EQUATIONS UTILIZED IN CONJUNCTION WITH ISM02.3

NOVEMBER 16, 2015

Introduction

This document provides details of equations used in the EPA Contract Laboratory Program (CLP) Statement of Work (SOW) for Inorganic Superfund Methods (ISM02.3) utilizing values reported in the Staged Electronic Data Deliverable (SEDD). The equations in the SOW use terminology relevant to the particular analytical method, which may or may not be consistent with the terminology used in the SEDD specification. This document defines the SOW equation variables in terms consistent with the location, name, and meaning in the SEDD. Please note that these equations are only applicable to a SEDD Stage 3 file.

> ***The formulas/calculations provided in this document were prepared based on "normal laboratory practices". Any deviations from these "normal laboratory practices" may invalidate these formulas. All CLP contractors must follow their contract requirements, including the ISM02.3 SOW reporting requirements for preparation of a fully compliant Electronic Data Deliverable.***

For each analytical method in Exhibit D of the SOW (ICP-AES, ICP-MS, Mercury, and Cyanide), the equations are reproduced in the following sections with the same equation number, title, and terms that appear in the SOW. For non-numbered equations, the SOW Section number is used to identify the equation. Following the equation, each variable is defined using terminology consistent with the SEDD.

If the result of the equation is reported in the SEDD, this result is defined first by listing the parent node and data element where the result is reported. For example, in EQ. 1 – ICV Percent Recovery in Exhibit D – ICP-MS, "%R = Analyte/PercentRecovery" means the result of Equation 1 (ICV Percent Recovery) is reported in the SEDD data element "PercentRecovery" under the "Analyte" node. Figure 1 at the end of this document depicts the SEDD Stage 3 data node hierarchy for reference.

Next, each equation variable is listed in the order in which they appear in the equation and falls into one of three categories: reported in the SEDD, calculated from another equation, or a constant. For example, "Found (ICV) = Reported Analyte/IntermediateResult (µg/L)" means that the variable "Found (ICV)" is a value reported in the SEDD and located in the data element "IntermediateResult" under the "Analyte" node with units of "µg/L". The definition "SD = Standard Deviation from EQ. 3" means that the variable "SD" is the result of equation "Standard Deviation" calculated in Equation 3. Constants are represented in the example "W_M = Minimum method required aliquot amount (1.00 g)" where "W_M" is equivalent to "1.00 g".

Some SOW equation variables are considered "intermediate results" in the SEDD, which means that they are results based on other equations using values reported in the SEDD. In these cases, sub-equations have been included to derive these intermediate results for inclusion in the SOW equations. These sub-equations are identified by the equation number of the "parent" equation in the SOW with a lowercase letter appended to it (e.g., EQ. 11a, EQ. 11b, etc.). For example, EQ. 11 – Matrix Spike and Post-Digestion Spike Percent Recovery in Exhibit D – ICP-MS defines the term "SA" as the "Expected Concentration from EQ. 11a for aqueous/water samples (µg/L), or EQ. 11b for soil/sediment samples (mg/kg)." The SOW does not specify how to calculate the Expected Result using values reported in the SEDD; therefore, EQ. 11a and 11b are added showing how this result is derived.

Equations for Exhibit D – ICP-AES

Section 9.3.4.3 ICAL Percent Difference

$$\%D = \frac{\text{Found (ICAL)} - \text{True (ICAL)}}{\text{True (ICAL)}} \times 100$$

where,

%D	=	Analyte/PercentDifference.
Found (ICAL)	=	Reported Analyte/Result (µg/L).
True (ICAL)	=	Reported Analyte/ExpectedResult (µg/L).

EQ. 1   ICV Percent Recovery

$$\%R = \frac{\text{Found (ICV)}}{\text{True (ICV)}} \times 100$$

where,

%R	=	Analyte/PercentRecovery.
Found (ICV)	=	Reported Analyte/Result (µg/L).
True (ICV)	=	Reported Analyte/ExpectedResult (µg/L).

EQ. 2   Percent Relative Standard Deviation Calculation

$$\%RSD = \frac{SD}{\overline{X}} \times 100$$

where,

%RSD	=	Peak/PercentRSD.
SD	=	Standard Deviation from EQ. 3.
$\overline{X}$	=	Mean Value from EQ. 4.

EQ. 3   Standard Deviation Calculation

$$SD = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \overline{x})^2}{(n-1)}}$$

where,

X_i = Reported PeakReplicate/Response.

