Permit LANL Order 9/10/03

Surveying of Well Locations and Other Site Attributes
at Los Alamos National Laboratory

LANL will use a professional land surveyor, registered in the State of New Mexico, to determine the location and elevation of all groundwater monitoring well casings and the brass caps identifying each well in accordance with the State Plane Coordinate System (§ 47-1-49 through 56, NMSA 1978) (Repl. Pamp. 1993). The surveys will be conducted in accordance with Sections 500.1 though 500.12 of the Regulations and Rules of the board of Registration for Professional Engineers and Surveyors Minimum Standards for Surveying in New Mexico. Horizontal positions will be measured to the nearest 0.1 ft, and vertical elevations will be measured to the nearest 0.01 ft.

For locating all other site attributes (sample sites, springs, outfalls, boreholes, monitoring stations, sampling grids, etc.), LANL uses a network of about 80 reference monuments that are distributed throughout the Laboratory, and one of two surveying systems. Eighty to ninety percent of the Laboratory can be surveyed, using the reference monuments, by either method to a horizontal accuracy of 0.5 ft. The first method is the Total Station, a surveyor's transit with infra-red electronic distance capability; the second is the Global Positioning System (GPS) with two receivers. The Total Station survey uses two reference monuments, and measures angles and distances from those known points. Measurements are accurate to at least 0.5 ft. A GPS system works differently. The base receiver is placed on a reference monument with a known location. The GPS base receiver calculates a location, and a correction factor based on the difference between the actual location of the reference monument and the location calculated by the base receiver. The instrument automatically applies the correction factor to all measurements to achieve an accuracy of 0.5 ft. Normally, when the GPS has an unobstructed view of the sky and is receiving a radio signal from five or six satellites, and the base station is set up over a LANL reference monument, the GPS consistently determines position to sub-centimeter accuracy. Those conditions are not always present.

LANL uses the Total Station in areas where the integrity of the satellite or radio signal on which the GPS depends is lost, as against vertical cliff walls or under trees. Using these two surveying methods, almost all surveying projects can consistently meet the 0.5 ft. horizontal accuracy requirement.

In the ten to twenty percent of the Laboratory area where reference monuments cannot be used to site against, LANL conducts "local" surveys. In a "local" survey, an arbitrary reference point is established, and locations are surveyed relative to the arbitrary reference point. The GPS is then used to determine the coordinates of the reference point so that the coordinates of the survey points can be determined. If the reference point is a building, for example, the Total Station method can locate points with a horizontal accuracy of 0.5 ft relative to the building, and the survey results are reproducible with the same accuracy. In the absence of a reference monument, the GPS system is configured so the receivers operate in the Wide Area Augmentation system (WAAS). The WAAS configuration uses signals from the rotating GPS satellite constellation as well as a signal from one fixed, geocentric GPS satellite. With signals from these two sources, the

position of the arbitrary reference is calculated to within three ft. Points can be located from the arbitrary reference with a horizontal accuracy of 0.5 ft, but the survey accuracy is limited by the three-ft uncertainty of the arbitrary reference point.

All survey data recorded in FIMAD are accompanied by a statement of accuracy.