

Appendix I

CLP SOW ILM05.4/ Inorganic Analysis
Method QC Criteria, Equations, and Definitions

APPENDIX I

The following method QC criteria, equations, and definitions apply to data generated according to the **USEPA CLP Statement of Work for Inorganic Analysis, Multi-Media, Multi-Concentration, ILM05.4**.

SECTION I: PRESERVATION AND TECHNICAL HOLDING TIME CRITERIA

Refer to the Region I, EPA-NE Data Validation Functional Guidelines for Evaluating Environmental Analyses, Part IV, Section INORG-I-B, for preservation and technical holding time data validation criteria.

SECTION II: ICP-MS TUNE CRITERIA

Refer to the following ICP-MS tune method QC criteria for data validation:

The tuning solution for instrument tuning and mass calibration consists of beryllium, magnesium, cobalt, indium, and lead at 100 ug/L in 1% (v/v) nitric acid. The tuning solution must be performed prior to instrument calibration and may be analyzed as five separate analyses or as a single analysis with at least five integrations.

Mass calibration must be within 0.1 amu over the range of 6 to 210 amu and peak width must be within the manufacturer's specifications. The percent relative standard deviation (%RSD) of the absolute signals for all analytes in the tuning solution must not exceed 5%.

SECTION III: CALIBRATION CRITERIA

Refer to the Region I, EPA-NE Data Validation Functional Guidelines for Evaluating Environmental Analyses, Part IV, Section INORG-III-B, for calibration data validation criteria and the following method QC criteria:

Instruments must be calibrated daily or once every 24 hours and each time the instrument is set up.

Initial Calibration:

ICP-AES - A blank and at least one calibration standard must be used to calibrate the instrument. At least two replicate integrations are required for data acquisition.

ICP-MS - A blank and at least one calibration standard must be used to calibrate the instrument. At least three replicate integrations are required for data acquisition.

Cold Vapor Mercury AA - A blank and at least four calibration standards in graduated amounts in the appropriate range must be used to calibrate the instrument. One of the standards must be at the CRQL. The correlation coefficient for the initial calibration curve must be ≥ 0.995 .

Cyanide - A blank and at least three calibration standards in graduated amounts in the appropriate range must be used to calibrate the instrument. One of the standards must be equal to the CRQL. The correlation coefficient for the initial calibration curve must be ≥ 0.995 .

Initial and Continuing Calibration Verification (ICV/CCV):

An ICV must be analyzed immediately after instrument calibration at each wavelength used for analysis or at each mass used to report final results. If a certified solution for an analyte is not available, then a standard from a different source than that used for instrument calibration must be prepared at a concentration other than that used for calibration. For cyanide, the ICV must be distilled with each batch of samples distilled, and the distilled samples must be analyzed with that particular ICV.

A CCV must be analyzed for each wavelength used for analysis or mass used to report final results at the beginning of the run, at a frequency of 10% or every 2 hours during an analysis run, whichever is more frequent, and after the last analytical sample of the run. The analyte concentrations in the CCV standard must be different from the concentrations in the ICV and must be near the mid-range of the initial calibration range.

Table App.I.III-1 - INITIAL AND CONTINUING CALIBRATION VERIFICATION
RECOVERY LIMITS

Analytical Method	Parameter	Method QC Criteria % Recovery
ICP-AES/ICP-MS	Metals	90 - 110
Cold Vapor AA	Mercury	80 - 120
Spectrophotometric	Cyanide	85 - 115

The ICV/CCV % recovery is calculated using the following equation:

$$\% \text{ Recovery} = \frac{\text{Found (ICV / CCV)}}{\text{True (ICV / CCV)}} \times 100$$

Where,

Found (ICV/CCV) = Concentration of the analyte determined in the ICV or CCV.

True (ICV/CCV) = True concentration of the ICV or CCV.

Contract Required Quantitation Limit (CRQL) Check Standard (CRI):

A standard at the CRQL (CRI) must be analyzed for every wavelength used for analysis or mass used to report final results at the beginning of the run, immediately following the ICV/ICB, at a frequency of not less than once per 20 analytical samples per analysis run, and at the end of each sample analysis run. The subsequent CRI analysis must be immediately followed by the CCV/CCB analysis. For ICP-AES, a CRI is not required for aluminum, barium, calcium, iron, magnesium, sodium, and potassium.

