SEQUENCE Demo

Introduction

Welcome to the SEQUENCE Demonstration Guide!

SEQUENCE (U.S. Patent Pending) is a revolutionary new software package that provides an innovative approach for visualizing the effects of natural attenuation based on a modified radial diagram method. Given the simplicity and effectiveness of this visualization approach, SEQUENCE visual aids are ideally suited for preparing presentations of natural attenuation to both technical and non-technical audiences.

Specifically, SEQUENCE visual aids may be used to simultaneously show spatial and temporal trends for multiple organic pollutants on one site map. For some sites, this one radial diagram map may provide the primary line of evidence necessary to support natural attenuation as a site remedy. In addition, the unique functionality and flexibility of SEQUENCE allows for the preparation of SEQUENCE-Redox maps, which are now being used to identify trends in redox indicators (including electron acceptors and metabolic by-products). These trends, which are clearly identified from SEQUENCE-Redox maps, provide an important secondary line of evidence supporting the occurrence of natural attenuation in groundwater.

SEQUENCE is a fully-integrated software package that features a comprehensive project data management system, as well as a number of convenient and time-saving tools for preparing radial diagram maps to illustrate natural attenuation trends in field-measured concentration data. The SEQUENCE environment is extremely flexible, to provide you with the functionality you need to manage your site-specific data requirements.

Once you start using SEQUENCE, you will see that it is truly one of the most powerful tools available for interpreting and documenting natural attenuation data.

Quick Start

This Demonstration Guide provides information on:

- the necessary hardware requirements;
- installation guidelines; and
- a tour of the SEQUENCE environment.

Hardware Requirements

To run SEQUENCE you will need the following minimum system configuration:

- Windows 95/98, or Windows NT 3.5.1 or later;
- Pentium PC;
- 32 Mb RAM;
- 25 Mb of hard disk space; and
- SVGA display and mouse.

Installing SEQUENCE

SEQUENCE must be installed on your hard disk to run. Please read the previous section to ensure that your system meets the requirements before proceeding with the installation.

The installation procedure outlined here assumes that the SEQUENCE demo program and tutorial files were downloaded from the internet as four separate zip files (DISK1.ZIP, DISK2.ZIP, DISK3.ZIP, and DISK4.ZIP). You will need the WINZIP program to extract the individual files from each of these compressed zip files.

To install the SEQUENCE demo on your hard disk:

1) create a temporary folder on your hard disk, if you do not already have one;

2) create four folders within this temporary folder: **Disk1**, **Disk2**, **Disk3**, and **Disk4**;

NOTE You may specify any name for the temporary folder, but you must use the specific "**Disk#**" names for each sub-folder.

3) extract the contents of each zip file into the respective folders that you just created;

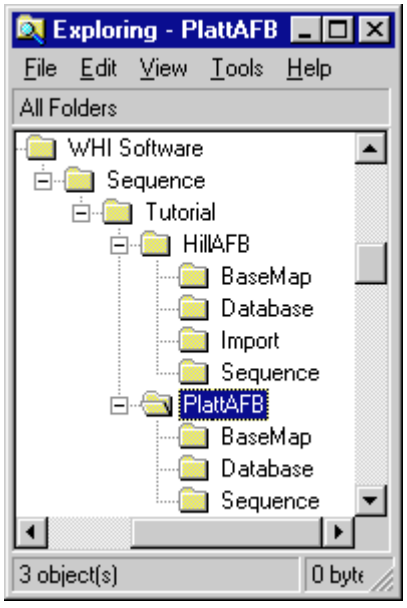
4) from Windows explorer, double-click on the Setup Application file in the **Disk1** folder (i.e. **Setup.exe**). This will execute the InstallShield program which will install the SEQUENCE program and tutorial files. The default directory for the SEQUENCE program is: **C:\Program Files\WHI Software\Sequence**.

What you get with the Demo installation

The installation will include the SEQUENCE V2.1-Demo program, as well as two sample project databases for you to work with. The demo version is identical to SEQUENCE V2.1, except that the print and export utilities have been disabled, as well as the options to create a new project database and to save changes to radial diagram property files.

The two sample projects are based on published data for the Hill Air Force Base (Utah) and the Plattsburgh Air Force Base (New York). Each project contains 3 or 4 sub-folders, containing the site base map DXF files, the project database files, text files which may be imported to the project database (Hill Air Force Base only), and the radial diagram properties files that may be used to evaluate spatial and temporal trends for petroleum hydrocarbons, chlorinated solvents (Plattsburgh Air Force Base only), and redox indicators. Figure 1 presents an example of the folders that will exist after the installation of the demo version is complete.

Figure 1 – Program and tutorial directories.



Starting SEQUENCE

You can start SEQUENCE the same way you start any Windows-based application:

- Double-click on the desktop icon (if you created one).
- Locate and double-click the SEQUENCE.EXE file from Windows Explorer.
- Choose Run from the Microsoft Windows Taskbar Start menu, and specify the path to SEQUENCE.EXE.

SEQUENCE Project Database

During the course of an environmental investigation or a groundwater monitoring program, it is necessary to collect, compile, and analyze the data. Because SEQUENCE provides you with the ability to prepare radial diagram maps to visualize trends in measured chemical concentrations, it was necessary to include a comprehensive interface that allows you to quickly and easily manage the site data that is required for this analysis.

SEQUENCE works on a project-basis. In other words, each time you run the SEQUENCE program, you must open an existing project database, or create a new project database. The interface for preparing the radial diagram maps is dynamically linked to this project database, so that any changes to the station coordinates or the chemical analysis results in the database will automatically be reflected in your radial diagram maps.

We recognize that every site is different, and that data requirements may vary widely between different sites. That is why the data management system incorporated into SEQUENCE has been designed to provide you with the flexibility you need to manage your site-specific data. This interface also includes a number of convenient tools that are designed to save you time in managing and analyzing your data, and will hopefully reduce the possibility for human-error when managing this data.

