Operation Manual

rfInvestigator V3

by
Joseph M. DiPietro, P.E.
and
Marshall Sutherland

with
Alexandra Johnson, Jennifer Hickman,
and Shayna Sutherland

617 NW 20th Avenue
Gainesville, Florida 32609
USA

Printed in the United States of America

Contents

INTRODUCTION TO RFINVESTIGATOR V3.....12

Minimum Computer System Requirements.....14
Processor Type and Speed.....14
Operating System.....14
Disk Space.....14
RAM.....14
Video Display.....14

Recommendations for Better Performance.....14

Installing rfInvestigator.....15
The Installer program.....15
MDAC and DCom.....15

Activating rfInvestigator.....16
3-second Data.....16
1-second Data.....17
Supplemental Maps.....17
2010 Census.....17

Program and Database Updates.....18
Updating rfInvestigator.....18
Updating the Master Database if you don't have Database Builder.....18
Installing an Updated Master Database.....18
Installing other Databases.....18
Initial Settings.....18
Cache Settings.....19
Contour Settings.....19
Limiting Freespace to 1.61km.....19

The Program Folder.....20
The rfSoftware Folder.....20
The Database Folder.....20
The Resources Folder.....20
Subfolders include:.....20
Files include:.....20
The Jobs Folder.....21

Other Folders used by rfInvestigator.....21
The System Folder.....21
The Cache Folder.....21
Uninstalling rfInvestigator.....21

DbBuilder (Database Builder).....22
Installing DbBuilder.....22

First Look.....23
rfInvestigator Main Form.....23
Pop-Up Menus.....23
Build and Open Your First Job.....23
Investigating Your First Job.....24

What's New in rfInvestigator Version 3.....27
Support for Multiple Monitors.....27
Improved Map Display.....27
Refresh Job.....27
Improved TOPO! Map Support.....27
Mode Buttons.....27
Improved Map Labels.....27
Lines Arrows and Polygons.....28
Draw Order Control.....28
Label Overlap Control.....28
User defined City Lists.....28
White/Gray Analysis Tool.....29

JOBS.....30

Job Fundamentals.....31
Overview.....31
Parts of a Job.....31
Valid Range of a Job.....31
Types of Analysis.....31
Opening an Existing Job.....31

Building a New Job.....32
The Build-New-Job Process.....32

The Job Map.....33
Overview 33
Types of Stations.....33
Job Control Dialog.....33
The Job Map Pop-Up Menu.....35
Map Options Control.....35
The Mouse Information Bar.....36
The Map Close-Up Window 36
The One-Click Site Information Window 37
The Map Center Information Window.....37
Controlling Colors.....38
Controlling Line Weights 38

The Station Table.....39
Overview.....39
Manipulating Columns.....39
The Fields Selector.....39

The Pop-Up Menu....40

The Contour Manager....40
Overview....40
Contour Groups....40
Adding a Proposed Station at Map Center....40
Adding Affected Stations....40
Adding Stations from the Station Table....41
The Pop-Up Menu....41
Contour Options....42
Limiting Freespace to 1.61km. 42

Printing 43

....43

Terrain Data....43
30 and 3 second DEM's....43
1 second High-Res and 1/3 second Ultra High-Res DEM's....43
Data Sources....43

Population Data....44
Population Distribution on a Grid....44

LULC Data....44

User Underlays....45
Overview....45
Registering an Image....45
Displaying User Underlays....45
National Geographic Topo! Maps....46

Job Analysis....47
73.207 Overview....47
73.215 Overview....47
NCE Overview....48
Auto Scan....48
Range and Clearance....48
Community of License....49
Lines Arrows and Polygons....50
rfInvestigator White/Gray Analysis Tool....52

Translators and Boosters....53
Introduction....53
How to Place a Translator or Booster....53
Translator Power Limits....54

What-If's....55

CONTOURS....57

The Contour Manager....58
Overview....58

Proposed Stations....58
Overview....58
Job Center....58
Existing Stations....58

Affected Stations....59
Overview....59
Job Center....59
Existing Stations....59

Types of contours....59
City Grade....59
Protected/Interfering Pairs....59
70, 60, 54dBu....59
Grade A/B....60
User Defined....60
Manual Contours - Advanced Feature....60

Adding the Job Center to the Contour List....60
Overview....60
8 Radial HAT's....60
Site Elevation and Antenna Height....61
Selecting Antenna and Max ERP....61
Selecting Contour Type....61
User Defined Contours....62

Adding the Short (Affected) Stations to the Contour List....62
Overview....62

Contour Options....63
Overview....63
Contour Options....63
Limiting Freespace to 1.61km.....64

Contour Editor....64
Overview....64
General....64
Antenna....64
HAT Radials....65
Appearance....65
Pop/Area....65
Census Blocks and Demographics....66
Counting Census Blocks....67

Selecting/Creating/Editing Antenna Patterns....68
Overview....68
Pattern, Grid and Contour Views....68
Saving and Exporting a Finished Pattern....69
Design Controls....69
The Automatic Antenna Tuner....69
Designing a Booster with the Automatic Antenna Tuner:....71

Manual Contours - Advanced Feature....73
Overview....73
Lines and Circles....73
12-Point Contours....74
Manual Contour Files....74

CALCULATORS....75

The Terrain Profiler....76
Overview....76
Job Map 'Rubber-Band' Lines....76
The Lat-Lon Calculator....76
Profiler Options Screen....76
Profiler Controls....77

The Link Budget Tool....78
Overview....78

Terrain Roughness Calculator....79
Overview....79
Terrain Roughness: Standard Radials Dialog....79
Terrain Roughness: Special Radial Dialog....80

Max ERP Calculator....80

Lat/Lon Calculator....80

SEARCHING FOR DATA....83

Basic Searches....84
Overview....84
Starting a Basic Database Search....84
Selecting a Database....84
Searchable Fields....84
Searching by Multiple Fields....84
Wildcard Searches, *,?, #....84

The Data Display Screen....85
Overview....85
Sorting Data....85

Changing Displayed Fields and Field Order....85
Exporting Data to a CSV File....86

The Master Database....86
Overview....86
Data Tables and Fields....86
Database Options....86
Naming Convention....87
The Database Folder....87

Building a Master Database....87

The Local Database....87
Overview....87
Data Tables, Records and Fields....87

Finding Records in the Local/Master Database....87
Searching For Records....88
Sorting Records....88
Manipulating Records....88
Deleting Records....88
Cloning Records....89
Adding Records....89
Editing Records....89
Inserting Records....89
Killing Records....89

The Job Database....89
Overview....89
The Job Information Table....89
Adding Markers to a Job....90
Editing Markers in the Job....90
Sending Markers to the Master (Local) Database....91

Exporting Data....91
CSV File Format....91
Data Available for Export....91
Search Results:....91
Station Table Data:....91
Profiles:....91
ITM (Longley-Rice) Arrays:....91
HAT Radials:....92
Antenna Patterns:....92
Path-Loss Profiles:....92

ADVANCED TOPICS: PROPAGATION....94

Overview....95

Creating Path-loss Files.....95
Overview.....95
Propagation Queue File Control 95
Adding a New Station.....96
Station Settings.....96
Model Settings.....96
Boundary Settings 97
Bins.....97
Templates.....97
Building the Path Loss File.....98

Creating Propagation Files.....98
Overview.....98
The Propagation Manager.....98
Coverage.....99
Best Server.....99
Interference.....99
Building the File.....99

Propagation Display and Analysis.....100
Overview.....100
Coverage/Best Server Tab.....100
Interference Tab.....100

APPENDIX A.....102

Projecting a Curved Surface onto a Flat Screen.....102
Overview.....102
Transverse Mercator 102
FCC Rules: 73.208.....103
Limits of the Job Map.....103
Underlay Maps.....103

APPENDIX B.....104

Definition of Antenna Height.....104

APPENDIX C.....106

External Queue File Format.....106

APPENDIX D.....108

Antenna Pattern File Formats.....108
'.apf' Files.....108
'.csv' Files.....108
'.pat' and '.lpf' Files.....108
'.fig' Files.....108
'.txt' Files.....108

APPENDIX E.....109

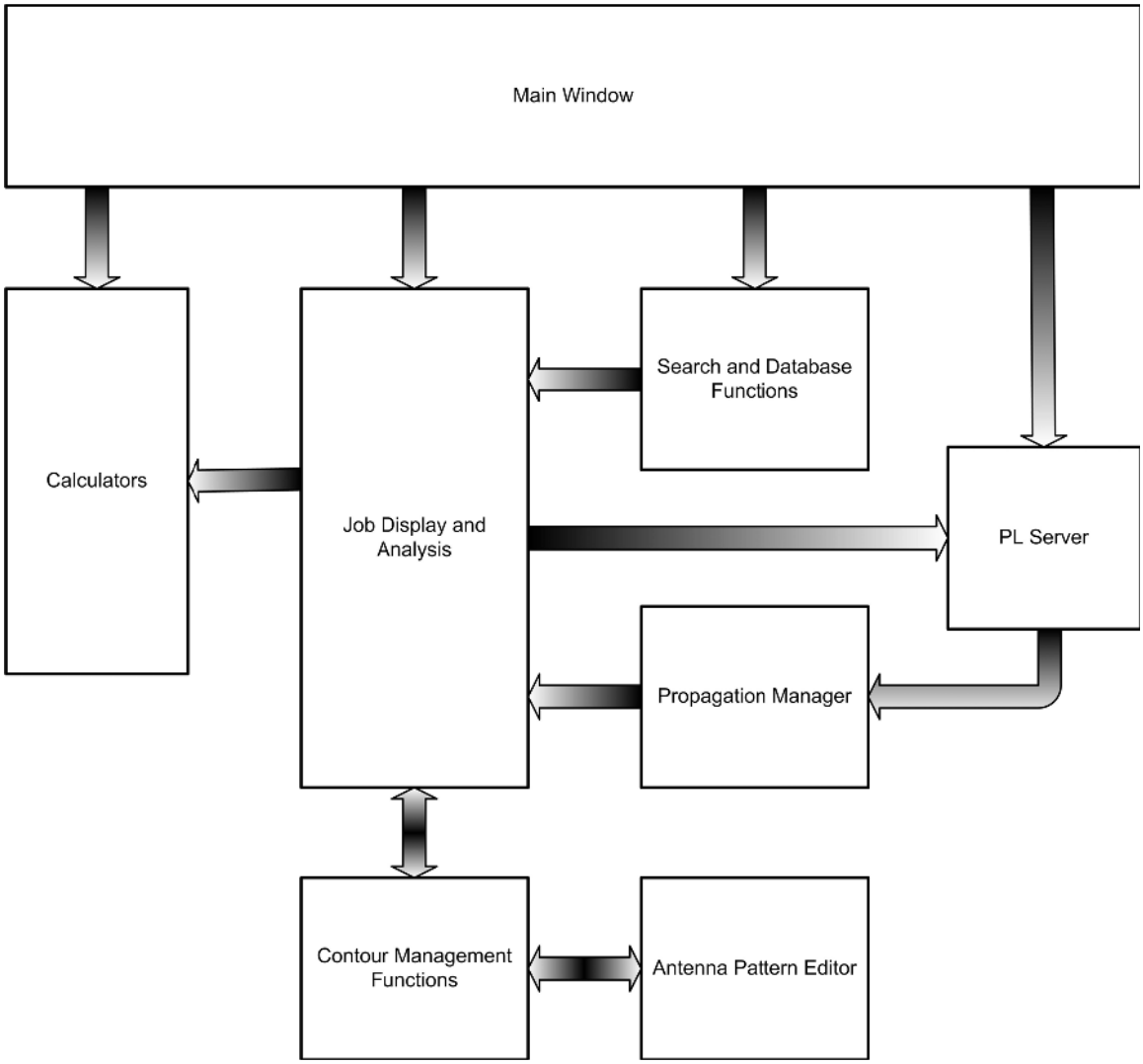
White Gray Study.....109

APPENDIX F.....111

User defined conductivity files.....111
Sample File:.....112

Notes:

Introduction to rfInvestigator V3



Notes:

Minimum Computer System Requirements

Processor Type and Speed

Any modern Computer running Windows.

Operating System

Windows 2000 (Version 5.0.2195)
Windows XP (Version 5.1.2600)
Windows Server 2003(Version 5.2.2600 & up)
RfInvestigator will NOT run under Windows Vista unless full administrator privileges can be granted to the program. This does not seem to be possible with some versions of Vista.
Windows 7-Pro inside a WinXP virtual machine.

Disk Space

1 GB without **Db-Builder**, 1.7 with **Db-Builder** (Database Builder).
Up to an additional 3 GB is needed for Census Block and Demographics.
Up to an additional 110 GB is needed for TOPO maps if you do not run them from CD or DVD.
One Second NED Terrain data requires an additional 160 GB.

RAM

Minimum:	512 MB, 2GB for 1-second terrain.
Recommended:	1GB for 3-second data. As much as possible for 1-second terrain

Video Display

Minimum:	800 x 600 - 16-bit color
Recommended:	1024 x 768 or better – 24-bit color **Multiple monitors are strongly recommended.**
Note:	The use of multiple monitors may be limited inside a virtual machine.

Recommendations for Better Performance

As with most applications, additional memory and/or CPU power will result in improved performance. In particular, additional disk space will permit rfInvestigator to cache a significant amount of commonly used data.

To improve performance in an existing computer we recommend:

- First: add disk space, (a bigger, faster hard drive)
- Second: add memory, and
- Third: upgrade your processor. Multi-core and multiple processors are supported.

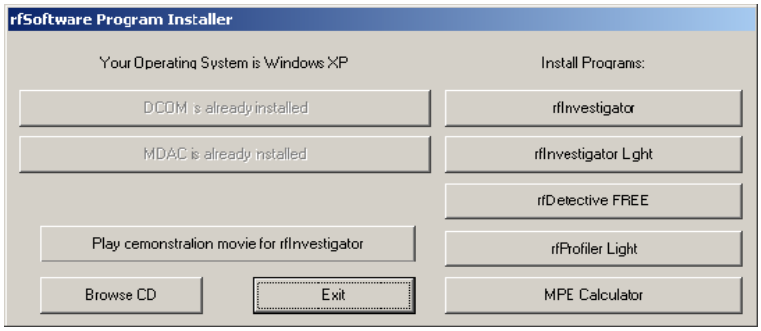
Ask rfSoftware about designing and building a high-performance computer, with rfInvestigator preinstalled, for you.

Installing rfInvestigator

All rfSoftware, **Inc.** programs have an automatic installer. *Be sure to **close** all other rfSoftware programs.* If this is not done, it is likely your installation will not be successful. Use Task Manager to insure that PL-Server is not running in the background. Should you encounter any problems, Email joed@rfsoftware.com or call 352-367-1700.

The Installer program

Inserting the rfInvestigator CD in your computer will auto-run the Program Installer. Should the auto-run not start the installer, navigate to the CD then launch the application called ***Install.exe***.



The installer will test the system for necessary prerequisite files. More information about these files can be found below in the ***MDAC and DCom*** section. Once these files are installed, you may proceed with the main program installation by clicking the **rfInvestigator** button.

To install software you must be logged in with **Full Administrator privileges**. See the note about Windows Vista and Administrator privileges in the operating system section above.

After installation is complete, press the **exit** button. You may need to reboot your computer after installing rfInvestigator. The installer will notify you if a reboot is necessary.

MDAC and DCom

The Installer Program tests your system for the presence of MDAC and DCom. These programs are Microsoft extensions to the Windows ™ Operating System and are not part of rfInvestigator. They are needed to perform various database access functions. If they are already installed then the buttons will be grayed out. If they are not, pressing the **Install DCom** and/or **Install MDAC** buttons will install these programs on your computer. After installing MDAC and/or DCom you will need to reboot your computer before proceeding to the rfInvestigator Install process.

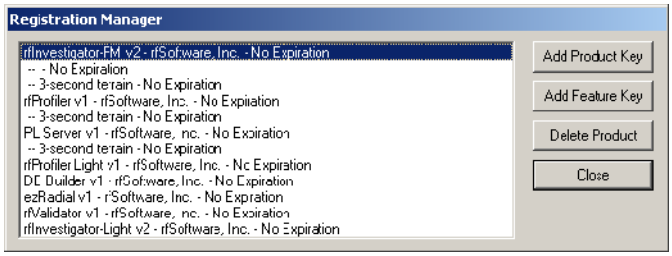
Since MDAC and DCom are Microsoft products, rfSoftware has no control over changes and upgrades to these programs. Therefore, it is strongly suggested that you check for operating system critical updates after installing MDAC and /or DCom and before proceeding to install rfInvestigator.

Activating rfInvestigator

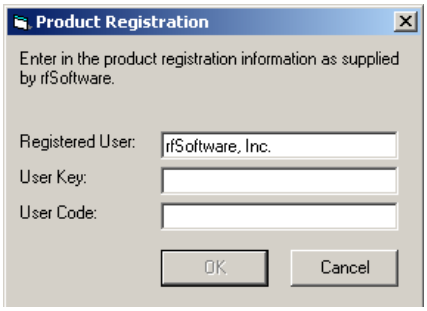
It is strongly suggested that you perform a manual update prior to launching rfInvestigator for the first time. The latest update can be found on-line at http://www.rfsoftware.com/rfi/downloads.shtml.

The first time rfInvestigator runs you will be presented with the Registration Manager.

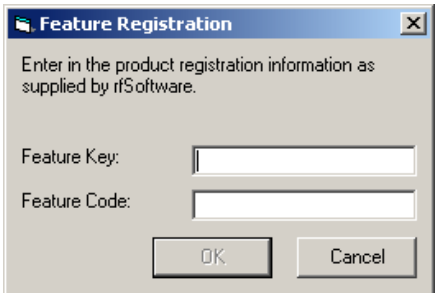
The Registration Manager displays the program name, owner and expiration date of all rfSoftware products installed and registered on your computer.



Click the **Add Product Key** button to open the Product Registration dialog.



You will receive registration information by email. Enter the indicated information exactly as it appears in the Registration email. To minimize the possibility of error we recommend you copy and paste the information from the email message.



It will be necessary to register additional features in the Feature Registration dialog to activate them.

If you have purchased any optional features you will need to register these using the supplied *Feature Key* and *Feature Code* information.

3-second Data

You may have received three arc-second terrain data on a separate CD.

The three arc-second terrain data may be placed on any available system disk. The recommended location is:

C:\Program Files\rfsoftware\resources\ter3sec

However, it may be placed on another drive, one with more available disk space, for example.

Accessing the data across a network, or reading it directly from the CD will work in most cases. Problems could occur in such a configuration if there are excessive system delays when reading the data.

Regardless of where you place the data, be sure to point to the appropriate data folder in Options – Folders – Terrain, USGS 3-sec.

1-second Data

The optional one-arc-second terrain data is supplied on a separate hard disk drive.

The drive letter will be automatically assigned by your operating system when the drive is mounted. Point to the appropriate drive letter and data folder in Options – Folders – Terrain, NED 1-sec.

Supplemental Maps

County and state boundaries are available from both the 1990 and the 2000 census. 1990 Census Maps are in NAD-27, 2000 Census Maps are NAD-83.

The State Line Maps are stored in the file "***stmaph.dat***" and the County Line Maps in "***comaph.dat***".

The program looks for these files in the Resources folder. The 2000 Census Maps are installed by default. Should you need to use the 1990 maps close all rfSoftware programs on your computer. Replace the **stmaph.dat** and /or **comaph.dat** files in:

C:\program files\rfSoftware\Resources with the ones from your installation CD then restart the program to load the new maps.

2010 Census

2010 Census data is now included with rfInvestigator. 2010 community reference coordinates will be released in late 2011. 2010 community boundaries should be available in mid 2012.

Program and Database Updates

Updating rfInvestigator

The auto-updater will keep rfInvestigator up-to-date with the latest bug fixes and new features. Alternatively, updates can be downloaded from the rfSoftware website. It is recommended that you join the rfInvestigator users group at

http://groups.google.com/group/rfInvestigator

This user group is where our clients exchange tips and ideas. It is also the best place to keep up-to-date about new features.

Updating the Master Database if you don't have Database Builder

If you do not have **Db-Builder** registered on your computer you will need to contact rfSoftware to obtain a database branded with your serial number.

Installing an Updated Master Database

An updated master database is normally obtained online from:

http://database.rfsoftware.com/rfInvestigator-FM.

The database will be in a ZIP file format.

The database MUST be unzipped directly into the database folder. See the instruction included with your zip/unzip utility for information on how to extract a zipped file into a specific folder.

The master database can be identified by its unique file extension of '.fmd'. Other files, such as an antenna pattern database or a new sync.bin file, may also be zipped together with a master database. These files are best placed in your database folder. The default database folder is:

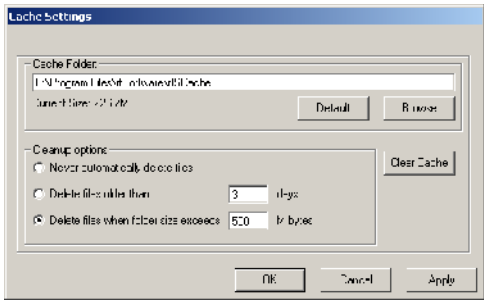
C:\Program Files\rfsoftware\database.

Installing other Databases

Other databases, such as the Antenna Pattern database, Antenna Structure Registry (ASR) database (updated weekly) and Airport database (updated approximately every 56 days), are normally obtained online from the rfSoftware website. Most databases are zipped. See the instruction included with your zip/unzip utility for instructions on how to extract a zipped file into a specific folder. Place the database files in the same folder as the master database.

Initial Settings

Several programs settings should be reviewed and possibly modified after installing rfInvestigator.



Cache Settings

From the Options menu, select Cache….

The Cache Folder should be placed on your computer's fastest internal disk drive.

Under most circumstances the best choice for Cleanup options is "***Delete files when folder size exceeds" N***.

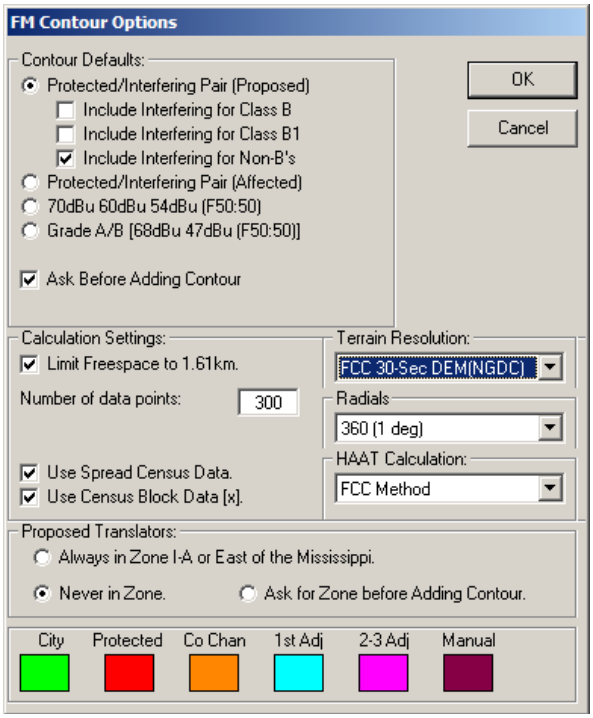
Depending on the speed and available disk space on your computer the value of ***N*** should be between set to 100 and 500 Megabytes.

If you set your cache threshold too small, your computer will be deleting data that it may need to reuse. If the cache size is set too large, your computer will waste time searching for data.

If your cache size exceeds the threshold you have set, rfInvestigator will begin deleting the older cached files.

Contour Settings

From the Options menu, select Contours….



Contour **Terrain Resolution** should be set to use either *FCC 30-Sec DEM (NGDC)* or, 3-Second terrain data, *USGS 3-Sec DEM (DMA)* or, 1-Second terrain data, *NED 1-Sec DEM (DMA)*.

The FCC currently does not accept the use of GLOBE terrain data for FM contours.

The **HAAT Calculation** method should be set to *Slope Method* for normal use and switched to the much slower *FCC Method* for final calculations.

The number of datapoints setting controls how many evenly spaced points are used to average a contours height. The FCC uses 51 points. The valid range is 50 to 300 points.

Limiting Freespace to 1.61km.

FCC rules state that under certain conditions the distance-to-contour calculation should stop using the prediction tables and switch to the freespace formula. Doing this in-accordance-with the rules will produce characteristic "spikes" on the contour. Limiting the freespace calculation to 1.61km (the beginning of the FCC curves) smooths out the contour.

Select *Limit Freespace to 1.61km* to have smooth contours.

Uncheck the box to have "Spiked" contours.

The Program Folder

The rfSoftware Folder

By default, the installer creates an rfSoftware folder in:

C:/Program Files/rfSoftware/.

You may choose a different folder during installation.

The rfSoftware folder contains program executables; uninstall files, libraries and data subfolders.

The Database Folder

The database folder, **C:\Program Files\rfsoftware\database,** is the default location for the FCC Master Database and antenna pattern files.

The Resources Folder

The resources folder, **C:\Program Files\rfsoftware\resources,** holds a wide range of files and subfolders essential to the operation of rfInvestigator.

Subfolders include:

lulc30sec—containing land use/land characteristic data files

m3—containing the M3 and R2 ground conductivity data bases

pop30sec—containing 2000 spread population data files

pop12sec—containing 2010 spread population data files

ter30sec—containing the GLOBE 30-second terrain data files

terFCC30sec—containing the FCC 30-second terrain data files

TOPO!_Maps—containing large-scale reference map files, and

ter3sec—containing three second terrain data

Files include:

MS*.dat – These files contain the FCC Minimum Separation Tables.

***.mdb** – These are the vector map databases. They contain information for drawing roads, railroads, hydrology, and city boundaries.

***MapH.dat** – These are the county and state line files.

tipofday.txt – This is a text file with helpful hints on using rfInvestigator.

Sync.bin – This file contains special keys for synchronizing the program to the various compressed databases.

rfInvestigator.chm – This is the rfInvestigator Help file.

motd.ftx – MOTD, or Message-Of-The-Day, contains the text to various system messages. Since the message text is not stored inside Investigator they can be easily updated without replacing the program executable.

license.txt – This is a copy of the License Agreement.

places.txt – This file contains a list of places, their locations and populations. This file comes from the National Atlas.

fccdbs*.txt – This file outlines the tables and fields in the FCC CDBS

Census2k.mdb – This file provides locations and labels for State and County names.

The Jobs Folder

The jobs folder, **C:\Program Files\rfsoftware\jobs,** is the default location for Job Files, Queries and CSV Files.

Other Folders used by rfInvestigator

The System Folder

The program stores files in various other locations. As with most Windows programs, rfInvestigator uses library files (*.dll and *.ocx) stored in the Windows System folder.

The System Folder varies with operating system, but is usually:

C:/Windows/System in Windows 95, 98 or Millennium, and
C:/.../System32 in Windows 2000, XP or NT

The Cache Folder

Some of the files created by rfInvestigator are cached in this system Temp folder. These files include:

*.contour – Contour Information files. Once a contour file is created for a site, new contours can be created and existing contours can be changed very quickly.

*.ter – Terrain Information files.

*.pop – Population Information files.

*.bmp – Terrain Map files.

Any file stored in the *Cache* folder may be deleted as long as rfInvestigator is *not* running. If the program needs a deleted file, it will simply recreate that file. However, if you do not delete the files rfInvestigator will run significantly faster.

If your disk space used by cached files exceeds a settable threshold rfInvestigator will begin deleting the older cached files.

Uninstalling rfInvestigator

Should it become necessary to uninstall the program you should first follow the Windows Add/Remove Programs process accessible via the Windows Control Panel.

If you have no other rfSoftware products on your computer, remove the **C:\Program Files\rfSoftware** folder.

DbBuilder (Database Builder)

If you have purchased a license to **DbBuilder,** you will have received a *User Key* and *User Code* for that product.

Installing DbBuilder

DbBuilder is a behind-the-scenes utility program that will automatically download data from the FCC website and create a database readable by rfInvestigator. It is an independent program, so you can continue to use rfInvestigator while building a database. Alternatively, **DbBuilder** can run on a second computer so it won't slow down your work.

DbBuilder ***only needs to be installed if you plan to make your own databases***.

Most people choose to download preprocessed databases from the rfSoftware website. A processed database is typically less than ten megabytes whereas the raw FCC data is more than forty megabytes.

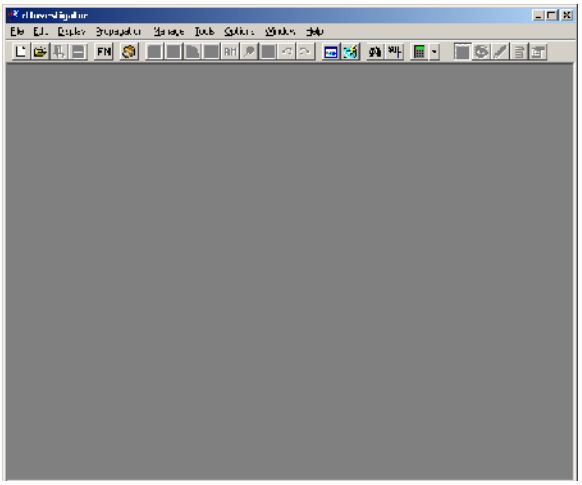
Processed rfSoftware databases are available on-line at:
http://www.rfsoftware.com/databases/rfInvestigator-FM/

To use a processed database ***you do not need to install*** the **DbBuilder** program, but **DbBuilder** ***needs to be registered*** on your computer.

If you choose to install **DbBuilder** simply, navigate to the CD then, execute the program "***installdatabasebuilder.exe***" and follow the directions.

The Master database is a collection of files located in the database folder.
The default database folder is **C:\Program Files\rfSoftware\database.**

First Look



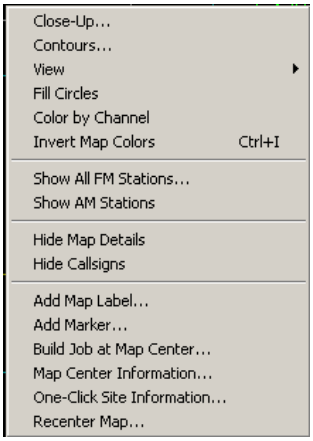
The installation process should have placed an rfInvestigator Icon on your computer desktop. Double-clicking on this Icon will launch the program. Alternatively, you can use the **Start** button by selecting: Start--Program Files--rfSoftware--rfInvestigator.

rfInvestigator Main Form

When you launch rfInvestigator, the first thing you will see is the Main Form. The Main Form contains drop-down menus and a button-bar for convenient access to various program features. See the section on **Job Map** for more information about buttons and controls.

Pop-Up Menus

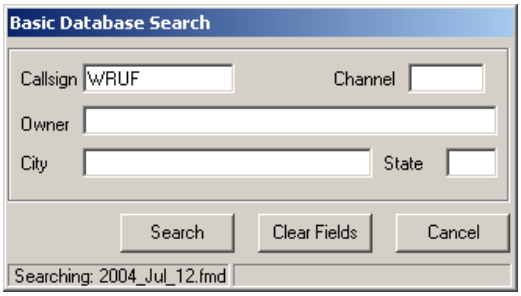
Various different *Pop-up* menus appear throughout the program. Some of the places they will appear from the *Main Program Window*, the *Job Map*, the *Station Table*, the *Station Table Headers* and the tabs of different dialog boxes. To access them, first place the mouse pointer in a window or select an item of interest. Then click the right mouse button.