The CRI % recovery is calculated using the following equation:

$$\% \text{ Recovery} = \frac{\text{CRI Found}}{\text{CRI True}} \times 100$$

Where,

CRI Found = CRI concentration determined for the analyte.

CRI True = True CRI concentration for the analyte.

Table App.I.III-2 - CONTRACT REQUIRED QUANTITATION LIMIT (CRQL) CHECK STANDARD (CRI)
RECOVERY LIMITS

Analytical Method	Parameter	Method QC Criteria % Recovery
ICP-AES	Metals (except Sb, Pb, Tl)	70 - 130
	Sb, Pb, Tl	50 - 150
ICP-MS	Metals (except Co, Mn, Zn)	70 - 130
	Co, Mn, Zn	50 - 150
Cold Vapor AA	Mercury	70 - 130
Spectrophotometric	Cyanide	70 - 130

SECTION IV: BLANK CRITERIA

Refer to the Region I, EPA-NE Data Validation Functional Guidelines for Evaluating Environmental Analyses, Part IV, Section INORG-IV-B, for blank validation criteria and the following method QC criteria:

Method-Required Blanks

- Preparation Blank - Contains all of the reagents, in the same volumes which were used to process samples. At least one preparation blank, processed through each sample preparation and analysis procedure, must be prepared and analyzed with each SDG or with each batch of samples prepared, whichever is more frequent.
- Calibration Blank - Contains reagents in reagent water. A calibration blank must be analyzed at each wavelength used for analysis or mass used to report final results immediately after every ICV and CCV, at a frequency of 10% or every 2 hours during the run, whichever is more frequent, and at the beginning of the run and after the last analytical sample. (For mercury, the calibration blank is carried through the entire preparation and analysis procedure.)

SECTION V: ICP-AES INTERFERENCE CHECK SAMPLE (ICS) CRITERIA

Refer to the Region I, EPA-NE Data Validation Functional Guidelines for Evaluating Environmental Analyses, Part IV, Section INORG-V-B, for ICS validation criteria and the following method QC criteria:

An ICS analysis consists of analyzing Solution A (ICSA) and Solution AB (ICSAB) consecutively (starting with the ICSA) for all target analytes and interferents (target and non-target), at the beginning and end of each analytical run (but not before the ICV) and at a frequency of not less than once per 20 analytical samples per analysis run.

Table App.I.V-1 - INTERFERENT AND ANALYTE CONCENTRATIONS IN THE ICP-AES
INTERFERENCE CHECK SAMPLE (ICS)

Analytes	Conc. (mg/L)	Interferents	Conc. (mg/L)
Silver	0.2	Aluminum	250
Arsenic	0.1	Calcium	250
Barium	0.5	Iron	100
Beryllium	0.5	Magnesium	250
Cadmium	1.0		
Cobalt	0.5		
Chromium	0.5		
Copper	0.5		
Manganese	0.5		
Nickel	1.0		
Lead	0.05		
Antimony	0.6		
Selenium	0.05		
Thallium	0.1		
Vanadium	0.5		
Zinc	1.0		

Note: ICS Solution A (ICSA) contains the interferents at the indicated concentrations; ICS Solution AB (ICSAB) contains all of the analytes plus all of the interferents in Solution A at the indicated concentrations.

Note: The CLP SOW ILM05.4 ICS method acceptance criteria differ from the Region I Functional Guidelines ICS criteria. If data quality objectives allow for greater variability of data, then expanded ICS validation criteria should be documented in the EPA-approved site-specific QAPP or amendment to the QAPP.

The ICS % recovery is calculated using the following equation:

$$ICS \% Recovery = \frac{Found\ Solution\ A/AB}{True\ Solution\ A/AB} \times 100$$

Where,

Found Solution A/AB = Concentration (positive, negative, or zero) of the analyte measured in the ICSA or ICSAB.

True Solution A/AB = True concentration of the analyte in the ICSA or ICSAB.

