User guide for RRL Plugin v3.0

Table of Contents

1. MODIFICATIONS 3
2. INTRODUCTION 13
AUTOMATIC MICROWAVE FREQUENCY COORDINATION USING ICS TELECOM EV AND RRL DATABASE 14
LMR FREQUENCY COORDINATION PROCEDURE 14
RRLPLUGIN LMS FDC ANALYSIS PLUS TX INTERMOD CHECK 14
3. SYSTEM REQUIREMENTS 14
4. INSTALLING RRL PLUGIN 15
5. RUNNING RRL PLUGIN FROM ATDI APPLICATION 19
6. CHECKING DATABASE STATUS 24
7. EXTRACTING MICROWAVE NETWORK FROM RRL DATABASE 25
8. EXTRACTING LAND MOBILE RADIO AND TERRESTRIAL SERVICES 33
9. QUICK MICROWAVE LINK CALCULATOR 38
10. SUMMARY OF IMPORTED MICROWAVE PARAMETERS 42
11. 400 MHZ STATION CULL ACCORDING TO DISTANCE AND FREQUENCY RANGE 43
12. STANDALONE MODE 49
13. MAP CONTROLS 51
14. UPDATING RRL PLUGIN 53
15. METHODOLOGY FOR UPDATING COORDINATES USING COORDINATION DISTANCE 54
16. TOOLS>>ELLIPSOIDAL DISTANCE CALCULATOR 57
17. SETTINGS>>ADVANCED QUERY SETTINGS 59

1. Modifications

Data	Plugin version	Changes
25/01/2017	V 1.0	Document released
30/01/2017	V 1.0	Added quick introduction video link
01/02/2017	V 1.1	Added ACMA SITE_ID
13/02/2017	V 1.2	Added “Find candidate channels for assignment” option under 400 MHz trunked radio to call stations, channels and produce map view with the option to analyse channel-by-channel
28/04/2017	V 1.3	General graphical optimization for “Find candidate channels for assignment”
17/07/2017	V 1.4	General GUI loading optimization
29/07/2017	V 1.5	Introducing microwave calculator, GHz, MHz, KHz units for frequency range query. Also added support for RPE (Microwave) antenna modelling using the RPE model number. Many other improvements.
06/08/2017	V 1.6	General improvements and new feature added tools>>Filter results by radius. Allowing circular geographical filtering for table results.
18/08/2017	V 1.7	Added option to export table as CSV for 400MHz channel search Added option to dump RRL’s enite site table in CSV for ATDI site update feature Added option to export links and LMR as KML General stability improvement
1/09/2017	V 1.8	Fixed issue with csv export; ms excel unable to read all lines due to use of quotes in site address. Optimized square boundary calculations for “Update coordinates using coordination distance” by using WGS84 ellipsoid. See manual for further details.
2/09/2017	V 1.9	“Filter results by radius” is now WGS-84 compatible and in compliance with (GDA Vincenty inverse calculation method). Works for both LMS & P2P queries.New feature Tools>>Ellipsoidal distance calculator.New feature Settings>>Advanced query settings. An option to select equipment type “T” or “T/R”
4/10/2017	V 2.0	Added Distance-frequency violation validation.Added transmitter generated Inter-modulation calculations
8/10/2017	V 2.1	Added support for frequency-distance constraints of LMRS vs LPMRS by implementing tables C8.4, C8.5 & C8.6. Optimization of CSV exportation for massive files. Added option to export all grid-views to CSV files
15/10/2017 – 2.3	V 2.3	Added compatibility to latest ICS Telecom EV. Station’s Callsigns and mw identities are now based on EFL_ID_x of the transmitter. Where x is increment number to guarantee non-duplication. Added support to broadcast records. Added condition; if antenna gain or feeder loss are not defined by ACMA; the plugin would only import EIRP. Also, if eirp is not matching transmission power plus gain – feeder loss; the nominal would be calculated from eirp
23/10/2017	V 2.4	Added capability to filter P2P links base on specific channels in duplex mode. Ability to add multiple of freq range filters in one shot. Also set MW Ident and station callsign to EFL_SYSTEM_x where x is a dummy increment number to maintain non-duplication. This cancels changes in earlier version but majntain the x increment. Fixed issue of 0 m height for

		legacy devices in ACMA database. An override configuration is added in main “Settings”. Applicable to all devices.
13/11/2017	V 2.5	Added support for Single frequency FDC tables Improved gui for LM8 coordination Drop-down band selection is now sorted New function to export FX bands as channel plans in ATDI format Database date is now visible in the main application form (bottom left corner). Ability to specify coordination EIRP settings for LMRS/LPMRS in LM8 coordination. Settings>>Coordination settings Ability to select multiple frequencies for assignment and run FDC analysis taking into account pre-selected frequencies. New icons added to “Add”, “Save” & “Load” a list of assignments. Microwave Ident and BTS callsign are now just increments (1, 2, 3 …) due to limitation in ICS Telecom. General improvements in GUI and visual responsiveness Introducing Batch TX Intermod calculations, “Analysis>>Batch Intermod” Now its possible to display detail FDC analysis for RX channels and automatically highlight interference-free channels for assignment Intermod analysis table now showing license number for the involved product Ability to export devices within cull to ESRI SHP & KML formats
2/12/2017	V 2.6	Added condition to check whether device height is “0” and apply user preference value. See “Settings” >> “Advanced query settings”, overrides. Both Lower/upper frequency limits now are automatically selected. Filters are now moved to separate menu for friendliness In Land mobile radio coordination – Site tab, all fields can listen to “Enter” key stroke -Channel tab, Upper and lower frequencies automatically selected

		-Constraints tab, user must select an option otherwise an error message will be displayed -Summary tab, Added FDC rules applicable as detected by the plugin. Also added band plan selected. ESRI SHP export has been improved to report all captured device parameters and site location
26/01/2018	V 2.7	-General optimization for the LMR coordination interface – Added new feature in LMR coordination to let users filter on FDC=0. View>>Keep FDC safe View>>Highlight FDC safe -Bug fixing for the frequency selection bucket prohibiting bucket to be used in intermod calculations -Added possibility to clear the bucket (frequency cart) – Added possibility to aggregate two adjacent 12.5 kHz channels into one 25kHz channels for all segments (1 and 2, 3 and 4, ….). Proposed channel bandwidth must be set to 25kHz and the option “25 kHz channel aggregation (1+2,3+4,…)” must be checked under “Settings>>Coordination settings”. -Added new table (tab) “TX Intermod entities” in LM8 coordination interface to list down all assignments being considered in intermod calculations. The idea is to export to 3rd party and verify the calculations -Added a feature to let users import channel plan from csv files by holding-down “Ctrl” key while clicking “FDC Analysis” button -Added a feature to import device database from CSV format for FDC analysis purposes. So coordination can be executed on offline records. Hold-down “Ctrl” key while clicking “Freq-Dist cull”. This will work with FDC analysis but NOT intermodulation analysis since intermod analysis is based on RRL database only. -Added a new capability allowing classification of RX devices as LMRS/LPMRS by mapping their EIRP level from their TX pair. The grouping is done by EFL_SYSTEM. “Settings>>Coordination settings”. This solves a well known issue of classifying RX devices as LPMRS regardess.
15/03/2018	V 2.91	Added Licencee name and expiry date to query table result both P2P and LMS (but not in EWX yet)

		Added “Filter>>Results by Licencee” in main application Channel/band drop-down are not sorted Minor bug fixing RRL database maintenance moved to “View>>RRL daily import summary” Introduced PFREQUENCY which is the Frequency pair of the device. This field can be updated from the TX/RX device pair. This field is only relevant to EWX file exchanged with ICS Telecom EV. The idea is to identify the RX frequency for each TX frequency, vice-versa, by looking up the “EFL_SYSTEM”. Should only be used with LMR and not PTS. It is not relevant to P2P links at all. Main application settings, TX/RX is now a by-default setting – thanks to introduction of PFREQUENCY
23/02/2019	V 2.93	Note: Ultra-low power is not enabled yet. Still work in progress. -Filter>>Results by Licensee, now also apply the filter when exchanged with ATDI tool. Previously was only applying the filter to the table view -Database date: Now displayed in green if recent and red if running 1 day late -Added Tools>>PTS Spectrum finder, a new interface to analyse spectrum usage and availibility of un-used channels -Added View>>Spectrum usage, a new function to show spectrum usage Vs distance -Added Tools>>Path loss calc, a very basic propagation loss calculator supporting Okumura-Hata, Ericsson 9999 and COST231-Hata
09/11/2020	V 2.96	-Introduction of Passive Intermodulation calculator and safe freq assigner (upto 11 frequencies) -Adding Grid Detail View – double-click row header for detailed view -Adding CERT_METHOD and EFL_FREQ_IDENT RRL fields for T/R querie (not P2P) -New feature for channel plan viewing, View>>Channel plan -Bug fix – During LM8 coordination, “Error getRF returned non-existing case 12”

		-Overall improvements in maps -Adding 'ID' as internal field (not RRL related) -Speed optimization to CSV export -Adding Mapview tab to main menu. Also adding new menu: Map>>Draw network – allowing to visualize queried network 26/07/2020 – 2.95 Adding Pager Exterior (>83W) FDC table from RALI LM02 section 5.2.1. Purely based on 'Delta F' with no reagrd to LMRS/LPMRS or victim/interferer's bandwidth configuration -Adding FDC analysis for 800MHz Trunking Band based on C9.1 and C9.2 (LM8 July 2020) – Adopting cull range (km) from table C1 Lm8 July 2020 -Urgent bug fix, LM8 Cull freq range manual entry (double click) was incorrectly mapped to another input field. -User can now select proposed site (LM8) by double-clicking a location on the map – Supporting user-defined frequency exclusion list (LM8 coordination) -Added capability to export all grid analysis to single excel file (devices, FDC, details, intermod)
06/10/2022	V 2.98	-PTS Frequency finder implementation and graphics optimization. Adding option to export table to CSV. Progress reporting and capping limits for markers presented on the map to avoid memory restrictions -New menu: Query, the ability to query licensed devices by their Licence number, client No or Site ID. User can query either LINKS or DEVICES depending on the query mode. -Presentation improvement for Map view and addition of infoBox. And markers are now clickable. A list is added to keep track of displayed layers/queries. 10/02/2022 – 2.97 General stability improvement and support for Windows 11 -Ability to select the map provide for map display -Adding RSSI level for Microwave link listing

5/6/2023	V 3.0	-New function – File>>Convert >> Centroids to circles. The ability convert a list of locations (name, lat, lon, radius_m) to SHP circles with 10m sampling. -EPSG 4326 is the default system grid for produced SHP files under "File" menu. -New function – File>>Convert>>Site list(CSV) to images. The function will automatically load a list of sites and for each site center the map and save screen capture. Format: Comment, lat, lon, zoomLevel Zoom level is 1 to 20 with 20 being the closest. The coordinates must be decimal degrees only. -Introduction of two new fields for all queries: LICENCE.LICENCE_TYPE_NAME LICENCE.LICENCE_CATEGORY_NAME -New function – Filter>>Results by licence type -New feature – adding distribution graph for Spectrum analysis function under Analysis>>Spectrum usage. Also possibility to run RSSI analysis. -Re-introducing a feature: Tools>>Report analysis. Query by client ID and licenses expiry date and generate quick report. Fees calculations is not ready. -New feature – support for GPS devices to establish real-time location and auto center the map. words supported: $GNRMC, $GPRMC, $GPGSV, $GNGSA, $GPGSA -Possibility display/hid infobox and layers treeView – Provisional features – (none permanent for now) Possibility to download spatial layers such as vectors from central GIS server and overlap on map. New GIS toolStrip with shortcut icons to Reset,add, download, export layers and re-center map. Possibility to display vector information and attributes. Possibility to export selected vector layers in HTZ format (.VECT): File>>Export

2. Author

This tool is designed, developed, and maintained by Yahya Khaled since 2016.
Yahya has master-professional-engineering degree (2010) in wireless communications from university of Sydney. Has worked in the field of Radio Frequency Planning and Spectrum Management under several roles with ATDI since 2010. The author has extensive experience with spectrum interference management and frequency de-confliction practices commonly used in the industry. Yahya has overseen ATDI's consultancy services in Australia and South-Asia-Pacific and occupied multiple leading roles including Technical Director.

Technical skills and competences	As senior RF & Spectrum engineer of ATDI South Pacific, Yahya is responsible for the technical content and methodology of all ATDI consultancy projects. He has great understanding and in-depth knowledge in radiocommunications. He has proven his remarkable level of utilization of ATDI solutions in radio technologies to model and analyses network issues and recommendations throughout many projects at ATDI. - Planning of 3G/4G/5G, broadcast networks (analogue, digital), Microwave, Tetra/DMR, APCO P25, Aviation, Rail Comms, Electronic Warfare, and antennas. - Interference analysis for co-existing technologies - Signal processing - Spectrum planning and analysis - Spectrum monitoring key measurements. - Electronic warfare (radar, jamming, interception, DF…) - RF Modelling & Simulations, Measurements, and surveys. - RF propagation, RF Planning, RF training. - Programming language: C++, Python, Visual Basic, Assembly for Microchip, C# - Optic fibre link design and network equipment - Languages: English and Arabic
COMPETENCES / EXPERIENCE:	Expert Consultancy Services ***850/900 MHz reverse band interference analysis and Technical Framework development (2023)*** Yahya developed technical framework to model and resolve reverse band interference between base stations sharing geographical area or position. Yahya also developed a software to automate the modeling and calculate mitigations to resolve the interference. ***100+ compatibility reports for ATC Radar and new 5G services within 7 km of airports in the UK (2021-2022, UK)*** Yahya's role was to establish the methodology (in-band blocking and spurious), model, and simulation environment to carry out such study following OFCOM's documentation. Yahya did all the derivations including MCL, beam-forming antenna simplification in addition to drafting the standard template to be used for such reports. ***Analysis for impact of new footbridge on DTRS (2021, Sydney)*** Yahya's role was to study, model, simulate, analyze, and recommend on the impact of new footbridge on DTRS reception. The study was also extended to include EME assessment (ARPANSA). ***Design, architect and set framework for HTZ automation RESFUL API (2021-2022, Sydney)*** Yahya designed, commercialized, and developed new business in the Automation API sector of ATDI business. Lead both business development

and specifications of the new product. The product concept was adopted and fully developed into a product and commissioned for BHP Billiton Australia.

Development of tool to analyze and visualize the performance of MANET TACTICAL RADIO (2021, Sydney)

Yahya's role was to find quick, efficient, and simple representation of MANET network in GIS platforms while summarizing the key KPIs.

Analysys Mason, 5G network and coverage validation (2020, Singapore)

Yahya's role was to lead and manage the technical team to ensure quality and reliability of the deliverables. Also to manage the communication with customer to ensure final acceptance.

IMDA + R&S, Interoperability, and co-existence study between Analogue TV across the border and future LTE in Singapore (2019, Singapore)

Yahya lead orchestrated the study methodology (Lab, analytics, measurements, simulation and presentation). Coordinated with stake holders and conducted the final onsite presentation to the director.

SydneyTrains, Spectrum Management Tool customization, integration and management (2019-2020, Australia)

Yahya's role was to manage the communication, development, deployment, integration, commissioning and acceptance of their new Spectrum Management tool (ICSM). In addition to training and support.

TAS-GRN P25 benchmark Radio Network Planning over Tasmania (2019, Australia)

Yahya's role was the lead engineer to carry out the link budget, network modeling and coverage prediction and analysis using ATDI's planning tool. The design was used as a benchmark by the main contractor to help validate the vendor's design

Analysis of impact of new foot-bridge on GSM-R coverage (2018, Australia)

Yahya's responsibilities in the study was a lead RF engineer to provide advice on modelling approach and impact criteria, cartographic data modification, management of customer relationship and verify vendor's analysis and approve final report

LTE Network design for open pit mine in WA (2019, Australia)

Yahya's role was a senior adviser to internal lead engineer. Validating network design and setting strategy for achieving planning targets.

RF planning automation for mining (BHP Billiton) (2019, Australia)

Yahya's role was to manage the project which includes writing specification, managing customer's communication, communicate with developers plus testing, acceptance and final deployment and documentations.

LoRa IoT network design and predictions (2019, Australia)

Yahya was the lead engineer modeling the Parkes Shire Council digital map and deriving link budget and running coverage predictions and analysis.

Automation Software development for Land Mobile Radio coordination procedures automation (2017, Australia)

Yahya developed a .NET application that fully automate LMR & P2P frequency coordination procedures including intermod analysis. The tool can identify congestion in spectrum segments and can identify re-useable channels.

Model tuning and calibration for GSM-R DCS-1800 over NSW (2017, Australia)

Yahya's role was Project manager and played successful role managing customer's requirements and expectations while communicating all technical details with Engineers.

Application development for Land Mobile Radio coordination procedures automation (2017, Australia)

Yahya developed a .NET application that fully automate LMR & P2P frequency coordination procedures including intermod analysis. The tool can identify congestion in spectrum segments and can identify re-useable channels.

Coexistence study between ERP and TDD LTE in 2.3 GHz in Singapore (2017, Singapore)

Yahya led the comprehensive study of the possibility of co-existence between existing ERP system and TDD LTE service in 2.3 GHz in Singapore and provide the recommendations to minimize the interference issues in spectrum regulation perspective.

Field measurements – investigating LTE interference impact into GSM-R network along rail corridor (2015-2016, Australia)

Yahya conducted & analyzed 7 concluded field measurements and the corresponding interference effect of LTE in DCS-1800 band into GSM-R network on the same band

Coexistence study for 800-900 MHz re-band planning (2014-2015, Singapore)

Yahya led the comprehensive study of the possibility of co-existence between the new and existing services and the approaches to harmonize the usage of this frequency band in Singapore and neighboring countries in 800-900 MHz band.

Digital Broadcast (DVB-T2) network design (2013, Thailand)

Yahya led the nationwide DVB-T2 network planning for TV5 Thailand. The study included coverage, interference and gap filling exercise.

GSM-R network preliminary design (2012, Australia)

Yahya participated in GSM-R network preliminary design for Queensland Rail. The study included coverage, interference and validation of sites.

GSM-R network design validation (2010, Australia)

Yahya participated in GSM-R network rollout design validation for RailCorp NSW. The study included RF planning verification and validation including coverage, interference, frequency planning, measurement and propagation model tuning.

TETRA/WRAN radio network planning (2011, Australia)

Yahya participated in TETRA/WRAN network planning for KLH Gas Plant. The study included RF planning verification and validation including coverage, interference, frequency planning, microwave link analysis, and equipment parameters recommendation.

Interoperability study between WBA and BSS systems (2010, Singapore)

Yahya participated in Interoperability study between WBA and BSS system for iDA Singapore.

The study included interference analysis between the systems and analyse the recommendation on co-existence measures/parameters between the affected BWA and BSS systems.

3. Introduction

This document entails steps to download, configure and run RRL plugin with ATDI tools.

What is RRL Plugin?
RRL Plugin is an integration of ACMA's RRL daily extracts into ATDI's RF modelling and simulation tools such as HTZ.

The plugin imports, on daily basis, and hosts a clone copy of RRL database online without any efforts required from end users. The entire importation process has been automated.

The provided records are read-only, hence no users can add or modify any of the existing records.

Is the end-user required to download entire/partial RRL database?
No, the entire driver behind the plugin is to make the records searching criteria and equipment importation extremely simple and effective. Users are not required to pre-download or post-process any form of records. The plugin will automatically liaise with its own, online-hosted, SQL database and overlay the licensed equipment within the tool.

How long does it take to get 500 microwave links or 1000 land-mobile stations on the map together with all subsequent RF parameters?

It's a matter of one minute including loading time. The actual downloading process would be 1-10 seconds depending on internet speed. It was tested with areas as big as NSW.

How does it work?
The plugin has two major parts,

- Online API: Obviously, internet connectivity is required to query and access the online database. The user has nothing else to do with this part.
- Local windows compatible executable that take the form of extension to ATDI's tools. The user is required to download and install this part to be able to make use of the service.
  Does it require fast internet connection?
  No not really. 56kbps internet speed will do fine. All online transactions are seamlessly compressed

Is it secure?
All online transactions are going through HTTPS SSL encryption. The certificate is typically updated every 6-12 months.

What are the requirements?
- Internet connectivity
- Pre-generated username/password (issued by ATDI PTY)
- Windows operating system (x86 or x64)
- .NET Framework 4.5 or higher (Typically available on Windows VISTA and above)
- One of ATDI's tools (ICS/HTZ)

Hardware requirements?
The plugin itself is not execution intensive – no need for a powerful PC. Any PC will do.

Will it work without using ATDI's products?
Yes, but you will only be able to view the records. In fact, the application can be run in stand-alone mode just like any other software.

What parameters can be imported?
The plugin can deal with P2P FX links and land mobile services (TX/RX). The following minimum parameters are supported:

- Antenna height
- EIRP and related parameters (gains/losses)
- Antenna type – also pattern for some RPE models
- Bandwidth and frequency
- emission designation
- License number
- Long/lat
- Address
- Antenna orientation
- others..

Please see section 11 for further details.
Shall I be concerned with firewall?
Firewall should not be a problem. The service provided is similar to web-browsing.

A quick introduction video for RRL plugin can be found in the link below:

A quick introduction video for RRL plugin	https://www.youtube.com/watch?v=bLnvyQR2rCU
Automatic microwave frequency coordination using ICS Telecom EV and RRL database	https://www.youtube.com/watch?v=58iaTHgf9og
LMR Frequency Coordination procedure	https://www.youtube.com/watch?v=bPoMKer_UKs&t=142s
RRLPlugin LMS FDC analysis plus TX INTERMOD CHECK	https://www.youtube.com/watch?v=9sPbmkdgRho&t=49s

4. System requirements

- NET Framework 4.5 – or better
- Windows 7 32 bit/64 bit – or higher

5. Installing RRL Plugin

To download RRL plugin follow the steps below:

- Go to the ATDI application server: https://ub-server.com/
  - Direct download link: https://atdiptyserver.com.au/rrl/RRLPluginSetup.exe
- Go to “updates and download” as shown in the screen shot below:

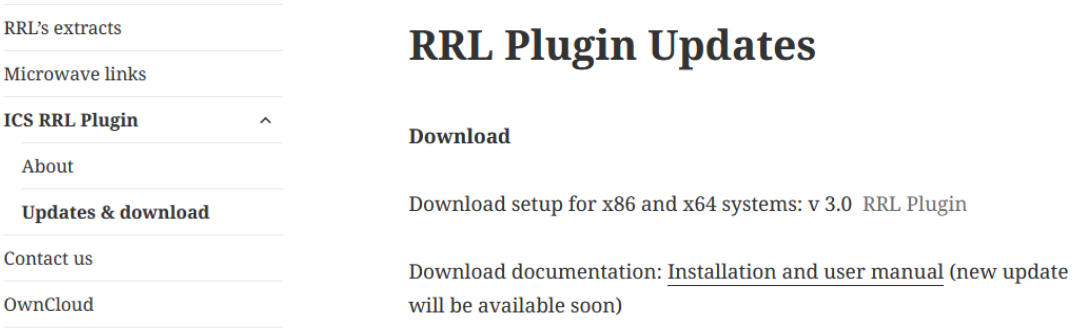


Figure 1 Download RRL plugin

To install RRL plugin follow the steps below:

