Question from Dr. Craig Yoder:

The question is a point of clarification. On page 6-7 of the draft, lines 9-12 and 19-23 seem to define the MDC as that concentration that has less than a 5% probability for which the measured value will less than the 95% upper confidence interval for the distribution of background measurements. That is, the MDC is that point when 95% of the measured values will exceed the critical level, Lc. I believe this makes the MDC equal to Ld, the detection limit as defined on line 7. This is the definition that I am used and it might be useful to state this explicitly. I want to confirm this because the example provided based on pure counting statistics ignores all of the other sources of measurement method uncertainty such that Ld will normally be much higher than that predicted solely on Poisson counting statistics. I would restate the MDC as that value around which the lower bound of the expanded uncertainty (k=2) is at Lc. As defined in MARLAP, method uncertainty is defined at a specific value that would be based on the DCGL in MARSSIM if I understand the concept correctly. The subtlety arises in the value at which the method uncertainty is observed may be different from the MDC and this may impact the MQO processes. It may also impact the MARSSIM intent to combine detectability with quantifiability. Generally, one is advised against comparing a specific measured value against the MDC because the MDC is method characteristic for instrument and procedure selection. I applaud the team for wanting to include measurement uncertainty and it is an important step forward but it does introduce more issues for consideration that what some of the examples would have one believe.

Response from the MARSSIM Workgroup (with thanks to Dr. David Stuenkel of the U.S. EPA for crafting the response):

It is correct that the values of L_D and MDC both correspond to the quantity of radioactive material that can be detected with a probability of 95% (i.e. result in a measurement of net activity above the critical level). The difference between L_D and MDC is in the units used to express this quantity of radioactive material. The values of L_C and L_D, as provided for in Equations (6-1) to (6-4) are in units of net counts (assuming the count time of any background [e.g. blank] and sample are the same). By itself, the number of counts is a not very meaningful. The same number of counts could correspond to different activity concentrations depending on the detector efficiency, count time, etc. The MDC as provided in Equation (6-5) translates this value of L_D into a minimum detectable concentration (MDC) in more meaningful units, such as becquerels per kilogram (Bq kg-1).

There is an assumption in this derivation of MDC (and many others) that the source of variability (uncertainty) in the final number is predominately from counting statistics. As the commenter mentioned, this may not always be true. If there are other non-negligible sources of uncertainty, this could lead to higher probabilities of both false positives and false negatives and a possible underestimation of the MDC. To improve the chapter, the discussion of MDC could be revised to first present the calculation of MDC in terms of the variability when no radioactive material is present, σ_B (as estimated through repeated measurements of blank samples), and then include MDC based on counting statistics as a special or limiting case.