The different Pop-up menus will have short cuts to many of the frequently used tools and additional dialogs.

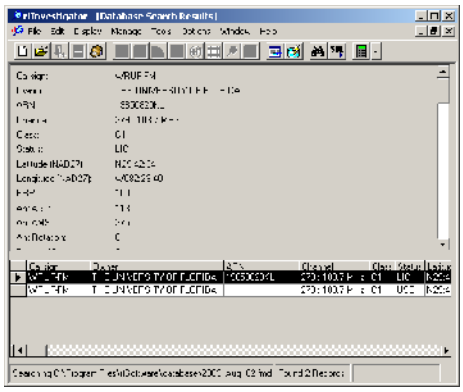
Build and Open Your First Job

The main feature of rfInvestigator is Job Analysis. The first step to Job Analysis is building a job. One method for building a job is described below.



From the Main Window's File menu select New Job.... Select a Master Database. After the database is opened, select Use the Basic Search Tool to find a template station and click **Next**. The Basic Database Search dialog will be displayed. Enter the call sign of a station-of-interest, and then click **Search**.

The Search Results Window will open listing the database records that matched your search criteria.



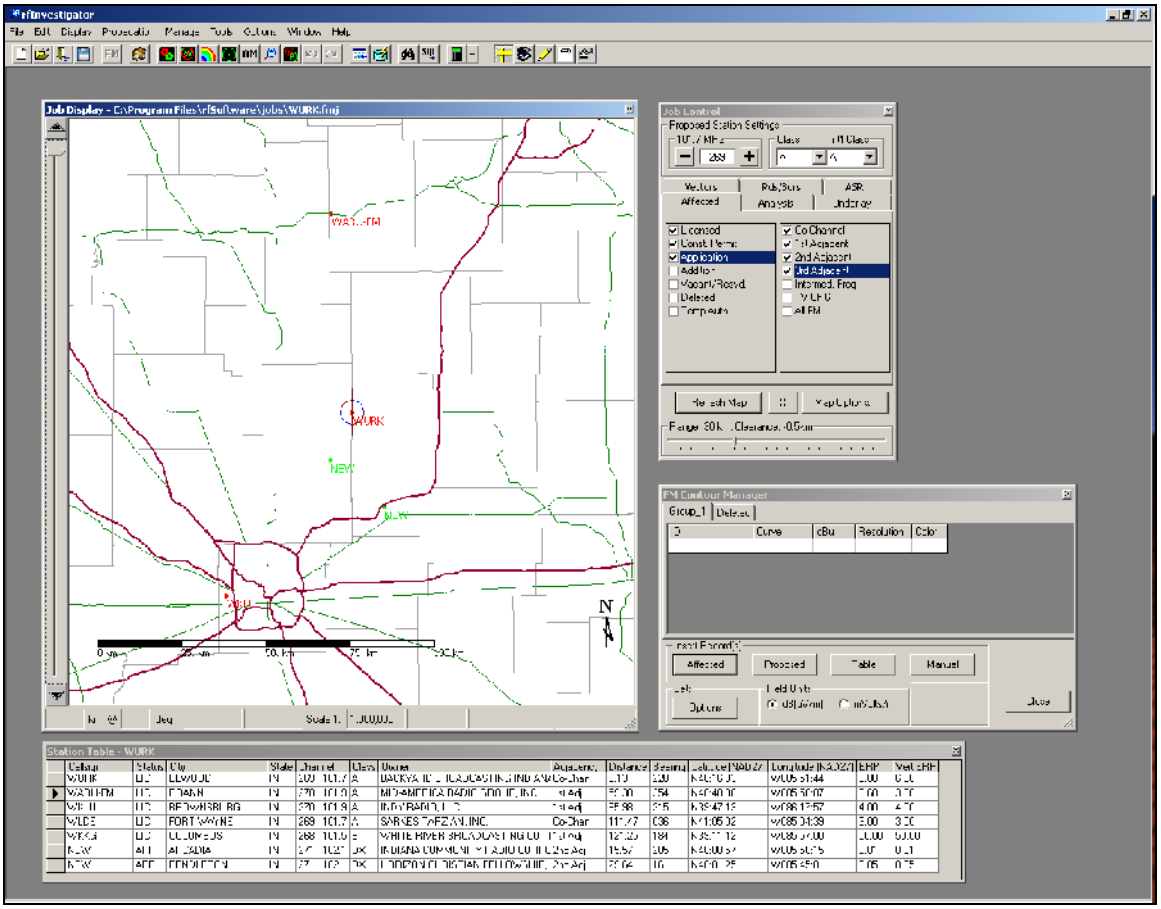
Select one of the records from the table in the bottom portion of the window. The Build New Job dialog will be displayed filled out with your chosen station's information.

Click the **Next** button three times and then clicl the **Build Job** button. Select a name for the job file and click the **Save** button. The job will build and then open.

Investigating Your First Job

Use the Affected, Analysis, Underlay, Vectors and Roads/Borders controls to show and hide various features on the Job Map display.

The vertical slider control on the left-hand side of the map controls the zoom level.



Click and drag a *rubber-band* line on the map to view *range* and *bearing* between two points and display a *path profile*.

Double-click on the map to re-center at the mouse pointer's location.

As you move the mouse about the screen note that the mouse coordinates, elevation and distance/bearing from map center is displayed on the lower task bar.

If you have a three-button mouse press the center button and instantly calculate the Height of Average Terrain for the current mouse position.

These are just a few of the many things you can do with rfInvestigator. To learn more, read on!

Notes:

What's New in rfInvestigator Version 3

Support for Multiple Monitors

Tool boxes now float separately from the main map screen. With multiple monitors you can move the job controls on one screen and then expand the map to full size on another.

Improved Map Display

The map is now a user re-sizable rectangle.
Calculate and display using spherical earth formula.
User defined map zoom levels.

Refresh Job

Update a job to the current database without losing your work.

Improved TOPO! Map Support

Seamless support for TOPO! Version 4. Map layers 1 and 2 are pre-installed for the Continental US.

Mode Buttons

The first button is **Measure Mode.** This is the normal mode for measuring and navigating around the map.

The nest button is **Close Up** mode. Zoom in on any part of the map without re-centering. This brings up the close-up screen.

The third button is **Draw Mode**. Create lines, arrows and polygons on the map.

The fourth button is **Label Mode**. In label mode you can create and edit text on the map.

The last button is the **Move Mode**. Use the mouse to move lines and labels on the map.

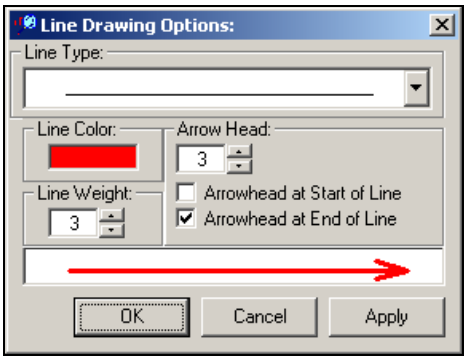
Improved Map Labels

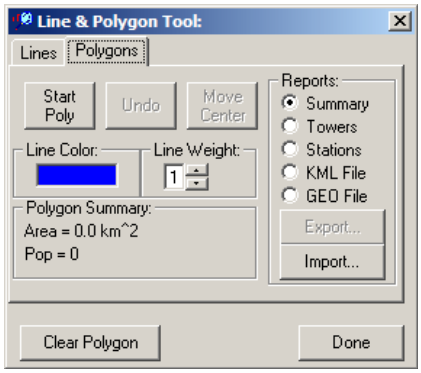
With the new Map Labels tool, you can place and move labels on the *Job Map* and independently set font type, size and color.

You activate the Map Labels dialog by selecting Labels… from the Edit menu, by selecting Add Map Label… from the *Job Map* Pop-Up menu or by clicking the **Label Mode** button on the tool bar.

While in the **Move Mode**, labels can be dragged and dropped around the *Map* using the mouse.

Lines Arrows and Polygons

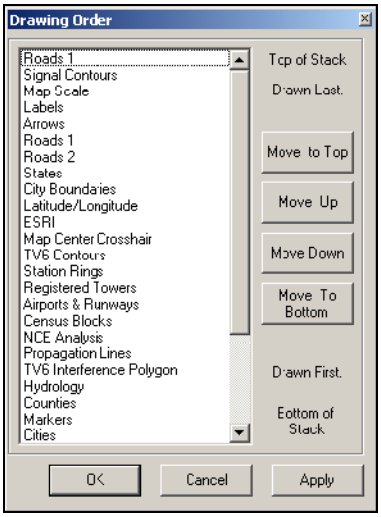




Use your mouse to draw lines and arrows on the map. These can be moved, changed color, or resized at any time when in the **Move Mode**.
The polygon tool allows you to draw any shape on the screen and calculate population & area or export station or tower information.

Draw Order Control

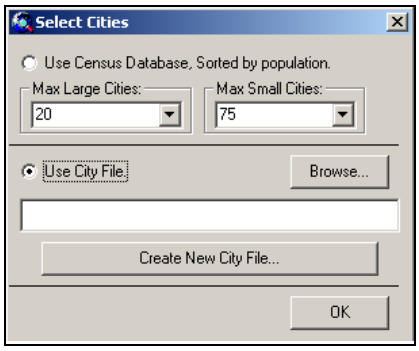
You now have complete control of the Drawing order of vectors on the map. This allows you to place the most important features on the top so they are not covered up.



Label Overlap Control

Activate Label Overlap and text drawn first will reserve its place on the map preventing later text from covering it.

User defined City Lists



Define a list of cities to show on the map. Save the list and import it into your jobs.

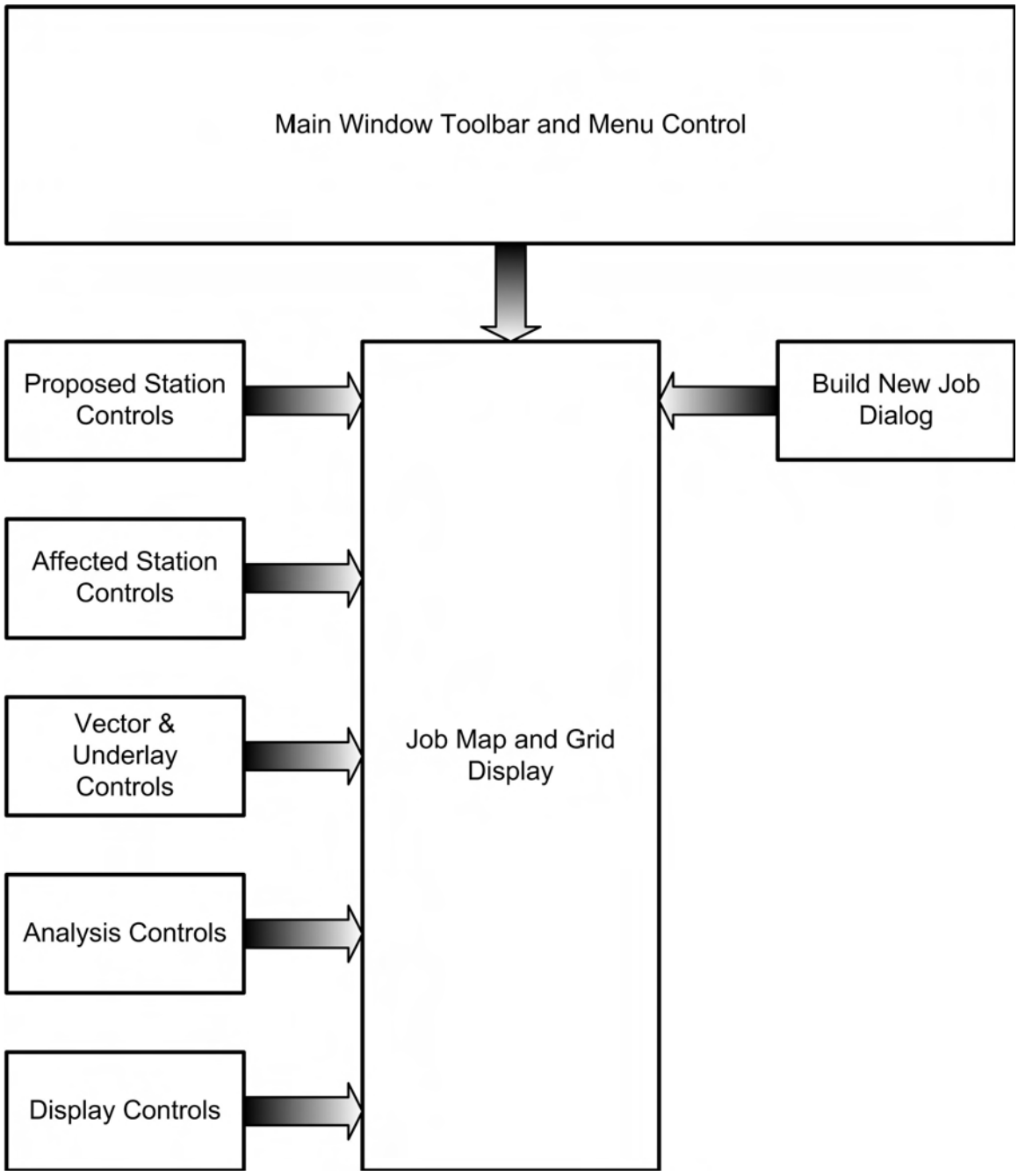
New Contour Related Features

Export translator power limits.
Build contours using the Mexican treaty rules.
Export a list of Zip Codes that are within a contour.
Create KML files of contours for display in Google Earth.
Create GEO files of contours for display in various GIS programs.
Build contours for everything listed on the station table with one click of the mouse.

White/Gray Analysis Tool

When the analysis is complete a box will be drawn on the screen displaying the analysis boundaries. Red, blue and green dots inside the box indicate population centroids from the US 2000 census. No NCE service displays as GREEN, one NCE service displays as BLUE and two or more displays as RED.

Jobs


Main Window Toolbar and Menu Control
Proposed Station Controls
Affected Station Controls
Vector & Underlay Controls
Analysis Controls
Display Controls
Job Map and Grid Display
Build New Job Dialog

Job Fundamentals

Overview

A Job is a subset of the master database. While the master database contains station information for all regions under FCC jurisdiction, a job contains data for a radius of from 150 to 1500 kilometers from the *Job Center*. This job radius or ***Scan Range*** is a user settable parameter.

In addition to FCC data, a Job contains map data. Depending upon the type of map data and assuming the default *Scan Range* of 350km, information stored in a job is limited to 100 to 450 km from the *Job Center*.

Using a *Scan Range* of 350km, jobs contain sufficient data for the study of a class C station within 60 km from the *Job Center* (49 km if near an international border). Lower powered classes can be studied further from the *Job Center*.

Parts of a Job

Each Job has a *Job Center*, a set of coordinates specified by Longitude/Latitude. When **rfInvestigator** builds a Job, data is gathered for a defined distance in all directions from the *Job Center*.

The fundamental purpose of a Job is to model a hypothetical or ***Proposed*** station and analyze its interactions with the surrounding ***Affected*** stations. The *Job Channel* and *Class* represent the Proposed station's channel and class. Unlike the *Job Center*, the Job Channel and Class can be changed without rebuilding the Job.

Valid Range of a Job

A Job has boundaries that limit its range of validity. These boundaries vary with the Scan Range, Job Class and the type of analysis being performed.

Types of Analysis

rfInvestigator provides for several types of analysis within a Job.

- 73.207 or 73.215 Minimum Separation
- 73.333 Contours
- Propagation Coverage, Interference and Best Server
- Field Measurements
- White/Gray Study
- Desired-to-Undesired Study

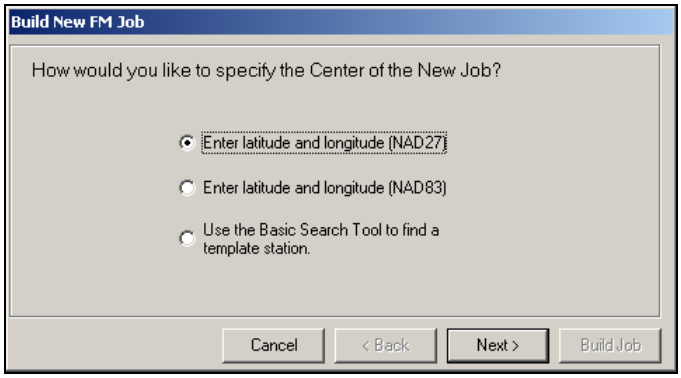
Opening an Existing Job

An existing Job can be opened by pressing the **Open Job** button, selecting Open Job from the File menu or right clicking on the Main Form and selecting Open Job from the pop-up menu.

The File and pop-up menus also allow you to select one of the five most-recently-used Jobs to open.

Building a New Job

The Build-New-Job Process



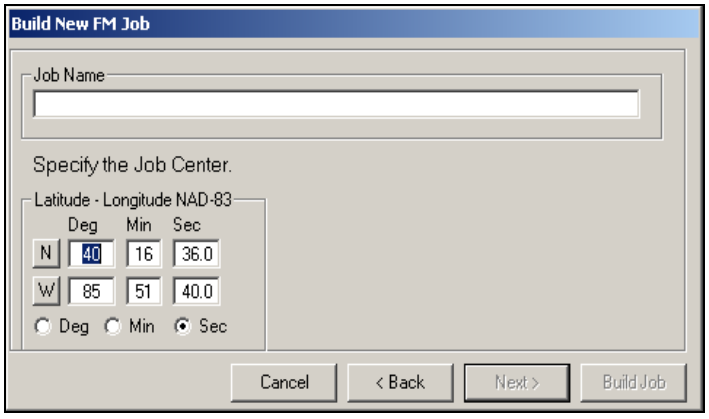
The build-new-job process can be started by pressing the **Build New Job** button, selecting New Job... from the File menu or right clicking on the Main Form and selecting Open Job... from a *pop-up* menu.

A new Job requires the following information:

- Data Source; an rfInvestigator Master Database
- Channel; an integer between 200 and 300
- Class; A, B, B1, C, C0, C1, C2, C3, L1, L2, DB or DX
- Job Center; specified by Longitude/Latitude
- Job Name

The information can be entered from scratch by selecting *Enter latitude and longitude* from the Build New Job screen, or an existing station can be used as a template to supply the required information.

A station can be designated a template by entering its callsign or entering a City-of-License and picking the station from a list.



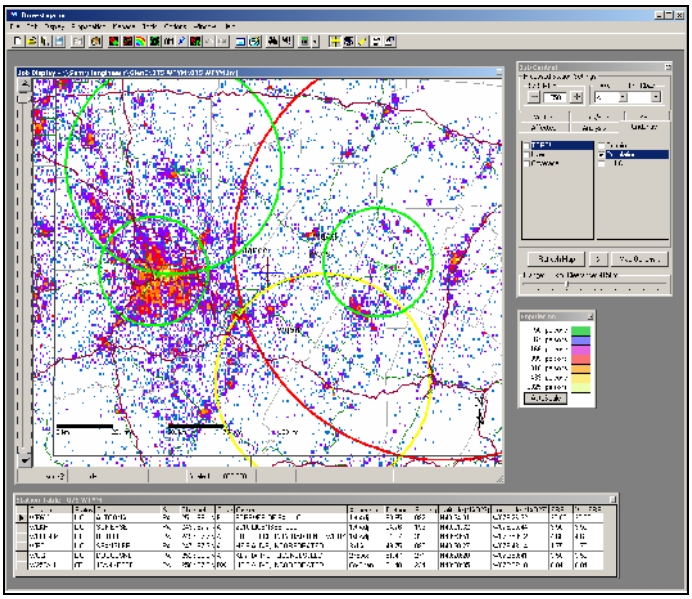
You can use the *Include* and *Scan Range* controls to select what kind of information to save in the job and how far out to search for stations.

Build This Job is also accessible from a *pop-up* menu on the *Station Table*.

Right clicking on the *Job Map* activates a *pop-up* menu with the option Build Job at Map Center.

The Job Map

Overview



The most complex part of a Job is the *Job Map*. The Map provides a graphical view of interactions between a ***Proposed*** and the various ***Affected*** stations.

The Map also provides positional references such as Latitude/Longitude lines, State, County and City boundary lines, Markers, Roads, Railroads and Hydrology.

Finally, the Map can display *Underlays* of Population distribution, Land Use Land Characteristic (LULC), Topographic Maps, Longley-Rice Coverage, Terrain or User Defined bitmaps. These underlays may only be displayed one at a time.

For an explanation of how maps Project a Curved Surface onto a Flat Screen see Appendix A.

Types of Stations

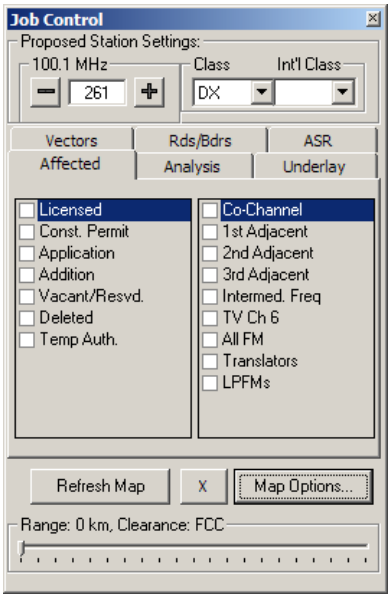
A ***Proposed*** station could be either a new station or, a modified existing station. There should be only ONE Proposed station in any given Analysis.

Affected stations are all FM, AM and TV6 stations and FM allocations affected by; and in the vicinity of; the Proposed station.

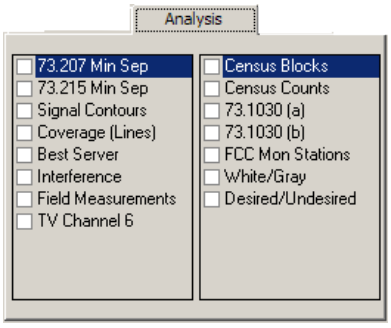
Job Control Dialog

The Job Class, International Job Class, and Job Channel controls located at the top of the Job Control Dialog, comprise the Proposed Station Settings.

The Affected Tab allows you to display or hide Affected stations based on their status, such as *Licensed, Construction Permit* or, *Application*.

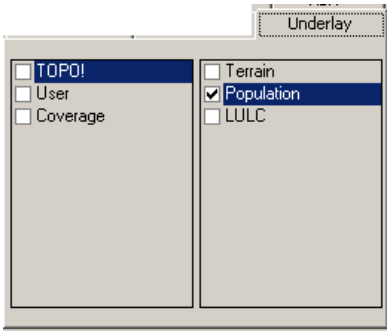


***IMPORTANT NOTE:** Settings under the Affected Tab will determine the validity of your analysis.

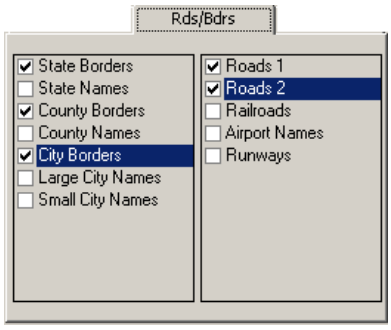


The Analysis Tab allows you to choose various types of studies.

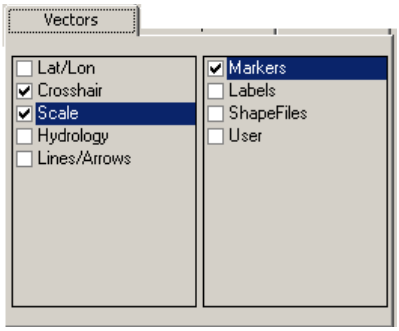
You can display FCC Minimum Separation rings, Contours, Field Measurement data or, using the optional PL-Server tool, Longley-Rice Coverage, Best-Server or Interference analyses.



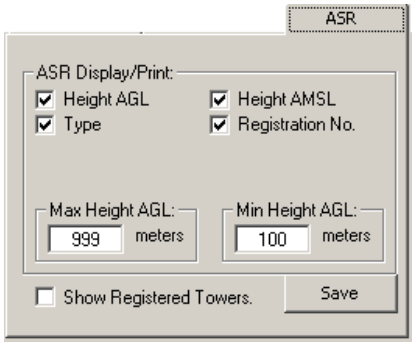
The Underlay Tab is used to select from various bitmaps. Only one underlay can be displayed at a time. In order to display Topographic and other USGS maps you will require the appropriate TOPO! Data. This data is sold by National Geographic and is available through **rfSoftware** as well as many map and sporting goods stores. One set of TOPO! Maps is included with rfInvestigator.



The Vectors and Rds/Bdrs Tabs allow you to display or hide various map references such as roads, markers, city boundaries, etc.



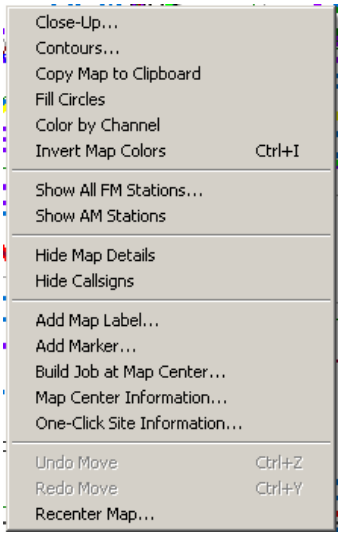
The ASR Tab controls display of Antenna Structure information on the map. The **Save** button allows you to export a list of towers to a file.



The Range Control controls the number of existing stations and allotments that are displayed beyond the range of Affected Stations.

The Clearance label indicates if actual FCC or deminimus separation values are being used to designate a station or allotment as Affected.

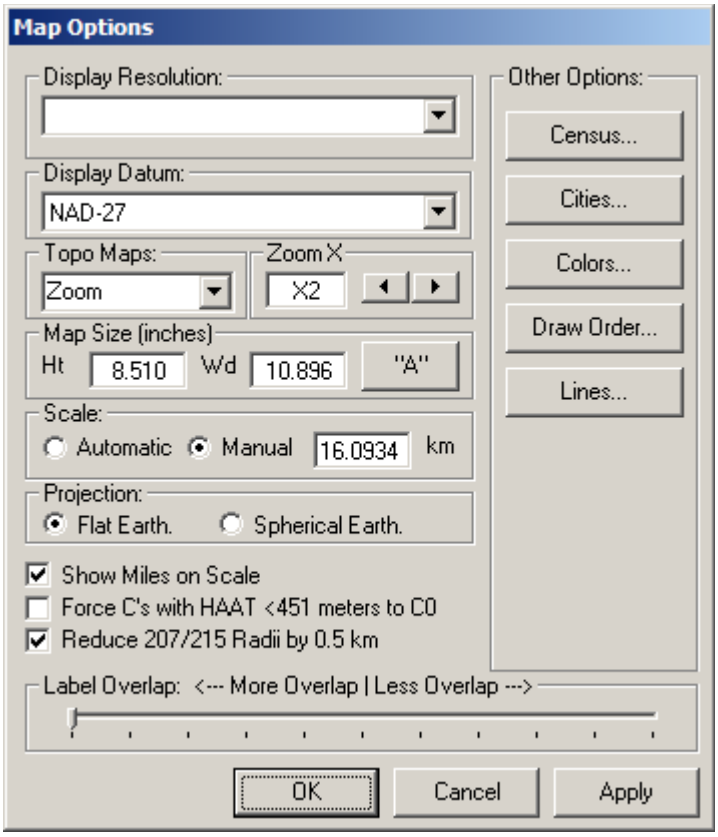
The Job Map Pop-Up Menu



Right clicking on the map will cause a pop-up menu to appear.

From this menu you can access many of the commonly used controls including; The Contour Manager, Add Marker, What-If, Recenter Map and Close-Up Dialogs. The pop-up menu also duplicates some of the frequently used buttons from the tool bar.

Map Options Control



The Map Options Dialog gives you quick access to many of the common option controls.

Map Options can be accessed from the button on the Job Control as well as Options--Map... on the Menu.

The Terrain Resolution Control selects the data source used for *Terrain Underlays*.

Checking the *Reduce .207 Radii by 0.5 km* box will change the 73.207 analysis to deminimus values instead of actual FCC values.

The ZoomX control is used to pre-scale the Map Zoom control.

The "A" button sets the map size for printing on 8 ½ " x 11" paper.

The Scale control allows you to override the automatic length feature. If the scale is too long to fit on the map control will revert to the automatic method.

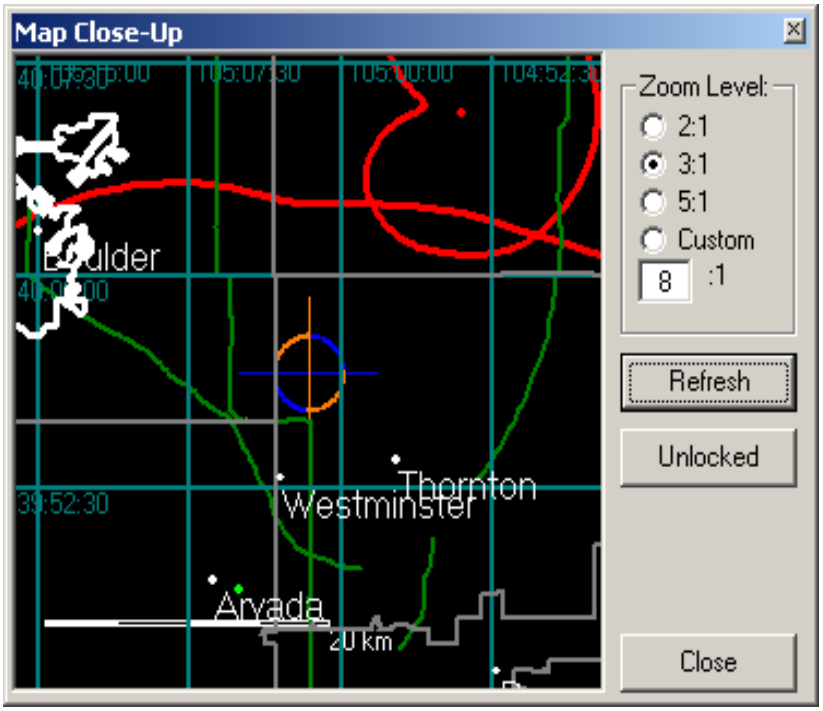
The Mouse Information Bar

The *Mouse Information Bar* is located at the bottom of the *Main Screen*.

The first two readings indicate the Range and Bearing to the Mouse Pointer from the Center of the Map, third, and fourth are the Latitude and Longitude of the Mouse Pointer, fifth is the Map Scale. The sixth indicator displays the height **AMSL** (Above Mean Sea-Level) at the Mouse Pointer position. The seventh and eight panes are dynamic and display different types of information depending where the mouse is located and which underlays are displayed.