$\overline{X}$ = Mean Peak Replicate Response from EQ. 4.

n = Number of reported Peak Replicate Responses.

EQ. 4   Mean Value Calculation

$$\overline{X} = \frac{\sum_{i=1}^{n} X_i}{n}$$

where,

$\overline{X}$ = Peak/Response.

X_i = Reported PeakReplicate/Response.

n = Number of reported Peak Replicate Responses.

EQ. 5   CCV Percent Recovery

$$\%R = \frac{Found\,(CCV)}{True\,(CCV)} \times 100$$

where,

%R = Analyte/PercentRecovery.

Found (CCV) = Reported Analyte/Result (µg/L).

True (CCV) = Reported Analyte/ExpectedResult (µg/L).

EQ. 6   Aqueous/Water and TCLP/SPLP Leachate Sample Concentration

$$Concentration\ (\mu g/L) = C \times \frac{V_f}{V} \times DF$$

where,

Concentration = Analyte/Result.

C = Reported Analyte/IntermediateResult (µg/L).

V_f = Reported PreparationPlusCleanup/FinalAmount from the preparation node (mL).

V = Reported PreparationPlusCleanup/AliquotAmount from the preparation node (mL).

DF = Reported Analysis/DilutionFactor.

Note: Convert units to mg/L for TCLP leachates by dividing the final calculated concentration by 1000.

EQ. 7   **Soil/Sediment Sample Concentration**

$$\text{Concentration (mg/kg dry weight)} = C \times \frac{V_f}{W \times S} \times DF/1000$$

where,

Concentration	=	Analyte/Result.
C	=	Reported Analyte/IntermediateResult (µg/L).
V_f	=	Reported PreparationPlusCleanup/FinalAmount from the preparation node (mL).
W	=	Reported PreparationPlusCleanup/AliquotAmount from the preparation node (g).
S	=	(Characteristic/CharacteristicValue ÷ 100) from the Characteristic node with Characteristic/CharacteristicType = "Percent_Solids". Default to 1 for Performance Evaluation samples.
DF	=	Reported Analysis/DilutionFactor.

EQ. 8   **Wipe Mass**

$$\text{Mass} (\mu g) = C \times V_f \times DF/1000$$

where,

Mass	=	Analyte/Result.
C	=	Reported Analyte/IntermediateResult (µg/L).
V_f	=	Reported PreparationPlusCleanup/FinalAmount from the preparation node (mL).
DF	=	Reported Analysis/DilutionFactor.

EQ. 9   **Adjusted Soil/Sediment CRQL**

$$\text{Adjusted CRQL (mg/kg)} = C \times \frac{W_M}{W \times S} \times \frac{V_f}{V_M} \times DF$$

where,

Adjusted CRQL	=	ReportedResult/QuantitationLimit.
C	=	Reported ReportedResult/ClientQuantitationLimit (mg/kg).
W_M	=	Minimum method required aliquot amount (1.00 g).
W	=	Reported PreparationPlusCleanup/AliquotAmount from the preparation node (g).

S   =   (Characteristic/CharacteristicValue ÷ 100) from the Characteristic node with Characteristic/CharacteristicType = "Percent_Solids". Default to 1 for Performance Evaluation samples.

V_f =   Reported PreparationPlusCleanup/FinalAmount from the preparation node (mL).

V_M =   Method required final sample digestion volume (100 mL or 50 mL).

DF   =   Reported Analysis/DilutionFactor.

EQ. 9a   Adjusted Aqueous/Water and TCLP/SPLP Leachate Sample CRQL

$$\text{Adjusted CRQL } (\mu g/L) = C \times \frac{V_f}{V} \times DF$$

where,

Adjusted CRQL   =   ReportedResult/QuantitationLimit.

C   =   Reported ReportedResult/ClientQuantitationLimit (µg/L).

V_f =   Reported PreparationPlusCleanup/FinalAmount from the preparation node (mL).

V   =   Reported PreparationPlusCleanup/AliquotAmount from the preparation node (mL).

DF   =   Reported Analysis/DilutionFactor.

Note: Convert units to mg/L for TCLP leachates by dividing the final calculated CRQL by 1000.

EQ. 10   Calculation of Hardness (Total) in Aqueous/Water Samples

$$\text{Hardness (mg/L)} = [\text{Conc. Ca (mg/L)} \times 2.497] + [\text{Conc. Mg (mg/L)} \times 4.118]$$

where,

Hardness   =   ReportedResult/Result for Hardness.

