United States Environmental Protection Agency (USEPA)

Background Study Report for Santa Susana Field Laboratory (SSFL)

Discussion of General Comments and EPAs Responses

September 28, 2011

Radiological Background Study Objectives

- The purpose of the Background Study is to determine the level of “ambient or background” radioactivity found in soil.

- The Background Study Report will be used in part to assist the State of CA in developing Clean-Up Values for the Look-Up Table as required by the Administrative Order on Consent (AOC). DOE, NASA and DTSC are parties to this AOC.

Agenda

- Brief Overview of SSFL Radiological Background Study Report
- Stakeholder General Comments on the SSFL Radiological Background Study Report
  1. Determining Background Threshold Values (BTVs) for Radionuclides with No or Few detections
  2. Potential Biases in Analytical Data (i.e., Spectral Interference)
  3. Potential of False Positives During Onsite Soil Sampling
  4. Potential Removal of Some Radionuclides from Further Consideration
  5. Comments on the Inclusion/Omission of Outliers
  6. Treatment of non-detect (ND) values in the BTV Calculations (i.e., use of the Kaplan-Meier Method)

Develop BTVs
Final Application

- Once the applicable data sets were determined, BTVs were calculated.

- Chose the best statistic to represent the BTV
  - 95% Upper Simultaneous Limit (USL95)

- Requirements of the AOC
  - Develop a Look-Up Table based on BTVs and practical application.
  - No averaging.
  - Compare individual discrete samples.

Summary of the Analyte Classifications from the Background Study Data

1. Radionuclides with **less** than 5 detections

2. Radionuclides with **greater or equal to** 5 detections
   - Radionuclides with one BTV from combined data
   - Radionuclides Exhibiting Differences Between Surface Soil and Subsurface Soil
   - Radionuclides Exhibiting Differences Between Geologic Formations
   - Radionuclides Exhibiting Variability Between RBRAs and Datasets

3. Rejected Results

Management Decisions for the Development of Look-Up Table Values

1. Use of agricultural Preliminary Remediation Goals (PRGs) when they are Higher than the BTV

2. Use of the Highest BTV when separate values were calculated for Surface and Subsurface Soils

3. Use of Combined BTVs when separate values were calculated for each Geologic Formation

4. Use of Combined BTVs when separate values were calculated for each RBRA or Dataset

5. Potential Removal of Some Radionuclides from Further Consideration

Determining BTVs for Radionuclides with No or Few Detections

- General Comment #1
  - Selection of the highest ND as the BTV increases the possibility of false positives.

- EPA Response
  - Minimum of 5 detections was necessary to make the statistical calculations.
  - EPA believes that any detection in a dataset consisting mostly NDs must be evaluated with caution.
  - A request that allows consideration of the maximum detected value for cleanup decisions can be made to the DTSC during the Look-Up Table review and comment period.

Potential Biases in Analytical Data (i.e., Spectral Interference)

- General Comment #2
  - Possible false detects for radionuclides analyzed using gamma spectroscopy due to interference with gamma peaks from naturally occurring radionuclides.

- EPA Response
  - Radionuclides that are subject to a known and consistent positive bias from ubiquitous, naturally occurring radionuclides, are believed to be acceptable for their intended use.
  - Background data that suffers from spectral interference but which is not similarly reliable or useable for its intended purpose has been appropriately rejected.

Potential of False Positives During Onsite Soil Sampling

- General Comment #3
  - Since there are cases when the BTV is less than the measured maximum in the background dataset, false positive errors will occur when compared to onsite data (i.e., contamination will be identified when it is really background). In the case when the BTV is less than the maximum value, revise the BTV to the maximum measured value, or include an additional step that allows consideration of the maximum detected value for cleanup decisions.

- EPA Response
  - EPA attempted to maintain a proper balance between the potential of false positives and false negatives when comparing results to onsite data. EPA believes that the use of the USL95 strikes this balance.
  - Final Clean-Up Values will be submitted by the DTSC for stakeholder review and comment. A request that allows consideration of the maximum detected value for cleanup decisions can be made to the DTSC during the Look-Up Table review and comment period.

Potential Removal of Some Radionuclides from Further Consideration

- General Comment #4
  - Some stakeholders believe that some radionuclides should be removed from further consideration because they are daughter products with short half-lives.
  - Other stakeholders are against removing any radionuclides from further consideration.
- EPA Response
  - EPA will not remove radionuclides from the Background Study Report, however, the removal of certain radionuclides may be considered by DTSC in the development of the Final Look-Up Table.