The data management system included with SEQUENCE will continue to evolve over time. We are already planning significant improvements that will increase the functionality available to you, and a number of options for preparing standard reports and exporting database information will also be incorporated. Please don't hesitate to let us know how we can add to the functionality of this system, so that we can make it easier for you to manage and analyze your project data.

Working with projects

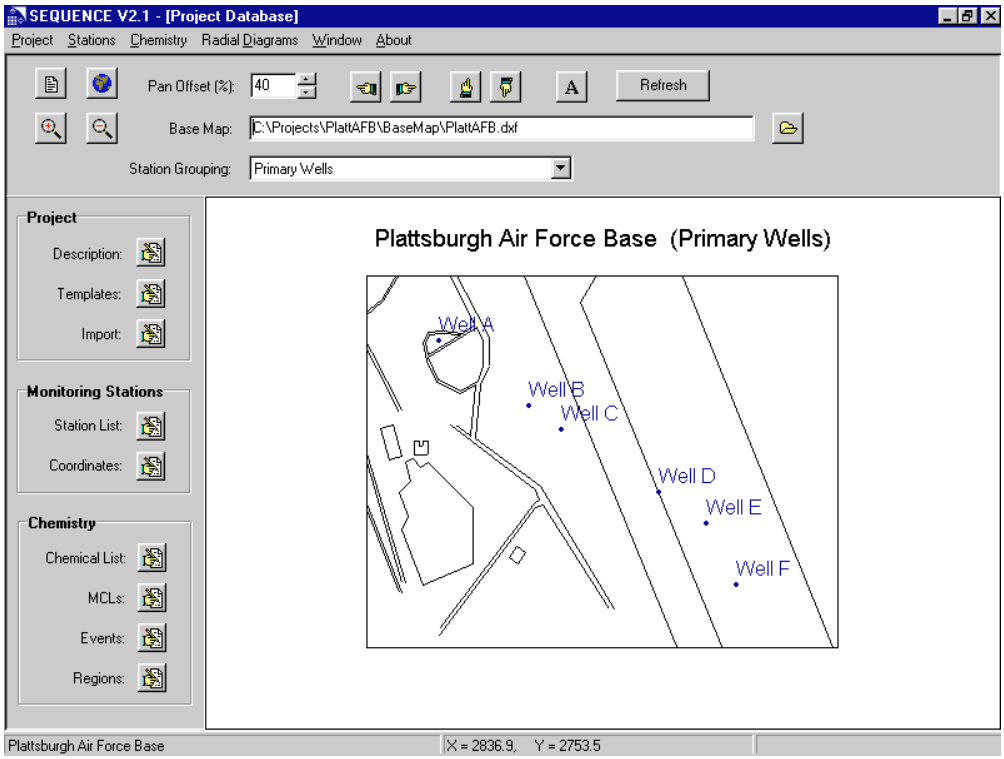
Once a project is open, a form will appear with a map of the site that shows the monitoring station locations, and provides various options for editing information in the project database. Figure 2 shows an example of the site map that is displayed when opening the database for the Plattsburgh Air Force Base.

The information stored in the project database includes:

- monitoring station names;
- station coordinates;
- project chemicals list, with default concentration units for each chemical;
- Maximum Concentration Levels (MCLs) for each chemical;
- station and chemical templates for convenient sorting and grouping of these items (to control the appearance of input/output tables);
- chemical monitoring event data; and
- regional concentration series data (e.g. background concentrations).

These items are described briefly below, followed by a brief description of the options available for importing information into the project database.

Figure 2 – Site map form



Project description

The database stores basic information about the project, including the reference number, name, description, location, client, and manager for the project.

Monitoring stations

A list of project monitoring stations is maintained within the database. (The term *station* is used as a more general reference than a *well*, because some chemical data may be collected from a surface water sampling station, or possibly from a temporary boring that is not used for a permanent well installation.

All coordinate values and chemical monitoring data are referenced back to this list of monitoring stations. If a monitoring station is deleted from the database, then all of the coordinate and monitoring data associated with this station will also be deleted.

Station coordinates

All monitoring stations have an easting and a northing coordinate field in the database. These coordinates will be used for displaying monitoring stations on the site map, or on radial diagram maps. It is assumed that the station coordinates are based on the same coordinate system and units used for the site base map.

Chemicals and concentration units

A list of project chemicals is maintained within the database. Each chemical is also assigned a default concentration unit (i.e. ug/L, mg/L, or g/L) which is used when manually entering monitoring data, or assigning a chemical to a radial diagram axis. In other words, when dealing with chemical concentrations, SEQUENCE will first assume that the concentration units for that chemical are the same as the default concentration units entered in the project chemical list. You will always have the option of changing those units, but the default units are provided as a convenient option that is intended to save you time when working with the project database or radial diagram maps.

All project MCLs, monitoring data, and regional concentration series are referenced back to this list of chemicals. If a chemical is deleted from the database, then all of the data associated with this chemical will also be deleted.

