Section 4

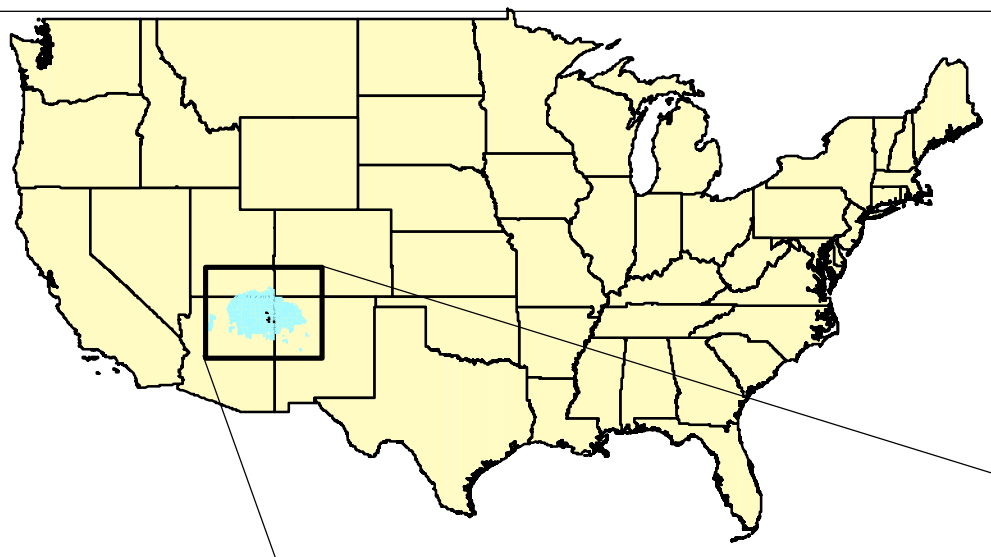
CENTRAL AREA

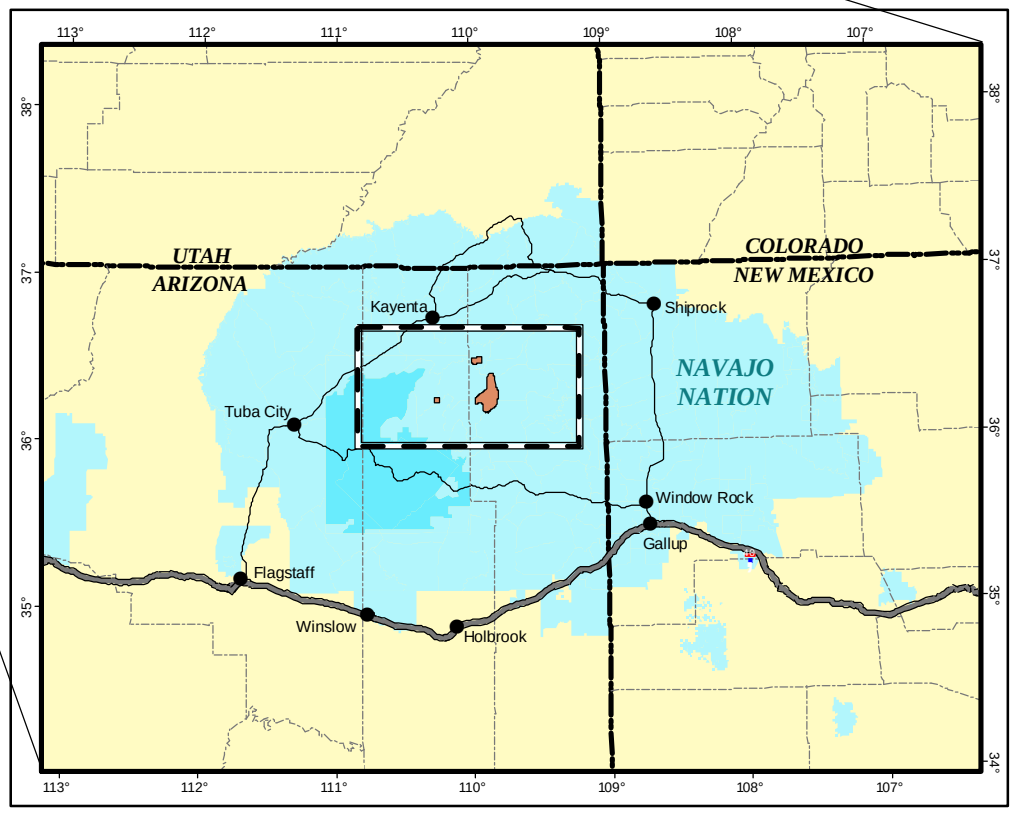
United States Environmental Protection Agency

ABANDONED URANIUM MINES PROJECT

Central Area

OVERVIEW MAP

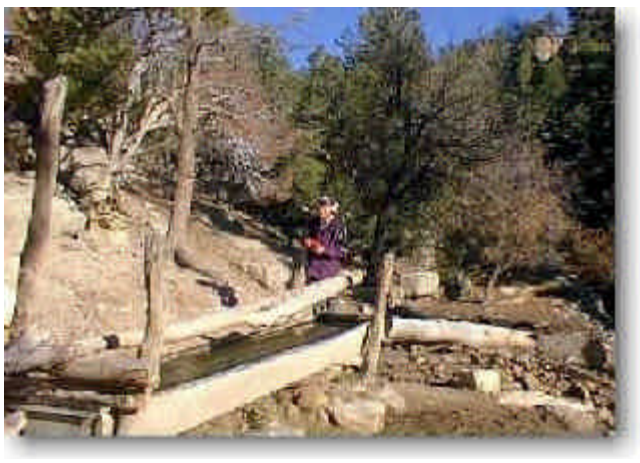




Burro Spring

Cliff Spring

Tank 8T-518

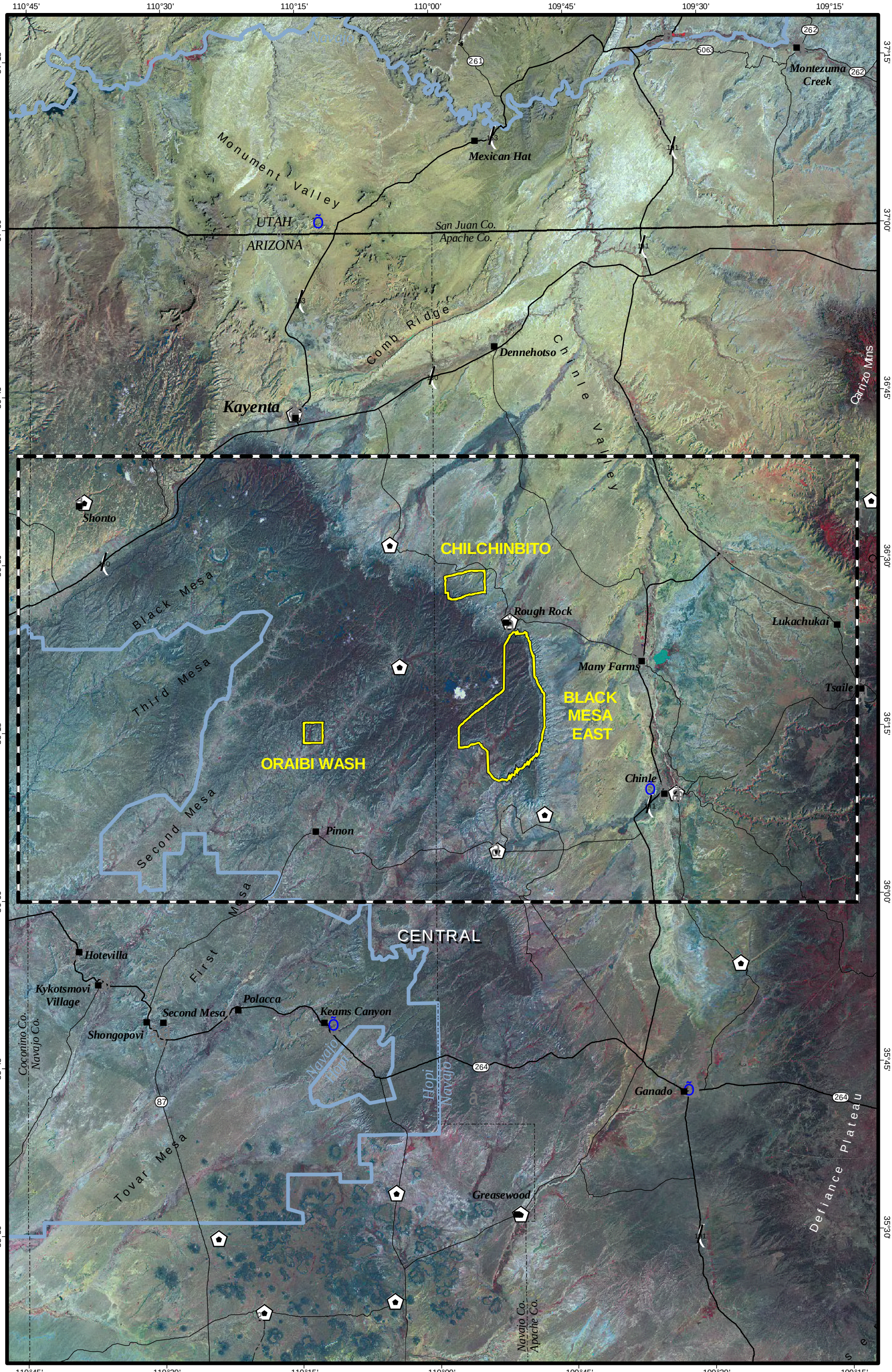


Waterfall Spring

The Central area is located in northeastern Arizona, and is centered in the Navajo Nation. Some of the physiography of the area is shown above in photos taken by Glynn Alsup (USACE).

The overview map shown on the facing page provides the map extent boundary for the Central area maps presented in Section 4. Three aerial radiation surveys were flown in the Central area: Chilchinbito, Oraibi Wash and Black Mesa East.

Water samples from 31 sites were collected in the Central area.



MAP FEATURES

- Map Extent Boundary
- Aerial Survey Boundary

4

OVERVIEW MAP

10 0 10 Miles

10 0 10 Kilometers

Scale 1:600,000

U.S. Environmental Protection Agency

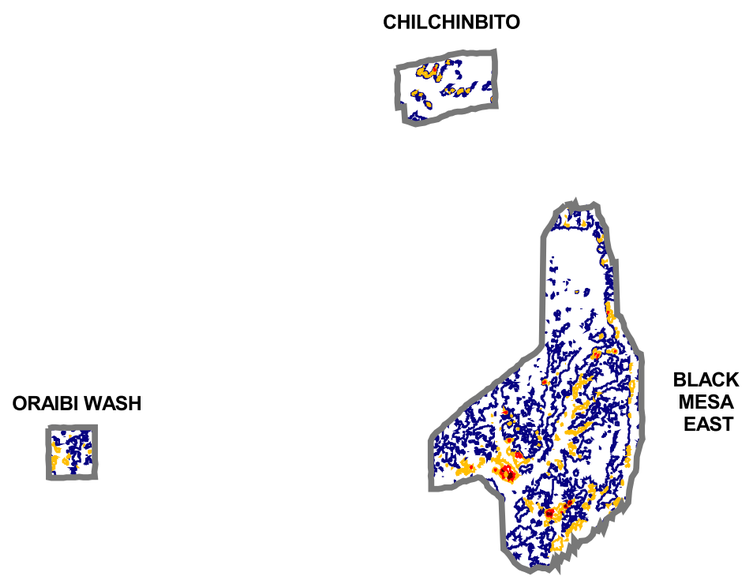
ABANDONED URANIUM MINES PROJECT

Central Area

ABANDONED URANIUM
MINES PROJECT

CENTRAL AREA

AERIAL RADIATION CONTOURS - GROSS COUNT



Aerial Radiation Contours

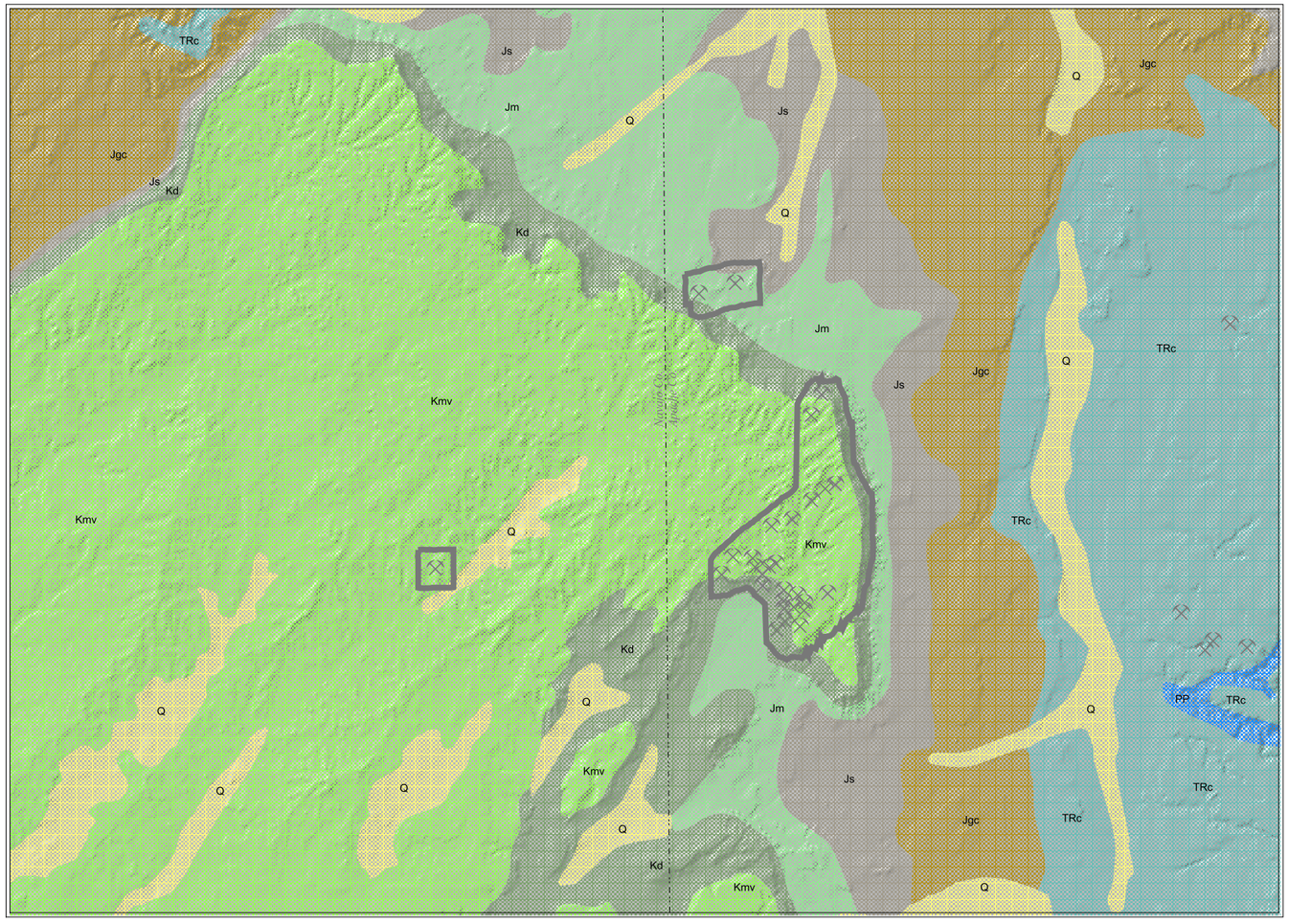
Derived terrestrial exposure rate at 1 meter above ground level. Does not include cosmic contribution (units: excess micro-R/hour)

- 9
- 12
- 16
- 24

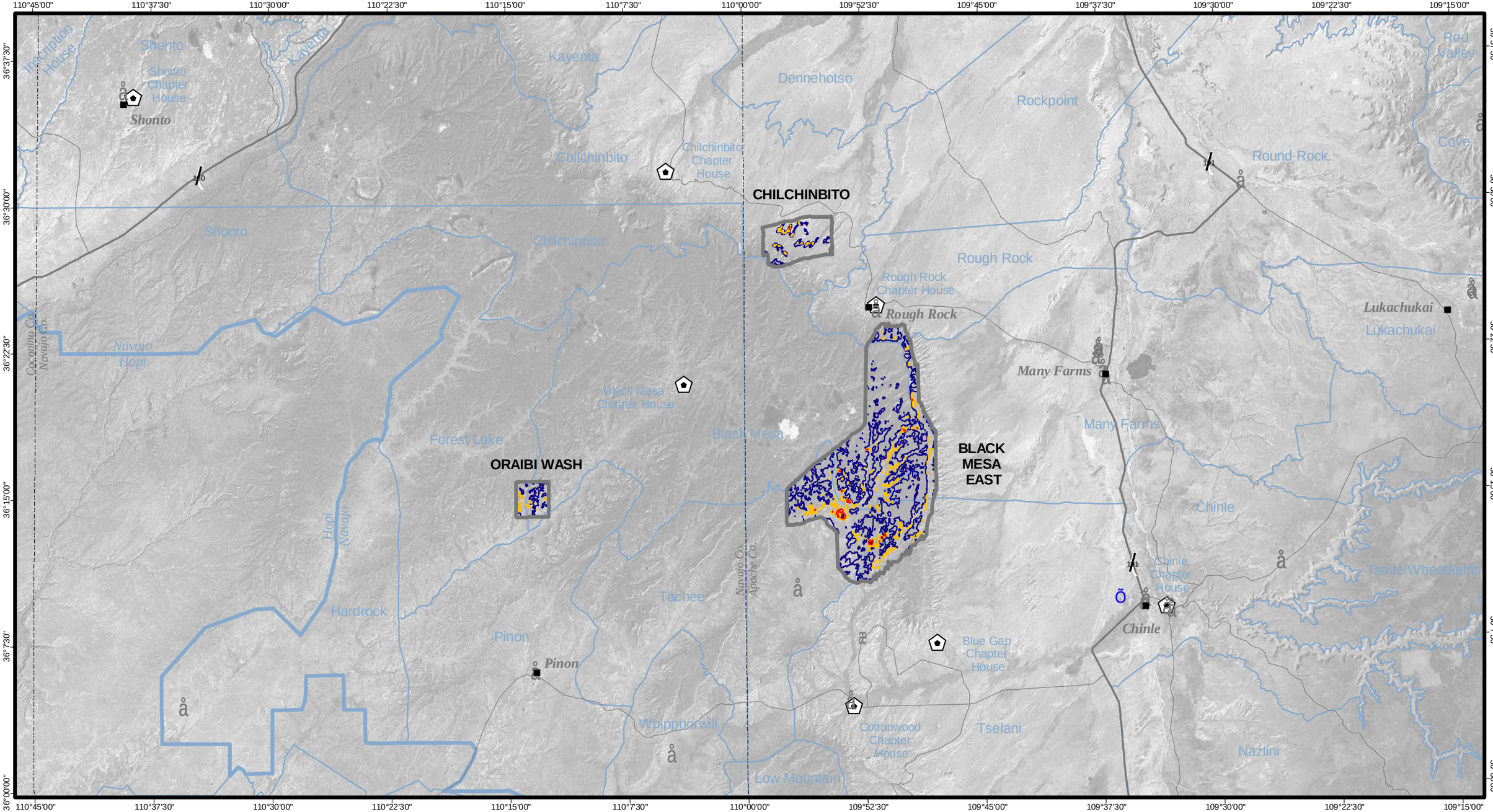
Aerial radiation contour values were compiled by Thane Hendricks, Department of Energy - Remote Sensing Laboratory. Units are in micro-Roentgens per hour. Derived from the total observed gamma spectrum. At the survey altitude of 150 feet, the footprint of the detection system is a circle approximately 300 feet in diameter. The data shown on this map are averages over this footprint at ground level.

Geological Units (Age and Unit Description)

- Q Quaternary Alluvium and Colluvium
- Kmv Cretaceous Mesa Verde Group
- Kd Cretaceous Dakota Sandstone
- Jm Jurassic Morrison Formation
- Js Jurassic San Rafael Group
- Jgc Jurassic Glen Canyon Group
- TRc Triassic Chinle Formation
- PP Permian to Pennsylvanian Sedimentary Rocks



Sources: Aerial survey boundaries are from the Department of Energy, Remote Sensing Laboratory, Las Vegas, Nevada. Geological information from the Geologic Map of Arizona, GIS database (Richard and Kneale, 1997). Uranium mine locations shown above are approximate and were compiled from various sources by Thane Hendricks, Department of Energy, Remote Sensing Laboratory, Las Vegas, Nevada.



See facing page for legend

4

AERIAL RADIATION CONTOURS GROSS COUNT

5 0 5 Miles

5 0 5 10 Kilometers

1:350,000

U.S. Environmental Protection Agency

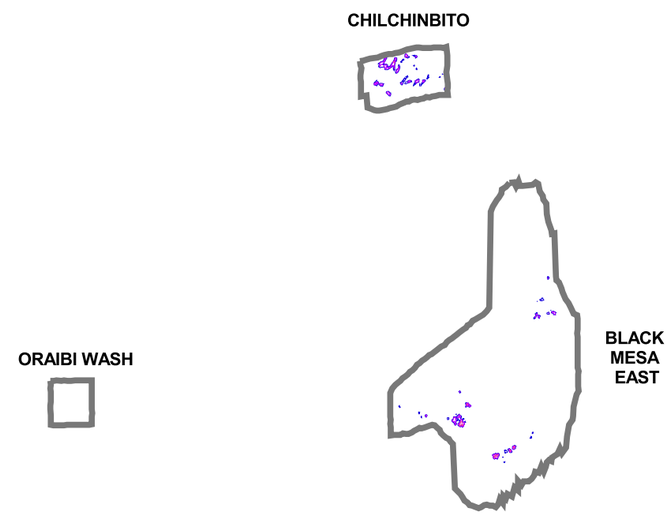
ABANDONED URANIUM MINES PROJECT

Central Area

ABANDONED URANIUM
MINES PROJECT

CENTRAL AREA

AERIAL RADIATION CONTOURS - BISMUTH 214



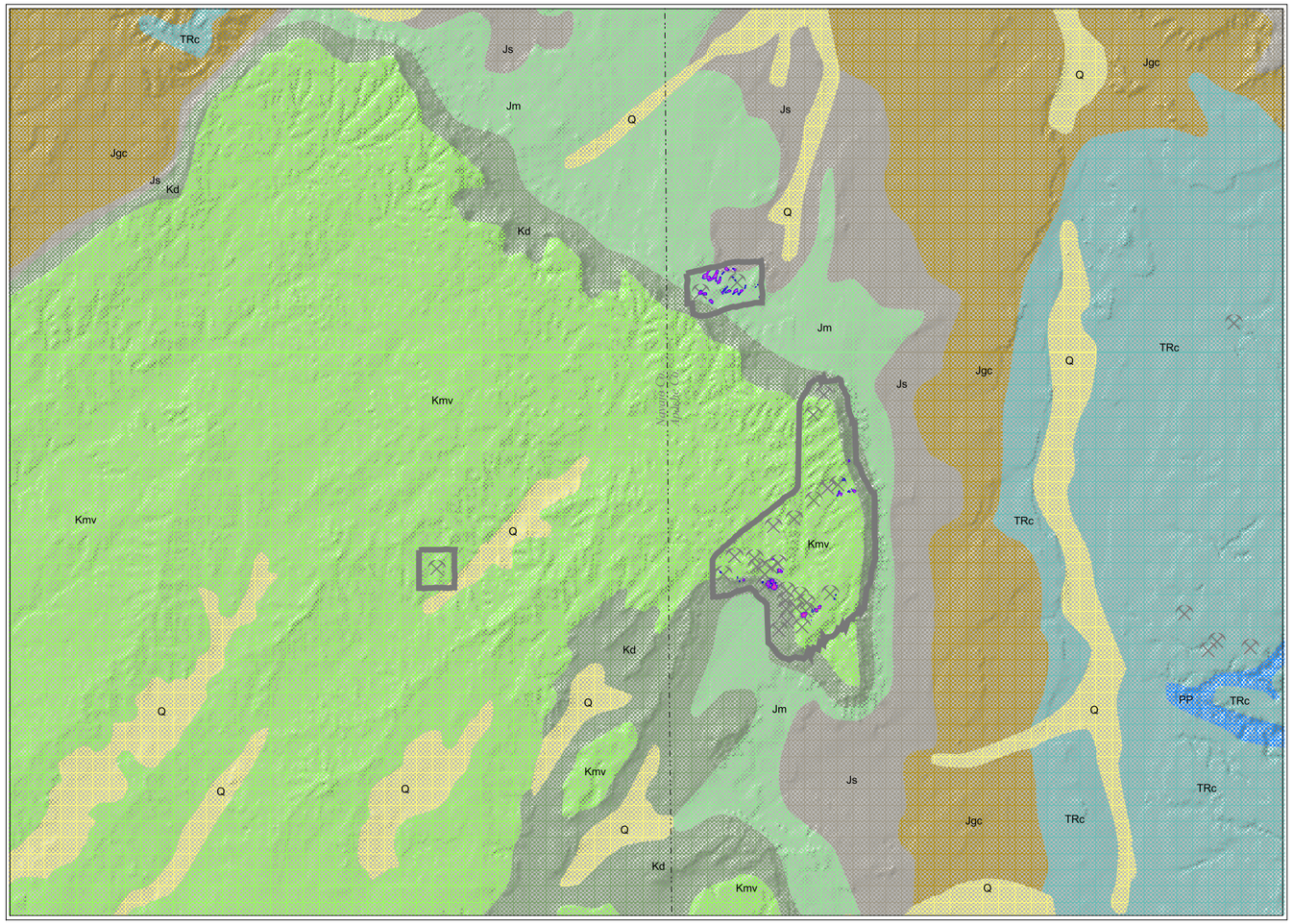
Aerial Radiation Contours	Derived contour-level Bismuth 214 photo-peak (excess counts per second)	Estimated exposure rate from excess Bismuth 214 (excess micro-R/hour)
	80	3.5
	170	7.4
	250	10.9
	800	34.9
	1200	52.4

Units are in micro-Roentgens per hour. The Bismuth 214 photo peak is at 1760 KeV. At the survey altitude of 150 feet above ground level, the footprint of the detection system is a circle approximately 300 feet in diameter. The data shown are averages over this footprint at ground level.

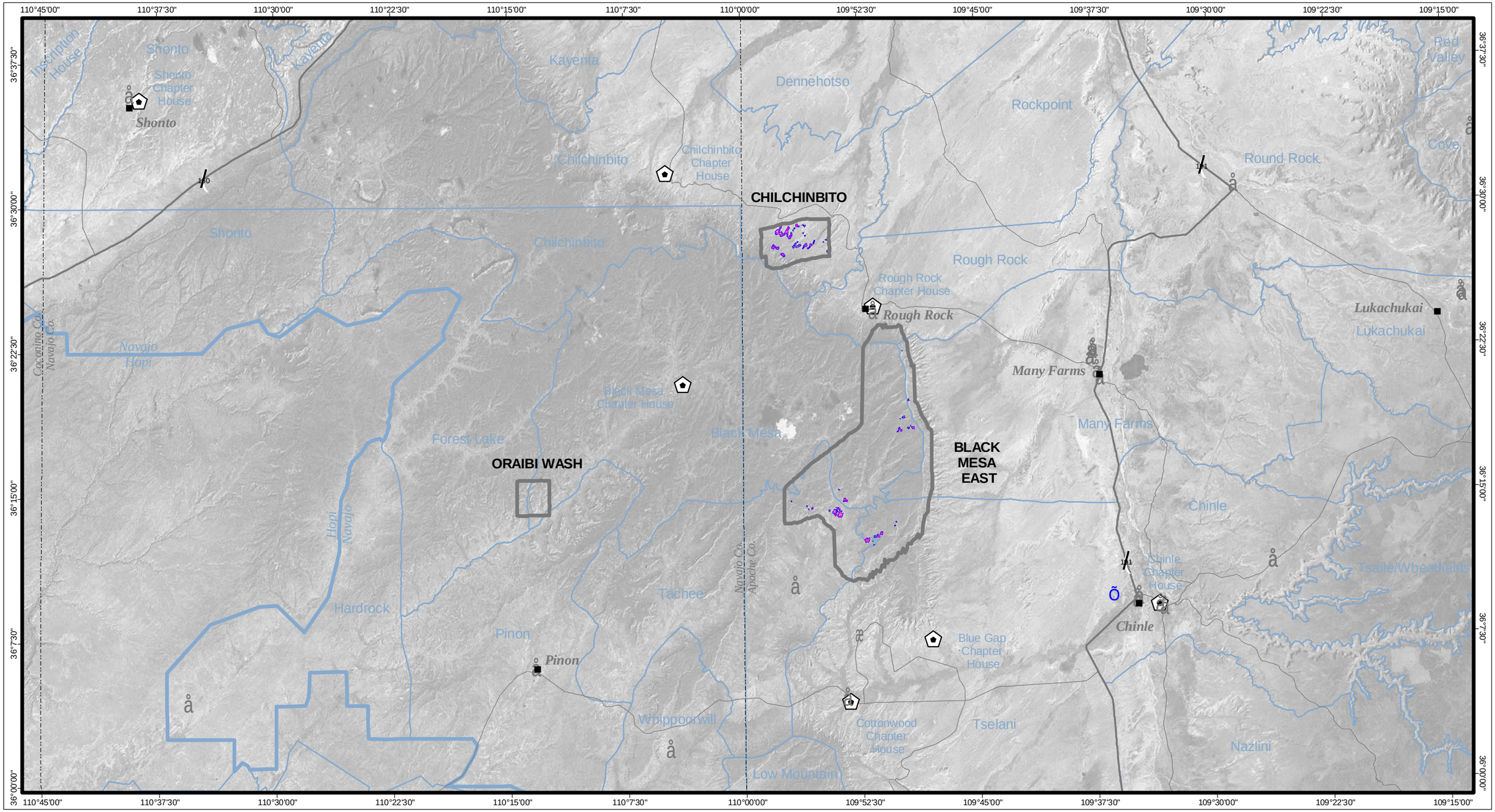
Derived and estimated values were compiled by Thane Hendricks, Department of Energy, Remote Sensing Laboratory, Las Vegas.

Geologic Map Units (formation and age description)

- Q Quaternary Alluvium and Colluvium
- Kmv Cretaceous Mesa Verde Group
- Kd Cretaceous Dakota Sandstone
- Jm Jurassic Morrison Formation
- Js Jurassic San Rafael Group
- Jgc Jurassic Glen Canyon Group
- TRc Triassic Chinle Formation
- PP Permian to Pennsylvanian Sedimentary Rocks



Sources: Aerial survey boundaries are from the Department of Energy, Remote Sensing Laboratory, Las Vegas, Nevada. Geological information from the Geologic map of Arizona, GIS database, edited by S.M. Richard, 1997. Uranium mine locations shown above are approximate and were compiled from various sources by Thane Hendricks, Department of Energy, Remote Sensing Laboratory, Las Vegas, Nevada.



MAP FEATURES

Aerial Survey Boundary

4

AERIAL RADIATION CONTOURS
BISMUTH 214

5 0 5 Miles

5 0 5 10 Kilometers

1:350,000

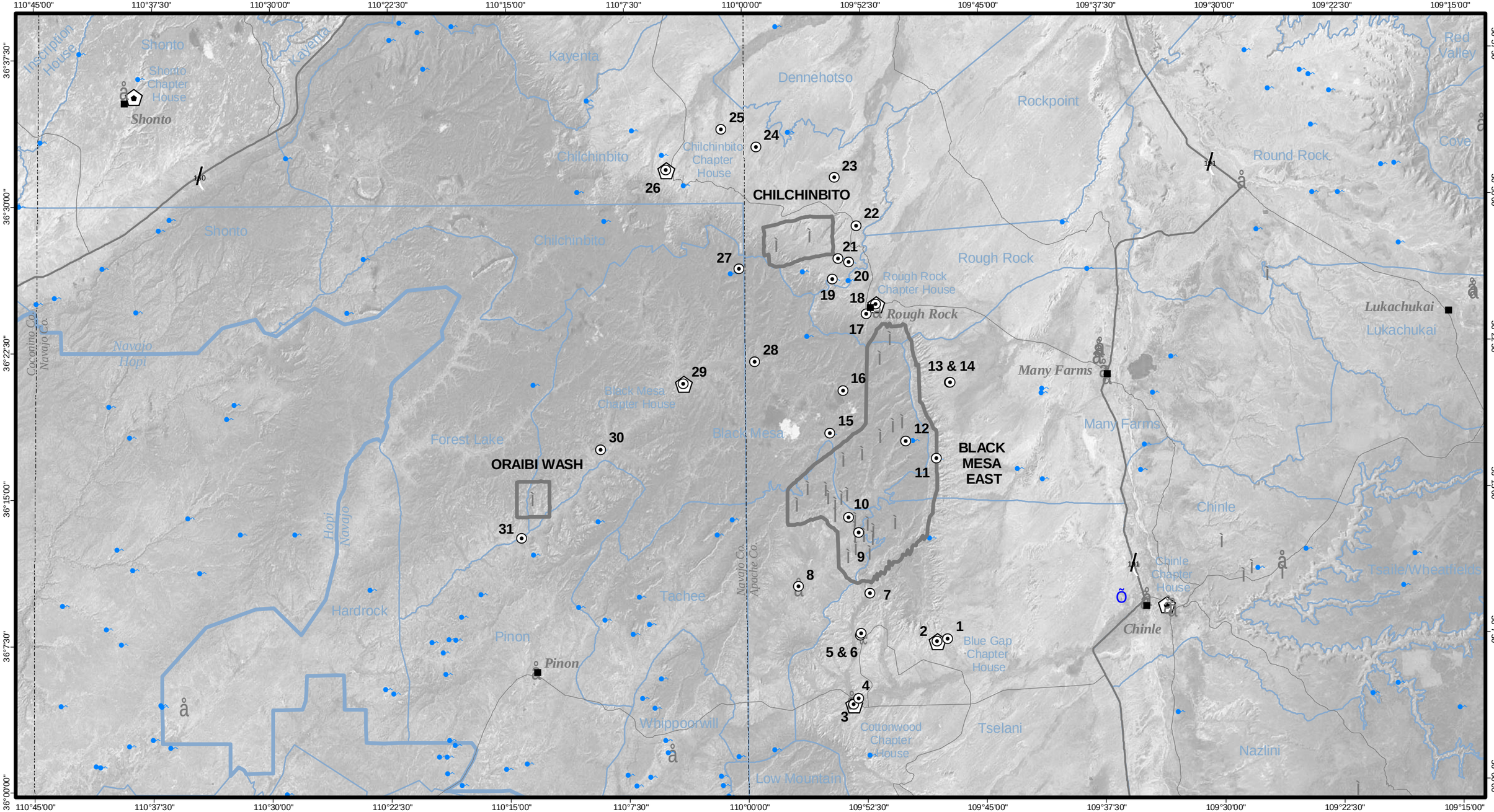
U.S. Environmental Protection Agency

ABANDONED URANIUM MINES PROJECT

Central Area

WATER SAMPLE INFORMATION

Map ID	Sample ID	Field Type	Sample Name	Longitude (DMS) (W)	Latitude (DMS) (N)	Elevation (ft)	Sample Date	Sample Time
1	CH990316TCS004	Spring	Dark Cave Spring	109 47 22.112	36 7 34.04521	5931	16-Mar-99	5:01 PM
2	CH990316TCS003	Spring	Shonto	109 48 2.0634	36 7 25.06079	5945	16-Mar-99	4:23 PM
3	CH981119TCW001	Well	Cottonwood Chapter House	109 53 20.502	36 4 14.12939	5991	19-Nov-98	9:27 AM
4	CH990316TCW004	Wind Mill	Tank 10R-51	109 53 1.3751	36 4 30.99061	5966	16-Mar-99	10:29 AM
5	CH990316TCS001	Spring	Cottonwood Chapter House	109 52 51.687	36 7 46.08299	6229	16-Mar-99	12:34 PM
6	CH990316TCS002	Spring	Refrigerator Springs	109 52 50.587	36 7 51.71818	6220	16-Mar-99	1:58 PM
7	CH981119TCW003	Wind Mill	Tank 10T-533	109 52 13.791	36 9 54.68641	6318	19-Nov-98	11:33 AM
8	CH981123BGW001	Well	Tank Blue Gap	109 56 46.256	36 10 17.5037	6418	23-Nov-98	2:51 PM
9	CH981124BGS002	Spring	White Clay Spring	109 52 55.032	36 13 1.40098	6899	24-Nov-98	12:24 PM
10	CH981123BGW002	Wind Mill	Tank 4T-386	109 53 32.485	36 13 47.4467	6594	23-Nov-98	3:49 PM
11	CH990315RRS004	Spring	Sweet Water Spring	109 47 57.689	36 16 47.0333	5986	15-Mar-99	5:35 PM
12	CH981104BGS001	Spring	Waterfall Spring	109 49 52.603	36 17 40.9530	7116	04-Nov-98	3:00 PM
13	CH990315RRS002	Spring	Alamo Springs	109 47 2.3106	36 20 40.4868	5771	15-Mar-99	1:19 PM
14	CH990315RRS003	Spring	Tanizohnnie Nez Spring	109 47 2.2038	36 20 40.3644	5778	15-Mar-99	3:03 PM
15	CH981104BMS001	Spring	Coal Spring	109 54 39.388	36 18 9.36179	6910	04-Nov-98	11:19 AM
16	CH981105BMW004	Well	Begay Well	109 53 48.851	36 20 19.9763	7084	05-Nov-98	2:57 PM
17	CH981120RRS001	Spring	Trading Post Spring	109 52 15.790	36 24 13.6590	6186	20-Nov-98	9:36 AM
18	CH981120RRW001	Well	Rough Rock Chapter House	109 51 39.670	36 24 43.4477	6156	20-Nov-98	9:00 AM
19	KY981008CHS004	Spring	Red Tree Spring	109 54 22.668	36 26 1.08718	5902	08-Oct-98	2:49 PM
20	KY981008CHS003	Spring	Tinyehtoh Spring	109 53 20.356	36 26 52.5558	5842	08-Oct-98	12:49 PM
21	KY981008CHS002	Spring	Burro Spring	109 54 2.4828	36 27 5.23501	5764	08-Oct-98	12:12 PM
22	KY981008CHS001	Spring	Benally Spring	109 52 51.423	36 28 45.4248	5632	08-Oct-98	11:09 AM
23	KY981008CHW002	Wind Mill	Tank 8T-518	109 54 13.091	36 31 13.2899	5554	08-Oct-98	3:54 PM
24	KY981008CHW003	Wind Mill	Tank 8T-528	109 59 9.3095	36 32 50.2932	5727	08-Oct-98	4:34 PM
25	KY981008CHW004	Wind Mill	Tank 8A-121	110 1 21.1086	36 33 45.5399	5579	08-Oct-98	5:14 PM
26	KY981008CHW001	Well	Chilchinbito Chapter House	110 4 53.1864	36 31 41.3267	5871	08-Oct-98	10:20 AM
27	CH981105BMS002	Spring	Aspen Spring	110 0 18.7602	36 26 36.6551	7340	05-Nov-98	11:33 AM
28	CH981103BMW001	Wind Mill	Tank 4T-399	109 59 21.767	36 21 50.0195	6764	03-Nov-98	8:57 AM
29	CH981105BMW003	Well	Black Mesa Chapter House	110 3 53.7252	36 20 45.3029	6628	05-Nov-98	9:16 AM
30	CH981105BMS003	Spring	Cliff Spring	110 9 10.1027	36 17 24.5760	6466	05-Nov-98	4:46 PM
31	CH981105BMW005	Wind Mill	Tank 308-1	110 14 12.333	36 12 55.2294	6238	05-Nov-98	5:37 PM



MAP FEATURES

- Water Sample Site
- Spring (GNIS) used in project planning
- Mine or Mineral occurrence (MRDS and MILS) used in project planning

4

WATER SAMPLE LOCATIONS

5 0 5 Miles

5 0 5 10 Kilometers

1:350,000

U.S. Environmental Protection Agency

ABANDONED URANIUM MINES PROJECT

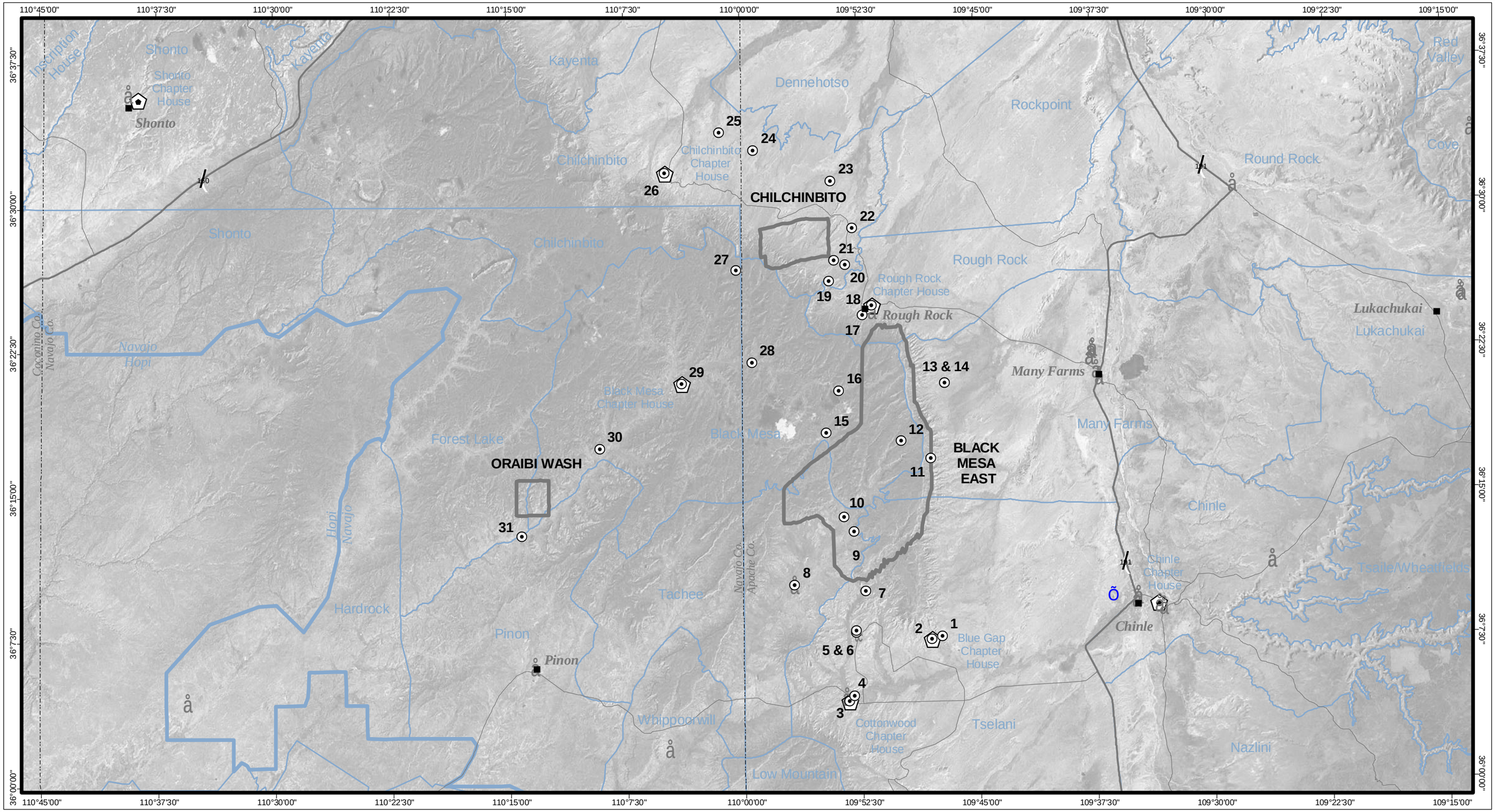
Central Area

WATER SAMPLE ANALYSIS FOR STABLE METALS

Map ID	Sample ID	Sample Name	Al	Sb[2]	As[2,4]	Ba	Be[2,4]	Cd[2,4]	Cr[2,5]	Cu[2]	Fe[2]	Pb	Mn[2]	Hg[2]	Ni[2]	Se[2]	Ag[2]	Th[2,5]	V[2]	Zn[2]	ILCR sta[1,7]	HI[3,7]
		Primary MCLs in Micrograms per Liter (µg/L)[7]	1000	6	50	1000	4	5	100	1300	300	15	50	2	None	50	100	2	None	5000		
		PRG Limits in Micrograms per Liter (µg/L)[8]	37000	15	0.045	2600	73	18	180	1400	11000	4	1700	11	730	189	180	2.6	260	11000		
1	CH990316TCS004	Dark Cave Spring	24.0	2.8	0	13.9	0	0	0	40.3	151.0	2.4	1.8	0.071	0	4.4	0	4.2	2.7	69.6	0.00E+00	1.90
2	CH990316TCS003	Shonto	31.2	0	0	12.5	0.2	0	0	17.9	486.0	0	4.9	0.072	0	25.9	0	0	1.3	106.0	0.00E+00	0.23
3	CH981119TCW001	Cottonwood Chapter House	42.3	0	6.0	87.5	0	0.4	10.2	4.6	127.0	0	1.8	0.180	0	3.2	1.4	6.2	2.7	80.5	1.33E-04	3.12
4	CH990316TCW004	Tank 10R-51	6390.0	0	0	25.4	0.2	0	4.2	8.8	4,240.0	2.3	261.0	0.081	3.9	0	0	0	9.2	66.6	0.00E+00	0.81
5	CH990316TCS001	Cottonwood Chapter House	47.1	3.6	3.5	88.2	0	0	0	16.5	53.6	0	1.5	0.069	0	2.9	0	0	6.0	23.6	7.78E-05	0.66
6	CH990316TCS002	Refrigerator Springs	39.6	2.7	0	99.9	0	0.3	0	0	355.0	2.4	207.0	0.074	0	0	0	4.6	0.9	24.6	0.00E+00	2.17
7	CH981119TCW003	Tank 10T-533	58.8	0	0	9.1	0	0	0	0	1,060.0	0	57.3	0.057	0	0	0	0	0	94.2	0.00E+00	0.15
8	CH981123BGW001	Tank Blue Gap	129.0	0	6.2	21.8	0	0	0	0	1,010.0	1.3	433.0	0.120	1.1	0	0	0	0	132.0	1.38E-04	0.95
9	CH981124BGS002	White Clay Spring	148.0	0	0	20.1	0	0	0	0	16.7	0	1.1	0.200	0	28.6	0	0	1.8	6.5	0.00E+00	0.19
10	CH981123BGW002	Tank 4T-386	158.0	0	0	7.6	0	0	0	0	260.0	0	321.0	0.310	1.5	0	0	6.3	0	1,460.0	0.00E+00	2.81
11	CH990315RRS004	Sweet Water Spring	37.7	0	0	11.1	0	0	4.8	0	5930.0	0	61.7	0.075	1.4	208.0	0.9	0	168.0	27.0	0.00E+00	2.37
12	CH981104BGS001	Waterfall Spring	160.0	0	0	45.5	0.6	0	0	0	0	0	2.7	0	2.3	23.5	0	0	19.4	31.4	0.00E+00	0.24
13	CH990315RRS002	Alamo Springs	27.3	3.7	0	99.9	0	0	0	6.5	17.0	0	1.4	0.069	0	3.3	0	0	4.7	21.4	0.00E+00	0.34
14	CH990315RRS003	Tanizohnnie Nez Spring	1690.0	3.2	2.8	58.3	0.2	0	2.8	4.5	2,100.0	9.7	73.4	0.072	0	6.9	0	0	7.2	62.8	6.22E-05	0.87
15	CH981104BMS001	Coal Spring	109.0	0	0	7.2	0	0	0	7.7	334.0	0	4.2	0.066	1.1	0	0	0	0	40.0	0.00E+00	0.06
16	CH981105BMW004	Begay Well	189.0	0	0	28.9	0	0	0	0	27.6	0	3.4	0.078	0	2.5	0	5.1	0	36.0	0.00E+00	2.01
17	CH981120RRS001	Trading Post Spring	53.0	0	0	84.7	0.2	0.5	0	0	0	1.3	0.3	0.370	0	0	1.0	0	0	220.0	0.00E+00	0.13
18	CH981120RRW001	Rough Rock Chapter House	30.1	0	44.1	8.2	0	0	17.1	2.0	93.6	2.3	6.2	0.110	0	0	0	0	70.3	21.0	9.80E-04	4.40
19	KY981008CHS004	Red Tree Spring	118.0	0	0	51.2	0.4	0	0	0	52.5	0	3.6	0.120	0	19.2	0	0	0	49.7	0.00E+00	0.15
20	KY981008CHS003	Tinyehtoh Spring	108.0	0	0	42.4	0.4	0	0	2.1	40.9	0	1.7	0.097	0	2.9	0	4.6	2.6	16.4	0.00E+00	1.84
21	KY981008CHS002	Burro Spring	7900.0	0	3.4	44.5	0	0	17.3	10.8	13,900.0	6.3	1390.0	0.010	17.3	0	0	4.8	15.5	661.0	7.56E-05	4.73
22	KY981008CHS001	Benally Spring	309.0	0	0.0	15.2	0	0	0	0	0	1.5	187.0	0.010	0	69.4	0	0	0	76.8	0.00E+00	0.51
23	KY981008CHW002	Tank 8T-518	60.9	0	28.5	3.7	0	0	29.7	11.3	953.0	1.7	7.1	0.220	0	0	0	6.1	81.0	132.0	6.33E-04	5.55
24	KY981008CHW003	Tank 8T-528	272.0	0	7.0	6.2	0	0	5.7	29.7	354.0	15.9	7.8	0.180	0	0	0	0	41.2	419.0	1.56E-04	0.95
25	KY981008CHW004	Tank 8A-121	63.1	0	0	10.8	0	0	0	1.2	115.0	0	2.5	0.150	0	0	0	4.9	0	251.0	0.00E+00	1.94
26	KY981008CHW001	Chilchinbito Chapter House	59.5	0	5.3	2.2	0.1	0	10.8	13.6	53.0	3.7	0.8	0.190	0	0	0	0	33.6	32.9	1.18E-04	0.71
27	CH981105BMS002	Aspen Spring	71.8	0	0	20.1	0.2	0	0	0	0	0	0	0.080	0	4.3	0	4.1	0	8.1	0.00E+00	1.62
28	CH981103BMW001	Tank 4T-399	143.0	0	0	20.5	0	0	0	0	51.9	2.4	448	0.054	0	0	0	5.9	0	1960	0.00E+00	2.73
29	CH981105BMW003	Black Mesa Chapter House	92.5	0	17.2	4.1	0.6	0	4.9	2.9	69.8	0	8.0	0.031	0	0	0	4.8	12.6	32.6	3.82E-04	3.52
30	CH981105BMS003	Cliff Spring	243.0	0	0	52.8	0.8	0	0	0	42.4	0	0	0	0	0	0	0	0	5.1	0.00E+00	0.04
31	CH981105BMW005	Tank 308-1	102.0	0	0	4.2	0.4	0	0	0	531.0	0	16.9	0	0	0	0	4.0	0	154.0	0.00E+00	1.62

1. ILCR = Incremental Lifetime Cancer Risk with Respect to Stable Metals.
2. The values of "0" represent a result of either "not detected" at the detection limit of the laboratory method or a negative count. In both cases, the result can be considered "0".
3. The evaluation of Beta is in two steps. The initial screening level is 50 pCi/L. If the measured level of Beta exceeds the 50 pCi/L, a further evaluation is merited. Beta-emitting radionuclides would be screened.
4. The values of "0" in the Pb210 column represent analytical results that measured less than the Minimum Detectable Activity (MDA).
5. Definition of final calculations and ranking is described and published in Appendix A.1 *Summary of the Characterization of Risk Leading to Exposure Reduction*.
6. When comparing these PRG's with the U.S. EPA's PRG list, the calculated PRG used for U238 is less than the EPA's PRG for U238D (D meaning that its decay daughters are included in the risk calculations).
7. MCL – Maximum Contaminant Levels are the maximum permissible level of a contaminant in water delivered to users of a public water system.
8. PRG – Preliminary Remediation Goals are tools for evaluating and cleaning up contaminated sites. They are risk-based concentrations derived from standardized equations, combining exposure information assumptions and EPA toxicity data.

Al = Aluminum Sb = Antimony As = Arsenic Ba = Barium Be = Beryllium Cd = Cadmium Cr = Chromium Cu = Copper Fe = Iron Pb = Lead Mn = Manganese Hg = Mercury Ni = Nickel Se = Selenium Ag = Silver Th = Thallium V = Vanadium Zn = Zinc



MAP FEATURES

⊙ Water Sample Site - Stable Metals

4

WATER SAMPLE ANALYSIS FOR STABLE METALS

5 0 5 Miles

5 0 5 10 Kilometers

1:350,000

U.S. Environmental Protection Agency

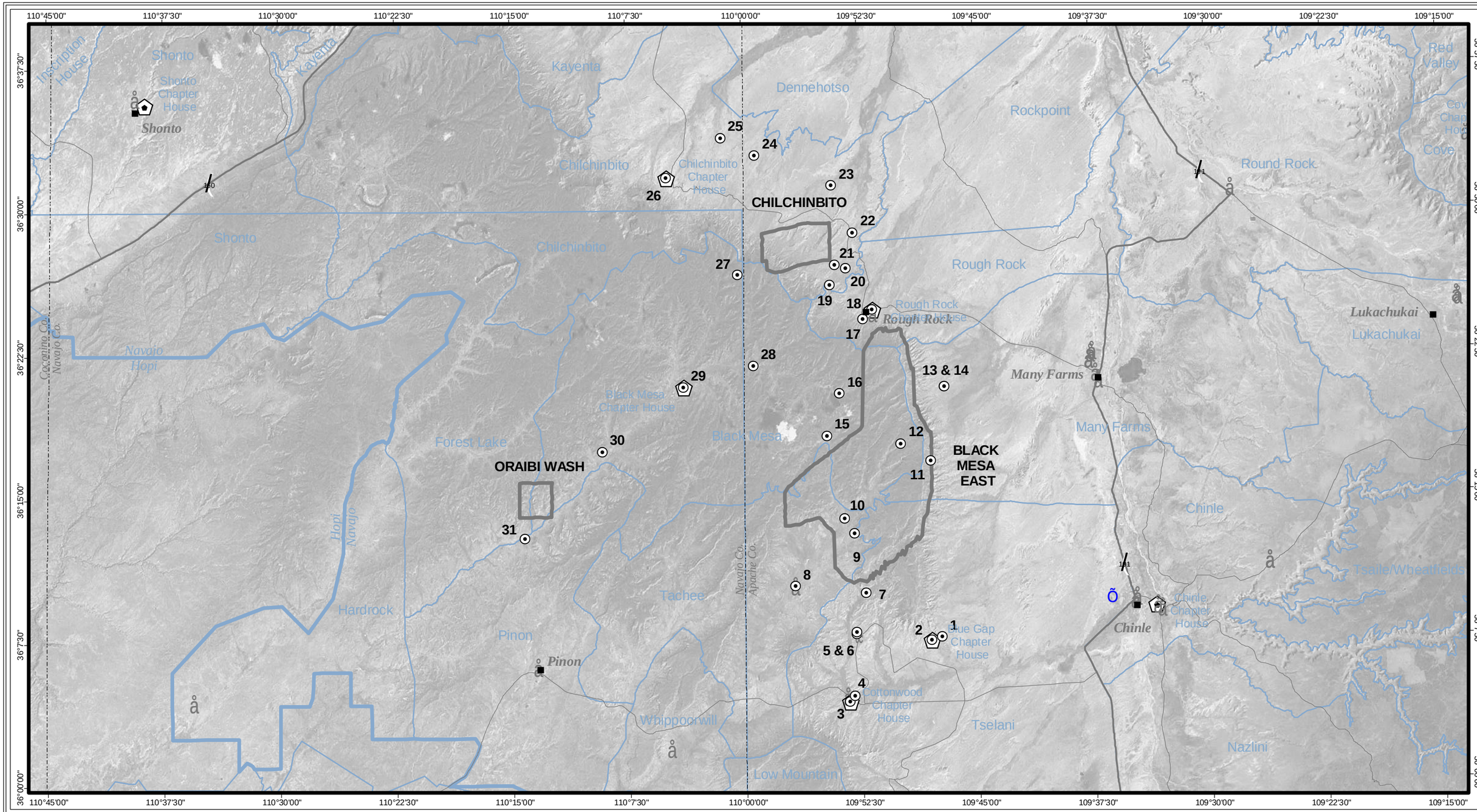
ABANDONED URANIUM MINES PROJECT

Central Area

WATER SAMPLE ANALYSIS FOR RADIOACTIVE METALS

Map ID	Sample ID	Sample Name	Alpha[2]	Beta[3]	Lead210[4]	Radium226[2]	Radium228[2]	Thorium228[2]	Thorium230[2]	Thorium232[2]	Uranium234[2]	Uranium235[2]	Uranium238[2,6]	ILCR rad[1,5]
		Primary MCLs in Pico-curies per Liter (pCi/L)[7]	15	50	None	5	5	None	None	None	20	20	20	
		PRG Limits in Pico-curies per Liter (pCi/L)[8]	None	None	0.047	0.16	0.19	0.21	1.3	1.5	1.1	1.1	0.71	
1	CH990316TCS004	Dark Cave Spring	3.52	3.83	0.39	0.106	0.394	0.000	0.013	0.000	3.00	0.073	1.93	8.26E-06
2	CH990316TCS003	Shonto	4.69	6.37	0.44	0.092	0.101	0.030	0.000	0.000	4.62	0.124	3.40	1.04E-05
3	CH981119TCW001	Cottonwood Chapter House	15.00	13.80	0.58	0.298	0.219	0.010	0.005	0.005	7.68	0.151	8.56	2.22E-05
4	CH990316TCW004	Tank 10R-51	17.80	24.10	0.38	0.156	0.368	0.108	0.070	0.070	13.20	0.389	8.73	2.82E-05
5	CH990316TCS001	Cottonwood Chapter House	13.80	10.80	0.04	0.108	0.206	0.041	0.000	0.000	6.92	0.310	3.56	1.35E-05
6	CH990316TCS002	Refrigerator Springs	14.80	4.31	0.48	0.039	0.320	0.003	0.000	0.000	6.80	0.125	4.15	1.41E-05
7	CH981119TCW003	Tank 10T-533	39.30	42.70	0.67	0.082	0.554	0.031	0.009	-0.002	20.00	1.910	51.10	9.55E-05
8	CH981123BGW001	Tank Blue Gap	-0.33	11.50	1.77	1.910	1.950	0.000	0.005	0.000	0.13	0.033	0.17	6.02E-05
9	CH981124BGS002	White Clay Spring	46.60	28.80	0.81	2.770	1.550	0.090	0.000	0.024	22.40	0.992	22.50	7.89E-05
10	CH981123BGW002	Tank 4T-386	10.00	10.50	1.04	1.460	2.220	0.089	-0.011	-0.011	3.80	0.176	3.43	5.18E-05
11	CH990315RRS004	Sweet Water Spring	9.03	17.80	0.31	0.110	0.359	0.000	0.011	0.000	5.80	0.384	6.39	1.72E-05
12	CH981104BGS001	Waterfall Spring	52.00	25.10	2.26	1.630	4.680	0.133	0.012	0.007	31.90	0.937	28.90	1.06E-04
13	CH990315RRS002	Alamo Springs	4.36	5.89	0.37	0.186	0.473	0.005	0.000	0.000	4.83	0.138	4.32	1.43E-05
14	CH990315RRS003	Tanizohnnie Nez Spring	13.30	10.60	0.00	0.125	0.247	0.010	0.000	0.000	8.47	0.219	4.92	1.70E-05
15	CH981104BMS001	Coal Spring	1.99	2.99	0.49	0.074	0.451	-0.005	0.019	-0.002	0.58	0.078	0.34	3.92E-06
16	CH981105BMW004	Begay Well	11.10	16.50	3.10	0.116	0.987	0.051	-0.003	0.013	2.15	0.068	2.91	1.23E-05
17	CH981120RRS001	Trading Post Spring	2.67	8.77	0.80	0.225	0.499	0.001	0.004	0.000	3.67	0.212	1.77	2.71E-05
18	CH981120RRW001	Rough Rock Chapter House	14.10	9.97	0.66	0.035	0.308	0.016	0.004	0.000	11.00	0.235	5.76	2.02E-05
19	KY981008CHS004	Red Tree Spring	15.00	6.60	0.17	0.147	0.172	-0.003	0.010	0.004	6.18	0.097	3.04	1.18E-05
20	KY981008CHS003	Tinyehtoh Spring	44.40	16.20	1.22	0.098	-0.080	0.007	0.003	-0.002	26.20	0.121	13.60	4.37E-05
21	KY981008CHS002	Burro Spring	87.90	54.10	1.03	0.245	1.770	0.143	-0.005	0.094	34.90	1.160	24.00	1.00E-04
22	KY981008CHS001	Benally Spring	64.00	36.20	0.88	0.065	0.639	0.533	-0.015	0.000	26.30	0.826	20.00	5.91E-05
23	KY981008CHW002	Tank 8T-518	13.30	5.03	0.23	0.032	-0.083	-0.006	-0.001	0.000	8.55	-0.004	3.43	1.28E-05
24	KY981008CHW003	Tank 8T-528	2.33	1.88	0.85	0.032	0.216	0.013	0.020	0.000	1.56	0.085	0.78	4.01E-06
25	KY981008CHW004	Tank 8A-121	1.79	3.31	0.62	0.069	-0.037	-0.007	0.005	0.000	0.18	-0.006	0.24	9.37E-07
26	KY981008CHW001	Chilchinbito Chapter House	2.71	2.01	1.57	0.004	0.242	-0.001	-0.001	0.005	1.78	-0.004	0.50	3.70E-05
27	CH981105BMS002	Aspen Spring	4.34	4.86	0.67	0.119	0.097	0.027	0.010	0.000	1.32	0.033	1.18	4.28E-06
28	CH981103BMW001	Tank 4T-399	2.09	13.30	0.45	1.320	5.170	0.257	0.000	0.008	0.48	0.033	0.62	3.80E-05
29	CH981105BMW003	Black Mesa Chapter House	1.25	0.98	0.13	0.088	0.530	0.002	0.003	0.000	0.59	-0.025	0.50	4.59E-06
30	CH981105BMS003	Cliff Spring	9.06	4.53	0.73	0.703	0.572	0.018	0.020	0.016	3.00	0.073	2.62	1.40E-05
31	CH981105BMW005	Tank 308-1	2.82	2.77	0.96	0.283	0.571	0.052	0.005	-0.001	0.42	-0.036	-0.05	5.41E-06

1. ILCR = Incremental Lifetime Cancer Risk with Respect to Radioactive Metals.
2. The values of "0" represent a result of either "not detected" at the detection limit of the laboratory method or a negative count. In both cases, the result can be considered "0".
3. The evaluation of Beta is in two steps. The initial screen level is 50pCi/l. If the measured level of Beta exceeds the 50 pCi/L, a further evaluation is merited. The Beta-emitting radionuclides would be screened.
4. The values of "0" in the Lead210 column represent analytical results that measured less than the Method Detection Activity (MDA).
5. Definition of final calculations and ranking is described and published in Appendix A.1 *Summary of the Characterization of Risk Leading to Exposure Reduction*.
6. When comparing these PRG's with the U.S. EPA's PRG list, the calculated PRG used for Uranium238 is less than the EPA's PRG for Uranium238D (D meaning that its decay daughters are included in the risk calculations).
7. MCL – Maximum Contaminant Levels are the maximum permissible level of a contaminant in water delivered to users of a public water system.
8. PRG – Preliminary Remediation Goals are tools for evaluating and cleaning up contaminated sites. They are risk-based concentrations derived from standardized equations, combining exposure information assumptions and EPA toxicity data.



MAP FEATURES

⦿ Water Sample Site - Radioactive Metals

4

WATER SAMPLE ANALYSIS FOR RADIOACTIVE METALS

5 0 5 Miles

5 0 5 10 Kilometers

1:350,000

U.S. Environmental Protection Agency

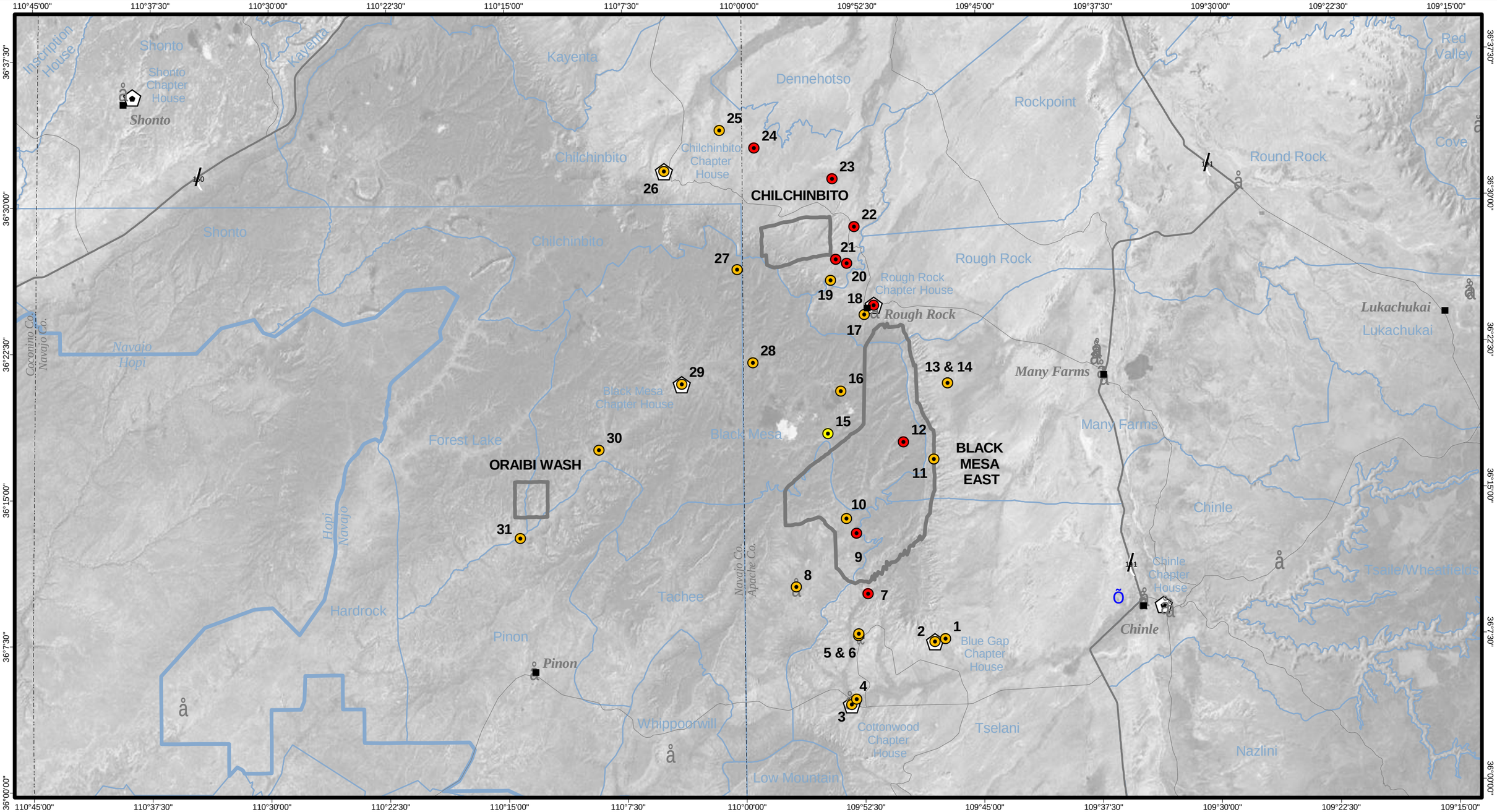
ABANDONED URANIUM MINES PROJECT

Central Area

SUMMARY OF WATER QUALITY ANALYSIS WITH RESPECT TO STABLE AND RADIOACTIVE METALS

Map ID	Sample ID	Sample Name	Total Cancer Risk	Hazard Index (HI)	Arsenic[3]	Lead[3]	Total U[2]		Water Quality with Respect to Stable and Radioactive Metals[4]			Risk Category	Risk Ranking[6]
		Primary MCLs in Micrograms per Liter (µg/L)[7]			50	15	30						
		PRG Limits in Micrograms per Liter (µg/L)[8]			0.045	4	None		Less Risk	Some Risk	More Risk		
1	CH990316TCS004	Dark Cave Spring	8.26E-006	1.90	0	2.4	4.93			HI		SOME	13
2	CH990316TCS003	Shonto	1.04E-005	0.23	0	0	8.02			ILCR		SOME	8
3	CH981119TCW001	Cottonwood Chapter House	1.56E-004	3.12	6.0	0	16.24			ILCR, HI		SOME	20
4	CH990316TCW004	Tank 10R-51	2.82E-005	0.81	0	2.3	22.32			ILCR		SOME	21
5	CH990316TCS001	Cottonwood Chapter House	9.13E-005	0.66	3.5	0	10.79			ILCR		SOME	16
6	CH990316TCS002	Refrigerator Springs	1.41E-005	2.17	0	2.4	10.95			ILCR, HI		SOME	17
7	CH981119TCW003	Tank 10T-533	9.55E-005	0.15	0	0	73.01				Total U	MORE	30
8	CH981123BGW001	Tank Blue Gap	1.98E-004	0.95	6.2	1.3	0.00			ILCR		SOME	14
9	CH981124BGS002	White Clay Spring	7.89E-005	0.19	0	0	45.89				Total U	MORE	26
10	CH981123BGW002	Tank 4T-386	5.18E-005	2.81	0	0	7.23			ILCR, HI		SOME	11
11	CH990315RRS004	Sweet Water Spring	1.72E-005	2.37	0	0	12.57			ILCR, HI		SOME	15
12	CH981104BGS001	Waterfall Spring	1.06E-004	0.24	0	0	61.74				Total U	MORE	28
13	CH990315RRS002	Alamo Springs	1.43E-005	0.34	0	0	9.15			ILCR		SOME	12
14	CH990315RRS003	Tanizohnnie Nez Spring	7.92E-005	0.87	2.8	9.7	13.61			ILCR, Lead		SOME	22
15	CH981104BMS001	Coal Spring	3.92E-006	0.06	0	0	0.92		X			LESS	1
16	CH981105BMW004	Begay Well	1.23E-005	2.01	0	0	5.06			ILCR, HI		SOME	5
17	CH981120RRS001	Trading Post Spring	2.71E-005	0.13	0	1.3	5.44			ILCR		SOME	9
18	CH981120RRW001	Rough Rock Chapter House	1.00E-003	4.40	44.1	2.3	17.00				ILCR	MORE	29
19	KY981008CHS004	Red Tree Spring	1.18E-005	0.15	0	0	9.22			ILCR		SOME	10
20	KY981008CHS003	Tinyehtoh Spring	4.37E-005	1.84	0	0	39.80				Total U	MORE	23
21	KY981008CHS002	Burro Spring	1.76E-004	4.73	3.4	6.3	60.06				Total U	MORE	31
22	KY981008CHS001	Benally Spring	5.91E-005	0.51	0	1.5	47.13				Total U	MORE	27
23	KY981008CHW002	Tank 8T-518	6.46E-004	5.55	28.5	1.7	11.98				ILCR	MORE	25
24	KY981008CHW003	Tank 8T-528	1.60E-004	0.95	7.0	15.9	2.34				Lead	MORE	24
25	KY981008CHW004	Tank 8A-121	9.37E-007	1.94	0	0	0.24			HI		SOME	2
26	KY981008CHW001	Chilchinbito Chapter House	1.55E-004	0.71	5.3	3.7	2.28			ILCR		SOME	18
27	CH981105BMS002	Aspen Spring	4.28E-006	1.62	0	0	2.50			HI		SOME	4
28	CH981103BMW001	Tank 4T-399	3.80E-005	2.73	0	2.4	1.09			ILCR, HI		SOME	7
29	CH981105BMW003	Black Mesa Chapter House	3.87E-004	3.52	17.2	0	1.09			ILCR, HI		SOME	19
30	CH981105BMS003	Cliff Spring	1.40E-005	0.04	0	0	5.62			ILCR		SOME	6
31	CH981105BMW005	Tank 308-1	5.41E-006	1.62	0	0	0.42			HI		SOME	3

1. ILCR = Incremental Lifetime Cancer Risk with Respect to Stable Metals and Radioactive Metals.
2. The PRG's and MCL's for Alpha, Beta, and Uranium are in Pico-Curies per Liter (pCi/L).
3. The PRG's and MCL's for Lead and Arsenic are in Micrograms per Liter (µg/L).
4. Water Quality Levels:
   - Less Risk — Total Cancer Risk is less than or equal to 1E-05 and Hazard Index is less than or equal to 1 and Lead is less than 4 and Total Uranium is less than 30.
   - Some Risk — Total Cancer Risk is less than or equal to 6E-04 but greater than 1E-05 or Hazard Index is less than 10 but greater than 1 or Lead is less than 15 but greater than 4 and Total Uranium is less than 30.
   - More Risk — Total Cancer Risk is greater than 6E-04 or Hazard Index is greater than 10 or Lead is greater than 15 or Total Uranium is equal to or greater than 30.
5. Proposed EPA MCl is 30 pCi/L for the sum of the three Uranium isotopes.
6. The definitions of the risk categories and the ranking is described and published in Appendix A.1 *Summary of the Characterization of Risk Leading to Exposure Reduction*.
7. MCL – Maximum Contaminant Levels are the maximum permissible level of a contaminant in water delivered to users of a public water system.
8. PRG – Preliminary Remediation Goals are tools for evaluating and cleaning up contaminated sites. They are risk-based concentrations derived from standardized equations, combining exposure information assumptions and EPA toxicity data.



- Less Risk
  Total Cancer Risk is less than or equal to 1E-05 and Hazard Index is less than or equal to 1 and Lead is less than 4 and U is less than 30.
- Some Risk
  Total Cancer Risk is less than or equal to 6E-04 but greater than 1E-05 or Hazard Index is less than 10 but greater than 1 or Lead is less than 15 but greater than 4 and U is less than 30.
- More Risk
  Total Cancer Risk is greater than 6E-04 or Hazard Index is greater than 10 or Lead is greater than 15 or U is equal to or greater than 30.

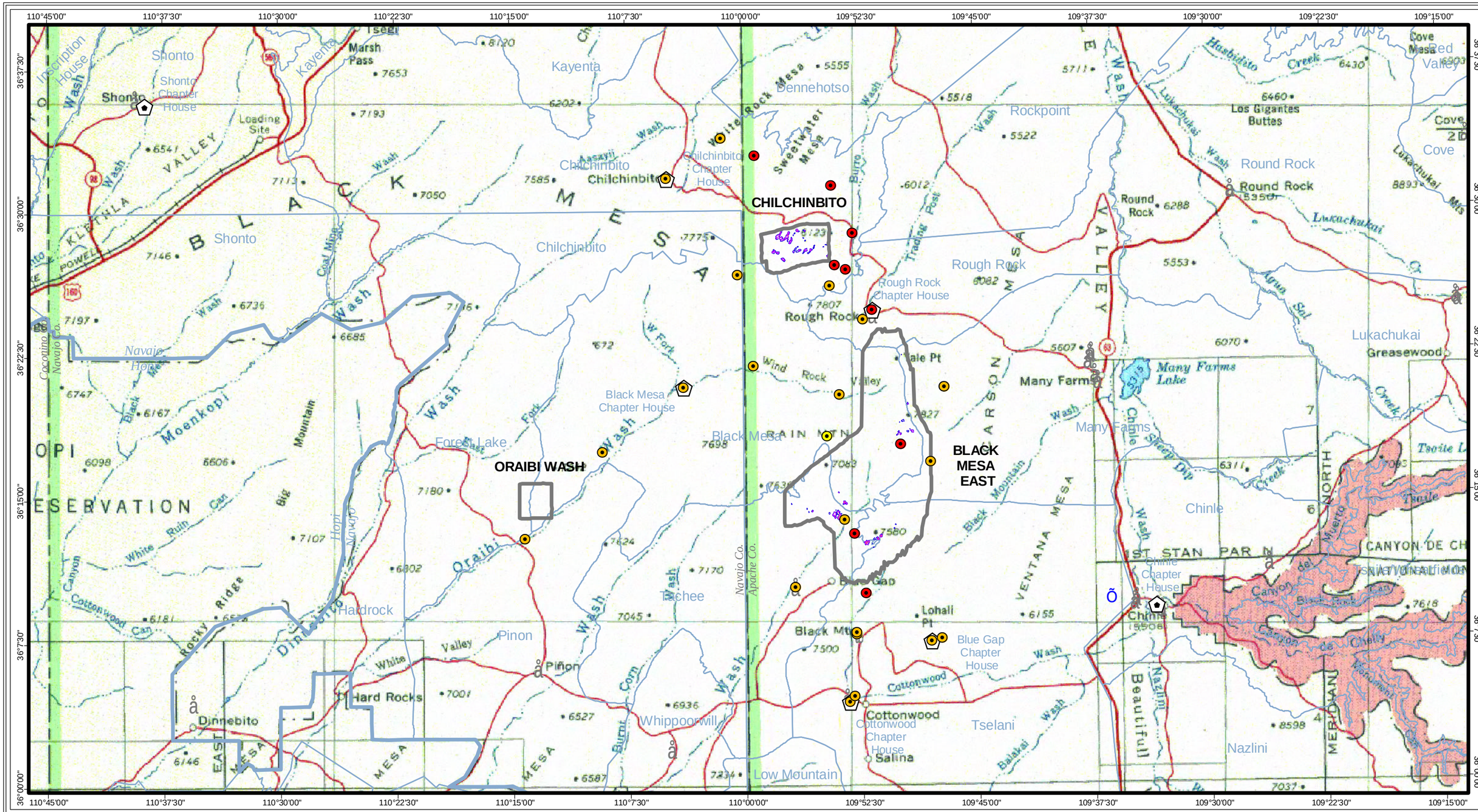
4

SUMMARY OF WATER QUALITY ANALYSIS WITH RESPECT TO STABLE AND RADIOACTIVE METALS

5 0 5 Miles
5 0 5 10 Kilometers
1:350,000

U.S. Environmental Protection Agency
ABANDONED URANIUM MINES PROJECT

Central Area



	Aerial Radiation Contours	Derived contour-level Bismuth 214 photo-peak (excess counts per second)	Estimated exposure rate from excess Bismuth 214 (excess micro-R/hour)
Less Risk		80	3.5
Some Risk		170	7.4
		250	10.9
More Risk		800	34.9
		1200	52.4

4

SUMMARY OF WATER QUALITY ANALYSIS AND BISMUTH 214 CONTOURS

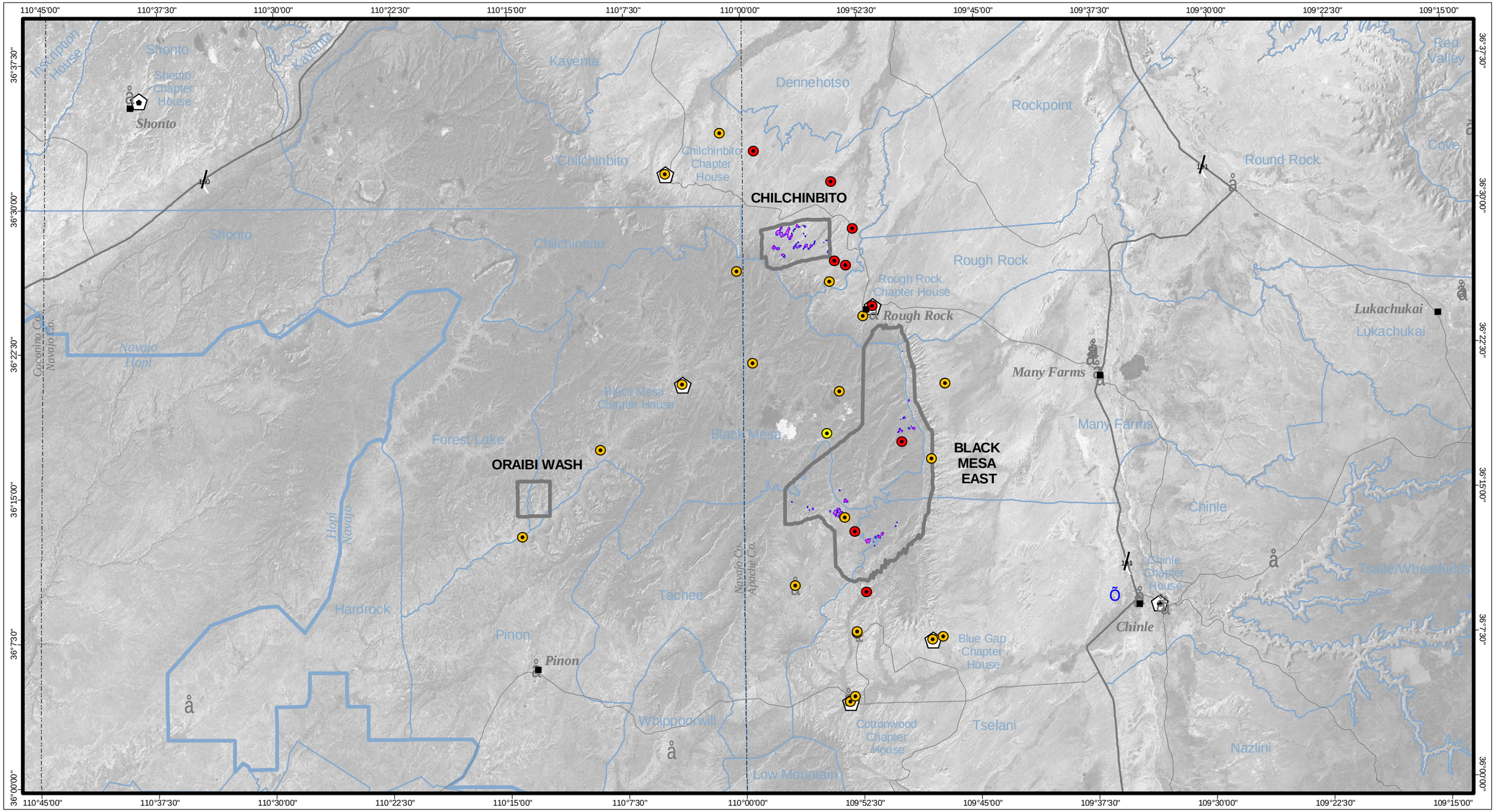
5 0 5 Miles

5 0 5 10 Kilometers

1:350,000

U.S. Environmental Protection Agency
ABANDONED URANIUM MINES PROJECT

Central Area



	Aerial Radiation Contours	Derived contour-level Bismuth 214 photo-peak (excess counts per second)	Estimated exposure rate from excess Bismuth 214 (excess micro-R/hour)
Less Risk		80	3.5
Some Risk		170	7.4
		250	10.9
More Risk		800	34.9
		1200	52.4

4

SUMMARY OF WATER QUALITY ANALYSIS AND BISMUTH 214 CONTOURS

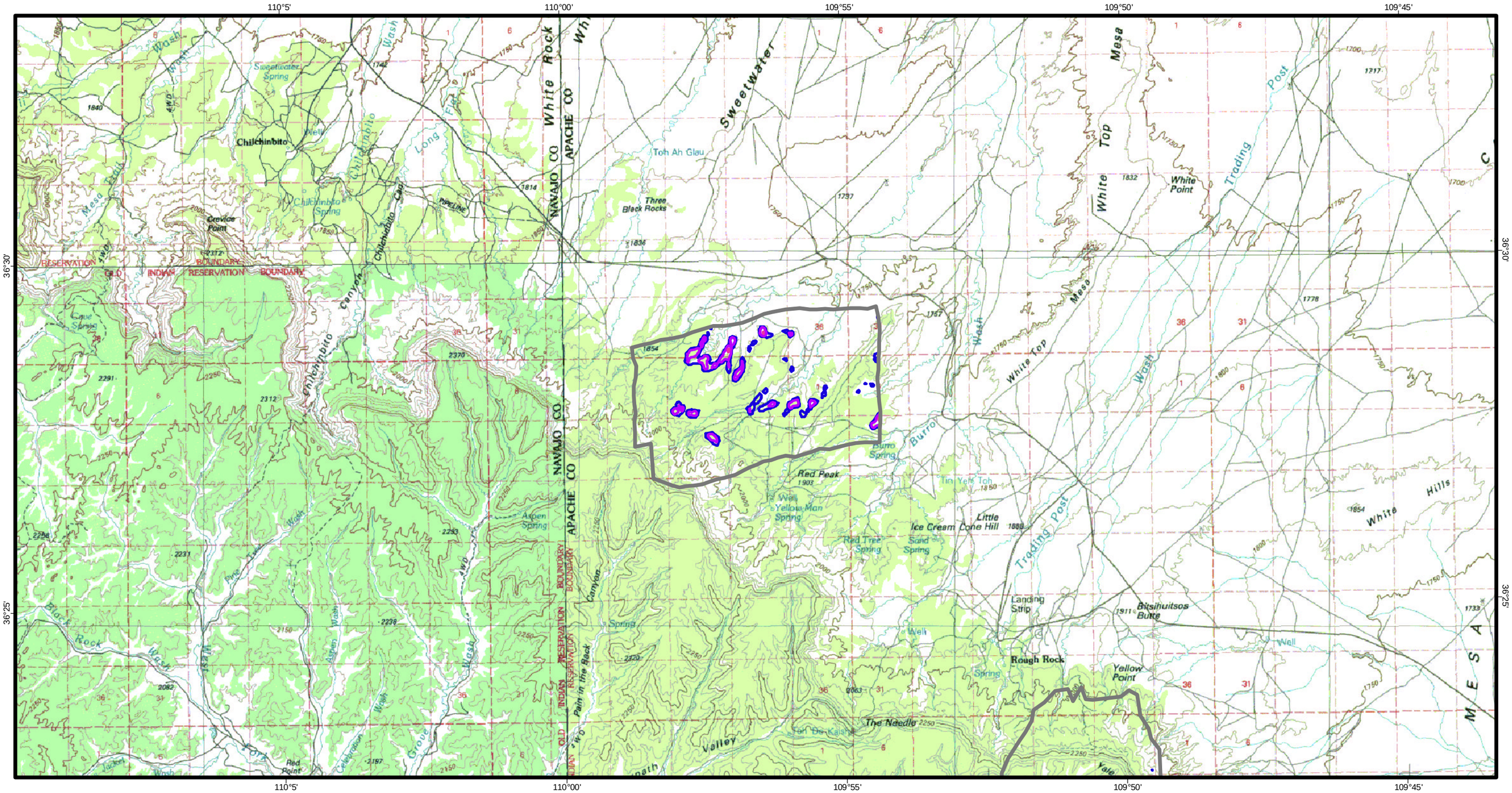
5 0 5 Miles

5 0 5 10 Kilometers

1:350,000

U.S. Environmental Protection Agency
ABANDONED URANIUM MINES PROJECT

Central Area



CHILCHINBITO

Aerial Radiation Contours	Derived contour-level Bismuth 214 photo-peak (excess counts per second)	Estimated exposure rate from excess Bismuth 214 (excess micro-R/hour)
	80	3.5
	170	7.4
	250	10.9
	800	34.9
	1200	52.4

4

AERIAL RADIATION CONTOURS BISMUTH 214 CHILCHINBITO

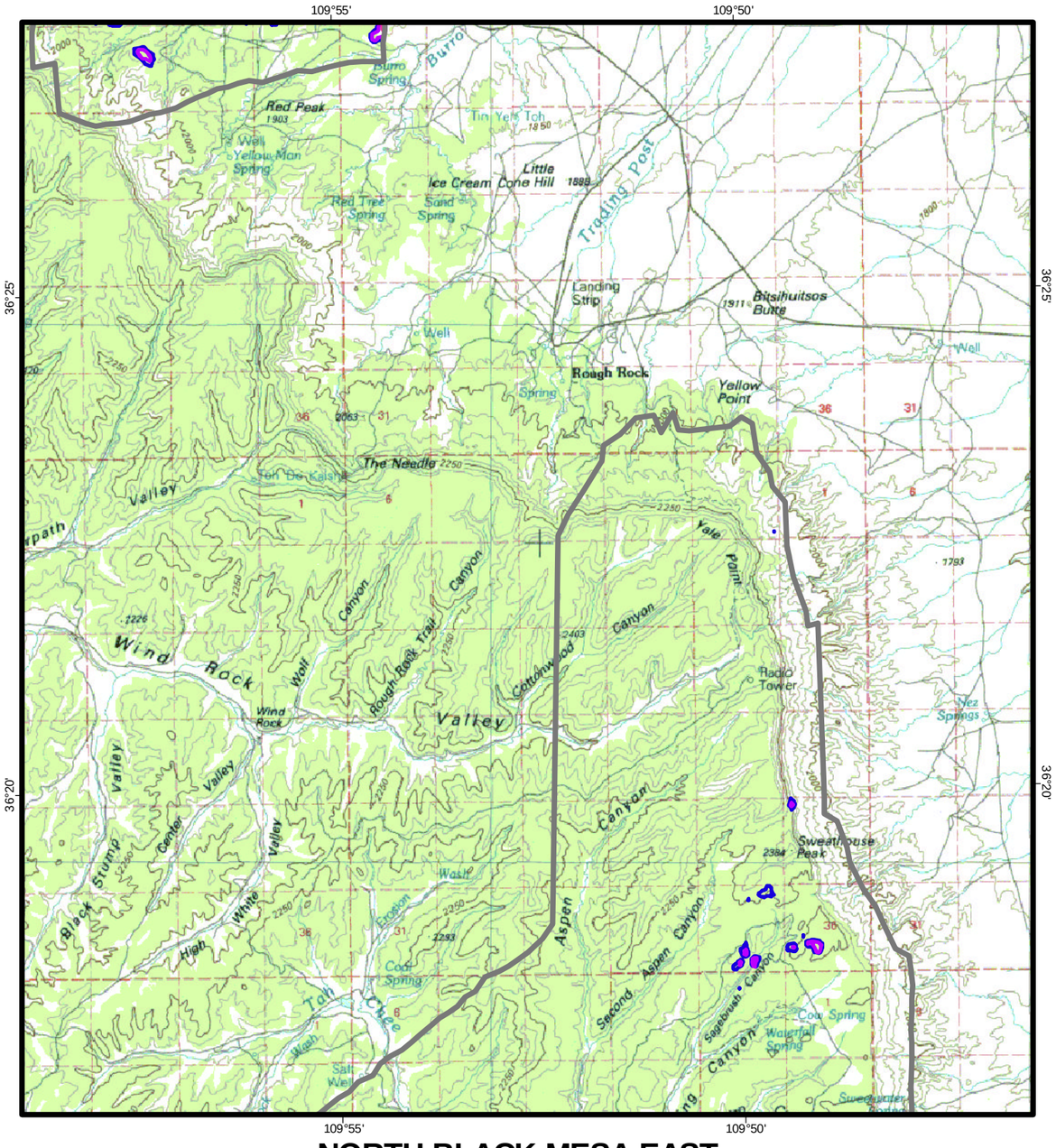
1 0 1 2 Miles

1 0 1 2 3 Kilometers

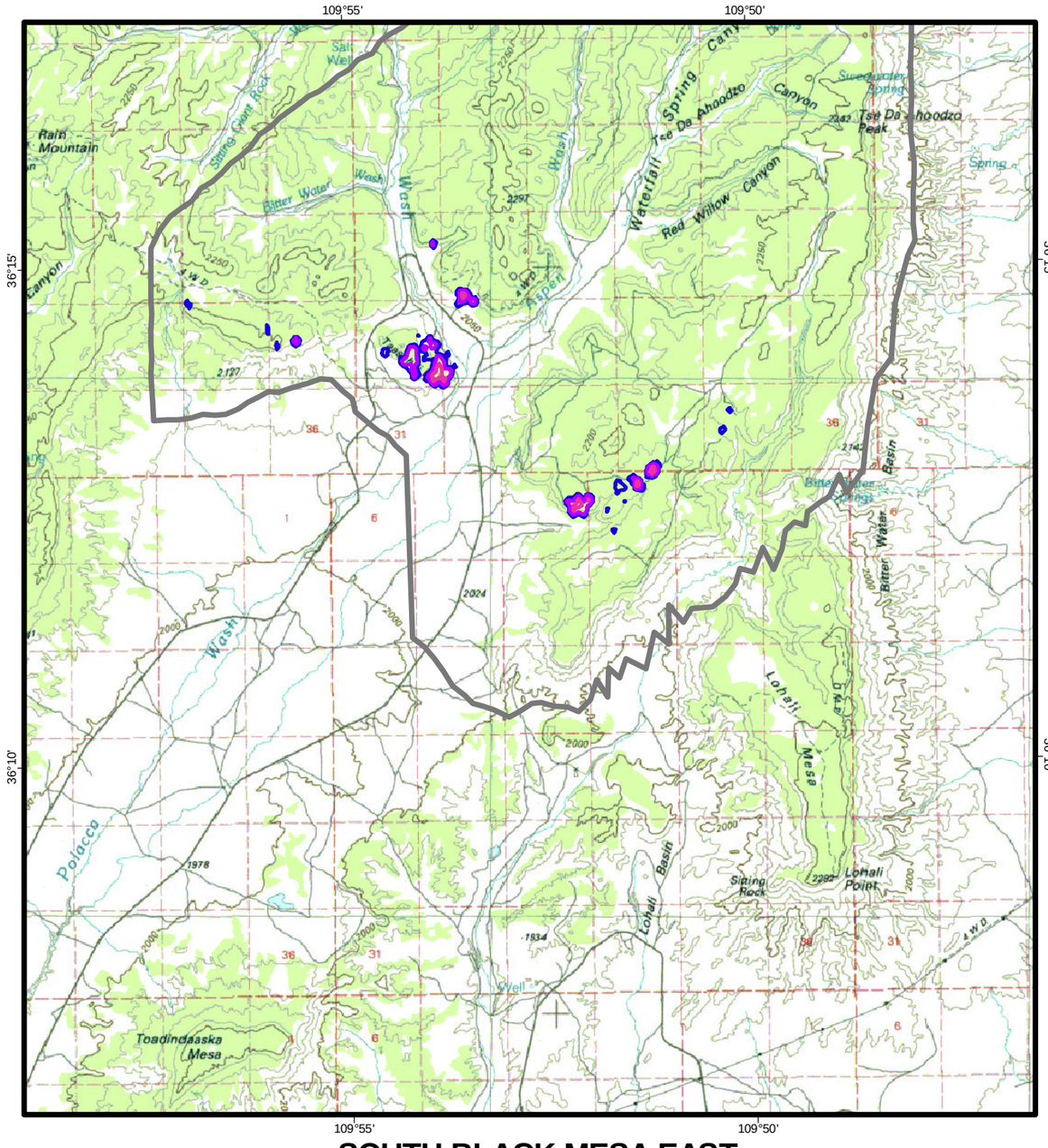
1:100,000

U.S. Environmental Protection Agency
ABANDONED URANIUM MINES PROJECT

Central Area



NORTH BLACK MESA EAST



SOUTH BLACK MESA EAST

Aerial Radiation Contours	Derived contour-level Bismuth 214 photo-peak (excess counts per second)	Estimated exposure rate from excess Bismuth 214 (excess micro-R/hour)
	80	3.5
	170	7.4
	250	10.9
	800	34.9
	1200	52.4

4

AERIAL RADIATION CONTOURS BISMUTH 214 NORTH AND SOUTH BLACK MESA EAST

1 0 1 2 Miles

1 0 1 2 3 Kilometers

1:100,000

U.S. Environmental Protection Agency
ABANDONED URANIUM MINES PROJECT

Central Area

Abandoned Uranium Mines Project
U.S. EPA/Navajo Nation EPA
Water Sampling/Home Construction Survey

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY • REGION 9 • SAN FRANCISCO, CALIFORNIA • SEPTEMBER 1998

U.S. EPA to Test Water and Home Construction Materials in Monument Valley Area

The U.S. Environmental Protection Agency (USEPA) will continue its investigation of the abandoned uranium mines by taking water samples and checking home construction materials in the Monument Valley area of the Navajo Nation. The water and home construction surveys follow the helicopter survey which took place last fall to determine where radiation is located in this region. Information from that helicopter survey is being provided to the Chapters.

This investigation is the result of a request by the Navajo Nation Environmental Protection Agency (NNEPA) that USEPA assist in determining if the old, abandoned uranium mines currently pose a health risk to people in the area. If any health risks are found, that information will be presented to the affected Chapters with recommendations as to what measures should be taken to minimize such risk.

Water Sampling

Water that people use for drinking or cooking will be tested to determine if it contains uranium or other metals that are found in the earth around the old uranium mines. If these metals get into the water, they can cause health problems. USEPA will test water from wells, springs or any other sources in the communities surrounding the old mines. The water samples will be sent to a laboratory for analysis. Results from the laboratory tests will be available in about three months, and this information will be provided to the affected Chapters.

Home Construction

It is possible that rock from an old uranium mine was used in home construction. If a rock contains uranium, the radiation that comes out of it could cause health problems. USEPA will measure rocks used in home construction to see if there is any radiation.

IF YOU WOULD LIKE TO HAVE YOUR WATER OR HOME CONSTRUCTION MATERIALS SAMPLED BY USEPA, PLEASE CONTACT YOUR CHAPTER COMMUNITY SERVICES COORDINATOR.

Who to Contact With Questions or Concerns

USEPA and NNEPA will provide information on the results of our investigations to the Chapters as it becomes available. Please feel free to contact us or your Chapter officials if you have questions or concerns about the abandoned uranium mines. USEPA has a toll-free number which is listed below.

US EPA

Vicki Rosen
Community Involvement Coordinator
US EPA Region 9
75 Hawthorne St. (SFD-3)
San Francisco, CA 94105
(415) 744-2187 or
toll-free (800) 231-3075

Affected Navajo Nation Chapters

Oljato Chapter
(801) 727-3259
Kayenta Chapter
(520) 679-5520
Shonto Chapter
(520) 672-2460
Dennehotso Chapter
(520) 658-3300

Navajo Nation EPA

Stanley Edison/Eugene Esplain
NNEPA, Superfund Program
43 Crest Rd.
St. Michaels, AZ 86511
(520) 871-6859