- Double click on the downloaded RRL and follow the instructions

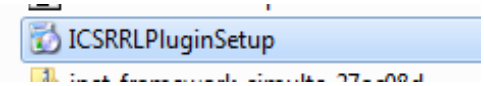


Figure 2 Setup RRL plugin

- Click next

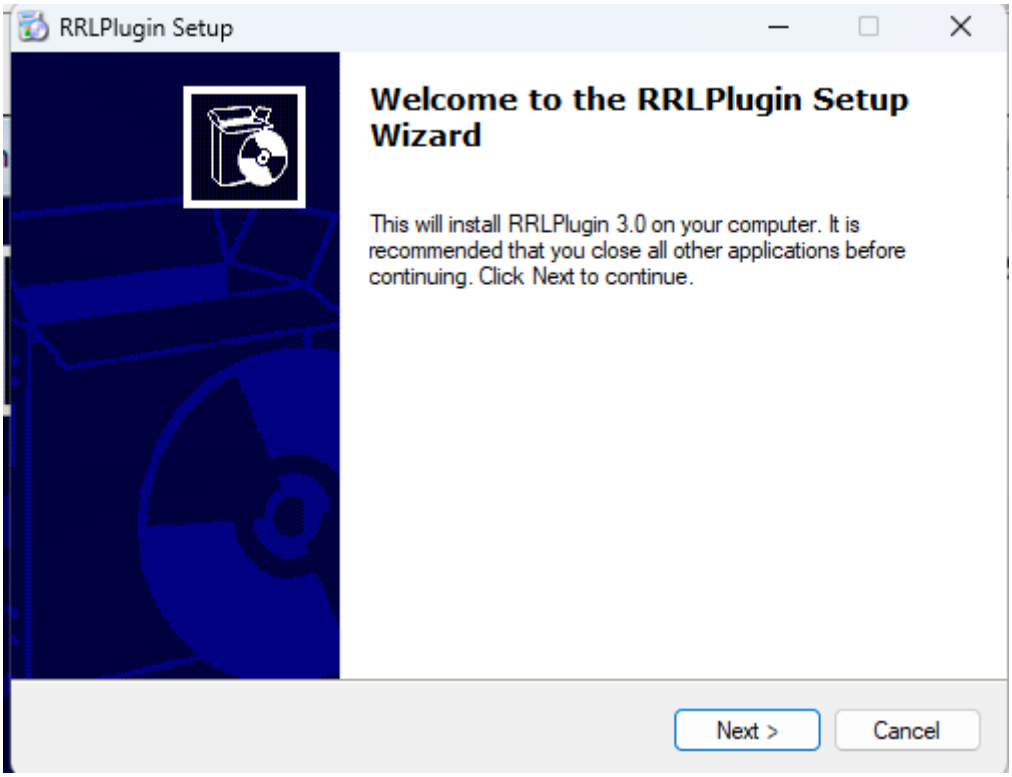


Figure 3

- Accept licence agreement and click next

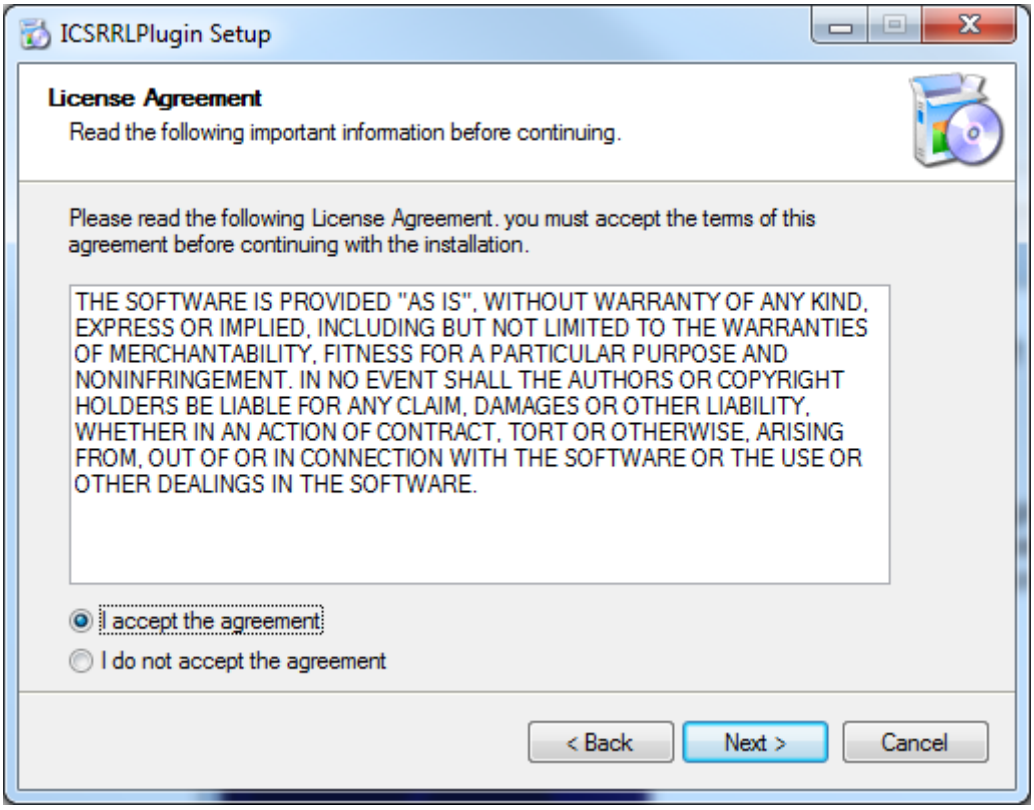


Figure 4: User agreement

- Click next (it is highly recommended you keep default destination folder)

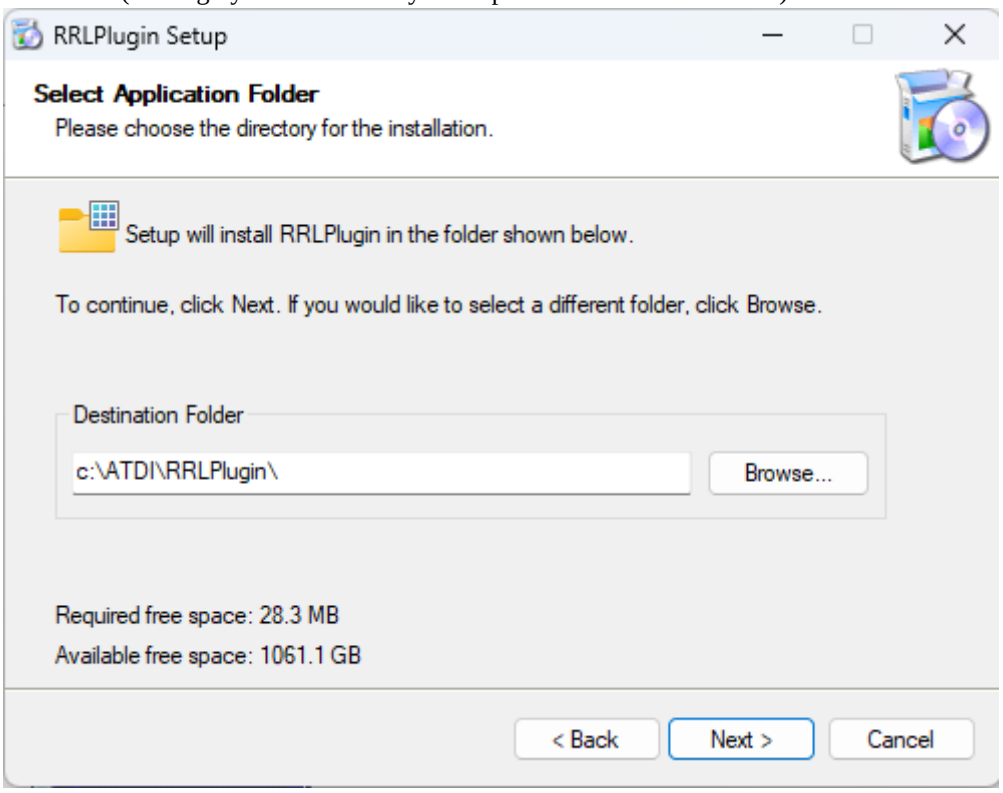


Figure 5: Specify installation directory

- Click next (It is highly recommended you check both options below if user wishes to run the plugin in standalone mode)

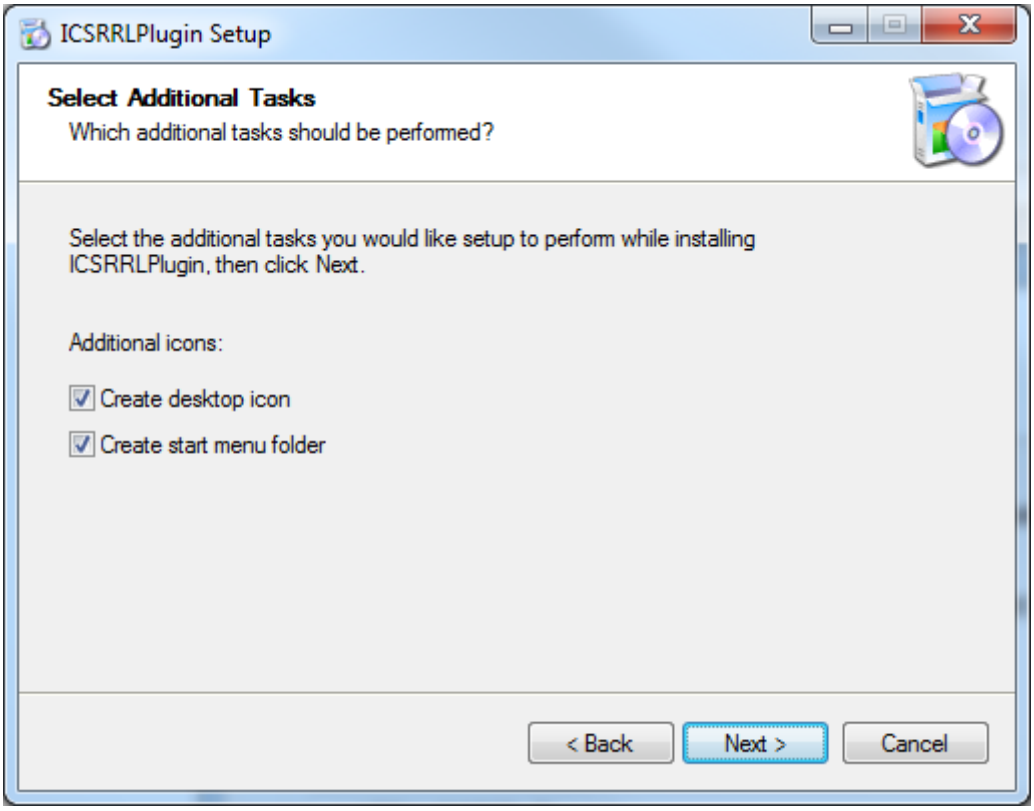


Figure 6: Create short cuts for standalone access

- Click finish to complete the installation

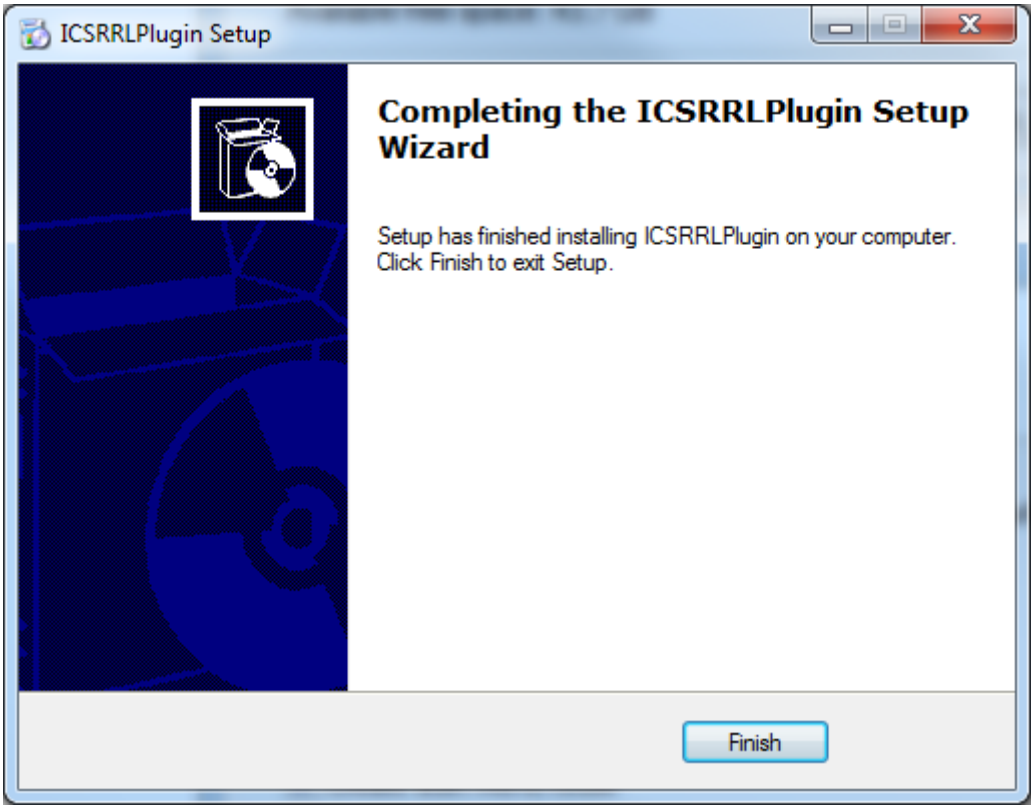


Figure 7: Finish

6. Running RRL plugin from ATDI application

To run RRL plugin from ATDI tools follow steps below:

- Open a project in ATDI ICS software.
- Define area where you want to extract station using rectangular tool by first left clicking on the upper left corner of target area then left click on the lower right corner.

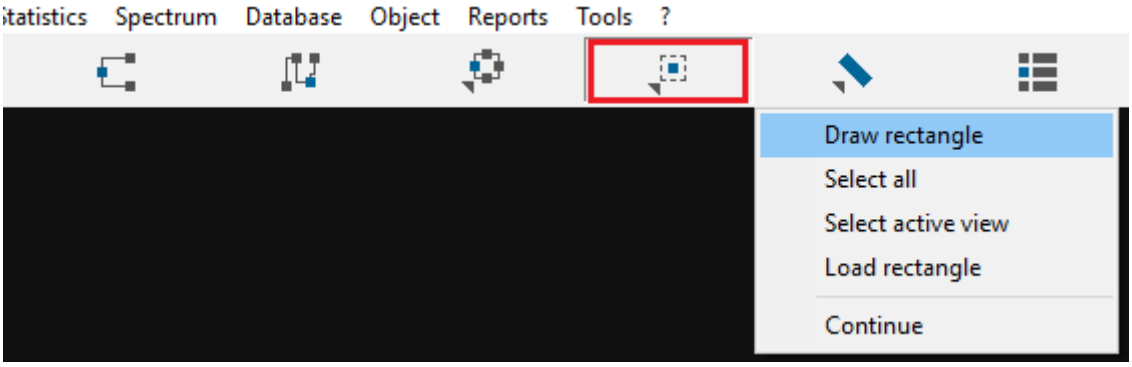


Figure 8 Rectangle tool to define target location

- Select RRL data access…(This area is acting as a geographical filter so users are responsible to draw large enough rectangle to cover the coordination radius – say 200km)

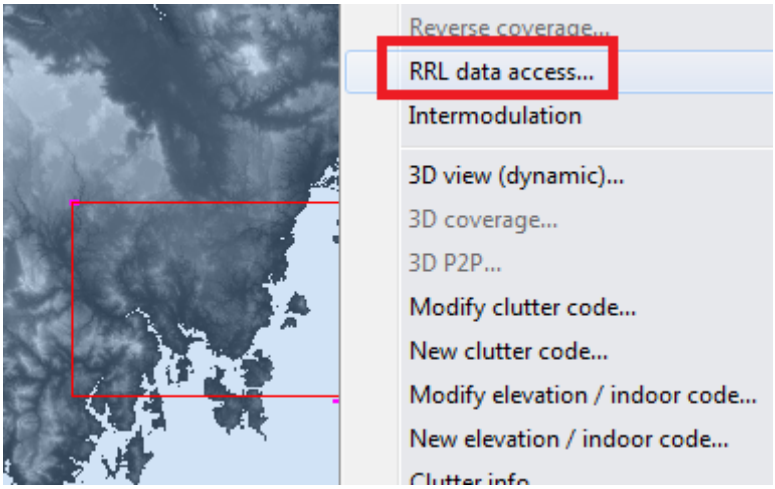


Figure 9 Accessing RRL plugin

- The location of RRL plugin and the network file where, the extracted station is required to be saved must be defined (This step is required only once):

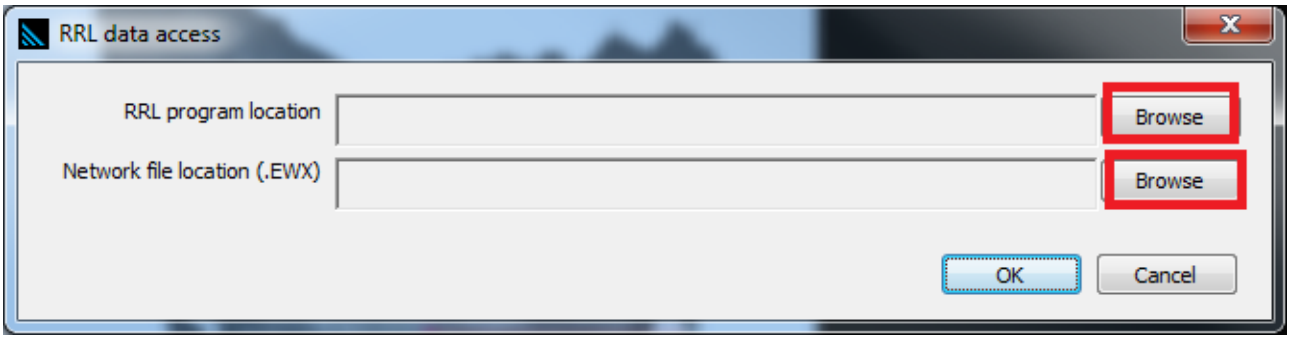


Figure 10 Configure RRL plugin

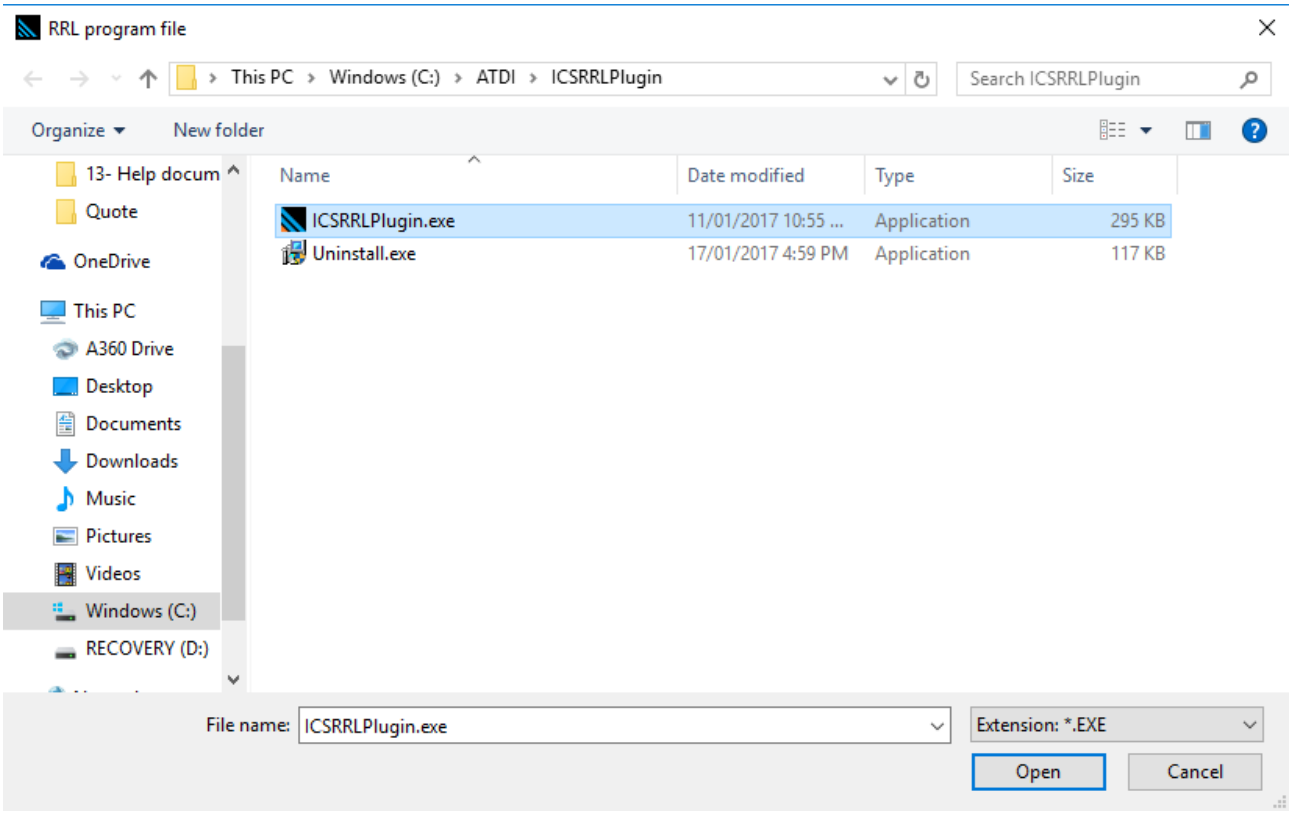


Figure 11: Linking ATDI with the plugin executable file for the first time

Note: Please select a **simple name** for the EWX file. No spaces are allowed. Then click “Save”

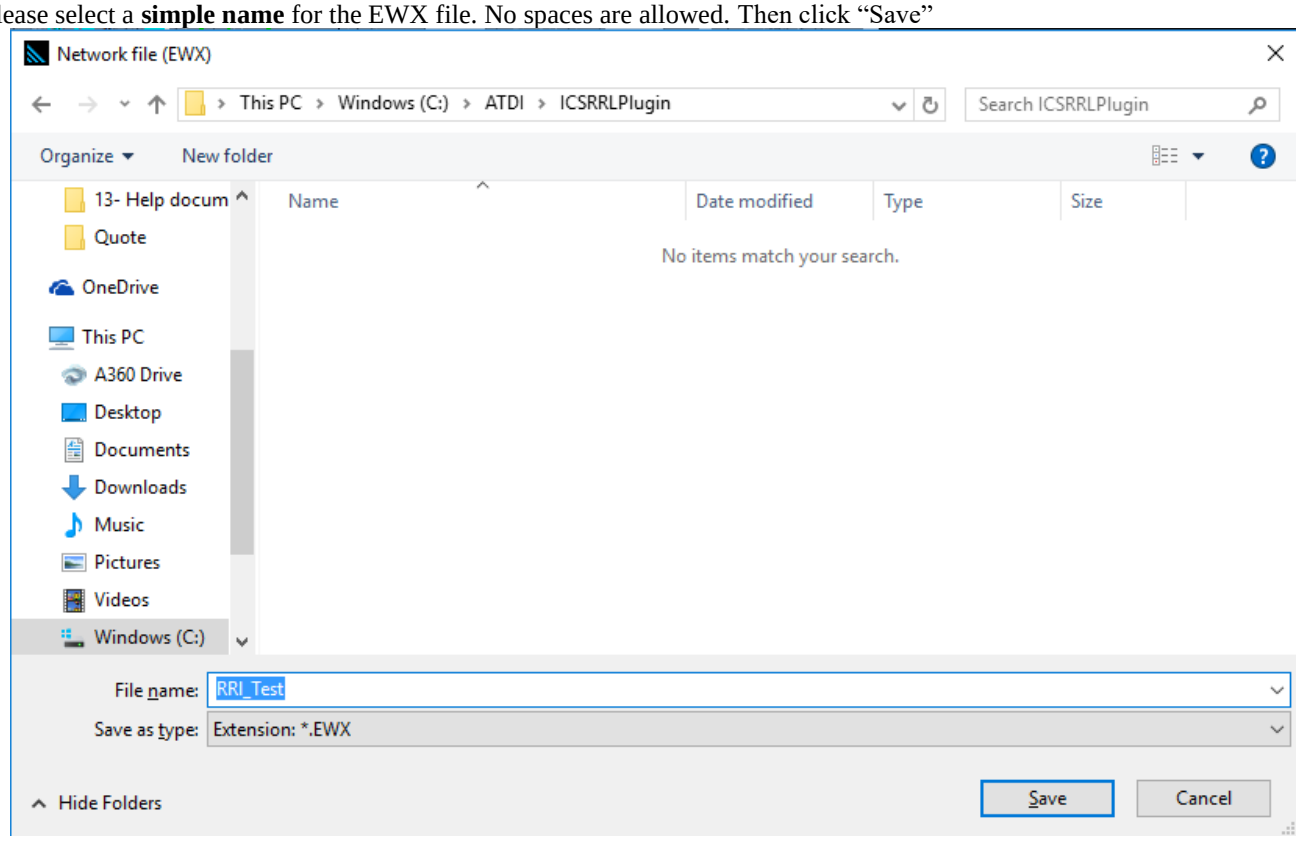
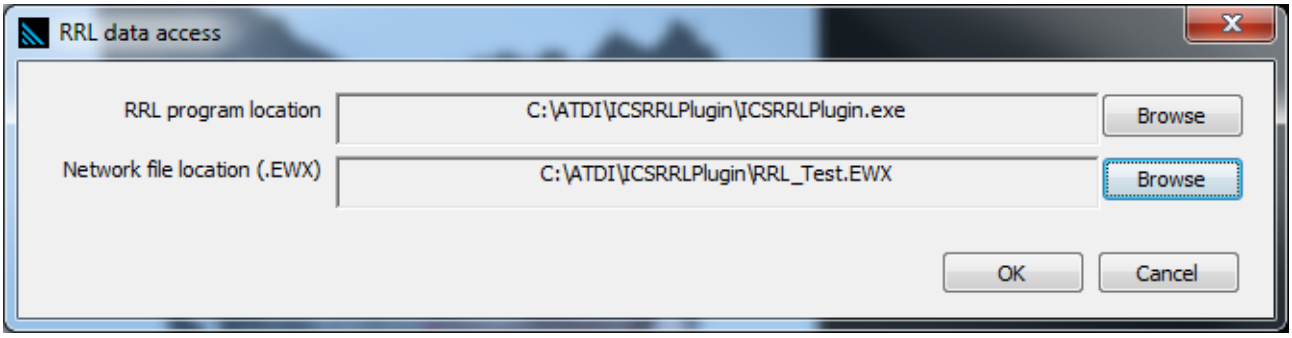


Figure 12: Creating EWX file link for network parameters exchange (Write-permission required)

- An example of such configuration could be:



- Above the network file location can be selected anywhere with write-permission. Doesn't have to be in the installation directory
- It is preferable to have a short path for the installation – some issues has been registered on some operating systems

Figure 13 RRL plugin configuration example

- RRL plugin window will now open: Make sure the status is "online" otherwise contact support

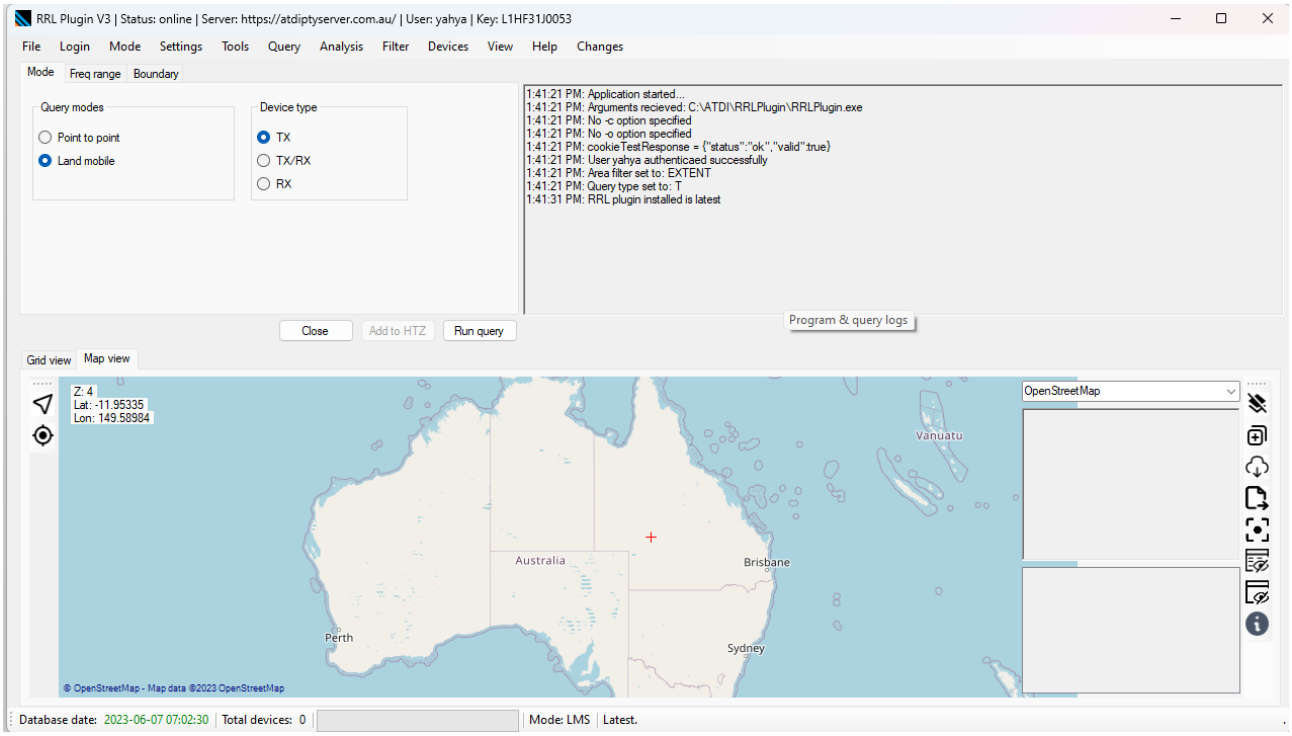


Figure 14 RRL server status check and user account

- Check the server status: it should be online. User: Account used to login in the RRL plugin
- Check the database date: Should be today's date
- Check the plugin status: Should be "Latest"

- Go to -> Login -> Use Existing account

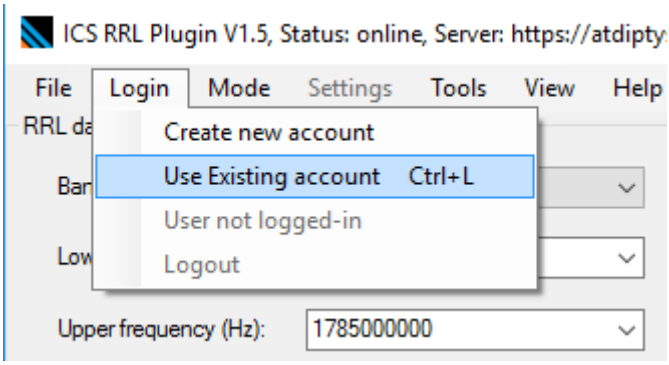


Figure 15 RRL user accounts

- Input the credential provided by ATDI (Contact ykhaled@atdi.com if you require demo license)
- Check the "Remember my credentials" check box so the plugin can save your encrypted password locally

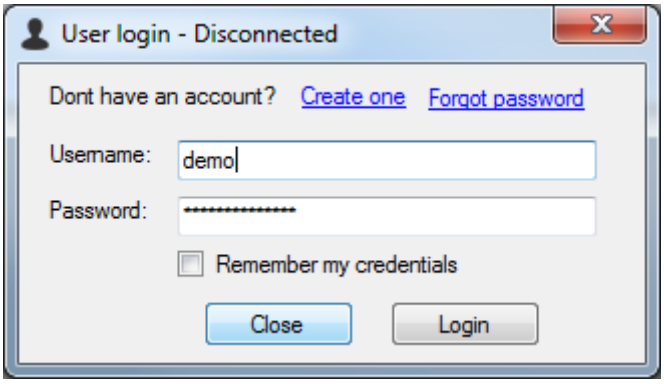


Figure 16 RRL login

- If login is successful - authenticated status will be shown.

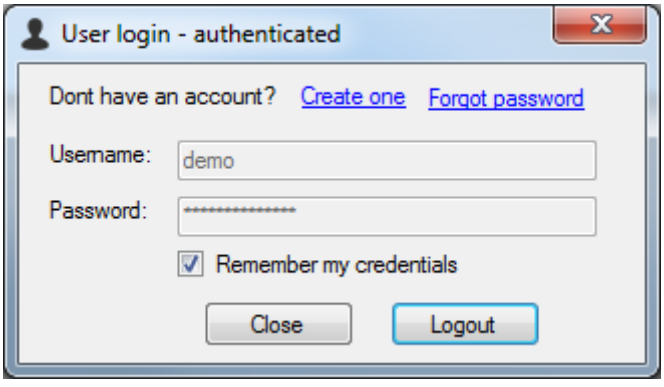
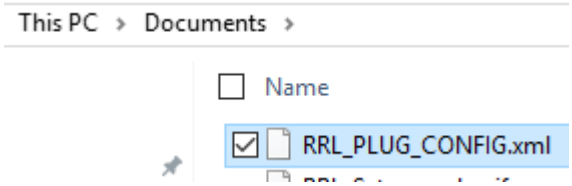


Figure 17

Encrypted version of the credentials is saved at the local user "Documents" folder with .XML extension



- The User status will change to the user account name.

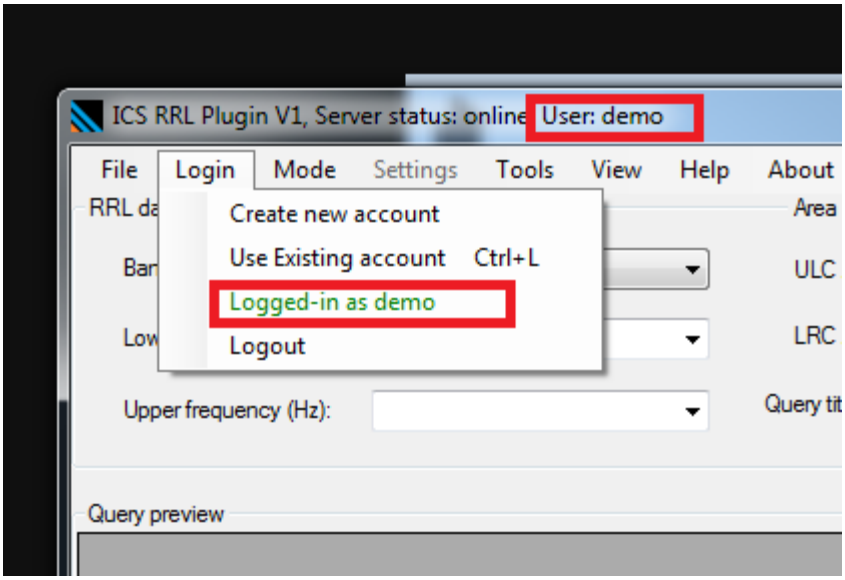


Figure 18 RRL current user status

7. Checking database status

This step is not compulsory but its highly recommended to check the integrity of the database before you use it. To check database station follow steps below:

- Go to View -> RRL daily import summary

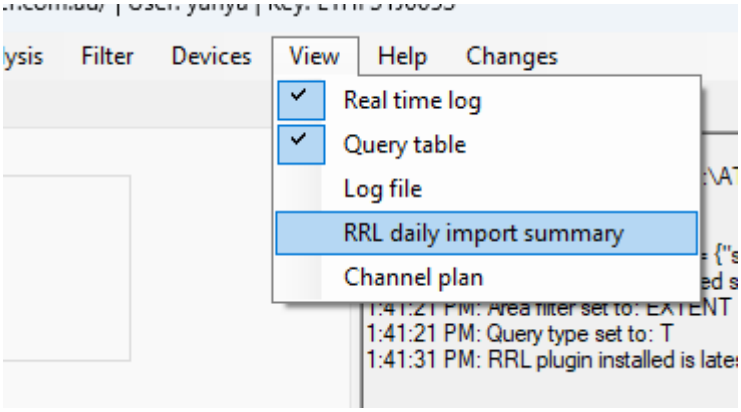
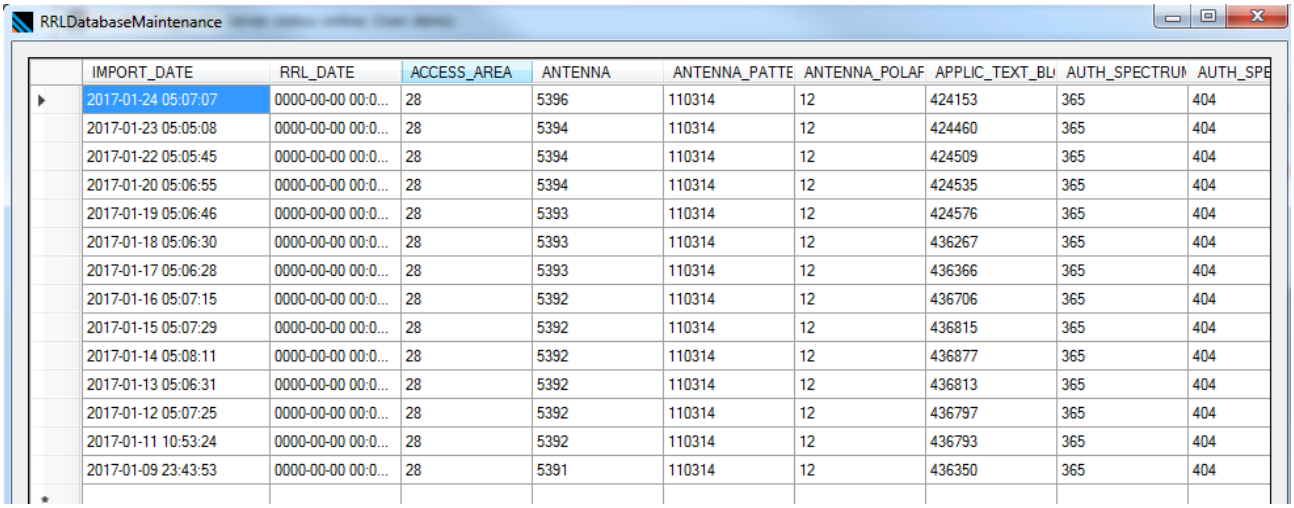


Figure 19 RRL database maintenance validation

- The update date of the database and the updates in various fields is reported:



IMPORT_DATE	RRL_DATE	ACCESS_AREA	ANTENNA	ANTENNA_PATTE	ANTENNA_POLAF	APPLIC_TEXT_BL	AUTH_SPECTRUM	AUTH_SPE
2017-01-24 05:07:07	0000-00-00 00:0...	28	5396	110314	12	424153	365	404
2017-01-23 05:05:08	0000-00-00 00:0...	28	5394	110314	12	424460	365	404
2017-01-22 05:05:45	0000-00-00 00:0...	28	5394	110314	12	424509	365	404
2017-01-20 05:06:55	0000-00-00 00:0...	28	5394	110314	12	424535	365	404
2017-01-19 05:06:46	0000-00-00 00:0...	28	5393	110314	12	424576	365	404
2017-01-18 05:06:30	0000-00-00 00:0...	28	5393	110314	12	436267	365	404
2017-01-17 05:06:28	0000-00-00 00:0...	28	5393	110314	12	436366	365	404
2017-01-16 05:07:15	0000-00-00 00:0...	28	5392	110314	12	436706	365	404
2017-01-15 05:07:29	0000-00-00 00:0...	28	5392	110314	12	436815	365	404
2017-01-14 05:08:11	0000-00-00 00:0...	28	5392	110314	12	436877	365	404
2017-01-13 05:06:31	0000-00-00 00:0...	28	5392	110314	12	436813	365	404
2017-01-12 05:07:25	0000-00-00 00:0...	28	5392	110314	12	436797	365	404
2017-01-11 10:53:24	0000-00-00 00:0...	28	5392	110314	12	436793	365	404
2017-01-09 23:43:53	0000-00-00 00:0...	28	5391	110314	12	436350	365	404

Figure 20 RRL Database update record

Note: The importation date need to be observed and make sure that there is an importation on that day in the morning. The RRL plugin database is updated every morning at 5 am, Sydney Local time. The table above shows number of records imported/available in every table of ACMA's RRL database. Increment number of records indicate daily additions//submissions of licensing/equipment.

8. Extracting Microwave network from RRL database

To extract microwave links using RRL plugin follow the steps provided below:

- In mode select *Point to point*

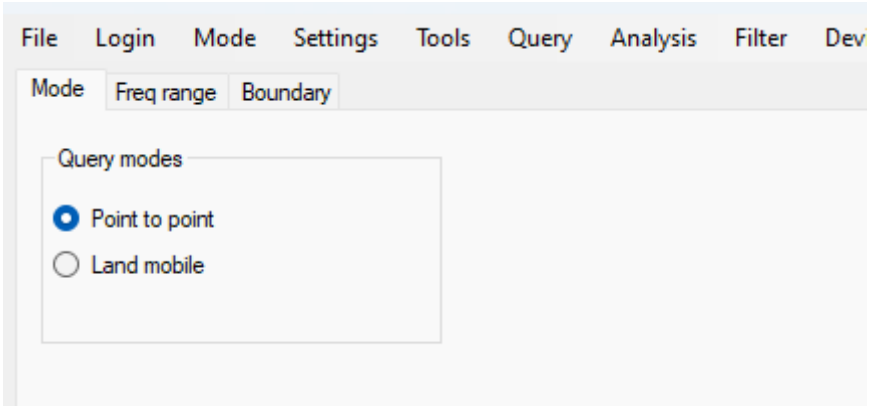


Figure 21 P2P mode like Microwave links

- Frequency band can be selected to limit the option for lower frequency and upper frequency

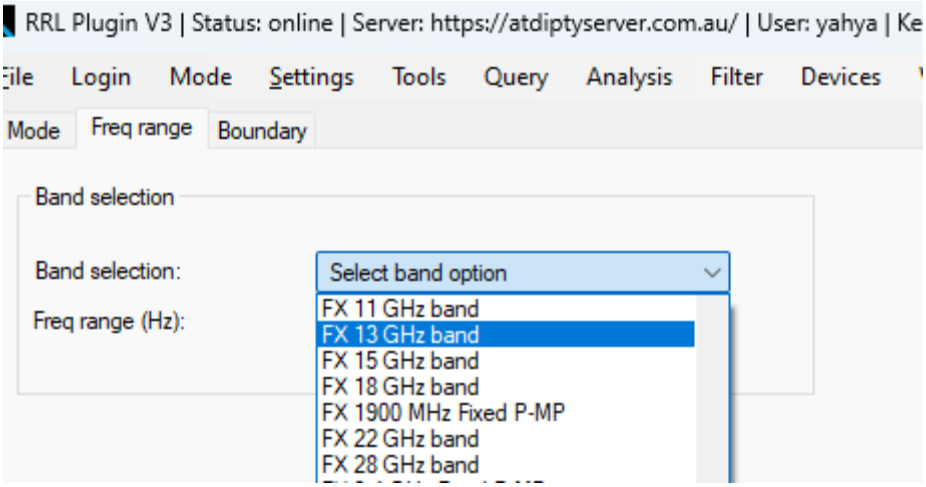


Figure 22 Frequency band selection

Note, the band drop-down list is only to assist the user load predefined centre-frequencies for the next two fields "Lower frequency" and "Upper frequency" and the default unit is Hz. Never the less, the user may skip band selection and specify the frequency range manually. If you wish to add specific band please contact the support – these bands can be added dynamically and at any time.

- Select the lower and upper frequency from the dropdown menu or manually enter the values.

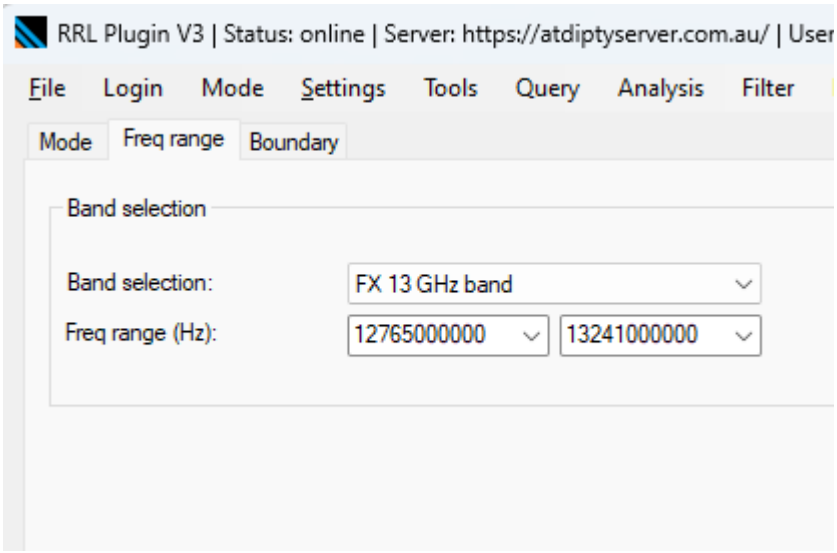


Figure 23 Lower and upper frequency limit configuration

- The RRL plugin search for sites inclusive of the lower and upper frequency bounds.
- Changing frequency unit (Hz, kHz, MHz and GHz)

Select the numeric input fields either “Lower frequency (Hz)” or “Upper frequency (Hz)” and push on the keyboard either h, k, m or g for Hz, kHz, MHz and GHz respectively

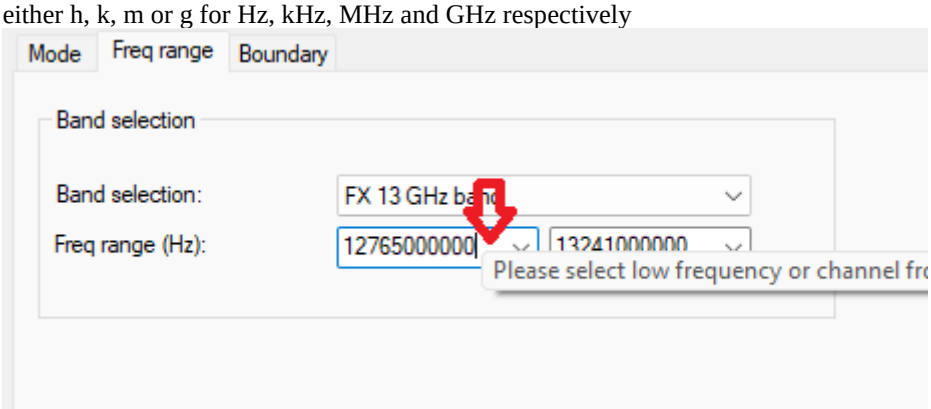


Figure 24 The frequency query range is Hz by default

Figure 25: Key board shortcuts for setting the frequency range unit to Hz, kHz, MHz & GHz

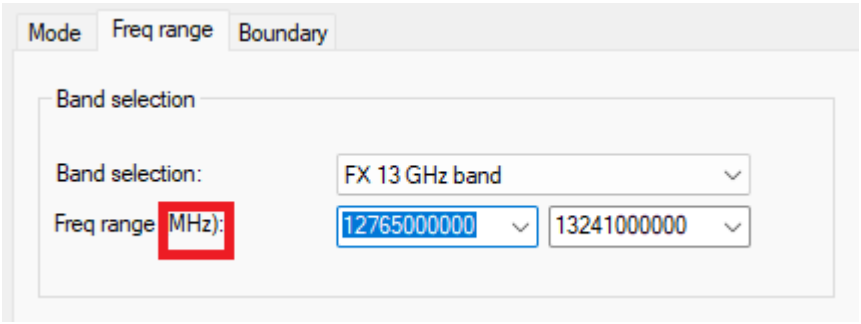


Figure 26 The frequency query range is set to MHz

Since RRL plugin was executed through HTZ – the geographical boundary is restricted to "From HTZ" only. The ULC/LRC are extracted from HTZ directly.