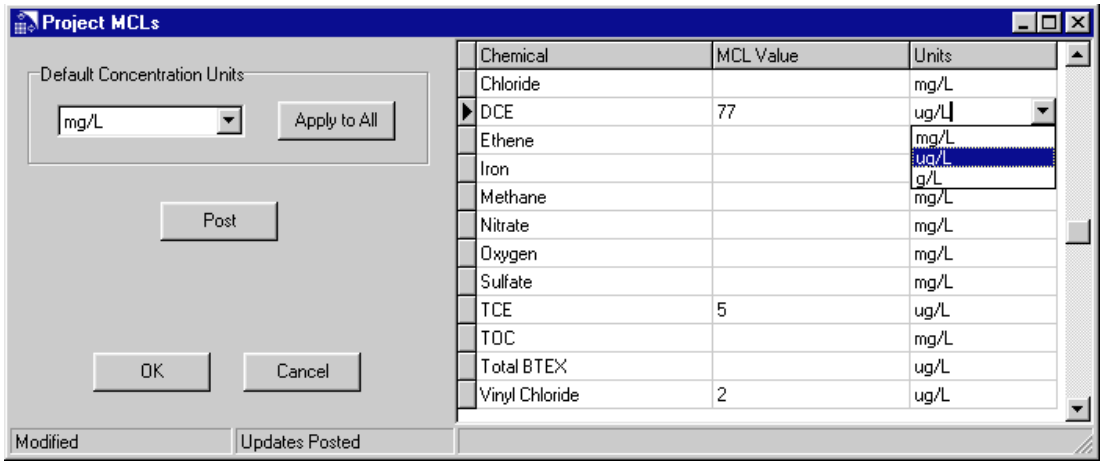
Project MCLs

A useful feature that has been built into SEQUENCE is the option to plot symbols on radial diagrams to indicate whether a measured concentration value is in exceedance of the MCL value. This allows you to quickly identify on a site map all the monitoring station locations where exceedances of the respective chemical MCLs occurs for any given monitoring event.

You can enter the chemical MCL values into the project database using any of the concentration units (i.e. ug/L, mg/L, or g/L). Figure 3 presents an example of the project MCL form.

If you select the exceedance symbols as part of the radial diagram map properties (refer to Figure 7 for an example of this), then SEQUENCE will automatically compare all measured values that are plotted on the chemical axes to the MCL values, and will plot different symbols for exceedances or non-exceedances of these MCL values, as per your specifications. Unit conversions are automatically performed by SEQUENCE if the chemical MCL values are in different units than the monitoring event data stored in the database.

Figure 3 – Chemical MCLs form



Station and chemical templates

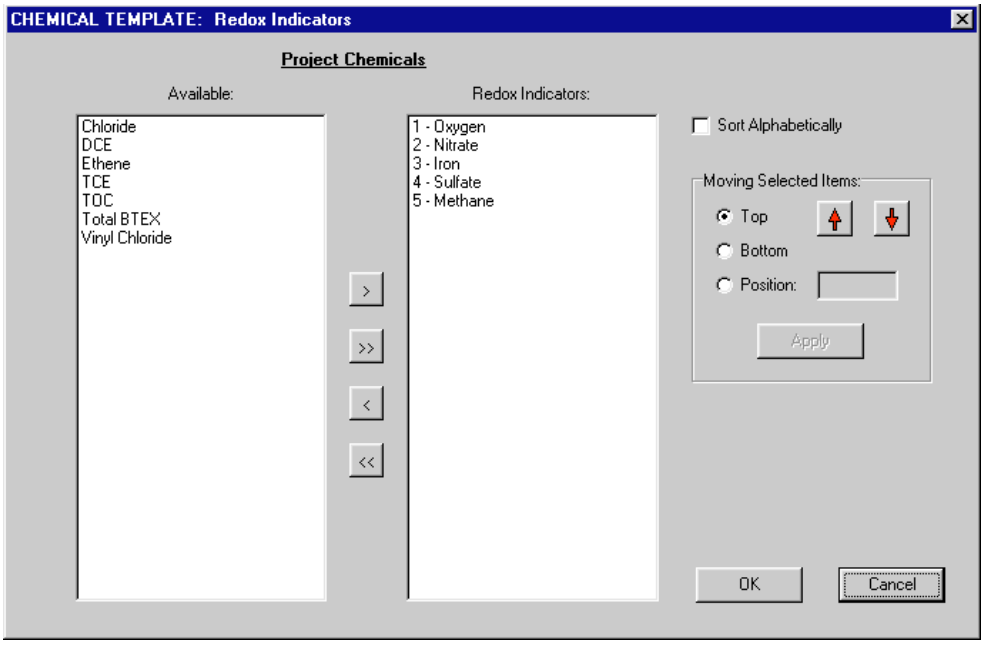
When working with lists of stations or chemicals, templates are often a convenient way to store groupings of these items, and to associate a specific order with each list of items. For example, when entering monitoring event data manually from a hardcopy, you will probably want to have the input list of stations and chemicals displayed in the same order as is presented on the hardcopy. SEQUENCE allows you to prepare multiple station and chemical

templates for this purpose. Figure 4 shows an example of a chemical template form.

These templates may also be used to group monitoring stations into different hydrostratigraphic units. When displaying monitoring station locations on the site map form, it is possible to show the locations for all stations, or to only show locations for stations included within a specific template. For example, it is possible to prepare different templates for shallow aquifer and deep aquifer wells, and to view these well locations separately on the site map.

When selecting the monitoring stations to be used for a radial diagram map, it is also possible to filter out the list of available stations by specifying a stations template. This saves time in selecting the desired stations from a large list when you want to prepare a radial diagram map for only shallow aquifer monitoring wells, for example.

Figure 4 – Chemical template form



Chemical monitoring events

The primary purpose of SEQUENCE is to plot radial diagrams that illustrate trends in measured chemical concentrations at individual monitoring stations. The chemical concentrations are stored in the SEQUENCE data management system using monitoring event tables, or as regional chemical concentrations (see below).

You can create a separate data table for each individual monitoring event conducted at a site. Each monitoring event table stores the measured

concentration value (or the method detection limit for non-detect samples), as well as the concentration units for each sample collected from a specific monitoring station. Each monitoring event can then be represented as a data series on a radial diagram map.

Regional chemical concentrations

Regional chemical concentrations provide a simple way to store concentration values that are not associated with any one specific monitoring station. For example, SEQUENCE-Redox radial diagrams are particularly effective when one data series is used to represent background concentrations of redox indicators, and another data series represents the concentrations of these redox indicators that were measured during a specific monitoring event at a specific station location. Because the background concentrations in this case would apply to all monitoring stations downgradient from the source area at a site, a separate means of storing these concentrations has been introduced into the data management system.

