April 23, 2024

TO: James C. Kenney, Cabinet Secretary, New Mexico Environment Department

FROM: Michael E. Ketterer, PhD

SUBJECT: Detection limit and background activity ambiguities in DOE's self-reported IntellusNM data for plutonium in water, soil and sediment at/near Los Alamos National Laboratory

I am writing to offer technical comments to New Mexico Environment Department and the citizens of New Mexico, summarized as follows:

- LANL must follow best accepted scientific practices in its reporting and usage of detection limits in its Pu data published on IntellusNM;

- When LANL and/or its contractors submit samples to commercial radiochemistry laboratories, much more consistent alpha spectrometric detection limit performance is imperative in $^{239+240}$Pu monitoring, particularly for off-site surface water samples, and in deep onsite borehole solids;

- LANL ascribes an activity of 0.054 pCi/g $^{239+240}$Pu to "background" or "fallout" activity concentration expected in surface soil/sediment samples, tacitly implying that Pu detected below this threshold originates from non-LANL sources. LANL should be compelled to distinguish between fallout- and LANL-originating Pu in all of its environmental Pu monitoring results, using ^{240}Pu/^{239}Pu ratios measured by mass spectrometry, and to produce reliable, transparent information about the relative contributions of LANL vs. fallout in all samples. Mass spectrometry, which LANL has substantial resources/expertise available in-house, has the added advantage of being more sensitive than alpha spectrometry. Its implementation at LANL would significantly improve many existing, interrelated issues in the IntellusNM Pu data with poor LOD performance, occult LOD criteria, and the lack of Pu source apportionment information.

I write to NMED and to the citizens of New Mexico as a US citizen; I am a resident of Colorado and Arizona, and am also a chemist/environmental scientist with extensive research experience in the detection of, and chemical properties of plutonium and related actinides as environmental contaminants. As Professor Emeritus of Chemistry and Biochemistry at Northern Arizona University, I conduct field/lab work and perform *pro Bono* outreach to benefit citizens of New Mexico and many other states. I regularly publish peer-reviewed papers focusing on source/fate/transport of plutonium and related elements in environmental settings using inductively coupled plasma mass spectrometry; for examples of my peer-reviewed scientific work please see: https://scholar.google.com/scholar?hl=en&as_sdt=0%2C6&q=Ketterer+flagstaff+plutonium&oq=Ketterer . Kindly also refer to my previous comment to NMED on July 21, 2023; comments I made at an in-person meeting with NMED staff on August 17, 2023; and a written comment on comprehensive cleanup at MDA-C that I submitted to NMED on November 6, 2023.

Please also draw your attention to the just-released user-friendly LANL contamination map developed for public use by Nuclear Watch New Mexico: https://nukewatch.org/interactive-map-plutonium-contamination-and-migration-around-lanl/. I applaud NWNM's development of this map, as it represents a leap forward in the public's ability to visualize and comprehend the contaminant geospatial patterns contained in the vast archive of raw results in IntellusNM (https://www.intellusnm.com/index.cfm). Using draft versions of the map in collaboration with NWNM has helped elucidate my own understanding of LANL's contaminant footprint, and I recommend that NMED present LANL-related information to New Mexicans in formats such as the NWNM map.

In this letter, ***I am specifically requesting that NMED make the following requests of the Department of Energy in reference to its self-reported IntellusNM data for plutonium in water, soil and sediment at/near Los Alamos National Laboratory:***

1. LANL must follow best accepted scientific practices in its reporting and usage of detection limits;

2. When LANL and/or its contractors submit samples to commercial radiochemistry laboratories, much more consistent alpha spectrometric detection limit performance is imperative in $^{239+240}$Pu monitoring, particularly for off-site surface water samples, and in deep onsite borehole solids;

3. LANL shall be compelled to use mass spectrometry in most Pu environmental monitoring situations as a mandatory supplement or replacement for alpha spectrometry;

4. LANL shall cease to refer to 0.054 pCi/g $^{239+240}$Pu as an activity concentration representing "background value" or "fallout value" in soils/sediments, as there is no definite connection between a sample's Pu activity and its origin; instead, the Pu should be source-apportioned by mass spectrometry to clearly define the contributions from LANL vs. non-LANL (fallout) sources of Pu.