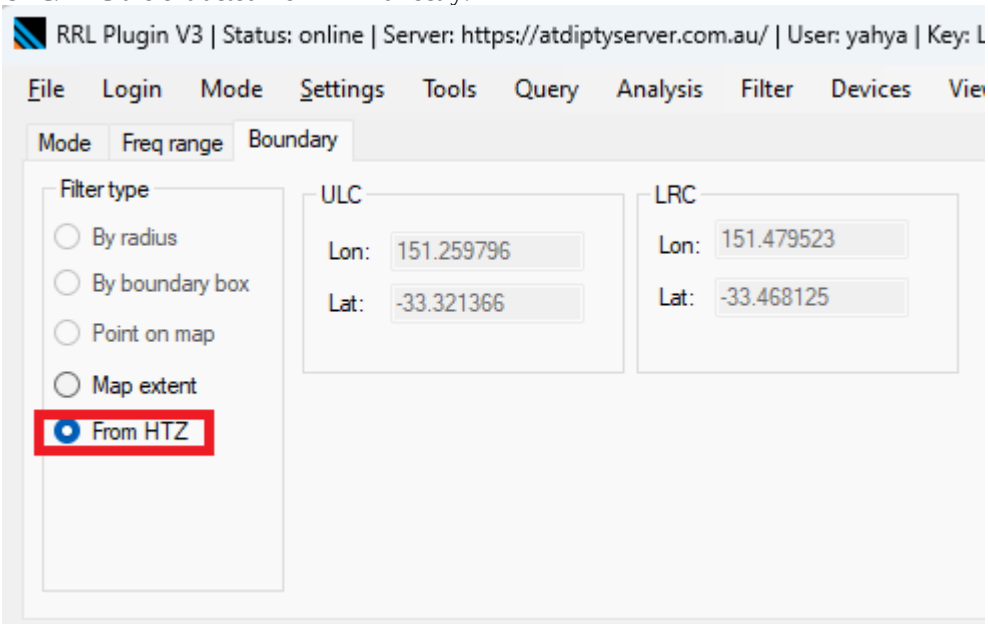


Figure 27 RRL query title

- Click on *Run Query*

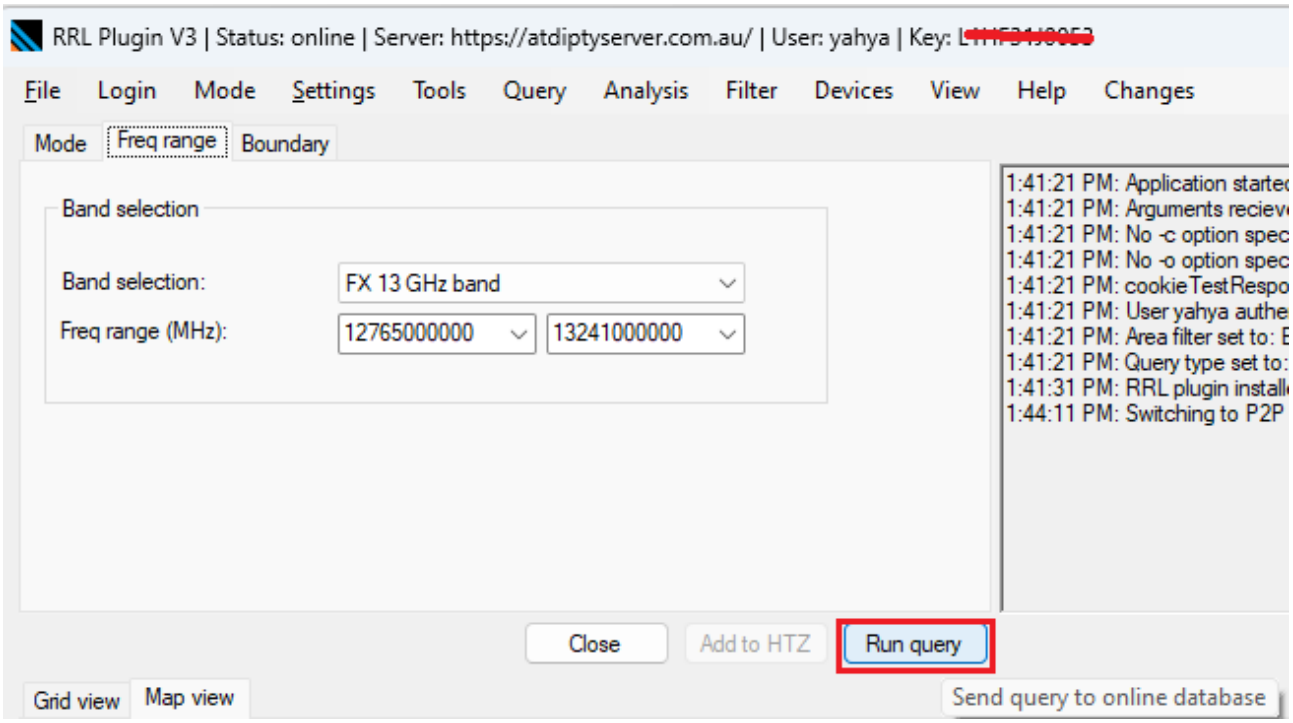
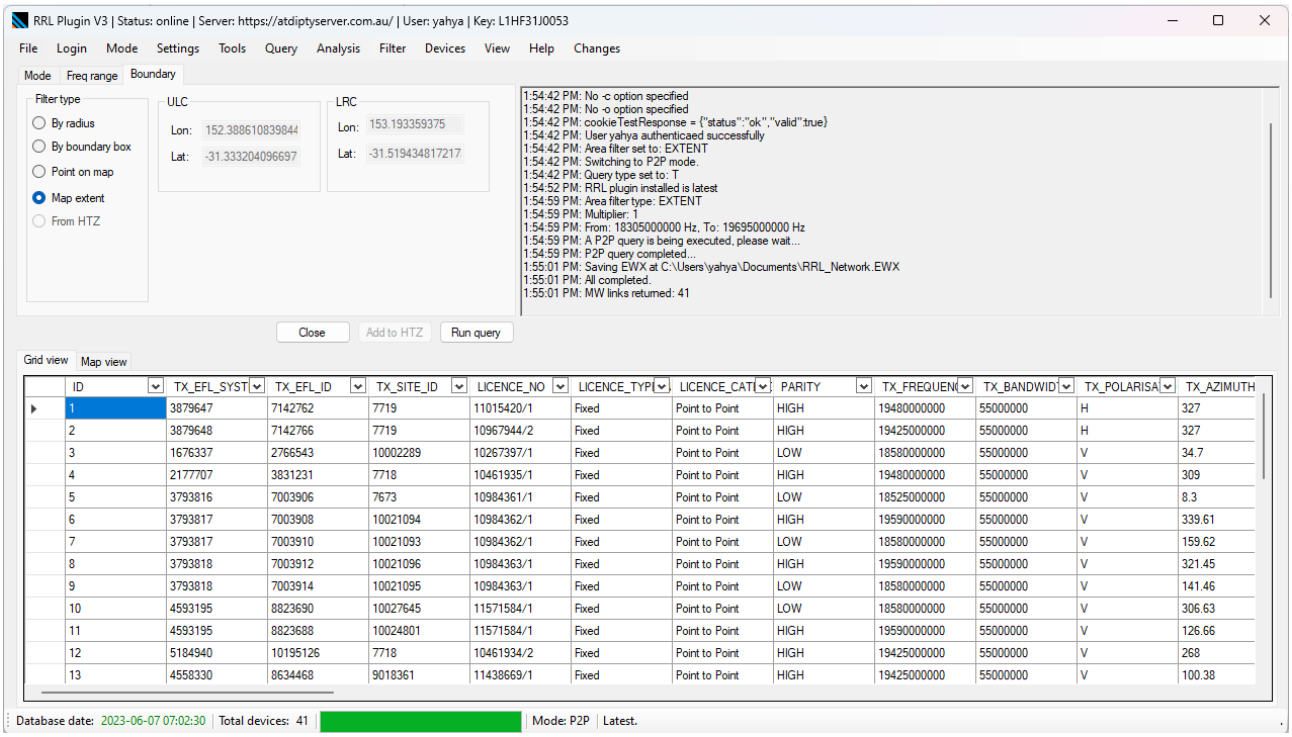


Figure 28 Running query

- List of links satisfying the search criteria will be listed



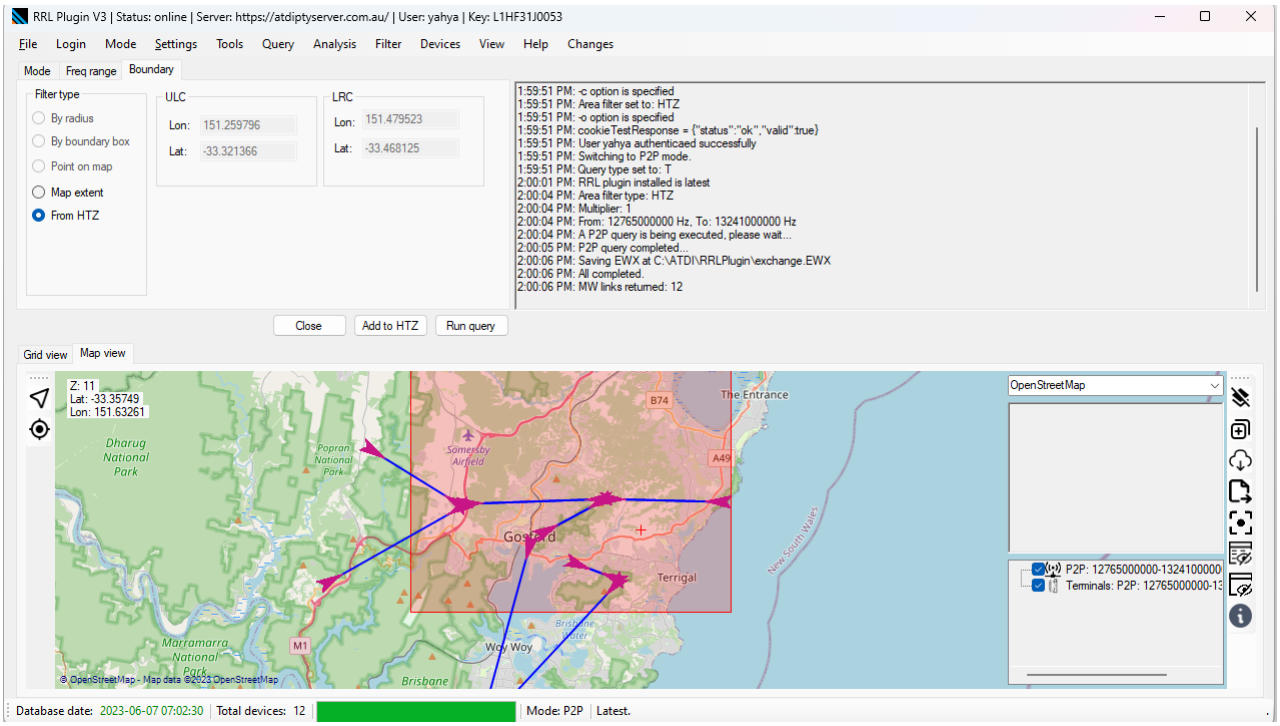


Figure 29 Query result

- Click on *Add to HTZ* to add the links to map and then *Done.*

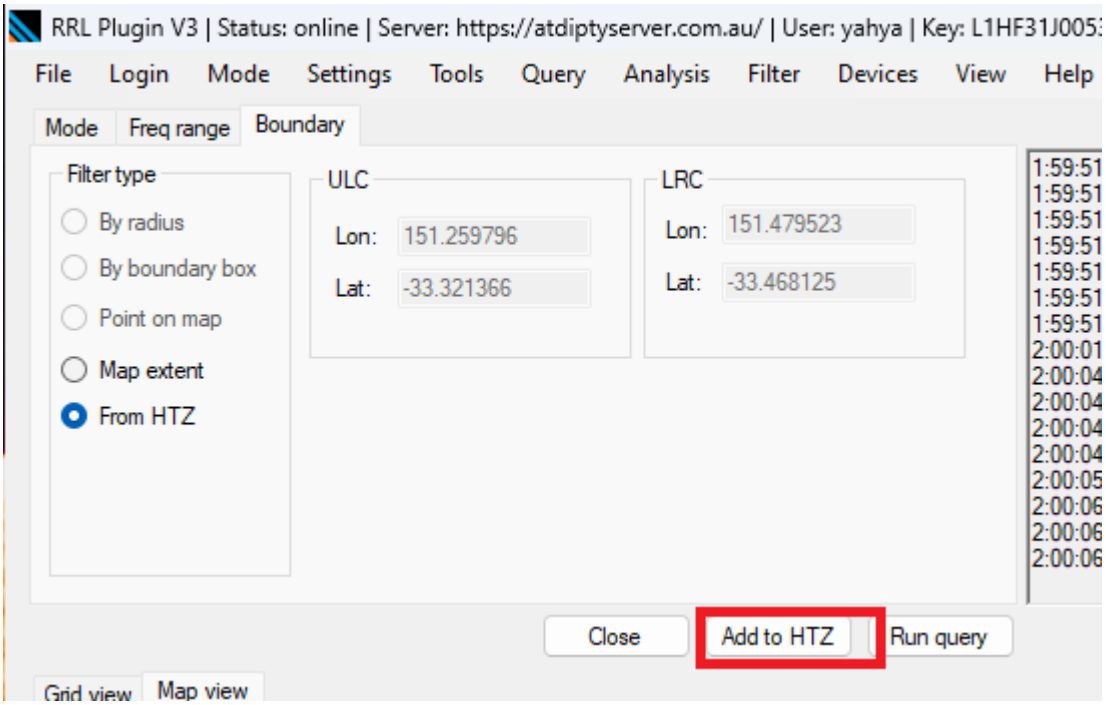


Figure 30 Adding station to map

- Optional: applying circular filter to query results
  This step is not compulsory, but some users might find it useful. The application run rectangular geographical query following the ULC and LRC corners. Since the query is not circular; some users may wish to apply a secondary circular filtering for coordination purposes. Where the circle is specified by a centre coordinates and a radius.

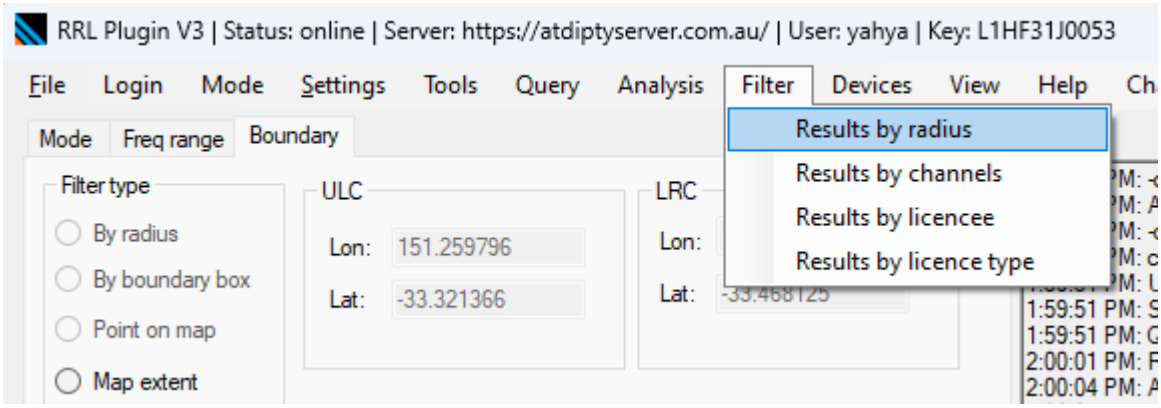


Figure 31: Filter results by radius

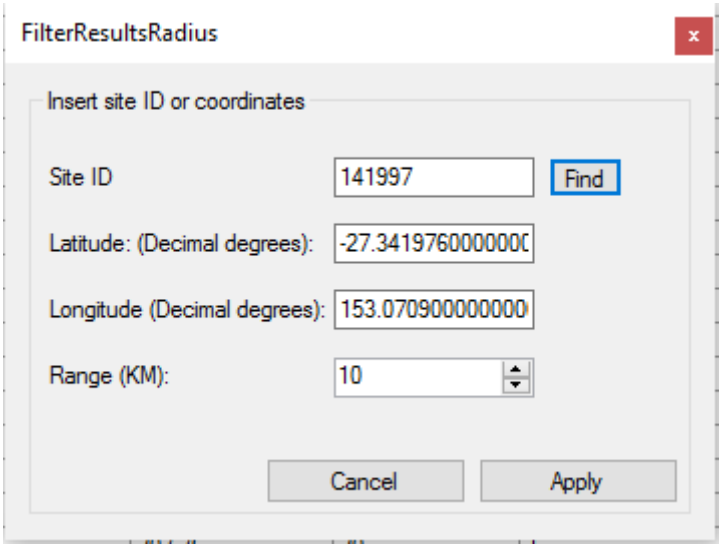


Figure 32: Defining circular limit filter to existing table

- The microwave sites will be added to the map.

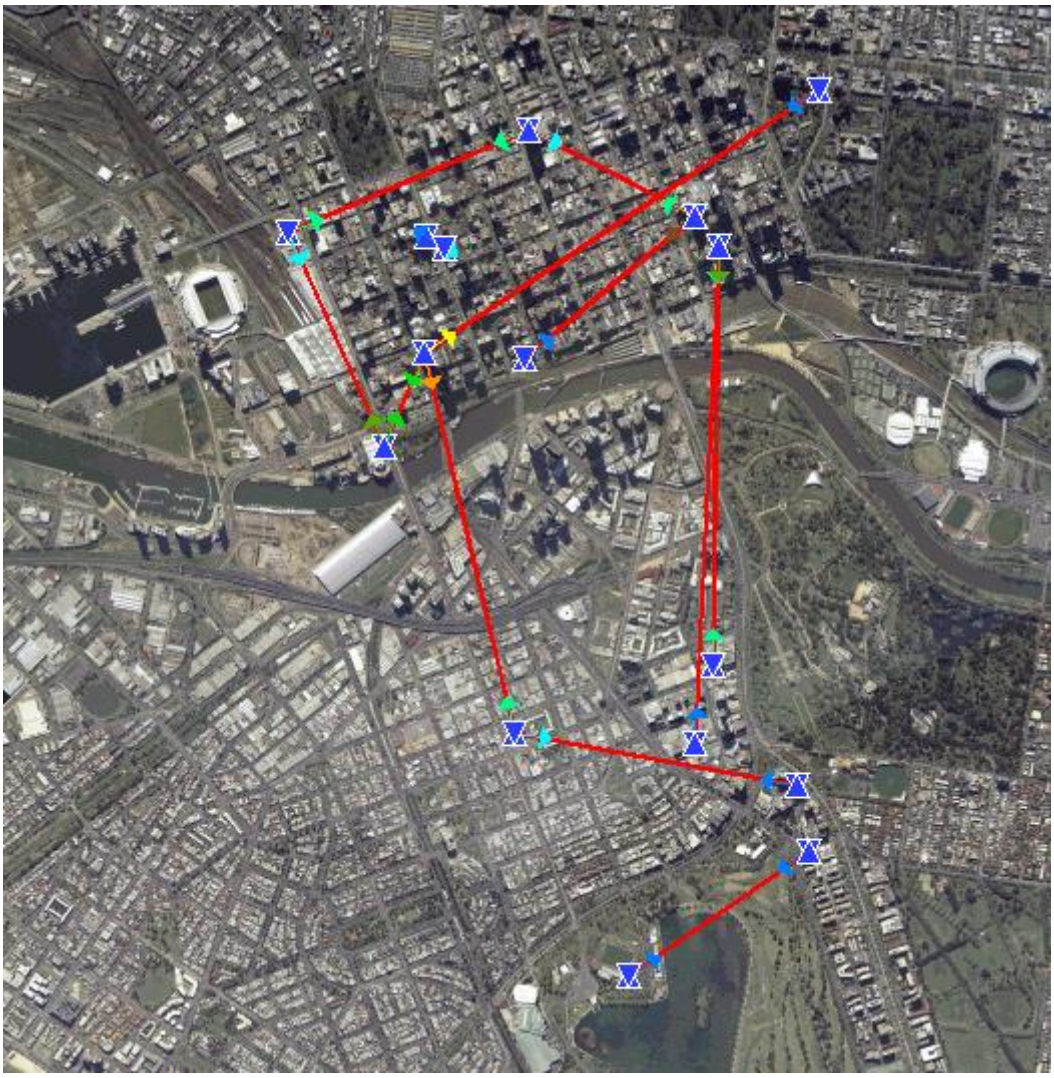


Figure 33 Imported microwave sites

It should be noted not all site details are available in ACMA database for all site so imported data for each site must be verified for correctness.

Highlighted parameters in the next two figures highlight imported fields (highlighted in red). The green fields are either assumed or calculated with the assistance of other parameters.

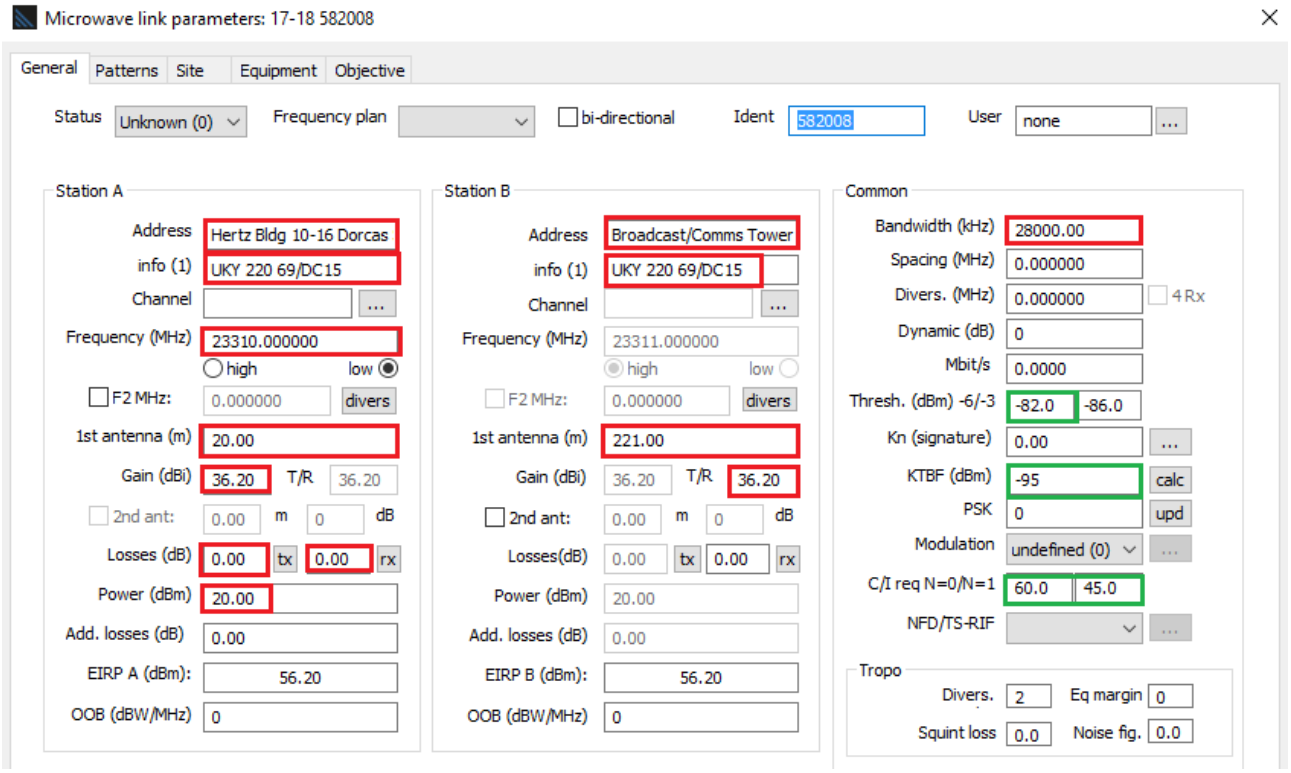


Figure 34 Imported general microwave parameters from RRL records

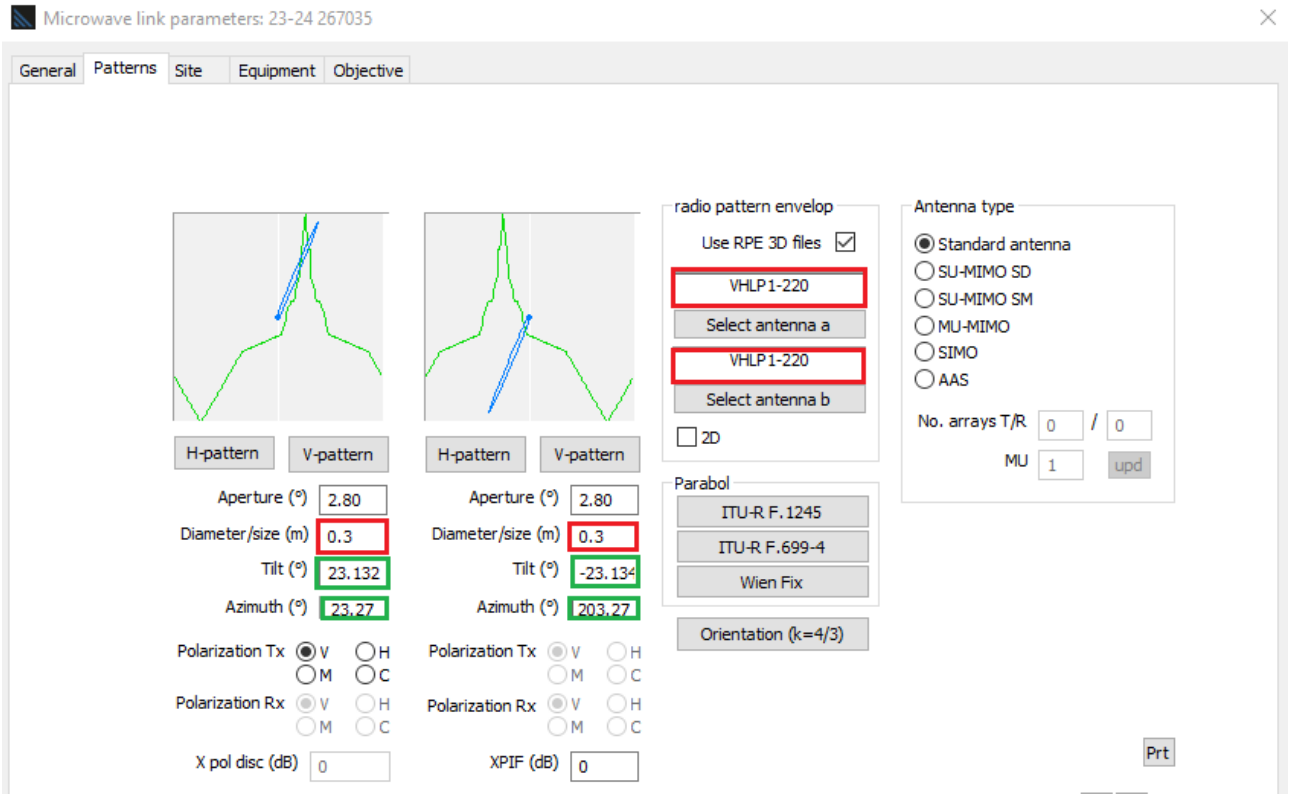


Figure 35 Imported antenna parameters from RRL records

RPE antenna model would automatically be selected if present I the database. Otherwise ITU-R F.699-4 would be used. ACMA's records for antenna orientation imported but not used. Links are autoamticaly re-oriented to suite ATDI's map and tool.

9. Extracting Land Mobile Radio and terrestrial services

To extract site information for LMR and other terrestrial services follow the steps below:

- Go to Mode-> Land mobile

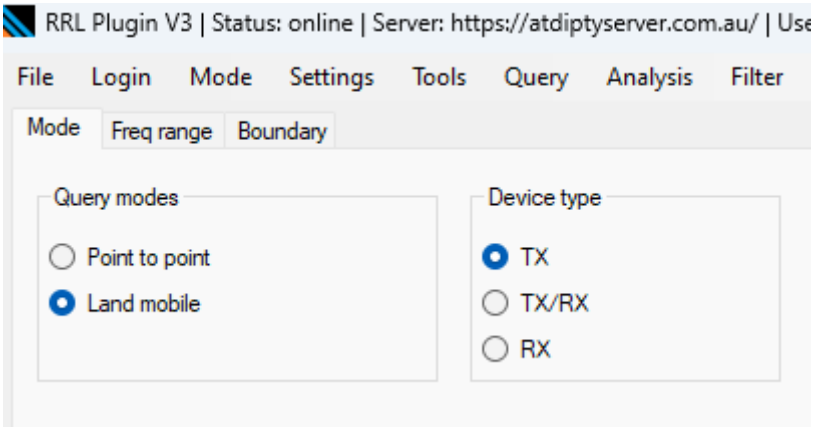


Figure 36 Land mobile mode

Device types

- TX: Only Transmission type devices are fetched from the database
- RX: Only Reception type devices are fetched from the database
- TX/RX both Transmission and reception type devices are fetched from the database

- You can select band and define lower and upper frequency limit.