Another example of regional concentrations that may be plotted as a data series on a radial diagram, for comparison purposes, is the representative source area concentrations for chlorinated solvents. Plotting the source area concentrations and the measured concentrations at a downgradient monitoring station as separate data series allows you to easily compare trends between parent species such as TCE, and daughter products such as DCE or vinyl chloride. If TCE is undergoing anaerobic reductive dechlorination in groundwater, then the TCE concentrations will decrease downgradient from the source area, and the DCE and vinyl concentrations will increase or remain stable, depending on whether they are degrading at a rate which is similar to their rate of production from TCE biodegradation. See Figure 7 for an example of a radial diagram which clearly illustrates these trends.

Importing project data

It is expected that much of the project data needed for SEQUENCE has already been compiled using third-party spreadsheet or database software. So the SEQUENCE data management system was designed with a convenient tool for importing station names, coordinates, or chemical monitoring event concentrations into the project database.

SEQUENCE is capable of importing text files (created from spreadsheets, for example) that are delimited by tabs, spaces, commas, semi-colons, or an alternate type. It is also possible to import text files with fixed-width columns. SEQUENCE will read the text file, and automatically choose the default format for the file based on the file extension. You can easily select which columns from the file you wish to import to the database, and you also have the option of deleting specific rows from the text file before importing

this information into the project database. Figures 5 and 6 show examples of some of the forms that are displayed during the import process.

Figure 5 – Assigning column properties.

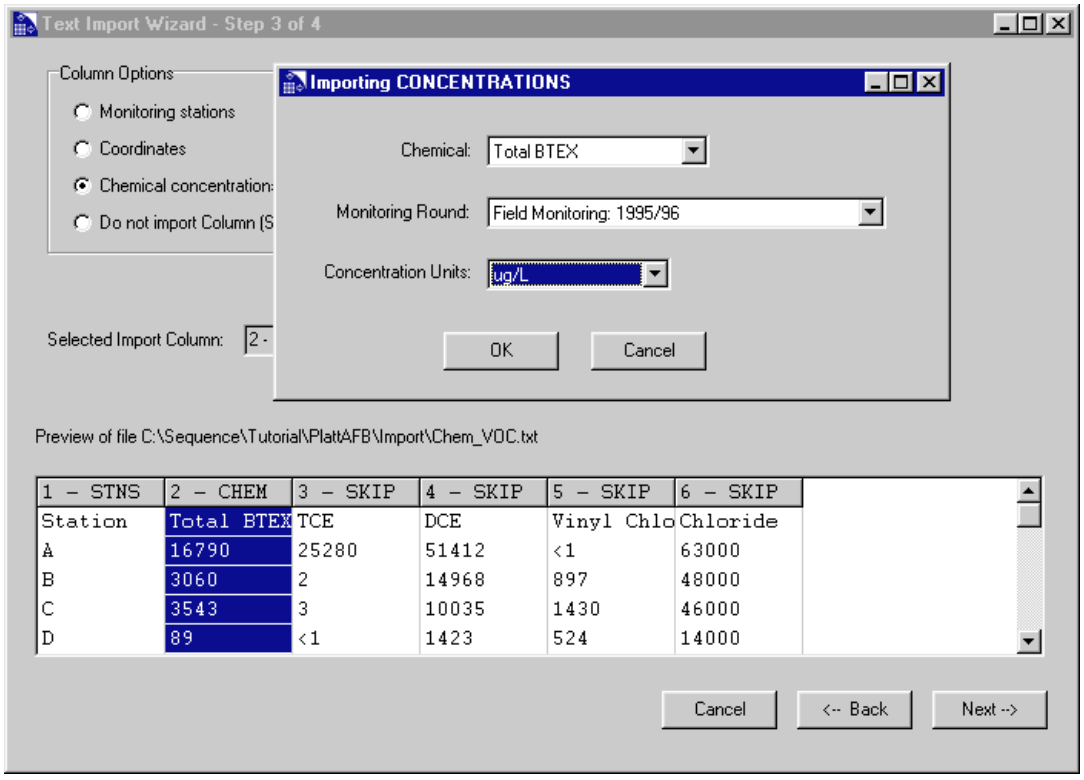
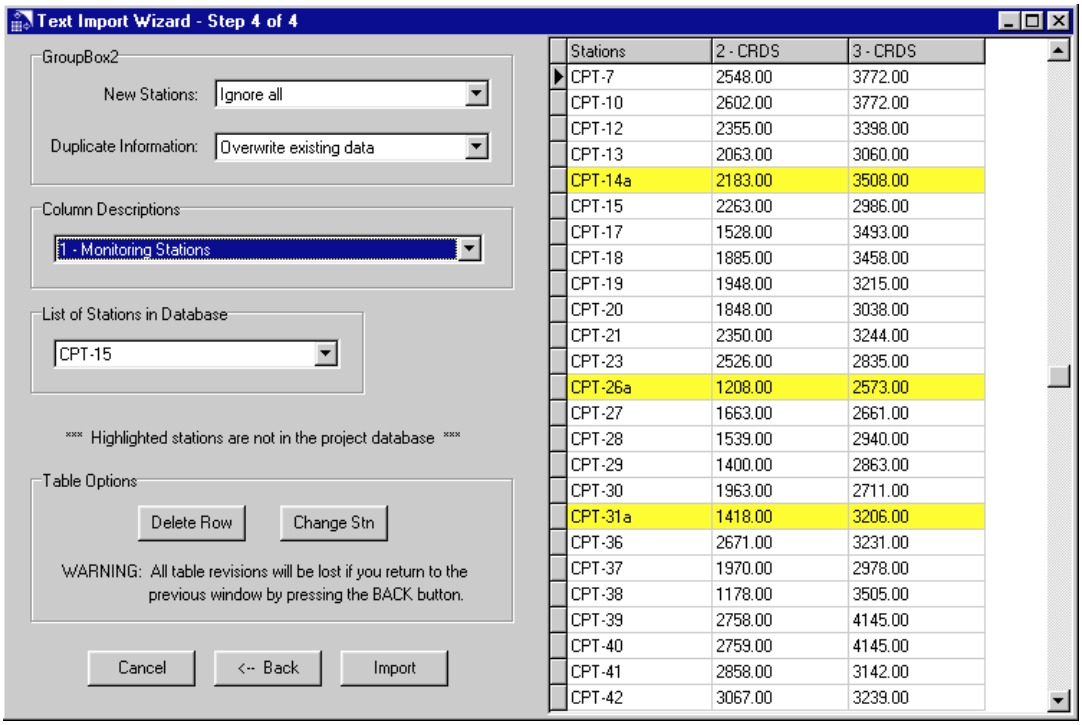


Figure 6 – Editing the Import table.



