassas, and click **feet**. Enter the city's latitude and longitude, 38° 50′ N and 77° 30′ W. Click **N** and **W**. Choose "Virginia" from the scrolling list of state names. Click **OK**.



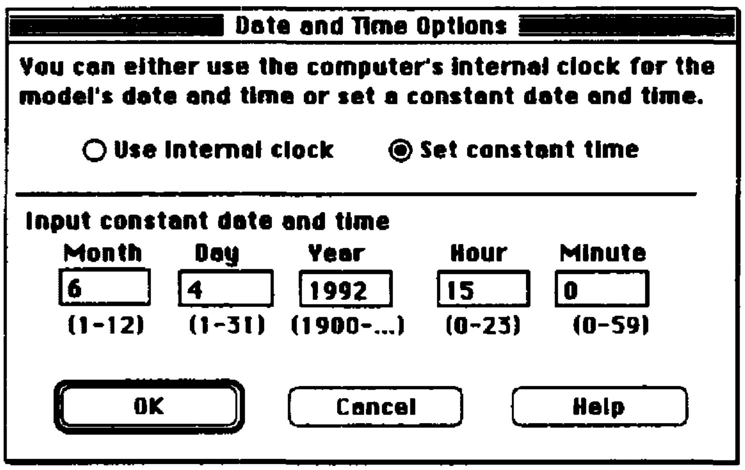
6 Click **Select**.



Second...

1 We'll ignore **Building Type** during this scenario, since we're interested in estimating *outdoor* concentration. Choose **Date & Time...** from the **SiteData** menu.

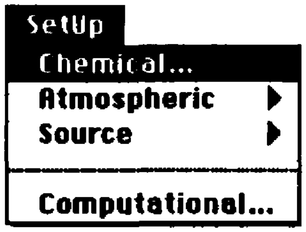
2 Select **Set constant time** and enter the month, day, year, hour and minute for this scenario.



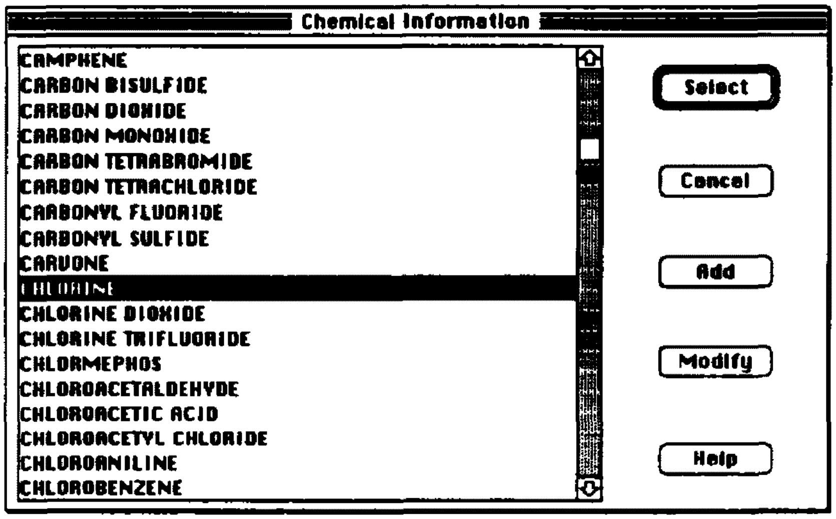
3 Click OK.

Third...

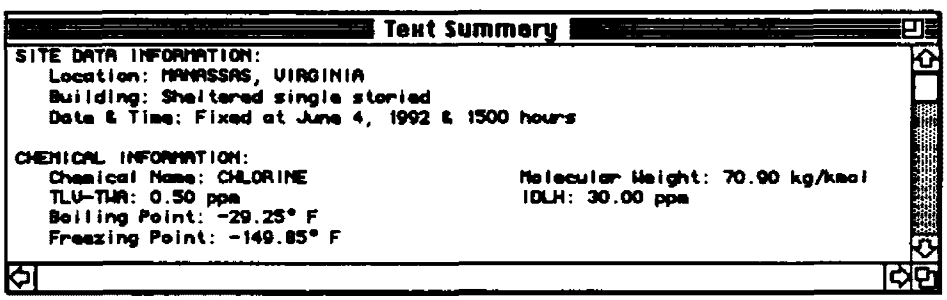
1 Select **Chemical...** from the **SetUp** menu.



2 Use the scroll bar or quickly type the characters "CH" to find "chlorine." Double-click on this name or click once on it, then click **Select**.

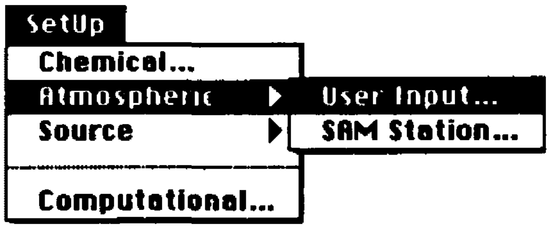


Check the Text Summary window to review information about the properties and toxicology of chlorine.

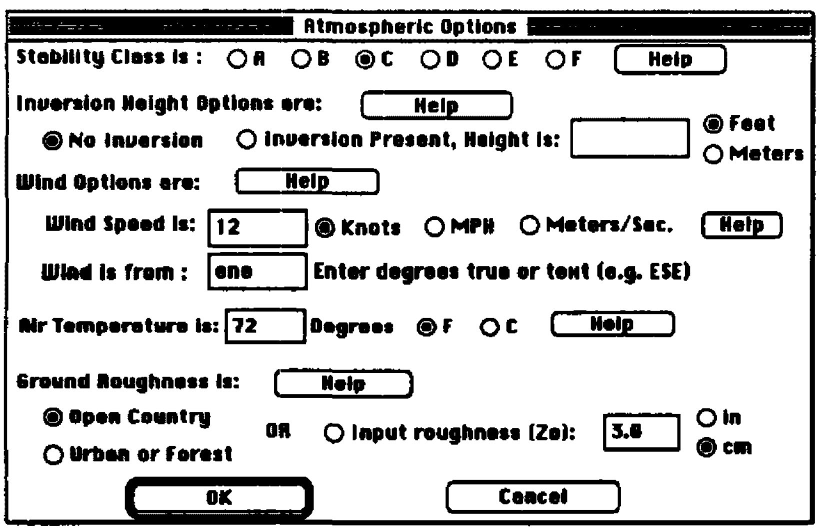


Fourth...

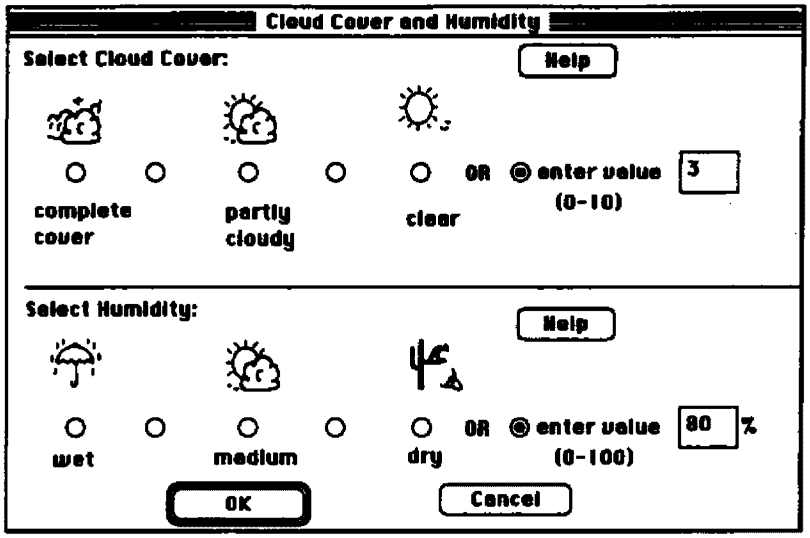
1 Select **User Input...** from the **Atmospheric** submenu in the **SetUp** menu.



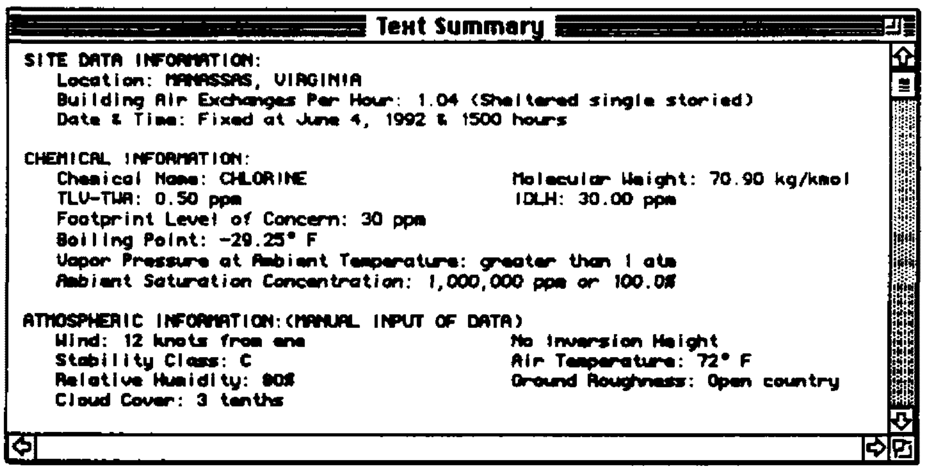
2 The wind speed is 12 knots and one-third of the sky is covered by clouds. By clicking on the stability class Help button (in the upper right corner of this screen), you can see that the best choice for stability class is C. Click C for stability. No inversion is present, so there's no need to change the default **No inversion** selection. Type in the wind speed and click **knots**. Type in the wind direction and air temperature and click F for temperature units. The area between the derailed tank car and the injured workmen is flat and free of obstacles, so choose **Open Country** for ground roughness. Click OK.



3 The sky is about one-third cloudy, so type in "3" for cloud cover, and then enter "80%" as the relative humidity value. Click **OK**.



Check the Text Summary screen to be sure that you've entered these data correctly.



Text Summary

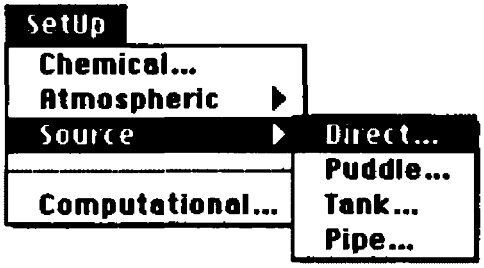
SITE DATA INFORMATION:
Location: MANASSAS, VIRGINIA
Building Air Exchanges Per Hour: 1.04 (Sheltered single storied)
Date & Time: Fixed at June 4, 1992 & 1500 hours

CHEMICAL INFORMATION:
Chemical Name: CHLORINE   Molecular Weight: 70.90 kg/kmol
TLV-TWA: 0.50 ppm   IDLH: 30.00 ppm
Footprint Level of Concern: 30 ppm
Boiling Point: -29.25° F
Vapor Pressure at Ambient Temperature: greater than 1 atm
Ambient Saturation Concentration: 1,000,000 ppm or 100.0%

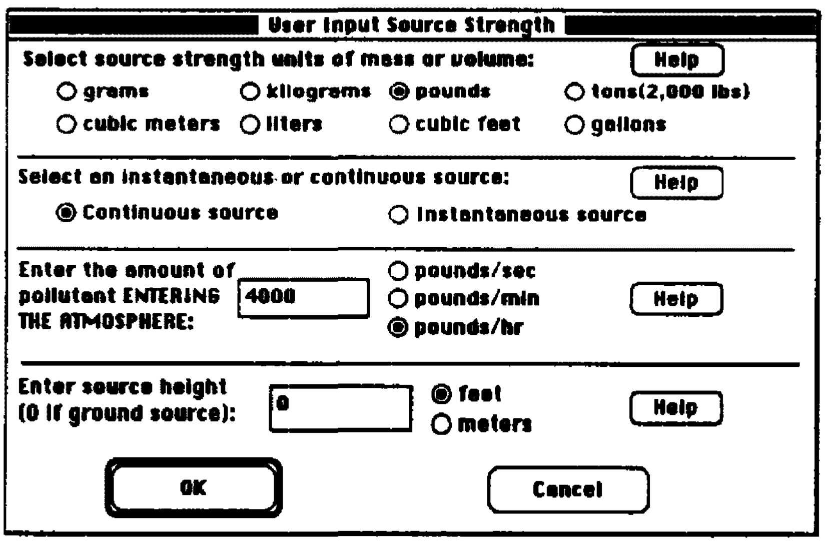
ATMOSPHERIC INFORMATION:(MANUAL INPUT OF DATA)
Wind: 12 knots from ene   No Inversion Height
Stability Class: C   Air Temperature: 72° F
Relative Humidity: 80%   Ground Roughness: Open country
Cloud Cover: 3 tenths

Fifth...