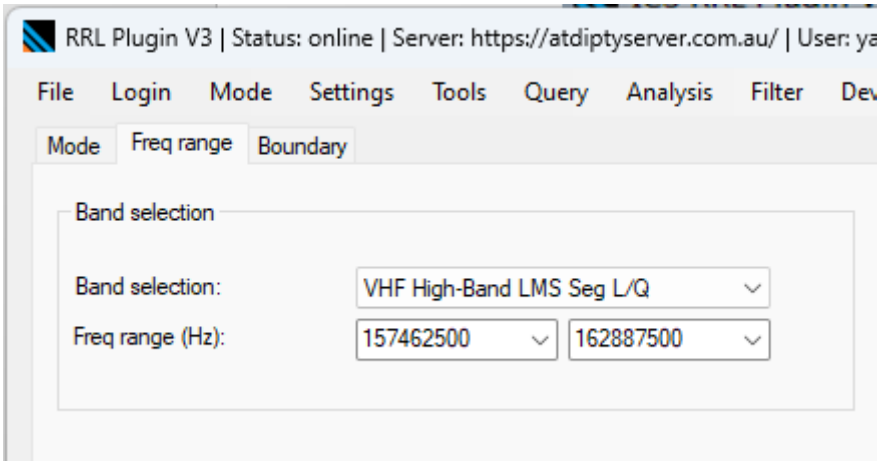


Figure 37 Frequency limits configuration

Note, the band drop-down list is only to assist the user load predefined centre-frequencies for the next two fields "Lower frequency" and "Upper frequency" and the default unit is Hz. Never the less, the user may skip band selection and specify the frequency range manually. If you wish to add specific band please contact the support – these bands can be added dynamically and at any time.
Note: All devices whose centre frequencies are within the frequency range specified are queried. This query doesn't look for bandwidth overlap.

- Sites satisfying the criteria are listed:

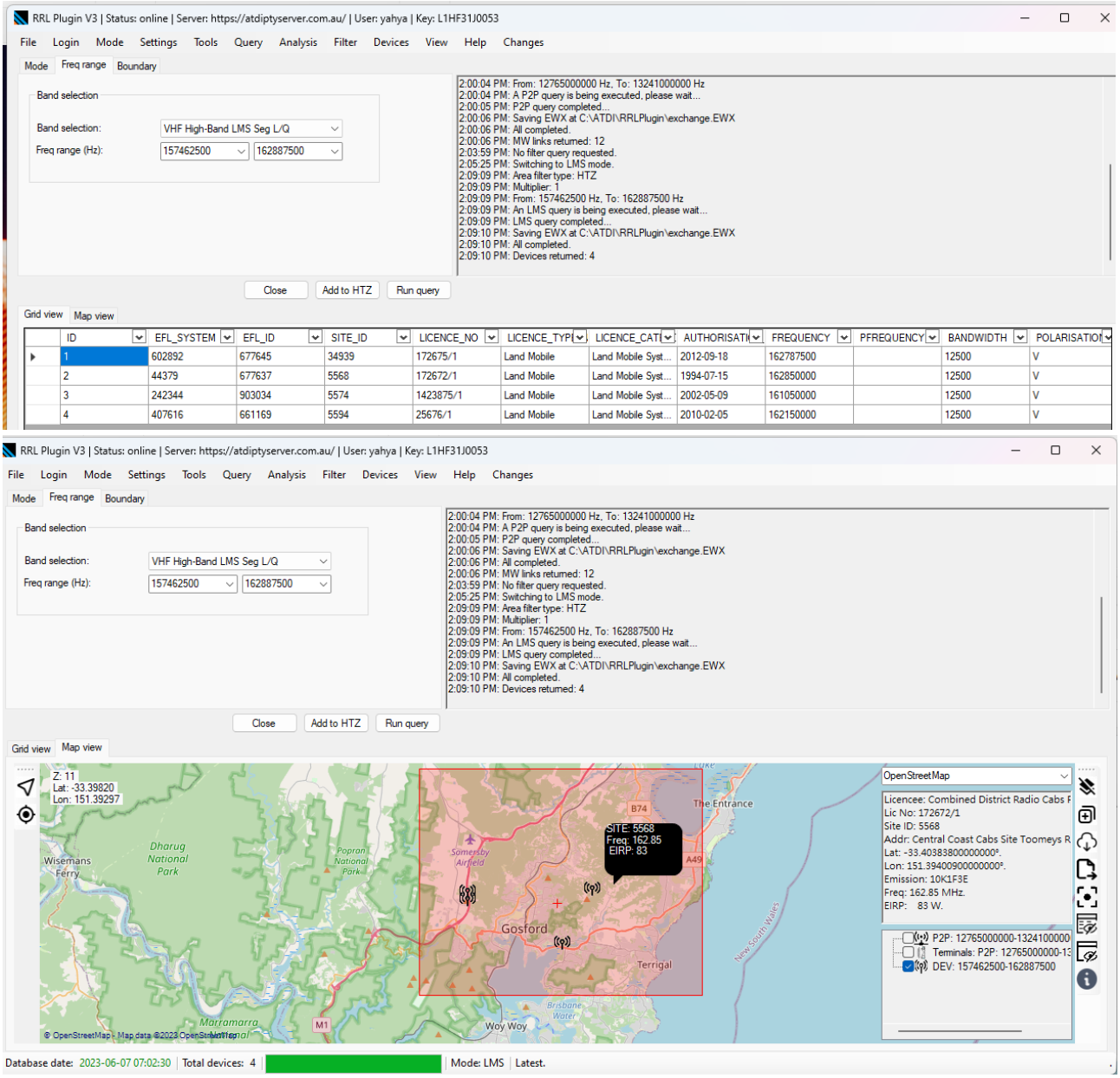


Figure 38 Query's result

- Optional: applying circular filter to query results
  This step is not compulsory but some users might find it useful. The application run rectangular geographical query following the ULC and LRC corners. Since the query is not circular; some users may wish to apply a secondary circular filtering for coordination purposes. Where the circle is specified by a centre coordinates and a radius.

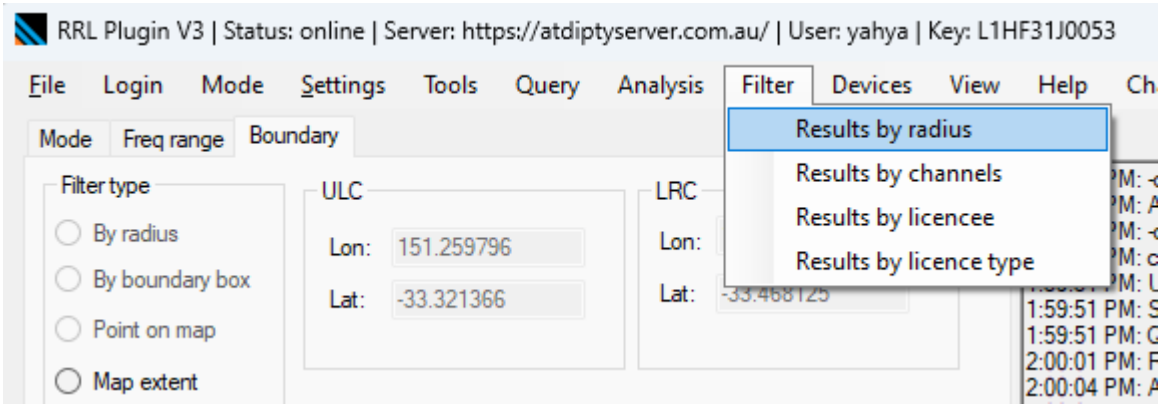


Figure 39: Filter results by radius

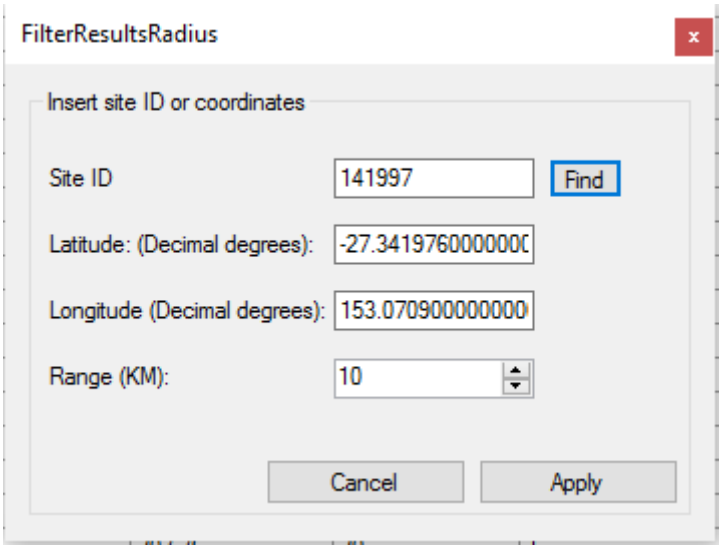


Figure 40: Defining circular limit filter to existing table

- Click on *Add to map* and *Done* to import the station on the map

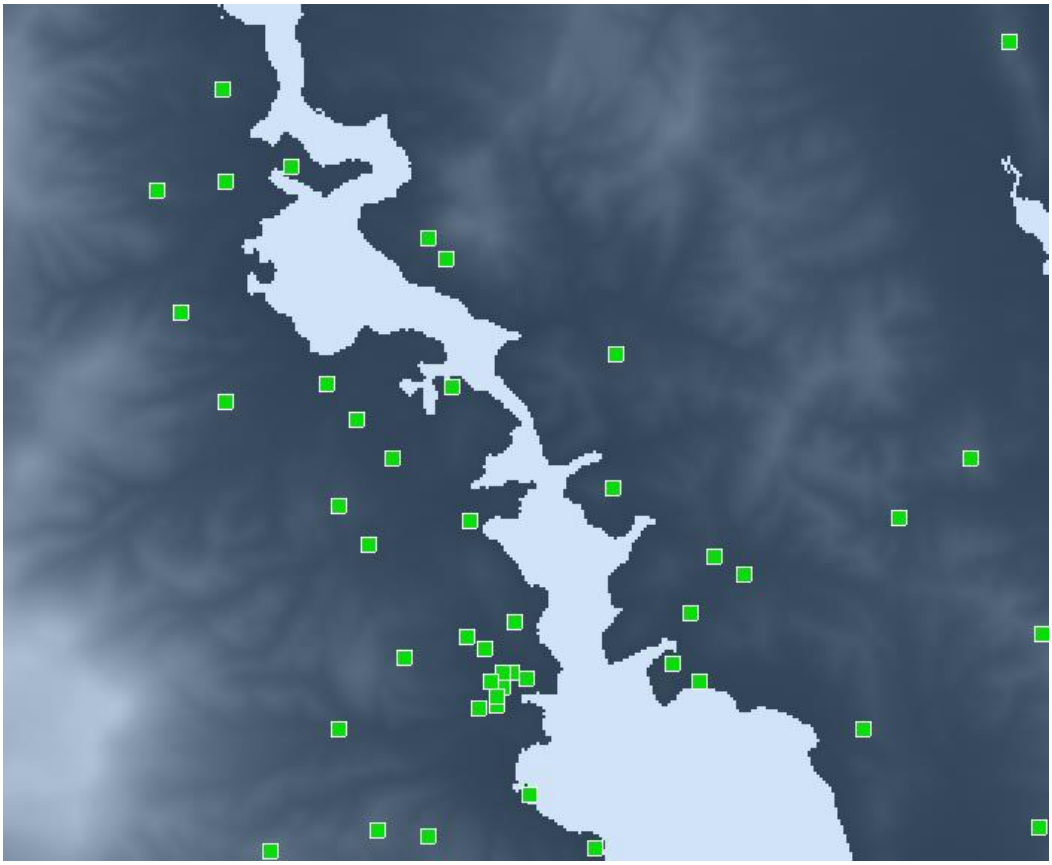
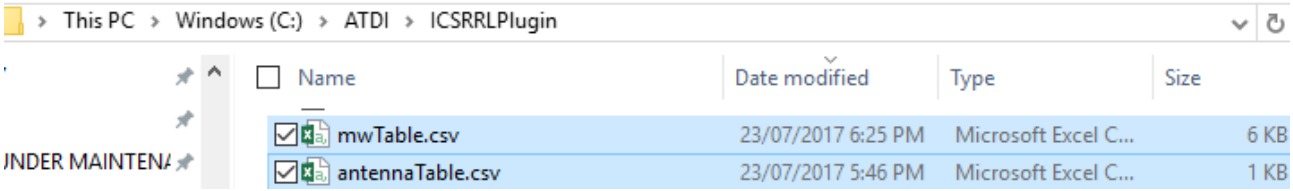


Figure 41 Result importation to map

It should be noted not all site details are available in ACMA database for all site so imported data for each site must be verified for correctness.

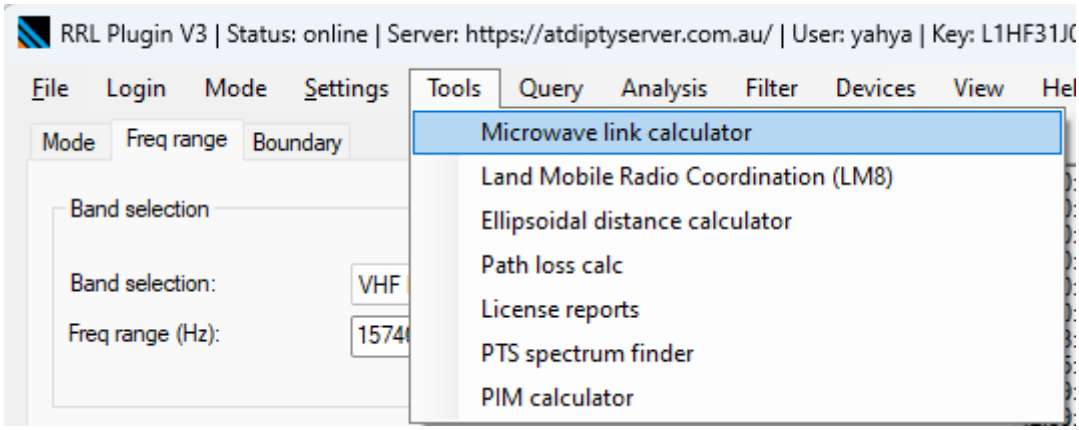
10. Quick microwave link calculator

This new menu recently added from version 1.4 and on. It is based on two CSV files:

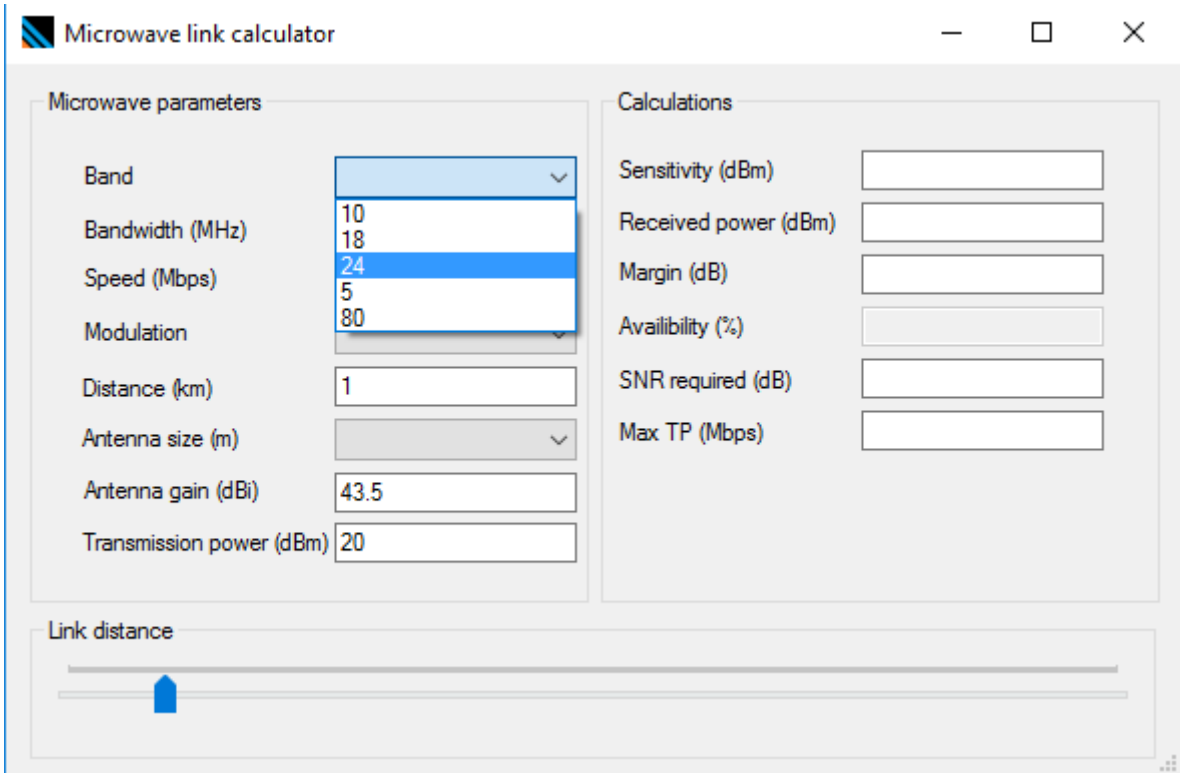


The user may contribute to these files to add new microwave equipment or antenna parameters.

