

Los Alamos NATIONAL LABORATORY memorandum

Environment, Safety, and Health Division
ESH-17 Air Quality Group

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Phone/FAX: 7-0998/FAX 5-3669
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The Flood Warning System in the Cerro Grande Burned Area

The Burned Area Emergency Rehabilitation (BAER) team requested that the ESH-17 Meteorology Project help site Remote Automated Weather Stations (RAWS) for a flood warning system. The decision regarding the number of stations and the locations of these stations was left primarily up to ESH-17 personnel. A flood warning system network of nine stations was determined after considering critical drainage basins, site accessibility and quality, knowledge of local convective thunderstorm movement, and overall measurement system spacing.

Network Description

A listing of each station's Bureau of Land Management (BLM) station number, location and elevation, and purpose is given below. Locations and elevations were provided by BLM technical staff. A Los Alamos area map showing the burned area and the station locations is attached to some copies of this memorandum. If a map was not attached to your copy and you would like one, contact Jeff Baars (667-0898) or George Fenton (667-8359), or contact EES-5 staff and request FIMAD map #108776.

- **Station 111: "Quemazon"** [Sited 6/8/00]
Purpose: Provides early warning for west-to-east moving storms.
Latitude/Longitude: 35°55'33"N / 106°23'05"W
UTM coordinates, zone 13 (m): 375170E / 3976403N
Elevation: 9770'
- **Station 222: "Water Canyon"** (Sited 06/02/00)
Purpose: Provides coverage of Water Canyon drainage basin; serves as an early warning station to the entire region for south-to-north moving storms.
Latitude/Longitude: 35°50'33"N / 106°22'22"W
UTM coordinates, zone 13 (m): 376084E, 3967150N
Elevation: 8143'
- **Station 333: "Pajarito Canyon"** [sited 06/04/00]
Purpose: Provides coverage of Pajarito Canyon drainage basin, as well as Los Alamos Canyon and Pueblo Canyon.
Latitude/Longitude: 35°52'28"N / 106°21'49"W
UTM coordinates, zone 13 (m): 376977E, 3970694N
Elevation: 8333'
- **Station 444: "Upper Los Alamos Canyon"** [sited 6/4/00]
Purpose: Provides coverage of Los Alamos Canyon and Pueblo Canyon; serves as early warning station for entire region for west-to-east moving storms.
Latitude/Longitude: 35°53'32"N / 106°22'18"W
UTM coordinates, zone 13 (m): 376267E, 3972663N
Elevation: 8800'
- **Station 555: "Pueblo Canyon"** [sited 05/31/00]
Purpose: Provides coverage of Pueblo Canyon, Los Alamos Townsite, and Rendija Canyon.
Latitude/Longitude: 35°53'41"N / 106°20'41"W



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UTM coordinates, zone 13 (m): 378709E, 3972907N
Elevation: 8500'

- **Station 666: "Guaje Canyon" [sited 06/03/00]**
Purpose: Provides coverage of Guaje Canyon drainage basin; serves as early warning station for Santa Clara Pueblo and related canyons.
Latitude/Longitude: 35°55'18"N / 106°19'25"W
UTM coordinates, zone 13 (m): 380660E, 3975862N
Elevation: 8310'
- **Station 777: "Garcia Canyon" [sited 05/31/00]**
Purpose: Provides coverage of Garcia Canyon and Sawyer Canyon, as well as Santa Clara Pueblo.
Latitude/Longitude: 35°56'43"N / 106°18'39"W
UTM coordinates, zone 13 (m): 381852E, 3978463N
Elevation: 8155'
- **Station 888: "Santa Clara Canyon" [sited 06/04/00]**
Purpose: Provides coverage for the Santa Clara Canyon.
Latitude/Longitude: 35°59'39"N / 106°16'55"W
UTM coordinates, zone 13 (m): 384538E, 3983857N
Elevation: 7940'
- **Station 999: "Upper Santa Clara Canyon" [sited 06/09/00]**
Purpose: Expands coverage of Santa Clara Coverage; serves as an early warning station for north-to-south moving storms.
Lat/Lon: 35°59'39"N / 106°21'40"W
UTM coordinates, zone 13 (m): 377420E, 3983948N
Elevation: 10640'

RAWS stations are maintained by the Remote Sensing Support Group at the National Interagency Fire Center (NIFC), which is a part of the BLM. RAWS stations are solar powered, 20 foot tall meteorological towers, and were used during the Cerro Grande fire to measure localized weather patterns to monitor the fire's behavior. These RAWS stations measure precipitation, wind speed and direction, temperature, relative humidity, soil moisture, soil temperature, and peak wind speed and direction. Additionally, RAWS stations can be configured to measure fuel moisture and solar radiation. The Pueblo Canyon station and the Garcia Canyon station include these additional measurements; the other seven stations are of the standard configuration.

Obviously, for the flood warning purpose of these RAWS stations, precipitation is by far the most important variable measured. The rain gauge is mounted at a height of 6 feet and is of the "tipping bucket" variety, which measures accumulated liquid precipitation with a resolution of 0.01 inches. This type of gauge is the standard in the field of meteorology and is used by the National Weather Service (NWS), as well as the ESH-17 Meteorology Project.