The Map Close-Up Window

The Map Close-Up window is a resizable, floating map window that displays a close-up view of the region surrounding the current mouse position. The close-up view automatically updates as the mouse moves around the screen.

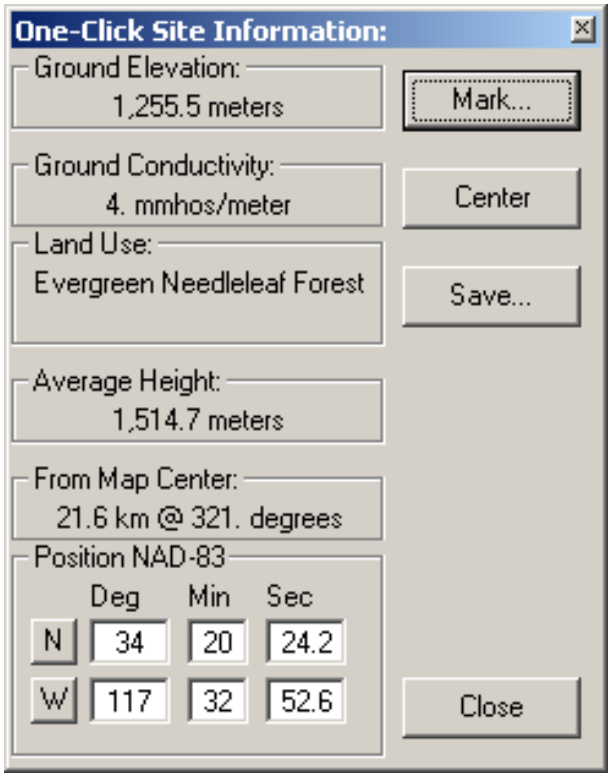


You can access the close-up window by pressing the **Close-up Mode** button or from the main menu by selecting Display--Close-Up… or by right clicking on the map and selecting Close-Up… from a *Pop-Up* menu.

When the Map Close-Up window is displayed, the Rubber-Band feature of the left mouse button is disabled. By clicking the left mouse button, the Map Close-Up window can be '**frozen**' at a particular location. This allows you to move the mouse pointer off the map and onto the Close-Up Window. If you click the left mouse button again, the Map Close-Up window will unfreeze.

Clicking the ***Refresh*** button on the Map Close-Up window will cause the map to regenerate with increased detail. Pressing the ***Locked/Unlocked*** button will also freeze or unfreeze the Close-Up display.

The One-Click Site Information Window



The One-Click Site Information window reports various kinds of information for a selected point on the job map. When the One-Click window is active, left-clicking once anywhere on the map will place a mark at that location. The One-Click window will display data for that point.

Pressing the ***Mark*** button will allow you to place a marker at the current point.

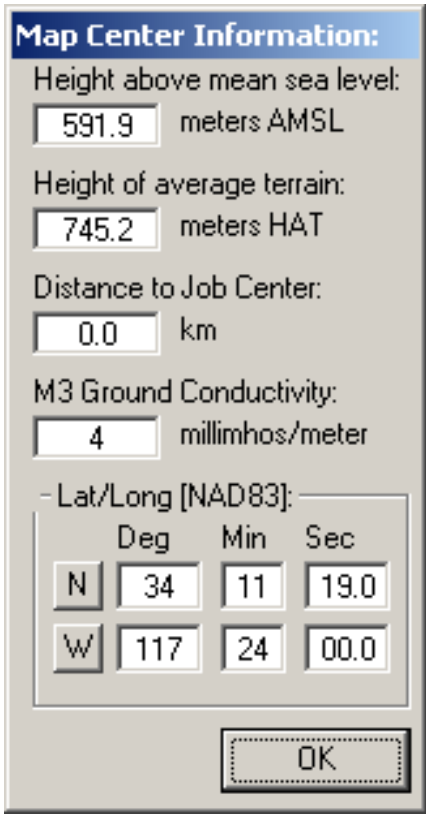
Pressing the ***Center*** button will re-center the job map at the current point.

Pressing the ***Save*** button will allow you to save the One-Click Site Information to a text file.

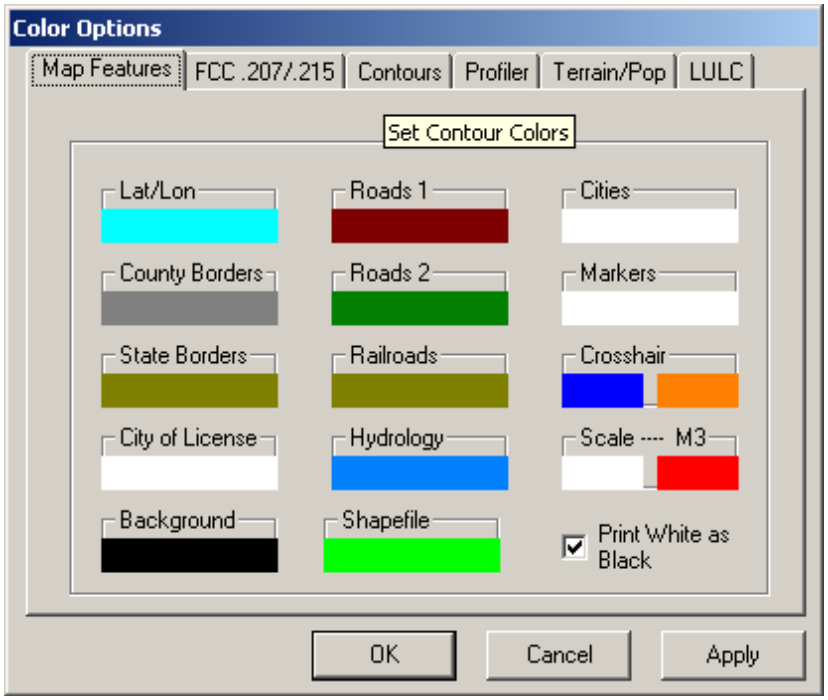
Access the window from the *Job Map Pop-Up* Menu or from the Main Menu Display--One-Click Site Information….

The Map Center Information Window

The Map Center Information Window reports various kinds of information for the current *Map center*. Access the window from the *Job Map* Pop-Up Menu or from the Main Menu Display—Map Center Information….



Controlling Colors



The Color Options Dialog can be accessed from the drop-down menu by selecting *Options—Colors....*

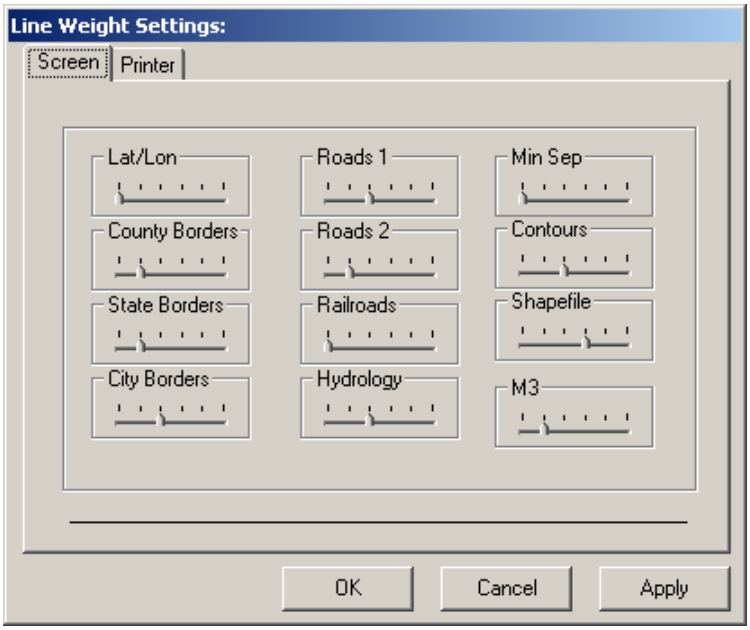
Clicking on a color will allow you to change the color for the associated feature.

Controlling Line Weights

The Line Weight Settings Dialog can be accessed from the drop-down menu by selecting Options—Line Weights....

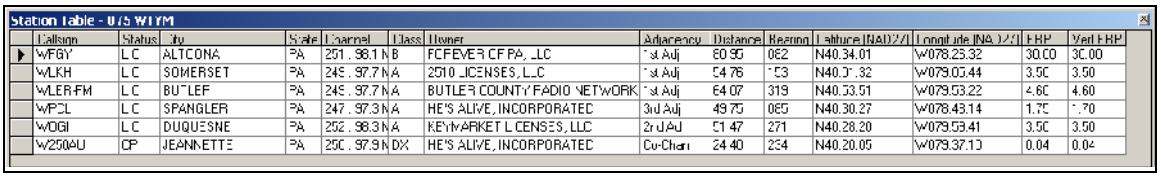
Adjusting a slider will allow you to change the line weight for the associated feature. The line at the bottom of the dialog represents the line weight chosen.

Separate controls are provided for screen and printer line weights.



The Station Table

Overview



The *Station Table* provides details on the various Affected stations. Additional stations may also be listed depending on the Range setting.

Manipulating Columns

The order of stations on the *Station Table* is controlled by first clicking on a column heading and then right clicking and selecting the desired *sort order* from a pop-up menu.

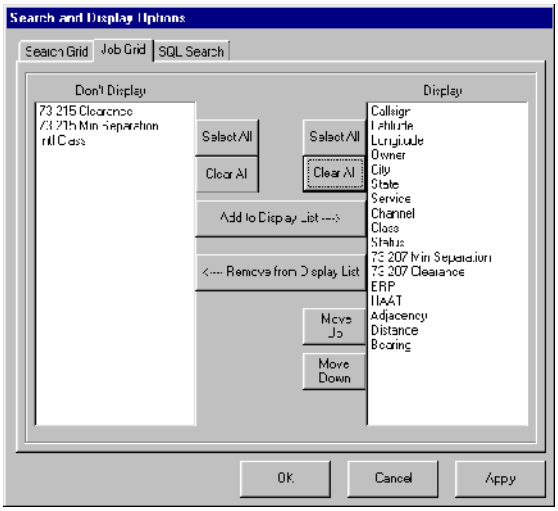
The station separation rings on the *Job Map* are drawn in the reverse order of stations on the *Station Table*. This is important when displaying filled circles, as the last station drawn will appear on top.

Individual columns can be resized by placing the mouse on the right-hand edge of the column heading and click-dragging the mouse.

The Fields Selector

The fields displayed on the Station Table and the order of the columns is controlled from the Search and Display Options Control.

The Search and Display Options Control can be accessed by pressing the **Select Fields** button, selecting Tools--Options--Display Fields... from the drop-down menu or, right clicking on the *Station Table* and selecting Change Displayed Fields from the pop-up menu. Select the *Station Table* tab. Two windows are displayed, Don't Display and Display. Fields listed in the Display window will appear on the Data Display Screen in the order that they are listed.

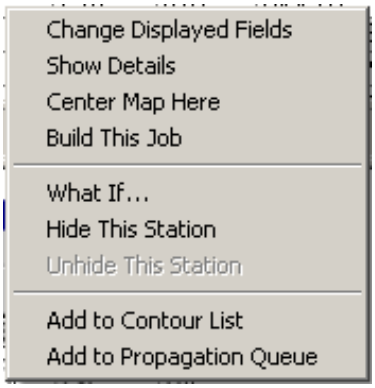


Select one or more fields in the Display window and change their position in the list with the ***Move Up*** and ***Move Down*** buttons.

To remove a field or fields from the Display window, select one or more fields in the Display window and click the ***Remove from Display List*** button.

To add a field or fields to the Display window, select one or more fields in the Don't Display window and click the ***Add to Display List*** button.

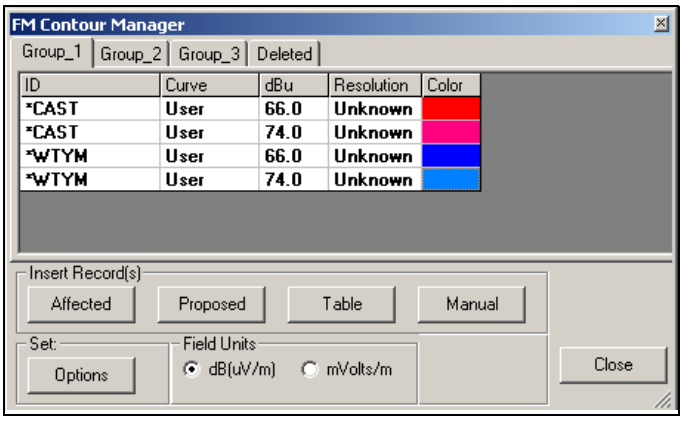
The Pop-Up Menu



Selecting a station from the *Station Table* and then right clicking will bring up a *pop-up* menu.

This menu allows easy access to many of the most frequently used functions.

The Contour Manager



Overview

The Contour Manager allows you to add, delete and edit 73.333 contours.

The Contour Manager can be accessed by pressing the ***Contour Manager*** button on the button bar, selecting Edit—Contours.... from the drop-down menu or, right-clicking on the *Job Map* and selecting Contour Manager... from the *pop-up* menu.

Contour Groups

Contour Groups can be created, renamed or deleted by right-clicking the mouse on the Contour Group Tabs and selecting from the *pop-up* menu. Use Ctrl-V, Ctrl-C or the *pop-up* menu to copy and paste contours between groups.

Adding a Proposed Station at Map Center

Click the **Proposed** button to begin the process of adding a hypothetical station located at the center of the map to the list of contours.

A series of dialog screens will appear to gather the information necessary to define the proposed station.
The process of adding this type of station is covered in more detail in **Creating and Managing Contours.**

Adding Affected Stations

Click the **Affected** button to begin the process of adding all the possible Affected stations to the list of contours.

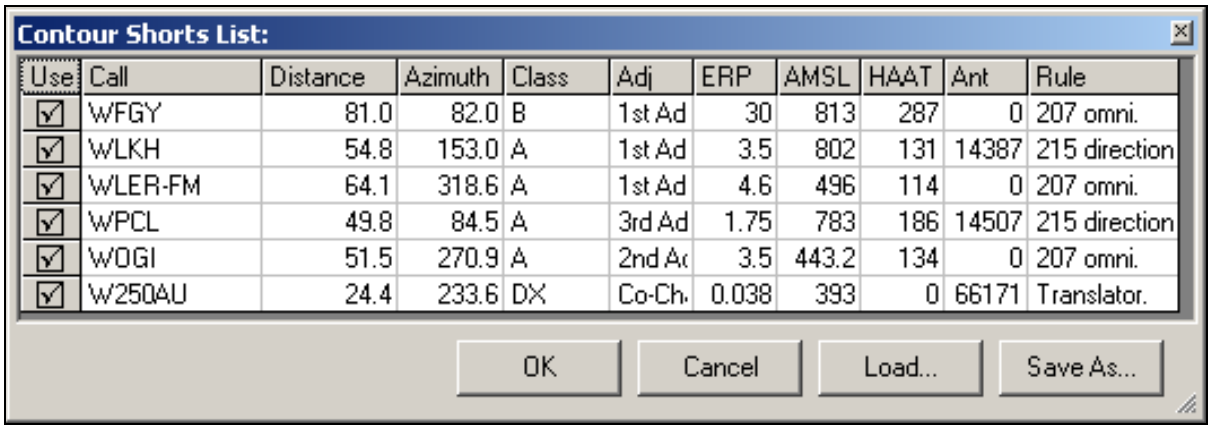
A series of dialog screens will appear to gather the information necessary to define the Affected station(s).

Adding Stations from the Station Table

A station on the Station Table can be added to the contour list as Affected station, or in the case of a station co-channel with the Job, as a Proposed station.

Select the station to be added from the Station Table. Right-click and select Add to Contour List from the pop-up menu. A series of dialog screens will follow to gather the information necessary to define the new contour.

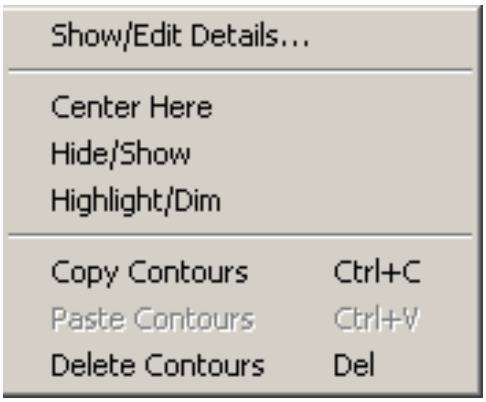
Pressing the **Table** Button will add all of the stations in the Station Table to the contour list.



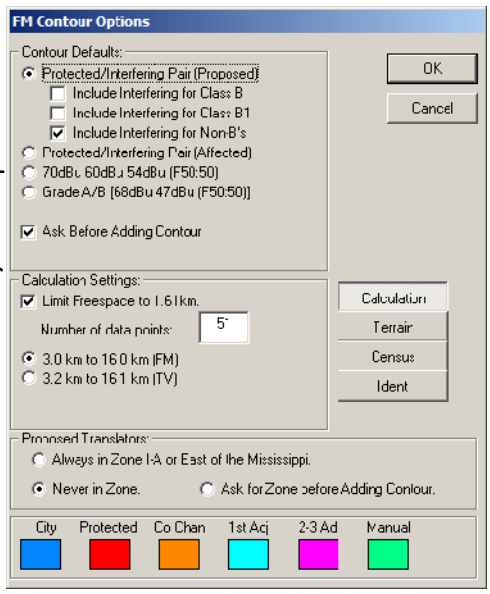
Pressing the **Affected** or **Table** Button will display the contour list. This gives you the opportunity to select which station contours you wish to create.

The Pop-Up Menu

Right clicking on the Contour Manager will bring up a pop-up menu. The menu allows you to access the Contour Editor, Hide/Show or Delete a contour, or recenter the map.



Contour Options



The Contour Options screen can be accessed by pressing the **Options** button on the *Contour Manager* or, selecting Options--Contours... from the Main Menu.

Contour Default settings control the state of several parameters used in contour calculations.

The Radials control allows you to select the number of evenly spaced radials used to display each contour. The minimum number of radials is 8 and the maximum is 360. 360 radials are always used to CALCULATE contours. The Radials Control only affects how the contour is DISPLAYED.

The HAAT Calculation control allows you to select between two different methods of determining height from the *Digital Elevation Model* (DEM).

- The "**FCC Method**" uses 4 points from the DEM to perform a linear interpolation of height.

- The "**Slope Method**" uses an array of 25 or more points from the DEM to predict height based on how the surrounding terrain changes.

The slope method, which is significantly faster than the FCC method, can be used for initial searches and what-if's.

FCC Rules require that linear interpolation methods be used for computer-determined heights. Therefore, all fine-adjustments and exhibits for submittal to the FCC should use the slower **FCC Method** of calculation.

Changes made on the Contour Options screen will not affect existing contours. Changes made here will be reflected only in new contours.

Limiting Freespace to 1.61km.

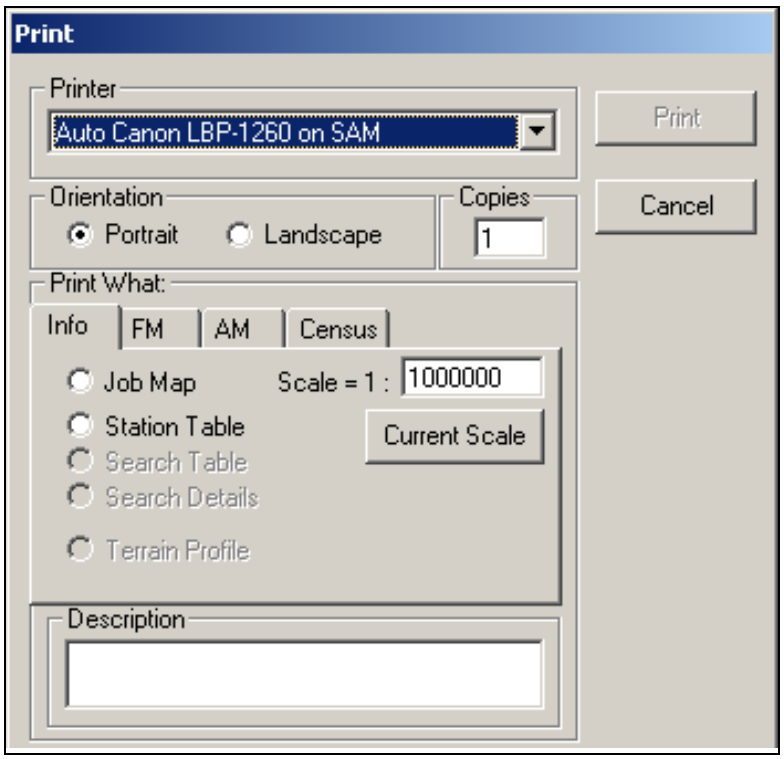
FCC rules state that under certain conditions the distance-to-contour calculation should stop using the prediction tables and switch to the freespace formula. Doing this in-accordance-with the rules will produce characteristic "spikes" on the contour. Limiting the freespace calculation to 1.61km (the beginning of the FCC curves) smooths out the contour. Some engineers claim that the FCC has instructed them to set this freespace limit, in disagreement with the rules. Other engineers claim that the contour is wrong if it does not have the "Spike." In an effort to please both camps, rfInvestigator supports both methods.

Select *Limit Freespace to 1.61km* to have smooth contours that **do not** conform to FCC rules. **Uncheck** the box to have "Spiked" contours that **do** follow the FCC rules.

Printing

The *Job Map* and *Station Table,* as well as *Search* information can be sent to any printer or plotter installed on your Windows system.

Access the print dialog by pressing the ***Print*** button from the button bar, select File--Print... from the drop-down menu or press Ctrl-P.



Terrain Data

30 and 3 second DEM's

Terrain data is stored as a Digital Elevation Model or DEM. The DEM is a two-dimensional computer array (like putting graph paper over the terrain).

Standard Terrain elevation data is available for rfInvestigator in 30 and 3 arc-second resolutions for most areas of the World.

1 second High-Res and 1/3 second Ultra High-Res DEM's

NED and finished SRTM are available in High-Res and Ultra High-Res for select areas of the United States. The availability and extent of this data changes day-to-day. Contact **rfSoftware** if you require high and ultra-high resolution for **rfInvestigator**.

Data Sources

The 30-second data was obtained from the FCC, and originally came from NOAA's National Geophysical Data Center (NGDC). This data has a vertical resolution of 10 meters. Coverage is limited to the continental United States.

The 3 arc-second DEM provides coverage for all of the contiguous United States and Hawaii. The elevation model was obtained from the US Geological Society's EROS Data Center. This data has a vertical resolution of 1 meter.

The alternative 30-second data is the *G*lobal *L*and *O*ne-km *B*ase *E*levation (*GLOBE*) database. This is supposed to be the latest and best 30-second terrain data available from NGDC. Worldwide data is available. rfInvestigator includes GLOBE data for most of North America. It has a vertical resolution of 1 meter.

****IMPORTANT NOTE:** There have been questions about the acceptance of GLOBE data by the FCC since, in some regions; it differs significantly from the old 30 second DEM.

The Shuttle Radar Topography Mission (SRTM) successfully collected Interferometric Synthetic Aperture Radar (IFSAR) data over 80 percent of the landmass of the Earth between 60 degrees North and 56 degrees South latitudes in February 2000. This data is selectively available in Raw and Finished form in 3-second and 1-second resolution for use by rfInvestigator.

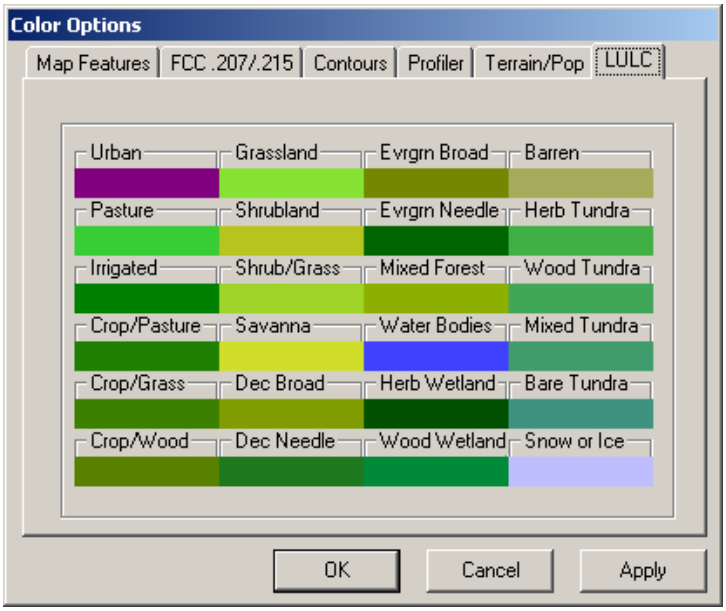
Population Data

Population Distribution on a Grid

Population data is stored and displayed in much the same way as terrain data. An X, Y grid of points is laid down over the *Job Map*. Each point is assigned a value equivalent to the population surrounding it. The grid can then be color coded to represent population distribution in the same manner as a terrain map represents elevation.

LULC Data

Land-Use Land-Characteristic (LULC) data is stored and displayed in much the same way as terrain data. An X, Y grid of points is laid down over the *Job Map*. Each point is assigned a value equivalent to the use or characteristic. The grid can then be color coded to represent LULC in the same manner as a terrain map represents elevation.

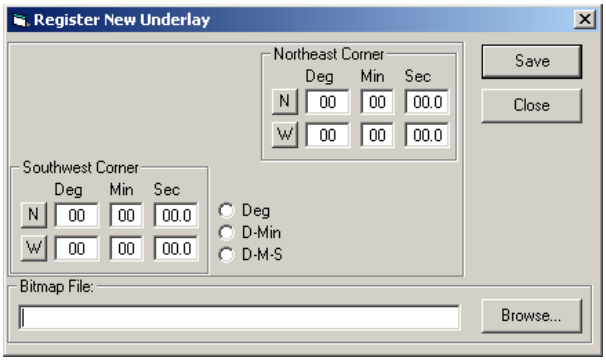


The Colors that represent the various uses and characteristics can be changed by selecting the last tab on the Color Options Dialog then, click on the color box of interest and select a new color.

User Underlays

Overview

User underlays provide you a method of placing any bitmap image on the screen. This tool is useful for placing street-maps or satellite images on the *Job Map*.



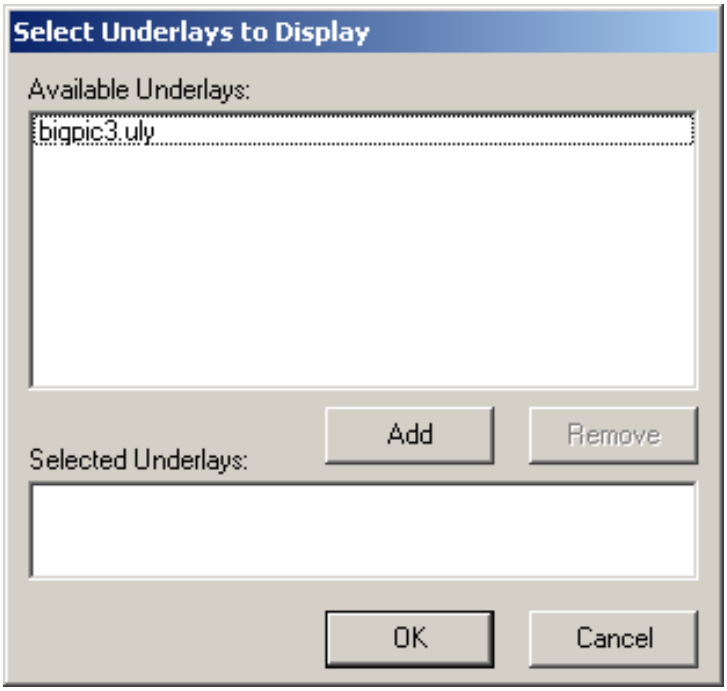
Registering an Image

In order for the program to be able to display bitmapped images, they must first be registered. Registration is a means of telling the program where the image fits within the map. Images are registered using the Register New Underlay Dialog. This screen is accessed from the Main Menu by clicking Tools--Register Bitmap….

Click the ***Browse*** button and select the image you wish to display. Enter the latitude and longitude of the northeast and southwest corner. Then click the ***Save*** button and assign your new underlay a descriptive name.

Displaying User Underlays

To display a user underlay click *User* on the *Job Map* Analysis/Underlay Tab. This will open the Select User Underlay Dialog.



The Dialog will list all underlays that are within range of the current Job Map boundaries. To display an underlay, select it from the Available Underlays list and add it to the Selected Underlays list. This can be done with the **Add** button or by simply double clicking on the item in the list.

Use the same procedure to remove items from the Selected Underlays list.

National Geographic Topo! Maps

There is an index of CDs. The index is:
{rfsoftware}/resources/ TopoIndex.mdb.
The index lists what CD a particular National Geographic file is located on.

When you index a CD this is where the info is stored. This database must be in resources. If it is not there, rfInvestigator will create a new index. If you are having problems with the program asking for old disks that you don't have anymore you can delete this file and reindex your CDs.

Note: The following discussion only applies to maps 3, 4 and 5. Maps 1 and 2 are ALWAYS stored in {rfsoftware}\resources\TOPO!_Maps\Map1 or Map2.

When you rip a CD it first gets indexed. The index is used to count how many files will be processed. This is used to scale the progress bar.

Next, there is an index of processed (ripped) map files. This index is called TOPOMapIndex.mdb. In most cases, there will be TWO of these files.

For example, I have an external 250GB hard disk that I use for ripped maps. The drive appears as "E:\" when it is plugged in. My TOPOMap setting in the program folder option screen is set to "E:\TOPO! _Maps."

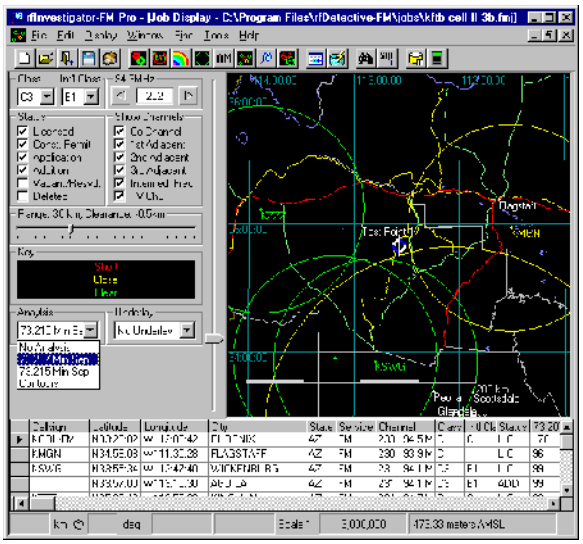
If I rip a CD and the external HDD is on-line then the program is supposed to rip the maps to "E:\TOPO!_Maps\Map3," Map4, or Map5. The index that points to these maps should be "E:\TOPO!_Maps\ TOPOMapIndex.mdb."

