ANNOTATED BIBLIOGRAPHY OF SELECTED CERRO GRANDE FIRE PUBLICATIONS

Los Alamos National Laboratory Report
LA-UR-03-8730

INTRODUCTION

The purpose of this selected bibliography is to provide interested persons in northern New Mexico with a concise overview of reports related to the Cerro Grande fire, including related findings. Annotations are provided for reports which focus on the direct impacts of the fire. Because of their broader scope, environmental surveillance reports containing fire recovery details are referenced in the bibliography without annotation.

The reports are organized into seven categories:

1. **Human health impact**
2. **Soils and foodstuffs**
3. **Water quality**
4. **Air quality**
5. **Fire descriptions**
6. **Fire recovery**
7. **Ecology**

All of the reports are available in the form of PDF files downloadable from a central Web site (http://em.lanl.gov/cerrogrande.htm) hosted by the Risk Reduction and Environmental Stewardship Division of Los Alamos National Laboratory. Documents preceded by ☑ are compiled in a printed information kit that is available upon request from the Division's Meteorology and Air Quality group, (505) 665-8855.

BIBLIOGRAPHY

1. Human Health Impact

☑ Bare, C., "Procedure for Identification, Removal, and Disposition of Potentially Contaminated Trees from Los Alamos National Laboratory Technical Areas," Los Alamos National Laboratory report LA-UR-01-6855 (December 2001).

Outlines the procedures for the distribution of firewood from Laboratory property, which ensures that all potentially contaminated trees are retained on Laboratory property. A companion document to R. Merker's "Firewood Distribution" memorandum.

☑ Gonzales, G.J., et al., "Contaminant Concentrations in Conifer Tree Bark and Wood Following the CerroGrande Fire," Los Alamos National Laboratory report LA-UR-01-6157 (November 2001).

An analysis of data from the measurement of radioactivity in bark and wood samples from ponderosa pine trees felled in Mortandad Canyon as part of a hazard reduction effort after the Cerro Grande fire, as well as preliminary estimates of radiation dose to the public that could result from burning trees and wood water material. The report concluded that no health effects were expected.

☑ New Mexico Environment Department, "IFRAT Risk Model: Purpose, Construction, and Results," New Mexico Environment Department, Santa Fe, NM (2000). http://www.nmenv.state.nm.us/ifrat/ (accessed 2003).

IFRAT (Interagency Flood Risk Assessment Team), a consortium of organizations established to integrate communications and deliver information on flood and contaminant risks related to the aftermath of the Cerro Grande fire, models potential risks using concentrations of chemicals and radionuclides measured in ash, sediment, groundwater, and surface water. The IFRAT model is a spreadsheet-based analysis that uses equations to conservatively calculate risk according to variables, using EPA default parameters when available. The results showed no substantial change in potential adverse or chronic health effects as a result of the fire. Of the radionuclides of potential concern (strontium-90, cesium-137, and thorium-228), only cesium-137 increased in concentration after the fire. The conclusion of the IFRAT risk assessment is that there is no substantial increase in overall risk as a result of the materials transported by floods following the fire.

Kraig, D.H., et al., "Radiological and Nonradiological Effects after the Cerro Grande Fire," Los Alamos National Laboratory report LA-13914 (March 2002).

Estimated potential radiological and nonradiological effects from the fire that might have been experienced downstream due to flooding in watersheds containing residual contamination from early Los Alamos operations. While observations and sampling showed that the fire's aftereffects did include increased concentrations of chemicals in runoff and in sediments deposited during calendar year (CY) 2000, the cause was thought to be the increased mobilization of locally deposited worldwide fallout or of naturally occurring substances that were concentrated by the fire. When the source of the effects could not be determined, the effects were calculated independent of source. Calculated CY 2000 exposures were not considered sufficient to cause health effects in exposed individuals.

☑ Kraig, D.H., et al., "Updated Calculation of the Inhalation Dose from the Cerro Grande Fire Based on Final Air Data," Los Alamos National Laboratory report LA-01-1132 (February 2001).