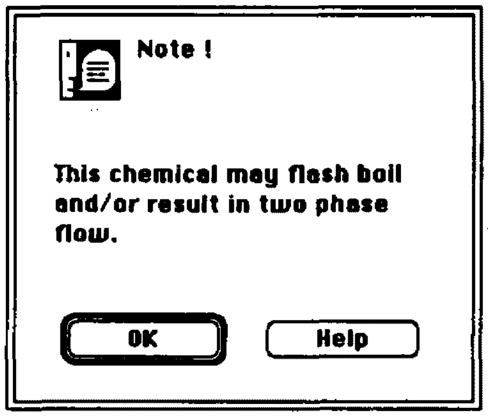
1 This is a release from a tank car, but you don't have all the information that you would need to model the release with ALOHA's Tank source option. You can model this release as a Direct Source, however. Choose **Direct...** from the **Source** submenu of the **SetUp** menu.



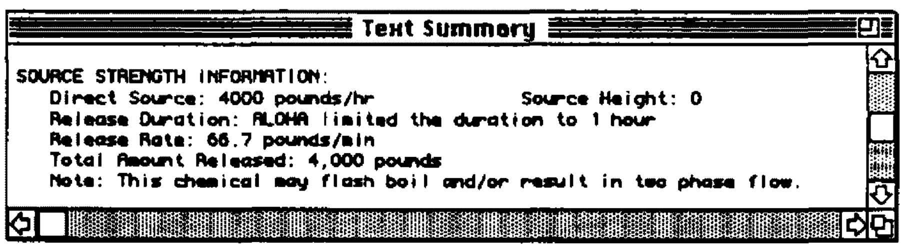
2 The chlorine was released over the course of an hour. Click **pounds** . Click **Continuous source,** then type "4000" as the release amount. Click on the **pounds/hour** button. Leave the source height as "0," and click **OK**.



ALOHA will display the warning below. The model recognizes that because the boiling point of chlorine is well below air temperature, the chemical may have been stored as a pressurized liquid. If so, it may flash-boil when released through a tank hole. During flash-boiling, much of the stored liquid turns instantly to vapor as it leaks, so that a mixture of liquid droplets and vapor (a two-phase flow) is released to the atmosphere. ALOHA's Tank release calculations account for these processes, but the Direct Source option does not. Since we don't have the necessary information to run the Tank option, we'll use the Direct Source calculations as the best approximation that we can make, recognizing that the model will treat this release as a steady flow of gas from the tank instead of a two-phase release. Click **OK**.

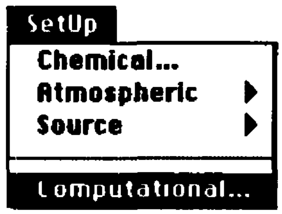


Check the Text Summary window to be sure that you entered these data correctly.

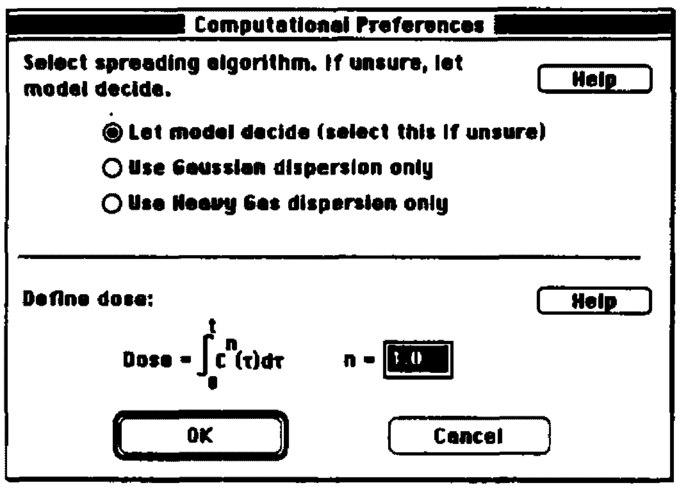


Sixth...

1 Choose **Computational** from the **SetUp** menu.

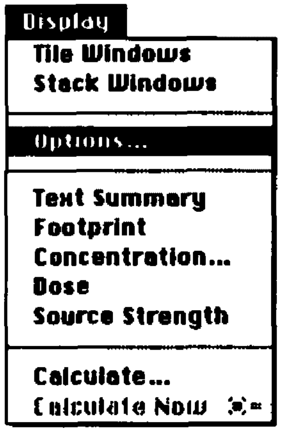


2 Check to be sure that **Let model decide** is selected (unless you specify otherwise, ALOHA will default to this setting). Click **OK**.



Seventh...

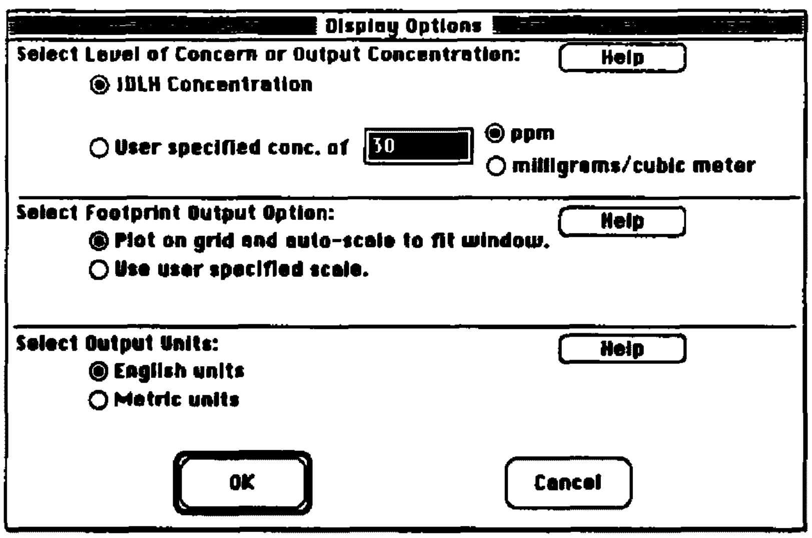
1 Select **Options...** from the **Display** menu.



2 Check to be sure that **IDLH Concentration** is selected.

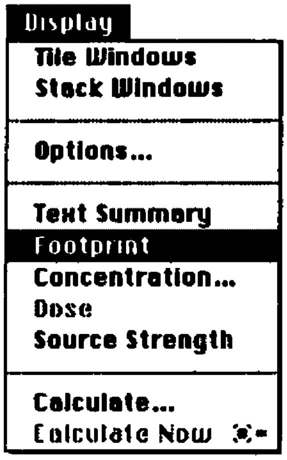
3 Check to ensure that **Plot on grid and autoscale to fit window** is selected.

4 Click **English units**. Then click **OK**.

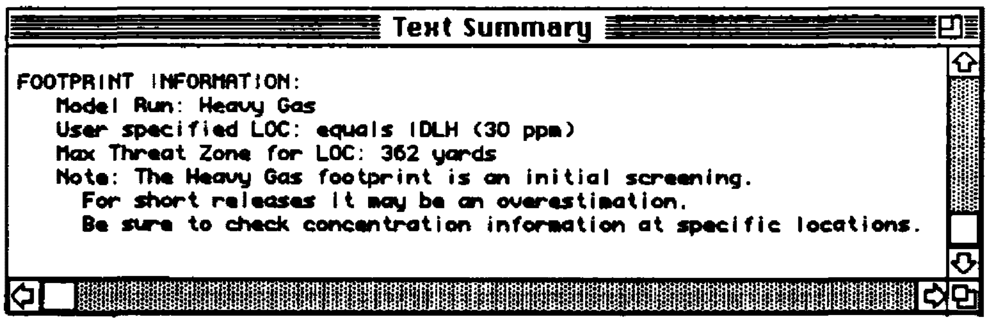


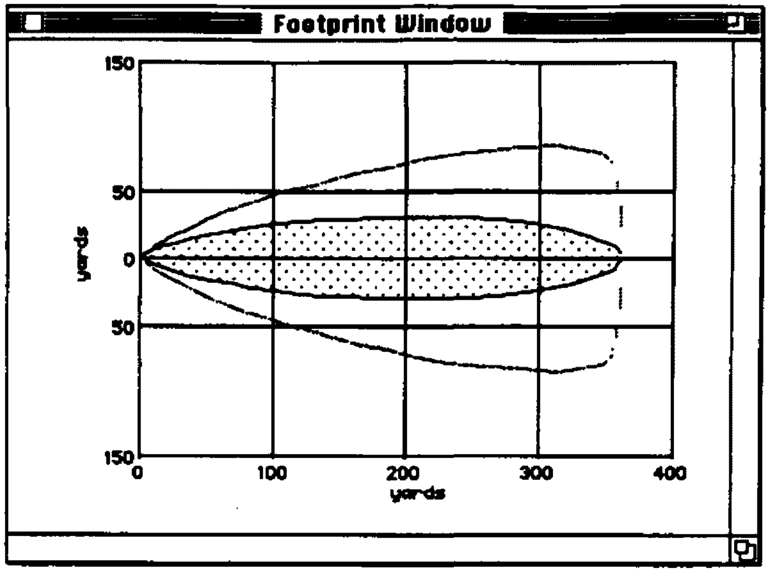
Eighth...

- Choose **Footprint** from the **Display** menu.



ALOHA will display a diagram of the footprint for this chlorine release. Check the Text Summary window to see the maximum downwind distance that the footprint may extend (the Maximum Threat Zone). ALOHA expects the footprint to extend downwind for about 362 yards.

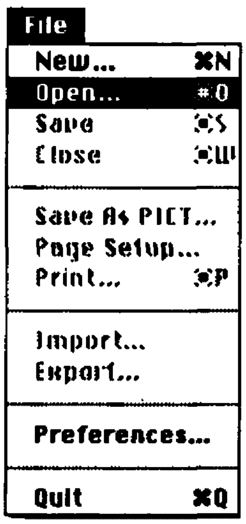




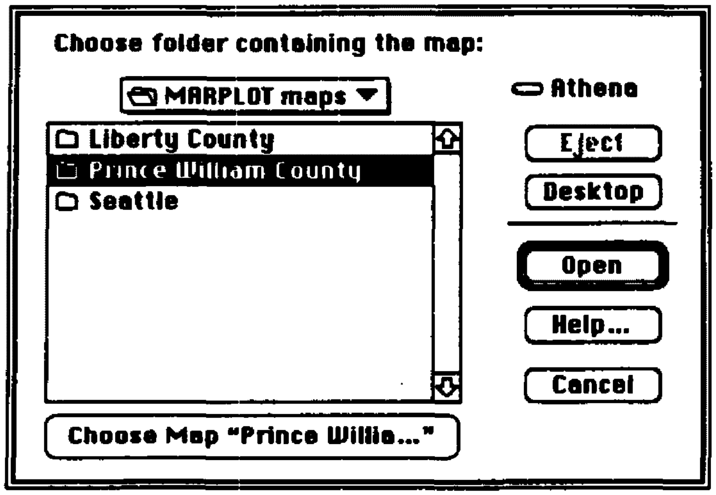
Ninth...

