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7. Abstract

This document provides estimates of how well the mean concentration of analytes are known as a function of the number of core samples, the number of composite samples, and the number of replicate analyses. The results are based upon core composite data from nine single-shell tanks. The results can be used to determine the number of core samples needed to "characterize" the waste in similar tanks.

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**NUMBER OF CORE SAMPLES: MEAN CONCENTRATIONS
AND CONFIDENCE INTERVALS**

January 1995

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LIST OF TERMS

CI	confidence interval
Dir.	direct
Fluor.	fluorometric
GEA	gamma energy analysis
HW	half-width
IC	ion chromatography
IC.w.	ion chromatography of a water leached sample
ICP	inductively coupled plasma
ICP.a.	inductively coupled plasma analysis of an acid digested sample
ICP.f.	inductively coupled plasma analysis of a fusion digested sample
ICP.w.	inductively coupled plasma analysis of a water leached sample
KOH/Ni	Potassium Hydroxide/Nickel
RHW	relative half-width
RS	residual solids
Spec.w.	spectroscopic method of a water leached sample
TA	total beta
TB	total alpha
TDS	total dissolved solids
TGA	thermal gravimetric analysis
TIC	total inorganic carbon
TOC	total organic carbon
μg/g	micrograms per gram
μCi/g	microcuries per gram

NUMBER OF CORE SAMPLES: MEAN CONCENTRATIONS AND CONFIDENCE INTERVALS

1.0 SUMMARY

This document provides estimates of how well the mean concentrations of analytes are known as a function of the number of core samples, composite samples, and replicate analyses. The estimates are based upon core composite data from nine recently sampled single-shell tanks. The results can be used when determining the number of core samples needed to "characterize" the waste from similar single-shell tanks.

A standard way of expressing uncertainty in the estimate of a mean is with a 95% confidence interval (CI). We investigate how the width of a 95% CI on the mean concentration decreases as the number of observations increase. Specifically, the tables and figures show how the "relative half-width" (RHW) of a 95% CI decreases as the number of core samples increases. The RHW of a CI is a unit-less measure of uncertainty.

The general conclusions are as follows.

- The RHW decreases dramatically as the number of core samples is increased. The decrease is much smaller when the number of composite samples or the number of replicate analyses are increased.
- If the mean concentration of an analyte needs to be estimated with a "small" RHW, then a "large" number of core samples is required.

The estimated number of core samples given in the tables and figures were determined by specifying different sizes of the RHW. Four nominal sizes were examined: 10%, 25%, 50%, and 100% of the observed mean concentration.

For a majority of analytes the number of core samples required to achieve an accuracy within 10% of the mean concentration is extremely large. In many cases, however, two or three core samples is sufficient to achieve a RHW of approximately 50 to 100%. Because many of the analytes in the data have small concentrations, this level of accuracy may be satisfactory for some applications.

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2.0 INTRODUCTION

A statistical analysis of waste characterization data from nine single-shell tanks (BX-107, C-109, C-110, C-112, S-104, T-104, T-105, T-107, and T-111) has been completed. The results of the statistical analyses, based upon analysis of variance methods applied to core composite data, are given in the references.

Core samples consist of several disjoint segments which represent, from top to bottom, the waste in the tank. Core composite samples are made by homogenizing individual segments and then combining material from these segments into a single sample. In some cases two core composite samples are created from each core.

When core composite samples are formed, vertical variability in the waste is removed. Core composite samples are used to estimate analyte mean concentrations and to predict tank inventory.

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3.0 DESCRIPTION OF THE DATA

Table 3-1 gives the number of core samples and the number of composite samples per core for each of the nine tanks. Two replicate analyses were done on each core composite.

Table 3-1. Number of Observations Per Tank.

Tank	Number of core samples	Number of composite samples	Number of observations per analyte	Number of analytes
BX-107	2	2	8	74
C-109	3	1	6	33
C-110	3	2	12	79
C-112	3	1	6	33
S-104	3	2	12	63
T-104	2	2	8	80
T-105	2	1	4	71
T-107	2	1	4	74
T-111	2	2	8	85

The chemical analyses performed on the samples were the following:

- inductively coupled plasma (ICP) analysis of an acid digested sample (ICP.a)
- ICP of a potassium hydroxide/nickel (KOH/Ni) fused sample (ICP.f)
- ICP analysis of a water leached sample (ICP.w)
- ion chromatography (IC) of a water leached sample (IC.w)
- radiochemistry.

The tables in the appendix identify results using the above notation. For example, ICP.a.Al refers to the Al concentration from an ICP analysis of an acid digested sample.

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4.0 STATISTICAL RESULTS

Analysis of variance methods were used to estimate three variance components from the core composite data: the spatial variability, $\hat{\sigma}^2(S)$; the compositing variability, $\hat{\sigma}^2(C)$; and the analytical measurement variability, $\hat{\sigma}^2(A)$. Compositing variability can only be estimated from data with more than one composite sample per core. Tables of the variance components are given in the references.

The half-width of a CI can be calculated using Equation (1). The half-width is a measure of how well a mean estimate is known. A small half-width indicates that the uncertainty associated with a mean concentration estimate is small, a large half-width indicates that the uncertainty is large.

$$HW(a, b, n) = t_{(a-1)} \sqrt{\frac{\hat{\sigma}^2(S)}{a} + \frac{\hat{\sigma}^2(C)}{ab} + \frac{\hat{\sigma}^2(A)}{abn}} \quad (1)$$

Using Equation (1), the number of core samples (a), the number of composite samples (b), and the number of replicate analyses (n) can be varied to study how the width of the CI changes.

The term $t_{(a-1)}$ is a value from Student's t distribution with a-1 degrees of freedom. Student's t distribution is used to account for the uncertainty in the estimates of the variances.

The numbers a, b, and n are in the denominators of Equation (1), consequently the terms $\hat{\sigma}^2(S)/a$, $\hat{\sigma}^2(C)/ab$, and $\hat{\sigma}^2(A)/abn$ decrease as the numbers a, b, and n increase. The number of core samples, a, has the most influence on the width of the CI because it is in all three terms. The values from Student's $t_{(a-1)}$ distribution also depends on the number of core samples. For a two sided 95% CI, the appropriate quantile points with one, two, and three degrees of freedom are 12.706, 4.303, and 3.182.

The RHW, in %, of a CI is the half-width divided by the mean analyte concentration $\bar{y}$. The formula for the RHW of a CI is given in Equation (2),

$$RHW(a, b, n) = HW(a, b, n) * 100 / \bar{y}. \quad (2)$$

In this document, the RHW is used to determine how the width of the CI decreases as the number of core samples, composite samples, and replicate analyses increase.

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5.0 NUMBER OF OBSERVATIONS

5.1 CHANGE IN RELATIVE HALF-WIDTH

The results given in this section were obtained by varying values of the numbers a, b, and n. The values $\hat{\sigma}^2(S)$, $\hat{\sigma}^2(C)$, $\hat{\sigma}^2(A)$, and $\bar{y}$ were obtained from the sampling data from a given tank. The values of these four parameters can be found in the references.

For several analytes in BX-107, Table 5-1 shows how dramatically the CI half-width decreases as the number of core samples is increased. The first column in Table 5-1 gives the analyte using the notation of Section 3.0. The second column gives the mean concentration estimate, $\bar{y}$, for the analyte in $\mu\text{g/g}$ (parts per million). The remaining columns report the RHW for different combinations of the numbers (a,b,n).