5. LANL shall be obligated to preserve, as physical evidence, all environmental samples for a period of six months following the date of publication of results on IntellusNM, and at NMED's written request, to provide splits, at DOE's own expense, of any off-site samples for independent testing by outside parties.

The balance of this letter serves to elaborate upon and to justify these requests. As in my previous communications, I offer to meet with NMED staff to discuss these comments.

In reporting low-activity alpha spectrometric results on IntellusNM for $^{239+240}$Pu in a variety of environmental media (e.g., soil, sediment, water, borehole solids), ***LANL does not follow generally accepted scientific***

practice, and fails to make clear statements of the detection limit, criteria for its determination, and does not provide raw lab results used for auditing calculations. Decades of precedent work in defining and evaluating limits of detection (LOD) includes highly cited sources such as Currie (1968), and Currie (1984). Modern chemical analysis textbooks for students and professionals alike contain essential presentations on LOD's and their interpretation (e.g., Harris and Lucy, 2019). Concepts of LOD's are taught in analytical chemistry courses, so that analytical data generators, customers of analytical laboratories, data reviewers/validators, and end users all uniformly understand the relevant principles, in order for different parties with disparate interests to agree, with clarity and transparency, as to what analytical results represent findings of "detected" vs. "not detected". In contrast to established practices in chemical analysis, users of DOE-posted IntellusNM radiochemical data are left befuddled, with no clear explanation offered for which detection limit values and protocol apply to any specific sample(s).

In all environmental monitoring, but especially in low-level detection situations, best scientific practices and peer-review processes obligate data generators to report data where LOD's and the protocols for attaining them are explicitly stated. The LOD's documented should be repeatable/reproducible; LOD's should follow reasonable limits of statistical control over long periods of time; the attained LOD's must consistently meet the needs of the monitoring situation, and should be subject to audits performed by the end user and third parties.

A cursory review of $^{239+240}$Pu activity data reported in IntellusNM reveals many specific situations where the reported $^{239+240}$Pu activities are quoted as extraordinarily high figures, while the result is nonetheless identified as "not detected" in IntellusNM. Some specific examples of these anomalous/inexplicably elevated LOD's are shown in Table 1. ***The surmised LOD's in these "not detected" situations are unreasonably high for alpha spectrometric measurements of $^{239+240}$Pu.*** This raises the question as to whether LANL and/or its contractors and labs are actually making deliberate efforts to artificially elevate LOD's, by using unrealistically short alpha source counting times and/or unreasonably small sample masses/volumes. From DOE's standpoint, the upshot of an ambiguous LOD situation is that it creates significant "gray area" where it is impossible for the lay public user of IntellusNM data to interpret whether, in reality, $^{239+240}$Pu contamination is present, or not.

Two examples of situations where the lack of transparency on LOD's generates unnecessary ambiguity are found in A) $^{239+240}$Pu activities in borehole solids from onsite locations, and B) $^{239+240}$Pu activities in surface water of the Rio Grande and its tributaries, offsite and downstream of LANL.