Visualizing Natural Attenuation Trends

Once the project database is set-up, it becomes a simple matter for you to prepare radial diagram maps to evaluate the primary and secondary lines of evidence which are needed to support monitored natural attenuation as a site remedy. The properties of each radial diagram map are stored in a text file (*.txt extension) that is referred to as a properties file. To work with a radial diagram map, you must either create a new properties file, or open an existing properties file.

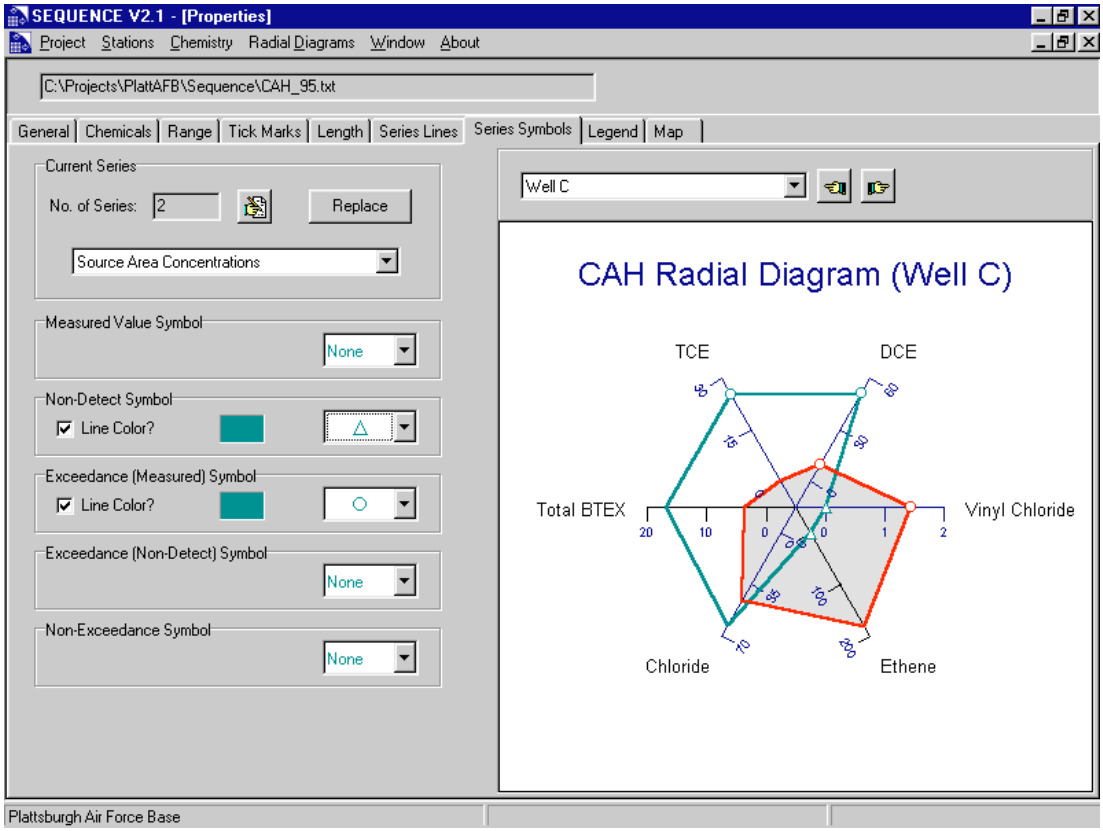
Once a properties file has been opened, a properties form will be displayed with a number of different options for changing the properties of the radial diagram map. For your convenience, this properties form also provides a radial diagram legend so that you can view the range of concentrations for each axis, as well as the overall appearance of the radial diagram. Any changes you make to the radial diagram properties will immediately appear on the legend, so you can quickly modify the settings to suit the needs of your project analysis.

When you have created the property settings that you are comfortable with, you can view the radial diagram map on the screen, and easily move between the properties form and the radial diagram map if further adjustments to the map properties are required.