Table 5-1. Relative Half-Width of 95% Confidence Intervals on the Mean (BX-107).

	Mean	(a,b,n)*						
Analyte	$\mu\text{g/g}$	(2,2,2)#	(3,2,2)	(4,2,2)	(2,3,2)	(2,4,2)	(2,2,3)	(2,2,4)
ICP.a.Al	1.42E+04	191%	53%	34%	191%	191%	191%	191%
ICP.a.Na	1.02E+05	11%	3%	2%	9%	8%	10%	10%
ICP.f.Al	1.43E+04	122%	34%	22%	112%	107%	121%	120%
ICP.f.Na	1.00E+05	24%	7%	4%	20%	17%	24%	24%
ICP.w.Al	1.34E+02	463%	128%	82%	378%	328%	453%	448%
ICP.w.Na	6.81E+03	148%	41%	26%	130%	120%	130%	120%
IC.w.F	9.19E+03	100%	28%	18%	92%	87%	100%	100%
IC.w.Cl	1.14E+03	36%	10%	6%	30%	26%	35%	35%
IC.w.PO4	1.42E+04	39%	11%	7%	37%	36%	39%	39%
IC.w.SO4	1.34E+04	70%	19%	12%	69%	69%	70%	70%

*: a=number of core samples, b=number of composite samples, n=number of replicate analyses.

#: Observed number of core samples, composite samples, and replicate analyses.

The analyte ICP.a.Al is given in the first row of Table 5-1. The mean concentration of ICP.a.Al is 14,200 $\mu\text{g/g}$ (1.42%). The RHW for two core samples, two composite samples, and two replicate analysis, (2,2,2), is 191%. When the number of core samples is increased from 2 to 3, (3,2,2), the RHW decreases to 53%. Increasing the number of core samples to four, (4,2,2), decreases the RHW to 34%. Changes in the number of composite samples, b, or the number of replicate analysis, n, have a negligible influence on the RHW. Similar results are observed for the other analytes in BX-107, and for each of the nine tanks in this study.

5.2 NUMBER OF CORE SAMPLES

The results in this section were obtained by determining the number of core samples so that the RHW is 10%, 25%, 50%, and 100% of the mean. Tables A-1 to A-9, in the appendix, contain the estimates. Each of these nine tables give the number of core samples on an analyte by analyte basis.

For each of the nine tanks, Figures A-1 to A-9, in the appendix, summarize the results for all of the analytes in a tank. Figure 5-1 combines the results from each of the individual figures.

In the figures, the number of analytes measured were divided into six groups: those that required two cores, three cores, four cores, 5 to 9 cores, 10 to 19 cores, and 20+ cores.

For a RHW of 50%, Table 5-2 gives the percent of the total number of analytes (592) which fall into the six groups. In Figure 5-1, the chart labeled "50 Percent of the Mean" displays the same information.

Table 5-2. All Data, Percent of Analytes with 50% RHW.

Core samples	% of Analytes	Cumulative %
2	14%	14%
3	34%	48%
4	14%	62%
5 to 9	24%	86%
10 to 19	10%	96%
20+	4%	100%

For example, if three core samples are obtained, then 34% of the analytes will have a 95% CI on the mean with a RHW of 50%. Note that if three core samples are obtained, then two core samples are also obtained. This means that with three core samples, 48% (14% + 34%) of the analytes will have a 95% CI on the mean with a RHW of less than or equal to 50%.

A conclusion from the figures is that if the mean concentration is to be estimated so that the width of a 95% CI is small, then a large number of core samples are required. From Figure 5-1, it is evident that if three core samples are obtained, then the half-width of the 95% CI is within 100% of the mean for 70 to 80% of the analytes, or within 50% of the mean for 40 to 50% of the analytes.

With the two cores samples taken from BX-107, T-104, T-105, T-107, and T-111, the observed half-width of the 95% CI was within 100% of the mean for 33%, 69%, 4%, 20%, and 39% of the analytes, respectively. Based on the three cores samples taken from C-109, C-110, C-112, and S-104, the observed half-width of the 95% CI was within 100% of the mean for 51%, 66%, 46%, and 70% of the analytes, respectively. Note the change in the percent of the analytes within the observed CIs as the number of core samples increases from two to three.

Figure 5-1. All Data, Number of Cores Needed to Achieve Desired Accuracy.

10 PERCENT OF THE MEAN

25 PERCENT OF THE MEAN

50 PERCENT OF THE MEAN

100 PERCENT OF THE MEAN

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6.0 CONCLUSION

The tables given in this document can be used to determine the number of core samples needed to "characterize" the waste in unsampled single-shell tanks. Two steps must be followed.

- The desired accuracy for the mean concentration of an analyte must be expressed in terms of a bound on the width of a confidence interval.
- The type of waste in an unsampled single-shell tank must be similar to the waste in one of the nine sampled tanks.

The number of core samples given in the nine tables are to be used to estimate the mean concentration of the analytes in the waste. These numbers are not the number of core samples needed to satisfy complex safety criteria.

In this document the number of core samples required to achieve RHW's of 10, 25, 50, and 100% of the mean, were calculated on a tank by tank basis. No assumptions about the similarity or differences between tanks were used in the calculations. At this time the validity of pooling data from groups of similar tanks is unknown. On an analyte by analyte basis, a statistical comparison between the nine tanks in this study is being performed. The results of this comparison will tell if data from similar tanks can be combined. If data from multiple tanks can be used when calculating estimates, the number of core samples required for a given application could be reduced.

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APPENDIX
FIGURES AND TABLES

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Figure A-1. BX-107, Number of Cores Needed to Achieve Desired Accuracy.

10 PERCENT OF THE MEAN

25 PERCENT OF THE MEAN

50 PERCENT OF THE MEAN

100 PERCENT OF THE MEAN

Table A-1. Predicted Number of Core Samples Required for a Specified
Half-Width of a 95% Confidence Interval in the Mean for BX-107.
(sheet 1 of 3)

Analyte	Mean	Half-Width of Confidence Interval as % of Mean			
	$\mu\text{g/g}$ or $\mu\text{Ci/g}$	10%	25%	50%	100%
ICP.a.Al	1.42E+04	20	6	4	3
ICP.a.B	4.71E+01	31	7	4	3
ICP.a.Ba	8.18E+00	33	8	4	3
ICP.a.Bi	2.42E+04	11	4	3	3
ICP.a.Ca	1.04E+03	123	22	8	4
ICP.a.Ce	1.78E+02	11	4	3	3
ICP.a.Cr	9.58E+02	10	4	3	3
ICP.a.Cu	4.28E+01	263	45	13	6
ICP.a.Fe	1.10E+04	19	6	4	3
ICP.a.K	2.63E+02	14	5	3	3
ICP.a.Mg	1.59E+02	9	4	3	3
ICP.a.Mn	3.98E+01	17	5	3	3
ICP.a.Na	1.02E+05	3	2	2	2
ICP.a.Ni	1.22E+01	16	5	3	3
ICP.a.P	2.31E+04	12	4	3	3
ICP.a.Pb	6.28E+01	24	6	4	3
ICP.a.S	4.57E+03	7	3	3	2
ICP.a.Se	3.26E+02	10	4	3	3
ICP.a.Si	1.66E+03	4	3	2	2
ICP.a.Sr	1.67E+02	6	3	3	2
ICP.a.Ti	3.86E+00	14	5	3	3
ICP.a.Zn	5.95E+01	44	10	5	3
ICP.a.Zr	9.62E+01	5	3	3	2
ICP.f.Al	1.43E+04	10	4	3	3
ICP.f.Bi	2.23E+04	9	4	3	3
ICP.f.Ca	3.96E+02	22	6	4	3
ICP.f.Cr	9.68E+02	6	3	3	2
ICP.f.Cu	5.16E+01	94	18	7	4
ICP.f.Fe	1.11E+04	11	4	3	3
ICP.f.Mg	1.12E+02	11	4	3	3