SECTION VI: ICP-MS INTERFERENCE CHECK SAMPLE (ICS) CRITERIA

Refer to Region I, EPA-NE Data Validation Functional Guidelines for Evaluating Environmental Analyses, Part IV, Section INORG-VI-B, for ICS validation criteria and the following method QC criteria:

An ICS analysis consists of analyzing Solution A (ICSA) and Solution AB (ICSAB) consecutively (starting with ICSA) for all target analytes and monitoring for all interferents at the beginning of each analytical sequence (but not before the ICV).

Table App.I.VI-1 - INTERFERENT AND ANALYTE CONCENTRATIONS IN THE ICP-MS INTERFERENCE CHECK SAMPLE (ICS)

Analytes	Conc. ($\mu\text{g/L}$)	Interferents	Conc. (mg/L)
Antimony	20	Aluminum	100
Arsenic	20	Calcium	100
Barium	20	Iron	100
Beryllium	20	Magnesium	100
Cadmium	20	Potassium	100
Chromium	20	Sodium	100
Cobalt	20	Phosphorus (as ortho-phosphate)	100
Copper	20	Sulfur (as sulfate)	100
Lead	20	Carbon	200
Manganese	20	Chloride	1000
Nickel	20	Molybdenum	2
Selenium	20	Titanium	2
Silver	20		
Thallium	20		
Vanadium	20		
Zinc	20		

Note: ICS Solution A (ICSA) contains the interferents at the indicated concentrations; ICS Solution AB (ICSAB) contains all of the analytes plus all of the interferents in Solution A at the indicated concentrations.

Note: The CLP SOW ILM05.4 ICS method acceptance criteria differ from the Region I Functional Guidelines ICS criteria. If data quality objectives allow for greater variability of data, then expanded ICS validation criteria should be documented in the EPA-approved site-specific QAPP or amendment to the

QAPP.

The ICS % recovery is calculated using the following equation:

$$ICS \% Recovery = \frac{Found\ Solution\ A/AB}{True\ Solution\ A/AB} \times 100$$

Where,

Found Solution A/AB = Concentration (positive, negative, or zero) of the analyte measured in the ICSA or ICSAB.

True Solution A/AB = True concentration of the analyte in the ICSA or ICSAB.

SECTION VII: ICP-MS INTERNAL STANDARD CRITERIA

Refer to the Region I, EPA-NE Data Validation Functional Guidelines for Evaluating Environmental Analyses, Part IV, Section INORG-VII-B, for ICP-MS internal standard data validation criteria and the following method QC criteria:

For full range mass scans, a minimum of five internal standards must be used and the masses of the internal standards must bracket the masses of the analytes. Internal standards must be added to all samples, standards, and blanks at identical levels and in a similar manner. The concentrations of the internal standards should be sufficiently high for good precision and to minimize the possibility of correction errors if the internal standard is naturally present in the sample. A concentration range of 20 ug/L to 200 ug/L for each internal standard is recommended.

Acceptable internal standards are listed below:

Table App.I.VII-1 - ICP-MS INTERNAL STANDARDS

Internal Standard	Mass
Lithium	6
Scandium	45
Yttrium	89
Rhodium	103
Indium	115
Terbium	159
Holmium	165
Lutetium	175
Bismuth	209

The absolute response of any internal standard must not deviate by more than 60-125% of the original response in the blank calibration standard.

If the internal standard does not meet the acceptance criteria, then the sample must be diluted by a factor of two, internal standards added, and the sample reanalyzed. If the internal standard responses for the diluted sample analysis are within criteria, then the results from the diluted sample analysis are reported. If the internal standard responses for the diluted sample analysis are not within criteria, then the results of the original undiluted sample

analysis are reported.

The internal standard percent relative intensity (%RI) is calculated using the following equation:

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

Where,

I_n = IS intensity in the sample.

I_o = IS intensity in the blank calibration standard.