However,

If I rip a CD and the external HDD is off-line (or unplugged) then the program is supposed to rip the maps to "{rfsoftware}\resources\TOPO! _Maps\Map3," Map4, or Map5. The index that points to these maps should be {rfsoftware}\resources\TOPO!_Maps\ TOPOMapIndex.mdb."

Job Analysis

73.207 Overview

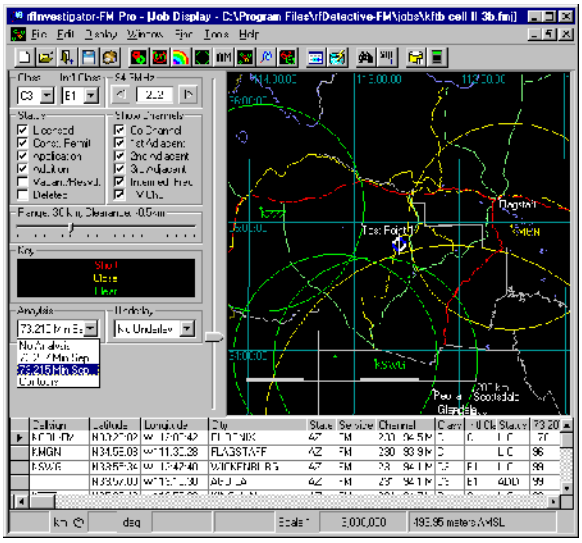


Rule 73.207 sets forth minimum separation requirements between Proposed stations and Affected stations. These separation values are primarily functions of each stations Class and Channel in relation to each other.

r**fInvestigator's** 73.207 Analysis mode automatically computes and displays these minimum separations as color-coded circles centered on each station. The color-coding can be *by-channel* or *by-clearance*. In the first mode, the color of each stations ring is dictated by its frequency relationship with the *Job Channel.* For example, *co-channel* could be red and 1st adjacent yellow.

In color *by-clearance* short stations (those whose rings include the Job Center) are red, station rings whose borders are close to Job Center are yellow and those well clear are green.

73.215 Overview



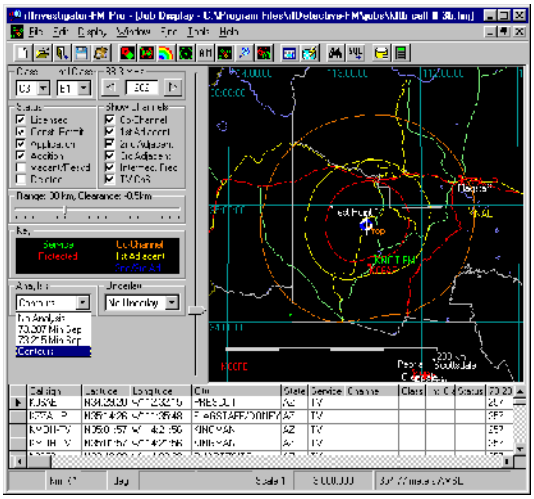
Rule 73.215 allows the *short-spacing* of commercial FM stations if certain conditions are met. These conditions involve minimum separation requirements similar to but less stringent than 73.207, and interfering-protected contours.

Rule 73.215 cannot be used to obtain a new allotment. It can only be applied to an existing station, application or allotment.

Prior to applying contour rules to a Proposed station, compliance with 73.215 minimum separation must be established. This is done by selecting *73.215 Min Sep* from the Analysis control. The Min-Sep rings are identical in functionality to those used for 73.207.

NCE Overview

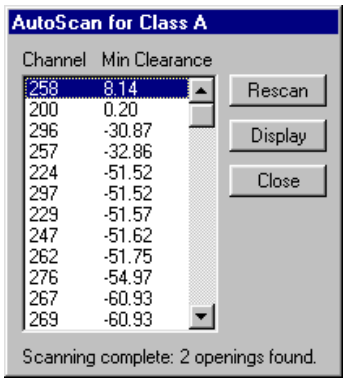
Non-Commercial Educational (NCE) stations are regulated by FCC rules 73.501 through .599 (subpart C). Separation between NCE stations is regulated by contour protection. 73.207 applies to separation from commercial stations.



After verifying 73.207 spacing has been achieved in regard to commercial stations, an NCE analysis can be performed using the contour mode.

The technique of considering only short stations as Affected stations works for NCE since contour protection is not required if .207 spacing exists.

Auto Scan

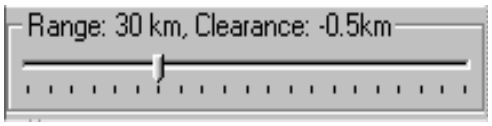


The Auto Scan feature will test every channel as a *Job Channel* using the current *Job Center* and *Class*. The results of the scan are displayed on a table sorted by clearance.

Double-clicking on a channel in the table, or selecting a channel and clicking the *Display* button, will change the *Job Map*, displaying the selected channel as the *Job Channel*.

Range and Clearance

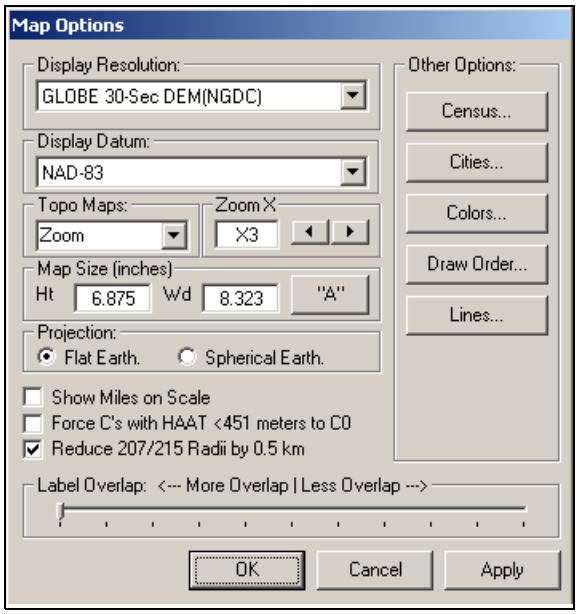
The *Range* slider controls how far from *Job Center* the program will look for *close* and *clear* stations. Setting the range to zero will display only *short* stations.



It is sometimes useful to display *clear* stations when you wish to relocate an existing station, or move a proposed *Job Center*.

The Clearance status is reported above the Range slider. This parameter is set on the bottom of the Map Options dialog.

Right-clicking on this control will allow you to set it to ranges beyond 100km.



The FCC will allow up-to a one-half kilometer encroachment over the minimum separation line without rejecting an application.

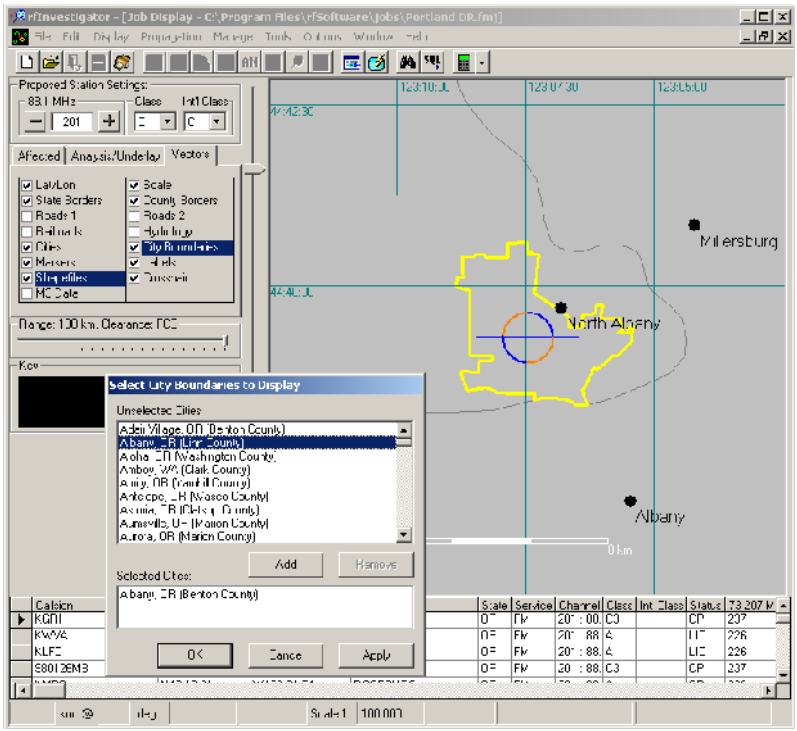
If the Clearance box is unchecked then the rings are drawn to the FCC published values in-accordance-with rule 73.207.

Check the Reduce box and the rings will be reduced in radius by one-half of a kilometer to reflect this tolerance.

Community of License

The *City Grade Contour*, which is the 70dBuV 50-50 curve, must cover all of the *city-of-license* for a commercial station and some part of the *city-of-license* for an NCE station.

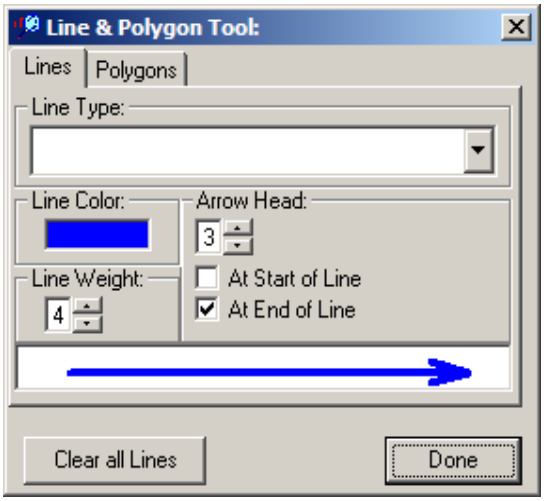
rfInvestigator uses political borders from the 2000 Census to display *city-of-license*. Select Edit--City of License... from the drop-down menu and select the desired city from the list.



Lines Arrows and Polygons.

Display of both Polygons and Lines/Arrows is turned on or off with the *Lines/Arrows* check box on the *Job Control Vectors Tab.*

To create lines, arrows or polygons select *Draw Mode* by clicking on the pencil button (3rd button from the right) on the tool bar.

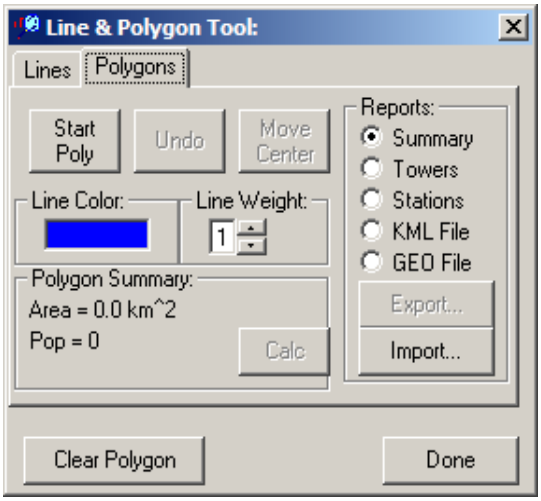


For Lines and Arrows select a *Line Color* and *Weight*. You can also adjust the size of the arrowhead and control where the arrowhead is placed, at the beginning, end or both ends of the line. You line or arrow will be previewed in the lower box.

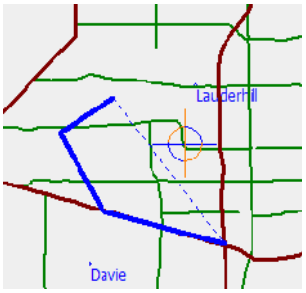
NOTE: Line Weight control will only work for solid line types.

Click and drag on the map to place a line.

Switch to *Move Mode* to change color, reposition or delete a line or arrow.



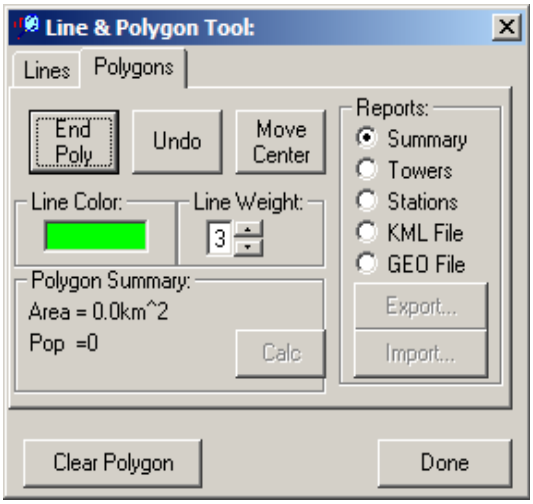
To create a new polygon click on the *Polygons* tab. Select a *Line Color* and *Line Weight* then click the *Start Poly* button.



Click on the map at your starting point. Reposition the mouse and click at your next point, and so on... A dotted line will show the path of the polygon's closing line. Click on the *Undo* button to back up to an earlier point.

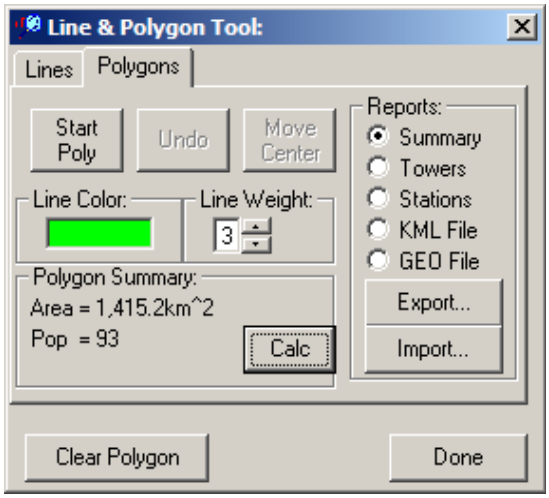
Zoom in to draw more precise lines. When you get close to the edge of the screen click the *Move Center* button to recenter on the last click.

Click the *End Poly* button to end the polygon. You can now save the polygon and open it later and resume the creation process from the last click location.



Polygon are saved in a *.GEO format. These saved polygons can be reloaded by opening the *Polygon Tool* and clicking the *Import* button. The polygon will be drawn with a dotted line connecting the last drawn point to the original starting point using the current color and line weight. You can continue drawing the polygon or simply click the *End Poly* button to close.

After ending a polygon you can optionally press the *Calc* button to find area and population.



Under the *Reports* label you can select Summary and click *Export* to save a summary of polygon information. Select *Towers, Stations, KML* or *GEO* to export one of these types of files.

To import a previously saved GEO file; Set the *Line Color* and *Weight*, click *Import* and select a file, then either continue creating the polygon from the last point entered or click the *End Poly* button.

rfInvestigator White/Gray Analysis Tool

Open a Job in the area to be analyzed. Center the job map in the middle of the area to be studied. Determine the distance from the map center that will need to be studied. Select the **Affected** tab on the "Job Control Dialog." Set the desired station status, normally **Licensed** and **CP** for an NCE study.

Select the **Analysis** Tab on the "Job Control Dialog." On the right hand column of the "Job Control Dialog", check the **White/Gray Study** box. The White/Gray Setup Dialog should appear. Set a desired contour value, normally 60dBu for NCE studies.

Set an **Analysis Range**, that is, the distance (radius) from the map center to include in the study. *Be sure to select a distance to the furthest population you wish to consider. Your contour must fit entirely inside the analysis area.*

Select the type of stations to include in the study. Normally **Full Service NCE** for an NCE Study. Also, insure that the "Show list of Stations" box is checked. Click the **Run New Analysis** button. Select an **FM Master** database if one is not already open.

A list of candidate stations will be displayed. Unselect any station on the list that should not be included in the study, for example a CP that has not filed for a license, or a licensed station with a CP that has applied for a license. Also, for an NCE study, unselect any NCE stations outside of the reserved band that are not on reserved channels… *channels without an * next to their allotment in **73.202.*** Then click **OK.**

Specify a name to save the study and wait for the process to complete.

When complete a box will be drawn on the screen displaying the analysis boundaries. Red, blue and green dots inside the box indicate population centroids from the selected US census (2000 or 2010). No NCE service displays as GREEN, one NCE service displays as BLUE and two or more displays as RED.

Create a coverage contour for your proposed station. The contour must be contained entirely within the analysis area (box) for the population count to be valid. Open the contour details dialog for the proposed coverage contour and click the **Export** button. Select "Current Contour White/Gray Population Counts" from the list of reports and click **OK**. Specify a name for the report and click **OK**.

The report is saved as a text file; open it with an appropriate program to see the population counts and percentages of first and second service for your proposed contour.

Note that the contour group is created in your job with the same name as your analysis. The contours used in the study are in this group.

Translators and Boosters

Introduction

Translators and Boosters are regulated by FCC rules 74.1201 through 74.1290 (subpart L). Rule 74.1204 deals with protecting existing FM radio stations from new or modified Translators and Boosters.

When used in combination with a thorough knowledge of the rules as they pertain to Translators and Boosters, **rfInvestigator** can be used to demonstrate compliance with the requirements of 74.1204.

Setting the proposed station class to **DX** will cause:

- 73.207 minimum separation rules to be applied for all stations plus or minus 53 or 54 channels from the proposed channel.
- 74.1204(a)(1) through (a)(4) Contour rules to be applied when creating *Short* and *Job Center* Contours.

****IMPORTANT NOTE:** The program applies rule 73.207 in all cases, even though the rule does NOT apply for translators under 100 Watts.

When computing the HAT for a Translator/Booster **rfInvestigator** automatically chooses a 12 radial pattern.

How to Place a Translator or Booster

Placement of Translators and Boosters are controlled by contour protection. Since **rfInvestigator's** Auto-Scan feature works only with minimum separation values Auto-Scan is of limited usefulness in finding sites for translators, but it is a good place to start.

Pick a possible location for the Translator or Booster. For fill-in Translators and Boosters the location must be within the parent station's coverage contour, see 74.1201(g). For non fill-in Translators pick a spot near where you wish to provide coverage, possibly on an existing tower or tall building.

Auto-Scan will tell you where 73.207's IF minimum spacing rules will prevent the placement of a (100 Watt or greater) Translator or Booster. For a Translator, pick a clear channel from the auto-scan list. If a Booster is blocked by 73.207 you must either relocate or reduce power below 100 Watts.

Next, use the *Contour Manager* to build contours for all Short stations. For Boosters and fill-in Translators, you should leave out the parent station. If the proposed location is inside any existing station's protected contour then try the next channel on the list (Translators) or look for a new location (Booster). Once you find a channel/location that is clear of protected contours, add *Map Center* contours and see if it works.

Translator Power Limits

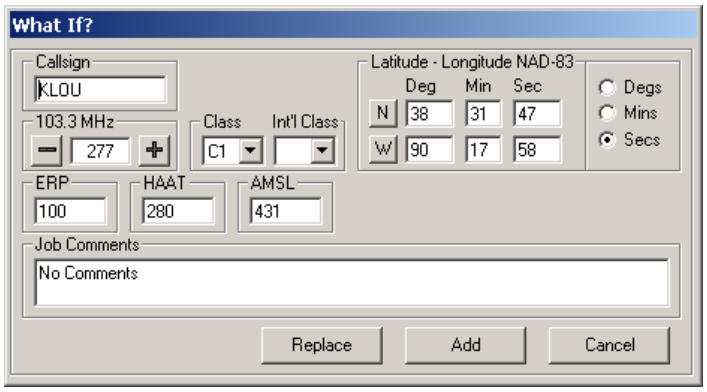
When working on translator applications it is necessary to examine the HAAT in each of 12 radial directions in order to find the max ERP for the bearings closest to that radial. See 74.1235(b).

In order to do this analysis, create a contour at your location of interest. Select Contour Details and click the 'Export...' button. Check "Export Translator Power Limits." from the Export Data Dialog and click "OK". Save the file where you can find it. Open the file with an spreadsheet program. The spreadsheet will list the antenna gain (field), HAAT, ERP, Max allowed ERP for East of the Mississippi & Region 1A, and Max allowed ERP for other areas. These values are given for 72 bearings. After opening the file in your favorite spreadsheet program change the format of the numeric fields to show more digits. You can also easily add a calculated column on the right that flags problem bearings. A sample spreadsheet is available on the rfInvestigator Users Group Web Site.

What-If's

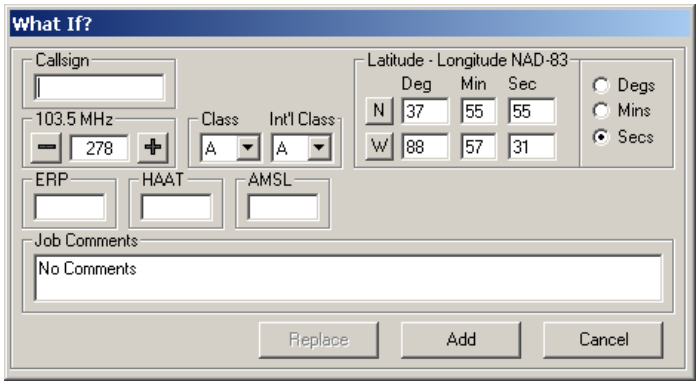
The What-If tool allows quick changes to an existing station to test their effect on other stations.

It can be accessed from the *Station Table* pop-up menu.



A second What-If tool is available for adding a new site to the *Job Map/Grid* at *Job Center*. It will open with the job center information loaded.

It can be accessed from the drop-down menu by selecting Edit—What If....

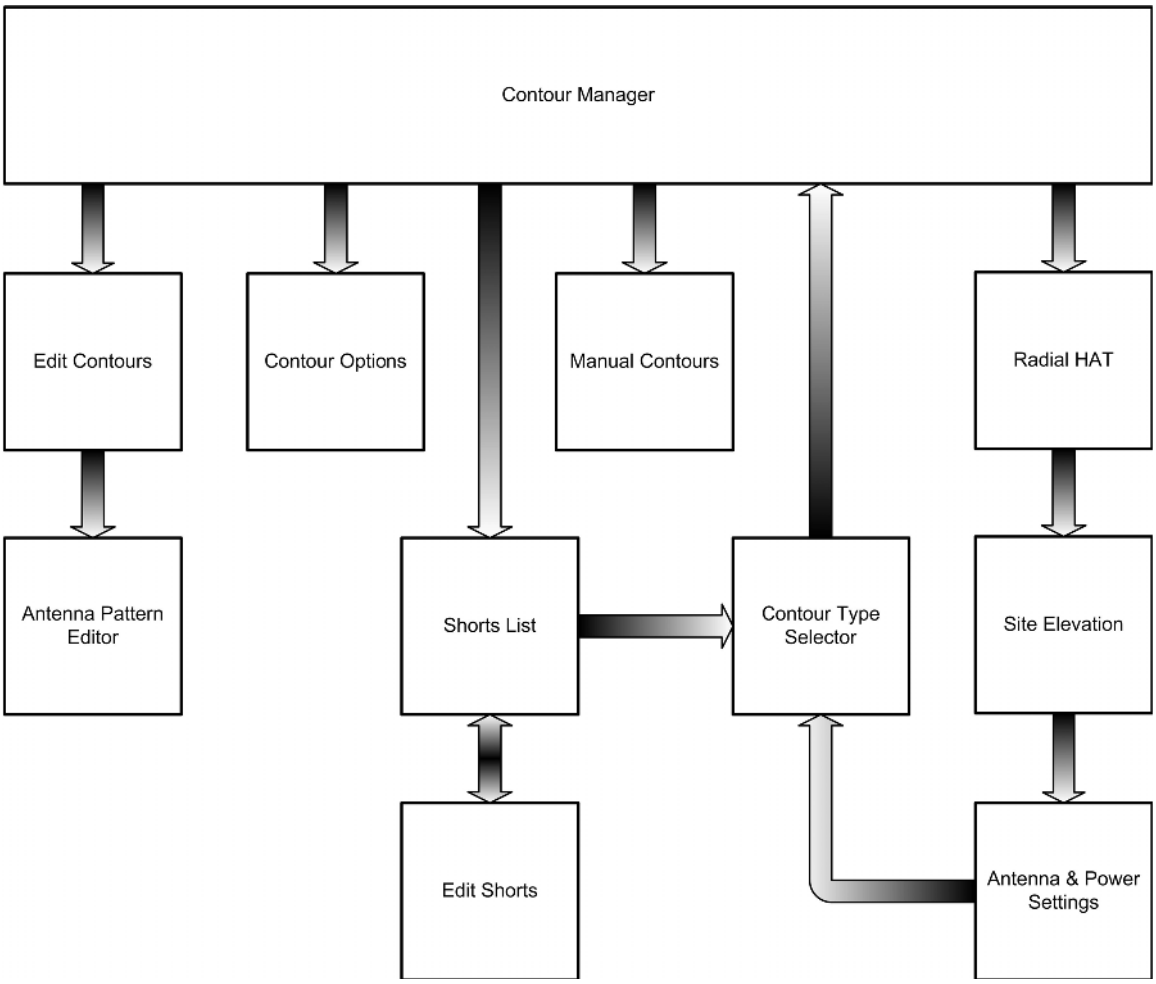


Once the *What-If* station is added it will become part of the job file. A *What-If* station may also be added to the Master Database from the main menu, Edit--Master Database. This is useful to correct errors in the FCC database.

Notes:

Notes:

Contours

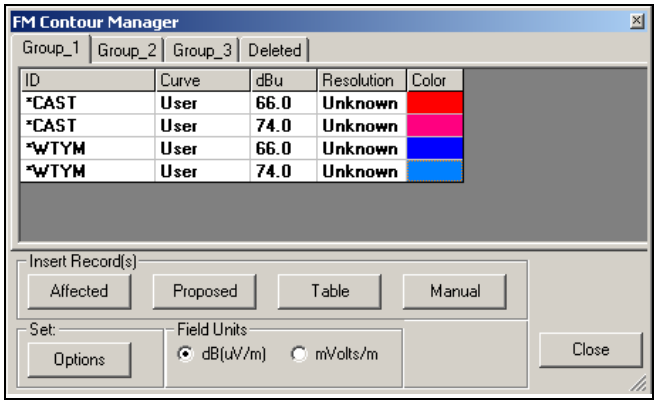

Contour Manager
Edit Contours
Contour Options
Manual Contours
Radial HAT
Antenna Pattern Editor
Shorts List
Contour Type Selector
Site Elevation
Edit Shorts
Antenna & Power Settings

The Contour Manager

Overview

The Contour Manager displays the contents of the various *Contour Groups*.

The Contour Manager can be accessed by clicking the ***Contour Manager*** button on the button bar, selecting Manage—Contours.... from the Main Menu or, right clicking on the *Job Map* and selecting Contour Manager... from the pop-up menu.



Placing a contour in a *Contour Group* adds that contour to the current Job. *Contour Groups* are saved with *Jobs*.

Proposed Stations

Overview

A Proposed station is a new or changed FM station. There should be only one Proposed station in a Job.

Job Center

In most cases the *Job Center*, *Job Class* and *Job Channel* will represent the Proposed Station when designing a new facility. Unless the new facility is co-locating with an existing radio station, a *Job Center* will not normally be located at an existing tower site.

A *Proposed Job Center* will rarely be co-located with an Affected FM Station.

Existing Stations

An existing FM station, FM application or FM allotment can be the Proposed station if the purpose of the *Job* is to modify that facility.

A Proposed existing station, application or allotment must be co-channel with the *Job Channel*.

Affected Stations

Overview

An Affected station is an existing FM, AM or TV-6 station, application or FM allotment that may be affected by the Proposed station.

Job Center

The *Job Center* cannot be an Affected station since it does not represent an existing station, application or allotment.

Existing Stations

An existing FM station, application or allotment is an Affected station if it is within the minimum separation distance of the Proposed station as defined by 73.207.

An AM station is an Affected station if it is nondirectional and within 0.8 km, or directional and within 3.2 km, of the Proposed station.

A TV-6 station is an Affected station if it is within the minimum separation distance of a Proposed station on channel 253 as defined by 73.207 or; if it is within the separation distance defined in 73.525 of an NCE Proposed station.

Types of contours

City Grade

A *City Grade* Contour is defined in **rfInvestigator** as a 70dB$_{uV}$ [3.16mV/m] contour read from the FCC's 73.333 50-50 curve.

Protected/Interfering Pairs

With the exception of commercial class B and B1 stations, a *Protected Contour* is a 60dB$_{uV}$ contour read from the FCC's 73.333 50-50 curve. A *Protected contour* for a commercial B station is 54dB$_{uV}$ (50-50) and 57dB$_{uV}$ (50-50) for a commercial B1.

Interfering contours are read from the FCC's 73.333 50-10 curve. The value of the *interfering contour* is a function of the frequency relationship between the Proposed and Affected stations.
An Affected station's *interfering contour* is determined in relation to *the Job Channel.*

Interfering contours for a Proposed station are automatically prepared for all Affected stations.

70, 60, 54dBu

The three most common F(50-50) *coverage contours* can be created with a single click of the mouse.

Grade A/B

The 68 and 47 dBu F(50-50) Protected contours for a TV-Channel 6 station.

User Defined

User defined contours allow you to specify *custom contours* to meet other needs.

Manual Contours - *Advanced Feature*

Manual contours allow you to draw lines and shapes on the screen without regard to power or antenna patterns.

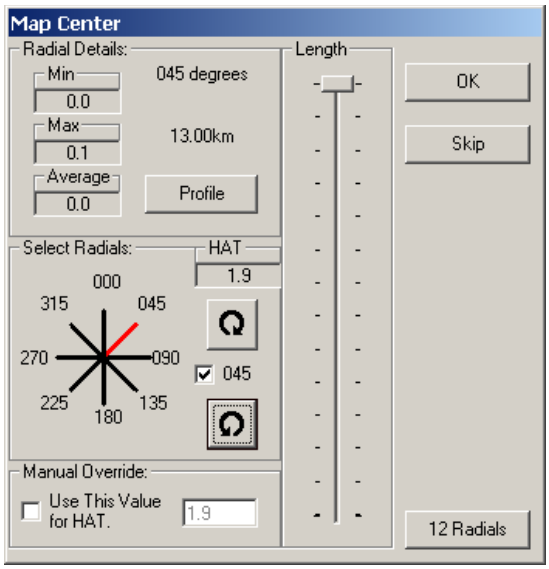
Adding the Job Center to the Contour List

Overview

Click the ***Proposed*** button to begin the process of adding a Proposed station located at the center of the *Job Map* to the contour list.

8 Radial HAT's

The first screen to appear will be the 8 Radial HAT dialog. The HAT value is the average of the radial heights of all the 'checked' radials.



This tool allows the tailoring of radial information to meet the requirements of FCC rule 73.313. In order to derive a valid HAT it is important that the user be thoroughly familiar with this rule.

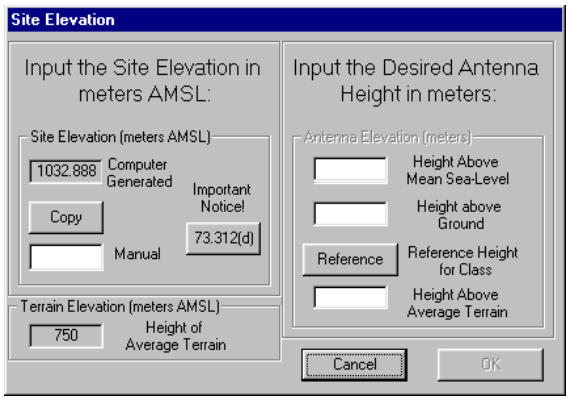
Uncheck a radial in the Select Radials box to remove it from consideration.