The LANL $^{239+240}$Pu activity data for onsite boreholes demonstrates that $^{239+240}$Pu has been transported by physicochemical processes to considerable depths; in some cases, plutonium is found more than 100 feet below grade. None of these deep borehole $^{239+240}$Pu readings are plausibly related to "fallout" from the atmospheric nuclear weapons tests; deposition from the Cold War-era tests is found within the top ~ 30 cm of soil (Kelley *et al*., 1999). Instead, Los Alamos is the imputed, single plausible source of any downcore-detected $^{239+240}$Pu activity. Nevertheless, onsite boreholes at LANL show examples of situations where $^{239+240}$Pu activities of 0.01 to 0.05 pCi/gram are inexplicably reported as not detected (i.e., IntellusNM displays the flags U and N in appropriate fields). One such example is found in samples collected from Location 21-24772, for which IntellusNM reports $^{239+240}$Pu results in pCi/g (Table 2). $^{239+240}$Pu is reported as being detected at two specific depths: at 10 feet depth, 0.119 pCi/g, and at 99 feet, 0.0524 pCi/g. In multiple additional depths, the reported results are in the range 0.01 – 0.05 pCi/g, and nevertheless, all such points at depths down to 335 feet are displayed in IntellusNM as not detected status. Accordingly, the LANL data cannot be used to address the common-sense question as to whether $^{239+240}$Pu has only migrated to 99 feet at 21-24772, or whether it has actually traveled to 335 feet. The levels of $^{239+240}$Pu which may/may not be present, equivalent to 0.37 to 1.9 Bq/kg, are detectable by alpha spectrometry on ~ one-gram samples using HASL or equivalent methods and experienced radiochemistry lab staff, and hence, one questions whether there is a concerted effort to ***not*** detect plutonium where it plausibly is present. In the case of deep boreholes such as 21-24772, the question about the potential presence of LANL-derived Pu, after migration to great depths, mandates application of monitoring techniques such as mass spectrometry with the lowest reasonably attainable LOD's, a task well within the scientific capabilities of the Laboratory.

Instead of providing citizens with the IntellusNM results of Table 2, LANL should transparently self-report to the public, all of its own, sophisticated low-level mass spectrometric results it has for 21-24772 and similar boreholes. It is safe to assume that LANL shows greater clarity and better practice towards *its own* scientific clients on Classified subject matter, than is reflected in some of the IntellusNM results; herein, New Mexicans (and all Americans) deserve better from LANL.

The presence of ambiguities and "gray areas" for $^{239+240}$Pu LOD's in LANL's IntellusNM database also encumbers interpretation of where/when plutonium is being detected in surface waters draining the LANL site, and flowing into the Rio Grande. ***Plutonium, whether in dissolved, colloidal, or suspended physical/chemical forms, is not a substance normally expected to be present in surface waters.*** In New Mexico, there are no enforceable, constituent-specific standards that are applicable to $^{239+240}$Pu, ^{238}Pu, ^{241}Am, or any other transuranium radioisotopes in water; New Mexico Section 20.6.4.114 sets a non-enforceable guideline of 1.5 pCi/liter for $^{239+240}$Pu in Rio Grande water.

In reviewing the off-site results for $^{239+240}$Pu activities in water reported by LANL on IntellusNM, one readily encounters situations where detection limits are inadequate to evaluate whether the State's public waters comply with the 1.5 pCi/L guideline. To wit, a series of surface waters collected from the Rio Grande in 2011-2012 near the Buckman Direct Diversion (BDD) intake reported detected $^{239+240}$Pu on multiple, non-consecutive dates in both years, with the highest being 3.6 pCi/L on August 21, 2011 (Table 3). At the same time, the IntellusNM database also reported samples as "N" under the Detected column, for other samples from 2012 and 2013, indicating that the "reported results" column values of 0.161 to 2.15 pCi/L for these four samples do not positively indicate the presence of $^{239+240}$Pu. This lack of specificity in LOD's cast unneeded doubt among users of the LANL IntellusNM data attempting to ascertain where/when any LANL-contaminated runoff is entering the Rio Grande, and whether the Rio Grande waters actually comply with the 20.6.4.114 guidance level of 1.5 pCi/L $^{239+240}$Pu.