Comments on the Inclusion/Omission of Outliers

- General Comment #5
  - Given the solid foundation for the background study sample locations and the DTL conclusion, some stakeholders question why some outliers were excluded from the BTV calculations.

- EPA Response
  - Most of the data sets collected from the various strata are fairly consistent with low variability. Considering the amount of data that were processed, not many outliers were identified in the various RBRA data sets.
  - For each radionuclide, the objective was to establish a defensible background data set represented by a “single” population free of outliers potentially representing impacted observations.
  - To control the number of false negatives, it is recommended not to include moderate to extreme outliers in the computation of USL95. USL95 should be computed based upon a data set representing the main dominant population.

Treatment of ND values in the BTV Calculations (i.e., use of the Kaplan-Meier Method)

- General Comment #6
  - Some stakeholders question the application of the Kaplan-Meier (KM) method to uncensored radionuclide data.

- EPA Response
  - At present, to the best of our knowledge, the non-parametric KM method is the most appropriate method (Singh, Maichle, and Lee, 2006) to compute various statistics of interest based upon data sets consisting of NDs (censored or uncensored), especially negative NDs.

United States Environmental Protection Agency (USEPA)

Santa Susana Field Laboratory (SSFL)

Discussion of Radiological Trigger Levels For Further Investigation

September 28, 2011

Overview: Radiological Trigger Levels

- Define terms used in this discussion
- Considerations
  - AOC provisions
  - List of radionuclides to evaluate
- What are Radiological Trigger Levels
  - How are they developed
  - How will they be applied to site soil results
- (Preliminary) Radiological Trigger Level Table
  - Examples of radionuclide trigger level approach

Terminology

BTV – Background Threshold Value

PRG – Preliminary Remediation Goal

MDC – Minimum Detectable Concentration

MDA – Minimum Detectable Activity (from the AOC)

NORM – Naturally Occurring Radioactive Material

Develop Radiological Trigger Levels from Recommended BTVs, 10^{-6} PRGs, and Minimum Detectable Concentrations

Evaluate Site Radiological Results From Low and High Contamination Subareas Using Radiological Trigger Levels

Apply Trigger Levels To Round 1 Results and Recommend Radiological Look Up Table Values To DTSC

AOC Requirements

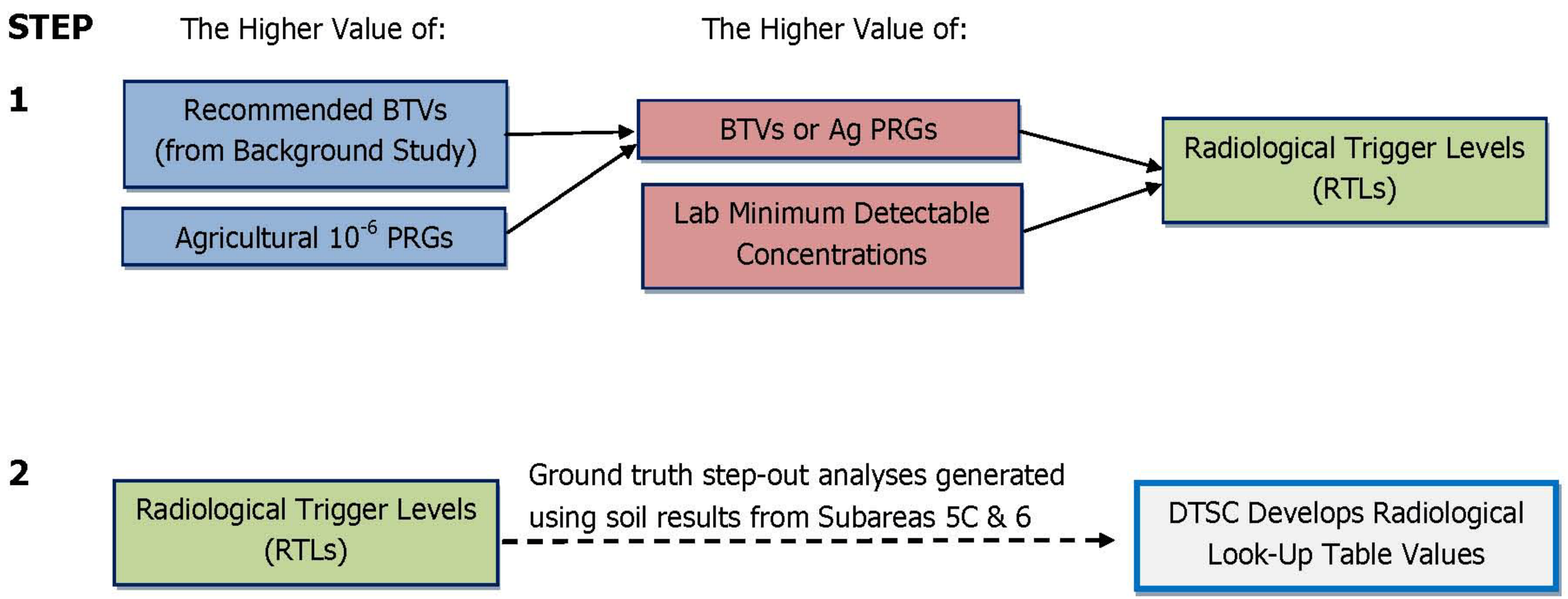
"For radiological contaminants, "detection limit" means minimum detectable activity (or MDA), which is defined as the smallest amount of activity that can be quantified for comparison with regulatory limits." **(p. 5)**