To limit the range of a radial to less than 16 km select the desired radial and adjust the *Length* control.

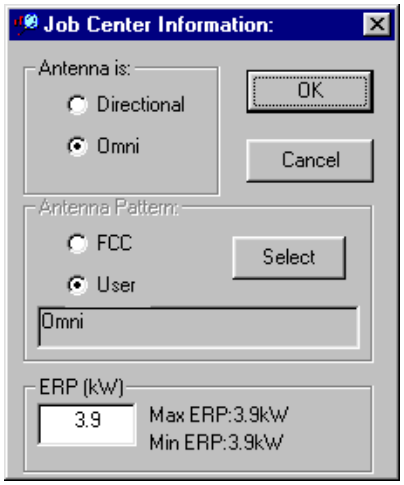
Site Elevation and Antenna Height

Next, the program will require information about the site elevation and proposed antenna height. FCC rule 73.312(d) contains important information about specifying site elevation. For preliminary evaluation purposes, the *Computer Generated* value can be used for Site Elevation.

Antenna height can be specified in AMSL, AGL or HAAT.
See Appendix B for diagram.



Selecting Antenna and Max ERP



If a directional antenna is desired, one may be selected from existing FCC or User designed pattern files.

If a custom designed antenna pattern is needed, select *omni* and use the Antenna Pattern Editor to create a new *User Pattern*.

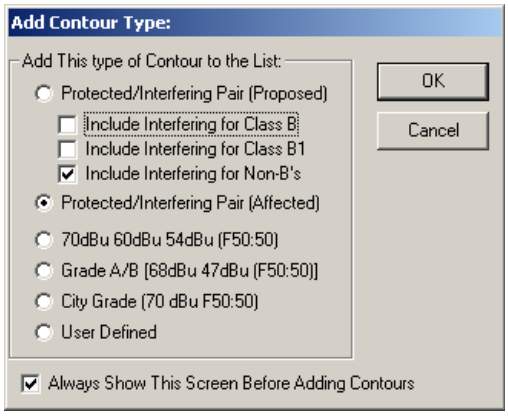
The *Effective Radiated Power* (ERP) displayed is the maximum value for the specified *Antenna HAAT*. Edit the ERP text box to change the value used for this set of contours.

Selecting Contour Type

Select *Protected/Interfering Pair, 70-60-54*, *City Grade* or *User Defined*.

Appearance of this dialog is optional. Uncheck the box at the bottom of the screen to always use the default contour type.

Default contour type can be set on the Contour Options dialog.

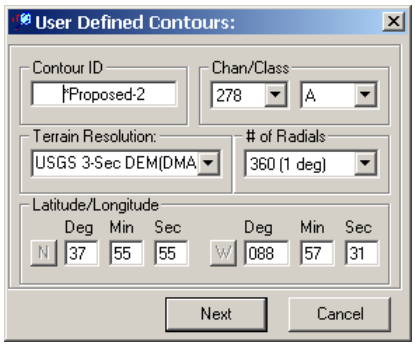


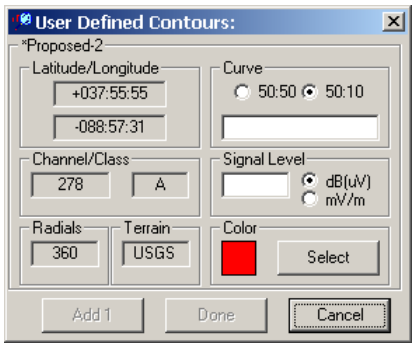
If disabled by unchecking the Always Show… box this screen can be reactivated from the Contour Options dialog.

User Defined Contours

If you select *User Defined,* the next screen will prompt you for *Contour location* and *ID* information. Click ***Next***.

Specify a *curve type*, *signal level* and *color*. Click ***Add***. You can continue to add contours for this station. Click ***Done*** after adding the last contour.

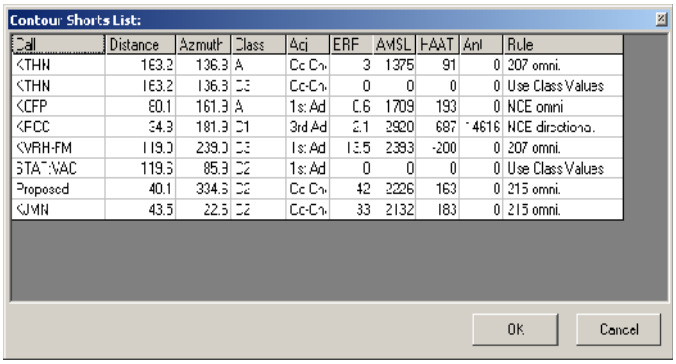




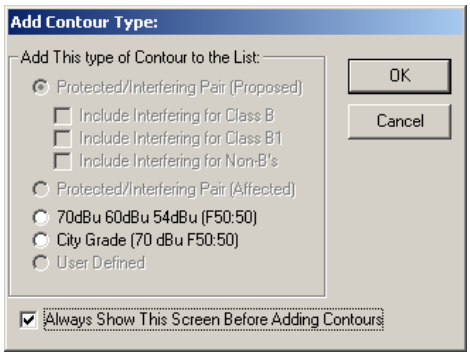
Adding the Short (Affected) Stations to the Contour List

Overview

Short stations are those Affected stations that are *short* to the Proposed station under 73.207 minimum separation rules. Any station that meets .207 spacing is not required to meet contour overlap requirement, so it is unlikely it would be needed in the *Contour List*.



Pressing the *Affected* button on the Contour Manager will display a list of all the *short stations*.



The Contour Shorts List Dialog affords you the opportunity to edit or delete stations from the shorts list. Select a station from the list and right click for a pop-up menu.

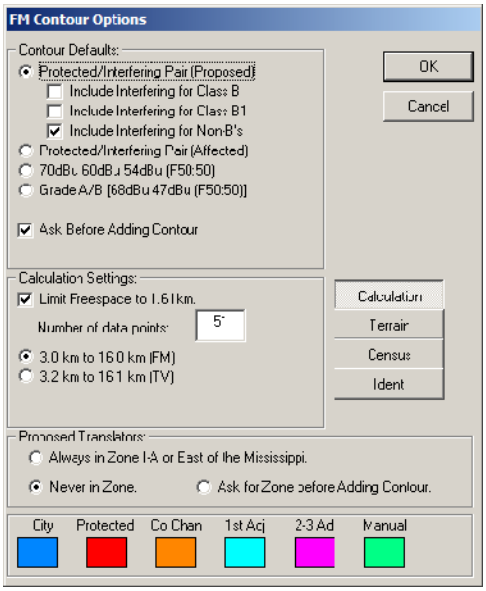
The Add Contour Type Dialog is displayed next. Select the type of contour you wish to add for each short station.

Contour Options

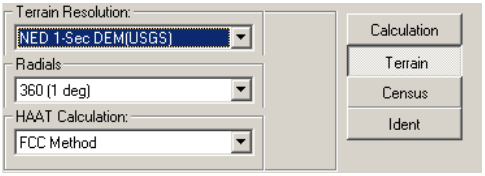
Overview

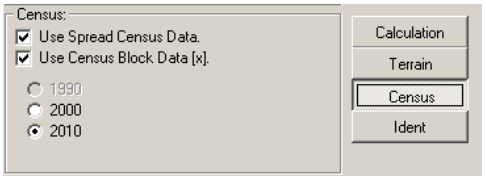
The color settings are for the Proposed station. An Affected station's *interfering contours* will be the same color as the Proposed station's *protected contour*. An Affected station's *protected contour* will be the same color as the Proposed station's channel-related *interfering contour*.

Contour Options



The Contour Options screen can be accessed by pressing the ***Options*** button on the *Contour Manager* or, selecting Options--Contours... from the Main Menu.





Contour Default settings control the state of several parameters used in contour calculations.

The Radials control allows you to select the number of evenly spaced radials used to display each contour. The minimum number of radials is 8 and the maximum is 360. 360 radials are always used to **CALCULATE** contours. The Radials Control only affects how the contour is DISPLAYED.

The HAAT Calculation control allows you to select between two different methods of determining height from the *Digital Elevation Model* (DEM).

- The "**FCC Method**" uses 4 points from the DEM to perform a linear interpolation of height.
- The "**Slope Method**" uses an array of 25 or more points from the DEM to predict height based on how the surrounding terrain changes.

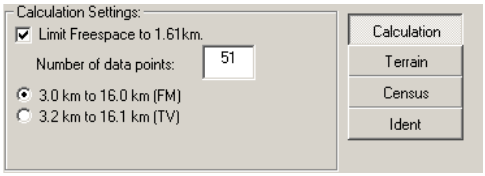
The slope method, which is significantly faster than the FCC method, can be used for initial searches and what-if's.

FCC Rules require that linear interpolation methods be used for computer-determined heights. Therefore, all fine-adjustments and exhibits for submittal to the FCC should use the slower **FCC Method** of calculation.

Changes made on the Contour Options screen will not affect existing contours. Changes made here will be reflected only in new contours.

Limiting Freespace to 1.61km.

FCC rules state that under certain conditions the distance-to-contour calculation should stop using the prediction tables and switch to the freespace formula. Doing this in-accordance-with the rules will produce characteristic "spikes" on the contour. Limiting the freespace calculation to 1.61km (the beginning of the FCC curves) smoothes out the contour. Some engineers claim that the FCC has instructed them to set this freespace limit, in disagreement with the rules. Other engineers claim that the contour is wrong if it does not have the "Spike." In an effort to please both camps, rfInvestigator supports both methods.



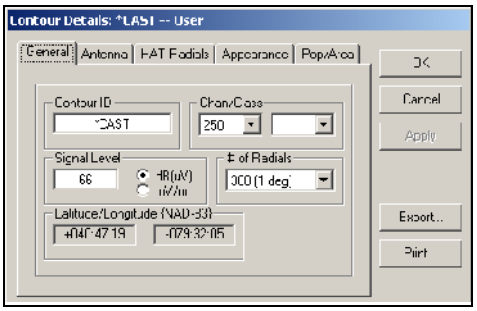
Select *Limit Freespace to 1.61km* to have smooth contours that **do not** conform to FCC rules.

Uncheck the box to have "Spiked" contours that **do** follow the FCC rules.

Contour Editor

Overview

The Contour Details Dialog can be accessed by selecting a *Contour* on the Contour Manager, right clicking and then selecting Show/Edit Details... from the *pop-up* menu, or you can just double-click on the contour-of-interest in the Contour Manager.



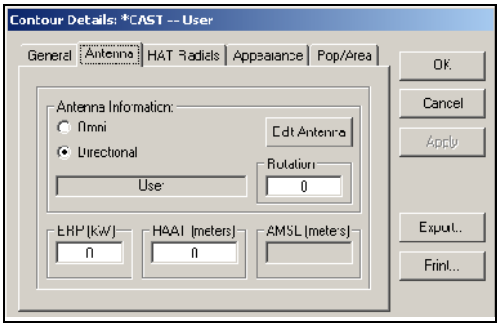
General

The General Page of the Contours Details dialog displays and allows you to change many details for the *contour-of-interest*. Changing a value and clicking ***OK*** will cause the contour to be recalculated (if necessary) with the changed value. The Longitude and Latitude of the Contour cannot be changed.

Antenna

Selecting the Antenna Tab at the top of the Contour Details dialog will display antenna and power related information.

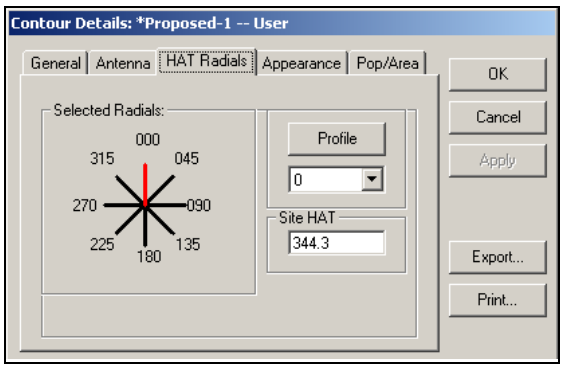
All of the information on this page, except for antenna AMSL, can be edited. Changes will immediately be made to the contour-of-interest on pressing the *OK* button.



The Antenna Pattern Editor can be accessed from this page by selecting a Directional antenna pattern and pressing the ***Edit/Select*** button.

HAT Radials

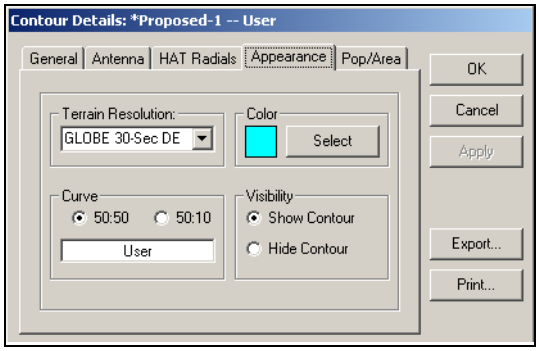
The HAT Radials Page displays which radials were used to determine HAT.



HAT Radials are only created for Proposed Stations. Each radial's profile can be viewed by selecting the desired radial and pressing the ***Profile*** button.

Site HAT can be changed to a manual value. The contour will be recalculated and redisplayed after clicking the ***OK*** button. Pressing the ***Export*** button will send the *8 HAT Radial* details to a CSV file.

Appearance



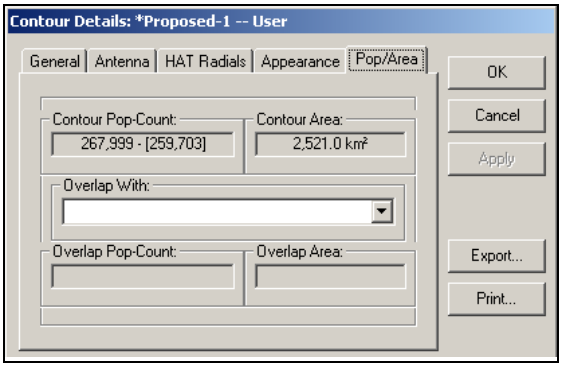
From the Appearance Page you can change the terrain data used to calculate the contour. This will cause the HAT to be recalculated using the new terrain resolution.

You can also change the *curve*, the *curve label* and *show* or *hide* the contour.

Changes will take effect when the ***OK*** button is pressed.

Pop/Area

Selecting the Pop/Area tab will calculate and display the population count and area (in km^2) contained *within the contour*.



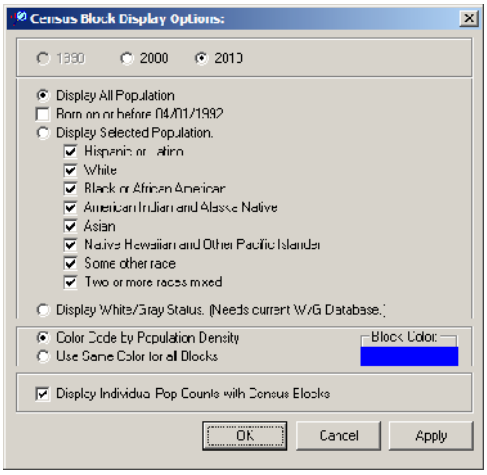
Selecting another Contour from the Overlap With drop-down box will cause the population count and area to be calculated for the *overlap of the two contours*.

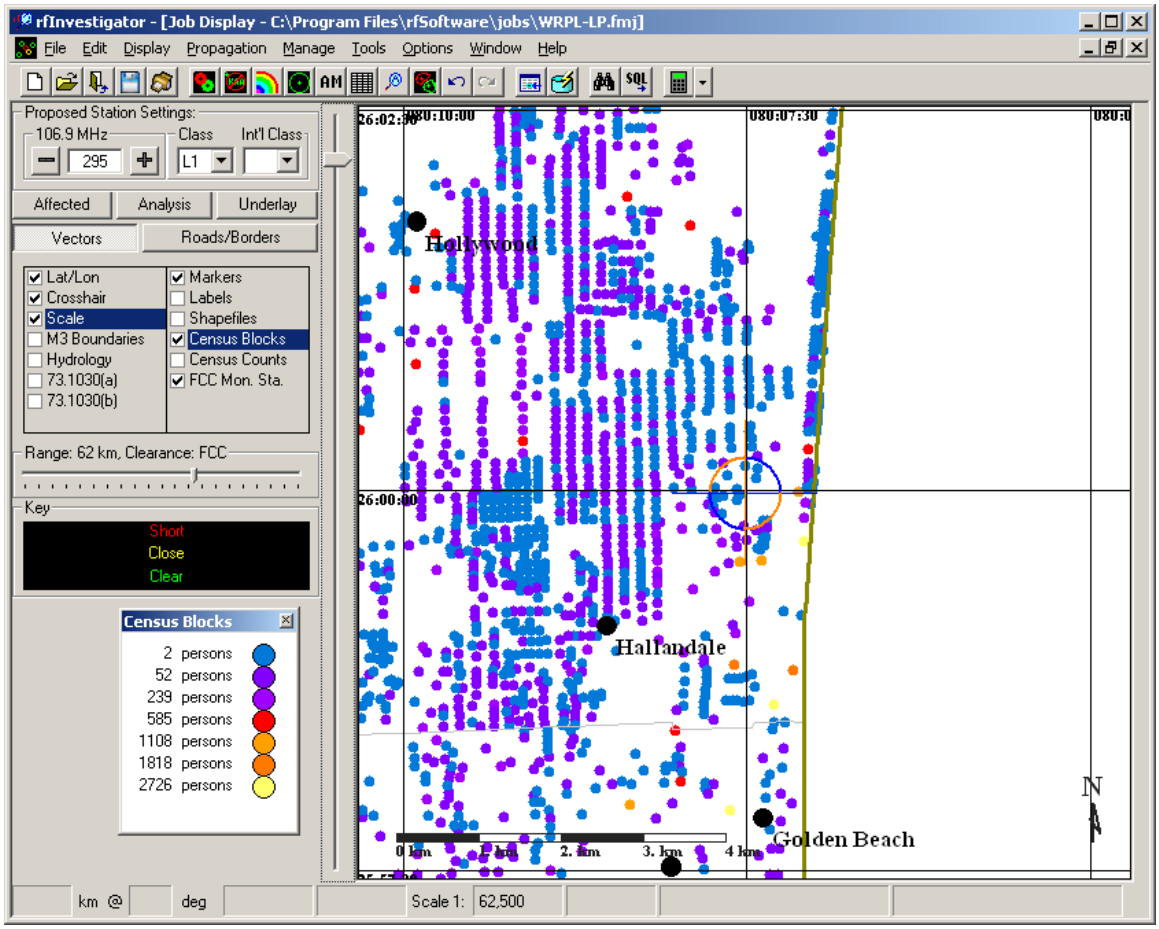
Census Blocks and Demographics

If you have the optional Census Block feature then you can display and calculate population using the highest possible resolution of Census data. Use the Census Block Options Dialog to control the type of population to count.

Color coding by density can also be enabled from this dialog.

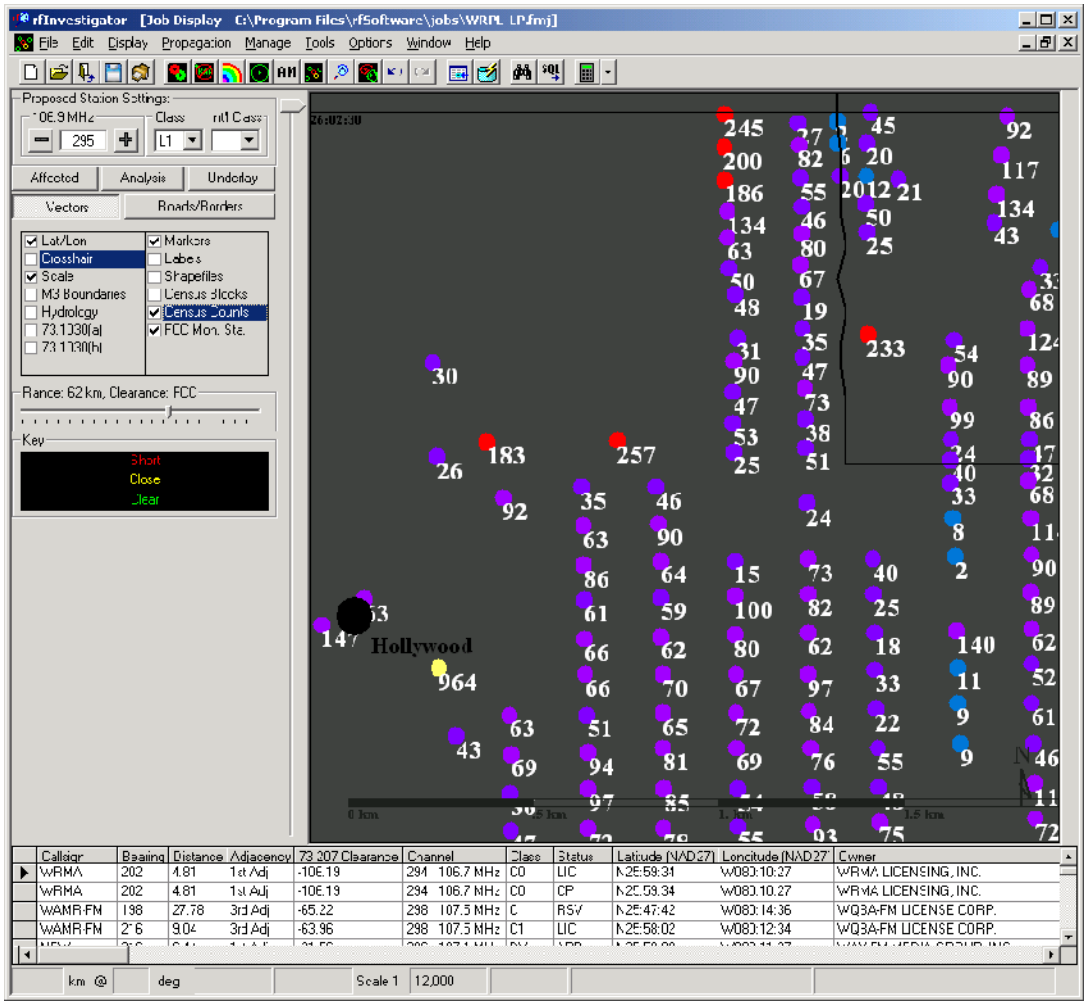
Census Block display is activated from the Vectors Control.





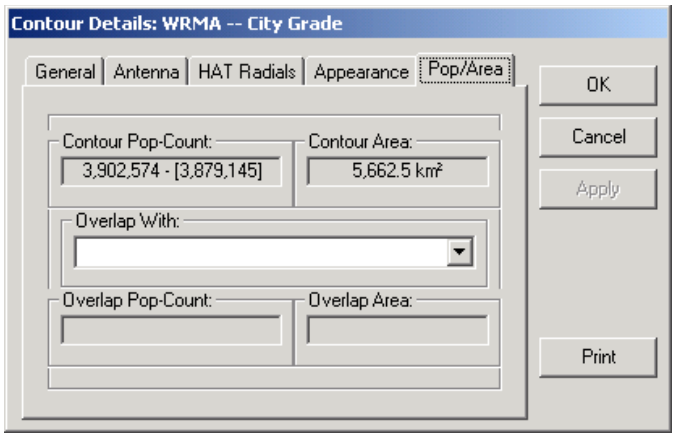
Counting Census Blocks

By setting the Map to maximum zoom you can display counts of individual Census Blocks.



The Census Block count within a contour is displayed in Square Braces in the Contour Details Dialog next to the Spread Population Count.

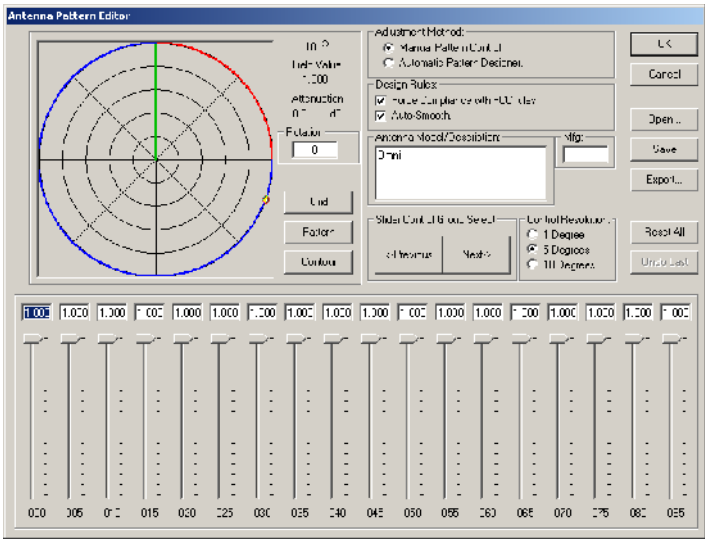
If the Census Block option is set to other than “Display All Population” then the Demographic count is shown with double asterisks.



Census Block Summary and Detailed reports are available by pressing the Print button on the Contour Details Dialog.

Selecting/Creating/Editing Antenna Patterns

Overview



The Antenna Pattern Editor is accessed by pressing the ***Edit/Select*** button on the Contour Details dialog—Antenna Page.

The Editor allows you to use existing FCC or *User patterns*, modify an existing pattern or design an entirely new pattern.

Slider controls are used to vary the antenna gain in any direction in as small as one-degree increments. *Auto-smooth* and *Force FCC compliance* controls keep the design within usable bounds. Select which Slide Control Group to adjust with the ***<Previous*** and ***Next>*** buttons.

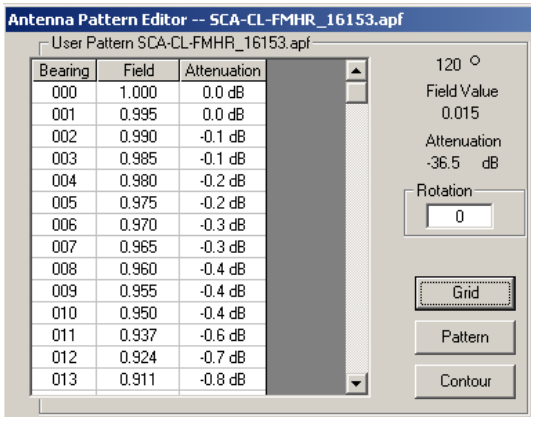
The finished design can be exported to a CSV file for submission to an antenna manufacturer.

Contour View allows you to instantly see the effect of a pattern change on a contour.

Changes made to a pattern will be applied to the current contour when the ***OK*** button is pressed.

Pattern, Grid and Contour Views

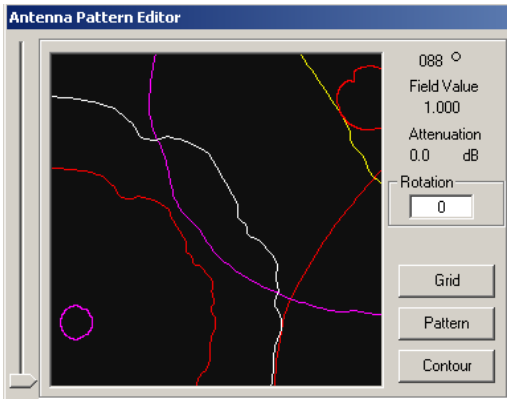
The Pattern View displays the current free-space horizontal antenna pattern. Moving the mouse pointer causes a cursor to track the pattern around the display. The antenna attenuation in *dB* and *Field Value* is displayed for the current cursor position.



Group Select shifts the "red zone" around the display. The red zone indicates the section of the pattern that is under control of the *attenuation sliders*.

The Grid View displays a spreadsheet showing Bearing, Field Value and dB Attenuation of the current pattern.

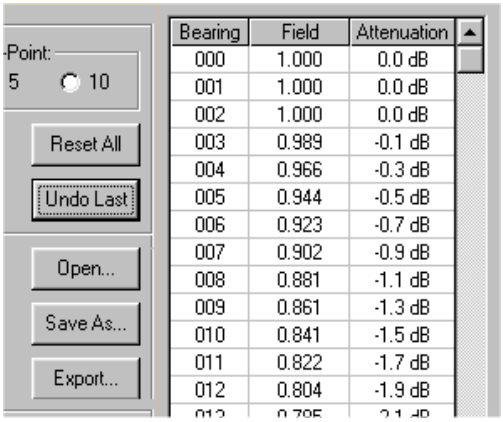
The Contour View displays the Job Map and contours.



When the pattern is altered, the effect can instantly be seen by a change in the contour shape.

Saving and Exporting a Finished Pattern

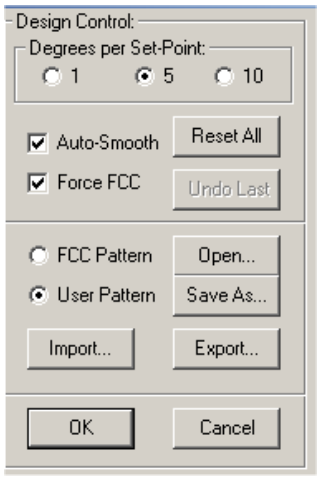
The tabulated details of the antenna you have designed can be seen on the *grid display*. The *grid lists Field* and *Attenuation values* for each degree of antenna azimuth in the horizontal plane.



A finished pattern can be saved as a User Pattern. Press the *Save As...* button and assign the pattern a file name. The pattern can now be assigned to other existing contours or used when building new contours.

Pressing the Export button will allow you to send pattern design information to a CSV file. An antenna manufacturer will need this data to design an antenna to meet your special needs.

Design Controls



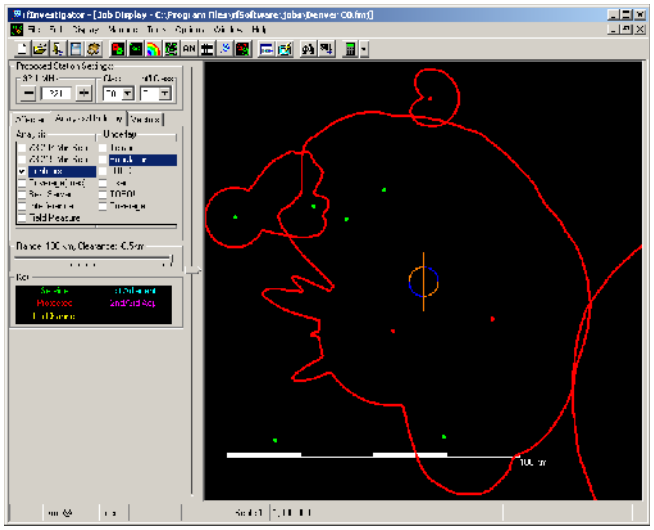
Aids to design include:

- ***Reset All*** and ***Undo Last*** buttons for discarding changes,
- ***Degrees per Set-Point*** for selecting how many degrees of pattern each slider will affect,
- ***Group Select*** buttons for determining what part of the pattern is affected by the sliders,
- ***Auto-Smooth*** to prevent jagged edges,
- ***Force FCC*** *to force the pattern into compliance with FCC rule 73.316(b)(2).*
- ***Import*** for reading antenna patterns from spreadsheets (*.csv) or ERI antenna pattern files (*.fig).
- ***Open*** and ***Save As*** for reading and saving antenna patterns in **rfSoftware** antenna pattern files (*.apf)

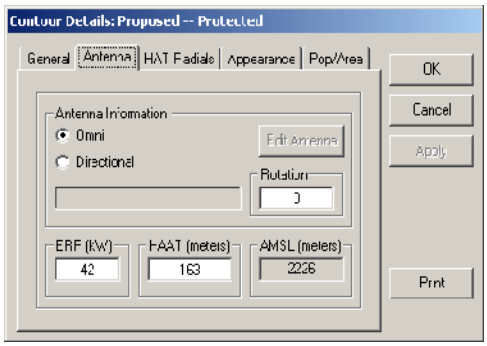
The Automatic Antenna Tuner

After filtering out all of the non-overlapping contours and hiding map features, this is what the *Main Job Map* will look like:

Double-Click on the Proposed Station's *Protected Contour* in the Contour manager. This will open the Contour Details Dialog for the selected contour.