Conc. Ca (mg/L)   =   ReportedResult/Result for Calcium (µg/L) ÷ 1000.

Conc. Mg (mg/L)   =   ReportedResult/Result for Magnesium (µg/L) ÷ 1000.

EQ. 11   ICSA Percent Recovery

$$\%R = \frac{\text{Found (ICSA)}}{\text{True (ICSA)}} \times 100$$

where,

%R	=	Analyte/PercentRecovery.
Found (ICSA)	=	Reported Analyte/Result (μg/L).
True (ICSA)	=	Reported Analyte/ExpectedResult (μg/L).

EQ. 12   ICSAB Percent Recovery

$$\%R = \frac{Found\,(ICSAB)}{True\,(ICSAB)} \times 100$$

where,

%R	=	Analyte/PercentRecovery.
Found (ICSAB)	=	Reported Analyte/Result (μg/L).
True (ICSAB)	=	Reported Analyte/ExpectedResult (μg/L).

EQ. 13   Matrix Spike and Post-Digestion Spike Percent Recovery

$$\%R = \frac{SSR - SR}{SA} \times 100$$

where,

%R	=	ReportedResult/PercentRecovery.
SSR	=	The Concentration value from EQ. 6 or 7 from the spike sample (μg/L or mg/kg).
SR	=	The Concentration value from EQ. 6 or 7 from the original sample (μg/L or mg/kg). If the sample concentration is less than ReportedResult/DetectionLimit, SR=0.
SA	=	The Expected Concentration from EQ. 13a for aqueous/water samples (μg/L), or EQ. 13b for soil/sediment samples (mg/kg).

EQ. 13a   Expected Concentration for Aqueous/Water Samples

$$\text{Expected Concentration (μg/L)} = C \times \frac{V_f}{V}$$

where,

Expected Concentration	=	ReportedResult/ExpectedResult.
C	=	Reported Analyte/StandardConcentration (μg/L).
V_f	=	Reported Analyte/AmountAdded (μL).
V	=	Reported PreparationPlusCleanup/AliquotAmount from the preparation node (mL).

EQ. 13b   Expected Concentration for Soil/Sediment Samples

$$\text{Expected Concentration (mg/kg)} = C \times \frac{V_f}{W \times S} \, / 1000$$

where,

Expected Concentration	=	ReportedResult/ExpectedResult.
C	=	Reported Analyte/StandardConcentration (µg/L).
V_f	=	Reported Analyte/AmountAdded (µL).
W	=	Reported PreparationPlusCleanup/AliquotAmount from the preparation node (g).
S	=	(Characteristic/CharacteristicValue ÷ 100) from the Characteristic node with Characteristic/CharacteristicType = "Percent_Solids". Default to 1 for Performance Evaluation samples.

EQ. 14   Duplicate Sample Relative Percent Difference

$$RPD = \frac{|S - D|}{(S + D)/2} \times 100$$

where,

RPD	=	ReportedResult/RPD.
S	=	Original Sample Result from EQ. 6 or 7.
D	=	Duplicate Sample Result from EQ. 6 or 7.

EQ. 15   LCS Percent Recovery

$$\%R = \frac{\text{Found(LCS)}}{\text{True(LCS)}} \times 100$$

where,

%R	=	ReportedResult/PercentRecovery.
Found (LCS)	=	Sample Concentration from EQ. 6, 7, or 8 (µg/L, mg/kg, or µg). If the sample concentration is less than ReportedResult/ DetectionLimit, Found (LCS) = 0.
True (LCS)	=	(Adjusted CRQL from EQ. 9 or 9a) × 2 (µg/L, mg/kg, or µg).

EQ. 16   **Serial Dilution Percent Difference**

$$\% \text{ Difference} = \frac{|I - S|}{I} \times 100$$

where,

%Difference	=	ReportedResult/PercentDifference.
I	=	Initial Sample Result from EQ. 6 or 7.
S	=	Serial Dilution Result from EQ. 6 or 7. If the sample concentration is less than ReportedResult/DetectionLimit, S = 0.