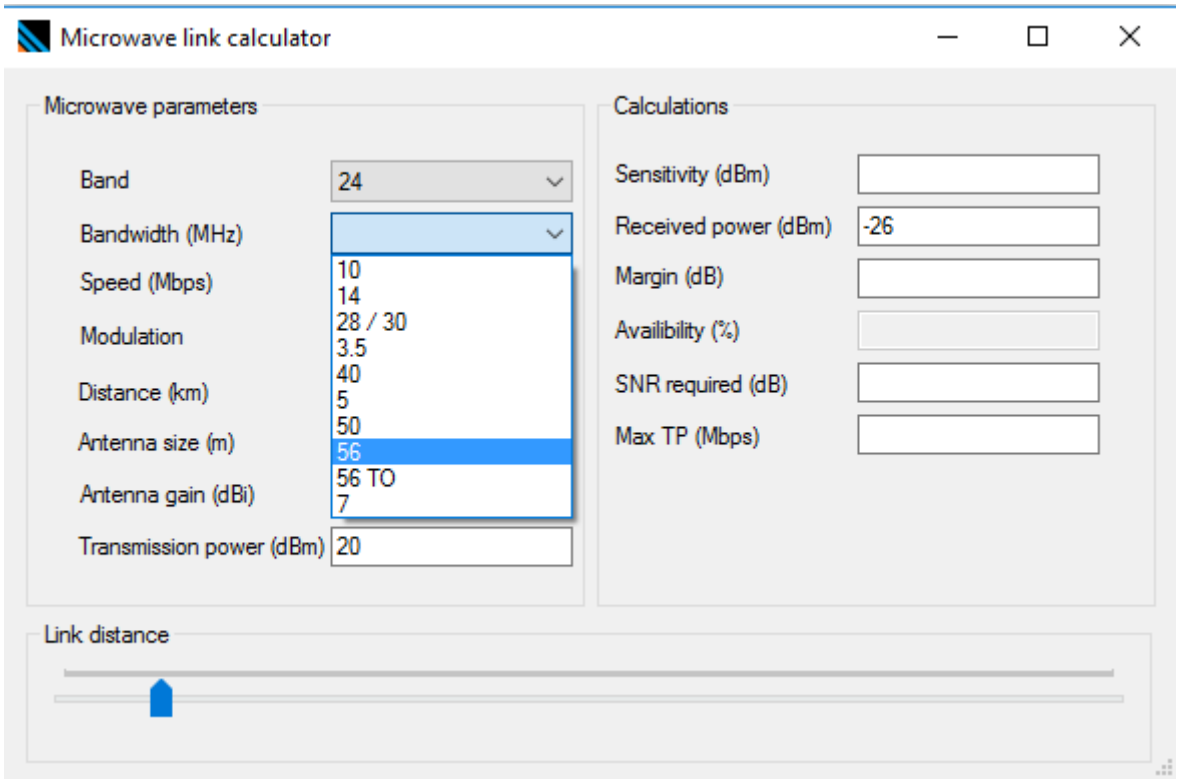
- To access the calculator



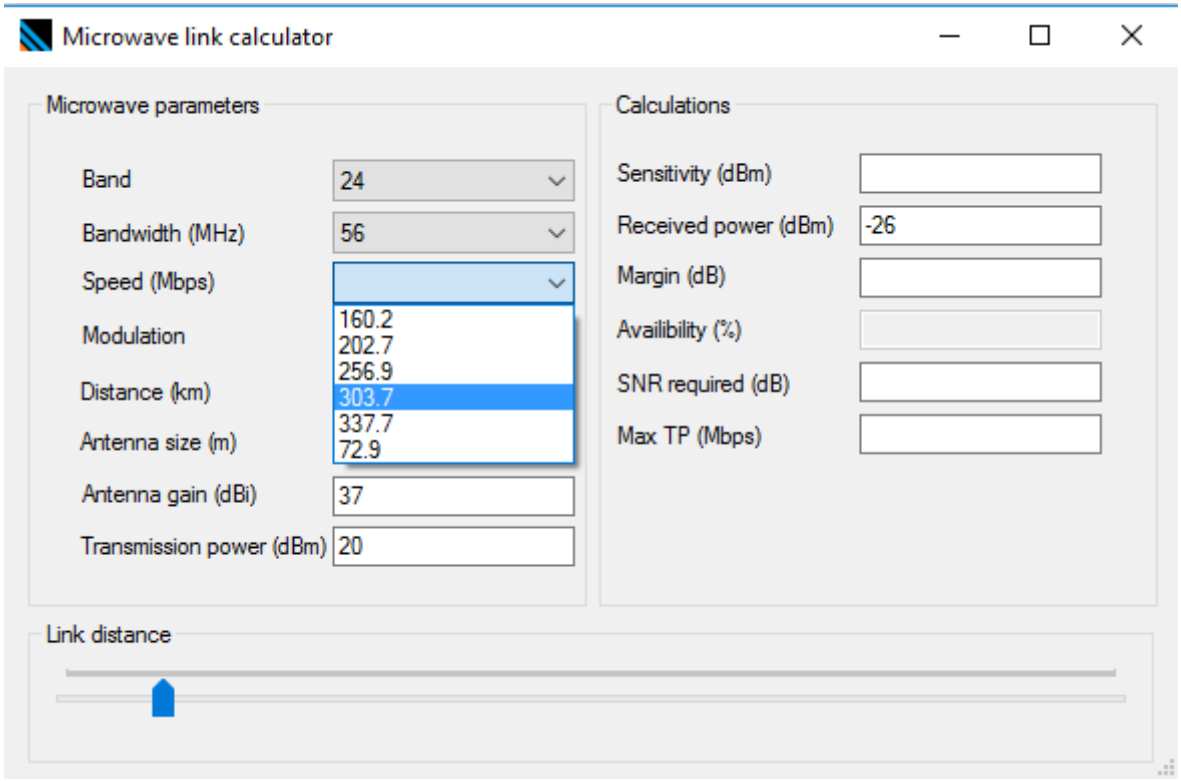
- Select the microwave band



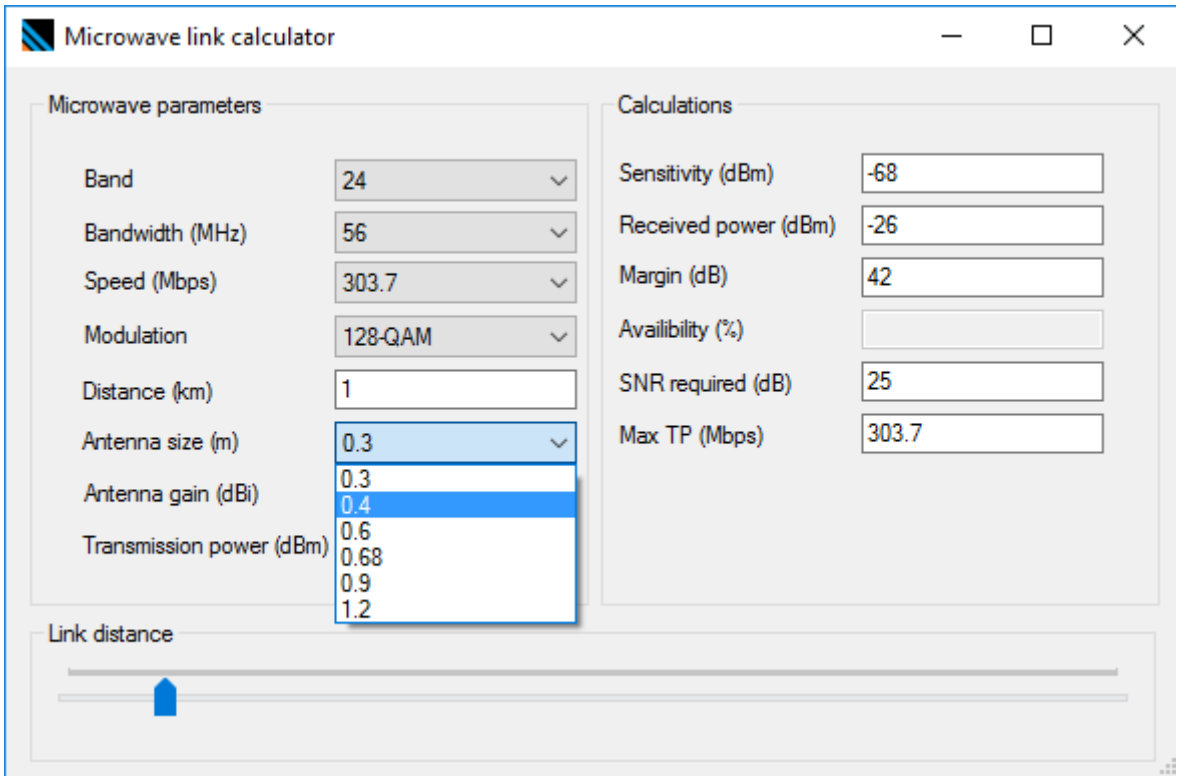
- Select the microwave bandwidth



- Select the microwave link speed

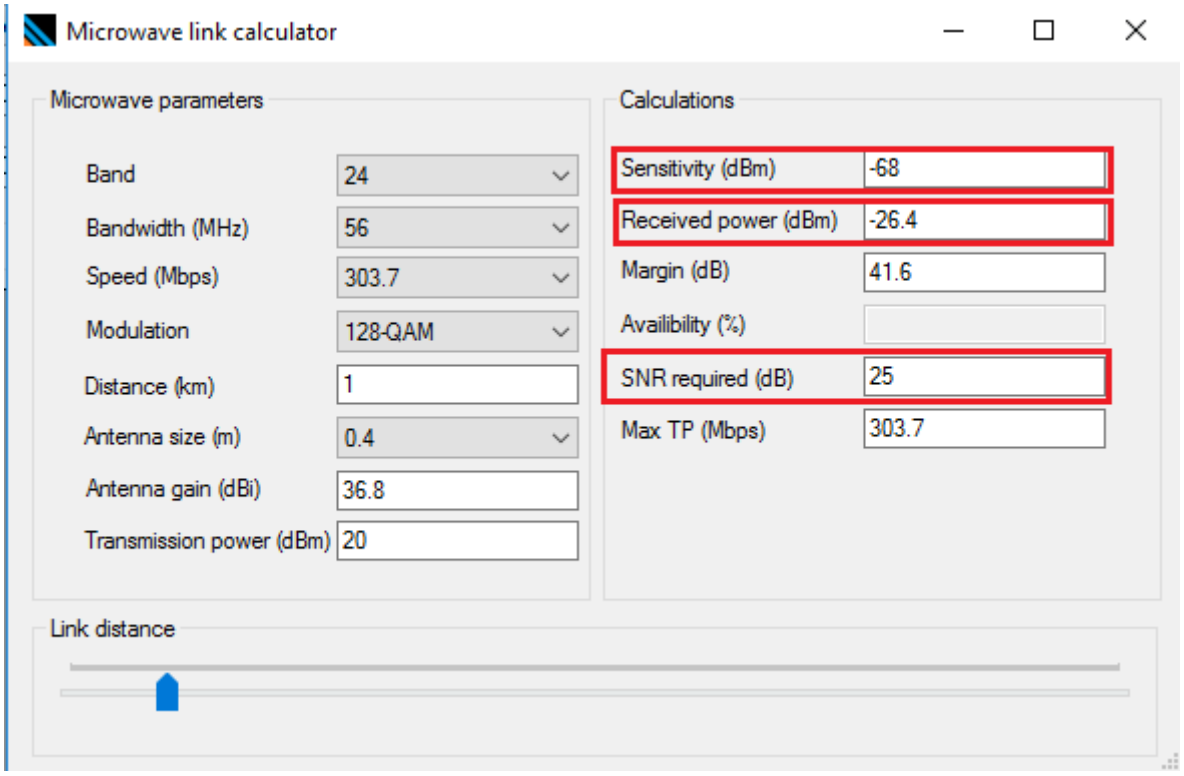


- Select the antenna size



- Calculations

The calculator would provide bandwidth options available from the selected band.
The speeds would be those available for the selected bandwidth
Modulation is according to the speed
Antenna sizes are those available bases on your band selection
Transmission power is user input
Sensitivity is relevant to the band, bandwidth & speed/modulation selected
Antenna gain is according to the antenna size selected
The Power received is assuming free space and counting the antenna gain
The calculator doesn't really calculate the sensitivity; it would look up the values accordingly to the two CSV files discussed earlier in this section


Microwave link calculator
Microwave parameters
Band
24
Bandwidth (MHz)
56
Speed (Mbps)
303.7
Modulation
128-QAM
Distance (km)
1
Antenna size (m)
0.4
Antenna gain (dBi)
36.8
Transmission power (dBm)
20
Calculations
Sensitivity (dBm)
-68
Received power (dBm)
-26.4
Margin (dB)
41.6
Availibility (%)
SNR required (dB)
25
Max TP (Mbps)
303.7
Link distance

11. Summary of imported microwave parameters

The RRP plugin imports and translates ACMA's RRL records for microwave P2P as per table below:

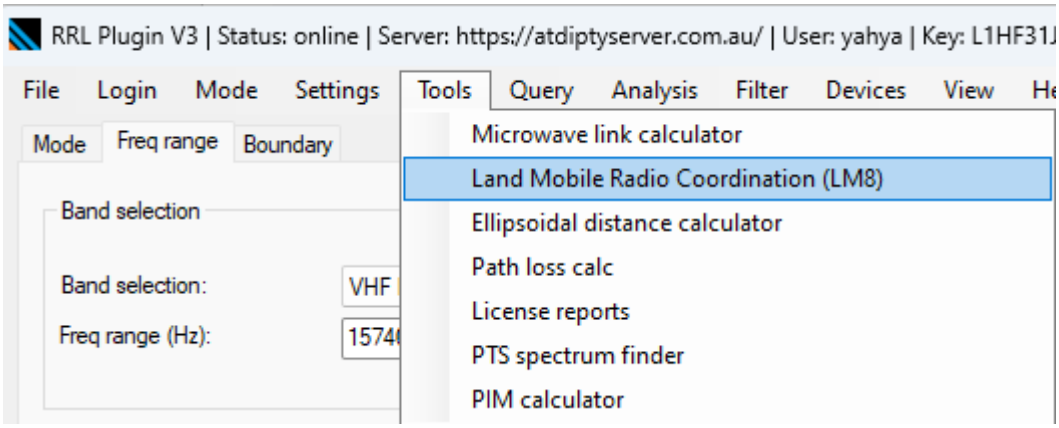
ATDI parameter	ACMA's parameter	Note
Ident	N/A	A dummy counter
power	TRANSMITTER_POWER	24dBm assumed if 0 is found
Frequency	Frequency	Hz to MHz
Rx_thr106	N/A	Sensitivity of -82dBm assumed
Polar	Polarization	
CIreq	N/A	65dB assumed
Azimuth	AZIMUTH	Positive from true North, re-oriented when loaded
Tilt	Tilt	Negative down-tilt, re-oriented when loaded
BW	BANDWIDTH	kHz
Tx_gainrx / Tx_gaintx	GAIN	dBi
Rx_gainrx / Rx_gaintx	GAIN	dBi
Tx_ant/ Rx_ant	HEIGHT	Meters AGL
Tx_gain/ Rx_gain	GAIN	dBi
Type_coord	N/A	162DEC assumed GDA94 Decimal degrees
Tx_adress/ Rx_adress	Site address	
X1/x2	Longitude	Decimal degrees 162DEC
Y1/y2	Latitude	Decimal degrees 162DEC
KTBF	BW	KTBF = -174 + 4 + 10 * Math.Log10(RX_BANDWIDTH)
Tx_ant_diameter/ Rx_ant_diameter	ANTENNA_SIZE	Meters
Tx_info1/ Rx_info1	LICENCE_NO	
Tx_info2/ Rx_info2	ANTENNA_MODEL	RPE's antenna model (information only)
CodeSiteA/ CodeSiteB	SITE_ID	ACMA's site ID
antenna1/ antenna2	ANTENNA_MODEL	RPE's antenna model (automatically looked-up in the NSMA database)
	EFL_SYSTEM	
CI_N0/ CI_N1	N/A	60 and 45 dB assumed. ATDI tool has its own ACMA's C/I table as well
TYPE_COORD	Coordinate system	GDA94=162DEC
NetidA/NetidB	TX_EFL_SYSTEM/ RX_EFL_SYSTEM	

Note: The tool would automatically lookup for exact match of the RPE's model number and attach it to the microwave equipment using ATDI's RPE database. ITU-R F.699-4 is assumed if no match is found in the database. When importation is complete – an error log is produce to list down those antennas with no matching RPE model number.

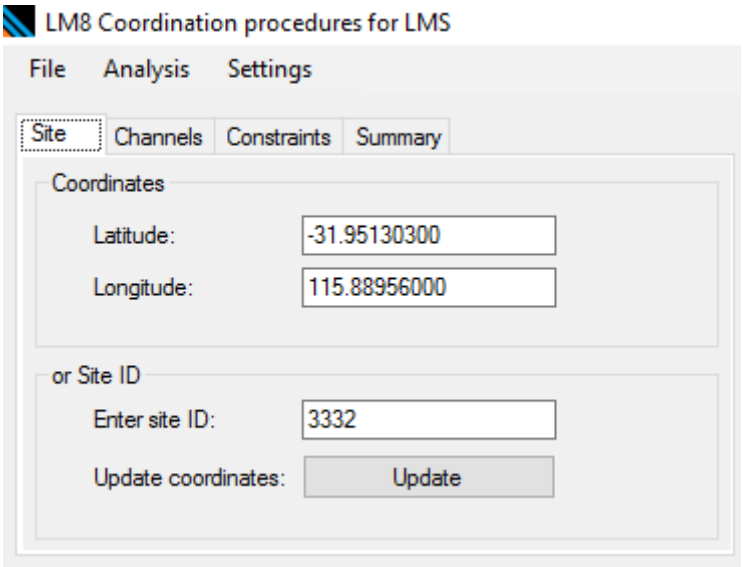
12. 400 MHz station cull according to distance and frequency range

The purpose of this function is not to automatically assign a frequency. Frequency assignment can be achieved using ICS Telecom Ev. This function helps AP to execute distance and frequency cull in batch mode. The tool also helps analyse frequency re-use and nearest station within cull limits and co-channel separation.
The culling is based on the "proposed" location and not the proposed frequency. There will be culling for every channel in the band selected identified by the lower and upper frequency limit.

- Access the function from Tools>>Land Mobile radio Coordination (LM8)

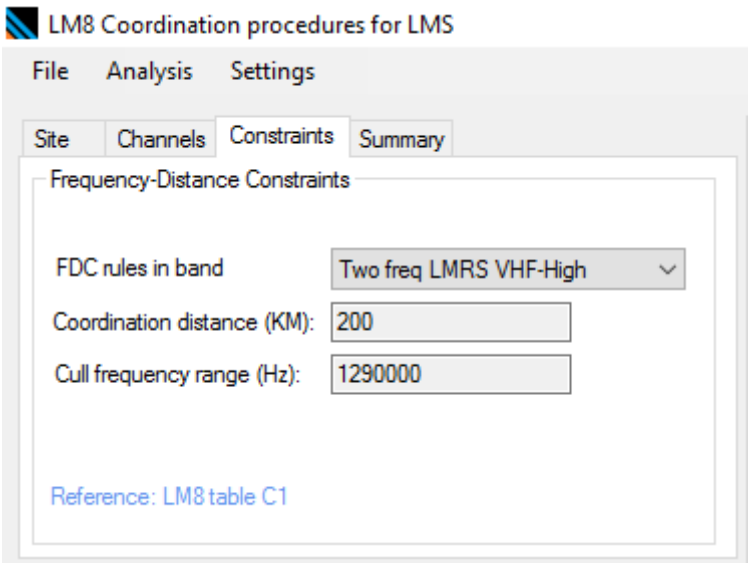


- Step number one is to enter coordinates of the new site being investigated. Alternatively, the user may specify the site ID if it's an existing site. The coordinates can be updated by clicking "Update"

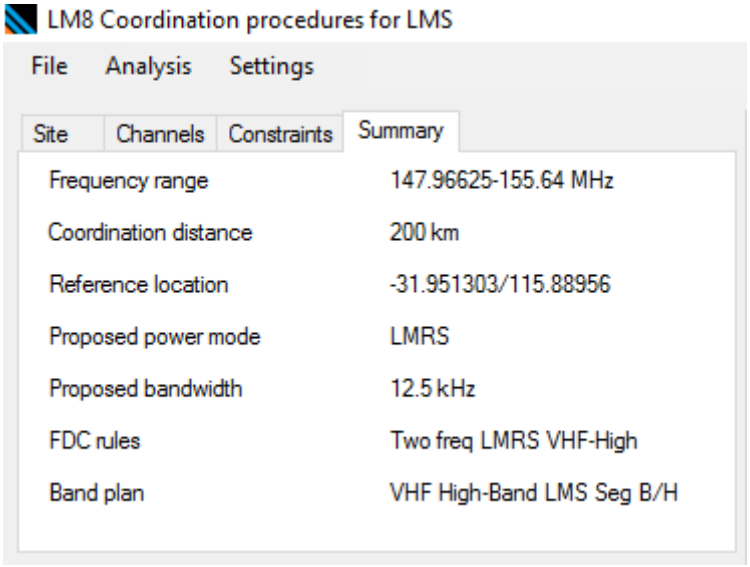


- Next is to select the band of interest. One selected the tool will automatically load the frequencies in the frequency range "Lower frequency" and "Upper frequency". The use may also specify the frequencies manually. The use may set any frequency range of interest and do not have to be available in the drop-down list. The frequencies are in ascending order including RX and TX channels. So the use may select any frequency range including reception channels.

- Select the band of operations following LM8 table C1 or specify the coordination distance and cull frequency range manually. The band drop-down list is to assist you and it's not restrictive.

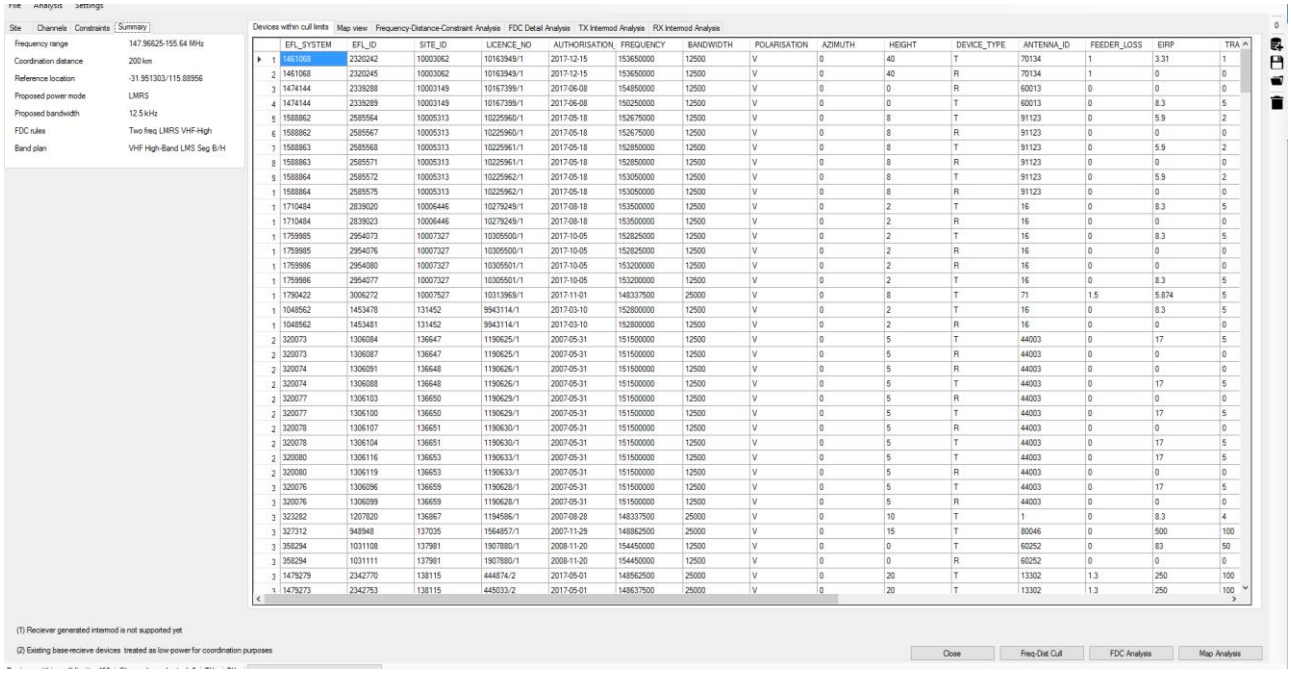


- Check all parameters in the summary tab

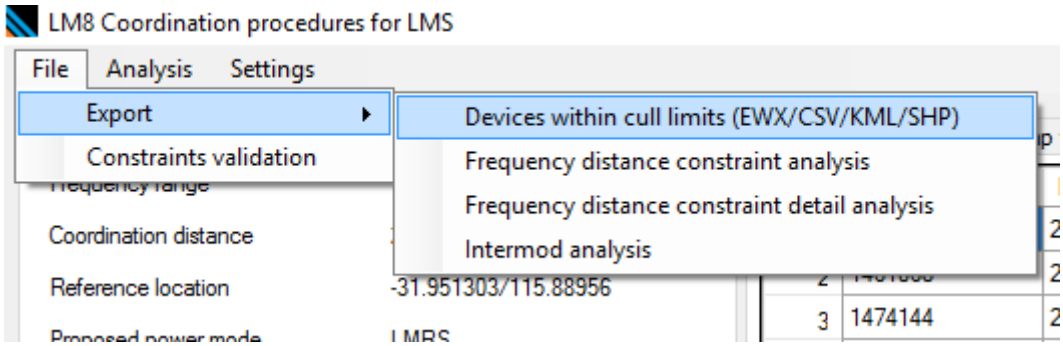


- User may now cull all stations within coordination distance of the proposed site specified in the first step. This culling is based on "Lower frequency (Hz)" and "Upper frequency (Hz)" frequency limits and the coordination distance (Km). The "cull frequency range (Hz)" is not utilized at this step. Hence, criteria as follows:

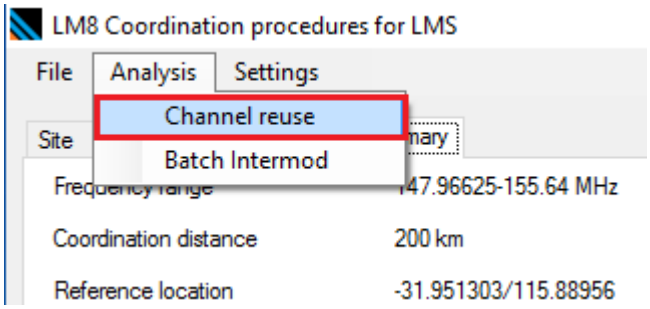
Freq >= "Lower frequency (Hz)"
Freq <= "Upper frequency (Hz)"
Distance (site, proposed site) <= "Coordination distance (KM)"



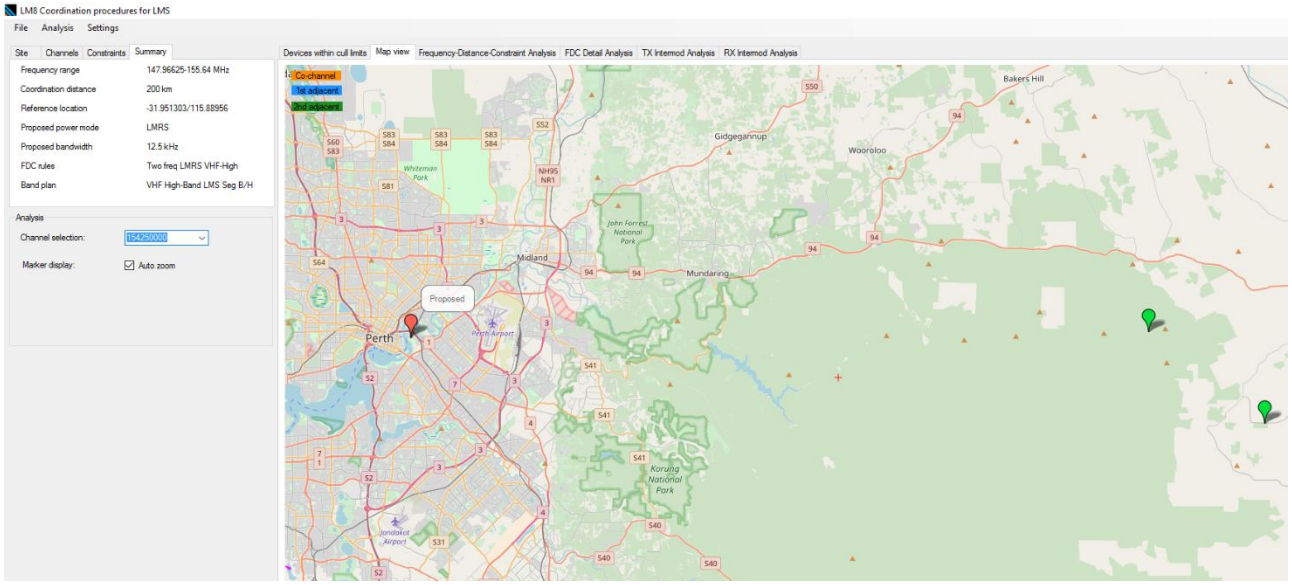
- User may choose to export all stations following the cull criteria above. Click “File>>Export>>Devices within cull limits”. Different formats available.

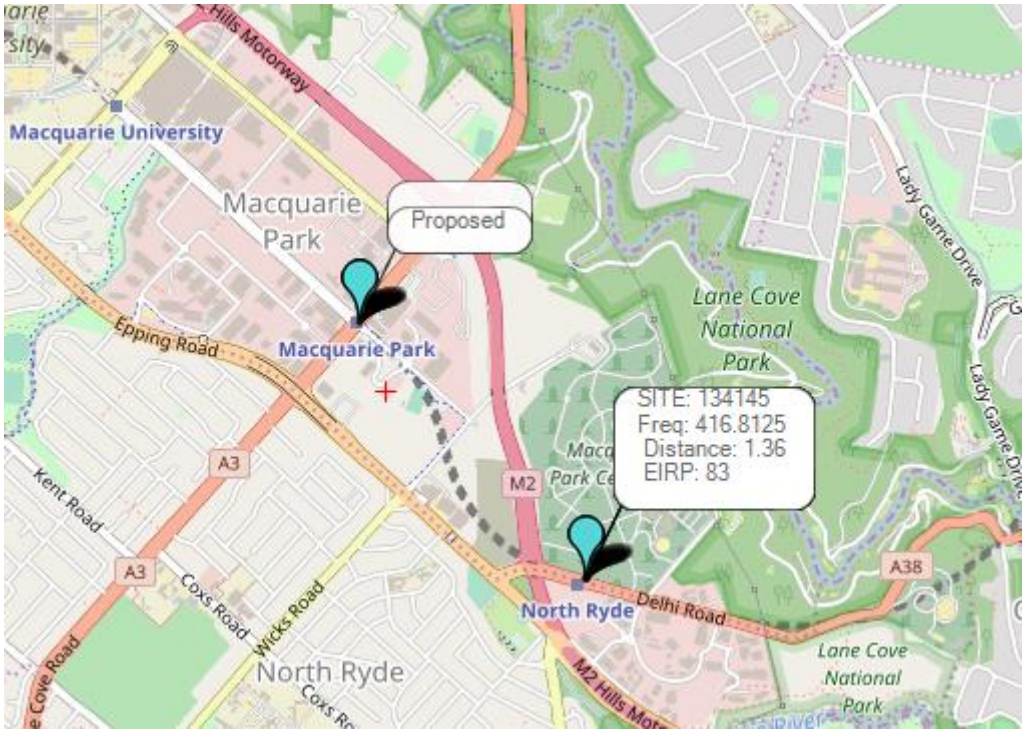


- The user might start visually analysing frequency re-use for every channel. Click “Analysis>>Channel reuse”

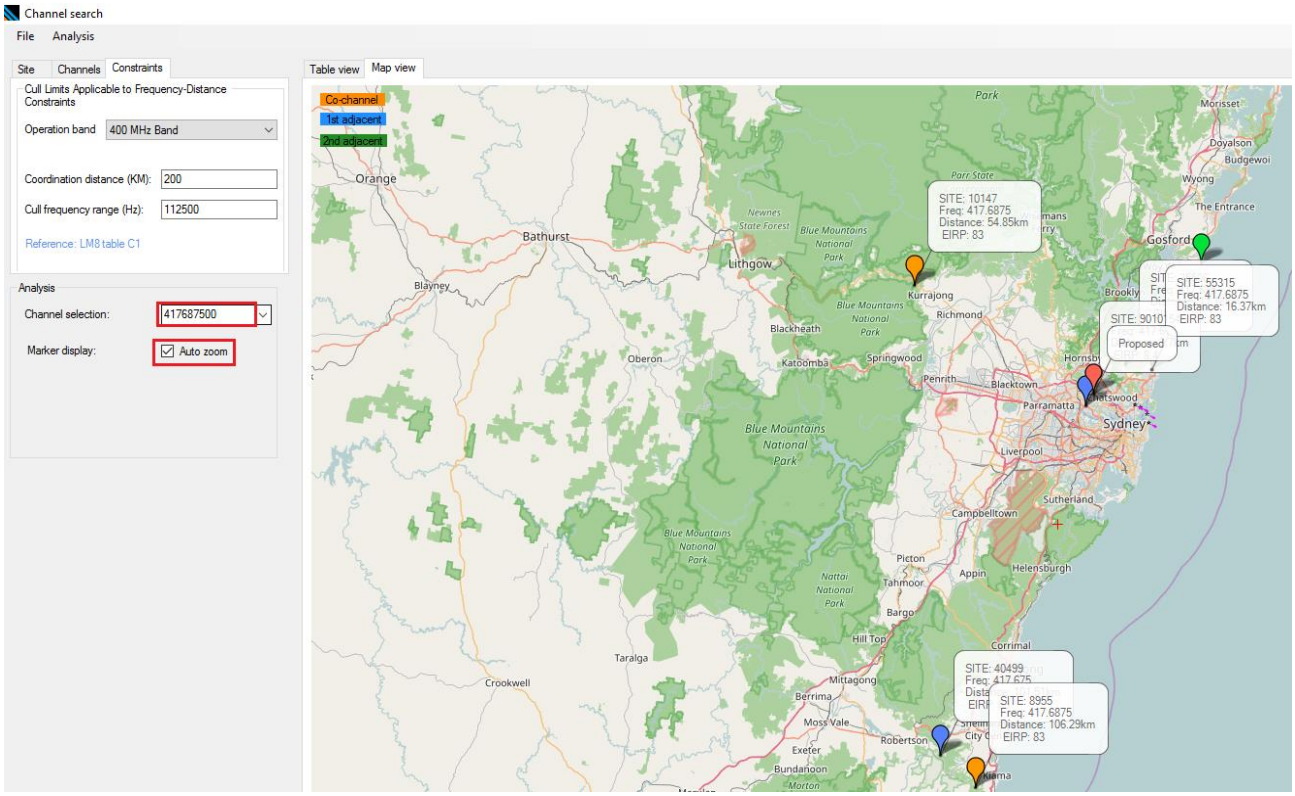


- The application would automatically display the map and overlay all stations within cull limits. The map would clearly shows the “Proposed” location. Hover the cursor over the surrounding sites – the marker would display site ID, frequency, distance to proposed site and EIRP level.