"US EPA, in the course of conducting its radioactive contaminant background study, will determine local background levels and detection limits. Upon completion of the EPA led radiologic local background study, a "look-up" table of the radiologic cleanup levels will be prepared [DTSC], which will *include both local background concentrations as well as minimum detection limits [MDC] for specific contaminants whose minimum detection limits [MDC] exceed local background concentrations*." **(AIP, p. 2)**

Radionuclides To Be Screened

- The Radiological Study reduced the number of radionuclides from those of the Background Study and adopted the use of default and site-specific analytical suites (65)
- Background Study recommends removal of four radionuclides from further evaluation due to gamma spectral interferences: Ag-108, Ag-108m, Ba-133, and Cf-249 (61)
- Ac-228, Ba-137m, Rn-220, Rn-222, Th-231, and U-240 have short half-lives (minutes to hours) and are linked to parent radionuclides, thus it is illogical to screen using both (55)

Development of Radiological Trigger Levels

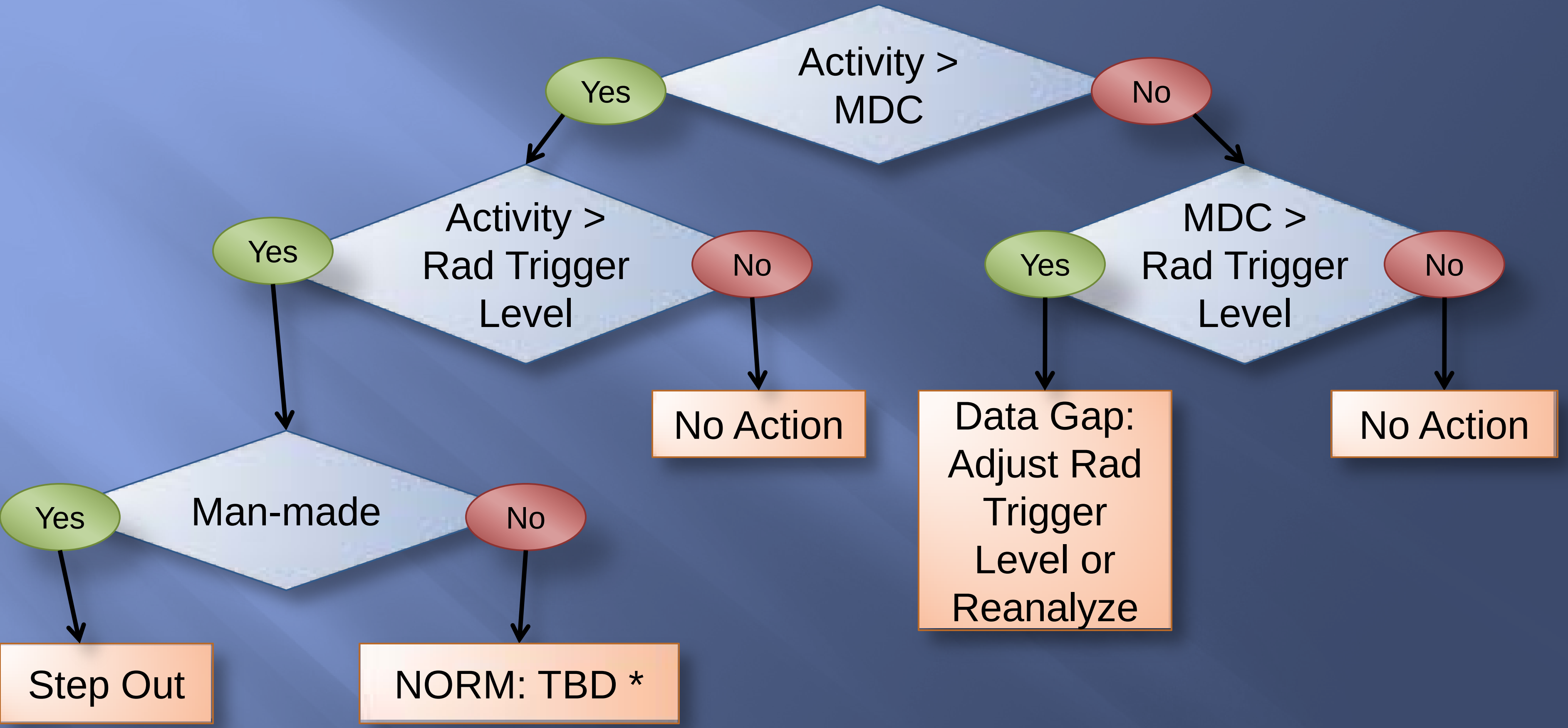


Choosing The Higher Value Of The BTV, 10^{-6} PRG, and Lab MDCs

- BTVs are background study recommendations describing ambient background concentrations, from a statistical pool of up to 149 sample results
- In lieu of attaining a BTV or PRG concentration, practically achievable MDCs are selected

Analytical Result Decision Tree

Preliminary Draft - For Discussion Purposes Only



* The AOC mentions the use of provisions for evaluating results of naturally occurring decay series of U, Th, and Ra

Combine BTVs, PRGs, and MDCs (1 of 3)