Changing radial diagram properties

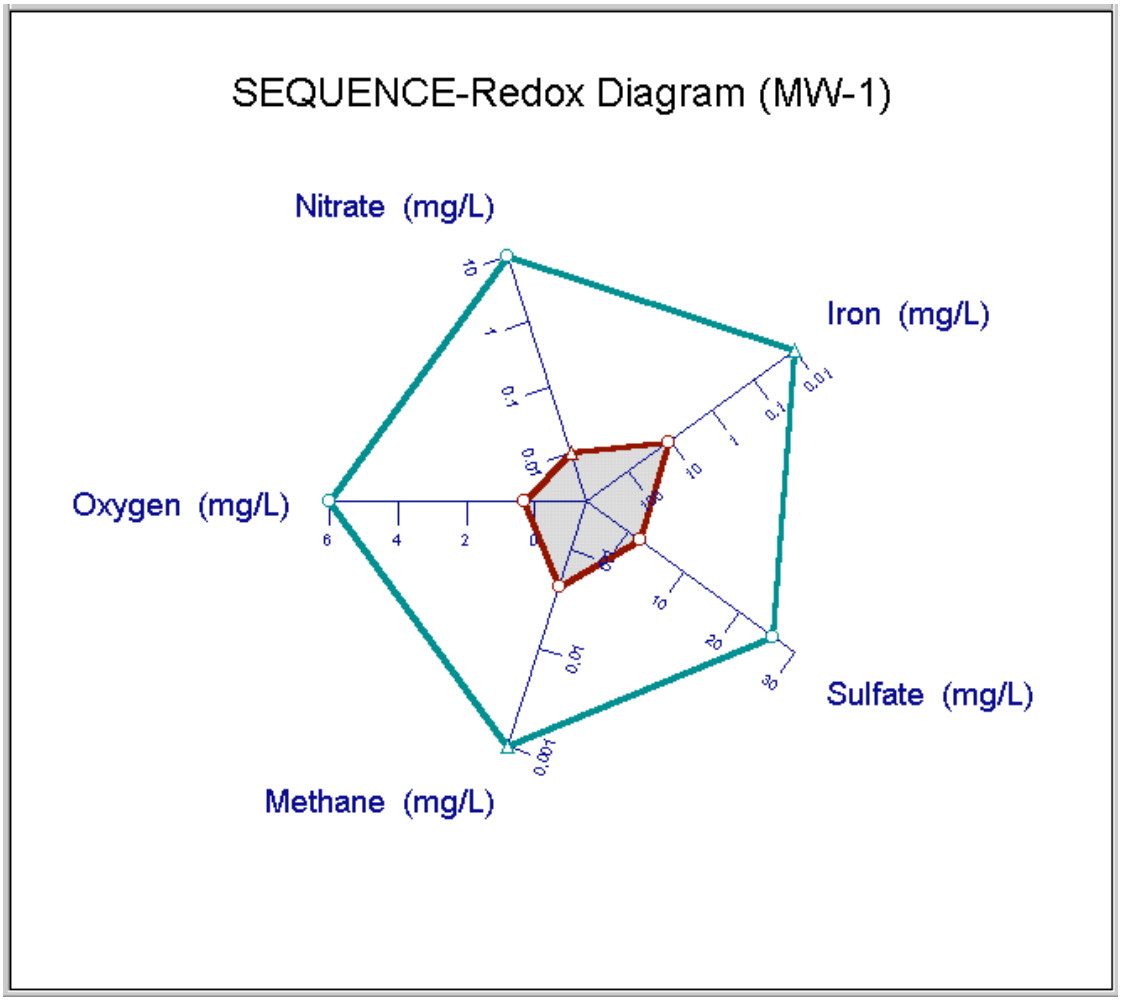
When opening an existing radial diagram properties file, a properties form will be displayed on the screen. The properties for a radial diagram map are segregated into different categories, and are easily modified by selecting the relevant tab from the properties form. For example, Figure 7 shows the **Series Symbols** page of the properties form for a SEQUENCE-BTEX/CAH radial diagram map.

Figure 7 – Example of a SEQUENCE-BTEX/CAH radial diagram



For comparison purposes, Figure 8 presents the legend for a SEQUENCE-Redox diagram.

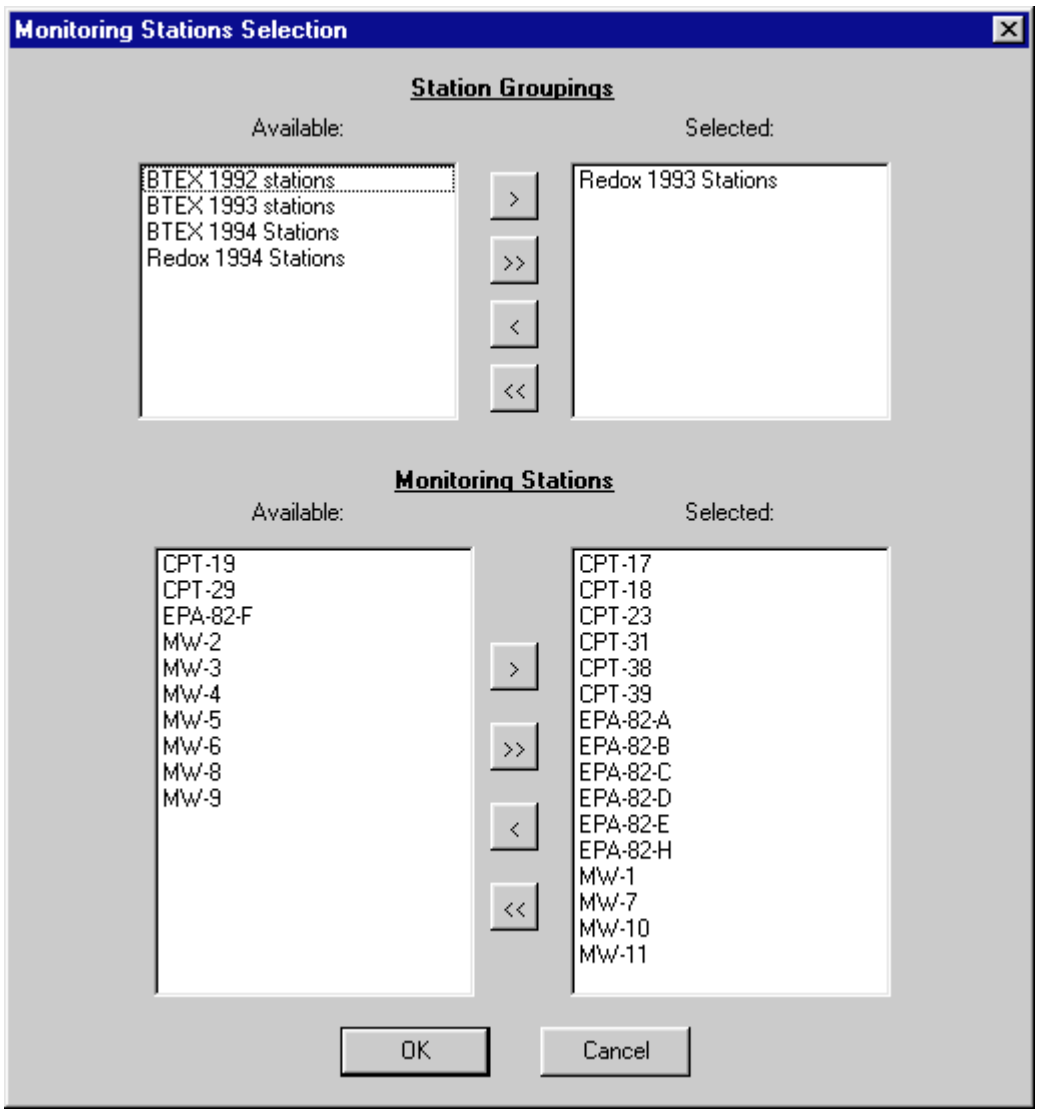
Figure 8 – Example of a SEQUENCE-Redox radial diagram