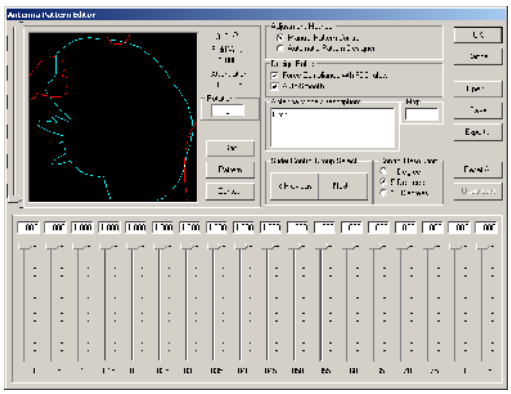
Click the Antenna Tab and select a Directional Antenna, then press the ***Edit Antenna*** Button. The Antenna Pattern Editor will appear. Click the ***Contour*** Button and zoom out.

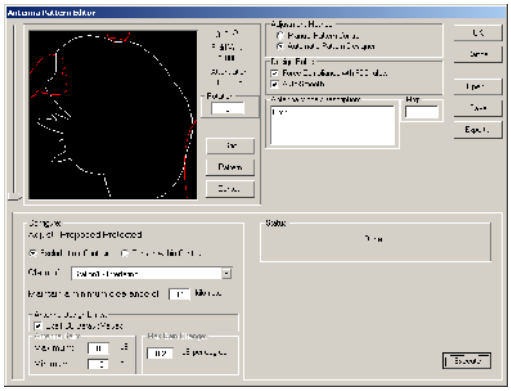


Next, select the Automatic Pattern Designer as your Adjustment Method. Configure the Designer to Exclude the *Proposed Protected Contour* from the Station-1 *Interfering contour*. Use the FCC Default values for Antenna Design Limits. Then Click the ***Execute*** button.

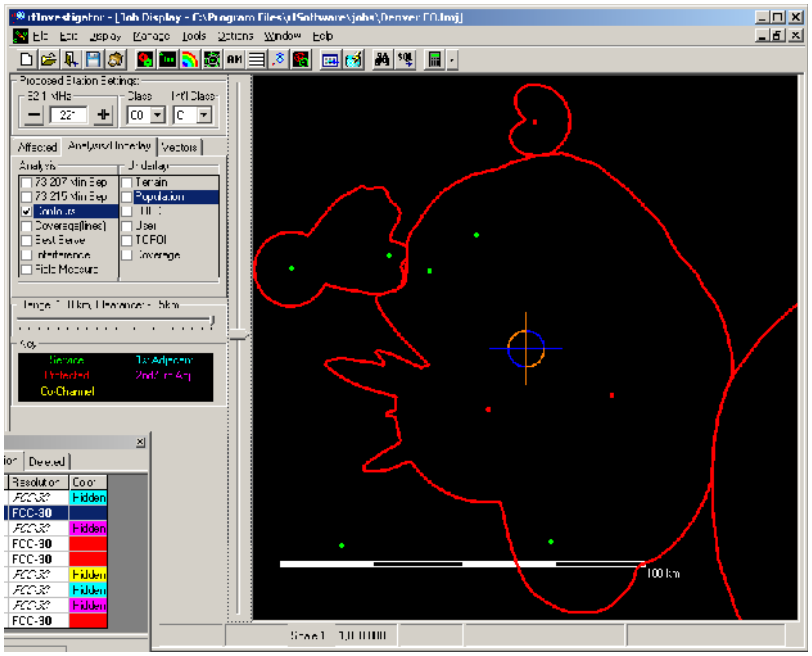
After a few moments, you will see the *Proposed Station* contour move clear of the protected station.

Continue with the DA design by selecting the Vacancy's *Interfering contour* and again click the ***Execute*** button.





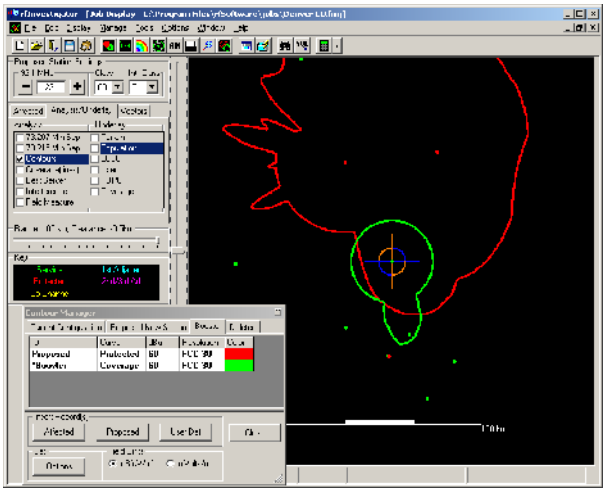
Finally, select the station-2 *Interfering contour* and click ***Execute***.
The *Proposed pattern* should now be clear of all prohibited overlap. Type a description in the Antenna Model/Description window and type USER in the Mfg window, then click ***Save***. Click ***OK*** to close the Antenna Pattern Editor. Then click ***OK*** to close the Contour Details Dialog. The Main *Job Map* should now look like this:



If overlap remains, check to see if any of the adjustments has reached the FCC limit of 15dB of attenuation. If so, a directional pattern will not solve this problem.

Designing a Booster with the Automatic Antenna Tuner:

After you have created contours for your new booster you may need to design a directional antenna to contain the Booster's *60dBu contour* within your stations *protected contour*.

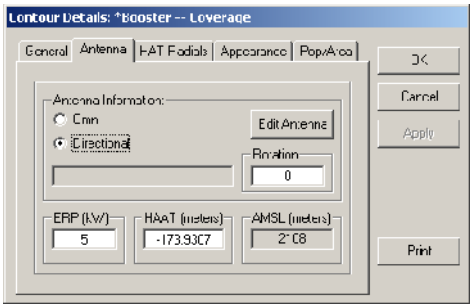


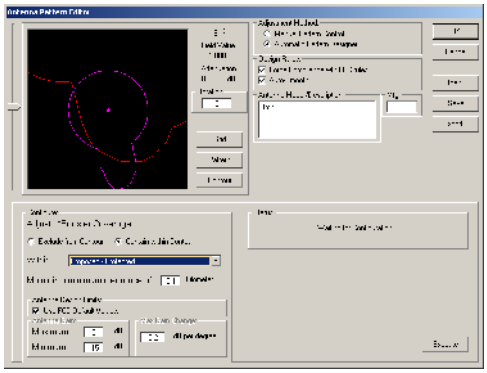
Here is the *Main Job Map* showing your *Protected contour* in red and the proposed *Booster contour* in green.

Double click on the *Booster contour* record on the Contour Manager to access the Contour Details Dialog.

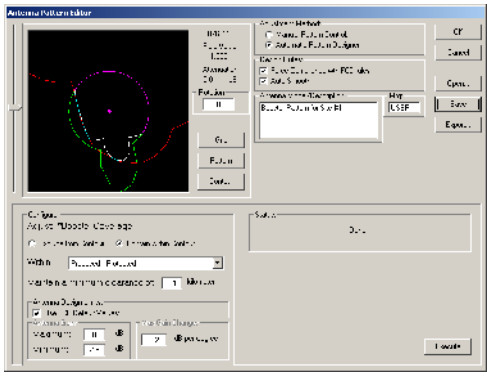
Click the Antenna Tab and select a Directional Antenna.

Click the ***Edit Antenna*** button to open the Antenna Pattern Editor.



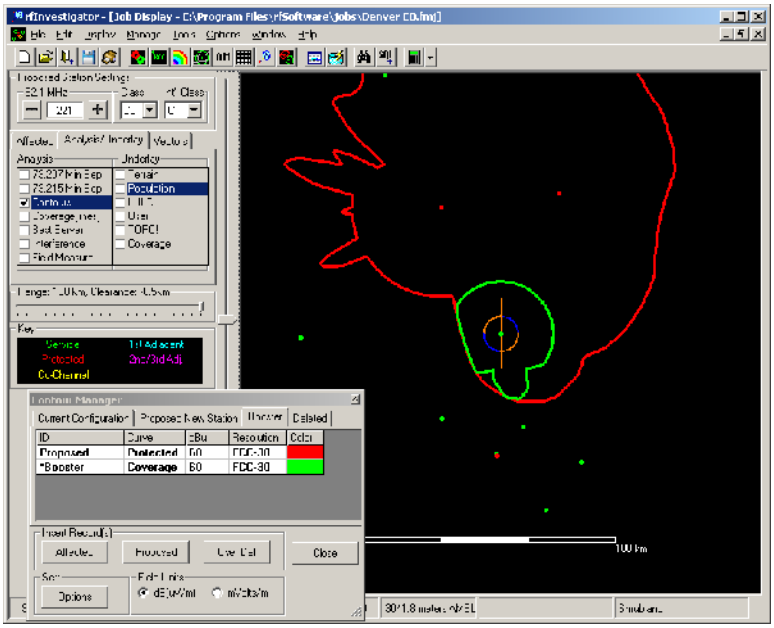


Click the **Contour** Button and select the Automatic Pattern Designer. Configure the Designer to Adjust Booster Coverage *Within the Proposed-Protected Contour*. Then click the ***Execute*** button.



Save the new pattern, click ***OK***, and then click ***OK*** on the Contour Details Dialog to apply the new pattern to the booster.

The *Main Job Map* should now look like this:



Manual Contours - Advanced Feature

Overview

The Manual Contour control allows you to draw lines, circles and other polygons on the *Job map*. Simple shapes can be created from the Manual Contour Dialog; more complex shapes must be created from data files.

Areas and population counts can be computed within *manual contours* and their overlaps.

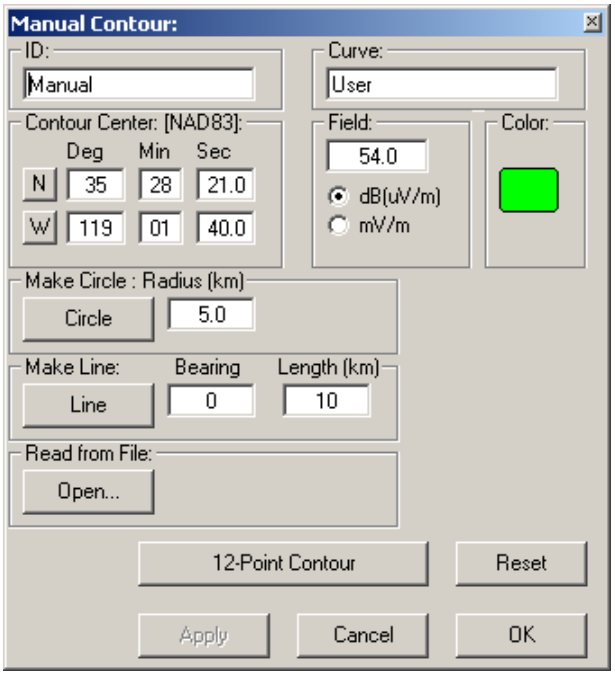
Regular contours can be adjusted within or excluded from *manual contours* using the antenna pattern editor.

Manual contours **cannot** be modified by the Antenna Pattern Editor or by adjusting ERP or antenna height.

The Manual Contour Dialog is accessed by pressing the ***Manual*** button in the Contour Manager.

Lines and Circles

The top section of the Manual Contour Dialog allows you to set a *Contour ID, Curve, Field* and *Color*. These settings are for reference and identification only and have no effect on the shape of the *Manual contour*.

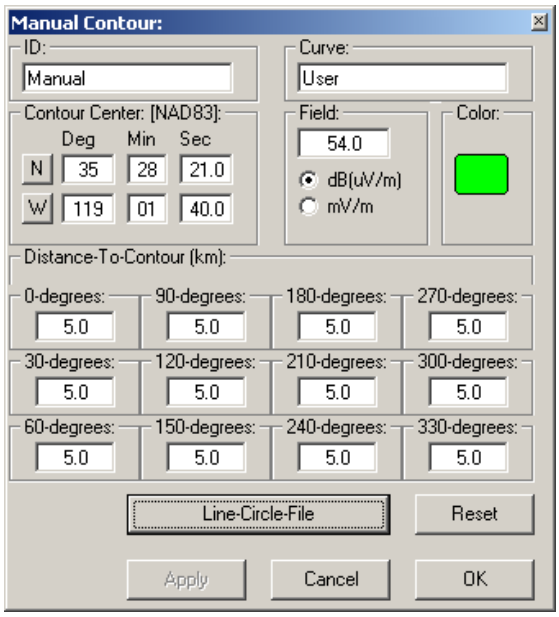


The Contour Center control sets the reference point for creating the *Manual contour*.

To create a circular contour set the desired *reference ID, Curve, Field* and *Color*. Set the center of the circle as the *Contour Center*. Set the *Circle radius* and click the ***Circle*** button. Finally, click the ***Apply*** button to place the circular contour in the Contour Manager's *Current Group*.

Contour Lines are created in the same fashion. Simply set the *Bearing* and *Length of the line*, click the *Line* button, and then click the ***Apply*** button.

12-Point Contours



Twelve-Point contours can be created directly from the Manual Contour Dialog. Click the ***12-Point Contour*** button to display the Distance-To-Contour array. Set the distance for each of the 12 bearings and click the ***Apply*** button to send the contour to the Contour Manager.

Tip: The initial value of the 12 bearings can be set with the ***Circle*** button.

Manual Contour Files

Manual contours using more than 12-points or using bearings other than the 12 evenly spaced bearings specified in the *12-Point array* can be created using a contour file.

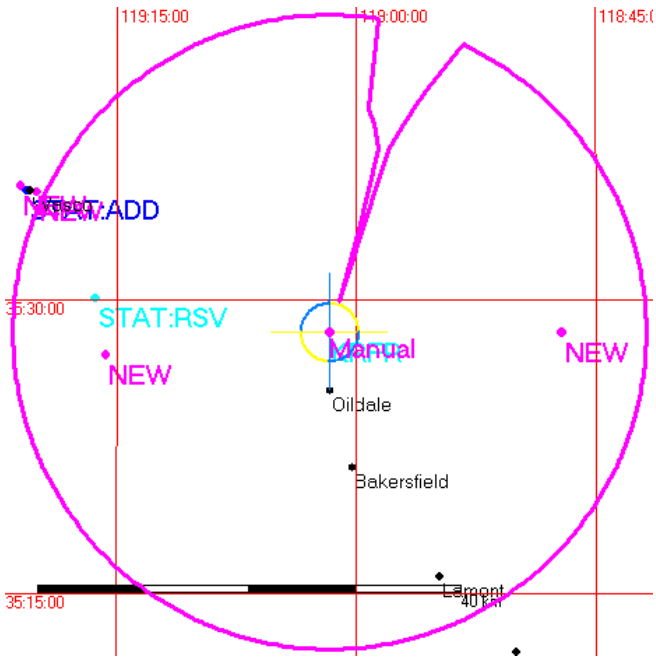
A *contour file* is a text file listing one *bearing* and the associated *distance-to-contour* per line. The *bearing* and *distance* can be separated by either a comma or a tab. A blank line will end the contour.

The *bearings* must be integers between 0 and 359 inclusive. They must be in increasing order.

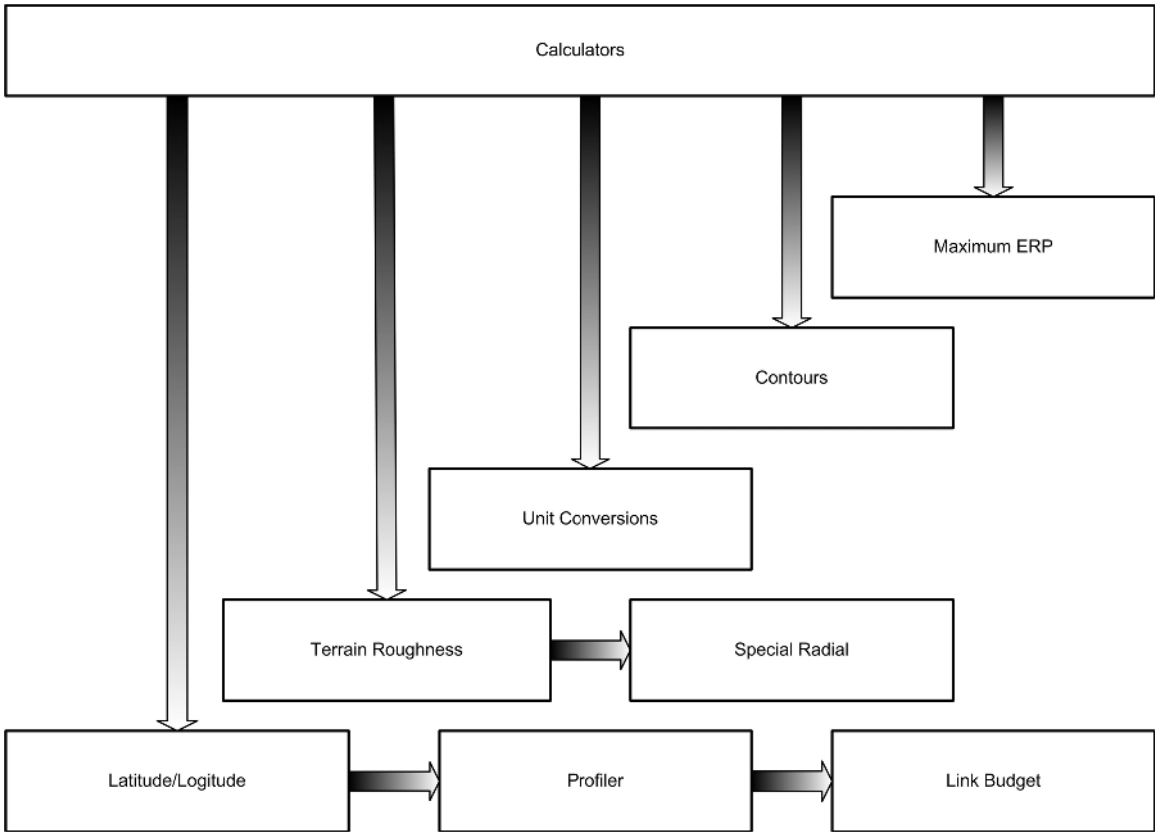
Bearings do not need to be evenly spaced.

The following file will create this contour:

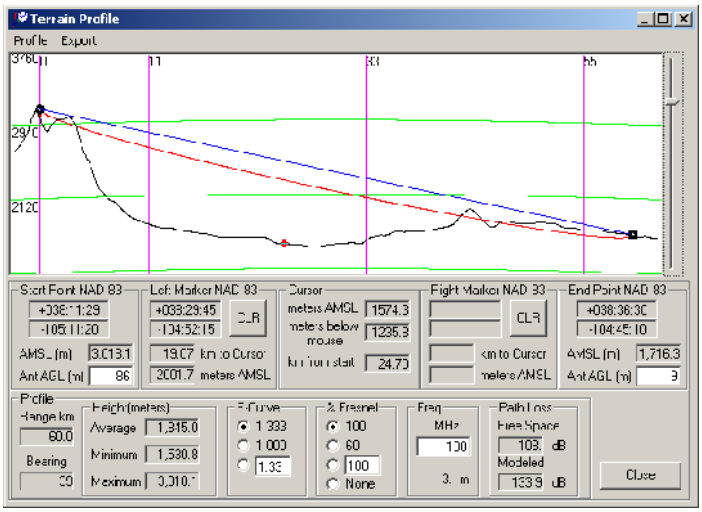
0,	30
9,	30
10,	21.5
15,	18
16,	10
17,	3
18,	18.125
25,	30



Calculators



The Terrain Profiler

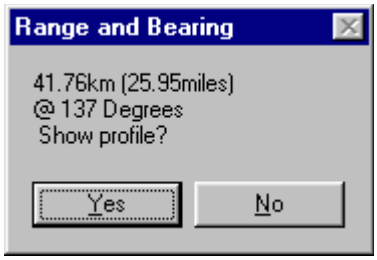


Overview

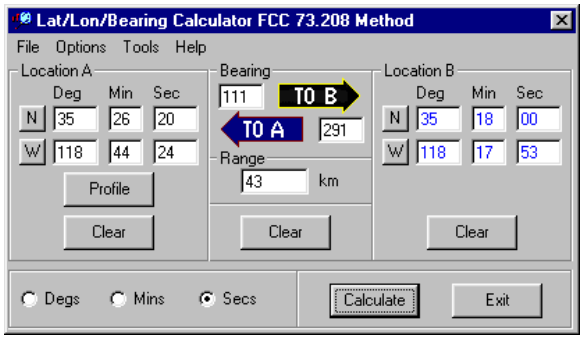
The Terrain Profiler displays obstructions, caused by changes in ground height and the curve of the earth, between two points. The Terrain Profiler does not take man-made structures or trees into account when determining obstruction heights.

Job Map 'Rubber-Band' Lines

If you Left-Click and drag the mouse across the *Job Map* you will draw a rubber-band line from the point the mouse button was pressed to the point it was released.



The Lat-Lon Calculator

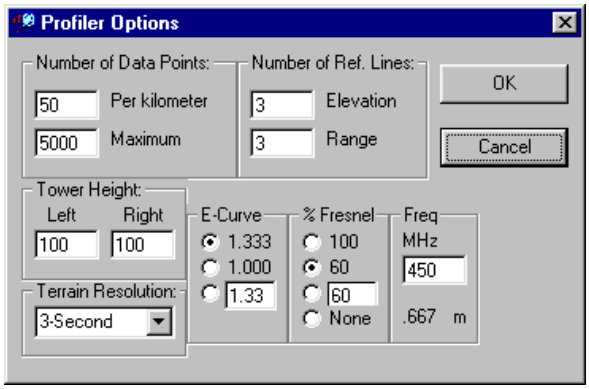


The Terrain Profiler can also be accessed from the Lat/Lon/Bearing Calculator. This tool can be accessed by pressing the ***Lat/Lon Calculator*** button, selecting Tools—Calculators--Lat-Lon Profiler from the drop-down menu or pressing Ctrl-F9.

Profiler Options Screen

The Profile Options screen is accessible from Options--Profiler... on the Main Menu.

The Terrain Resolution control on the Profiler Options screen will have no affect on data used for *Maps* or *Contours*.

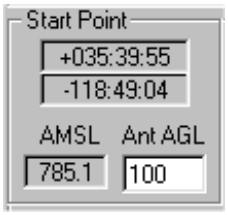


Valid ranges:

Number of Data Points 20 to 100 per km and 20 to 5000 maximum points.
Number of Ref. Lines 0 to 20.
Earth Curvature 0.5 to 5.0.
Percent Fresnel 0 to 100.
Frequency 20 to 20,000 megaHertz.

Profiler Controls

The *slider* control located on the right-hand edge of the display can be used to expand the *vertical scale* of a profile.

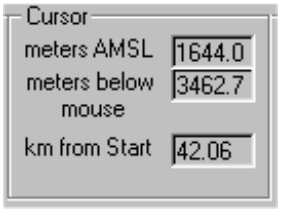


Start and *End Point* information is in the boxes at each end of the *Profile* Display. *Longitude/Latitude* and *ground elevation* AMSL in meters can be viewed in each box. *Antenna height* above ground in meters can be entered to model a radio path between the points.

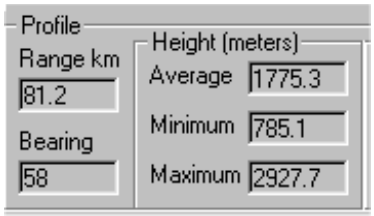
Two *markers* can be placed on the display by clicking the left mouse button in the display window. The first click will place the *Left Marker*; a second click will place the *Right Marker* if the location is to the right of the first marker. Otherwise, the first marker information will shift to the Right Marker box and the new information will appear in the *left* box. In this way the Left Marker box will always contain the leftmost marker's information.
Marker *Latitude/Longitude, height* AMSL and *distance* from cursor appear in the respective Marker boxes.

If two *markers* are placed and they are at least one kilometer apart, the view in the *Display* Window can be expanded between the markers. That is, in an expanded view the display will start at the left marker and end at the right marker.

The *cursor* (a red ball) will move along the ground profile line as the mouse is moved across the display window. The Cursor box contains information about its current *height* and *distance* from the starting point.

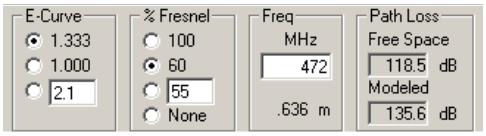


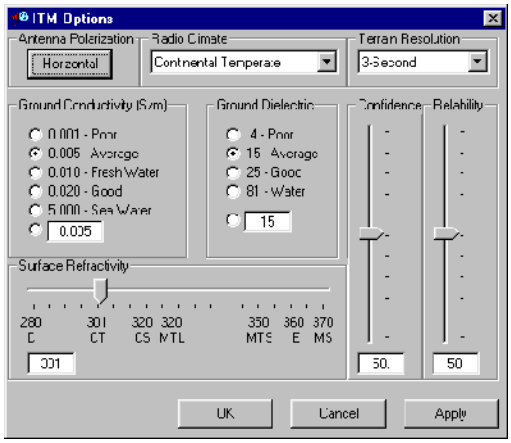
Additionally, the *vertical distance* between the *cursor* and the mouse *crosshairs* is displayed. This feature is useful for measuring the *vertical distance* between ground level and the *Fresnel zone* or between ground level and the *line-of-sight line*.



The Profile Summary box displays the overall length of the profile, the *bearing* of the line from the *start point* to the *end point* as well as the *minimum, maximum,* and *average heights.*

To the right of the Profile Summary box are user controls for setting the *Earth curvature*, *percent Fresnel zone* and *the Fresnel frequency*. Selecting None for a Fresnel zone will also turn off the *line-of-sight line*.





An Irregular Terrain Model (ITM) based on version 1.2.2 of the Longley-Rice model has been implemented in **rfInvestigator**. The model is available for use between two fixed points using the Terrain Profiler or for point-to-multipoint analysis using the optional **PLServer** Module.

Set the ITM parameters with the ITM Options control, accessible by selecting Options—ITM from the drop-down menu.

The ITM *path-loss* value is displayed for the current Option settings in the Path Loss box.
The *free-space loss* for the same path is also reported, based on:

$$\text{FreeSpaceLoss} = 32.4 + 20 * (\text{LOG10}(d\_km)) + 20 * (\text{LOG10}(f\_MHz))$$

An array of ITM loss values for Confidence values of 1 to 99 and Reliability values of 1 to 99 can be exported to a CSV file by pressing the *Path Loss* button in the Export box.

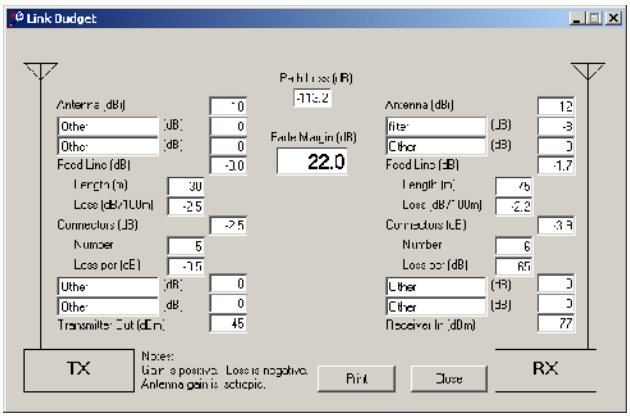
A summary of the data used to create the profile as well as *pathloss* and *signal level* information can be exported to a CSV file from the Export item on the drop-down menu.

A bitmap image of the *Profile Display* can be created by selecting Path to BMP… from the Export menu.

The Link Budget Tool

Overview

The Link Budget tool is accessed from the Profile menu. Select Profile: Link Budget… from the Terrain Profiler dialog.



Enter a value for Transmitter Out in dBm. Enter a desired Receiver In level in dBm. Path loss is automatically obtained from the *Profile*. The Fade Margin will update as you enter information in the various boxes. Enter negative values for *loss* (connectors, coax, passive filters, etc.) and positive values for *gain* (antenna gain, amplifiers, etc.). All values are in deciBels Antenna gain is isotropic.

Terrain Roughness Calculator

Overview

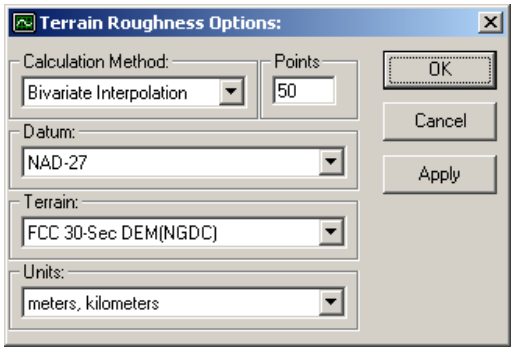
If the terrain roughness if not in the range of 20 to 100 meters then alternative methods, such as Longley-Rice may be used to determine coverage of the *city of license*. The Terrain Roughness Calculator will tell you what radials at a particular location deviate from this range.

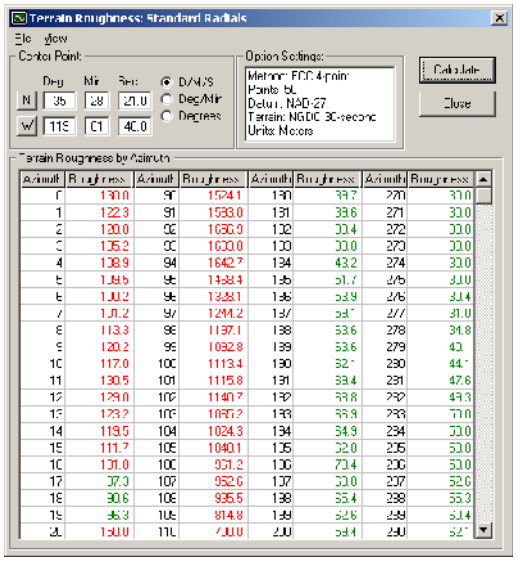
The Terrain Roughness Calculator can be accessed from the Tools menu by selecting Tools—Calculators—Terrain Roughness… or by clicking the ***drop down arrow*** beside the ***Calculator*** Button and selecting Terrain Roughness….