Radionuclide	Method	BTV (pCi/g)	Agricultural 10^{-6} PRG (pCi/g)	Lab A Estimated MDC UCL	Lab B Estimated MDC UCL	Background Estimated MDC UCL	Rad Trigger Level Source
actinium-227+D	Gamma 1	1.27E-01	8.31E-02	1.82E-01	1.84E-01	3.59E-01	MDC
antimony-125+D		3.21E-01	4.60E-01	4.64E-02	5.42E-02	8.98E-02	PRG
bismuth-212		2.04E+00	2.24E+04	1.47E-01	1.80E-01	1.60E-01	PRG
bismuth-214		1.57E+00	8.19E+03	2.86E-02	3.38E-02	4.00E-02	PRG
cadmium-113m		2.95E+03	5.26E-03	5.24E+01	5.28E+01	1.22E+04	BTV
lead-212		2.67E+00	8.00E+01	3.42E-02	3.48E-02	8.39E-02	PRG
lead-214		1.68E+00	3.49E+04	3.14E-02	3.41E-02	3.29E-02	PRG
cesium-134		3.00E-02	7.47E-03	1.60E-02	7.42E-02	6.55E-02	MDC
cesium-137+D		1.93E-01	1.20E-03	1.71E-02	2.06E-02	3.23E-02	BTV
cobalt-60		5.56E-03	9.01E-04	1.91E-02	2.40E-02	1.92E-02	MDC
europium-152		1.69E-02	3.76E-02	4.46E-02	4.86E-02	8.46E-02	MDC
europium-154		2.51E-02	4.72E-02	1.02E-01	1.29E-01	1.86E-01	MDC
europium-155		1.98E-01	3.74E+00	6.43E-02	4.63E-02	1.82E-01	PRG
holmium-166m		3.65E-02	1.10E-02	2.66E-02	3.27E-02	5.48E-02	BTV
neptunium-236		3.14E-02	2.81E-03	3.34E-02	4.03E-02	1.16E-01	MDC
neptunium-239		4.27E-02	2.26E+01	1.20E-01	1.11E-01	3.19E-01	PRG
niobium-94		1.65E-02	1.15E-02	1.54E-02	1.84E-02	2.70E-02	MDC
potassium-40		3.05E+01	4.45E-02	1.29E-01	1.86E-01	4.35E-01	BTV
protactinium-231		7.91E-01	2.10E-01	7.41E-01	7.45E-01	1.61E+00	BTV
sodium-22		7.87E-03	8.52E-02	2.32E-02	3.18E-02	6.32E-02	PRG
tellurium-125m		7.61E-02	3.20E+01	1.07E-02	1.25E-02	2.07E-02	PRG
thallium-208		9.23E-01	2.26E+04	1.83E-02	2.34E-02	2.08E-02	PRG
thulium-171		6.59E+01	1.25E+03	1.42E+01	8.67E+00	4.07E+01	PRG
tin-126		4.90E-03	7.11E-01	1.70E-02	2.03E-02	3.47E-02	PRG