Szabo *et al.* (2005) provides a good example of a non-DOE study, performed by the Federal government, exhibiting an appropriate level of thoroughness in specifying its alpha spectrometric detection limit criteria and in justifying the study's 0.10 pCi/L "laboratory reporting level" and < 0.10 "sample specific minimum detectable concentrations" for $^{239+240}$Pu in natural water. The USGS-USAF Szabo study sought to investigate, with the lowest routinely achievable LOD's, whether there were impacts to shallow groundwater from Pu dispersed from a 1960 Air Force missile silo fire at the Fort Dix BOMARC site in the New Jersey coastal plain; no contamination was found with a LRL of 0.10 pCi/L $^{239+240}$Pu in a clearly explicated report. ***Why cannot LANL achieve a similar degree of clarity, transparency and consistency in using detection limits and in all its reporting for $^{239+240}$Pu?***

Los Alamos' lack of consistency in the achieved LOD's, and ambiguity in its treatment of Pu detection limits in the presentation of IntellusNM data leads to vagaries in the public's ability to understand the relative risk posed by LANL-originating nuclides. For purposes of evaluating risk to human health, the most conservative/precautionary approach would be for one to assume that an analyte is present at the reported LOD, as a worst-case upper bound on the actual activity. Are we to assume, that the first sample shown in Table 3, water collected from the Rio Grande itself on September 12, 2013, contains 2.15 pCi/L$^{239+240}$Pu? Or, does it contain zero pCi/L? How should this sampling event be treated in the public's risk evaluation? How does LANL handle these situations? ***Is a 2.15 pCi/L "not detected" result for $^{239+240}$Pu, in a 2013 Rio Grande water sample, above the 1.5 pCi/L guidance level in 20.6.4.114, or is it not?***

The DOE fails to employ best scientific practice by exclusively using alpha spectrometry in its studies of LANL Pu impacts in the environment off-site; notwithstanding that, LANL publishes results on IntellusNM that clearly reflect flawed analytical performance.

The DOE should, instead, be using different forms of sensitive mass spectrometry for activity measurements and isotopic source elucidation in most of its environmental monitoring for $^{239+240}$Pu; this usage is critically needed in situations such as water measurements in the Rio Grande and tributaries, and in deep borehole solids. LANL has substantial experience, capability, and well-deserved respect among the world mass spectrometry community (e.g., Rokop *et al*., 1995; Inkret *et al*., 1998; Oldham *et al*., 2016), and is capable of performing the work in a straightforward manner on behalf of its most important client, the citizens of the USA and the people of New Mexico.

Were LANL to convert its $^{239+240}$Pu environmental monitoring analytical work to mass spectrometry, it would also clarify and unravel the misleading usage by LANL of the terms "background value" or "fallout value" (BV/FV). In its 2003 Investigation Workplan for Material Disposal Area C (LANL, 2003), a BV/FV of 0.054 pCi/g for ^{239}Pu (presumably, meaning $^{239+240}$Pu) is listed in Table B12 describing the frequency of radionuclide detection at MDA-C soil and fill samples. LANL is hence implying that a level of 0.054 pCi/g $^{239+240}$Pu can be automatically interpreted as having originated from non-LANL sources, namely, from 1950's-1960's atmospheric weapons test fallout from Nevada, Pacific, and Soviet sources. In assuming that this "background" level of $^{239+240}$Pu is present in any sample, LANL avoids accountability and responsibility for having contaminated many media, both on-site and off-site, at levels both well above as well as, below, this threshold.

It is incorrect to conclude that a soil/sediment's $^{239+240}$Pu must originate from BV/FV sources because of its activity < 0.054 pCi/g; there is no *a priori* relationship between a sample's $^{239+240}$Pu and its origin. To wit, I can personally cite soil samples that I have collected in public areas near LANL, having activities resembling LANL's BV/FV, yet my own mass spectrometric data show that essentially 100% of the Pu originates from LANL. At the same time, I can also cite examples of soil samples I've collected/analyzed from elsewhere in New Mexico having $^{239+240}$Pu exceeding 0.054 pCi/g, yet essentially 100% of the $^{239+240}$Pu is fallout-derived. Nevertheless, it is appropriate and conservative to assume that essentially all of the high activity $^{239+240}$Pu readings in IntellusNM (e.g., contaminated sediments in Los Alamos Canyon) are accounted for by LANL Pu sources.