SECTION VIII: MATRIX SPIKE CRITERIA

Refer to the Region I, EPA-NE Data Validation Functional Guidelines for Evaluating Environmental Analyses, Part IV, Section INORG-VIII-B, for matrix spike data validation criteria and the following method QC criteria:

A matrix spike sample must be analyzed for each group of samples of a similar matrix or for each SDG. The matrix spike analytes are spiked at the following concentrations:

ICP-AES: Water - aluminum and barium at 2000 µg/L; iron at 1000 µg/L; cobalt, manganese, nickel, vanadium, and zinc at 500 µg/L; copper at 250 µg/L; chromium at 200 µg/L; antimony at 100 µg/L; beryllium, cadmium, selenium, silver, and thallium at 50 µg/L; arsenic at 40 µg/L; and lead at 20 µg/L. Soil - spike concentrations are a factor of 5 less than the water spike concentrations in mg/kg (e.g., cobalt is at 100 mg/kg); no spike is required for aluminum and iron.

ICP-MS: Water - Barium at 2000 µg/L; cobalt, manganese, nickel, vanadium, and zinc at 500 µg/L; copper at 250 µg/L; chromium at 200 µg/L; antimony at 100 µg/L; beryllium, cadmium, silver, and thallium at 50 µg/L; arsenic at 40 µg/L; lead at 20 µg/L; and selenium at 10 µg/L.

Hg: 1 µg/L (water); 0.5 mg/kg (soil).

Cyanide: 100 µg/L in the final sample solution for analysis, e.g., 25 µg cyanide for a 250 mL final distillate volume (non-midi-distillation); 5 µg cyanide for a 50 mL final distillate volume (mini-distillation).

The method QC criteria for matrix spike recovery is 75-125%. When the sample concentration exceeds the spike added concentration by a factor of 4 or more, the method QC criteria for recovery do not apply.

If the matrix spike recovery is outside the method QC criteria and the sample result does not exceed 4 times the spike added concentration, a post-digestion/distillation spike must be performed using the same sample that was used for the matrix spike analysis for ICP-AES, ICP-MS, and cyanide (not mercury). The post-digestion spike concentration must be 2x the indigenous level or 2x the CRQL, whichever is greater.

The matrix spike sample % recovery is calculated using the following equation:

$$\text{Matrix Spike \% Recovery} = \frac{SSR - SR}{SA} \times 100$$

Where,

SSR = Spiked Sample Result

SR = Sample Result

SA = Spike Added

SECTION IX: LABORATORY DUPLICATE SAMPLE CRITERIA

Refer to the Region I, EPA-NE Data Validation Functional Guidelines for Evaluating Environmental Analyses, Part IV, Section INORG-IX-B, for laboratory duplicate sample data validation criteria and the following duplicate sample method QC criteria:

A laboratory duplicate sample must be analyzed for each group of samples of a similar matrix or for each SDG. Duplicate sample analysis is required for percent solids determination.

The method QC criteria for laboratory duplicate samples are as follows: For original and duplicate sample values $\geq 5 \times \text{CRQL}$, the relative percent difference (RPD) must be $\leq 20\%$. If either the sample or the duplicate sample value is $< 5 \times \text{CRQL}$, then the absolute difference between the two must be $\leq \text{CRQL}$. If both the sample and duplicate sample values are $< \text{CRQL}$ or $< \text{MDL}$, then no control limit applies.

The duplicate sample relative percent difference (RPD) is calculated using the following equation:

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

Where,

S = Sample result (original)

D = Duplicate sample result

SECTION X: FIELD DUPLICATE CRITERIA

Refer to the Region I, EPA-NE Data Validation Functional Guidelines for Evaluating Environmental Analyses, Part IV, Section INORG-X-B, for field duplicate data validation criteria.

SECTION XI: ICP SERIAL DILUTION CRITERIA

Refer to the Region I, EPA-NE Data Validation Functional Guidelines for Evaluating Environmental Analyses, Part IV, Section INORG-XI-B, for ICP serial dilution data validation criteria and the following method QC criteria:

The ICP serial dilution analysis must be performed for each group of samples of a similar matrix or for each SDG, whichever is more frequent.

The serial dilution (a five-fold dilution) must be within 10% of the original sample determination after correction for dilution, if the analyte concentration is minimally a factor of 50 above the MDL in the original sample.

The serial dilution percent difference (%D) is calculated using the following equation:

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

Where,

I = Initial sample result (instrument reading)

S = Serial dilution result (instrument reading x 5)

SECTION XII: SENSITIVITY CHECK CRITERIA

Refer to the Region I, EPA-NE Data Validation Functional Guidelines for Evaluating Environmental Analyses, Part IV, Section INORG-XII-B, for sensitivity check data validation criteria.