Table A-1. Predicted Number of Core Samples Required for a Specified Half-Width of a 95% Confidence Interval in the Mean for BX-107.
(sheet 2 of 3)

	Mean	Half-Width of Confidence Interval as % of Mean			
Analyte	$\mu\text{g/g}$ or $\mu\text{Ci/g}$	10%	25%	50%	100%
ICP.f.Mn	6.46E+01	10	4	3	3
ICP.f.Na	1.00E+05	3	2	2	2
ICP.f.Ni	5.68E+03	99	18	7	4
ICP.f.P	2.34E+04	6	3	3	2
ICP.f.S	4.44E+03	7	3	3	2
ICP.f.Si	6.78E+03	7	3	3	2
ICP.f.Sr	1.68E+02	4	3	3	2
ICP.f.Zn	8.33E+01	55	11	5	3
ICP.f.Zr	1.36E+02	33	8	4	3
ICP.w.Al	1.34E+02	105	19	7	4
ICP.w.B	2.50E+01	16	5	3	3
ICP.w.Bi	2.34E+02	280	47	14	6
ICP.w.Ca	4.34E+02	367	61	18	7
ICP.w.Cr	1.51E+02	4	3	3	2
ICP.w.Fe	1.18E+02	273	46	14	6
ICP.w.K	1.47E+02	6	3	3	2
ICP.w.Mg	1.65E+01	231	39	12	5
ICP.w.Na	6.81E+04	13	5	3	3
ICP.w.P	4.79E+03	3	2	2	2
ICP.w.S	4.43E+03	4	3	2	2
ICP.w.Si	2.94E+02	83	16	6	4
ICP.w.Sr	2.46E+00	95	18	7	4
ICP.w.Zn	2.49E+00	413	69	19	7
IC.w.F	9.19E+03	8	4	3	3
IC.w.Cl	1.14E+03	3	3	2	2
IC.w.NO3	1.37E+05	6	3	3	2
IC.w.NO2	8.12E+03	71	14	6	4
IC.w.PO4	1.42E+04	4	3	2	2
IC.w.SO4	1.34E+04	5	3	3	2
Dir.%TGA	5.91E+01	5	3	3	2
Dir.%Water	5.67E+01	3	2	2	2

Table A-1. Predicted Number of Core Samples Required for a Specified
Half-Width of a 95% Confidence Interval in the Mean for BX-107.
(sheet 3 of 3)

	Mean	Half-Width of Confidence Interval as % of Mean			
Analyte	$\mu\text{g/g}$ or $\mu\text{Ci/g}$	10%	25%	50%	100%
Dir.CN	2.49E+00	21	6	4	3
Spec.w.NO2	1.23E+04	5	3	3	2
pH	9.71E+00	2	2	2	2
TIC	1.16E+03	8	4	3	3
Fluor.U	7.68E+03	434	72	20	7
TA	9.63E-02	26	7	4	3
TB	4.67E+01	8	4	3	3
GEA.Cs-137	1.74E+01	68	13	6	4
Pu-239/240	5.72E-02	17	5	3	3
Am-241	1.30E-02	7	4	3	2
Tc-99	3.69E-02	10	4	3	3
Sr-90	9.87E+00	8	4	3	2
H-3	5.77E-04	35	8	4	3

Figure A-2. C-109, Number of Cores Needed to Achieve Desired Accuracy.

10 PERCENT OF THE MEAN

25 PERCENT OF THE MEAN

50 PERCENT OF THE MEAN

100 PERCENT OF THE MEAN

Table A-2. Predicted Number of Core Samples Required for a Specified Half-Width of a 95% Confidence Interval in the Mean for C-109.
(sheet 1 of 2)

Analyte	Mean	Half-Width of Confidence Interval as % of Mean			
	$\mu\text{g/g}$ or $\mu\text{Ci/g}$	10%	25%	50%	100%
ICP.a.Al	5.43E+04	231	39	12	5
ICP.a.Ca	1.50E+04	36	8	4	3
ICP.a.Fe	1.87E+04	133	24	8	4
ICP.a.Na	8.36E+04	6	3	3	2
ICP.a.Ni	1.40E+04	10	4	3	3
ICP.a.P	1.83E+04	19	6	4	3
ICP.a.Pb	3.36E+03	705	115	31	10
ICP.a.U	1.07E+04	68	13	6	4
ICP.f.Al	8.40E+04	237	40	12	5
ICP.f.Ca	1.91E+04	30	7	4	3
ICP.f.Fe	1.77E+04	71	14	6	4
ICP.f.Na	8.79E+04	10	4	3	3
ICP.f.P	1.82E+04	14	5	3	3
ICP.f.Pb	4.05E+03	490	81	22	8
ICP.f.U	1.47E+04	186	32	10	5
ICP.w.Ca	1.07E+02	154	27	9	4
ICP.w.Fe	9.78E+02	11	4	3	3
ICP.w.Na	7.04E+04	14	5	3	3
ICP.w.Ni	6.94E+01	194	33	11	5
ICP.w.P	6.61E+03	49	10	5	3
IC.w.Cl	7.33E+02	5	3	3	2
IC.w.NO2	4.08E+04	6	3	3	2
IC.w.NO3	4.03E+04	13	5	3	3
IC.w.PO4	2.05E+04	49	10	5	3
IC.w.SO4	7.70E+03	16	5	3	3
FREE.CN	8.80E+02	70	14	6	4
TOTAL.CN	8.46E+03	138	25	8	4
U	1.57E+01	176	31	10	5
TA	3.41E-01	717	117	31	10
Sr-90	7.66E+02	175	31	10	5

Table A-2. Predicted Number of Core Samples Required for a Specified
Half-Width of a 95% Confidence Interval in the Mean for C-109.
(sheet 2 of 2)

	Mean	Half-Width of Confidence Interval as % of Mean			
Analyte	$\mu\text{g/g}$ or $\mu\text{Ci/g}$	10%	25%	50%	100%
Pu-239/240	3.41E-01	717	117	31	10
w.Cs-137	7.95E+00	35	8	4	3
f.Cs-137	8.20E+02	36	8	4	3

Figure A-3. C-110, Number of Cores Needed to Achieve Desired Accuracy.