In the absence of appropriate mass spectrometry results for lower-activity samples, LANL is not justified in claiming that the Pu in a specific sample is from non-LANL sources. NMED should compel LANL to cease presenting information by comparing activities to a BV/FV value, and instead, should transparently tell the public "how much is ours" in all future IntellusNM data presented to the public.

New Mexicans should expect to see better outcomes, and better furtherance of the State's specific interests from the staff at Los Alamos National Laboratory, particularly in light of the generous Federal support the lab receives. The Lab is not shy in reminding the public about hosting some of the country's brightest scientists; New Mexicans deserve to see some of the Lab's best scientific efforts being used to protect the public health of its neighbors and the quality of its own environment.

Respectfully submitted:

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	A	B	C	D	E	F	G	H	I	J	K
1	**Field Sample ID**	**Location ID**	**Sample Date**	**Parameter Name**	**Report Result**	**Report Units**	**Lab Qualifier**	**Detected**	**Sample Matrix**	**Latitude (Decimal)**	**Longitude (Decimal)**
2	RE00-22-238224	00-248	1/24/22	Plutonium-239/240	12.4	pCi/g	U	N	SO		
3	WST00-21-234405	WST-600902	9/8/21	Plutonium-239/240	2.38	pCi/g	U	N	SO	35.8935201	-106.3186835
4	RE00-22-248957	00-61590	4/5/22	Plutonium-239/240	2.3	pCi/g	U	N	SO	35.8783844	-106.2883345
5	RE09-23-269552	09-305	2/18/23	Plutonium-239/240	2.24	pCi/g	U	N	SO	35.8587797	-106.3458707
6	RE00-22-248889	00-61568	3/30/22	Plutonium-239/240	1.86	pCi/g	U	N	SO	35.8787005	-106.2882566
7	WST00-21-234408	WST-600902	9/8/21	Plutonium-239/240	1.84	pCi/g	U	N	SO	35.8935201	-106.3186835
8	RE00-22-238149	00-214	1/4/22	Plutonium-239/240	0.974	pCi/g	U	N	SO	35.8787191	-106.2882953
9	RE00-22-248970	00-61594	4/7/22	Plutonium-239/240	0.92	pCi/g	U	N	SO	35.8788652	-106.2882399
10	CAMO-23-259371	MO-61334	11/22/22	Plutonium-239/240	0.919	pCi/g	U	N	SED	35.8608837	-106.2700662
11	RE39-22-253638	39-61740	10/5/22	Plutonium-239/240	0.8	pCi/g	U	N	SO	35.8063183	-106.2632824
12	WST00-22-239559	WST-600902	12/21/21	Plutonium-239/240	0.644	pCi/g	U	N	SO	35.8935201	-106.3186835
13	RE09-22-255412	Sep-43	8/26/22	Plutonium-239/240	0.62	pCi/g	U	N	SO	35.8584128	-106.3463177
14	RE39-22-253608	39-61738	9/21/22	Plutonium-239/240	0.472	pCi/g	U	N	SO	35.8072069	-106.2641273
15	ASER-23-259525	MO-61334	11/22/22	Plutonium-239/240	0.472	pCi/g	U	N	SED	35.8608837	-106.2700662
16	RE39-22-253465	39-61713	10/5/22	Plutonium-239/240	0.437	pCi/g	U	N	SO	35.806386	-106.2634845
17	RE09-23-269737	09-318	2/24/23	Plutonium-239/240	0.431	pCi/g	U	N	SO	35.8551293	-106.3420281
18	RE39-22-253580	39-61734	10/8/22	Plutonium-239/240	0.401	pCi/g	U	N	SO	35.806916	-106.2640054
19	RE39-22-253627	39-61742	9/26/22	Plutonium-239/240	0.384	pCi/g	U	N	SO	35.8076119	-106.2655181
20	RE39-22-253437	39-61707	9/23/22	Plutonium-239/240	0.373	pCi/g	U	N	SO	35.8075148	-106.2654363
21	RE39-22-253474	39-61714	10/5/22	Plutonium-239/240	0.339	pCi/g	U	N	SO	35.8064911	-106.2635796
22	CAMO-23-259370	MO-61333	11/28/22	Plutonium-239/240	0.334	pCi/g	U	N	SED	35.8651791	-106.295293
23	RE39-22-253436	39-61707	9/23/22	Plutonium-239/240	0.327	pCi/g	U	N	SO	35.8075148	-106.2654363
24	RE00-22-249993	00-61644	4/21/22	Plutonium-239/240	0.316	pCi/g	U	N	SO	35.877917	-106.2884973
25	RE00-22-251004	00-61681	5/18/22	Plutonium-239/240	0.313	pCi/g	U	N	SO	35.8784228	-106.2876722
26	RE00-22-251001	00-61678	5/18/22	Plutonium-239/240	0.311	pCi/g	U	N	SO	35.8784117	-106.287444
27	RE00-22-248929	00-61581	4/1/22	Plutonium-239/240	0.308	pCi/g	U	N	SO	35.878834	-106.2882168
28	WST00-22-239569	WST-600902	1/5/22	Plutonium-239/240	0.3	pCi/g	U	N	SO	35.8935201	-106.3186835
29	RE39-22-253582	39-61734	10/8/22	Plutonium-239/240	0.295	pCi/g	U	N	SO	35.806916	-106.2640054
30	RE39-22-253473	39-61714	10/5/22	Plutonium-239/240	0.258	pCi/g	U	N	SO	35.8064911	-106.2635796
31	RE00-22-250997	00-61674	5/18/22	Plutonium-239/240	0.25	pCi/g	U	N	SO	35.8784008	-106.2875189
32											