1 You're now ready to plot this footprint on a map of the area in MARPLOT, and to obtain a concentration estimate for the workmen's location. Select **Go to Map** from the **MARPLOT** submenu under ALOHA's **Sharing** menu to bring MARPLOT forward.

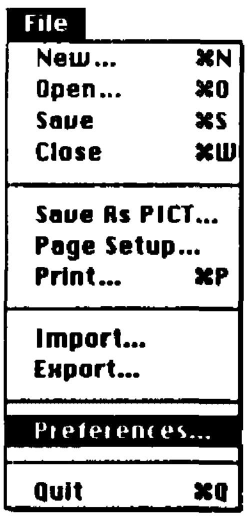
2 Choose **Open** from MARPLOT's **File** menu.



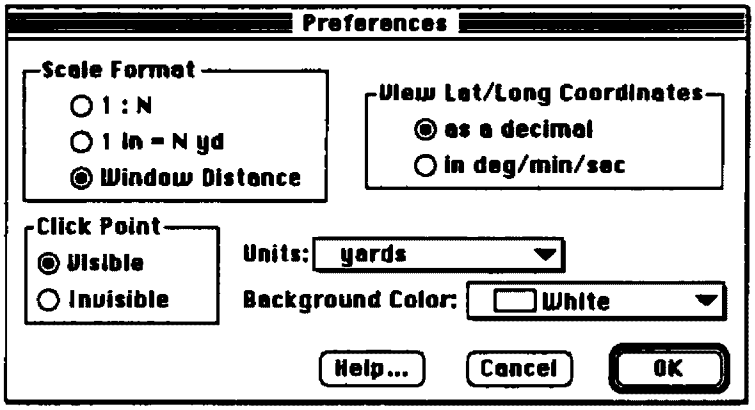
3 Click on the map folder titled "Prince William County." Click **Choose Map "Prince Willia...."**



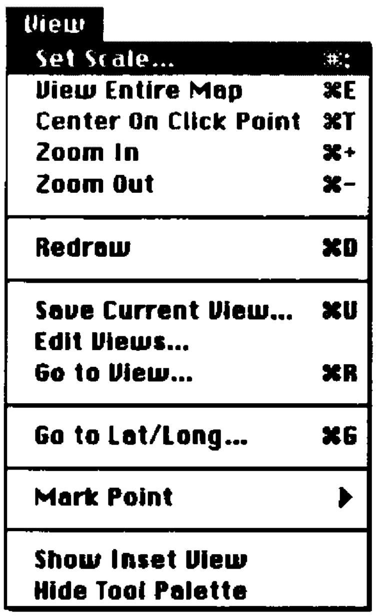
4 You're about to change the map settings to make streets and railways visible. You'll need to zoom the map in before you do so. (Otherwise, so many features will be visible on the map that you won't be able to distinguish among them.) First, we'll choose units for the map scale. Choose **Preferences** from the **File** menu.



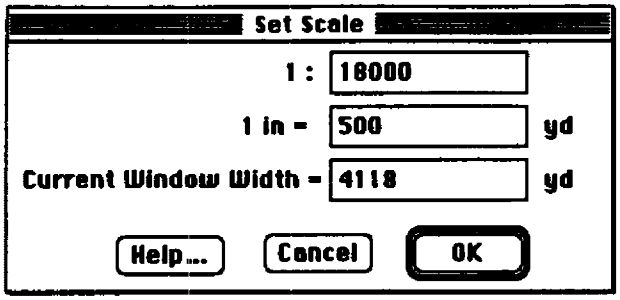
5 Choose **yards** from the popup menu as your units of map scale. Also check to be sure that **Visible** click point is selected. (This means that MARPLOT will place a small crosshair mark wherever you last click on the map.) If you wish, you may also change the map's background color and/or the formats for displaying the map scale and the geographical coordinates of locations on the map. Click **OK**.



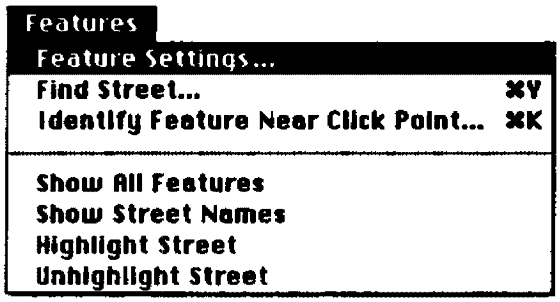
6 Choose **Set Scale...** from the **View** menu.



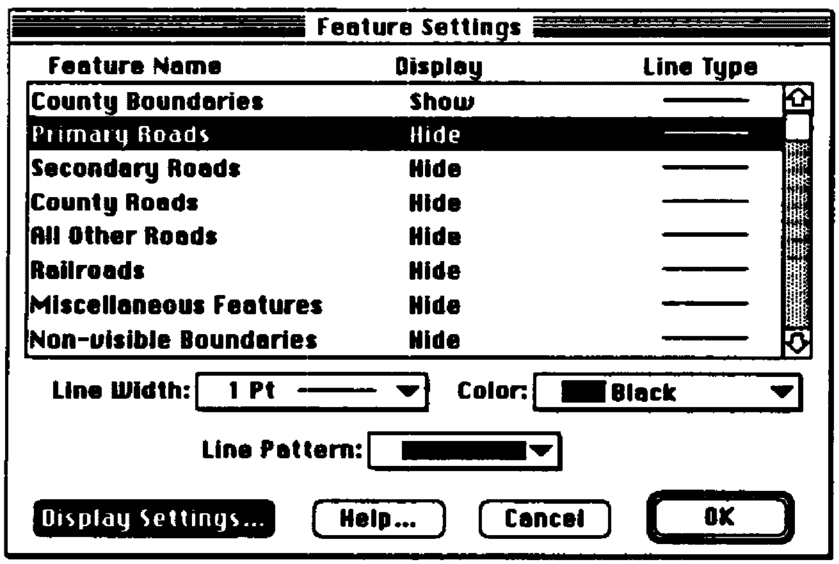
7 Enter "500" in the middle data field, so that the map scale becomes 1 inch to 500 yards. Click **OK**.



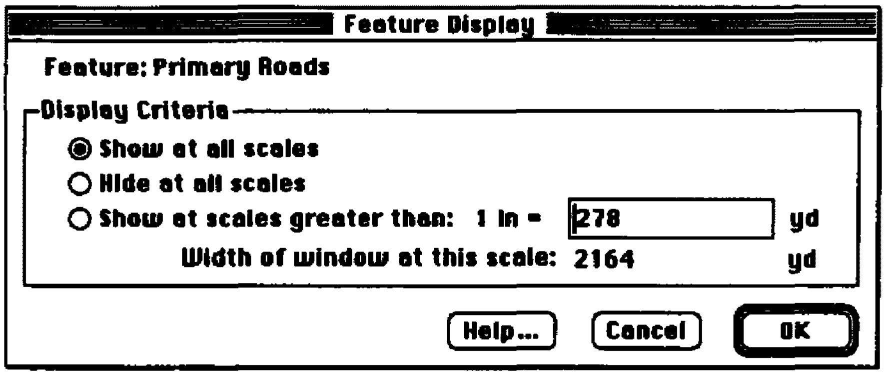
8 Choose **Feature Settings...** from the **Features** menu.



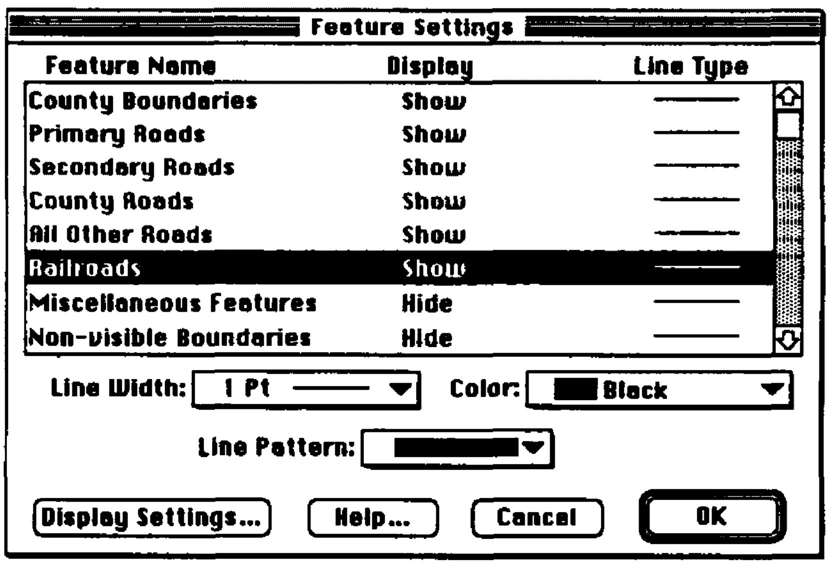
9 Click on **Primary Roads**, then click **Display Settings...**.



10 Click on **Show at all scales**, then click **OK**.

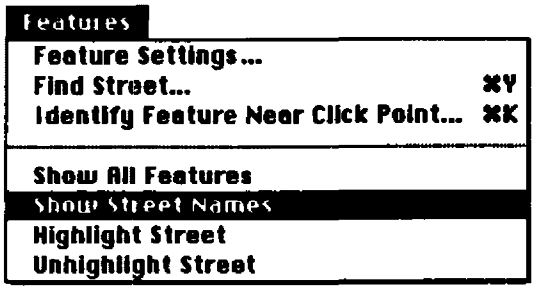


11 Repeat this procedure for the following features: Primary Roads, Secondary Roads, County Roads, All Other Roads, and Railroads. (As a shortcut, you can toggle a feature's setting by holding down the option key, then clicking on the feature's name in the Feature Settings screen.) Your Feature Settings screen should look like the one below. When you've finished, click **OK**.

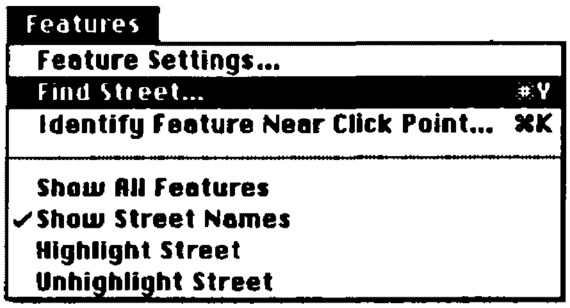


MARPLOT will automatically redraw the map, with streets and railroad lines visible.

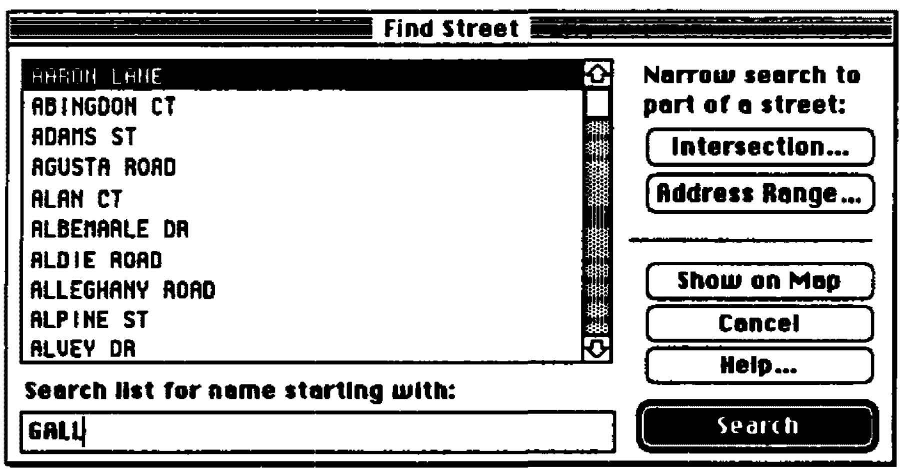
12 Choose **Show Street Names** from the **Features** menu.



