RPP-RPT-58867
Revision 0

AX Farm Groundwater Risk Constituent Concentration Determination

A. R. Olander
Washington River Protection Solutions, LLC
Richland, WA 99352
U.S. Department of Energy Contract DE-AC27-08RV14800

EDT/ECN:	NA	UC:	
Cost Center:	2FH	Charge Code:	201773
B&R Code:	N/A	Total Pages:	54 CGH, 8/19/15

Key Words:
Tank Waste Retrieval Work Plan (TWRWP), groundwater, risk, leak

Abstract:
This document provides tanks AX-101, AX-102, AX-103, and AX-104 postulated leak concentrations should a leak occur during retrieval operations. The concentrations are intended to be used in a groundwater risk assessment model as required by legal decree.

TRADEMARK DISCLAIMER. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof or its contractors or subcontractors.

APPROVED
By GE Bratton at 8:40 am, Aug 19, 2015

Release Approval Date

DATE:
Aug 19, 2015
HANFORD RELEASE

Release Stamp

Approved For Public Release

RPP-RPT-58867
Revision 0

AX Farm Groundwater Risk Constituent Concentration Determination

Prepared by

A. R. Olander
Washington River Protection Solutions, LLC

Date Published
August 2015

Prepared for the U.S. Department of Energy
Office of River Protection

Contract No. DE-AC27-08RV14800

Approved for Public Release;
Further Dissemination Unlimited

TABLE OF CONTENTS

1.0 BACKGROUND 1
1.1 PRE-RETRIEVAL WASTE CONCENTRATIONS & MODEL INPUT.....1
2.0 THERMODYNAMIC MODEL 13
2.1 CONDITIONS AND ASSUMPTIONS FOR RECONCILIATION 13
2.2 RETRIEVAL SIMULATION 17
3.0 RESULTS 19
4.0 REFERENCES 21
APPENDIX A PLOTS A-1

LIST OF FIGURES

Figure A-1. AX-101 Cold Water: Technetium Max 1.27E-4 moles/L..... A-2
Figure A-2. AX-101 Cold Water: Iodine Max 9.68E-6 moles/L..... A-3
Figure A-3. AX-101 Cold Water: Uranium Max 1,220 mg/L..... A-4
Figure A-4. AX-101 Cold Water: Chromium Max 4,510 mg/L..... A-5
Figure A-5. AX-101 Cold Water: Nitrite Max 121,000 mg/L..... A-6
Figure A-6. AX-101 Cold Water: Nitrate Max 247,000 mg/L..... A-7
Figure A-7. AX-102 Hot Water: Technetium Max 2.55E-5 moles/L..... A-8
Figure A-8. AX-102 Hot Water: Iodine Max 5.08E-6 moles/L A-9
Figure A-9. AX-102 Hot Water: Uranium Max 3,650 mg/L..... A-10
Figure A-10. AX-102 Hot Water: Chromium Max 690 mg/L..... A-11
Figure A-11. AX-102 Hot Water: Nitrite Max 30,900 mg/L A-12
Figure A-12. AX-102 Hot Water: Nitrate Max 1.57E 5 mg/L A-13
Figure A-13. AX-103 Cold Water: Technetium Max 9.54E-5 moles/L..... A-14
Figure A-14. AX-103 Cold Water: Iodine Max 6.88E-6 moles/L..... A-15
Figure A-15. AX-103 Cold Water: Uranium Max 440 mg/L..... A-16
Figure A-16. AX-103 Cold Water: Chromium Max 4,840 mg/L..... A-17
Figure A-17. AX-103 Cold Water: Nitrite Max 1.23E 5 mg/L A-18
Figure A-18. AX-103 Cold Water: Nitrate Max 1.56E 5 mg/L..... A-19
Figure A-19. AX-104 Cold Water: Technetium Max 1.87E-4 moles/L..... A-20
Figure A-20. AX-104 Cold Water: Iodine Max 2.49E-7 moles/L..... A-21
Figure A-21. AX-104 Cold Water: Uranium Max 2,520 mg/L..... A-22

Figure A-22. AX-104 Cold Water: Chromium Max 444 mg/L A-23
Figure A-23. AX-104 Cold Water: Nitrite Max 1,720 mg/L A-24
Figure A-24. AX-104 Cold Water: Nitrate Max 35,000 mg/L A-25

LIST OF TABLES

Table 1-1. AX-101 A1 Saltcake Liquid 5
Table 1-2. AX-101 A1 Saltcake Solid 6
Table 1-3. AX-101 SRR Solid 7
Table 1-4. AX-102 (All Waste Types Totaled) 8
Table 1-5. AX-103 A1 Saltcake Liquid 9
Table 1-6. AX-103 A1 Saltcake Solid 10
Table 1-7. AX-103 P2 Solid 11
Table 1-8. AX-104 P2 Solid 12
Table 2-1. AX-101 Predicted Species 14
Table 2-2. AX-102 Predicted Species 15
Table 2-3. AX-103 Predicted Species 16
Table 2-4. AX-104 Predicted Species 17
Table 3-1. AX-101 Maximum Concentrations 19
Table 3-2. AX-102 Maximum Concentrations 19
Table 3-3. AX-103 Maximum Concentrations 20
Table 3-4. AX-104 Maximum Concentrations 20

LIST OF TERMS

Abbreviations and Acronyms

BBI	Best Basis Inventory
HISI	Hanford Information System Inventory
OLI	OLI Systems, Inc.
P2 Solid	*PUREX waste also called inorganic wash waste and fission product waste (from aluminum and zirconium clad fuel)
A1 Saltcake	*Evaporator slurry generated between 1976 and 1980
SDDS	Surveillance Data Display System
SRR Solid	*Strontium recovery waste from sluiced P sludge
Stream Analyzer	Standalone Software Component of OLI Studio
TWINS	Tank Waste Information Network System
TWRWP	Tank Waste Retrieval Work Plan

Units

Ci	Curie
°F	Fahrenheit
g	gram
kg	kilogram
kL	kiloliter
L	liter
mg	milligram
Mol	gram mole
pH	a value that represents the acidity or alkalinity of a water system
wt%	weight percent

* LA-UR-96-858, Appendix A

1.0 BACKGROUND

Consent Decree N0. 08-5085-FVS requires that the Tank Waste Retrieval Work Plan (TWRWP) include a pre-retrieval groundwater risk assessment. Part of the risk assessment is based on a potential leak during retrieval. To estimate the risk during retrieval, the concentrations of waste constituents needs to be determined during retrieval process.

The planned retrieval in AX farm uses water to sluice solids from the tank. The water will be recirculated and reused as a sluicing fluid until it becomes saturated with dissolved salt and other waste constituents. Both raw water and hot water will be used to dissolve and mobilize the waste for retrieval. Not all of the waste constituents will reach maximum concentrations at the same conditions. Some constituents reached a maximum concentration in hot water while others reached a maximum concentration in cold water. Maximum concentrations are selected for each constituent of concern regardless of the conditions since it is unknown what conditions may exist when a leak might occur. The thermodynamic model, OLI Systems Inc. Stream Analyzer, was used to determine maximum concentrations of constituents that may occur during retrieval. These maximum concentrations are used as input to the groundwater risk model.

1.1 PRE-RETRIEVAL WASTE CONCENTRATIONS & MODEL INPUT

Pre-retrieval waste concentrations are calculated from the best basis inventory (BBI). Data was downloaded from the Tank Waste Information Network System (TWINS) data base 2-17-15 for the AX Farm tanks. Not all of the BBI constituents were used in the thermodynamic model. Chemicals that are the bulk of the mass and therefore affect the system chemistry, were included in the model. Constituents of concern to groundwater risk^, selected in consultation with Ecology, were also included in the model. All told, 24 of the 25 BBI nonradioactive chemicals and three radionuclides were included in the model.

The BBI does not include a mass for hydroxide and the inventory listed is not charge balanced. Hydroxide measured in samples may be misleading for modeling because the waste absorbs carbon dioxide from the air and carbonic acid forms consuming the hydroxide over time. It is unlikely that hydroxide deficient, low pH waste was discharged to the single shell tanks, so sample data pH was not used as a model input. Generally, hydroxide is used as a slack variable to charge balance the waste inventory before modeling. In some cases, it is necessary to add cation mass to charge balance the inventory or to have a more reasonable simulation. If cation mass is needed the mass of sodium is adjusted since it is normally the predominant cation and a small change in its mass would not change the overall characteristics of the system. In rare cases, when the system characteristics are unusual, adjustments are made to the major cations and anions as needed to compensate for abnormalities. For example, an abnormality that would indicate an adjustment is needed is if the thermodynamic model predicts the waste is acidic after

^ For C-Farm NO_2, Cr, and Tc-99 were evaluated (RPP-22521). Other constituents that can be mobile in the soil (iodine, fluoride, and uranium) were also included.

the charge reconciled inventory is simulated. The BBI is based on limited sample information, mass balance, and modeling. It is assumed for this concentration determination that the values presented in the BBI may be adjusted by ± 20% without affecting the waste characteristics or exceeding the range of variation inherent to the BBI inventory data.

Some elements have multiple valence states. In order to charge balance, the expected valence is chosen based on the expected compounds in the chemical system. For chromium, Ecology requested that the valence state of +6 be used in the simulation to provide a worst case scenario with more soluble chrome.

The total organic carbon value listed in the BBI includes all of the organic carbon including the carbon in the separately listed oxalate. For modeling purposes it is assumed that the organic carbon that is not oxalate is formate (Waste Management 2000). About 27% of the weight of oxalate is from carbon; the weight fraction calculation is shown below:

Oxalate Chemical Formula C_2O_4

C atomic weight = 12.011	2 x 12.011 =	24.0220
O atomic weight = 15.9994	4 x 15.9994 =	63.9976
	Total	88.0196

Carbon Fraction: 24.0220÷88.0196 = 0.2729 kg C per kg C_2O_4

Likewise carbon is about 27% of the weight of formate; the weight percent calculation is shown below:

Formate Chemical Formula HCO_2

C atomic weight = 12.011	1 x 12.011 =	12.0110
O atomic weight = 15.9994	2 x 15.9994 =	31.9988
H atomic weight = 1.0079	1 x 1.0079 =	1.00790
	Total	45.0177

Carbon Fraction: 12.011÷45.0177 = 0.2668 kg C per kg HCO_2

To calculate the quantity of formate the following formula is used:

(BBI TOC-BBI Oxalate x 0.2729)÷0.2668 = Mass of Formate in kg

Some elements were changed to molecular compounds because the element with the expected valance state was not in the OLI data base. Chromium, silicon, technetium, and uranium were in this category. The molecular compounds use were Cr_2O_7-2, $HSiO_3$-1, TcO_4-1, and UO_2+2. The BBI elemental masses were adjusted as follows:

Chromium

Cr atomic weight = 51.996	2 x 51.996 =	103.992
O atomic weight = 15.9994	7 x 15.9994 =	111.996
	Total	215.988

Chromium Fraction: 103.992÷215.988 = 0.48147 kg Cr per kg Cr_2O_7-2

To calculate the quantity of Cr_2O_7-2 the following formula is used:

BBI Chromium ÷0.48147 = Mass of Cr_2O_7-2 in kg

Silicon

H atomic weight = 1.0079	1 x 1.0079 =	1.0079
Si atomic weight = 28.0855	1 x 28.0855 =	28.0855
O atomic weight = 15.9994	3 x 15.9994 =	47.9982
	Total	77.0916

Silicon Fraction: 28.0855÷77.0916 = 0.3643 kg Si per kg $HSiO_3$-1

To calculate the quantity of $HSiO_3$-1 the following formula is used:

BBI Silicon ÷0.3643 = Mass of $HSiO_3$-1 in kg

Technetium-99

Tc atomic weight = 99	1 x 99 =	99
O atomic weight = 15.9994	4 x 15.9994 =	63.998
	Total	162.998

Technetium-99 Fraction: 99÷162.998 = 0.60737 kg Tc-99 per kg TcO_4-1

To calculate the quantity of TcO_4-1 the following formula is used:

BBI Technetium-99 ÷0.60737 = Mass of TcO_4-1 in kg

Uranium

U atomic weight = 238.029	1 x 238.029 =	238.029
O atomic weight = 15.9994	2 x 15.9994 =	31.9988
	Total	270.028

Uranium Fraction: 238.029÷270.028 = 0.8815 kg U per kg UO_2

To calculate the quantity of UO_2+2 the following formula is used:

BBI Uranium ÷0.8815 = Mass of UO_2+2 in kg

The BBI inventory data is presented by mass of each constituent in each waste type along with the volume for that waste type. The concentration of constituents was calculated for each constituent and for each waste type. Each waste type was modeled separately and then combined except for AX-102. Due the unusual properties exhibited after simulating each AX-102 waste type separately, the tank was modeled with all of the waste types combined first, before simulating in the thermodynamic model.

The radionuclides were not decayed to the present date since maximum values are desired.

Table 1-1 through 1-8 show the constituent concentrations modeled and the derivation of the concentrations. The model input species are listed in the first column of the tables. The species were entered as shown except for silicon and uranium. Chromium, silicon, technetium, and uranium were entered into the OLI model as the molecular species shown in column 7; Cr_2O_7-2, $HSiO_3$-1, TcO_4-1, and UO_2+2.

Table 1-1. AX-101 A1 Saltcake Liquid

Input Species	BBI kg or Ci	(1)Specific Activity (Ci/g)	(2)Mass Adjust.	Molecular Weight (g/mole)	(3)Moles	Possible Compounds	Valence	(4)Eq. Charges	BBI Volume (kL)	(5)Conc. (mg/L)
Al	8.95E+03			26.98	3.32E+05	$NaAl(OH)_4$	3	9.95E+05	178	5.03E+04
Bi	6.85E+00			208.98	3.28E+01	$Bi(OH)_3$	3	9.83E+01	178	3.85E+01
Ca	1.07E+01			40.08	2.67E+02	$Ca(OH)_2$	2	5.34E+02	178	6.01E+01
Cl	1.57E+03			35.453	4.43E+04	NaCl	-1	-4.43E+04	178	8.82E+03
Tic as CO_3	1.97E+03			60.0092	3.28E+04	Na_2C0_3	-2	-6.57E+04	178	1.11E+04
Cr	3.12E+01			51.996	3.00E+02	Cr_2O_7-2	-2	-6.00E+02	178	3.64E+02
^{137}Cs	5.55E+04	8.678E+01		137	4.67E+00	CsOH	1	4.67E+00	178	3.59E+00
F	1.03E+01			18.99	5.42E+02	NaF	-1	-5.42E+02	178	5.79E+01
Fe	5.42E+00			55.847	9.71E+01	$Fe(OH)_3$	3	2.91E+02	178	3.04E+01
Hg	5.40E-02			200.59	2.69E-01	Hg	0	0.00E+00	178	3.03E-01
^{129}I	5.27E-02	1.765E-04		129	2.31E+00	NaI	-1	-2.31E+00	178	1.68E+00
K	1.32E+03			39.0983	3.38E+04	KOH	1	3.38E+04	178	7.42E+03
Mn	1.07E+00			54.938	1.95E+01	$Mn(OH)_2$	2	3.90E+01	178	6.01E+00
Na	5.02E+04		-10%	22.989	1.97E+06	NaOH	1	1.97E+06	178	2.54E+05
Ni	2.14E+00			58.7	3.65E+01	$Ni(OH)_2$	2	7.29E+01	178	1.20E+01
NO_2	3.08E+04			46	6.70E+05	$NaNO_2$	-1	-6.70E+05	178	1.73E+05
NO_3	4.84E+04			62	7.81E+05	$NaNO_3$	-1	-7.81E+05	178	2.72E+05
C_2O_4	9.01E+01			88.0196	1.02E+03	$Na_2C_2O_4$	-2	-2.05E+03	178	5.06E+02
Pb	2.26E+01			207.2	1.09E+02	$Pb(OH)_2$	2	2.18E+02	178	1.27E+02
PO_4	1.09E+03			94.9706	1.15E+04	$Na_3(PO_4)$	-3	-3.44E+04	178	6.12E+03
Si	2.81E+01			28.0855	1.00E+03	$HSiO_3$-1	-1	-1.00E+03	178	4.33E+02
SO_4	3.47E+02			95.0576	3.61E+03	$Na2(SO_4)$	-2	-7.22E+03	178	1.95E+03
Sr	1.10E-02			87.62	1.26E-01	$Sr(OH)_2$	2	2.51E-01	178	6.18E-02
^{99}Tc	5.54E+01	1.695E-02		99	3.30E+01	TcO_4-1	-1	-3.30E+01	178	3.02E+01
*TOC HCO_2	7.08E+02 **2.56E+03**			45.018	5.69E+04	$NaCO_2H$	-1	-5.69E+04	178	1.44E+04
U	1.56E-01			238.029	6.55E-01	UO2+2	2	1.31E+00	178	9.94E-01
Zr	1.07E+00			91.224	1.17E+01	$Zr(OH)_4$	4	4.69E+01	178	6.01E+00
(6)OH	2.265E+4			16.9994	1.33E+06	NaOH	-1	-1.33E+06	178	1.27E+05
Total								0.00E+00		

Calculations

1) Specific activities from Table 2-6, RPP-17152, Rev. 11

2) Mass Adjustment and Convert to Moles: ((BBI Mass kg + BBI Mass kg x Mass Adj. %) x 1000 g/kg)÷Molecular Weight g/mole = Moles

3) Convert to Moles: (BBI Mass kg x 1000 g/kg)÷Molecular Weight g/mole = Moles. For radionuclides Ci must first be converted to mass (BBI Ci ÷ specific activity) ÷ 1000 = BBI Mass in kg

4) Equivalent Charge: Moles x Valence = Equivalent Charge

5) Concentration: (BBI Mass x 1000 g/kg)÷BBI Volume = Concentration in mg/L, Cr_2O_7-2, $HSiO_3$-1, TcO_4-1, and UO_2+2 mass calculation shown above in section 1.1.

6) Hydroxide Mass is calculated iteratively by guessing a mass and calculating the equivalent charge of hydroxide. Then all the equivalent charges are summed until the total equivalent charge is near zero.

*See section 1.1 for method and justification for converting TOC to formate.

Table 1-2. AX-101 A1 Saltcake Solid

Input Species	BBI kg or Ci	(1)Specific Activity (Ci/g)	(2)Mass Adjust.	Molecular Weight (g/mole)	(3)Moles	Possible Compounds	Valence	(4)Eq. Charges	BBI Volume (kL)	(5)Conc. (mg/L)
Al	4.23E+04			26.98	3.32E+05	$NaAl(OH)_4$	3	4.70E+06	1,164	3.63E+04
Bi	3.80E+01			208.98	3.28E+01	$Bi(OH)_3$	3	5.46E+02	1,164	3.26E+01
Ca	8.43E+02			40.08	2.67E+02	$Ca(OH)_2$	2	4.21E+04	1,164	7.24E+02
Cl	7.04E+03			35.453	4.43E+04	NaCl	-1	-1.99E+05	1,164	6.05E+03
Tic as CO_3	2.25E+05			60.0092	3.28E+04	Na_2C0_3	-2	-7.50E+06	1,164	1.93E+05
Cr	6.11E+03			51.996	3.00E+02	Cr_2O_7-2	-2	-1.18E+05	1,164	1.09E+04
^{137}Cs	3.14E+05	8.678E+01		137	4.67E+00	CsOH	1	2.64E+01	1,164	3.11E+00
F	1.61E+03			18.99	5.42E+02	NaF	-1	-8.48E+04	1,164	1.38E+03
Fe	4.62E+02			55.847	9.71E+01	$Fe(OH)_3$	3	2.48E+04	1,164	3.97E+02
Hg	2.00E+00			200.59	2.69E-01	Hg	0	0.00E+00	1,164	1.72E+00
^{129}I	2.43E-01	1.765E-04		129	2.31E+00	NaI	-1	-1.07E+01	1,164	1.18E+00
K	6.11E+03			39.0983	3.38E+04	KOH	1	1.56E+05	1,164	5.25E+03
Mn	6.61E+01			54.938	1.95E+01	$Mn(OH)_2$	2	2.41E+03	1,164	5.68E+01
Na	4.38E+05		-10%	22.989	1.97E+06	NaOH	1	1.71E+07	1,164	3.39E+05
Ni	1.94E+02			58.7	3.65E+01	$Ni(OH)_2$	2	6.61E+03	1,164	1.67E+02
NO_2	1.34E+05			46	6.70E+05	$NaNO_2$	-1	-2.91E+06	1,164	1.15E+05
NO_3	2.87E+05			62	7.81E+05	$NaNO_3$	-1	-4.63E+06	1,164	2.47E+05
C_2O_4	2.62E+04			88.0196	1.02E+03	$Na_2C_2O_4$	-2	-5.95E+05	1,164	2.25E+04
Pb	1.78E+02			207.2	1.09E+02	$Pb(OH)_2$	2	1.72E+03	1,164	1.53E+02
PO_4	7.78E+03			94.9706	1.15E+04	$Na_3(PO_4)$	-3	-2.46E+05	1,164	6.68E+03
Si	4.28E+02			28.0855	1.00E+03	$HSiO_3$-1	-1	-1.52E+04	1,164	1.01E+03
SO_4	5.91E+04			95.0576	3.61E+03	Na2(SO_4)	-2	-1.23E+06	1,164	5.08E+04
Sr	1.68E+00			87.62	1.26E-01	$Sr(OH)_2$	2	3.83E+01	1,164	1.44E+00
^{99}Tc	2.34E+02	1.695E-02		99	3.30E+01	TcO_4-1	-1	-1.39E+02	1,164	1.95E+01
*TOC HCO_2	1.29E+04			45.018	5.69E+04	$NaCO_2H$	-1	-2.87E+05	1,164	1.11E+04
U	1.13E+03			238.029	6.55E-01	UO2+2	2	9.49E+03	1,164	1.10E+03
Zr	6.03E+01			91.224	1.17E+01	$Zr(OH)_4$	4	2.64E+03	1,164	5.18E+01
(6)OH	7.28E+04			16.9994	1.33E+06	NaOH	-1	-4.28E+06	1,164	6.25E+04
Total								0.00E+00		

Calculations

1) Specific activities from Table 2-6, RPP-17152, Rev. 11

2) Mass Adjustment and Convert to Moles: ((BBI Mass kg + BBI Mass kg x Mass Adj. %) x 1000 g/kg)÷Molecular Weight g/mole = Moles

3) Convert to Moles: (BBI Mass kg x 1000 g/kg)÷Molecular Weight g/mole = Moles. For radionuclides Ci must first be converted to mass (BBI Ci ÷ specific activity) ÷ 1000 = BBI Mass in kg

4) Equivalent Charge: Moles x Valence = Equivalent Charge

5) Concentration: (BBI Mass x 1000 g/kg)÷BBI Volume = Concentration in mg/L, Cr_2O_7-2, $HSiO_3$-1, TcO_4-1, and UO_2+2 mass calculation shown above in section 1.1.