Table 1. Examples of results for $^{239+240}$Pu activities in soil and sediment, reported on IntellusNM as being not detected, in spite of having very high reported activities on a pCi/g basis.

1	**Sample 21-24772**	
2	**Depth**	**239+240Pu pCi/g**
3	360	0.00308
4	360	-0.0246
5	340	0.0099
6	340	-0.0033
7	**335**	**0.0245**
8	335	-0.0105
9	230	0.00737
10	230	-0.00184
11	227	0.00388
12	227	0.00968
13	172	7.33E-10
14	**172**	**0.0307**
15	150	-0.0109
16	150	0.0218
17	150	0
18	**150**	**0.041**
19	99	0.0123
20	**99**	**0.0524 Detected**
21	**99**	**0.025**
22	99	0.0179
23	45	-0.00286
24	45	0.0143
25	35	-0.00322
26	35	0.0129
27	25	0.00626
28	25	0.0125
29	15	-0.0037
30	**15**	**0.0444**
31	**10**	**0.00312**
32	**10**	**0.119 Detected**
33	0.5	0.00572
34	**0.5**	**0.0372**

Table 2. Results for $^{239+240}Pu$ activities, in pCi/gram, for borehole sediment samples from 21-24772.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
Site ID	**Field Sample ID**	**Location ID**	**Sample Date**	**Parameter Name**	**Report Result**	**Report Units**	**Lab Qualifier**	**Detected**	**Sample Time**	**Latitude**	**Longitude**	**Filtered**	**COC #**	**Lab Method**
N3B	BDDRIO-13-42038	Rio Grande at BDD Intake	9/12/13	Plutonium-239/240	2.15	pCi/L	U	N	21:16	35.8362399	-106.16182	N	2013-2025	HASL-300:ISOPU
N3B	BDDRIO-12-13736	Rio Grande at BDD Intake	7/11/12	Plutonium-239/240	0.939	pCi/L	U	N	22:03	35.8362399	-106.16182	N	2012-2072	HASL-300:ISOPU
N3B	BDDRIO-12-13735	Rio Grande at BDD Intake	7/11/12	Plutonium-239/240	0.93	pCi/L	U	N	21:18	35.8362399	-106.16182	N	2012-2072	HASL-300:ISOPU
N3B	BDDRIO-13-34348	Rio Grande at BDD Intake	9/11/13	Plutonium-239/240	0.161	pCi/L	U	N	1:38	35.8362399	-106.16182	N	2013-1889	HASL-300:ISOPU
N3B	BDDRIO-11-22429	Rio Grande at BDD Intake	8/21/11	Plutonium-239/240	3.6	pCi/L		Y	18:58	35.8362399	-106.16182	N	Nov-90	HASL-300:ISOPU