Equations for Exhibit D – ICP-MS

Section 9.4.4.3 ICAL Percent Difference

$$\%D = \frac{\text{Found (ICAL)} - \text{True (ICAL)}}{\text{True (ICAL)}} \times 100$$

where,

%D	=	Analyte/PercentDifference.
Found (ICAL)	=	Reported Analyte/Result (µg/L).
True (ICAL)	=	Reported Analyte/ExpectedResult (µg/L).

EQ. 1   ICV Percent Recovery

$$\%R = \frac{\text{Found (ICV)}}{\text{True (ICV)}} \times 100$$

where,

%R	=	Analyte/PercentRecovery.
Found (ICV)	=	Reported Analyte/Result (µg/L).
True (ICV)	=	Reported Analyte/ExpectedResult (µg/L).

EQ. 2   Percent Relative Standard Deviation Calculation

$$\%RSD = \frac{SD}{\overline{X}} \times 100$$

where,

%RSD	=	Peak/PercentRSD.
SD	=	Standard Deviation from EQ. 3.
$\overline{X}$	=	Mean Value from EQ. 4.

EQ. 3   Standard Deviation Calculation

$$SD = \sqrt{\frac{\sum_{i=1}^{n}\left(x_i - \overline{x}\right)^2}{(n-1)}}$$

where,

X_i	=	Reported PeakReplicate/Response.
$\overline{X}$	=	Mean Peak Replicate Response from EQ. 4.
n	=	Number of reported Peak Replicate Responses.

EQ. 4   Mean Value Calculation

$$\overline{X} = \frac{\sum_{i=1}^{n} X_i}{n}$$

where,

$\overline{X}$	=	Peak/Response.
X_i	=	Reported PeakReplicate/Response.
n	=	Number of reported Peak Replicate Responses.

EQ. 5   CCV Percent Recovery

$$\%R = \frac{Found\,(CCV)}{True\,(CCV)} \times 100$$

where,

%R	=	Analyte/PercentRecovery.
Found (CCV)	=	Reported Analyte/Result (µg/L).
True (CCV)	=	Reported Analyte/ExpectedResult (µg/L).

EQ. 6   Aqueous/Water Sample Concentration

$$Concentration\ (\mu g/L) = C \times \frac{V_f}{V} \times DF$$

where,

Concentration	=	Analyte/Result.
C	=	Reported Analyte/IntermediateResult (µg/L).
V_f	=	Reported PreparationPlusCleanup/FinalAmount from the preparation node (mL).
V	=	Reported PreparationPlusCleanup/AliquotAmount from the preparation node (mL).
DF	=	Reported Analysis/DilutionFactor.

EQ. 7   **Soil/Sediment Sample Concentration**

$$\text{Concentration (mg/kg dry weight)} = C \times \frac{V_f}{W \times S} \times DF/1000$$

where,

Concentration	=	Analyte/Result.
C	=	Reported Analyte/IntermediateResult (μg/L).
V_f	=	Reported PreparationPlusCleanup/FinalAmount from the preparation node (mL).
W	=	Reported PreparationPlusCleanup/AliquotAmount from the preparation node (g).
S	=	(Characteristic/CharacteristicValue ÷ 100) from the Characteristic node with Characteristic/CharacteristicType = "Percent_Solids". Default to 1 for Performance Evaluation samples.
DF	=	Reported Analysis/DilutionFactor.

EQ. 8   **Adjusted Soil/Sediment CRQL**

$$\text{Adjusted CRQL (mg/kg)} = C \times \frac{W_M}{W \times S} \times \frac{V_f}{V_M} \times DF$$

where,

Adjusted CRQL	=	ReportedResult/QuantitationLimit.
C	=	Reported ReportedResult/ClientQuantitationLimit (mg/kg).
W_M	=	Minimum method required aliquot amount (1.00 g).
W	=	Reported PreparationPlusCleanup/AliquotAmount from the preparation node (g).
S	=	(Characteristic/CharacteristicValue ÷ 100) from the Characteristic node with Characteristic/CharacteristicType = "Percent_Solids". Default to 1 for Performance Evaluation samples.
V_f	=	Reported PreparationPlusCleanup/FinalAmount from the preparation node (mL).
V_M	=	Method required final sample digestion volume (100 mL).
DF	=	Reported Analysis/DilutionFactor.