10 PERCENT OF THE MEAN

25 PERCENT OF THE MEAN

50 PERCENT OF THE MEAN

100 PERCENT OF THE MEAN

Table A-3. Predicted Number of Core Samples Required for a Specified
Half-Width of a 95% Confidence Interval in the Mean for C-110.
(sheet 1 of 3)

	Mean	Half-Width of Confidence Interval as % of Mean			
Analyte	$\mu\text{g/g}$ or $\mu\text{Ci/g}$	10%	25%	50%	100%
ICP.a.Al	1.45E+04	4	3	2	2
ICP.a.B	2.12E+01	14	5	3	3
ICP.a.Ba	7.68E+00	23	6	4	3
ICP.a.Bi	1.68E+04	9	4	3	3
ICP.a.Ca	3.81E+02	229	39	12	5
ICP.a.Ce	2.10E+02	8	4	3	2
ICP.a.Cr	4.70E+02	5	3	3	2
ICP.a.Cu	3.00E+01	63	13	5	3
ICP.a.Fe	1.10E+04	9	4	3	3
ICP.a.K	5.57E+02	6	3	3	2
ICP.a.Mg	1.49E+02	24	6	4	3
ICP.a.Mn	3.58E+01	15	5	3	3
ICP.a.Na	7.70E+04	9	4	3	3
ICP.a.Ni	2.39E+01	40	9	4	3
ICP.a.P	1.85E+04	11	4	3	3
ICP.a.Pb	2.32E+02	208	36	11	5
ICP.a.S	4.08E+03	11	4	3	3
ICP.a.Se	7.00E+01	286	48	14	6
ICP.a.Si	7.26E+02	77	15	6	4
ICP.a.Sr	1.28E+02	35	8	4	3
ICP.a.Ti	5.09E+00	8	4	3	2
ICP.a.V	6.17E+00	51	11	5	3
ICP.a.Zn	1.39E+02	103	19	7	4
ICP.a.Zr	4.16E+01	47	10	5	3
ICP.f.Al	1.43E+04	3	3	2	2
ICP.f.Bi	1.37E+04	5	3	3	2
ICP.f.Ca	1.15E+03	128	23	8	4
ICP.f.Cr	4.64E+02	5	3	3	2
ICP.f.Cu	9.89E+01	187	32	10	5
ICP.f.Fe	1.07E+04	8	4	3	3
ICP.f.Mg	1.53E+02	8	4	3	3
ICP.f.Mn	5.63E+01	17	5	3	3

Table A-3. Predicted Number of Core Samples Required for a Specified Half-Width of a 95% Confidence Interval in the Mean for C-110.
(sheet 2 of 3)

	Mean	Half-Width of Confidence Interval as % of Mean			
Analyte	$\mu\text{g/g}$ or $\mu\text{Ci/g}$	10%	25%	50%	100%
ICP.f.Na	8.26E+04	4	3	3	2
ICP.f.Ni	7.42E+03	91	17	7	4
ICP.f.P	2.03E+04	6	3	3	2
ICP.f.Pb	2.58E+02	160	28	9	5
ICP.f.S	3.96E+03	16	5	3	3
ICP.f.Si	7.16E+03	7	4	3	2
ICP.f.Sr	1.31E+02	37	9	4	3
ICP.f.Zn	2.24E+02	19	6	4	3
ICP.f.Zr	1.72E+02	12	4	3	3
ICP.w.Al	1.15E+03	137	24	8	4
ICP.w.B	2.50E+01	14	5	3	3
ICP.w.Bi	6.83E+01	27	7	4	3
ICP.w.Ca	1.54E+02	154	27	9	4
ICP.w.Cr	2.06E+02	58	12	5	3
ICP.w.Cu	2.11E+00	514	85	23	8
ICP.w.Fe	5.84E+02	400	66	19	7
ICP.w.K	4.11E+02	42	9	5	3
ICP.w.Mg	1.65E+01	147	26	9	4
ICP.w.Mn	1.99E+00	368	61	18	7
ICP.w.Na	6.63E+04	8	4	3	3
ICP.w.P	7.66E+03	136	24	8	4
ICP.w.S	3.65E+03	51	11	5	3
ICP.w.Se	4.92E+01	116	21	8	4
ICP.w.Si	2.36E+02	101	19	7	4
ICP.w.Sr	5.25E+00	404	67	19	7
ICP.w.Zn	1.13E+01	210	36	11	5
ICP.w.Zr	1.18E+01	346	58	17	6
IC.w.Cl	1.06E+03	72	14	6	4
IC.w.F	7.63E+03	22	6	4	3
IC.w.NO2	6.89E+03	228	39	12	5
IC.w.NO3	1.10E+05	8	4	3	3

Table A-3. Predicted Number of Core Samples Required for a Specified Half-Width of a 95% Confidence Interval in the Mean for C-110.
(sheet 3 of 3)

	Mean	Half-Width of Confidence Interval as % of Mean			
Analyte	$\mu\text{g/g}$ or $\mu\text{Ci/g}$	10%	25%	50%	100%
IC.w.PO4	2.81E+04	77	15	6	4
IC.w.SO4	1.48E+04	49	10	5	3
Spec.w.NO2	9.29E+03	91	17	7	4
Fluor.U	1.48E+03	42	9	5	3
TA	1.25E-01	7	4	3	2
TB	4.24E+01	5	3	3	2
GEA.Cs-137	1.95E+01	22	6	4	3
Pu239/40	8.02E-02	45	10	5	3
GEA.Tc-99	3.27E-02	51	11	5	3
GEA.Sr-90	4.92E+00	57	12	5	3
GEA.H-3	1.18E-03	36	8	4	3
GEA.C-14	4.59E-04	108	20	7	4
GEA.Se-79	1.98E-03	566	93	25	9
Dir.TGA	5.75E+01	4	3	3	2
Dir.%water	5.98E+01	4	3	2	2
pH	1.10E+01	3	2	2	2

Figure A-4. C-112, Number of Cores Needed to Achieve Desired Accuracy.

10 PERCENT OF THE MEAN

25 PERCENT OF THE MEAN

50 PERCENT OF THE MEAN

100 PERCENT OF THE MEAN

Table A-4. Predicted Number of Core Samples Required for a Specified Half-Width of a 95% Confidence Interval in the Mean for C-112.
(sheet 1 of 2)

	Mean	Half-Width of Confidence Interval as % of Mean			
Analyte	$\mu\text{g/g}$ or $\mu\text{Ci/g}$	10%	25%	50%	100%
ICP.a.Al	2.45E+04	248	42	13	5
ICP.a.Ca	1.67E+04	38	9	4	3
ICP.a.Fe	2.19E+04	14	5	3	3
ICP.a.Na	8.96E+04	16	5	3	3
ICP.a.Ni	1.31E+04	39	9	4	3
ICP.a.P	2.29E+04	37	9	4	3
ICP.a.Pb	2.55E+03	138	25	8	4
ICP.a.U	5.84E+04	185	32	10	5
ICP.f.Al	2.65E+04	259	44	13	6
ICP.f.Ca	2.00E+04	42	9	5	3
ICP.f.Fe	2.79E+04	14	5	3	3
ICP.f.Na	1.04E+05	22	6	4	3
ICP.f.P	2.80E+04	42	9	5	3
ICP.f.Pb	2.94E+03	183	32	10	5
ICP.f.U	8.07E+04	108	20	7	4
ICP.w.Al	5.21E+02	125	22	8	4
ICP.w.Ca	3.38E+02	66	13	6	4
ICP.w.Fe	1.17E+03	67	13	6	4
ICP.w.Na	8.85E+04	40	9	4	3
ICP.w.Ni	6.79E+02	75	14	6	4
ICP.w.P	1.01E+04	156	27	9	5
ICP.w.U	2.17E+03	482	80	22	8
IC.w.Cl	9.80E+02	29	7	4	3
IC.w.NO2	4.72E+04	32	8	4	3
IC.w.NO3	6.20E+04	37	8	4	3
IC.w.PO4	3.08E+04	146	26	9	4
IC.w.SO4	1.20E+04	36	8	4	3
Free CN	1.25E+03	85	16	6	4
U	6.86E+04	240	41	12	5
Sr-90	2.19E+03	240	41	12	5