Naturally Occurring Radionuclides
Maximum Non-Detect BTV Suggests Use of MDC
MDC Estimated
Background MDC UCL for comparison

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Rad Trigger Levels To Be Determined

Combine BTVs, PRGs, and MDCs (2 of 3)

Radionuclide	Method	BTV (pCi/g)	Agricultural 10^{-6} PRG (pCi/g)	Lab A Estimated MDC UCL	Lab B Estimated MDC UCL	Background Estimated MDC UCL	Rad Trigger Level Source
strontium-90+D (Y-90)	Sr-Y	7.50E-02	1.39E-03	4.17E-01	6.22E-02	2.07E-02	MDC
thorium-228+D	Th-isotopic	3.67E+00	3.38E-02	1.69E-01	2.11E-02	1.29E-01	BTV
thorium-230		2.04E+00	1.05E-02	9.28E-02	1.19E-02	7.30E-02	BTV
thorium-232		2.95E+00	9.42E-03	8.79E-02	1.23E-02	5.07E-02	BTV
thorium-234		3.04E+00	1.53E+01	2.61E-01	2.22E-01	7.53E-01	PRG
thorium-229+D	Th-229	4.62E-02	1.71E-03	1.25E-01	1.67E-02	1.09E-01	MDC
uranium-233/234	U-isotopic	1.87E+00	1.84E-03	7.49E-02	1.09E-02	6.34E-02	BTV
uranium-235+D/236		1.30E-01	1.81E-03	6.65E-02	1.05E-02	4.13E-02	BTV
uranium-238+D		1.68E+00	1.47E-03	6.54E-02	9.57E-03	4.85E-02	BTV
uranium-232	U-232	5.65E-02	5.90E-04	1.01E-01	1.46E-02	1.75E-01	MDC
plutonium-238	Pu-isotopic	4.25E-03	7.31E-03	3.56E-02	8.40E-03	9.75E-03	MDC
plutonium-239/240		1.42E-02	6.09E-03	3.47E-02	6.29E-03	1.01E-02	MDC
plutonium-242		2.46E-03	6.42E-03	3.49E-02	1.33E-02	8.85E-03	MDC
plutonium-236	Pu-236	1.84E-02	1.04E-01	3.85E-02	7.78E+00	3.92E-02	MDC
plutonium-244+D	Pu-244	1.56E-03	5.06E-03	2.69E-02	4.91E-03	6.90E-03	MDC
plutonium-241	Pu-241	3.49E-01	1.05E+00	8.91E+00	6.03E-01	8.58E-01	MDC

Legend:
- (green) Naturally Occurring Radionuclides
- (blue) Maximum Non-Detect BTV Suggests Use of MDC
- (orange) MDC Estimated
- (purple) Background MDC UCL for comparison

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Rad Trigger Levels To Be Determined

Combine BTVs, PRGs, and MDCs (3 of 3)

Radionuclide	Method	BTV (pCi/g)	Agricultural 10^{-6} PRG (pCi/g)	Lab A Estimated MDC UCL	Lab B Estimated MDC UCL	Background Estimated MDC UCL	Rad Trigger Level Source
americium-241	Am-Cm Isotopic	1.62E-02	1.32E-02	3.90E-02	1.57E-02	3.62E-02	MDC
curium-243/244		1.47E-02	1.27E-02	3.80E-02	1.41E-02	4.07E-02	MDC
curium-245/246		1.62E-02	9.22E-02	2.63E-02	1.29E-02	3.48E-02	MDC
curium-248	Cm-248	2.34E-02	1.43E-03	2.86E-02	9.75E-03	2.92E-02	MDC
americium-243+D	Am-243	1.34E-02	1.11E-02	3.45E-02	1.57E-02	3.40E-02	MDC
neptunium-237+D	Np-237	1.09E-02	4.48E-04	3.44E-02	1.22E-02	4.60E-02	MDC
radium-226+D	Gamma 2	1.88E+00	6.32E-04	2.86E-02	3.38E-02	7.35E-02	BTV
radium-228+D		2.30E+00	1.16E-03	1.00E-01	1.18E-01	1.32E-01	BTV
tritium (H-3) organic	H-3	7.38E+00	1.60E-01	1.02E+01	9.72E-02	7.98E+00	MDC
carbon-14	C-14	2.54E+00	5.63E-05	8.79E-01	3.14E-02	4.69E+00	MDC
iron-55	Fe-55	5.08E+00	8.21E-01	5.10E+00	7.37E-01	2.82E+01	MDC
nickel-59	Ni-59	3.44E-01	2.15E+00	5.12E+00	1.81E-02	1.07E+00	MDC
nickel-63	Ni-63	4.52E-01	1.01E+00	4.23E+00	5.26E-01	1.35E+00	MDC
technetium-99	Tc-99	3.68E-01	5.57E-03	1.40E+00	8.50E-02	5.10E-01	MDC
promethium-147	Pm-147	4.96E+00	6.69E+02	1.50E+01	2.37E+00	7.72E+00	PRG

