Radiation protection of the environment: providing knowledge and skills to the user community

UPDATES TO THE ERICA TOOL – VERSION RELEASED 2014

Objective of this briefing note

Since being released in 2007 a number of updates have been released. Typically these have been to resolved minor 'bugs' and other problems reported by users. Changes are noted in 'Release Notes' accessed via the 'Help' drop down menu.

In 2014 a revised version of the Tool will be released with more substantial changes. It had been hoped that this version would be available and tested for the April 2014 training course at CEH Lancaster. However, this now looks unlikely so this briefing note provides an over view of what will change in the Tool. These will be expanded upon during the course and a half day refresher course will be held in the first few months after the updated version is released.

The changes to the Tool were predominantly prompted by experience gained since 2007 and user feedback, developments in and analyses of transfer parameter databases (see separate briefing note) and ICRP publications.

Default Radionuclides

Ba-140, Ca-45, Cr-51, Cf-252, Ir-192, La-140, Pa-231 & Zn-65 have been added to the default list within the Tool. This means the ERICA Tool is now consistent with radionuclides considered within the ICRP Reference Animal and Plant approach (see ICRP Publications 108 and 114); default radionuclides, Concentration Ratios (CRs) and Dose Conversion Coefficients (DCCs) have been generated for these additional radionuclides.

You can continue to add additional radionuclides.

Reference Organisms

The ERICA Tool was supposed to contain Reference Organisms encompassing all European protected species. User feedback noted that it was missing Freshwater Reptile; there are protected freshwater reptile species in Europe. The 2014 version of the Tool contains a Freshwater Reptile Reference Organism. The geometry assumed is: length 18 cm, width 12 cm, height 6cm and mass of 1 kg. This is representative of an adult female European pond turtle (*Emys orbicularis*). The default occupancy factor is 1 at the sediment-water interface (i.e. it is assumed to spend 100% of the time on bed sediments.

Bird egg has been removed from the default Reference Organism list. This was inconsistent with approaches for other organism and furthermore there are no empirical data for $CR_{wo\text{-}soil}$ for bird eggs. If users wish, they can add a bird egg geometry at Tiers 2 and 3.

The original Tool had two geometries for the 'Sea anemones or true corals' geometry, polyp and colony. This has now been simplified with only the polyp geometry being retained.

Some changes have been made to the naming of the default references organism. These make the Tool more consistent with the terminology used in the IAEA wildlife transfer parameter handbook (see ' transfer' briefing note) and remove some ambiguity. The revised and original reference organism lists are compared in Table 1.

The marine Macroalgae reference organism geometry (mass 0.0065 kg) was based upon information provided by the ICRP during the initial stages of the development of the ICRP Reference Animals and Plant (RAP) approach. However, the brown seaweed geometry as published by the ICRP (Publication 108) has a mass of 0.652 kg. The 2014 version of the ERICA Tool is consistent with ICRP Publication 108.

All DCCs for external exposure of the Lichen & bryophytes geometry have been recalculated (discrepancies had been noted within the original dataset).

DCCs have been generated for the new and modified reference organism geometries.

Occupancy Factors

The default occupancy factor for terrestrial amphibian has been changed to 100% in soil to ensure conservatism in Tier 1 and be consistent with the treatment of other organisms.

Default Transfer Parameters

As noted in the briefing note on transfer there has been a significant effort to improved wildlife transfer ($CR_{wo\text{-}media}$ values) databases. Where empirical data exist for a Reference Organism – radionuclide combination these are used to provide the revised default value within the ERICA database.

In the original ERICA Tool only about 40% of the required CR_{wo} values were available. Where no empirical data were available a range of extrapolation approaches have been applied. There is still a need to derive missing CR_{wo} values using extrapolation approaches. However, these approaches have been simplified and refined in part based on an evaluation of how well the approaches used in the original ERICA Tool had worked now that additional

data are available (see Brown et al. paper below). The revised extrapolation approaches are shown in Table 2.

Table 1. Reference Organisms from the original and revised ERICA Tool versions.