Table A-4. Predicted Number of Core Samples Required for a Specified
Half-Width of a 95% Confidence Interval in the Mean for C-112.
(sheet 2 of 2)

	Mean	Half-Width of Confidence Interval as % of Mean			
Analyte	$\mu\text{g/g}$ or $\mu\text{Ci/g}$	10%	25%	50%	100%
Pu-238	6.45E-02	837	136	36	11
Pu-239/240	6.02E-02	447	74	21	7
Cs-137	7.47E+02	5	3	3	2

Figure A-5. S-104, Number of Cores Needed to Achieve Desired Accuracy.

10 PERCENT OF THE MEAN

25 PERCENT OF THE MEAN

50 PERCENT OF THE MEAN

100 PERCENT OF THE MEAN

Table A-5. Predicted Number of Core Samples Required for a Specified Half-Width of a 95% Confidence Interval in the Mean for S-104.
(sheet 1 of 2)

Analyte	Mean	Half-Width of Confidence Interval as % of Mean			
	$\mu\text{g/g}$ or $\mu\text{Ci/g}$	10%	25%	50%	100%
ICP.a.Al	3.89E+04	41	9	5	3
ICP.a.B	1.44E+01	71	14	6	4
ICP.a.Ba	2.16E+01	6	3	3	2
ICP.a.Ca	2.47E+02	15	5	3	3
ICP.a.Ce	2.21E+01	8	4	3	2
ICP.a.Co	2.52E+00	8	4	3	3
ICP.a.Cr	2.35E+03	4	3	2	2
ICP.a.Cu	1.94E+01	132	24	8	4
ICP.a.Fe	7.71E+02	13	5	3	3
ICP.a.K	3.00E+02	13	5	3	3
ICP.a.Mg	4.28E+01	20	6	4	3
ICP.a.Mn	9.27E+02	28	7	4	3
ICP.a.Na	1.21E+05	3	3	2	2
ICP.a.Ni	5.60E+01	5	3	3	2
ICP.a.P	2.12E+01	8	4	3	3
ICP.a.S	3.94E+02	6	3	3	2
ICP.a.Si	1.92E+02	14	5	3	3
ICP.a.Sr	3.26E+02	5	3	3	2
ICP.a.Ti	6.35E+00	84	16	6	4
ICP.a.Zn	2.01E+01	46	10	5	3
ICP.a.Zr	3.36E+01	4	3	2	2
ICP.f.Al	1.17E+05	3	2	2	2
ICP.f.Ba	3.31E+01	7	3	3	2
ICP.f.Ca	4.23E+03	739	121	32	10
ICP.f.Cr	2.35E+03	5	3	3	2
ICP.f.Cu	5.47E+01	26	7	4	3
ICP.f.Fe	1.72E+03	4	3	2	2
ICP.f.Mg	1.57E+02	239	41	12	5
ICP.f.Mn	1.15E+03	44	10	5	3
ICP.f.Na	1.18E+05	3	2	2	2
ICP.f.Ni	5.01E+03	11	4	3	3
IPC.f.P	9.31E+01	11	4	3	3

Table A-5. Predicted Number of Core Samples Required for a Specified Half-Width of a 95% Confidence Interval in the Mean for S-104.
(sheet 2 of 2)

Analyte	Mean	Half-Width of Confidence Interval as % of Mean			
	$\mu\text{g/g}$ or $\mu\text{Ci/g}$	10%	25%	50%	100%
ICP.f.S	4.72E+02	4	3	2	2
ICP.f.Si	1.33E+03	13	5	3	3
ICP.f.Sr	4.24E+02	5	3	3	2
ICP.f.Zn	2.24E+02	499	82	23	8
ICP.f.Zr	2.12E+01	97	18	7	4
ICP.w.Al	4.68E+03	131	23	8	4
ICP.w.B	9.08E+00	26	7	4	3
ICP.w.Ca	1.56E+02	163	29	9	5
ICP.w.Cr	1.90E+03	144	25	9	4
ICP.w.K	2.53E+02	87	16	6	4
ICP.w.Mg	8.34E+00	186	32	10	5
ICP.w.Na	9.21E+04	103	19	7	4
ICP.w.S	3.40E+02	148	26	9	4
ICP.w.Si	3.98E+01	211	36	11	5
IC.w.Cl	3.20E+03	4	3	2	2
IC.w.NO2	2.08E+04	10	4	3	3
IC.w.NO3	1.91E+05	4	3	2	2
IC.w.SO4	2.27E+03	4	3	2	2
CN	3.70E+00	7	3	3	2
Percent.H2O	5.16E+01	204	35	11	5
Spec.w.NO2	2.59E+04	5	3	3	2
TIC.w.CO3	4.14E+03	36	8	4	3
pH	1.29E+01	3	3	2	2
C-14	9.01E-04	23	6	4	3
GEA.Cs-137	6.23E+01	4	3	2	2
Gross.beta	6.41E+02	216	37	12	5
H-3	3.38E-03	19	6	4	3
Pu-239/40	2.82E-01	71	14	6	4
Sr-90	3.10E+02	4	3	2	2
Tc-99	2.42E-02	6	3	3	2
U	6.69E+03	7	3	3	2

Figure A-6. T-104, Number of Cores Needed to Achieve Desired Accuracy.

10 PERCENT OF THE MEAN

25 PERCENT OF THE MEAN

50 PERCENT OF THE MEAN

100 PERCENT OF THE MEAN

Table A-6. Predicted Number of Core Samples Required for a Specified Half-Width of a 95% Confidence Interval in the Mean for T-104.
(sheet 1 of 3)

	Mean	Half-Width of Confidence Interval as % of Mean			
Analyte	$\mu\text{g/g}$ or $\mu\text{Ci/g}$	10%	25%	50%	100%
ICP.a.Al	1.62E+04	7	4	3	2
ICP.a.B	1.56E+01	10	4	3	3
ICP.a.Ba	7.64E+00	4	3	2	2
ICP.a.Bi	1.89E+04	3	2	2	2
ICP.a.Ca	2.62E+02	18	5	3	3
ICP.a.Cd	1.69E+00	5	3	3	2
ICP.a.Ce	1.94E+02	5	3	3	2
ICP.a.Cr	9.01E+02	4	3	2	2
ICP.a.Cu	1.25E+01	4	3	2	2
ICP.a.Fe	9.02E+03	4	3	2	2
ICP.a.K	8.90E+01	3	2	2	2
ICP.a.Mg	1.03E+02	4	3	2	2
ICP.a.Mn	3.06E+01	3	3	2	2
ICP.a.Na	6.45E+04	4	3	2	2
ICP.a.Ni	1.13E+01	26	7	4	3
ICP.a.P	2.40E+04	3	3	2	2
ICP.a.Pb	4.98E+01	29	7	4	3
ICP.a.S	1.28E+03	3	2	2	2
ICP.a.Si	1.02E+03	19	6	4	3
ICP.a.Sn	1.16E+01	9	4	3	3
ICP.a.Sr	9.68E+01	5	3	3	2
ICP.a.Ti	4.56E+00	5	3	3	2
ICP.a.Zn	2.35E+01	6	3	3	2
ICP.a.Zr	6.75E+01	81	15	6	4
ICP.f.Al	1.56E+04	14	5	3	3
ICP.f.Ba	8.58E+00	3	3	2	2
ICP.f.Bi	1.74E+04	6	3	3	2
ICP.f.Ca	1.45E+03	219	37	12	5
ICP.f.Ce	1.60E+02	9	4	3	3
ICP.f.Cr	8.67E+02	3	3	2	2
ICP.f.Cu	5.10E+01	54	11	5	3
ICP.f.Fe	8.84E+03	7	3	3	2