Selecting radial diagram stations

When first creating a properties file, it is necessary to select the monitoring stations from the database that are to be included on the radial diagram map. Figure 9 shows a sample of a stations selection form that allows you to select the desired monitoring stations. Note that the list of available stations can be filtered by specifying one or more stations templates from the list of available templates in the box at the top-right of the form. Stations can be selected or de-selected by using the appropriate speed buttons situated between the lists of available and selected stations, or simply by using a drag-and-drop approach.

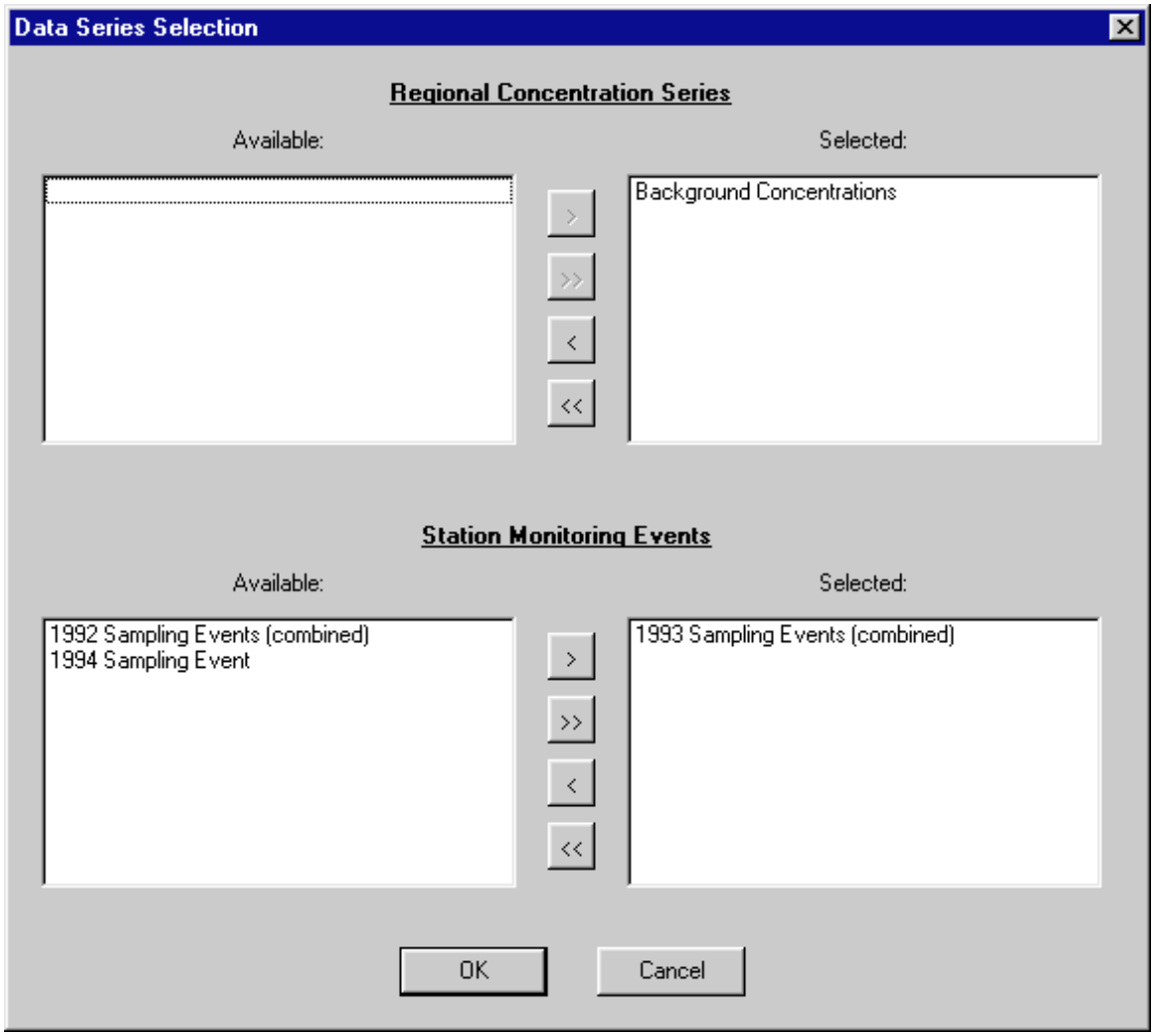
Figure 9 – Radial diagram stations selection form



Selecting data series for radial diagrams

It is also necessary to select the data series that are to be displayed on each radial diagram. Multiple data series can be selected, and may represent monitoring events and/or regional concentration (e.g. background) series. Figure 10 shows a sample of a series selection form that allows you to select one or more data series. Series can be selected or de-selected by using the appropriate speed buttons situated between the lists of available and selected series, or simply by using a drag-and-drop approach.