Legend:
- (green) Naturally Occurring Radionuclides
- (blue) Maximum Non-Detect BTV Suggests Use of MDC
- (orange) MDC Estimated
- (purple) Background MDC UCL for comparison

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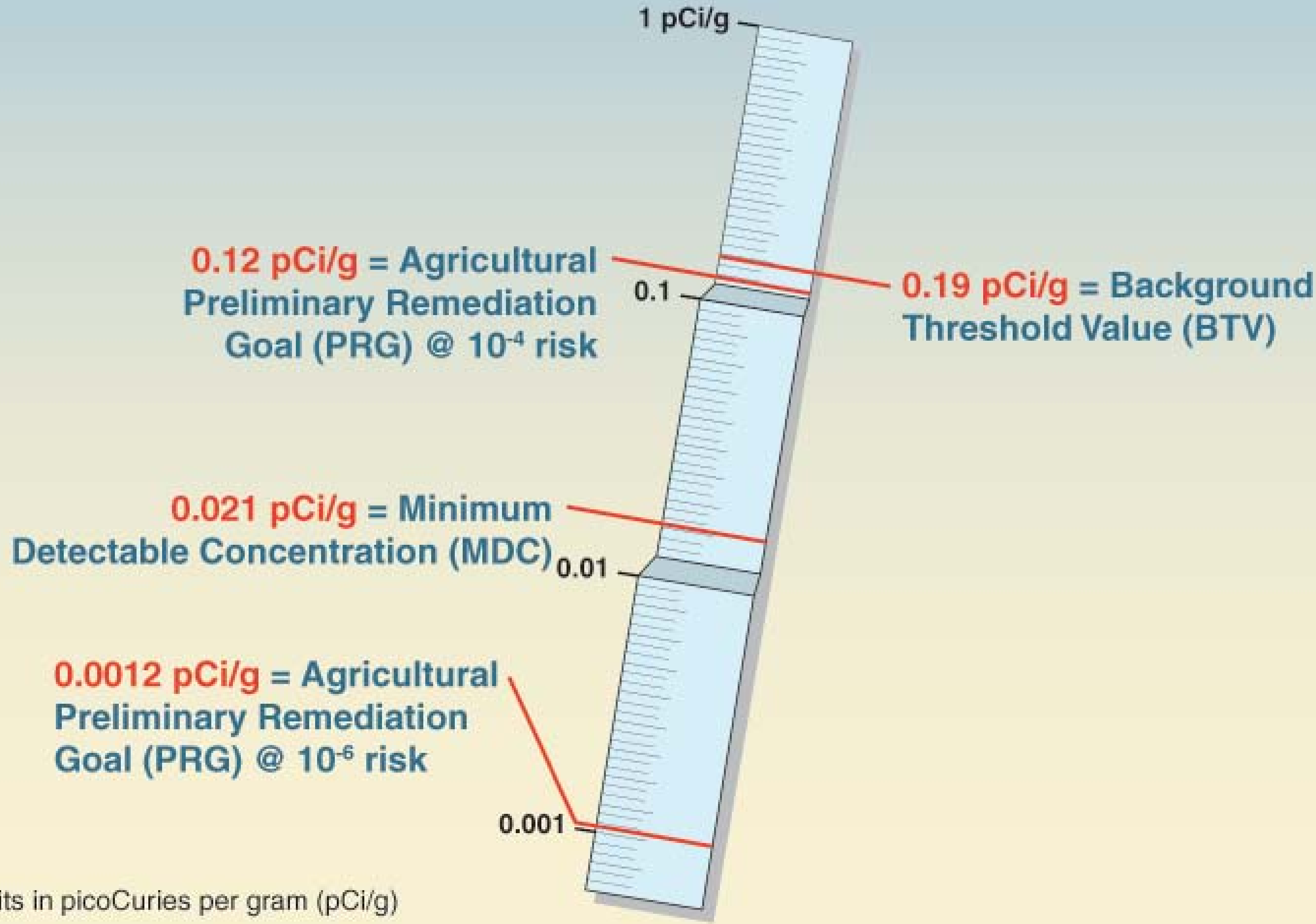
Rad Trigger Levels To Be Determined

Why are some BTV values lower than attainable lab MDCs ?