6) Hydroxide Mass is calculated iteratively by guessing a mass and calculating the equivalent charge of hydroxide. Then all the equivalent charges are summed until the total equivalent charge is near zero.

*See section 1.1 for method and justification for converting TOC to formate.

Table 1-3. AX-101 SRR Solid

Input Species	BBI kg or Ci	(1)Specific Activity (Ci/g)	(2)Mass Adjust.	Molecular Weight (g/mole)	(3)Moles	Possible Compounds	Valence	(4)Eq. Charges	BBI Volume (kL)	(5)Conc. (mg/L)
Al	0.00E+00			26.98	0.00E+00	$NaAl(OH)_4$	3	0.00E+00	11	0.00E+00
Bi	0.00E+00			208.98	0.00E+00	$Bi(OH)_3$	3	0.00E+00	11	0.00E+00
Ca	1.47E+02			40.08	3.67E+03	$Ca(OH)_2$	2	7.34E+03	11	1.34E+04
Cl	1.91E+01			35.453	5.39E+02	NaCl	-1	-5.39E+02	11	1.74E+03
Tic as CO_3	3.44E+02			60.0092	5.73E+03	Na_2C0_3	-2	-1.15E+04	11	3.13E+04
Cr	0.00E+00			51.996	0.00E+00	Cr_2O_7-2	-2	0.00E+00	11	0.00E+00
^{137}Cs	1.38E+03	8.678E+01		137	1.16E-01	CsOH	1	1.16E-01	11	1.45E+00
F	0.00E+00			18.99	0.00E+00	NaF	-1	0.00E+00	11	0.00E+00
Fe	9.27E+02			55.847	1.66E+04	$Fe(OH)_3$	3	4.98E+04	11	8.43E+04
Hg	1.15E+01			200.59	5.73E+01	Hg	0	0.00E+00	11	1.05E+03
^{129}I	2.18E-05	1.765E-04		129	9.57E-04	NaI	-1	-9.57E-04	11	1.12E-02
K	4.58E+00			39.0983	1.17E+02	KOH	1	1.17E+02	11	4.16E+02
Mn	0.00E+00			54.938	0.00E+00	$Mn(OH)_2$	2	0.00E+00	11	0.00E+00
Na	2.03E+03			22.989	8.83E+04	NaOH	1	8.83E+04	11	1.85E+05
Ni	0.00E+00			58.7	0.00E+00	$Ni(OH)_2$	2	0.00E+00	11	0.00E+00
NO_2	2.57E+02			46	5.59E+03	$NaNO_2$	-1	-5.59E+03	11	2.34E+04
NO_3	1.23E-08			62	1.98E-07	$NaNO_3$	-1	-1.98E-07	11	1.12E-06
C_2O_4	5.19E-02			88.0196	5.90E-01	$Na_2C_2O_4$	-2	-1.18E+00	11	4.72E+00
Pb	0.00E+00			207.2	0.00E+00	$Pb(OH)_2$	2	0.00E+00	11	0.00E+00
PO_4	0.00E+00			94.9706	0.00E+00	$Na_3(PO_4)$	-3	0.00E+00	11	0.00E+00
Si	8.31E+02			28.0855	2.96E+04	$HSiO_3$-1	-1	-2.96E+04	11	2.07E+05
SO_4	8.47E+01			95.0576	8.82E+02	Na2(SO_4)	-2	-1.76E+03	11	7.70E+03
Sr	2.86E+00			87.62	3.26E+01	$Sr(OH)_2$	2	6.53E+01	11	2.60E+02
^{99}Tc	3.55E-01	1.695E-02		99	2.12E-01	TcO_4-1	-1	-2.12E-01	11	3.13E+00
*TOC HCO_2	8.90E-02			45.018	1.98E+00	$NaCO_2H$	-1	-1.98E+00	11	8.09E+00
U	5.28E+02			238.029	2.22E+03	UO2+2	2	4.44E+03	11	5.45E+04
Zr	0.00E+00			91.224	0.00E+00	$Zr(OH)_4$	4	0.00E+00	11	0.00E+00
(6)OH	1.72E+03			16.9994	1.01E+05	NaOH	-1	-1.01E+05	11	1.56E+05
Total								0.00E+00		

Calculations

1) Specific activities from Table 2-6, RPP-17152, Rev. 11

2) Mass Adjustment and Convert to Moles: ((BBI Mass kg + BBI Mass kg x Mass Adj. %) x 1000 g/kg)÷Molecular Weight g/mole = Moles

3) Convert to Moles: (BBI Mass kg x 1000 g/kg)÷Molecular Weight g/mole = Moles. For radionuclides Ci must first be converted to mass (BBI Ci ÷ specific activity) ÷ 1000 = BBI Mass in kg

4) Equivalent Charge: Moles x Valence = Equivalent Charge

5) Concentration: (BBI Mass x 1000 g/kg)÷BBI Volume = Concentration in mg/L, Cr_2O_7-2, $HSiO_3$-1, TcO_4-1, and UO_2+2 mass calculation shown above in section 1.1.

6) Hydroxide Mass is calculated iteratively by guessing a mass and calculating the equivalent charge of hydroxide. Then all the equivalent charges are summed until the total equivalent charge is near zero.

*See section 1.1 for method and justification for converting TOC to formate.

Table 1-4. AX-102 (All Waste Types Totaled)

Input Species	BBI kg or Ci	(1)Specific Activity (Ci/g)	(2)Mass Adjust.	Molecular Weight (g/mole)	(3)Moles	Possible Compounds	Valence	(4)Eq. Charges	BBI Volume (kL)	(5)Conc. (mg/L)
Al	2.37E+03			26.98	8.78E+04	$NaAl(OH)_4$	3	2.64E+05	113	2.10E+04
Bi	2.63E+00			208.98	1.26E+01	$Bi(OH)_3$	3	3.78E+01	113	2.33E+01
Ca	2.44E+02			40.08	6.09E+03	$Ca(OH)_2$	2	1.22E+04	113	2.16E+03
Cl	1.09E+02			35.453	3.07E+03	NaCl	-1	-3.07E+03	113	9.65E+02
Tic as CO_3	1.24E+04		+10	60.0092	1.86E+05	Na_2C0_3	-2	-3.72E+05	113	9.88E+04
Cr	1.02E+02			51.996	9.81E+02	Cr_2O_7-2	-2	-1.96E+03	113	1.87E+03
^{137}Cs	2.24E+04	8.678E+01		137	1.88E+00	CsOH	1	1.88E+00	113	2.28E+00
F	5.92E+01			18.99	3.12E+03	NaF	-1	-3.12E+03	113	5.24E+02
Fe	6.40E+03			55.847	1.15E+05	$Fe(OH)_3$	3	3.44E+05	113	5.66E+04
Hg	7.59E+00			200.59	3.78E+01	Hg	0	0.00E+00	113	6.72E+01
^{129}I	1.68E-02	1.765E-04		129	7.38E-01	NaI	-1	-7.38E-01	113	8.42E-01
K	6.15E+01			39.0983	1.57E+03	KOH	1	1.57E+03	113	5.44E+02
Mn	5.22E+02			54.938	9.50E+03	$Mn(OH)_2$	2	1.90E+04	113	4.62E+03
Na	2.43E+04		+10	22.989	1.16E+06	NaOH	1	1.16E+06	113	2.37E+05
Ni	1.49E+02			58.7	2.54E+03	$Ni(OH)_2$	2	5.08E+03	113	1.32E+03
NO_2	5.07E+03		-10	46	9.92E+04	$NaNO_2$	-1	-9.92E+04	113	4.04E+04
NO_3	2.58E+04		-10	62	3.75E+05	$NaNO_3$	-1	-3.75E+05	113	2.05E+05
C_2O_4	3.06E+03		-10	88.0196	3.13E+04	$Na_2C_2O_4$	-2	-6.26E+04	113	2.44E+04
Pb	4.43E+02			207.2	2.14E+03	$Pb(OH)_2$	2	4.28E+03	113	3.92E+03
PO_4	1.16E+03		-10	94.9706	1.10E+04	$Na_3(PO_4)$	-3	-3.30E+04	113	9.24E+03
Si	1.01E+03		-10	28.0855	3.24E+04	$HSiO_3$-1	-1	-3.24E+04	113	2.21E+04
SO_4	4.62E+02			95.0576	4.81E+03	$Na2(SO_4)$	-2	-9.62E+03	113	4.09E+03
Sr	1.16E+02			87.62	1.32E+03	$Sr(OH)_2$	2	2.65E+03	113	1.03E+03
^{99}Tc	6.30E+00	1.695E-02		99	3.75E+00	TcO_4-1	-1	-3.75E+00	113	5.42E+00
*TOC HCO_2	1.95E+04		-10	45.018	3.91E+05	$NaCO_2H$	-1	-3.91E+05	113	1.56E+05
U	5.39E+02			238.029	2.26E+03	UO2+2	2	4.53E+03	113	5.41E+03
Zr	1.89E+01			91.224	2.07E+02	$Zr(OH)_4$	4	8.29E+02	113	1.67E+02
(6)OH	7.45E+03			16.9994	4.38E+05	NaOH	-1	-4.38E+05	113	6.59E+04
Total								0.00E+00		

Calculations

1) Specific activities from Table 2-6, RPP-17152, Rev. 11

2) Mass Adjustment and Convert to Moles: ((BBI Mass kg + BBI Mass kg x Mass Adj. %) x 1000 g/kg)÷Molecular Weight g/mole = Moles

3) Convert to Moles: (BBI Mass kg x 1000 g/kg)÷Molecular Weight g/mole = Moles. For radionuclides Ci must first be converted to mass (BBI Ci ÷ specific activity) ÷ 1000 = BBI Mass in kg

4) Equivalent Charge: Moles x Valence = Equivalent Charge

5) Concentration: (BBI Mass x 1000 g/kg)÷BBI Volume = Concentration in mg/L, Cr_2O_7-2, $HSiO_3$-1, TcO_4-1, and UO_2+2 mass calculation shown above in section 1.1

6) Hydroxide Mass is calculated iteratively by guessing a mass and calculating the equivalent charge of hydroxide. Then all the equivalent charges are summed until the total equivalent charge is near zero.

*See section 1.1 for method and justification for converting TOC to formate.

Table 1-5. AX-103 A1 Saltcake Liquid

Input Species	BBI kg or Ci	(1)Specific Activity (Ci/g)	(2)Mass Adjust.	Molecular Weight (g/mole)	(3)Moles	Possible Compounds	Valence	(4)Eq. Charges	BBI Volume (kL)	(5)Conc. (mg/L)
Al	2.84E+03			26.98	1.05E+05	$NaAl(OH)_4$	3	3.16E+05	75	3.79E+04
Bi	2.45E+00			208.98	1.17E+01	$Bi(OH)_3$	3	3.52E+01	75	3.27E+01
Ca	4.73E+00			40.08	1.18E+02	$Ca(OH)_2$	2	2.36E+02	75	6.31E+01
Cl	7.09E+02			35.453	2.00E+04	NaCl	-1	-2.00E+04	75	9.45E+03
Tic as CO_3	1.31E+03			60.0092	2.18E+04	Na_2C0_3	-2	-4.37E+04	75	1.75E+04
Cr	1.29E+02			51.996	1.24E+03	Cr_2O_7-2	-2	-2.48E+03	75	3.57E+03
^{137}Cs	2.43E+04	8.678E+01		137	2.04E+00	CsOH	1	2.04E+00	75	3.73E+00
F	2.57E+01			18.99	1.35E+03	NaF	-1	-1.35E+03	75	3.43E+02
Fe	1.94E+00			55.847	3.47E+01	$Fe(OH)_3$	3	1.04E+02	75	2.59E+01
Hg	1.93E-02			200.59	9.62E-02	Hg	0	0.00E+00	75	2.57E-01
^{129}I	1.88E-02	1.765E-04		129	8.26E-01	NaI	-1	-8.26E-01	75	1.42E+00
K	5.20E+02			39.0983	1.33E+04	KOH	1	1.33E+04	75	6.93E+03
Mn	4.64E-01			54.938	8.45E+00	$Mn(OH)_2$	2	1.69E+01	75	6.19E+00
Na	1.77E+04		-10	22.989	6.93E+05	NaOH	1	6.93E+05	75	2.12E+05
Ni	2.18E+00			58.7	3.71E+01	$Ni(OH)_2$	2	7.43E+01	75	2.91E+01
NO_2	9.15E+03			46	1.99E+05	$NaNO_2$	-1	-1.99E+05	75	1.22E+05
NO_3	1.43E+04			62	2.31E+05	$NaNO_3$	-1	-2.31E+05	75	1.91E+05
C_2O_4	3.88E+01			88.0196	4.41E+02	$Na_2C_2O_4$	-2	-8.82E+02	75	5.17E+02
Pb	4.82E+00			207.2	2.33E+01	$Pb(OH)_2$	2	4.65E+01	75	6.43E+01
PO_4	2.35E+02			94.9706	2.47E+03	$Na_3(PO_4)$	-3	-7.42E+03	75	3.13E+03
Si	1.09E+01			28.0855	3.88E+02	$HSiO_3$-1	-1	-3.88E+02	75	3.99E+02
SO_4	2.81E+02			95.0576	2.93E+03	Na2(SO_4)	-2	-5.85E+03	75	3.75E+03
Sr	3.94E-03			87.62	4.50E-02	$Sr(OH)_2$	2	8.99E-02	75	5.25E-02
^{99}Tc	1.98E+01	1.695E-02		99	1.18E+01	TcO_4-1	-1	-1.18E+01	75	2.56E+01
*TOC HCO_2	1.09E+03			45.018	2.43E+04	$NaCO_2H$	-1	-2.43E+04	75	1.46E+04
U	1.66E-01			238.029	6.97E-01	UO2+2	2	1.39E+00	75	2.51E+00
Zr	4.86E-01			91.224	5.33E+00	$Zr(OH)_4$	4	2.13E+01	75	6.48E+00
(6)OH	8.27E+03			16.9994	4.87E+05	NaOH	-1	-4.87E+05	75	1.10E+05
Total								0.00E+00		

Calculations

1) Specific activities from Table 2-6, RPP-17152, Rev. 11

2) Mass Adjustment and Convert to Moles: ((BBI Mass kg + BBI Mass kg x Mass Adj. %) x 1000 g/kg)÷Molecular Weight g/mole = Moles

3) Convert to Moles: (BBI Mass kg x 1000 g/kg)÷Molecular Weight g/mole = Moles. For radionuclides Ci must first be converted to mass (BBI Ci ÷ specific activity) ÷ 1000 = BBI Mass in kg

4) Equivalent Charge: Moles x Valence = Equivalent Charge

5) Concentration: (BBI Mass x 1000 g/kg)÷BBI Volume = Concentration in mg/L, Cr_2O_7-2, $HSiO_3$-1, TcO_4-1, and UO_2+2 mass calculation shown above in section 1.1

6) Hydroxide Mass is calculated iteratively by guessing a mass and calculating the equivalent charge of hydroxide. Then all the equivalent charges are summed until the total equivalent charge is near zero.

*See section 1.1 for method and justification for converting TOC to formate.

Table 1-6. AX-103 A1 Saltcake Solid

Input Species	BBI kg or Ci	(1)Specific Activity (Ci/g)	(2)Mass Adjust.	Molecular Weight (g/mole)	(3)Moles	Possible Compounds	Valence	(4)Eq. Charges	BBI Volume (kL)	(5)Conc. (mg/L)
Al	1.07E+04			26.98	3.97E+05	$NaAl(OH)_4$	3	1.19E+06	298	3.59E+04
Bi	7.63E+00			208.98	3.65E+01	$Bi(OH)_3$	3	1.10E+02	298	2.56E+01
Ca	1.29E+02			40.08	3.22E+03	$Ca(OH)_2$	2	6.44E+03	298	4.33E+02
Cl	2.50E+03			35.453	7.05E+04	NaCl	-1	-7.05E+04	298	8.39E+03
Tic as CO_3	2.89E+04			60.0092	4.82E+05	Na_2C0_3	-2	-9.63E+05	298	9.70E+04
Cr	1.78E+03			51.996	1.71E+04	Cr_2O_7-2	-2	-3.42E+04	298	1.24E+04
^{137}Cs	6.64E+04	8.678E+01		137	5.59E+00	CsOH	1	5.59E+00	298	2.57E+00
F	5.10E+02			18.99	2.69E+04	NaF	-1	-2.69E+04	298	1.71E+03
Fe	6.72E+01			55.847	1.20E+03	$Fe(OH)_3$	3	3.61E+03	298	2.26E+02
Hg	4.01E-01			200.59	2.00E+00	Hg	0	0.00E+00	298	1.35E+00
^{129}I	4.87E-02	1.765E-04		129	2.14E+00	NaI	-1	-2.14E+00	298	9.26E-01
K	1.49E+03			39.0983	3.81E+04	KOH	1	3.81E+04	298	5.00E+03
Mn	4.67E+00			54.938	8.50E+01	$Mn(OH)_2$	2	1.70E+02	298	1.57E+01
Na	8.72E+04			22.989	3.79E+06	NaOH	1	3.79E+06	298	2.93E+05
Ni	2.15E+01			58.7	3.66E+02	$Ni(OH)_2$	2	7.33E+02	298	7.21E+01
NO_2	4.47E+04			46	9.72E+05	$NaNO_2$	-1	-9.72E+05	298	1.50E+05
NO_3	5.18E+04			62	8.35E+05	$NaNO_3$	-1	-8.35E+05	298	1.74E+05
C_2O_4	3.58E+03			88.0196	4.07E+04	$Na_2C_2O_4$	-2	-8.13E+04	298	1.20E+04
Pb	3.51E+01			207.2	1.69E+02	$Pb(OH)_2$	2	3.39E+02	298	1.18E+02
PO_4	2.03E+03			94.9706	2.14E+04	$Na_3(PO_4)$	-3	-6.41E+04	298	6.81E+03
Si	2.29E+02			28.0855	8.15E+03	$HSiO_3$-1	-1	-8.15E+03	298	2.11E+03
SO_4	6.44E+03			95.0576	6.70E+04	Na2(SO_4)	-2	-1.34E+05	298	2.16E+04
Sr	4.02E-01			87.62	4.59E+00	$Sr(OH)_2$	2	9.18E+00	298	1.35E+00
^{99}Tc	4.69E+01	1.695E-02		99	2.79E+01	TcO_4-1	-1	-2.79E+01	298	1.53E+01
*TOC HCO_2	4.70E+03			45.018	1.04E+05	$NaCO_2H$	-1	-1.04E+05	298	1.58E+04
U	7.00E+01			238.029	2.94E+02	UO2+2	2	5.88E+02	298	2.66E+02
Zr	5.36E+00			91.224	5.88E+01	$Zr(OH)_4$	4	2.35E+02	298	1.80E+01
(6)OH	2.96E+04			16.9994	1.74E+06	NaOH	-1	-1.74E+06	298	9.92E+04
Total								0.00E+00		

Calculations

1) Specific activities from Table 2-6, RPP-17152, Rev. 11

2) Mass Adjustment and Convert to Moles: ((BBI Mass kg + BBI Mass kg x Mass Adj. %) x 1000 g/kg)÷Molecular Weight g/mole = Moles

3) Convert to Moles: (BBI Mass kg x 1000 g/kg)÷Molecular Weight g/mole = Moles. For radionuclides Ci must first be converted to mass (BBI Ci ÷ specific activity) ÷ 1000 = BBI Mass in kg

4) Equivalent Charge: Moles x Valence = Equivalent Charge

5) Concentration: (BBI Mass x 1000 g/kg)÷BBI Volume = Concentration in mg/L, Cr_2O_7-2, $HSiO_3$-1, TcO_4-1, and UO_2+2 mass calculation shown above in section 1.1

6) Hydroxide Mass is calculated iteratively by guessing a mass and calculating the equivalent charge of hydroxide. Then all the equivalent charges are summed until the total equivalent charge is near zero.

