
RAM vs. Other Contaminated Land Risk Assessment Models

Comparison Guide

Introduction

ESI's new risk assessment tool, RAM, is set to become one of the most widely-used models for determining groundwater risks and remedial targets for contaminated land sites. At present, the majority of these risk assessments are performed using the EA-sponsored ConSim and the American tool, the RBCA Tool Kit for Chemical Releases. The RBCA Tool Kit was developed for the US regulatory environment and ConSim was developed prior to the current Environment Agency tiered methodology. Until now, the only publicly available software that fully implements this methodology was the Remedial Targets Worksheet, produced by the EA itself. RAM was developed by ESI to explicitly comply with the tiered methodology; it offers not only more modelling sophistication than the Remedial Targets Worksheet, but also exceeds the capabilities of ConSim and the RBCA Tool Kit.

In developing this guide, we have divided the characteristics of a groundwater risk assessment model into four broad categories:

- User interface and technical support
- Conceptual model development and description
- Pathway (source-pathway-receptor) description
- Calculation and presentation of results

In the following sections a brief summary of the issues of each category is given and tables are presented which summarise the key features supported by the four models. The differences between the products are highlighted. If you have any questions as you read this please feel free to call us on (+44) 01743 280020. You can also send email to RAM@esinternational.com.

The following charts and discussions compare the capabilities of RAM with those of the Remedial Targets Spreadsheet, ConSim and the RBCA Tool Kit for Chemical Releases. We have tried to be as accurate as possible, but if you find an error or omission please let us know and we will correct it immediately. The comparison guide is based on RAM v1, Remedial Targets Spreadsheet v1.1, ConSim v1.05 and RBCA Tool Kit v1.2. As new versions become available, this guide will be modified.

Please note that only the groundwater modelling capability of the RBCA Tool Kit is described here. It is capable of performing risk assessments with pathways other than groundwater.

User Interface and Technical Support

The user interface enables you to develop your model. It affects how easy it is to develop, and how flexible and complex your calculations can be. There are two fundamentally different approaches to this in the models listed here. ConSim has its own specifically-developed user interface whereas the other software packages use the Microsoft Excel spreadsheet environment.

When you do run into problems or if you have any questions, technical support becomes an issue. We pride ourselves on the quality of our technical support so if you have any questions you will get a quick response from an experienced modeller.

Feature	RAM	Remedial Targets Spreadsheet	ConSim	RBCA Tool Kit
Runs within Excel	Yes	Yes	No	Yes
Comprehensive on-line help	Yes	No	Yes	Yes
Unlimited free technical support	Yes	No	No	No
MDI (Multi-Document-Interface) Using multiple models at same time	Yes	Yes	No	No
Price (UK £)	£ 399 (£ 799 with Crystal Ball)	Free, but £20 for accompanying EA R&D Report	£700	~£560 (\$795)

We consider that models which run within the Excel environment offer significant advantages over those which are application-based. For example, formulae may be entered as inputs directly into cells; these may be as simple as unit conversions, or as complex as a water balance. RAM takes this one step further and provides capability for site-specific water balances. Some unit conversions are also built-in.

RAM comes with a full electronic help file. The EA Remedial Targets Spreadsheet has no help facility, although there are comments written on the spreadsheet. ConSim has context-sensitive help and a database of parameter values that might be used in your risk assessment. This is seen by some as both an advantage and a disadvantage, in that although values are instantly available, it avoids the use of more appropriate site-specific data and values which should be changed may not be, through oversight. The RBCA Tool Kit also has context-sensitive help, and the hard copy manual has some very useful appendices. This model also carries a chemical database, although caution should be used because many of the default parameters are not applicable to UK risk assessments.

Our technical support is generally acknowledged as the best in the business. This is because you will actually talk with the authors and frequent users of the software who know every aspect of the software and use it in day-to-day consulting projects. As we develop more complex models within the RAM environment, so you will be able to access that capability. If you find a bug we will immediately fix it and upload an update to our website. There are no technical support facilities for the Remedial Targets Spreadsheet. Free ConSim support is

limited to installation problems – although other assistance is available for an appropriate fee. For The RBCA Tool Kit you have to phone the States and you are subject to charges for help.

We even customise RAM to meet your unique needs. For example, there are versions available and in development which model landfills, vapour transport, river flow, dual porosity, petroleum and other NAPL migration. If you have any ideas for enhancements that would help your project, just let us know. We often make these changes immediately and post the update to the web the same day. No other software company in our business can make this claim!