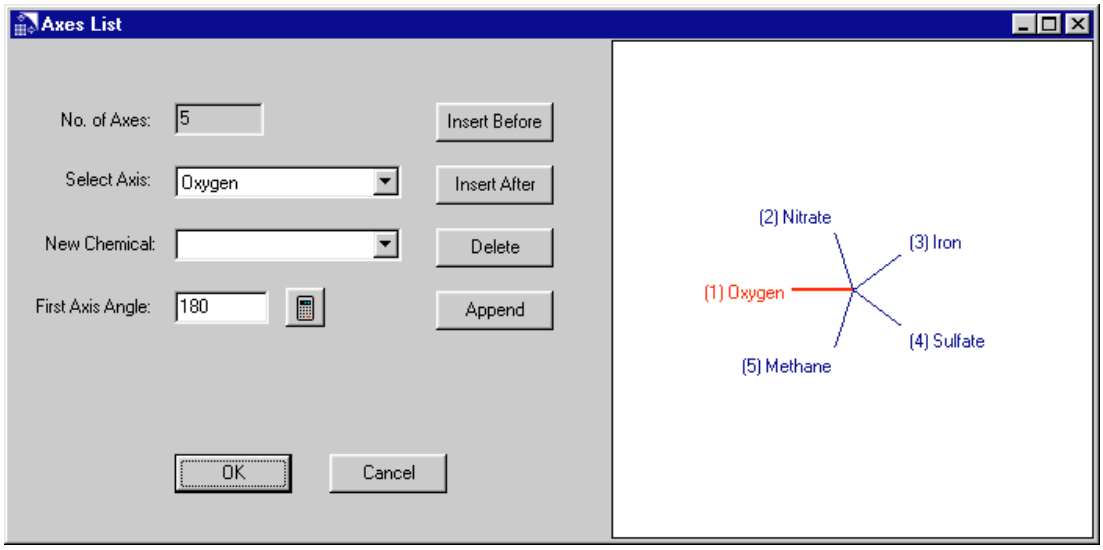
Figure 10 – Radial diagram data specifications form



Working with the chemical axes

The next step when creating a radial diagram properties file is to specify the number of axes to be included on each radial diagram, the orientation of the axes, and the chemical to be associated with each axis. Figure 11 shows an example of the form that allows you to edit these axis properties for the radial diagram map.

Figure 11 – Axis chemical specifications form

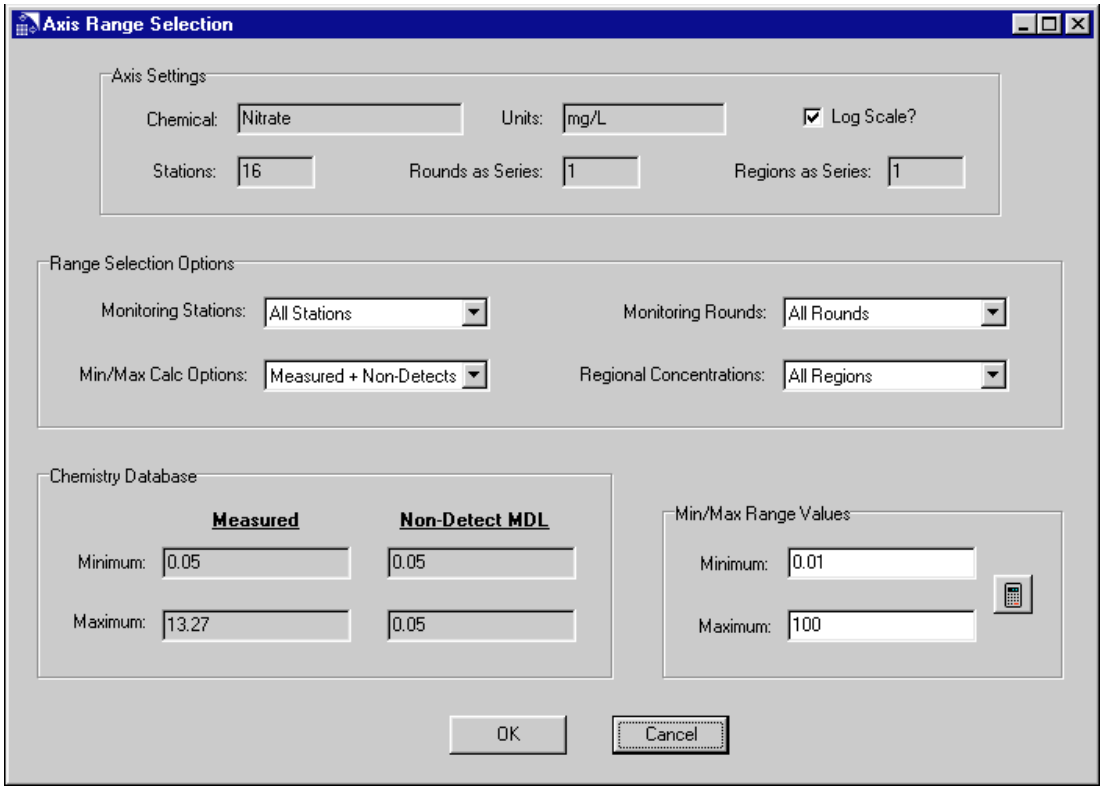


Determining axis min/max values

Perhaps one of the most convenient and flexible features of the SEQUENCE radial diagram interface is the ability to automatically calculate the axis minimum and maximum concentration values, based on a search of the monitoring event and regional concentration data stored in the project database. The calculation of the axis minimum and maximum values for a specific axis will depend on the whether a log or normal scale is used, as well as the search parameters used to specify the extent of the database search (based on the selected or all monitoring stations, the selected or all monitoring events, and the selected or all regional concentration series). Calculation of the axis minimum and maximum values will also depend on whether it is based only on the measured values in the database, or whether this also includes a search of the method detection limits for non-detect samples.

Figure 12 shows an example of the range selection form that identifies the database search parameters for calculating the axis minimum and maximum values.

Figure 12 – Chemical min/max concentrations search form



Viewing the radial diagram map

Figure 13 shows an example of the form that displays the radial diagram map. A toolbar at the top of this form provides a number of options for changing the extents of the map shown on the screen.

There are also speed buttons that allow you to change the size of the station labels and the symbols shown on the radial diagrams (if they were specified from the properties form). Clicking on the button with the 'D' caption will cause the text or symbols to revert to their default size, which is the minimum size that will be shown on the map. Clicking on the up/down arrows allows you to customize the size of the text and symbols for printing purposes, and are particularly useful when you are changing the extents of the map viewing area.

Figure 13 – Radial diagram map form