A recalculation of the preliminary dose assessment that calculated the inhalation dose of radionuclides received during the Cerro Grande fire by fire workers and members of the public. This report expands on preliminary data from the Laboratory's ambient air monitoring network (AIRNET), to provide final air monitoring calculations based on data available as of December 2000. In addition to routine analyses, AIRNET samples were analyzed for lead and polonium, which may have become airborne during the fire. Dose calculations for lead, polonium, and bismuth, when compared with the doses received each year from natural background radiation in northern New Mexico, are insignificant. Dose calculations for uranium isotopes also indicate very small radiological doses. No health effects are expected to occur as a result of radiological intakes during the fire, and no toxicological health effects are expected from potential exposures.

☑ McKinney, P., "Cerro Grande Fire and Heavy Metals: What Does It Mean?" New Mexico Poison Center, University of New Mexico Health Sciences Center, Albuquerque, NM (undated).

A comparison study of levels of nickel, uranium, cesium, and chromium in blood samples drawn from unexposed people and exposed workers at 12 U.S. population sites including New Mexico. An unexpected finding of the study was that people in both groups had above-reference (but not necessarily toxic) levels of each of the specified heavy metals in their urine, but in the New Mexico samples, smoke exposure during the Cerro Grande fire was not associated with increases in urinary heavy metals. Other potential sources of heavy metals include food supplements and such food products as cocoa, dried beans, oatmeal, and soy. The study highlights the fact that New Mexico populations have lower-than-national-average rates of lung, nasal, and larynx cancers associated with chromium and nickel.

☑ Ramsey, B.A., "Firewood Distribution," letter to R. Merker (April 8, 2003).

A memorandum from Los Alamos National Laboratory written in response to an inquiry from the New Mexico Department of Health's Office of Epidemiology regarding the possible health risks of firewood originating on Laboratory property. Dosages from cutting, splitting, and carrying the wood, inhaling the wood smoke, carrying and inhaling the ash, and proximity to the ash while it is stored are calculated. The Laboratory's conclusions are set forth. (Also see C. Bare's report, "Procedure for Identification, Removal, and Disposition of Potentially Contaminated Trees from Los Alamos National Laboratory Technical Areas," above.)

☑ Risk Assessment Corporation, "Fact Sheet: Cerro Grande Fire," New Mexico Environment Department (undated).

The RAC Fact Sheet summarizes background information and findings about primary health risks to the public as a result of the fire, itemizes the nature of the releases to the air during the fire, specifies study methods and limitations, and graphically illustrates the area taken into account in the study.

☑ Risk Assessment Corporation, "SUMMARY REPORT. Analysis of Exposure and Risks to the Public from Radionuclides and Chemicals Released by the Cerro Grande Fire at Los Alamos," New Mexico Environment Department, RAC Report No. 5-NMED-2002-FINAL (June 2002), http://www.nmenv.state.nm.us/DOE_Oversight/rac/Summary_Report.pdf (accessed 2003).

Information contained in the RAC Report "Analysis of Exposure and Risks to the Public from Radionuclides and Chemicals Released by the Cerro Grande Fire at Los Alamos," came from an independent study performed by the Risk Assessment Corporation on 815,000 acres and selected locations outside the primary study area, at the request of the New Mexico Environment Department and funded by the U.S. Department of Energy. The SUMMARY REPORT is a four-page summary of the information that is provided in more detail in the final reports. It reiterates the fire and study background and an overview of results from the study group's tasks: analysis of estimated risks from releases to air and surface water, and a statement of the scope and intent of observations and recommendations made in the final study regarding calculating and communicating risks.

Soholt, L.F., "Environmental Radiological Dose Assessment," in "Environmental Surveillance at Los Alamos during 2000," Los Alamos National Laboratory report LA-13861-ENV, Chap. 3, p. 69 (October 2001).

Webb, M.D., and K. Carpenter, "The Cerro Grande Fire, Los Alamos, New Mexico," Los Alamos National Laboratory report LA-UR-01-1630 (March 2001).