*See section 1.1 for method and justification for converting TOC to formate.

Table 1-7. AX-103 P2 Solid

Input Species	BBI kg or Ci	(1)Specific Activity (Ci/g)	(2)Mass Adjust.	Molecular Weight (g/mole)	(3)Moles	Possible Compounds	Valence	(4)Eq. Charges	BBI Volume (kL)	(5)Conc. (mg/L)
Al	1.53E+03			26.98	5.67E+04	$NaAl(OH)_4$	3	1.70E+05	30	5.10E+04
Bi	0.00E+00			208.98	0.00E+00	$Bi(OH)_3$	3	0.00E+00	30	0.00E+00
Ca	2.16E+02			40.08	5.39E+03	$Ca(OH)_2$	2	1.08E+04	30	7.20E+03
Cl	1.17E+01			35.453	3.30E+02	NaCl	-1	-3.30E+02	30	3.90E+02
Tic as CO_3	2.63E+03			60.0092	4.38E+04	Na_2C0_3	-2	-8.77E+04	30	8.77E+04
Cr	2.18E+02			51.996	2.10E+03	Cr_2O_7-2	-2	-4.19E+03	30	1.51E+04
^{137}Cs	1.46E+04	8.678E+01		137	1.23E+00	CsOH	1	1.23E+00	30	5.61E+00
F	3.79E+00			18.99	2.00E+02	NaF	-1	-2.00E+02	30	1.26E+02
Fe	4.47E+03			55.847	8.00E+04	$Fe(OH)_3$	3	2.40E+05	30	1.49E+05
Hg	4.82E+00			200.59	2.40E+01	Hg	0	0.00E+00	30	1.61E+02
^{129}I	2.13E-04	1.765E-04		129	9.36E-03	NaI	-1	-9.36E-03	30	4.02E-02
K	4.70E+00			39.0983	1.20E+02	KOH	1	1.20E+02	30	1.57E+02
Mn	6.10E+02			54.938	1.11E+04	$Mn(OH)_2$	2	2.22E+04	30	2.03E+04
Na	1.74E+03			22.989	7.57E+04	NaOH	1	7.57E+04	30	5.80E+04
Ni	2.47E+02			58.7	4.21E+03	$Ni(OH)_2$	2	8.42E+03	30	8.23E+03
NO_2	8.40E+01			46	1.83E+03	$NaNO_2$	-1	-1.83E+03	30	2.80E+03
NO_3	2.25E+03			62	3.63E+04	$NaNO_3$	-1	-3.63E+04	30	7.50E+04
C_2O_4	0.00E+00			88.0196	0.00E+00	$Na_2C_2O_4$	-2	0.00E+00	30	0.00E+00
Pb	3.48E+02			207.2	1.68E+03	$Pb(OH)_2$	2	3.36E+03	30	1.16E+04
PO_4	1.20E+03			94.9706	1.26E+04	$Na_3(PO_4)$	-3	-3.79E+04	30	4.00E+04
Si	9.27E+02			28.0855	3.30E+04	$HSiO_3$-1	-1	-3.30E+04	30	8.48E+04
SO_4	1.53E+03			95.0576	1.59E+04	Na2(SO_4)	-2	-3.19E+04	30	5.10E+04
Sr	4.54E+01			87.62	5.18E+02	$Sr(OH)_2$	2	1.04E+03	30	1.51E+03
^{99}Tc	3.55E+00	1.695E-02		99	2.12E+00	TcO_4-1	-1	-2.12E+00	30	1.15E+01
*TOC HCO_2	0.00E+00			45.018	0.00E+00	$NaCO_2H$	-1	0.00E+00	30	0.00E+00
U	1.23E+02			238.029	5.17E+02	UO2+2	2	1.03E+03	30	4.65E+03
Zr	1.48E+02			91.224	1.62E+03	$Zr(OH)_4$	4	6.49E+03	30	4.93E+03
(6)OH	5.20E+03			16.9994	3.06E+05	NaOH	-1	-3.06E+05	30	1.73E+05
Total								0.00E+00		

Calculations

1) Specific activities from Table 2-6, RPP-17152, Rev. 11

2) Mass Adjustment and Convert to Moles: ((BBI Mass kg + BBI Mass kg x Mass Adj. %) x 1000 g/kg)÷Molecular Weight g/mole = Moles

3) Convert to Moles: (BBI Mass kg x 1000 g/kg)÷Molecular Weight g/mole = Moles. For radionuclides Ci must first be converted to mass (BBI Ci ÷ specific activity) ÷ 1000 = BBI Mass in kg

4) Equivalent Charge: Moles x Valence = Equivalent Charge

5) Concentration: (BBI Mass x 1000 g/kg)÷BBI Volume = Concentration in mg/L, Cr_2O_7-2, $HSiO_3$-1, TcO_4-1, and UO_2+2 mass calculation shown above in section 1.1

6) Hydroxide Mass is calculated iteratively by guessing a mass and calculating the equivalent charge of hydroxide. Then all the equivalent charges are summed until the total equivalent charge is near zero.

*See section 1.1 for method and justification for converting TOC to formate.

Table 1-8. AX-104 P2 Solid

Input Species	BBI kg or Ci	(1)Specific Activity (Ci/g)	(2)Mass Adjust.	Molecular Weight (g/mole)	(3)Moles	Possible Compounds	Valence	(4)Eq. Charges	BBI Volume (kL)	(5)Conc. (mg/L)
Al	2.67E+03			26.98	9.90E+04	$NaAl(OH)_4$	3	2.97E+05	28	9.54E+04
Bi	0.00E+00			208.98	0.00E+00	$Bi(OH)_3$	3	0.00E+00	28	0.00E+00
Ca	6.10E+02			40.08	1.52E+04	$Ca(OH)_2$	2	3.04E+04	28	2.18E+04
Cl	1.58E+01			35.453	4.46E+02	NaCl	-1	-4.46E+02	28	5.64E+02
Tic as CO_3	4.51E+03			60.0092	7.52E+04	Na_2C0_3	-2	-1.50E+05	28	1.61E+05
Cr	2.91E+01			51.996	2.80E+02	Cr_2O_7-2	-2	-5.60E+02	28	2.16E+03
^{137}Cs	4.53E+04	8.678E+01		137	3.81E+00	CsOH	1	3.81E+00	28	1.86E+01
F	5.09E+00			18.99	2.68E+02	NaF	-1	-2.68E+02	28	1.82E+02
Fe	1.36E+04			55.847	2.44E+05	$Fe(OH)_3$	3	7.31E+05	28	4.86E+05
Hg	8.27E+00			200.59	4.12E+01	Hg	0	0.00E+00	28	2.95E+02
^{129}I	3.66E-04	1.765E-04		129	1.61E-02	NaI	-1	-1.61E-02	28	7.41E-02
K	8.07E+00			39.0983	2.06E+02	KOH	1	2.06E+02	28	2.88E+02
Mn	2.36E+02			54.938	4.30E+03	$Mn(OH)_2$	2	8.59E+03	28	8.43E+03
Na	2.17E+03			22.989	9.44E+04	NaOH	1	9.44E+04	28	7.75E+04
Ni	7.35E+02			58.7	1.25E+04	$Ni(OH)_2$	2	2.50E+04	28	2.63E+04
NO_2	1.13E+02			46	2.46E+03	$NaNO_2$	-1	-2.46E+03	28	4.04E+03
NO_3	2.30E+03			62	3.71E+04	$NaNO_3$	-1	-3.71E+04	28	8.21E+04
C_2O_4	5.25E+01			88.0196	5.96E+02	$Na_2C_2O_4$	-2	-1.19E+03	28	1.88E+03
Pb	4.67E+02			207.2	2.25E+03	$Pb(OH)_2$	2	4.51E+03	28	1.67E+04
PO_4	1.26E+02			94.9706	1.33E+03	$Na_3(PO_4)$	-3	-3.98E+03	28	4.50E+03
Si	4.38E+01			28.0855	1.56E+03	$HSiO_3$-1	-1	-1.56E+03	28	4.29E+03
SO_4	2.39E+02			95.0576	2.49E+03	Na2(SO_4)	-2	-4.98E+03	28	8.54E+03
Sr	4.80E+01			87.62	5.48E+02	$Sr(OH)_2$	2	1.10E+03	28	1.71E+03
^{99}Tc	2.06E+01	1.695E-02		99	1.23E+01	TcO_4-1	-1	-1.23E+01	28	7.15E+01
*TOC HCO_2	1.02E+00			45.018	2.26E+01	$NaCO_2H$	-1	-2.26E+01	28	3.64E+01
U	1.65E+02			238.029	6.93E+02	UO2+2	2	1.39E+03	28	6.69E+03
Zr	1.99E+02			91.224	2.18E+03	$Zr(OH)_4$	4	8.73E+03	28	7.11E+03
(6)OH	1.70E+04			16.9994	9.99E+05	NaOH	-1	-9.99E+05	28	6.06E+05
Total								0.00E+00		

Calculations

1) Specific activities from Table 2-6, RPP-17152, Rev. 11

2) Mass Adjustment and Convert to Moles: ((BBI Mass kg + BBI Mass kg x Mass Adj. %) x 1000 g/kg)÷Molecular Weight g/mole = Moles

3) Convert to Moles: (BBI Mass kg x 1000 g/kg)÷Molecular Weight g/mole = Moles. For radionuclides Ci must first be converted to mass (BBI Ci ÷ specific activity) ÷ 1000 = BBI Mass in kg

4) Equivalent Charge: Moles x Valence = Equivalent Charge

5) Concentration: (BBI Mass x 1000 g/kg)÷BBI Volume = Concentration in mg/L, Cr_2O_7-2, $HSiO_3$-1, TcO_4-1, and UO_2+2 mass calculation shown above in section 1.1

6) Hydroxide Mass is calculated iteratively by guessing a mass and calculating the equivalent charge of hydroxide. Then all the equivalent charges are summed until the total equivalent charge is near zero.

*See section 1.1 for method and justification for converting TOC to formate.

2.0 THERMODYNAMIC MODEL

OLI Stream Analyzer version 9.1 revision 9.1.5 was used to simulate the retrieval. Stream Analyzer is a computer model used to perform thermodynamic equilibrium calculations. The Stream Analyzer software was chosen to model the AX retrieval process because chemical reaction and dissolution is a thermodynamic equilibrium process and water washing plots can be easily produced and analyzed.
The inputs to Stream Analyzer are described in Section 1.1 and the outputs from the modeling can be found in this section. The inputs to, configuration of, and outputs from Stream Analyzer were peer reviewed for accuracy and to ensure good engineering judgment was used in the modeling process.

Stream Analyzer is registered in Hanford Information System Inventory (HISI) under ID number 2094. Stream Analyzer is registered as Grade D software, and the results of modeling done in Stream Analyzer shall be used in accordance with that grade level. The software owner Stream Analyzer is the Tank Waste Inventory and Characterization Group.

2.1 CONDITIONS AND ASSUMPTIONS FOR RECONCILIATION

The BBI data from section 1 was reconciled at standard temperature and pressure. The BBI is a composite of information with sample data used if available. Standard temperature and pressure conditions approximate the laboratory conditions.

The Stream Analyzer model has chemistry model options available. The mixed solvent electrolyte model was selected to simulate the AX tank waste because of the low water content and high ionic strength of the waste.

During reconciliation some slight adjustments may occur to the mass of the dominant ions based on the most thermodynamically stable species predicted by the model. The dominant ion adjusted is normally hydroxide or sodium.

If more than one phase was present, the phases were reconciled independently and the mixed together except for AX-102. The individual phases of AX-102 did not charge balance well independently so total mass values were used as model input.

The temperature of the mixture was an assumed temperature based on a review of past temperature records accessed through the Surveillance Data Display System (SDDS). The SDDS temperature data is more than 5 years old and it was unclear the location of the working thermocouples or whether they were in calibration. If temperature data was not readily found or was just below standard temperature, standard temperature was assumed (77 °F). AX-101 assumed to be at 80 °F and AX-103 was assumed to be at 90 °F when the phases were mixed. AX-102 and 104 had only one phase and were assumed to be at 77 °F.

Tables 2-1 through 2-4 show the molecular species and quantities predicted by the model for the wastes in the AX tanks. Species with masses less than 10^{-4} kg aqueous mass and no solids were deleted from the tables.

Table 2-1. AX-101 Predicted Species

Molecular Species	Total (kg)	Aqueous (kg)	Solid (kg)
H2O	9.81E+05	9.81E+05	0.00E+00
OH-1	4.49E+03	4.49E+03	0.00E+00
Al(OH)3	1.02E+05	4.16E-04	1.02E+05
Al(OH)4-1	8.55E+02	8.55E+02	0.00E+00
Bi(OH)3	3.70E+01	4.33E+00	3.27E+01
Bi(OH)4-1	1.99E+01	1.99E+01	0.00E+00
CaCO3	2.79E-02	2.79E-02	0.00E+00
Cl-1	8.63E+03	8.63E+03	0.00E+00
CO3-2	7.06E+04	7.06E+04	0.00E+00
HCOO-1	1.55E+04	1.55E+04	0.00E+00
CrO4-2	1.37E+04	1.37E+04	0.00E+00
Cs+1	4.28E+00	4.28E+00	0.00E+00
FeO2-1	2.35E-02	2.35E-02	0.00E+00
F-1	3.32E+02	3.32E+02	0.00E+00
H2SiO4-2	1.70E+00	1.70E+00	0.00E+00
HCO3-1	8.89E+00	8.89E+00	0.00E+00
HCrO4-1	9.23E-04	9.23E-04	0.00E+00
Hg	1.36E+01	4.35E-02	1.36E+01
HMnO2-1	3.16E-01	3.16E-01	0.00E+00
HPbO2-1	2.32E+02	2.32E+02	0.00E+00
HPO4-2	1.43E+01	1.43E+01	0.00E+00
HSiO3-1	6.75E-02	6.75E-02	0.00E+00
HUO4-1	1.06E+03	1.06E+03	0.00E+00
HZrO3-1	2.04E-01	2.04E-01	0.00E+00
I-1	1.67E+00	1.67E+00	0.00E+00
K+1	7.44E+03	7.44E+03	0.00E+00
MnO2-2	6.01E-01	6.01E-01	0.00E+00
MnO	3.07E-02	3.07E-02	0.00E+00
Mn(OH)+1	1.18E-04	1.18E-04	0.00E+00
NaOH.Na2SO4	4.60E-01	4.60E-01	0.00E+00
Na+1	2.93E+05	2.93E+05	0.00E+00

Molecular Species	Total (kg)	Aqueous (kg)	Solid (kg)
NaOH	6.48E-02	6.48E-02	0.00E+00
NaOHCO3-2	4.39E+03	4.39E+03	0.00E+00
NO2-1	1.65E+05	1.65E+05	0.00E+00
NO3-1	3.36E+05	3.36E+05	0.00E+00
C2O4-2	5.58E+01	5.58E+01	0.00E+00
Pb(CO3)2-2	1.08E-02	1.08E-02	0.00E+00
PbO	2.32E-01	2.32E-01	0.00E+00
PbOH+1	5.92E-04	5.92E-04	0.00E+00
PO4-3	3.29E+03	3.29E+03	0.00E+00
SO4-2	1.32E+04	1.32E+04	0.00E+00
SrCO3	7.65E+00	7.86E-06	7.65E+00
Sr+2	3.03E-03	3.03E-03	0.00E+00
SrOH+1	1.59E-03	1.59E-03	0.00E+00
TcO4-1	2.81E+01	2.81E+01	0.00E+00
UO2(CO3)2-2	2.89E-04	2.89E-04	0.00E+00
UO2(CO3)3-4	1.38E+00	1.38E+00	0.00E+00
UO3	2.76E-02	2.76E-02	0.00E+00
UO4-2	1.04E+03	1.04E+03	0.00E+00
ZrO2	8.27E+01	2.10E-03	8.27E+01
Ca5F(PO4)3	2.52E+03	0.00E+00	2.52E+03
Na8Al6Si6O24CO3.1 H2O	7.45E+03	0.00E+00	7.45E+03
Fe2O3	1.46E+03	0.00E+00	1.46E+03
Mn(OH)2	1.08E+02	0.00E+00	1.08E+02
NA2[COO]2	3.99E+04	0.00E+00	3.99E+04
Na2CO3.1H2O	2.25E+05	0.00E+00	2.25E+05
Na2SO4.NaF	7.52E+03	0.00E+00	7.52E+03
2Na2SO4.Na2CO3	8.61E+04	0.00E+00	8.61E+04
NaAlCO3(OH)2	7.63E+04	0.00E+00	7.63E+04
Na7F(PO4)2.19H2O	1.55E+04	0.00E+00	1.55E+04
NiFe2O4	7.85E+02	0.00E+00	7.85E+02
Total (by phase)	2.49E+06	1.92E+06	5.65E+05

Table 2-2. AX-102 Predicted Species

Molecular Species	Total kg	Aqueous kg	Solid kg
H2O	8.18E+04	8.18E+04	0.00E+00
OH-1	2.31E-02	2.31E-02	0.00E+00
Bi(OH)3	3.28E+00	3.19E-01	2.96E+00
CaCO3	1.40E-03	1.40E-03	0.00E+00
Cl-1	1.09E+02	1.09E+02	0.00E+00
CO2	3.70E-02	3.70E-02	0.00E+00
CO3-2	1.22E+03	1.22E+03	0.00E+00
HCOO-1	1.76E+04	1.76E+04	0.00E+00
Cr2O7-2	6.86E-04	6.86E-04	0.00E+00
CrO4-2	2.27E+02	2.27E+02	0.00E+00
Cs+1	2.58E-01	2.58E-01	0.00E+00
F-1	3.61E+01	3.61E+01	0.00E+00
H2PO4-1	8.44E-02	8.44E-02	0.00E+00
H2SiO4-2	7.11E-03	7.11E-03	0.00E+00
HCO3-1	1.32E+03	1.32E+03	0.00E+00
HCOOH	2.23E-01	2.23E-01	0.00E+00
HCrO4-1	1.78E-01	1.78E-01	0.00E+00
HF	1.75E-04	1.75E-04	0.00E+00
Hg	7.59E+00	3.21E-03	7.59E+00
HNO2	2.16E-03	2.16E-03	0.00E+00
HPO4-2	6.74E+02	6.74E+02	0.00E+00
HSiO3-1	4.39E+00	4.39E+00	0.00E+00
I-1	9.51E-02	9.51E-02	0.00E+00
K+1	6.15E+01	6.15E+01	0.00E+00
Mn(C2O4)2-2	2.16E-02	2.16E-02	0.00E+00
MnC2O4	3.35E+00	3.35E+00	0.00E+00
Mn(C2O4)Cl-1	1.14E-01	1.14E-01	0.00E+00
Mn(C2O4)SO4 -2	8.69E-02	8.69E-02	0.00E+00
MnCl+1	1.52E-01	1.52E-01	0.00E+00
Mn+2	8.74E-01	8.74E-01	0.00E+00