The flood warning system will remain in place for three years. BLM staff will visit the sites annually to re-calibrate the instrumentation, and visits will also take place if individual instruments are seen to be recording bad data. Instrumentation calibrations are traceable to the National Bureau of Standards standards, and meteorological measurement guidelines follow the NWS Fire Weather Standards. Complete documentation of RAWS stations is available in BLM (1997).

Adequacy of the Network

Due to the localized nature of summertime convective thunderstorms in the Los Alamos area, a relatively dense network was needed. The average spacing between stations is roughly 4 km. Single cell thunderstorms (the type seen during the summertime in New Mexico) range in diameter from about 8 km to 16 km. It is of course possible

that storms could brush drainage basins and primarily miss all of the gauges in the network. Other sources of information (flow gauges, real-time National Weather Service NEXRAD Doppler radar data, spotters, etc.) are needed to compliment the system for early flood warning purposes.

Alerts from the System

The RAWS stations in this network are programmed to trigger an alarm when a rainfall intensity of 0.16" per 10-min (0.96"/hour) is reached. It is assumed that this rate was chosen by hydrologists on the BAER team. A storm producing a total of 1 inch in an hour is approximately a 2 year storm (it occurs once every two years on average—see Bowen (1996)), and thus appears to be a fairly conservative early warning rainfall rate.

When this rainfall rate is achieved at a station, an omni-directional RF signal (at 163.350 MHz) is sent which can be picked up with any VHF scanner that has a line-of-sight to the tripped RAWS station. This signal is a warning broadcast message, which will say "WARNING... WARNING... Station XXX has received YYY inches of rain." A roof-mounted antenna at a relatively elevated location would probably be needed to pick up all of the stations in the network.

The Los Alamos Police Department (LAPD), the Santa Clara Pueblo Dispatch Center, and the Lab's Emergency Operations Center (EOC) are set up to receive this signal. Each of these organizations presumably have their respective storm warning alert procedures that will go into effect upon receiving an alert from the RAWS flood warning system. For more information on these procedures, contact the respective organizations directly.

Flood Warning Information to Complement the System

A variety of flood-related decisions will be made on a seasonal basis, a daily basis, and a storm-by-storm basis at the Laboratory. The RAWS system gives a short lead warning for a particular storm. For this reason, other complementary flood warning information is needed.

On a daily basis, thunderstorm forecast information is being provided by the ESH-17 Meteorology project on-line at <http://weather.lanl.gov:5000/html/tstorm.html>. A daily probability of occurrence of a strong (and potentially flood-producing) thunderstorm is given, along with other useful links for observing and forecasting thunderstorms. This forecast is primarily a hybrid of ESH-17 Meteorologists forecasts and the NWS forecast. Also, the NWS is issuing a "potential for flash flood producing rain" forecast (similar to the ESH-17 forecast) for the three burned areas in New Mexico in its daily Special Weather Statements, which can be accessed at <http://iwin.nws.noaa.gov/iwin/nm/special.html>. The NWS will also issue its regular flood watches (meaning conditions are favorable for a flood), with special consideration for the nature of the burned area in and around Los Alamos.

On a storm-by-storm basis, the NWS will phone the LAPD when storms potentially capable of producing 1.0"/hour rainfall rates are forming or moving into the Los Alamos Area. This rainfall rate is roughly the same rate that will trigger an alert from the RAWS system. The NWS prefers a single contact for disseminating information of this type, but they will also attempt to phone the Laboratory EOC in such a case. During very active weather days in New Mexico (e.g. severe weather, numerous thunderstorms), the NWS may not be able to make this second call.

For this reason, the EOC is on the LAPD's call list. The NWS will also take phone calls during storm events at the following numbers (in order of which they should be used, with the last number being a "last resort"):

(888) 386-7637
(505) 224-9007
(505) 244-9148 ("last resort" number)

The ESH-17 Meteorology project staff can be contacted to provide storm information, supplemental to the NWS, at 667-7079. This source may be most useful when the NWS is busy or for further explanation of current conditions and forecast information. Because there are only two meteorologists on staff however, the project is more limited in the services it can provide.

Acquiring Data from the Network

The nine RAWS stations, in addition to eight precipitation gauges sited throughout the Laboratory by the ESH-17 Meteorology project, will allow for detailed coverage of the Los Alamos area over a three year period. Note that RAWS stations collect data hourly, whereas ESH-17 stations collect data every 15-min.

The primary source for gathering this archive is the Desert Research Institute (DRI), and current data can be accessed from their web page at <http://www.wrcc.dri.edu/losalamos/> (with varying reliability). Longer term archived data will be available through the DRI as well.

If you know of anyone who should receive this memo please forward a copy onto them, or have them contact Jeff Baars (667-0898) or George Fenton (667-8359).

REFERENCES:

BLM 1997: "Remote Automatic Weather Stations (RAWS) and Remote Environmental Monitoring Systems (REMS) Standards for the U. S. Department of Interior Bureau of Land Management," RAWS/REMS Support Facility, BLM/NIFC 3905 Vista Ave., Boise, ID 83705, Revised February 12, 1997.

Bowen 1996: Rainfall and Climate Variation over a Sloping New Mexico Plateau during the North American Monsoon. *Journal of Climate*, 9, 3432-3442.

JB/GF/In

Att. a/s:

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