How lessons learned from past wildfires mitigated the Cerro Grande fire's damaging effects. Fire ecology, smaller wildfires occurring in and around Los Alamos in 1954 and 1977, and new lessons learned from the Cerro Grande fire are discussed.

☑ Wolfe, M., "Investigation of Heavy Metals, Cerro Grande Fire, Los Alamos, New Mexico," CDC Epi-Aid 2000-40 (May 2000).

Routine environmental monitoring in Los Alamos after the fire showed acceptable (background) levels of metals in most samples. Levels of particulate matter were low in all areas surround the Laboratory except for Technical Area 54, where the levels were elevated on two days during the fire. Samples taken in the town of Los Alamos revealed air concentrations of asbestos to be 10 times below occupational standards. Radiation and metal monitoring showed radioactive material concentrations in the Los Alamos area to be well below regulatory levels for safety, and revealed only very low concentrations of volatile organic compounds (toluene, benzene), polyaromatic hydrocarbons (pyrene), and metals at six monitoring sites around the Laboratory from May 12–17. In subsequent human testing, which was recommended for heavy metals but not for asbestos and radiation exposures, questionnaires were distributed among groups most exposed to smoke—firefighters, National Guard, city and state police, and residents of Española—and urine samples were requested. Data did not show that metals detected in the sample populations were associated with wildfire smoke exposure. It did identify an unexpectedly large number of people with uranium, cesium, chromium, and nickel levels that exceeded levels in the general U.S. population. The report discusses the standards applied in the analysis and the relevance of above-normal metal levels.

2. Soils and Foodstuffs

Fresquez, P.R., et al., "Effects of the Cerro Grande Fire (Smoke and Fallout Ash) on Soil Chemical Properties Within and Around Los Alamos National Laboratory," Los Alamos National Laboratory report LA-13769-MS (November 2000).

Reports on radionuclides, radioactivity, and heavy metal trace elements found in soil surface samples collected from areas within and around the Laboratory just after the fire and compared to soil samples collected in 1999. Results showed that smoke and fallout ash from the fire had very minimal impacts on regional, perimeter, and Laboratory sites.

☑ Fresquez, P.R., et al., "Effects of the Cerro Grande Fire (Smoke and Fallout Ash) on Possible Contaminants in Soils and Crops Downwind of Los Alamos National Laboratory," Los Alamos National Laboratory report LA-13842-MS (June 2001).

This report compared soils and crops downwind from the fire to soils and crops upwind and to regional concentrations from previons years. Researchers examined radionuclide concentrations, trace elements, and organic constituents at farming locations in Abiquiu, Embudo, Española Valley, Ojo Sarco, Pecos, Cochiti (Sile), Peña Blanca, San Ildefonso, El Rancho, Arroyo Seco, and La Puebla. They concluded that the fire did not significantly affect the soil and crop resources of farming communities downwind.

Soholt, L.F., "Soil, Foodstuffs, and Associated Biota," in "Environmental Surveillance at Los Alamos during 2000," Los Alamos National Laboratory report LA-13861-ENV, Chap. 6, p. 408 (October 2001).

3. Water Quality

Bitner, K.A., et al., "Review of Wildfire Effects on Chemical Water Quality," Los Alamos National Laboratory report LA-13826-MS (May 2001).

Summarizes the reported effects of fire on runoff water chemistry and on soils that contribute to runoff water chemistry, with the aim of providing a context for understanding changes noted in the composition of runoff water—particularly, increases in inorganic components and pH.

Gallaher, B.M., et al., "Quality of Storm Water Runoff at Los Alamos National Laboratory in 2000 with Emphasis on the Impacts of the Cerro Grande Fire," Los Alamos National Laboratory report LA-13926 (May 2002).