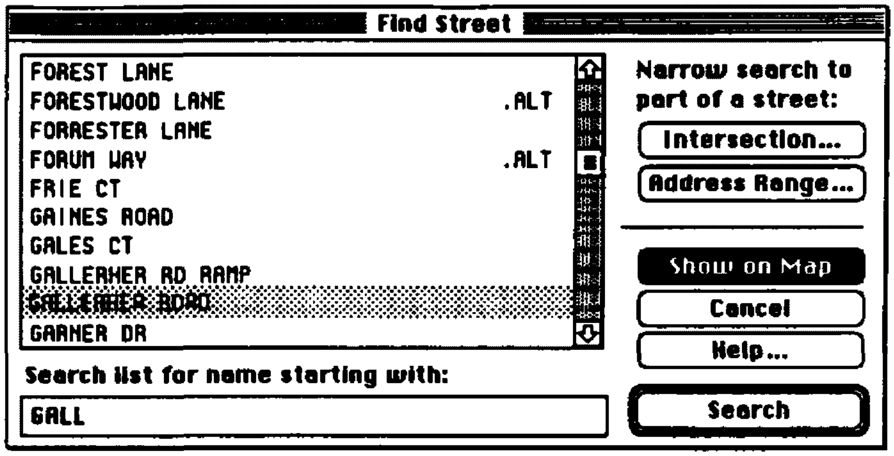
13 Now you'll search on the map for the area where the accident occurred. Choose **Find Street** from the **Features** menu.



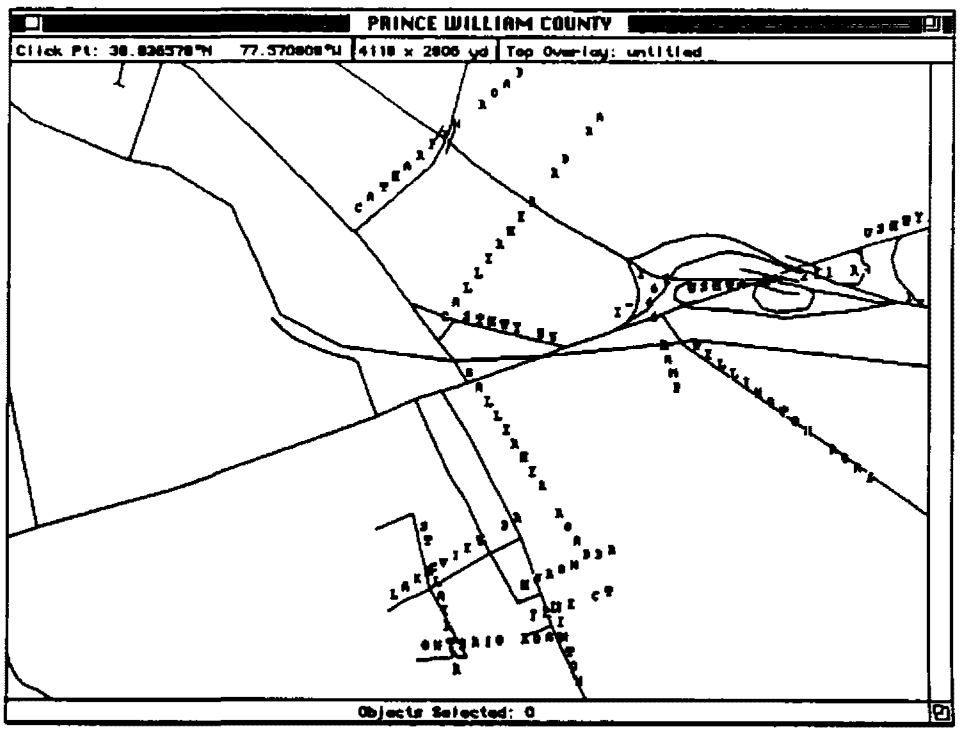
14 To search for Gallerher Road, type "GALL" in the **Search list for name starting with:** field. Click Search



15 Click "GALLERHER ROAD," then click **Show on Map**.

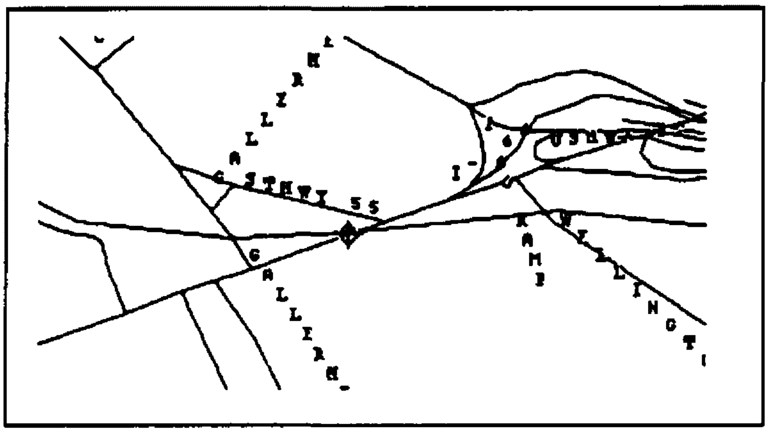


16 Your map should look like the one below. If you have a color monitor, Gallerher Road will appear in red, and all other streets and roads will be drawn in black. U.S. Highway 29 (211) crosses the map as a straight line from the lower left to the upper right of the map. The Southern Railway, which is not labeled, crosses the map as a winding line from the upper left corner to the middle right side of the map.

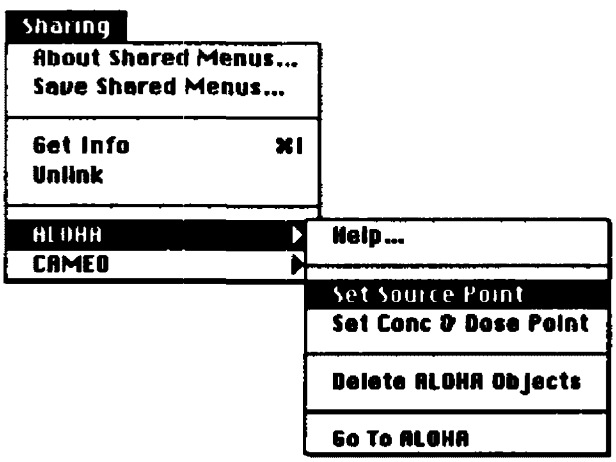


17 Find the point where the Southern Railway line crosses U. S. Highway 29 (211).

Choose  from the tool palette, then click once at that point to set a source location for ALOHA. MARPLOT will place a visible crosshair mark, or "click point" at this location.

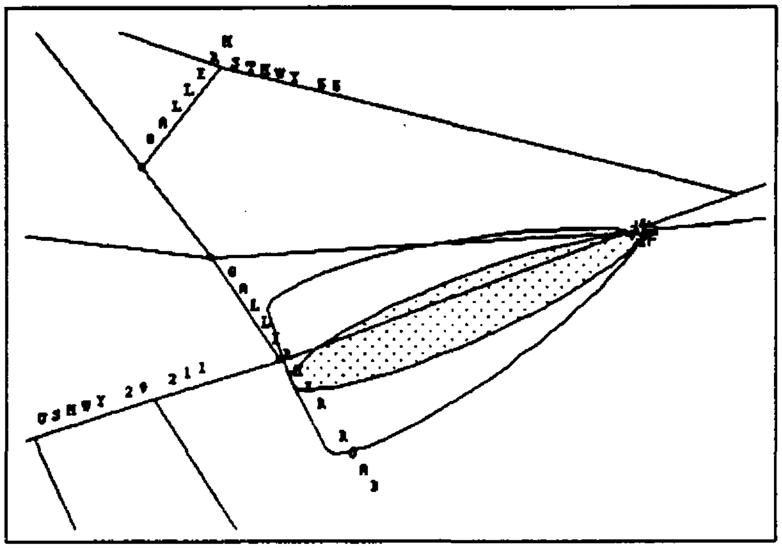


18 Choose **Set Source Point** from the **ALOHA** submenu under MARPLOT's **Sharing** menu.



19 An ALOHA footprint should automatically be drawn at that point (this may take a few seconds).

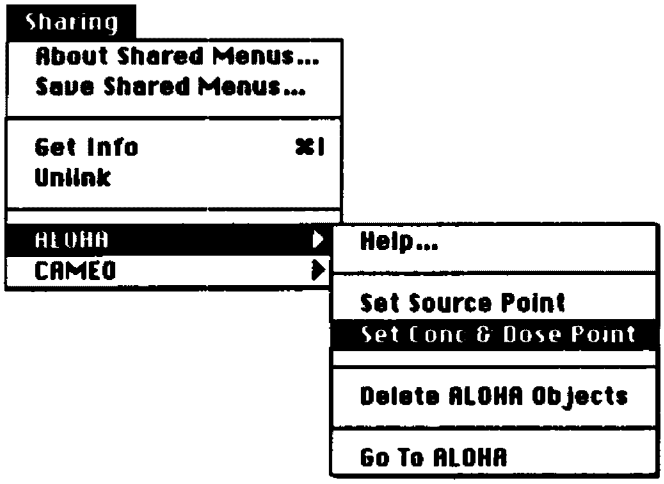
If you wish, click on  in the tool palette, then click on the footprint to zoom in for a closer view.



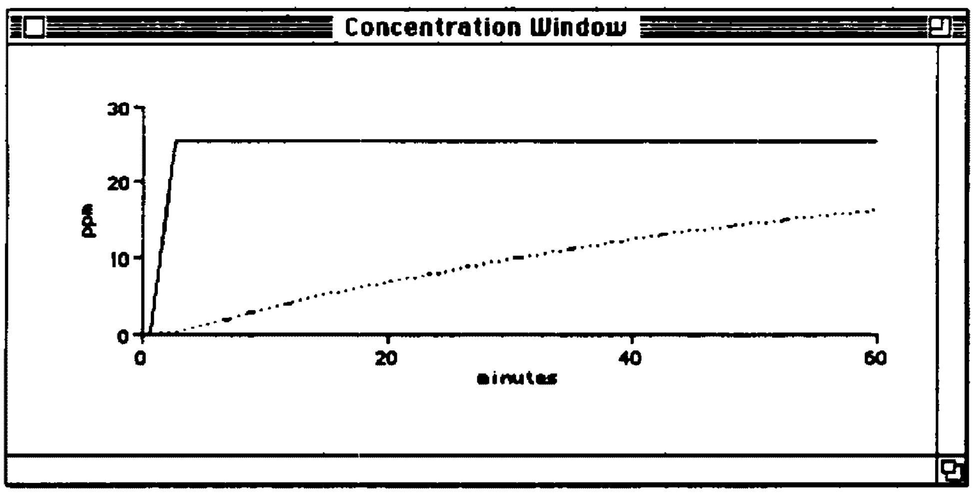
Now you'll choose the location for which you'd like an ALOHA Concentration graph. Find the intersection of Gallerher Road and U. S. Highway 29 (211). (The leading edge of the footprint should nearly touch this intersection.)

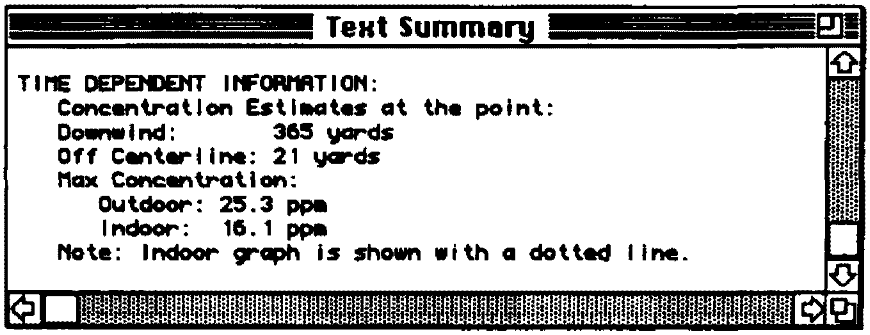
Be sure that you've selected the arrow tool, , from the tool palette, then click on this point.