Table A-6. Predicted Number of Core Samples Required for a Specified
Half-Width of a 95% Confidence Interval in the Mean for T-104.
(sheet 2 of 3)

	Mean	Half-Width of Confidence Interval as % of Mean			
Analyte	$\mu\text{g/g}$ or $\mu\text{Ci/g}$	10%	25%	50%	100%
ICP.f.Mg	1.41E+02	20	6	4	3
ICP.f.Mn	6.18E+01	4	3	3	2
ICP.f.Na	6.21E+04	3	3	2	2
ICP.f.Ni	1.05E+04	23	6	4	3
ICP.f.P	2.47E+04	9	4	3	3
ICP.f.S	1.27E+03	3	3	2	2
ICP.f.Si	6.52E+03	3	3	2	2
ICP.f.Sr	9.91E+01	4	3	2	2
ICP.f.Ti	9.67E+00	20	6	4	3
ICP.f.Zn	1.37E+02	98	18	7	4
ICP.f.Zr	3.75E+01	7	4	3	2
ICP.w.Al	1.58E+02	8	4	3	3
ICP.w.B	1.15E+01	5	3	3	2
ICP.w.Bi	1.68E+02	8	4	3	3
ICP.w.Ca	1.71E+02	7	3	3	2
ICP.w.Cr	1.44E+02	4	3	2	2
ICP.w.Fe	8.08E+01	7	4	3	2
ICP.w.K	3.59E+01	4	3	2	2
ICP.w.Mg	6.06E+00	40	9	4	3
ICP.w.Na	4.65E+04	3	3	2	2
ICP.w.P	6.41E+03	4	3	2	2
ICP.w.S	1.28E+03	3	2	2	2
ICP.w.Si	1.67E+02	3	3	2	2
ICP.w.Sr	1.17E+00	18	5	3	3
ICP.w.Zr	2.45E+00	6	3	3	2
IC.w.Cl	6.70E+02	3	2	2	2
IC.w.F	8.57E+03	3	2	2	2
IC.w.NO2	4.08E+03	2	2	2	2
IC.w.NO3	5.80E+04	3	2	2	2
IC.w.PO4	1.78E+04	5	3	3	2
IC.w.SO4	3.90E+03	3	2	2	2

Table A-6. Predicted Number of Core Samples Required for a Specified
Half-Width of a 95% Confidence Interval in the Mean for T-104.
(sheet 3 of 3)

	Mean	Half-Width of Confidence Interval as % of Mean			
Analyte	$\mu\text{g/g}$ or $\mu\text{Ci/g}$	10%	25%	50%	100%
GEA.Am-241	1.42E-02	6	3	3	2
GEA.Cs-137	1.99E-01	3	3	2	2
GEA.Eu-155	3.42E-03	6	3	3	2
GEA.Gross.alpha	1.09E-01	4	3	3	2
GEA.Gross.beta	7.59E+00	12	4	3	3
Am-241	1.73E-02	5	3	3	2
Pu-239	9.68E+01	2	2	2	2
Pu-240	3.19E+00	4	3	3	2
Pu-241	3.99E-02	43	9	5	3
Spec.w.NO2	4.24E+03	3	2	2	2
Sr-90	2.63E+00	9	4	3	3
U	8.97E+02	3	3	2	2
U-234	7.25E-03	26	7	4	3
U-235	6.74E-01	3	2	2	2
U-236	6.75E-03	15	5	3	3
U-238	9.93E+01	2	2	2	2
Percent.H2O	7.05E+01	2	2	2	2

Figure A-7. T-105, Number of Cores Needed to Achieve Desired Accuracy.

10 PERCENT OF THE MEAN

25 PERCENT OF THE MEAN

50 PERCENT OF THE MEAN

100 PERCENT OF THE MEAN

Table A-7. Predicted Number of Core Samples Required for a Specified Half-Width of a 95% Confidence Interval in the Mean for T-105.
(sheet 1 of 3)

	Mean	Half-Width of Confidence Interval			
Analyte	$\mu\text{g/g}$ or $\mu\text{Ci/g}$	10%	25%	50%	100%
ICP.a.Ag	1.66E+01	31	8	4	3
ICP.a.Al	9.24E+04	338	57	16	6
ICP.a.Bi	1.33E+03	5	3	3	2
ICP.a.Ca	1.42E+03	6	3	3	2
ICP.a.Cr	5.05E+02	150	27	9	4
ICP.a.Fe	2.73E+04	345	58	17	6
ICP.a.K	3.05E+02	74	14	6	4
ICP.a.Mg	1.06E+03	4	3	3	2
ICP.a.Mn	1.16E+04	394	65	19	7
ICP.a.Mo	3.43E+01	30	7	4	3
ICP.a.Na	5.63E+04	39	9	4	3
ICP.a.Ni	8.13E+01	30	7	4	3
ICP.a.P	1.49E+03	37	8	4	3
ICP.a.Pb	5.34E+02	192	33	11	5
ICP.a.S	2.61E+03	59	12	5	3
ICP.a.Si	1.16E+03	678	111	30	10
ICP.a.Sr	1.48E+02	16	5	3	3
ICP.a.Ti	5.88E+01	22	6	4	3
ICP.a.Zr	5.08E+01	434	72	20	7
ICP.f.Ag	4.62E+01	195	34	11	5
ICP.f.Al	9.51E+04	268	45	14	6
ICP.f.Bi	1.22E+03	17	5	3	3
ICP.f.Ca	3.67E+03	112	20	7	4
ICP.f.Cd	1.54E+01	50	11	5	3
ICP.f.Ce	7.90E+01	137	24	8	4
ICP.f.Cr	4.32E+02	137	24	8	4
ICP.f.Fe	3.31E+04	43	9	5	3
ICP.f.Li	3.59E+00	28	7	4	3
ICP.f.Mg	1.10E+03	16	5	3	3
ICP.f.Mn	1.04E+04	411	68	19	7
ICP.f.Mo	3.17E+01	50	11	5	3
ICP.f.Na	4.92E+04	56	11	5	3

Table A-7. Predicted Number of Core Samples Required for a Specified Half-Width of a 95% Confidence Interval in the Mean for T-105.
(sheet 2 of 3)