This report evaluated the possible water quality impact to water bodies downstream of Los Alamos through runoff monitoring and sampling at more than 40 sites. Samples were analyzed for radionuclide, metal, inorganic, and organic constituents and results were compared with historical levels and relevant standards. Spatial and temporal trends were considered. Most of the radionuclides and metals found in samples were bound to suspended sediments in the runoff. At the Laboratory's upstream boundary, a 10–50 times increase in radionuclide concentrations in the ash from the burned hillslopes showed an accelerated movement of the fallout radionuclides and metals that had accumulated in vegetation and soil as larger magnitude stream flows carried more sediment downstream from the Laboratory.

Gallaher, B.M., et al., "Runoff Following the Cerro Grande Fire," in *Water, Watersheds, and Land Use in New Mexico*, New Mexico Decisionmakers Field Guide No. 1, New Mexico Bureau of Mines & Mineral Resources (2001).

To understand the possible impact of post-fire increases in predicted runoff and sediment yields, runoff events were monitored and more than 90 separate samples were taken by the end of 2000. Results indicated that the most significant aspect of the runoff water's chemical quality was the contaminants it carried rather than dissolved contaminants. Post-fire sediment and ash samples contained higher levels of radionuclides and metals—apparently from decades of accumulation of radioactive fallout in plants and forest ground litter—than had been measured in local background soils and sediments before the fire. Although concentrations of most dissolved metals were below EPA or NM drinking water standards, a few metal concentrations were above standards. Radionuclide concentrations were slightly elevated or comparable to pre-fire levels.

Johansen, M., et al., "Storm Water Quality in Los Alamos Canyon following the Cerro Grande Fire," Los Alamos National Laboratory report LA-13816-MS (April 2001).

Samples from the first post-fire rainfall in a canyon containing known legacy waste sites were analyzed for radionuclide, metal, inorganic, and organic constituents. Results showed radionuclide concentrations at or below pre-fire maximum levels at locations within the canyon and downstream. Greater concentrations of cesium-137 and strontium-90, both fallout-associated radionuclides, were seen arriving in the canyon from upstream areas, mostly bound to sediments. Seven of 25 metals tested for were above pre-fire levels, and eight of the 18 general chemistry parameters tested exceeded historic norms. Dissolved metal concentrations did not exceed state livestock and wildlife standards.

Koch, R.J., et al., "Precipitation Events and Storm Water Runoff Events at Los Alamos National Laboratory after Cerro Grande Fire," Los Alamos National Laboratory report LA-13849-MS (July 2001).

This report describes fire-related precipitation and storm water runoff events that occurred during 2000 at the Laboratory between June 2 and October 29, 2000. It was undertaken to provide background information to assist in the understanding of the chemical water quality data obtained from storm water runoff samples collected at stream gaging stations. The analysis includes available information pertaining to the location of significant precipitation events,

precipitation amounts, and resulting storm water flow rates and flow volumes, and lists the storm water runoff samples collected.

Koch, R.J., et al., "Snowmelt and Storm Water Runoff at Los Alamos National Laboratory in 2001," Los Alamos National Laboratory report LA-13947-MS (2002).

This study describes precipitation and fire-related snowmelt and storm runoff events that occurred one year after the fire, based on data obtained from stream gaging stations. It incorporates information about the location of precipitation events, amounts, and resulting water flow rates and flow volumes, and summarizes the storm water runoff samples collected in 2001.

Koch, R.J., et al., "Storm Runoff at Los Alamos in 2002," Los Alamos National Laboratory report LA-14080 (2003).

This report describes precipitation and fire-related storm runoff events that occurred two years post-fire, based on data obtained from stream gaging stations where runoff occurred in 2002. It incorporates information about the location of precipitation events, amounts, and resulting runoff rates and volumes.

Kraig, D.H., et al., "Radiological and Nonradiological Effects after the Cerro Grande Fire," Los Alamos National Laboratory report LA-13914 (March 2002).