SECTION XIII: PE SAMPLES - ACCURACY CHECK CRITERIA

Refer to the Region I, EPA-NE Data Validation Functional Guidelines for Evaluating Environmental Analyses, Part IV, Section INORG-XIII-B, for accuracy check data validation criteria and the following method QC criteria for laboratory control samples (Zero Blind PES):

An aqueous or solid laboratory control sample (LCS) must be analyzed for each analyte and for each matrix, SDG, or each batch of samples prepared, whichever is more frequent. An aqueous LCS is not required for mercury and cyanide (the ICV serves as the aqueous LCS).

The % recovery method QC criteria for the aqueous LCS are 80 -120% for all elements (except Ag and Sb by ICP-AES).

For the solid LCS, use the control limits documented and provided with the certified solid LCS.

The LCS % recovery is calculated using the following equation:

$$LCS \% Recovery = \frac{LCS\ found}{LCS\ true} \times 100$$

Where,

LCS found = Concentration of the analyte measured in the LCS.

LCS true = True concentration of the analyte in the LCS.

SECTION XIV: ANALYTE QUANTITATION AND REPORTED QUANTITATION LIMITS CRITERIA

Refer to the Region I, EPA-NE Data Validation Functional Guidelines for Evaluating Environmental Analyses, Part IV, Section INORG-XIV-B, for analyte quantitation and reported quantitation limit data validation criteria and the following method QC criteria:

Target analytes must be quantitated using the established initial calibration. Internal standardization must also be used for ICP-MS. The sample target analytes must be reported to the CRQLs listed below.

Table App.I.XIV-1 - INORGANIC TARGET ANALYTE LIST (TAL) AND
CONTRACT REQUIRED QUANTITATION LIMITS (CRQLs) for ILM05.4 SOW

Analyte	Quantitation Limits ^{1,2}		
	ICP-AES Water ³ (µg/L)	ICP-AES Soil ^{3,4} (mg/kg)	ICP-MS Water (µg/L)
Aluminum	200	20	--
Antimony	60	6	2
Arsenic	10	1	1
Barium	200	20	10
Beryllium	5	0.5	1
Cadmium	5	0.5	1
Calcium	5000	500	--
Chromium	10	1	2
Cobalt	50	5	1
Copper	25	2.5	2
Iron	100	10	--
Lead	10	1	1
Magnesium	5000	500	--
Manganese	15	1.5	1
Mercury ³	0.2	0.1	--
Nickel	40	4	1
Potassium	5000	500	--
Selenium	35	3.5	5
Silver	10	1	1
Sodium	5000	500	--
Thallium	25	2.5	1
Vanadium	50	5	5
Zinc	60	6	2
Cyanide ³	10	2.5	--

¹The CRQLs are the minimum levels of quantitation acceptable under the contract Statement of Work (SOW).

²Method Detection Limits (MDLs) must be less than one-half of the CRQLs.

³Mercury is analyzed by cold vapor atomic absorption. Cyanide is analyzed by colorimetry/spectrophotometry.

⁴The CRQLs for soil are based on 100% solids. Samples quantitation limits must be adjusted for % solids, preparation factors, and dilutions.

SAMPLE CONCENTRATION FOR ICP-AES - The amount of analyte present in the sample is calculated using the following equations:

Sample concentration for water:

$$\mu\text{g} / \text{L} = \frac{(C)(V_f)(DF)}{(V_i)}$$

Where,

C = Instrument value in $\mu\text{g}/\text{L}$.

V_f = Final digestion volume (mL)

V_i = Initial digestion volume (mL)

DF = Dilution Factor

Sample concentration for soil/sediment:

$$\text{mg} / \text{kg} (\text{dry wt.}) = \frac{(C)(V)(DF)}{(W)(S)}$$

Where,

C = Concentration (mg/L)

V = Final sample volume in Liters (L)

W = Wet sample weight (kg)

S = % Solids/100

DF = Dilution Factor

MDL/CRQL CALCULATIONS FOR ICP-AES

Adjusted MDL/CRQL for water:

The adjusted MDL or adjusted CRQL for water samples is calculated by substituting the value of the MDL ($\mu\text{g}/\text{L}$) or CRQL ($\mu\text{g}/\text{L}$) into the "C" term in the water equation above.