EQ. 8a   **Adjusted Aqueous/Water CRQL**

$$\text{Adjusted CRQL } (\mu g/L) = C \times \frac{V_f}{V} \times DF$$

where,

Adjusted CRQL	=	ReportedResult/QuantitationLimit.
C	=	Reported ReportedResult/ClientQuantitationLimit ($\mu g/L$).
V_f	=	Reported PreparationPlusCleanup/FinalAmount from the preparation node (mL).
V	=	Reported PreparationPlusCleanup/AliquotAmount from the preparation node (mL).
DF	=	Reported Analysis/DilutionFactor.

EQ. 9   **ICSA Percent Recovery**

$$\%R = \frac{\text{Found}(ICSA)}{\text{True}(ICSA)} \times 100$$

where,

%R	=	Analyte/PercentRecovery.
Found (ICSA)	=	Reported Analyte/Result ($\mu g/L$).
True (ICSA)	=	Reported Analyte/ExpectedResult ($\mu g/L$).

EQ. 10   **ICSAB Percent Recovery**

$$\%R = \frac{\text{Found}(ICSAB)}{\text{True}(ICSAB)} \times 100$$

where,

%R	=	Analyte/PercentRecovery.
Found (ICSAB)	=	Reported Analyte/Result ($\mu g/L$).
True (ICSAB)	=	Reported Analyte/ExpectedResult ($\mu g/L$).

EQ. 11   **Matrix Spike and Post-Digestion Spike Percent Recovery**

$$\%R = \frac{SSR - SR}{SA} \times 100$$

where,

%R	=	ReportedResult/PercentRecovery.
SSR	=	The Concentration value from EQ. 6 or 7 from the spike sample (μg/L or mg/kg).
SR	=	The Concentration value from EQ. 6 or 7 from the original sample (μg/L or mg/kg). If the sample concentration is less than ReportedResult/DetectionLimit, SR=0.
SA	=	Expected Concentration from EQ. 11a for aqueous/water samples (μg/L), or EQ. 11b for soil/sediment samples (mg/kg).

EQ. 11a   **Expected Concentration for Aqueous/Water Samples**

$$\text{Expected Concentration (μg/L)} = C \times \frac{V_f}{V}$$

where,

Expected Concentration	=	ReportedResult/ExpectedResult.
C	=	Reported Analyte/StandardConcentration (μg/L).
V_f	=	Reported Analyte/AmountAdded (μL).
V	=	Reported PreparationPlusCleanup/AliquotAmount from the preparation node (mL).

EQ. 11b   **Expected Concentration for Soil/Sediment Samples**

$$\text{Expected Concentration (mg/kg)} = C \times \frac{V_f}{W \times S} /1000$$

where,

Expected Concentration	=	ReportedResult/ExpectedResult.
C	=	Reported Analyte/StandardConcentration (μg/L).
V_f	=	Reported Analyte/AmountAdded (μL).
W	=	Reported PreparationPlusCleanup/AliquotAmount from the preparation node (g).
S	=	(Characteristic/CharacteristicValue ÷ 100) from the Characteristic node with Characteristic/CharacteristicType = "Percent_Solids". Default to 1 for Performance Evaluation samples.

EQ. 12   **Duplicate Sample Relative Percent Difference**

$$RPD = \frac{|S - D|}{(S + D)/2} \times 100$$

where,

RPD	=	ReportedResult/RPD.
S	=	Original Sample Result from EQ. 6 or 7.
D	=	Duplicate Sample Result from EQ. 6 or 7.

EQ. 13   **LCS Percent Recovery**

$$\%R = \frac{Found\,(LCS)}{True\,(LCS)} \times 100$$

where,

%R	=	ReportedResult/PercentRecovery.
Found (LCS)	=	Sample Concentration from EQ. 6 or 7 (µg/L or mg/kg). If the sample concentration is less than ReportedResult/ DetectionLimit, Found (LCS) = 0.
True (LCS)	=	(Adjusted CRQL from EQ. 8 or 8a) x 2 (µg/L or mg/kg).

EQ. 14   **Serial Dilution Percent Difference**

$$\% \text{ Difference} = \frac{|I - S|}{I} \times 100$$

where,

%Difference	=	ReportedResult/PercentDifference.
I	=	Initial Sample Result from EQ. 6 or 7.
S	=	Serial Dilution Result from EQ. 6 or 7. If the sample concentration is less than ReportedResult/DetectionLimit, S = 0.

EQ. 15   **Percent Relative Intensity**

$$\%RI = \frac{I_n}{I_0} \times 100$$

where,

$\%RI$ = Peak/PercentRatio.

I_n = Reported Peak/Response of the internal standard in the sample.