Molecular Species	Total kg	Aqueous kg	Solid kg
MnO	2.24E-03	2.24E-03	0.00E+00
Mn(OH)+1	1.79E-01	1.79E-01	0.00E+00
Na+1	2.23E+04	2.23E+04	0.00E+00
NaOHCO3-2	3.25E-03	3.25E-03	0.00E+00
NO2-1	4.57E+03	4.57E+03	0.00E+00
NO3-1	2.32E+04	2.32E+04	0.00E+00
C2O4-2	4.34E+00	4.34E+00	0.00E+00
Pb(CO3)2-2	6.37E-01	6.37E-01	0.00E+00
PbCO3	9.34E-03	9.34E-03	0.00E+00
PbOH+1	1.65E-04	1.65E-04	0.00E+00
PO4-3	3.01E+01	3.01E+01	0.00E+00
SiO2	1.33E+00	1.33E+00	0.00E+00
SO4-2	4.62E+02	4.62E+02	0.00E+00
SrCO3	1.96E+02	4.81E-07	1.96E+02
Sr+2	3.18E-03	3.18E-03	0.00E+00
TcO4-1	6.12E-01	6.12E-01	0.00E+00
UO2(CO3)2-2	6.29E-01	6.29E-01	0.00E+00
UO2(CO3)3-4	1.02E+03	1.02E+03	0.00E+00
ZrO2	2.55E+01	1.83E-04	2.55E+01
Ca5F(PO4)3	6.14E+02	0.00E+00	6.14E+02
Fe2O3	8.74E+03	0.00E+00	8.74E+03
Mn(OH)2	8.41E+02	0.00E+00	8.41E+02
NA2[COO]2	4.19E+03	0.00E+00	4.19E+03
NaAlCO3(OH)2	1.27E+04	0.00E+00	1.27E+04
NaHCO3	3.92E+03	0.00E+00	3.92E+03
NiFe2O4	5.96E+02	0.00E+00	5.96E+02
2PbCO3.Pb(OH)2	5.52E+02	0.00E+00	5.52E+02
SiO2	1.94E+03	0.00E+00	1.94E+03
Total (by phase)	1.89E+05	1.55E+05	3.43E+04

Table 2-3. AX-103 Predicted Species

Molecular Species	Total kg	Aqueous kg	Solid kg
H2O	3.05E+05	3.05E+05	0.00E+00
OH-1	7.26E+03	7.26E+03	0.00E+00
Al(OH)3	3.67E+04	1.95E-04	3.67E+04
Al(OH)4-1	4.48E+03	4.48E+03	0.00E+00
Bi(OH)3	5.23E-01	5.23E-01	0.00E+00
Bi(OH)4-1	1.28E+01	1.28E+01	0.00E+00
CaCO3	6.22E-03	6.22E-03	0.00E+00
CaOH+1	1.14E-04	1.14E-04	0.00E+00
CaZrO3	3.84E-04	3.84E-04	0.00E+00
Cl-1	3.22E+03	3.22E+03	0.00E+00
CO3-2	1.72E+04	1.72E+04	0.00E+00
HCOO-1	5.80E+03	5.80E+03	0.00E+00
CrO4-2	4.74E+03	4.74E+03	0.00E+00
Cs+1	1.21E+00	1.21E+00	0.00E+00
FeO2-1	5.39E-02	5.39E-02	0.00E+00
F-1	1.08E+02	1.08E+02	0.00E+00
H2SiO4-2	1.33E+00	1.33E+00	0.00E+00
HCO3-1	4.09E-01	4.09E-01	0.00E+00
Hg	5.25E+00	1.82E-02	5.23E+00
HMnO2-1	6.10E-01	6.10E-01	0.00E+00
HPbO2-1	4.50E+02	4.50E+02	0.00E+00
HPO4-2	8.11E-01	8.11E-01	0.00E+00
HSiO3-1	4.79E-02	4.79E-02	0.00E+00
HUO4-1	3.51E+01	3.51E+01	0.00E+00
HZrO3-1	2.32E-01	2.32E-01	0.00E+00
I-1	3.84E-01	3.84E-01	0.00E+00
K+1	2.01E+03	2.01E+03	0.00E+00
MnO2-2	7.07E+00	7.07E+00	0.00E+00
MnO	1.22E-02	1.22E-02	0.00E+00

Molecular Species	Total kg	Aqueous kg	Solid kg
NaOH.Na2SO4	1.44E+00	1.44E+00	0.00E+00
Na+1	8.81E+04	8.81E+04	0.00E+00
NaOH	2.28E-01	2.28E-01	0.00E+00
NaOHCO3-2	5.22E+03	5.22E+03	0.00E+00
NO2-1	5.39E+04	5.39E+04	0.00E+00
NO3-1	6.84E+04	6.84E+04	0.00E+00
C2O4-2	1.97E+01	1.97E+01	0.00E+00
PbO	1.41E-01	1.41E-01	0.00E+00
PO4-3	2.01E+03	2.01E+03	0.00E+00
SO4-2	3.86E+03	3.86E+03	0.00E+00
SrCO3	7.70E+01	5.90E-06	7.70E+01
Sr+2	1.03E-03	1.03E-03	0.00E+00
SrOH+1	5.46E-03	5.46E-03	0.00E+00
TcO4-1	6.82E+00	6.82E+00	0.00E+00
UO3	2.19E-04	2.19E-04	0.00E+00
UO4-2	2.10E+02	2.10E+02	0.00E+00
ZrO2	2.07E+02	5.19E-04	2.07E+02
Ca5F(PO4)3	8.80E+02	0.00E+00	8.80E+02
Na8Al6Si6O24CO3.1H2O	6.76E+03	0.00E+00	6.76E+03
Fe2O3	5.75E+03	0.00E+00	5.75E+03
Mn(OH)2	9.87E+02	0.00E+00	9.87E+02
Na2CO3.1H2O	2.31E+04	0.00E+00	2.31E+04
Na2SO4.NaF	2.93E+03	0.00E+00	2.93E+03
2Na2SO4.Na2CO3	5.81E+03	0.00E+00	5.81E+03
Na7F(PO4)2.19H2O	3.59E+03	0.00E+00	3.59E+03
NiFe2O4	1.08E+03	0.00E+00	1.08E+03
NA2[COO]2	5.47E+03	0.00E+00	5.47E+03
Total (by phase)	6.65E+05	5.72E+05	9.33E+04

Table 2-4. AX-104 Predicted Species

Molecular Species	Total kg	Aqueous kg	Solid kg
H2O	2.65E+04	2.65E+04	0.00E+00
OH-1	7.09E+00	7.09E+00	0.00E+00
Al(OH)3	3.48E+03	6.79E-06	3.48E+03
Al(OH)4-1	2.90E+00	2.90E+00	0.00E+00
CaCO3	1.30E+03	4.33E-02	1.30E+03
Ca+2	5.25E-03	5.25E-03	0.00E+00
CaOH+1	3.13E-04	3.13E-04	0.00E+00
CaSO4	1.95E-03	1.95E-03	0.00E+00
Cl-1	1.58E+01	1.58E+01	0.00E+00
CO3-2	2.92E+02	2.92E+02	0.00E+00
HCOO-1	1.02E+00	1.02E+00	0.00E+00
CrO4-2	6.50E+01	6.50E+01	0.00E+00
Cs+1	5.21E-01	5.21E-01	0.00E+00
H2SiO4-2	4.16E-03	4.16E-03	0.00E+00
HCO3-1	9.52E-01	9.52E-01	0.00E+00
Hg	8.26E+00	7.38E-04	8.26E+00
HMnO2-1	1.18E-04	1.18E-04	0.00E+00
HPbO2-1	3.68E-02	3.68E-02	0.00E+00
HPO4-2	8.20E-03	8.20E-03	0.00E+00
HSiO3-1	2.25E-02	2.25E-02	0.00E+00
HUO4-1	1.76E+00	1.76E+00	0.00E+00
HZrO3-1	1.29E-04	1.29E-04	0.00E+00
I-1	2.07E-03	2.07E-03	0.00E+00
K+1	8.06E+00	8.06E+00	0.00E+00
Mn(C2O4)2-2	1.30E-04	1.30E-04	0.00E+00
MnC2O4	1.91E-04	1.91E-04	0.00E+00
MnO	3.65E-04	3.65E-04	0.00E+00
Mn(OH)+1	2.06E-04	2.06E-04	0.00E+00

Molecular Species	Total kg	Aqueous kg	Solid kg
NaOH.Na2SO4	2.82E-03	2.82E-03	0.00E+00
Na+1	1.38E+03	1.38E+03	0.00E+00
NaOHCO3-2	1.84E-01	1.84E-01	0.00E+00
NO2-1	1.13E+02	1.13E+02	0.00E+00
NO3-1	2.30E+03	2.30E+03	0.00E+00
C2O4-2	5.26E+01	5.26E+01	0.00E+00
Pb(CO3)2-2	1.41E-02	1.41E-02	0.00E+00
PbO	1.04E-03	1.04E-03	0.00E+00
PbOH+1	4.00E-04	4.00E-04	0.00E+00
PO4-3	8.30E-02	8.30E-02	0.00E+00
SO4-2	2.39E+02	2.39E+02	0.00E+00
SrCO3	8.07E+01	1.11E-07	8.07E+01
Sr+2	1.27E-03	1.27E-03	0.00E+00
TcO4-1	2.00E+00	2.00E+00	0.00E+00
UO2(CO3)2-2	3.32E-03	3.32E-03	0.00E+00
UO2(CO3)3-4	3.09E+02	3.09E+02	0.00E+00
UO3	1.38E-03	1.38E-03	0
UO4-2	7.98E-02	7.98E-02	0.00E+00
ZrO2	2.69E+02	4.20E-05	2.69E+02
Ca5F(PO4)3	1.35E+02	0.00E+00	1.35E+02
Ca5(OH)(PO4)3	8.72E+01	0.00E+00	8.72E+01
Na8Al6Si6O24CO3 .1H2O	2.53E+02	0.00E+00	2.53E+02
Fe2O3	1.93E+04	0.00E+00	1.93E+04
Mn(OH)2	3.82E+02	0.00E+00	3.82E+02
NaAlCO3(OH)2	7.61E+03	0.00E+00	7.61E+03
NiFe2O4	2.94E+02	0.00E+00	2.94E+02
2PbCO3.Pb(OH)2	5.83E+02	0.00E+00	5.83E+02
Total (by phase)	6.50E+04	3.13E+04	3.37E+04

2.2 RETRIEVAL SIMULATION

The retrieval was simulated by incremental washing of the waste (predicted species) shown in Tables 2.1-1 through 2.1-4 with both hot and cold water. The hot water was assumed to be at 120 °F and the cold water was assumed to be at 60 °F. The hot water skid operating temperature is planned to be 130 °F and some cooling is expected when the hot water is added to the tanks and contacted with the waste. Cold water is expected to cool or warm to about the ground

temperature. Some of the solids have retrograde solubility and dissolve more efficiently in cold water. The highest concentration achieved with either a hot or cold water wash is used for the groundwater model input value.

In the model maximum solubility is reached as soon as the first water is added to the waste and before any dilution can occur; however, the first gallon of water added cannot contact all of the waste in the tank and then dissolve all of the constituents of concern. Ten thousand gallons was chosen as the volume of the maximum concentration rather than an unrealistically small volume of water. Although there might be some reduction in the maximum concentration due to dilution the other conservative assumptions maximizing the concentration are more significant.

The modeling simulation assumed that equilibrium is attained and that the waste and wash water are perfectly mixed. The simulation also assumed the entire mixture reached the wash solution temperature. These assumptions maximize the concentrations or solubilities that will be produced during the first and second retrieval steps using water for sluicing and high pressure water for size reduction of waste agglomerations.

3.0 RESULTS

The results for constituents of concern are summarized in tables 3-1 through 3-4. Full water wash plots from the Stream Analyzer model can be found in the appendix. The maximum concentrations shown in the tables should be used in the groundwater model for risk.

Table 3-1. AX-101 Maximum Concentrations

Constituents of Concern	Maximum Concentration*	Units	Ci/L or g/L
Tc-99	1.27E-04	moles/L	2.13E-04
I-129	9.68E-06	moles/L	2.20E-07
U	1,220	mg/L	1.22
Cr	4,510	mg/L	4.51
NO2	121,000	mg/L	121
NO3	247,000	mg/L	247

Tc-99 Conversion: Conc x 99 g/mole x 1.695E-02 Ci/g

I-129 Conversion: Conc x 129 g/mole x 1.765E-04 Ci/g

*Maximum concentration in first 10,000 gallons of sluice water.

Table 3-2. AX-102 Maximum Concentrations

Constituents of Concern	Maximum Concentration	Units	Ci/L or g/L
Tc-99	2.55E-05	moles/L	4.28E-05
I-129	5.08E-06	moles/L	1.16E-07
U	3,650	mg/L	3.65
Cr	690	mg/L	0.69
NO2	30,900	mg/L	30.9
NO3	157,000	mg/L	157

Tc-99 Conversion: Conc x 99 g/mole x 1.695E-02 Ci/g

I-129 Conversion: Conc x 129 g/mole x 1.765E-04 Ci/g

*Maximum concentration in first 10,000 gallons of sluice water.

Table 3-3. AX-103 Maximum Concentrations

Constituents of Concern	Maximum Concentration	Units	Ci/L or g/L
Tc-99	9.54E-05	moles/L	1.60E-04
I-129	6.88E-06	moles/L	1.57E-07
U	440	mg/L	0.44
Cr	4,840	mg/L	4.84
NO2	123,000	mg/L	123
NO3	156,000	mg/L	156

Tc-99 Conversion: Conc x 99 g/mole x 1.695E-02 Ci/g

I-129 Conversion: Conc x 129 g/mole x 1.765E-04 Ci/g

*Maximum concentration in first 10,000 gallons of sluice water.

Table 3-4. AX-104 Maximum Concentrations

Constituents of Concern	Maximum Concentration	Units	Ci/L or g/L
Tc-99	1.87E-04	moles/L	3.14E-04
I-129	2.49E-07	moles/L	5.67E-09
U	2,520	mg/L	2.52
Cr	444	mg/L	0.444
NO2	1,720	mg/L	1.72
NO3	35,000	mg/L	35

Tc-99 Conversion: Conc x 99 g/mole x 1.695E-02 Ci/g

I-129 Conversion: Conc x 129 g/mole x 1.765E-04 Ci/g

*Maximum concentration in first 10,000 gallons of sluice water.

4.0 REFERENCES

Consent Decree for Washington vs. DOE, Case No. 08-5085-FVS, United States District Court Eastern District of Washington, October 25, 2010.

LA-UR-96-858, *Hanford Tank Chemical and Radionuclide Inventories: HDW Model*, Rev. 3, Chemical Science and Technology Division, Los Alamos National Laboratory, Los Alamos New Mexico

RPP-22521, *Tanks C-101, C-102, C-105, C-110, and C-111 Long-Term Human Health Risk Calculations to Support Tank Waste Retrieval Work Plans*, Rev. 7, Washington River Protection Solutions, LLC, Richland, Washington.

RPP-17152, *Hanford Tank Waste Operations Simulator (HTWOS) Version 7.9 Model Design Document*, Rev. 11, Washington River Protection Solutions, LLC, Richland, Washington.

Tank Waste Information Network System (TWINS), Queried 2/17/2015, https://twins.labworks.org/twinsdata/Forms/About.aspx.

Waste Management 2000, *The Aging of Organic Chemicals in Hanford High-Level Wastes*, Harry Babad of Babad Technical Services and Donald Camaioni of Pacific Northwest National Laboratory, Richland Washington.