Adjusted MDL/CRQL for soil/sediment:

$$\text{Adjusted MDL} / \text{CRQL} = (C) \times \frac{(W_M)(V_R)(DF)}{(W_R)(V_M)(S)}$$

Where,

C = MDL or CRQL concentration (mg/kg)

W_M = Minimum method-required wet sample weight (g)

W_R = Reported wet sample weight (g)

V_M = Method-required final sample volume (mL)

V_R = Reported final sample volume (mL)

S = % Solids/100

DF = Sample Dilution Factor

SAMPLE CONCENTRATION FOR ICP-MS - The amount of analyte present in the sample is calculated using the following equations:

Sample concentration for water prepared by method HW2:

$$\mu\text{g} / \text{L} = \frac{(C)(V_f)(V_f)(DF)}{(V_i)(20)}$$

Where,

C = Instrument value in $\mu\text{g}/\text{L}$

V_f = Final digestion volume (50 mL)

V_i = Initial digestion volume (100 mL)
 DF = Dilution Factor

Sample concentration for water prepared by method HW3:

$$\mu\text{g} / \text{L} = \frac{(C)(V_f)(DF)}{(V_i)}$$

Where,
 C = Instrument value in $\mu\text{g}/\text{L}$
 V_f = Final digestion volume (mL)
 V_i = Initial digestion volume (mL)
 DF = Dilution Factor

MDL/CRQL CALCULATIONS FOR ICP-MS

Adjusted MDL/CRQL for water:

The adjusted MDL or adjusted CRQL for water samples is calculated by multiplying the value of the MDL ($\mu\text{g}/\text{L}$) or CRQL ($\mu\text{g}/\text{L}$) by the sample dilution factor.

SAMPLE CONCENTRATION FOR MERCURY - The amount of analyte present in the sample is calculated using the following equations:

Sample concentration for water by the Automated Technique:

A linear regression equation is used to determine the sample concentration. If samples were diluted for analysis, multiply the results from the linear regression by the dilution factor.

Sample concentration for water by the Manual Technique:

$$\mu\text{g} / \text{L} = \frac{(\mu\text{g Hg, curve})(1000 \text{ mL})}{(\text{aliquot volume, mL})(1\text{L})}$$

Sample concentration for soil/sediment:

$$\text{mg} / \text{kg} (\text{dry wt.}) = (\mu\text{g} / \text{g}) = \frac{(C)(0.1\text{L})}{(W)(S)}$$

Where,
 C = Concentration from curve ($\mu\text{g}/\text{L}$)
 W = Wet sample weight (g)
 S = % Solids/100

MDL/CRQL CALCULATIONS FOR MERCURY

Adjusted MDL/CRQL for water:

The adjusted MDL or adjusted CRQL for water samples is calculated by multiplying the value of the MDL ($\mu\text{g}/\text{L}$) or CRQL ($\mu\text{g}/\text{L}$) by the sample dilution factor.

Adjusted MDL/CRQL for soil/sediment:

$$\text{Adjusted MDL / CRQL} = (C) \times \frac{(W_M)(DF)}{(W_R)(S)}$$

Where,

C = MDL or CRQL concentration (mg/kg)

W_M = Method-required wet sample weight (g)

W_R = Reported wet sample weight (g)

S = % Solids/100

DF = Sample Dilution Factor

SAMPLE CONCENTRATION FOR CYANIDE - The amount of analyte present in the sample is calculated using the following equations:

Non-Midi-Distillation

Sample concentration for water by semi-automated colorimetric determination (non-midi-distillation):

A linear regression equation is used to determine the sample concentration. Multiply the results by one-half since the original volume was 500 mL and the distillate volume was 250 mL. If samples were diluted for analysis, multiply the results by the dilution factor.

Sample concentration for water by manual colorimetric determination (non-midi-distillation):

$$\mu\text{g} / \text{L} = \frac{(A)(1000 \text{ mL} / \text{L})(50 \text{ mL})}{(B)(C)}$$

Where,

A = μg CN read from standard curve (per 250 mL)

B = mL of original sample for distillation

C = mL taken for colorimetric analysis

50 mL = Volume of original sample aliquot

1000 mL/L = Conversion mL to L

The minimum value that can be substituted for A is the Method Detection Limit (MDL) value adjusted for volume.