Estimated potential radiological and nonradiological effects from the fire that might have been experienced downstream due to flooding in watersheds containing residual contamination from early Los Alamos operations. While observations and sampling showed that the fire's aftereffects did include increased concentrations of chemicals in runoff and in sediments deposited during calendar year (CY) 2000, the cause was thought to be the increased mobilization of locally deposited worldwide fallout or of naturally occurring substances concentrated by the fire. When the source of the effects could not be determined, the effects were calculated independent of source. Calculated CY 2000 exposures were not considered sufficient to cause health effects in exposed individuals.

McLin, S.G., et al., "Predicting Floodplain Boundary Changes Following the Cerro Grande Fire," *Hydrological Processes* **15**, 15, p. 2967–2980 (October 30, 2001).

Mullen, K.I., "Watersheds and Wildfires: A View of the Cerro Grande Fire," Los Alamos National Laboratory report LA-UR-00-5651 (2000).

An overview of the fire's scope, resultant alterations to the watershed's hydrologic characteristics, and rehabilitation efforts. This report covers Pajarito Plateau canyons directly affected by the fire, predicted hydrologic and water quality impacts and flood protection measures, and long-term monitoring of runoff for post-fire effects.

Risk Assessment Corporation, "SUMMARY REPORT. Analysis of Exposure and Risks to the Public from Radionuclides and Chemicals Released by the Cerro Grande Fire at Los Alamos," New Mexico Environment Department, RAC Report No. 5-NMED-2002-FINAL (June 2002), http://www.nmenv.state.nm.us/DOE_Oversight/rac/Summary_Report.pdf (accessed 2003).

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Soholt, L.F., "Surface Water, Groundwater, and Sediments," in "Environmental Surveillance at Los Alamos during 2000," Los Alamos National Laboratory report LA-13861-ENV, Chap. 5, p. 201 (October 2001).

Wilson, C.J., and M. Gard, "Predicting Increased Sediment Delivery from the Cerro Grande Fire Using a Distributed Profile-Based Hillslope Erosion and Deposition Model in a GIS Framework," Los Alamos National Laboratory report LA-UR-01-1888 (2001).

A report of predictions made by a profile-based, analytical hillslope erosion model integrated into a GIS framework to assess the impact of the fire on erosion and sediment delivery associated with a 100-year design rain event. Applied across an 800 km^2 region of the Pajarito Plateau, the model predicted that the fire will cause runoff to increase from 3–6 times and sediment yield to increase by more than one order of magnitude.

4. Air Quality

Kraig, D.H., et al., "Radiological and Nonradiological Effects after the Cerro Grande Fire," Los Alamos National Laboratory report LA-13914 (March 2002).

Estimated potential radiological and nonradiological effects from the fire that might have been experienced downstream due to flooding in watersheds containing residual contamination from early Los Alamos operations. While observations and sampling showed that the fire's aftereffects did include increased concentrations of chemicals in runoff and in sediments deposited during calendar year (CY) 2000, the cause was thought to be the increased mobilization of locally deposited worldwide fallout or of naturally occurring substances that were concentrated by the fire. When source of the effects could not be determined, the effects were calculated independent of source. Calculated CY 2000 exposures were not considered sufficient to cause health effects in exposed individuals.

Kraig, D.H., et al., "Updated Calculation of the Inhalation Dose from the Cerro Grande Fire Based on Final Air Data," Los Alamos National Laboratory report LA-UR-01-1132 (February 2001).

A recalculation of the preliminary dose assessment that calculated the inhalation dose of radionuclides received during the Cerro Grande fire by fire workers and members of the public. This report expands on preliminary data from the Laboratory's ambient air monitoring network (AIRNET), to provide final air monitoring calculations based on data available as of December 2000. In addition to routine analyses, AIRNET samples were analyzed for lead and polonium, which may have become airborne during the fire. Dose calculations for lead, polonium, and bismuth, when compared with the doses received each year from natural background radiation in northern New Mexico, are insignificant. Dose calculations for uranium isotopes also indicate very small radiological doses. No health effects are expected to occur as a result of radiological intakes during the fire, and no toxicological health effects are expected from potential exposures.