- To assist in display and analysis. The use may attempt to check the “Auto zoom” option. Then use the channel selection drop-down list and select a transmission frequency. The frequency range is sorted and include reception and transmission channels. The tool will automatically display co-channel, first adjacent and 2nd adjacent channels and their peresptive locations. The use may also click in the channel selection field and use UP/DOWN keyboard key to automatically jump to the second frequency and so forth.



- Channel culling is the second step after “Freq-Dist Cull“ which was purely distance. The purpose of this “Cull channels” to automatically analyse all channels in the band and report per channel the number of violators for the cull limits.

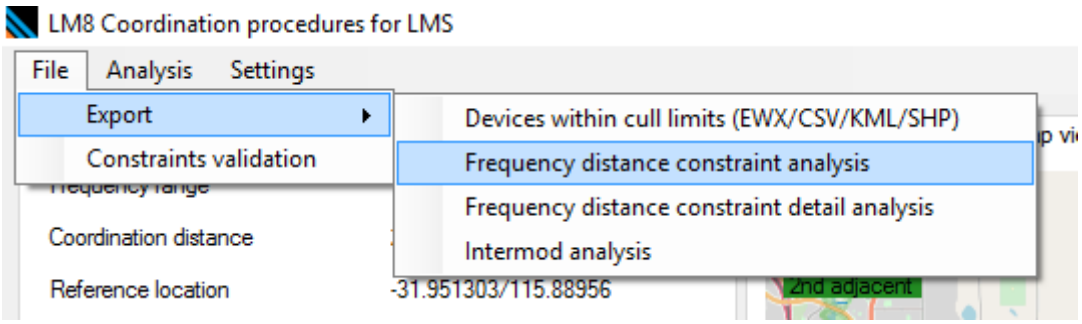
- Channel culling criteria

Stations pool:
Freq >= “Lower frequency (Hz)”
Freq <= “Upper frequency (Hz)”
Distance (site, proposed site) <= “Coordination distance (KM)”
Per channel:
Channel being considered – Feq <= “Cull frequency range (Hz)”

The total per channel is the number of sites within cull limits. i.e coordination distance and “cull frequency range (Hz)”

Devices within cull limits | Map view | Frequency-Distance-Constraint Analysis | FDC Detail Analysis | TX Intermod Analysis | RX Intermod Analysis

Proposed Frequency (Hz)	ACN	Parity	Proposed Bandwidth (Hz)	Stations within freq+dist cull	Nearest co-channel (kM)	FDC violations	FDC investigations
149256250	1	1	12500	161	116.093	0	0
153856250	1	0	12500	164	200	1	0
149262500	2	1	12500	163	116.093	0	0
153862500	2	0	12500	166	200	0	0
149268750	3	1	12500	163	200	0	0
153868750	3	0	12500	165	200	0	0
149275000	4	1	12500	163	200	0	0
153875000	4	0	12500	165	200	0	0
149281250	5	1	12500	163	200	0	0
153881250	5	0	12500	165	200	0	0
149287500	6	1	12500	164	200	0	0
153887500	6	0	12500	166	200	0	0
149293750	7	1	12500	164	200	0	0
153893750	7	0	12500	164	200	0	0
149300000	8	1	12500	164	200	0	0
153900000	8	0	12500	164	200	0	0
149306250	9	1	12500	164	200	0	0
153906250	9	0	12500	164	200	0	0
149312500	10	1	12500	166	200	0	0
153912500	10	0	12500	164	200	0	0



13. Standalone mode

The RRL plugin can be operated in standalone mode with no dependency on HTZ. The installation will also create desktop and start-menu shorts to run the plugin in standalone mode.

- Run the RRL Plugin from start menu or Desktop

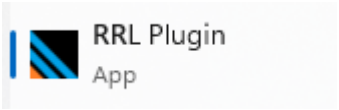


Figure 42: RRL Plugin icon

- The application starts with “No -c option” and “No -o option” specified; Indicating that the plugin will not pass the network file to ICS and it will not read the area filter mask (polygon) from HTZ

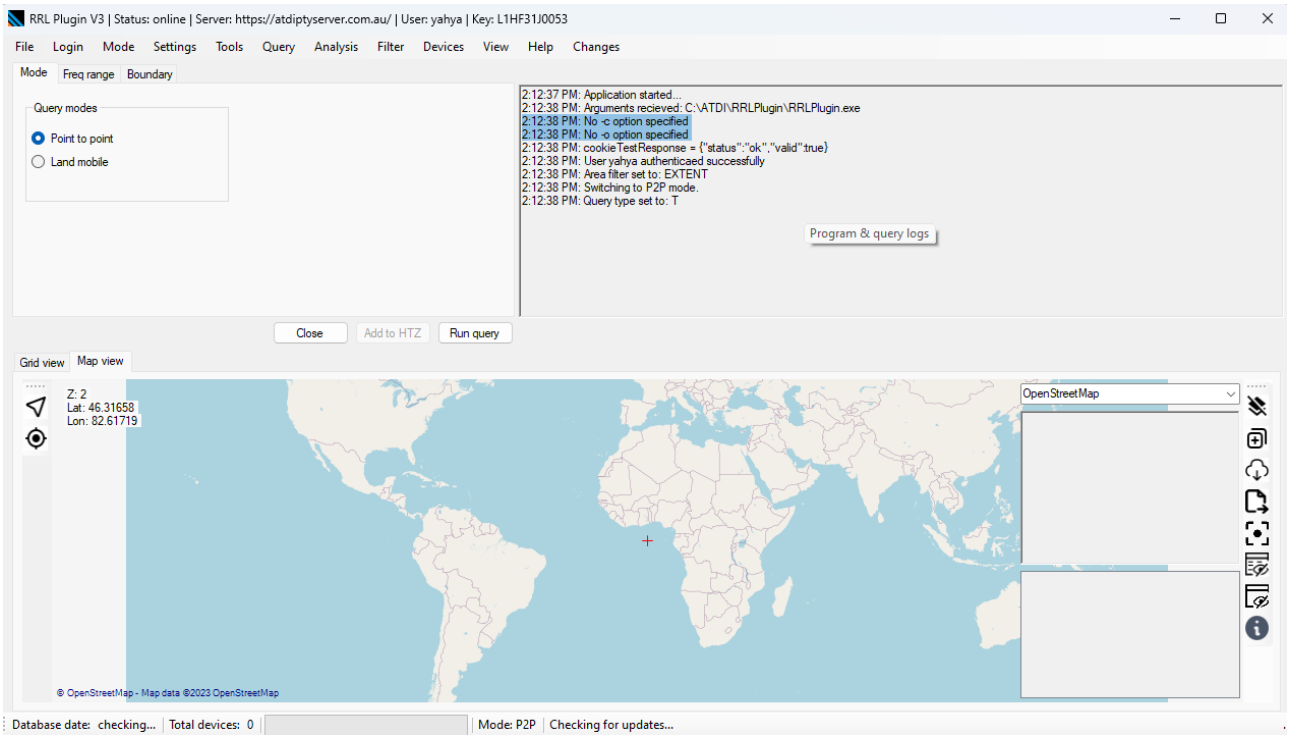
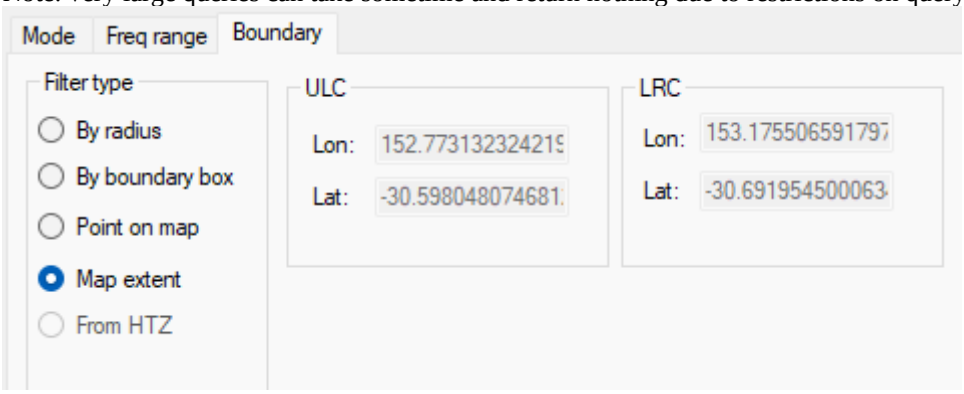


Figure 43: RRL Plugin in standalone mode

- With standalone mode the plugin doesn’t provide an option to specify a destination for the network file (XML) to be generated. By default, it goes to “**C:/Users/<CURRENT_USER>/Documents/RRL_Network.EWX”.**
- This file can be safely disregarded by the user since it can be produced using the ***File>>export>>ATDI EWX*** menu.

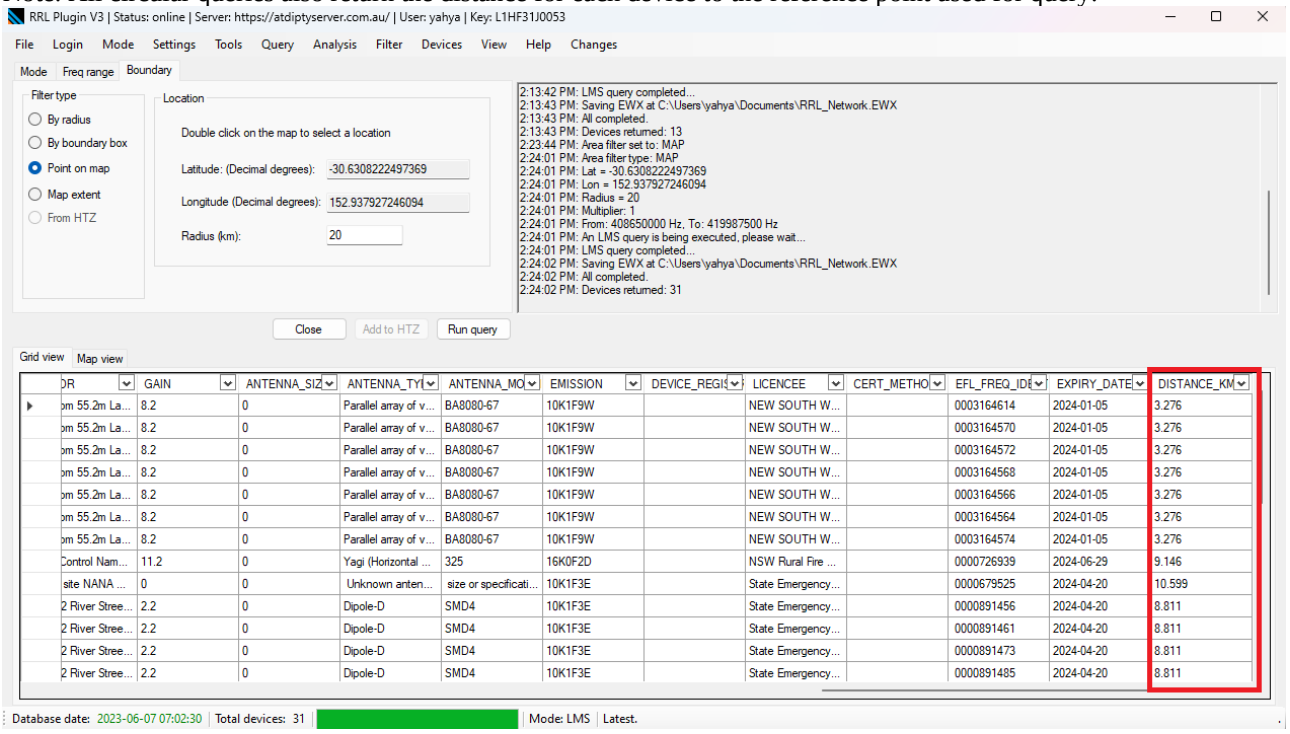
- Specifying geographical area

There are 5 different options that the user can pick from for running geographical queries.
Note: very large queries can take sometime and return nothing due to restrictions on query size on the server.



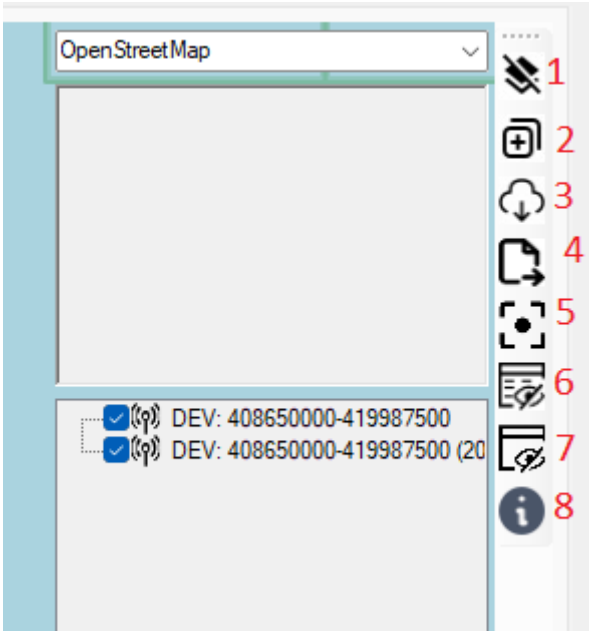
- By radius: By specifying a lat/long or site ID and radius (km). This is a circular query.
- By Boundary box: By specifying ULC/LRC corners coordinates. This is a rectangular query.
- Point on map: By specifying the range (km) and double clicking on the map. This is a circular query
- Map extend: This is the easiest approach – the tool tracks the map extend being displayed by the user and use the map extend for the rectangular query.
- From HTZ: This option is only available when RRLPlugin is executed through HTZ software. This is a rectangular query.

Note: All circular queries also return the distance for each device to the reference point used for query.



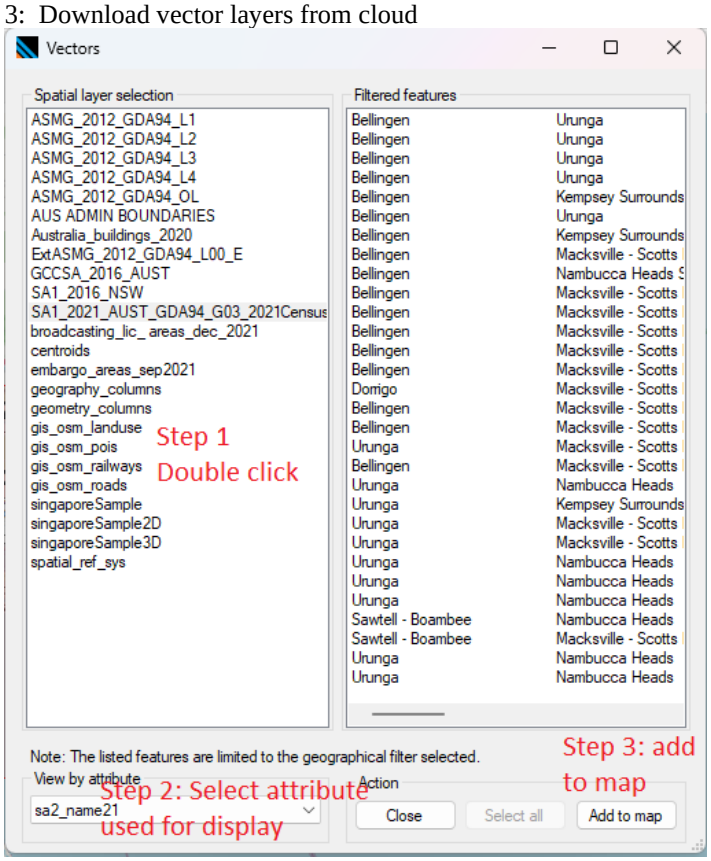
DR	GAIN	ANTENNA_SIZ	ANTENNA_TY	ANTENNA_MO	EMISSION	DEVICE_REGIS	LICENCEE	CERT_METHO	EFL_FREQ_IDE	EXPIRY_DATE	DISTANCE_KM
om 55.2m La...	8.2	0	Parallel array of v...	BA8080-67	10K1F9W		NEW SOUTH W...		0003164614	2024-01-05	3.276
om 55.2m La...	8.2	0	Parallel array of v...	BA8080-67	10K1F9W		NEW SOUTH W...		0003164570	2024-01-05	3.276
om 55.2m La...	8.2	0	Parallel array of v...	BA8080-67	10K1F9W		NEW SOUTH W...		0003164572	2024-01-05	3.276
om 55.2m La...	8.2	0	Parallel array of v...	BA8080-67	10K1F9W		NEW SOUTH W...		0003164568	2024-01-05	3.276
om 55.2m La...	8.2	0	Parallel array of v...	BA8080-67	10K1F9W		NEW SOUTH W...		0003164566	2024-01-05	3.276
om 55.2m La...	8.2	0	Parallel array of v...	BA8080-67	10K1F9W		NEW SOUTH W...		0003164564	2024-01-05	3.276
om 55.2m La...	8.2	0	Parallel array of v...	BA8080-67	10K1F9W		NEW SOUTH W...		0003164574	2024-01-05	3.276
Control Nam...	11.2	0	Yagi (Horizontal ...	325	16K0F2D		NSW Rural Fire ...		0000726939	2024-06-29	9.146
site NANA ...	0	0	Unknown anten...	size or specificati...	10K1F3E		State Emergency...		0000679525	2024-04-20	10.599
2 River Stree...	2.2	0	Dipole-D	SMD4	10K1F3E		State Emergency...		0000891456	2024-04-20	8.811
2 River Stree...	2.2	0	Dipole-D	SMD4	10K1F3E		State Emergency...		0000891461	2024-04-20	8.811
2 River Stree...	2.2	0	Dipole-D	SMD4	10K1F3E		State Emergency...		0000891473	2024-04-20	8.811
2 River Stree...	2.2	0	Dipole-D	SMD4	10K1F3E		State Emergency...		0000891485	2024-04-20	8.811

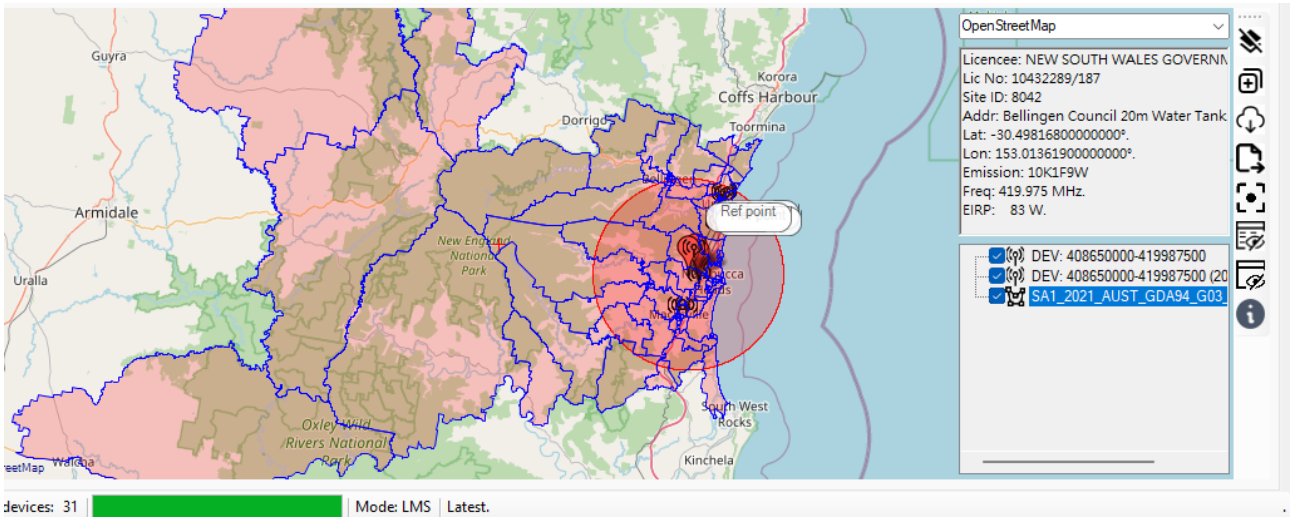
14. Map controls



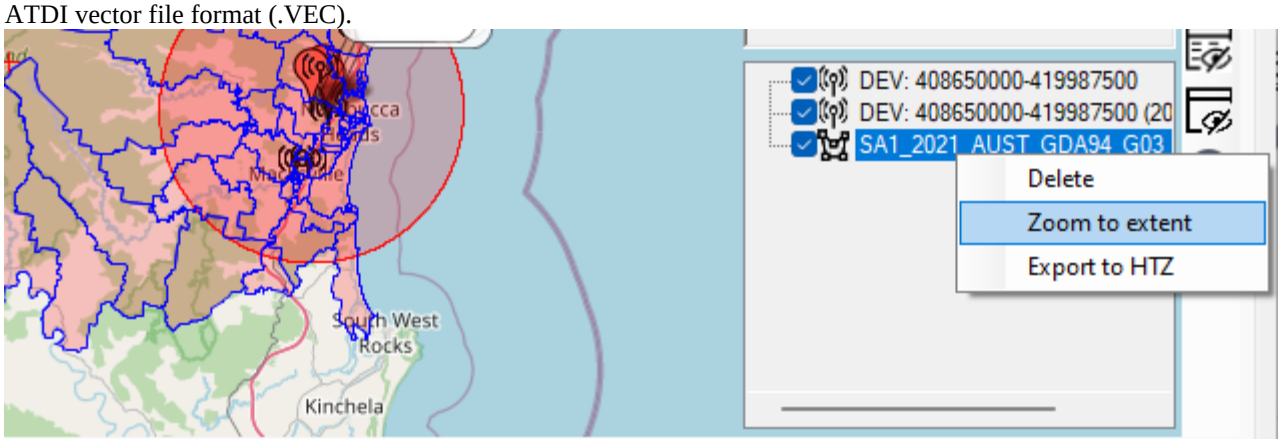
1: Remove and reset all vector and network objects on the map. Also reset the vector list.
2: Add the latest Network query (P2P or Mobile) to map. This will also add a new layer in the vector list.
3: Download vector layers from ATDI's hosted GIS layers.
4: Export all check GIS layers from the vector List to ATDI .VEC file format. This file can be manually loaded from HTZ.
5: Re-centre the map to accommodate all vector layers currently activated
6: Hide/Display top Info-box
7: Hide/Display bottom vector List
8: If enabled the tool will display all vector attributes when clicking a vector object on the map

3: Download vector layers from cloud





Layer download is limited to the geographical filter selected by the user. In the example above an “Extent” was used. The tool also adds the vector layer to Vector List.
User can Check/Un-check vector layer from the “vector List”. Can also delete the corresponding layer or export to ATDI vector file format (.VEC).