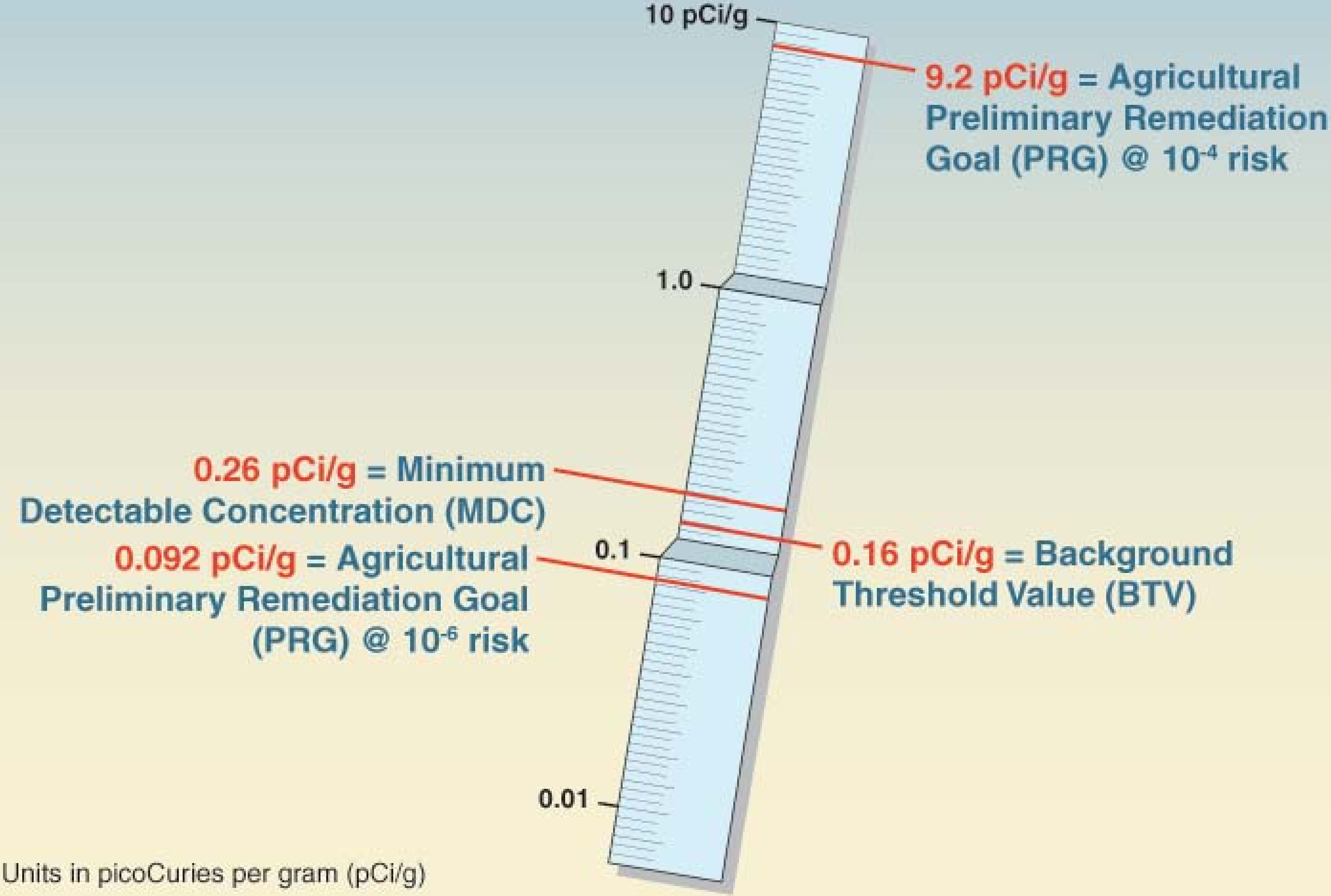
- The BTVs are obtained by **up to 149 sample measurements** and are a function of the statistical “cohesiveness” of that pool of data
- A lab MDC is a concentration for an **individual sample result**
- In several cases, the MDC of a single sample cannot be achieved at or below a BTV

