



**DOE Oversight Bureau  
Investigations at the Buckman Direct  
Diversion**

Distribution of Radionuclides in Northern Rio  
Grande Fluvial Deposits near Los Alamos National  
Laboratory New Mexico

April 2007

<ftp://ftp.nmenv.state.nm.us/www/doe/publications/lanl/2007DistRadRioLANL.pdf>

Contaminant Study at the Buckman Direct Diversion

August 2008

<ftp://ftp.nmenv.state.nm.us/www/doe/publications/lanl/2008ContamBuckman.pdf>



## 2007 Study

- Identified radionuclide contamination along the Rio Grande originating from LANL.
- At the Cañada Ancha Site, an abandoned channel (slough) near the Buckman Direct Diversion (BDD), we sampled 12 intervals along a 11 foot deep core.
- We expected and found contaminant concentrations to be low and investigated multiple methods to identify LANL impacts.
- Concentrations were near (above and below) established background values (McLin and Lyons, 2002) or statistically derived background reference levels for Rio Grande sediments.



# Results

- The highest levels of most radionuclides were found at the 40 to 43 inch (101 cm – 110 cm) deep interval within a four foot thick clay lens.
- The highest concentration of total uranium of 5.98 mg/kg is 1.3 times background level of 4.49 mg/kg
- The highest concentration of Cs-137 of 0.98 pCi/g is 1.75 times background level of 0.56 pCi/g.
- The highest concentration of Pu-239/240 of 0.067 pCi/g is 5 times the background level of 0.013 pCi/g.
- Pu-238, Am-241, and Sr-90 results were less than background levels in all intervals sampled.

	101 - 110 cm (40"- 43") interval	Highest concentration found at any interval	BGUL	Comparison to BGUL
Total Uranium (mg/kg)	5.98	5.98	4.49	1.3
Cs-137 (pCi/g)	0.60	0.98 (54" - 64")	0.56	1.75
Pu-238 (pCi/g)	0.0056	0.0056	0.0087	<BGUL
Pu-239/240 (pCi/g)	0.067	0.067	0.013	5.2
Am-241 (pCi/g)	0.026	0.029	0.076	<BGUL
Sr-90 (pCi/g)	0.36 (ND)	0.64 (ND) (54" – 64")	1.02	<BGUL



## 2008 Study

- Determine the downstream extent of the slough identified in first study and whether planned construction activities would intercept the slough.
- 10 boreholes along and perpendicular to the proposed construction were sampled at an interval predicted to be at the same elevation of the clay lens found in the previous study. The clay lens was not found in any of these holes.
- Another borehole was sampled within the slough near its southernmost extent. Two intervals were sampled within the clay lens found in this hole.



# Results

- All radionuclides were below their background reference values in the 11 boreholes along and perpendicular the proposed construction for the BDD.
- Again, the highest levels all radionuclides were found in the clay lens in the two samples from the slough and were near (above and below) their background reference values.
- The highest concentration of Cs-137 was 1.70 pCi/g which is 3 times the background level of 0.56 pCi/g.
- The highest concentration of Pu-239/240 was 0.1 pCi/g which is approximately 8 times the background level of 0.013 pCi/g.
- Pu-238, Am-241, and Sr-90 results were less than background levels in all intervals sampled.

	(51" -60") Interval	BGUL	Comparison to BGUL
Cs-137 (pCi/g)	1.70	0.56	3.0
Pu-238 (pCi/g)	0.0029 (68" - 84")	0.0087	<BGUL
Pu-239/240 (pCi/g)	0.1	0.013	7.7
Am-241 (pCi/g)	0.026	0.076	<BGUL
Sr-90 (pCi/g)	0.51 (ND)	1.02	<BGUL



# How Legacy Contaminants are Identified

- Compare individual radionuclide concentrations to background reference values. This is the most commonly used method. There are multiple reference values available, and the environment contains a fair amount of variability.
- Thermal Ionization Mass Spectrometry (TIMS). This determines the ratio of Pu-240 to Pu-239 atoms in each sample. Identifies the percent of Pu-239/240 attributable to LANL as compared to plutonium derived from atmospheric testing fallout. TIMS analysis showed 38% to 99% (average 44%) of the plutonium in the Cañada Ancha site at depth was due to historical (1958 through 1967) LANL releases.
- Radiological risk assessment exercise for a group of measurements in each sample. This calculation integrates all of the radionuclides found in each sample and allows comparison with other sample locations.



# Rad Risk Exercise

- Used the Superfund Preliminary Remediation Goal (PRG) for Radionuclides Risk Calculator. [http://epa-prgs.ornl.gov/radionuclides/prg\\_search.shtml](http://epa-prgs.ornl.gov/radionuclides/prg_search.shtml)
- Used the overly conservative Residential Scenario which includes direct ingestion of soil, inhalation of fugitive dusts, external exposure to radionuclides in the soil, and ingestion of homegrown produce.
- Exposure period is 6 years as a child and 24 years as an adult for a total of 30 years.
- All measured radionuclides are included in the assessment, including natural occurring elements and values reported below background and analytical detection levels.
- Values from the buried, 3 foot thick clay layer were used to reflect a residential exposure for the entire interval that extends from 0 to 10 feet.
- Calculated the risk due to each radionuclide and summed to determine total risk.
- Results of exercise showed a clear difference (4 times higher) between the Cañada Ancha site and the upstream Santa Clara site (Reference Site).





# South Fork Acid Canyon Cleanup Level for Plutonium at LANL

- In 2001, LANL conducted a cleanup of South Fork Acid Canyon in Los Alamos County.
- LANL used soil cleanup levels (Single Radionuclide Soil Guidelines or SRSGs) generated by the Extended Backyard Scenario developed by LANL and NMED.
- In 2005, the Institute for Energy and Environmental Research (IEER) evaluated the SRSGs used by LANL and while their report recommended more conservative assumptions in some cases it also noted where LANL's assumptions were over conservative in other cases.
- The report states "Finally, the soil guidelines derived by Los Alamos for this scenario are about right due to the approximate canceling of over and underestimates in the *Interim Report*".
- The SRSG for Plutonium 239/240 for the Extended Backyard Scenario is 280 pCi/g as compared to the maximum value of 0.1 pCi/g found in the slough at the Buckman Direct Diversion. The levels found in the slough are nearly 3,000 times less than the cleanup goals in South Fork Acid Canyon.



# Conclusions

- The slough located north (upstream) from the Buckman Direct Diversion has LANL legacy contaminants buried from 3 to 6 feet deep.
- The contaminants are near (above and below) regional statistical reference values or Background Upper Limits (BGULs) for Rio Grande sediments established by McLin in 2002.
- Concentrations of Pu-239/240 are three orders of magnitude lower than the single radionuclide soil guideline for the extended backyard scenario used in the South Fork Acid Canyon cleanup.
- The DOE Oversight Bureau believes the concentrations of contaminants in the slough are unlikely to result in adverse health impacts to the public.
- The DOE Oversight Bureau does not believe there is a need for further characterization, fate and transport assessment or signage at the Buckman Direct Diversion project area.

