

**Table 6.1-30 Niobrara River Suspended Radiological Water Quality Baseline Data Collected by Crow Butte**

Analyte	Sample Locations			
	N1 (Niobrara River West Side)		N2 (Niobrara River East Side)	
	RESULTS	RL	RESULTS	RL
	pCi/l			
<b>January 2011</b>				
Lead 210	<1.0 U	1	<1.1U	1.1
Lead 210 MDC	1	--	1.1	--
Lead 210 precision (±)	0.6	--	0.6	--
Polonium 210	<0.3 U	0.3	<0.3 U	0.3
Polonium 210 MDC	0.3	--	0.3	--
Polonium 210 precision (±)	0.1	--	0.1	--
Radium 226	<0.18 U	0.18	<0.13 U	0.13
Radium 226 MDC	0.18	--	0.13	--
Radium 226 precision (±)	0.08	--	0.07	--
Thorium 230	<0.2 U	0.2	<0.06 U	0.06
Thorium 230 MDC	0.2	--	0.06	--
Thorium 230 precision (±)	0.2	--	0.04	--
Uranium Activity (uCi/ml)	<2.0E-10	2.0E-10	<2.0E-10	2.0E-07
Uranium (metal) (mg/l)	<3.0E-04	3.0E-04	<3.0E-04	3.0E-04
<b>February 2011</b>				
Lead 210	1.4	1	<1 U	0.9
Lead 210 MDC	1	--	0.9	--
Lead 210 precision (±)	0.6	--	0.5	--
Polonium 210	<0.5 U	0.5	<0.2 U	0.2
Polonium 210 MDC	0.5	--	0.2	--
Polonium 210 precision (±)	0.2	--	0.2	--
Radium 226	<0.2 U	0.19	<0.2 U	0.19
Radium 226 MDC	0.19	--	0.19	--
Radium 226 precision (±)	0.13	--	0.08	--
Thorium 230	<0.1 U	0.1	<0.1 U	0.1
Thorium 230 MDC	0.1	--	0.1	--
Thorium 230 precision (±)	0.09	--	0.07	--
Uranium Activity (uCi/ml)	<2.0E-10	2.0E-10	<2.0E-10	2.0E-10
Uranium (metal) (mg/l)	<3.0E-04	3.0E-04	<3.0E-04	3.0E-04
<b>March 2011</b>				
Lead 210	<0.9 U	0.9	<0.9 U	0.9
Lead 210 MDC	0.9	--	0.9	--
Lead 210 precision (±)	0.5	--	0.5	--
Polonium 210	<0.2 U	0.2	0.3	0.2
Polonium 210 MDC	0.2	--	0.2	--
Polonium 210 precision (±)	0.1	--	0.3	--
Radium 226	<0.13 U	0.13	<0.13 U	0.13
Radium 226 MDC	0.13	--	0.13	--
Radium 226 precision (±)	0.06	--	0.06	--
Thorium 230	<0.1 U	0.1	<0.1 U	0.1
Thorium 230 MDC	0.1	--	0.1	--
Thorium 230 precision (±)	0.1	--	0.1	--
Uranium Activity (uCi/ml)	<2.0E-10	2.0E-10	3.4E-10	2.0E-10
Uranium (metal) (mg/l)	<3.0E-04	3.0E-04	5.0E-04	3.0E-04

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Analyte	Sample Locations			
	N1 (Niobrara River West Side)		N2 (Niobrara River East Side)	
	RESULTS	RL	RESULTS	RL
	pCi/l			
<b>April 2011</b>	No suspended analyses performed			
<b>May 2011</b>				
Lead 210	<1.1 U	1.1	<0.9 U	0.9
Lead 210 MDC	1.1	--	0.9	--
Lead 210 precision (±)	0.6	--	0.5	--
Polonium 210	<0.2 U	0.2	<0.2 U	0.2
Polonium 210 MDC	0.2	--	0.2	--
Polonium 210 precision (±)	0.2	--	0.1	--
Radium 226	<0.1 U	0.1	<0.1 U	0.1
Radium 226 MDC	0.1	--	0.1	--
Radium 226 precision (±)	0.06	--	0.04	--
Thorium 230	<0.1 U	0.1	<0.1 U	0.1
Thorium 230 MDC	0.1	--	0.1	--
Thorium 230 precision (±)	0.06	--	0.06	--
Uranium Activity (uCi/ml)	<2.0E-10	2.0E-10	<2.0E-10	2.0E-10
Uranium (metal) (mg/l)	<3.0E-04	3.0E-04	<3.0E-04	3.0E-04
<b>June 2011</b>				
Lead 210	<9.0 U	9	<0.8 U	0.8
Lead 210 MDC	9	--	0.8	--
Lead 210 precision (±)	5.3	--	0.5	--
Polonium 210	<0.2 U	0.2	<0.2 U	0.2
Polonium 210 MDC	0.2	--	0.2	--
Polonium 210 precision (±)	0.2	--	0.1	--
Radium 226	<0.13 U	0.13	<0.12 U	0.12
Radium 226 MDC	0.13	--	0.12	--
Radium 226 precision (±)	0.07	--	0.06	--
Thorium 230	0.07	0.05	<0.04 U	0.04
Thorium 230 MDC	0.05	--	0.04	--
Thorium 230 precision (±)	0.04	--	0.03	--
Uranium Activity (uCi/mL)	<2.0E-10	2.0E-10	<2.0E-10	2.0E-10
Uranium (metal) (mg/l)	<3.0E-04	3.0E-04	<3.0E-04	3.0E-04
<b>July 2011</b>				
Lead 210	0.7	0.5	<0.5 U	0.5
Lead 210 MDC	0.5		0.5	
Lead 210 precision (±)	0.3		0.3	
Polonium 210	<0.2 U	0.7	<0.2 U	0.2
Polonium 210 MDC	0.2		0.2	
Polonium 210 precision (±)	0.2		0.1	
Radium 226	<0.1 U	0.2	<0.1 U	0.1
Radium 226 MDC	0.1		0.1	
Radium 226 precision (±)	0.06		0.09	
Thorium 230	<0.1 U	0.1	<0.1 U	0.1
Thorium 230 MDC	0.1		0.1	
Thorium 230 precision (±)	0.08		0.08	