Terrain Roughness: Standard Radials Dialog

The Terrain Roughness: Standard Radials dialog opens on the *Job Map center* coordinates.

Other options can be set via the Terrain Roughness Options dialog, accessible by double-clicking the mouse over the Options Settings window or by selecting Options… from the View menu.

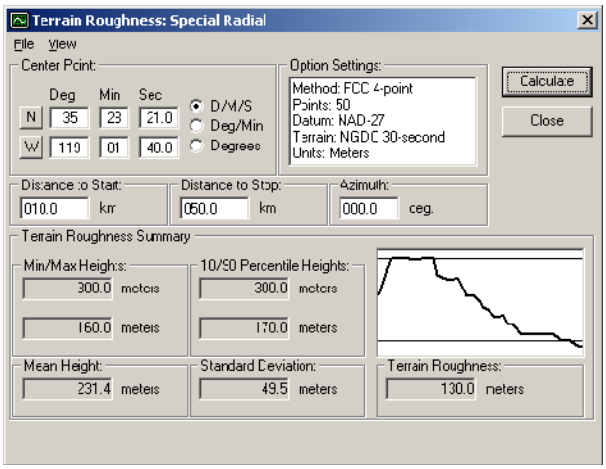




Terrain roughness can then be calculated by clicking the **Calculate** button.

Values displayed in *green* indicate radials whose terrain roughness is within the 20 to 100 meter range where the FCC assumes contours are accurate. Values in *red* indicate areas where alternative methods of calculation may be permitted.

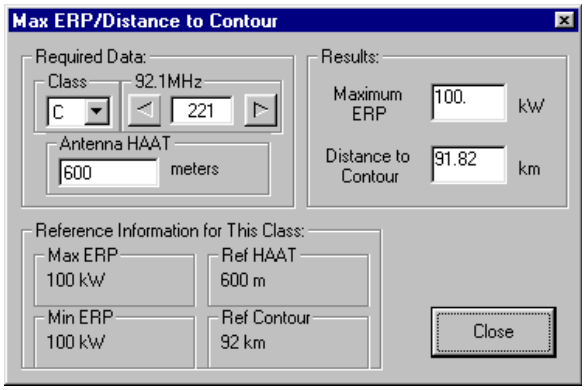
Terrain Roughness: Special Radial Dialog



Terrain Roughness for a single radial can be calculated using the Special Radial dialog.

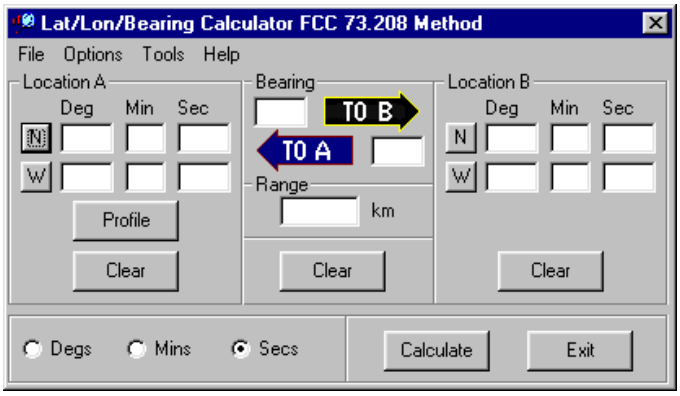
You can switch back and forth between *Standard* and *Special* radials using the View menu.

Max ERP Calculator



The Max ERP Calculator, accessible from the drop-down menu by selecting *Tools—Maximum ERP...* will calculate the maximum permissible ERP for a given class and antenna HAAT. Further, it will display the reference information for a given Class.

Lat/Lon Calculator



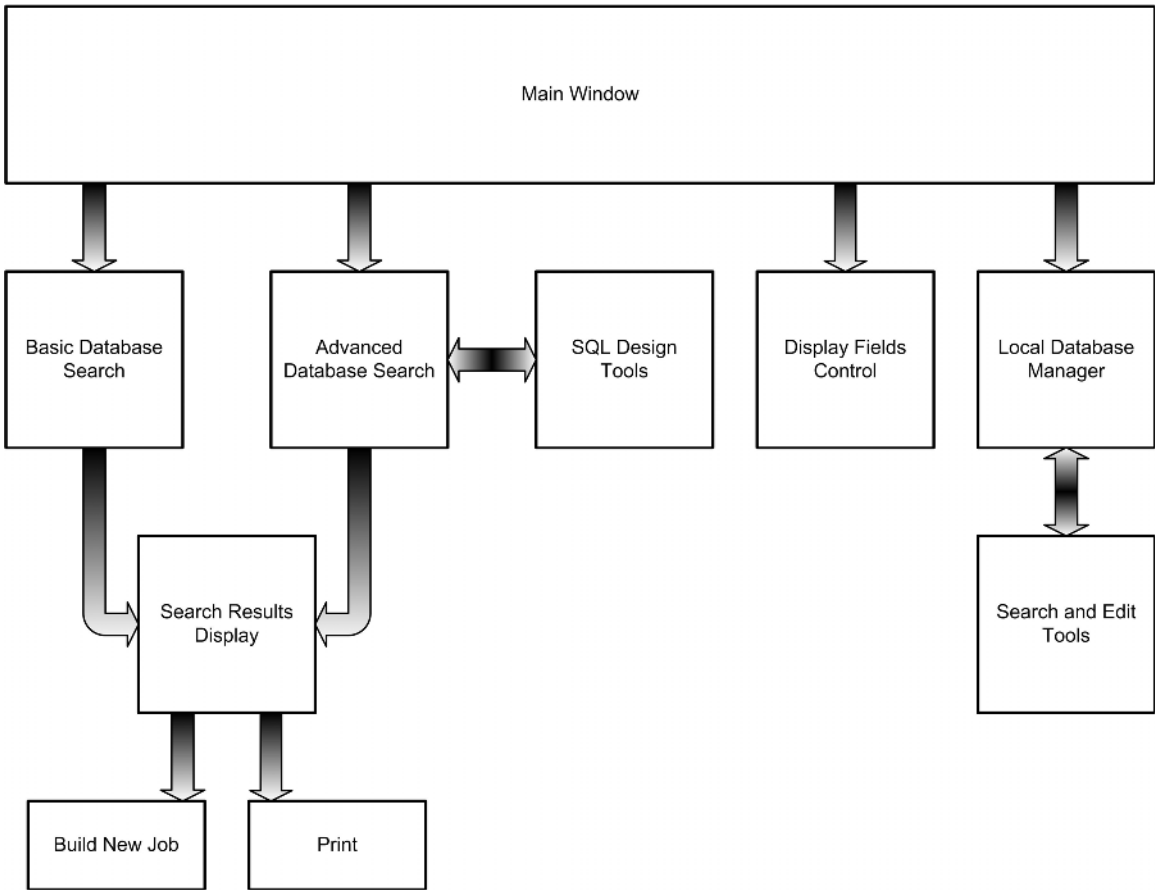
The Lat/Lon/Bearing Calculator is accessible from the drop-down menu by selecting Tools—Lat/Lon Calculator..., or pressing Ctrl-F9. This tool will calculate the *Range* and *Bearing* between two Locations or, will calculate a second location given a first location and a range and bearing. Formulas specified in FCC rule 73.208 are used to calculate the results. This tool is *limited* to distances *less than* 475 kilometers.

Pressing the ***Profile*** button will run the Terrain Profiler between the two locations specified by the Lat/Lon Calculator.

Notes:

Notes:

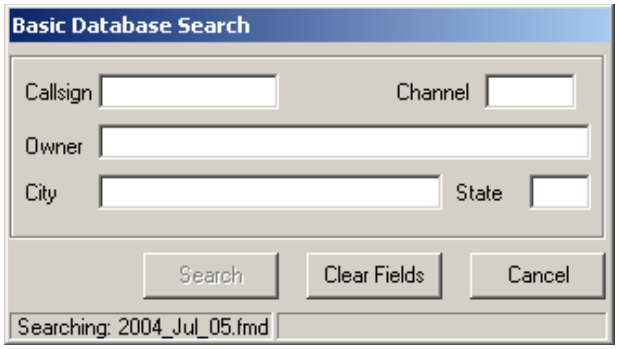
Searching for Data



Basic Searches

Overview

A database search will retrieve records from the **rfInvestigator** master database. Search results may be used to build new jobs or sent to a printer or spreadsheet.



Starting a Basic Database Search

The search screen can be accessed in several ways. The most direct is to simply press the ***Basic Database Search*** button. A second method is to select Tool—Find--Basic Database Search from the Main Form's drop-down menu or, simply press Ctrl-F7 to initiate a search.

Selecting a Database

If a master database has not been loaded, **rfInvestigator** will prompt you for the name of the database to be searched.

If the master database that is already loaded is not the one you wish to search, you must designate another current database. To do this simply press the ***Select Database*** button on the tool bar or select Tools – Select Database from the drop-down menu.

Searchable Fields

The *Basic Database* search allows you to designate up to five search fields; *Callsign, Channel, Owner*, and, *City/State of License*. Simply type some or all of the desired data in the appropriate box and press the ***Search*** button. The data is not case sensitive. The lower-left corner of the search screen indicates what master database is being searched.

Searching by Multiple Fields

By placing data in more than one box, the search can be narrowed. Multiple fields are automatically ANDed.

Wildcard Searches, *,?,

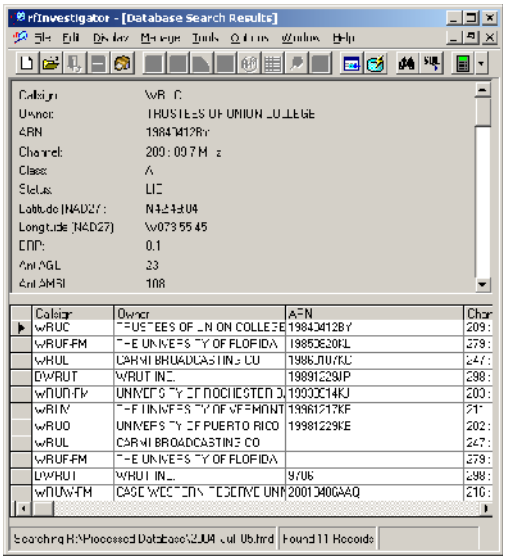
The Basic Search recognizes three wildcard characters. * for zero or more characters, ? for one character and # for one number.

The Data Display Screen

Overview

The Data Display screen presents the results of a search.

Sorting Data

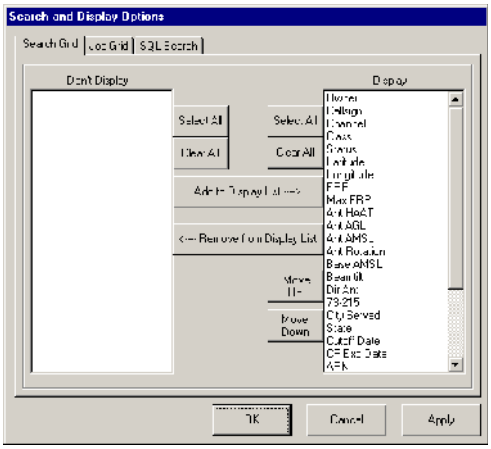


Basic search results can be sorted by selecting a column and picking the desired sort direction from the *Pop-Up* menu. Click on any column heading to select it then right click to display the *Pop-Up* menu.

Changing Displayed Fields and Field Order

The fields displayed on the Data Display Screen and the order of the columns can be controlled from the Search and Display Options Control.

The Search and Display Options Control can be accessed by pressing the ***Select Fields*** button, selecting Options—Display Fields... from the drop-down menu or, right clicking on the Data Display Screen and selecting Change Displayed Fields from the *pop-up* menu.



Select the Search Grid tab. Two windows are displayed, Don't Display and Display. *Fields* listed in the Display window will appear on the Data Display Screen in the order that they are listed.

Select one or more *fields* in the Display window, and change their position in the list with the ***Move Up*** and ***Move Down*** buttons.

To remove a field or fields from the Display window, select one or more fields in the Display window and click the ***Remove from Display List*** button.

To add a field or fields to the Display window, select one or more fields in the Don't Display window and click the ***Add to Display List*** button.

Exporting Data to a CSV File

The results of a search can be exported to a Comma Separated Value file by selecting Tools--Export--Search Results to CSV... from the drop-down menu.

The Master Database

Overview

The **rfInvestigator** *Master Database* is a custom designed, high-performance, compilation of information from the FCC's Consolidated Database System (CDBS). Extensive pre-processing allows a large amount of data to be squeezed into a small space without a performance trade-off.

Data Tables and Fields

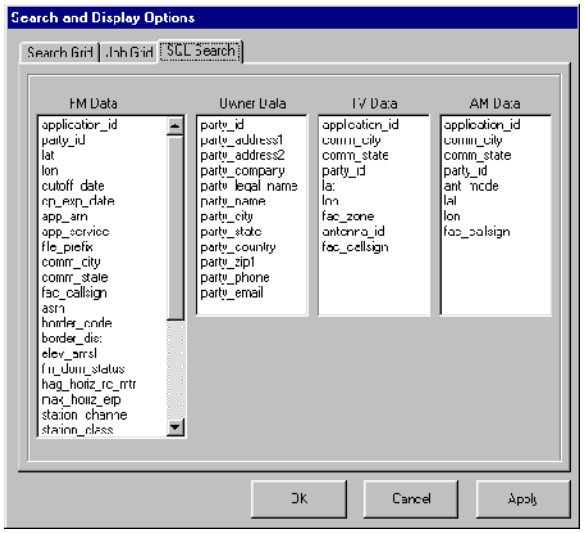
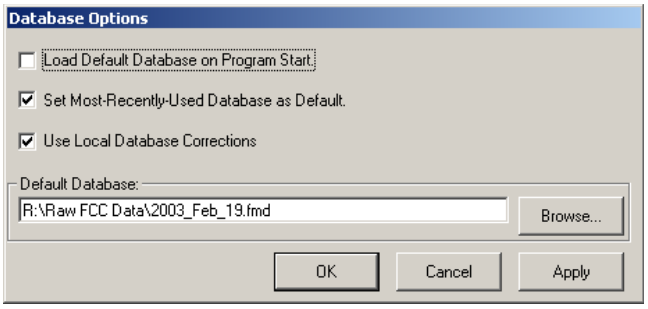


Table and *field* names can be seen with the Fields Selector. The FM, TV and AM tables are each related to the Owner table by the party_id field.

Database Options

The Database Options dialog can be accessed by selecting Options--Database from the Main Menu.



The first two options are self-explanatory. The third option, Use Local Database Corrections allows you to enable or disable the use of modified fields from the local database.

Naming Convention

Databases obtained from **rfSoftware** are named with the Year-Month-Day of their source data. For example, if a database was build from the August 3, 2001 CDBS the filename would be:

2001_AUG_03.fmd

The associated *Antenna Pattern* file would be: 2001_AUG_03.pat
The associated *Antenna Information* file would be: 2001_AUG_03.fam

The Database Folder

If the default values are used during install, the database folder will be *C:\Program Files\rfSoftware\database*.

Building a Master Database

The database building process is performed by the **DbBuilder** Program. Refer to the Operation Manual for **Database Builder** for details.

The Local Database

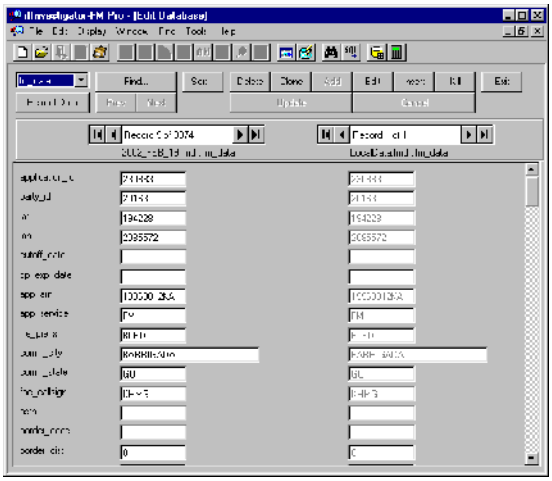
Overview

The *Local Database* allows changes to be maintained even when the *Master Database* has been updated. It does this by making a local copy of the edited record. Whenever data is retrieved from the *Master Database*, the *Local Database* is checked to see if an edited copy of that record exists.

Data Tables, Records and Fields

Information in a Database is organized into *Tables*, *Records* and *Fields*. A *Field* is a container that holds one piece of information. A *Record* is a collection of *Fields*. A collection of identically structured *Records* is a *Table*. A collection of *Tables* is a *Database*.

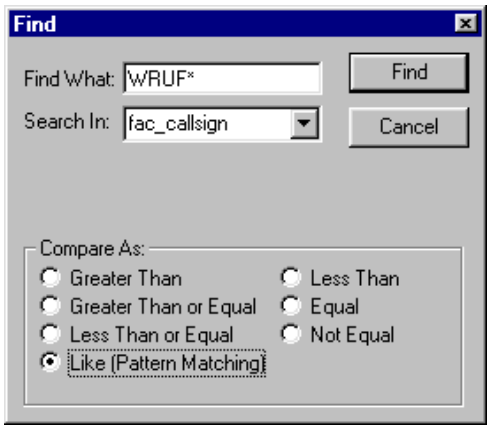
The *Local Database* has three *Tables*; am_data, fm_data and, tv6_data.



Finding Records in the Local/Master Database

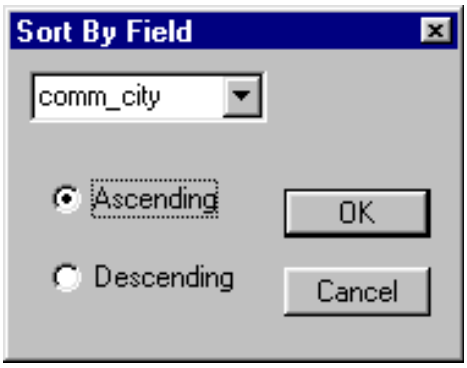
Searching For Records

Select a table from the drop-down box and press ***Reload Data***. Next Click **Find....**



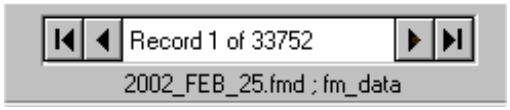
Enter your search string, using wildcards if necessary. Select a *field* to search. Select a *Compare As* mode, pattern matching is best for text searches.

Click the ***Find*** button to execute the search.



Sorting Records

Click the ***Sort...*** button. Select the field to sort by. Select the direction of the sort. Click ***OK***.



Use the Record Control to move through the data records.

Manipulating Records

Master Database records are manipulated by making a copy of the record-of-interest in the *Local Database* then operating on that local record.

Deleting Records

Pressing the ***Delete*** button marks a copy of the record in the *Local Database* as deleted. If this record exists in the *Master Database*, it will be ignored.

Cloning Records

Pressing the ***Clone*** button makes a copy of the current *Master Database* record and places it in the *Local Database* with a new application ID. This appears to the system as an entirely new record.

Adding Records

Pressing the ***Add*** button makes a copy of the current *Master Database* record and places it in the *Local Database*. The system will use this copy instead of the original record.

Editing Records

Pressing the ***Edit*** button will allow you to make changes to the current *Local Database* record.

Inserting Records

Pressing the ***Insert*** button will create an entirely new record in the *Local Database.*

Killing Records

Pressing the ***Kill*** button will remove the current record from the *Local Database.*

The Job Database

Overview

A *Job File* is a database. It contains:

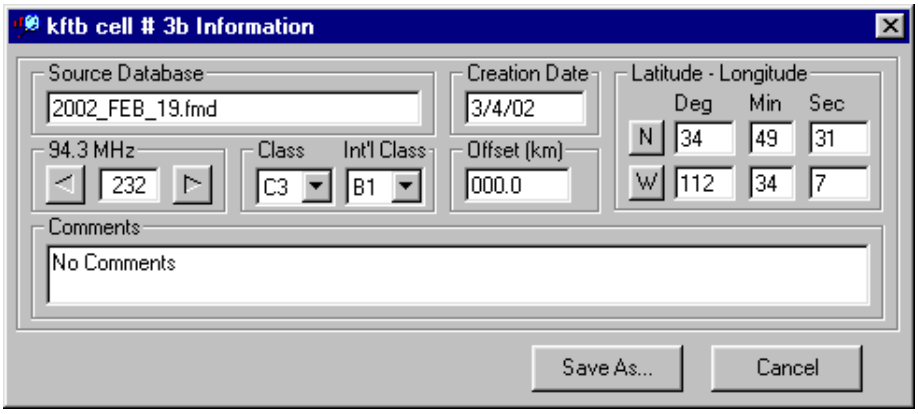
Job Information
Extracts from the *Master Database*
State, County and City borders
Roads, Railroads and Water features (Hydrology)
Contour Information

The Job Information Table

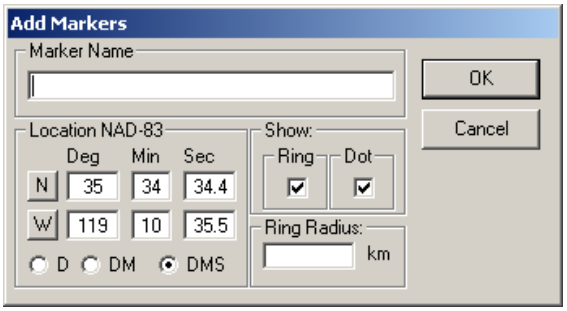
The Job Information Table contains the name of the *Master Database* that was used to build the *Job*, the *Job creation date*, *Job Center*, *Channel, Class* and *Comments*.

Job Channel, Class, Int'l Class and *Comments* can be changed and saved into a new Job.

You can access the Job Information dialog from the drop-down menu. Select Edit--Job Information....



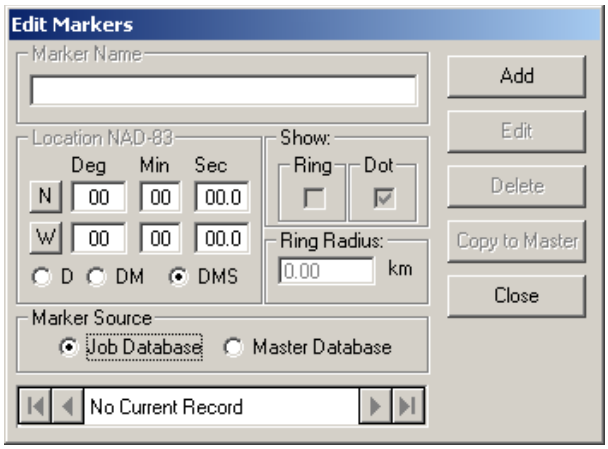
Adding Markers to a Job



A *Marker* is a dot with a label and an optional ring that can be placed on the *Job Map*.

Place the mouse on or near the location you wish to mark. Right click and select Add Marker... from the *pop-up* menu. You may add a ring around your marker by inserting a distance in km. in the Ring Radius box. Give the marker a name and adjust the lon/lat if necessary.

Editing Markers in the Job



Existing markers can be edited or removed with the Edit Markers dialog. Select Edit--Markers... from the drop-down menu. Click the right/left record control arrows at the bottom of the dialog to find the record of interest. Click the ***Edit*** button to change the marker or Click ***Delete*** to remove it.

Sending Markers to the Master (Local) Database

Markers can be saved in the *Master Database* from the Edit Markers dialog. These markers will appear in *New Jobs* built in the current area. To save a *marker* in the *Master Database* select the desired marker with the record control and click the ***Copy to Master*** button.

If there is no current *Master Database* selected the ***Copy to Master*** button will not enabled.

Changing the Marker Source to *Master Database* will allow you to Add, Edit or Delete markers in the *Master Database*.

Exporting Data

CSV File Format

A *Comma Separated Value* (CSV) file is a standardized format that many spreadsheet programs, such as Microsoft Excel, can access directly.

The data is stored as plain text. Each line of text represents one row (one record) of information on the spreadsheet. Individual cell (field) values are separated by commas. A comma can be included in a cell by enclosing the information in single or double quotes.

Data Available for Export

Most data that can be displayed in a tabular format can be exported from **rfInvestigator**. This includes:

Search Results:

The first line consists of column headings. The following lines contain the field data. The number of fields and their order depends on the settings of the *Fields Selector*. The number of lines output equals the number of records returned by the search plus one for the heading.

Station Table Data:

Station Table output is identical in structure to Search Results.

Profiles:

The first line is column headings, followed by one line of data.

The third line is column headings, followed by two lines of data.
The sixth line is column headings, followed by as-many-as 5000 lines of data, depending on the length of the profile and the profile options settings.

ITM (Longley-Rice) Arrays:

The first line is column headings, followed by one line of data.

Next is an array of data arranged in 99 columns of Confidence by 99 rows of Reliability values.

HAT Radials:

The first line is column headings, followed by one line of data. fields. Line three is column headings, followed by 2400 lines of data fields.

Antenna Patterns:

The first line is column headings, followed by 360 lines of data.

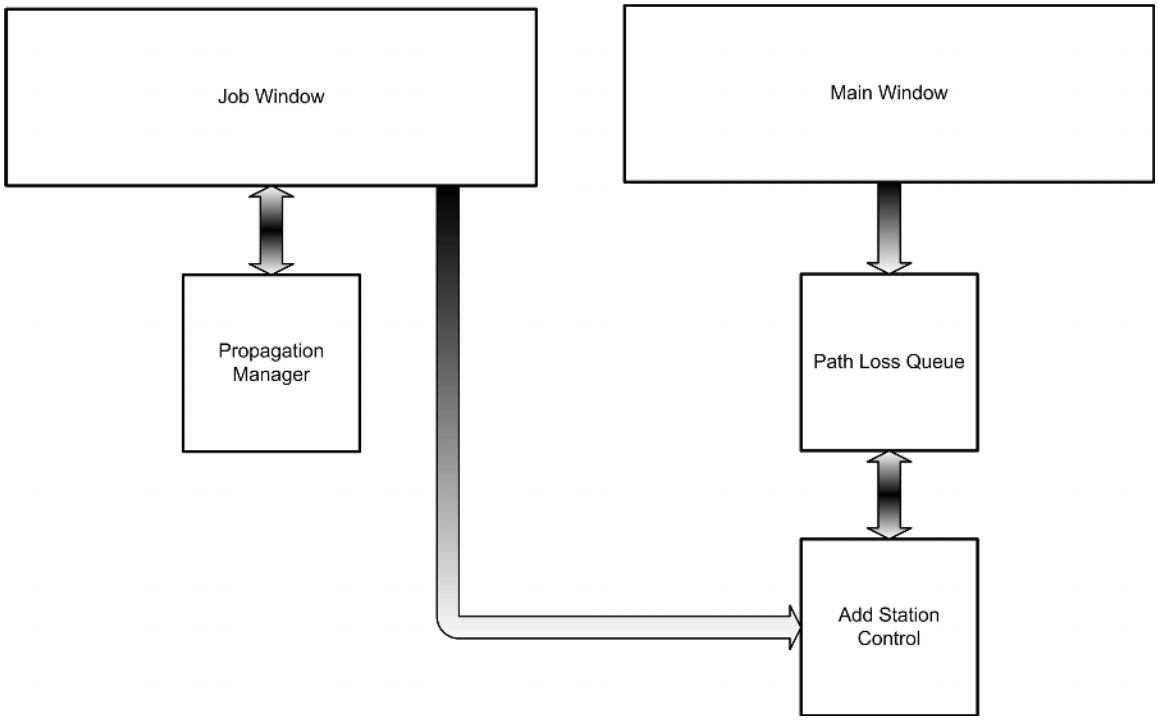
Path-Loss Profiles:

Available from the profiler drop-down menu. Exports terrain heights, lat/lon, pathloss and predicted signal level along a radial path.

Notes:

Notes:

Advanced Topics: Propagation



Overview

Path-loss files can take a considerable amount of time to generate. With this in mind, **rfSoftware** has designed **PLServer** to run independently from **rfInvestigator**. While *path-loss* files are being generated, you may continue to open and close Jobs or even shutdown and restart **rfInvestigator**.

There are several steps required to get from the *Path-loss* files to *Propagation files.* **rfInvestigator** uses *Propagation files* to Display/Analyze Coverage, Best Server and Interference analyses.

First, it is necessary to set up the information needed to create *Path-loss* files. This information is input through a series of dialogs. After these dialogs are completed for each station, the *Path-loss* files can then be created.

Next, the *Path-loss* files of interest are selected from the Propagation Manager, and additional information about power and antenna information are input. At this point, the Propagation files are created. These files may now be loaded and displayed in **rfInvestigator** via the Coverage Manager.

Creating Path-loss Files

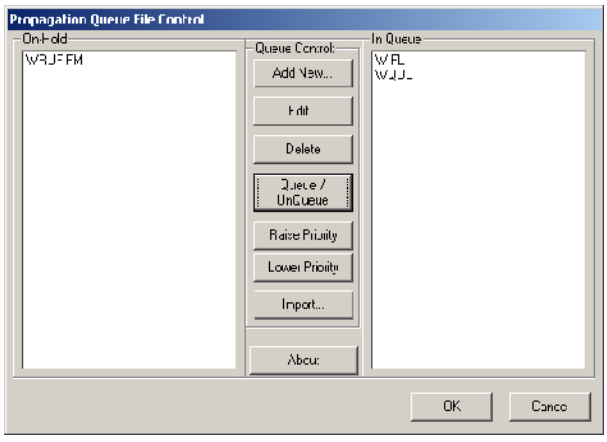
Overview

PLServer builds *path-loss* files from a queue. *PL Jobs* can be added, edited or deleted from the *queue*. The order of jobs in the *queue* is adjustable. In order to manipulate the *queue*, *PLServer* calculation must first be paused.

Jobs can be placed in the *queue* en-masse from a spreadsheet, manually using the Add Stations Dialog, or from the Station Grid of an open **rfInvestigator** Job.