	Mean	Half-Width of Confidence Interval			
Analyte	$\mu\text{g/g}$ or $\mu\text{Ci/g}$	10%	25%	50%	100%
ICP.f.P	1.53E+03	61	12	5	3
ICP.f.Pb	4.53E+02	89	17	6	4
ICP.f.S	2.62E+03	84	16	6	4
ICP.f.Si	6.98E+03	13	5	3	3
ICP.f.Sr	1.41E+02	8	4	3	3
ICP.f.Ti	2.28E+02	309	52	15	6
ICP.f.Zr	1.19E+02	43	9	5	3
ICP.w.Al	2.83E+02	164	29	9	5
ICP.w.B	3.35E+02	10	4	3	3
ICP.w.Ca	2.87E+02	272	46	14	6
ICP.w.Cr	1.48E+02	100	19	7	4
ICP.w.Fe	1.04E+01	431	71	20	7
ICP.w.K	2.76E+02	98	18	7	4
ICP.w.Mg	1.44E+01	240	41	12	5
ICP.w.Mo	3.47E+01	111	20	7	4
ICP.w.Na	4.95E+04	42	9	5	3
ICP.w.P	6.55E+02	103	19	7	4
ICP.w.S	2.76E+03	53	11	5	3
ICP.w.Si	7.47E+02	94	17	7	4
IC.w.Cl	4.02E+02	59	12	5	3
IC.w.NO2	2.98E+04	59	12	5	3
IC.w.NO3	2.12E+04	58	12	5	3
IC.w.PO4	2.19E+03	32	8	4	3
IC.w.SO4	8.55E+03	59	12	5	3
GEA.w.Am-241.RS	8.57E-01	395	66	19	7
GEA.w.Co-60.RS	3.83E-02	120	22	8	4
GEA.w.Cs-137	3.23E+01	56	11	5	3
GEA.w.Eu-154.RS	1.79E+00	357	60	17	7
GEA.w.Eu-155.RS	2.11E+00	385	64	18	7
f.Gross.alpha	6.47E-01	57	12	5	3
f.Gross.beta	8.63E+02	161	28	9	5

Table A-7. Predicted Number of Core Samples Required for a Specified
Half-Width of a 95% Confidence Interval in the Mean for T-105.
(sheet 3 of 3)

	Mean	Half-Width of Confidence Interval			
Analyte	$\mu\text{g/g}$ or $\mu\text{Cl/g}$	10%	25%	50%	100%
TIC	5.67E+03	98	18	7	4
TOC	4.59E+03	11	4	3	3
w.TDS.percent	1.93E-01	162	28	9	5
Hg	2.39E+01	227	39	12	5
CN	1.14E+01	158	28	9	5
w.Gross.alpha	4.40E-03	42	9	5	3
w.Gross.beta	3.77E+01	67	13	6	4
H-3.RS	1.24E-02	668	109	30	10

Figure A-8. T-107, Number of Cores Needed to Achieve Desired Accuracy.

10 PERCENT OF THE MEAN

25 PERCENT OF THE MEAN

50 PERCENT OF THE MEAN

100 PERCENT OF THE MEAN

Table A-8. Predicted Number of Core Samples Required for a Specified Half-Width of a 95% Confidence Interval in the Mean for T-107.
(sheet 1 of 3)

	Mean	Half-Width of Confidence Interval as % of Mean			
Analyte	$\mu\text{g/g}$ or $\mu\text{Ci/g}$	10%	25%	50%	100%
ICP.a.Al	1.44E+04	391	65	18	7
ICP.a.B	1.70E+01	202	35	11	5
ICP.a.Bi	1.09E+04	57	12	5	3
ICP.a.Ca	7.23E+02	28	7	4	3
ICP.a.Cd	6.40E+00	15	5	3	3
ICP.a.Cr	3.54E+02	8	4	3	3
ICP.a.Fe	3.15E+04	16	5	3	3
ICP.a.K	2.34E+02	5	3	3	2
ICP.a.Li	5.48E+00	58	12	5	3
ICP.a.Mg	2.14E+02	42	9	5	3
ICP.a.Mn	2.22E+02	23	6	4	3
ICP.a.Na	1.30E+05	5	3	3	2
ICP.a.Nd	7.29E+01	191	33	11	5
ICP.a.Ni	2.92E+02	4	3	3	2
ICP.a.P	3.00E+04	7	4	3	2
ICP.a.Pb	7.96E+02	119	21	8	4
ICP.a.S	3.05E+03	25	7	4	3
ICP.a.Si	8.75E+02	589	97	26	9
ICP.a.Sm	2.85E+02	306	51	15	6
ICP.a.Sr	9.62E+02	67	13	6	4
ICP.a.Zr	7.16E+01	340	57	16	6
ICP.f.Al	1.63E+04	329	55	16	6
ICP.f.Bi	1.20E+04	74	14	6	4
ICP.f.Ca	7.61E+02	3	3	2	2
ICP.f.Cr	3.60E+02	4	3	2	2
ICP.f.Fe	2.92E+04	23	6	4	3
ICP.f.Mg	2.26E+02	6	3	3	2
ICP.f.Mn	2.13E+02	23	6	4	3
ICP.f.Na	1.17E+05	5	3	3	2
ICP.f.Ni	2.64E+03	34	8	4	3
ICP.f.P	3.21E+04	4	3	2	2
ICP.f.Pb	6.49E+02	22	6	4	3

Table A-8. Predicted Number of Core Samples Required for a Specified Half-Width of a 95% Confidence Interval in the Mean for T-107.
(sheet 2 of 3)

	Mean	Half-Width of Confidence Interval as % of Mean			
Analyte	$\mu\text{g/g}$ or $\mu\text{Ci/g}$	10%	25%	50%	100%
ICP.f.S	3.28E+03	9	4	3	3
ICP.f.Si	6.06E+03	33	8	4	3
ICP.f.Sr	8.78E+02	9	4	3	3
ICP.f.Zr	9.32E+01	29	7	4	3
ICP.w.Al	6.51E+02	53	11	5	3
ICP.w.B	3.26E+02	699	114	31	10
ICP.w.Bi	2.43E+02	290	49	14	6
ICP.w.Ca	2.71E+02	442	73	21	7
ICP.w.Cr	2.11E+02	6	3	3	2
ICP.w.Fe	3.56E+02	45	10	5	3
ICP.w.K	3.16E+02	143	25	9	4
ICP.w.Mg	9.83E+00	11	4	3	3
ICP.w.Mo	7.88E+00	11	4	3	3
ICP.w.Na	1.08E+05	48	10	5	3
ICP.w.S	3.54E+03	14	5	3	3
ICP.w.Se	6.67E+01	53	11	5	3
ICP.w.Sr	5.53E+00	8	4	3	3
ICP.w.Zr	6.07E+00	440	73	20	7
IC.w.F	1.14E+04	31	8	4	3
IC.w.Cl	5.41E+02	55	11	5	3
IC.w.NO2	1.17E+04	75	15	6	4
IC.w.NO3	7.45E+04	49	10	5	3
IC.w.PO4	1.14E+05	24	6	4	3
IC.w.SO4	9.89E+03	63	13	5	3
TDS(wt%)	3.95E-01	3	2	2	2
RS(wt%)	2.87E+01	10	4	3	3
CN	6.88E+01	88	17	6	4
Spec.w.NO2	1.11E+04	64	13	5	3
TIC	4.23E+03	83	17	7	4
TOC	1.70E+03	21	6	4	3
TA	2.70E-03	504	83	23	8

Table A-8. Predicted Number of Core Samples Required for a Specified Half-Width of a 95% Confidence Interval in the Mean for T-107.
(sheet 3 of 3)

	Mean	Half-Width of Confidence Interval as % of Mean			
Analyte	$\mu\text{g/g}$ or $\mu\text{Ci/g}$	10%	25%	50%	100%
TB	1.34E+01	44	10	5	3
C-14	1.81E-04	70	14	6	4
H-3	1.24E-03	11	4	3	3
GEA.Cs-137	9.25E+00	71	14	6	4
RS.GEA.Cs-137	1.20E+01	160	28	9	5
RS.GEA.Co-60	1.85E-02	251	43	13	5
RS.GEA.Eu-154	1.33E-01	5	3	3	2
RS.GEA.K-40	3.76E-02	3	2	2	2
%Solids	5.02E+01	4	3	3	2
pH	1.15E+01	3	2	2	2
Dir.CN	7.61E+01	55	11	5	3

Figure A-9. T-111, Number of Cores Needed to Achieve Desired Accuracy.