APPENDIX A

PLOTS

Figure A-1. AX-101 Cold Water: Technetium Max 1.27E-4 moles/L

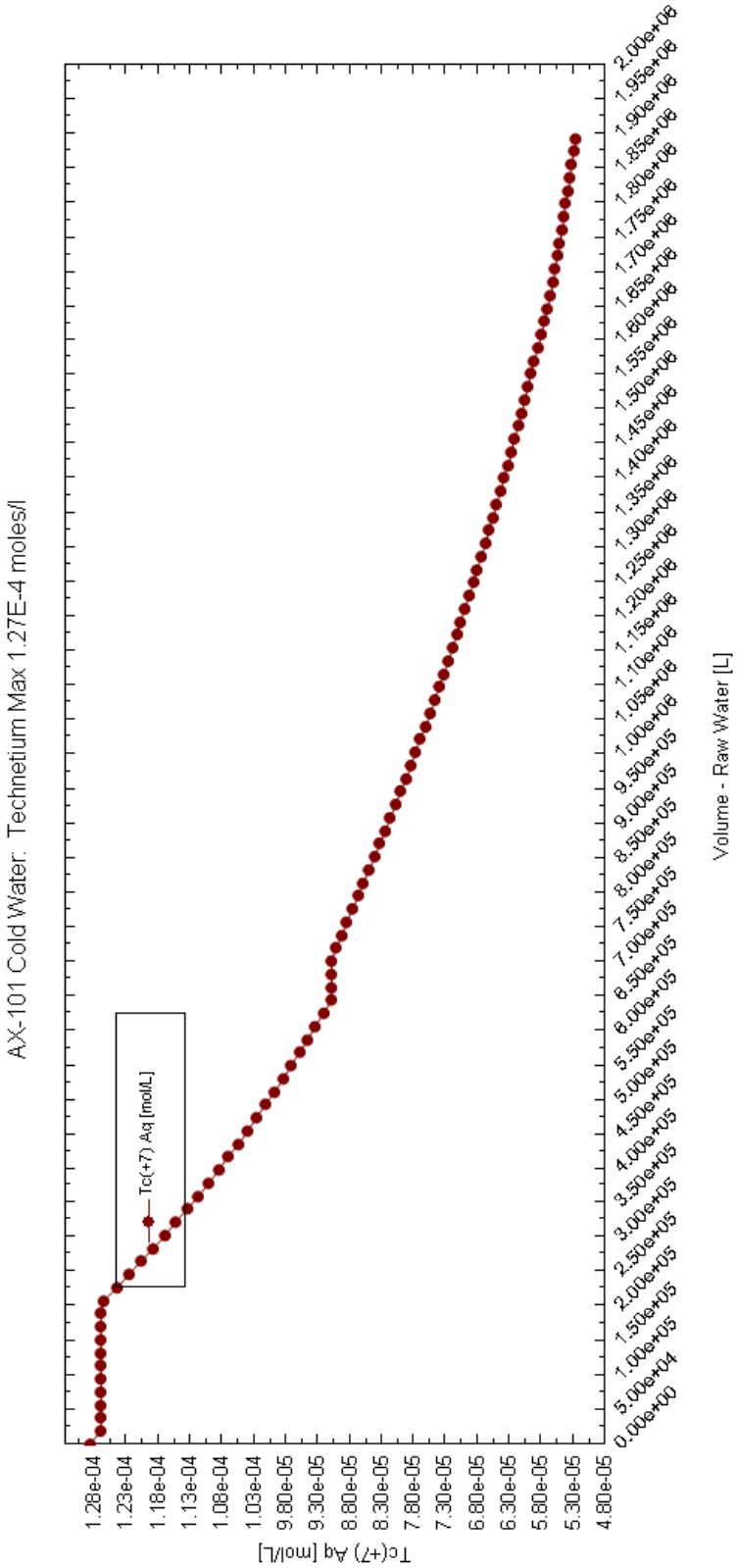

Figure A-2. AX-101 Cold Water: Iodine Max 9.68E-6 moles/L

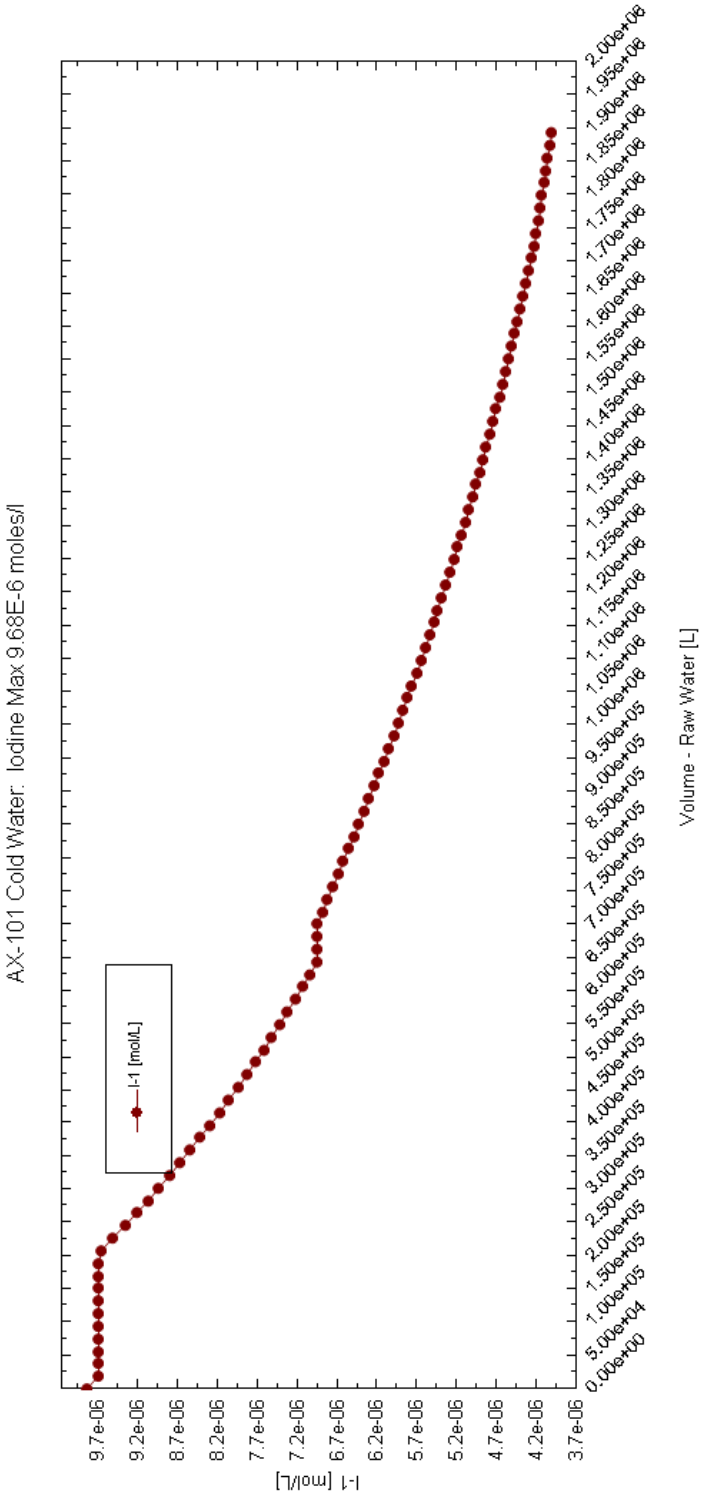

Figure A-3. AX-101 Cold Water: Uranium Max 1,220 mg/L

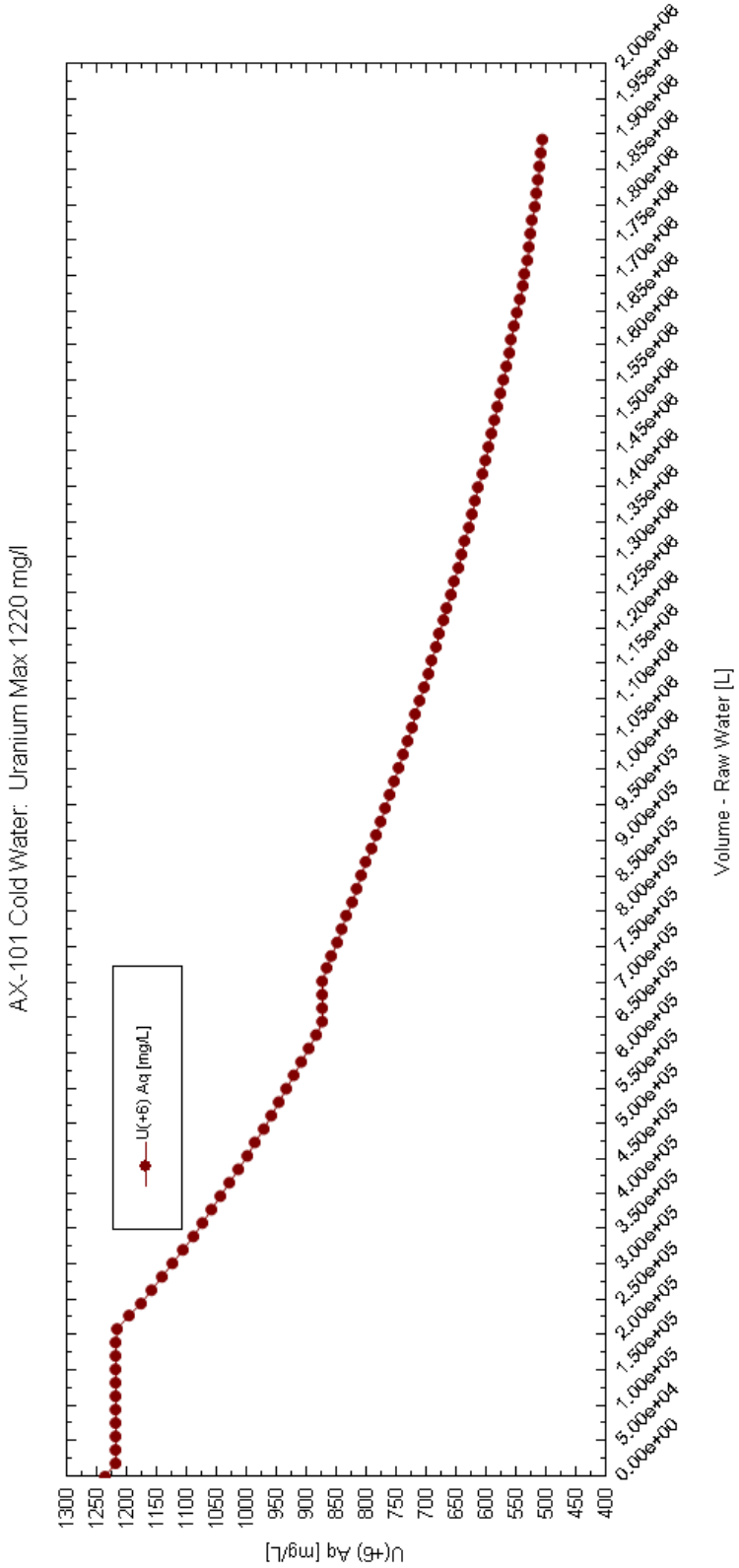

Figure A-4. AX-101 Cold Water: Chromium Max 4,510 mg/L

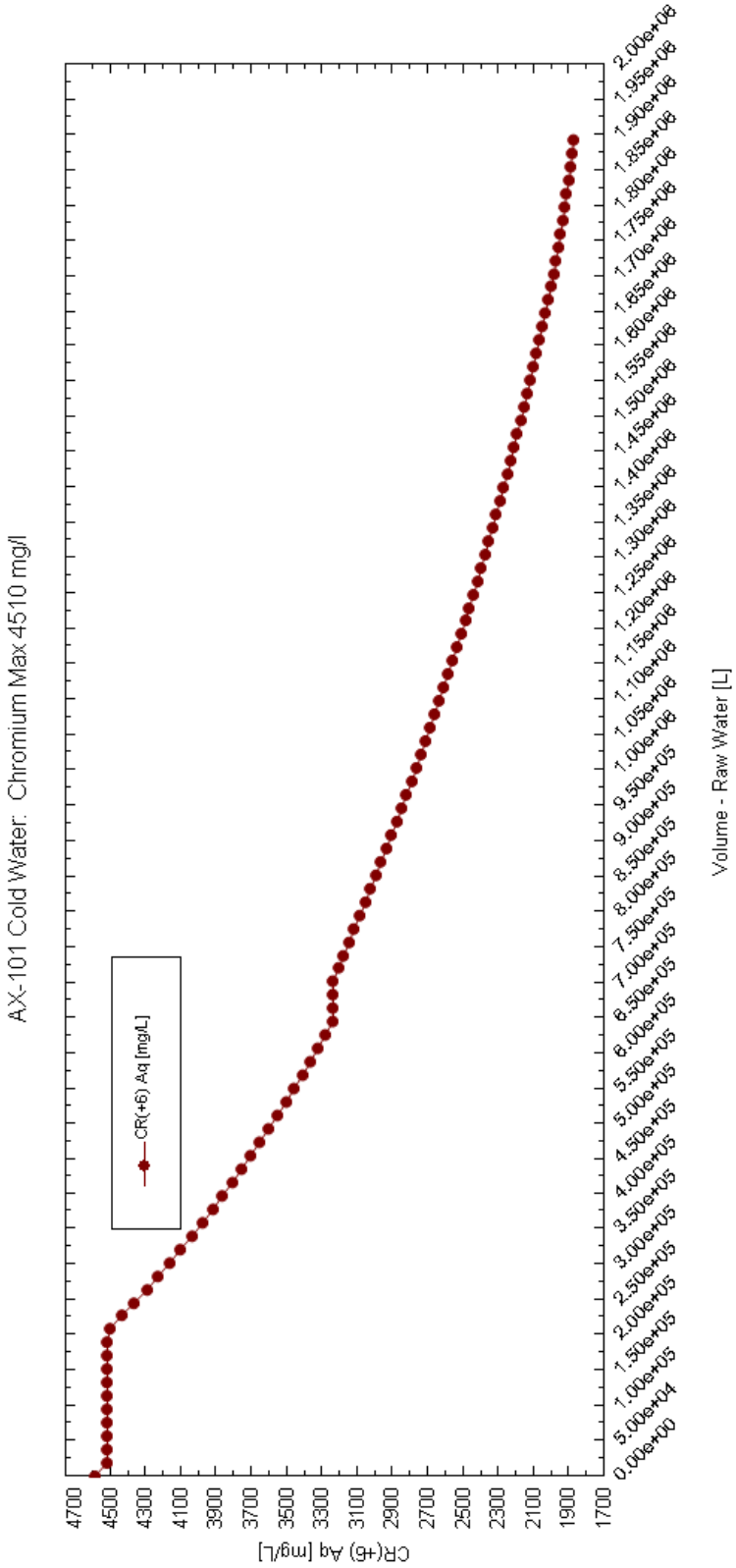

Figure A-5. AX-101 Cold Water: Nitrite Max 121,000 mg/L

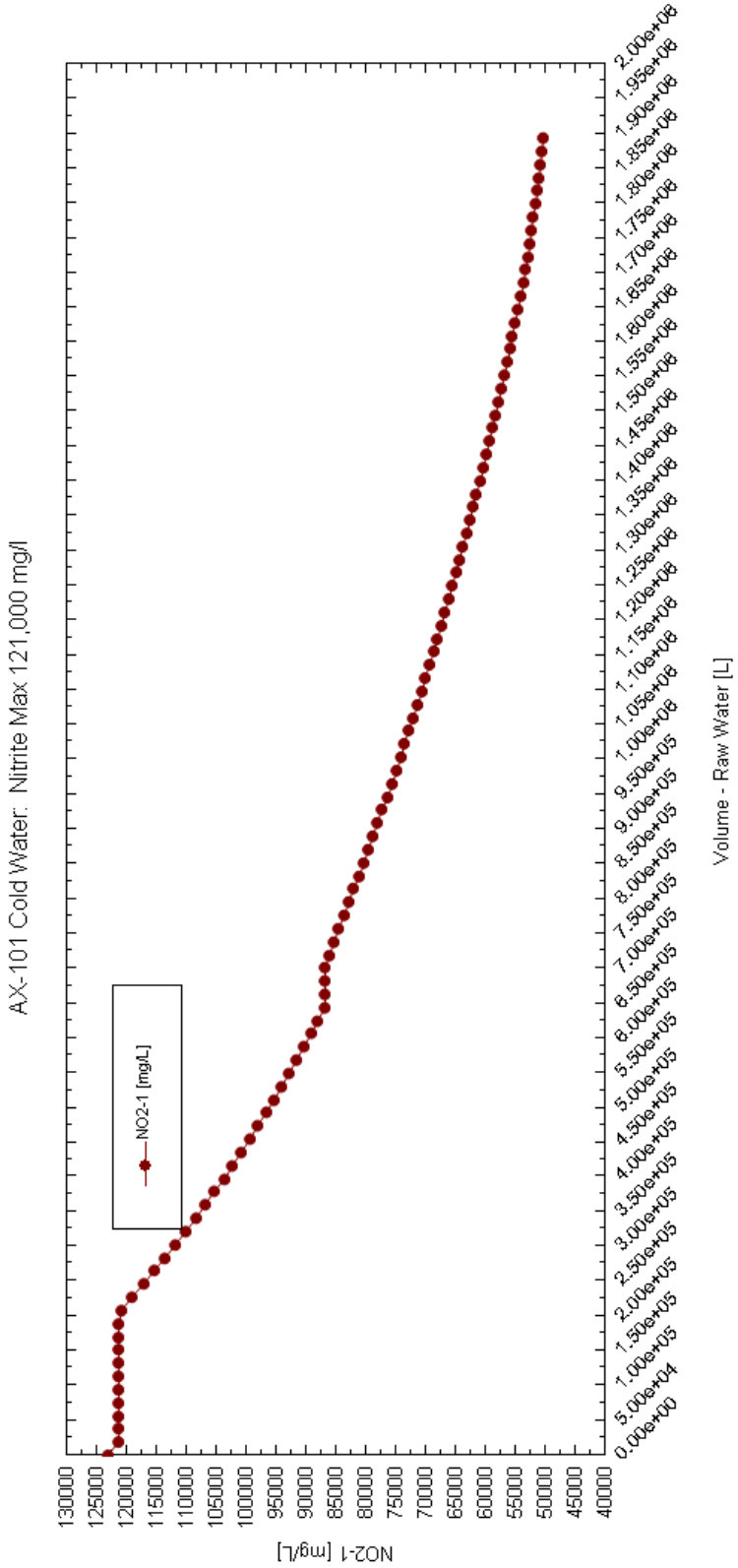

Figure A-6. AX-101 Cold Water: Nitrate Max 247,000 mg/L

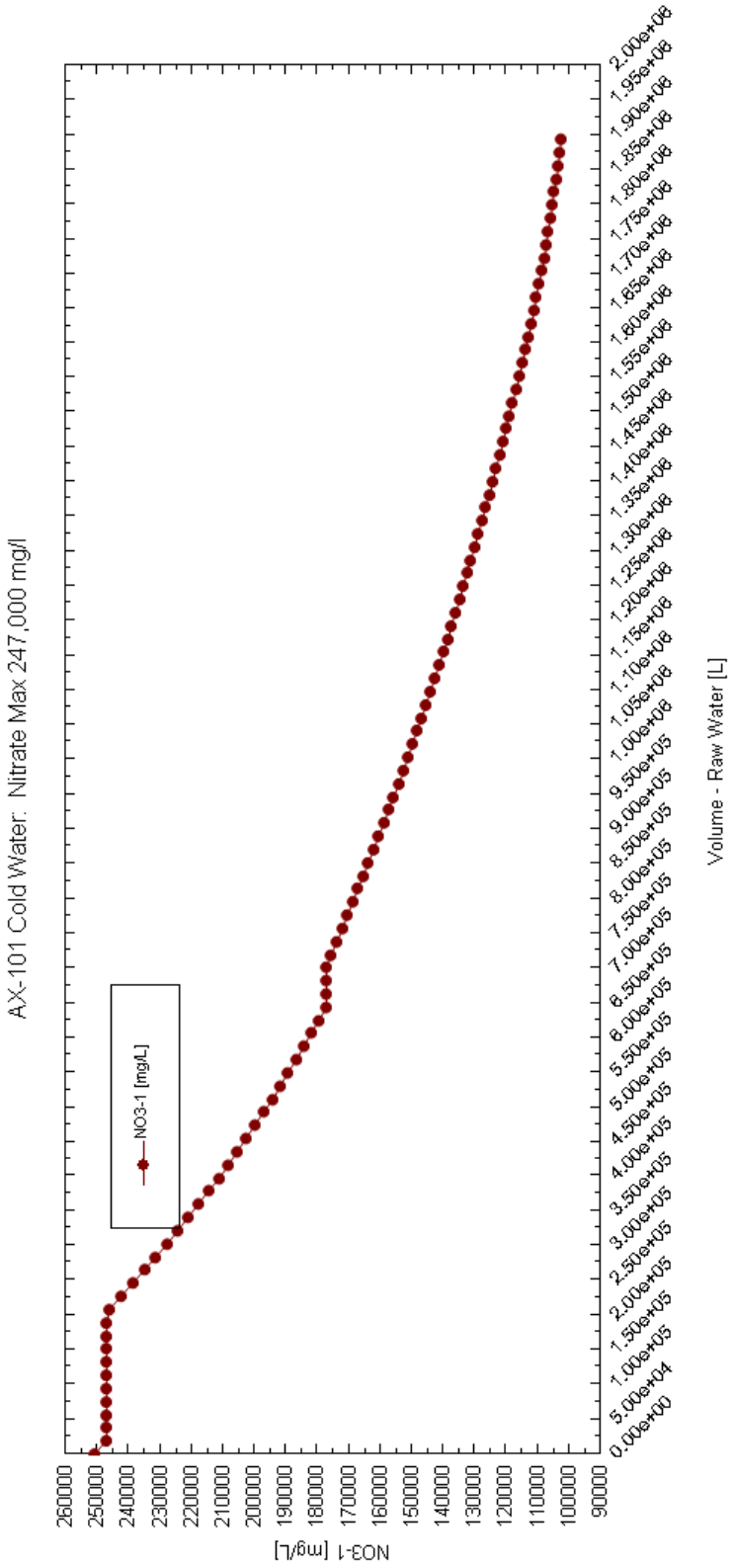