Propagation Queue File Control

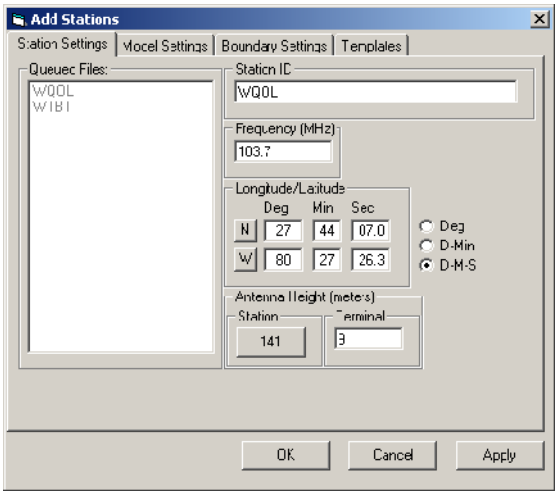
The Propagation Queue File Control can be accessed directly from the Main Menu by selecting Propagation--Queue…



Adding a New Station

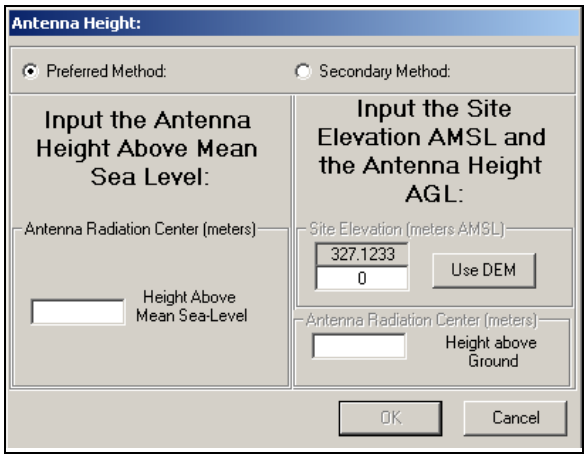
Use the ***Add New*** button to manually add a station to the queue.

When accessed without an **rfInvestigator** Job the Add Stations Dialog opens filled with the previous *PL Job* data. Enter the required data manually. If a Job is open, the Add Stations Dialog will open filled out with the current *map center* information.



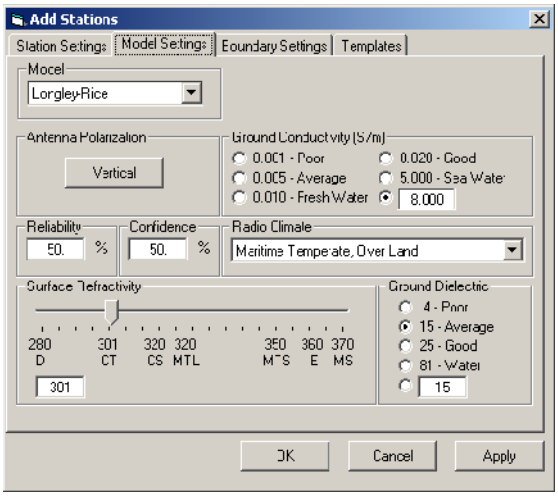
Another option is to select a station from the *Station Table*, right click and select Add to Propagation Queue from the *Pop-Up* Menu.

Station Settings



Antenna Heights are *Above-Ground-Level* in meters. *See Appendix B.* The *terminal height* is the height at the receiver. Set the *Station height* by clicking the ***Station*** button. Use the Site Elevation dialog to specify transmitter antenna height.

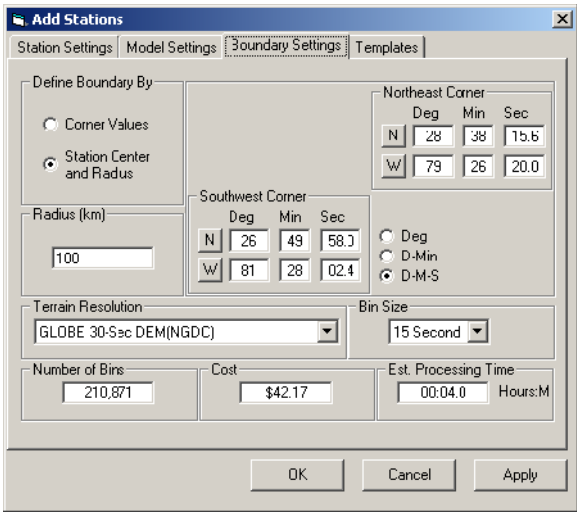
Model Settings



Next, click the Model Settings Tab on the Add Stations dialog. These are the Longley-Rice model settings.

Configure the Model Settings for your particular station location.

Boundary Settings



The next tab on the Add Stations Dialog is Boundary Settings. This is where you designate what area you wish to analyze.

Boundaries are defined by Northeast and Southwest corner lat/lon values. It is not necessary to include the *Station Center* within the boundaries when specifying the corner values. This is useful if you wish to analyze a small area in greater detail.

The boundary may also be designated by the *Station Center* and a radius.

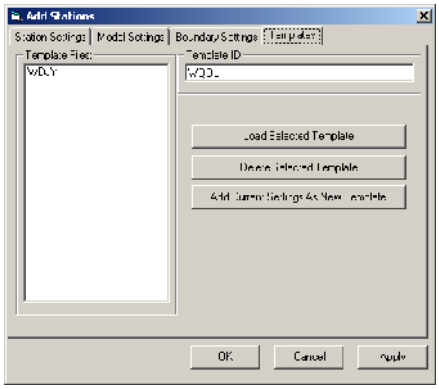
The *Terrain database* used in the *path loss* calculations is specified from the Boundary Settings tab. The default *Terrain database* is the GLOBE 30-second database from NGDC. Other *Terrain databases* are available which may give more accuracy to the calculations.

Bins

In order to create a *Path-Loss File*, the area defined by your *Boundary Settings* is divided in to a grid of discrete cells called *bins*. A path loss calculation is then performed from the *transmitter location* to each *bin*. Therefore, the smaller (and more numerous) the *bins* the larger the computing task becomes.

Bin size is specified in seconds of arc. Thirty seconds of arc is approximately 900 meters. Therefore, 30-second bins will be slightly smaller than one square kilometer. **PLServer** can be set to use 30, 15, 9, 6 or 3-second bins. Three seconds of arc is about 90 meters.

The number of bins in a *path-loss* file, the cost of producing the file (if ordered from **rfSoftware**) and a very rough estimate of the processing time is displayed at the bottom of the Boundary Settings Page.



Templates

The last tab of the Add Stations Dialog allows you to save or retrieve path-loss settings as a *template*.

Station information can also be imported into the queue from a comma-delimited or *.csv file.

The source file should be in text format and configured as specified in Appendix C.

Building the Path Loss File

Once the Propagation Queue is populated, you can begin building path-loss files. Select Start Processing from the Propagation Menu to begin the building process.

The process can be paused by selecting Propagation--Halt Processing.

Creating Propagation Files

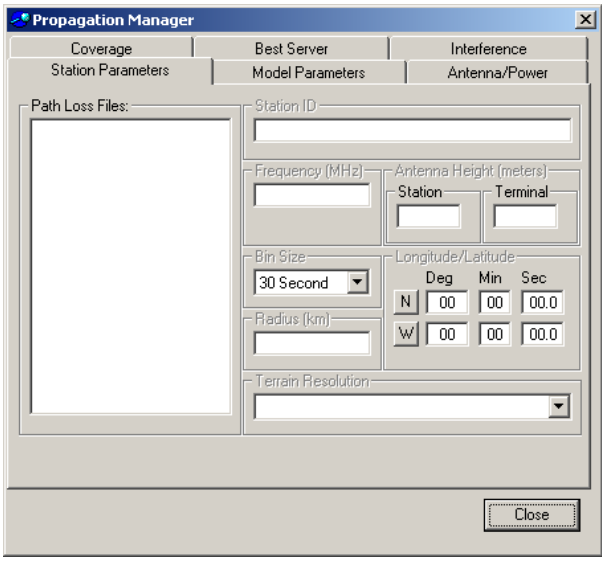
Overview

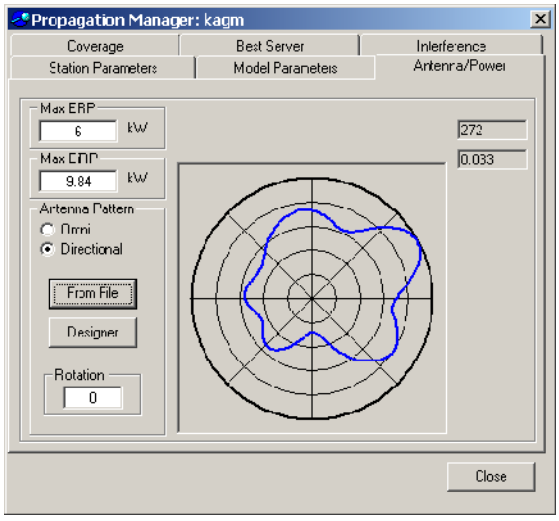
This process begins with the Propagation Manager. You access it through the Propagation Menu with Propagation.

The Station Parameters and Model Parameters are for reference only. They tell what the settings were in the *PL File*. They cannot be changed here. If changes to these settings are required, a new Path-loss file must be created.

The Propagation Manager

The Propagation Manager will display a list of the current *Path Loss Files*. Select the one you wish to work with, and then click the Antenna/Power tab. Set the maximum ERP.

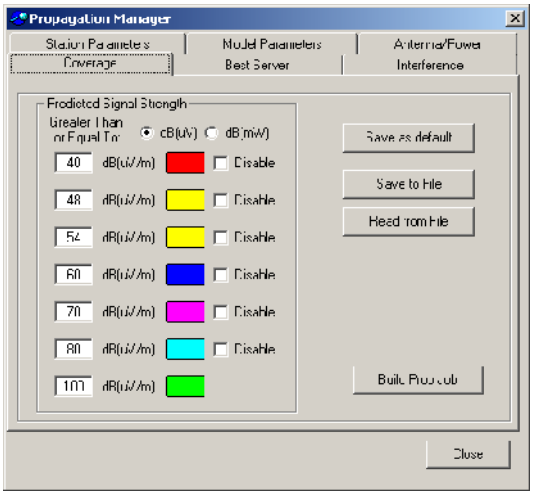




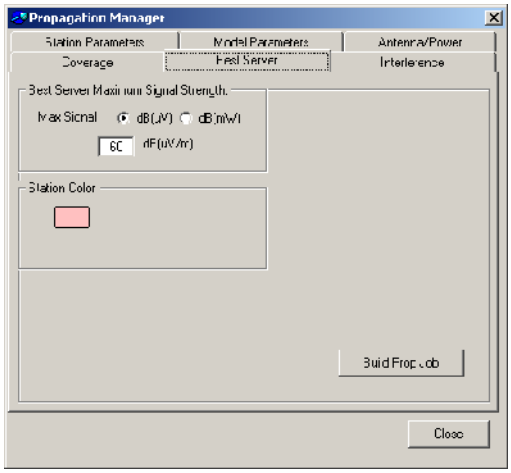
If a directional antenna is desired you can obtain it from the local or FCC database or import it from an *.apf file. You may also use the Antenna Pattern Designer to create a user defined antenna pattern. If necessary, set the antenna rotation.

Coverage

Click the Coverage tab and set the Predicted Signal Strength ranges. Change the color for a given *signal strength range* by clicking on the colored block.



Best Server

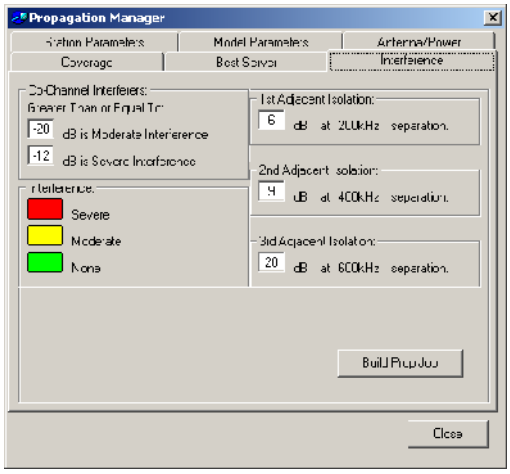


If you are interested in displaying Best Server Coverage, click the Best Server tab, set a maximum signal strength level and a unique color.

Interference

If you are interested in displaying Interference, click the interference tab. Set threshold values for moderate and severe co-channel interference. Set interference colors as desired.

All interference is assumed to be co-channel. Assign appropriate isolation values for 1st, 2nd and 3rd adjacent channels.

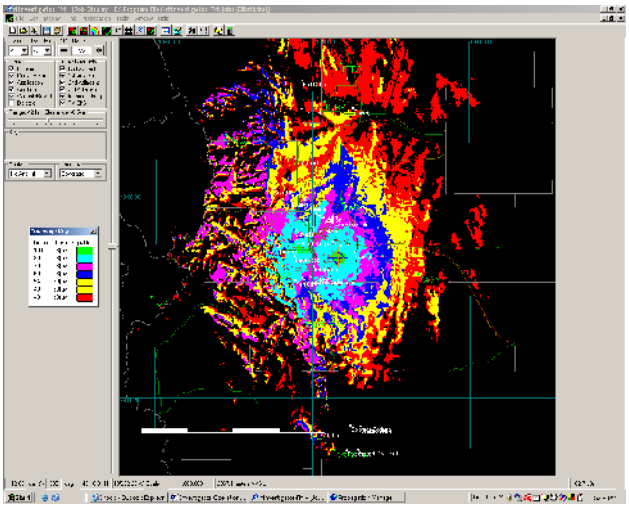


Building the File

After specifying power, antenna, and coverage parameters click the Build Prop Job button to create the propagation file.

Propagation Display and Analysis

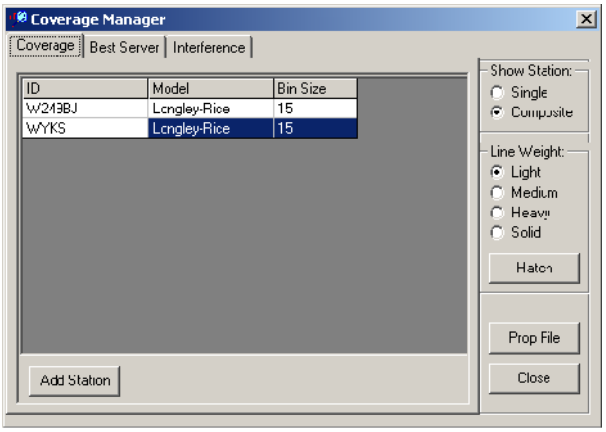
Overview



After the propagation files are built, they can be used for coverage and interference analysis. Propagation coverage can be displayed either as an underlay (bitmap) or as a vector map. To display an underlay simply select coverage from the Analysis/Underlay Control and specify the propagation file you wish to display.

Propagation display of vector maps is controlled through the *Coverage Manager*. The *Coverage Manager* can be accessed by selecting coverage from the Propagation menu.

Coverage/Best Server Tab



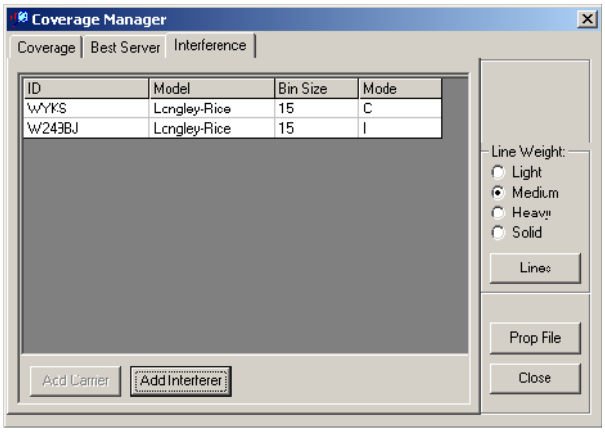
Add one or more propagation files to the *coverage/Best Server* list by pressing the ***Add Station*** button and selecting the desired propagation file. Display single station coverage by selecting stations from the list.

Display *composite coverage* for all stations on the list by selecting Composite from the Show Station control.

Press the ***Lines*** button to toggle between lines and crosshatch.

Interference Tab

Press the Add Carrier button to add the single carrier (desired) propagation file. Press the Add Interferer button to one or more interferer (undesired) propagation files.



Notes:

Appendix A

Projecting a Curved Surface onto a Flat Screen

Overview

A *Projection* is the process of displaying a curved surface onto a flat surface. Generally, a flat surface is 'wrapped' around the curved object in some manner, the information is transferred from the curved surface and the flat surface is then 'unwrapped'.

Map Projections are classified by how the flat surface is positioned relative to the curved surface (cylindrical, conical, etc.)

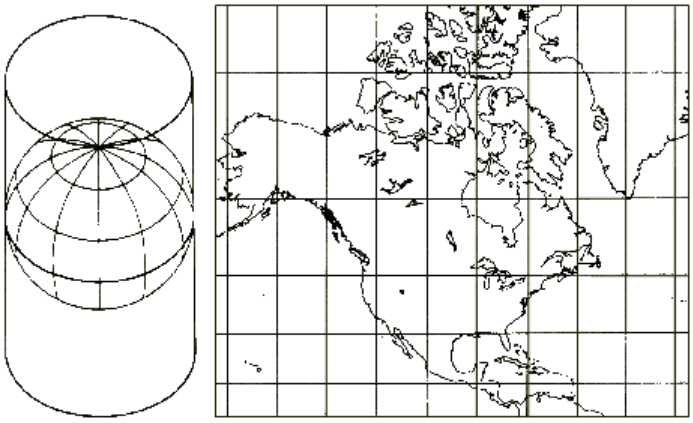


Figure 1. Regular cylindrical projection: the Mercator.

Projections can be conformal; preserving angular relationships between the curved and flat surfaces or, equal-area; where the two surfaces have common scales. It is not possible for a projection to be both conformal and equal-area.

Transverse Mercator

The *Transverse Mercator* is the type of projection used on maps common to radio broadcast licensing purposes.

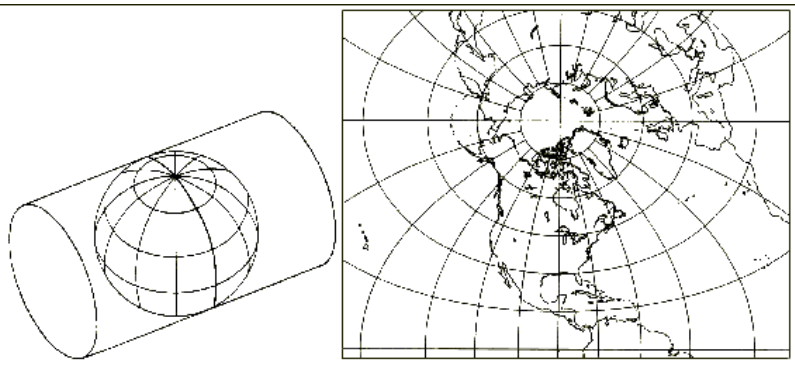


Figure 2. Transverse cylindrical projection: the Transverse Mercator.

FCC Rules: 73.208

Part 73.208 of the FCC rules specifies a method to be used in determining distances between stations for the purposes of licensing FM broadcast facilities. Using these formulas rfSoftware developed a transverse pseudocylindrical projection that, we feel, is especially appropriate to the broadcast industry.

Limits of the Job Map

As with all map projections, the method used by rfInvestigator has several limitations.

FCC rule 73.208(c) says "...The method set forth in this paragraph is valid only for distances not exceeding 475 km." This means that displays that are more than about 700 km across will be significantly distorted at the extremities of the map.

An additional limitation imposed by using this map projection is significant distortion north of about 75 degrees latitude. **rfInvestigator** will not permit a site to be modeled or a Job Map to be recentered north of 75 degrees North Latitude.

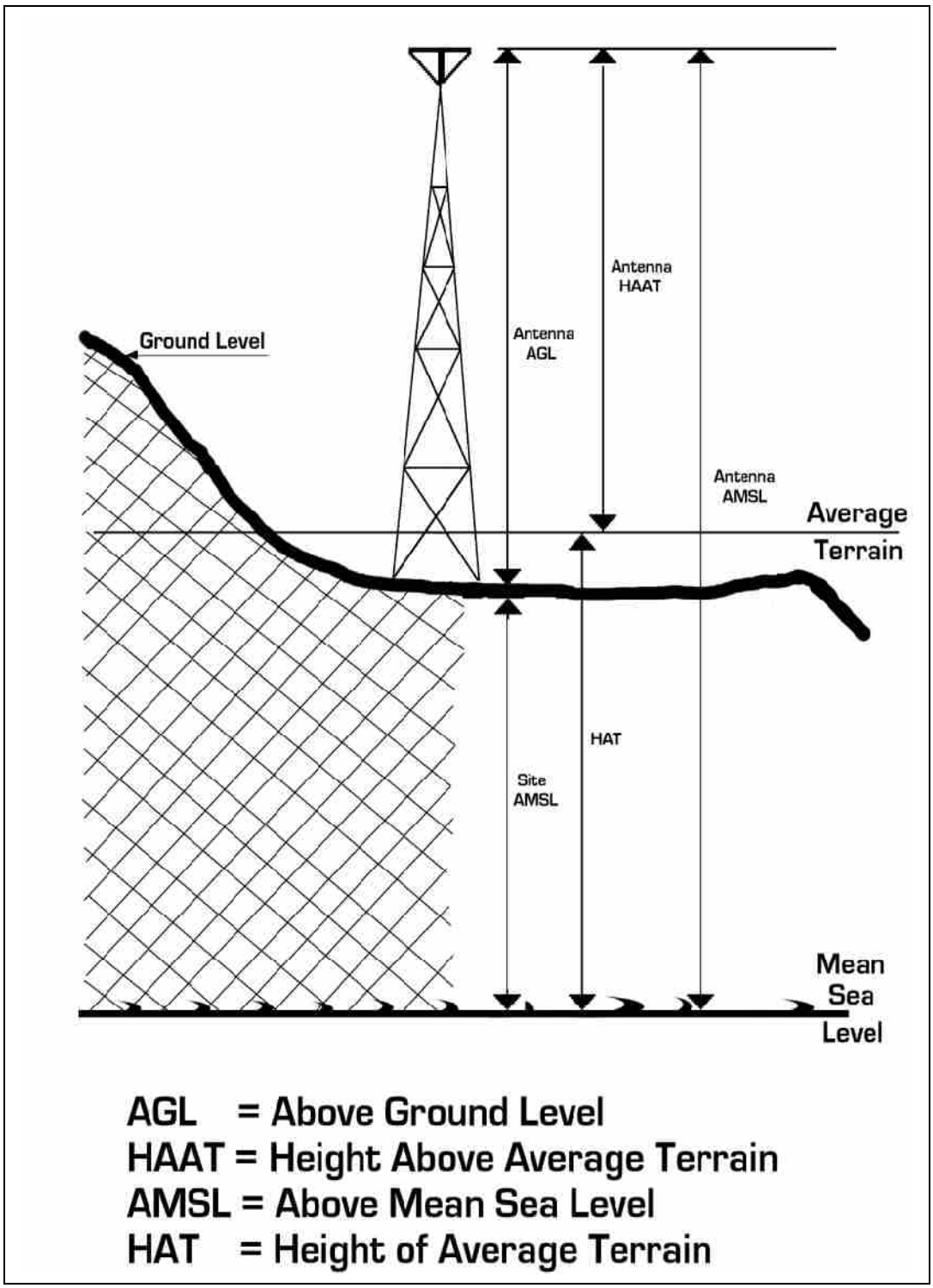
Underlay Maps

Underlay maps are bitmaps (pictures) that are stretched or shrunk to the current map scale and placed on the screen for reference purposes. Due to the distortion of the map projection, underlay maps are only accurate at the map center.

Since underlay maps are a picture, only ONE underlay may be displayed at a time.

Appendix B

Definition of Antenna Height



Notes:

Appendix C

External Queue File Format

Fld #	Field Name	Remarks
1	Station ID	Up to of 26 characters.
2	Frequency	Frequency in MHz, Min = 20, Max = 20,000
3	Center Latitude	Station location in decimal degrees
4	Center Longitude	Station location in decimal degrees
5	Tx AGL	Meters above ground level to radiation center.
6	Rx AGL	Meters above ground level to radiation center.
7	Terrain	1 = GLOBE 30-sec, 2 = USGS 3-sec, 3 = FCC 30-sec.
8	Bin Size	3, 6, 9, 15, or 30 seconds.
9	Radius	Radius in km, set to zero if specifying corner boundaries.
10	North Latitude	Corner boundaries, set to zero if using radius.
11	East Longitude	Corner boundaries, set to zero if using radius.
12	South Latitude	Corner boundaries, set to zero if using radius.
13	West Longitude	Corner boundaries, set to zero if using radius.
14	Prop Model	0 = Longley-Rice
15	Ant Polarization	0 = Horizontal, 1 = Vertical
16	Reliability	1 to 99 per cent.
17	Confidence	1 to 99 per cent.
18	Radio Climate	Integer 1 through 7. See details below.
19	Refractivity	Integer 280 through 370. See details below.
20	Dielectric Const	Integer 1 – 81. 4 = Poor, 15 = Average, 81 = Sea Water
21	Conductivity	0.001 through 5.0 in Mho's per meter. Set to 0 to use M3.

Longley-Rice settings:

Antenna Polarization, Field # 15
- 0 - horizontal
- 1 – vertical

Radio Climate, Field # 18
- 1 - Equatorial
- 2 - Continental Subtropical
- 3 - Maritime Tropical
- 4 - Desert
- 5 - Continental Temperate
- 6 - Maritime Temperate, Over Land
- 7 - Maritime Temperate, Over Sea

Dielectric constant of ground, Field # 20
- 15 – Average
- 4 - Poor
- 25 - Good
- 81 - Fresh Water
- 81 - Sea Water

Ground conductivity, Field # 21
- 0.005 - Average
- 0.001 - Poor
- 0.020 - Good
- 0.010 - Fresh Water
- 5.0 - Sea Water
- 0.0 – Use M3 conductivity value

Surface refractivity, Field # 19
- 280 - Desert
- 301 - Continental Temperate
- 320 - Maritime Temperate over Land
- 320 - Continental Subtropical
- 350 - Maritime Temperate over Sea
- 360 - Equatorial
- 370 - Maritime Subtropical

Confidence, Field # 17
- 1% to 99%

Reliability, Field # 16
- 1% to 9

Notes:

Appendix D

Antenna Pattern File Formats

'.apf' Files

Files ending in .apf are rfInvestigator's native format antenna pattern files. They are binary format and only readable by rfInvestigator. These files can be created and read by rfInvestigator.

'.csv' Files

Files ending in .csv are comma separated value format antenna pattern files. They are text format and readable by rfInvestigator, text editors and spreadsheet programs. These files can be created and read by rfInvestigator. The format is as follows:
Line 1: Headings and comments.
Lines 2-361 azimuth and field values separated by a comma. Azimuths must be in order from 0 to 359. Field values must be normalized to 1.

'.pat' and '.lpf' Files

Files ending in .pat are databases of antenna pattern files. They are binary format and only readable by rfInvestigator. These files can be created and read by rfInvestigator. The FCC pattern database is distributed as a .pat file.

'.fig' Files

Files ending in .fig are ERI antenna pattern files. They are text format and readable by rfInvestigator and text editor programs. These files can be read but not created by rfInvestigator.

'.txt' Files

Files ending in .txt are comma separated value format antenna pattern files. They are text format and readable by rfInvestigator and text editor programs. These files can read but not created by rfInvestigator. The format is as follows:
Line 1 through n-2: Headings and comments.
Line n-1 should contain only the word “START” (without the quote marks).
Lines following “START” should contain azimuth and field values separated by a comma. Azimuths must be integers, in increasing order between 0 and 359. The azimuths do not need to be evenly spaced. There cannot be more than 360 azimuths but there can be fewer. Field values must be normalized to 1.
The last line of the file should contain only the word “END” (without quotes).
This format will also read Scala antenna pattern files that use the following headings:
"ANGLE REL. FIELD REL. DB DBD POWER GAIN"
"AZIMUTH FIELD REL.DB DBD PWR GAIN"
"ANGLE REL. FIELD REL. DB DBD PWRMULT"

Notes:

Appendix E

White Gray Study

1. Build the contour to be studied.
2. Display the contour and measure the greatest distance to contour of any radial.
3. On the *Job Control dialog*, set the *Affected* stations to *Licensed* and *Construction Permit*.
4. Make sure that the map is centered on the site to be studied.
5. On the *Job Control dialog*, change to the *Analysis* tab, check the *White/Gray* box, the *White-Gray Setup* dialog will open.
6. Set a contour value for the Servers. This will normally 60dBu for NCE studies.
7. Set the *Analysis Range* to the value determined in Step 2 (plus a couple of kilometers to be safe). The default value for the analysis range is the *Range* setting on the bottom of the *Job Control* dialog.
8. Check the boxes for the types of stations to be included in the study.
9. Check the Show List of Stations box.
10. Press the *Run New Analysis...* button. Specify a master FM database if necessary.
11. The *White Gray Select* dialog will open with a list of stations found. Uncheck the box for stations to be ignored, for example; CPs of licensed stations that have not applied for a license to cover. Click *OK* when through.
12. The *Save Analysis To* dialog will open. Name the study. This will be the location and name of the MDB database and the name of the Contour Group.
13. Click *OK* and the process will run for a few minutes.
14. When the process completes open the *Contour Manager*.
15. Select *Signal Contours* from the *Job Control Analysis* tab.
16. Copy the contour you created in Step 1 into the new group containing the Server contours. Change its color if necessary to make it stand out from the Server contours.
17. To create a summary text report, open the *Contour Details* dialog of the contour under study and click the *Export* button.
18. Select *Current Contour White/Gray Population Counts* from the *Export Data* list. Click *OK*.
19. Specify a file name for the report. The report will summarize the population service figures within the contour.

Important note: Adding or removing contours from the Group will not change the summary text report. This report is based on the database file created in Step 12. The only way to add or remove stations is to rerun the study and add/remove stations from the list, see Step 11.

Notes:

Appendix F

User defined conductivity files.

File format: ASCII text, Comma delimited data

File extension must be ".CSV"

Any line that does not begin with a valid integer bearing is assumed to be a comment.

Bearings must begin at zero and increase in order to 355 in 5-degree steps. Any skipped bearings will be replaced by M3 values. If a line begins with a number that is not a modulus of 5 it will be treated as a comment.

Distances are in kilometers and, for each group of bearings, must be in increasing order.

The first distance must always be zero. The valid range is between zero and 2150.

Conductivity is in miliSiemens-per-meter. The valid range is between 0.01 and 5000. There is no limit (within reason) to the number of conductivity breaks along a bearing.

Each line holds one bearing, one distance to break in kilometers and one conductivity value. The conductivity value is for the specified breakpoint and beyond.

The last line for a given bearing can, optionally, replace the conductivity value with "M3" to indicate that the rest of the bearing should use the M3 database.

Sample File:

This is a Comment since it does not start with a number.
Bearing, Distance, Conductivity

Since they are skipped, bearings 0 through 15 will use M3 data.

The next line is the first data recognized by the program.
20, 0, 2
20, 18.2, 4
20, 33.7, 15
20, 37.0, 4.0
20, 55.1, M3

Blank lines are ignored

25, 0, 2
25, 19.4, 4
25, 61, M3
Bearing 25 degrees will use 2mS from zero to 19.39km, 4mS from 19.4 to 60.99km and M3 values from 61km and beyond.

30, 0, 2
30, 18.1, 4
30, 66.9, 2
30, 115.9, 15
30, 159.0, 8
30, 197.7, 2
30, 229.1, 4
These are some more user comments that are ignored since the line does not start with a valid bearing.
30, 301.9, 1.5
30, 315.1, 5000

We skip 35 so it defaults to M3.
Remember, don't start the comment line with the number 35!
40, 0, 2
40, 22.5, 4
40, 70.1, M3
The remaining bearings are skipped so they will use M3 data.

Notes: