FINAL RESULTS

August 2010

NAVAJO NATION

UNREGULATED WATER SOURCE SAMPLING RESULTS

OCTOBER 2009 SAMPLING EVENT

Drinking Water Office, WTR-6

USEPA Region 9

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San Francisco, CA 94105

SUMMARY

In October 2009, the Centers for Disease Control and Prevention (CDC), the Navajo Nation Environmental Protection Agency (NNEPA) and the Diné Network for Environmental Health (DiNEH) Project, in partnership with the United States Environmental Protection Agency Region 9 (USEPA), sampled 36 unregulated water sources on the Navajo Nation in the Eastern Agency and chapters in the South and North Central areas of the reservation. Based on data of acceptable quality, 12 water sources exceeded primary drinking water standards, including five sources that exceeded the primary drinking water standard for uranium.

Maximum Contaminant Level Exceedances[1]

Water Source	Chapter	Nearest Uranium Mine (Mine ID#)	Uranium Ppb	Arsenic ppb	Selenium ppb	Lead ppb	Nitrate mg/L
			MCL 30 ppb	MCL 10 ppb	MCL 50 ppb	Action Level 15 ppb	MCL 10 mg/L
Becenti Trail Spring	Church Rock	1 mile Grace Insitu Leach (309); <2 miles Church Rock (307)	110				
17-8 Snakewell	Greasewood Springs	<8 miles Gwen Claim (851)	31 32	19 20 20			
17H-146	Indian Wells	<10 miles Hoskie Tso No.1 (852)	65 67 69	47 48 51			
9Y-12[2]	Red Mesa	<6 miles Tom Morgan 1 (190) Barton 3 (220)	650 680 700		140 140 140	33 37 68	
16T-519[3]	Smith Lake	<1 mile Ruby 1 (321)	34	32			
17T-517	Steamboat			230			
17T-518	Steamboat			110			
17T-545	Steamboat			28 28 29			
17T-589	Steamboat			20			
17M-246	Steamboat			11			
17-6-1 Joseph Spring	Steamboat						12
PBOR Pedro well	Casamero						16

[1] Results shown include Quality Assurance field and laboratory duplicates.
[2] 9Y-12 was sampled by CDC in 2006/2007 and had uranium at 260 ppb.
[3] 16T-519 was sampled by USEPA in 2008 and had Uranium at 34 ppb and arsenic at 30 ppb.

INTRODUCTION

In October 2009, CDC, NNEPA, and the DiNEH Project, in partnership with USEPA, sampled 36 unregulated water sources on the Navajo Nation in the Eastern Agency and chapters in the South Central and North Central areas of the reservation.

PURPOSE AND NEED

This water sampling is part of a larger effort to investigate potential radioactivity and other related public health threats on the Navajo Nation. Previous water samples indicate that some unregulated water sources contain levels of uranium and other contaminants in excess of USEPA primary drinking water standards. Although NNEPA advises against using unregulated water sources for drinking water, some residents continue to haul drinking water from unregulated water sources. According to a 2004 study conducted by NNEPA, approximately 30% of Navajo Nation residents haul drinking water because they do not have piped water to their homes.

This sampling effort was primarily conducted to assess: (1) unregulated water sources near abandoned uranium mines for Superfund Site Screens in the Eastern Agency and Superfund Preliminary Assessments for Marino Lake and Moonlight Mines; and, (2) unregulated water sources identified by the CDC Investigation of Drinking Water Exposures in Dennehotso, Ganado, Lower Greasewood, Red Mesa and Steamboat chapters. The original sample list also included other water sources, in the same chapters as those sources identified above, that were either: recommended for sampling during the 2008 sampling event; recommended by the DiNEH project; or, had elevated levels of uranium from prior sampling (Navajo Uranium Resource Evaluation 1976-1979; United States Geological Survey and United States Army Corps of Engineers 1994-2004). An additional 12 sources were sampled based on field recommendations from representatives of local communities, the DiNEH Project, or NNEPA.

The sample results will be shared with residents and chapter officials to inform them about the quality of the water sources sampled. The results will also be used to assess impacts of abandoned uranium mines. For sources with uranium results in excess of the primary drinking water standard maximum contaminant level (MCL), solutions to minimize associated risks will be identified and implemented.

WATER SOURCES SAMPLED

A total of 72 water sources were visited October 12-19, 2009. Samples were taken from 36 sources in 16 chapters; samples were not taken from the remaining sources. Four teams performed the sampling, with representatives from CDC, NNEPA and the DiNEH Project. The following table identifies all sources sampled.

Water Sources Sampled

Well ID	Well Name	Chapter	Source Type	Latitude	Longitude
PBOR	Pedro Well	Casamero	Spring	35.50579	-108.12476
	Becenti Trail Spring	Church Rock	Spring	35.60084	-108.58712
16T-534	Superman 1	Church Rock	Windmill Well	35.59677	-108.64469
16T-608	Sundance	Church Rock	Windmill Well	35.51871	-108.63884
16K-336	Superman 2	Church Rock	Windmill Well	35.57262	-108.63694
16K-340		Church Rock	Windmill Well	35.59447	-108.59752
14M-4	Old School Windmill Well	Coyote Canyon	Windmill Well	35.77673	-108.61936
14T-538		Coyote Canyon	Windmill Well	35.71244	-108.52934
10-21-65 Well 17	Saten's pass Well	Crownpoint	Spring	35.60987	-108.12073
15-B-19	Tall House Ruin Windmill	Crownpoint	Windmill Well	35.67995	-108.11188
Unknown	Ronald E Tyree	Crownpoint	Artesian Well	35.82332	-108.06559
8K-436		Dennehotso	Windmill Well	36.806111	-110.024722
17-8	Snakewell	Greasewood Springs	Spring	35.444111	-109.899092
Unknown 1		Greasewood Springs	Windmill Well	35.510217	-109.85675
17H-146		Indian Wells	Sub pump	35.35066	-109.892987
Unknown 2		Iyanbito	Artesian Well	35.5144	-108.45242
16-4-16	Smith Well	Iyanbito	Spring	35.53508	-108.45155
Unknown 1	Pigeon Springs Well	Iyanbito	Spring	35.53125	-108.46418
8K-441		Kayenta	Windmill Well	36.7854	-110.078217
16T-323	Rock Canyon/Francisco	Mariano Lake	Windmill Well	35.61884	-108.31364
15T-529		Nahodishgish	Windmill Well	35.753917	-108.318936
Unknown 2, 15R318A	Happy Well	Nahodishgish	Windmill Well	35.69616	-108.23444
16T-535	Second Canyon Well	Pinedale	Windmill Well	35.5889361	-108.4808472
9Y-12		Red Mesa	Windmill Well	36.98758	-109.52805
16T-519		Smith Lake	Windmill Well	35.52314	-108.21259
17T-545		Steamboat	Windmill Well	35.738617	-109.759472
17-6-1	Joseph Spring	Steamboat	Spring	35.679633	-109.77105
17M-246		Steamboat	Windmill Well	35.6471	-109.831533
	No name/ID on well	Steamboat	Spring	35.755931	-109.846108
17T-589		Steamboat	Windmill Well	35.775806	-109.888639
17T-520	(Family Windmill)	Steamboat	Windmill Well	35.804722	-109.739722
17T-517		Steamboat	Windmill Well	35.613142	-109.847186
17T-518		Steamboat	Windmill Well	35.608056	-109.962847
17T-519		Steamboat	Windmill Well	35.665758	-109.945706
17K-338		Steamboat	Windmill Well	35.584133	-109.7663
14M-1	Plummer's Well 14 unk-004	Tohatchi	Other	35.77273	-108.69254

The following sources were not sampled. For the sources visited, field notes indicate the reason why many (but not all) of the sources were not sampled, as summarized below.

Water Sources Not Sampled

Well ID/Name	Chapter	Source Type	Latitude	Longitude	Reason not Sampled
Warehouse Well	Becenti		35.836513	-108.053664	No field notes
2 well cluster	Church Rock	NTUA valve	35.57068	-108.603223	NTUA valve
NW section of site	Church Rock	Capped well	35.616488	-108.589899	Capped
Tank	Church Rock	Empty tank	35.61694	-108.55313	Abandoned Tank
Road E of Site	Church Rock	NTUA valve	35.57288	-108.563913	NTUA valve
Pump	Church Rock		35.61694	-108.55313	Not found
30K Tank S of Eunice Bencenti mine site	Church Rock	NTUA Water Tank	35.50082	-108.64463	NTUA regulated tank
10K Tank W of Eunice Bencenti mine site	Church Rock	NTUA tank	35.50426	-108.64684	NTUA tank
NW section of site	Church Rock		35.616488	-108.589899	No field notes
S of site, compound	Coyote Canyon		35.662496	-108.503971	No field notes
S/SE of site, compound	Coyote Canyon		35.662496	-108.586367	Not found
Chapter House, 14K-302	Coyote Canyon	Hand pump	35.77442	-108.61888	Well was dry
14T-586	Coyote Canyon	Motor well	35.66199	-108.51544	Well was dry
14T324	Coyote Canyon	Livestock Well Spout	35.79436	-108.53184	Spout not working
	Coyote Canyon		35.72906	-108.62975	Well was dry
	Coyote Canyon	Windmill Well			Not able to collect water
Road Well	Crownpoint		35.833987	-108.058654	Not able to collect water
West of HRI Compound & Rocky Canyon Road	Crownpoint		35.68640	-108.21933	No field notes
17M-77	Ganado				Not able to collect water
Ganado Dam	Ganado				Not able to collect water
264	Ganado				Not able to collect water
191	Ganado				Not able to collect water
Sheep dip springs	Lower Greasewood	Spring			Well was dry
20 NN	Lower Greasewood				No field notes
20 LL	Lower Greasewood				No field notes
20 JJ	Lower Greasewood				No field notes
LO 8NN	Lower Greasewood				No field notes
II 14-J5	Lower Greasewood				No field notes
17K-306	Lower Greasewood	Windmill Well			Well was dry
17T-548	Lower Greasewood	Spring			Well was dry
17-3-4 Burnt House Dry Well	Lower Greasewood	Spring			Well was dry

Water Sources Not Sampled (continued)

Well ID/Name	Chapter	Source Type	Latitude	Longitude	Reason not Sampled
Helen Clark Well	Lower Greasewood	Other			Not in use
District 16	Mariano Lake	Unnamed spring	35.5508	-108.2894	No field notes
Fallen Windmill Well	Mariano Lake	Unknown			Inaccessible, road fenced off & vegetation overgrown
SE Corner of Mariano Lake AUM site	Mariano Lake		35.54589	-108.281454	Well was dry
16-T-555	Mariano Lake	Windmill Well	35.59823	-108.33272	Well was dry
16K-528 Chapter House Well	Mariano Lake	Hand pump-NTUA Line Broken	35.57678	-108.32467	Broken
N Compound NE Well	Nahodishgish		35.745671	-108.300123	Not able to collect water
N Compound NW well	Nahodishgish		35.745624	-108.300369	Not able to collect water
N Compound, near S well	Nahodishgish		35.745106	-108.300388	Not able to collect water
N Compound, far S well	Nahodishgish		35.741635	-108.30052	Not able to collect water
Lena Chee	Oljato				Not able to collect water
2.5 miles NE Moonlight mine	Oljato		36.978719	-110.246233	Not able to collect water
Seventh day Adventist 3 miles NE of moonlight mine	Oljato				Not able to collect water
Lobo	Pinedale		35.619441	-108.45345	Not able to collect water
Morgan Well	Pinedale		35.582449	-108.45345	Not able to collect water
G00012	Pinedale		35.657257	-108.510053	Not able to collect water
	08-50-0352-0	Steamboat			No field notes
	Livestock Well A	Steamboat	N. 40.776	W.46.261	No field notes

ANALYTICAL RESULTS

Three laboratories analyzed the water samples: Navajo Tribal Utility Authority (NTUA) for nitrate, nitrite and non-regulated water chemistry parameters; USEPA Region 9 Laboratory for metals; and, the USEPA National Air and Radiation Environmental Laboratory (NAREL) for radium 226 and 228, gross alpha and beta particles. Page 1 of this report summarizes the MCL exceedances for data of acceptable quality. A spreadsheet of sample results is included in Attachment 3. Attachment 4 contains the lab reports which will be made available upon request.

FINDINGS

The following are key findings.

- 12 water sources (33%) in 7 chapters exceeded the MCLs for uranium, arsenic, selenium, lead and/or nitrates.
- 5 water sources (14%) in 5 chapters exceeded the MCL for uranium.

- 1 water source (9Y-12) in Red Mesa had uranium at 650-700 ppb (20 times the MCL). This water source was sampled by CDC in 2006/2007 and had uranium at 260 ppb. The water source is within 6 miles of an abandoned uranium mine.
- Of the sources with uranium exceedances, 2 are within 1 mile of an abandoned uranium mine, and 3 are within 10 miles of an abandoned uranium mine(s).
- 9 water sources (12%) visited were dry.
- 5 water sources (7%) listed below lack signs indicating water is not for drinking.

Sources Lacking Signs Indicating Water is Not Safe to Drink

Well I.D./Name	Chapter
14M-1 Plummer Well	Tohatchi
14T-538	Coyote Canyon
15T-529	Nahodishgish
Unknown 1	Greasewood Springs
17K-338	Steamboat

QUALITY ASSURANCE

A Quality Assurance Sampling Plan (QASP) was prepared on 10/1/09 (Attachment 1). On 10/7/09, EPA Region 9's Laboratory provided training for CDC on the QASP. Prior to sampling, CDC conducted QASP training for sampling personnel. No changes were made to the QASP until it was fully executed on 11/12/09. The QASP identifies the analytical parameters and action levels.

USEPA Region 9's Quality Assurance Office conducted a data validation review (see Attachment 2). The review concluded that data for primary metals of concern are considered data of known and acceptable quality, except as noted below.

1. Nitrite results – USEPA cannot validate the reported nitrite results (80% of all samples had reported nitrite exceedances). EPA Region 9's Laboratory reviewed the nitrite results and the chromatogram provided by NTUA, and concluded that there appears to be an interferent that caused a baseline upset and broad tailing baseline shift that was misinterpreted as nitrite.

2. Gross alpha – NAREL's gross alpha results failed the matrix spike Quality Control acceptance criteria. To compensate for the presumptive low bias in the gross alpha sample results, USEPA divided the results by 0.73 as a conservative estimate.

3. All analyte resampling - Due to disagreement between calculated and measured dissolved solids, the two sources listed below should be resampled and analyzed for all analytes in

duplicate with additional detailed field documentation of sample homogeneity to rule out sampling and analytical error.

All Analyte Resampling Recommended

Water Source	Chapter
10-21-65 Well 17, Saten's Pass Well	Crownpoint
16-4-16 Smith Well	Iyanbito

4. Radionuclide resampling - Due to suggested possible data anomalies, the following eight sources should be resampled and analyzed for uranium, gross alpha, radium-226 and -228.

Radionuclide Resampling Recommended

Water Source	Chapter
Unknown 1, Pigeon Springs Well	Iyanbito
Unknown 2, Happy Well (15R318A DWR database)	Nahodishdish
15T-529	Nahodishgish
17T-517	Steamboat
17T-518	Steamboat
17T-519	Steamboat
17T-545	Steamboat
17T-589	Steamboat

5. Coliforms and *E. coli* – USEPA did not validate the coliform and *E. coli* data CDC collected using a new methodology because it was not included in the QASP. This data is included in Attachment 3.

6. 16T-535 location - This report and the attached spreadsheet of sample results identifies the location of well 16T-535 as 35.588936, -108.480847, based on Navajo Nation Department of Water Resources records. The sampling field notes indicate the location of this well is 35.39833 -108.48093; however, this location is off reservation about five miles south of Iyanbito chapter, in a wooded location with no visible roads or other structures (Google Earth).

DEVIATIONS FROM THE QASP

1. Sources Sampled

In the QASP, EPA identified 63 water sources to be sampled. Twenty-four of these water sources were sampled, and 39 sources were not sampled for various reasons (e.g., they could not be located with the limited information provided, they were dry or inoperable, they could not be access, or they were part of Navajo Tribal Utility Authority public water systems).

An additional 12 sources were sampled based on field recommendations from representatives of local communities, the DiNEH Project, or NNEPA. Below are the sample reasons for the original sample list and actual sources sampled.

Planned and Actual Sources Sampled by Sample Reason

Sample Reason	QASP Sample List	Actual Sources Sampled
1. Wells and other sources that exceeded uranium MCLs according to USACE sampling results in the Red Valley Atlas	2	1
3. Wells that exceeded the uranium MCL according to SRIC and NURE sampling results and data - Eastern Agency	4	3
4. Public water supply wells currently regulated or wells requiring regulatory attention	1	0
5. Sources added during Feb 26 - Mar 7, 200 8 sampling	2	0
6. Moonlight Mine Superfund Preliminary Assessment	2	0
7. USEPA Superfund Mariano Lake Preliminary Assessment	1	0
8. USEPA Superfund Eastern Agency Abandoned Uranium Mine Site Screens	18	2
9. DiNEH recommendations since 2008	14	11
12. CDC study area	19	7
13. Local communities identified during 10/09 sampling event	0	8
14. NNEPA identified during 10/09 sampling event	0	1
15. DiNEH identified during 10/09 sampling event	0	3
TOTAL	63	36

2. CDC collected coliforms and *E. coli* using a new methodology. These results were not included in the QASP and are the data was not validated. The results are included in the Attachment 3 Sample Results.

3. Two bottles were sent to NAREL for most samples, but only one bottle was intended for NAREL and the other was intended for the USEPA Region 9 Lab. NAREL sent the smaller 500mL bottle to the USEPA Region 9 Lab on 10/26/09.

4. Sample A9.08763 (08-50-F0085) for well 9Y-12 was sent to NAREL in error and was returned after it had been logged into the NAREL sample identification system.

RECOMMENDATIONS FOR FUTURE SAMPLING

Nitrites – Future sampling and analysis efforts should take extra precautions to obtain a robust nitrite data set and record complete field parameters (e.g., pH and temperature) for all samples.

USEPA Region 9 Lab recommends that for future sampling the lab attempt to decrease the effect of the interference by diluting the sample with column eluent at two times dilution.

Dissolved oxygen – It is recommended that future field sampling obtain dissolved oxygen and oxidation-reduction potential data (using a multi-parameter groundwater probe) to support data quality, particularly for the time-critical nitrite data.

FIELD ACTIVITIES

Attachment 5 contains an electronic file of field notes and photos which will be made available upon request.

CONCLUSION AND RECOMMENDATIONS

Consistent with previous sampling efforts, the results of this sampling effort indicate that some unregulated water sources include the following contaminants in levels exceeding primary drinking water standards: uranium, arsenic, selenium, lead, and nitrates.

The following next steps are recommended:

- Outreach should be conducted to inform residents about the findings of this report.
- Permanent warning signs should be posted at water sources with uranium exceedances.
- Signs advising that the water is not safe to drink should be painted on the 5 water sources that lack signs.
- Solutions should be identified and implemented to minimize health risks.
- The need for additional regulated water hauling points should be evaluated.
- Water infrastructure projects that would serve water hauling homes within 10 miles of the water sources with uranium exceedances should be identified and prioritized.
- Homes that cannot be connected to piped water in the near future should be considered for the Navajo Nation Department of Water Resources Water Hauling Feasibility Study and Pilot Program.

Attachment 1: Quality Assurance Sampling Plan – available upon request
Attachment 2: Quality Assurance Data Validation Memo
Attachment 3: Sample Results, and Water Sources Visited but Not Sampled
Attachment 4: Laboratory Results – available upon request
Attachment 5: Sampling Field Notes and Photos – available upon request