Original	Revised
Freshwater	
Amphibian	
Benthic fish	
Bird	
Bivalve mollusc	
Crustacean	
Gastropod	
Insect larvae	
Mammal	
Pelagic fish	
Phytoplankton	
Vascular plant	
Zooplankton	
missing	Reptile (new Reference Organism
Marine	
(Wading) bird	Bird
Benthic fish	
Bivalve mollusc	Mollusc - bivalve
Crustacean	
Macroalgae	
Mammal	
Pelagic fish	
Phytoplankton	
Polychaete worm	
Reptile	
Sea anemone or true coral - polyp	Sea Anemones/True Coral
Sea anemone or true coral - colony	Removed
Vascular plant	
Zooplankton	
Terrestrial	
Amphibian	
Bird	
Bird egg	Removed

Original	Revised
Detritivorous - invertebrate	Arthropod – Detritivorous
Flying insects	
Gastropod	Mollusc - Gastropod
Grassess and herbs	
Lichen & bryophytes	
Mammal(Deer)	Mammal – large
Mammal(Rat)	Mammal – small-burrowing
Reptile	
Shrub	
Soil Invertebrate (worm)	Annelid
Tree	

CR_{wo} and Kd values are assumed to be log-normally distributed in the ERICA Tool when based upon empirical data. When values were derived by extrapolation approaches or if no standard deviation estimate was available for an empirically derived value, then an exponential distribution was assumed in the original Tool. There has been a attempt to avoid using exponential distribution assumptions in the revised Tool on the basis that it did not make best use of available knowledge and, most especially in aquatic ecosystems, it resulted in some extreme estimates of EMCL values. Therefore, in the updated Tool databases approaches such as Bayesian statistics have been used to derive SD values when they are not available.

Table 2. Revised extrapolation approaches used in the ERICA Tool

Ref (code)	**Descriptor**
1	Similar reference organism
2	From published review
3	Modelling approaches
4	Element of similar biogeochemistry for reference organism
5	Element of similar biogeochemistry for similar reference organism
6	Highest available value
7	Estuarine data
8	Highest animal value
9	Highest plant/algae value
10	Combined method*

*using one or more of the above approaches and/or methods to derive a missing SD value.

The original ERICA Tool applied a number of marine Kd values for the freshwater ecosystem – where possible these have been replaced by values derived in freshwater environments.

Environmental Media Concentration Levels (EMCLs)

EMCL values are being derived using the revised transfer parameters, distributions and where appropriate geometries/occupancies. The EMCL is the media activity concentration that gives rise to the highest 95th percentile predicted dose rate to any Reference Organism in an ecosystem type. To ensure conservatism, where extrapolation approaches have been used to derive transfer parameter values the revised ERICA Tool may use 99th percentile predicted dose rates to calculate EMCL values – this is under discussion at the time of writing (March 2014). The application of the 95th percentile will be retained where transfer parameters are based on empirical data.

Uncertainty factors

In Tier 2 of the ERICA Tool uncertainty factors (UFs) that are intended to provide an approximation of the 95th or 99th percentile risk quotient (RQ) are used. The 95th and 99th percentiles of the RQ are estimated by multiplying the expected value of the RQ by an uncertainty factor. The values of UF used in the original ERICA Tool were 3 and 5 to provide approximations of the 95th and 99th percentile RQs respectively. There has been some discussion of if these are the most appropriate values of UF to use (see Avila et al below). Currently, the values of UF which will be included in the revised Tool are being evaluated using probabilistic estimations of EMCL values using the revised Tool parameters.

Relevant reading

Brown J.E, Beresford N.A. Hosseini A. 2013. Approaches to providing missing transfer parameter values in the ERICA Tool - How well do they work? J. Environ. Radioact. 126, 399-411. http://dx.doi.org/10.1016/j.jenvrad.2012.05.005

Hosseini, A., Stenberg, K., Avila, R., Beresford, N.A. & Brown, J.E. 2013. Application of the Bayesian approach for derivation of PDFs for concentration ratio values. J. Environ. Radioact. 126, 376-387. http://dx.doi.org/10.1016/j.jenvrad.2013.04.007

Avila, R., Beresford, N., Brown, J., Hosseini, A. 2014. The selection of parameter values in studies of environmental radiological impacts. J. Radiol. Prot. 34, 261-262. http://stacks.iop.org/0952-4746/34/261