Conceptual Model Development and Description

The conceptual model of your hydrogeological system describes how the contaminants travel from sources to receptors. For UK contaminated land and groundwater risk assessments, the process of developing a conceptual model, and the way the results are examined, have been formalised by the Environment Agency into a four tiered structure, with each tier incorporating increasing complexity and site-specific data.

Feature	RAM	Remedial Targets Spreadsheet	ConSim	RBCA Tool Kit
Complies with the tiered structure of the EA Remedial Targets Methodology	Yes	Yes (up to Tier 3)	No	No
Graphical conceptual model	Yes	No	Yes	Yes
Site-specific conceptual models (EA Tier 4)	Yes	No	No	No
Custom site water balance	Yes	No	No	No

RAM has been specifically developed with the Agency Tiered Methodology in mind. Unlike the Remedial Targets Spreadsheet, RAM is capable of generating Tier 4 models with multiple sources, pathways and receptors – all within the same model. ConSim was developed before the EA Tiered Methodology was released, and its levels, although similar, are not equivalent. The RBCA Tool Kit similarly has a tiered system to describe additional model complexity, but these are not comparable either.

During the progress of carrying out your project, you may have developed a conceptual model of the hydrogeological system. On translation of your conceptual model to the computer-based model, generalisations have to be made to fit the two together. In RAM's unique Tier 4 development mode, you can describe and represent your conceptual model in detail with essentially unlimited numbers of sources, aquifer units and receptors. The conceptual model is translated into a RAM computer model with an intuitive drag-and-drop graphical interface. Once the model has been constructed, additional sources, pathways or receptors may be added or removed as your model gradually becomes more realistic.

RAM is the only model that allows a complex water balance to be calculated within its structure. In the other three models the only option is to specify the infiltration rate and the area of your site; the resulting flow is constant along the pathway. RAM provides options to use such a simple idealisation, but also enables more detailed water balances to be defined for the site hydrogeology. Unlike in the RBCA Tool Kit, all spreadsheet features are available to

the model developer. Even iterative equations for a simple or more sophisticated 'lumped-mass' water balance model may be created if required.

Pathway (Source-Pathway-Receptor) Description

Once the conceptual model has been developed, parameters describing the sources, pathways and receptors have to be entered into the computer model. These may be entered as single values (deterministic) or as ranges over which a parameter may vary (probabilistic not in RT Spreadsheet + RBCA).

Feature	RAM	Remedial Targets Spreadsheet	ConSim	RBCA Tool Kit
Source Description				
Multiple contaminants	Yes	No	Yes	Yes
Soil and groundwater sources	Yes	Yes	No	Yes
Multiple sources of each type	Yes	No	No	No
Pathway Description				
Unsaturated and saturated pathways	Yes	No	Yes	Yes
Multiple pathways of both types	Yes	No	No	No
Multiple Pathway sections	Yes	No	No	No
Receptor Description				
Multiple groundwater receptors	Yes (unlimited)	No	No	Yes (3)

Unlike all the other models, RAM is capable of modelling multiple hydrogeological units together. For example, a pathway may consist of a number of unsaturated lithologies through which the contaminant moves vertically, followed by several saturated aquifer lithologies. RAM is the only model capable of describing these units individually. Using the other models, one may have to omit some of the units, or average them, leading to incorrect estimation of the overall attenuation capacity of the system.

Calculation and presentation of results

Any risk assessment model is only as good as the results it presents.

Feature	RAM	Remedial Targets Spreadsheet	ConSim	RBCA Tool Kit
Time-variant calculation of unsaturated zone fluxes	Yes	No	Yes	No
Receptor concentration (forward) modelling	Yes	No	Yes	Yes
Remedial target derivation (backward modelling)	Yes	Yes	No	Yes
Deterministic modelling	Yes	Yes	Yes	Yes
Probabilistic modelling	Yes	No	Yes	No
User-specified percentiles and confidence limits	Yes	No	7 fixed percentiles	No
Automatic audit trail for model development and sensitivity analysis	Yes	No	No	No

The perceived advantage of using probabilistic modelling is that you no longer need to calculate worst-case scenarios using extreme values of these parameters. Regulatory bodies understand that except in the simplest cases (ie. of only one or two varying parameters) not every parameter will be at its extreme limit. This acts to reduce predicted concentrations at receptors, and to increase the remedial targets at sources by removing the conservatism of unrealistic parameter combinations.