Comparison of Agric. PRGs, BTV, and MDC for Cesium-137 (^{137}Cs) in Soil



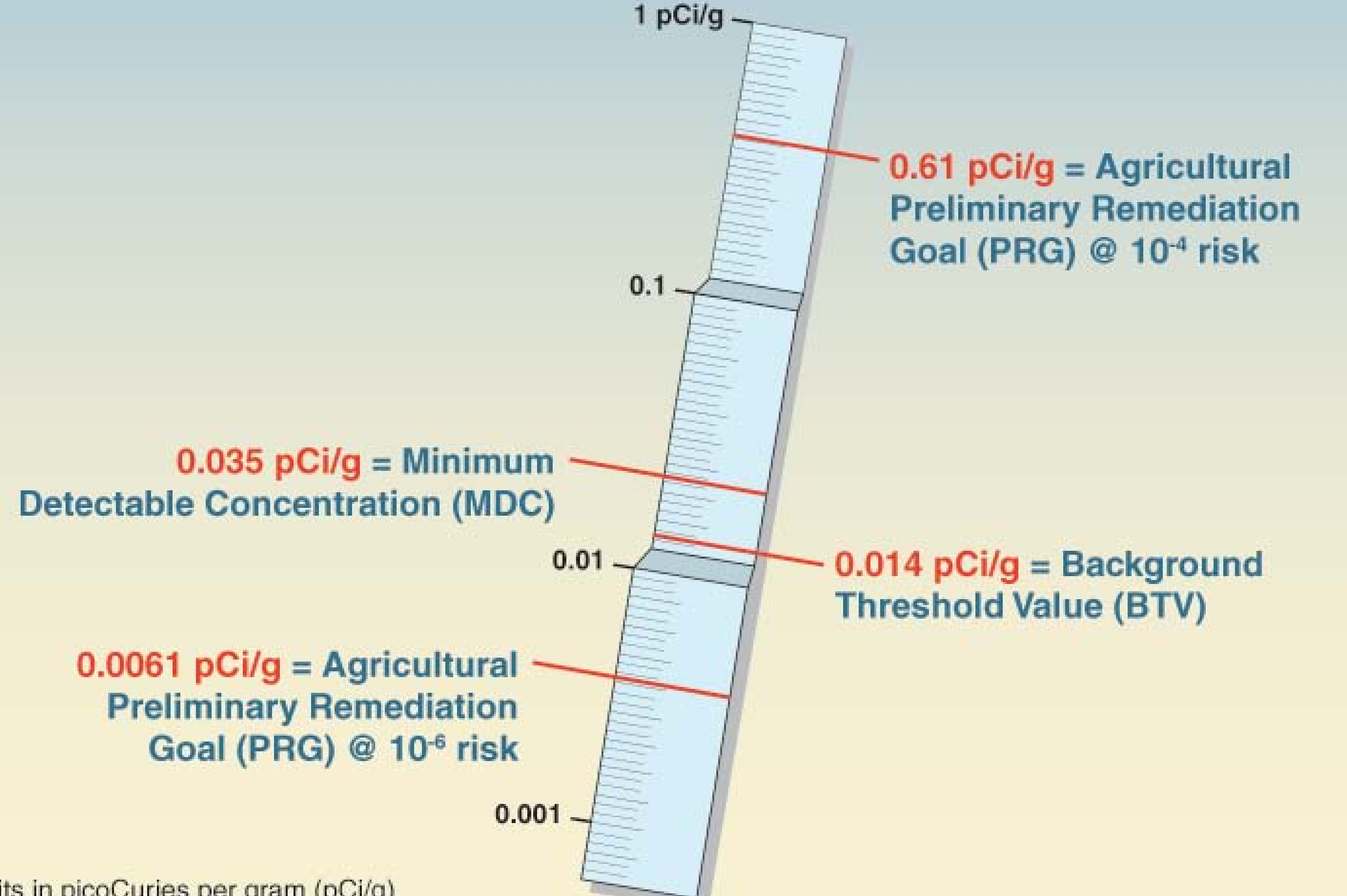
Units in picoCuries per gram (pCi/g)

Comparison of Agric. PRGs, BTV, and MDC for Curium-245/246 ($^{245/246}Cm$) in Soil



Units in picoCuries per gram (pCi/g)

Comparison of Agric. PRGs, BTV, and MDC for Plutonium-239/240 ($^{239/240}Pu$) in Soil



Units in picoCuries per gram (pCi/g)

Next Steps

- Compare 5C results to Rad Trigger Levels
- Produce a technical memorandum with rationale for selection of Rad Trigger Levels to determine Round 2 soil sample locations
- Develop Round 2 Field Sampling Plan with stakeholder input
- Field Soil Sampling

Questions?