15. Updating RRL plugin

New updates for RRL plugin can be checked from *Help-> Check for updates*. You can follow the instruction to update the plugin to the latest one whenever it is outdated.

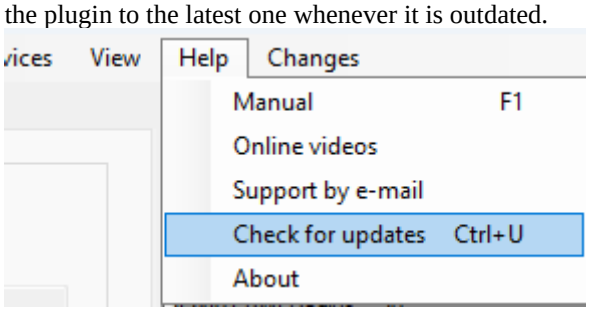


Figure 44 Checking RRL updates

User login required.

The plugin will automatically compare the current version with latest one available online. The plugin will verify both database version and plugin executable version.

If plugin or database version is not matching – the tool will automatically download latest executables, shutdown the application and proceed with the installation.

- New update detected; press ok to download

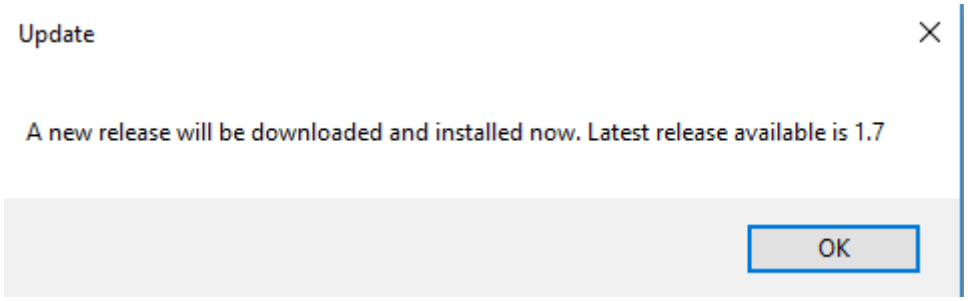


Figure 45: A new release has been detected

- Download completed; press ok to start installation

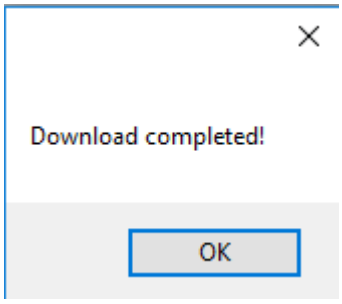


Figure 46

Kindly refer to the installation section for further instructions on installation.

16. Methodology for updating coordinates using coordination distance

This section details the calculations approach for the boundary box using in geographical queries. Below is an example of calculations from version 1.7 together with the visual representation in GE for verification purposes.

The tool queries the RRL database following a rectangle filtering for speed and efficiency; never the less, the user may still be able to apply circular filtering after the first query is issued. The engine assumes Earth ellipsoid model following WGS-84 and not a sphere.

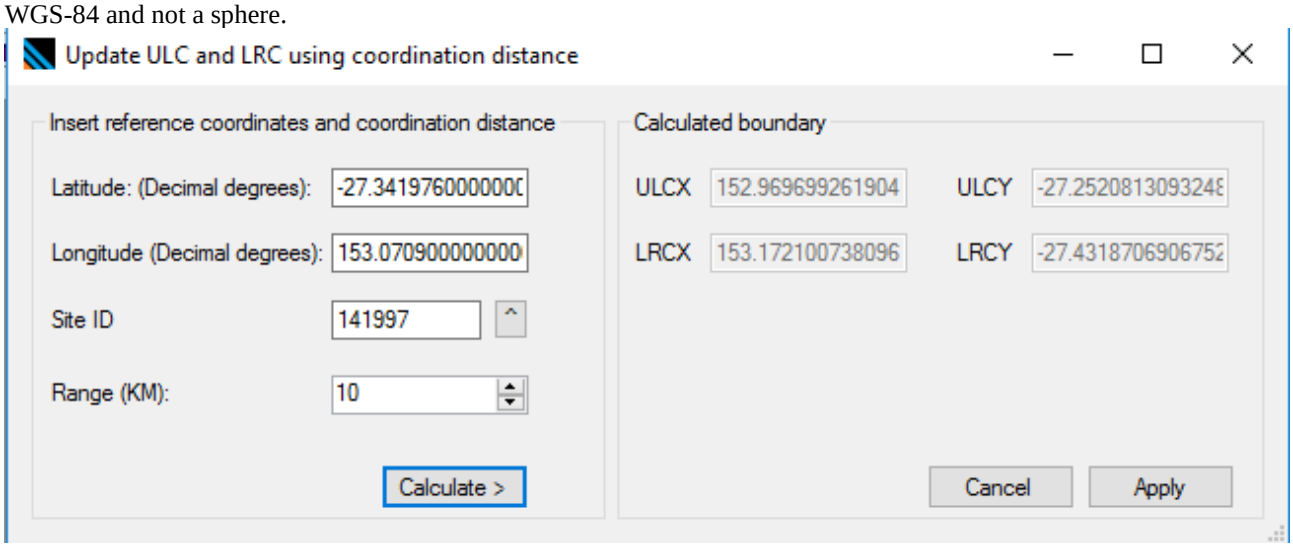


Figure 47: Sample location and boundary box calculations

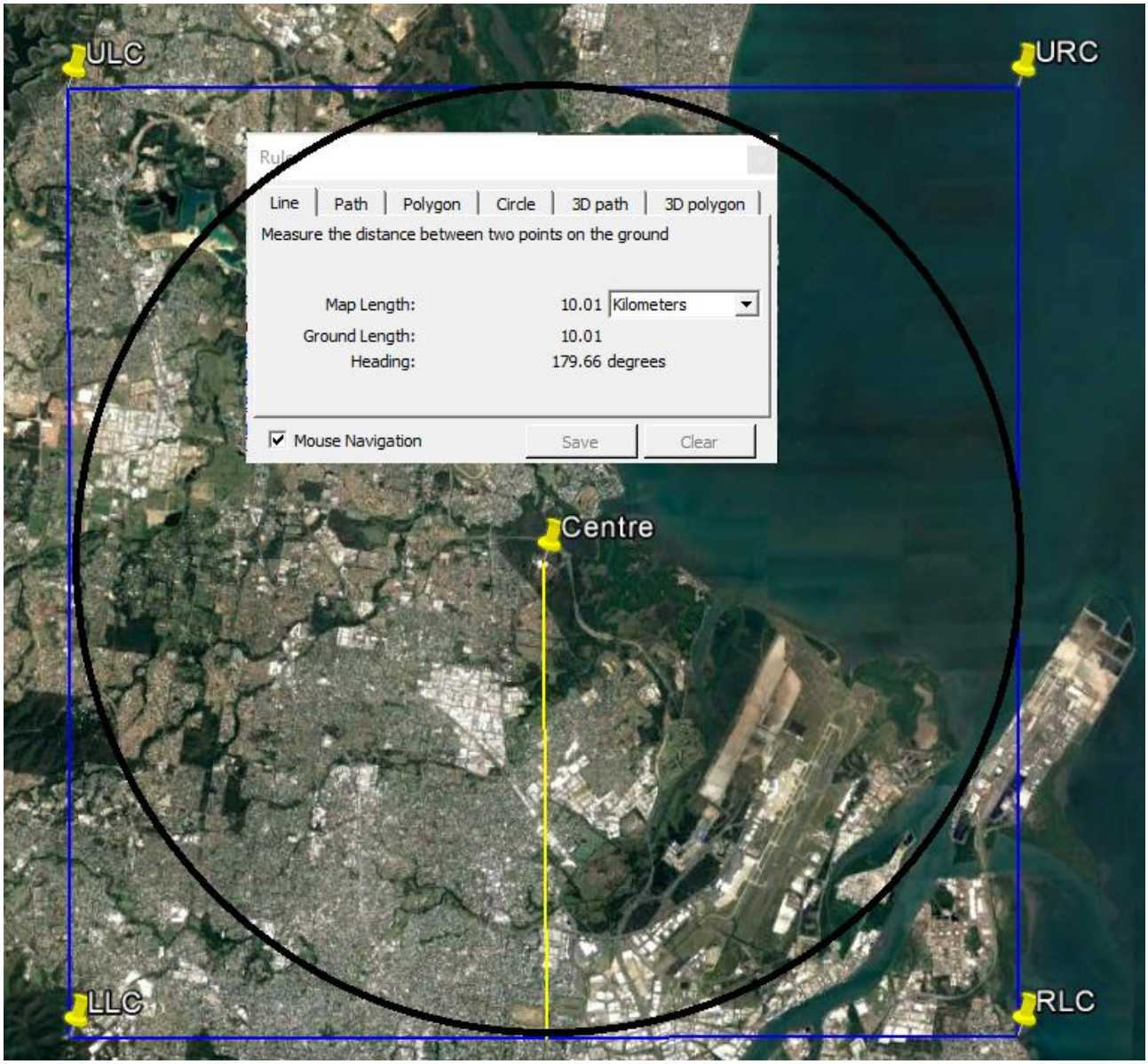


Figure 48: Visualization of the boundary box calculations

Where:

- Centre: The input Long/Lat as per Figure 47
- ULC, URC, LLC and LRC are the calculated boundary as per Figure 47

Code:

```
public class MapPoint
{
   public double Longitude { get; set; } // In Degrees
   public double Latitude { get; set; } // In Degrees
}

public class BoundingBox
{
   public MapPoint MinPoint { get; set; }
   public MapPoint MaxPoint { get; set; }
}

// Semi-axes of WGS-84 geoidal reference
```

```
private const double WGS84_a = 6378137.0; // Major semiaxis [m]
private const double WGS84_b = 6356752.3; // Minor semiaxis [m]

// 'halfSideInKm' is the half length of the bounding box you want in kilometers.
public static BoundingBox GetBoundingBox(MapPoint point, double halfSideInKm)
{
   var lat = Deg2rad(point.Latitude);
   var lon = Deg2rad(point.Longitude);
   var halfSide = 1000 * halfSideInKm;

   // Radius of Earth at given latitude
   var radius = WGS84EarthRadius(lat);
   // Radius of the parallel at given latitude
   var pradius = radius * Math.Cos(lat);

   var latMin = lat - halfSide / radius;
   var latMax = lat + halfSide / radius;
   var lonMin = lon - halfSide / pradius;
   var lonMax = lon + halfSide / pradius;

   return new BoundingBox {
      MinPoint = new MapPoint { Latitude = Rad2deg(latMin), Longitude = Rad2deg(lonMin) },
      MaxPoint = new MapPoint { Latitude = Rad2deg(latMax), Longitude = Rad2deg(lonMax) }
   };
}

// degrees to radians
private static double Deg2rad(double degrees)
{
   return Math.PI * degrees / 180.0;
}

// radians to degrees
private static double Rad2deg(double radians)
{
   return 180.0 * radians / Math.PI;
}

// Earth radius at a given latitude, according to the WGS-84 ellipsoid [m]
private static double WGS84EarthRadius(double lat)
{
   // http://en.wikipedia.org/wiki/Earth_radius
   var An = WGS84_a * WGS84_a * Math.Cos(lat);
   var Bn = WGS84_b * WGS84_b * Math.Sin(lat);
   var Ad = WGS84_a * Math.Cos(lat);
   var Bd = WGS84_b * Math.Sin(lat);
   return Math.Sqrt((An*An + Bn*Bn) / (Ad*Ad + Bd*Bd));
}
```

Outcome:

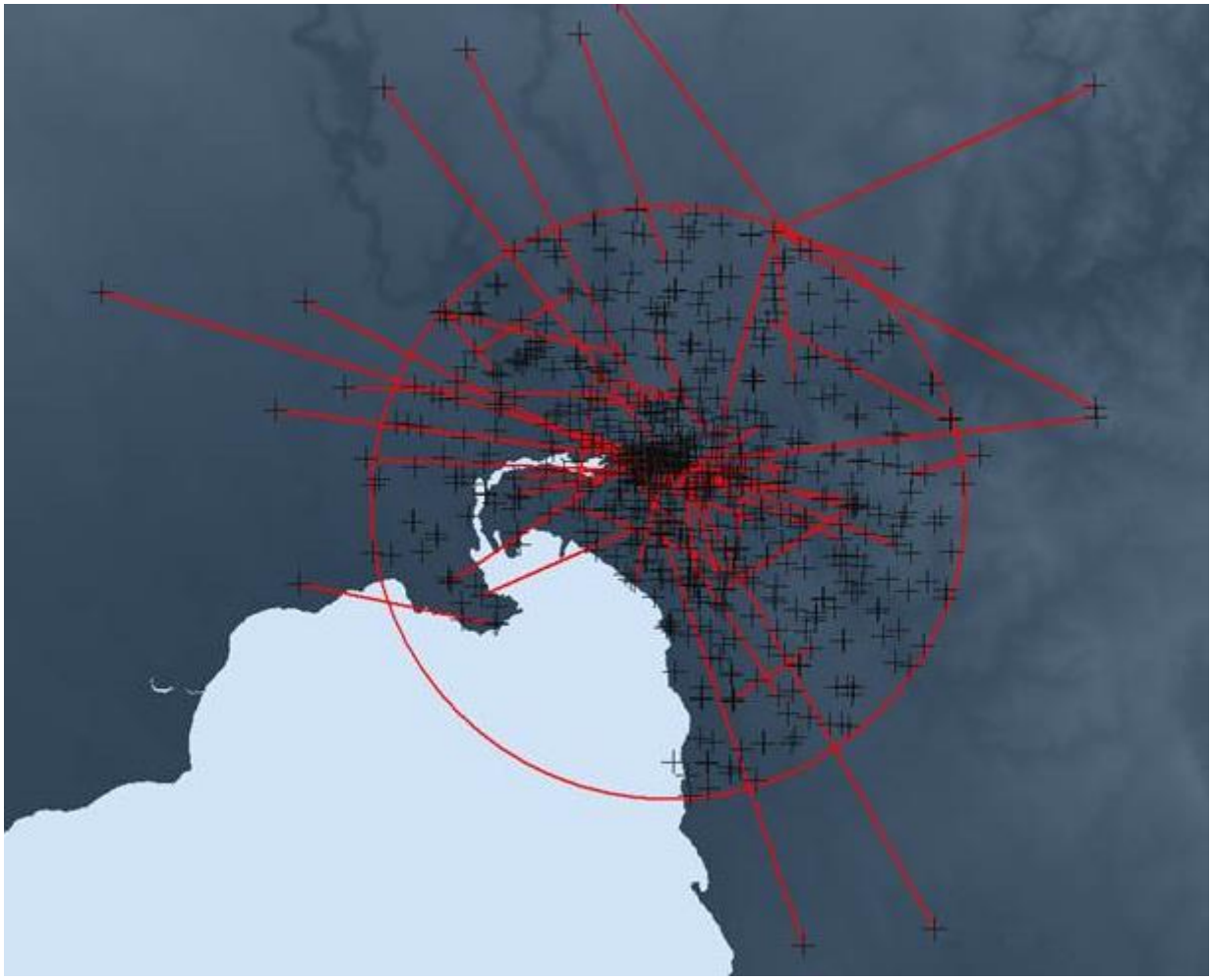


Figure 49: Filter results by radius for P2P mode

For P2P, if any of the terminals is inside the circle the link will be included for coordination.

17. Tools>>Ellipsoidal distance calculator

This is an advanced distance calculator for two points. The calculations are based on Inverse Vincenty method.

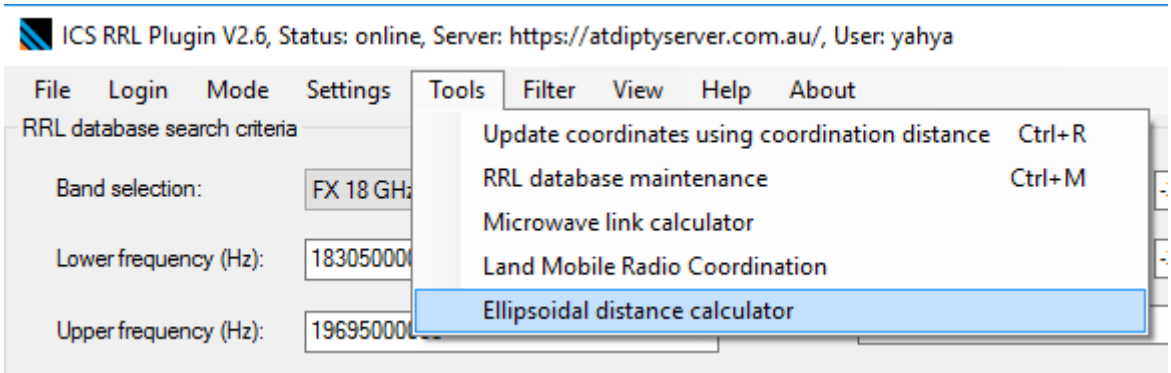


Figure 50: Ellipsoidal distance calculator

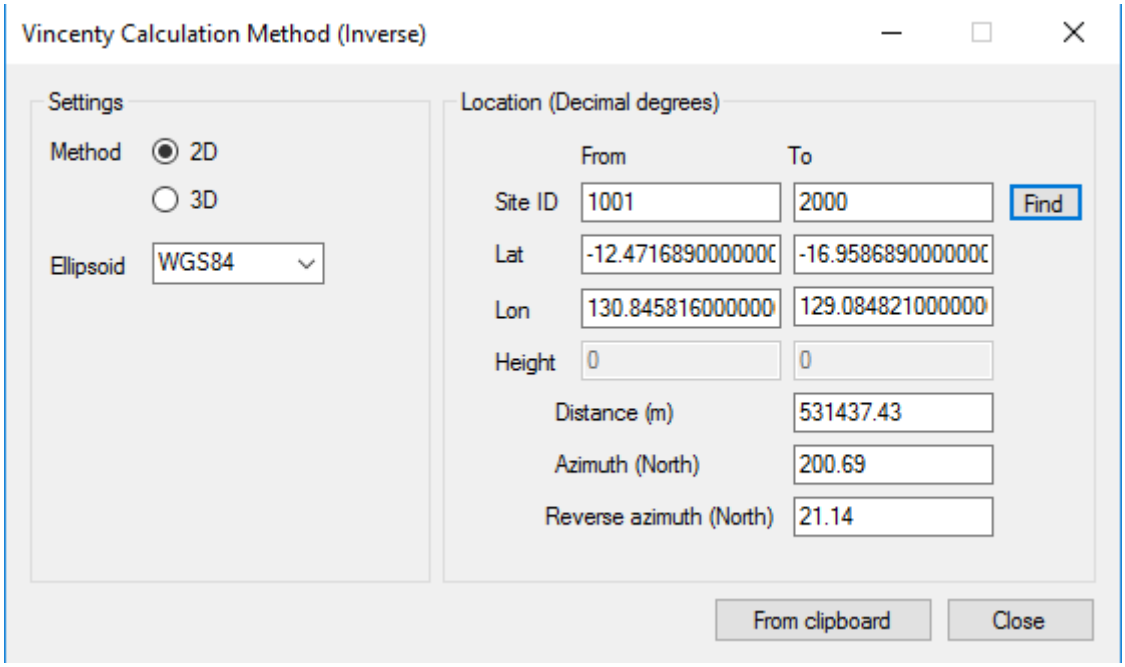


Figure 51: Ellipsoidal distance calculator configuration

- 2D: Only Lat/Long knowledge required. It assumes both locations are at the average sea level (0 meter)
- 3D: Just like 2D but requires elevation information. It calculates the 3D distance between two points
- Ellipsoid: Specifies the geodetic reference model of the planet. Use WGS-84 for compliance with GDA94
- Lat/Long must all be in decimal degrees. Can be updated from clipboard or from site IDs by pressing the "Find" button
- Azimuth: Orientation of the first point to the second point. From true North
- Reverse azimuth: Orientation of the second point to the first point. From true North
- Distance is calculated if all inputs are correct

This function has no impact on how the current or future queries you run in the plugin. Its independent of other forms.

See drawing below for further illustration for distance calculation method:

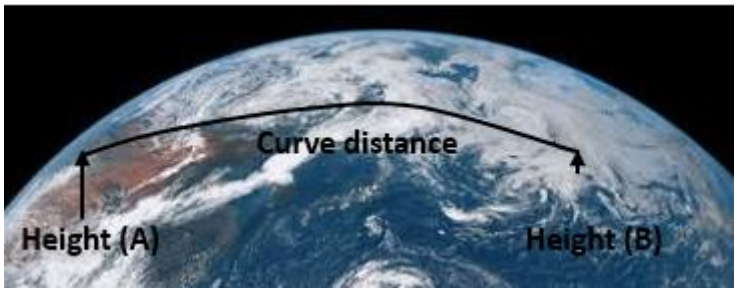
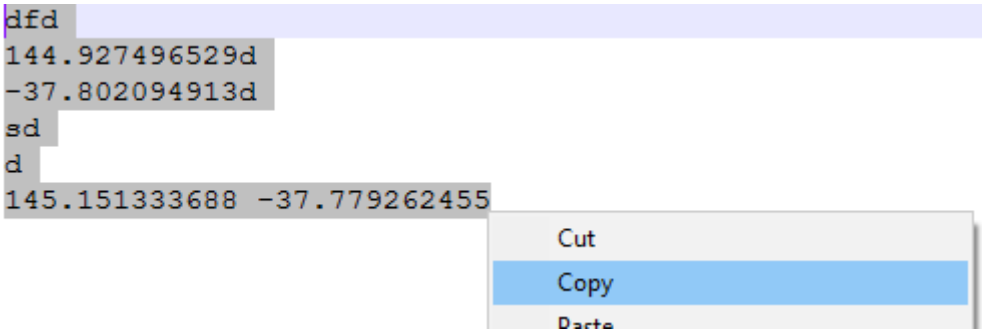


Figure 52: Illustration for ellipsoidal distance

Note: you can copy 4 coordinates to clip-board and automatically set the "From" "To" fields by clicking the button "From clipboard". Example of accepted format below:



18. Settings>>Advanced query settings

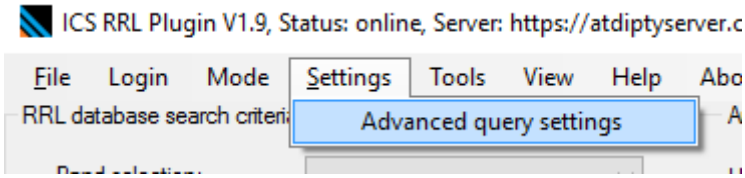


Figure 53: Advanced query settings

This function applies to future queries you run and not to currently executed queries. User selection in this form is maintained while the plugin is open. The Device type will always restore to TX only every time the user run the plugin.

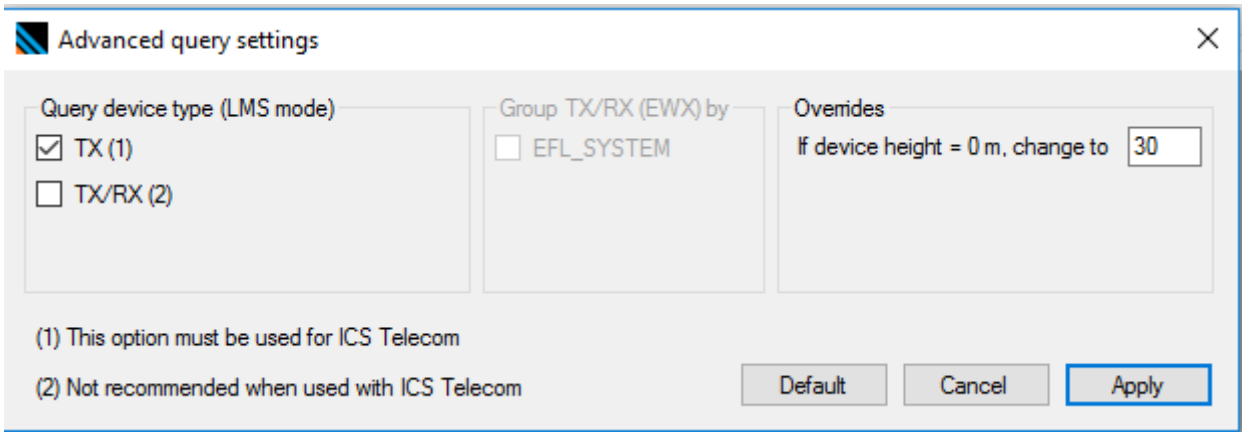


Figure 54: Advanced query settings form

By default, the RRL plugin only returns equipment of the type "T" for LMS queries. P2P mode such as microwave is always T->R so this form doesn't apply to P2P mode.

- TX: Applies to future queries; only equipment of type "T" are returned by the API
- TX/RX: Applies to future queries until the plugin is restarted. Both "T" and "R" type equipment are returned. Especially useful if user wishes to extract the data into a CSV. Don't use this option when modelling the network for ICS Telecom EV importation.
- Overrides: Check if condition is valid and change to user-defined value when exporting to ATDI compatible format only