21 Choose **Set Conc & Dose Point** from the **ALOHA** submenu under MARPLOT's **Sharing** menu.



ALOHA will come forward and will display a Concentration graph for the location you choose. Review the graph and the Text Summary window. ALOHA estimated that the workmen were exposed to an outdoor concentration of about 25 ppm, somewhat less than the IDLH for chlorine, for about an hour after the start of the release.





The purpose of running this scenario in ALOHA and MARPLOT was to get an estimate of the concentration of chlorine to which the workmen were exposed. Don't be concerned if the numbers that you see on your screen differ slightly from those shown here. ALOHA's estimates are affected by exactly where on the map you click. ALOHA was designed to give you "ballpark" estimates of source strength and dispersion. It cannot give you completely accurate predictions for a real release, because no model can account for every uncertainty. For example, ALOHA predicted that the workmen were exposed to a steady concentration of about 25 ppm of chlorine. That concentration would have been high enough to cause adverse health effects in the workers. However, if the wind shifted during the course of the release, the concentration at the workmen's location could have been higher or lower than ALOHA's estimate. If the chlorine was stored as a pressurized liquid, its initial release rate was probably greater than ALOHA predicted. Downwind concentrations then would have been higher, too. If you were responding to a real event, you might wish to obtain values for the tank car's dimensions, the amount of chlorine it contained, the size and location of the hole, and other information that you'd need to run ALOHA's more realistic Tank option.

Appendix B

Troubleshooting

This section addresses some of the issues that may raise the most questions in ALOHA. These include things that are not truly problems but may be troublesome when you're trying to interpret what ALOHA is saying or asking of you. In most cases, when you encounter a problem while running ALOHA, the model will alert you of the problem and suggest a solution. These cases are *not* discussed here. Less often, you may encounter problems and be unsure of how to solve them. Following are some of these cases.

I want to modify a chemical (either inside ALOHA or using ChemManager), and I can't change a property—it appears gray.

The property in question is internally calculated by ALOHA from information in its chemical library. You must add a new chemical (with a different name, such as chlorine-2) and enter a new value for the property.

I have drawn a footprint, but when I double-click inside to get the concentration and dose curves, I get a message saying that the concentration at that point is insignificant.

Your footprint was drawn using the heavy gas calculations. Remember that, for the footprint calculation, the heavy gas calculations use the maximum average release rate as though it were continuous for the entire 60 minutes or seconds (whichever is appropriate). In a case where the release rate is high to start with, then decreases significantly (e.g., a pressurized release), the heavy gas model will overpredict the footprint. ALOHA calculations of concentration and dose made for a particular location, however, account for changes in the release rate over time, and are not overpredicting. Gaussian footprint calculations also account for changing release rate over time.

I am trying to model the release of gas from a gas pipeline, but ALOHA will not run because it says the pipe is too short. It tells me that the length must be at least 200 times the diameter of the pipe.

In some instances the pipe may be too short relative to its diameter. If this is the case, and the diameter of the pipe is greater than 20 cm, you may use the **Tank** option instead, selecting the configuration of a horizontal tank. If the length of your pipe is less than one meter and it is connected to a tank source, you may also use the **Tank** option and select **short pipe/valve** as the type of leak. Both of these alternatives should produce conservative estimates of downwind dispersion.

I'm using a Macintosh, and ALOHA will not open my save file. I either get an error message, or the file opens, then gets lost.

Your save file may not be compatible with the version of ALOHA that you are using. The current ALOHA cannot read any save files made with previous versions of ALOHA. In addition, check to see whether you have installed both the math coprocessor and the non-math coprocessor versions of ALOHA on your hard drive. If you have, ALOHA may save a math coprocessor version-file as a non-math coprocessor-version file. Remove the version that you do not need (e.g., if you're using a machine without a math coprocessor, remove the math coprocessor version of ALOHA).

I have a SAM hooked up, and I have set the SAM options using the Atmospheric menu, but the Source menu option is grayed out—I can't set my source.

The SAM has not been collecting data for five minutes or it has not received valid data. In order for the SAM to send information to help determine the most appropriate stability class, it must have at least five minutes' worth of data. Your Text Summary screen should tell you that you do not have five minutes' worth of data yet or that the transmissions have not been valid. In addition, look at the **Show processed data** option under the **SAM Options** menu. If it reports sigma theta as -1.0, the station has been running for less than five minutes.

ALOHA tells me that my value is not within allowable limits.

ALOHA will accept values for numeric inputs within specified ranges. These restrictions help ensure that you do not inadvertently use unrealistic values for an input. If you enter a value outside of the allowable range, ALOHA will warn you and tell you what the limits are. You must reset the value before ALOHA will continue. Most of these ranges are summarized in the table in this appendix. Check ALOHA's on-line help topic for more information about any ALOHA input.

The Text Summary screen shows a Maximum Computed Release Rate that is significantly higher than the Maximum Sustained Averaged Release Rate. How should I interpret these numbers?

ALOHA averages the release rate over five steps. The maximum computed release rate corresponds to the very highest release rate possible with the given scenario. The maximum sustained averaged release rate is averaged over at least a minute. If these values are significantly different, the maximum release rate was sustained for less than a minute. This is most common in the case of pressurized releases.

When I change atmospheric conditions, ALOHA tells me that it is unable to verify the consistency between my new atmospheric data and the source data. Then I have to reset the source.

Puddle, **Tank**, and **Pipe** source strength calculations are directly affected by atmospheric conditions. Changing atmospheric conditions will change these source calculations so source strength must be recomputed. The Text Summary screen will remind you which source option was last used. If you return to the same source option, information about the scenario will still be there EXCEPT information about the amount released (puddle size, height of hole in tank, etc.).

I want to make a few changes, but every time I make one change I have to wait for ALOHA to recalculate and redraw everything before I can make the next change.

You should select **Calculate** from the **Display** menu and tell ALOHA that you only want to update ALOHA's windows when you select them manually. To do this, choose **Manual update of all visible windows.** The **Calculate** option is set by default to update the windows automatically every time something is changed.

When saving an ALOHA file, not all of my data is saved.

ALOHA will save all information which does not pertain to meteorological conditions and the amount spilled. The model was developed as a tool for first responders; saving a wind speed and release scenario that would most likely never be exactly repeated may be misleading. Hence, all information EXCEPT meteorological conditions and information about the amount spilled can be saved. If you want to archive the results of an ALOHA scenario run for later viewing, save a Spy file.

When I save an ALOHA file in the Spy format, I can't open it from ALOHA.

Spy files can only be opened by AlohaSpy. These files cannot be opened or used by ALOHA.

I am trying to run a scenario, and a progress bar saying "Heavy Gas Calculations in Progress" has been up forever! How long will this take to run?

Heavy gas calculations may be slow to complete, especially if you're using a computer without a match coprocessor. Use the progress bar to get a rough estimate of how long ALOHA will take to finish calculating. If you've waited three minutes and the bar is about half-way across the dialog, you have about three minutes to go. If you don't have that long to wait, you may cancel the calculations and then run the Gaussian module. You should rerun the scenario with the heavy gas module as time allows.

The Text Summary screen warns me that it is unable to save the archived SAM data because the disk is full.

The floppy disk or hard drive to which you are archiving SAM data has no more room left. Insert another disk (or hook up another hard drive) and continue archiving your data.

I'm using a Macintosh. While unpacking ALOHA, I get the message, "Can't write to destination file."

You have run out of space on your hard drive or have tried to unpack the file to the original floppy disk.

If you tried to unpack to your hard drive and received this message, remove unneeded files from your hard drive, including the partially filled ALOHA™ folder, until you have at least two megabytes of hard disk space available, and begin the unpacking process again.

If you received the message because you tried to unpack to the floppy that the file came on, click **OK**, then begin the unpacking process again, this time clicking the **Drive** button till your hard drive appears.

I'm running BitPlot with ALOHA in Windows. I have a map file that I created by scanning in a paper map. However, I can't open it in BitPlot. What's wrong?

A variety of graphic file formats are available for users of DOS and Windows. The scanned map that you created is likely to be in .pcx format. You must convert it to .bmp format before BitPlot can read it in; that's the only format that BitPlot recognizes. We describe how to make the conversion in the BitPlot Appendix.

I'm running BitPlot with ALOHA in Windows. I have the current ALOHA footprint displayed on a map in BitPlot, and I'm trying to print it. It's so slow! Am I doing something wrong?

Bitmapped graphics may print very slowly because the graphic must be resized while it's being printed. If your time is limited and you need a printout of the footprint, print out the footprint displayed on a grid from within ALOHA.

I'm running BitPlot with ALOHA in Windows while I'm responding to a spill. I'm also using a SAM station to collect weather data. I've had a footprint displayed in BitPlot for the last half hour. I know the wind has shifted direction but the footprint hasn't changed at all. What's wrong?

Whenever you bring BitPlot forward in Windows, you'll halt data transmission from the SAM to ALOHA. The same thing can happen when you use MARPLOT and ALOHA together on a Macintosh. Bring ALOHA forward to update the weather data and footprint.

I thought I knew what an ALOHA footprint looks like. But on my current footprint plot, I see a big, shaded circle around my source point. What is it?

There are two possible explanations, depending on your scenario. Is your source a puddle of spilled liquid (either standing by itself or pooling under a leaking tank)? If so, and if the puddle is large in diameter relative to the size of the footprint, you may be seeing it on the footprint plot.

You may also have a heavy gas footprint. If a heavy gas is escaping into the atmosphere at a fast enough rate, it will form a large "blanket" of gas over the source point before it moves downwind. If the blanket is big enough, ALOHA will show it on your footprint plot.

We have two computers in our office that sometimes give different answers for the same ALOHA scenario.

Individual computers can come up with different answers when they make the same calculations. In particular, different computers will round off numbers differently as they make their calculations. This can have a visible effect on ALOHA's source and dispersion estimates. You may have one machine with a math coprocessor and one without, or a Macintosh and an IBM-compatible, or your computers may differ in other ways.

I'm using a Macintosh. I just copied ALOHA onto my hard drive. I started the program, and chose Location from the SiteData menu. But instead of seeing the list of cities, I got an error, "Error returned from FillCityList()". Then when I chose Chemical from the SetUp menu, I got another error, "Error returned from FillChemList()". Did I break ALOHA?

You may have very little room remaining on your hard drive. ALOHA needs about 100 kilobytes of space to create index files for its city and chemical libraries. The program displays the errors that you saw if it can't find enough room. From your Desktop, click on the icon for your hard drive, then choose **Get Info** from the **File** menu to see how much room you have left. You can solve this problem by removing some files from your drive to make more room for ALOHA's index files.

I'm running ALOHA under Microsoft Windows. Every now and then, I get an error message, "System Error – Cannot write to device AUX." Then I'm given a choice of choosing "Cancel" or "Retry." Am I doing something wrong? What should I do here?

This error message is Windows' way of alerting you that something is wrong. It can appear when you're trying to select an item from the menu, print an ALOHA document, or at other times. It's hard to figure out what the problem may be when this message appears. The best thing to do is to choose "Cancel," then quit ALOHA, and restart the program.

Allowable Input

Properties	Must be... ...greater than (or equal to)	...less than (or equal to)
SiteData		
Air exchange rate	0.01 per hour	60 per hour
Elevation	-500 ft (-153 m)	28,000 ft (8,535 m)
Latitude	0°	90°
Longitude	0°	180°
Month	1	12
Day	1	31
Hour	0	23
Minute	0	59
Meteorological		
Air temperature	-100°F (-73°C)	150°F (65°C)
Cloud cover	0/10	10/10
Ground roughness	0.0004 in (0.001 cm)	78 in (200 cm)
Inversion height	10 ft (3 m)	5000 ft (1,524 m)
Relative humidity	0%	100%
Wind speed	2 kts (1 m/s, 2.3 mph)	100 kts (51 m/s, 115 mph)
Source Input		
Amount entering the atmosphere (Direct)	0 (any units)	1,000,000,000 (any units)
Ground temperature	-58°F (-50°C)	188°F (70°C)
Pipe diameter	0.4 in (1 cm)	32.8 ft (10 m)
Pipe hole size	0	diameter of the pipe
Pipe length	200 times pipe diameter	6.2 mi (10 km)
Pipe pressure	twice ambient	680 atm (10,000 psi)
Pipe temperature	boiling point	2,795°F (1535°C)
Puddle area	4 sq. in. (25 sq. cm)	12,100 sq. yds (10,000 sq. m)
Puddle depth	0.1 in (0.25 cm)	110 yds (100 m)
Puddle mass	0.22 lbs (0.1 kg)	110 tons (100 metric tons)
Puddle volume	0.03 gal (.1 l)	2,640,000 gal (10000 cu.m)
Source height	0	5000 ft (1,525 m)
Tank diameter	0.7 ft (20 cm)	3,280 ft (1,000 m)
Tank length	1.7 ft (50 cm)	3,280 ft (1,000 m)
Tank mass	0	2,000,000 lbs (907,200 kg)
Tank opening	0.04 in (0.1 cm)	circular, cross-sectional area or 10% of surface area —whichever is smallest
Tank pressure	1.1 atm	68 atm (1,000 psi)
Tank temperature	-459°F (-273°C)	19,937°F (5503°C)
Display		
Dose setting	1	5
User spec. conc.	0	1,000,000 ppm
User spec. scale	1:0	1:1,267,200

Appendix C

AlohaSpy

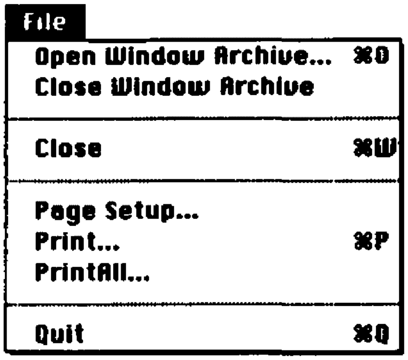
AlohaSpy is a companion application to ALOHA. Use it to view or print archived Spy files that you have previously saved from within ALOHA. You may wish to create a Spy file whenever you have run an ALOHA scenario and would like to save your results for later viewing. An archived Spy file contains the information from all the windows visible in ALOHA at the time the file was saved.

Whenever you'd like to create a Spy file, first check that all of the windows that you'd like to archive are visible in ALOHA. Then select **Save As...** from ALOHA's File menu. Click **SPY** on the **Save As** Options dialog, type in a file name, andclick **OK**.

Spy files can be opened only with AlohaSpy.

Double-click on the AlohaSpy icon when you wish to use the application to view or print Spy files. Each menu item available in AlohaSpy is described below.

AlohaSpy's File menu



Open Window Archive...

opens a Spy archive file that has been created in ALOHA. If you are currently viewing a Spy archive file, selecting a new archive file to open will close the current file.

Close Window Archive

closes an open Spy archive file.

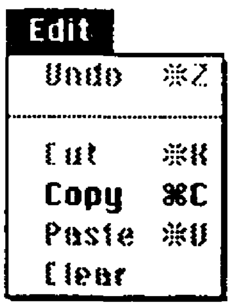
Close

closes the front window of the current archive display.

Print...

prints the contents of the front window.

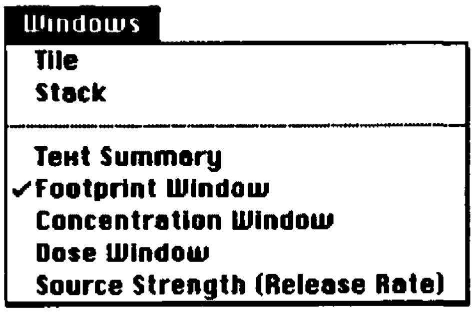
Edit menu



The Undo, Cut, Paste, and Clear menu items are not available in AlohaSpy.

Copy

copies the contents of the front window to paste into another application.



Windows menu

Tile

allows you to view all of the open archive windows simultaneously on the screen, with the windows arranged side by side and fit to the screen.

Stack

layers all of the open archive windows on top of each other, so that only the title bars from the back windows, along with the entire front window, are visible.

Menu items displayed below the **Stack** menu item represent the individual window names. To open a closed window or bring a window forward, choose the desired window name from this list. A check mark is placed next to the name of the current front window.

Appendix D

BitPlot

In this appendix...

Introduction

BitPlot, a companion application provided with ALOHA Windows, is installed in your ALOHA directory when you install ALOHA (and it needs to be kept in the same directory as ALOHA). It allows you to use a simple electronic map of your city or community with ALOHA. When you open such a map in BitPlot, mark the location of a spill on the map, and run a footprint calculation in ALOHA, BitPlot will display the ALOHA footprint on your map.

BitPlot can use any map saved as a Windows device-independent bitmap (.bmp) file. Such files have names ending with a .bmp extension. BitPlot cannot directly use files produced with vector-based graphics programs such as AutoCAD. However, it is possible to convert many vector-based graphics files to .bmp format by first converting them to .pcx format. BitPlot cannot use MARPLOT maps; use MARPLOT if you wish to plot an ALOHA footprint on a MARPLOT map. Refer to the MARPLOT manual for information about how to do this.

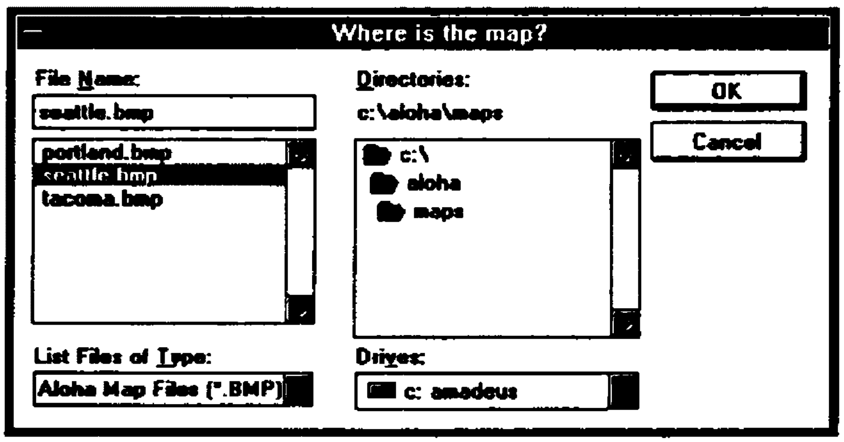
Plotting an ALOHA footprint in BitPlot

Once you have created a background map for footprint plotting, and have saved it as a .bmp file, you can load it into BitPlot and plot a footprint on it. You must be running both ALOHA and BitPlot simultaneously in order to do this.

In ALOHA, choose a chemical, enter atmospheric conditions, complete a source option, and ask for a footprint. If BitPlot is present in your ALOHA directory, ALOHA will display a hierarchical **BitPlot** menu item under its **Sharing** menu. Select **Go to map** from the BitPlot menu item to launch BitPlot or to bring it forward if it is already running.

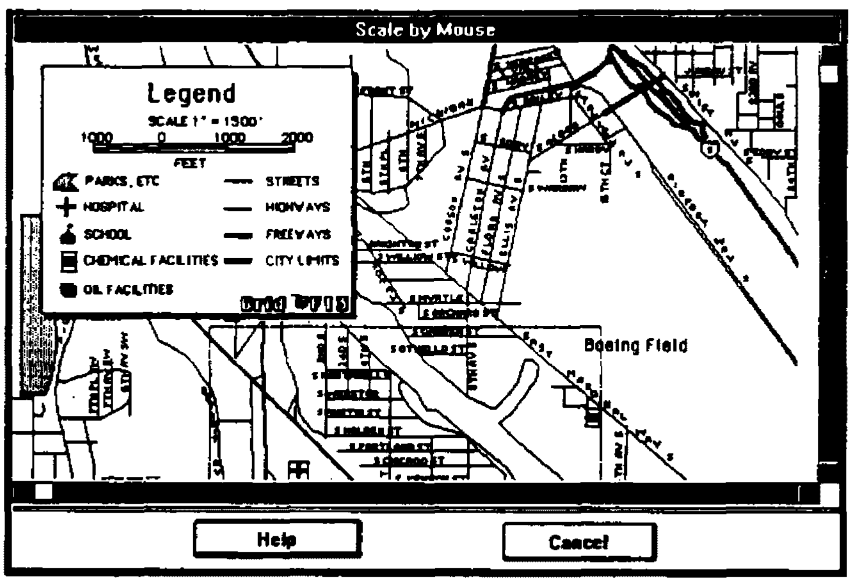
Opening a new map

When you first open BitPlot, the program will display a dialog box titled "Where is the map?" (You can access this dialog later by choosing **Open Map...** from BitPlot's **File** menu.) Choose the map file that you'd like to open. Click **OK** to open the map.

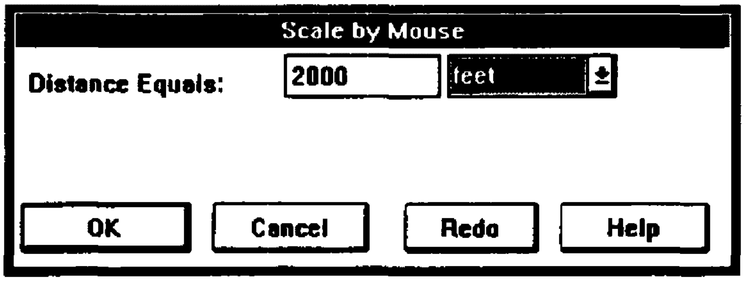


Entering the map scale

Next, you'll need to enter your map scale. You will see your map displayed on your screen inside a scrolling window. You'll need to know the distance between any two points visible on your map. These can be physical places, such as the grocery store on Main Street and the Post Office on Elm, or tick marks on a map legend. We recommend that whenever you create a map for use with ALOHA and BitPlot, you place a scale bar in the upper left corner to facilitate setting the map scale. Scroll the map until both points are visible on your screen. Move the cross-hair cursor to the first point, click your mouse button once, then move the cross-hair to the second point and click the mouse button again.



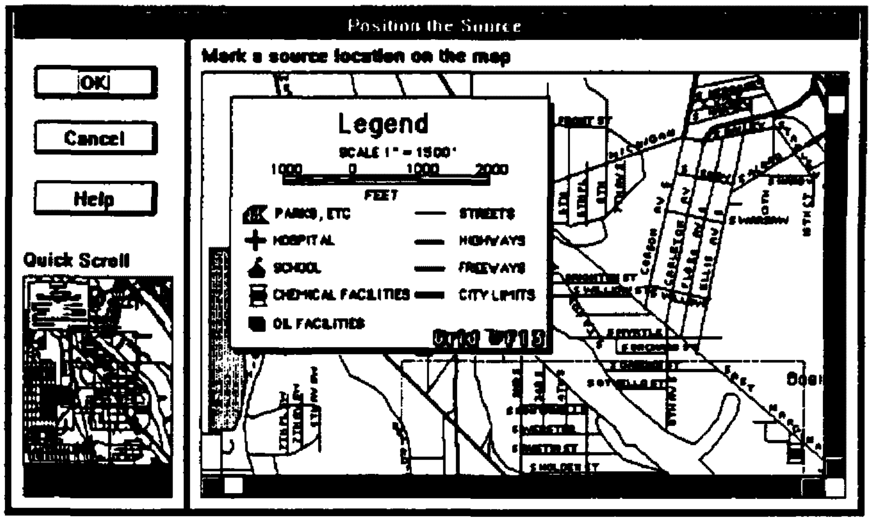
You'll see the following dialog box:



Enter the distance between the two points in the input field next to 'Distance Equals:'. Click on the pull-down units menu and choose appropriate distance units. If you made a mistake when you chose your two points, click **Redo**. You'll be returned to your map for another opportunity to choose two points and set a distance. Click **OK** when you're finished.

Locating the spill source

After you click OK, you'll see your map again on your screen. Scroll the map until you can see the spill location on your screen. You can navigate rapidly around on your map by clicking on the approximate spill location on the small map in the Quick Scroll window in the lower left corner of the screen. The full-sized map will center on the point that you clicked. Once you have located the spill point on the full-sized map, click once directly on it. You will see a blinking red cross-hair mark at that point. If you make a mistake, just click again on the correct location; the cross-hair mark will be relocated to the new click point. Once you are satisfied, click **OK** to set your source point.



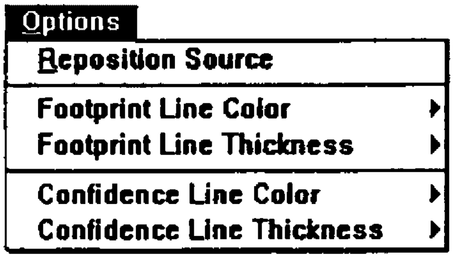
Remember that ALOHA does not account for hills, valleys, and other terrain types when it makes footprint calculations. The footprint that you will see in BitPlot will simply be plotted over the map.

Displaying the footprint

If a footprint is already displayed in ALOHA, it will automatically be drawn on your map in BitPlot. (If you haven't completed footprint calculations in ALOHA, choose **Go to ALOHA** from BitPlot's **Sharing** menu to return to ALOHA or to start ALOHA if it's not yet running. Complete footprint calculations in ALOHA, then choose 'Go to map' from the hierarchical **BitPlot** menu item under ALOHA's **Sharing** menu to return to BitPlot; your footprint will automatically be drawn on the BitPlot map when you do so.)

Copying, printing, and modifying the footprint

You may choose to change the line thickness and color of the footprint and the confidence lines drawn by BitPlot. Choose from among the hierarchical **Line Color** and **Line Thickness** menu items in the Options menu to make these changes. Checkmarks in the menu will identify the colors and thicknesses that you have chosen. Also, the settings that you choose will be saved and will be in effect for your next BitPlot session.



Choose Copy from the **Edit** menu if you wish to copy the map and footprint displayed in BitPlot's window into the Windows Clipboard.

Choose **Print** from the **File** menu to print the footprint displayed on the background map. Note that printing of bitmapped graphics from BitPlot can be very slow, because the graphics must be resized before being printed.

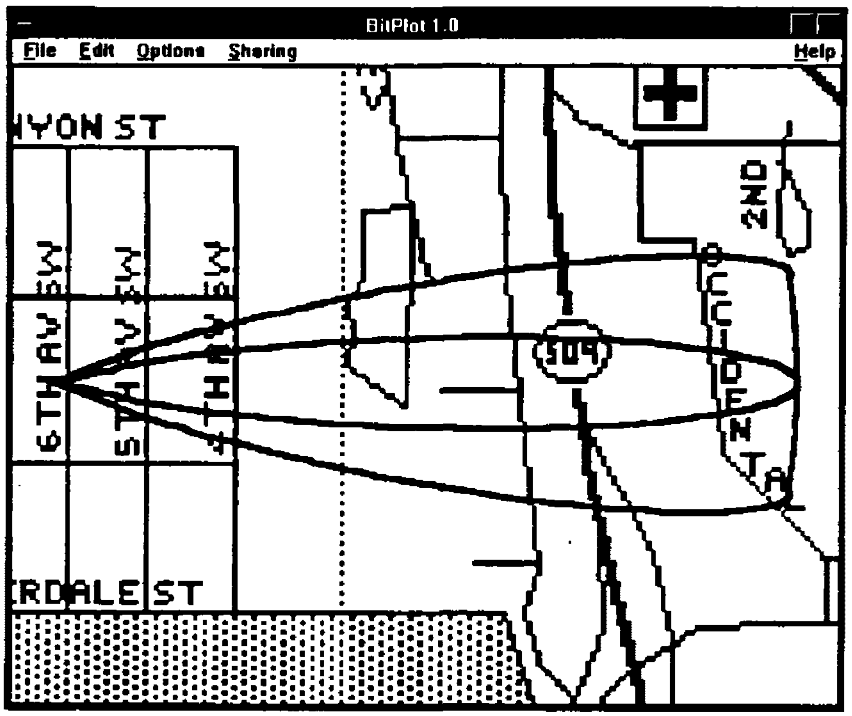
Getting a Concentration vs. Time graph

If you'd like to see ALOHA's Concentration vs. Time graph for a location on your map in BitPlot, just double-click on that point on the map. ALOHA will come forward automatically, and will display a Concentration graph for your location. When you've finished viewing the graph, choose **Go to map** from the BitPlot submenu under ALOHA's **Sharing** menu to return to BitPlot.

When you indicate a location to ALOHA by clicking on your map in BitPlot, ALOHA will remember the location in terms of its fixed east-west, north-south coordinates.

If you later wish to reposition the source location, choose **Reposition Source** from the **Options** menu. You can close the map by choosing **Close Map...** from the **File** menu. You also can open a new map at any time, by choosing **Open Map...** from the File menu. Opening a new map will automatically close any map that you had already opened.

Figure E-1.
An ALOHA footprint displayed on a background map in BitPlot.



If you won't be using BitPlot...

If you do not wish to use BitPlot, you may remove it from your computer by deleting the program BitPlot.exe and its associated help file BitPlot.hlp from your ALOHA directory.

Converting .pcx files to use with BitPlot

Graphic files saved in .pcx format are a common type of bitmapped graphic file available to users of DOS and Windows. This is a typical format for maps or other images created using a scanner.

You can easily convert .pcx files to .bmp files with your Paintbrush program, which should have come packaged with your copy of Windows. If you have a map in .pcx format that you would like to use with BitPlot, follow these steps to make a .pcx to .bmp conversion:

1. Open your .pcx file in Paintbrush. Choose **Open** from the Paintbrush File menu to do this. Click once to highlight the name of your map file, then click on the **OK** button.

2. Next, choose **Save As** from the Paintbrush File menu. Choose **Monochrome bitmap (.BMP)** from the pulldown list of file types. The file name extension for your file will automatically change to .bmp, the appropriate extension for files to be used with BitPlot. (You may also save BitPlot maps as 16-color bitmaps - but you will rarely want to do so. Color graphic files require about four times as much space in memory as monochrome maps.)

3. Finally, click **OK** to save your converted map file. It's now ready to be loaded into BitPlot whenever you need it.

Glossary

ALOHA — The air dispersion model, Areal Locations of Hazardous Atmospheres, also known as the CAMEO Air Model. (ALOHA is a trademark of the U.S. Government.)

ALOHA Helps — The file containing all of the text that ALOHA uses during on-line Help inquiries.

ALOHA Resources — The file that contains most of the resource code for ALOHA.

Aerosol — Liquid or solid particles suspended in a gas.

AlohaSpy — AlohaSpy is a companion application to ALOHA. Use it to view or print ALOHA model runs.

Ambient pressure — The atmospheric pressure at a given location.

Ambient saturation concentration — The concentration of the vapor in equilibrium with the atmosphere. The value shown on the ALOHA screen represents the maximum concentration at which the vapor could be sustained in a closed room at the given (ambient) temperature and pressure. Substances that are gases at ambient temperature and pressure have an ambient saturation concentration of 100%, or 1,000,000 ppm.

Ambient temperature — The temperature of the air at a given location.

Anhydrous

Without water. Some chemicals are commonly shipped or stored as a solution, using water as the solute.

Archive data

An option that allows an ASCII tab-delineated file to be created from data transmitted to ALOHA by a meteorological station (SAM).

Atmospheric stability

A measure of the tendency of a "parcel" of air to move upward or downward. In the air model the stability is scaled from A-F, where A implies very unstable conditions and F is for very stable conditions.

Automatic update

An option that lets you automatically update all visible windows that are opened in ALOHA each time that location, building type, source strength, or display options are changed (see Calculate).

Average

The sum of *n* values divided by *n*.

Boiling point

The maximum temperature at which a substance's liquid phase can exist in equilibrium with its vapor phase. Above the boiling point a liquid vaporizes completely. (The boiling point is also the temperature at which the vapor pressure of a liquid is equal to the applied atmospheric pressure.) The boiling point depends on the chemical's composition and pressure. As pressure increases, the boiling point of a substance also increases. The "normal" boiling point is the temperature at which a liquid under one atmosphere of pressure boils.

For example, the normal boiling point of pure water is 100°C. Because pressure variations can be significant within a tank or pipe, the temperature at which a liquid boils under these conditions can differ significantly from its normal boiling point.

Calculate Located on the **Display** menu, this option lets you choose whether the windows in ALOHA will be updated manually or automatically.

CAMEO Air Model The air dispersion model that is used in conjunction with Computer-Aided Management of Emergency Operations (CAMEO™ 4.0). The CAMEO Air Model is also known as ALOHA.

ChemLib ALOHA's library of chemical properties. This library contains available physical and toxicological properties for each chemical in ALOHA.

ChemManager An application that can be used to permanently add, modify, or delete chemicals in the ChemLib.

CityLib ALOHA's location library. This library contains latitude and longitude, elevation, and time zone information.

Cloud cover The fraction of the sky overhead that is obscured by clouds.

Computational Located on the SetUp menu, this option lets you select the type of dispersion calculation to use in ALOHA (Gaussian or heavy gas). You can also change the dose exponent in the dose vs. time equation with this option.

Concentration The amount of a chemical in the air. It is usually expressed in ppm (by volume) or milligrams per cubic meter.

Conservative estimate An estimate is "conservative" if it is an overestimate.

Continuous source A release of pollutant into the air that lasts for a period of time. The maximum time that ALOHA considers is sixty minutes.

Crosswind The direction perpendicular, or at right angles, to the wind.

Cryogenic A term relating to substances at low temperatures. For purposes of the air model, this term refers to the use, storage and possible spilling of gases liquefied by refrigeration.

DEGADIS DEnse GAs DISpersion model. These are the computations that ALOHA uses to calculate the dispersion of a heavy gas.

DIPPR Design Institute for Physical PRoperty data. Many of the chemicals in ALOHA's chemical library use physical and chemical data from DIPPR.

Daylight savings time One hour is added to the local time during the spring for most U.S. locations; ALOHA checks the date that you enter and automatically makes this correction. If you select a location where the daylight savings time correction is unknown (e.g., outside the U.S.), ALOHA will ask you for this information.

Density

The mass of a substance per unit volume.

Direct Source

A source option that allows you to enter the amount of vapor entering the atmosphere. This can be entered as an instantaneous or continuous release.

Dispersion

The distribution of molecules or finely divided particles into a gaseous or liquid medium (e.g., the distribution of a toxic chemical cloud in the atmosphere).

Dose

The accumulated amount of chemical to which a person is exposed.

Dusts

Fine, solid particles at rest or suspended in a gas (usually air). These may have damaging effects on the environment, may be dangerous by inhalation or contact, and frequently constitute an explosion hazard when dispersed in air.

Eddies

Parcels of air of various sizes that leave their normal position within an otherwise orderly, smooth flow. For example, air that encounters an obstacle must go over or around it. This change in the direction of air flow often causes "swirls" of air, or eddies, to tumble off the back of the obstacle. Impediments to airflow can range from simple friction (grass) to larger obstacles (buildings), leading to eddies generated at many different sizes.