10 PERCENT OF THE MEAN

25 PERCENT OF THE MEAN

50 PERCENT OF THE MEAN

100 PERCENT OF THE MEAN

Table A-9. Predicted Number of Core Samples Required for a Specified
Half-Width of a 95% Confidence Interval in the Mean for T-111.
(sheet 1 of 3)

Analyte	Mean	Half-Width of Confidence Interval as % of Mean			
	$\mu\text{g/g}$ or $\mu\text{Ci/g}$	10%	25%	50%	100%
ICP.a.Ag	1.26E+02	384	64	18	7
ICP.a.Al	5.41E+02	31	7	4	3
ICP.a.B	2.80E+01	10	4	3	3
ICP.a.Ba	6.90E+01	13	5	3	3
ICP.a.Bi	2.59E+04	10	4	3	3
ICP.a.Ca	1.88E+03	49	10	5	3
ICP.a.Cd	5.80E+00	72	14	6	4
ICP.a.Ce	3.37E+01	10	4	3	3
ICP.a.Co	4.30E+00	71	14	6	4
ICP.a.Cr	1.98E+03	6	3	3	2
ICP.a.Cu	3.35E+01	245	42	13	5
ICP.a.Fe	1.85E+04	6	3	3	2
ICP.a.K	1.14E+03	4	3	3	2
ICP.a.La	4.22E+03	16	5	3	3
ICP.a.Mg	3.77E+02	37	9	4	3
ICP.a.Mn	6.33E+03	3	3	2	2
ICP.a.Na	3.69E+04	4	3	2	2
ICP.a.Ni	1.32E+02	26	7	4	3
ICP.a.P	1.03E+04	4	3	2	2
ICP.a.Pb	3.47E+02	172	30	10	5
ICP.a.S	1.21E+03	3	3	2	2
ICP.a.Sb	3.14E+01	16	5	3	3
ICP.a.Si	4.69E+02	6	3	3	2
ICP.a.Sr	3.00E+02	6	3	3	2
ICP.a.Ti	1.95E+01	285	48	14	6
ICP.a.V	1.45E+01	27	7	4	3
ICP.a.Zn	6.50E+01	121	22	8	4
ICP.f.Ag	1.28E+02	380	63	18	7
ICP.f.Al	5.70E+02	26	7	4	3
ICP.f.Ba	6.46E+01	8	4	3	2
ICP.f.Bi	2.36E+04	16	5	3	3

Table A-9. Predicted Number of Core Samples Required for a Specified
Half-Width of a 95% Confidence Interval in the Mean for T-111.
(sheet 2 of 3)

	Mean	Half-Width of Confidence Interval as % of Mean			
Analyte	$\mu\text{g/g}$ or $\mu\text{Ci/g}$	10%	25%	50%	100%
ICP.f.Ca	2.42E+03	14	5	3	3
ICP.f.Cd	8.12E+00	23	6	4	3
ICP.f.Co	1.15E+01	10	4	3	3
ICP.f.Cr	1.80E+03	3	3	2	2
ICP.f.Cu	2.93E+01	35	8	4	3
ICP.f.Fe	1.80E+04	13	5	3	3
ICP.f.La	4.11E+03	17	5	3	3
ICP.f.Mg	3.55E+02	47	10	5	3
ICP.f.Mn	6.28E+03	3	3	2	2
ICP.f.Na	3.70E+04	6	3	3	2
ICP.f.Ni	8.14E+03	77	15	6	4
ICP.f.P	1.04E+04	9	4	3	3
ICP.f.Pb	3.65E+02	57	12	5	3
ICP.f.S	1.23E+03	9	4	3	3
ICP.f.Si	5.67E+03	4	3	3	2
ICP.f.Sr	2.98E+02	3	3	2	2
ICP.f.Ti	4.79E+01	207	36	11	5
ICP.f.V	1.47E+01	6	3	3	2
ICP.f.Zn	1.06E+02	3	3	2	2
ICP.w.Al	1.09E+01	40	9	4	3
ICP.w.B	4.07E+00	34	8	4	3
ICP.w.Bi	2.02E+02	48	10	5	3
ICP.w.Ca	6.16E+01	10	4	3	3
ICP.w.Cr	2.18E+02	3	3	2	2
ICP.w.Fe	1.28E+02	18	5	3	3
ICP.w.K	7.19E+02	5	3	3	2
ICP.w.La	1.10E+01	92	17	7	4
ICP.w.Mg	3.64E+00	6	3	3	2
ICP.w.Mn	2.47E+01	33	8	4	3
ICP.w.Na	3.30E+04	5	3	3	2
ICP.w.P	5.68E+03	4	3	2	2

Table A-9. Predicted Number of Core Samples Required for a Specified
Half-Width of a 95% Confidence Interval in the Mean for T-111.
(sheet 3 of 3)

	Mean	Half-Width of Confidence Interval as % of Mean			
Analyte	$\mu\text{g/g}$ or $\mu\text{Ci/g}$	10%	25%	50%	100%
ICP.w.S	1.15E+03	4	3	3	2
ICP.w.Si	5.72E+02	16	5	3	3
ICP.w.Sr	1.96E+00	20	6	4	3
IC.w.Cl	4.50E+02	7	4	3	2
IC.w.F	2.30E+03	97	18	7	4
IC.w.NO3	4.12E+04	7	3	3	2
IC.w.PO4	1.55E+04	8	4	3	3
IC.w.SO4	3.54E+03	5	3	3	2
GEA.Am-241	4.24E-02	4	3	2	2
GEA.Cs-137	1.66E-01	96	18	7	4
Gross.alpha	3.73E-01	4	3	2	2
Gross.beta	1.51E+01	120	22	8	4
TGA.Percent.H2O	7.65E+01	6	3	3	2
Am-241	4.26E-02	5	3	3	2
Hg	1.43E+00	33	8	4	3
Percent.H2O	7.60E+01	3	2	2	2
Pu-239/40	1.39E-01	3	3	2	2
Spec.w.NO2	7.93E+02	14	5	3	3
Sr-90	5.41E+00	95	18	7	4
TOC	3.12E+03	33	8	4	3
Tc-99	7.92E-03	112	20	7	4
U	2.79E+03	23	6	4	3
pH	9.98E+00	3	2	2	2

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