Figure A-7. AX-102 Hot Water: Technetium Max 2.55E-5 moles/L

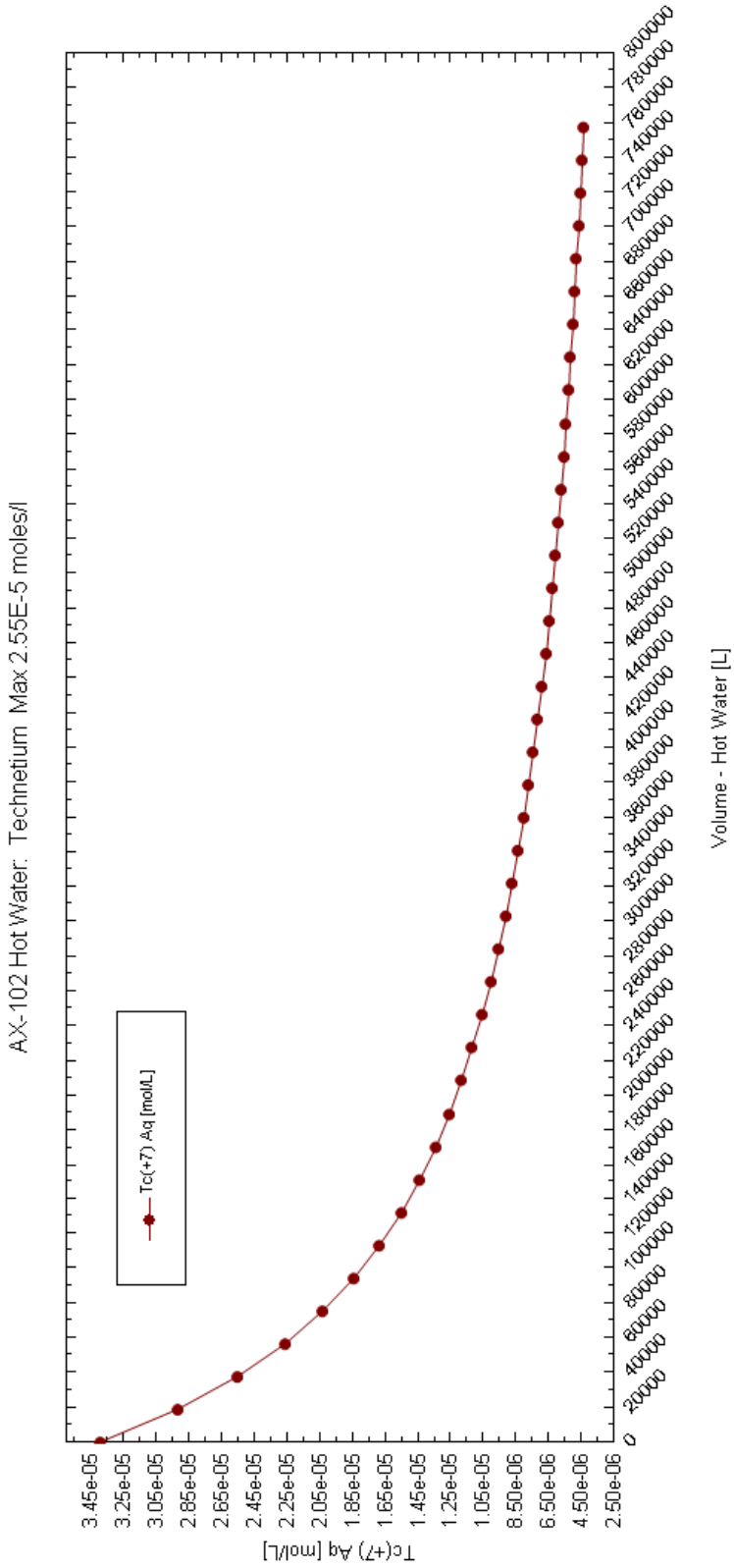

Figure A-8. AX-102 Hot Water: Iodine Max 5.08E-6 moles/L

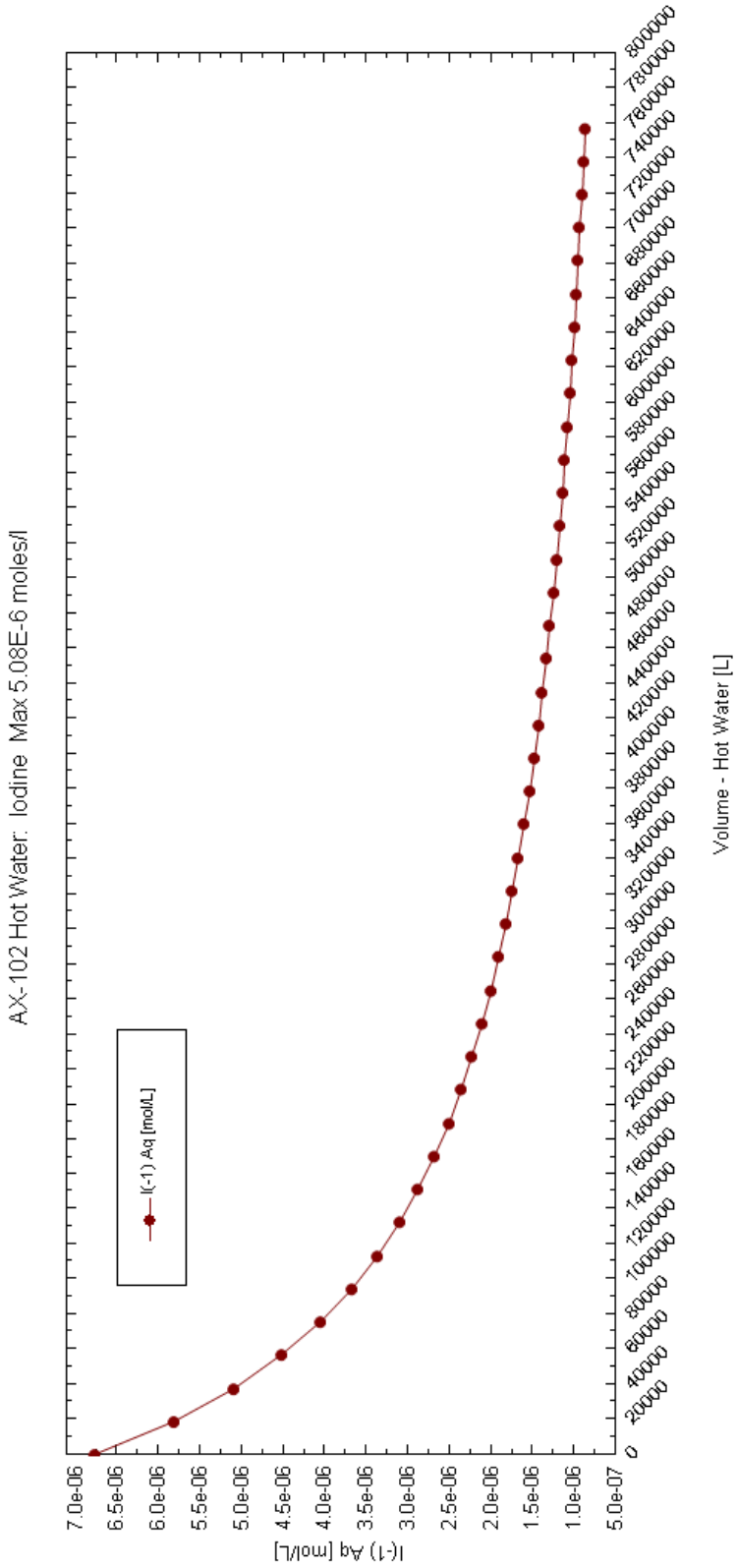

Figure A-9. AX-102 Hot Water: Uranium Max 3,650 mg/L

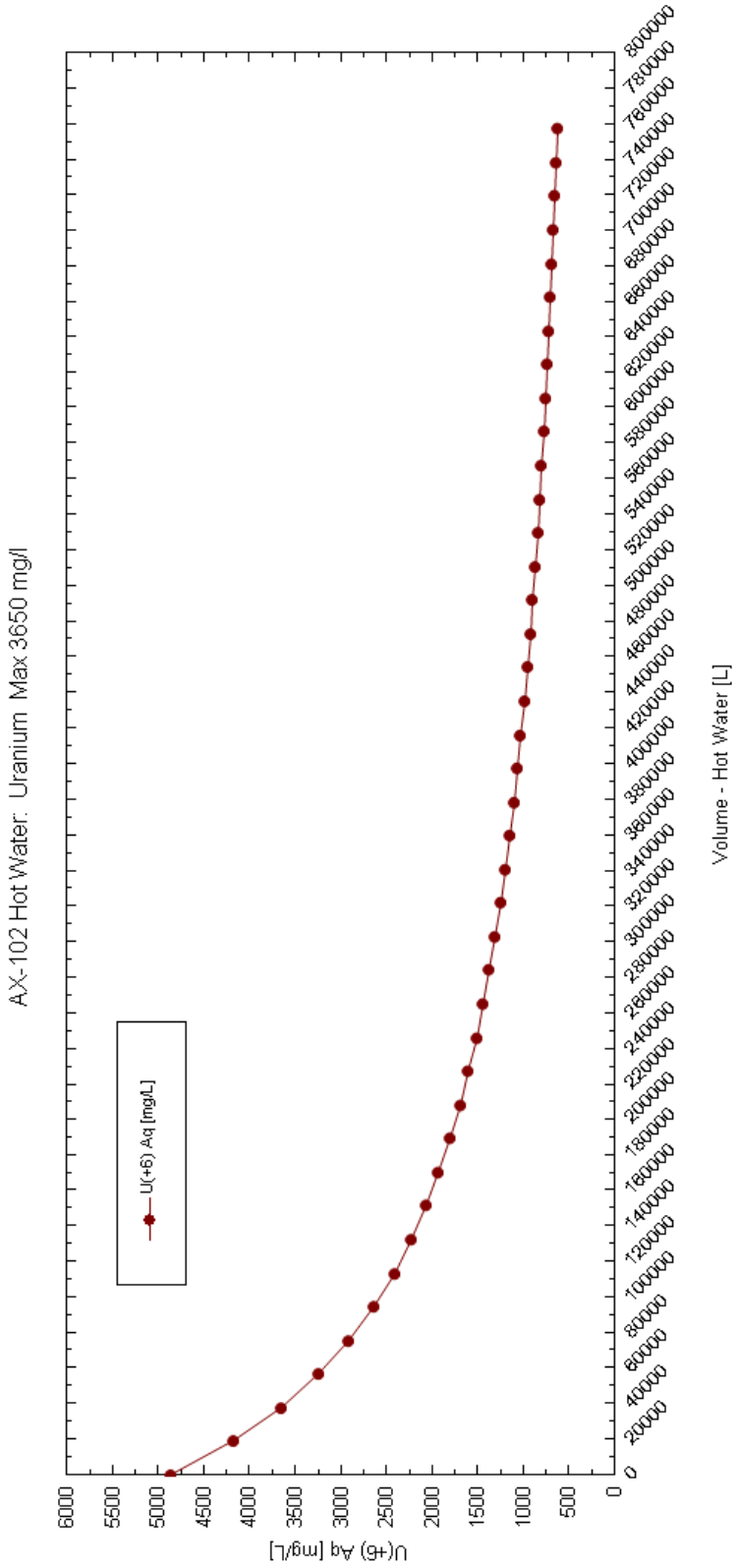

Figure A-10. AX-102 Hot Water: Chromium Max 690 mg/L

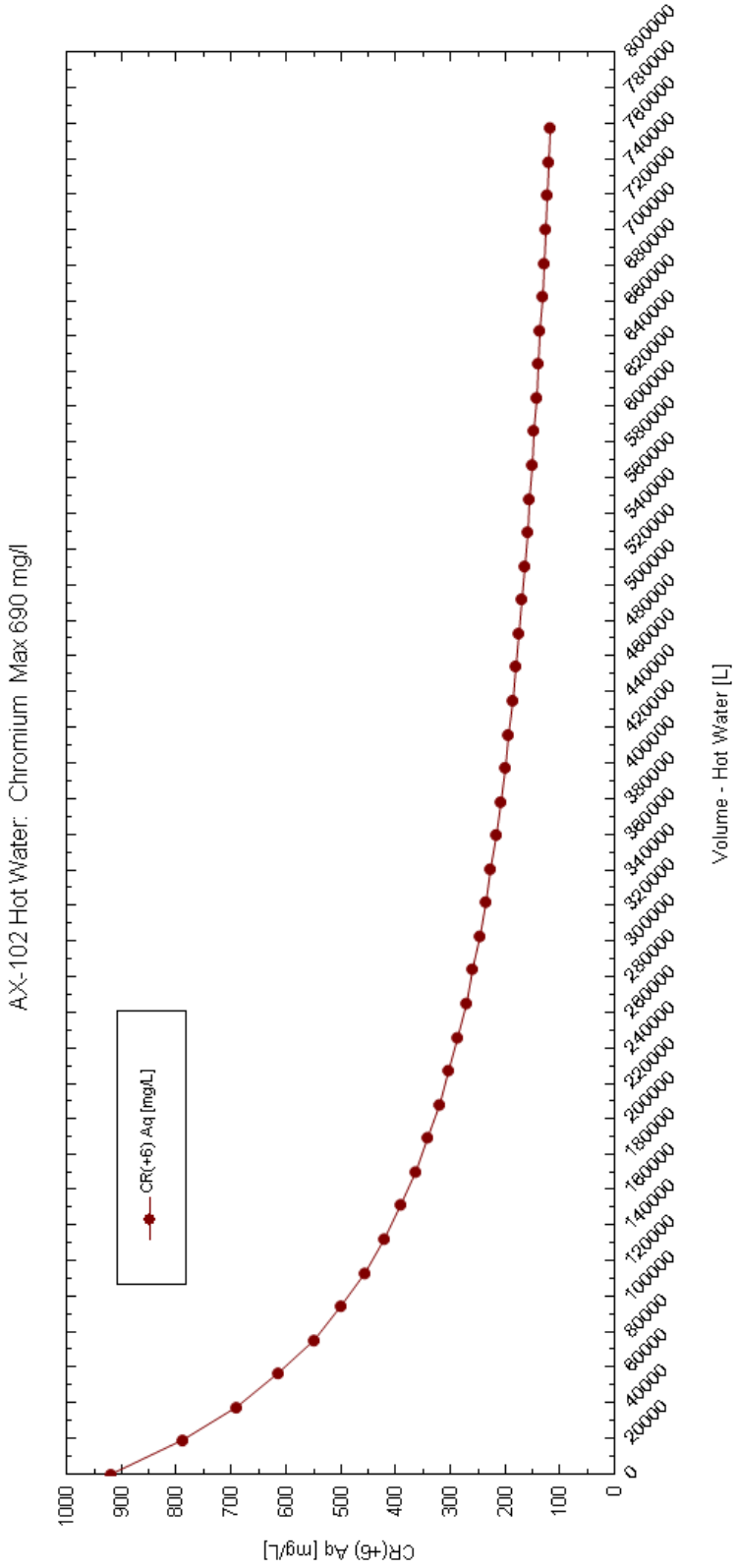

Figure A-11. AX-102 Hot Water: Nitrite Max 30,900 mg/L

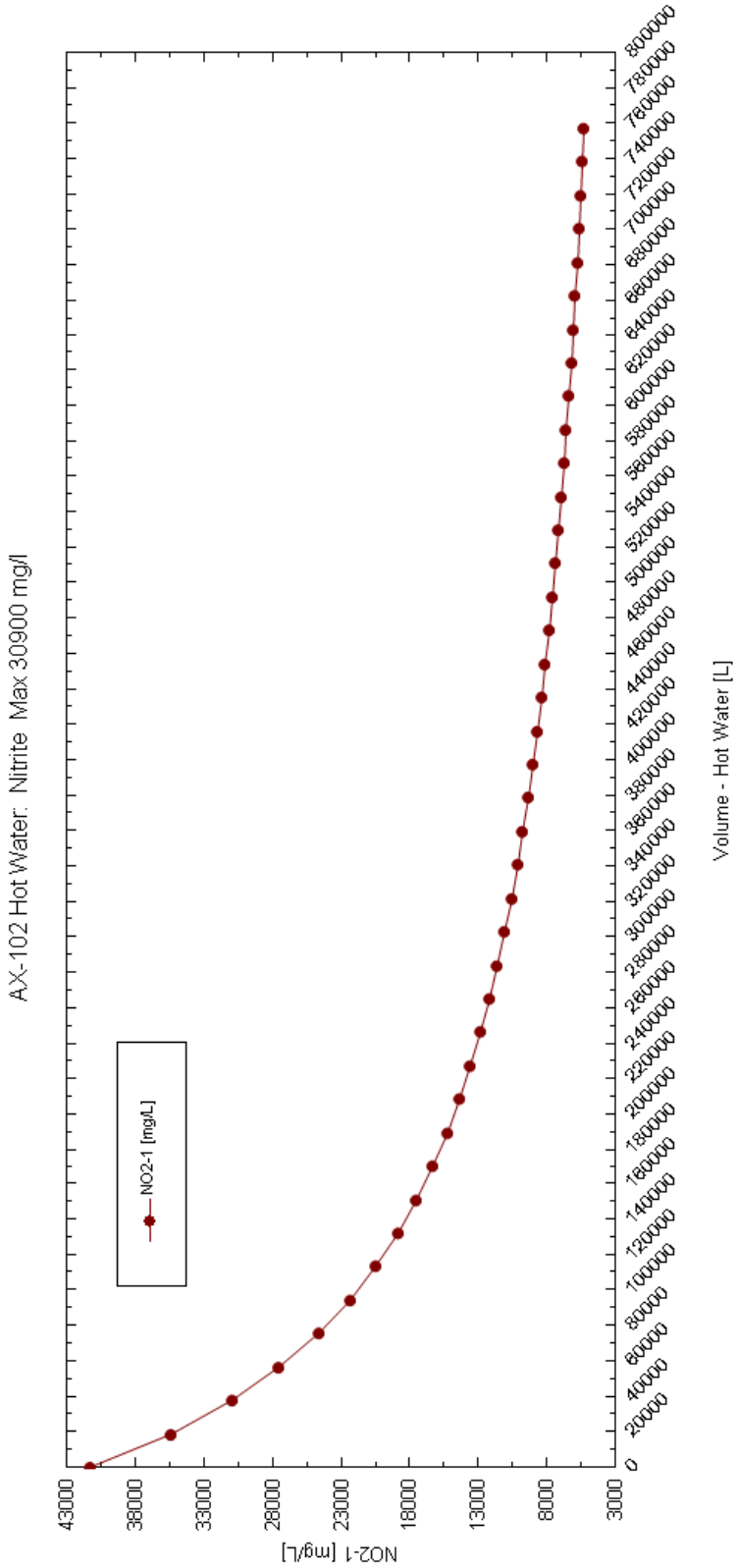

Figure A-12. AX-102 Hot Water: Nitrate Max 1.57E 5 mg/L

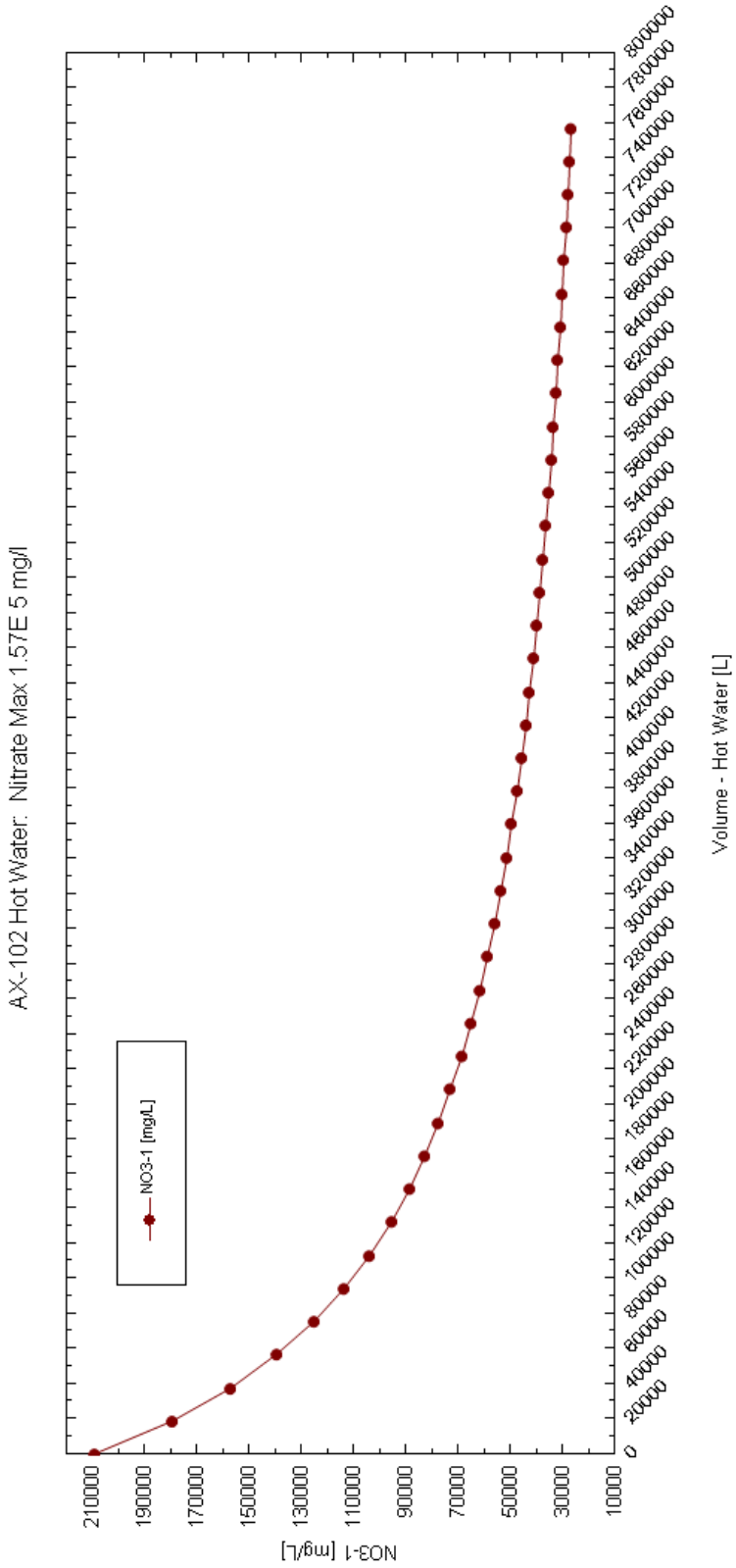