Risk Assessment Corporation, "Summary Report, Analysis of Exposure and Risks to the Public from Radionuclides and Chemicals Released by the Cerro Grande Fire at Los Alamos," New Mexico Environment Department, RAC Report No. 5-NMED-2002-FINAL (June 2002), http://www.nmenv.state.nm.us/DOE_Oversight/rac/Summary_Report.pdf (accessed 2003).

Information contained in the RAC Report "Analysis of Exposure and Risks to the Public from Radionuclides and Chemicals Released by the Cerro Grande Fire at Los Alamos," came from an independent study performed by the Risk Assessment Corporation on 815,000 acres and selected locations outside the primary study area, at the request of the New Mexico Environment Department and funded by the U.S. Department of Energy. The Summary Report is a four-page summary of the information that is provided in more detail in the final reports. It reiterates the fire and study background and an overview of results from the study group's tasks: analysis of estimated risks from releases to air and surface water, and a statement of the scope and intent of observations and recommendations made in the final study regarding calculating and communicating risks.

Soholt, L.F., "Air Surveillance," in "Environmental Surveillance at Los Alamos during 2000," Los Alamos National Laboratory report LA-13861-ENV, Chap. 4, p. 108 (October 2001).

5. General Cerro Grande Fire Descriptions

Soholt, L.F., "Introduction," in "Environmental Surveillance at Los Alamos during 2000," Los Alamos National Laboratory report LA-13861-ENV, Chap. 1, p. 18 (October 2001).

6. Cerro Grande Fire Recovery

Buckley, K.J., et al., "Progress Report on Los Alamos National Laboratory Cerro Grande Fire Rehabilitation Activities One Year after Burned Area Rehabilitation," Los Alamos National Laboratory report LA-UR-02-4921 (August 2002).

Buckley, K.J., et al., "Progress Report on Los Alamos National Laboratory Cerro Grande Fire Rehabilitation Activities Two Years after Burned Area Rehabilitation," Los Alamos National Laboratory report LA-UR-03-5196 (2003).

Buckley, K.J., et al., "Final Report on Los Alamos National Laboratory Cerro Grande Fire Rehabilitation Activities Three Years after Burned Area Rehabilitation," Los Alamos National Laboratory report LA-UR-03-7139 (October 2003).

Veenis, S.J., "Cerro Grande Fire: Aftermath ER Activities to Reduce the Potential Movement of Contamination at Potential Release Sites," Los Alamos National Laboratory report LA-UR-00-3767 September 2000).

Veenis, S.J., "Emergency Rehabilitation Efforts Resulting from the Cerro Grande Fire at the Los Alamos National Laboratory," Los Alamos National Laboratory report LA-UR-00-3906 (September 2000).

7. Ecology

☑ Foxx, T.S., "Out of the Ashes—A Story of Natural Recovery," Los Alamos National Laboratory report LA-LP-01-20 (2001).

A descriptive and poetic look at fire in the wildlands of northern New Mexico, and its role as an elemental force for change and regeneration.

Nyhan, J.W., et al., "Estimation of Soil Erosion in Burnt Forest Areas Resulting from the Cerro Grande Fire in Los Alamos, New Mexico," Los Alamos National Laboratory report -UR-01-4658 (April 2001).

Two methods of estimating wildfire-induced surface soil erosion hazards were compared—the first, used by the Interagency Burned Area Rehabilitation Team on the Cerro Grande fire, multiplied pre-fire estimates of soil loss by five factors to account for burn severity and hydrophobic soils to obtain post-fire soil erosion estimates; the second, the Enhanced Universal Soil Loss Equation Approach, was based on soil erosion estimates that incorporated multiple precipitation zones and estimates of changes in ground and canopy cover. Both methods showed much lower pre-fire soil erosion rates across the area later burned by the Cerro Grande Fire, and the latter method pinpointed areas needing conservation measures to prevent soil loss.

Soholt, L.F., "Soil, Foodstuffs, and Associated Biota," in "Environmental Surveillance at Los Alamos during 2000," Los Alamos National Laboratory report LA-13861-ENV, Chap. 6, p. 408 (October 2001)