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Analyte	Sample Locations			
	N1 (Niobrara River West Side)		N2 (Niobrara River East Side)	
	RESULTS	RL	RESULTS	RL
	pCi/l			
Uranium Activity (uCi/mL)	3.6E-09	2.0E-10	<2.0E-10	2.0E-10
Uranium (metal) (mg/l)	5.0E-04	3.0E-04	<3.0E-04	3.0E-04
<b>August 2011</b>				
Lead 210	<0.8 U	<0.8	<0.7 U	0.7
Lead 210 MDC	0.8	0.8	0.7	
Lead 210 precision (±)	0.5	0.5	0.4	
Polonium 210	0.4	0.4	<0.3 U	0.3
Polonium 210 MDC	0.2	0.2	0.3	
Polonium 210 precision (±)	0.3	0.3	0.2	
Radium 226	0.14	0.14	<0.08 U	0.08
Radium 226 MDC	0.08	0.08	0.08	
Radium 226 precision (±)	0.07	0.07	0.05	
Thorium 230	0.1	0.1	0.1	0.07
Thorium 230 MDC	0.05	0.05	0.07	
Thorium 230 precision (±)	0.05	0.05	0.05	
Uranium Activity (uCi/mL)	2.4E-10	2.0E-10	2.2E-10	2.0E-10
Uranium (metal) (mg/l)	4.0E-04	3.0E-04	3.0E-04	3.0E-04
<b>September 2011</b>				
Lead 210	<0.6 U	0.6	<0.6 U	0.6
Lead 210 MDC	0.6		0.6	
Lead 210 precision (±)	0.3		0.3	
Polonium 210	<0.2 U	0.2	0.3	0.2
Polonium 210 MDC	0.2		0.2	
Polonium 210 precision (±)	0.1		0.2	
Radium 226	0.1	0.1	0.1	0.1
Radium 226 MDC	0.1		0.1	
Radium 226 precision (±)	0.06		0.06	
Thorium 230	0.2	0.1	0.2	0.1
Thorium 230 MDC	0.1		0.1	
Thorium 230 precision (±)	0.1		0.1	
Uranium Activity (uCi/mL)	2.2E-10	2.0E-10	4.5E-09	2.0E-10
Uranium (metal) (mg/l)	3.0E-04	3.0E-04	6.6E-03	3.0E-04
<b>October 2011</b>				
Lead 210	<0.5 U	0.5	<0.9 U	0.9
Lead 210 MDC	0.5		0.9	
Lead 210 precision (±)	0.3		0.6	
Polonium 210	0.3	0.3	0.3	0.3
Polonium 210 MDC	0.3		0.3	
Polonium 210 precision (±)	0.2		0.3	
Radium 226	<0.06 U	0.06	0.08	0.06
Radium 226 MDC	0.06		0.06	
Radium 226 precision (±)	0.03		0.05	
Thorium 230	0.2	0.1	0.2	0.1
Thorium 230 MDC	0.1		0.1	
Thorium 230 precision (±)	0.1		0.1	

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Analyte	Sample Locations			
	N1 (Niobrara River West Side)		N2 (Niobrara River East Side)	
	RESULTS	RL	RESULTS	RL
	pCi/l			
Uranium Activity (uCi/mL)	2.3E-10	2.0E-10	<2.0E-10	2.0E-10
Uranium (metal) (mg/l)	3.0E-04 B	3.0E-04	<3.0E-04	3.0E-04
<b>November 2011</b>				
Lead 210	<0.6 U	0.6	<0.7 U	0.7
Lead 210 MDC	0.6		0.7	
Lead 210 precision (±)	0.4		0.4	
Polonium 210	<0.4 U	0.4	<0.4 U	0.4
Polonium 210 MDC	0.4		0.4	
Polonium 210 precision (±)	0.2		0.3	
Radium 226	0.1	0.1	0.1	0.1
Radium 226 MDC	0.1		0.1	
Radium 226 precision (±)	0.05		0.05	
Thorium 230	0.1	0.1	<0.1 U	0.1
Thorium 230 MDC	0.1		0.1	
Thorium 230 precision (±)	0.07		0.07	
Uranium Activity (uCi/mL)	<2.0E-10	2.0E-10	<2.0E-10	2.0E-10
Uranium (metal) (mg/l)	<3.0E-04	3.0E-04	<3.0E-04	3.0E-04
<b>January 2012</b>				
Lead 210	<0.7 U	0.7	<0.8 U	0.8
Lead 210 MDC	0.7		0.8	
Lead 210 precision (±)	0.4		0.5	
Polonium 210	<0.8 U	0.8	<0.8 U	0.8
Polonium 210 MDC	0.8		0.8	
Polonium 210 precision (±)	0.3		0.3	
Radium 226	<0.1 U	0.1	<0.1 U	0.1
Radium 226 MDC	0.1		0.1	
Radium 226 precision (±)	0.05		0.07	
Thorium 230	<0.1 U	0.1	0.2	0.1
Thorium 230 MDC	0.1		0.1	
Thorium 230 precision (±)	0.08		0.1	
Uranium Activity (uCi/mL)	<2.0E-10	2.0E-10	<2.0E-10	2.0E-10
Uranium (metal) (mg/l)	<3.0E-04	3.0E-04	<3.0E-04	3.0E-04

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Analyte	Sample Locations			
	N1 (Niobrara River West Side)		N2 (Niobrara River East Side)	
	RESULTS	RL	RESULTS	RL
	pCi/l			
<b>February 2012</b>				
Lead 210	<1.0 U	1	<1.0 U	1
Lead 210 MDC	1		1	
Lead 210 precision (±)	NA		NA	
Polonium 210	<1.0 U	1	<1.0 U	1
Polonium 210 MDC	1		1	
Polonium 210 precision (±)	NA		NA	
Radium 226	<0.2 U	0.2	<0.2 U	0.2
Radium 226 MDC	0.2		0.2	
Radium 226 precision (±)	NA		NA	
Thorium 230	<0.2 U	0.2	<0.2 U	0.2
Thorium 230 MDC	0.2		0.2	
Thorium 230 precision (±)	NA		NA	
Uranium Activity (uCi/mL)	<2.0E-01	2.0E-01	<2.0E-01	2.0E-01
Uranium (metal) (mg/l)	<3.0E-04	3.0E-04	<3.0E-04	3.0E-04
<b>March 2012</b>				
Lead 210	1.7	1	2.1	1
Lead 210 MDC	1		1	
Lead 210 precision (±)	0.6		0.5	
Polonium 210	<1.0 U	1	<1.0 U	1
Polonium 210 MDC	1		1	
Polonium 210 precision (±)	NA		NA	
Radium 226	<0.2 U	0.2	<0.2 U	0.2
Radium 226 MDC	0.2		0.2	
Radium 226 precision (±)	NA		NA	
Thorium 230	<0.2 U	0.2	<0.2 U	0.2
Thorium 230 MDC	0.2		0.2	
Thorium 230 precision (±)	NA		NA	
Uranium Activity (uCi/mL)	<2.0E-01	2.0E-01	<2.0E-01	2.0E-01
Uranium (metal) (mg/l)	<3.0E-04	3.0E-04	<3.0E-04	3.0E-04

**Notes:**

- B = Analyte was detected in the method blank
- U = Not detected at minimum detectable concentration
- MDC = minimum detectable concentration
- pCi/l = picoCuries per liter
- RL = reporting limit
- uCi/ml = microCuries per milliliter
- NA = Not Applicable, not detected below the RL

**Table 6.1-31 Niobrara River Non-Radiological Water Quality Baseline Data Collected by Crow Butte**

Analyte Group	Units	N1 (Niobrara River West Site)		N1 (Niobrara River West Site)		N1 (Niobrara River West Site)		N1 (Niobrara River West Site)		N1 (Niobrara River West Site)		N1 (Niobrara River West Site)			
		2/11/2011		5/16/2011		6/24/2011		8/12/2011		11/28/2011		1/13/2012		2/21/2012	
		RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL
<b>Major Ions</b>															
Alkalinity Total as CaCO3	mg/L	230	1	261	1	235	1	185	1	208	1	187	1	190	5
Bicarbonate as HCO3	mg/L	271	1	297	1	286	1	226	1	254	1	229	1	232	5
Carbonate as CO3	mg/L	5	1	10	1	<1	1	<1	1	<1	1	<1	1	<5	5
Calcium	mg/L	60	1	58	1	53	1	46	1	53	1	52	1	50	1
Chloride	mg/L	6	1	6	1	4	1	5	1	5	1	5	1	4	1
Fluoride	mg/L	0.7	0.1	0.8	0.1	0.7	0.1	0.7	0.1	0.7	0.1	0.7	0.1	0.6	0.1
Magnesium	mg/L	11	1	12	1	11	1	9	1	11	1	9	1	9	1
Nitrogen Ammonia as N	mg/L	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.1	0.1
Nitrogen Nitrate+Nitrite as N	mg/L	1.4	0.1	0.2	0.1	0.4	0.1	1	0.1	1.1	0.1	1.5	0.1	1	0.1
Potassium	mg/L	8	1	10	1	8	1	6	1	8	1	8	1	8	1
Silica	mg/L	62.4	0.2	41.3	0.2	45.2	0.2	58.1	0.2	53.1	0.2	58.1	0.2	51	1
Sodium	mg/L	22	1	38	1	25	1	24	1	23	1	22	1	22	1
Sulfate	mg/L	13	1	12	1	10	1	13	1	15	1	13	1	11	1
<b>Physical Properties</b>															
Conductivity @ 25 C	umhos/cm	460	1	498	1	443	1	388	1	440	1	422	1	420	1
pH	s.u.	8.11	0.01	8.38	0.01	8.16	0.01	8.2	0.01	8.05	0.01	8.13	0.01	7.9	0.1
Solids Total Dissolved TDS @ 180 C	mg/L	315	10	335	10	313	10	262	10	276	10	252	10	290	10
<b>Metals Dissolved</b>															
Aluminum	mg/L	<0.1	0.1	0.2	0.1	<0.1	0.1	0.2	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1
Arsenic	mg/L	0.006	0.001	0.008	0.001	0.006	0.001	0.007	0.001	0.006	0.001	<0.001	0.001	0.005	0.001
Barium	mg/L	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	<0.1	0.1	0.1	0.1
Boron	mg/L	<0.1	0.1	<0.1	0.1	0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1
Cadmium	mg/L	<0.005	0.005	<0.005	0.005	<0.005	0.005	<0.005	0.005	<0.005	0.005	<0.005	0.005	<0.005	0.005
Chromium	mg/L	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05
Copper	mg/L	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.1	0.1
Iron	mg/L	<0.03	0.03	0.2	0.03	0.07	0.03	0.27	0.03	0.04	0.03	<0.03	0.03	0.05	0.05
Lead	mg/L	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.05	0.05
Manganese	mg/L	<0.01	0.01	0.02	0.01	0.01	0.01	0.02	0.01	<0.01	0.01	<0.01	0.01	0.01	0.01
Mercury	mg/L	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001
Molybdenum	mg/L	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1
Nickel	mg/L	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05
Selenium	mg/L	<0.001	0.001	<0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.001	<0.001	0.001	<0.001	0.001
Vanadium	mg/L	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.02	0.02
Zinc	mg/L	<0.02	0.01	0.02	0.01	0.01	0.01	0.02	0.01	0.02	0.01	<0.01	0.01	<0.01	0.01
<b>Data Quality</b>															
A/C Balance (± 5)	%	-0.594	--	1.1	--	-2.06	--	-0.351	--	-0.0267	--	1.95	--	1.61	--
Anions	meq/L	5.16	--	5.69	--	5.07	--	4.21	--	4.73	--	4.31	--	4.26	--
Cations	meq/L	5.1	--	5.82	--	4.87	--	4.18	--	4.72	--	4.48	--	4.40	--
Solids Total Dissolved Calculated	mg/L	344	--	342	--	312	--	292	--	312	--	302	--	270	--

**Notes:**

- meq/L = milliequivalents per liter
- mg/L = milligrams per liter
- ND = not detected
- RL = reporting limit
- s.u. = standard units
- umhos/cm = micromhos per centimeter

**Table 6.1-31 Niobrara River Non-Radiological Water Quality Baseline Data Collected by Crow Butte**

Analyte Group	Units	N2 (Niobrara River East Site)		N2 (Niobrara River East Site)		N2 (Niobrara River East Site)		N2 (Niobrara River East Site)		N2 (Niobrara River East Site)		N2 (Niobrara River East Site)		N2 (Niobrara River East Site)	
		2/11/2011		5/16/2011		6/24/2011		8/12/2011		11/28/2011		1/13/2011		2/21/2012	
		RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL
<b>Major Ions</b>															
Alkalinity Total as CaCO3	mg/L	223	1	253	1	253	1	180	1	184	1	211	1	179	5
Bicarbonate as HCO3	mg/L	262	1	290	1	308	1	219	1	224	1	257	1	218	5
Carbonate as CO3	mg/L	5	1	9	1	<1	1	<1	1	<1	1	<1	1	<5	5
Calcium	mg/L	57	1	56	1	54	1	48	1	49	1	57	1	47	1
Chloride	mg/L	5	1	5	1	5	1	5	1	5	1	6	1	4	1
Fluoride	mg/L	0.7	0.1	0.8	0.1	0.8	0.1	0.7	0.1	0.7	0.1	0.7	0.1	0.6	0.1
Magnesium	mg/L	10	1	12	1	12	1	9	1	9	1	10	1	8	1
Nitrogen Ammonia as N	mg/L	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<1	0.05	<0.05	0.05	<0.1	0.1
Nitrogen Nitrate+Nitrite as N	mg/L	1.2	0.1	<0.1	0.1	<0.1	0.1	0.9	0.1	1.3	0.1	1.6	0.1	1	0.1
Potassium	mg/L	7	1	9	1	11	1	7	1	7	1	9	1	7	1
Silica	mg/L	59.1	0.2	41.6	0.2	48.4	0.2	64.8	0.2	58.6	0.2	63	0.2	49	1
Sodium	mg/L	20	1	36	1	29	1	24	1	23	1	23	1	21	1
Sulfate	mg/L	12	1	12	1	9	1	13	1	14	1	17	1	12	1
<b>Physical Properties</b>															
Conductivity @ 25 C	umhos/cm	437	1	478	1	481	1	387	1	406	1	475	1	398	1
pH	s.u.	7.91	0.01	8.3	0.01	7.84	0.01	8.21	0.01	8.16	0.01	7.92	0.01	7.90	1
Solids Total Dissolved TDS @ 180 C	mg/L	302	10	326	10	334	10	258	10	275	10	300	10	270	10
<b>Metals Dissolved</b>															
Aluminum	mg/L	<0.1	0.1	<0.1	0.1	<0.1	0.1	0.3	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1
Arsenic	mg/L	0.005	0.001	0.006	0.001	0.006	0.001	0.007	0.001	0.006	0.001	0.006	0.001	0.005	0.001
Barium	mg/L	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	<0.1	0.1
Boron	mg/L	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	0.1	0.1	<0.1	0.1	<0.1	0.1
Cadmium	mg/L	<0.005	0.005	<0.005	0.005	<0.105	0.005	<0.005	0.005	<0.005	0.005	<0.005	0.005	<0.005	0.005
Chromium	mg/L	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05
Copper	mg/L	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.1	0.1
Iron	mg/L	0.04	0.03	0.08	0.03	0.04	0.03	0.3	0.03	0.03	0.03	0.04	0.03	<0.05	0.05
Lead	mg/L	<0.001	0.001	<0.001	0.001	<0.001	0.001	0.001	0.001	<0.001	0.001	<0.001	0.001	<0.05	0.05
Manganese	mg/L	0.02	0.01	<0.01	0.01	0.04	0.01	0.06	0.01	<0.01	0.01	<0.01	0.01	0.01	0.01
Mercury	mg/L	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001
Molybdenum	mg/L	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1
Nickel	mg/L	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05
Selenium	mg/L	0.002	0.001	<0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.001	0.001	0.001	<0.001	0.001
Vanadium	mg/L	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.02	0.02
Zinc	mg/L	<0.01	0.01	0.02	0.01	0.02	0.01	0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01
<b>Data Quality</b>															
A/C Balance (± 5)	%	-2.5	--	0.802	--	-1.79	--	2.51	--	2.19	--	0.624	--	1.03	--
Anions	meq/L	4.95	--	5.5	--	5.42	--	4.11	--	4.22	--	4.9	--	4.03	--
Cations	meq/L	4.71	--	5.58	--	5.23	--	4.32	--	4.41	--	4.96	--	4.11	--
Solids Total Dissolved Calculated	mg/L	325	--	330	--	334	--	300	--	298	--	333	--	260	--

Notes:  
MDC = Minimum detectable concentration  
pCi/L - picocuries per liter  
RL = reporting limit  
mg/L = milligrams per liter  
meq/L = milliequivalents per liter  
s.u. = standard units  
umhos/cm = micromhos per centimeter

**Table 6.1-32 Summary of Radiological Baseline Data for Niobrara River Near Marsland Expansion Area Collected by Crow Butte**

Analyte	Concentration (pCi/L) <sup>a</sup>		Non-Detection Frequency <sup>b</sup>	Non-Detection Value <sup>c</sup>	
	Minimum	Maximum		Minimum	Maximum
<b>NIOBRARA RIVER UPGRADIENT SAMPLING POINT N-1</b>					
<b>Dissolved Radiological Analytes</b>					
Lead 210	<0.6	1.7	13/14	0.6	1.6
Polonium 210	<0.4	0.8	12/14	0.4	0.9
Radium 226	<0.1	1.7	3/14	0.09	0.16
Thorium 230	<0.1	<0.3	14/14	0.1	0.3
Uranium Activity (μCi/ml)	2.4E-10	4.4E+00	0/14	2.0E-10	2.0E-01
Uranium (mg/L)	4.0E-04	1.04E-02	0/14	3.0E-04	3.0E-04
<b>Suspended Radiological Analytes</b>					
Lead 210	<0.5	<9.0	10/13	0.5	9.0
Polonium 210	<0.2	0.4	10/13	0.2	1.0
Radium 226	<0.06	0.14	10/13	0.06	0.2
Thorium 230	<0.1	0.2	9/13	0.05	0.2
Uranium Activity (μCi/ml)	<2.0E-10	3.6E-09	9/13	2.0E-10	2.0E-01
Uranium (mg/L)	<3.0E-04	5.0E-04	10/13	3.0E-04	3.0E-04
<b>NIOBRARA RIVER DOWNGRADIENT SAMPLING POINT N-2</b>					
<b>Dissolved Radiological Analytes</b>					
Lead 210	<0.6	50	13/14	0.6	1.2
Polonium 210	<0.4	4.6	12/14	0.4	0.9
Radium 226	<0.1	1.3	7/14	0.09	0.2
Thorium 230	<0.1	<0.8	14/14	0.1	0.8
Uranium Activity (μCi/ml)	<2.0E-10	4.9E+00	1/14	2.0E-10	2.0E-01
Uranium (mg/L)	<3.0E-04	9.0E-03	1/14	3.0E-04	3.0E-04
<b>Suspended Radiological Analytes</b>					
Lead 210	<0.5	2.1	12/13	0.5	1.1
Polonium 210	<0.2	0.3	10/13	0.2	1.0
Radium 226	<0.08	0.1	10/13	0.01	0.2
Thorium 230	<0.04	0.2	9/13	0.04	0.2
Uranium Activity (μCi/ml)	<2.0E-10	4.5E-09	10/13	2.0E-10	2.0E-01
Uranium (mg/L)	<3.0E-04	6.6E-04	10/13	3.0E-04	3.0E-04

<sup>a</sup> Unless noted otherwise. Individual analytical results with RLs are presented in Tables 6.1-29 and 6.1-30.

<sup>b</sup> Number of samples with values less than the Non-Detection Limit; 5/6 = five of six samples with values below the detection limit.

<sup>c</sup> The minimum and maximum non-detection values for all samples during that testing period.

mg/L = milligrams per liter

pCi/L = picoCuries per liter

μCi/ml = microCuries per milliliter

**Table 6.1-33 Summary of Non-Radiological Baseline Data for Niobrara River Near Marsland Expansion Area Collected by Crow Butte**

Analytes	Units	Crow Butte Niobrara River Sampling Locations			
		N-1		N-2	
		Minimum	Maximum	Minimum	Maximum
Alkalinity	mg/L	185	261	179	253
Bicarbonate	mg/L	226	297	218	308
Carbonate	mg/L	<1	10	<1	9
Conductivity @ 25° C	µmhos/cm	388	498	387	481
Calcium	mg/L	46	60	47	57
Chloride	mg/L	4	6	4	6
Fluoride	mg/L	0.6	0.8	0.6	0.8
Magnesium	mg/L	9	12	8	12
Nitrogen Ammonia as N	mg/L	<0.05	<0.1	<0.05	<1.0
Nitrogen Nitrate-Nitrite as N	mg/L	0.2	1.5	<0.1	1.6
Potassium	mg/L	6	10	7	11
Silicia	mg/L	41.3	62.4	41.6	64.8
Sodium	mg/L	22	38	20	36
Sulfate	mg/L	10	15	9	17
pH	s.u.	7.90	8.38	7.84	8.3
Total Dissolved Solids @ 180° C	mg/L	252	335	258	334
Dissolved Metals	The majority of parameters were measured at or below the RL (see Table 2.9-28).				

Individual analytical results with RLs are presented in Table 6.1-31.

s.u. = standard unit

mg/L = milligrams per liter

RL = Reporting Limit

µmhos/cm = micromhos per centimeter

**Table 6.1-34 Daily Contents in Acre-Feet of Water for Box Butte Reservoir (USGS 06455000)– 2003 to August 2013**

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Spt	Oct	Nov	Dec
	Acre-feet											
<b>2003</b>												
Mean	8,489	9,899	11,053	12,365	13,503	13,380	11,134	5,236	4,151	4,841	5,587	6,376
Minimum	7,740	9,449	10,394	11,743	12,775	11,865	7,922	3,517	3,848	4,455	5,209	5,992
Maximum	9,390	10,359	11,818	13,167	14,000	14,588	14,051	7,805	4,434	5,176	5,974	6,950
<b>2004</b>												
Mean	7,182	8,138	9,232	9,969	11,743	11,610	9,468	4,779	4,018	5,142	6,205	7,266
Minimum	6,856	7,755	8,586	8,965	10,822	11,537	6,890	2,803	3,460	4,604	5,730	6,745
Maximum	7,683	8,775	9,976	11,158	11,865	11,715	11,658	7,137	4,566	5,695	6,712	7,769
<b>2005</b>												
Mean	8,285	9,482	10,710	12,018	13,504	14,668	12,782	7,578	5,691	6,752	7,668	8,662
Minimum	7,805	8,878	10,140	11,361	12,912	13,970	9,660	5,678	5,270	6,053	7,143	8,188
Maximum	8,839	10,089	11,324	12,872	13,949	15,158	15,137	9,593	6,035	7,110	8,151	9,169
<b>2006</b>												
Mean	9,811	10,956	12,473	14,207	14,968	14,703	9,481	4,465	3,891	4,084	4,497	4,815
Minimum	9,202	10,429	11,537	13,555	14,715	13,687	5,962	3,522	3,599	3,834	4,096	4,588
Maximum	10,385	11,500	13,475	14,683	15,094	14,936	13,535	5,968	4,366	4,229	4,802	5,081
<b>2007</b>												
Mean	5,381	6,102	6,791	--	--	11,312	7,073	3,603	3,830	4,311	4,912	5,559
Minimum	5,065	5,760	6,583	--	--	11,090	3,809	2,352	3,628	4,054	4,631	5,215
Maximum	5,730	6,524	7,063	--	--	11,445	11,213	4,721	4,019	4,609	5,192	5,895
<b>2008</b>												
Mean	5,019	5,570	6,636	7,923	9,034	9,502	7,200	4,212	4,308	4,699	5,474	6,130
Minimum	4,759	5,293	5,970	7,306	8,415	9,278	4,677	3,608	4,039	4,546	5,125	5,821
Maximum	5,275	5,914	7,272	8,361	9,220	9,572	9,563	4,999	4,536	4,875	5,797	6,375
<b>2009</b>												
Mean	6,682	7,375	8,360	10,159	11,859	12,619	11,155	7,021	6,273	7,029	8,508	9,733
Minimum	6,394	7,020	7,816	8,992	11,398	12,174	7,852	5,177	6,158	6,466	7,794	9,204
Maximum	7,000	7,765	8,943	11,313	12,095	12,950	13,512	8,562	6,446	7,743	9,171	10,213

**Table 6.1-34 Daily Contents in Acre-Feet of Water for Box Butte Reservoir (USGS 06455000)– 2003 to August 2013**

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Spt	Oct	Nov	Dec
	Acre-feet											
<b>2010</b>												
Mean	10,650	11,550	13,893	16,421	18,491	20,587	20,265	13,904	11,666	12,048	12,884	13,938
Minimum	10,240	11,096	12,363	15,293	17,669	19,479	16,939	11,303	11,560	11,782	12,403	13,396
Maximum	11,068	12,293	15,180	17,644	19,440	21,432	21,500	18,366	11,782	12,373	13,344	14,523
<b>2011</b>												
Mean	14,909	15,942	18,007	20,264	22,174	24,478	21,075	14,939	12,694	13,044	13,860	15,278
Minimum	14,512	15,407	16,569	19,427	21,147	23,930	17,546	12,695	12,164	12,644	13,470	15,090
Maximum	15,384	16,510	19,349	21,120	23,844	24,927	24,942	16,819	12,868	13,428	14,304	15,464
<b>2012</b>												
Mean	15,973	17,002	18,440	19,820	20,026	18,998	11,713	6,090	6,211	6,680	7,311	7,969
Minimum	15,498	16,486	17,620	19,284	19,739	17,424	7,445	5,275	6,057	6,394	7,007	7,650
Maximum	16,463	17,583	19,272	20,291	20,318	19,726	16,939	7,142	6,388	6,986	7,628	8,308
<b>2013</b>												
Mean	8,648	9,329	10,229	11,497	12,336	12,965	12,412	6,541	5,295	ND	ND	ND
Minimum	8,338	9,000	9,699	10,837	5,322	12,960	8,855	5,209	5,121	ND	ND	ND
Maximum	8,976	9,673	10,800	12,393	12,981	12,971	12,971	8,280	5,977	ND	ND	ND
<b>2003-2013 Summary</b>												
Mean <sup>a</sup>	9,184	10,122	11,439	13,464	14,764	14,984	12,160	5,271	16,184	6,196	7,691	8,573
Minimum	4,759	5,293	5,970	7,306	5,322	9,278	3,809	2,352	3,460	3,834	4,096	4,588
Maximum	16,463	17,583	19,349	21,120	23,844	21,927	24,942	18,366	12,868	13,428	14,304	15,464

Source: USBR 2013 b

<sup>a</sup>Average of average values presented in table.

ND = No data

USGS = U.S. Geological Survey

**Table 6.1-35 Range Values for Box Butte Reservoir Water Contents**

<b>Date</b>	<b>Average</b>	<b>Minimum</b>	<b>Maximum</b>
	<b>Acre-feet</b>		
2003 – 2013	6,196 – 14,984	2,352 – 9,278	12,868 – 24,942

USGS Station 06455000

USGS = U.S. Geological Survey

Source: USBR 2011b

**Table 6.1-36 Parameters Used to Estimate Wet-weight Vegetable Concentrations from Dry-weight Soil Concentrations**

Parameter	Parameter Description	Plant Type	Radionuclide	Value	Unit
ML <sub>v</sub>	Mass Loading factor	Root Vegetables	Parameter is not Radionuclide Specific	0.1	pCi/kg dry-weight plant per pCi/g dry-weight soil
		Leafy Vegetables			
		Fruits			
B <sub>jk</sub>	Concentration Factor for Root Uptake	Root Vegetables	Natural Uranium	0.014	pCi/kg dry-weight plant per pCi/g dry-weight soil
			Thorium-230	0.00012	
			Radium-226	0.0032	
			Lead-210	0.0032	
			Polonium-210	0.009	
		Leafy Vegetables	Natural Uranium	0.017	
			Thorium-230	0.0025	
			Radium-226	0.075	
			Lead-210	0.0058	
			Polonium-210	0.0025	
		Fruits	Natural Uranium	0.004	
			Thorium-230	0.000085	
			Radium-226	0.0061	
			Lead-210	0.009	
			Polonium-210	0.0004	
W <sub>v</sub>	Dry weight to Wet Weight Conversion Factor	Root Vegetables	Not Radionuclide Specific	0.2	Unitless
		Leafy Vegetables		0.25	
		Fruits		0.18	

ML<sub>v</sub> = plant soil mass-loading factor for re-suspension of soil to plant v (pCi/kg dry-weight plant per pCi/g dry-weight soil)

B<sub>jk</sub> = concentration factor for uptake of radionuclide j from the soil in plant v (pCi/kg dry-weight plant per pCi/g dry-weight soil)

W<sub>v</sub> = dry to wet-weight conversion factor (unitless)

**Table 6.1-37 Total Radionuclides and Metals in Tissue of Northern Pike Collected from Inlet of Box Butte Reservoir**

<b>Radionuclide - Total</b>	<b>Result <sup>a</sup></b>	<b>Units</b>	<b>Qualifiers</b>	<b>RL</b>	<b>Result</b>	<b>Units</b>	<b>Qualifiers</b>	<b>RL</b>
	<b>August 22, 2011</b>				<b>May 25, 2012</b>			
Lead 210	<1E-06	uCi/kg	U	1E-06	7.9E-07	uCi/kg	U	7.9E-07
Lead 210 Precision (+)	7.0E-07	uCi/kg	--	--	8.1E-07	uCi/kg	--	--
Lead 210 MDC	1.0E-06	uCi/kg	--	--	1.0E-06	uCi/kg	--	--
Polonium 210	5.0E-07	uCi/kg	--	5.0E-07	2.8E-07	uCi/kg	U	2.8E-07
Polonium 210 Precision (+)	4.E-07	uCi/kg	--	--	1.0E-06	uCi/kg	--	--
Polonium 210 MDC	5.0E-07	uCi/kg	--	--	2.1E-06	uCi/kg	--	--
Radium 226	<2E-07	uCi/kg	U	2.0E-07	2.2E-07	uCi/kg	--	2.2E-07
Radium 226 Precision (+)	1.0E-07	uCi/kg	--	--	1.5E-07	uCi/kg	--	--
Radium 226 MDC	2.0E-07	uCi/kg	--	--	1.9E-07	uCi/kg	--	--
Thorium 230	1.0E-05	uCi/kg	--	8.0E-06	6.7E-08	uCi/kg	U	6.7E-08
Thorium 230 Precision (+)	6.0E-06	uCi/kg	--	--	5.8E-06	uCi/kg	--	--
Thorium 230 MDC	8.0E-06	uCi/kg	--	--	1.4E-05	uCi/kg	--	--
<b>Metals - Total</b>							--	--
Uranium, Total	<0.0003	mg/kg	--	0.0003	0.00099	mg/kg	D	0.00040
Uranium, Activity	<2E-07	uCi/kg	--	2.0E-07	6.7E-07	uCi/kg	D	2.7E-07

<sup>a</sup> Results reported on a wet weight basis (as received) for composite of two or more samples (digestion, radiochemistry)..

uCi/kg = microcuries per kilogram.

U = Not detected at the reporting limit.

D = RL increased due to sample matrix,

RL = Analyte reporting limit.

MDC = Minimum detectable concentration.

mg/kg – milligram per kilogram

**Table 6.1-38 Radionuclide and Metal Analyses for Niobrara River Sample Locations N-1 and N-2 Sediment Samples**

Radionuclide	Units	Result	Reporting Limit (RL)
		3/20/2013 (Collection Date)	
<b>N - 1</b>			
Lead-210	pCi/g - dry	0.3	0.2
Lead 210 precision (+)	pCi/g - dry	0.1	--
Lead 210 MDC	pCi/g - dry	0.2	--
Radium 226	pCi/g - dry	0.4	0.04
Radium 226 precision (+)	pCi/g - dry	0.06	--
Radium 226 MDC	pCi/g - dry	0.04	--
Thorium 230	pCi/g - dry	0.2	0.2
Thorium 230 precision (+)	pCi/g - dry	0.1	--
Thorium 230 MDC	pCi/g - dry	0.2	--
<b>METALS</b>			
Uranium	mg/kg - dry	0.4	0.3
Uranium Activity	pCi/g - dry	0.3	0.2
<b>N - 2</b>			
Lead-210	pCi/g - dry	0.3	0.2
Lead 210 precision (+)	pCi/g - dry	0.1	--
Lead 210 MDC	pCi/g - dry	0.2	--
Radium 226	pCi/g - dry	0.4	0.04
Radium 226 precision (+)	pCi/g - dry	0.06	--
Radium 226 MDC	pCi/g - dry	0.04	--
Thorium 230	pCi/g - dry	0.2	0.2
Thorium 230 precision (+)	pCi/g - dry	0.1	--
Thorium 230 MDC	pCi/g - dry	0.2	--
<b>METALS</b>			
Uranium	mg/kg - dry	0.4	0.3
Uranium Activity	pCi/g - dry	0.3	0.2

MED – Marsland Ephemeral Drainage  
 RL - Analyte reporting limit  
 MDC – Minimum detectable concentration  
 mg/kg-dry – milligram/kilogram-dry weight  
 pCi/g-dry – picocuries per gram -dry weight

**Table 6.1-39 Radionuclide and Metal Analyses for Marsland Ephemeral Drainage (MED) Sample Locations**

Radionuclide	Units	Reporting Limit (RL)		Reporting Limit (RL)	
		Result	12/02/2011 (Collection Date)	Result	3/20/2013 (Collection Date)
<b>MED - 1</b>					
Lead-210	pCi/g-dry	0.2	0.2	<0.2	0.2
Lead 210 precision (+)	pCi/g-dry	0.1	--	0.1 U	
Lead 210 MDC	pCi/g-dry	0.2	--	0.2	
Radium 226	pCi/g-dry	0.3	0.02	0.2	0.04
Radium 226 precision (+)	pCi/g-dry	0.04	--	0.05	
Radium 226 MDC	pCi/g-dry	0.02	--	0.04	
Thorium 230	pCi/g-dry	0.4	0.1	<0.1 U	0.1
Thorium 230 precision (+)	pCi/g-dry	0.2	--	0.1	
Thorium 230 MDC	pCi/g-dry	0.1	--	0.1	
<b>METALS</b>					
Uranium	mg/kg-dry	0.5	0.3	<0.3	0.3
Uranium Activity	pCi/g-dry	0.3	0.2	<0.2	0.2
<b>MED - 2</b>					
Lead-210	pCi/g-dry	0.7	0.2	0.4	0.2
Lead 210 precision (+)	pCi/g-dry	0.1		0.1	
Lead 210 MDC	pCi/g-dry	0.2		0.2	
Radium 226	pCi/g-dry	0.4	0.02	0.4	0.04
Radium 226 precision (+)	pCi/g-dry	0.04		0.06	
Radium 226 MDC	pCi/g-dry	0.02 U		0.04	
Thorium 230	pCi/g-dry	<0.2	0.2	0.2	0.2
Thorium 230 precision (+)	pCi/g-dry	0.1		0.1	
Thorium 230 MDC	pCi/g-dry	0.2		0.2	
<b>METALS</b>					
Uranium	mg/kg-dry	0.5	0.3	0.4	0.3
Uranium Activity	pCi/g-dry	0.3	0.2	0.3	0.2
<b>MED - 3</b>					
Lead-210	pCi/g-dry	0.6	0.2	0.3	0.2
Lead 210 precision (+)	pCi/g-dry	0.1		0.1	
Lead 210 MDC	pCi/g-dry	0.2		0.2	
Radium 226	pCi/g-dry	0.4	0.02	0.3	0.04

**Table 6.1-39 Radionuclide and Metal Analyses for Marsland Ephemeral Drainage (MED) Sample Locations**

Radionuclide	Units	Result	Reporting Limit (RL)	Result	Reporting Limit (RL)
		12/02/2011 (Collection Date)		3/20/2013 (Collection Date)	
Radium 226 precision (+)	pCi/g-dry	0.04		0.06	
Radium 226 MDC	pCi/g-dry	0.02		0.04	
Thorium 230	pCi/g-dry	0.2	0.2	0.2	0.2
Thorium 230 precision (+)	pCi/g-dry	0.1		0.1	
Thorium 230 MDC	pCi/g-dry	0.2		0.2	
<b>METALS</b>					
Uranium	mg/kg-dry	0.5	0.3	<0.3	0.3
Uranium Activity	pCi/g-dry	0.3	0.2	<0.2	0.2
<b>MED - 4</b>					
Lead-210	pCi/g-dry	1.3	0.2	0.9	0.2
Lead 210 precision (+)	pCi/g-dry	0.1		0.1	
Lead 210 MDC	pCi/g-dry	0.2		0.2	
Radium 226	pCi/g-dry	0.8	0.02	0.7	0.04
Radium 226 precision (+)	pCi/g-dry	0.06		0.08	
Radium 226 MDC	pCi/g-dry	0.02		0.04	
Thorium 230	pCi/g-dry	0.5	0.2	0.3	0.2
Thorium 230 precision (+)	pCi/g-dry	0.2		0.2	
Thorium 230 MDC	pCi/g-dry	0.2		0.2	
<b>METALS</b>					
Uranium	mg/kg-dry	1.0	0.3	0.7	0.3
Uranium Activity	pCi/g-dry	0.7	0.2	0.5	0.2
<b>MED - 5</b>					
Lead-210	pCi/g-dry	1.5	0.2	0.9	0.2
Lead 210 precision (+)	pCi/g-dry	0.1		0.1	
Lead 210 MDC	pCi/g-dry	0.2		0.2	
Radium 226	pCi/g-dry	0.8	0.02	0.5	0.04
Radium 226 precision (+)	pCi/g-dry	0.06		0.07	
Radium 226 MDC	pCi/g-dry	0.02		0.04	
Thorium 230	pCi/g-dry	0.3	0.2	0.2	0.2
Thorium 230 precision (+)	pCi/g-dry	0.2		0.1	
Thorium 230 MDC	pCi/g-dry	0.2		0.2	

**Table 6.1-39 Radionuclide and Metal Analyses for Marsland Ephemeral Drainage (MED) Sample Locations**

Radionuclide	Units	Reporting Limit (RL)		Reporting Limit (RL)	
		12/02/2011 (Collection Date)		3/20/2013 (Collection Date)	
<b>METALS</b>					
Uranium	mg/kg-dry	0.9	0.3	0.5	0.3
Uranium Activity	pCi/g-dry	0.6	0.2	0.3	0.2
<b>MED - 6</b>					
Lead-210	pCi/g-dry	1.3	0.2	0.4	0.2
Lead 210 precision (+)	pCi/g-dry	0.1		0.1	
Lead 210 MDC	pCi/g-dry	0.2		0.2	
Radium 226	pCi/g-dry	0.6	0.02	0.3	0.04
Radium 226 precision (+)	pCi/g-dry	0.05		0.06	
Radium 226 MDC	pCi/g-dry	0.02		0.04	
Thorium 230	pCi/g-dry	0.2	0.2	<0.2	0.2
Thorium 230 precision (+)	pCi/g-dry	0.1		0.07	
Thorium 230 MDC	pCi/g-dry	0.2		0.2	
<b>METALS</b>					
Uranium	mg/kg-dry	0.6	0.3	<0.3	0.3
Uranium Activity	pCi/g-dry	0.4	0.2	<0.2	0.2

MED - Marsland Ephemeral Drainage

RL - Analyte reporting limit

U - Not detected at the reporting limit

MDC - Minimum detectable concentration

mg/kg-dry - milligram/kilogram-dry weight

pCi/g-dry - picocuries per gram -dry weight

**Table 6.1-40 Marsland Expansion Area Gamma Exposure Results**

Location	Exposure of Dosimeter (mRems ambient dose equivalent)		Net Cumulative Totals			Number of Dosimeters Reported
	Gross	Net	Calendar Quarter	Year to Date	Permanent	
	<b>10/01/2011 – 12/31/2011</b>					
Transient Control	13.9	-1.0	--	--	--	--
Deploy Control	15.0	0.0	--	--	--	--
MA-1	21.7	6.7	6.7	6.7	6.7	1
MA-2	21.6	6.7	6.7	6.7	6.7	1
MA-3	21.4	6.5	6.5	6.5	6.5	1
MA-4	19.9	5.0	5.0	5.0	5.0	1
MA-5	20.9	5.9	5.9	5.9	5.9	1
<b>1/01/2012 – 3/31/2012</b>						
Transient Control	25.7	-0.6	Q1	2012	--	--
Deploy Control	26.3	0	--	--	--	--
MA-1	32.8	6.5	6.5	6.5	13.2	1
MA-2	33.8	7.5	7.5	7.5	14.2	1
MA-3	31.4	5.1	5.1	5.1	11.6	1
MA-4	40.8	14.5	14.5	14.5	19.5	1
MA-5	32.5	6.2	6.2	6.2	12.1	1
<b>4/01/2012 – 6/30/2012</b>						
Transient Control	30.7	--	Q2	2012	--	--
Deploy Control	30.3	--	--	--	--	--
MA-1	40.0	9.6	9.6	16.1	22.8	1
MA-2	Lost Badge	--	--	7.5	14.2	1
MA-3	34.9	4.6	4.6	9.7	16.2	1
MA-4	40.9	10.5	10.5	25.0	30.0	1
MA-5	38.1	7.7	7.7	13.9	19.8	1
<b>7/01/2012 – 9/30/2012</b>						
Transient Control	--	--	Q3	2012	--	--
Deploy Control	28.8	--	--	--	--	--
MA-1	38.6	9.9	9.9	26.0	32.7	1
MA-2	39.2	10.4	10.4	17.9	24.6	1
MA-3	37.5	8.7	8.7	18.3	24.8	1
MA-4	39.2	10.4	10.4	35.5	40.5	1
MA-5	33.3	4.5	4.5	18.4	24.3	1
<b>10/01/2012 – 12/31/2012</b>						
Transient Control	--	--	Q4	2012	--	--
Deploy Control	27.3	--	--	--	--	--
MA-1	39.2	11.9	11.9	37.9	44.6	1
MA-2	36.8	9.5	9.5	27.4	34.1	1

**Table 6.1-40 Marsland Expansion Area Gamma Exposure Results**

Location	Exposure of Dosimeter (mRems ambient dose equivalent)		Net Cumulative Totals			Number of Dosimeters Reported
	Gross	Net	Calendar Quarter	Year to Date	Permanent	
	MA-3	34.5	7.2	7.2	25.6	
MA-4	37.3	10.0	10.0	45.5	50.5	1
MA-5	34.0	6.8	6.8	25.2	31.1	1

mRems – millirems

MA-1 air sampling locations

Minimum Detectable Dose = 0.1 mRems ambient dose equivalent

**Table 6.1-41 Marsland Expansion Area Preoperational/Preconstruction Monitoring Program**

Type of Sample	Sample Collection				Sample Analysis	
	Number	Location	Method	Frequency	Frequency	Type of Analysis
Air Particulates	3	On MEA northern boundary	Continuous	Weekly filter change	Quarterly composites of weekly samples	Natural uranium, Ra-226, Th-230, and Pb-210
	1	Nearest Resident	Continuous	Weekly filter change	Quarterly composites of weekly samples	Natural uranium, Ra-226, Th-230, and Pb-210
	1	Control background location east of MEA License Boundary	Continuous	Weekly filter change	Quarterly composites of weekly samples	Natural uranium, Ra-226, Th-230, and Pb-210
Radon Gas	3	On MEA northern boundary	Continuous	Quarterly	Quarterly	Rn-222
	1	Nearest Resident	Continuous	Quarterly	Quarterly	Rn-222
	1	Control background location east of MEA License Boundary	Continuous	Quarterly	Quarterly	Rn-222
Groundwater	1	Wells within MEA license boundary and 2 km radius: <ul style="list-style-type: none"> <li>· Private Wells</li> <li>· <u>Arikaree Wells</u></li> <li>· MEA Brule Wells</li> <li>· MEA Ore Zone Wells</li> </ul> (See Figures 2.7-6 and 2.9-3)	Grab	Quarterly	Quarterly	Suspended & Dissolved Natural Uranium, Ra-226, Th-230, Th-230 Pb-210 & Po-210
Surface Water	2 <sup>a</sup>	Niobrara River (N-1 and N-2) Ephemeral Drainages	Grab	<u>Monthly</u>	<u>Monthly</u>	Suspended & Dissolved Natural Uranium, Ra-226, Th-230
			Grab		Semiannually	Suspended & Dissolved Pb-210 & Po-210
Vegetation	3	Grazing areas near the site in different sectors that will have the highest predicted air particulate concentrations during milling operations	Grab	3 times during grazing season	3 Times	Natural Uranium, Ra-226, Th-230, Pb-210, & Pb-210
Food	3	Crops	Grab	Time of Harvest or Slaughter	1	Natural Uranium, Ra-226, Th-230, Pb-210, & Po-210
	3	Livestock			1	
	3	Private Garden Vegetables ( <u>alternate of garden soil sampling to be used</u> )			1	

**Table 6.1-41 Marsland Expansion Area Preoperational/Preconstruction Monitoring Program**

Type of Sample	Sample Collection				Sample Analysis	
	Number	Location	Method	Frequency	Frequency	Type of Analysis
Fish	Each Body of Water	Collection of fish from Niobrara River ( <u>headwaters of Box Butte Reservoir</u> )	Grab	Semiannually	2	Natural Uranium, Ra-226, Th-230, Pb-210, & Po-210
Surface Soil <sup>b</sup>	Up to 40	300 meter intervals to a distance of 1500 meters in each of 8 directions from center-point of satellite facility; additional transects through wellfields	Grab	Once prior to construction. Repeat for location disturbed by excavation, leveling or contouring	1	All samples for Ra-226, 10% of samples natural uranium, Th-230 & Pb-210
	5	Same location used for collection of air particulates	Grab	Once prior to construction	1	Natural Uranium, Ra-226, Th-230 & Pb-210
Subsurface Soil <sup>c</sup>	5	At center-point of satellite facility & at distances of 750 meters in each of 4 directions	Grab	Once prior to construction. Repeat for location disturbed by construction	1	Ra-226 (all samples) Natural Uranium, Th-203 & Pb210 (one set of samples)
Sediment <sup>d</sup>	<u>1</u> from each stream ( <u>2</u> ) & <u>ephemeral drainage</u> ( <u>6</u> ) <u>sampling points</u>	Up and down gradient samples from ephemeral drainages ( <u>total of 6 samples</u> ) & Niobrara River (N-1 & N-2)	Grab (Composite samples)	Once following spring runoff & late summer following period of extended low flow	2	Natural Uranium, Ra-226, Th-230 & Pb-210
Direct Radiation (Survey)	Up to 80	150 meter intervals to a distance of 1500 meters in each of 8 directions from center-point of satellite facility	Grab	Once prior to construction. Repeat for areas disturbed by site preparation or construction	1	Gamma exposure using sodium iodide scintillometer
Direct Radiation (Continuous)	5	Same location used for collection of air particulates	Grab	Once prior to construction	1	Gamma exposure using a continuous integrating device

<sup>a</sup>Two samples from the Niobrara River per sampling event and one (1) from each sampling point (total of 6) located on ephemeral streams (Figure 3.4-4) . MEA = Marsland Expansion Area

<sup>b</sup>Surface soil samples collected to a depth of 5 cm using a consistent technique.

<sup>c</sup>Subsurface soil samples collected to a depth of 1 meter; samples divided into 3 equal sections for analysis.

<sup>d</sup>Sediment sample locations shown in Figure 3.4-4

**Table 6.1-42 Marsland Expansion Area Operational Effluent and Environmental Monitoring Plan**

Type of Sample	Sample Collection			Sample Analysis		
	Number	Location	Method	Frequency	Frequency	Type of Analysis
<b>AIR</b>						
<b>Particulates</b>	3	At or near site boundaries and in sector(s) having the highest predicted concentrations of airborne particulates <sup>a</sup>	Continuous	Weekly filter change or more frequently as required by dust loading	Quarterly composites of weekly samples	Nat-Uranium, Ra-226, Th-230, Pb-210
	1	At or close to nearest residence(s) <sup>a</sup>	Continuous	Weekly filter change or more frequently as required by dust loading	Quarterly composites of weekly samples	Nat-Uranium, Ra-226, Th-230, Pb-210
	1	Control or background location <sup>a</sup>	Continuous	Weekly filter change or more frequently as required by dust loading	Quarterly composites of weekly samples	Nat-Uranium, Ra-226, Th-230, Pb-210
<b>Radon Gas</b>	5	Same locations as air particulates <sup>a</sup>	Continuous using RadTrak type DRNF	Continuous	Continuous	Rn-222
<b>WATER</b>						
<b>Groundwater</b>	One each	Wells (within license boundary and 1 km radius <sup>c</sup> <ul style="list-style-type: none"> <li>· Private wells</li> <li>· MEA Brule wells</li> <li>· MEA Ore Zone wells</li> </ul>	Grab	Quarterly	Quarterly	Dissolved and suspended Nat-Uranium, Ra-226, Th-230, Pb-210, Po-210
<b>Surface Water</b>	Two from <u>each of 3</u> designated ephemeral drainage <u>sampling points (total of 6 samples)</u>	Surface waters passing through license area (subject to available flow) <sup>b,d</sup>	Grab	Quarterly	Quarterly	Suspended and dissolved Nat-Uranium, Ra-226, Th-230, Pb-210, <u>Po-210</u>

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**Table 6.1-42 Marsland Expansion Area Operational Effluent and Environmental Monitoring Plan**

Type of Sample	Sample Collection			Sample Analysis		
	Number	Location	Method	Frequency	Frequency	Type of Analysis
<b>VEGETATION</b>	None	N/A	N/A	N/A	N/A	N/A
<b>FOOD</b>	None	N/A	N/A	N/A	N/A	N/A
<b>FISH</b>	None	N/A	N/A	N/A	N/A	N/A
<b>SOIL AND SEDIMENT</b>						
<b>Soil</b>	5 or more	At same locations used for collection of air particulate samples <sup>a</sup>	Grab (0 to 5 cm)	Annually	Annually	Nat-Uranium, Ra-226, Pb-210
<b>Sediment</b>	Two from each ephemeral drainage sampling points (6)	Same as surface water sample locations <sup>b,d</sup>	Grab (minimum of 3 samples for each sample composite)	Annually	Annually	Nat-Uranium, Ra-226, Th-230, Pb-210
<b>DIRECT RADIATION</b>						
<b>Continuous</b>	One each	Air monitoring stations <sup>a</sup>	Dosimeter	Continuous	Quarterly	Gamma exposure rate, using Sodium Iodide scintillometer

<sup>a</sup> Figure 6.1-2

<sup>b</sup> Figure 3.4-4

<sup>c</sup> Figures 3.1-3 and 3.4-7

<sup>d</sup> upstream and downstream

N/A = not applicable

MEA = Marsland Expansion Area

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