Figure A-13. AX-103 Cold Water: Technetium Max 9.54E-5 moles/L

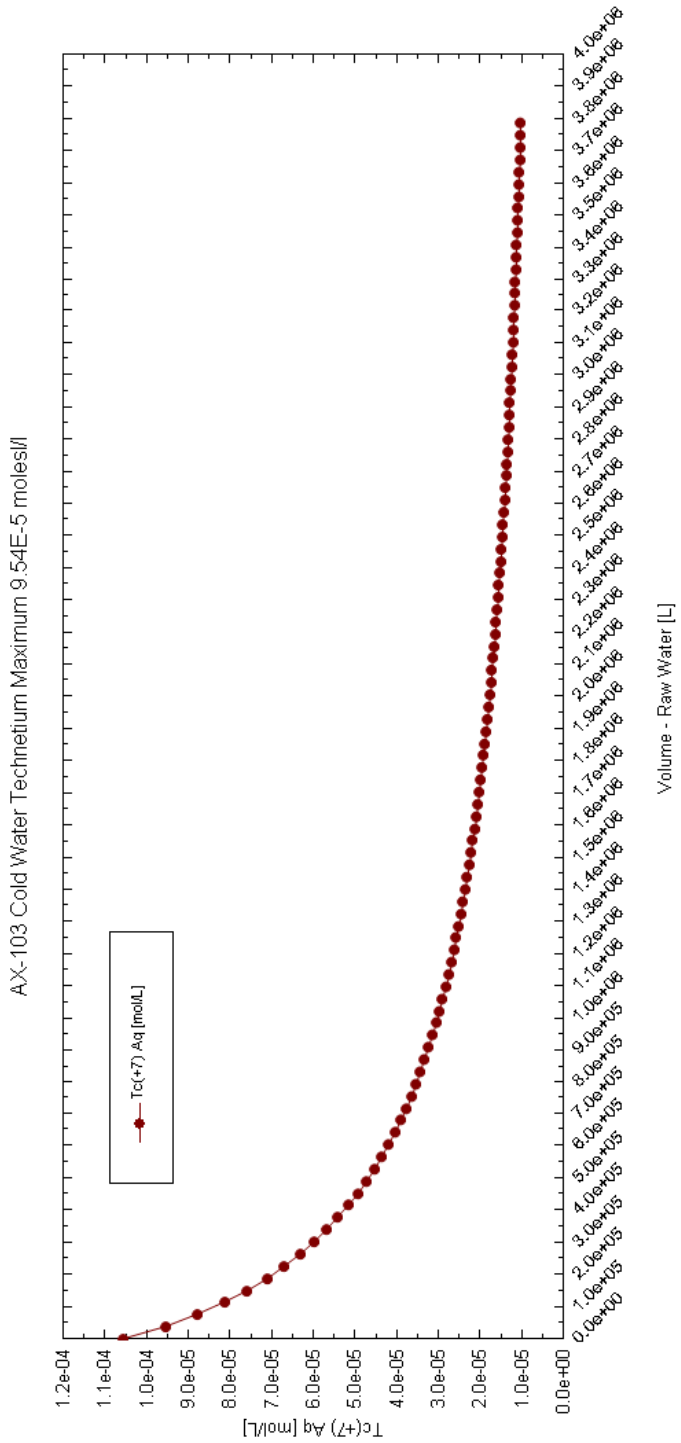

Figure A-14. AX-103 Cold Water: Iodine Max 6.88E-6 moles/L

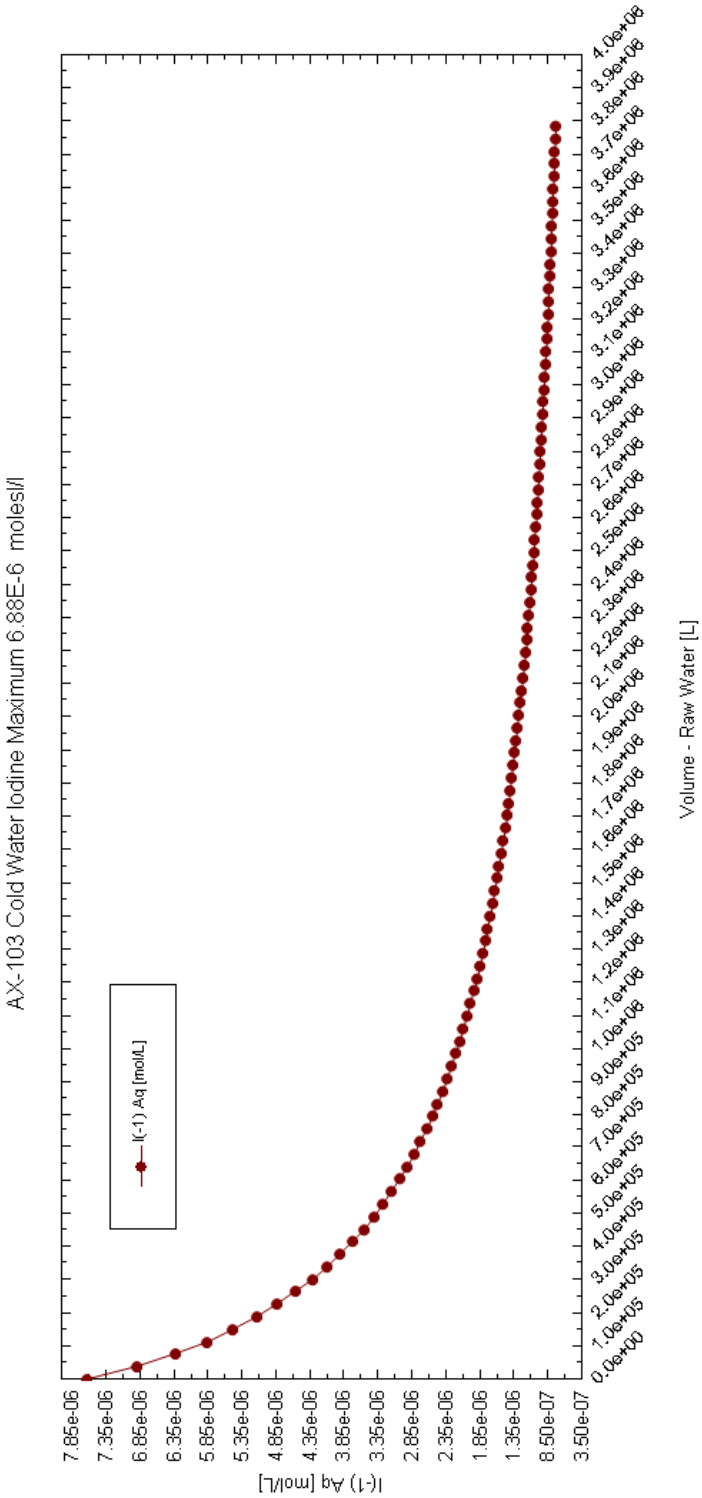

Figure A-15. AX-103 Cold Water: Uranium Max 440 mg/L

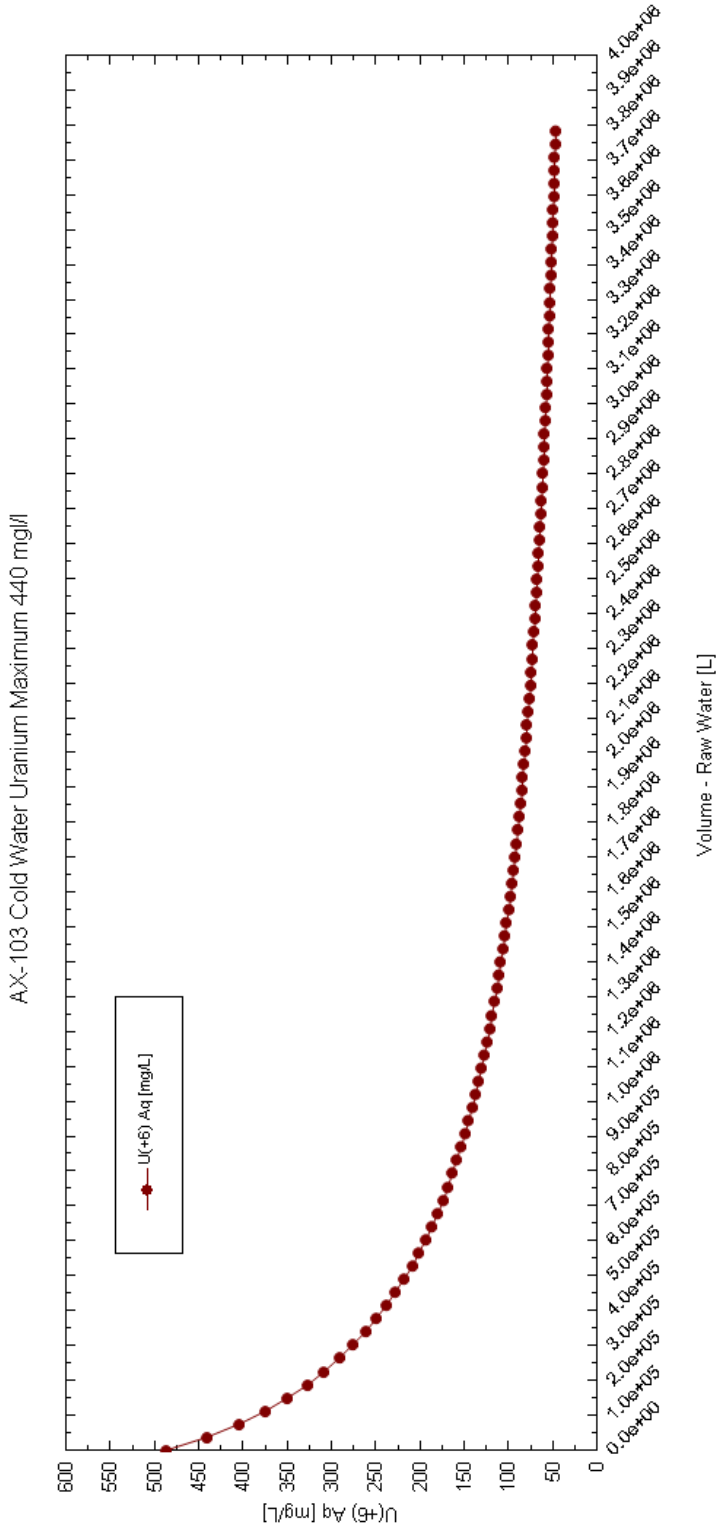

Figure A-16. AX-103 Cold Water: Chromium Max 4,840 mg/L

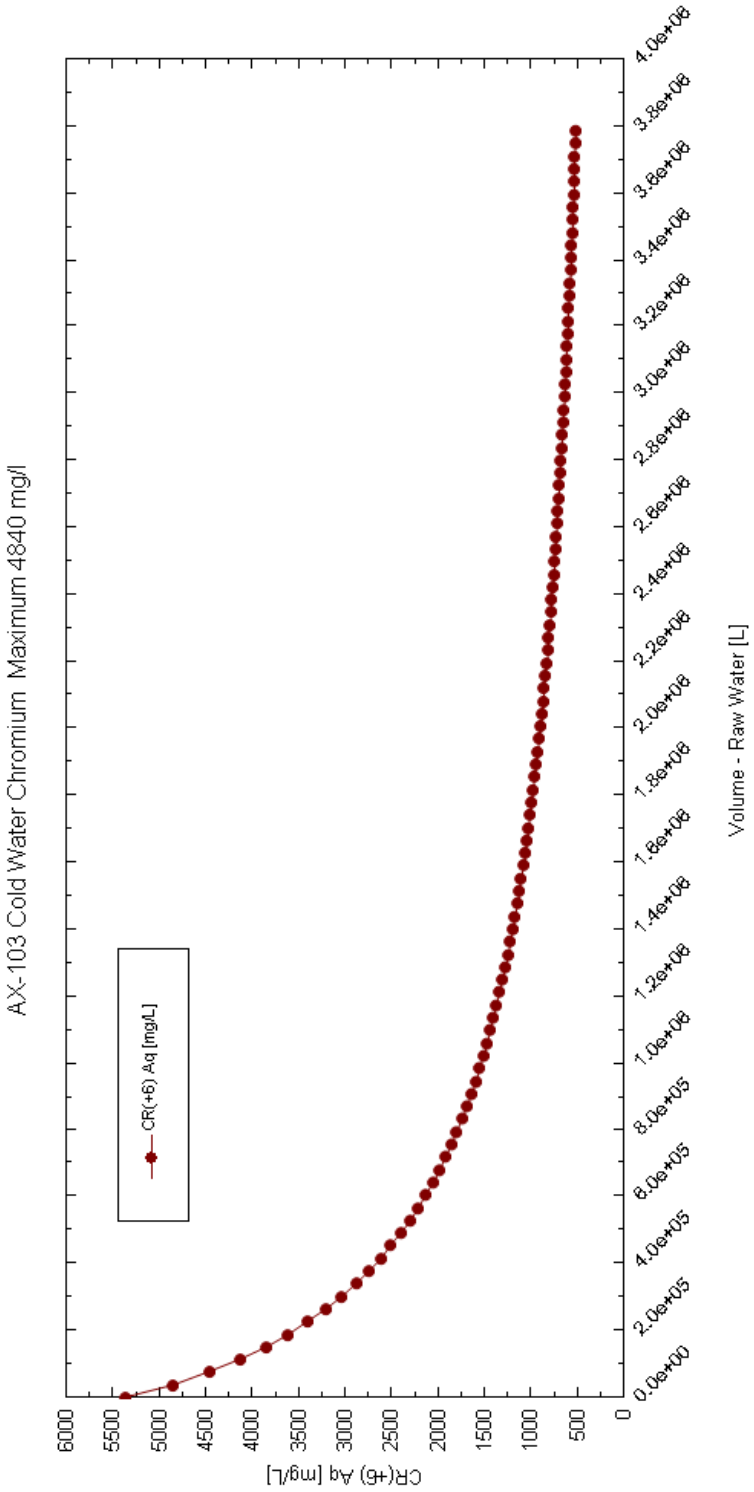

Figure A-17. AX-103 Cold Water: Nitrite Max 1.23E 5 mg/L

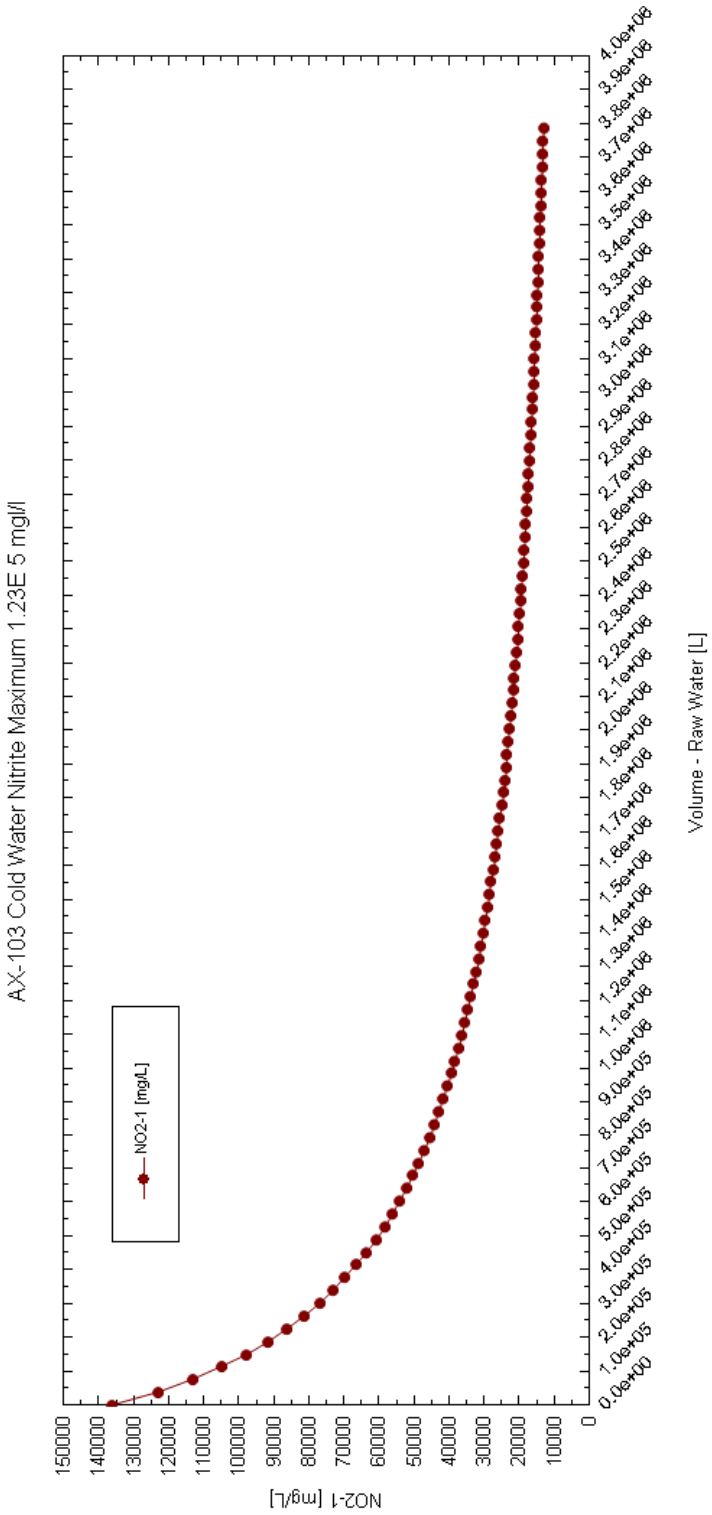

Figure A-18. AX-103 Cold Water: Nitrate Max 1.56E 5 mg/L

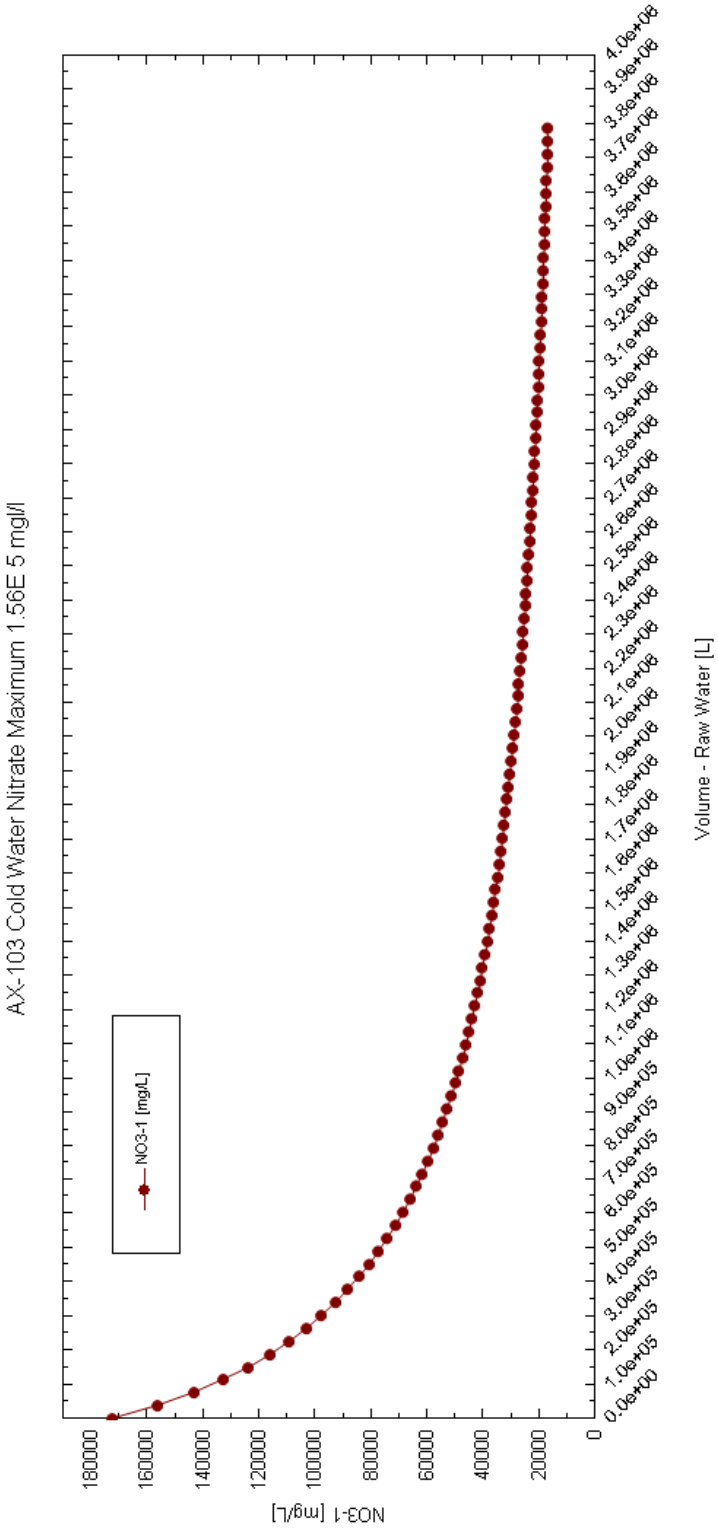