Entrainment

The mixing of environmental air into a preexisting organized air current so that the environmental air becomes part of the current. For example, as a toxic cloud moves and mixes air into it, the pure gas cloud quickly becomes a gas/air mixture.

Flash boil

The sudden vaporization of a liquid. This most often occurs when a chemical is a gas at standard temperature and pressure, but is stored as a liquid by pressurization. If the storage container is breached, the sudden reduction in pressure can superheat the material (leave the material in a liquid state above its boiling point), at which point it will flash boil.

Footprint

One of ALOHA's graphical outputs. The "footprint" gives a picture that shows an overhead view of the ground-level dispersion of a vapor cloud out to the level of concern that you set.

Freezing point

The temperature at which the solid and liquid phases of a substance exist in equilibrium. The freezing point depends on the chemical composition and the applied pressure. The "normal" freezing point is defined at a pressure of one atmosphere. For example, the normal freezing point of water is 0°C.

Fumes

The characteristic smoky appearance and choking cloud resulting from the release of fuming materials, such as highly reactive liquids, gases, or molten metal (e.g., concentrated hydrochloric acid, sulfur monochloride). Fuming corrosive materials produce dense, choking, smoke-like emanations on contact with the moisture in air. Some liquefied gases that react with water when they evaporate may also be said to fume (e.g., anhydrous hydrogen fluoride, anhydrous hydrogen chloride). Fumes from hot or molten metals may not have a dense, smoke-like appearance but are hazardous, usually by inhalation.

GMT Greenwich Mean Time or Coordinated Universal Time. The reference time along the prime meridian or 0° longitude at Greenwich, England.

Gas(es) A very even dispersion of molecules of a material above its boiling point at the ambient temperature with the ability to occupy a space with uniformity. Typical gases include oxygen, air (a mixture of nitrogen, oxygen, and trace amounts of other gases), chlorine, and carbon dioxide.

Gaussian A bell-shaped, or "normal," probability curve. ALOHA can use a Gaussian distribution to describe the movement and spreading of a gas that is neutrally buoyant.

Ground roughness A description of the size of the obstacles on the ground that the toxic cloud is moving over. In ALOHA, you can select either Urban or Forest or Open Country, or enter a roughness length.

Ground temperature The temperature of the ground surface. The air model uses the temperature of the ground to estimate the amount of heat that is transferred from the ground to an evaporating puddle.

Ground type The physical composition of the ground beneath a puddle. The ground type is especially important for a spill of refrigerated liquids, where the heat required for evaporation is often supplied by the ground rather than by the atmosphere.

Heavy gas A gas that has a density greater than that of the surrounding air. There are several reasons why a gas may be a heavy gas, or may behave like a heavy gas: 1) because its molecular weight is greater than that of air (29 kg/kmol), 2) because it is stored cryogenically (refrigerated), or 3) because aerosols form in sufficient amounts during a release to make the mixture behave like a heavy gas.

IDLH Immediately Dangerous to Life or Health. This value represents a maximum concentration from which a person could escape within 30 minutes without any escape-impairing symptoms (like severe eye or respiratory irritation) or any irreversible health effects. (NIOSH/OSHA Pocket Guide to Chemical Hazards, 1987).

Infinite tank source

An approximation used to describe a situation in which the volume of a discharging, pressurized tank is much greater than the volume of a long pipe connecting it to its discharge point. The pressure and temperature of the material in the pipe can then be taken to be constant throughout the duration of the release.

Instantaneous source

A release that occurs very rapidly. ALOHA assumes that an instantaneous release lasts one minute.

Inversion

An atmospheric condition in which a shallow, unstable layer of air near the ground lies beneath a markedly stable layer of air above. The height of the abrupt change of atmospheric stability is known as the "inversion height."

An inversion can cause the surface concentration of a pollutant to remain considerably higher than might be expected.

Latent heat of vaporization

The amount of heat released when a unit mass of a substance vaporizes.

Level of concern

The concentration at which you wish ALOHA to draw a footprint.

Manual update

When this option is selected, the visible windows will be updated only when you select **Calculate Now** from the **Display** menu.

Mass

Amount of chemical by weight.

Maximum sustained average release rate

The highest average release rate sustained for at least a minute. This value will be seen on the source strength graph. Note that a pressurized release may have a very high rate for the first few seconds and a considerably lower release rate once the pressure inside the releasing vessel has been reduced. In this case, the maximum sustained average release rate may be considerably lower than the maximum computed release rate.

Maximum computed release rate

The maximum release rate that could occur from the given scenario. This rate can be significantly higher than the maximum sustained average release rate seen on the source strength graph of ALOHA, particularly in the case of a pressurized release. (See maximum sustained average release rate).

Military time

Time based on a 24-hour clock (e.g., 1330 is the military expression of 1:30 p.m.). The spill time for the air model is taken from either the internal clock in the Macintosh or the spill time that you enter. The time that you enter must be in a military time format.

Mist

A dispersion of fine droplets in a gas cloud (mostly air) resulting from air entrainment, spray atomization, or condensing of a material as its vapor cools. Mists are also referred to as aerosols.

Mixing

For the purposes of ALOHA, mixing is the process by which the air gets mixed. This includes both mechanical (wind and ground roughness-induced) and thermal (heat-induced) mixing.

Mole

A quantity of a substance that contains 6.02 x 10^{23} molecules. The molecular weight of a chemical is the mass of one mole of that chemical.

Molecular weight

The sum of the atomic weights of all the atoms in the molecule (the weight of one molecule of the chemical).

Neutrally buoyant gas

A gas that behaves like air or has the same density as air.

Open country

An area of few, or widely spaced, obstacles, such as a parking lot or open field.

Parts per billion (ppb)

Commonly used to express the concentration of a gas or vapor in air: parts of vapor or gas per billion parts of contaminated air. ALOHA uses ppm (1 ppm = 1 ppb x .001).

Parts per million (ppm)

Commonly used to express the concentration of a gas or vapor in air: parts of vapor or gas per million parts of contaminated air. In ALOHA, ppm is by volume, not by weight.

Particulates

Fine, solid particles. ALOHA does NOT model particulate dispersion.

Patchiness Isolated puffs of higher concentrations of a pollutant often caused by eddies or by the varying orientation of a dispersing chemical cloud. Think of patchiness as campfire smoke, which varies with wind direction, speed, and intensity of turbulence.

Pipe A type of carrier for hazardous materials. ALOHA considers only gas leaks (no liquid leaks) from pipes. Pipe lengths must be at least 200 times the diameter of the pipe.

Pipe pressure The pressure of the gas inside a pipe before the leak occurred.

Plume A cloud of dispersing chemical, referred to throughout this manual as "footprint."

Plume rise The term used for gases in a plume being transported upward (e.g., out of a smokestack). ALOHA does not incorporate plume rise calculations.

Processed data A menu item that will display the meteorological station's data. These data have been processed.

Puddle Liquid pooled on the ground.

Puff In short-duration footprints, the cloud of dispersing chemical appears as a series of puffs.

Raw data An option that displays unprocessed ASCII data that has been transmitted by the meteorological station.

Relative humidity The percentage of the measured vapor pressure to the saturation vapor pressure at the observed temperature. ALOHA lets you select dry, medium, or wet, or enter a percent value.

Release duration The period of time over which the release occurs. ALOHA limits this period to one hour.

Rough pipe An interior pipe surface that is pitted or corroded.

Roughness length A measure of the size of the "roughness elements," such as grass, trees, or buildings, that act as obstacles to the movement of air. The average size of roughness elements determines ground roughness. See Z_o.

Running average An average taken in overlapping segments (e.g., the average of the first five values, then the average of the second through sixth values, then the average of the third through seventh values, etc.). See Average.

SAM Station for Atmospheric Measurements. The meteorological measurement station that can be directly linked to the air model through a computer serial port.

STP Standard Temperature and Pressure. Chemical properties (e.g., boiling point) are often expressed at standard temperature, 0°C and standard pressure, one atmosphere.

Saturation concentration The maximum concentration that a vapor in air can maintain without raining out.

Serial port A data interface on the back of the computer that can be hooked up to other peripheral devices, such as a SAM, scanner, printer, or digitizing tablet. ALOHA uses a serial port to receive ASCII data from SAM.

Sigma theta The standard deviation of the wind direction. The SAM Station transmits a sigma theta based on a five-minute running average. The stability class is then determined by the sigma theta and the wind speed.

Smoke A mixture of gases, suspended solid particles, and vapors resulting from the combustion process. Color varies from thick black for hydrocarbon fires to light gray for cellulose (wood) smoke burning in an air-rich environment. Class A (wood/paper) fires release a rich yellow to brown smoke in air-lean environments such as basements or concealed spaces. Hazardous components may include varying percentages of HCl, NO_x's, sulfur compounds, acrolein, and free radicals.

Smooth pipe A smooth interior pipe surface.

Solution A mixture of compounds in which the molecules of the chemical are intermixed. Many commonly encountered solutions are mixtures of soluble chemicals and water. For example, alcohol in water or table salt in water.

Source height

The distance above the ground level from which a chemical has been released. This allows you to model releases from elevated pipes or other above-ground sources, but you must know the amount entering the atmosphere and choose the Direct source option.

Source strength

The amount of a pollutant entering the atmosphere, either all at once (instantaneously) or over a period of time (continuously).

Stability class

(see Atmospheric Stability).

Stable

A term used in atmospheric dispersion to indicate that the atmosphere has little tendency to mix.

Stack Windows

Located on the **Display** menu, this option layers all the windows containing ALOHA data on the computer screen. The active window will be the front window and only the titles of the other windows will remain visible.

Standard deviation

A measure of how much individual values deviate from the average value.

Street canyon

An area with high-rise buildings that channel the wind parallel to the streets.

TLV-TWA

Threshold Limit Value-Time Weighted Average. The time weighted average concentration for a normal 8-hour workday and a 40-hour workweek, to which nearly all workers may be repeatedly exposed, day after day, without adverse effects (Threshold Limit Values and Biological Exposure Indices for 1990-91, American Conference of Governmental Industrial Hygienists).

Threat distance

The downwind distance along the centerline of a chemical cloud, out to the level of concern that you set. ALOHA's footprint length, reported in the Text Summary window, is a threat distance.

Threat zone

The area downwind of the source of an escaping pollutant, within which concentrations of pollutant are high enough to threaten people. ALOHA's footprint is a diagram of a threat zone.

Text summary screen

The window always open while you are in ALOHA. This window summarizes your input and the model's calculations as you move through ALOHA.

Tile Windows

Located on the **Display** menu, this option places all of the windows containing ALOHA data next to each other on the computer screen.

Time-dependent dispersion — A time-dependent value is something that changes over time. ALOHA's dispersion modules take into account release rates that change over time. The dispersion modules do NOT account for changing atmospheric conditions.

Time-dependent source — A release rate that changes over time.

Two-phase flow — A gas-aerosol mixture that may be released when a pressurized liquid is stored in a tank.

Unstable — A term used in atmospheric dispersion to indicate that the atmosphere has a great tendency to mix.

Urban — For the purposes of ALOHA, an area where there are a lot of obstacles interrupting the flow of air. This would include suburban areas as well as areas that are forested.

Vapor — The gas produced by the evaporation of a liquid or sublimation of a solid. For example, the gas produced when liquid water evaporates is water vapor.

Vapor pressure — The pressure of a vapor in equilibrium with its liquid or solid form at a given temperature.

Volatility — The tendency of a liquid or solid to form a vapor.

Wind direction — A measurement of which way the wind is coming from, expressed in either angular or one- to three-letter directional terms.

Wind rose — A diagram that summarizes the last ten values received from the SAM for wind direction and speed.

Z_o — A term used to define ground roughness. Approximately 1/30 of the height of the underlying obstacles.

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