Sample concentration for soil/sediment by semi-automated colorimetric determination (non-midi-distillation):

$$\text{mg} / \text{kg} (\text{dry wt.}) = \frac{(A)(0.25)}{(C)(S)}$$

Where,

A = $\mu\text{g}/\text{L}$ determined from standard curve

C = Wet weight of original sample (g)

0.25 = Conversion factor for distillate final volume

S = % Solids/100

The minimum value that can be substituted for A is the MDL value.

Sample concentration for soil/sediment by manual colorimetric determination (non-midi-distillation):

$$mg / kg (dry wt.) = \frac{(A)(50 mL)}{(C)(B)(S)}$$

Where,

A = μ g CN read from standard curve (per 250 mL)

B = mL of distillate taken for colorimetric determination

C = Wet weight of original sample (g)

50 mL = Standard volume taken for colorimetric determination

S = % Solids/100

Midi-Distillation

Sample concentration for water by semi-automated colorimetric determination (midi-distillation):

$$\mu g / L = \frac{(A)(D)(F)}{(B)}$$

Where,

A = μ g/L CN of sample from regression analysis

B = Volume of original sample for distillation (0.050 L)

D = Any dilution factor necessary to bracket sample value within standard values

F = Sample receiving solution volume (0.050 L)

The minimum value that can be substituted for A is the MDL value.

Sample concentration for soil/sediment by semi-automated colorimetric determination (midi-distillation):

$$mg / kg (dry wt.) = \frac{(A)(D)(F)}{(B)(E)}$$

Where,

A = μ g/L CN of sample from regression analysis curve

B = Wet weight of original sample

D = Any dilution factor necessary to bracket sample value within standard values

E = % Solids/100

F = Sample receiving solution volume (0.050 L)

The minimum value that can be substituted for A is the MDL value.

MDL/CRQL CALCULATIONS FOR CYANIDE

Adjusted MDL/CRQL for water (non-midi-distillation, semi-automated colorimetric determination):

Multiply the MDL or CRQL for water samples by one-half (1/2) since the original volume was 500 mL and the distillate volume was 250 mL. If samples were diluted for analysis, multiply only the MDL (μ g/L) or CRQL (μ g/L) by the dilution factor.

Adjusted MDL/CRQL for water (non-midi-distillation, manual colorimetric determination):

$$Adjusted MDL / CRQL = \frac{(A)(1000 mL / L)(50 mL)}{(B)(C)}$$

Where,

A = MDL or CRQL concentration (μ g/L) X 0.25

B = mL of original sample for distillation

C = mL taken for colorimetric analysis
 50 mL = Volume of original sample aliquot
 1000 mL/L = Conversion mL to L

Adjusted MDL/CRQL for water (midi-distillation, semi-automated colorimetric determination):

$$\text{Adjusted MDL / CRQL} = (C) \times \frac{(D)(F)}{(B)}$$

Where,

C = MDL or CRQL concentration ($\mu\text{g/L}$)

B = Volume of original sample for distillation (0.050 L)

D = Any dilution factor necessary to bracket sample value within standard values

F = Sample receiving solution volume (0.050 L)

Adjusted MDL/CRQL for soil/sediment (all methods):

$$\text{Adjusted MDL / CRQL} = (C) \times \frac{(W_M)(DF)}{(W_R)(S)}$$

Where,

C = MDL or CRQL concentration (mg/kg)

W_M = Minimum method-required wet sample weight (g)

W_R = Reported wet sample weight (g)

S = % Solids/100

DF = Dilution Factor

SECTION XV: SYSTEM PERFORMANCE CRITERIA

Refer to the Region I, EPA-NE Data Validation Functional Guidelines for Evaluating Environmental Analyses, Part IV, Section INORG-XV-B, for system performance data validation criteria.

SECTION XVI: OVERALL ASSESSMENT CRITERIA

Refer to the Region I, EPA-NE Data Validation Functional Guidelines for Evaluating Environmental Analyses, Part IV, Section INORG-XVI-B, for overall assessment data validation criteria.