I_0 = Reported Peak/Response of the internal standard in the calibration blank (S0).

Equations for Exhibit D – Mercury

Section 9.3.4.3 ICAL Percent Difference

$$\%D = \frac{\text{Found (ICAL)} - \text{True (ICAL)}}{\text{True (ICAL)}} \times 100$$

where,

%D	=	Analyte/PercentDifference.
Found (ICAL)	=	Reported Analyte/Result (µg/L).
True (ICAL)	=	Reported Analyte/ExpectedResult (µg/L).

EQ. 1   ICV Percent Recovery

$$\%R = \frac{\text{Found (ICV)}}{\text{True (ICV)}} \times 100$$

where,

%R	=	Analyte/PercentRecovery.
Found (ICV)	=	Reported Analyte/Result (µg/L).
True (ICV)	=	Reported Analyte/ExpectedResult (µg/L).

EQ. 2   CCV Percent Recovery

$$\%R = \frac{\text{Found (CCV)}}{\text{True (CCV)}} \times 100$$

where,

%R	=	Analyte/PercentRecovery.
Found (CCV)	=	Reported Analyte/Result (µg/L).
True (CCV)	=	Reported Analyte/ExpectedResult (µg/L).

EQ. 3   Aqueous/Water and TCLP/SPLP Leachate Sample Concentration

$$\text{Hg Concentration (µg/L)} = C \times DF$$

where,

Hg Concentration	=	Analyte/Result.
C	=	Reported Analyte/IntermediateResult (µg/L).
DF	=	Reported Analysis/DilutionFactor.

Note: Convert units to mg/L for TCLP leachates by dividing the final calculated concentration by 1000.

EQ. 4   **Soil/Sediment Sample Concentration**

$$\text{Hg Concentration (mg/kg dry weight)} = C \times \frac{1}{W \times S} \times DF \times 0.1$$

where,

Hg Concentration	=	Analyte/Result.
C	=	Reported Analyte/IntermediateResult (µg/L).
W	=	Reported PreparationPlusCleanup/AliquotAmount from the preparation node (g).
S	=	(Characteristic/CharacteristicValue ÷ 100) from the Characteristic node with Characteristic/CharacteristicType = "Percent_Solids". Default to 1 for Performance Evaluation samples.
DF	=	Reported Analysis/DilutionFactor.

EQ. 5   **Adjusted Soil/Sediment CRQL**

$$\text{Adjusted CRQL (mg/kg)} = C \times \frac{W_m}{W \times S} \times DF$$

where,

Adjusted CRQL	=	ReportedResult/QuantitationLimit.
C	=	Reported ReportedResult/ClientQuantitationLimit (mg/kg).
W_m	=	Minimum method required aliquot amount (0.50 g).
W	=	Reported PreparationPlusCleanup/AliquotAmount from the preparation node (g).
S	=	(Characteristic/CharacteristicValue ÷ 100) from the Characteristic node with Characteristic/CharacteristicType = "Percent_Solids". Default to 1 for Performance Evaluation samples.
DF	=	Reported Analysis/DilutionFactor.

EQ. 5a   **Adjusted Aqueous/Water and TCLP/SPLP Leachate Sample CRQL**

$$\text{Adjusted CRQL (µg/L)} = C \times DF$$

where,

Adjusted CRQL	=	ReportedResult/QuantitationLimit.
C	=	Reported ReportedResult/ClientQuantitationLimit (µg/L).
DF	=	Reported Analysis/DilutionFactor.

Note: Convert units to mg/L for TCLP leachates by dividing the final calculated CRQL by 1000.

EQ. 6   **Matrix Spike Percent Recovery**

$$\%R = \frac{SSR - SR}{SA} \times 100$$

where,

%R	=	ReportedResult/PercentRecovery.
SSR	=	The Concentration value from EQ. 3 or 4 from the spike sample (µg/L or mg/kg).
SR	=	The Concentration value from EQ. 3 or 4 from the original sample (µg/L or mg/kg). If the sample concentration is less than ReportedResult/DetectionLimit, SR=0.
SA	=	Expected Concentration from EQ. 6a for aqueous/water samples (µg/L), or EQ. 6b for soil/sediment samples (mg/kg).

EQ. 6a   **Expected Concentration for Aqueous/Water Samples**

$$\text{Expected Concentration (µg/L)} = C \times \frac{V_f}{1000}$$

where,

Expected Concentration	=	ReportedResult/ExpectedResult.
C	=	Reported Analyte/StandardConcentration (µg/L).
V_f	=	Reported Analyte/AmountAdded (µL).