N3B	BDDRIO-11-22555	Rio Grande at BDD Intake	8/21/11	Plutonium-239/240	1.95	pCi/L		Y	20:28	35.8362399	-106.16182	N	Nov-90	HASL-300:ISOPU
N3B	BDDRIO-11-22517	Rio Grande at BDD Intake	8/3/11	Plutonium-239/240	1.81	pCi/L		Y	18:27	35.8362399	-106.16182	N	Nov-02	HASL-300:ISOPU
N3B	BDDRIO-12-13737	Rio Grande at BDD Intake	7/11/12	Plutonium-239/240	1.42	pCi/L		Y	22:52	35.8362399	-106.16182	N	2012-2072	HASL-300:ISOPU
N3B	BDDRIO-11-22519	Rio Grande at BDD Intake	8/21/11	Plutonium-239/240	0.797	pCi/L		Y	19:44	35.8362399	-106.16182	N	Nov-90	HASL-300:ISOPU
N3B	BDDRIO-11-22520	Rio Grande at BDD Intake	8/27/11	Plutonium-239/240	0.62	pCi/L		Y	19:07	35.8362399	-106.16182	N	Nov-26	HASL-300:ISOPU
N3B	BDDRIO-11-22553	Rio Grande at BDD Intake	8/3/11	Plutonium-239/240	0.617	pCi/L		Y	19:12	35.8362399	-106.16182	N	Nov-02	HASL-300:ISOPU
N3B	BDDRIO-11-22544	Rio Grande at BDD Intake	8/27/11	Plutonium-239/240	0.499	pCi/L		Y	19:52	35.8362399	-106.16182	N	Nov-26	HASL-300:ISOPU
N3B	BDDRIO-11-22536	Rio Grande at BDD Intake	8/26/11	Plutonium-239/240	0.22	pCi/L		Y	21:17	35.8362399	-106.16182	N	Nov-26	HASL-300:ISOPU
N3B	BDDRIO-11-22512	Rio Grande at BDD Intake	7/28/11	Plutonium-239/240	0.216	pCi/L		Y	19:24	35.8362399	-106.16182	N	Nov-19	HASL-300:ISOPU
N3B	BDDRIO-11-22550	Rio Grande at BDD Intake	7/28/11	Plutonium-239/240	0.18	pCi/L		Y	20:09	35.8362399	-106.16182	N	Nov-19	HASL-300:ISOPU
N3B	BDDRIO-11-22513	Rio Grande at BDD Intake	8/26/11	Plutonium-239/240	0.171	pCi/L		Y	20:32	35.8362399	-106.16182	N	Nov-26	HASL-300:ISOPU
N3B	BDDRIO-11-22427	Rio Grande at BDD Intake	7/28/11	Plutonium-239/240	0.161	pCi/L		Y	18:39	35.8362399	-106.16182	N	Nov-19	HASL-300:ISOPU

Table 3. $^{239+240}Pu$ activities in water samples collected in 2011-2013 from the Rio Grande, at the BDD inlet, as reported on IntellusNM. Note the lack of consistency in LOD performance for the first four samples in comparison to the other samples.