Figure A-19. AX-104 Cold Water: Technetium Max 1.87E-4 moles/L

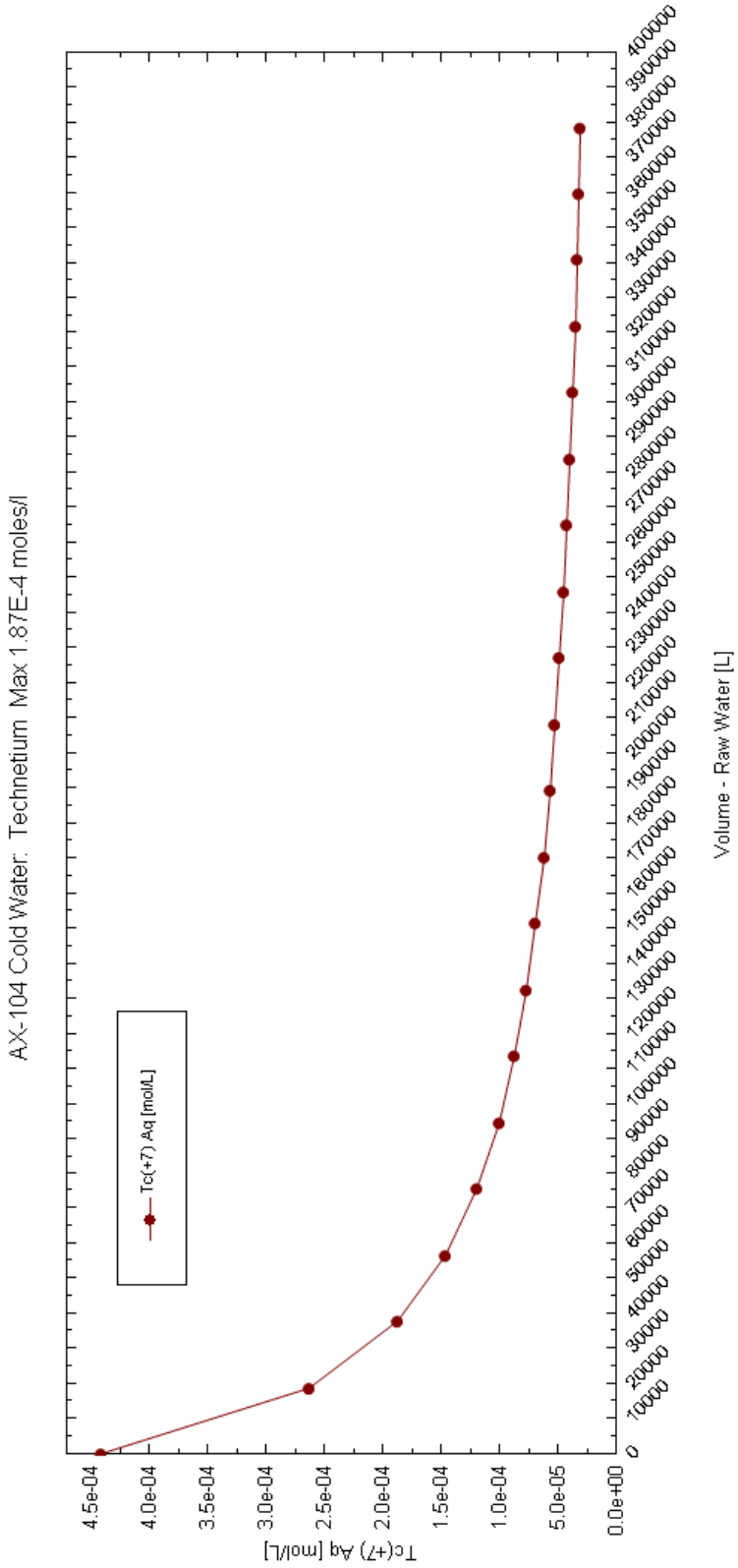

Figure A-20. AX-104 Cold Water: Iodine Max 2.49E-7 moles/L

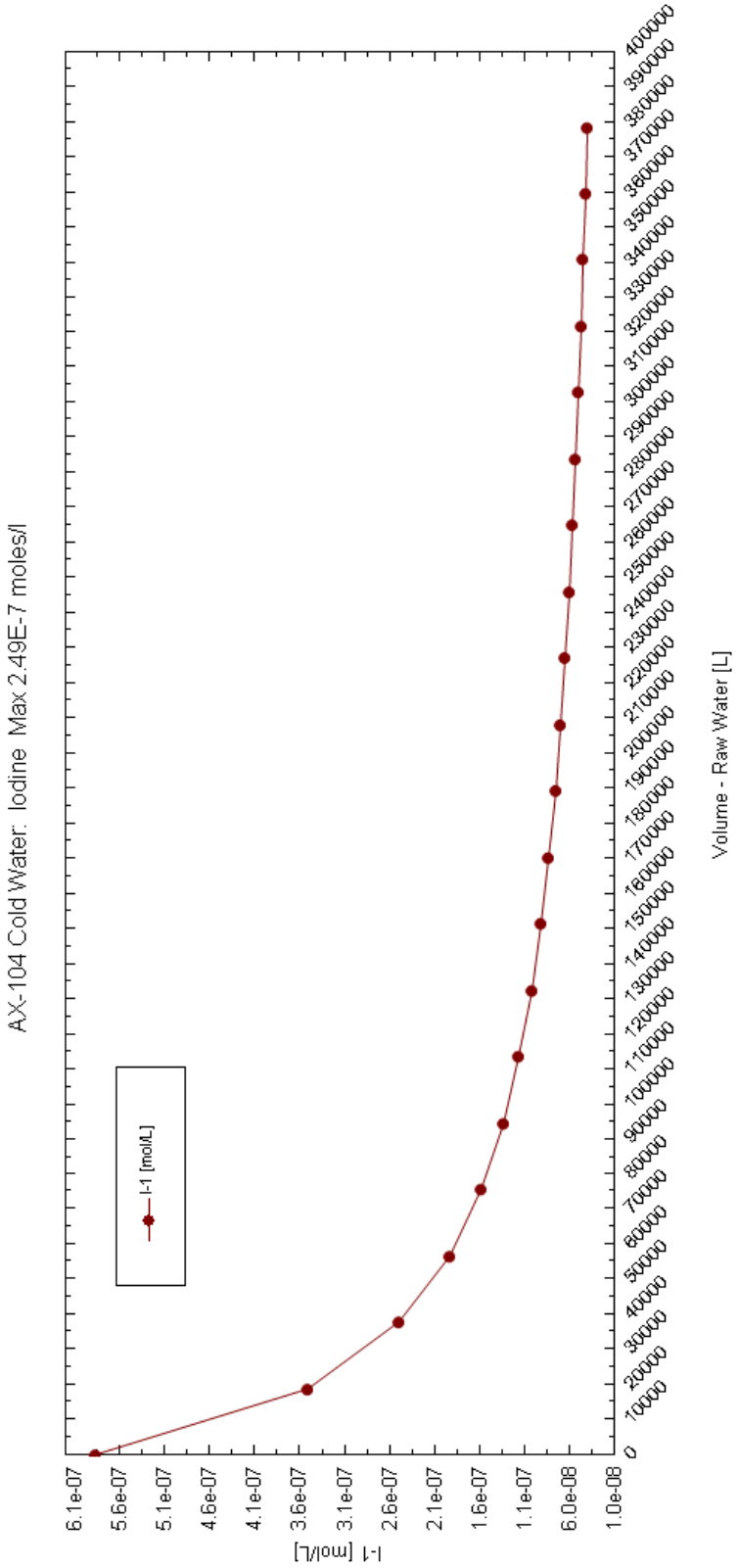

Figure A-21. AX-104 Cold Water: Uranium Max 2,520 mg/L

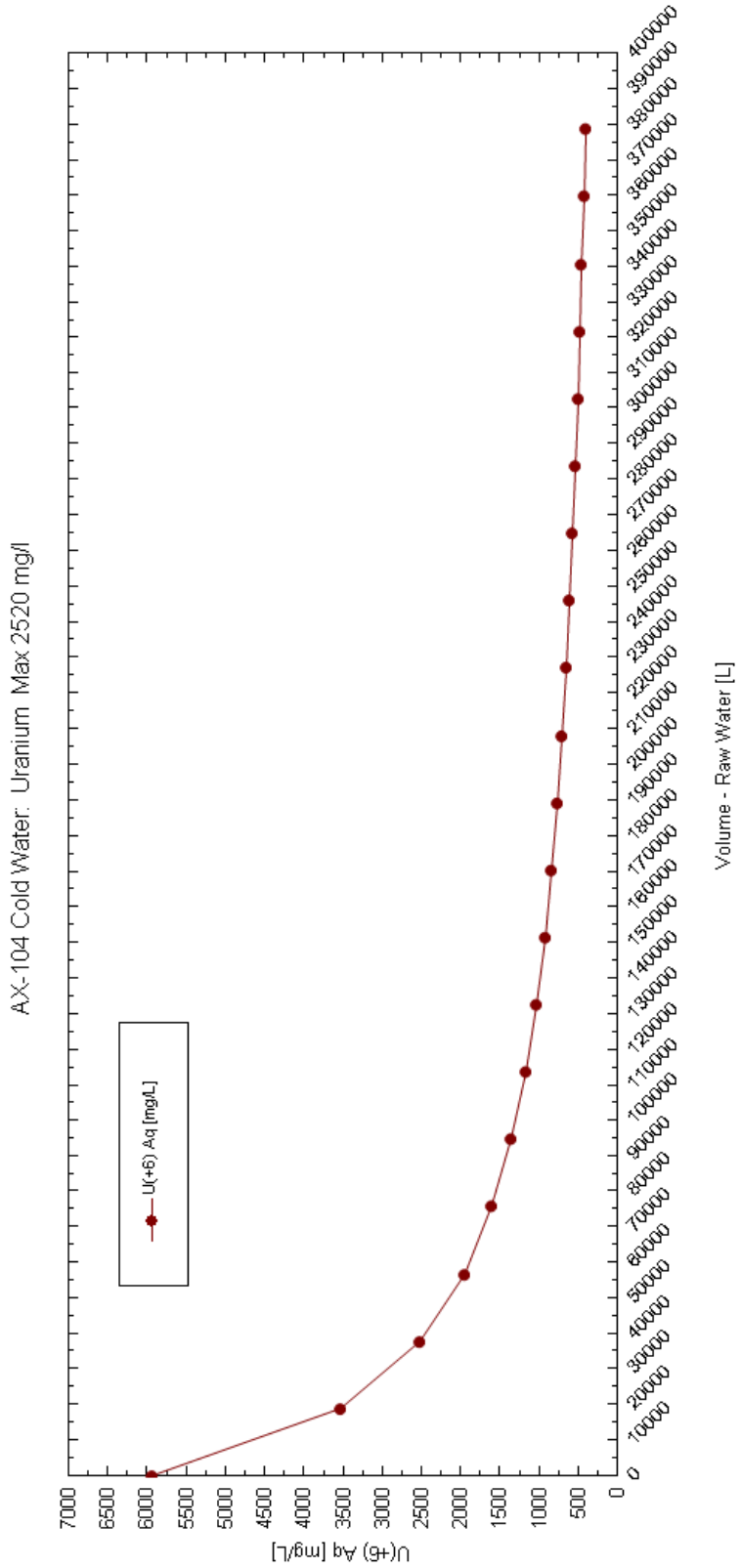

Figure A-22. AX-104 Cold Water: Chromium Max 444 mg/L

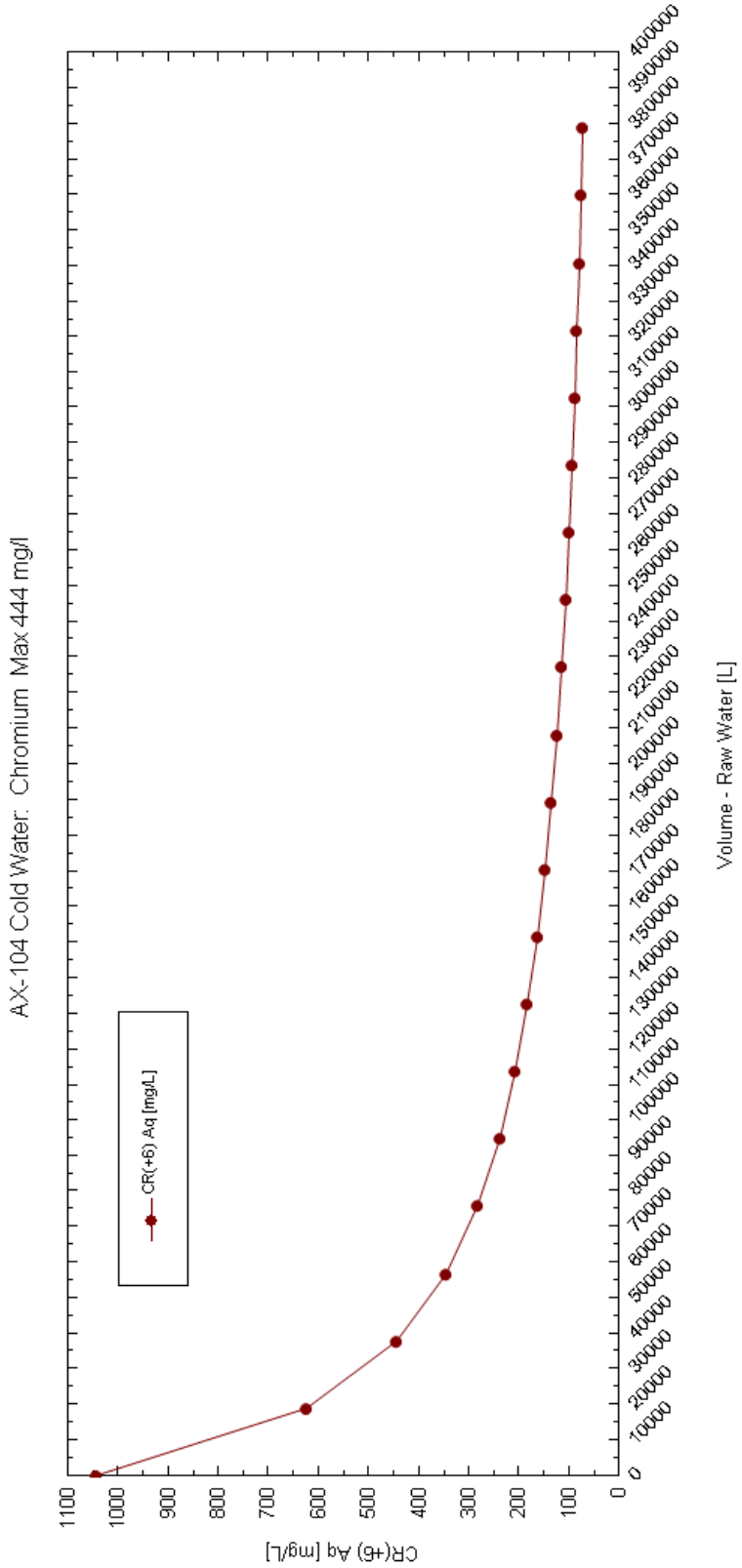

Figure A-23. AX-104 Cold Water: Nitrite Max 1,720 mg/L

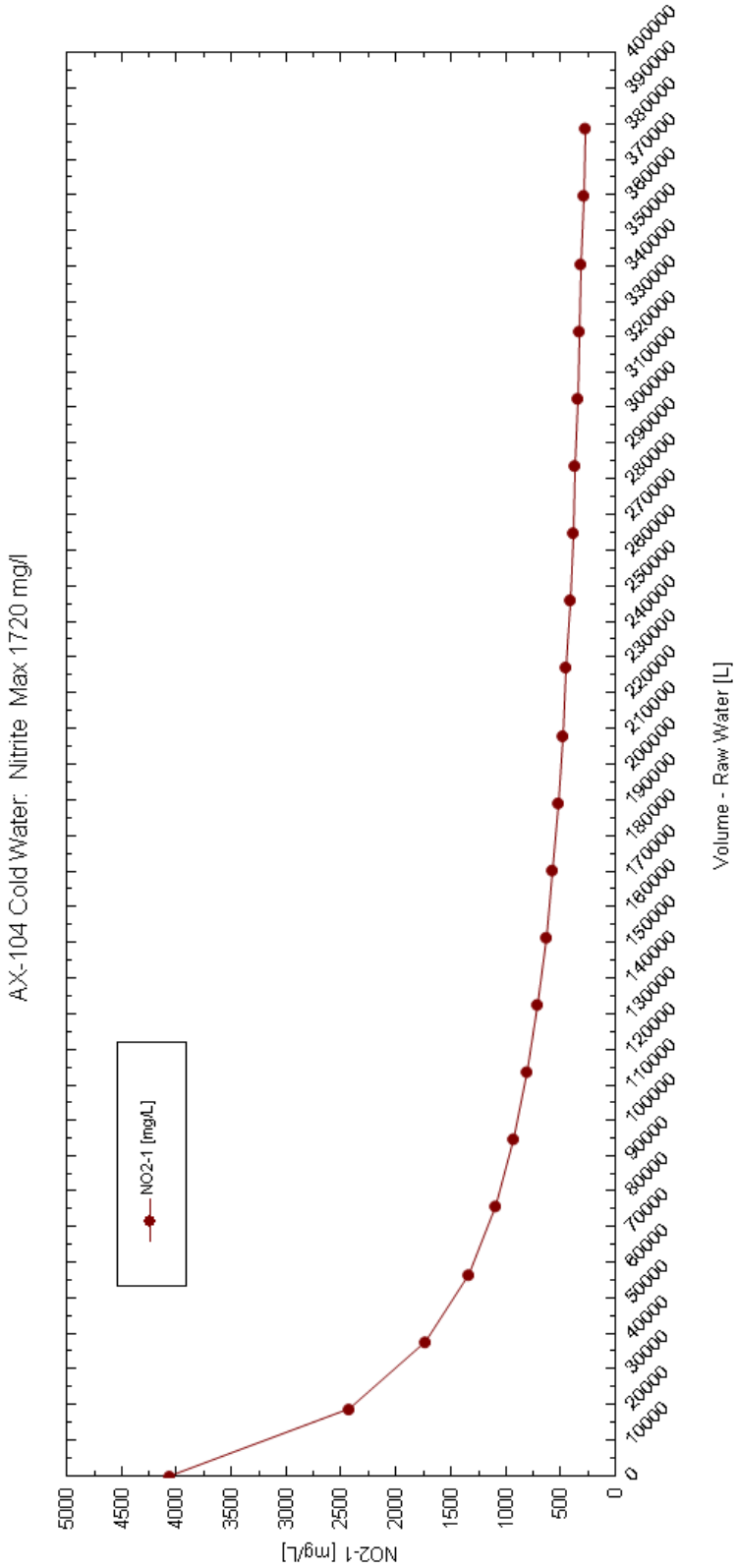
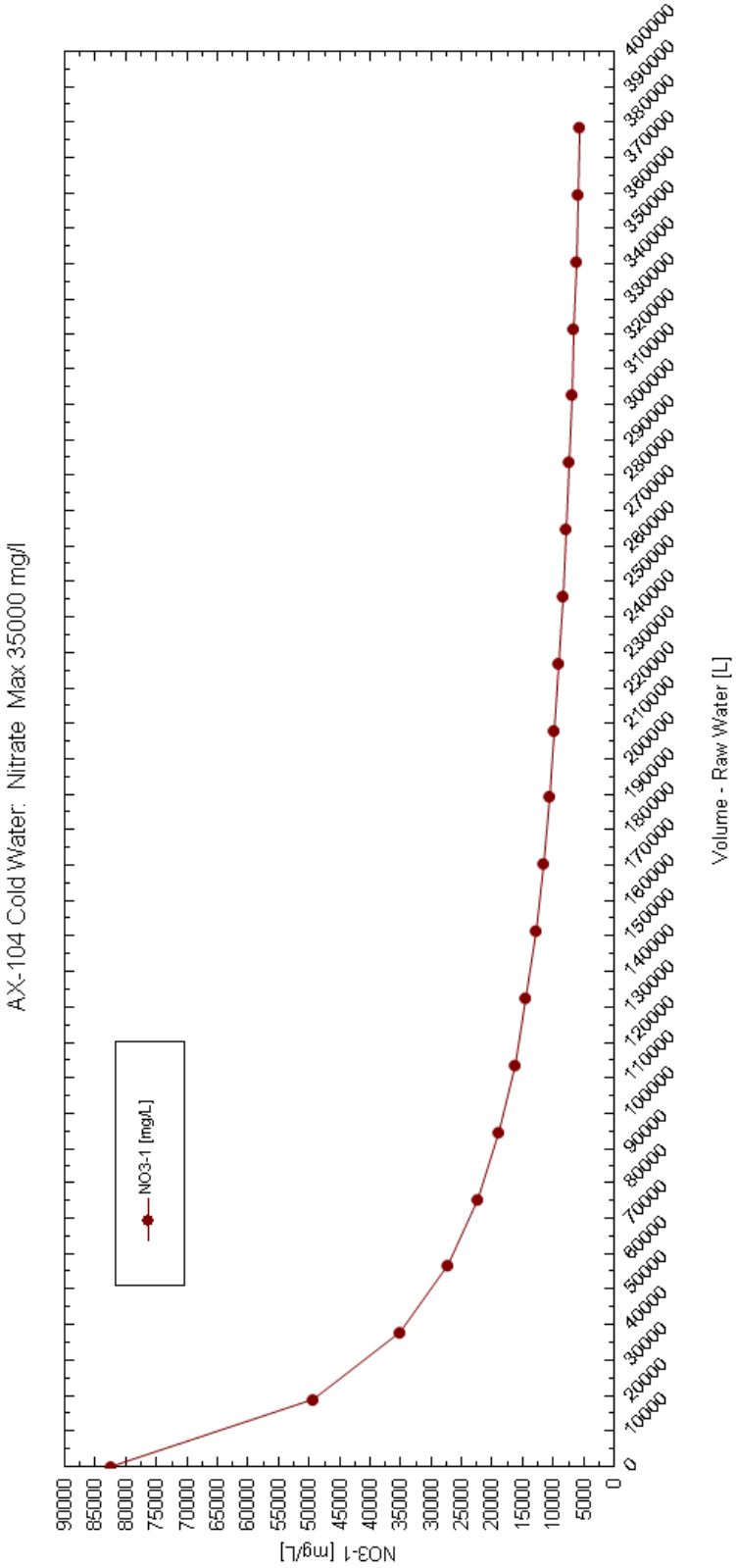
Figure A-24. AX-104 Cold Water: Nitrate Max 35,000 mg/L