EQ. 6b   **Expected Concentration for Soil/Sediment Samples**

$$\text{Expected Concentration (mg/kg)} = C \times \frac{V_f}{W \times S} / 100000$$

where,

Expected Concentration	=	ReportedResult/ExpectedResult.
C	=	Reported Analyte/StandardConcentration (µg/L).
V_f	=	Reported Analyte/AmountAdded (µL).
W	=	Reported PreparationPlusCleanup/AliquotAmount from the preparation node (g).
S	=	(Characteristic/CharacteristicValue ÷ 100) from the Characteristic node with Characteristic/CharacteristicType = "Percent_Solids". Default to 1 for Performance Evaluation samples.

EQ. 7   **Duplicate Sample Relative Percent Difference**

$$RPD = \frac{|S - D|}{(S + D)/2} \times 100$$

where,

RPD   =   ReportedResult/RPD.

S   =   Original Sample Result from EQ. 3 or 4.

D   =   Duplicate Sample Result from EQ. 3 or 4.

Equations for Exhibit D – Cyanide

Section 9.3.4.3 ICAL Percent Difference

$$\%D = \frac{\text{Found (ICAL)} - \text{True (ICAL)}}{\text{True (ICAL)}} \times 100$$

where,

%D	=	Analyte/PercentDifference.
Found (ICAL)	=	Reported Analyte/Result (µg/L).
True (ICAL)	=	Reported Analyte/ExpectedResult (µg/L).

EQ. 1   ICV Percent Recovery

$$\%R = \frac{\text{Found (ICV)}}{\text{True (ICV)}} \times 100$$

where,

%R	=	Analyte/PercentRecovery.
Found (ICV)	=	Reported Analyte/Result (µg/L).
True (ICV)	=	Reported Analyte/ExpectedResult (µg/L).

EQ. 2   CCV Percent Recovery

$$\%R = \frac{\text{Found (CCV)}}{\text{True (CCV)}} \times 100$$

where,

%R	=	Analyte/PercentRecovery.
Found (CCV)	=	Reported Analyte/Result (µg/L).
True (CCV)	=	Reported Analyte/ExpectedResult (µg/L).

EQ. 3   Aqueous/Water and SPLP Leachate Sample Concentration

$$\text{CN Concentration (µg/L)} = C \times \frac{V_f}{V} \times DF$$

where,

CN Concentration	=	Analyte/Result.
C	=	Reported Analyte/IntermediateResult (µg/L).
V_f	=	Reported PreparationPlusCleanup/FinalAmount from the preparation node (mL).
V	=	Reported PreparationPlusCleanup/AliquotAmount from the preparation node (mL).
DF	=	Reported Analysis/DilutionFactor.

EQ. 4   Soil/Sediment Sample Concentration

$$\text{CN Concentration (mg/kg dry weight)} = C \times \frac{V_f}{W \times S} \times (1/1000) \times DF$$

where,

CN Concentration	=	Analyte/Result.
C	=	Reported Analyte/IntermediateResult (µg/L).
V_f	=	Reported PreparationPlusCleanup/FinalAmount from the preparation node (mL).
W	=	Reported PreparationPlusCleanup/AliquotAmount from the preparation node (g).
S	=	(Characteristic/CharacteristicValue ÷ 100) from the Characteristic node with Characteristic/CharacteristicType = "Percent_Solids". Default to 1 for Performance Evaluation samples.
DF	=	Reported Analysis/DilutionFactor.

EQ. 5   Adjusted Soil/Sediment CRQL

$$\text{Adjusted CRQL (mg/kg)} = C \times \frac{W_M}{W \times S} \times DF$$

where,

Adjusted CRQL	=	ReportedResult/QuantitationLimit.
C	=	Reported ReportedResult/ClientQuantitationLimit (mg/kg).
W_M	=	If PreparationPlusCleanup/ClientMethodID = "Midi-distillation", W_M = 1.00 g. If PreparationPlusCleanup/ClientMethodID = "Micro-distillation", W_M = 0.50 g.
W	=	Reported PreparationPlusCleanup/AliquotAmount from the preparation node (g).

S   =   (Characteristic/CharacteristicValue ÷ 100) from the
Characteristic node with Characteristic/CharacteristicType =
"Percent_Solids". Default to 1 for Performance Evaluation
samples.

DF   =   Reported Analysis/DilutionFactor.

EQ. 5a   Adjusted Aqueous/Water and SPLP Leachate Sample CRQL

$$\text{Adjusted CRQL (µg/L)} = C \times \frac{V_f}{V} \times DF$$

where,

Adjusted CRQL   =   ReportedResult/QuantitationLimit.

C   =   Reported ReportedResult/ClientQuantitationLimit (µg/L).

V_f =   Reported PreparationPlusCleanup/FinalAmount from the
preparation node (mL).

V   =   Reported PreparationPlusCleanup/AliquotAmount from the
preparation node (mL).

DF   =   Reported Analysis/DilutionFactor.

EQ. 6   Matrix Spike and Post-Distillation Spike Percent Recovery

$$\%R = \frac{SSR - SR}{SA} \times 100$$

where,

%R   =   ReportedResult/PercentRecovery.

SSR   =   The Concentration value from EQ. 3 or 4 from the spike
sample (µg/L or mg/kg).

SR   =   The Concentration value from EQ. 3 or 4 from the original
sample (µg/L or mg/kg). If the sample concentration is less
than ReportedResult/DetectionLimit, SR=0.

SA   =   Expected Concentration from EQ. 6a for aqueous/water
samples (µg/L), or EQ. 6b for soil/sediment samples
(mg/kg).

EQ. 6a   Expected Concentration for Aqueous/Water Samples

$$\text{Expected Concentration (µg/L)} = C \times \frac{V_f}{V}$$

where,

Expected Concentration = ReportedResult/ExpectedResult.

C = Reported Analyte/StandardConcentration (μg/L).

V_f = Reported Analyte/AmountAdded (μL).

V = Reported PreparationPlusCleanup/AliquotAmount from the preparation node (mL).

EQ. 6b   Expected Concentration for Soil/Sediment Samples

$$\text{Expected Concentration (mg/kg)} = C \times \frac{V_f}{W \times S} /1000$$

where,

Expected Concentration = ReportedResult/ExpectedResult.

C = Reported Analyte/StandardConcentration (μg/L).

V_f = Reported Analyte/AmountAdded (μL).

W = Reported PreparationPlusCleanup/AliquotAmount from the preparation node (g).

S = (Characteristic/CharacteristicValue ÷ 100) from the Characteristic node with Characteristic/CharacteristicType = "Percent_Solids". Default to 1 for Performance Evaluation samples.

EQ. 7   Duplicate Sample Relative Percent Difference

$$RPD = \frac{|S - D|}{(S + D)/2} \times 100$$

where,

RPD = ReportedResult/RPD.

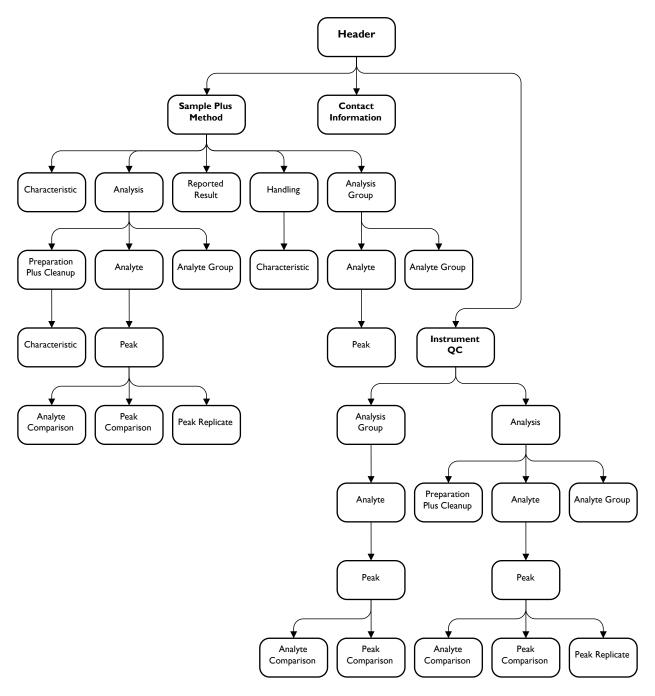S = Original Sample Result from EQ. 3 or 4.

D = Duplicate Sample Result from EQ. 3 or 4.

Figure 1: SEDD Stage 3 Data Node Hierarchy